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Bachelor Thesis

EXPLAINING EQUITY LIQUIDITY ON THE BALTIC STOCK MARKETS: ROLE OF TRADITIONAL AND NOVEL DETERMINANTS

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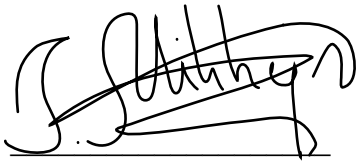

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Abstract

This paper explores the notion of liquidity on the Baltic Markets. Commonly they are perceived as being not perfectly liquid; thus, liquidity costs associated with transacting process exist and generally are large in magnitude. We explore factors that have impact on liquidity costs. We consider two sets of determinants for explaining equity liquidity on the Baltic Market – traditional, variables that have been proven to affect liquidity on developed and developing markets, and novel determinants, variables that have not been researched intensively and have been tested on a small number of markets. We find statistically significant relationships between equity liquidity and all traditional determinants (except for a proxy for size of the company). Presence of novel determinants is weak, which we believe can be attributed to emerging nature of the market. Given high potential for development of the market, this paper has several direct implications for enhancement of trading activity from perspectives of different agents: the stock exchange operator, traders, management of issuing companies and investors.

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1 Introduction

It is widely acknowledged that a properly functioning stock market is one of the cornerstones in the foundation of a prospering economy. Stock markets ensure current functionality of the system, as well as provide necessary tools for future development (e.g. by providing required for future growth opportunities for saving and investing). Therefore, it is of high importance to ensure proper functionality of a stock market.

The Baltic Stock markets, which are by definition emerging markets, have evolved a lot in the past years and have also experienced a dramatic improvement with respect to market microstructure (Adamson & Backemar, 2006). However, there is still a long way ahead; the operator of three local exchanges (Tallinn, Riga and Vilnius Stock Exchanges), NASDAQ OMX Group, admits that some issues have not yet been completely addressed: it is believed that liquidity of the markets needs to be enhanced in order to increase their attractiveness for both domestic and foreign investors (NASDAQ OMX Baltic, 2012a).

Generally, liquidity is a complex concept. Although many efforts have been made to provide a precise definition the concept still remains to be better interpreted on intuitive rather than formal level. One of the most accurate definitions is provided in Neuman (1936) - "liquidity indicates the quality held by assets of being transformable into money without loss at some given moment of time".

Presence of sufficient level of liquidity on the market is important, as otherwise lack of liquidity becomes a form of friction (Stoll, 2000) which can diminish activity on the market and have adverse effects on asset values (Amihud & Mendelson, 1986). In an extreme case highly liquid assets are traded with no price impact and assets with very low liquidity almost cannot be traded (Breen, Hodrick, & Korajczyk, 2002). Furthermore, importance of accounting for liquidity is enhanced by Bekaert, Harvey and Lundblad (2007) who show that models which incorporate liquidity outperform those based on market risk solely in predicting future returns.

All things considered, it is difficult to underrate significance of liquidity – exploring it is critical from both scientific and practical perspectives (Chordia, Shivakumar & Subrahmanyam, 2004). Therefore, it is of great interest and applicability to understand what factors influence stock liquidity. Establishing exact relationships between liquidity and its determinants improves pricing (Alzahrani, 2011). Moreover, since liquidity is proven to influence corporate policy (Amihud & Mendelson, 1986) and thus capital structure (Weston, Butler, & Grullon, 2005), knowing its determinants makes valuations of a companies more

precise. Overall, having a clear model for explaining stock's liquidity provides a number of benefits in different fields of modern Financial Economics.

1.1 Research Question

As it is argued above, liquidity plays a critical role on capital markets. Thus, the authors are convinced that the understanding of its determinants provides additional theoretic and practical insights. Taking into consideration the current state of the Baltic Stock Markets, namely process of gradual development, it is important to establish **which traditional factors, as well as those discovered in more recent research, have explanatory power over liquidity of equity traded on the Baltic Stock Exchanges.** Similar research has been already conducted (Kokoškins & Baumanis, 2001). However, it studies the effect of Russian crisis of 1998 on only 14 stocks listed on Riga and Tallinn Stock Exchanges. Hence, this paper contributes to existing literature by expanding its focus to all three Baltic stock markets as well as by relying on larger sample. It also investigates effects of greater number of determinants of liquidity. In addition, in the past decade the Baltic markets have evolved substantially, and thus, this research provides more insights into current situation as it is based on up-to-date data.

Apart from the direct goal of providing additional insights into the microstructure of the Baltic Markets, this study has also implications for asset pricing. Establishing which of the known liquidity determinants work on the Baltic Markets provides investors tools for forming expectations about future liquidity and, since liquidity is connected to corporate policy, it is therefore possible to make conclusions about future cost of capital and hence returns on assets. Furthermore, there are also trading implications – when determinants are known, any change in them is expected to cause a consequent change in trading costs (liquidity cost component in them); therefore, insights provided in this paper are also applicable for optimizing trading strategies.

The paper is structured as follows. Section 2 describes the theoretical setting required for proper understanding of liquidity and its components. Section 3 covers previous research in the area. Section 4 explains the methodology of the study and Section 5 presents the results. Section 6 describes the implications of the research. Last section concludes.

2 Theoretical Background

This section provides a theoretical setting for researching liquidity in general, as well as its determinants in particular. First, we develop a precise definition of liquidity, which is followed by description of its dimensions. Next part shows which differences in liquidity

appear among various types of markets. The last section links theoretical notion of liquidity to its real life implication – liquidity costs.

2.1 Definition of Liquidity

A concept of liquidity is among the most popular and widely known characteristics of financial markets. It is very clear on intuitive level but, nonetheless, there is no single traditional definition.

One of the first applications of the concept of liquidity belongs to Keynes (1930, as cited in Miller (1965)) where he interprets liquidity of an asset as a combination of time it takes to close a deal and associated transaction costs. The second part of the definition is crucial, but since it is vague it is often being ignored (e.g. see Encyclopedia Britannica Online – Liquidity (n.d.)). Neuman (1936) modifies the definition by placing more significance on trading costs - "the degree of loss connected with the saleability of an asset at a given moment of time". Later works (e.g. Madhavan & Cheng (1997) or O'Hara (2004)) associate liquidity with trading volume; according to these papers liquid markets are those capable of absorbing high volume trades with no or low price impact.

The most recent and complete definition (Alzahrani, 2011) states: "…a market is considered perfectly liquid if a participant can trade at observed prices irrespective to the quantity, time and order type (buy or sell) desired. It is defined as the ability to buy or sell significant quantities of a security quickly, anonymously and with little price impact".

2.1.1 Dimensions of liquidity.

In general, liquidity is an important characteristic of a stock market that can have major impact on prices of securities; therefore, it is critical to recognize, understand and measure it (Alzahrani, 2011). Usually, measures of liquidity are based on its several dimensions which are derived from the definition above:

- Tightness, or "bid-ask spread"[1], is defined as cost of turning position around in a short period of time; the narrower the spread is, the more liquid the market is considered to be;
- Depth describes an ability to close a deal after a number of similar deals before at the same price;
- Breadth or Width measures an ability to close a deal while creating no impact on the market price;

[1] Bid-Ask Spread is the difference between best ask and best bid quotes or, put it differently, the difference between prices at which one agent agrees to sell and another to buy an asset.

- Resiliency is the speed at which the price returns to the previous level after a large trade was closed;
- Immediacy measures cost at which it is possible to immediately execute an order (Alzahrani, 2011).

All these are various dimensions of liquidity. Such complexity of the paradigm makes it rather difficult to measure. Taking into consideration previous research in the field and nature of our data we focus only on tightness and width, as for other dimensions the data does not allow us to calculate the measures or no reliable way to approximate them exists.

2.2 Liquidity Costs

Trading costs are the direct consequence of liquidity. As it is argued above, they are an important but often ignored component of its definition. Therefore, in the following two sections we look into, first, nature of trading costs and reasons why they occur and, second, what they are actually composed of.

2.3.1 Nature of liquidity costs.

Liquidity is to a large extent about matching sellers and buyers, and thus, it plays a role in price discovery; but the latter notion is not a prerequisite or a determining factor (O'Hara, 2003). Consider the following simple example given by O'Hara (2003). Suppose all buyers of an asset arrive to a market place on Monday and all sellers on Tuesday. There might be consensus among them about the "true fundamental value" of an asset, but they are operating in a perfectly illiquid world and there will appear nothing like market price. Therefore, neither will trading activity emerge on Monday due to absence of sellers, nor on Tuesday. This setting shows how important an intermediary is – it will sell on Monday and buy on Tuesday. But it also requires certain compensation for matching services and as a result a spread between buying and selling prices appears.

Therefore, one of the reasons why trading costs appear is the necessity for presence of an intermediary on the market to ensure that it functions. Generally, there are three different approaches to make buyers and sellers meet each other. The first type, quote-driven or specialist market, resolves this matching problem by involving a dealer who buys when somebody wants to sell and sells when there is a buy order (Næs & Skjeltorp, 2006); and it requires a compensation for doing so in a form of a bid-ask spread. Second way to match trade counterparties is to gather all orders, both buy and sell, in a Limit Order Book and to execute them automatically. In this case, traders provide liquidity voluntarily, but still, the bid-ask spread exists, indicating that risks that are born by dealers still persist but now they

are incurred by different agents. A number of markets combine both designs, as the Baltic Markets do.

Overall, liquidity costs in stock markets appear due to necessity to compensate an intermediary for ensuring continuity of trading by supplying liquidity on either side of the deal. Regardless of the type of the market these costs persist in one or another way.

2.3.2 Components of the liquidity costs.

In this section we look into components of costs associated with closing a deal on the market.

Usually it is argued that during the transfer of the title of share a trader pays two components of trading costs: brokerage commission and liquidity costs (Tinic, 1972). Brokerage commissions are incurred each time a deal goes through the stock exchange. They are not of any significance to this research, as they are predetermined by the stock exchange and brokerage houses; furthermore, they are uniformly distributed between assets of the same kind and therefore have the same influence on liquidity of any ordinary stock. Therefore, they are ignored in the current research, as they cannot be used to explain different levels of liquidity of stocks.

The second component of trading costs is associated with liquidity services (Tinic, 1972). A major part of literature developed in this context is based on quote-driven (or dealer) markets. However, many conclusions are still applicable for order driven and mixed type markets.

Glosten and Harris (1988) suggest dividing all liquidity costs into two groups. First groups accounts for *transitory costs*. They arise due to inventory costs that a dealer incurs for holding some inventory of the stock in order to be able to supply liquidity at any moment in time. Glosten and Harris (1988) argue that they have only marginal impact on share price since they are not related to the underlying true fundamental value. Therefore, these costs are purely liquidity costs – compensation demanded for provision of liquidity. Although directly applicable to mixed type markets, in order-driven markets presence of these costs is ambiguous: traders are likely to redistribute them to counterparties.

The second component of liquidity costs arises due to presence of informed traders. In quote driven markets this *adverse-selection* component appears because rational market-makers choose to widen their bid-ask spreads to compensate for losses they incur due to activity of informed traders who possess superior information about future price changes (Glosten & Harris, 1988). Unlike *transitory costs*, *adverse-selection costs* are more likely to be identified in order-driven markets. As other investors start receiving signals of presence of

an informed trader on the market, they might become more reluctant to close any deals due to high degree of uncertainty until asymmetry of information is eliminated. Ultimately, this leads to widening of bid-ask spread or, in an extreme case, when uninformed participants decide not to post any quotes until they receive information, complete dry-out of liquidity on the market.

