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1.0 Introduction:

In this Thesis, we want to examine if ownership structure affect limits to arbitrage by looking at the link between Ownership Structure and Short-Sale Constraints. It is based on replicating “Ownership Structure, Limits to Arbitrage, and Stock Returns: Evidence from Equity Lending Markets” by Prado, Saffi, and Sturgess (2014) which investigated 5000 U.S. stocks and found that higher Ownership Concentration led to higher limits to arbitrage.

We will replicate these analyzes for the Norwegian Market to see if we find the same patterns. This is done through investigating four hypotheses with multivariate regression and cross-sectional studies.

Motivation and contribution:

As data on shorting in Norway until today is still proprietary, research on this topic has, to the extent of our knowledge, not yet been conducted. We have already received data from two Norwegian Banks that is not publicly available, and this will help us answer our research questions in a good way.

The Norwegian and U.S. market are very different in terms of ownership. While most shares are privately held by institutional owners in the U.S., a large part of the shares on Oslo Stock Exchange is held by the Norwegian Government. They are likely to have other goals and incentives than a typical institutional owner, such as financial stability and “healthy” markets. Thereby, we might see other mechanisms in the Norwegian Stock Market.

If the results have implications for stock prices and returns, Ownership Concentration might prove to be something investors in the Norwegian market should take into consideration in their investment strategy. It will violate the theories of efficient markets, and thereby have interesting economic implications. If we find a particular pattern for Norway, it could also be applicable for the other Scandinavian countries, as they have similar Government Ownership Structure in their public companies.

Research on this topic has often been conducted with Short Interest as the main source of data, but with this Thesis we hope to investigate the effects in a more

direct way by using the actual Borrowing Fee and the Supply and Demand of lendable Shares.

2.0 Literature review and background

In this Thesis, we will focus on earlier studies on arbitrage opportunities, limits to arbitrage, ownership structure, and short sale constraints to reveal results and findings from earlier papers. For someone to use short selling as a trade-strategy, there has to be investors with a belief that the securities are overvalued. Miller (1977) found that stocks will be overvalued in a market with restricted short-selling, due to divergence in beliefs. The lack of pessimistic investors will make the optimistic investors overvalue the stocks as they do not take into consideration their absence. Jones and Lamont (2002) also recognizes imperfections in the shorting market, and find that stocks with high valuations are expensive to short and have low subsequent returns.

Short-selling constraints is essential for our thesis, since they limit arbitrage opportunities. Asquith, Pathak, and Ritter (2005) describe these constraints in the following way: "(Short-sale) Constraints exist when investors wish to sell short but either are unable to borrow shares or can only do so by receiving a low rebate rate on the proceeds from their short sales".

Diamond and Verrecchia (1987) found that short-selling constraints reduces the speed of adjustment to private information, and this applies especially to bad news. It eliminates some informative trades, but does not pressure the prices upward. They also predict that announcements day returns are more left skewed and returns have larger absolute values when there are constraints in short-selling. This is also strengthened by Bris, Goetzmann, and Zhu (2007) which finds evidence that in countries where short sales are practiced, prices incorporate negative information faster than positive information.

Further evidence on arbitrage limits by shorting constraints is shown by Reed (2007) where prices become less informative, trading volume falls, and price reaction on the announcement day are smaller when short selling is constrained. Just as Diamond and Verrecchia (1987), Reed also find announcement day returns to be left-skewed. Cohen, Diether, and Malloy (2007) prove that an increase in

shorting demand leads to negative abnormal returns the next month. In addition, they find that the results are stronger in markets with less information available for the public, meaning that the shorting market is a significant factor for private information revelation. Some of the research methodology of Cohen et al. (2007) is also relevant to our thesis, where they observe the effect of price-quantity pairs on stock returns to identify shifts in shorting demand and supply.

Kaplan, Moskowitz, and Sensoy (2013) finds that lending supply impact short sale constraints, such as fees and quantities, through exogenous shocks to lendable shares. Saffi and Sigurdsson (2010) found something similar where stocks with limited lending supply and high borrowing fees responded more slowly to shocks in the market.

In our thesis we want to see how ownership structure corresponds with short-selling constraints. Aggarwal, Saffi, and Sturgess (2015) finds that investors value their right to vote and therefore restrict lendable supply and/or recall loaned shares prior to the record date to exercise voting rights. This is relevant for our thesis as more concentrated ownership should result in owners retaining their stocks for available lending. Further on, Nagel (2005) argues that short-sale constraints should mainly affect stocks with low *institutional* ownership, both in direct short-selling costs and indirect institutional constraints. However, in Brunnermeier and Nagel (2004) short constraints were not the crucial limit to arbitrage under the burst of the technology bubble in 2000. Though this period can be said to be a special case.

