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Trade Level Delivery Failures - New Evidence from the Finnish Market

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Abstract
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PURPOSE OF THE STUDY

The purpose of this study is to examine delivery failures at trade level and determine which factors affect the likelihood of delivery failures. In the existing literature cost of borrowing stock is found to have relation to delivery failures but these studies are conducted by using aggregated data and are done in the U.S context. This study applies trade level data from the Finnish market, providing new evidence on delivery failures. This study also illustrates for the reader how the post-trade processes work and what are the differences between markets.

DATA

This thesis applies trade level data of a remote broker operating in the Finnish market. All OTC trades settled during a six month period from January to June 2012 are included in the original sample. The analyzed sample consists of 4153 deliveries, of which 242 deliveries are failures. In addition, stock specific variables are determined for each trade in order to proxy the cost of borrowing. Market capitalization, turnover, cash flow and price-to-book data are from Thomson One Banker database, institutional ownership data are from Orbis database and Internet message board activity is collected from Kauppalehti's Internet message board.

RESULTS

The results show that delivery failures are mostly short-term in the Finnish market, lasting one to three days. The results give support for the hypotheses that when stock loan supply increases, the likelihood of delivery failures decreases, and when the stock loan demand increases due to differences of opinion among investors, the likelihood increases. Increase in market capitalization decreases the likelihood of delivery failures, having marginal effect up to -11.35%. Turnover, price-to-book and Internet message board activity increase the likelihood of short-term delivery failures.

KEY WORDS

Clearing, settlement, post-trade market, failures, fail-to-deliver, naked short sales, stock loan, cost of borrowing stock

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TRADE LEVEL DELIVERY FAILURES: NEW EVIDENCE FROM THE FINNISH MARKET

TUTKIELMAN TAVOITTEET

Tutkielman tavoitteena on tutkia osakkeiden toimitushäiriöitä ja selvittää, mitkä tekijät vaikuttavat toimitushäiriöiden todennäköisyyteen. Osakelainojen kustannukset ovat aiemmassa kirjallisuudessa todettu vaikuttavan toimitushäiriöihin, mutta tutkimukset ovat perustuneet yhdisteltyihin aineistoihin, jotka ovat peräisin Yhdysvalloista. Tämä tutkimus käyttää kauppatason lähdeaineistoa Suomen markkinoilta ja näin ollen tuo uutta näyttöä toimitushäiriöistä. Tämä tutkimus myös havainnollistaa lukijalle miten osakkeiden selvitysprosessi toimii ja miten eri markkinoiden prosessit eroavat toisistaan.

LÄHDEAINEISTO

Tässä tutkielmassa käytetään kauppatason lähdeaineistoa Suomessa toimivalta etävälittäjältä. Kaikki välittäjän OTC-kaupat kuuden kuukauden ajalta tammikuusta kesäkuuhun 2012 ovat mukana alustavassa otannassa. Analysoitu otanta käsittää 4153 myyntiä, joista 242 ei toimitettu ajallaan. Lisäksi jokaiselle kaupalle on määritelty osakekohtaisia muuttujia, jotka indikoivat osakkeen lainaamisen kustannusta. Aineisto osakkeiden markkina-arvosta, osakkeen vaihdosta, kassavirrasta ja P/B-luvusta on kerätty Thomson One Banker -tietokannasta, institutionaalisten omistajien tiedot Orbis -tietokannasta ja Internetin keskustelupalsta-aktiivisuus on kerätty Kauppalehden keskustelupalstalta Internetistä.

TULOKSET

Tulokset osoittavat, että osakkeiden toimitushäiriöt ovat enemmikseen lyhytaikaisia Suomen markkinoilla, kestäen yhdestä kolmeen päivää. Tulokset tukevat hypoteeseja, joiden mukaan toimitushäiriöiden todennäköisyys laskee osakelainojen tarjonnan kasvaessa ja todennäköisyys kasvaa osakelainojen kysynnän noustessa sijoittajien mielipide-erojen vuoksi. Markkina-arvon kasvu laskee toimitushäiriöiden todennäköisyyttä jopa 11.35%. Osakkeen vaihdon, P/B-luvun ja keskustelupalsta-aktiivisuuden kasvu lisäävät lyhytaikaisten toimitushäiriöiden todennäköisyyttä.

AVAINSANAT

Osakeselvitys, toimitushäiriöt, kattamaton lyhyeksi myynti, osakelaina, osakelainan kustannukset

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1 Introduction

1.1 Background

The European Parliament set a new regulation effective on November 1st 2012 that bans naked short selling by requiring short sellers to borrow, agree to borrow or otherwise ensure the availability of the security being sold short at the time of settlement. Short sellers are also required to notify their net short positions if they break the threshold level.[1] Similar regulation was set in the U.S. in 2004, called Regulation SHO, which has been adjusted in the following years. In July 2008 the U.S. Securities and Exchange Commission announced a temporary naked short selling restriction for stocks of 19 financial firms, "in the public interest and for the protection of investors to maintain fair and orderly securities markets, and to prevent substantial disruption in the securities markets".[2] Why are regulators setting these kind of regulations and why especially in the past few years?

The concept of ownership is in the heart of the modern society. Everyday people and companies buy and sell all sorts of commodities and governments have set laws to guide these transactions and to protect the rights of the participants. It is the common presumption that the participants engaging in these transactions fulfill their responsibilities and there should be no problems determining the ownership of the commodity being traded after the transaction.

However, in the securities market this is not entirely true. As the securities market has developed heavily in the past years, including globalization and dematerialization, the governments and regulators have had difficulties to keep up with the development. Current systems and procedures supporting the transactions of securities between market participants allow these participants to neglect their responsibilities. These systems and procedures in the securities transaction are referred as *clearing and settlement*.

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[1] Financial Supervisory Authority:
http://www.finanssivalvonta.fi/en/Publications/supervision_releases/2012/Pages/63_2012.aspx

[2] The U.S. Securities and Exchange Commission, Release No. 34-58572/ September 17, 2008, p. 3

Loader (2002) defines clearing as "the preparation through matching, recording and processing instructions of a transaction for settlement". Settlement refers to the transfer of securities from the seller to the buyer, and the related payment from the buyer to the seller (Holthausen and Tapking, 2006). Many organizations are involved in the process of clearing and settlement, including clearing houses (CHs), central clearing parties (CCPs), central securities depositaries (CSDs) and clearing participants, among others. These organizations have all different roles in the process and there are differences between markets. The process of clearing and settlement in European, Finnish and U.S. context is described in more detail in Section 2.

In the academic literature a lot of research has been done in the theoretical side of the securities market, e.g. how perfectly markets operate, how the value of a company's stock can be evaluated most accurately, how rationally investors operate in the market and so on. A lot of these important issues are focused on the pre-trade phase of the securities trading. Less focus has been given to what happens after the trade has been made. Anderson (2005) argues that the lack of formal literature on clearing and settlement institutions is disturbing, as it makes the analysis and decision making regarding these processes difficult. Post-trade issues are often seen as only infrastructural matters and often assumed to happen without problems (Cruickshank, 2001).

However, the post-trade phase of the securities trading is not problem free and increasing number of market stakeholders have given attention to these matters. One of the topics getting more attention is the amount of settlement failures. The ownership of a security being traded transfers from the seller to the buyer on predefined settlement date. The most frequent settlement date cycle is *T+3*, referring to the third business day after the trade date. A failure occurs when a trade is not settled on the original settlement date because the seller fails to deliver the security or buyer fails to pay for the trade.

Settlement failures can happen for multiple reasons: human error and miscommunication, administrative delays, operational problems and naked short selling (Putniņš 2010; Fleming and Garbade 2005). All the factors, except naked short selling, are unintentional and market participants try to eliminate them in their operations. Naked short selling, however, is

intentional behavior as the seller chooses not to cover the short and therefore may not be able to deliver the securities on time.

Traditional short sellers borrow the security they sell short, buy it back from the market afterwards in order to return it to the equity lender, and try to gain from the decline of the security's market price (see, e.g., Christian et al., 2007; Culp and Heaton, 2007). Naked short sellers do not borrow or locate the security they sell short before shorting (thus the term naked) and therefore they may be insufficient to deliver the security at original settlement date. Evans et al. (2009) introduce the idea that short sellers choose not to deliver, when the short constraints, e.g. the cost of borrowing the security being sold is higher than failing-to-deliver. Boni (2006) calls these kinds of settlement failures as *strategic failures-to-deliver*.

When the short seller fails-to-deliver, it is economically equivalent to a zero-fee, zero-rebate stock loan to the short seller from the buyer (Evans et al., 2009; Putniņš 2010). The expected cost of being forced to deliver by so called buy-in procedure and the expected fees for not delivering on time also affect the cost to fail. However, these extra costs are only due when the buyer demands them, which happens rarely (Evans et al., 2009; Finnish Competition Authority, 2001). If the security is difficult and/or expensive to borrow, failing-to-deliver can be less expensive than borrowing. Therefore the cost of borrowing stock can affect the level of delivery failures.

To summarize, as the clearing and settlement systems do not have any significant disincentives for it, the buyers allow it and it is economically profitable, settlement failures persist in the market. The global financial system is built on trust. When trading with securities domestically and internationally, participants need to be sure that the counterparty will fulfill its part of the transaction. This has become even greater importance as the financial market has become larger, more complex and rapid. If delivery failures persist in the market, it will diminish the trust in the market and can have broad negative effects.

1.2 Research question and contribution

The purpose of this thesis is to find factors affecting the likelihood of delivery failures at trade level. The essence of this thesis is the unique trade level data being studied. Although this

thesis follows closely the study by Boni (2006), the benefits and comprehensiveness of trade level data should give interesting results and deepen the knowledge of settlement failures. Existing studies are based on aggregated data, and to my knowledge, this is the first study using trade level data to find evidence on settlement failures.

Settlement failures have not been studied intensively, and the existing studies are done by both academics and practitioners. Main reason for the lack of research has been the unavailability of settlement failure data. Most studies done in the field are based on proprietary data (see, e.g., Boni, 2006; Evans et al., 2009) but in the U.S. there are couple public sources of data. The SEC started to publish daily failures-to-deliver data of stocks settled by the NSCC in the beginning of 2004.[3] However, the failures are aggregated over all NSCC members and are net balances, i.e. failures cannot be identified to specific market participants and does not necessarily describe truthfully how many sellers have failed-to-deliver. Also on a given day the failures are cumulative number of all failures outstanding and failing on that day. Therefore the age of the failures cannot be determined from the data. In addition, the Federal Reserve Bank of New York publishes weekly settlement failures data of treasury securities, agency securities, mortgage-backed securities and corporate securities.[4] The data are available from July 1990 onwards, but has the same limitations as the data provided by the SEC.

In the Finnish market settlement failure data has not been made public as in the U.S. I had the opportunity to get access to the trade level settlement failures data of a clearing party operating in the Finnish market. This thesis exploits this opportunity and contributes to the scarce existing literature on settlement failures. The objectives of this thesis are twofold.

Firstly, as the majority of the existing literature is in the U.S. context, my aim is to illustrate how the European and especially Finnish post-trade market works and how it differs from the U.S. Therefore, I describe the clearing and settlement process in Europe and especially in Finland. I also provide description of the U.S. clearing and settlement process to give a comprehensive understanding of post-trade systems for the reader.

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[3] The U.S. Securities and Exchange Commission: http://www.sec.gov/foia/docs/failsdata.htm

[4]The Federal Reserve Bank of New York: http://www.newyorkfed.org/markets/pridealers_failsprimer.html

Secondly, by studying empirically the daily trades of a single remote broker operating in the Finnish market, I aim to distinguish if the likelihood of delivery failures is affected by the cost of borrowing stock. The advantage of this study is comprehensive content of the data set, which has not the same limitations as the data sets used in previous studies. By studying actual trades with trade-specific details, without cumulating, aggregating or netting, fewer assumptions and generalizations have to be made and the result are more explanatory. Another distinguishing fact of the data is that Finnish market regulation concerning naked short selling is different from the U.S. during the studied time period. As the naked short selling ban was initiated in the beginning of November 2012 in the Finnish market, the regulation allowed uncovered shorting during the time period under study. The data are described in more detail in section 5.

1.3 Main findings and limitations of the study

The results show that delivery failures are mostly short-term in the Finnish market, lasting one to three days. This tells that the Finnish clearing and settlement process works relatively well, as longer average failure durations would indicate that there are more serious problems with the clearing and settlement processes used. These short-term failures can be due to human errors, operational problems or intentional behavior. As Boni (2006) argues, the longer the failures, the more likely they are intentional as failures caused by other reasons are fixed quickly. However, as there are only few long-term failures in the sample data I assume that intentional failures can also be short-term and the same reasons can affect the likelihood of both short-term and long-term failures.

The results also show that the delivery failures concentrate on few stock issues. In the sample 44.8% of stocks being traded do not have any failures and only 17.2% of the stock issues have failures lasting at least five days. This implies that some stock specific factor determines the likelihood of failures. The results show that when the supply of stock loans increases, proxied by market capitalization, the likelihood of delivery failures decreases. The largest marginal effect is for failures lasting at least two days, being -11.35% at the mean. The results also indicate that when demand for stock loans increase, proxied by turnover, price-to-book and Internet message board activity, the likelihood of short-term delivery failures increases. The

results are most robust for delivery failures lasting at least one or two days. The results do not give support for institutional ownership and cash flow variables, indicating that these variables may not have the suggested relationship to cost of borrowing in the Finnish market.

As the data used in this thesis is based on single remote broker in Finland, any generalizations made based on the results have to be careful. Although this thesis contributes to the existing scarce literature of settlement failures, especially in the Finnish context, the reader should acknowledge the limitations of this study. The results in section 6 give valuable information of the behavior of market participants in the Finnish market, but assuming that the same arguments also hold in different markets can be misleading. The market regulation and other macro level differences can affect the behavior of investors and should be taken into account. Also, other market participants might behave differently due to their own decisions and internal rules.

1.4 Structure of the thesis

The rest of the paper is organized as follows. Section 2 describes the clearing and settlement processes in U.S., European and Finnish context; Section 3 gives an overview on the existing literature on settlement failures, short selling and stock borrowing; Section 4 presents the hypotheses; Section 5 describes the data and methods used; Section 6 presents the empirical results and Section 7 finally concludes.

2 Description of clearing and settlement processes

In this section I will describe how the U.S., European and Finnish clearing and settlement systems are organized, as there are some major differences in the way they operate. I will go in more detail describing the Finnish clearing and settlement process, as the data for the empirical study includes only domestic trades in the Finnish market. I will concentrate on the equities settlement, as that is the focus of my study. I will also provide some definitions of the basic terms and facilities in order to make the text more understandable for the reader. The aim is that after reading this section the reader has a satisfactory level of understanding how equities are cleared and settled in different markets.

2.1 Definitions

Some terms and institutions are commonly used in literature and by practitioners regarding clearing and settlement. Therefore I will provide short definitions of the most important ones.

Central Counterparty (CCP): An entity that interposes itself between counterparties to contracts traded in one or more financial markets, becoming the buyer to every seller and the seller to every buyer, with the aim of ensuring that trades are completed if one or more counterparties defaults (Norman, 2011).

Central securities depository (CSD): An infrastructure that holds or controls the holding of physical or dematerialized financial instruments belonging to all, or a large proportion, of the investors in a particular securities market. CSD controls the transfer of ownership of such securities by entries on its books and records (Norman, 2011).

Clearing: The preparation for settlement through matching, recording and processing instructions of a transaction (Loader, 2002). Clearing includes the calculation and confirmation of the obligations and entitlements of the counterpartys, resulting in gross or net obligations (Niemeläinen, 2008).

Clearing house (CH): The institution responsible for clearing of the trades. CH ensures that the trades fulfill the clearing requirements and that the settlement can be done successfully at the predetermined date (Niemeläinen, 2008). CHs often operate also as CCPs in their market, if the clearing and settlement system is based on central clearing (Norman, 2011).

Failed transaction or failure: A failure to settle a transaction on the intended settlement date, which is often three business days after trade date (Norman, 2011).

International central securities depository (ICSD): Same as CSD but operates over national borders in several markets.

Multilateral netting: Each clearing participant's bilateral net positions or obligations with other participants are netted in order to get a single multilateral net position (Norman, 2011).

Netting: An agreed offsetting of obligations or positions between participants in the clearing system. Netting reduces settlement volumes by changing gross positions or obligations to a smaller number of net obligations or positions (Norman, 2011).

Over-the-counter (OTC) market: Market outside organized exchanges in which trades are conducted through traditional methods (e.g. telephone) or computer networks. OTC trades are often not cleared centrally (Norman, 2011).

Settlement: The obligations defined in the clearing of trades are fulfilled by transferring the securities to the buyer and cash to the seller. As the settlement is finished successfully, the trade is final (Niemeläinen, 2008).

