NORWEGIAN SCHOOL OF ECONOMICS

Bergen, spring 2015

Master Thesis within the main profile of Financial Economics

Thesis supervisor: Chunbo Liu (PhD)

HOW FINANCIAL CONSTRAINTS AFFECT CASH HOLDINGS: EVIDENCE FROM NORWEGIAN FIRMS

By

Cheng Zeng

Abstract

This paper examines the cash holding and how it is determined by financial constraints of corporate Norway using a comprehensive dataset that covers both private and public firms from 1995 to 2012. I find that aggregate cash holdings increase almost twofold from 1990s (around 5-6%) to recent years (9-10%), a trend similar to U.S. firms, though slightly less significant. I then examine the correlation between cash holdings and financial constraints both on the aggregate level and the individual firm level. Time series evidence supports the notion that aggregate cash holdings decline following better macro-economic conditions. However, firm-level cash holdings are negatively correlated with conventional measures of financial constraints, such as Whited-Wu index and Hadlock and Pierce index. The contradiction with theory here implies that the extent of financial constraint might be mis-measured, an issue recently discussed in Farre-Mensa and Ljungqvist (2013). I use two event studies to revolve the measurement error and endogeneity problem involved. Specifically, I trace the evolution of cash holdings around IPO and delisting events which suddenly alter the extent of financial constraints faced by firms. I find that the cash ratio decreases roughly by 35% within two years after a private firm becomes public and increases by 37.5% two years after a public firm goes private, which is in line with cash holdings increasing with financial constraints. This finding is robust to several competing hypotheses, such as changes in corporate governance and growth opportunities around such events.

Acknowledgement

This thesis completes my master's degree in financial economics at Norwegian School of Economics (NHH). The past two years have been a rewarding and intensive period with lots of knowledge gained and returns achieved.

I would like to express my gratitude to my supervisor Chunbo Liu, who gave me the opportunity to conduct this research paper, for useful guidance, generous contribution of expertise and encouragement through the learning process of this thesis.

Table of Contents

"There is no necessity to hold idle cash to bridge over intervals if it can be obtained without difficulty at the moment when it is actually required."

John Maynar Keynes

The General Theory of Employment, Interest and Money

1. Introduction

There is a secular trend of US firms holding more and more cash while at the same time cash holdings exhibit considerable variations across firms (Bates, Kahle and Stulz, 2009). The surprisingly high cash in hands of some giant firms such as Apple has drawn lots of attention from both academic scholars and industry practitioners[1]. The natural question to ask is why firms hold so much cash. Admittedly, holding cash arises from the existence of frictions in the market for external financing as there is no reason to hold cash in a perfect world. This then becomes a difficult question to answer as there are several motives playing a role. In this paper, I rely on a sample comprised of both public and private firms operating in Norway and relate firms' cash holdings to the degree of financial constraints. My result highlights the importance of financial constraints in determining firms' optimal cash holdings.

To answer why a firm holds cash is a complex task because there are many kinds of motives that play a role in shaping cash holding policy for a firm. Financial literature casts light on several motives concerning why a firm holds cash. Starting with a transactional point of view, it is costly for firms to convert non-cash assets into cash assets; hence it is necessary to hold cash in case of urgent payments. Also, the precautionary motive of holding cash prevails in financial literature, namely when external economic shocks come, it will become difficult for firms to get access to external capital markets. Holding sufficient cash in event of such external shocks could help firms get funding for potential investment projects. Taxation considerations also determine how multi-nationals allocate their cash across subsidiaries. The last frequently mentioned motive rests on agency theory. Jensen (1986) claims that managers tend to hold more cash for personal benefits (e.g. excessive expansion) when lucrative investment opportunities are not available.

Financial constraints can be simply defined as financial frictions that prevent firms from getting necessary funding. Literature also identifies several financial constraint

[1] Holding more than $190 billion cash per May 2015, Apple is the leading firm among S&P 500 firms in terms of cash holding. Source: Matt Krantz. "$194B! Apple's cash piles hit record," *USA Today*, April 27, 2015

measurements. As one of the tasks in this paper is to understand how financial constraints affect cash holding, it is thus necessary to have concrete financial constraint measurements. Whited-Wu and Hadlock and Pierece indices are two measurements used in this paper. Another commonly used index is Kaplan and Zingal index; however, it is not possible to construct this index due to limitations of the dataset. Intuitively, financial constraints will negatively affect cash holding for a firm from a precautionary perspective. Nevertheless, I use Norwegian data to address this relationship empirically. Before doing that, I develop a full understanding of how cash holding situation evolves for Norwegian firms.

I obtain corporate cash holding of Norwegian firms from Norwegian Corporate Accounts (*SNFs and NHHs database med regnskaps- og foretaksinformasjon for norske selskaper*), which is jointly maintained by Norwegian School of Economics (NHH) and Centre for Academic Research at NHH. The sample data covers firms from 1995 to 2012 with positive book values. I start with presenting cash holdings development for Norwegian firms in a holistic way. Here, I also check how aggregate cash ratio interacts with some macroeconomic parameters (crude oil price, GDP growth rate and inflation rate), and then I investigate how cash holdings development unfolds for fishing and oil sectors as they impose significant impacts on Norwegian economy. Second, I study the relationship between cash holding and firm characteristics in a Norwegian setting. By performing different regressions between cash ratio and firm characteristics, I obtain a view of how this relationship displays in a Norwegian setting. Third, my key objective is to test whether the relationship between financial constraints and cash holdings stands for Norwegian firms. Using firm characteristics variables as control variables, I add financial constraint variables to test this relationship. Specifically, I examine how two financial constraint indices, Whited-Wu index and Hadlock – Pierece index, influence cash holdings. Purposely, I drop KZ-index as the lack of number of outstanding shares and stock price makes it impossible to calculate market capitalization, which is an essential component for constructing KZ index. Fourth, I conduct two event studies on how cash holdings change when firms are listed and delisted. The main reason of doing event studies is to try to overcome some shortcomings generated by OLS regressions. OLS regressions are susceptible to omitted variable bias, which can lead to endogeneity problem. The results of event study are interpreted with respect to agency theory suggested by Michael Jensen (1986).

Some important findings of this paper are as following:

The aggregate cash ratio of Norwegian firms during sample year period has experienced a stably increasing trend, and this trend is negatively correlated with GDP growth rate and interest rate. Norwegian private firms hold more cash than public firms over the sample period. Also, Norwegian firms that pay dividend hold more cash than firms that do not pay dividend.

Financial constraint measurements, WW index and HP index, have a negative correlation with cash holdings for Norwegian firms, and HP index have a better explanation power than WW index because HP index is made of components that cannot be changed by the firm itself. One standard deviation change of WW index leads to -0.016 standard deviation change of cash ratio according to OLS regression. Equivalently, one standard deviation change of HP index leads to -0.060 standard deviation change of cash ratio. Theory suggests that the financially constrained firms will hold less cash and the findings contradict with theory. This contradiction could potentially be attributed to measurement error which is recently discussed by Farre-Mensa and Ljungqvist (2013) and endogeneity problem from which simple OLS regressions suffer. Meanwhile, dividend payment, being considered as a financial constraint measurement in literature, is positively correlated with cash holdings in this Norwegian sample, which could be explained by the fact that dividend-paying firms will hold more cash to fulfill this commitment.

My data makes it possible to study the cash holding evolution around IPO and delisting events, which are two types of events resulting in sudden changes in financial constraints. When a firm goes public, it is generally believed that reaching out for new financing becomes easier. In contrast, firms will find it more difficult to secure outside financing when needed after they are delisted. Therefore, these two events offer a setting to test the causal effect of financial constraints on corporate cash holdings. I find that when a private firm becomes public, namely being listed, cash holding of this firm decreases. The average cash ratio decreases from 20% at IPO year to around 13% two years after IPO. Equivalently, when a public firm becomes private, namely being delisted, cash holding of this firm increases. The average cash ratio increases from 8% at delisting year to around 11% two years after delisting.

The results of event studies could be justified from a financial constraint perspective and could serve as interesting comparisons with respect to agency theory proposed by Michael Jensen (1986).

Contribution of this paper is threefold. First, I study how cash holding situation changes for a wide range of Norwegian firms across a long time framework in a systematic way, establishing a thorough and fair understanding of cash holding situation in Norway from 1995 to 2012. Second, I examine interplay between aggregate cash ratio and other macroeconomic parameters, probing the dynamic relationship between the cash ratio evolvement with respect to general macroeconomic changes in Norway. Third, by studying the evolution of corporate cash holdings around IPOs and delisting events, I establish a causal relationship between financial constraints and cash holdings which distinguish this paper from most previous work.

2. Related literature and hypotheses

2.1 Literature review

Under imperfect capital markets outside the classic perfect market case of Miller and Modigliani (1958), firms operate with frictions and imperfect financial flexibility. In fact, in a survey result by Graham and Harvey (2001), most CFOs believe financial flexibility to be the most important factor that determines the level of debt, as opposed to such common determents of capital structures as interest tax shield, credit risk or cash flow volatility (Akguc and Choi, 2013). Public and private firms would have different degrees of financial flexibility as private firms face more frictions than public firms given their constraint in raising new equity and higher borrowing costs than do public firms (Saunders and Steffen, 2011). As holding cash entails firms with the flexibility to invest, and it is the very flexibility that is cherished by most firms, so holding cash could contribute to alleviating some problems that are associated with investment.

According to Bates, Kahle and Stulz (2009), there are four major incentives for firms to hold cash in economic and finance literature, and those four motives are as following:

2.1.1 The transaction motive

Transaction costs incur when a firm convert noncash asset into cash and conduct payment with the cash, hence it is less expensive for firms to hold cash (or liquid assets) so as to get through urgent payments. If it is costly for the firm to be short of liquid assets, the firm equates the marginal cost of holding liquid assets to the marginal benefit. Holding an additional dollar of liquid assets reduces the probability of being short of liquid assets and decreases the cost of being short of cash under the reasonable assumption that the marginal benefit of liquid assets in a state of world decreases as the amount of liquid assets increase (Opler, Pinkowitz, Stulz and Williamson, 1999). Since there are economies of scale with the transaction motive, large firms hold less cash (Bates, Kahle and Stulz, 2009). From a transaction point of view, holding cash contributes to reducing costs for the firm, thus it creates strong incentive for the firm to hold cash.

2.1.2 The precautionary motive

The main idea of precautionary motive is that firm needs to hoard cash to cope with unexpected external shocks when accessing the capital market so that the firm would be able to finance NPV-positive investment or similar projects. For a firm with low cash flow, it is quite costly to raise funds externally because capital market would grant fund cautiously in such situation. Findings of OPSW demonstrate that firms that have the greatest access to the capital markets (e.g. large firms and those with credit ratings) tend to hold lower ratios of cash to total assets. Almeida, Campello and Weisback (2004) model the precautionary demand of cash and find that financially constrained firms invest in cash out of cash flow, while unconstrained firms do not. (Bates, Kahle and Stulz, 2009) Han and Qiu (2007) construct a model to show that cash holdings of financially constrained firms are sensitive to cash flow volatility because the financial constraints create an inter-temporal trade-off between current and future investments. Moreover, Acharya, Almeida and Campello (2007) demonstrate that financially constrained firms with high hedging needs have a strong propensity to save cash out of cash flows, while showing no propensity to reduce outstanding debt.

2.1.3 The tax motive

In addition to transaction cost motive and precautionary motive, the tax motive gives us a powerful tool to understand why many firms hold cash. Hartzell, Titman, and Twite (2007)

provide tax-based explanation regarding cash holdings for firms, and they argue that U.S multinational firms hold cash in their foreign subsidiaries because of the tax costs associated with repatriating foreign income. Empirical result is consistent with the hypothesis, showing that firms that face higher repatriation tax burdens hold higher levels of cash, hold this cash abroad, and hold this cash in affiliates that trigger high tax costs when repatriating earnings.

2.1.4 The agency motive

The agency problem could cause firms to hoard extra cash after controlling for the effects from transaction cost and precautionary incentive. Jensen (1986) claims that entrenched managers are more inclined to hoard cash rather than giving out dividend when firms are faced with non-appealing investment projects. Dittmar, Mahrt-Smith, and Servaes (2003) conclude that corporations in countries where shareholders rights are not well protected hold up to twice as much cash as corporations in countries with good shareholder projection. Dittmar and Mahrt-Smith (2007) and Pinkowitz, Stulz and Williamson (2006) demonstrate that cash is worth less when agency problems between insiders and outside shareholders are greater.

Those four motives for holding cash have different implications for the causes and consequences of the secular increase in cash for U.S. firms (Bates, Kahle and Stultz, 2009). Some firms hold extra cash due to one or two motives, however, while for some firms, all four motives are applicable. The growth in derivative markets and improvements in forecasting and control suggest, all else equal, a lower precautionary demand for cash holdings. However, there has been a secular increase in idiosyncratic risk (Campbell, Lettau, Malkiel, and Xu, 2001). After having gained understanding of why firms choose to hold cash, I proceed to review determinants of cash holdings.

2.1.5 Determinants of cash holdings

Extant literature has illuminated some key determinants of cash holdings for firms. Opler, Pinkowitz, Stulz and Williamson (1999) find that there are several influential factors determining cash balances including corporate growth prospects, short-term working capital imbalances, leverage, industry volatility, and firm size. There results show high consistency with precautionary motive. Also, the authors also find that correlation between use of derivatives and cash holdings.

2.1.6 Measures of financial constraints

It is difficult to measure financial constraints that a firm faces; therefore indirect measurements are used to address this issue. Existing proxies aim to infer financial constraints from firms' statements about their funding situation or changes in investment plans, their actions (such as not paying a dividend), or their characteristics (such as being young, or small, or having low leverage, or not having a credit rating). The literature is divided on which of these best captures financial constraints and as a result, empirical studies tend to employ a range of measures for robustness (Farre-Mensa and Ljungqvist, 2013). Lamont, Polk and Saá-Requejo (2001) define financial constraints as frictions that prevent the firm from funding all desired investments. They argue that this inability to fund investment might be due to credit constraints or inability to borrow, inability to issue equity, dependence on bank loans, or illiquidity of assets. Although there is interconnectedness among financial constraints, financial distress and bankruptcy risk, etc. it is important not to confound financial constraints with other similar concepts.

In order to understand and study the importance of financial constraints with regard to firm behaviors, many different indices have been suggested. Based on Hayashi's Q-investment model, Fazarri, Hubbard and Petersen (FHP, 1988) find a significant sensitivity of investment to cash flow in a sample of 422 firms over the period 1970 to 1984. Based on the finding that cash flow sensitivities are especially large among the 49 sample firms that pay no or low dividends, FHP conclude that significant cash flow sensitivities reflect empirically important financial constraints (Farre-Mensa and Ljungqvist, 2013). One implicit finding from FHP's research is that low dividend is a good measurement of financial constraints.

By studying the annual reports of the 49 low-dividend firms proposed by FHP, Kaplan and Zingales have found out that only 15% of firm-years show evidence of firms being unable to fund their desired investments (Farre-Mensa and Ljungqvist, 2013). Further findings indicate that cash flow sensitivities fail to predict financial constraints among sample firms and yield contrarily adverse results. Moreover, they also show that low dividends are not a proper indicator of financial constraints.

The actual KZ index is consummated by Lamont, Polk, and Saa-Requejo (2001). Those authors estimate an ordered logit model relating the degree of financial constraints according

to Kaplan and Zingales' (1997) classification to five readily available accounting variables: cash flow, market value, debt, dividends, and cash holdings, each scaled by total assets (Farre-Mensa and Ljungqvist, 2013). The KZ index is higher for firms that are more constrained (Lamont, Polk and Saa-Requejo, 2001).

Hadlock and Pierece (2010) use qualitative information to categorize a firm's financial constraint status by carefully reading statements made by managers in SEC filings for a sample of randomly selected firms from 1995 to 2004. To evaluate the KZ index, Hadlock and Pierce (2010) estimate ordered logit models in which a firm's categorized level of constraints is modeled as a function of five Compustat- based variables. This modeling approach parallels the analysis of Lamont et al. (2001), who create the original KZ index by estimating similar models using the original Kaplan and Zingales (1997) sample. In the ordered logit models Hadlock and Pierce (2010) estimate, only two of the five components of the KZ index, cash flow and leverage, are consistently significant with a sign that agrees with the KZ index. The index created by Hadlock and Pierce rests on size (with a negative loading), size-squared (positive), and age (negative) (Farre-Mensa and Ljungqvist, 2013).

Another commonly used measurement of financial constraint is credit rating. According to Farre-Mensa and Ljungqvist (2013), there are two main motivations for this specific measurement. First, unrated firms are assumed to have no access to the public debt markets. (Faulkender and Petersen, 2006) and they need to resort to intermediaries such as banks on less competitive terms. Second, a rated firm may suffer less from information asymmetries problem between the investors and the firm. An unrated firm is more opaque and the external investors are more likely to place some sanction on them compared to rated firms.

Whited and Wu (2006) construct an index of firms' external finance constraints via generalized method of moments (GMM) estimation of an investment Euler equation.
Unlike the commonly used KZ index, theirs is consistent with firm characteristics associated with external finance constraints. (Whited and Wu, 2006)

The index is effectively measured as the projection of the shadow price of raising equity capital onto the following variables: cash flow to assets (with a negative loading); a dummy capturing whether the firm pays a dividend (negative); long-term debt to total assets (positive); size (negative); sales growth (negative); and industry sales growth (positive).

Denis and Sibilkov (2009) used a sample of 74,347 firm-year observations between 1985 and 2006 to confirm that positive association between cash and firm value is stronger for financially constrained firms. Another finding of their study demonstrates that association between firm value and investment is much stronger for constrained firms than for the unconstrained ones. Taken together, these findings are consistent with the view that cash holdings are more valuable to constrained firms because cash allows constrained firms to increase investment, and the marginal investment of constrained firms is more strongly related to value than that of unconstrained firms (Denis and Sibilkov, 2009).