3 Prior Research

Given existence of liquidity costs and their nature, there should be factors determining them. First, we review traditional determinants – variables that have been proven to influence liquidity on majority of markets; and then we switch to some novel factors whose effect on liquidity has been discovered recently and documented only on some markets. A table in Appendix A makes a summary of commonly used variables across numerous research papers in the field.

3.1 Traditional Determinants

Research into determinants of liquidity costs, or simply – liquidity, began with the seminal paper *"The Cost of Transacting"* by Harold Demsetz (1968). He sets, among other matters, to analyze determinants of liquidity on the New York Stock Exchange. Quoted bid-ask spread is used as a liquidity measure. He concentrates on relatively few variables: only three are introduced to gauge the characteristics of stocks that lead to different levels of liquidity. Two of them are transaction rate, which is approximated by the number of transactions during a certain period, and the number of shareholders. Demsetz (1968) explains his choice of variables by hypothesizing that there are economies of scales on the market of liquidity provision: higher number of shareholders is likely to result in increasing number of transactions which in turn is expected to push bid and ask quotes closer to each other, thus narrowing the spread and increasing liquidity. Another variable is the number of markets where security is listed. If security is cross-listed, liquidity providers face additional competition from other dealers which results into changes in bid and ask quotes they post. The last variable is share price, because it has direct impact on the size of bid-ask spread and thus liquidity costs. Overall, Demstez (1968) shows liquidity to be negatively related to price and positively to number of markets where security is listed and to transaction rate. The estimates are significant for all variables except number of markets.

Consequent papers argue that although determinants established by Demstez (1968) are important they are not sufficient to explain complete behaviour of liquidity (Tinic, 1972). Tinic (1972) builds an elaborate model explaining liquidity costs on a quote-driven market – NYSE. Quoted bid-ask spread is used as a measure of liquidity. He analyzed impact of

already established determinants, such as price, number of transactions and competition, which is measured by Herfindahl's Index of concentration that takes into account not only the number of markets where security is listed (as opposed to Demstez's (1968) work) but also size and distribution of trading activity across these markets. In addition this paper introduces average volume, standard deviation of price, trading continuity (number of days when trades occur relative to number of days in the period), institutional investors' holdings of the stock and several specialist-market specific variables (purchasing capacity of a specialist and total number of speciality stocks carried by a particular market-maker). Additionally to Demsetz's (1968) results, he proves that liquidity is positively related to average volume, institutional ownership and trading continuity and negatively – to standard deviation of price. All coefficients except for the latter are significant.

From this moment on, as the main approach and the basic model had been developed, the research started to expand into different markets. For example Branch and Freed (1977) use the same set of variables (trading volume, number of exchanges where security is listed, price appreciation and inverse of price) to examine determinants of liquidity on NYSE and AMEX. The findings are generally similar to Tinic (1972). Furthermore, Benston and Hagerman (1974) extend existing evidence of liquidity determinants into Over-the-Counter (OTC) markets. They show that liquidity on the OTC markets in negatively related to price, positively – to the number of shareholders and dealers, and to unsystematic risk. Yet another example is Cannon and Cole (2011) who focus on liquidity determinants of Real Estate Investment Trusts (REITs). By relying on annual data from 1988 to 2007 for REITs listed on NYSE and AMEX they again show that share price, dollar turnover and market capitalization are positively related to liquidity of the REIT's and volatility of return – negatively.

Based on the body of literature that investigates relationship between traditional determinants and liquidity we formulate the following hypothesis.

Hypothesis 1: We expect to observe strong presence of traditional determinants of liquidity on the Baltic Markets, namely statistically significant positive effect of Size and Volume and similar negative effect of Price level and Standard Deviation of Returns on equity liquidity.

3.2 Novel Determinants

Another direction of modern research in determinants of liquidity is establishing alternative to traditional (described above) factors that explain variation in stock liquidity across companies or countries.

Lesmond (2005), for example, examines how legal origin, enforcement of insider trading laws and political stability influence liquidity, while controlling for traditional liquidity determinants (volume, volatility and market capitalization). According to La Porta, Lopez de Silanes, Shleifer and Vishny (1997) common law countries have stronger investor protection and better developed financial markets than civil law countries and based on finding of Bhattacharya and Daouk (as cited in Lesmond, 2005) that liquidity providers widen bid-ask spreads to protect themselves against insiders, Lesmond (2005) establishes a connections between legal origins and liquidity. In addition, he argues that political risk also plays determining role in liquidity: if political risk is high, there exists high level of corruption and thus no protection of investors against expropriation. As a result, he shows that more stable political system provides grounds for more liquid financial markets.

Another alternative set of liquidity determining variables was established in Gopalan, Kadan and Pevzner (in press). The paper examines the effect of managerial investment decisions on stock liquidity through asset liquidity. The link can work in both directions: on the one hand, more liquid assets-in-place, as measured by proportion of cash and equivalents on the balance sheet, make valuation less uncertain and thus improve stock liquidity. On the other hand, more cash creates ample opportunities for future investments and therefore increases uncertainty about future cash flows, which is reversely related to stock liquidity. To estimate the relation, the authors rely on several liquidity measures and different asset-liquidity measures weighted according to liquidity of assets on balance sheet. Despite this twofold effect, the authors identify a strong positive link between asset liquidity and stock liquidity. They claim that after controlling for firm-fixed effects, a one standard deviation in asset liquidity will result into 15% increase in stock liquidity.

Another research by Frieder and Martell (2006) also aims to fill the gap in liquidity determinants research and establish a link between balance sheet structure and liquidity of assets. They are particularly interested in the effect of leverage on liquidity. Expected relation between them is direct – more debt, first, reduces agency costs as the number and power of debt holders increases resulting in higher liquidity, and, second, reduces information asymmetry between equity and debt capital providers because additional debt disciplines managers and forces them to make better and more profitable investment decisions as they face higher interest payments. They find a strong persistent positive relation between liquidity and leverage. However, we are convinced that these results should be treated with high degree of precaution, as relationship between liquidity and leverage is indeed twofold and direction of causality is unclear.

Other papers also research liquidity determinants of large block trades. For example, Alzahrani (2011) uses high frequency intra-day data with intervals of 1 minute from the Saudi Stock Market to show that there is a price impact asymmetry between buyer and seller initiated block trades: sellers tend to pay higher liquidity premiums. Alzahrani (2011) also controls for price level, volume, standard deviation of returns, firm's size and number of trades. He finds that already established liquidity determinants apply for large block trades, too.

Breen et al. (2002) also rely on high frequency data to establish several interesting determinants. First of them is recent price appreciation, which is motivated by "locked-in" capital gain which provide disincentives to asset holders to sell and capitalize on the gains thereby restraining liquidity. Second variable is dividend yield. Since trading volume increases around ex-dividend date, dividend yield has positive relation to liquidity. Third novel liquidity determinant is a fraction of firm's return variance explained by return on stock market portfolio. The higher it is, the lower will be firm's individual level of e.g. adverse selection risk. Therefore, it is shown to be positively related to liquidity.

Another substantial body of literature focuses on determinants of stock liquidity that deal with investor protection and corporate governance. For example, Brockman and Chung (2003) use Stock Exchange of Hong Kong as a natural experiment, because it lists companies from different investor protection environments – Hong Kong with one of the best investor protection environments in the world and mainland China with one of the worst. The authors prove that bid-ask spread is narrower for Hong Kong based firms, thus concluding that Hong Kong's strong investor protection environment improves overall stock liquidity. This result is robust to the inclusion of traditional variables – volume, price and stock return volatility; relationships with them are as established in the previous research.

Chen, Chung, Lee and Liao (2007) investigate effects of information transparency and disclosure practices on equity liquidity. The logic behind it is that less transparent companies with poor disclosure practices will suffer from greater information asymmetry. Therefore, liquidity providers will demand larger bid-ask spreads to compensate for adverse selection risks. Transparency and Disclosure (T&D) rankings of the individual stocks on the S&P 500 index are used as a proxy for corporate governance. The results confirm that T&D rankings have a significant and negative relationship with the information asymmetry component, meaning that poor disclosure practices in fact broaden the equity spread and increase the asymmetric information risk as perceived by the market.

Another research by Brennan and Subrahmanyam (1996) also looks into liquidity determinants that are not related to company structure or characteristics of trading of its shares. They construct a measure of adverse selection costs and argue that the number of investment analysts that follow a stock has direct positive impact on liquidity. The idea behind it is that the higher the number of analysts is, the lower asymmetry of information and associated costs are. The result is robust to inclusion of traditional variables – trading volume, price level and return volatility.

The body of literature concerning liquidity and its determinants on individual stock level is abundant. However, not much literature has been dedicated to researching those notions on market-wide level. Intuitively any investor can tell a liquid market from a rather illiquid one. Therefore, individual liquidities of different companies should share some common traits. This allows us to argue that individual liquidity (similarly to individual stock returns) is composed of systematic (market-wide) and idiosyncratic components. In this context market-wide liquidity becomes an important determinant of individual liquidity.

Chordia, Roll and Subrahmanyam (2000) adapt orthodox justification of existence of liquidity costs (see Section 2.3.2) to explain existence of commonality in liquidity. Regarding inventory costs of market makers, they argue that given a market-wide price shock trading activity can dramatically change, thus creating pressure on dealer's inventory of stock resulting in deteriorating market depth and widening bid-ask spreads. Since the shock is on the market level, all securities are likely to be affected, which in turn will create co-movements in individual liquidities. Liquidity costs arising due to asymmetric information can also be adapted to support the idea of commonality in liquidity. It is reasonable to expect that there are groups of people that possess private information that can affect many companies on the market, e.g., one group knows that soon a new technology will be released that might revolutionize some industry. Therefore, it creates possibility for existence of commonality in liquidity across many firms due to asymmetry of information distribution.

Chordia et al. (2000) develop a framework which allows them to demonstrate that commonality in liquidity exists. They create several individual and market-wide liquidity measures and show that beta coefficients from regressing individual liquidity on market liquidity are positive and statistically significant. Furthermore they show that effect of market-wide liquidity is robust to inclusion of traditional determinants.

On the other hand, Hasbrouk and Seppi (2001) employ a similar approach but claim that commonality in liquidity is weak. The estimates they obtain are statistically significant but rather small in magnitude. In addition, they find that only up to 13% of variation in

liquidity can be attributed to a single factor, which means that only e.g. market-wide liquidity is not enough to explain all variation in liquidity on individual level.

All in all, existing research in the field of commonality in liquidity is associated with a small but evolving body of literature, but it still provides a comprehensive setting for testing how successful market liquidity is in determining individual liquidity of stocks listed on the Baltic Stock Markets.

Overall, given the data availability we are primarily interested in investigating effect of asset liquidity, market-wide liquidity and corporate governance on stock liquidity. Since the presence of the aforementioned novel liquidity determinants has been documented only on some markets, we do not anticipate all of them being strongly present on the Baltic Market. However, we formulate the following hypothesis:

Hypothesis 2: corporate governance and market-wide liquidity are positively related to stock liquidity; the relation with asset liquidity is ambiguous.

3.3 Research on the Baltic Market

The notion of liquidity determinants has not been intensively studied on the Baltic Market. There were only several attempts to investigate factors explaining variation in liquidity.