2.2 The U.S. system

In the U.S. the clearing and settlement of securities is highly centralized. The Depository Trust and Clearing Corporation (DTCC) provides clearing, settlement and information services for equities, bonds, money market instruments and derivatives. It is the world's largest financial post-trade infrastructure organization. The DTCC provides custody and asset servicing for more than 3.6 million securities issues, valued at USD 36.5 trillion, and 2010 settled nearly USD 1.66 quadrillion in securities transactions[5]. The DTCC operates through 10 subsidiaries, of which two play major roles in the stock clearing and settlement process: National Securities Clearing Corporation (NSCC) and the Depository Trust Company (DTC).

Fig. 1 illustrates the broker-to-broker trade, clearing and settlement process in the U.S. market (Putninš, 2010). The process starts by investors sending buy and sell orders to their brokers. These instructions are then matched on the stock exchanges. After the orders are matched and the trades have been made, stock exchanges transmit the details of all trades to the NSCC. NSCC then assumes the role of CCP: it clears the trades and assumes the position between the participants, guaranteeing the obligations of both parties. The CCP procedure reduces the counterparty risk for both participants. NSCC does also multilateral netting of all trades and related payments, reducing the overall number of trades and payments being made between

[5] The Depositary Trust and Clearing Corporation: http://dtcc.com/about/business/index.php

market participants. DTCC reports that netting reduces the total number of trading obligations requiring financial settlement by 97 % on average[6]. NSCC informs one day prior to settlement date all participants of their net positions of stock and cash.

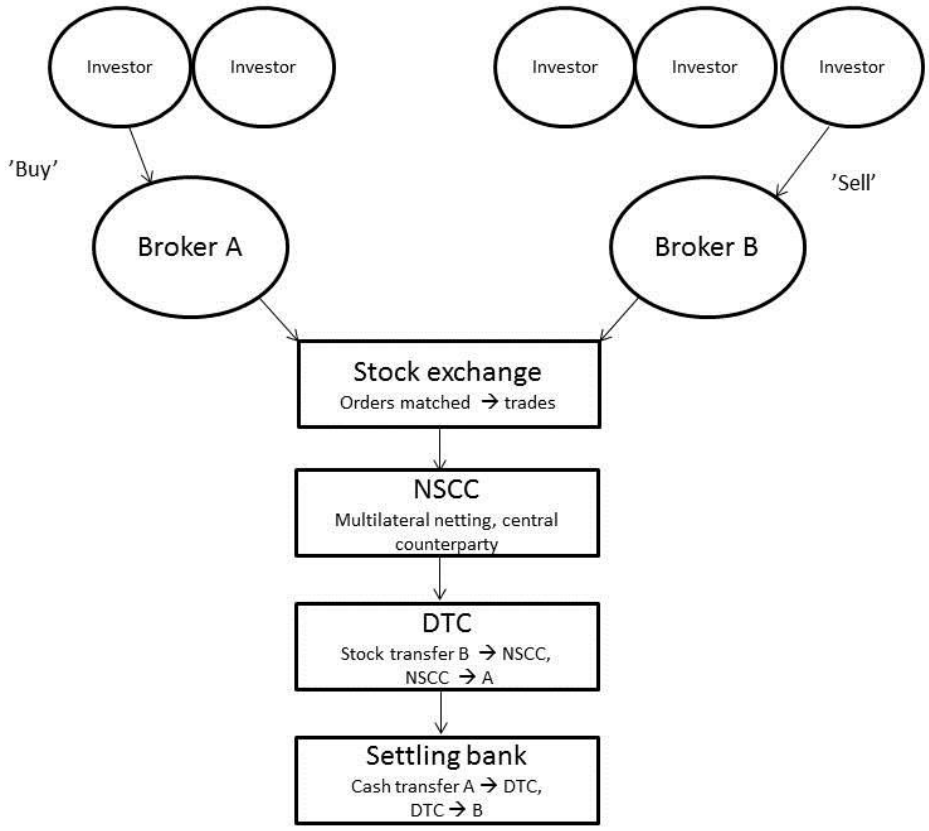

Figure 1: Clearing and settlement process in the U.S.

This figure illustrates the clearing and settlement process of stock trades in the U.S. The figure is a simplification and presents the case of a broker-to-broker trade. NSCC stands for National Securities Clearing Corporation, which is the main central counterparty in the U.S. DTC stands for the Depository Trust Company, which is the central securities depositary in the U.S. Source: Putniņš, 2010.

On the settlement date, all the trades in NSCC's system are to be settled. The stocks are held in DTC, which is responsible for the actual transfer of securities and cash between participants. Most of the securities are held in book-entry accounts in electronic form, but there are still some physical certificates. When DTC receives the net settlement instructions

[6] The Depositary Trust and Clearing Corporation:
http://www.dtcc.com/downloads/about/Broker_to_Broker_Trade.pdf

from NSCC, it debits and credits accordingly participants' book-entry accounts and cash accounts. Buyer receives the shares and seller receives the cash.

The transfer of stock is done in two cycles. In the 'night cycle' all the short positions are transferred from the participants' accounts to the NSCC's account. Then the stocks are transferred from the NSCC's account to participants with long position by using an algorithm. The algorithm allocates stocks by first transferring to priority groups in descending order, age of position within a priority group and random numbers within age groups. Participants can request to receive stocks first or they can submit buy-in notices in order to ensure that stock are allocated to them. In the second or 'day cycle' the stocks are transferred on a continuous basis during the day. In a perfect situation all buyers receive their stock on time. Related payments are netted at the end of the day by the DTC and transferred between DTC's account at Federal Reserve Bank of New York and sellers' settling banks.

If sellers do not fulfill their obligations and fail-to-deliver, NSCC does not receive all the stocks it needs to transfer to the buyers. In this situation the buyer receives an IOU of stocks from NSCC and the seller owes an IOU of stocks to NSCC. These IOUs can be traded similar to stocks, and often the end clients do not even know that they did not receive the actual stocks[7]. Only the NSCC and the clearing participants know the real situation. The buyer pays normally for the IOU although he does not receive the actual stocks. However, the payment is not transferred to the seller, who failed-to-deliver, but NSCC holds that payment as collateral until the seller fulfills its obligations and the IOU is cancelled. If the value of the stocks owed by the seller to NSCC increase, the seller has to make cash adjustments. If the value of stocks decrease, the cash collateral stays untouched, i.e. seller does not receive cash adjustments.

There are some differences between the clearing and settlement process of broker-to-broker trades and institutional trades. However, I will not go into detail of that process, as the idea of this section is give an overview how trades are cleared and settled on the U.S. market, and to make a comparison with European and Finnish processes. To conclude, the clearing and settlement process in the U.S. is highly centralized and effective as there are only couple

[7] Dividends are debited from the seller that failed-to-deliver to the buyer with the IOU. However, the buyer does not receive voting rights and cannot lend the stock until the stock is actually received.

national institutions handling the transactions. The contrast to more fragmented European system, which is presented in the next section, is notable.

2.3 European system

The European securities market is fragmented and heterogeneous, and especially the clearing and settlement processes (Niemeläinen, 2008). The market consists of several deviating national systems, which are regulated by national laws and practices. On a national level these systems operate efficiently and they fulfill the needs of national securities trading. However, the consequence of these fragmented national systems is inefficiencies and high costs at the European level.

A former chairman of the London stock exchange, Don Cruickshank (2001) states in his article that "clearing and settlement or 'back-office' services…are an essential function of trading". He argues that the biggest barrier to a pan-European capital market is inefficiencies in clearing and settlement of securities. As stock exchanges generally have ownership in domestic clearing and settlement systems, the author suggests that exchanges do not have the incentives to create more efficient systems. That would jeopardize their investments and profits under the current systems. In the current European system it costs more to hold and trade foreign securities than domestic ones. According to Cruickshank, investors have the option to do cross-border trades, but it is five times more expensive when there is an effective link between national CSDs and up to 30 times more expensive if there is no link. Therefore investors that would otherwise be willing to invest abroad may withdraw their intentions.

The high transaction costs increase the investors' required rates of return and conversely the cost of capital for companies. That affects the investment tendency of companies and therefore the competitiveness and productivity growth in Europe. The inefficiency of clearing and settlement systems can be one of the reasons for low productivity growth in Europe compared to the U.S. (Niemeläinen, 2008).

Cruickshank (2001) proposes that it is economically most efficient when all investors and all securities are handled in the same clearing and settlement system. Thus a single well regulated clearing and settlement system would serve best the efficient pan-European capital

market and reduce costs to the investors. Cruickshank argues that the benefits of a monopoly outweigh the dangers, also as it improves competition at the trading level among exchanges.

The following figure illustrates how fragmented the European clearing and settlement system is compared to the process in the U.S., which was illustrated in more detail in the previous section.

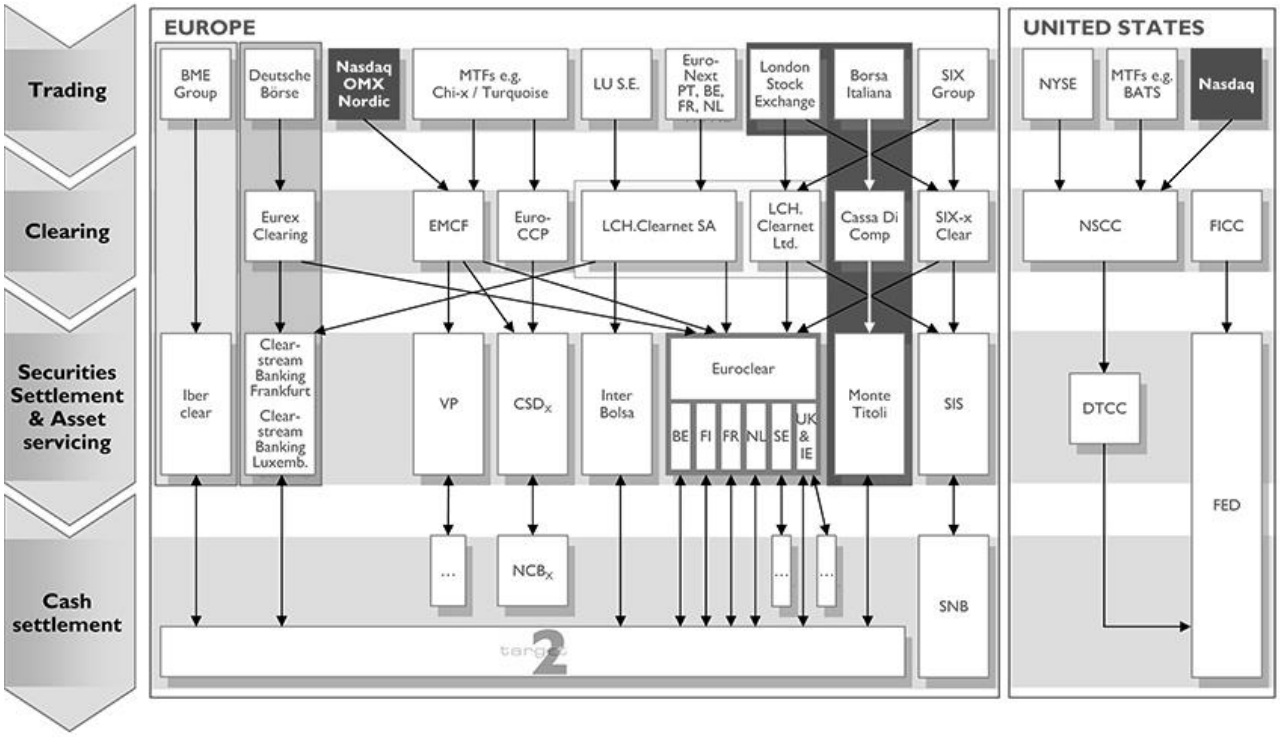

Figure 2: European clearing and settlement system vs. the U.S. system

This figure illustrates the European clearing and settlement landscape. The corresponding system in the U.S. is presented on the left side of the figure. On the first row of the figure is the trading level, including all the market places. On the second row is the clearing level, including all institutions involved in clearing of trades. In the third row is the settlement and asset servicing level, including all involved institutions. On the fourth row is the cash settlement level. Arrows represent how different institutions are linked with each other. Source: European Central Bank.

As can be seen in Fig. 2, the amount of organizations in the European system is manifold compared to the U.S. Beginning from the trading level, there are multiple market places in Europe, including stock exchanges, multilateral trading facilities (MTFs) and so on. That is due to the Markets in Financial Instruments Directive (MiFID), which ended the monopolies

of national stock exchanges and opened market for alternative market places (Weller, 2012). These market places connect to different clearing facilities, which in turn connect to multiple settlement facilities. Some of these settlement facilities operate locally only in certain domestic markets, e.g. CSDs operated by Euroclear, and some operate internationally in different countries, e.g. Clearstream. There are 19 CSDs in the Euro area, two ICSDs and 16 other CSDs operating in the EU.[8]

The immediate result from the fragmented infrastructure is that the costs are higher and the organizations servicing their customers are heavy. Especially the cross-border settlement is very costly, involving at least two CSDs and often one or more custodian banks. The settlement is also usually monopolized in every country, and thus killing any competition among European operators. The fragmented system also creates legal, technical and fiscal differences between markets and creates risks for market participants. In comparison the U.S. system is highly centralized and has lower settlement fees.

The ideas presented by Cruickshank and others have been heard by European regulators and institutions involved in clearing and settlement. There has been some development in past years towards a more consolidated and efficient post-trade market in Europe. In the clearing side, after the implementation of MiFID clearing of trades became open to more wide competition. The aim is to lower the costs related to clearing. The new regulation generated more competition by the introduction of pan-European CCPs in 2007. These CCPs are the alternative to traditional national clearing houses, which have operated monopolistically on national level. Now trading platforms have the choice to clear their trades centrally, and with reduced costs.

Currently the two major CCPs in Europe are European Multilateral Clearing Facility (EMCF) and European Central Counterparty Limited (EuroCCP). EMCF is currently owned by ABN AMRO Clearing Bank N.V., ABN AMRO Bank N.V. and OMX AB. It offers CCP services in 19 European markets through ten MTFs and nine stock exchanges. EuroCCP is a wholly owned subsidiary of the DTCC, and it offers its services for eight trading platforms.

[8] European Central Bank: https://www.ecb.int/paym/t2s/about/about/html/index.en.html

There has also been progress in the settlement side of post-trade processes. The European Central Bank (ECB) has launched a harmonization project called TARGET2-Securitites (T2S). It is one of the largest infrastructure projects launched by the Eurosystem. The objectives of the project are to reduce clearing and settlement costs for all market participants, to create an integrated market for settlement and make settlement more efficient and safer (Weller, 2012). These objectives are achieved by creating a single platform for settlement, single set of standards and single operational framework.

Although the focus has been on reducing the costs of cross-border settlement, T2S will generate other benefits as well. In T2S domestic and cross-border settlement will have same processes, cost and efficiency. When the settlement process is harmonized, investors have better access to foreign securities[9]. This improves liquidity of the markets and makes it easier for companies to raise funds at European level. As the settlement procedures are harmonized for domestic and cross-border transactions, market participants can streamline their back office organizations. This will reduce the overall cost of settlement for the end-investors.

As the current market situation is risk conscious, managing collateral and liquidity has become more difficult. T2S should make it easier for banks to manage collateral and liquidity more efficiently. The new harmonized system should also decrease counterparty and settlement agent risks by implementing a robust business continuity solution. T2S uses central bank money, i.e. cash transfers are between participants' accounts held at the respective national central banks.

The new system would separate infrastructure from the service, and thus increase competition. When the infrastructure is supplied by the public sector, the service providers (CSDs, custodian banks etc.) need to compete more in order to hold their current client base and obtain new clients. In the T2S system the clients have the opportunity to choose their service provider, which gives the best outcome at the European level. Increased competition should reduce costs for market participants, as has the MiFID done for the trading side of

[9]Euroclear Finland:
https://www.euroclear.com/dam/EFi/Reports/Euroclear%20Finland%20T2S%20planning%20guide.pdf

security transactions. Activities other than settlement are still operated and maintained by CSDs, such as asset servicing, corporate actions processing, and tax and regulatory reporting.

Although market places or participants are not forced to join T2S, excluding themselves from the new system can be risky. The markets left outside T2S would seem isolated and would not benefit from the cost reductions and increased efficiency. As has happened after MiFID to the old national stock exchanges, markets falling behind in development can be fatal and the advantages for first movers can be great.

The ultimate goal of the T2S project is to create a single and competitive European market for financial services. In the current situation the fragmented layout is not as efficient and appealing as in the U.S. The previously mentioned development of T2S and pan-European CCPs are a move to a better direction. The announcement by EMCF and EuroCCP in March 2013 to join their companies in order to offer even better efficiency and to increase competition in European securities clearing is another big change in the European post-trade market[10]. The results from the consolidation will be seen in the future, but it can be said that the European post-trade market is facing turmoil in the following years.