2.2 Hypotheses formulation

In spite of diversity of financial constraint measurement, the essence of a financial constraint measures a firm's ability to access external funding. When lucrative investment opportunities rise, a financially constrained firm will have difficult in raising funding to finance investments, meanwhile a financially unconstrained firm will have ease to get access to external capital market and raise funding for own use. Firms that are financially constrained effectively face an inelastic supply of external capital: raising external capital quickly becomes even more expensive (reflecting a steep supply curve) and in the limit the firm is shut out of the capital markets (a vertical supply curve). In contrast, firms that can raise a large amount of external capital without much of an increase in the cost of capital are plausibly unconstrained (Farre-Mensa and Ljungqvist, 2013).

In previous literature review, I have identified four motives regarding why a firm holds cash, however, it is complex to understand exactly why a firm holds cash as many factors can play a role in making this decision. Intuitively, a financial constrained firm would hold more cash due to its limitations to external capital market. By holding cash, a financially constrained firm would then have the ease of financing good investment opportunities. Accordingly, the first hypothesis is based on this very intuition and the purpose of this hypothesis is to confirm or disconfirm the intuitive relationship between being financially constrained and holding cash.

Hypothesis 1: In Norwegian setting, financial constraint measurement will have a positive correlation with cash holding.

The transition from private firm to public firm is associated with the increased capability of getting access to external capital market. By selling shares, in most cases it is easier for a public firm to get external capital than a private firm. Based solely on the essence of financial constraints and the different degrees of access to capital market, it is also interesting to explore how firm's status transition will exert impacts on cash holdings for private and public firms. Within the same firm, it can be inferred that being private entails the stronger need for holding more cash compared to being public, hence I formulate hypothesis 2 as following:

Hypothesis 2: Compared to being private, a firm will reduce its cash holding when it becomes listed.

Correspondingly, the cash holding situation would be reverse when a firm transits from being private to being public, so hypothesis 3 is also formulated in similar way.

Hypothesis 3: *Compared to being public, a firm will increase its cash holding after it is delisted.*

The first hypothesis is formulated to test out the direct relationship between being financially constrained and holding cash, and the second and third hypotheses are extensions of testing this relationship by using specific events. In the following part of this paper, I disclose the empirical results by analyzing Norwegian firms**.**

3. Methodology and data

3.1 Methodology

In this paper, I will use OLS, Fama-MacBeth, and fixed effects regressions to explore how firm characteristics and financial constraint measurements affect cash holdings. However, simple OLS regressions cannot be free from endogeneity problem which could possibly over- or under-estimate the effect of interest. For instance, omitted variables such as corporate governance could determine both the amount of cash holdings and the level of financial constraints. Realizing the pitfalls of cross-sectional studies, I conduct two event studies to exploit within-firm variations which better captures the effect of sudden changes of financial

constraints on the decision to hold cash. Specifically, I examine the evolution of cash holdings around IPO and delisting events, with the assumption that becoming a public firm relieve financial constraints and delisted firms generally become more difficult to secure outside financing when needed.

3.2 Data description and sample selection

Based on database of Norwegian Corporate Accounts, made jointly by Norwegian School of Economics (NHH) and Centre for Academic Research at NHH, I construct a sample for the period from 1995 to 2012. The database consists of existing and non-existing firms that appear in Norwegian Corporate Accounts at any time in this sample period. Criteria I made for sample selection are as following: a). Firms should have positive values for book value of total assets, thus I exclude non-positive observations. b). Firms should carry positive sales revenues, thus non-positive sales revenues observations are also excluded; c). Financial firms (SN2007 code 64 to 69) are excluded because they may carry cash to meet capital requirements, hence including them could create bias. Also, utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are also excluded because they their cash holdings might be affected by regulation. The generated panel has 72602 observations for 17559 unique firms. d). Sample only covers Norwegian firms.

3.3 Summary statistics

Table of Summary Statistics

This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. After controlling for a series of independent variables, the number of observations is reduced to 21918 for net debt issuance and net equity issuance variables, and 25484 for other independent variables. This table shows the summary statistics of dependent variables and most important independent variables.

Summary Statistics	Number of observations	Mean	Median	Min	Max	Standard deviation
Cash ratio	25484	0.150	0.100	0.001	0.728	0.149
Log cash ratio	25484	-2.273	-2.202	-6.322	0.972	1.367
Industry sigma	25484	0.042	0.035	0.014	0.157	0.022
Sales growth	25484	0.482	0.039	-0.961	25.070	2.660
Real size	25484	12.002	11.728	6.196	16.210	1.492
Cash flow to assets	25484	0.087	0.087	-0.536	0.367	0.100
NWC to assets	25484	0.018	0.015	-0.869	0.550	0.206
Capex	25484	-0.035	0.000	-1.629	0.526	0.268
Leverage ratio	25484	0.288	0.248	0.000	1.157	0.233

R&D to sales	25484	0.004	0.000	0.000	0.201	0.024
WW Index	25484	4.896	-0.414	-1.081	190.523	23.803
HP Index	25484	-3.346	-3.253	-6.382	-1.301	0.901
Dividend dummy	25329	0.099	0.000	0.000	1.000	0.299
d_2000s	25484	0.956	1.000	0.000	1.000	0.206
Net debt issuance	21918	0.299	0.030	-0.798	6.029	1.024
Net equity issuance	21918	0.151	0.022	-0.638	2.734	0.512
Loss	25484	0.199	0.000	0.000	1.000	0.399

The table shows general statistics of dependent and independent variables for regressions in later sections. The sample covers 66796 observations for 17558 unique firms after excluding financial firms and utilities. After controlling for different independent variables, the number of observations for regressions has reduced to between 20000 and 30000.

3.4 Cash holding for Norwegian firms in a holistic perspective

Table I(A)

Average and Median Cash and Leverage Ratios from 1995 to 2012 for Norwegian Firms

This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. Variable definitions are presented in Appendix.

Year	N	Aggregate Cash Ratio	Average Cash Ratio	Median Cash Ratio	Average Leverage	Median Leverage	Average Net Leverage	Median Net Leverage
1995	6665	0,0696	0,1410	0,0857	0,3622	0,3010	0,2221	0,1943
1996	7126	0,0666	0,1394	0,0860	0,3640	0,3048	0,2253	0,2011
1997	8113	0,0474	0,1402	0,0866	0,3636	0,3103	0,2242	0,1971
1998	8556	0,0510	0,1343	0,0792	0,3642	0,3171	0,2308	0,2153
1999	2820	0,0580	0,1261	0,0797	0,3213	0,2866	0,1959	0,1907
2000	2748	0,0496	0,1248	0,0731	0,3197	0,2784	0,1950	0,1864
2001	2797	0,0526	0,1237	0,0743	0,3221	0,2864	0,1990	0,1930
2002	2676	0,0533	0,1310	0,0794	0,3309	0,2974	0,1999	0,1941
2003	2310	0,0769	0,1335	0,0887	0,3248	0,2935	0,1913	0,1861
2004	2232	0,0835	0,1387	0,0944	0,3134	0,2793	0,1747	0,1739
2005	2332	0,0928	0,1400	0,0975	0,3135	0,2786	0,1735	0,1735
2006	2194	0,0890	0,1439	0,0961	0,2927	0,2555	0,1488	0,1468
2007	2382	0,0943	0,1458	0,1001	0,2933	0,2568	0,1473	0,1388

2008	2527	0,0821	0,1396	0,0915	0,3120	0,2677	0,1726	0,1617
2009	2590	0,0820	0,1467	0,1002	0,3127	0,2721	0,1661	0,1614
2010	2581	0,1005	0,1455	0,0969	0,3033	0,2598	0,1577	0,1560
2011	3017	0,0848	0,1456	0,0928	0,3040	0,2597	0,1585	0,1562
2012	3130	0,0855	0,1354	0,0882	0,3057	0,2661	0,1707	0,1689

The second column of Table I (A) is the number of sample firms each year. Cash ratio is measured as the relationship between cash and cash equivalents (*cash* variables in the dataset) and total assets (*TotalAssets* variable in the dataset). The third column is the aggregate cash ratio, which is calculated by using sum of cash divided by sum of total assets. This ratio is about 6.96% at 1995 and it decreased slightly to 5.33% in 2002, then it increases to peak at 10.05% in 2010. By 2012, this ratio is 8.55%, which is higher than the initial year. As for mean cash ratio, it experiences a minor decrease until year 2002, and then it starts to experience another minor increase. Generally, the mean cash ratio fluctuates around the initial level, which is around 14.10%. Regarding median cash ratio, there is slight decrease until year 2001, decreasing from 8.57% to 7.43%, then it starts to increase again until 2007, amounting to 10.01%. In the last five years, fluctuations occur and median cash ratio ends up with 8.82 %, which is not very different from the initial value. I am also interested in knowing if there is a statistically significant trend in the aggregate cash ratio, thus I run regression of average cash ratio on a constant and time measured in year (not reported in Table I (A)). The coefficient on the year for average cash ratio reports a yearly decrease of 0.23% for cash ratio and the p-value is below 0.01. R^2 of the regression is 55.5%.

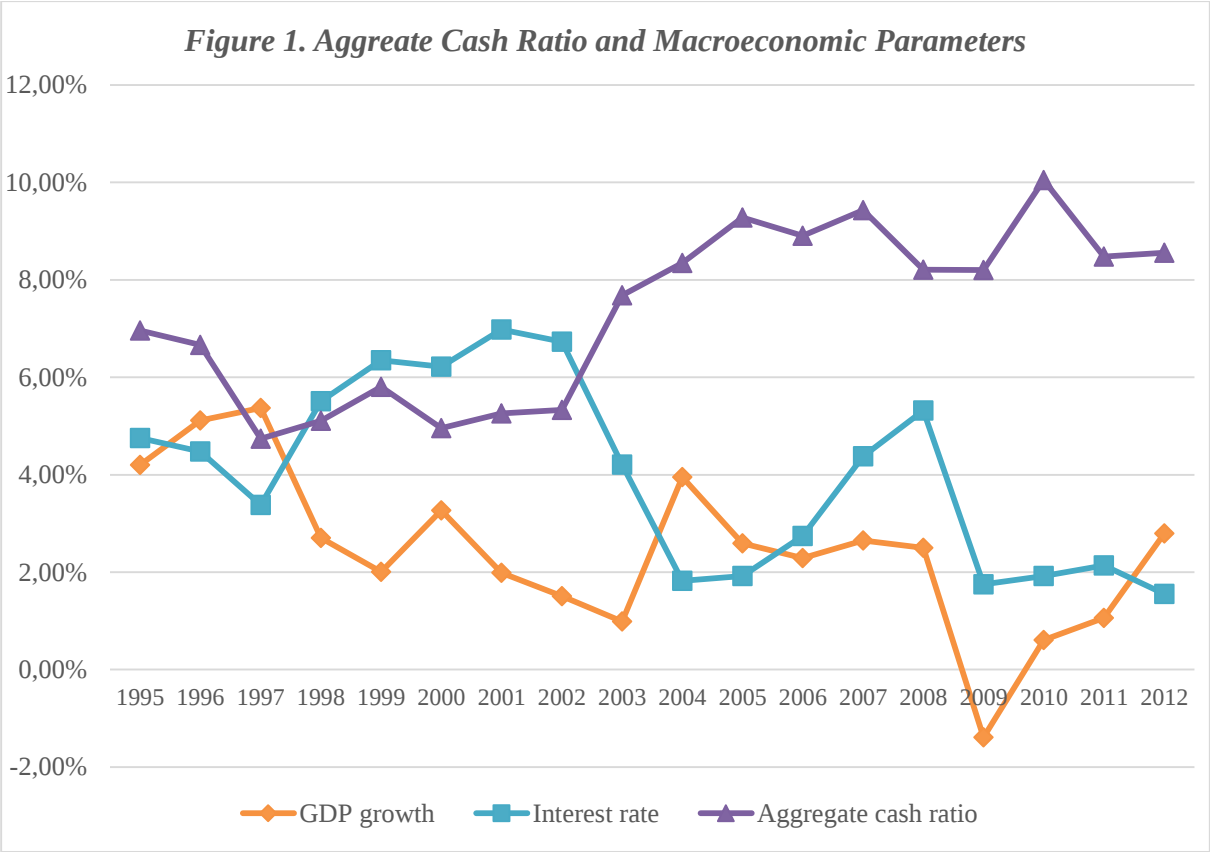


Figure 1. Aggregate Cash Ratio and Macroeconomic Parameters. This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. Interest rate is derived from Norwegian central bank and GDP growth rate is based on statistics from the World Bank. Aggregate cash ratio derives from Table 1A.

I compare interest rate [2] development and GDP growth [3] from 1995 to 2012 in Norway to aggregate cash ratio to see how this ratio resonates with macroeconomic parameters.

As Figure 1 shows, the aggreate cash ratio shares a slightly increasing trend whereas GDP growth and interest rates experience decreasing trends over sample years. Between 2003 and 2006, aggregate cash ratio has increased from around 5% to 9%, which is the most dramatic increase observed in this graph. During the same period, there are fluctuations in both interest rate and GDP growth and the dominating trend is downwards. According to precautionary motive, firms need to hold more cash to deal with unexpected external shocks. Weak macroeconomy will impose shocks to firms in terms of getting access to external capital

[2] Interest rate is based on statistics from Norges Bank (Norway's central bank). Access: http://www.norges-bank.no/Statistikk/Rentestatistikk/Styringsgrente-arlig/

[3] GDP growth rate is based on statistics from The World Bank. Access: http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG

market and financing future investments, which could help explain the trend that is observed in Figure 1, suggesting a negative correlation between cash holdings and general macroeconomic outlook.

In order to have a better understanding of how aggregate cash ratio changes with respect to macro economy, I also run regressions between aggregate cash ratio and other some macroeconomic parameters. Those regressions are conducted by using *arima* command in Stata. In addition to GDP growth rate, I include also inflation rate and real oil price growth rate (nominal oil price growth rate minus inflation rate).

Table I (B1) shows aggregate cash ratio is positively correlated with lag GDP growth rate. Even though the coefficients are not significant, it demonstrates that if previous GDP growth is negative, it will lead to increasing cash ratio for Norwegian firms. As oil price is another proxy of how GDP growth unfolds for Norwegian economy, I can also see a negative correlation between oil price and aggregate cash ratio. Current GDP growth rate is positively correlated with aggregate cash ratio. When GDP outlook seems promising, Norwegian firms will increase their cash holding.

Table I (B2) shows that how differenced macroeconomic parameters affect differenced aggregate cash ratio. Consistent with Table I (B1), the differenced GDP growth rate also has a negative impact on differenced aggregate cash ratio. Looking at current level, the current differenced GDP growth is positively correlated with differenced aggregate cash ratio, meaning that if the GDP growth rate between current year and previous year is positive, Norwegian firms will also hold more cash than previous year, namely the differenced aggregate cash ratio is positive. Similar with Table I (B1), the differenced oil price parameter has the same effect on differenced aggregate cash ratio for Norwegian firms.

Table I (B1)

Aggregate Cash Ratio and Macroeconomic Parameters

This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. In this table, dependent variable is aggregate cash ratio. The table is generated by using *arima* command in Stata, which predicts models with time-dependent disturbances, which are allowed to follow a linear autoregressive moving-average (ARMA). The first table is calculated by using one lag.

	Current Level			Lag Level			Next Level		
GDP Growth Rate	0.121			-0.21			0.24		
	-0.576			-0.116			-0.204		
Inflation Rate		-0.183			-0.17			0.058	
		-0.555			-0.455			-0.83	
Real Oil Price Growth Rate			0.009			-0.011			0.017
			-0.468			-0.119			-0.112
Constant	0.064***	0.071***	0.067***	0.078***	0.076***	0.074***	0.059***	0.066***	0.066***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
L.ar	0.834***	0.805***	0.809***	0.749***	0.782***	0.831***	0.868***	0.804***	0.840***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sigma constant	0.011***	0.011***	0.011***	0.010***	0.010***	0.009***	0.011***	0.012***	0.010***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wald Chi2 (2)	36.89	32.16	39.15	17.83	21.64	39.6	71.7	26.84	31.59
N	20	20	20	19	19	19	19	19	19

Table I (B2)

Aggregate Cash Ratio and Macroeconomic Parameters

This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. In this table, dependent variable is aggregate cash ratio. The table is generated by using *arima* command in Stata, which predicts models with time-dependent disturbances, which are allowed to follow a linear autoregressive moving-average (ARMA).This table is differenced, meaning that it predicts how differenced independent variables predict the differenced dependent variable.

	Current Level			Lag Level			Next Level		
Differenced GDP Growth Rate	0.142			-0.161			0.299		
	-0.507			-0.355			-0.092		
Differenced Inflation Rate		-0.142			-0.148			0.077	
		-0.533			-0.593			-0.766	
Differenced Real Oil Price Growth Rate			0.008			-0.012			0.016*
			-0.48			-0.106			-0.035
Constant	0.003	0.002	0.003	0.001	0.001	0.002	0.003	0.003	0.003
	-0.366	-0.381	-0.341	-0.651	-0.76	-0.486	-0.249	-0.39	-0.321
Sigma Constant	0.012***	0.012***	0.011***	0.010***	0.010***	0.010***	0.011***	0.012***	0.010***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wald Chi2 (2)	4.440	0.390	0.500	0.850	0.290	2.610	2.840	0.090	4.470
N	19	19	19	18	18	18	18	18	18

I also want to understand the implications of changes in cash ratio for the measurement of leverage. Column 6 of Table I measures average debt for the sample firms by year.
I also want to understand the implications of changes in cash ratio for the measurement of leverage. Column 6 of Table I measures average debt for the sample firms by year.
Leverage is measured by using long-term liabilities divided by book value of total assets. (Including the short-term liabilities variable in the dataset will cause abnormal leverage ratios; hence I exclude short-term liabilities to establish a more realistic picture of leverage ratio). We can see that average leverage ratio of Norwegian firms has experienced a decreasing trend over sample years. It reaches peak at year 1998 with 36.42 % and then it starts to decrease gradually in the following years. By 2010, the average leverage is 30.33%, which is lowest. Median leverage, showed in column 7, has also experienced a gradual decrease. It starts with 30.10% at year 1995 and ends with 26.61% at year 2012, and the yearly decrease is small yet consecutive. Taking a look at average net leverage ratio, which subtracts cash from debt, the general trend is approximately the same, showing that average net leverage ratio has decreased with some fluctuations. The initial value of average net leverage ratio at 1995 is 22.21% and the value is 17.07% at year 2012. The evidence from Table I (A) illustrates a stable decrease in average cash ratio till year 2005 and a gradual increase trend from 2005 to 2012; however, the values of average cash ratios do not deviate a lot from the initial value. I also observe a corresponding decrease in net debt. The decrease in net debt in this sample occurs because Norwegian firms have less debt rather than they hold more cash. In order to assess whether the changes in cash is associated with firm size, I divide the sample firms into quintiles each year according to the book value of total assets.