Our thesis is to a large degree based on the research of Prado et al. (2014). They find that stocks with lower, more concentrated, short-term, and less passive ownership exhibit lower lending supply, higher costs of shorting, and higher arbitrage risk. These constraints will delay corrections of mispricing, and limit arbitrageurs of taking short positions. We are using this study to see if there are similarities in the Norwegian market.

3.0 Hypotheses and Theory

Our Thesis is based upon replicating the findings of Prado et al. (2014) for the Norwegian market, and our hypotheses will be heavily based on this paper. We will use the hypotheses that we find most relevant and most interesting to test in the Norwegian market. Below we will present our hypotheses and the theoretical foundation that supports, or are related to, our claims. All hypotheses are based upon testing how Ownership Concentration affect various factors, and to a certain degree they are built upon each other.

Hypothesis 1: *Higher ownership concentration leads to decreasing Equity Lending Supply*

The argument behind this hypothesis is that higher concentration will lead to lower supply due to lack of willingness to lend their shares: Higher concentration means that each shareholder on average owns a larger share of the company which in turn leads to a larger influence on the stock price. Shorting tends to put downward pressure on the stock price [e.g. Bris et al. (2007)], which is in conflict with their interests if they prefer high valuations.

If short-sale constraints lead to overpricing of the stock [e.g. Jones and Lamont (2002), Cohen et al. (2007)] shareholders could purposely create these constraints by not lending out their stocks. If this is the case we will see a negative relationship between Ownership Concentration and Equity Lending Supply, which is what this hypothesis is suggesting.

Prado et al. (2014) found that more concentrated ownership led to lower lending supply in the U.S. market, and thereby we expect to find similar results in the Norwegian market.

There are also other factors related to Lending Supply that could be interesting to investigate. For instance, Short-term investors could be more reluctant to lend out their shares as those with short horizons will be relatively more affected by a price decrease [Prado et al. (2014)] The same could be evident for long-term investors that wish to maintain control in the company, as lending out shares will mean a loss of voting rights. [Aggarwal et al. (2015)]

One should also look at how Total Institutional Ownership affect Lending Supply. It has been well-documented that a higher share of institutional owners have a positive effect on lending supply [e.g. Asquith et al. (2005), Nagel (2005) and Prado et al. (2014)] This should however be separated from the concentration of Institutional Ownership, which we expect to have the reverse effect.

Hypothesis 2: *Higher Ownership Concentration leads to higher short-sale constraints*

While we might find results that supports Hypothesis 1, this will not have any real consequences for the investor's if it does not affect, or more specifically constraints, short-sale.

We will examine how Ownership Concentration affect two types of short-sale constraints; The Stock Borrowing Fee, which is a direct form of short-sale constraint, and the Arbitrage Risk, which constraints short-sale by increasing the risk.

Arbitrage Risk will be found by using the 4-factor model from Carhart (1997). An increase in idiosyncratic risk will heighten the risk for arbitrageurs and offer significant costs [e.g. Pontiff (2006)] and in turn create short-sale constraints.

The Borrowing Fee is likely to be higher for stocks with Concentrated Ownership if we see that higher concentration decrease supply. This would be coherent with classical economic theory. Higher concentration could also assign more influence on the Borrowing Fee to the shareholders, which could lead to an increase.

The other factors we test in relation to Lending Supply, as short-term investors and Total Institutional Ownership, should also be tested in relation to short-sale constraints.

Hypothesis 3: *Higher Ownership Concentration leads to abnormal negative returns*

Many studies have found that short-sale constraints lead to lower return [e.g. Jones and Lamont (2002) and Duan, Hu, and McLean (2010)] and this could be due to investors that short stocks, demand compensation in form of larger negative returns

when the cost of shorting is higher, as argued in Prado et al. (2014) and Drechsler and Drechsler (2014).

With basis in these theories we expect to see abnormal negative returns in presence of high ownership concentration because of the increasing effect it might have on short-sale constraints.

Hypothesis 4: *Higher Ownership Concentration will create slower and milder reactions to negative earnings announcements.*

By investigating how Ownership Concentration affects the Stock Price's reaction to shocks, we introduce an alternative way of investigating short-sale constraints and limits to arbitrage. If we could find the same results and indications here as in the other hypotheses, we will strengthen the credibility of our earlier findings.

While the direct way of investigating short-sale constraints, as in Hypothesis 1-3 is less prevalent, there have been more research on how it affects reactions to earnings announcements. We expect to find that the factors leading to higher short-sale constraints, such as higher Ownership Concentration, will slow down the reactions to earnings announcements.