2.4 Finnish system

In this section I will describe in more detail how the clearing and settlement of stocks is handled in the Finnish market. There are two different systems working simultaneously, one for stock exchange and MTF trades, and one for OTC trades. I will describe the process of OTC trade clearing and settlement process in more detail, as the data used in this thesis consists of OTC trades, but also give a short description of how stock exchange trades are processed. I will also provide some descriptive settlement figures of the Finnish market and elaborate how delivery failure fees are utilized.

The main institutions operating the clearing and settlement systems in Finland are Euroclear Finland (EFi), EMCF and the clearing parties in the equity market system. EFi operates the

[10] European Multilateral Clearing Facility and European Central Counterparty Ltd: http://www.emcfeuroccp.co.uk/

CSD in Finland, thus responsible for maintaining the register of all domestic equities and offering settlement service for the Finnish market. Thus EFi serves both stock market and OTC trading systems in Finland. The book-entry accounts holding all the securities are operated by Central Register system, which different custodians access with their own internal systems.

EMCF is the CCP for stock exchange and MTF trades for total of 19 European markets, including NASDAQ OMX Helsinki. In the equity market system (OM-system), which is used to clear and settle OTC trades[11], there were 23 clearing parties in January 2013, including all major Nordic banks[12]. Only these clearing parties are allowed to operate in the OM-system, and other participants willing to enter the market have to either use the services of existing clearing parties or establish their own operations in Finland.

There are two main differences between the two systems. Firstly, OM-system does not have CCP but trades are cleared bilaterally, whereas in EMCF trades are cleared centrally. Secondly, trades in EMCF are netted multilaterally and in OM-system bilaterally. Therefore the amount of needed settlement transactions between participants is lower in EMCF, as multilateral netting results in single transaction per stock. In OM-system settlement transactions are netted between every individual bilateral pair of participants, which results in higher number of transactions between different participants.

2.4.1 Stock exchange trades

Trades made in the NASDAQ OMX Helsinki stock exchange are cleared centrally. In 2009 EMCF and NASDAQ OMX Nordic agreed that EMCF operates as a CPP for all cash equity trades made in their stock exchanges[13]. Large and Mid Cap stocks started to be cleared by EMCF in November 2009, and Small cap and warrants followed in July 2012. Fig. 3

[11] Stock exchange trades of Small Cap stocks and warrants were also cleared and settled in the OM-system until June 2012.

[12]Euroclear Finland: https://secure.ncsd.eu/files/ClearingPartiesEquityMarketSystem.pdf

[13] Asset Servicing Times: http://www.assetservicingtimes.com/countryfocus/country.php?country_id=36

illustrates the whole process of stock trades from transaction through clearing finishing in settlement.

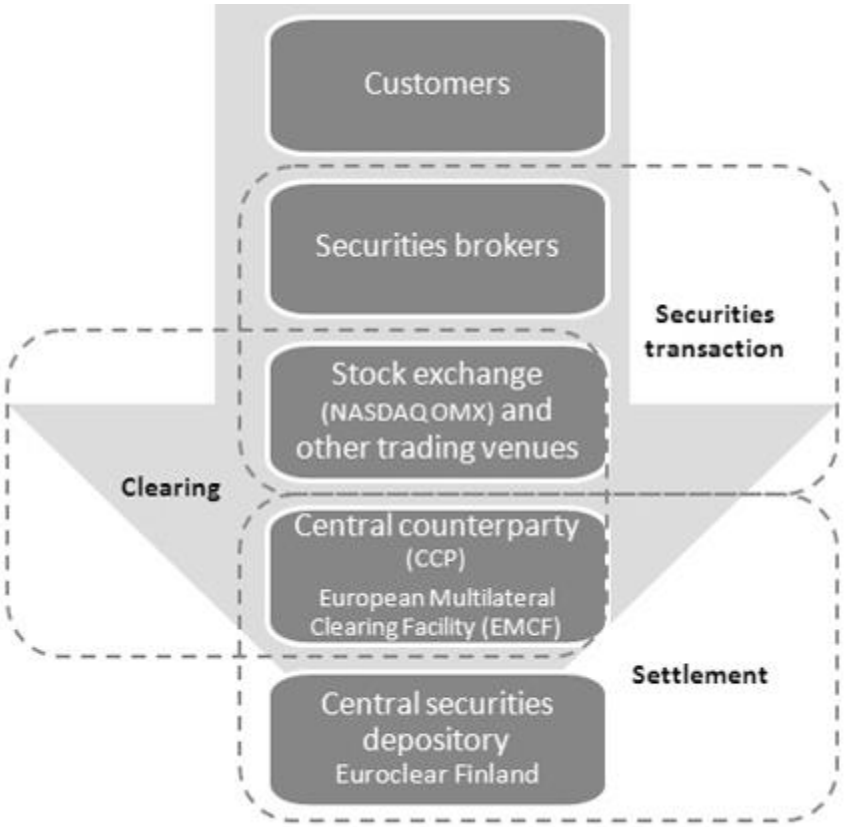

Figure 3: Clearing and settlement process of stock exchange trades in the Finnish market

This figure illustrates the clearing and settlement process of stock exchange trades in the Finnish market. In the securities transaction phase brokers reach an agreement to trade stocks in the stock exchange (other trading venues e.g. MTFs can also be used). In the clearing phase trades are transferred to the European Multilateral Clearing Facility (EMCF) to be cleared. At this point EMCF interposes itself between the buyer and seller as central counterparty. In the settlement phase trades are settled in the Euroclear Finland, which is the central securities depositary in Finland. At this point the seller receives the cash and buyer receives the stocks. Source: Bank of Finland.

The process starts when the investor (customer) informs his broker to engage in a stock trade. The broker does the trade on the stock exchange and the details of the trade are set with the counterparty's broker. All trades made in a single trading day are then transferred to be cleared to the CCP, which assumes the role of buyer to the seller and the role of seller to the buyer, guaranteeing the trade for both counterparties and reducing counterparty risk. All trades are multilaterally netted in the beginning of settlement date, in order to reduce the amount of needed transfers between counterparties. At the end of the settlement date CCP

instructs domestic CSD in Finland to settle the trades, i.e. transfer securities to the buyer's book-entry account and cash to seller's cash account.

The process has similarities with the process used in the U.S., which is introduced in the previous section. In both systems trades are cleared centrally by CCP. The main difference is that in the U.S. there is one CSD operating in the market, but EMCF is connected to several national CSDs. From the investors perspective the process is similar to the U.S., but it has to be taken into account that EMCF is an international player in the market.

2.4.2 OTC trades

OTC trades are cleared and settled bilaterally in the OM-system, which is operated by EFi. The infrastructure is called HEXClear. The following description is based on the processes of a clearing party/custodian bank operating in Finland, so I must emphasize that there can be differences between the processes of different service providers. In the following example the custodian is also acting as the clearing party for the client. These two services can be separated. However, I argue that the description gives a good outlook how clearing and settlement is done in general. Fig. 4 illustrates how the process proceeds step by step.

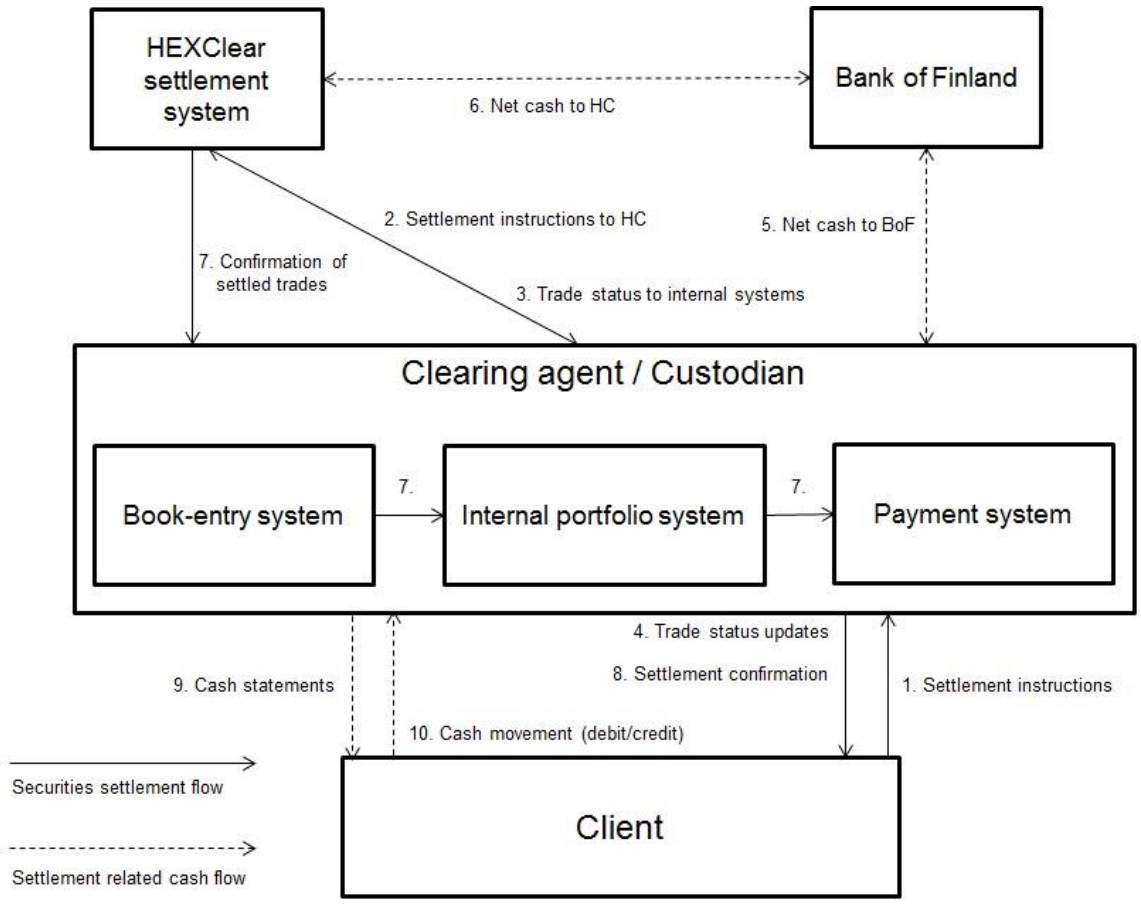

Figure 4: Clearing and settlement process of OTC trades in the Finnish market

This figure illustrates the clearing and settlement process of OTC trades in the Finnish market. The process is based on information from a clearing party/custodian bank operating in Finland. The solid arrows represent settlement instruction flow and dotted arrows represent cash flows. The numbers denote the sequence of different phases.

As can be seen in the above figure, the process starts when the client sends settlement instruction to its clearing agent (1). After receiving the instruction, the clearing agent passes the instruction on to the market system, HEXClear (2). The agent can oversee all the trades on the market system with their internal portfolio system (3). The status of the trade is passed on to the client, so the client is also informed of the situation of the trade (4).

Similarly, the counterparty sends its matching instruction to the market system. When the instructions match, the seller confirms the delivery to the buyer and the trade waits to be settled on the settlement day. If the instructions do not match, the agent informs its client of the possible differences in the instructions or the absence of counterparty's instruction. The client can then contact its counterparty and sort out the possible problems in the instructions. If this is done before the end of intended settlement day, the trade can settle on time, but if the

client can't sort out the problem, the trade transfers to the next settlement day. In other words, the trade fails.

On the settlement day morning, the clearing agent checks its net cash balance for all the trades they have sent to the market system. If there are more purchases than deliveries for the ongoing day, the clearing agent transfers the missing net cash balance to the Bank of Finland (5), which is then registered at HEXClear (6). In other words, the agent guarantees the payment of the purchases. If there are more deliveries than purchases, the cash proceeds of the deliveries cover the cash need for the purchases.

After all market participants have sent their net cash balances to the market system, all trades waiting for settlement between participants are settled. All trades waiting for seller's confirmation, with differences in the determining factors or missing counterparty's instruction are then settled on real-time basis during the settlement day. As mentioned above, all trades that are not settled during the settlement day fail and will be transferred to the next settlement day. At the end of the day the clearing agent repatriates all cash from the market system.

When the trade settles on the market system, confirmation of the settlement is received on the custodian's book-entry system and internal portfolio system (7), and passed on to the client (8). After confirmation the position of stocks updates in the book-entry system and in the internal portfolio system, i.e. sellers' position decreases and buyers position increases. At the end of the day, the custodian credits its client's cash accounts for the deliveries and debits for purchases. Clients receive cash statements of their balances (9) and correspondingly credit or debit their accounts (10).

The main difference between the OM-system and the systems used in the U.S. and in Finland with stock exchange trades is the lack of CCP. The bilateral clearing can cause problems if the clearing participants operating in the system do not have sufficient resources or knowledge how to do things. In problematic situations counterparties have to solve the situations themselves, which can be time consuming and costly. In centrally cleared systems the reliability of the system is suggested to be higher as CCP interposes in between counterparties. Also bilateral netting in OM-system increases the number of needed transactions, when compared to the centrally cleared systems using multilateral netting.

2.4.3 Settlement figures

Following figures illustrate the Finnish stock market volumes in number and value of trades from December 2009 to June 2012. Numbers are separated for trades traded and cleared in different platforms. NOMX includes Small Cap stock and warrant trades made in NASDAQ OMX Helsinki stock exchange and cleared in OM-system, CCP includes Large Cap and Mid Cap stock trades cleared in EMCF and other transactions refers to OTC trades cleared in OM-system. Also the rate of trades settled on time is provided in number and value of trades for NOMX and CCP trades. The rate is not available for OTC trades.

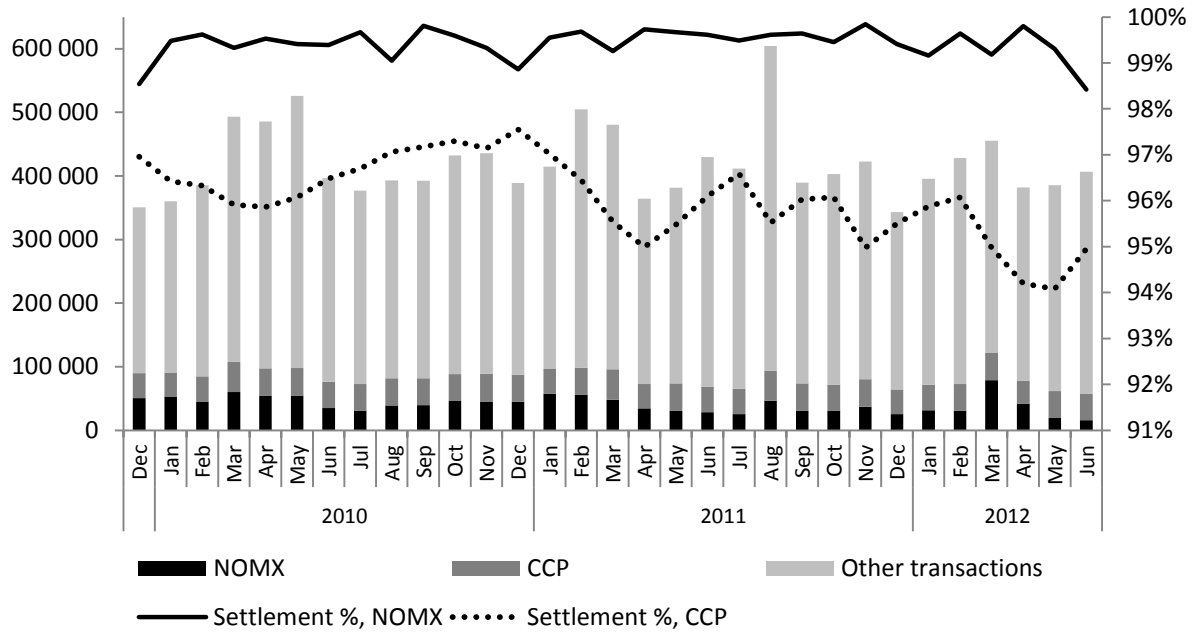

Figure 5: Finnish stock market settlement volume

This figure presents the number of trades settled in the Finnish market between December 2010 and June 2012. The bars indicate the volume of the month. The volume is divided into three groups: CCP consists of Large and Mid Cap stock exchange trades, NOMX consists of Small Cap and warrant trades and other transactions consists of OTC trades. The solid line presents the rate of timely settled (T+3) NOMX trades, and the dotted line presents the rate of timely settled CCP trades. Source: Euroclear Finland.

Fig. 5 illustrates the development of monthly number of trades and the level of successful settlements in number of trades during December 2009 to June 2012. The average monthly number of trades is 420,058 trades. The notable highest peak is in August 2011. This is most likely due to the sharp decline in stock market prices as the European sovereign debt crisis

culminated and fears of contagion spread. Also Standard & Poor's downgraded the credit rating of the U.S. for the first time from AAA to AA+. The other highest volumes are in the first months of 2010 and 2011. In these months the OMX Helsinki index peaked after the sharp drop in 2008 after the financial crisis.