Figure 2 illustrates the average cash ratios for different quintiles over sample period. As it shows, the average cash ratio shares a stable trend over sample years for each quintile, but the increase is more evident for quintile 5, which represents largest size of firms. Quintile 1 shares a minor increase in the first three years before decreasing to 2000, after 2000, quintile 1 has experienced a stable and very little increase. As for quintile 5, the decrease is obvious for the first five years, and then it experiences an increase to around 2006 before it encounters another small decrease until the end of sample period. Regarding quintile 2, 3, 4, they share a similar pattern of changes except for the last three years. Before 2009, Q2, Q3 and Q4 experience a small decrease until 2000, and then they have a minor increase until 2009. For the last three years, Q2 and Q3 increase a little before having a minor decrease, whereas Q4 shares a stably small decrease. Again, I run regression the cash ratio on a constant and time

(measured in years) for quintile 1 to 5, and find out that only slope is positive for Q3, and negative for Q4 and Q5. Coefficients of Q3 and Q4 are statistically significant whereas Q5 are highly statistically significant. Notably, coefficients of Q1 and Q2 are not significant. I can then conclude that the cash ratio is mainly driven by bigger firms for Norwegian sample.

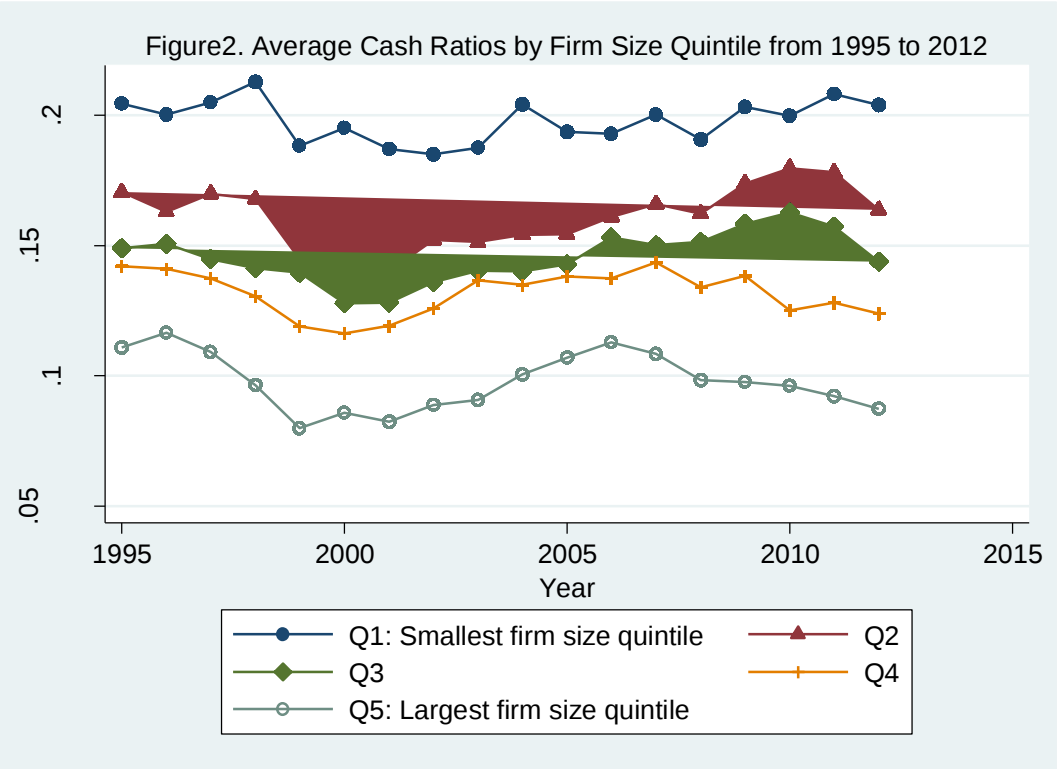


Figure 2. Average Cash Ratios by Firm Size Quintile from 1995 to 2012. This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. Firms are sorted into quintiles based on value of total assets. The first quintile (Q1) represents the smallest firms, while the fifth quintile (Q5) represents the largest firms in this sample.

Figure 3 shows the average net leverage ratios for different quintiles over sample period. Quintiles 1, 2 and 3 have experienced a decline in average net leverage ratios over sample years, and Q1 has the most pronounced decrease among those three quintiles. Concerning quintile 4, I can see that the ratio has a slight decrease from 1995 to 2006, and then it has again a small increase, which compensates the previous decrease. As for quintile 5, representing the largest size of firms, there is an increase from 1995 to 2002, and then a slight decrease follows up to 2007 before it increases again to the end of sample period. Figure 4 (in

Appendix), median net leverage ratios also share a similar pattern with average net leverage ratios, showing that quintile 5 has increased whereas quintile 1, 2 and 3 have decreased.

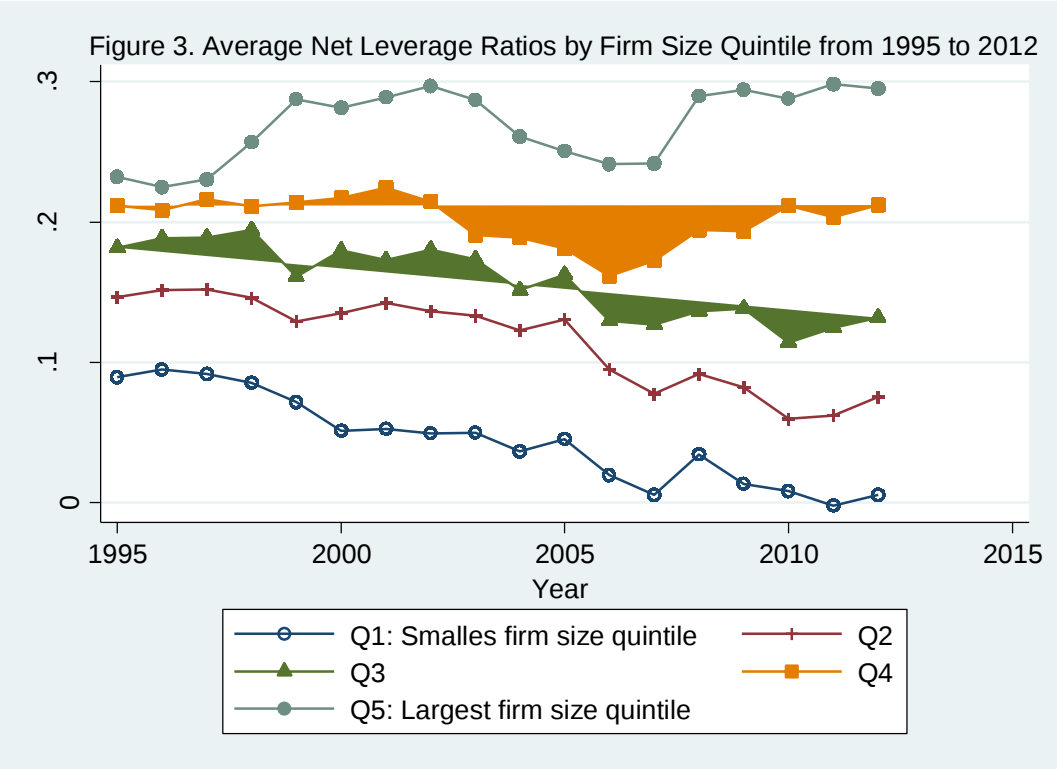


Figure 3. Average Net Leverage Ratios by Firm Size Quintile from 1995 to 2012. This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. Firms are sorted into quintiles based on value of total assets. The first quintile (Q1) represents the smallest firms, while the fifth quintile (Q5) represents the largest firms in this sample.

Private and public firms have different needs for cash holdings. Gao, Harford and Li (2012) argue that there are two dynamics working against each other in terms of cash holdings for public and private firms: 1). Agency conflicts between owners and managers are more pronounced for private firms than public firms, which could lead public firms to hoard more cash than private firms. 2). Financial frictions are less prevalent among public firms compared to private counterparts, causing public firms to hold less cash. Intuitively, due to its size and opaqueness private firms find more challenging to get external sources of financing compared to public firms. Those two factors could lead to opposite sentiments towards cash holdings for private and public firms and it is interesting to know how the outcome spells out for Norwegian firms.

Table II (A)

Average Cash Ratios from 1995 to 2012 Delineated by Firm Status, the Payment of Dividends, and Accounting Performance

This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. A private firm is not registered at Oslo Stock Exchange. A public firm has done IPO and is currently available on Oslo Stock Exchange. A firm is classified as dividend payer if the firm pays dividend in the year. According to t-test, * indicates that the result is significant at 10% level, ** significant at 5% level and ***significant at 1% level. Variable definitions are presented in Appendix.

	Firm Status		Dividend Status		Accounting Performance	
Year	Private	Public	Non-dividend payer	Dividend Payer	Nonnegative Net Income	Negative Net Income
1995	0.1414	0.1075**	0.1320	0.1703***	0.1540	0.1013***
1996	0.1397	0.1187*	0.1301	0.1739***	0.1538	0.0980***
1997	0.1406	0.1182**	0.1319	0.1705***	0.1515	0.1054***
1998	0.1348	0.1085**	0.1248	0.1710***	0.1509	0.0959***
1999	0.1268	0.1140	0.1248	0.1717***	0.1382	0.0948***
2000	0.1251	0.1193	0.1248	0.1425	0.1345	0.1010***
2001	0.1249	0.1015**	0.1237		0.1385	0.0932***
2002	0.1317	0.1194	0.1311	0.0369	0.1433	0.1063***
2003	0.1329	0.1497	0.1317	0.1680***	0.1486	0.0938***
2004	0.1371	0.1753	0.1389	0.1338*	0.1434	0.1195***
2005	0.1394	0.1520	0.1388	0.1524	0.1473	0.1006***
2006	0.1430	0.1597	0.1427	0.1511	0.1529	0.0970***
2007	0.1461	0.1408***	0.1451	0.1497	0.1552	0.1058***
2008	0.1419	0.1030***	0.1361	0.1690***	0.1630	0.1004***
2009	0.1484	0.1155***	0.1415	0.1775***	0.1635	0.1035***
2010	0.1467	0.1221**	0.1413	0.1706***	0.1651	0.0935***
2011	0.1469	0.1164**	0.1404	0.1790***	0.1642	0.0962***
2012	0.1365	0.1061**	0.1296	0.1673***	0.1488	0.0954***

Table II (A) shows that average cash ratio of private firms is higher than public firms in most years except for the period from year 2003 to year 2006. According to Figure 5, it can also be observed that average cash ratio of private firms experiences less dramatic changes compared to public firms. An observed trend for private firms is that average cash ratio decreases first, and then it stabilizes. As for public firms, there are some fluctuations from 1995 to 2001 before it starts to rise again until 2004. After 2004, it starts to have a significant decreasing trend again. The initial value of average cash ratios for private firms is 14.14% and it ends up

with 13.65% at 2012. The difference between initial value and end value is small. Even though the changes of average cash ratio for public firms are more volatile, the initial value with 10.75% has even smaller difference compared to the end value with 10.61%. In most years, private firms hold more cash than public firms, and this can be explained by referring to the one of the two reasons mentioned by Gao, Harford and Li (2012), namely that private firms face stronger financial frictions, making it more difficult for them to access external capital market, hence they hold more cash. The results from t-test also show that there are 11 significant results out of 18 years, proving that validity of the observation in Norwegian sample. Table II (B) (In Appendix) illustrates median cash ratios between private and public firms. It can also be observed that private firms have generally higher median cash ratios than public firms and exceptions occur in year 2003, 2004, 2005 and 2006 where the opposite outcome is the case. The same trend that is concluded for average cash ratios are also applicable to median cash ratio.

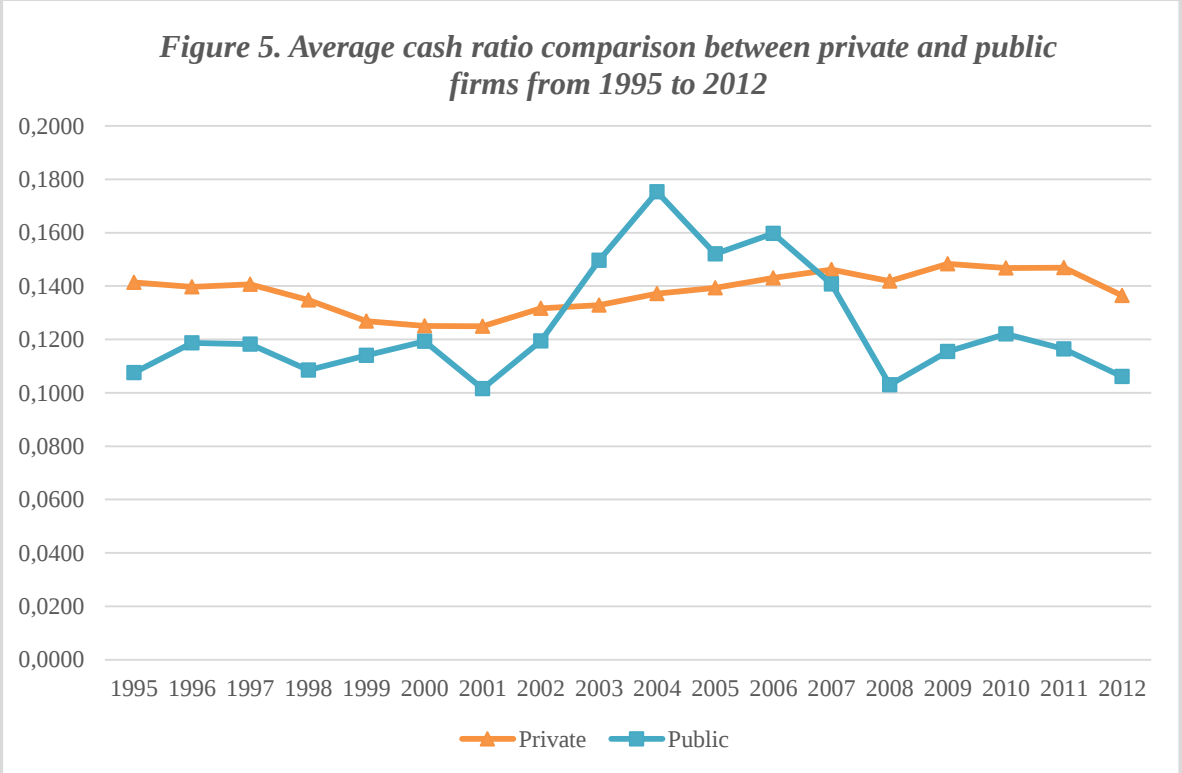


Figure 5. Average Cash Ratio Comparison between Private and Public firms from 1995 to 2012. This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. Average cash ratios for public and private firms are derived from Table II (A).

After examining the role of firm status, I would turn to the role of dividend. Jensen's (1986) free cash flow theory shows that non-dividend payers with dim growth opportunities will hoard more cash. In columns 4 and 5 of Table II (A), it shows that dividend payers, however, hold more than non-dividend payers. As there is lack of data in 2001 and the cash ratio of dividend payer in 2002 is surprisingly low, I treat both years as outliers, thus they are excluded from interpretation. This outcome runs contrary to what free cash flow theory claims, which could invite different interpretations.

The relationship between dividend payment and cash holdings is not always straightforward as it seems. Ozkan and Ozkan (2004) argues that firms that pay dividends can afford to hold less cash because they can simply cut dividend paying when they need extra funding. Also, paying dividend is often associated with being less financially constrained, which could also lead the firm to hold less cash. Nevertheless, they also argue that it is also possible that dividend payers hold more cash than non-dividend payers to avoid the situation where they are short of cash to fulfill dividend payment. Dividend is considered as a commitment to shareholders, and cutting dividend would send a negative signal to the market, affecting stock performance. The dynamic relationship between cash holdings and dividend payment makes it reasonable to assume that the latter explanation of Ozkan and Ozkan (2004) reflects the reality of cash holdings among Norwegian firms. When taking a look at Table II (B), which also summarizes the median cash ratios for dividend and non-dividend payers, it shows that the median cash ratio of dividend payers is higher than non-dividend payers. This outcome aligns with what is observed in Table II (A) regarding average cash ratio.

Bates, Kahle and Stulz (2009) argue that firms with negative net income are more likely to be financially constrained than firms with positive net income and their findings also demonstrate that cash flow sensitivity of corporate investment in cash differs for financially constrained firms. Based on this principle, I divide the sample into firms with nonnegative net income and firms with negative income. As Table II (A) shows, the average cash ratio is calculated for those two groups. In Norwegian setting, my observation is that average cash ratio of firms with nonnegative net income is higher than firms with negative net income, and there are bigger fluctuations in this ratio for former group than the latter one. No clear trending can be spotted.