First, Kokoškins and Baumanis (2001) study liquidity of Riga Stock Exchange and Tallinn Stock Exchange in the light of the Russian crisis that took place on August 17, 1998. Their analysis includes 14 most traded stocks: 8 from RSE and 6 from TSE. The authors mostly study the change in strength of traditional determinants, such as volume, volatility and price inverse, which occurred due to the Russian crisis. Market capitalization is argued to be too collinear with price and, therefore, is excluded from regressions. According to the results of analysis, the only variable that has a consistent (positive) impact on percentage spread on both stock exchanges both before and after August 17 is price inverse. This variable serves as a proxy for tick size, so it is only logical that increase in tick size has an unfavourable effect on liquidity. Trading volume is positively related to spread before the Russian crisis and negatively after it, but this relationship is mostly insignificant. In three cases out of four, higher volatility is positively and significantly associated with spreads, which is consistent with theory. The major drawback of this study is the sample. First, it consists of only 14 companies; second, the inclusion of the most traded stocks to the sample only automatically implies that these stocks are more liquid.

Secondly, Kazlauskaite and Makauskas (2006) make a rigorous research on liquidity determinants on the Baltic Stock market in order to construct a synthetic spread for private

companies. Because of the specifics of their research, the authors do not include some usual variables, such as return volatility or price. However, some less common factors (profitability and asset liquidity) are taken into account. Using the panel data regression with random effects Kazlauskaite and Makauskas (2006) test various proxies for each of the determinants and chose the most appropriate ones based on statistical significance. Despite common practice, natural logarithm of sales is selected as a proxy for company size. They establish that size is positively related to spread (at 8% significance level), thus contradicting to evidence from prior research. Higher trading volume, asset liquidity (current assets to total assets) and profitability (natural logarithm of EBIT) are found to improve stock liquidity.

Overall, the authors intend to expand these research and supplement it with up-to-day data and wider set if determinants.

4 Methodology

4.1 Data

The sample covers the period from January 2006 to December 2010 and is restricted by data availability. The initial sample consists of companies listed on NASDAQ OMX Tallinn, NASDAQ OMX Riga and NASDAQ OMX Vilnius stock exchanges' main and secondary equity lists and excludes preference shares. During the sample period their number varied due to some companies becoming listed, some – delisted or merged with other companies; as a result initial sample of market data contains 138 companies. Trading data were not available for only 9 firms; thereby almost all companies listed during the period are included in the sample, eliminating any survivorship bias. Data on daily stock price (adjusted for stock splits), best ask and best bid quotes, number of trades, total volume and dollar volume are obtained from NASDAQ OMX Baltic website. We follow conventional practice and eliminate all observations when either share price or both bid and ask quotes are equal to zero; also we disregard trading firm-days when bid quote is higher than ask. In case of new companies entering the market or leaving it, we include them into analysis only if they are listed for at least half of a year.

The authors also use Investor Relations index calculated for all NASDAQ OMX Baltic Main List companies and Baltic Secondary List companies with average capitalization over EUR 10 million (NASDAQ OMX Baltic, 2012b) in order to investigate effect of quality of corporate governance on stock liquidity. The index has been computed by the stock exchange annually since 2006, thus limiting our sample period. In different years it covers from 60% to over 90% of all listed companies. Original Index is calculated based on

information that covers 1.5 years of a company's operations; therefore it is rescaled to cover only one calendar year (See Appendix B for description of the Index).

Balance sheet data for companies, namely amount of cash and cash equivalents, non-cash current assets, tangible fixed assets and total assets, are retrieved from Odin Database. Missing data, where possible, are obtained from annual reports of companies. Following conventional practice we exclude financial companies from this part of analysis, as the nature and properties of their balance sheet entries differs from those of non-financial firms. Since Investor Relations index and balance sheet data are only measured once a year, we use annual frequency data throughout the paper (data with higher frequency is averaged over annual periods).

4.2 Liquidity Measures

In order to investigate presence of traditional and novel liquidity determinants on the Baltic markets we start by calculating three measures of liquidity based on daily observations: quoted bid-ask spread, relative bid-ask spread and price impact measure as proposed by Amihud (2002).

Spreads exist to offset order processing costs, inventory carrying costs, and adverse selection costs of trading with informed investors. **Quoted spread (*QBAS*)** and **Percentage spread (*PBAS*)** are calculated from stock's daily closing bid and ask quotes according to the following formulas:

$$QBAS_t = ask\ price_t - bid\ price_t \quad [1]$$

$$PBAS_t = \frac{(ask\ price_t - bid\ price_t)}{(ask\ price_t + bid\ price_t)/2} \quad [2]$$

Both measures represent only *tightness* dimension of stock's liquidity (Cannon & Cole, 2011). *PBAS* is a more relevant measure for investors (Brockman & Chung, 2003), since it is easily comparable across stocks. Moreover, considering the nature of the Baltic stock markets, namely rather low activity in many assets, we do not disregard quotes when either only bid or only ask is available. This means that *QBAS* equal to bid or ask quote (when only one of them is available) indicates absolute illiquidity; *PBAS* is set to be equal to one under the same conditions, which also points towards perfectly illiquid state of an asset. Overall, higher values of both measures indicate lower liquidity.

The **price impact** measure of liquidity was originally proposed by Amihud (2002) and is primarily an indicator of the *depth* dimension of liquidity (Cannon & Cole, 2011) that measures the average absolute change in share price per dollar of volume traded. Illiquidity of stock *i* over *D* days is calculated as:

$$ILLIQ_j(t) = \frac{1}{Days_j(t)} \sum_{d=1}^{Days_j(t)} \frac{|r_j(td)|}{V_j(td)} \quad [3]$$

Where $r_j(td)$ is the return of the j^{th} security on day d in t^{th} month, $V_j(td)$ is the dollar volume of the j^{th} security on day d in t^{th} month, and $Days_j(t)$ is the total number of trade days of the j^{th} security in t^{th} month. Thus, higher Amihud's illiquidity measure indicates that absolute stock returns' reaction to smaller dollar volume is more pronounced (Alzahrani, 2011).

4.3 Determinants of Liquidity

To analyze cross-sectional variation in liquidity, first, we focus on already well documented determinants (Appendix A shows commonly used variables across numerous research papers in the field): stock price, firm size, trading volume and volatility of stock returns. Secondly, we consider the potential of three less traditional variables to influence stock liquidity: Investor Relations Index, as a proxy for quality of corporate governance, liquidity of assets in place, and market wide liquidity.

4.3.1 Traditional determinants.

First, we consider well explored and documented determinants in our specifications.

Price is a log scaled daily closing stock price averaged over an annual trading period. It is directly linked to liquidity through the notion of risk – investors might prefer to widen spreads because of *adverse changes* in prices – percentage change in an expensive stock is more pronounced in pecuniary terms than same change in a relatively cheaper asset. Therefore, risk of providing liquidity in an expensive stock is higher, which leads to lower liquidity. Hence, highly priced stocks are associated with wider bid-ask spreads and thus lower liquidity, implying that there should be a negative relationship between prices and liquidity.

However, West and Brouilette (1970, as cited in Woolridge & Chambers, 1983) argue that equity traded at low price might be perceived as a low quality asset and investors may refrain from trading it, as associated *adverse selection costs* are high. Thus, price should be positively related to liquidity.

Copeland (1997) indirectly considers these two opposite lines of argumentation and suggests that there might be a certain price rage at which trading is more likely to occur. From the other perspective, one could argue that in order to enhance asset's liquidity prices should not tend to extreme values.

Size is measured as lagged log scaled market capitalization at the end of the trading year for each stock. Researchers (e.g. Alzahrani, 2011; Lesmond, 2005; Breen et al., 2002; Cannon & Cole, 2011) agree that stocks of larger companies are more liquid for several

reasons. First of all, large firm are better known, more thoroughly reviewed by analysts and better secured from informed or speculative trading, thereby lowering the *adverse selection* component of liquidity costs. Secondly, inventory risk for large companies is lower because of ease of finding trade counterparty.

Standard Deviation of stock returns is computed as annualized standard deviation of daily stock returns over an annual trading period for each stock. It is unequivocally negatively associated with liquidity (Alzahrani, 2011; Brockman & Chung, 2003; Frieder & Martell, 2006; Lesmond, 2005) due to several reasons. First, greater volatility increases *inventory* component of liquidity cost, as dealers or investors will require higher compensation for providing liquidity in a riskier security. Second, it amplifies adverse selection risk – if stock returns are rather volatile, unless investors are given explanation for why it happens, they will be reluctant to engage in trading, and thus, they will prefer to post quotes that widen the bid-ask spread.

Volume is the natural logarithm of average number of shares traded per day over an annual trading period for each stock. Higher volume associates with higher liquidity for several reasons. First, it is a proxy for free float of the shares. For example, given two firms with the same number of shares outstanding but one having a large block of shares held privately, *ceteris paribus,* closely held firm will have fewer shares available for trading on the marketplace and thus lower trading volume. High volume signals lower inventory costs, because it's easier and faster to match buy and sell orders for such stock (Lesmond, 2005). If volume is high market makers can afford lower fixed costs per unit traded (Brockman & Chung, 2003) and actions of a single informed trader cannot translate into a large price impact (Breen et al., 2002).

4.3.2 Corporate governance.

To gauge for cross-sectional variation in liquidity caused by different quality of corporate governance we rely on **Investor Relations index** computed by NASDAQ OMX Baltic (See Appendix B for description). Existing body of literature (e.g. Brockman & Chung, 2003; Chen et al., 2007; Brennan & Subrahmanyam, 1996) proves that better investor protection, disclosure practices and corporate governance enhance stock liquidity through decreasing information asymmetry. As a result parties involved in a transaction require lower compensation in a form of spreads which makes a stock more liquid.

4.3.3 Liquidity of assets in place.

Following Gopalan at al. (in press) the authors explore the link between the liquidity of a company's assets and its traded stock. Generally, the expected relation is twofold. On the

one hand, higher proportion of liquid assets in total assets lowers uncertainty about valuation of the company, and thus, decreases *information asymmetry* component of liquidity costs, making traded equity easier to exchange. On the other hand, bigger cash holdings imply more potential future investments. It increases uncertainty and makes traders more reluctant to engage in a transaction, and decreases stock liquidity. In addition, higher asset liquidity can undermine stock liquidity of poor corporate governance firms, as investors will anticipate managers of such companies to use existing cash holdings inefficiently.

Following Gopalan et al. (in press) the authors compute three **weighted asset liquidity** measures to trace the link between equity and asset liquidity. The first measure (*WAL1*) accounts for the most liquid firm assets – cash and cash equivalents:

$$WAL1_{j,t} = \frac{Cash\ \&\ Equivalents_{j,t}}{Total\ Assets_{j,t-1}} \times 1 \quad [4.1],$$

where *j* indicates different entities and *t* – years.

The next measure (*WAL2*) accounts for most liquid assets and non-cash current assets that can be converted to cash relatively quickly and at low cost, but are less liquid:

$$WAL2_{j,t} = \frac{Cash\ \&\ Equivalents_{j,t}}{Total\ Assets_{j,t-1}} \times 1 + \frac{Non{-}Cash\ CA_{j,t}}{Total\ Assets_{j,t-1}} \times 0.5 \quad [4.2]$$

The last measure (*WAL3*) includes, in addition to all the aforementioned assets, tangible fixed assets that are rather illiquid (e.g. buildings, plants), but are easier to convert into cash than intangible assets, such as goodwill:

$$WAL3_{j,t} = \frac{Cash\ \&\ Equivalents_{j,t}}{Total\ Assets_{j,t-1}} \times 1 + \frac{Non{-}Cash\ CA_{j,t}}{Total\ Assets_{j,t-1}} \times 0.75 + \frac{Tangible\ FA_{j,t}}{Total\ Assets_{j,t-1}} \times 0.5 \quad [4.3]$$

This study by Gopalan et al. (in press) provides strong support for a positive relation between all measures of asset liquidity and equity liquidity.