The number of OTC trades is overwhelming compared to stock exchange trades. This is most likely due to the multilateral netting of trades by CCP, which reduces the amount of settled trades significantly. The effect of netting all bilateral trades into only necessary actual transfers between participants can be seen in the figure. As the OTC trades are cleared bilaterally, the number of trades is also higher. However, it has to be taken into consideration that the number of settled trades does not tell how many actual trades are made in different trading venues. More like the figure illustrates the differences between clearing processes.

There are differences in the rates of trades settled on time between trades cleared in the OM-system and in EMCF. The average settlement rate for NOMX trades is 99.4% and for CCP trades 96.10%. This is somewhat surprising, as it is generally taught that central clearing improves the efficiency of settlement, as CPP interposes between participants and ensures the trades. Fig. 5 shows that trades cleared in OM-system bilaterally are settled more efficiently during the whole observed time period. The lower rate of successful settlements in CCP cleared trades could be due to the fact that the procedure was implemented in November 2009 and might have had some launch difficulties, but it does not explain why the rate has sustained at a low level.

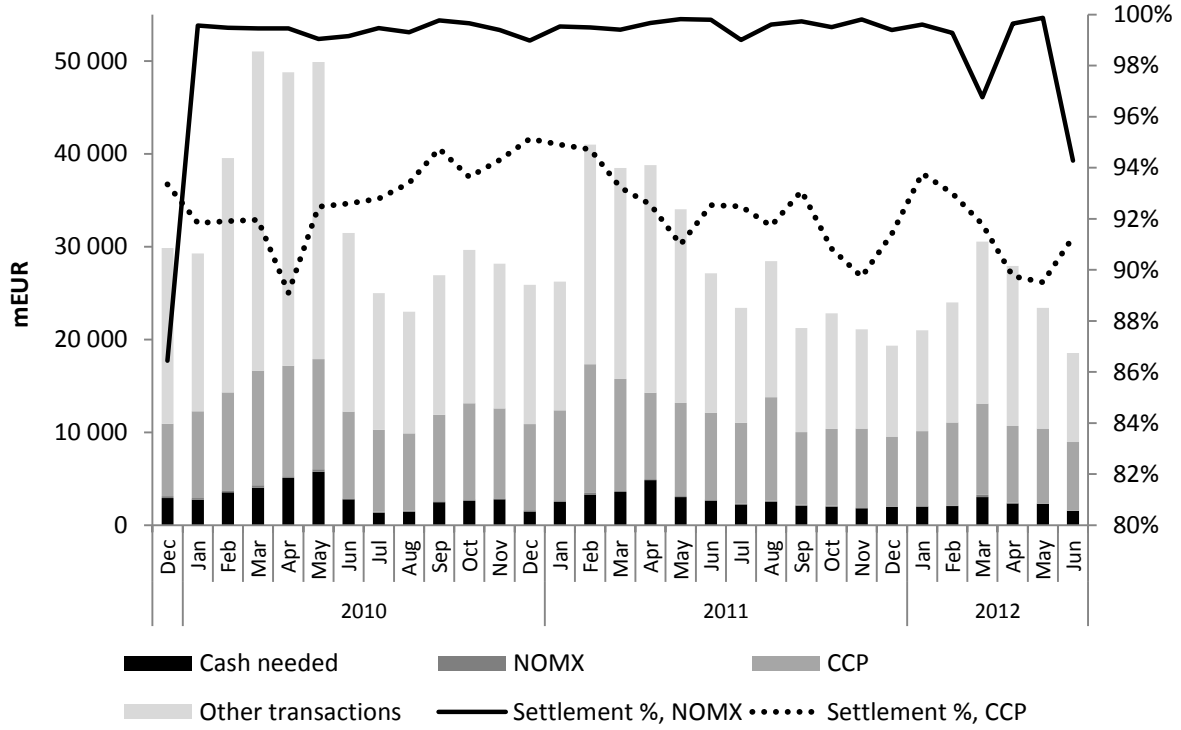

Figure 6: Finnish stock market settlement value

This figure presents the value of trades settled in the Finnish market between December 2010 and June 2012. The bars indicate the value of the month. The volume is divided into four groups: CCP consists of Large and Mid Cap stock exchange trades, NOMX consists of Small Cap and warrant trades, other transactions consists of OTC trades and cash needed consists of trades needing cash. The solid line presents the rate of timely settled (T+3) NOMX trades, and the dotted line presents the rate of timely settled CCP trades. Source: Euroclear Finland.

Fig. 6 presents the same details as Fig. 5 but in value of trades. The average monthly value of trades is EUR 29,860 million. The peaks in total value of trades are during the first months of 2010 and 2011, when the stock market prices were high. Also the value of OTC trades is higher than stock exchange trades, due to same reasoning of multilateral netting as when comparing the number of trades. However, the difference is smaller in value than in number of trades. The rate of successful settlements is higher in value for trades cleared in OM-system than in EMCF during the observed time period, except in December 2009. The average rate of successful settlements is 98.82% for NOMX trades and 92.44% for CCP trades.

2.4.4 Delivery failure fees

In order to improve the rate of successful deliveries, EFi has set penalty fee for participants that do not deliver on time. The penalty is paid by the seller guilty for failing delivery to the innocent buyer. The penalty is 0.5% of the value of stocks not delivered on time for every day following the intended settlement date. The maximum fee is 10% of the value per each delivery but EUR 200 at minimum. EFi subtracts their expenses for collecting the fee from the guilty participant, being EUR 50 at minimum and 10% of the collected fee at maximum. The value of the stocks not delivered on time is based on the price set in the transaction contract, or if there is none, the highest trading quotation of the trade date. The buyer can also cancel the trade, and if the value of the stocks is higher on the cancellation date, the seller is obligated to compensate the difference to the buyer.[14]

The main issue regarding the fee is that it is only put into action when the innocent buyer demands for it. This almost never happens. The suggested reason for the unwillingness to punish guilty parties is that the same penalty could be used against them later (Finnish Competition Authority, 2001). In other words, there prevails a common understanding between the market participants that no one uses the penalty and thus everyone is spared from it. Participants claim that they do not want to use the penalty, because EFi cannot sufficiently identify which participant is truly guilty for the failure, and due to high collecting fees proportion to the relevantly low fee payments. However, the fact no one ever dares to use the penalty fee against sellers that fail-to-deliver cripples the whole idea of the penalty fee. As the risk for the sellers to receive the penalty is practically zero, they can estimate the cost of failing to be zero.

3 Literature review

The following subsections will give an overview of the existing literature relevant to this paper. Topics such as settlement failures, short selling and stock borrowing are discussed. As

[14] Euroclear Finland:
https://secure.ncsd.eu/files/ViivastysmaksutEuroclearFinlandinSelvitystoiminnassa2013.pdf

the existing literature is somewhat scarce on some of the topics, sources can be both academic and made by practitioners.

3.1 Settlement failures

The ownership of a security being traded transfers from the seller to the buyer on predefined settlement date. The most frequent settlement date cycle is T+3, referring to the third business day after the trade date. A failure occurs when a trade is not settled on the original settlement date because the seller fails to deliver the security or buyer fails to pay for the trade.

Settlement failures can happen for multiple reasons: human error and miscommunication, administrative delays, operational problems and naked short selling (Putniņš 2010; Fleming and Garbade 2005). All the factors, except naked short selling, are unintentional and market participants try to eliminate them in their operations. Naked short selling, however, is intentional behavior as the seller chooses not to deliver. Settlement failures can cascade more failures and weaken the efficiency of the clearing and settlement process. This cascade of failures is called a *daisy chain*: A's failure-to-deliver to B causes B failing-to-deliver to C, and so on. When the first participant failing-to-deliver is also the last participant failing-to-receive, it is called a *round robin*.

Fleming and Garbade (2005) study money market instrument settlement failures data provided by the U.S. Federal Reserve between July 1990 and December 2004. The data include U.S. Treasury securities, agency debt securities, mortgage-backed securities and corporate debt securities. They find delivery failures correlating highly with failures-to-receive, and thus focus only on failures-to-deliver. They report that settlement failures are not uncommon, as the daily delivery failures average USD 3.8 billion, but were as high as USD 190 billion per day after the September 11 attacks and USD 232 billion in the summer of 2003. The authors suggest that the high level of failures after September 11 were caused by operational problems, as the World Trade Center had back office functions of several market participants, and general turmoil in New York affected the normal processing of trades for many days. The high level of delivery failures in the summer of 2003 was caused by low interest rates, as the authors suggest low interest rates discourage sellers to borrow securities

to ensure delivery, as the return on proceeds the sellers would get are smaller than the cost of borrowing.

In another study by Fleming and Garbade (2002) concentrating on the settlement failures of money market instruments around September 11 attacks, they find the level of failures prevailing at a higher level than before the attacks. They suggest that the cost of borrowing was as high as failing-to-deliver and therefore did not motive sellers to deliver timely. The U.S. Treasury responded by reopening the on-the-run 10-year note, increasing the supply of the security. This made borrowing less costly and failing less attractive. The authors suggest a lending facility and penalty fees as solutions to prevailing failures.

Degennaro and Moser (1990) study the effects of delivery failures on Treasury bill prices in the U.S. and find that Treasury bill prices reflect the value of being failed. Investors bid prices to a premium to reflect the possibility of obtaining the zero-interest loans that delivery failures represent. They also find that the bid-ask spread increases as the length of a potential failure increases, indicating that delivery failures add a source of risk to the transaction.

In the U.S. market makers that engage in *bona fide* trades that ensure the market liquidity, are allowed the exception to short sell without first borrowing or locating the stock.[15] Evans et al. (2009) study proprietary data of a major U.S. option maker, and find that in most hard-to-borrow situations it chooses not to borrow but fail-to-deliver. The authors suggest that failures-to-deliver are similar to zero-fee, zero-rebate loans, and when borrowing is difficult and/or costly, the market maker chooses failing over borrowing. The buyer has the right to force delivery by using buy-in procedure, thus if the seller wants to maintain short position, he has to purchase the security and give it to the buyer, and sell short again. The expected cost of this roundtrip has to be included when comparing borrowing and failing. However, the authors find buy-ins extremely rare, as only 0.12% of the failing positions over two-year period were bought-in.

[15]The U.S. Securities and Exchange Commission: http://sec.gov/spotlight/keyregshoissues.htm

Evans et al. (2009) also find part of the value of failing passing to the option prices, as the relation between borrowing costs and option prices is weaker when failing is cheaper than borrowing, i.e. shorting costs move options out of parity. The market maker profits from the mispricing significantly on average. As the U.S. clearing corporation passes the buy-in demands to the oldest delivery failures, and large market makers have higher trading volume and thus higher portfolio turnover, large market makers have competitive edge on this arbitrage pricing.

Boni (2006) continues the study by Evans et al. (2009)[16] by examining delivery failure data for all U.S. equities on three different settlement dates during 2003 and 2004, prior to Regulation SHO was introduced in the U.S. The author uses the idea by Evans et al. (2009) of market makers intentionally failing-to-deliver on hard-to-borrow stocks and refers these trades as strategic failures-to-deliver. She defines a failure-to-deliver as strategic, when the fail position has lasted five days or longer, consistent with the threshold criteria by Regulation SHO. Boni recognizes the fact that this definition underestimates the strategic failures of less than five days. However, she argues that as it is impossible to distinguish which failures-to-deliver are strategic, and which unintentional caused by miscommunication and other errors, it is probable that failures caused by other than strategic decisions should not be persistent. Therefore, failures lasting five days or longer are likely the result of strategic failures-to-deliver.

Boni (2006) finds most U.S. equities experiencing delivery failures each day. While the rate of failures-to-deliver proportioned to shares outstanding is very low, significant portion of equities experienced persistent delivery failures of five days or more; 42% of listed and 47% of unlisted stocks. About 4% of the equities would have been added to the threshold list under Regulation SHO.

Boni (2006) tests if strategic failures-to-deliver are due to difficulty and cost of borrowing equity. She finds evidence that strategic failures are more likely to happen when stocks are hard-to-borrow, proxied by institutional ownership, book-to-market, and market cap. The

[16] The studies are not in chronological order, because Boni refers to a working paper by Evans et al., which is later published in Review of Financial Studies in 2009.

author finds similar result with Evans et al. (2009) that stock with options listings experience more strategic failures, when stocks are hard-to-borrow. She also discusses the possible reasons why buyers do not exercise the buy-in procedure more often, and suggests that buyers that allow others to fail-to-deliver are themselves responsible for delivery failures in other stocks. The author finds evidence that buyers hope to gain goodwill from other market participants by not forcing delivery. In other words delivery failures are seen as acceptable behavior among market participants. This finding is in line with the report made by the Finnish Financial Competition Authority, which findings regarding the penalty fee of failing are presented in Section 2.4.4.

3.2 Short selling

In this subsection I will describe theories and studies relevant to short selling. Emphasis is on equities as that is my focus on this paper. Vast majority of literature regarding short sales is focused on equities, but e.g. Asquith et al. (2013) have studied the corporate bond loan market.

3.2.1 Short selling constraints

The ability to sell short has been a strong assumption in the finance theory. If arbitrage pricing can be found in the market, arbitrageurs will try to benefit from it and as a result the arbitrage will vanish from the market, i.e. prices in the market reflect all available information, and thus markets are efficient (Fama, 1970). In order for this assumption to hold, short sellers would need to be able to borrow securities without cost and constraints (D'Avolio, 2002). Consequently short selling can be seen as a positive and a crucial thing for the capital markets as it contributes to the price formation.

However, in reality short selling is not costless nor without constraints, which limits the ability of arbitrageurs to operate. Short selling is constrained, when investors wishes to sell short but are either unable to borrow shares or the cost of doing so is high (Asquith, 2005). There are a lot of studies examining what are the effects of short sale constraints. Miller (1977) suggests that securities can be overpriced, if 1) short sellers are restricted from effectively shorting these securities due to constraints, and 2) investors have heterogeneous beliefs concerning the value of the securities. Thus the prices only reflect the views of optimistic investors. Diamond and Verrecchia (1987) argue that short sale constraints do not

bias prices upward, but slow down the speed of adjustment of bad news on prices and thus securities can be overvalued.

Ofek and Richardson (2003) study Internet-related companies during 1998-2000 and find that these companies' stocks were heavily constrained at first because of lockups, which affected the emergence of the DotCom bubble. They find that when these lockups started to expire, and the short sale constraints loosened, the bubble burst and the prices declined heavily. Chang et al. (2007) find in the Hong Kong market that short selling constraints cause stock overvaluation and the effect is higher when there are a lot of differences in the investor opinion about the value of a specific stock.

The consensus in the previously mentioned studies is that short selling enhances the pricing efficiency of stocks. Increase in short selling constraints decreases the efficiency and can cause overpricing or even bubbles as optimistic investors dominate the market.

3.2.2 Short interest

There are different views in the literature how short interest (the amount of shares being shorted relative to outstanding shares) affects stock returns. The first view is that short selling does not affect stock returns. Brent et al. (1990) suggest that if short selling is motivated by hedging strategies, arbitrage transactions, and tax-related reasons, short selling is unrelated to stock prices. Investors having a long position in a stock might engage in short sales only to remove the uncertainty in the stock's price i.e. using the *shorting against box* technique. Such short sales are not motivated by negative beliefs of the stock's value but are mere instruments to cover risks or avoid taxes, and therefore do not affect the stock returns. Senchack and Starks (1993) have similar suggestions, as they eliminate noninformational short selling from their sample. The authors argue that e.g. risk arbitrage activities do not imply negative expectations of the fundamental values of companies.

Another popular view among investors is that high short interest signals bullish future returns, as it can signal latent demand for stocks. When short sellers close their short position, they purchase the stock in the market and return it to their lender. The purchases in the market can push the price of the stock higher, especially if there is high demand and lack of supply of the

stock. In extreme cases the short covering can result in a short squeeze (Brent et al., 1990; Desai et al., 2002). To support this view, Boulton and Braga-Alves (2011) find that returns are generally positive for stocks following fail-to-deliver threshold list addition announcements. They study threshold lists provided by AMEX, Nasdaq and NYSE during 2006-2008. The authors find positive CARs averaging 1.3% - 1.9% over the five trading days following the announcements.

The third and prevailing view is that high short interest decreases stock returns. Diamond and Verrecchia (1987) argue that because there are costs related to short selling, short sellers must be informed traders, implying that higher short interest is a bearish signal. Using intraday data from the Australian market, Aitken et al. (1998) find significantly negative abnormal return for stocks after short sales are initiated. Desai et al. (2002) find after studying the monthly data from Nasdaq between 1988 and 1994 that heavily shorted companies experience significant negative abnormal returns after controlling for market, size, book-to-market, and momentum factors. They suggest that higher level of short interest is strong bearish signal. Asquith et al. (2005) get consistent results in their study using a sample of stock from NYSE and Amex between 1980 and 2002, and from Nasdaq between 1988 and 2002. Using short interest ratio as a proxy for borrowing demand, and institutional ownership ratio as a proxy for supply, they find constrained stocks underperforming significantly.