After establishing an understanding of how cash holding situation evolves in Norway as an entity, I now want to distill two representative industries in Norway to analyze. The reason I choose fishing and oil industries is that Norwegian firms have cutting-edge competences and large market shares in both industries globally and they are vital for Norwegian economy, making them interesting candidates to probe.

3.4.1 Cash holding trend for fishing industry in Norway

Table III

Average and Median Cash and Leverage Ratio from 1995 to 2012 for Fishing Industry in Norway

This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. The following table is on based the sample data and focuses solely on fishing industry in Norway. Variable definitions are presented in Appendix.

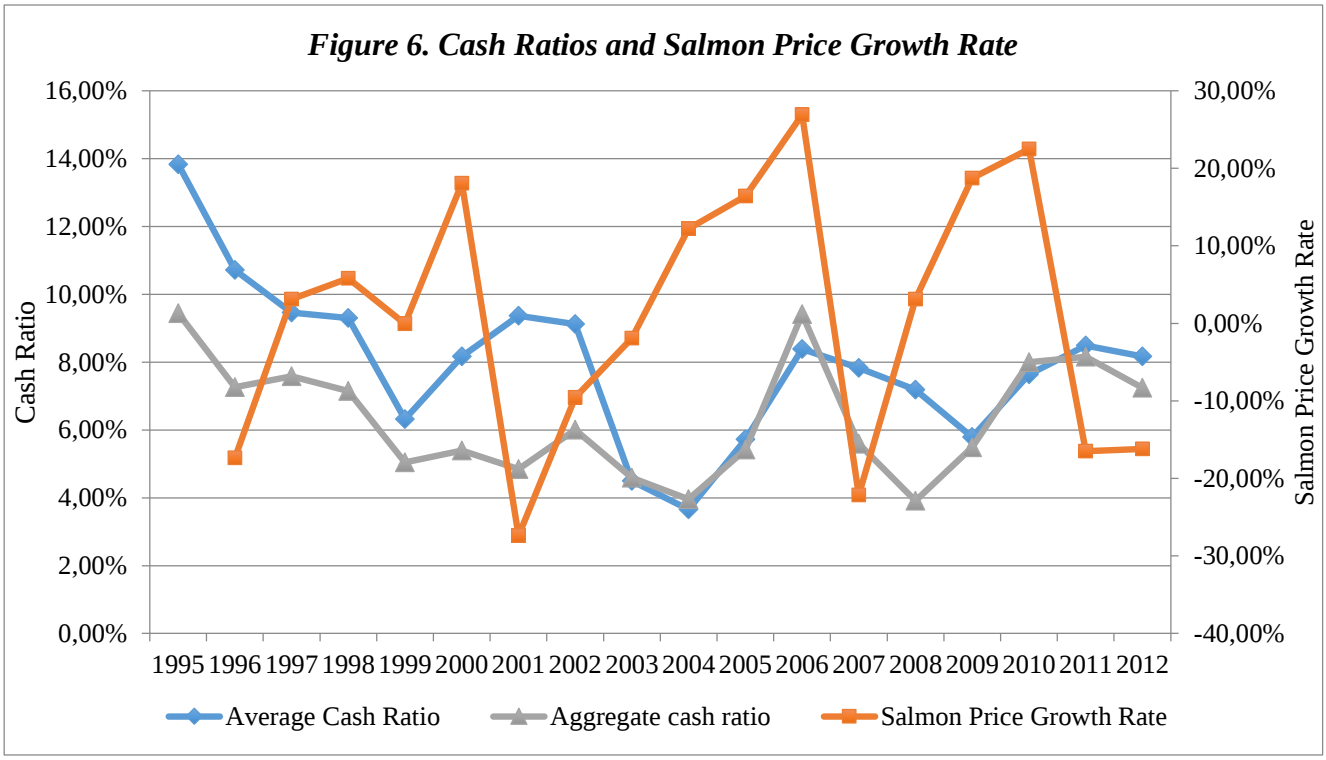
Year	N	Aggregate Cash Ratio	Average Cash Ratio	Median Cash Ratio	Average Leverage	Median Leverage	Average Net Leverage	Median Net Leverage
1995	68	0.0944	0.1383	0.0518	0.3288	0.2704	0.1905	0.1800
1996	73	0.0726	0.1072	0.0282	0.3305	0.2661	0.2229	0.2427
1997	93	0.0758	0.0946	0.0384	0.3593	0.3402	0.2647	0.2829
1998	102	0.0715	0.0930	0.0432	0.3923	0.4034	0.2993	0.3149
1999	40	0.0504	0.0631	0.0205	0.4355	0.4305	0.3723	0.3848
2000	41	0.0539	0.0817	0.0607	0.4563	0.5147	0.3745	0.4070
2001	50	0.0485	0.0937	0.0316	0.4430	0.4676	0.3486	0.3950
2002	56	0.0600	0.0912	0.0333	0.4554	0.4653	0.3642	0.3998
2003	54	0.0459	0.0449	0.0195	0.5278	0.5315	0.4829	0.4919
2004	52	0.0396	0.0366	0.0158	0.5252	0.5197	0.4886	0.5033
2005	50	0.0542	0.0572	0.0417	0.4774	0.4469	0.4202	0.4298
2006	51	0.0941	0.0839	0.0523	0.3756	0.3532	0.2918	0.2763
2007	55	0.0559	0.0783	0.0381	0.3519	0.3171	0.2736	0.2574
2008	58	0.0391	0.0719	0.0381	0.4054	0.3723	0.3336	0.3108
2009	60	0.0549	0.0579	0.0301	0.4313	0.3828	0.3734	0.3554
2010	61	0.0800	0.0764	0.0582	0.4420	0.3624	0.3641	0.2995
2011	71	0.0816	0.0849	0.0519	0.4478	0.3967	0.3619	0.3309
2012	72	0.0724	0.0816	0.0497	0.4390	0.3895	0.3573	0.3330

There are in total 1107 observations during over sample period for fishing industry. As Table III shows, generally average cash ratio has a decreasing trend, starting with roughly 13.83% at 1995 and ending with 8.16% at 2012. This ratio decreases until year 1999, and it has experience some fluctuations until year 2009. After 2009, the average ratio has again a slight increase and it finally ends at 8.16%, which is around 5.6% lower than the starting value. The

aggregate cash ratio is also interesting indicator to examine. By using the similar method, I calculate the aggregate cash ratio for the Norwegian fishing industry. The development of this ratio is more volatile than other ratios. It starts with 9.44% at year 1995, and then it drops to the bottom at 3.96% at 2004 before it quickly reaches a high value at 9.41% at year 2006. Interestingly, it drops again quickly to 3.91% at year 2008. Since 2008, this ratio has increased again and it stops at 7.24% at year 2012.

I construct salmon price growth rate from 1996 to 2012[4] in order to see if how salmon price growth rates interact with average cash ratio and aggregate cash ratio. According to Figure 6, over the most sample years, cash ratios decrease when salmon price goes up. When salmon price goes up, it will bring positive effects to fishing industry, increasing revenues and cash flows for firms in this industry, displaying a good economic outlook. Referring to precautionary motive, firms will hold more cash when there are unexpected shocks to economy. When the general outlook of an industry is good, firms will most likely to reduce cash holdings. This reverse relationship between salmon price and cash holdings can be explained by using precautionary motive. Figure 6 also shows that aggregate cash ratio is lower than average cash ratio in most sample years.

Figure 6. Cash Ratios and Salmon Price Growth Rate



[4] Based on data covering salmon price history from week 01.1995 until 12.2013 from Norwegian Seafood Federation (FHL) and Norwegian Seafood Council

Figure 6. Cash Ratios and Salmon Price Growth Rate. This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. Average cash ratios and aggregate cash ratios derive from table III and salmon price growth rate is based weekly data from 01.1995 to 12.2013 from Norwegian Seafood Federation (FHL) and Norwegian Seafood Council.

According to Figure 7 (In Appendix), average leverage ratio, median leverage ratio, average net leverage ratio and median net leverage ratio follow a similar trend. Those four ratios encounter an increase until year 2003, and then they experience a decrease until 2007 before having another minor increase. There are some individualistic variations in terms of the degree of increase and decrease for those four ratios, however, those variations are trivial and the pattern is more pronounced.

3.4.2 Cash holding trend for oil industry in Norway

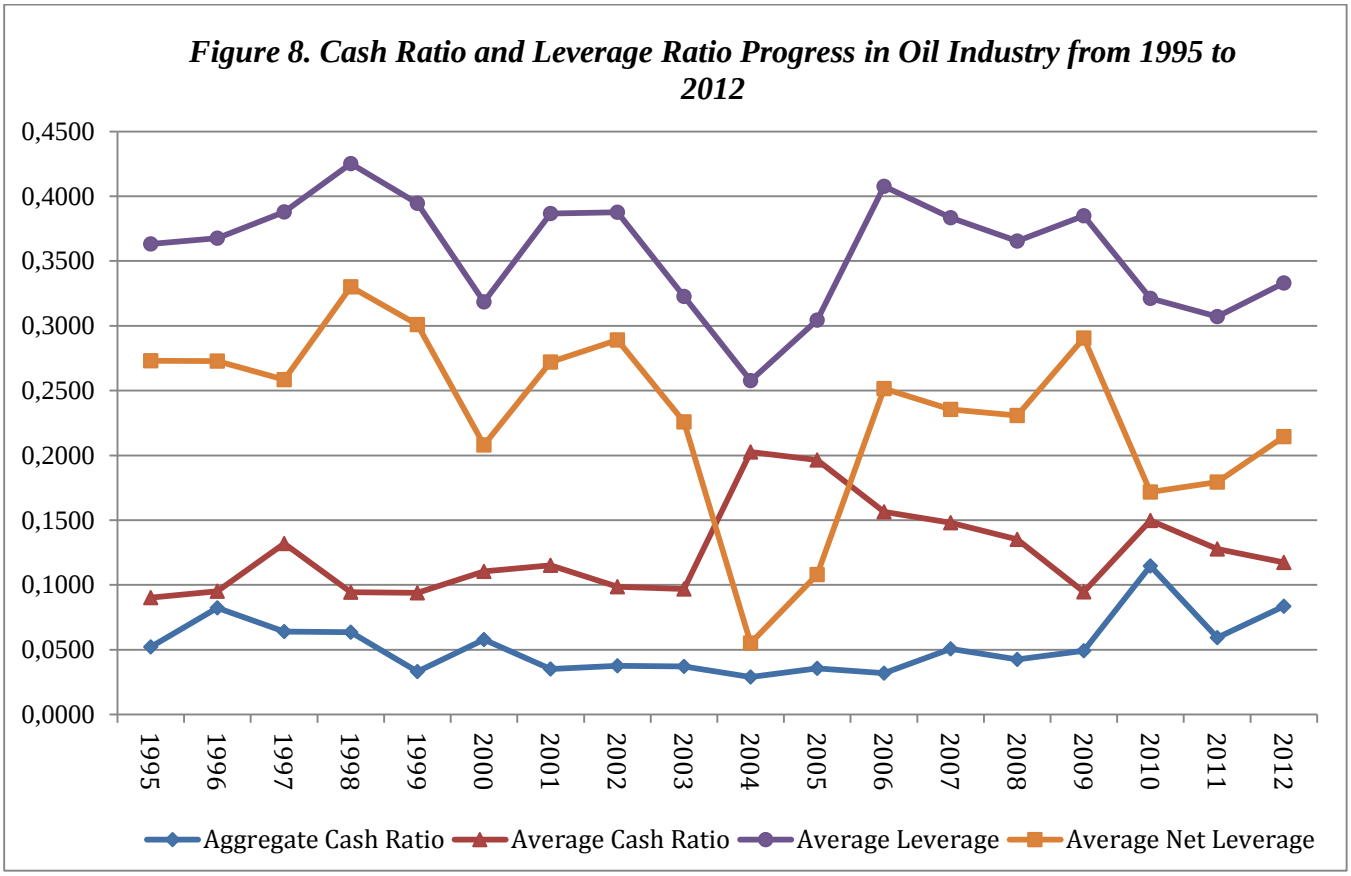


Figure 8. Cash Ratio and Leverage Ratio progress in oil industry from 1995 to 2012. This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and

utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. All ratios in this figure are calculated within oil industry in Norway.

Table IV

Average and Median Cash and Leverage Ratio from 1995 to 2012 for Oil Industry in Norway

This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. The following table is on based the sample data and focuses solely on oil industry in Norway. Variable definitions are presented in Appendix.

Year	N	Aggregate Cash Ratio	Average Cash Ratio	Median Cash Ratio	Average Leverage	Median Leverage	Average Net Leverage	Median Net Leverage
1995	16	0.0521	0.0903	0.0587	0.3632	0.3764	0.2730	0.2924
1996	17	0.0822	0.0950	0.0464	0.3677	0.3563	0.2727	0.2918
1997	21	0.0639	0.1320	0.0853	0.3879	0.3643	0.2583	0.2938
1998	24	0.0636	0.0944	0.0566	0.4252	0.3822	0.3301	0.3086
1999	20	0.0330	0.0938	0.0582	0.3946	0.3672	0.3008	0.2727
2000	17	0.0579	0.1105	0.0551	0.3186	0.3464	0.2081	0.2416
2001	18	0.0350	0.1152	0.0621	0.3867	0.4401	0.2719	0.3689
2002	17	0.0377	0.0986	0.0672	0.3876	0.4215	0.2891	0.3370
2003	17	0.0372	0.0969	0.0539	0.3226	0.3017	0.2257	0.2645
2004	16	0.0289	0.2025	0.1139	0.2576	0.2157	0.0551	-0.0097
2005	15	0.0356	0.1964	0.0991	0.3044	0.2863	0.1080	0.1530
2006	19	0.0319	0.1563	0.1008	0.4077	0.3795	0.2514	0.2949
2007	25	0.0507	0.1481	0.0942	0.3835	0.3565	0.2355	0.2616
2008	29	0.0426	0.1351	0.0610	0.3653	0.4489	0.2307	0.3099
2009	27	0.0492	0.0945	0.0557	0.3850	0.3879	0.2905	0.2983
2010	29	0.1147	0.1496	0.0715	0.3213	0.3221	0.1716	0.1199
2011	34	0.0592	0.1277	0.0950	0.3070	0.2685	0.1793	0.1250
2012	38	0.0836	0.1174	0.0875	0.3331	0.2876	0.2146	0.1992

In total there are 399 observations in oil industry over the sample years, there is a slightly decreasing trend in aggregate cash ratio until year 2006. From 2006 to 2012, an increasing trend can be easily observed. The peak of aggregate cash ratio is at year 2010, amounting to 11.47%, whereas the bottom of this ratio is at year 2004 with a value at 2.89%. As for average cash ratio and median cash ratio, the trends are similar except that average cash ratio has higher value than median cash ratio, so description of one suffices to capture the development of these two ratios. The average cash ratio has experience some degree of fluctuations until year 2003, and from 2003 onwards, there is a significant jump in average cash ratio, increasing from 9.69% at 2003 to 20.25% at 2004. A decreasing trend is salient from year

2004 to year 2009. In the last three years of the sample, the average cash ratio increases a bit and it ends up with a value at 11.74%, which is slightly higher than the initial value at 9.03%.

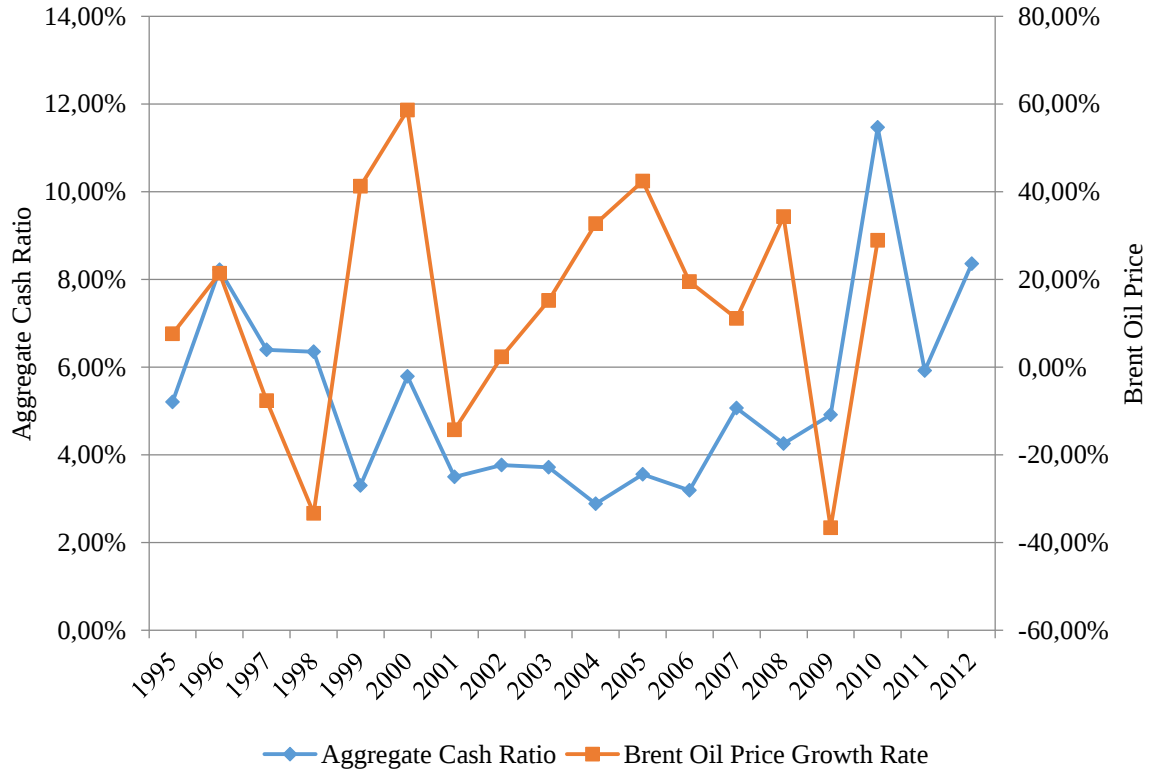
As Figure 8 shows the ratios regarding debt (both leverage ratio and net average ratio) have shared an overlapping pattern to a large extent, however, the changes in net leverage ratios are more dramatic than leverage ratios. Taking average leverage ratio and average net leverage ratio as examples, in spite of a decreasing trend, those two ratios have experienced large fluctuations from 1995 to 2000. From 2000 onwards, there is first an increase to 2002 before they drop significantly in 2004, which is the bottom point for all leverage ratios. After reaching the lowest value at 2004, those two ratios start to increase again dramatically in the following two years, and then some fluctuations again come through between 2006 and 2009. Finally, there is an obvious decreasing trend in the last three years. The similar pattern also applies to median leverage ratio and median net leverage ratio. At year 2004, the sharp drop in net leverage ratios is coupled with significant increase in average cash ratios. By examining the database, I find out that there are two firms whose average cash ratios have increased dramatically from year 2003 to 2004.