4.3.4 Market-wide liquidity.

Traditionally liquidity has been researched on individual level. The variables described above also work in this dimension. However, *ex ante* reasoning suggests that liquidity also exists on market-wide level: intuitively every investor can tell a reasonably liquid market from a rather illiquid one. Therefore, liquidity of different stocks should share some common traits and thus covary across entities and time. So, we adopt a perspective that there exists commonality in liquidity on the market level. This allows us to argue that individual liquidity (similarly to individual stock returns) is composed of a systematic (market-wide) and an idiosyncratic component. It is particularly interesting to estimate this relationship on the Baltic markets because they are widely considered to be relatively illiquid, and therefore, a well-known “lemon problem effect” can play a major role: a stock which has

characteristics that should make it perfectly liquid will not be such only because it is traded on an illiquid market.

To investigate this paradigm, first, we start by computing market wide liquidity measures based on three presented above individual measures; we do it separately for three Baltic Markets. Following approach in Chordia et al. (2000), we construct two kinds of aggregate measures: equally-weighted and dollar volume-weighted. Let cross-sectional liquidity measure be denoted by $L_{m,i}$, where *m* indicates cross-sectional nature of the measure and *i* is a battery of liquidity measures, *i*={Quoted Spread, Percentage Spread and Amihud's measure}. Then Equally-Weighted ($EWL_{m,i}$) measures are computed based on the technique that puts equal weight to every point in the cross-section:

$$EWL_{m,i} = \frac{1}{J}\sum_1^J L_{j,i,t} \quad [5]$$

Simply saying, we average out i^{th} liquidity measure for t^{th} period for all stocks (j=J).

Second type of market-wide liquidity measures, Volume-Weighted ($VWL_{m,i}$), relies on technique weighs liquidity of each security by its trading volume in period *t*:

$$VWL_{m,i} = \frac{\sum_1^J L_{j,i,t} * Volume(L_{j,i,t})}{\sum_1^J Volume(L_{j,i,t})} \quad [6],$$

where $Volume(L_{j,i,t})$ is trading dollar volume of security *j* in day *t* for which individual liquidity measure *i* is calculated. Following Beaupain, Giot and Petitjean (2006) we exclude dependent stock's liquidity from cross-sectional measure (both simple and volume-weighted).

Table 1 summarizes the relations between equity liquidity and all its potential determinants that the authors expect to observe.

Table 1

Expected Relations between Potential Determinants, Liquidity and Its Measures

	Variable	Effect on Liquidity	Effect on Liquidity Measure
Determinants	*Share Price*	-	+
	Market Capitalization	+	-
	Volume	+	-
	Standard Deviation of returns	-	+
	Investor relations index	+	-
	3 Weighted Asset Liquidity Measures	**?**	**?**
	Market-wide liquidity	-	+

4.4 Model

While usage of panel data set consisting of observations on multiple entities (firms or countries) across multiple periods of time is typical in finance, procedures employed to work with these data, specifically with standard errors are very different. The reason for this is that

the OLS assumption about standard errors being independent and identically distributed rarely holds in reality.

Petersen (2009) documents that independency assumption is often violated in empirical finance research, since market-wide shocks frequently create correlation between firms at a moment of time and firm-specific factors create correlation across time within an entity, which most researchers do not account for. The omission of these effects leads to biased coefficients and underestimation of standard errors and thus to overoptimistic t-statistics and mistakenly significant results. In this light it is essential to explore rigorously the nature of the data and, if necessary, estimate coefficients by fixing effects and clustering errors. It is common to fix entity effects in order to capture some unobserved firm effect in the estimates. Less common is to control for time effects, as well. Even less frequently we can encounter standard errors that are adjusted for simultaneous correlation across both dimensions. Peterson (2009) suggests a procedure for estimating variance-covariance matrix of standard errors clustered on two dimensions:

$$V_{Firm\&Time} = V_{Firm} + V_{Time} - V_{White}, \quad [8]$$

where V_{Firm} – variance of a coefficient clustered by firm, V_{Time} – variance clustered by time and V_{White} – heteroskedasticity robust (or White) variance. Petersen (2009) argues that this method allows us to calculate standard errors that are as close to the underlying true ones as possible (supporting it with evidence from Monte Carlo simulations).

Before choosing the econometric model, we run several tests that explore the nature of the data. In order to check for multicollinearity between the independent variables we employ a Variance Inflation Factor (VIF) test. The test is performed for different regression specifications. Among all of them the highest VIF is reported to be 3.34 (for the natural logarithm of lagged market capitalization). The mean VIF is at most equal to 2.05. The outcome of the VIF test is satisfactory, as these results are much less than the recommended limit of 10, meaning that there are no multicollinearity problems among the independent variables. See Appendix C, Tables C1 through C5 for more details. We make a choice between fixed and random effects model with the help of the Hausman test. The results of the test (Appendix C, Table C6) show that fixed effects model fit our data better (the chi squared measure being equal to 45.12). Modified Wald test for groupwise heteroskedasticity in fixed effects regression model confirms that our standard errors are heteroskedastic (Appendix c, Table C7). However, it does not imply any problems, as it can be easily controlled for. Wald tests confirm our data being subject to time- and firm-fixed effects (F-statistics are 18.76 and 4.69 respectively). See Appendix C, Tables C8 and C9 for tests' output.

We use Petersen's (2009) approach to check for presence of firm effects that remain after applying both firm- and time-fixed effects. We do this by comparing firm clustered SE to White SE and firm and time clustered SE to time clustered SE. Substantial difference in SE indicates the need for clustering errors across firms because firm effects are not constant. Comparing the time clustered SE to the White and the firm and time clustered SE to the firm clustered SE is the way to look at remaining time effects. The difference again is rather large.

Following Petersen (2009) we conclude that the most appropriate way to establish the determinants of liquidity on the Baltic stock markets is to use panel data with fixed firm- and time-effects and perform double-clustering so that error terms would be unbiased and estimates as precise as possible. In addition, inclusion of both time- and firm-fixed effects eliminates any impact of the crisis or any possibility of omitted variables bias.

We estimate a number of relations between liquidity measures and its determinants based on the following specification:

$$L_{j,i,t} = \alpha_j + \beta_1 (Novel\ Deterimant)_{j,t} + \sum \beta_n (Traditional\ Determinant)_{j,t,n} + \varepsilon_{j,i,t} \quad [9.0]$$

In this specification $L_{j,i,t}$ denotes a liquidity measure, where j=1,2….,J is the number of security, i={Quoted Spread, Percentage Spread, Amihud's measure} is a vector of liquidity measures and t is a time-stamp for every trading year in the sample. Novel Determinants are represented by Investor Relations index, denoted by $Index_{j,t}$, asset liquidity, denoted by $WAL_{j,k,t}$, where k={*WAL1, WAL2, WAL3*} is a vector of weighted asset liquidity measures, and market-wide liquidity, as denoted by L_m={$EWL_{m,i}$, $VWL_{m,i}$}. Traditional variables include stock price *(Price)*, size *(MarketCap)*, volume *(Volume)* and standard deviation of returns (*StDev*).

At first, we look at explanatory power of Traditional Variables only. For each Novel Variable we estimate regressions with and without Traditional ones. We use the whole, sample in the analysis, rather than split it according to the geographical location of particular market (Estonia, Latvia and Lithuania), because, first, three different markets are rather homogenous with respect to activity on them as well as market place design. Secondly, splitting the sample would result into a relatively low number of observations per country which could make obtained estimates less reliable.

5 Empirical Findings

5.1 Descriptive statistics

5.1.1 Liquidity and its measures.

Table 2 represents descriptive statistics of the chosen liquidity measures: Quoted Spread, Percentage Spread and Amihud's Illiquidity measure. As a result of filtering procedures, we are left with 469 firm-year observations in total and a bit less than 100 observations for each year.

Table 2

Descriptive Statistics of Liquidity Measures

		Quoted Spread	*Percentage Spread*	*Amihud Illiq.*
2006-2010	Observations	469	469	464
	Mean	0.4813	17%	0.0018
	Std. Dev.	1.3932	0.2465	0.0064
2006	Observations	97	97	96
	Mean	0.4855	13%	0.0009
	Std. Dev.	1.5336	0.2182	0.0051
2007	Observations	98	98	97
	Mean	0.4772	12%	0.0008
	Std. Dev.	1.1522	0.2200	0.0025
2008	Observations	98	98	97
	Mean	0.6658	21%	0.0021
	Std. Dev.	1.7542	0.2624	0.0074
2009	Observations	89	89	87
	Mean	0.4589	20%	0.0023
	Std. Dev.	1.4374	0.2402	0.0070
2010	Observations	87	87	87
	Mean	0.2964	18%	0.0031
	Std. Dev.	0.8836	0.2804	0.0084

Source: Created by the authors.

Notably, both spread-based measures indicate similar dynamics. In 2006-2007, while the market was still experiencing the stage of rapid growth, both measures remained relatively low and even declined from 2006 to 2007 due to activity on the market being high and investors willing to close more deals by posting closer quotes. However, in 2008 a substantial widening of spreads can be observed; it followed the slump of the market and halt of the activity, indicating investors' reluctance to agree on the price in order to execute a transaction. Ever since the spreads have being declining, indicating recovery of the markets in this respect.

Overall, the magnitude of the measures is high. Average quoted spread of 48 euro cents or average percentage spread of 17% indeed shows that the markets are rather illiquid. Since prices of transacting are high, some investor may prefer to refrain from frequent trades,

which deteriorates liquidity even further.

Described magnitudes of liquidity measures are similar to those of simple market-wide measures, reported in Table 3. However, they are substantially different from respective across the board measures constructed using the weighting procedure. The latter ones are several times smaller, which means that very illiquid stocks, those with wide spreads and infrequent and small trading volumes, inflate average liquidity measures. For example, average quoted spread during 2006 – 2010 was almost 50 euro cents, while the corresponding weighted market-wide measure was close to 10 cents. This means that on aggregate level the market is more liquid.

Table 3

Descriptive Statistics of Market-Wide Liquidity Measures

		Market-wide Simple Quoted Spread	*Market-wide Weighted Quoted Spread*	*Market-Wide Simple Percentage Spread*	*Market-Wide Weighted Percentage Spread*	*Market-wide Simple Amihud Illiq.*	*Market-wide Weighted Amihud Illiq.*
2006-2010	Obs	469	469	469	469	464	464
	Mean	0.4837	0.0966	15.07%	2.89%	0.001457	0.000060
	Std. Dev.	0.2878	0.0565	0.1082	0.0204	0.001228	0.000090
2006	Obs	97	97	97	97	96	96
	Mean	0.4369	0.0840	10.84%	1.47%	0.000924	0.000045
	Std. Dev.	0.1654	0.0226	0.0802	0.0062	0.001028	0.000055
2007	Obs	98	98	98	98	97	97
	Mean	0.4804	0.0872	10.89%	1.41%	0.000549	0.000009
	Std. Dev.	0.2855	0.0294	0.0970	0.0056	0.000420	0.000005
2008	Obs	98	98	98	98	97	97
	Mean	0.7073	0.1332	19.05%	3.62%	0.001757	0.000036
	Std. Dev.	0.3745	0.0420	0.1035	0.0130	0.000957	0.000021
2009	Obs	89	89	89	89	87	87
	Mean	0.4216	0.0866	17.94%	5.27%	0.002035	0.000126
	Std. Dev.	0.1632	0.0673	0.0700	0.0222	0.000951	0.000117
2010	Obs	87	87	87	87	87	87
	Mean	0.3512	0.0902	17.06%	2.91%	0.002146	0.000092
	Std. Dev.	0.2481	0.0851	0.1474	0.0195	0.001631	0.000129

Source: Created by the authors.