When shorting is difficult due to shorting-constraints, it is harder for investors with pessimistic views to trade on their beliefs, which could lead to overpricing [(Miller, 1977), Jones and Lamont (2002)]. This also means that limits to arbitrage in form of limited lending supply and high borrowing fees could lead to slower price adjustments, especially after negative earnings announcements [e.g. Reed (2007), Diamond and Verrecchia (1987) and Saffi and Sigurdsson (2010)] because of the inability to create downward price pressure.

4.0 Methodology

To find a reliable answer to our research question, we need to test our hypotheses through different approaches and calculations. Since our Thesis is based upon the findings of Prado et al. (2014) we will base our methodology on this paper, and mainly follow their approach.

Our hypotheses are in simple terms based on finding how Ownership Structure affect various factors such as lending supply and short-sale constraints. To investigate this, we will base our methodology on OLS. To highlight the details on how we investigate the different factors, we will give an overview of the methodology for each of the hypotheses we would like to test. First, we will emphasize which methodology we will use to measure the key factors in our research:

Ownership Concentration:

To measure Ownership Concentration, we will use data on Stock Ownership and find the Herfindal-Hirschman Index for each individual stock. The calculation is defined as:

$$HHI = \sum_{i=1}^n (SO_i)^2$$

Where $SO_i = \text{Stock Ownership}$, and represent the total percentage of stocks in a particular firm owned by shareholder i . With this measurement, we can compare different stocks and reach a conclusion on the Ownership Concentration.

Arbitrage Risk:

Arbitrage Risk is the same as Idiosyncratic Risk and represent the risk that is not picked up by traditional risk-measures. The method used in Prado et al. (2014) to find Arbitrage Risk is using the residual from the Four-Factor Model by Carhart (1997). The four-factor model picks up large parts of the variations in stock price, and therefore the residual from this model is a good measurement of idiosyncratic risk.

Hypothesis 1 & 2:

To investigate how different factors affect Lending Supply we will use a standard pooled OLS regression where Lending Supply is the dependent variable. Several factors will be tested in relation to Lending Supply, such as:

- Ownership Concentration
- Total Institutional Ownership (% of institutional investors)
- Proportion of Short-term investors
- Proportion of Long-term Investors
- Firm Size (measured in billion KR)

These factors will be tested on a quarter-wise basis.

In our second hypothesis, we will research many of the same factors, but this time with Borrowing Fee and Arbitrage Risk as our dependent factors. Mainly, there will be two regressions where the first regression will have Borrowing Fee as the dependent variable and the second regression will have Arbitrage Risk as the dependent variable.

An important factor in this hypothesis to check is how Lending Supply correlate with the dependent factors. We must then do a prediction of Lending Supply; In Prado et al. (2014) they predict Lending Supply by setting it as a linear function of Total Institutional Ownership and Ownership Concentration.

Hypothesis 3:

To test this hypothesis, we must compare the abnormal returns for firms with higher ownership concentration to those with low concentration. The way this will be done is through the methodology proposed by Cohen et al. (2007):

We will test the sensitivity of the returns to the ownership composition, given an outward shift of demand. We make two dummy variables where one variable captures increase in shorting costs and quantity of shorting (DOUT=1, zero otherwise). This can be interpreted as investors who are betting the price will decrease in larger quantities, even though the shorting cost has increased. The other variable (DIN) captures the effects if shorting costs and the quantity of shorting has

declined (DIN=1, zero otherwise). In the regression, the effect on the first variable should be larger than the second. The dummies could be defined as follows:

$$DOUT_{i,t-1} \begin{cases} 1 & \text{if } Fee\ Score_{t-1} - Fee\ Score_{t-2} > 0 \text{ and } On\ loan_{t-1} - On\ loan_{t-2} > 0 \\ 0 & \text{otherwise} \end{cases}$$

$$DIN_{i,t-1} \begin{cases} 1 & \text{if } Fee\ Score_{t-1} - Fee\ Score_{t-2} < 0 \text{ and } On\ loan_{t-1} - On\ loan_{t-2} < 0 \\ 0 & \text{otherwise} \end{cases}$$

Next, we will compare the first variable (DOUT) in a cross-sectional regression with variables of ownership concentration. The ownership concentration variables are also dummies and are spilt into a top segment (dummy=1) and a low segment (dummy=0). We will calculate abnormal returns of portfolios based on the outward demand shocks, and check if there are larger negative abnormal returns for ownership with high concentration when borrowing fees is higher and demand for shorting is higher.