As the number of analyzable data is small from 2003 to 2004, the vast increases in cash ratios for those two firms have also contributed to increasing the average and median cash ratios for the oil industry during that period. One firm is Altinex ASA and the other is DNO ASA. Regarding Altinex, its cash ratio has increased from 8.9% to 44.03%. Going through Altinex's history, I find out that this firm in 2005 conducts a significant equity emission to acquire about 12% of Brage oil field from Eni S.p.A. At 2004, the firm also established two daughter firms in Oslo and Stavanger. Interestingly, at 2006, the firm was acquired by another Stavanger-based firm named Noreco. This acquisition has experienced several steps and eventually the transaction was completed in 2007. Opler et al. (1999) show that cash reserves and following acquisition are positively correlated and Harford (1999) argues that cash-rich firms are more likely than other firms to undertake acquisition and the acquisition by those firms are value decreasing, destroying seven cents in value for every excess dollar of cash reserves held. Based on this finding, it can be inferred that Altinex held more cash by emitting equity from 2003 to 2004 in order to achieve an acquisition. After the acquisition, Altinex was then again acquired by another firm. The entire acquisition history of Altinex is consistent with Harford's theory; hence it is logical to believe that the sudden increase in cash holdings from 2003 to 2004 is largely due to the attempt of going through an acquisition.

For DNO ASA, the cash ratio increased from around 5.38% to 55.70% from 2003 to 2004. By investigating further, DNO had sold part of its assets to the Swedish petroleum firm Lundin for USD 165 million in 2004. This sale of assets brought a huge amount of cash to the firm. Checking other financial items such as debt, net profits, tax, etc., it is reasonable to believe that the dramatic increase in cash ratio for DNO ASA is attributed to this asset sale decision.

To examine how oil price interacts with aggregate cash ratio in Norway, I construct the Brent oil price growth rate [5] between 1995 and 2010. As Figure 9 illustrates, the pattern can be decomposed into three parts. First, the aggregate cash ratio to a greater extent follow the same trend as normalized Brent oil price change rate before 2005, namely the ratio increases when oil price increases and the ratio decreases when the oil price drops. Second, between 2005 and 2009, the reverse pattern can be observed, showing that ratio increases when oil price drops and the ratio decreases when oil price goes up. Third, at 2010, the last year of this comparison, we can again see that aggregate cash ratio increases together with oil price.

Figure 9. Aggreate Cash Ratio and Brent Oil Price Growth Rate for Oil Industry



[5] The Brent blend oil price is based on BP: statistical review of world energy - spot crude prices.

Figure 9. Aggregate Cash Ratio and Brent Oil Price Growth Rate for Oil Industry. This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. Brent oil price growth rate is statistical review published by British Petroleum and aggregate cash ratio is based on table IV.

3.5 Firm characteristics and cash holding in a Norwegian setting

In this section, I will study the relationship between firm characteristics and cash holdings and how this relationship changes over time for Norwegian firms. Staring with the regression that explores the how firm characteristics can explain cash holdings, I will further investigate whether the increase in cash holdings can be attributed to changes in firm characteristics.

The literature employs several alternative definitions of the cash ratio, including 1) cash to assets, 2) cash to net assets (net assets equals total assets minus cash), 3) log of cash to net assets, and (4) cash to sales (Bates, Kahle and Stulz, 2009). In this paper, I will mainly use the most traditional measure i.e. cash to assets. In addition to this measure, I will also include logarithm of cash to net assets ratio. Foley et al. (2007) use the logarithm of the cash to net assets ratio by following method mentioned by Opler et al. (1999). This logarithm measure can reduce extreme outliers, which is suitable in our database.

The independent variables used are mainly inspired by cash holding determinants described by Opler, Pinkowitz, Stulz and Williamson (1999) and variables used are as following:

1. *Sales growth*. Firms with better sales growth opportunities value cash more as they are required to finance more projects when sales are growing.

2. *Firm size*. It is believed that economies of scale also apply to cash holding, implying that a positive relation between firm size and cash holdings.

3. *Cash flow to assets*. Being potentially exposed to lucrative investment opportunities, firms with better cash flow tend to hold more cash, ceteris paribus.
4. *Net working capital to assets*. Net working capital measures the relationship between current assets and current debt and a negative relationship between NWC and cash holding can be expected.

5. *Leverage*. Leverage is measured as long-term liabilities divided by total assets. With a high amount of debt, firms can be constrained to grow; hence it is reasonable to believe that firms will use cash to reduce the level of debt, expecting a negative relation between leverage and cash holdings. Conforming to the hedging argument of Acharya, Almeida, and Campello (2007), constrained firms will allocate excess cash flows into cash holdings if their hedging needs are high, implying a positive relation between leverage and cash holdings.

6. *R&D to sales*. This variable is a proxy of growth opportunities. Opler, Pinkowitz, Stulz and Williamson (1999) argue that cost of financial distress to be larger for firms with high R&D expenses, since R&D expenses are a form of investment where information asymmetries are most important. Consequently, it should be expected that firms with higher R&D expenses would hold more cash.

7. *Industry cash flow risk (Industry sigma).* Industry sigma is measured as the mean of standard deviation of cash flows to total assets over 5 years for firms in the same industry, as defined by the SN2007 code. Firms with bigger cash flow risk are inclined to hold more cash according to precautionary motive.

8. *Dividend payout dummy.* A dummy variable equals to one when a firm pays dividend and equals zero otherwise. As previously discussed, the relationship between dividend payment and cash holdings is dynamic, however, it is true that firms that pay dividends are less risky and have greater access to external capital markets, indicating that the need of holding cash for precautionary motive is not that strong.

9. *Capital expenditure to assets.* Capital expenditure is measured as difference in tangible assets between current year and previous year. If the increasing tangible assets can be used as collateral, it would increase the debt capacity, which would again reduce the need for holding cash. A negative relation can be expected. Furthermore, Riddick and White (2009) argue that a productivity shock that increases investment can lead to a lower level of cash.

The data requirements limit the size of the panel data. Both independent variable and dependent variables are winsorized at the 1% level before running regressions. The results are reported in Panel A of Table V. Panel A of Table V consists of 8 models. Model 2 and Model 6 use the logarithm of cash divided by net assets as dependent variable, and other models use cash divided by total assets as dependent variable. Model 3 and model 6 document the how changes in variables could impact the results of regression. The lagged change in cash and the lagged level of cash are included to adjust cash ratio partially to equilibrium level. Comparing model 3 with model 1, the significance of industry sigma is different with model 1 being significant and model 3 being insignificant, also the sign of coefficient on sales growth is opposite with model 1 being positive and model 3 being negative. Model 7 use Fama-MacBeth regression and model 8 adopts fixed effects regression. No dummy variables for years or industries are used in this regression.

Table V

Regression Estimating the Firm Characteristics of Cash holdings

This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. Taking start point in this sample data, I add other firm characteristics as dependent variables, resulting in many lost variables. The number of observations for regressions is smaller than the sample data. Table V includes two panels. By adding more independent variables in Panel B, more observations are missed due to limitation of the database, thus Panel A has more observations than Panel B. Model 2 and Model 3 in Panel B include IPO indicator variables, which are also relevant for firms that are listed, therefore the numbers of observations for regressions in Model 2 and Model 3 are much smaller than Model 1. Panel A include 8 models in which model 1 to model 6 are OLS regressions, model 7 is Fama MacBeth regression and model 8 is fixed effects regression. Dependent variables are either cash to assets or logarithm of cash to assets. Values in parentheses represent *p*-values, which are based on standard error robust to clustering by organization number. Fama-MacBeth regressions use Newey and West (1987) standard errors to control for autocorrelation Panel B include separate slopes and intercepts for firm-year observations from 2000 through 2012. * indicates that the result is significant at 10% level, ** significant at 5% level and ***significant at 1% level.

Panel A

	1	2	3	4	5	6	7	8
Model	OLS	OLS	Changes	OLS	OLS	Changes	F-M(2000s)	FE
Dependent Variable	Cash/Assets	Log(Cash/Net Assets)	Cash/Assets	Cash/Assets	Log(Cash/Net Assets)	Cash/Assets	Cash/Assets	Cash/Assets
Intercept	0.341***	-0.661***	0.104***	0.332***	-0.712***	0.099***	0.348***	0.088***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lag dcash			-0.334***			-0.334***		
			(0.000)			(0.000)		
Lag cash			0.747***			0.747***		
			0.000			0.000		
Industry sigma	0.176**	1.807***	0.008	0.174**	1.792***	0.007	0.238***	-0.006
	(0.00)	(0.000)	(0.81)	(0.00)	(0.000)	(0.844)	(0.001)	(0.842)
Sales growth	0.001	0.007*	-0.001*	0.001	0.007*	-0.001*	0.001	-0.001***

	(0.052)	(0.043)	(0.016)	(0.053)	(0.043)	(0.016)	(0.119)	(0.000)
Real size	-0.012***	-0.101***	-0.003***	-0.012***	-0.101***	-0.003***	-0.013***	0.007***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash flow/assets	0.072***	0.955***	0.022*	0.071***	0.952***	0.022	0.075***	0.109***
	(0.000)	(0.000)	(0.05)	(0.000)	(0.000)	(0.05)	(0.000)	(0.000)
NWC/assets	-0.228***	-1.725***	-0.122***	-0.228***	-1.723***	-0.122***	-0.230***	-0.219***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capex	-0.008*	-0.03	-0.042***	-0.009**	-0.032	-0.042***	-0.012**	-0.032***
	(0.012)	(0.385)	0.000	(0.008)	(0.347)	0.000	(0.005)	0.000
Leverage	-0.218***	-1.917***	-0.075***	-0.218***	-1.917***	-0.075***	-0.213***	-0.090***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R&D/assets	-0.137*	-0.678	-0.175***	-0.139*	-0.688	-0.176***	-0.110*	-0.330***
	(0.02)	(0.18)	0.00	(0.02)	(0.17)	(0.000)	(0.04)	(0.000)
Dividend dummy	0.019***	0.183***	0.007**	0.018***	0.181***	0.007**	0.014	0.015***
	(0.000)	(0.000)	(0.00)	(0.000)	(0.000)	(0.00)	(0.06)	(0.000)
2000s dummy				0.010**	0.061	0.006		
				(0.006)	(0.080)	(0.053)		
Adjusted R-squared	0.2720	0.227	0.627	0.272	0.227	0.627	0.28	0.147
N	25455	25357	20740	25455	25357	20740	24320	25455

Panel B

	1		2		3	
Model	Cash/Assets		Cash/Assets		log(Cash/Net Assets)	
Dependent Variable	Estimate	Interaction 2000s	Estimate	Interaction 2000s	Estimate	Interaction 2000s
Intercept	0.396***	-0.052	0.248	0.284	-3.951	4.825
	(0.000)	(0.133)	(0.302)	(0.272)	(0.164)	(0.097)
Industry sigma	0.289	-0.123	1.727***	-1.057*	16.938***	-11.567**
	(0.203)	(0.594)	(0.000)	(0.016)	(0.000)	(0.008)
Sales growth	0.00200	-0.002	0.08400	-0.087	0.48900	-0.517
	(0.076)	(0.163)	(0.371)	(0.356)	(0.697)	(0.681)
Real size	-0.018***	0.006*	-0.018	-0.01	-0.037	-0.204
	(0.000)	(0.044)	(0.185)	(0.537)	(0.834)	(0.268)
Cash flow/assets	-0.012	0.084	0.077	-0.16	1.832	-1.791
	(0.853)	(0.198)	(0.904)	(0.807)	(0.654)	(0.667)
NWC/assets	-0.210***	-0.035	-0.023	-0.092	3.442	-4.675
	(0.000)	(0.176)	(0.929)	(0.726)	(0.231)	(0.112)
Capex	-0.015	0.01	0.079	-0.093	0.252	-0.218
	(0.158)	(0.365)	(0.734)	(0.692)	(0.900)	(0.914)
Leverage	-0.186***	-0.02	0.006	-0.16	1.191	-2.48
	(0.000)	(0.291)	(0.965)	(0.278)	(0.553)	(0.222)
R&D/assets	-0.537*	0.357	-1.223	1.135	-0.329	0.79
	(0.040)	(0.183)	(0.256)	(0.299)	(0.975)	(0.941)
Dividend dummy	0.044	-0.027	0.114**	-0.073	1.730**	-1.519*
	(0.093)	(0.293)	(0.001)	(0.228)	(0.002)	(0.027)
Net debt issuance		-0.015***	-0.292	0.274	-2.392	2.275
		(0.000)	(0.074)	(0.092)	(0.147)	(0.166)
Net equity issuance		0.041***	0.115	-0.071	0.171	0.129
		(0.000)	(0.305)	(0.526)	(0.876)	(0.906)

Loss dummy		-0.026	-0.098
		(0.114)	(0.534)
T-bill		-0.001	0.126
		(0.974)	(0.433)
Credit spread		0.005	-0.082
		(0.779)	(0.532)
IPO1		0.01	0.046
		(0.570)	(0.739)
IPO2		-0.002	-0.021
		(0.812)	(0.806)
IPO3		0.004	0.018
		(0.588)	(0.733)
IPO4		0.003	-0.02
		(0.529)	(0.592)
IPO5		0.009*	0.066*
		(0.027)	(0.048)
R-squared	0.286	0.297	0.307
N	21889	652	650

Sales growth and cash flow risk (industry sigma) have positive and significant coefficients in most models. Industry sigma does not have significant coefficients for model 3 and 6, and a negative coefficient can be observed for fixed effects regression. The coefficient of sales growth under Fama MacBeth regression is not significant, and the coefficients are negative in model 3, 6 and 8. The sign of coefficients on leverage and NWC to assets are negative and all of them are statistically significant, meanwhile the sign of coefficients on cash flow to assets is positive and significant. As mentioned previously, the leverage and cash holdings can have either a positive relation or negative relation; the result shows that the negative relation is prevalent for Norwegian sample, implying that firms with higher leverage hold more cash so that they use the cash to reduce constraints imposed by the high level of leverage. The negative relation between cash holdings and NWC to asset is also in accordance with what the previous conjecture.

The coefficients on capital expenditure are negative and significant in most models except of model 2 and model 5 where dependent variable is log of cash to net assets. Pursuant to treating capital expenditure as collaterals, firms with higher capital expenditures would decrease cash demand and increase debt level; a negative relation can be expected. The results here also reflect such relation for Norwegian firms.

Regarding real size, the sign of coefficients is negative and significant in most models with exception in model 8 where the sign is changed and significance remains the same, implying that the bigger firms are, the less cash they hold.

Interestingly, the coefficients on R&D to sales are negative for Norwegian firms, differing from what theory suggests. Under mode 2 and model 5, the coefficients on R&D to sales are not significant. A potential reason for this discrepancy could be attributed to the quality of the data as components of R&D variable in this database could be different from the traditional components of R&D. Concerning dividend dummy variable, all coefficients are positive and significant across all models, demonstrating that a firm paying dividend has higher cash holdings, and this result is also consistent with the second argument proposed by Ozkan and Ozkan (2004), suggesting that a firm which pays dividend will hold more cash to avoid the situation where they cannot fulfill the dividend payment duty.

Regression with cash to total assets as dependent variables has a higher R^2 than those with log of cash to total assets as dependent variable, indicating that using cash to total assets as dependent variable could better explain the variation in cash holding. Again, we can see that including lagged cash into regression is associated with increased R^2 in our sample. Model 3 and model 6 have highest R^2 among all the models.

I also add one indicator variable to allow for intercept shifts in 2000s since the database contains data only in 1990s and 2000s. In accordance with the Table V, coefficients on this dummy variable are positive and significant for Model 4 and Model 5, which is in alignment with the increasing trend in cash holdings in 2000s that cannot be explained by changes in firms characteristics showed by Table I. Model 6 is an re-estimating of Model 3 with addition of this dummy variable, and the conclusion is the same as Model 4 and Model 5.

Briefly, we can see the relation between cash holding and firm characteristics is quite consistent across different models in Table III Panel A. Exceptions happen for fixed effects regression where the sign of coefficients are reverted for real size and industry sigma. Also, the coefficients on sales growth also vary in different models. I also include one indicator variable to count for intercept change in 2000s and find out that cash holdings have increased in 2000s in all three models, and this finding also resonates with previous increasing trend in cash holdings showed by Table I.