In addition, the aforementioned dynamics of the measures also hold on market-wide level. However, the magnitude is not that pronounced, meaning, that once adjusted for trading volume, liquidity does not appear to be so scarce on the market.

5.1.2 Determinants of the spread.

Table 4 presents descriptive statistics of the variables that, after certain transformations (see Appendix D), are used to explain cross-sectional variation in liquidity. First of all, the sample is composed of companies that are relatively small on international level; average capitalization is slightly below 100 million EUR, with as low as 115,000 EUR

and as high as 2 billion EUR. Daily returns are rather volatile – their annualized standard deviation is above 70%. Average price is slightly below EUR 4.5.

Table 4

Descriptive Statistics of Potential Liquidity Determinants

	Obs	*Mean*	*Std. Dev.*	*Min*	*Max*
Volume	469	9766131	32000000	0	401000000
MarketCap	469	99400000	206000000	115571	2080000000
SharePrice	469	4.4914	15.3278	0.0478	181.7450
StDev	466	0.7331	0.5515	0.0820	6.7981
Index	286	69.7822	14.7127	27.3929	97.5550
WAL1	428	0.0851	0.2337	0.0000	3.8625
WAL2	428	0.2783	0.4166	0.0009	7.8957
WAL3	428	0.6265	0.5869	0.0063	11.6114
MW_S_QBAS	469	0.4837	0.2878	0.0395	1.2188
MW_W_QBAS	469	0.0966	0.0565	0.0149	0.2614
MW_S_PBAS	469	0.1507	0.1082	0.0117	0.3653
MW_W_PBAS	469	0.0289	0.0204	0.0060	0.0921
MW_S_ILLIQ	464	0.0014570	0.0012276	0.0000005	0.0074212
MW_W_ILLIQ	464	0.0000596	0.0000900	0.0000005	0.0007098

Note. *Volume* is annual cumulative number of traded shares. *MarketCap* is annual market capitalization at the end of each year. *SharePrice* is average annual closing price. *StdDev* is annualized standard deviation of daily stock returns. *Index* is NASDAQ OMX Baltic Investor relations Index. *WAL1* is Weighted Asset Liquidity measure 1 that incorporates only most liquid assets for every company on annual basis. *WAL2* is Weighted Asset Liquidity measure 2 that incorporates most and relatively less liquid assets (with different weights) for every company on annual basis. *WAL3* is Weighted Asset Liquidity measure 3 that incorporates most and relatively less liquid assets, as well as all tangible fixed assets (with different weights) for every company on annual basis. *MW_S_QBAS* and *MW_W_QBAS* are simple and dollar volume weighted average daily market wide quoted bid-ask spreads computed on annual basis. *MW_S_PBAS* and *MW_W_PBAS* are simple and dollar volume weighted average daily market wide percentage bid-ask spreads computed on annual basis. *MW_S_ILLIQ* and *MW_W_ILLIQ* are simple and dollar volume weighted average daily *ILLIQ* measure computed on annual basis. Source: Created by the authors.

For some of the variables the number of firm-year observations is lower. For example, Investor Relations Index is represented by 286 firm-year observations with average value of 69.8 (out of 100); and Weighted Asset Liquidity measures by 428, due to some companies becoming delisted before filing reports. On average, the most liquid assets, namely cash and cash equivalents, stand for 8.5% of all assets, as denoted by *WAL1*. *WAL2*, which incorporates the most liquid assets with non-cash current assets stands at 0.28. *WAL3*, which adds tangible fixed assets to the previous measure, on average has value of 0.56.

Some of these variables underwent normalization procedure before being included in regressions (see Appendix D for descriptions).

5.1 Explaining Equity Liquidity

5.1.1 Traditional determinants.

Table 5 outlines estimates obtained from regressing three different liquidity measures on traditional liquidity determinants: standard deviation of returns, average price, volume (in shares) and market capitalization.

Table 5

Traditional Liquidity Determinants and Their Explanatory Power over Liquidity Measures

	QBAS	*QBAS*	*QBAS*	*QBAS*	*PBAS*	*PBAS*	*PBAS*	*PBAS*	*ILLIQ*	*ILLIQ*	*ILLIQ*	*ILLIQ*
StDev	**0.2896c**				**0.3996a**				**1.3652a**			
	0.1552				0.1023				0.3496			
SharePrice		**0.5836a**				**-0.4001a**				**-0.8626a**		
		0.1064				0.0990				0.2509		
Volume			**-0.3509a**				**-0.1988a**				**-0.4912a**	
			0.0575				0.0437				0.1809	
MarketCap				**0.3343a**				**-0.2263a**				**-0.4643c**
				0.0906				0.0856				0.2429
Constant	**-2.5879a**	**-2.7028a**	**1.9549a**	**-8.0872a**	**-2.5405a**	**-2.6597a**	-0.7307	1.0319	**-8.9910a**	**-9.4717a**	-2.9835	-1.8890
	0.0735	0.0238	0.7393	1.4791	0.0366	0.0110	0.6213	1.3836	0.1187	0.0687	2.4330	3.9442
N	466	469	466	450	466	469	466	450	464	464	464	445
adj. R^2	89.1%	90.1%	91.7%	89.3%	89.1%	88.6%	89.1%	88.2%	84.5%	81.7%	82.7%	81.1%

Note. *QBAS* is the natural logarithm of the annual average of the daily quoted bid-ask spread. *PBAS* is the natural logarithm of the annual average of the daily percentage bid-ask spread. *ILLIQ* is Amihud Illiquidity measure that is calculated on monthly basis and averaged over a year. *StdDev* is the natural logarithm of the annualized standard deviation of daily stock returns. *Share Price* is the natural logarithm of the average annual closing price. *Volume* is the natural logarithm of the annual cumulative number of traded shares. *MarketCap* is first lag of the natural logarithm of annual market capitalization at the end. For each independent variable the first number is the coefficient, the second – standard error. a, b and c indicate statistical significance at 1%, 5% and 10%, respectively. Every regression includes company- and year-specific dummies, coefficients of which are not reported here. Source: Created by the authors.

Individually all the aforementioned variables tend to have statistically significant relations with all liquidity measures. First, standard deviation of return is, as expected, positively related to liquidity measures (thus negatively to liquidity), proving that more volatile stocks pose more risk to liquidity providers, therefore pushing them to widen spreads. The impact of 1% increase in this determinant on liquidity measures ranges from 0.29% for quoted spread, through 0.40% for percentage spread to 1.37% for Amihud's measure. Therefore, the relation between volatility of return and liquidity is unambiguously negative. Second, the relation between liquidity and cumulative annual volume is also straightforward – higher volume lowers the risk for liquidity suppliers by providing them more abundant opportunities for opening and closing positions, therefore, decreasing chances of them being unable to liquidate their positions. As a result, they narrow quoted spreads and increase liquidity. The estimates indicate that a 1% increase in volume will cause reduction in liquidity measures ranging from 0.20% for percentage spread to 0.49% for Amihud's measure. Third, average price is also proven to be a significant determinant of liquidity. Negative statistically significant coefficient obtained in regression with Amihud's measure allows us to conclude that indeed price is linked to liquidity via the idea that commonly highly illiquid assets are priced at quite low. The magnitude of this effect is large, 1% increase in share price leads to 0.86% reduction in percentage spread. On the other hand, positive estimate obtained for *SharePrice* in regression with Quoted spread indicates that price level determines liquidity through risk – changes in more expensive stocks are more

pronounced in nominal terms, which makes such stocks riskier. Overall, the effect of average price is rather ambiguous, as different theories are sufficiently supported by empirical evidence (the issue is to be addressed in detail in Section 6). The last commonly quoted liquidity determinant is market capitalization. Regressions with Percentage spread and Amihud's measure produce negative estimates, which indicate that 1% increase in market capitalization would decrease the measures by 0.22% and 0.46%, respectively. The coefficient in regression with quoted spread as dependent variable is positive, which is counterintuitive (see Section 6 for explanation).

Table 6 reports results of regressing three liquidity measures on all traditional determinants simultaneously. As it can be noticed, estimates for three explanatory variables, namely standard deviation, average price and volume, tend to remain significant even when used all together in one specification. Also, they tend to remain of almost the same magnitude. All in all, this allows us to conclude, that these three variables indeed have propensity to explain equity liquidity and their impact is rather permanent.

However, market capitalization loses its statistical significance, indicating that, size of the company is not that important on the Baltic markets, as long as majority of companies are still considered to be small on international scale. Having access to global markets where companies' capitalization is measured in tens and hundreds of billions of euro, investors treat all Baltic companies as small firms, making market capitalization a poor determinant of liquidity on the Baltic market.

Table 6

Combined Effect of All Traditional Liquidity Determinants

	QBAS	*PBAS*	*ILLIQ*
StDev	**0.3721a**	**0.3553a**	**1.2786a**
	0.1356	0.0969	0.3375
SharePrice	**0.7032a**	**-0.3761a**	**-0.7513a**
	0.2020	0.1039	0.2948
Volume	**-0.3352a**	**-0.2228a**	**-0.5638a**
	0.0700	0.0339	0.1431
MarketCap	-0.1205	0.0253	0.0768
	0.1559	0.0575	0.3041
Constant	3.8319	0.0023	-2.7442
	2.9056	1.1530	4.6739
N	446	446	445
adj. R^2	93.5%	91.3%	87.1%

Note. *QBAS* is the natural logarithm of the annual average of the daily quoted bid-ask spread. *PBAS* is the natural logarithm of the annual average of the daily percentage bid-ask spread. *ILLIQ* is Amihud Illiquidity measure that is calculated on monthly basis and averaged over an annual period. *StdDev* is the natural logarithm of the annualized standard deviation of daily stock returns. *SharePrice* is the natural logarithm of the average annual closing price computed on annual basis. *Volume* is the natural logarithm of the annual cumulative number of traded shares in over an annual period. *MarketCap* is log of the natural logarithm of annual market capitalization at the end of the year. For each independent variable the first number is the coefficient, the second – standard error. a, b and c indicate statistical significance at 1%, 5% and 10%, respectively. Every regression includes company- and year-specific dummies, coefficients of which are not reported here. Source: Created by the authors.

All in all, concerning *Hypothesis 1*, we can conclude that it rather strongly supported; it is weakened only by absence of statistically significant relationship between liquidity and size of the company. Other variables affect liquidity as expected; perhaps, only share price is linked to liquidity in a more complicated way than hypothesized. Overall, explanatory power of traditional determinants is confirmed on the Baltic Market.

In the following section we will consider the novel determinants, while keeping these four variables as controls.

5.1.2 Quality of corporate governance.

Table 7 reports results of regressing three liquidity measures on Investor Relations Index with and without inclusion of traditional determinants.

Regression results show that the estimate for NASDAQ Investor Relations Index is constantly negative, which confirms our expectations. As corporate governance improves, liquidity providers become more secure about the symmetry of information distribution and demand smaller compensation for adverse selection risk in the form of bid-ask spreads. The coefficient, however, is almost never statistically significant. It is only significant at 10% level for one specification and indicates that an increase in the *Index* by 1 point would lead to 2.53% decrease in Amihud's illiquidity measure. The effects of volatility, price and volume on all three liquidity measures are statistically significant and follow predictions inferred from previous section.