3.2.3 Traditional vs. naked short selling

Short selling can be divided into two classes: traditional (covered) short selling, and naked (uncovered) short selling. In traditional short selling the stock being sold is borrowed or other arrangements has been made to ensure the delivery of the stock at settlement date. The short seller purchases the stock from the market or borrows it from other lender afterwards in order to return the stock loan to the original lender (see e.g. Christian et al., 2007; Culp and Heaton, 2007). Thus traditional short seller believes that the stock being shorted is overvalued and its value will drop in the future, and tries to gain from the price drop by selling the stock at higher value and then purchasing it at lower value afterwards. Traditional short seller must also take into consideration the short selling constraints discussed earlier in order to define is the short sale profitable after loan and other transaction fees. Stock loans are discussed in more detail in the next subsection. However, naked short selling is uncovered, because the

short seller does not borrow or make any other arrangements to ensure the delivery of the stock at settlement date.

The public opinion is currently against naked short selling, as it is seen as abusive, manipulative and as a cause to settlement failures, and thus creating mistrust in the market. The financial crisis and the Eurozone crisis have increased the amount of criticism on naked short selling[17]. As discussed in the introduction of this paper, regulators in the U.S., Europe and elsewhere have already taken actions to limit naked short selling. The grounds for these regulations are somewhat hazy, as the effects of naked short selling have not been studied intensively, and the few existing academic studies do not support restrictions on naked short sales.

Contrary to the public opinion, in their recent study Fotak et al. (2010) find naked short selling , proxied by delivery failures in the U.S., net beneficial to the pricing efficiency and market liquidity. They find that naked short selling has similar positive effects as traditional, covered short selling, and that it did not accelerate any market distortions, like the price falls in the 2008 financial crisis. Boulton and Braga-Alves (2010) study the effects of an Emergency Order announced in 2008 by SEC restricting naked short selling of the stocks of 19 publicly traded financial firms. The authors find that the restriction successfully eliminated naked short selling for the restricted firms, but naked short selling increased heavily for a closely matched sample of financial companies. They also find that the restriction damaged market quality by resulting in overpriced securities, higher bid-ask spreads, and lower trading volume. In another study by Boulton and Braga-Alves (2011), they find market reacting positively to increased naked short selling activity. As they suggest that naked short sellers are *contrarian* investors i.e. sell overpriced stocks, naked short sellers provide liquidity in bullish market conditions. Thus naked short sellers are not pushing already declining stock prices down but contribute positively to well-functioning markets by providing liquidity when prices are rising.

[17] The Guardian: http://www.guardian.co.uk/commentisfree/2012/jul/06/banning-naked-short-selling-eurozone-crisis

3.3 Stock borrowing

Geczy et al. (2002) define stock loan as a temporary swap of ownership, as the lender transfers legal ownership of shares to the borrower, who in turn transfers collateral (usually cash) to the lender. Stock loans are primarily used to facilitate short selling and to cover failed deliveries (Geczy et al., 2002). Stock loans can be settled T+0 (same-day basis), so the short seller can borrow the shares at the time, when the short position is due to be settled. However, current regulation in the U.S. and European Union requires the short seller to ensure before making the short sale that at the time of delivery the equity loan is available, i.e. short seller must *locate* the shares. Usually the original short seller uses a broker to facilitate the trade. The broker can locate the needed shares in its inventory, or in its customer's accounts willing to lend their shares. If unsuccessful, the broker can contact other potential lenders in the lending market. Institutional investors such as insurance companies, index funds, and pension funds are natural lenders, as they often have large portfolios of long-term buy-and-hold investments. The search for the needed shares can be done electronically, but more traditional methods such as email, fax, or telephone are still used (Duffie et al., 2002).

All legal rights of the ownership transfer to the borrower, including voting rights (Geczy et al., 2002). However, dividends and other cash-flow rights do not transfer and the borrower has to pay them to the lender (D'Avolio, 2002). Christoffersen et al. (2007) find in their study of the U.S. and U.K. equity lending markets, that equity loans are also used to trade votes. Surprising finding in their study is that these loans used for vote trading are priced on average to zero. Thus they suggest that equity lenders pass their voting rights to the borrowers because of asymmetric information. This hypothesis assumes that lenders do not know how to vote and hence they hope that the borrowers do, and will vote in line with lenders' preferences.

In the U.S. the standard for collateral is 102% of the shares being borrowed. The parties negotiate a *rebate rate*, which is the amount of interest the lender pays to the borrower for the collateral, i.e. the equity-borrower is a lender of cash to the equity-lender and the rebate rate is the interest on this cash loan. In turn, the borrower pays a fee for the equity-loan, which is deducted from the rebate rate. Thus negative rebate rates can occur when the fee is high. The rebate rate is defined by how scarce is the supply of particular share in the loan market, i.e. the *specialness* of the share. Shares lend at low rebate rates are called *specials*, and vast

majority of shares lend at the baseline rebate rate are called *General Collateral* (D'Avolio, 2002; Geczy et al., 2002).

The specialness of the stock is determined by multiple factors. Duffie et al. (2002) list the capitalization of the issue, the float (number of shares available to trade), whether the stock is included in an index, the liquidity, concentration of ownership, and any special activity, such as IPOs, mergers, spinoffs, or acquisitions, as factors that can affect the supply of the stock and thus the rebate rate. Geczy et al. (2002) find by analyzing a year of equity loan data from one of the world's most active lenders that loans of IPO, DotCom, large-cap, growth and low-momentum stock are cheap relative to the profits that can be made by short selling. On the other hand, they find that the strongest difficulty of efficiently and profitably to short sell is in companies that are undergoing a merger, especially when the acquirer is small. Geczy et al. conclude that specialness is a stock-specific rather than categorical consideration. But what are these stock-specific factors that affect the specialness?

D'Avolio (2002) studies data consisting eighteen months of loan supply, fees, and recall activity from a large financial institution in the U.S. and identifies factors affecting stock specialness. He argues that factors affecting the supply and demand of stock loans should affect the likelihood of stock being special. As previously mentioned institutional owners often have passive portfolios and are willing to lend shares in order to get extra return. Thus high institutional ownership increases supply and lowers the cost to borrow stock. High market cap reduces the possibility that investors not willing to lend shares hold significant portion of shares outstanding. Therefore higher market cap indicates higher amount of willing stock lenders and higher possible supply of stock loans.

When short sellers have perception that a stock is overpriced, borrowing demand increases. Therefore increase in differences of opinion between investors of stock valuations should increase the demand for stock loans and thus the specialness. There is evidence in the existing literature suggesting possible proxies for differences of opinion. Harris and Raviv (1993) find that stock turnover increases when differences of opinion among investors increases. Houge and Loughran (2000) argue that investors have a cognitive error valuating companies with low cash flows, as investors prefer investing in companies that have high current earnings. Low or nonexistent cash flows make it hard for investors to value companies, as valuation is

normally based on discounting future cash flows to the present. Houge and Loughran find investors overvaluing stocks with low cash flows, which makes low cash flow stocks a good target for short sellers, and thus increasing stock borrowing demand.

Miller (1977) argues that when investors have differences in opinion, increased investor attention regarding stocks increases optimism in the prices. This leads to most optimistic investors to buy and most pessimistic to sell short the stock. Thus increased activity in Internet message boards of a particular stock that increases the attention of that stock among investors implies increased differences of opinion among investors. Miller also suggests that differences of opinion are high among IPOs. D'Avolio (2002) suggests higher borrowing demand for stock with higher pricing multiples, as they are common short-sale targets.

D'Avolio (2002) tests the previously mentioned factors and finds that the specialness of a stock decreases with market capitalization and institutional ownership, which indicate supply of stock loans. He also finds stock specialness increasing when proxies for differences of opinion among investors increase. These proxies are high turnover, low cash flows, increased message board activity, dummy for IPO within a year and high price multiples.[18]

D'Avolio's findings regarding stock specialness are applied in the study presented in the following sections. Therefore it is important to see if equity loan market is similar in the U.S. and Finland, and the findings can be used to proxy stock specialness also in the Finnish market. D'Avolio states that the aggregate market is easy to borrow, as at the most 16% of stocks are potentially impossible to short and these stocks represent only less than 1% of the market valuation of stocks in the study. He finds the fees for 91% of the stocks to be less than 1% per annum (mean 17 basis points) and for the rest the mean fee is 4.3% per annum. In comparison, an article in Kauppalehti (2005) states that short stock loans have become common in the Finnish market after it was made possible in 1995[19]. Half of the stocks loans are for long-term and half for short-term, which are usually used to cover delivery failures.

[18] D'Avolio (2002) also tests if dispersion in analyst forecasts, Internet and "loser" momentum stocks affect the likelihood of being special, but does not find robust evidence.

[19] Kauppalehti:
http://www.kauppalehti.fi/5/i/talous/uutiset/avoinarkisto/index.jsp?xid=1294694&date=2005/01/19

The borrowing fees are stabilized to below 100 basis points level, and in most popular stocks to even below 50 basis points level.

A professional working in the stock lending business confirms that also in Finland the fee to borrow stocks is usually between 10 and 25 basis points. The rate is dependent on the supply and demand for borrowing stocks. When there is sufficient supply of a particular stock (e.g. Nokia) the rate is between the ranges previously mentioned. But when the supply is low, the fees can rise quickly to 200 basis points. These fees are without perceptions of market participants, thus when there is down pressure on stock's value, the demand for borrowing that stock is higher and also the fee increases. In order to give another example of the stock borrowing costs in the Finnish market, Nordet, a bank offering short selling and stock borrowing to its customers, states in their website that the base fee for borrowing stock is 3% per annum plus EUR 30 fixed cost per stock loan[20]. They also state that the fee is subjective to market conditions. The collateral required to borrow is between 120% and 150% of the value of borrowed stocks.

As a conclusion, I argue that the stock loan markets in the U.S. and Finland have sufficiently similar characteristics in order to use D'Avolio's findings of stock specialness in the study presented in the following sections.

4 Hypotheses

This paper follows the studies by Evans et al. (2009) and Boni (2006) regarding settlement failures, and utilizes the study by D'Avolio (2002) of the stock loan market. In this section the hypotheses for the study are developed based on the existing literature.

Evans et al. (2009) introduce the idea of short sellers intentionally failing deliveries in hard-to-borrow situations. They suggest that failures-to-deliver are equal to zero-fee, zero-rebate loans. The expected cost of buy-in procedure or penalties for failing-to-deliver also affect the price of failing, but as presented in Section 2.4.4, these events happen extremely rarely and

[20]Nordnet: https://www.nordnet.fi/palvelut-ja-tuotteet/sijoittamisen-tukena/luotot.html#lyhyeksimyynti

thus the expected costs can be estimated to be zero. Thus when failing is cheaper than borrowing, short seller chooses to fail. The authors find evidence that option market makers, which are exempt from the locate requirement when short selling in the U.S., indeed choose failing over borrowing in hard-to-borrow situations. Boni (2006) continues on the same topic, finding evidence that equity market makers, also exempt from the locate requirement, fail-to-deliver when borrowing costs are high.

Based on these studies, a short seller has the following options: either he can execute the short sale traditionally and borrow the stock before shorting, or he can choose not to borrow and choose not to deliver on time. This decision depends on the cost and difficulty of borrowing. As described in Section 3, usually borrowing equity is relatively cheap, easy to locate, and short seller receives rebate for the collateral. Thus short seller assumedly chooses to borrow. But if the stock being shorted is hard-to-borrow, a short seller chooses not to borrow but fail-to-deliver, as it is equivalent to zero-fee, zero-rebate loan.

It is difficult to know for certain which trades are intentionally failed-to-deliver and which due to other unintentional issues. However, I argue along with Boni (2006) that the longer the failures persist, the more likely it is that the failure is intentional. I also acknowledge that concentrating only to failures with long duration underestimates the possibility of intentional failures with short duration. Therefore I will execute my study with different magnitudes of failures, so that it can be seen how the duration of failures affects the results.

As there is no regulation in the Finnish market to borrow or locate stock before short selling during the time period of my study, I suggest that all market participants in the Finnish market can execute intentional failures-to-deliver, when willing to do so. Therefore the findings by Evans et al. (2009) and Boni (2006) of market makers failing deliveries intentionally in hard-to-borrow situations should hold for all market participants in the Finnish market.

In order to test the relation between failures-to-deliver and cost of borrowing equity, it is important to identify which stocks are hard-to-borrow. As I do not have direct stock loan fee information in general, nor the information what kind of stock loan agreement the market participant in my study has, I have to use proxies to identify the specialness of the stock.

D'Avolio (2002) studies the equity loan market and the specialness, i.e. cost of borrowing stock. He argues that factors indicating supply of stocks and divergence of opinion should have relation with the specialness of a stock. The author finds high market capitalization and institutional ownership to decrease the likelihood of stock being special. The likelihood increases with high turnover, high message board activity, high price-to-book ratio and low cash flows. In the absence of empirical evidence from the Finnish market, I suggest that the findings of D'Avolio also hold in the Finnish market.

To conclude, I suggest that the relation between likelihood of failures-to-deliver and the proxies provided above is similar with the proxies and the likelihood of a stock being special.

Based on the earlier mentioned studies, the hypotheses are:

Hypothesis 1. High market capitalization decreases the likelihood of failures-to-deliver.

Hypothesis 2. High institutional ownership decreases the likelihood of failures-to-deliver.

Hypothesis 3. High turnover increases the likelihood of failures-to-deliver.

Hypothesis 4. Low cash flow increases the likelihood of failures-to-deliver.

Hypothesis 5. High price-to-book ratio increases the likelihood of failures-to-deliver.

Hypothesis 6. High message board activity increases the likelihood of failures-to-deliver.

5 Data and methodology

5.1 Data description

The essence of this thesis is the unique set of data being studied. Although this thesis follows the study by Boni (2006) closely, I must emphasize the differences between the data used in his study and in this thesis. The data provided by the NSCC and used in the study by Boni (2006) is for three separate dates during 2003 and 2004, including failures-to-deliver for all U.S. stocks. The data includes the total failures of each clearing firm for each equity issue

with the failure position age in days. The advantage of Boni's (2006) data is the comprehensive coverage of all U.S. stocks, but it has also some shortcomings.

Firstly, as the failures are only divided by each clearing firm, it is impossible to say how many trades of single broker-dealers, market makers or customers are aggregated to the ultimate failure amount per stock per clearing firm. This causes a problem, when observing the age of the aggregated failures, as the age is the maximum consecutive number of days of a single stock of a single clearing firm has. This number may include several trades with several different durations of failures. Therefore it is impossible to observe the exact ages of failures from Boni's (2006) data. As the age of the failures is the definition of strategic failures-to-deliver, the data used by Boni might not give as inclusive picture of the persisting failures. There is a risk a single strategic failure-to-deliver that has lasted long "marks" the other failures-to-deliver also as strategic, although these other failures would not fulfill the criteria of being strategic.

Secondly, as the data is provided for only three separate dates, it is impossible to say what is the true settlement duration of the trades. Boni's (2006) data gives only a snap shot of the failures-to-deliver situation on those three separate dates, but the failures on those dates can persist for even longer. Therefore the data used in Boni's study might underestimate the duration of the failures.

As the data used in this thesis is trade specific, I can observe the precise age of all trades. Although this study does not cover the whole Finnish market, as Boni's (2006) study does for the U.S. market, the advantage of this study is the inclusiveness of the data. As the trades are not aggregated, the data does not have the same problem of indicating only the maximum duration of failures. Also, as the exact settlement dates are provided per trade and the time period under study is continuous, the data used in this thesis is not only a snapshot of the failure situation.

The result from the more precise data can be that the average duration of failures decreases compared to previous studies, as the aggregation of failures does not affect the study and if the marking of shorter failures by longer failures has been significant. The average duration of

failures can also increase, if the snap shot methodology has underestimated the true duration of failures.

5.1.1 Trade level data

The data consists of all OTC stock trades made by a single remote broker in the Finnish market between January 1st and June 30th 2012. All stocks are listed in the OMX NASDAQ Helsinki stock exchange. For each trade, the following details are provided:

- Trade date and settlement date
- Buy or sell
- ISIN code
- Quantity of shares
- Unit price
- Total value of trade
- Counterparty identification
- Market place
- Number of days to settle

All the above details regarding settlement are obtained directly from the broker's custodian bank. The data includes 9,449 trades, of which 4,845 are purchases (51%) and 4,604 are deliveries (49%). The average quantity of a single transaction is 100,196 shares and the average total value of a trade is 353,333 euros. In comparison, the average value of an OTC trade in the Finnish market between January and June 2012 is 40,697 euros[21]. Thus the broker observed in the sample made larger deals than on average. The number of different stocks being traded is 58, thus the market participant under study traded on approximately half of the stocks listed on the NASDAQ OMX Helsinki. Table 1 illustrates the details of the data.