Panel B is constructed to count for changes in both the intercept and slopes. Model 1 of Panel B is based on Model 1 of Panel, adding an indicator variable for the 2000s that interacts with all independent variables. Model 2 and Model 3 are variations of Model 1 by incorporating with several extra indicators variables. I include net debt issuance; net equity issuance, loss dummy, T-bill yield and credit spread measure. Net debt issuance to assets is calculated by using current liabilities minus previous year liability divided by total assets. Equivalently, net equity issuance is equal to the difference between current total equity and previous total equity divided by total assets. T-bill yield is an American parameter based on the average 3-month rate published by Federal Reserve St. Louis. Similarly, the credit spread is the difference between AAA and BAA bonds from Federal Reserve. By adding five IPO indicator variables, the intent is to examine the intuition that capital raising comes usually in a big amount and firms should hold more cash immediately after raising capital and the cash holding should increase over time. Model 3 is similar with Model 2 except for using log of

cash to net assets as the dependent variable. Noticeably, Model 2 and Model 3 only include public firms, i.e. the variable *listing* = 1, since it makes logical sense to exclude private firms when running regressions that include IPO variables. [6]

Starting with Model 1, the sign of coefficients remain unchanged for leverage, cash flow to assets and NWC to assets. Only coefficients on NWC to assets and leverage at 1990s are significant among those three variables, and the coefficients all become insignificant at 2000s with interaction variables. Regarding industry sigma, the coefficient is positive and significant at 1990s and the sign becomes reverse and insignificant at 2000s. Similarly, the coefficient on sales growth follows the same pattern, becoming trivially negative and insignificant at 2000s. Clearly, there is a negative and significant relation between cash holding and real size at 1990s, and this relation turns to be positive, remaining significant at 2000s. This shows inconsistency with transaction motive, which implying that large firms hold less cash. A potential explanation could be associated with agency reasons, namely managers will hold more cash when the organization becomes larger. Considering the relation between capital expenditure and cash holdings, it also follows the same pattern as real size; however, the relation turns insignificant at 2000s. With respect to Model 1 in Panel A, the relation between R&D to sales and cash holdings is negative and significant, which is also the case at Panel B. Nevertheless, the relation becomes insignificant and negative at 2000s.

Looking at Model 2, in 1990s the relation between industry sigma and cash ratios is positive and insignificant; however, it turns negative and insignificant in 2000s. The same changes have also happened to sales growth. The coefficient on real size is negative and significant in 1990s and it, however, become positive and insignificant in 2000s. Markedly, the sign of coefficient on NWC to assets are negative and significant for 1990s and 2000s, which also resonates with results from Panel A. Concerning coefficients on capital expenditure and R&D to assets; both are positive and insignificant in 1990s and become negative and insignificant in 2000s. For leverage, the coefficients are negative for both 1990s and 2000s; however, it is significant in 1990s and insignificant in 2000s. For dividend payment, the coefficient is positive in 1990s and negative in 2000s, however, both are insignificant. For net debt issuance,

[6] An unreported approach has been tried to find better sample for Model 2 and Model 3, which is to use the firms that have ever been listed, and the results produced differ significantly from what theory suggests, hence the approach is not adopted.

a negative correlation with cash ratios can be observed in both 1990s and 2000s; however, the coefficient is only significant in 2000s. Regarding net equity issuance, the coefficients are positive for both 1990s and 200s, and it is only significant in 2000s too.

From a transaction point of view, if the risk-free rate decreases, the cost of holding cash will also decrease, expecting a positive relation between cash holdings and T-bill yield, which is also the not case for the Norwegian sample. Contrastingly, an increase in credit spread will lead to an increase in default risk, which again will increase precautionary demand for cash, which is confirmed in the Norwegian sample according to Model 2 in Panel B. With respect to IPO indicators variables, the results are not in accordance with the suggested intuition since the signs of coefficients change irregularly.

The third model in Panel B has log of the ratio of cash to net assets as dependent variable. Model 3 to a large extent resembles Model 2 with some noticeable differences. First, the sign of coefficients on capital expenditures are reverse compared to Model 2 with unchanged significance. Second, the coefficient on leverage in Model 3 is positive in 1990s and negative in 2000s whereas both coefficients are negative in Model 2. Regarding T-bill, a positive and insignificant relation can be observed. Nevertheless, a negative and insignificant correlation can also be found for coefficient on credit spread, which is not in alignment with common intuition. For the IPO variables, despite insignificance, we can find that the suggested intuition is better reflected in Model 3 where the coefficients gradually reduce when IPO becomes more distant.

In Panel B, the majority of results for Model 2 and Model 3 are insignificant and this is probably because of the size of the sample data. With exclusion of all private firms, the remaining data size consists of only 652 firms for Model 2 and 650 for Model 3. Enlarging the sample size, which is not achievable in this dataset, could potentially alleviate the insignificant results for most coefficients.

3.6 Financial constraints and cash holding for Norwegian firms

Table V Panel A has also examined how firm characteristics interact with cash holdings for Norwegian firms. One of those independent variables is dividend payment, which is also a financial constraint measurement according to literature. As Panel A shows, dividend

payment variable is positively correlated with cash ratios and all coefficients are significant. Seen from a financial constraint perspective, a dividend-paying firm, which is considered to be less financially constrained, should hold less cash. Nevertheless, there are other forces explained by Ozkan and Ozkan (2004) that pull the opposite direction, for instance, dividend payment is a commitment to shareholders and firms could hold more cash to fulfil this commitment. In this setting, the case in point could be that the ability to fulfill dividend payment duty takes a dominating role when it comes to interplay between cash holdings and dividend payment.

In addition to dividend payment, I construct two financial constraint (Whited-Wu index and Hadlock-Pierce index) measurements in order to examine how they affect cash holdings for Norwegian firms, and I exclude KZ index because of the incompleteness of dataset where there is a lack of essential component for KZ index's construction.

By adding Whited-Wu index, Table VI (A) is conducted in a similar way as Panel A in Table V. I replace dividend dummy variable with WW index since dividend payment has also been considered as a financial constraint measurement and other variables such as industry sigma, sales growth, real size, cash flow to assets, etc. are included as other independent variables.

As Table VI (A) shows, there are also 8 Models in this panel. Dependent variables are both ratio of cash to assets and the log of the ratio of cash to assets. It can be observed that WW index has a trivially negative correlation with cash ratios and they are significant in all Models except for Model 8 where fixed effects regression is conducted. The results also share similarities with Panel A to a great extent; the correlations between cash ratios and other independent variables are extremely comparable to Panel A. In terms of R^2, Model 3 and Model 6 where lag cash variable and 2000s dummy variable are included have highest R^2 at 62.70%, showing that those two Models explain regression better. Fixed effect regression has lowest R^2 at 14.56%.

Table VI (A)

Regressions Estimating the Financial Constraint Index (Whited-Wu Index) of Cash Holdings

This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. Taking start point in this sample data, I add other firm characteristics as dependent variables, resulting in many lost variables. The number of observations for regressions is smaller than the sample data. Panel A include 8 models in which model 1 to model 6 are OLS regressions, model 7 is Fama MacBeth regression and model 8 is fixed effects regression. Dependent variables are either cash to assets or logarithm of cash to assets. Values in parentheses represent *p*-values, which are based on standard error robust to clustering by organization number. Fama-MacBeth regressions use Newey and West (1987) standard errors to control for autocorrelation Panel B include separate slopes and intercepts for firm-year observations from 2000 through 2012. * indicates that the result is significant at 10% level, ** significant at 5% level and ***significant at 1% level.

WW Index								
	1	2	3	4	5	6	7	8
Model	OLS	OLS	Changes	OLS	OLS	Changes	F-M(2000s)	FE
Dependent Variable	Cash/Assets	Log(Cash/Net Assets)	Cash/Assets	Cash/Assets	Log(Cash/Net Assets)	Cash/Assets	Cash/Assets	Cash/Assets
Intercept	0.341***	-0.644***	0.104***	0.332***	-0.702***	0.099***	0.347***	0.077***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lag dcash			-0.334***			-0.333***		
			(0.000)			(0.000)		
Lag cash			0.746***			0.746***		
			(0.000)			(0.000)		
Industry sigma	0.170**	1.767***	0.006	0.168**	1.751***	0.004	0.240***	-0.006
	(0.005)	(0.000)	(0.869)	(0.006)	(0.000)	(0.904)	(0.001)	(0.838)
Sales growth	0.001	0.007*	-0.001*	0.001	0.007*	-0.001*	0.001	-0.001***
	(0.057)	(0.044)	(0.015)	(0.057)	(0.044)	(0.015)	(0.130)	(0.000)
Real size	-0.011***	-0.100***	-0.003***	-0.012***	-0.100***	-0.003***	-0.012***	0.008***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash flow/assets	0.070***	0.938***	0.021	0.070***	0.935***	0.021	0.074***	0.103***

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
NWC/assets	-0.229***	-1.730***	-0.122***	-0.228***	-1.728***	-0.122***	-0.230***	-0.219***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capex	-0.008*	-0.024	-0.042***	-0.008*	-0.027	-0.042***	-0.012**	-0.032***
	(0.019)	(0.473)	0.000	(0.013)	(0.422)	0.000	(0.006)	0.000
Leverage	-0.220***	-1.932***	-0.076***	-0.219***	-1.931***	-0.076***	-0.214***	-0.092***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R&D/assets	-0.147*	-0.766	-0.178***	-0.148*	-0.776	-0.179***	-0.115*	-0.332***
	(0.011)	(0.126)	0.000	(0.010)	(0.121)	(0.000)	(0.040)	(0.000)
WW Index	-0.000**	-0.001	-0.000*	-0.000**	-0.001	-0.000*	-0.000*	0
	(0.007)	(0.057)	(0.024)	(0.008)	(0.059)	(0.025)	(0.012)	(0.512)
2000s dummy				0.011**	0.070*	0.006*		
				(0.002)	(0.043)	(0.039)		
Adjusted R-squared	0.271	0.226	0.627	0.271	0.226	0.627	0.279	0.146
N	25584	25484	20856	25584	25484	20856	24449	25584

Table VI (B)

Regressions Estimating the Financial Constraint Index (Hadlock and Pierce Index) of Cash Holdings

This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. Taking start point in this sample data, I add other firm characteristics as dependent variables, resulting in many lost variables. The number of observations for regressions is smaller than the sample data. Panel A include 8 models in which model 1 to model 6 are OLS regressions, model 7 is Fama MacBeth regression and model 8 is fixed effects regression. Dependent variables are either cash to assets or logarithm of cash to assets. Values in parentheses represent *p*-values, which are based on standard error robust to clustering by organization number. Fama-MacBeth regressions use Newey and West (1987) standard errors to control for autocorrelation Panel B include separate slopes and intercepts for firm-year observations from 2000 through 2012.

HP Index

	1	2	3	4	5	6	7	8
Model	OLS	OLS	Changes	OLS	OLS	Changes	F-M(2000s)	FE
Dependent Variable	Cash/Assets	Log(Cash/Net Assets)	Cash/Assets	Cash/Assets	Log(Cash/Net Assets)	Cash/Assets	Cash/Assets	Cash/Assets
Intercept	0.171***	-2.180***	0.057***	0.164***	-2.218***	0.052***	0.163***	0.097***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lag dcash			-0.335***			-0.335***		
			(0.000)			(0.000)		
Lag cash			0.751***			0.751***		
			(0.000)			(0.000)		
Industry sigma	0.213***	2.196***	0.018	0.212***	2.189***	0.017	0.277***	-0.017
	(0.001)	(0.000)	(0.600)	(0.001)	(0.000)	(0.622)	(0.000)	(0.571)
Sales growth	0.000	0.003	-0.001**	0.000	0.003	-0.001**	0.000	-0.001**
	(0.476)	(0.350)	(0.005)	(0.482)	(0.352)	(0.005)	(0.672)	(0.006)
Cash flow/assets	0.071***	0.948***	0.023*	0.071***	0.946***	0.022*	0.076***	0.106***
	0.000	0.000	(0.041)	(0.000)	(0.000)	(0.043)	(0.000)	(0.000)
NWC/assets	-0.235***	-1.792***	-0.123***	-0.235***	-1.791***	-0.123***	-0.237***	-0.217***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capex	-0.012***	-0.057	-0.043***	-0.012***	-0.059	-0.043***	-0.016**	-0.024***
	(0.001)	(0.094)	(0.000)	(0.000)	(0.085)	(0.000)	(0.001)	(0.000)
Leverage	-0.229***	-2.003***	-0.077***	-0.229***	-2.003***	-0.077***	-0.223***	-0.091***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R&D/assets	-0.122*	-0.528	-0.171***	-0.123*	-0.533	-0.171***	-0.087	-0.326***
	(0.032)	(0.283)	(0.000)	(0.031)	(0.278)	(0.000)	(0.110)	(0.000)
HP Index	-0.010***	-0.101***	-0.003***	-0.010***	-0.101***	-0.003***	-0.011***	-0.022***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
2000s dummy				0.007	0.039	0.005		
				-0.053	-0.261	-0.101		
Adjusted R-squared	0.261	0.218	0.626	0.261	0.218	0.626	0.268	0.146
N	25612	25512	20881	25612	25512	20881	24477	25612

Equivalently, I conduct the same regressions for cash ratios and HP index. Since real size is one variable that is used to construct HP index, I exclude real size variable to achieve a better result of correlation between HP index and cash ratios. As Table VI (B) shows, HP index has a stronger negative correlation with cash ratios compared to WW index, and all coefficients are negative and significant, meaning that HP index has a negative impact on cash ratios. Regarding other independent variables, the correlations between cash ratios and those independent variables are similar to Panel A. $R^2$of Model 3 and Model 6 is also highest among all Models.

Table VI shows how financial constraints measurements interact with cash holdings controlling for a series of firm characteristics variables. According to those two panels, a clear-cut observation is that financial constraint variables are negatively correlated with cash ratios across all Models and all coefficients are significant except for one in fixed effects regression in Table VI (A). A conclusion can be drawn here is that a financially constrained firm has more cash holdings compared to a non-financial constrained one based on evidence from regressions in Table VI. This is, however, inconsistent with what theory suggest. Accroding to theory, a financially constrained firm will hold more cash than a non-financially constrained firm. The explanation could be that there is a mis-measurement of those two financial constraint indices, which is also an issue recently discussed in Farre-Mensa and Ljungqvist (2013).

Another observation is that HP index serves as a better financial constraint measurement compared to WW index. A feasible explanation is that components of HP index are real size and age, which are determined by the firm itself and cannot be changed by the firm; whereas components of WW index include, for instance, sales growths, cash flow to assets, long-term debt to total asset, etc., which could be changed by the firm in a short run.

In light of Panel B of Table V, I also interact indicator variable for 2000s with HP index and WW index in order to see how financial constraint measurements impact cash holdings over time. As Table VII (A) (In Appendix) shows, the correlations between WW index and cash holdings are not significant despite the signs have changed in Model 1 and Model 2. By creating the identical interaction variables for HP index, Table VII (B) (In Appendix) shows that both coefficients on HP index are negative and insignificant for Model 1. Recognizably, in Model 2, the coefficient on HP index is positive and significant in 1990s and it turns to

negative and significant in 2000s in Model 2, indicating that the negative impact HP index imposes on cash ratios is mainly caused in 2000s. In Model 3, the exact trend occurs again with coefficient being positive in 1990s and negative in 2000s, hence it can conclude that the negative correlation between HP index and cash ratios is more attributable to 2000s in spite of insignificance.

Referring back to hypothesis 1, which takes starting point in the intuition that financially constrained firms will hold more cash as raising external capital becomes more difficult for them than unconstrained firms, the evidence from OLS and other regressions by using two financial constraint measurements shows that the hypothesis is not true in Norwegian setting. In addition to potential mis-measurement of those two financial constraint indices suggested by Farre-Mensa and Ljungqvist (2013), it could also be attributed to endogeneity problem that OLS regressions suffer, which will be elaborated in next session.

3.7 Cash holding changes in the event of listing and delisting

In previous section, I examine how financial constraints affect cash holdings for Norwegian firms by using two indices based on OLS and other regressions. The results produced demonstrate that financial constraint measurements are negatively correlated with cash holdings. Despite the results confirm my first hypothesis; it is worthy pointing out that there are several pitfalls of OLS regression methods, which could potentially lead to skewed conclusions.

The first shortcoming of OLS regression is omitted variable bias (OVB). The regression formulas used are not comprehensive and could not possibly include all independent variables that could correlate with cash ratio. The identified independent variables are based on the classical determinants for cash holdings suggested by Opler, Pinkowitz, Stulz and Williamson (1999). The cash holding determinants have covered the most critical components that affect the cash holding situation for a firm, however, they might be other variables which could also be correlated with cash holdings. For instance, corporate governance can determine how much cash a firm should hold. With stringent corporate governance, national authorities could purposely increase threshold of cash holdings for firms in certain industry, resulting in increase of cash holdings. Possibly, stock performance could also be correlated with cash holdings. With gradually increasing stock performance, a firm receives higher public

appreciation and shares a profitable outlook, making it easier for a firm to get external funding; hence the cash holding could reduce. More thorough research needs to be done in order to uphold or refute those conjectures, yet the focal point is that omitted variables in OLS regressions could lead to inaccurate predications, which deviate from the reality.

A consequence of omitted variable bias is endogeneity problem. Endogenous variables are correlated with other variables (both independent and dependent) in a regression. Although it is difficult to quantify, the firm's reputation and goodwill could probably be an endogenous variable, which affect both a firm's cash holdings and financial constraint situation. For instance, a firm with stellar rating and outstanding reputation shall encounter little hindrance when it comes to raising fund, indicating that such a firm is not financially constrained; meanwhile this firm would have also achieved solidly financial performance, providing a resourceful way to hoard cash. Those correlations are hardly reported in an OLS regression, which could lead to endogeneity problem. A possible solution to overcome omitted variable bias is to introduce instrument or proxy variables for the omitted variables, however, since the assumption of this approach is very strong and they are hardly practical. Another commonly used method is fixed effects method, which is also used in previous regressions.