Table 7

Effect of Corporate Governance on Stock Liquidity

	QBAS	*QBAS*	*PBAS*	*PBAS*	*ILLIQ*	*ILLIQ*
Index	-0.0112	-0.0091	-0.0108	-0.0065	**-0.0253c**	-0.0124
	0.0105	0.0082	0.0075	0.0082	0.0142	0.0162
StDev		**0.4657a**		**0.2919a**		**0.7480b**
		0.1021		0.0638		0.3318
SharePrice		**0.6620b**		**-0.3420c**		**-0.6719b**
		0.2815		0.1712		0.3124
Volume		**-0.4634a**		**-0.1781a**		**-0.6638a**
		0.0852		0.0504		0.1766
MarketCap		-0.0104		**0.1425c**		-0.1041
		0.1842		0.0799		0.3512
Constant	**-2.5751a**	4.4049	**-2.7277a**	-2.6665	**-9.4018a**	1.8118
	0.7536	3.7838	0.5504	2.0603	1.0681	5.6663
N	286	276	286	276	285	276
adj. R^2	84.6%	93.3%	83.8%	87%	82.4%	87.6%

Note. *QBAS* is the natural logarithm of the annual average of the daily quoted bid-ask spread. *PBAS* is the natural logarithm of the annual average of the daily percentage bid-ask spread. *ILLIQ* is Amihud Illiquidity measure that is calculated on monthly basis and averaged over a year t. *Index* is NASDAQ OMX Baltic Investor relations Index. *StdDev* is the natural logarithm of the annualized standard deviation of daily stock returns. *SharePrice* is the natural logarithm of the average annual closing price computed on annual basis. *Volume* is the natural logarithm of the annual cumulative number of traded shares. *MarketCap* is the lag of natural logarithm of annual market capitalization at the end of the year. For each independent variable the first number is the coefficient, the second – standard error. a, b and c indicate statistical significance at 1%, 5% and 10%, respectively. Every regression includes company- and year-specific dummies, coefficients of which are not reported here. Source: Created by the authors.

5.1.3 Market-wide liquidity.

Our initial prediction about connection between liquidity on individual and market-wide level is based on the notion of commonality in liquidity similar to the one present in returns: part of them is entity specific, the other is systematic. Table 8 reports the estimates of relations between different individual and market-wide liquidity measures with and without traditional determinants. The link between them appears to be weak. Only two of three individual measures seem to be explained by market-wide liquidity at least to some degree. For instance, weighted aggregate liquidity measure has expected considerable relationship with quoted bid-ask spread, namely, positive statistically significant coefficient indicates that one standard deviation increase in the weighted market-wide quote bid-ask spread (0.057) leads to 21% change in the respective individual spread. However, the result fades in the regression when traditional determinants are included. Regarding percentage spread, simple market-wide measure proved to be more efficient. Both with and without control variables it is positively related to illiquidity on individual level. In presence of traditional determinants the coefficient falls from 3.25 to 2.59, indicating that one standard deviation increase in systematic liquidity leads to 28% increase in individual liquidity. Regression with Amihud's Illiquidity measure does not produce any reliable estimates.

Table 8

Effect of Commonality in Liquidity on Stock Liquidity

	QBAS	*QBAS*	*QBAS*	*QBAS*	*PBAS*	*PBAS*	*PBAS*	*PBAS*	*ILLIQ*	*ILLIQ*	*ILLIQ*	*ILLIQ*
Simple MW	-0.0516	0.2011			**3.2548c**	**2.5905c**			163.61	4.7889		
Measure	0.5383	0.4738			1.7998	1.3454			206.43	98.8311		
Weighted			**3.7401c**	2.4076			-3.5979	-3.3200			1686.39	-360.31
MW measure			1.9738	1.6966			10.5742	7.2263			2655.34	1112.86
StDev		**0.3774a**		**0.3389a**		**0.3151a**		**0.3607a**		**1.2763a**		**1.2885a**
		0.1377		0.1112		0.0684		0.0981		0.3450		0.3570
Share Price		**0.6993a**		**0.7175a**		**-0.3890a**		**-0.3756a**		**-0.7518b**		**-0.7517b**
		0.2104		0.2065		0.1023		0.1070		0.3012		0.2921
MrktCap		-0.1079		-0.1462		0.0374		0.0332		0.0765		0.0853
		0.1798		0.1633		0.0551		0.0574		0.3007		0.3072
Volume		**-0.3350a**		**-0.3325a**		**-0.2251a**		**-0.2239a**		**-0.5641a**		**-0.5649a**
		0.0699		0.0674		0.0347		0.0337		0.1455		0.1415
Constant	**-2.6610a**	3.5543	**-3.0193a**	3.9794	**-3.2364a**	-0.6327	**-2.5708a**	-0.0123	**-9.8585a**	-2.7478	**-9.6621a**	-2.8309
	0.1981	3.4293	0.1856	2.9975	0.3109	1.2300	0.3063	1.1411	0.4493	4.7161	0.2469	4.7388
N	469	446	469	446	469	446	469	446	464	445	464	445
adj. R^2	88.7%	93.5%	89.2%	93.7%	88.2%	91.6%	87.7%	91.3%	80.9%	87%	80.9%	87%

Note. *QBAS* is the natural logarithm of the annual average of the daily quoted bid-ask spread. *PBAS* is the natural logarithm of the annual average of the daily percentage bid-ask spread. *ILLIQ* is Amihud Illiquidity measure that is calculated on monthly basis and averaged over a year t. *Simple MW* and *Weighted MW Measures* for *Percentage* and *Quoted Spreads* are respective daily measures averaged over an annual period without and with application of weighting procedure. *Simple MW* and *Weighted MW Measures* for *Amihud Illiquidity measure* are respective monthly liquidity measures averaged over an annual period without and with application of weighting procedure. *SharePrice* is the natural logarithm of the average annual closing price in computed on annual basis. *StdDev* is the natural logarithm of the annualized standard deviation of daily stock returns. *Volume* is the natural logarithm of the annual cumulative number of traded shares in a year. *MarketCap* is the lag of natural logarithm of annual market capitalization at the end of the year. For each independent variable the first number is the coefficient, the second – standard error. a, b and c indicate statistical significance at 1%, 5% and 10%, respectively. Every regression includes company- and year-specific dummies, coefficients on which are not reported here. Source: Created by the authors.

Overall, we receive mixed evidence about presence of common factor in stock liquidity on the Baltic market, a relationship we investigate further in Section 6.

5.1.4 Asset liquidity.

Table 9 shows that the link between asset and equity liquidity of the companies listed on the Baltic Stock Markets is not that firm. Even though all three asset liquidity measures are negatively related to both spread-based liquidity measures, supporting proposition that higher proportion of liquid assets lowers uncertainly about valuation of a company, the reported coefficients are mostly statistically insignificant. The only reliable coefficient is before *WAL3* in Percentage Spread regression; it indicates that 1% increase in the weighted proportion of all liquid assets in total assets will lead to 0.12% decrease in Percentage Spread. The result persists after inclusion of other asset liquidity measures and traditional determinants. However, for a similar regression with Amihud's Illiquidity measure, coefficient on *WAL3* is positive and significant, indicating that accounting for liquidity of tangible fixed assets increases uncertainty about valuation of the company. The magnitude of the coefficient is rather high – 1% increase in *WAL3* leads to 0.38% (0.57%) increase in *ILLIQ* measure in presence of traditional variables (and also other asset liquidity measures).

Table 9

Effect of Asset Liquidity on Liquidity of Equity

	QBAS	*QBAS*	*QBAS*	*QBAS*	*PBAS*	*PBAS*	*PBAS*	*PBAS*	*ILLIQ*	*ILLIQ*	*ILLIQ*	*ILLIQ*
WAL1	-0.0204			-0.0207	-0.0229			-0.0168	0.0378			0.0465
	0.0189			0.0204	0.0212			0.0271	0.0771			0.0828
WAL2		-0.0425		0.0318		-0.0900		0.0007		0.1400		-0.2812
		0.0714		0.0874		0.0479		0.0866		0.2191		0.3190
WAL3			-0.0642	-0.0765			**-0.1195a**	**-0.1101b**			**0.3830b**	**0.5724a**
			0.0639	0.0680			0.0343	0.0491			0.1652	0.1940
StDev	**0.3844a**	**0.3774a**	**0.3782a**	**0.3830a**	**0.3795a**	**0.3665a**	**0.3693a**	**0.3715a**	**1.3539a**	**1.3751a**	**1.3838a**	**1.3568a**
	0.1366	0.1362	0.1378	0.1410	0.1071	0.1074	0.1106	0.1120	0.3538	0.3356	0.3395	0.3162
SharePrice	**0.7275a**	**0.7280a**	**0.7318a**	**0.7384a**	**-0.2959b**	**-0.2814a**	**-0.2780a**	**-0.2696b**	**-0.6160b**	**-0.6380a**	**-0.6973a**	**-0.6860a**
	0.2186	0.2193	0.2149	0.2205	0.1308	0.1179	0.1145	0.1246	0.2482	0.2367	0.2383	0.2362
MarketCap	-0.1115	-0.1089	-0.1089	-0.1163	0.0238	-0.0312	-0.0286	-0.0377	-0.0395	-0.0292	-0.0013	-0.0101
	0.1686	0.1688	0.1662	0.1698	0.0665	0.0687	0.0669	0.0684	0.2694	0.2516	0.2689	0.2377
Volume	**-0.2851a**	**-0.2879a**	**-0.2887a**	**-0.2868a**	**-0.2054a**	**-0.2102a**	**-0.2114a**	**-0.2100a**	**-0.5299a**	**-0.5223a**	**-0.5129a**	**-0.5193a**
	0.0557	0.0562	0.0561	0.0567	0.0308	0.0320	0.0317	0.0322	0.1431	0.1461	0.1468	0.1406
Constant	2.9169	2.9215	2.9625	3.0185	-0.4700	0.5891	0.6362	0.7025	-1.0457	-1.2223	-1.7719	-1.7175
	2.7810	2.8157	2.7844	2.7922	1.1946	1.2725	1.2643	1.2478	4.6518	4.1474	4.1917	4.1569
N	406	406	406	406	406	406	406	406	405	405	405	405
adj. R^2	92.7%	92.7%	92.7%	92.6%	91.5%	91.5%	91.5%	91.5%	86.6%	86.6%	86.7%	86.7%

Note. *QBAS* is the natural logarithm of the annual average of the daily quoted bid-ask spread. *PBAS* is the natural logarithm of the annual average of the daily percentage bid-ask spread. *ILLIQ* is Amihud Illiquidity measure that is calculated on monthly basis and averaged over a year. *WAL1* is the natural logarithm of Weighted Asset Liquidity measure 1 that incorporates only most liquid assets for every company in a given year. *WAL2* is the natural logarithm of Weighted Asset Liquidity measure 2 that incorporates most and relatively less liquid assets (with different weights) for every company in a given year. *WAL3* is the natural logarithm of Weighted Asset Liquidity measure 3 that incorporates most and relatively less liquid assets, as well as all tangible fixed assets (with different weights) for every company in a given year. *StdDev* is the natural logarithm of the annualized standard deviation of daily stock returns. *SharePrice* is the natural logarithm of the average annual closing price in computed on annual basis. *MarketCap* is the lag of natural logarithm of annual market capitalization at the end of the year. *Volume* is the natural logarithm of the annual cumulative number of traded shares in a year. For each independent variable the first number is the coefficient, the second – standard error. a, b and c indicate statistical significance at 1%, 5% and 10%, respectively. Every regression includes company- and year-specific dummies, coefficients of which are not reported here. Source: Created by the authors.

Overall, it is reasonable to conclude that the effect of asset liquidity, notably of the measure that incorporates the highest portion of assets, is present; however, as long as effects for two liquidity measures point in different directions, it is implausible to establish its nature and to pinpoint the mechanism which it works through.