[21] Calculated from the data presented in Section 2.4.3. in Fig. 5 and Fig. 6.

Table 1: Descriptive statistics of trade level data

This table presents descriptive statistics of the trade level data. The data consists of all OTC trades made by a remote broker in the Finnish market between January and June 2012. Statistics are provided for all trades and separately for purchases and deliveries.

	Purchases	Deliveries	All
Number of trades	4,845	4,604	9,449
Average quantity of a trade	97,749	102,771	100,196
Average total value of a trade, EUR	352,235	354,487	353,333
Number of securities being traded	58	58	58
Average number of days to settle	2.90	2.94	2.92

As can be seen from Table 1, the details of deliveries and purchases are quite similar. This refers to so called "in-and-out" trading strategy, but that is not in the focus of this study. Rest of the thesis focuses on the deliveries and delivery failures, but it is also informative to see the details of the purchase side of the trades.

The following figure illustrates how the number of stocks traded and the total value of trades develops during the time period under study. The values are based on settlement dates.

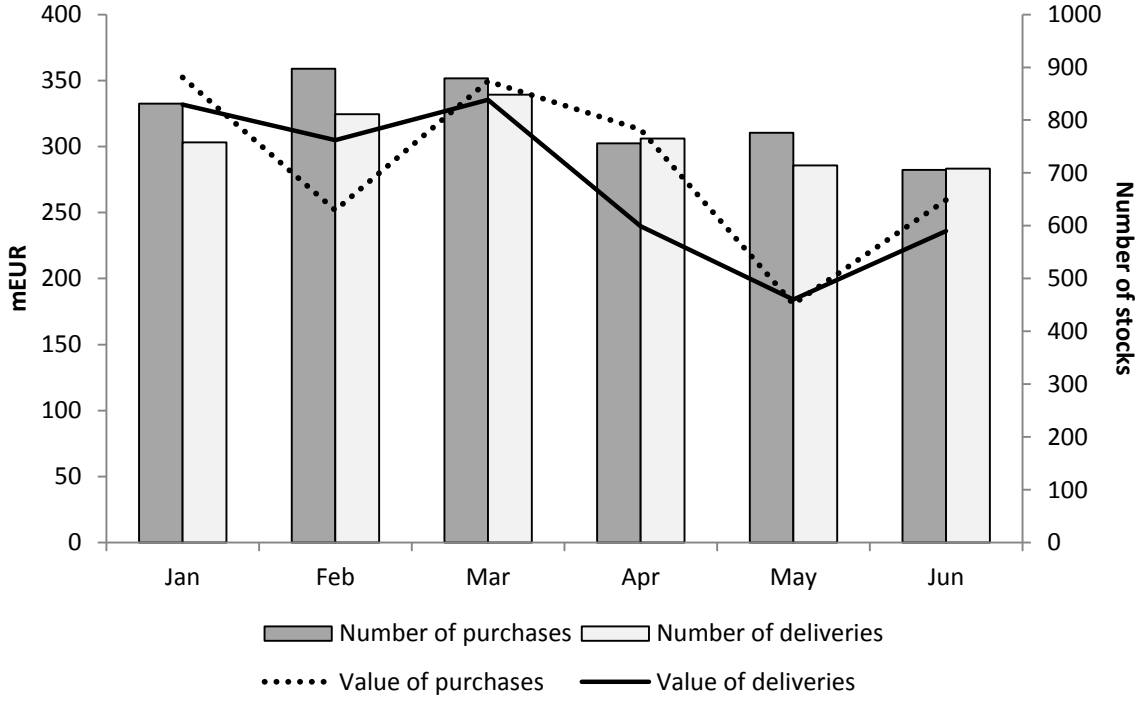

Figure 7: Number of stocks traded and value of trades in the original data sample

This figure illustrates the number and value of trades in the original data sample. The data consists of all OTC trades made by a remote broker in the Finnish market between January and June 2012. Bars indicate how many stocks are purchased and delivered in a month. The dotted line presents the total value of purchases made in a month, and the solid line the total value of deliveries in a month.

As can be seen in Fig. 7, the number of trades does not vary substantially during the six month period. March has the highest number of trades, as it is the case for the whole Finnish market presented in Section 2.4.3. Highest value of trades is also in March, which is as well in line with the whole Finnish market. The lowest total value of trades is in May. The increase in value of trades in June is not in line with the rest of the market, as June is the lowest point for the market. However, Fig. 7 shows that the sample data is in general consistent with the whole Finnish market during the observed time period.

The difference in number of purchases and deliveries is not significant during the time period. There is however variation in the value of trades during the time period, March being the peak month. There is also significant difference in the value of deliveries and purchases in February and April, value of deliveries being under the level of purchases in February and over the level in April. This could be due to some market conditions being more favourable to buy-side in February and to sell-side in April.

5.1.2 Independent variable data

In order to execute study presented in Section 6, I obtain stock specific data as independent variables for the regressions. The variables are based on D'Avolio's (2002) study and introduced in more detail in Section 3.3. As comparison, Boni (2006) uses also IPO dummy variable in her study, but it was excluded from this study as there were no IPOs in the Finnish market in 2011[22]. I collect the following data for each trade:

- Market capitalization of the stock being traded
- Monthly turnover of the stock divided by shares outstanding
- Cash flow divided by assets
- Price-to-book
- Internet message board activity
- Institutional ownership proportion of outstanding shares

The following table describes in more detail the independent variables.

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[22] Finnish Foundation for share promotion: http://www.porssisaatio.fi/blog/statistics/listautumiset-pohjoismaissa-viimevuosina/

Table 2: Descriptive statistics of independent variable data

This table presents descriptive statistics of independent variable data. The data consists of stock specific factors collected for each trade in the trade level data. Market capitalization, turnover, cash flow and price-to-book data are from Thomson One Banker database, institutional ownership data are from Orbis database and Internet message board activity is collected from Kauppalehti's Internet message board. Market capitalization is calculated by multiplying the share price on trade date by the number shares outstanding. Institutional ownership is the proportion of institutional owners of the outstanding shares. Turnover is the monthly sum of daily trading volume for one month preceding the trade date divided by shares outstanding. Cash flow is the yearly cash flow of the issuing firm for the ongoing year by trade date divided by average of previous and current year's total assets. Price-to-book is calculated by using the price of the share on trade date and the last quarterly reported book value of the company. Internet message board activity is the number of threads containing reference to a specific stock.

Variable	Mean	Median	Max	Min
Market cap (mEUR)	6,092.6	3,184.4	23,829.8	16.2
Institutional ownership	48.19%	45.57%	94.78%	3.36%
Turnover	10.70%	9.13%	34.66%	0.01%
Cash flow	5.50%	6.43%	30.87%	-5.65%
Price-to-book	2.42	1.41	29.78	0.36
Internet message board activity	32	29	63	0

Market capitalization, trading volume, cash flow and price-to-book information is collected by using the Thomson One Banker program. Market capitalization is calculated by multiplying the share price on trade date by the number shares outstanding. Monthly turnover is the sum of daily trading volume for one month preceding the trade date divided by shares outstanding. The number of shares outstanding used to divide the monthly turnover of the stock is the number at the end of last twelve months from the trade date. Cash flow is the yearly cash flow of the issuing firm for the ongoing year by trade date divided by average of previous and current year's total assets. Price-to-book is calculated by using the price of the share on trade date and the last quarterly reported book value of the company.

Internet message board activity is suggested by D'Avolio (2002) to be an indicator of divergence in investor opinion regarding the value of stocks. The higher the activity and therefore divergence, the more expensive a stock is to borrow. D'Avolio (2002) uses a web crawler program to collect the activity in the U.S. from Yahoo Finance Internet message board. Boni (2006) does not use message board activity as a proxy in her study, as the variable is not available to her. I include the variable in this study, as it is relatively easier task to collect manually the activity in the smaller Finnish market than in the large U.S. market. The addition of the variable adds the contribution of this thesis.

Internet message board activity is collected manually from Kauppalehti's website[23], which message board has very active discussion regarding investing and stocks. Kauppalehti is one of the most popular daily newspapers in Finland focused on economy news. Therefore I consider its website to be suitable portal to collect message board activity information. The unit for activity is the number of threads containing reference to a specific stock. I don't exclude any categories of discussion, use the name of the stock as the search word and focus my search on the time period between January 1st and June 30th 2012. I use the total number of threads found by my criteria for all the trades of the specific stock. Therefore the message board activity variable is static per stock for the whole time period.

Institutional ownership data is collected manually from the Orbis database. The search criteria is for publicly listed, active, Finnish companies and I include the ownership of banks, industrial and financial companies, foundations and research institutes, mutual, pension and trust funds, and states and governments as institutional ownership. I only include direct ownership, as the total ownership figures might be overlapping with direct ownership figures. As the data from Orbis can be somewhat imprecise, I cross-check few ownership details from companies' annual report and/or website in order to verify the validity of the data.

When the trade data was cross-checked with the stock-specific independent variable data, some figures were not available in the databases and those trades were excluded from the analysis. Share turnover figures were not available for Nordea bank's (74 trades) and

[23] Kauppalehti's message board: http://keskustelu.kauppalehti.fi/5/i/keskustelu/search!default.jspa

Talvivaara's stock (17 trades). Outokumpu new shares (4 trades) and Metsä board's old shares (28 trades) lacked all the variables. Price-to-book information was not available to UPM-Kymmene's stock (177 trades). The message board activity was difficult to determine for Tieto, as the company's name as a search word generated results not related to the company (151 trades). Therefore total of 451 trades were excluded from the analysis. That is 9.8% of the original 4,604 deliveries.

5.2 Methodology

Choosing the methodology to test the hypotheses presented in Section 4, I will follow the study by Boni (2006). I use the logistic regression in order to determine how proxies for cost of borrowing stock affect the likelihood of failures-to-deliver. Logistic regression measures the relationship between a categorical dependent variable and either continuous or categorical independent variable (or several), by converting the dependent variable to probability scores. As the observed outcome of my study is binominal, as a delivery can be either successful or failed at settlement date, the logistic regression is a better method than the OLS regression. As the logistic regression is a cross-sectional study with control group (the deliveries settled on time), it gives better understanding why strategic failures happen. A time series study would be possible, but then it would be hard to identify how much of the increase of strategic failures is due to overall increasing number of failures. Therefore cross-sectional study is more explanatory.

Using different criteria for failures (different durations of failures), I will set the dependent variable as 1 if the delivery fails and as 0 if the delivery settles successfully. The use of different criteria is to make sure the study does not manipulate the results by focusing on only specific failure durations, as explained in Section 4. Boni (2006) uses four different criteria for the strategic failures-to-deliver, but they are for at least five days of continuous failures, following the criteria of Regulation SHO in the U.S. As the decision for the criteria of failures is subjective, I try to make the study as robust as possible by studying different criteria.

The independent variables introduced in the previous section and in the development of hypotheses are log of market capitalization, institutional ownership, turnover, cash flow,

price-to-book and Internet message board activity. All the independent variables are in line with the study by D'Avolio (2002), as described previously.

Logit regression estimates the likelihood of the event of delivery failure by using the following equation (Dougherty, 2007):

$$p = F(Z_i) \quad (1)$$

where Z_i is based on the following equation:

$$Z_i = \alpha + \beta_1 LogMarketCap_i + \beta_2 Turnover_i + \beta_3 CashFlow_i + \beta_4 PB_i + \beta_5 MsgBoard_i + \beta_6 InstOwner_i \quad (2)$$

where Z_i is a binary dependent variable set to 1 if the delivery fails and to 0 if the delivery settles successfully, $LogMarketCap_i$ is the log of market capitalization of stock i, $Turnover_i$ is the turnover of stock i, $CashFlow_i$ is the cash flow of stock i, PB_i is the price-to-book ratio of stock i, $MsgBoard_i$ is the Internet message board activity of stock i, and $InstOwner_i$ is the institutional ownership of stock i. All the variables are explained in more detail in Section 5.1.2.

In order to interpret the coefficients of the logit regression, I will calculate the marginal effects of the independent variables at the mean on the likelihood of delivery failure p as follows (Dougherty, 2007):

$$\mathrm{f}(Z) = \frac{e^{-Z}}{(1+e^{-Z})^2}\,\beta_i \quad (3)$$

To test the goodness of fit of the regression models, I use Hosmer-Lemeshow test and Nagelkerke's Pseudo R^2 measure. Both measures are generated by the statistical program SPSS used to perform the regressions. When Hosmer-Lemeshow test indicates that the model has significant p-value, the model does not fit the data properly. Nagelkerke's Pseudo R^2 measure is a R^2 measure for logistic regression, as normal R^2 measure is not suitable for regressions using binominal dependent variable. Pseudo R^2 can be interpreted similarly as normal R^2 as it gets values between 0 and 1, i.e. the higher the measure, the better the fit of the model.

6 Empirical results

In this section I will first present some descriptive statistics of delivery failures, and then present and analyze the results of the logistic regressions analyses.

6.1 Descriptive statistics of delivery failures

The dependent variable of this study, the delivery failures, are obtained from the data by indicating trades with settlement duration excess of three days (trades settled within three days from trade date are successful trades). I divide the failures into five different groups in order to study how the results change when only failures of certain minimum duration are included as dependent variables. The failure groups are S+1, S+2, S+3, S+5 and S+10, indicating how many days over the intended settlement date the failures lasted at minimum at that particular group. Thus S+1 group gathers all failures and the others tighten the criterion.

In order to clarify for the reader how the failures are distributed over different stocks, weekdays and months, I will present some descriptive statistics of the delivery failures. These are useful statistics to evaluate how intentional the delivery failures are, or are they due to some other factors.

Appendix 1 shows how the failures are distributed among the different stock issues being traded over the time period. As can be seen in the table, 26 stocks (44.8%) do not have any failures. For comparison, Boni (2006) finds only 19.7% of listed stocks not having any failures in the U.S. When the failure criterion is tightened, even fewer stocks have failures. Only ten stock issues (17.2%) have failures lasting five days or more, and only five stocks (8.6%) have failures lasting 10 days or more. Boni (2006) finds in the U.S. 33.6% of all listed stocks having failures lasting five days and 25.2% of listed stocks having failures of ten days[24]. These findings suggest that in the Finnish market significantly fewer stocks have failures compared to the U.S. market. The reason can be some regulatory or macro level differences between Finnish and U.S. markets. One reason can be that the U.S. stock loan market is not as efficient as in the Finnish market in preventing delivery failures. It is hard to

[24] Numbers derived from Fig.1. in Boni's (2006) study on page 9.

give any explicit reason for the difference, and it has to be taken into account that Boni's (2006) study covers the whole U.S. market as this study utilizes trading data of a single broker in the Finnish market.

When viewing failures lasting a day or more, Konecranes and Outotec have the highest absolute number of failures-to-deliver. Ericsson B and Raisio V that have been traded only few times have the highest failure levels, 25% and 20%, respectively. 11 stocks have failure levels above ten percent. The failures are not concentrated to certain industries. When looking at failures lasting five days or more, Technopolis and Outokumpu have the highest level of failures (3.57% and 3.06% respectively). All the above findings suggest that the failures are concentrated to few stocks and that some underlying stock specific factors drive the failure levels.

As can be seen in the bottom row of Appendix 1, the number of delivery failures decreases rapidly when the criteria defining delivery failures is tightened. That alone is an interesting result, as it suggests that delivery failures are not as persistent in the Finnish market as in the U.S. The rate of successful settlements is 94.17%, which is below the average rate in Finnish market presented in Section 2.4.3[25]. Therefore the broker in this study is slightly more prone to fail deliveries than on average. The data used in this study shows only 0.4% of all deliveries having failures of at least 5 days. Fig. 8 illustrates graphically how the amount of delivery failures drops when the duration of failures increases.

[25] Average rate of successful settlements during December 2009 to June 2012 is 99.43 % for Small Cap and warrant trades cleared in OM-system and 96.10 % for Large Cap and Mid Cap trades cleared in EMCF.