The second pitfall of OLS regression rests on the fact that it is not able to conduct comparisons within a firm over time. The purpose of OLS regression is to conduct comparisons in a cross-sectional setting. In other words, the OLS regressions used aim to see how firm financial constraint measurement affects cash holdings across different firms instead of examining the situation for the same firm. Undoubtedly, there are many distinctive traits of every firm, which are hard to measure and identify. For example, different firms might have different sizes, sales growths, and cash flows etc. Also, they might be located in entirely different industries, which make it extremely difficult to draw precise conclusions when comparing one with the other.

Realizing the pitfalls of results yielded by OLS regressions, I conduct two event studies to examine how cash holdings change for firms within a given time framework. The first event study will explore how cash ratios change for firms that have been listed. I study the how cash ratios change 5 years before IPO and 5 years after IPO in Norwegian setting. The second event study shares the same methodology, investigating how cash ratios change 5 years before delisting and 5 years after. By conducting those two event studies, it allows me to see

how cash ratios change within firms over time instead of achieving cross-sectional results yielded by OLS regressions, making it clearer to see how the real changes in cash ratios unfold for specific firms. Listing and delisting are two external shocks, imitating the external effects of financial constraint measurements. The advantage of using two external financial constraint measurements is that it can circumvent obstacles set by OLS regressions regarding omitted variable bias and endogeneity problem.

Public firms and private firms differ in several different ways. Gao, Hsu and Li (2013) find that public firms generate more patents than private firms and the patents of public firms are more exploitive (i.e., mainly making use of existing knowledge) and less exploratory (i.e., pursuing new knowledge) than the patents of private firms, and their conclude that short-termism associated with public equity markets contributes to an exploitative innovation strategy. They further add that public firms are required to disclose more transparent than private firms concerning information environment and CEOs of public firms are more likely to be professional managers whereas CEOs of private firms are more likely to be entrepreneurs. Some more differences pointed out by Gao, Hsu and Li (2013) cover different life cycles public firms and private firms are located in. Public firms try more aggressively to commercialize their ideas and products than private firms. Moreover, public firms are more active than private firms in merger and acquisition transactions (Maksimovic, et al., 2013)

In addition to those differences, two previous studies have examined how borrowing cost and power change after a firm gets listed. Pagano et al. (1998) and Schenone (2010) examined the going-public decisions for Italian firms and they conclude that the borrowing cost decreases after those firms go public. Similarly, Schenone (2010) studies a panel of U.S firms and the conclusion is that the borrowing-cost bargaining power increases after IPO. Anthony and Sascha (2011) identify that private firms pay on average 27-bps-higher loan spreads than public firms, which is considered as a significant loan cost disadvantage.

Aforementioned differences between public firms and private firms could also have some impacts on cash holding situation, especially different borrowing costs. More importantly, when the transition from a public firm to a private firm entails a thorough alteration in information environment, namely a public firm discloses more information than a private firm. Gao, Hsu and Li (2013) argue that greater information disclosure could reduce asymmetric information problem between corporate insiders and outsiders, which also could

reduce the financing cost and the likelihood of the firm being undervalued by stock market, diminishing the possibility of being taken over. Furthermore, Anthony and Sascha (2011) further confirm that information opacity, especially the information opacity associated with firm's being private, has first-order importance on the cost of borrowing debt. Intuitively, public firms which face lower borrowing costs will hold less cash whereas private firms with higher borrowing costs will hold more cash. While recognizing those differences, the two crafted event studies will analyze how cash holdings change for firms that either go public or go private.

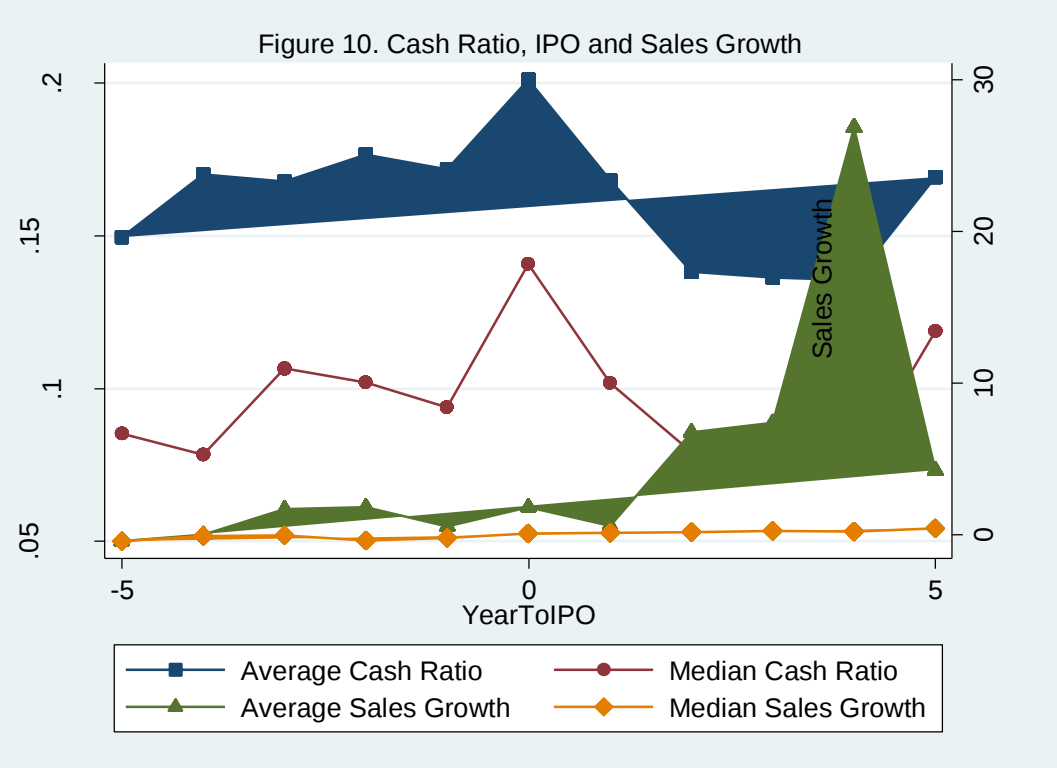


Figure 10. Cash Ratio, IPO and Sales Growth. This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. This figure examines how cash ratio and sales growth rate change before and after listing.

Referring to hypothesis 2 and hypothesis 3, theoretically, when a firm is listed, its access to public access is widened and it becomes less financially constrained, therefore its cash holding will most likely to reduce. Correspondingly, when a firm is delisted, its access to public funding is significantly limited, making it hard for the firm to raise external capital. In this case, the firm is more financially constrained, and its cash holding will more likely to increase. As Figure 10 shows, prior to IPO, the average cash ratio of firms has experienced an increasing trend, meaning that firms hold more cash before they go public. The average cash

ratio has increased from 15% to 20% before IPO. Nevertheless, when it becomes listed, the cash ratio has encountered a sharp decrease, falling below 15%, and 4 years after IPO, the average cash ratio has again had a minor increase. Taking a look at median cash ratio, it to a great extent follows the same trend as average cash ratio. In Figure 10, I also include the average sales growth to probe how cash ratios change with respect to sales growth. Clearly, after being listed, the sales growth has increased greatly, which reflects that it moves towards the opposite direction compared to cash ratios. As showed in Panel A in Table V, the coefficients on sales growth are positive for OLS regressions, indicating that cash ratios will increase when sales growth increases, however, in this event study, an opposite conclusion is reached. Potentially explanations could be tow fold; 1). OLS regression fails to distill the exact cash development within firms and the event study explores the trend specifically within a firm, hence it is natural to have difference. 2). The reduced cash holdings could be more attributed to the fact that IPO changes the financial constraint status of a firm and it is easier for them to raise external capital now, hence they reduce cash holdings. Seemingly, the second force takes a dominating role. Hypothesis 2 predicts that firms will reduce cash holdings after being listed, and this event study confirms this hypothesis.

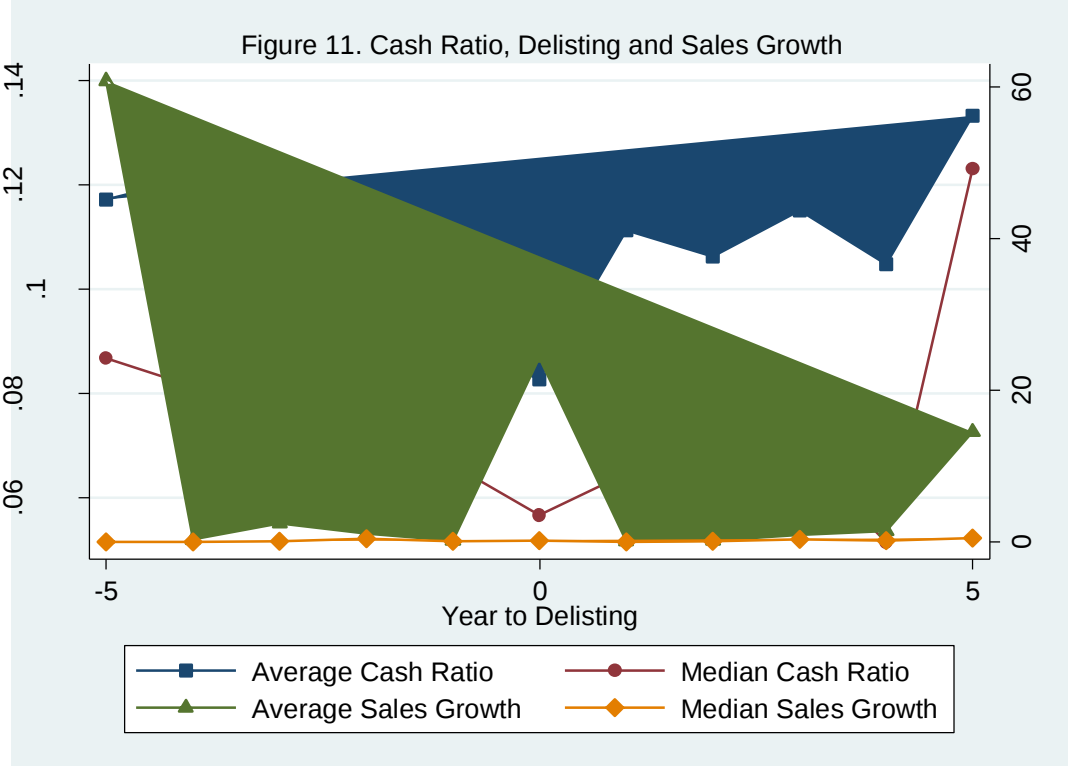


Figure 11. Cash Ratio, Delisting and Sales Growth. This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39

plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. This table examines how cash ratio and sales growth rate change before and after delisting.

According to Figure 11, the average cash ratio decreases prior to delisting and it starts with around 12% 5 years before delisting and it ends up with around 8% right before delisting. After delisting, a positive trend in average cash ratio can be spotted and the average cash ratio has increased to around 14% 5 years after delisting. Median cash ratio has similar development as average cash ratio before delisting with lower values. After delisting, the median cash ratio follows an increasing trend with some fluctuations; however, from year 4 to year 5, this ratio has increased from 5% to around 13%. Regarding average sales growth, it has been stable for most years except for some sudden changes around delisting event and there is no real pattern to be observed between average sales growth and cash ratios for delisting.

As Figure 11 suggests, the average cash ratio increases after delisting, which could be partially explained by financial constraint argument. When a firm becomes delisted, the firm status has changed from being public to private, which truncate the access to external capital market. In terms of the financing sources, private firms face more financing frictions than public firms and they mainly depend on debt financing (Brav, 2009; Gao, Harford, and Li, 2013). The consequence is that the firm gets financially constrained, which again would propel the cash holding desire. This argument is imbedded in hypothesis 3 and I can therefore conclude that the hypothesis 3 is confirmed by the evidence from this event study.

Another argument rests on how monitoring mechanism works for public and private firms. On one hand, being public, a firm is exposed to public shareholder monitoring. Since public shareholders are widely dispersed, they are not equipped with strong enough power to monitor how managers perform and operate the firm. Simultaneously, a private firm is tightly monitored by a less disperse group of shareholders who have stronger power to follow how managers steer the firm. The transition from public firm to private firm entails stronger monitoring power according to this perspective. Michael Jensen (1986) argues that managers with abundant free cash flow can increase dividend payment or buy back stock to consume cash that would otherwise be invested in low-return projects and he further argues that debt enables managers to bond their promise to pay out future cash flows, hence serving at substitute for dividends.

With stronger monitoring, a firm should reduce cash holdings according to Jensen's view with one precondition specifying that there are not enough lucrative investment opportunities available. Strong monitoring makes it hard for managers to misuse cash for their own interests and they are required to either invest the extra cash in profitable projects to achieve higher returns or distribute cash as dividends to shareholders. Interestingly, the evidence from the second event study contradicts what Michael Jensen suggests as I can see that cash holdings increase after a firm becomes private for this sample.

It is very arbitrary to say that this result is able to overthrow theory suggested by Michael Jensen; however, I can interpret the result with precaution by revealing two possible reasons why such discrepancy exists. First, while it is believed that monitoring should decrease when a firm becomes private, however, it will not necessarily be the case. With presence of publicly external monitoring forces such as media monitoring and authoritative monitoring, a public firm does not necessarily face weaker monitoring compared to a private firm. If monitoring does not increase when a firm becomes private, the cash holding situation would most likely remain the same and it will not decrease. More radically, if external forces disappear and the monitoring force incurred by shareholder is not strong enough to compensate the disappearance of external monitoring, it could contribute to decreasing monitoring forces. In this case, the cash holdings would increase just as the evidence demonstrates in this sample.

Second, one precondition ensuring that a strong monitoring force leads to lower cash holdings is lack of good investment opportunities. In this sample, it could be the case where there are sufficient good investment opportunities; hence the firm will hold more cash in order to invest in those profitable projects. Those two reasons could justify the occurred discrepancy between Michael Jensen's theory and the evidence from event study, leaving plenty of places for further research and discussion.

The purpose of those two event studies is to overcome shortcomings incurred by using OLS regressions. My findings are a going-public private firm will decrease cash holdings after being listed and a going-private public firm will increase cash holdings after being delisted. The potential discrepancies have also been explained with respect to the theory suggested by Michael Jensen. Also, the results resonate with the laid hypotheses in this paper.

4. Conclusions

I document a moderate increase in cash holdings for Norwegian firms from 1995 to 2012 in aggregate cash ratio and a stable yet minor fluctuation in average cash ratio. I also show that aggregate cash ratio of Norwegian firms is negatively correlated with macroeconomic parameters. In a Norwegian setting, private firms hold more cash than public firms. Dividend-paying firms hold more cash than non-dividend-paying firms.

Regarding the average aggregate cash ratio for specific industries, a minor decrease trend can be observed for fishing industry, whereas a minor increase trend is showed for oil industry. Dividend payment, being considered as a financial constraint measurement is positively correlated with cash holdings in the Norwegian sample. Two financial constraint measurements (WW index and HP index) are negatively correlated with cash holding, which disapproves hypothesis 1, saying that a financially constrained firm will hold more cash. The potential explanation for this inconsistency could be the mis-measurement of financial constraint indices discussed by Farre-Mensa and Ljungqvist (2013) and potential endogeneity problem OLS regressions suffer.

Private firms and public firms differ in several ways, and the cash holding situation is also different. Two event studies show that a going-public private firm will decrease cash holdings after being listed and a going-private public firm will increase cash holdings. From a financial constraint perspective, a public firm has wider access to external capital market, thus it is less financially constrained compared to a private firm. Being less financially constrained also entails the need for holding less cash. Also, a private firm faces higher borrowing costs, which could potentially curtail its ability to get external funding, thus it is more likely that a going-private public firm will hold more cash to resist aforementioned hindrances when it goes private.

References

Acharya, Viral A., Heitor Almeida, and Murillo Campello, 2007, Is cash negative debt? A hedging perspective on corporate financial policies, *Journal of Financial Intermediation 16, 515-554.*

Akguc, Serkan and Jongmoo Jay Choi, 2013, Cash holdings in private and public firms: Evidence from Europe, *Fox School of Business, Temple University*

Brav, Omer, 2009. Access to capital, capital structure, and the funding of the firm, *Jounral of Finance 64, 263-308*

Dittmar, Amy, Jan Mahrt-Smith, and Henri Servaes, 2003, International corporate governance and corporate cash holdings, *Journal of Financial and Quantitative Analysis 38*

Denis, David J. and Valeriy Sibilkov, 2009, Financial constraints, investment, and the value of cash holdings, *The Review of Financial Studies 23*

Farre-Mensa, Johan and Alexander Ljungqvist, 2013, Do measures of financial constraints measure financial constraints? *NBER Working Paper Series, National Bureau of Economic Research*

Faulkender, Michael, and Mitchell A. Petersen, 2006, Does the source of capital affect capital structure? *Review of Financial Studies 19, 45-79*

Foley, C. Fritz, Jay Hartzell, Sheridan Titman, and Garry J. Twite, 2007, Why do firms hold so much cash? *A tax-based explanation, Journal of Financial Economics 86, 579-607*

Gao, Huasheng, Jarrad Harford, and Kai Li, 2012. Determinants of corporate cash policy: Insights from private firms. *Working Paper, University of Washington, University of British Columbia, and Nanyang Business School.*

Gao, Huasheng, Po-Hsuan Hsu, and Kai Li, 2015, Public market listing and corporate innovation strategies: evidence from private firms. *University of British Columbia, working paper*

Graham, John R., Campbell R. Harvey, 2001, The theory and practice of corporate finance: evidence from the field, *Journal of Financial Economics 60, 187-243*

Han, Seungjin and Jiaping Qiu, 2007, Corporate precautionary cash holdings, *Journal of Corporate Finance 13, 43-57*

Harford, Jarrad, 1999, Corporate cash reserves and acquisition. *The Journal of Finance, 1969-97*

Jensen, Michael, 1986, Agency costs of free cash flow, corporate finance and takeovers, *American Economic Review 76, 323-329*

Lamont, Owen, Christopher Polk and Jesús Saá-Requejo, 2001, Financial constraints and Stock Returns. *The Review of Financial Studies Summer 2001 14 (2), 529-554*

Modigliani, Franco and Merton H. Miller, 1958, The cost of capital, corporation finance and the theory of investment, 1958, *The American Economic Review 48 (3), 261-297*

Newey, Whitney K., and Kenneth D. West, 1987, A simple positive semi-definite heteroscedasticity and autocorrelation consistent covariance matrix, *Econometrica 55, 3-46*

Opler, Tim, Lee Pinkowitz, René Stulz and Rohan Williamson, 1999, The determinants and implications of corporate cash holdings, *Journal of Financial Economics 52, 3-46*

Ozkan, Aydin and Neslihan Ozkan, 2004, Corporate cash holdings: An empirical investigation of UK firms. *Journal of Banking & Finance 28 (2004) 2103 -2134*

Pagano, M. F. Panetta, and L. Zingales, 1998, Why do firms go public? An empirical analysis. *Journal of Finance 53, 27-64*

Pinkowitz, Lee, René M. Stulz, and Rohan Williamson, 2006, Do firms in countries with poor protection of investor rights hold more cash? *Journal of Finance 61, 2725-2751*

Riddick, Leigh A., and Toni M. Whited, 2009, The corporate propensity to save, *Journal of Finance 64, 1729 -1766.*

Saunders, Anthony and Sascha Steffen, 2011, The cost of being private: evidence from the loan market. *The Review of Financial Studies 24 (12) 4091-4122*

Schenone, C. 2010. Lending relationships and information rents: do banks exploit their information advantages? *Review of Financial Studies 23, 1149-99*

Whited, Toni and Guojun Wu, 2006, Financial constraints risks, *Review of Financial Studies 19, 531-55*

Appendix

Variable Definitions List

Cash ratio: the ratio of cash and other equivalent marketable securities to the book value of total assets.