The usual set of traditional variables is statistically significant in regressions; notably their coefficients are highly persistent across specifications and relations are as expected.

Concerning initially formulated *Hypothesis 2*, we anticipated that since the presence of analyzed novel determinants has not been researched intensively and has been tested and documented only on a few markets, no full support of effect of these determinants on liquidity should be expected. Obtained results tend to prove our expectations. Statistically significant relations with liquidity are documented, but they are commonly inconsistent across specifications or not robust to inclusion of traditional determinants. Given that no strong relationship is registered when novel determinants are analysed individually, the authors do not test them all together. Overall, we believe that divergence of our results regarding novel determinants from those estimated in the previous research is explained by the fact that the latter was conducted on developed market meanwhile Baltic markets are considered to be emerging.

5.2 Exploring the Nature of Results

The fundamental property of panel data is presence of entity and time specific effects. We explore this characteristic by examining how successful and significant only those effects are in explaining cross-sectional and serial variation in liquidity on the Baltic markets.

Table 10 provides a valuable insight into these relations by outlining estimates from regressing liquidity measures only on company or time dummies. Panel A indicates that all firm-fixed effects are very substantial, as all dummy variables are statistically significant. In addition, adjusted R-squared varies from 72% to 87% percent. Therefore, to major extent liquidity of each stock can be attributed to individual characteristics of its issuer, leaving a rather modest margin for common cross-sectional determinants.

Panel B considers importance of time-effects in explaining variation in liquidity on the Baltic Markets. All coefficients on binary variables for years are also statistically significant, indicating that some variation in liquidity can be attributed to the time of observation. Furthermore, as dummy variables for all years should be compared to the omitted one, it allows us to trace dynamics in liquidity; for instance, a substantial break in the measures in 2008 (relative to 2006) indicates that there was a certain liquidity dry-out which

can be attributed to financial crisis. In 2009 for quoted spread it is followed by a decrease, showing a positive improvement in the situation. However, more precise measures, namely percentage spread and Amihud's measure, are even higher in 2009 than in 2008, yielding a conclusion that liquidity problem attributed to the crisis persisted for at least two years on the market. All measures for 2010 indicate an improvement relative to the crisis years. Nevertheless, time effects are substantially lower than firm-effects, as only from 2% to 7% of total variation in liquidity measures is explained by them.

Table 10

Time and Firm Fixed Effects

	Panel A			**Panel B**		
	QBAS	***PBAS***	***ILLIQ***	***QBAS***	***PBAS***	***ILLIQ***
Firm effects						
# of dummies (one omitted)	115	115	115			
% significant	100%	100%	100%			
Time effects						
# of dummies (one omitted)				4	4	4
% significant				100%	100%	100%
D_2007				**0.0047a**	**-0.1308a**	**-0.1830a**
				0.0000	0.0000	0.0000
D_2008				**0.2942a**	**0.7833a**	**1.3138a**
				0.0000	0.0000	0.0000
D_2009				**-0.2670a**	**0.8740a**	**1.9857a**
				0.0000	0.0000	0.0000
D_2010				**-0.5281a**	**0.3794a**	**0.8898a**
				0.0000	0.0000	0.0000
N	469	469	469	469	469	464
adj. R^2	87%	76%	72%	2%	7%	6%
Fixed Effects & Clustering	**Firm**			**Year**		

QBAS is the natural logarithm of the annual average of the daily quoted bid-ask spread. *PBAS* is the natural logarithm of the annual average of the daily percentage bid-ask spread. *ILLIQ* is Amihud Illiquidity measure that is calculated on monthly basis and averaged over a year t. D_# is a dummy variable for each year. For each independent variable the first number is the coefficient, the second – standard error. a, b and c indicate statistical significance at 1%, 5% and 10%, respectively. Source: Created by the authors.

All things considered, time and firm effects are very strong on the Baltic markets, meaning that to major extent liquidity of a company depends on firm specific characteristics and a period when liquidity is measured. Therefore, as it is demonstrated above, only a few variables indeed influence liquidity of the stocks; insignificance of other variables should be attributed only to peculiarities of the chosen markets.

6 Discussion and Implications

Overall, there is empirical evidence of presence of certain liquidity determinants on the Baltic markets; thus, we explore which of them are trustworthy and how obtained results might be used on the real market place. The following section, first, looks into effects and

implications of traditional liquidity determinants and, second, analyses importance of novel determinants.

6.1 Traditional Determinants and Their Role on the Market

In this section we look at obtained estimates and develop practical implications of results concerning presence of traditional liquidity determinants on the Baltic Stock Market.

6.1.1 Volatility.

Expected relationship between liquidity and volatility mainly relies on the hypothesis that greater price volatility leads to greater risk associated with execution of the dealership function (Benston & Hagerman, 1974), because market makers would want higher compensation for keeping an inventory of a risky security, especially in case when the reason behind stock price behaviour is unknown.

Confirming this supposition the coefficient before *Standard Deviation* is positive and statistically significant at 1% level in all regression specifications for all illiquidity measures. Moreover, the magnitude of the coefficient is rather stable, meaning that the effect is persistent on the Baltic market and robust to inclusion of other variables.

We believe that this result has a direct implication for trading strategies. Deuskar (2006) argues that individuals are subject to certain heuristics and behavioural biases, which taken together, indicate that people tend to extrapolate their past experiences to forecast future events. In the context, it means when investors perceive risk to be low, they are willing to provide more liquidity. Since this perception of risk is created in the present but based on past volatility, we can infer that a trader tries to estimate his costs of exiting the position well in advance, probably even before he opens a position in a particular security.

6.1.2 Price.

It is theorized that there are various mechanisms which price can have an impact on equity liquidity through. Our evidence supports several of them.

First, looking at the *tightness* dimension of liquidity, our data seem to deliver controversial results – positive relation is estimated between *Quoted Spread* and *Price*, but negative – between *Percentage Spread* and *Price* (both are measures of *tightness* component of liquidity). The former relation confirms presence of *adverse selection costs* – investors are reluctant to invest in pricy stocks unless compensated appropriately because a small relative change in their prices can be rather pronounced in real terms.

There is also a negative relation estimated between *Percentage Spread* and *Price*. However, we believe that it does not contradict the previous finding. By construction this relation is bound to be negative, as percentage spread is nothing different but quoted spread

divided by midquote (which is highly correlated with price). In addition, negative relation shows that the effect of increase in price on percentage spread is stronger than effect of increasing price on quoted spread. Considering the results obtained for these two measures, quoted and percentage spreads, it is reasonable to conclude that the fixed cost component of the spread is quite high and, therefore, it is costly to quickly turn a position around.

Considering the last liquidity measure, Amihud's Illiquidity, which is a proxy for *depth* or *price impact* dimension of liquidity – a negative relation is estimated, indicating that on the Baltic market investors perceive price as an indicator of quality of assets; therefore, the higher the price is, the higher is probability that yet another deal will be executed at the prevailing price with no or small impact on currents quotes (higher price is associated with lower price impact).

These results also have direct implication for various agents on the market place. First, taking into consideration that high prices diminish tightness, management of issuing companies might prefer to execute a stock split to lower the price and thus make company's equity more desirable to investors, thereby enhancing investor relations. Furthermore, if equity is traded at very low prices management might choose a reverse stock split to improve its image and thus potentially improve liquidity by reducing price impact associated with trading its stock. Second, there is also a robust trading implication, stating that in order to reduce liquidity costs it is rational to execute large block trades with stocks priced at high levels, as under such conditions price impact is lower.

Overall, share price is a robust and significant liquidity determinant on the Baltic market with realistic implications.

6.1.3 Volume.

The negative relation between liquidity measures and cumulative annual volume is explained by the fact that higher volume improves investors' chances of finding trade counterparties, thereby easing the process of opening or closing positions. As a result, quoted spreads become narrower. On markets characterized by high volume levels dealers can afford lower fixed costs per unit traded (Brockman & Chung, 2003) and a single informed trader cannot move the price substantially (Breen et al., 2002). Our findings on the Baltic market are in line with prior studies: the higher the volume is, the more liquid the stock is.

In practice it is often observed that on the Baltic market limit order book is empty, or entries are present only on one side (bid or ask), or divergence between quotes and the last price at which the security was traded is very large. Huge price impact resulting from one single trade (sometimes a change of 3-5%), has a discouraging effect on market participants,

decreasing liquidity further. Since empirically the link between volume and liquidity is so strong, this connection could be exploited to improve the situation. One of possible policy implications is introduction of more market makers, who would be interested in providing liquidity. At the moment of writing there are only two market makers on the whole Baltic market: Orion Securities in Lithuania provide liquidity for four stocks, Finasta in Latvia – only for one (NASDAQ OMX Baltic, 2012d). Another option is to increase the number of shares available for trading by raising the free float. This would also be a signal of less monopolistic powers within a company, and enhance investors' loyalty.

6.1.4 Size.

Market capitalization, as a proxy for company size, has the least expected relationship with equity liquidity. Prior studies unanimously report a positive and statistically significant relationship between this variable and liquidity. When size is the only determinant of liquidity, they are related in the same manner as price and liquidity (statistically significant, positive for Quoted Spread, negative for Percentage Spread and Amihud's measure of illiquidity), which is logical, since market capitalization is nothing else but a product of price and number of shares. Our analysis, however, suggests that in presence of other determinants this relationship falls apart, capitalization becomes insignificant and often takes the opposite sign. Overall, we expect absence of the strong link between capitalization of a company and liquidity of its shares to be explained by the fact that when Baltic markets compete for investors' attention with international giants, even largest local companies seem rather small; thus, investors may not pay so much attention to their size. This idea is also reinforced by the fact that previous studies which documented a strong relationship are based on samples of companies with average market capitalization at least several times larger than in our case (from 250 million USD in Cannon and Cole (2011) to 39 billion USD in Chen et al. (2007)).

Thus, the absence of consistent results indicates that size is not one of the dimensions across which stocks compete for investors' liquidity.

6.2 Novel Determinants and Their Role on the Market

In this subsection we investigate obtained results concerning causality between liquidity and its novel determinants; we also look for potential implications of those.

6.2.1 Corporate governance.

The initial prediction states that causality runs from corporate governance to equity liquidity – the better disclosure practices are the better stock liquidity should be. To some extent, obtained results prove this relationship and point towards conclusion that better investor relations enhance symmetry of information distribution between management of a

company and its shareholders, thereby reducing liquidity costs arising due to *information asymmetry* and increasing liquidity. However, the results disallow us from generalizing. Even though estimated relationships between quality of investor relations and liquidity measures are negative, implying that poor disclosure practices in fact widen equity spreads and increase the asymmetric information risk, their statistical significance is rather low. A potential explanation lies in the fact that the chosen measure of quality of corporate governance, namely NASDAQ OMX Baltic Investor Relations Index, is rather noisy, as it combines a number of different factors which might transfer weak indirect effect on corporate governance to one index.

Overall, due to low significance of estimates potential implications are weak. Obtained results might become yet another stimulus for managements of companies to improve their image (in order to ease the process of trade for investors); furthermore, this result might become a secondary tool in investors' toolbox for choosing most liquid companies to invest in.

6.2.2 Asset liquidity.

By investigating impact of asset liquidity on equity liquidity we explore the effect of managerial investment decisions on stock liquidity. Even though three asset liquidity measures are computed, only one of them is significant in regressions with two (out of three) liquidity measures. Since the only significant asset liquidity measure incorporates all assets (except for intangibles) with different weights, we can conclude that what matters for investors on the Baltic markets is overall liquidity of the balance of a company (or tangibility of assets). The mechanism through which the causality runs is hard to pinpoint, as the iresults of regression with *Percentage Spread* as a dependent variable support the idea that the higher liquidity of assets-in-place makes valuation of a company more certain and thus reduces adverse selection liquidity costs and improves equity liquidity. Meanwhile estimates obtained in regression with *Amihud's Illiquidity* measure, support the idea that more liquid assets create ample opportunities for future investments and increase uncertainty about future cash flows, thereby create negative impact on liquidity.