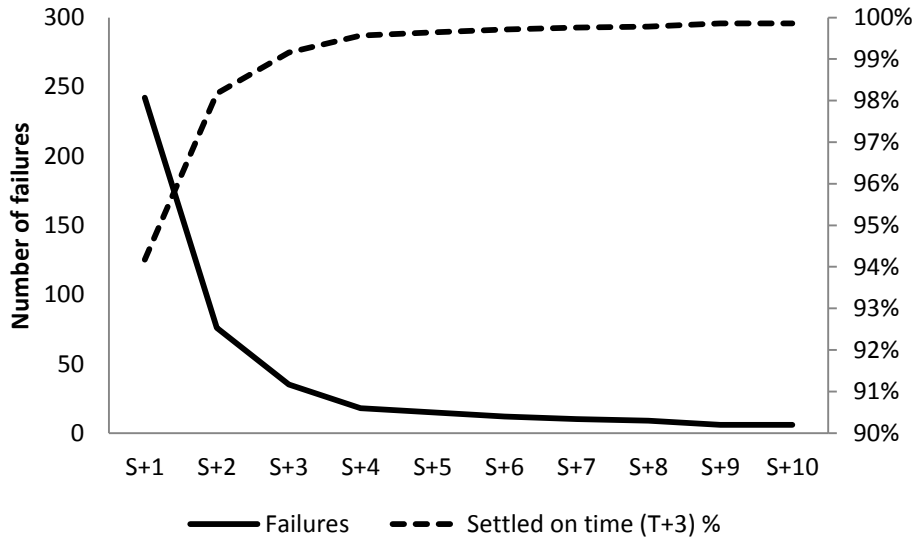

Figure 8: Number of failures and rate of deliveries settled on time

This figure presents the number of delivery failures and the rate of deliveries settled on time (T+3). The sample consists of 4153 deliveries made by a remote broker in the Finnish market between January and June 2012. The failures are divided into ten groups by the minimum duration of failures. The horizontal axis denotes the minimum duration of failures in days excess of intended settlement date S. The solid line indicates the number of delivery failures of specific failure duration. The dotted line shows the rate of deliveries settled on time (T+3) of all deliveries.

As can be seen in the above figure, after the criteria for failure exceeds three days, the level of failures drops and stays low substantially. The suggestion is that in the Finnish market the delivery failures are only persistent up to three days and longer failures are quite abnormal. This indicates that Finnish market does not suffer from long, persistent failures but from short-term failures.

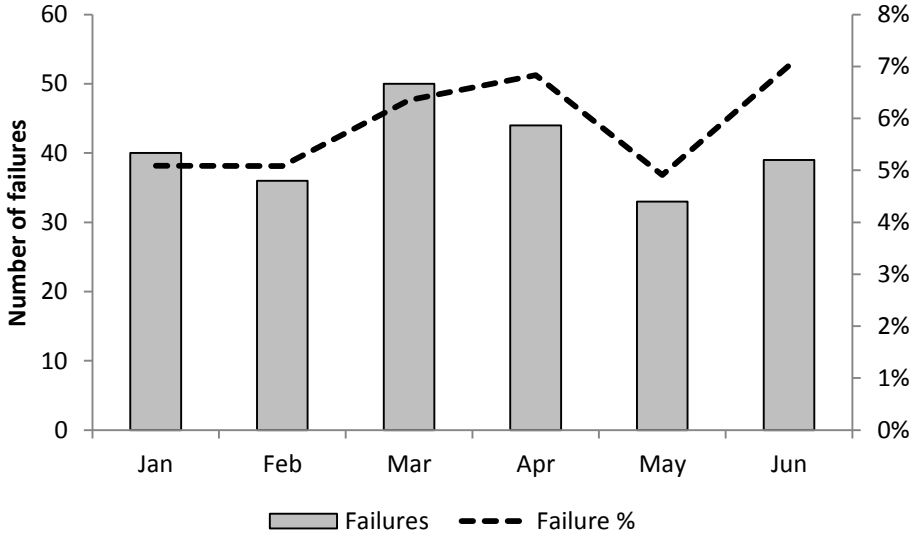

Figure 9: Monthly distribution of delivery failures

This figure presents the monthly distribution of delivery failures and the rate of delivery failures of all deliveries in a month. The sample consists of 4153 deliveries made by a remote broker in the Finnish market between January and June 2012. The bars indicate the number of delivery failures in a month. The dotted line shows the rate of deliveries failed to settle on time of all deliveries in a month. Failure duration criterion is failing of at least one day.

The above figure shows how the number of failing deliveries and the failure level distributes between the six month period under study. All failures are included in the figure. As can be seen in Fig. 9 the highest amount of failures is in March and the lowest in May. This result follows the total number of deliveries in those months, presented in Fig. 7. The relative proportion of failures is at the highest point in June and at the lowest level in May. The high level of failures in June could indicate that the level of human errors increase in the beginning of summer. In Finland a lot of the regular workforce is replaced during summer by summer job workers, who might not be as qualified as the regular employees. As the trades are cleared and settled bilaterally in the OM-system, if either of the counterparties does not operate efficiently, it can affect the failure levels. However, the level of failures is also high in April, which is not explained by increased human errors.

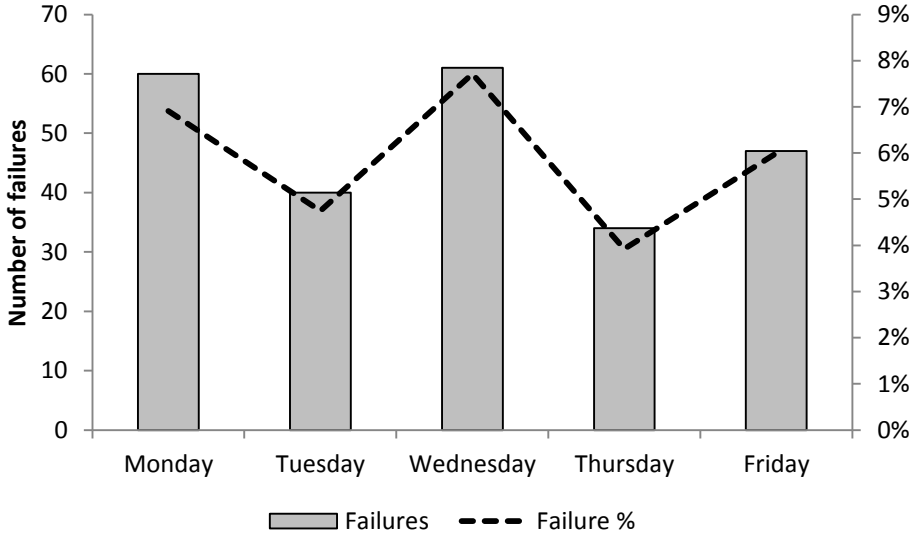

Figure 10: Weekday distribution of delivery failures

This figure presents the weekday distribution of delivery failures and the rate of delivery failures of all deliveries in a weekday. The sample consists of 4153 deliveries made by a remote broker in the Finnish market between January and June 2012. The bars indicate the number of delivery failures for each weekday. The dotted line shows the rate of deliveries failed to settle on time of all deliveries in a specific weekday. Failure duration criterion is failing of at least one day.

The above figure presents how the number of failures and level of failures is distributed between weekdays. All failures are included in the figure. As it is difficult to indicate which failures are intentional and which due to human error and careless mistakes, it is interesting to see how failures are distributed between weekdays. It could be suggested that Mondays and Fridays are worst days for successful settlement rates, as people responsible for the processes might not perform at their best level. However, the data does not support this suggestion. Fig. 10 shows that the number and level of failures is highest on Wednesdays, Mondays being the second highest. Tuesdays and Thursdays have the lowest number and level of failures. Any concrete conclusions cannot be made from Fig. 10 as the level of failures varies a lot between weekdays.

6.2 Regression results

I perform binary logistic regression (logit) by using different durations of delivery failures as dependent variables, and stock-specific variables that indicate the specialness of a stock as independent variables, which are described in Section 5.1.2. The data is analyzed by using statistical program SPSS.

The aim of this study is to indicate if the specialness of a stock, i.e. the cost of borrowing stock affects the likelihood of failures-to-deliver. The hypotheses 1-6 presented in Section 4 indicate how the likelihood of delivery failures is anticipated to change when the independent variables change. The results of the regressions are presented in the following table.

Table 3: Logit regression results

This table presents the results of logit regression performed for the data. The trade level data consists of 4153 stock deliveries made by a remote broker in the Finnish market between January and June 2012. The independent variable data consists of stock specific factors collected for each trade in the trade level data. Market capitalization, turnover, cash flow and price-to-book data are from Thomson One Banker database, institutional ownership data are from Orbis database and Internet message board activity is collected from Kauppalehti's Internet message board. Log market capitalization is the log of stock's market cap. Market capitalization is calculated by multiplying the share price on trade date by the number shares outstanding. Institutional ownership is the proportion of institutional owners of the outstanding shares. Turnover is the monthly sum of daily trading volume for one month preceding the trade date divided by shares outstanding. Cash flow is the yearly cash flow of the issuing firm for the ongoing year by trade date divided by average of previous and current year's total assets. Price-to-book is calculated by using the price of the share on trade date and the last quarterly reported book value of the company. Internet message board activity is the number of threads containing reference to a specific stock. Panels (1) to (5) denote five different regressions: Panel (1) has all delivery failures as dependent variable, (2) has failures with duration of minimum two days, (3) minimum of three days, (4) minimum of five days and (5) minimum of ten days. For each regression is provided the coefficient, p-value (in parentheses) and marginal effect at the mean of every independent variable. Also the coefficient of constant, Hosmer-Lemeshow test score and Nagelkerke's R^2 are provided. ***, ** or * indicates that the coefficient is statistically significant at 1%, 5% or 10% level, respectively.

Independent variable	**Logit regressions**				
	(1)	(2)	(3)	(4)	(5)
Constant	-2.498	0.274	-1.827	-2.634	-12.381
Log of market capitalization	-0.264* (0,086) -1.32%	-0.597** (0,023) -11.35%	-0.389 (0.298) -0.30%	-0.250 (0.644) -0.12%	1.158 (0.199) 0.00%
Institutional ownership	0.006 (0.117) 0.03%	0.108 (0.867) 2.05%	0.007 (0.450) 0.01%	0.016 (0.992) 0.01%	-0.040 (0.207) 0.00%
Turnover	0.066*** (0,001) 0.33%	0.055*** (0,005) 1.05%	0.03 (0.293) 0.02%	0.018 (0.715) 0.01%	-0.179 (0.240) 0.00%
Cash flow	0.079*** (0,001) 0.40%	0.072*** (0,002) 1.37%	0.04 (0.234) 0.03%	0.054 (0.344) 0.03%	-0.042 (0.659) 0.00%

Table 3: Continued

Independent variable	**Logit regressions**				
	(1)	(2)	(3)	(4)	(5)
Price-to-book	0.092***	0.010	0.012	-0.472	-0.662
	(0,001)	(0.858)	(0.870)	(0.143)	(0.315)
	0.46%	0.19%	0.01%	-0.22%	0.00%
Internet message board activity	0.015***	0.009	-0.007	-0.014	-0.019
	(0,001)	(0.259)	(0.525)	(0.472)	(0.588)
	0.08%	0.17%	-0.01%	-0.01%	0.00%
Hosmer-Lemeshow test	*9.814*	*14.89*	*4.493*	*6.57*	*4.079*
	(0.278)	*(0.061)*	*(0.810)*	*(0.584)*	*(0.850)*
Nagelkerke R^2	*0.032*	*0.026*	*0.017*	*0.055*	*0.107*

Table 3 presents the coefficients, p-values and marginal effects at the mean of independent variables for each regression. The coefficient for the constant is also presented. Panels (1) to (5) show the results for different failure durations: Panel (1) has all delivery failures as dependent variable, (2) has failures with duration of minimum two days, (3) minimum of three days, (4) minimum of five days and (5) minimum of ten days. The signs of coefficients show if the relation of the independent variable is negative or positive to the dependent variable. P-value tells at which level the variable is significant. In order to interpret the coefficients, marginal effect at the mean tells how much the likelihood of delivery failure will change, when the independent variable is increased by one unit at the mean.

Results in Panels (1) to (4) support Hypothesis 1, as the coefficients of log market cap have negative relation to delivery failures with different durations. Panel (1) indicates that the marginal effect of one unit increase in log market cap decreases the likelihood of delivery failures by 1.32%, in Panel (2) by 11.35%, in Panel (3) by 0.30% and in Panel (4) by 0.12%. Therefore the strongest effect of market capitalization to the likelihood of delivery failures is for failures lasting at least two days. Panel (5) does not support Hypothesis 1, as the coefficient has positive relation to delivery failures. However, the marginal effect is less than 0.01% and therefore trivial. As only Panels (1) and (2) have statistically significant results, the results in other regressions have to be interpreted with caution. In general, market

capitalization seems to decrease the likelihood of delivery failures, which supports the argument that the supply of stock loans increases with higher market cap stocks and thus the specialness of these stocks decreases. The results are in line with Boni (2006) regarding failures lasting at least five days, but not in line regarding failures of at least ten days. However, Boni finds significant results only when observing failures with magnitude of 0.5% of outstanding shares as my regressions do not have this kind of criterion.

Hypothesis 2 has only weak support in Panel (5) and rest of the regression do not support the argument that higher institutional ownership increases the supply of stock loans, lowering the cost to borrow stock and making delivery failures less attractive. The coefficient in Panel (5) shows negative relation to delivery failures, but the marginal effect is less than 0.01%. The marginal effects in Panels (1) to (4) indicate that increase in institutional ownership actually increases the likelihood of delivery failures. This is surprising, as Boni (2006) finds institutional ownership decreasing the likelihood of failures in all of her regressions. The explanation could be that in Finland institutional owners are not as willing to lend shares as in the U.S. and therefore the supply of stock loans actually decreases when proportion of institutional owners of shares outstanding increases. This could be due to the fact that Finnish stock loan market is relatively young and institutions are not as familiar of the benefits of lending stocks as in the U.S. and thus not as active lenders as the institutions in the U.S. However, all the results in Panels (1) to (5) are statistically insignificant at conventional levels, so any solid conclusions should be made carefully.

Hypothesis 3 is supported by the results in Panels (1) to (4), as increase in turnover increases the likelihood of delivery failures. One percentage point increase in monthly turnover divided by share outstanding increases the likelihood of all failures by 0.33%, failures lasting at least two days by 1.05%, failures lasting at least three days 0.02% and failures lasting at least five days 0.01%. As in the results of market cap, the strongest effect is for failures lasting at least two days. Panel (5) does not support Hypotheses 3, as the coefficient has negative relation to delivery failures. Though, the marginal effect is less than 0.01%. Only the results in Panel (1) and (2) have explanatory power and therefore results in Panels (3) to (5) should be interpreted with caution. Generally the results indicate that increased turnover increases the cost of borrowing stock and makes failing deliveries more attractive. Results are in line with Boni (2006) regarding failures lasting at least five days, but not in line regarding failures of at least

ten days. Boni finds significant results for turnover only when observing failures with magnitude of 0.5% of outstanding shares.

Hypothesis 4 has support only from results in Panel (5) and the other regressions imply that increase in cash flow increases the likelihood of failures. The highest marginal effect is for failures lasting at least two days, being 1.37%. The marginal effect in Panel (5) is minor, being less than 0.01%. The results in Panel (1) and (2) have explanatory power, as the other results are statistically insignificant and should be interpreted carefully. The results do not support the argument that low cash flow stocks are targeted by short sellers and therefore the demand for such stock loans would increase the cost of borrowing and make failing more attractive. The reason why stocks with high cash flows are more likely to be failed can be due to higher borrowing demand for such stocks. However, findings by Houge and Loughran (2002) do not give support for this argument as high cash flow stocks are usually undervalued and therefore not a good short selling target. Thus the implications of the results regarding cash flow are inconclusive. Boni (2006) does not find statistically significant results supporting cash flow as an indicator of delivery failures and therefore our results are not analogous.

Hypothesis 5 is supported by the results in Panel (1), (2) and (3). The marginal effect of one percentage point increase in price-to-book ratio increases the likelihood of delivery failures by 0.46% in Panel (1), by 0.19% in Panel (2) and by 0.01% in Panel (3). The coefficients in Panels (4) and (5) are not supporting the argument that borrowing stocks with high pricing multiples is more costly and thus more likely to be failed, as the relation of the coefficients is negative to delivery failures. However, only in Panel (4) the marginal effect has significant magnitude, being -0.22%. Panel (1) has statistically significant results and the other regressions do not have explanatory power for price-to-book variable. In general, higher price-to-book ratio seems to increase the likelihood of short-term delivery failures, but decrease it for longer failures. The results are not in line with Boni (2006) regarding failures of at least five and ten days.

Hypothesis 6 has support in Panel (1) and (2), as the increase of one message board thread increases the likelihood of delivery failures by 0.08% for all failures and 0.17% for failures lasting at least two days. Panels (3) to (5) indicate opposite results, as the coefficients have

negative relation to delivery failures. However, the marginal effects are at minor magnitude, being at most -0.01%. Only results in Panel (1) are statistically significant. The results support the argument that increased message board activity does increase the borrowing cost of stocks and thus increase the likelihood of short-term delivery failures. Boni (2006) does not study the effect of Internet message board activity on the likelihood of delivery failures. Therefore the findings in this thesis provide new evidence on the subject and add the contribution of this thesis.