Leverage: the ratio of long-term debt to the book value of total assets.

Net Leverage: the ratio of difference between debt and cash to the book value of total assets.

Dividend Dummy: a dummy variable denoting the dividend payment status of firms. 1 denotes paying dividend and 0 means the opposite.

Listing: a dummy variable indicating whether a firm is listed on Oslo Stock Exchange or not. 1 means that the firm is listed on Oslo Stock Exchange and 0 indicates the opposite.

Net Income: a dummy variable measuring the results of net income. Net Income is equal to 0 if net income is negative and it is equal to 1 if net income is not negative.

Cash Flow: EBIDTA - Interest - taxes - common dividends

Industry sigma: the mean of the standard deviation of cash flows/total assets over 5 years for firms in the same industry, as defined by the SN2007 code

Sales growth: the annual sales growth for each firm

Real size: the natural log of the book value of total assets

NWC: calculated as net working capital minus cash and cash equivalents

Capex: the ratio of capital expenditures to total assets. Capital expenditures are calculated as the tangible assets difference between two years.

Leverage: the ratio of total debt to the total assets, where debt is equal to the sum of long-term debt and current liabilities.

R&D/assets: the ratio of research and development expenses to total assets

T-bill: the U.S Treasury bill yield measured as the average 3-month rate published by the Federal Reserve St. Louise

IPO1 through IPO5: Dummy variables equal to one if the firm went public 1, 2, 3, 4 or 5 years ago.

Loss: A dummy variable equal to one if net come is less than zero, and zero otherwise

Net debt issuance: Calculated as current liabilities minus previous year liabilities, divided by total assets

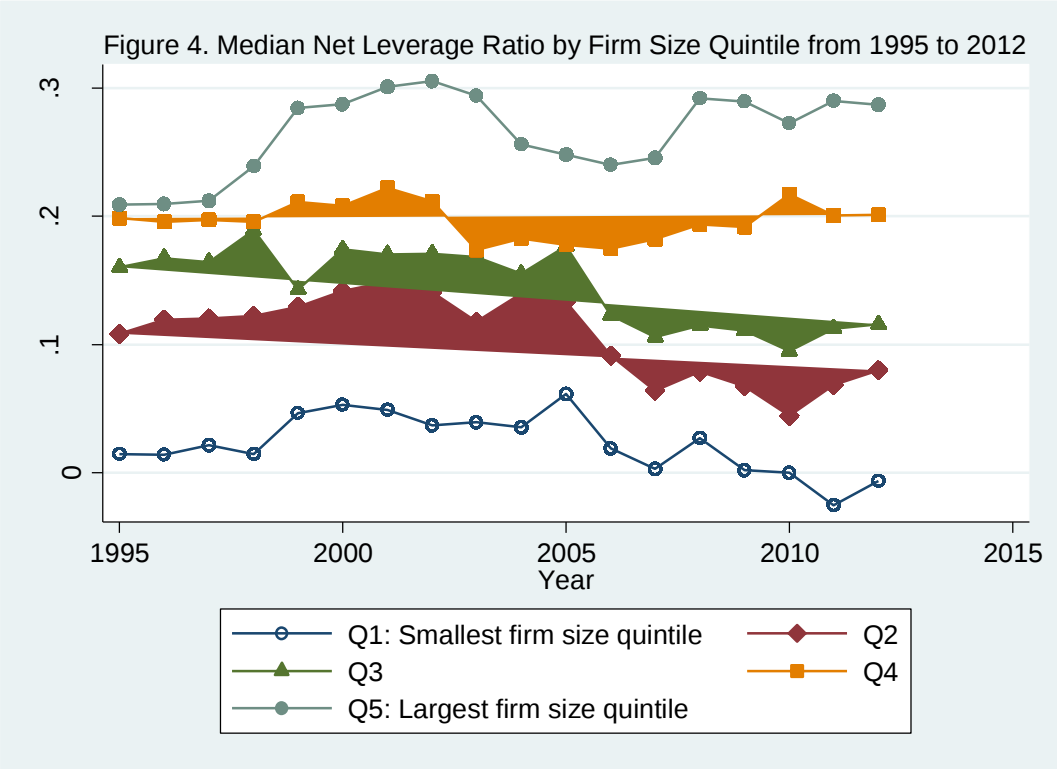
Net equity issuance: Calculated as current total equity minus previous year total equity, divided by total assets

Credit spread: The difference between the AAA and BAA yields published by the Federal Reserve St. Louise

2000s dummy: A dummy variable equal to one if the years are equal or above 2000, and zero otherwise

WW Index: An index is constructed following Whited and Wu (2006) and Hennessy and Whited (2007) as -0.091[(cash flow/total assets)]-0.06[dividend indicator] +0.021[long-term debt/total assets]-0.044[log (total assets)] + 0.102*(industry sales growth0-0.035*(sales growth]

HP Index: an index is constructed following Hadlock and Pierce (2010) as -0.737Size+0.043$Size^2$-0.040Age, where Size is Real size equaling the log of book value of total assets. Age is equal to year minus incorporation year



This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. Firms are sorted into quintiles based on value of total assets. The first quintile (Q1) represents the smallest firms, while the fifth quintile (Q5) represents the largest firms in this sample.

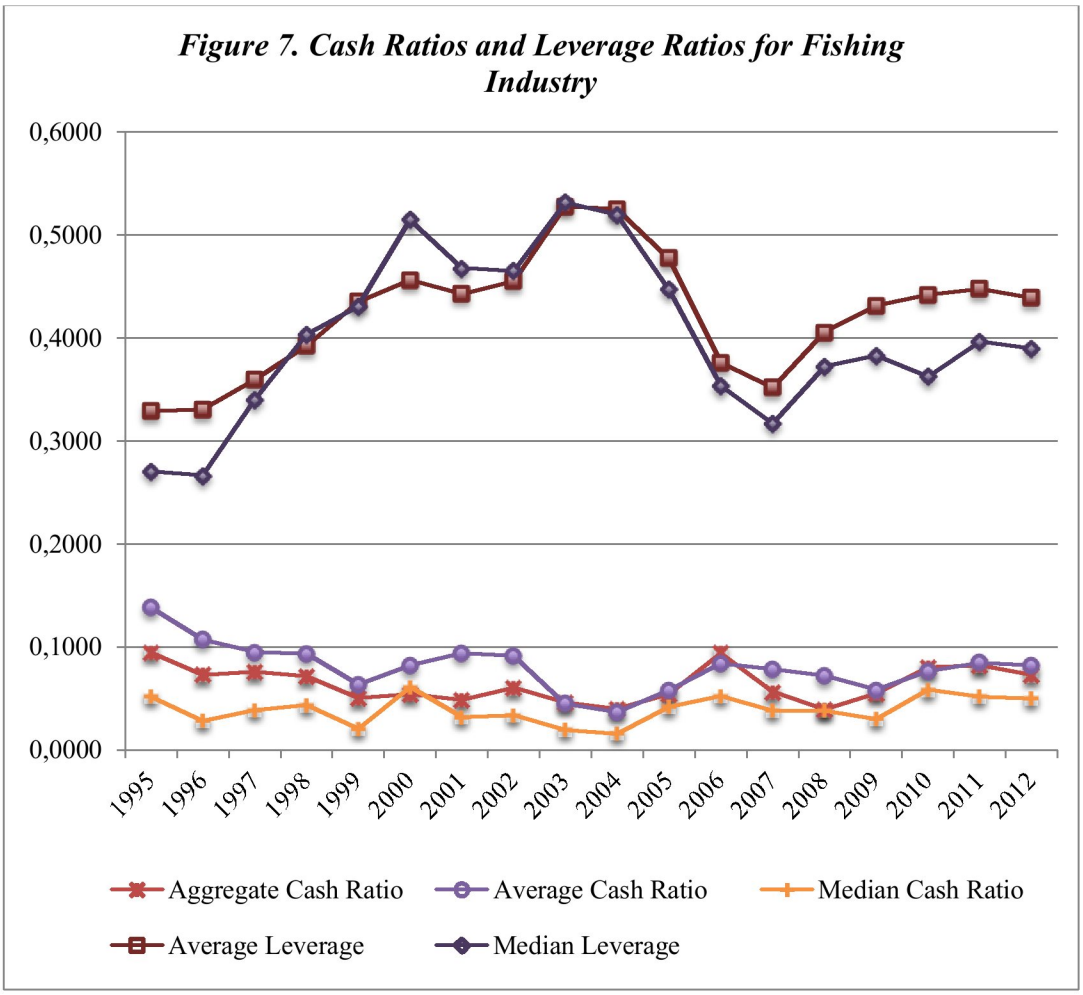


Figure 7. Cash Ratios and Leverage Ratios for Fishing Industry. This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. This figure illustrates development of aggregate cash ratio, average cash ratio, median cash ratio, average leverage ratio and median leverage ratio for fishing industry in Norway.

Table II (B)

Median Cash Ratios from 1995 to 2012 Delineated by Firm Status and the Payments of Dividends in Norway

This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. A private firm is not registered at Oslo Stock Exchange. A public firm has done IPO and is currently available on Oslo Stock Exchange. A firm is classified as dividend payer if the firm pays dividend in the year.

	Firm Status		Dividend Status		Accounting Performance	
Year	Private	Public	Non-dividend payer	Dividend Payer	Nonnegative Net Income	Negative Net Income
1995	0.0857	0.0881	0.0770	0.1206	0.0994	0.0552
1996	0.0863	0.0713	0.0768	0.1251	0.1015	0.0529
1997	0.0866	0.0844	0.0788	0.1197	0.0983	0.0584
1998	0.0796	0.0674	0.0720	0.1174	0.0959	0.0507
1999	0.0801	0.0715	0.0791	0.1331	0.0928	0.0589
2000	0.0746	0.0591	0.0729	0.1425	0.0838	0.0564
2001	0.0759	0.0632	0.0743		0.0922	0.0535
2002	0.0797	0.0742	0.0794	0.0369	0.0933	0.0565
2003	0.0882	0.0932	0.0877	0.1126	0.1063	0.0569
2004	0.0936	0.1135	0.0949	0.0862	0.1011	0.0725
2005	0.0967	0.1226	0.0971	0.1079	0.1068	0.0638
2006	0.0953	0.1011	0.0945	0.1091	0.1090	0.0564
2007	0.1005	0.0953	0.0975	0.1239	0.1113	0.0635
2008	0.0938	0.0706	0.0876	0.1341	0.1182	0.0616
2009	0.1017	0.0852	0.0953	0.1335	0.1175	0.0634
2010	0.0973	0.0928	0.0942	0.1270	0.1198	0.0608
2011	0.0934	0.0777	0.0882	0.1351	0.1141	0.0576
2012	0.0882	0.0889	0.0851	0.1212	0.1052	0.0557

Table VII (A)

Regressions Estimating the Financial Constraint Index (Whited and Wu Index) of Cash Holdings with Interaction Variable

This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. I use dummy variable d_2000s to interact with WW index variable and include also other variables that appear in Table V and Table VI.* indicates that the result is significant at 10% level, ** significant at 5% level and ***significant at 1% level.

WW Index						
	1		2		3	
Model	Cash/Assets		Cash/Assets		log(Cash/Net Assets)	
Dependent Variable	Estimate	Interaction 2000s	Estimate	Interaction 2000s	Estimate	Interaction 2000s
Intercept	0.331***	0.012**	0.390***	0.032	-0.353	0.26
	(0.000)	(0.001)	(0.000)	(0.065)	(0.534)	(0.198)
Industry sigma	0.168**		0.409*		3.392	
	(0.006)		(0.042)		(0.056)	
Sales growth	0.001		-0.001		-0.009	
	(0.057)		(0.373)		(0.422)	
	-		-		-	
Real size	0.012***		0.018***		0.154***	
	(0.000)		(0.000)		(0.000)	
Cash flow/assets	0.070***		-0.01		0.644	
	(0.000)		(0.876)		(0.200)	
	-		-			
NWC/assets	0.228***		0.138***		-1.097**	
	(0.000)		(0.000)		(0.002)	
Capex	-0.008*		-0.001		-0.088	
	(0.013)		(0.963)		(0.340)	
	-		-			
Leverage	0.219***		0.156***		-1.117**	
	(0.000)		(0.000)		(0.001)	
R&D/assets	-0.148*		0.079		1.534	

	(0.010)		(0.593)		(0.188)	
WW Index	0	0	0	0	0	-0.001
	(0.370)	(0.130)	(0.755)	(0.895)	(0.983)	(0.957)
Net debt issuance			-0.019***		-0.117**	
			(0.000)		(0.006)	
Net equity issuance			0.041***		0.294***	
			(0.000)		(0.000)	
Loss dummy			-0.02		-0.081	
			(0.072)		(0.442)	
T-bill			-0.015		0.003	
			(0.258)		(0.981)	
Credit spread			0.014		-0.002	
			(0.198)		(0.985)	
IPO1			0.01		-0.017	
			(0.593)		(0.917)	
IPO2			-0.001		-0.017	
			(0.923)		(0.843)	
IPO3			0.008		0.041	
			(0.213)		(0.442)	
IPO4			0.002		-0.038	
			(0.665)		(0.360)	
IPO5			0.006		0.037	
			(0.130)		(0.280)	
R-squared	0.271		0.217		0.177	
N	25584		1119		1110	

Table VII (B)

Regressions Estimating the Financial Constraint Index (Hadlock and Pierce Index) of Cash Holdings with Interaction Variable

This sample includes all observations from Norwegian Corporate Account from 1995 to 2012 with positive values for the book value of total assets and sales revenue for firms in Norway. Financial firms (SN2007 code 64 to 69) and utilities (SN2007 code 35 to 39 plus code 4399 and 8129) are excluded from the sample, yielding a panel with 66796 observations for 17558 unique firms. I use dummy variable d_2000s to interact with HP index variable and include also other variables that appear in Table V and Table VI.* indicates that the result is significant at 10% level, ** significant at 5% level and ***significant at 1% level.

HP Index						
	1		2		3	
Model	Cash/Assets		Cash/Assets		log(Cash/Net Assets)	
Dependent Variable	Estimate	Interaction 2000s	Estimate	Interaction 2000s	Estimate	Interaction 2000s
Intercept	0.324***	0.005	0.446***	0.042	0.251	0.119
	(0.000)	(0.720)	(0.000)	(0.210)	(0.748)	(0.790)
Industry sigma	0.174**		0.372		3.16	
	(0.004)		(0.064)		(0.075)	
Sales growth	0.001		-0.001		-0.01	
	(0.053)		(0.374)		(0.409)	
Real size	-0.011***		-0.021***		-0.175***	
	(0.000)		(0.000)		`	
Cash flow/assets	0.069***		-0.007		0.654	
	(0.000)		(0.912)		(0.189)	
NWC/assets	-0.229***		-0.137***		-1.091**	
	(0.000)		(0.000)		(0.002)	
Capex	-0.008*		0		-0.076	
	(0.014)		(0.992)		(0.406)	
Leverage	-0.218***		-0.156***		-1.118**	
	(0.000)		(0.000)		(0.001)	
R&D/assets	-0.143*		0.069		1.421	
	(0.013)		(0.643)		(0.227)	

HP Index	-0.001	-0.002	0.004	0.004	0.091	-0.034
	(0.794)	(0.608)	(0.692)	(0.714)	(0.494)	(0.792)
Net debt issuance			-0.019***		-0.119**	
			(0.000)		(0.006)	
Net equity issuance			0.041***		-0.12	
			(0.000)		(0.749)	
Loss dummy			-0.02		-0.069	
			(0.082)		(0.515)	
T-bill			-0.014		0.002	
			(0.266)		(0.988)	
Credit spread			0.014		0	
			(0.199)		(0.997)	
IPO1			0.007		-0.046	
			(0.734)		(0.787)	
IPO2			-0.003		-0.037	
			(0.797)		(0.659)	
IPO3			0.007		0.035	
			(0.287)		(0.520)	
IPO4			0.002		-0.042	
			(0.742)		(0.312)	
IPO5			0.005		0.034	
			(0.170)		(0.326)	
R-squared	0.271		0.219		0.181	
N	25612		1121		1112	