Further on, we will test the hypothesis by using a multivariate regression to check how ownership concentration following an outward demand shift affect returns. We estimate average abnormal return with a cross-sectional pooled regression, and use dummy variables for outward shifts in demand, top segment of the ownership concentration (high) and total institutional ownership. $DOUT_{i,t-1}$ is a dummy equal to 1 if there was an outward demand shift the prior week, $Top(OWN_{i,q-1})$ equals 1 if ownership characteristic were above the 75th percentile the previous quarter (both are zero otherwise). And $TOTAL_{i,q-1}$ represent institutional ownership. CTRLS is the set of additional controls that is used. We will also investigate the results with investment horizon as a factor. The general equation will look this:

$$R_{i,t} = \alpha + \theta_t + \beta_1 DOUT_{t-1} + \beta_2 Top(OWN_{i,q-1}) + \beta_3 TOTAL_{i,q-1} + \beta_4 DOUT_{t-1} * Top(OWN_{i,q-1}) + \beta_6 CTRLS_{i,t-1} + \varepsilon_{i,t}$$

Prior to the results of Prado et al. (2014) and Cohen et al (2007), we should observe that concentrated ownership with outward demand shocks should have relatively more negative abnormal returns.

Hypothesis 4:

To see how Ownership Concentration affect reactions to earnings announcements we will go back to a OLS framework where Cumulative Accumulated Return (CAR) will be the dependent variable.

We are interested in looking at the reactions to the announcements in different time frames, such that we can assess both the immediate reaction and the price drift after the announcement date. Three different time frames will be used; CAR1, which assess the immediate reaction by looking at the price from the day before until the day after [t-1, t+1]. CAR2 will look at the drift in the [t+2, t+10] period, while CAR3 will assess the long-term drift by looking at the reaction from day 2 [t+2] until the next quarterly announcement.

In order to catch unexpected earnings that give real price effects we will only look at the 20% most extreme pricing announcements. Thereby the top quintile will represent the good news and the bottom quintile will represent the bad news.

This approach will be used for all factors in the regression by the use of dummy variables. If the dummy = 1 it will indicate the bottom quantile, while 0 will represent the top quantile. The factors will be Standardized Unexpected Earnings (SUE), Ownership Concentration (CONC), Arbitrage Risk and Total Institutional Ownership (Total). The equation will in general be as follows:

$$CAR_{i,t} = \beta_1 + \beta_2 D_{i,t}^{SUE} + (\beta_3 + \beta_4 D_{i,t}^{SUE}) * D_{i,t-1}^{Conc} \\ + (\theta_1 + \theta_2 D_{i,t}^{SUE}) D_{i,t-1}^{Arbitrage\ risk} + (\gamma_1 + \gamma_2 D_{i,t-1}^{SUE}) D_{i,t-1}^{Total} + \epsilon_{i,t}$$

This could be interpreted quite straightforward where we test each factor for the effect on CAR for good ($D_{i,t}^{SUE} = 0$) and bad ($D_{i,t}^{SUE} = 1$) news.

Data:

Generally speaking, we need two types of data: Financial data and Ownership data.

Data on ownership will be extracted from Bloomberg and Thompson Reuters One, where we have access to quarterly historical data on stock ownership for all major Norwegian firms. These databases also distinguish between institutional and non-institutional ownership.

Thompson Reuters have their own data on earnings surprises, which gives easy access to data needed for hypothesis 4.

When it comes to financial data we need Stock Prices and Equity Data. Data on stock prices and returns are easily accessible and will be available through a range of different databases and web sites.

The most challenging part of the data collection will be access to Equity Data. For our thesis, we will need Borrowing Fee, Lending Supply, Quantity On Loan and Utilization. These type of data are viewed as sensitive information, and therefore institutions are reluctant to share them. However, we already have access to two years of data on Quantity On Loan, Utilization and Lending Supply for the OBX (25 firms) via two Norwegian Banks.

We are now in the process of getting a larger dataset and have ongoing contact with Markit, which is the world's largest provider of Equity Data, and another bank with access to Equity Data.

5.0 Further progress:

Our further progress and tentative schedule will be the following:

February 10th: Finalize all data collection

We will continue our communication with Markit and the other banks with the goal of expanding our dataset. Within this date all the data we need should be in place and we should be ready to start the analyzes.

March 30th: All empirical tests conducted and results gathered

From our dataset is ready until this date we should work on analyzing the material. All hypotheses will be tested and the statistical results should be ready.

May 25th: First draft of Master Thesis

Within this date the first draft of our Master Thesis should be ready, and we will send it to our supervisor for feedback.

June: Review and finalize Thesis

In June, we will revise the Thesis and make the final adjustments based on the feedback we get from our supervisor.

July 1st: Deliver Master Thesis

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