The fact that only Panels (1) and (2) have statistically significant results is most likely due to the low amount of delivery failures in the rest of the regressions. The low statistical significance has to be taken into account when estimating the robustness of the results. Marginal effects in Panel (5) being all less than 0.01% is most probably also due to the low amount of failures lasting ten days or more. However, the low amount of long-term delivery failures as such is an illustrating result of the likelihood of delivery failures in the Finnish market, as presented in the previous section.

In the bottom of Table 3 are presented the results of Hosmer-Lemeshow test and Nagelkerke's Pseudo R^2 measure for all five regression models. These measures indicate the goodness of fit of the models. The results of Hosmer-Lemeshow test indicate that all five models fit the data properly, as all test results are insignificant at 95% confidence level. However, as Hosmer-Lemeshow test is a significance test it only shows if the model fits or not. It does not estimate the extent of the fit. Therefore Pseudo R^2 results are important to analyze in order to get better understanding of the goodness of fit. Contrary to Hosmer-Lemeshow test results, all Pseudo R^2 measures indicate that all five models have poor fit, as the measure is at highest only 10.7%. Therefore the results suggest that the added value of the independent variables to the model is low. As these two measures give conflicting results, any inconclusive interpretations of the regressions' goodness of fit are hard to make, but should be taken into consideration when evaluating the robustness of the results.

To further analyze the results, I investigate how the failures are distributed as a function of the independent variables in order to see if the failures are concentrated to minimum or maximum values of the independent variables, or if the failures follow some curve. I divide the trades

into ten deciles by the value range of the independent variable. I then calculate the failure level in each of these deciles. Failures lasting at least one day are used in the figures.

The distribution figure for turnover variable is provided below. For the rest of the five variables the results are mostly inconclusive and do not give any additional insight, and therefore left out. The problems with these distributions are that some deciles do not have any failures creating sudden drops in the figures, and the failure levels change distantly making no clear distribution curve. The fact that the failure levels do not distribute nicely between the deciles or concentrate to the extreme values does not denote that the results of the regressions are misleading. But it has to be taken into consideration that the distributions of these five variables do not give any additional support for the hypotheses.

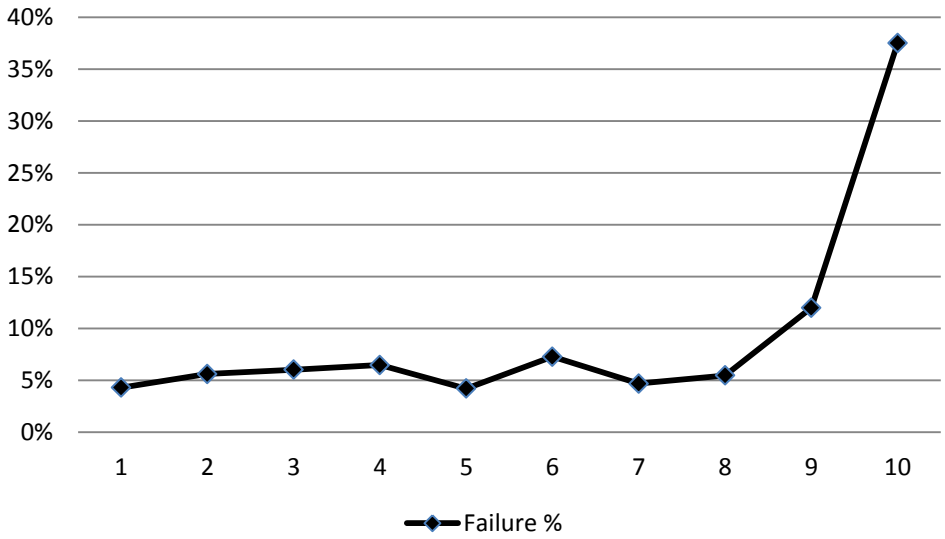

Figure 11: Distribution of delivery failure rate in relation to turnover

This figure presents distribution of delivery failures as a function of turnover. The data consists of 4153 deliveries made by a remote broker in the Finnish market between January and June 2012. Failure duration criterion is failing of at least one day. Turnover is the monthly sum of daily trading volume for one month preceding the trade date divided by shares outstanding. Turnover is divided into ten deciles over its value range. Failures are distributed to the deciles according delivery's turnover value. Failure rate is calculated by dividing all failures of each decile by the number of trades in that decile.

Fig. 11 presents the distribution of delivery failure rate in relation to turnover. As can be seen in the figure, in the nineth and tenth decile the level of failures jumps rapidly. This is in line with the hypothesis that increase in turnover increases the likelihood of failures. At the highest level of turnover the portion of failures is 37,5%. That is significantly higher than on

low levels of turnover, which failure levels are quite static and stay at 5 percent level. This suggests that turnover is an important factor affecting the likelihood of failures and gives strong support for Hypothesis 3.

To summarize, Hypothesis 1, 3, 5 and 6 are supported by the results at some level, indicating that cost of borrowing does affect the likelihood of delivery failures. The results are most robust in regressions, where the dependent variable delivery failure is short-term. This is most likely due to the small number of long-term delivery failures. The results do not support Hypothesis 2, which indicates that institutional ownership can have a negative relation to supply of stock loans in the Finnish market or the variable does not proxie stock loan supply properly. As well, the results do not support Hypothesis 4, which is in line with previous study by Boni (2006). Increase in cash flow seems to have positive relation to delivery failures, which is not explained by the existing theory. The distribution of failures as a function of turnover gives support for Hypothesis 3, as failure level rises rapidly in the highest deciles of turnover.

7 Conclusion

The focus of this thesis is to study delivery failures at trade level in the Finnish market in order to get better insight which factors affect the likelihood of failing. This thesis utilizes trade level data of OTC trades made in the Finnish market by a remote broker in a six month period in 2012. Previous studies made regarding settlement failures are done by utilizing aggregated data, which has its shortcoming compared to trade level data. Therefore the results of this thesis should give more robust evidence on delivery failures.

This thesis also tries to contribute to the scarce existing academic literature regarding clearing and settlement, and give better understanding for the reader what are the post-trade processes concerning stock trades and how they differ in different markets. The clearing and settlement system in the U.S. is highly centralized, as European system consists of multiple fragmented systems. However, many projects to make the European system more efficient are on the way, and the industry faces many changes in the following years. The Finnish system consists of parallel interfaces that are used for different types of stock trades, which adds the complexity of the clearing and settlement process.

The results show that delivery failures are mostly short-term in the Finnish market, lasting one to three days. This tells that the Finnish clearing and settlement process works relatively well, as longer average failure durations would indicate that there are more serious problems with the clearing and settlement processes used. These short-term failures can be due to human errors, operational problems or intentional behavior. As Boni (2006) argues, the longer the failures, the more likely they are intentional as failures caused by other reasons are fixed quickly. However, as there are only few long-term failures in the sample data I assume that intentional failures can also be short-term and the same reasons can affect the likelihood of both short-term and long-term failures.

The results also show that the delivery failures concentrate on few stock issues. Stock issues not having any failures represent 44.8% of stocks being traded in the sample and only 17.2% of the stock issues have failures lasting at least five days. This implies that some stock specific factor determines the likelihood of failures. The idea suggested by Boni (2006) and Evans et. al (2009) is that stock borrowing cost affects the behavior of the short seller. If the stock being shorted is expensive or impossible to borrow due to low supply or high demand of stock loans, the short seller can choose to fail the delivery.

When short seller chooses not to borrow stocks at the time of trade (i.e. a naked short sale), the short seller has two options at the time of delivery. He can borrow the stocks and ensure successful delivery to the buyer, or he can fail-to-deliver. The decision is made by comparing the cost of borrowing stocks and failing. Normally the stocks are easy to borrow, the fees are at low level and in addition the borrower receives rebate for the collateral, resulting in extra income if the rebate rate is higher than the fee. Thus short seller is assumed to borrow the stocks in most cases. However, when the cost of borrowing is high, the incentive to fail the delivery increases. The cost of failing is practically zero, as the possible costs related to forced buy-in procedure or failure fees are only due when the buyer demands it. This almost never happens, thus making delivery failure equivalent to zero-fee, zero-rebate stock loan. D'Avolio (2002) suggests that cost of borrowing increases when the supply of stock loans decreases and demand increases. This thesis studies how the likelihood of delivery failures changes when the proxies for supply and demand of stock loans change.

The results show that when the supply of stock loans increases, proxied by market capitalization, the likelihood of delivery failures decreases. The largest marginal effect is for failures lasting at least two days, being -11.35% at the mean. The results also indicate that when demand for stock loans increase, proxied by turnover, price-to-book and Internet message board activity, the likelihood of short-term delivery failures increases. The results are most robust for delivery failures lasting at least one or two days. The results do not give support for institutional ownership and cash flow variables, indicating that these variables may not have the suggested relationship to cost of borrowing in the Finnish market.

As the cost of borrowing seems to significantly affect the likelihood of failures, regulators and market participants should take this into consideration when trying to affect the timely delivery of stocks. Effective stock loan market that provides low fees, sufficient supply and easy access for all investors operating in the market is essential when trying to tackle the problem with delivery failures. When the stock loan market works efficiently, short sellers do not have the incentive to fail their deliveries. If short sellers can borrow stock at reasonable rates, buyers receive their stocks more often on time, and in addition stock lenders receive extra return for their passive portfolios, it is a win-win situation for all players in the market.

The key element in enhancing the stock loan market would be to increase the supply. As the results show, the highest negative marginal effect on the likelihood of delivery failures is market capitalization, proxy for stock loan supply. As the Finnish market and the listed companies are relatively small, naturally the possible amount of stock loans is also relatively small. In addition as the ownership is somewhat concentrated in Finland and family ownership still prevails in many of the companies, liquidity can be a serious issue for some of the stocks. I encourage market participants and regulators to find solutions to the problems. If the problem of delivery failures could be tackled, the confidence of investors in the financial market would increase and the financial environment would became more stable. I argue that in the current events of financial crises all over the world this kind of development would be warmly welcomed.

7.1 Suggestions for future research

During the time period of my sample there was no prohibition on naked short selling in Finland. I suggest for further research to study how the new Short Selling Regulation set by the European Parliament and the Council to ban naked short selling affects the level of delivery failures. The regulation entered into force on November 1st 2012 and thereafter short sellers are obligated to borrow, agree to borrow or otherwise ensure the timely delivery of the stocks sold short. However, how the short sellers behave under the new regulation would be interesting topic to study, as there is always resistance to new rules when sources of profit are limited by market regulators. I argue that although the new regulation prohibits naked short selling, it will not remove entirely naked short sales from the market. Regulators most likely have a hard time overseeing that all market participants follow the new regulation accordingly.

Another interesting topic to study would be the fact that buyers almost never use the tools they have to discipline the sellers not delivering on time. The market rules allow fees to be collected from the sellers if they do not deliver on time, when the buyer demands for it. If buyers would use this tool more often, the expected cost of fail-to-deliver would increase, thus making failing less appealing. Boni (2006) finds evidence in the U.S. market that buyers allow others to fail deliveries to them as they have failures to others as well. Thus penalties are not demanded as then others would more probably demand penalties from them too. I suggest that this topic would be studied more closely and also in European or Finnish context, as the goodwill among market participants can be even higher in smaller and more concentrated markets like Finland.

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Appendix

Appendix 1: Distribution of delivery failures by stock

This table presents the distribution of delivery failures by stock. The data consists of 4153 deliveries made by a remote broker in the Finnish market between January and June 2012. Fifty eight different stock issues are traded in the sample period. The table presents the failures of different durations by dividing the failures into ten groups. Columns 3 to 12 indicate how many days excess of intended settlement date S the failures have lasted. For each stock issue the number of failures and failure rate is provided. Failure rate is calculated by dividing the number of failures by the total number of trades of that stock.

Stock	Number of deliveries	Delivery failures									
		S+1	S+2	S+3	S+4	S+5	S+6	S+7	S+8	S+9	S+10
Ahlström	1	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Amer Sports	134	6	4	4	2	2	1	0	0	0	0
		4.48%	2.99%	2.99%	1.49%	1.49%	0.75%	0.00%	0.00%	0.00%	0.00%
Basware	1	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Cargotec	43	4	0	0	0	0	0	0	0	0	0
		9.30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Citycon	16	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Comptel	10	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Cramo	6	1	0	0	0	0	0	0	0	0	0
		16.67%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Elektrobit	7	1	0	0	0	0	0	0	0	0	0
		14.29%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Elisa	160	4	1	1	1	1	1	1	1	1	1
		2.50%	0.63%	0.63%	0.63%	0.63%	0.63%	0.63%	0.63%	0.63%	0.63%
Ericsson B	5	1	1	0	0	0	0	0	0	0	0
		20.00%	20.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Appendix 1: Continued

Stock	Number of deliveries	Delivery failures									
		S+1	S+2	S+3	S+4	S+5	S+6	S+7	S+8	S+9	S+10
Finnair	1	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Finnlines	5	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
F-secure	14	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Fortum	188	2	1	1	1	1	1	1	1	1	1
		1.06%	0.53%	0.53%	0.53%	0.53%	0.53%	0.53%	0.53%	0.53%	0.53%
Huhtamäki	26	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Konecranes	163	26	7	2	0	0	0	0	0	0	0
		15.95%	4.29%	1.23%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Kesko B	128	2	1	1	1	1	1	1	1	1	1
		1.56%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%
Kone B	194	20	3	2	0	0	0	0	0	0	0
		10.31%	1.55%	1.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Kemira	142	12	4	3	2	1	0	0	0	0	0
		8.45%	2.82%	2.11%	1.41%	0.70%	0.00%	0.00%	0.00%	0.00%	0.00%
Lassila & Tikanoja	2	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Martela A	2	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Metso	183	7	3	2	2	2	1	1	0	0	0
		3.83%	1.64%	1.09%	1.09%	1.09%	0.55%	0.55%	0.00%	0.00%	0.00%
Metsä Board	17	1	0	0	0	0	0	0	0	0	0
		5.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Neste Oil	170	2	1	0	0	0	0	0	0	0	0
		1.18%	0.59%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Appendix 1: Continued

Stock	Number of deliveries	Delivery failures									
		S+1	S+2	S+3	S+4	S+5	S+6	S+7	S+8	S+9	S+10
Nokia	779	22	5	2	1	0	0	0	0	0	0
		2.82%	0.64%	0.26%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Nokian Renkaat	155	6	0	0	0	0	0	0	0	0	0
		3.87%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Oriola-KD B	2	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Orion A	1	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Orion B	130	1	1	1	0	0	0	0	0	0	0
		0.77%	0.77%	0.77%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Outokumpu	98	10	6	4	4	3	3	3	3	0	0
		10.20%	6.12%	4.08%	4.08%	3.06%	3.06%	3.06%	3.06%	0.00%	0.00%
Outotec	161	26	6	2	0	0	0	0	0	0	0
		16.15%	3.73%	1.24%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Pohjola Pankki	129	5	0	0	0	0	0	0	0	0	0
		3.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Pöyry	2	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Raisio V	4	1	0	0	0	0	0	0	0	0	0
		25.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Ramirent	5	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Rautaruukki	70	5	3	1	0	0	0	0	0	0	0
		7.14%	4.29%	1.43%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Revenio Group	1	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Ruukki Group	3	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Appendix 1: Continued

Stock	Number of deliveries	Delivery failures									
		S+1	S+2	S+3	S+4	S+5	S+6	S+7	S+8	S+9	S+10
Sampo A	186	12	6	3	2	2	2	2	2	2	2
		6.45%	3.23%	1.61%	1.08%	1.08%	1.08%	1.08%	1.08%	1.08%	1.08%
Sanoma	124	6	2	1	0	0	0	0	0	0	0
		4.84%	1.61%	0.81%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Sponda	22	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Stockmann B	4	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Stonesoft	7	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Stora Enso A	1	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Stora Enso B	189	5	2	1	1	1	1	1	1	1	1
		2.65%	1.06%	0.53%	0.53%	0.53%	0.53%	0.53%	0.53%	0.53%	0.53%
Technopolis	28	5	4	2	1	1	1	0	0	0	0
		17.86%	14.29%	7.14%	3.57%	3.57%	3.57%	0.00%	0.00%	0.00%	0.00%
Teleste	1	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Teliasonera	116	20	3	1	0	0	0	0	0	0	0
		17.24%	2.59%	0.86%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Tikkurila	3	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Talentum	1	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Tulikivi A	2	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Uponor	18	1	1	0	0	0	0	0	0	0	0
		5.56%	5.56%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Appendix 1: Continues

Stock	Number of deliveries	Delivery failures									
		S+1	S+2	S+3	S+4	S+5	S+6	S+7	S+8	S+9	S+10
Vacon	1	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Vaisala	1	0	0	0	0	0	0	0	0	0	0
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Wärtsilä	155	9	3	1	0	0	0	0	0	0	0
		5.81%	1.94%	0.65%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
YIT	136	19	8	0	0	0	0	0	0	0	0
		13.97%	5.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Total	**4153**	**242**	**76**	**35**	**18**	**15**	**12**	**10**	**9**	**6**	**6**