Gopalan et al. (in press) claim that the link between asset and equity liquidity is weaker for firms with higher growth opportunities and for poorly governed companies. These might be the reasons for poor results that we obtain; namely, the Baltic companies have higher growth opportunities and lower quality of corporate governance. In addition they show that the relationship between asset and equity liquidity depends on investment opportunities;

thereby, absence of significant result can be attributed to low investment opportunities on the Baltic market during the chosen time period.

Overall, the data allows us to conclude that only liquidity of all assets-in-place (their tangibility) matters, but its impact on equity liquidity is unclear.

6.2.3 Commonality in liquidity.

By estimating relationship between individual and market-wide liquidity we explore an intuitive prediction that an investor can tell the difference between a liquid and an illiquid market, and therefore that the negative externalities of a market being perceived as illiquid affect liquid assets traded on it.

Overall, mixed and inconsistent evidence is obtained, namely, different market-wide liquidity measures (simple or volume-weighted) are statistically significant in regressions with different dependent variables. Hence, our evidence supports the idea that a market-wide shock on the Baltic Stock Exchanges has different effect on inventory costs for all assets. Thus, such shock will in different way influence depth, or bid-ask spreads, of various stocks. Furthermore, the argument that liquidity of numerous stocks can be affected by some private information through an increase in liquidity costs arising due to asymmetry of information is also weakly supported. Usually, it is argued that such private information exists and plays a role on industry level; therefore, weak estimates can be explained by a low number of companies within each industry on the Baltic market.

Real life implication of our results is that the "lemon problem" effect on the Baltic is rather weak, meaning that there is not enough evidence to conclude that illiquidity of one security has any impact on liquidity of another. Perhaps, an explanation lies in the notion that the number of listed companies is low and investors know them all well.

6.3 Our Findings and Previous Research

Little research into determinants of liquidity has been conducted on the Baltic markets; but, our findings, which are based on larger sample, generally confirm unsystematic results of previous studies.

First, considering estimates in Kokoškins and Baumanis (2001), our regressions with Amihud's Illiquidity measure as dependent variable indicate same relation with share price, namely positive relation between liquidity and price level. Furthermore, findings of this paper eliminate ambiguity regarding effect of volume and volatility of returns on liquidity in Kokoškins and Baumanis (2001) – the former is undoubtedly related positively to liquidity and the latter – negatively.

Second, regarding results in Kazlauskaite and Makauskas (2006), we confirm that market capitalization contrary to theory does not have any statistically significant effect on the Baltic Market. Another comparison can be made with respect to asset liquidity. Similarly with Kazlauskaite and Makauskas (2006) we document absence of impact of Cash-to-Assets ratio on liquidity. However, they document a weak relationship between current assets to total assets ration and liquidity (similar to our *WAL2* measure). We contribute to existing literature by taking one step forward and documenting that what matters on the Baltic markets in tangibility of assets (via *WAL3* measure which is essentially ratio of tangible-to-total assets).

Overall, regarding prior research on the Baltic Markets, by relying on wider panel and up-to-date data we resolve some ambiguity existing in the previous research by documenting statistically significant relations (and relying on several liquidity measures) or their consistent absence, and by providing additional insights in previously established relationships.

7 Conclusion

Liquidity of a stock market is crucial for insuring its functionality; otherwise, poor liquidity affects channels through which capital flows to owners of new business ideas, which has negative spillovers into real economy by widening the gap between potential and factual performance of the whole economy. Given emerging state of the Baltic market, researching liquidity becomes crucial for its future development. Thereby, the stated research question, concerning presence of traditional and novel liquidity determinants, is highly relevant, as it uncovers company- and market-specific characteristics which affect liquidity and thus can be used to enhance it.

In this paper we, first, develop a strong econometric model which serves to establish true relations between liquidity and previously documented determinants; in addition, restrictive nature of the model (as opposed to methods widely used in similar research) insures that significance and magnitude of the estimates are as close to unknown underlying parameters as possible. Thus, obtained relations are claimed to be robust.

Generally, we document strong presence of traditional determinants, and rather weak influence of novel variables on liquidity. Regarding the first category, we connect a robust negative effect of stock returns volatility to equity liquidity through risk. Price level negatively impacts *tightness* components of liquidity via adverse selection costs; in addition, it has positive effect on *price impact* component via the perception that stocks priced at low levels might be of poor quality. Furthermore, volume has a strong positive impact on equity liquidity as probability of finding a trade counterparty increases and risk falls. Apparently,

size of the company does not matter, as given investors' access to international markets, all Baltic companies seem to be of rather small size.

Concerning novel determinants, we investigated effect of three categories of variables. First, quality of corporate governance tends to have positive effect on liquidity, but we cannot generalize this relationship, since statistical significance of respective estimates is poor. Second, we consider effect of asset liquidity on stock liquidity; generally, we conclude that what matters for investors on the Baltic market is tangibility of assets; however, impact on liquidity is ambiguous. Lastly, we investigate how market-wide trends of liquidity affect individual stock liquidity; we find no consistent and statistically significant relationship between them. This allows us to reject the intuitively appealing explanation that "lemon effect" is present on the market and that illiquidity of some assets has impact on liquidity of the others.

Overall, we conclude that variables discovered several decades ago, which we refer to as traditional ones, are strongly present on the Baltic Market. However, novel variables, which are only being investigated now and whose relations with liquidity are being documented on developed markets, are weakly present. Somewhat random and seemingly spurious results that are obtained in regressions with them are with high likelihood attributed to emerging state of the Baltic market. Nevertheless, some conclusions can be still drawn from them.

All in all, this paper provides numerous implications, mostly – for trading strategies; knowing liquidity determinants allows investors to minimize liquidity costs associated with the transfer of the title of the share. In addition, estimated relationships provide some directions for further improvement of the market place.

Lastly, this research contributes to the existing body of literature on liquidity determinants on the Baltic Market by analyzing bigger number of potential determinants and by relying on much longer and wider panel, than has ever been attempted to. In addition, our analysis systemically classifies presence of most widely used and some novel determinants and thus summarizes which of them are consistently present on the market.

Suggestions of Further Research

Further research into liquidity determinants on the Baltic markets can follow several paths. First, it is reasonable to consider some less orthodox liquidity measures and a number of other novel determinants, as time restrictions and the scope of this thesis allowed us to analyze only a minor number of novel determinants. Second, when the NASDAQ OMX Investor Relations Index is available for a longer period of time, there might be discovered a

more robust link between quality of corporate governance and liquidity. Lastly, during the research process it was noticed that unclear econometric approach (especially with respect to the structure of error terms) is commonly used to establish liquidity determinants; therefore, it could be suggested to investigate presence of some factors (particularly novel ones) on developed markets relying on a more restrictive (and more robust) econometric model.

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Appendix A: Variables Used in Previous Research

		Tinic (1972)	Branch and Freed (1977)	Benston and Hagerman (1974)	Lesmond (2005)	Gopalan, Kadan and Pevzner (in press)	Frieder and Martell (2006)	Brockman and Chung (2003)	Alzahrani (2011)	Breen, Hodrick and Korajczyk (2002)	Chen, Chung, Lee and Liao (2007)	Demsetz (1968)	Cannon and Cole (2011)	Brennan and Subrahmanyam (1996)
Common Liquidity Measurer	Quoted Bid-Ask Spread	✓		✓					✓		✓	✓		
	Relative Bid-Ask Spread (deflated by midpoint)							✓	✓		✓		✓	
	Percentage Bid-Ask Spread (deflated by price)		✓											
	Effective Bid-Ask Spread (various modifications)					✓	✓		✓		✓			
	Amihud's measure				✓	✓							✓	
	Roll's measure				✓ †	✓								
	Dollar Volume				✓ †			✓					✓ †	
Specific Measures					LOT Measure	Zero Return Days		Dollar Depth		Price- and Quote-Net Turnover Based Illiquidity Measures	Transparency and Disclosure (T&D) rankings			Proxy for Adverse Selection Costs
Common Determinants	Price	✓	✓ (Inverse)	✓	✓			✓			✓	✓	✓	✓
	Size (Market Capitalization)				✓	✓	✓		✓	✓	✓		✓	✓
	Volume (number of Shares)	✓	✓		✓		✓	✓	✓	✓	✓ (Dollar Volume)		✓ (Dollar Volume)	✓
	Number of Transactions	✓ (No. of transactions)		✓					✓		✓	✓		
	St. Dev. Or Variance of Stock Returns	✓ (St. Dev. Of price)			✓ (St. Dev.)	✓	✓ (Variance)	✓ (Return Volatility)	✓ (St. Dev.)		✓		✓	✓
	Participation of institutional Investors	✓ (# of ints. inv.)					✓ (% held by ints. inv.)			✓ (% held by ints. inv.)				
	Number of Shareholders			✓								✓		
	Competition	✓ (Index)	✓ (Number of Markets)	✓ (Number of Competing Dealers) ‡ ‡								✓ (Number of Markets)		
	Price Appreciation		✓							✓				

† - not used for establishing liquidity determinants

‡‡ - in making market in a given security

Appendix A (continued)

	Tinic (1972)	Branch and Freed (1977)	Benston and Hagerman (1974)	Lesmond (2005)	Gopalan, Kadan and Pevzner (in press)	Frieder and Martell (2006)	Brockman and Chung (2003)	Alzahrani (2011)	Breen, Hodrick and Korajczyk (2002)	Chen, Chung, Lee and Liao (2007)
Specific Variables	Trading Continuity	Number of Securities Handled by a Specialist	Systematic risk (CAPM beta)	Legal Origins	4 Asset Liquidity Measures	Leverage	Dummy for China/Hong-Kong	Time Dummies	S&P 500 Inclusion Dummy	Liquidity (Simultaneous eq. model)
	Number of stocks carried by a specialist registered in a given stock		Unsystematic Risk	Enforcement of Insider Laws	Capital Expenditures	Return-on-Assets	Dummy for Blue Chip companies	Trade Sign	Dividend Yield	Transparency & Disclosure (T&D) rankings (Simultaneous eq. model)
	Total Purchasing Power of a Specialist			Efficiency of Judicial System	Market-to-Book ratio	Lagged Liquidity Measure			R-squared ‡‡‡	Asymmetric information
				Political Risk	Discretionary accruals				Old/up-to-date earnings release dummy	
					Return-on-Assets				Market Dummies	
					BHAR ‡				Options traded dummy	

‡ - Buy and Hold Annual Abnormal returns: Difference between annual return on firm's stock and return on a value weighted index
‡‡‡ - Percentage of the firm's return variance explained by return on an aggregate stock market portfolio - R-squared from CAPM regression

Appendix B: NASDAQ OMX Investor Relations Index

NASDAQ OMX Investor Relations Index is computed on annual basis since 2006. Every year all companies present on the Main list, as well as companies from the Secondary list with capitalization over 10 million Euros, are evaluated. The core purpose is to establish and award companies with the best Investor Relations practices.

The evaluation follows five basic lines. First, annual and corporate governance reports are analyzed. The idea is to establish how willing the companies are to disclose information in their reporting. The following is taken into account: information regarding financials, strategies, human resource policies, etc. In addition, disclosures about members of boards as well as their stakes in the company are highly appreciated. All in all, around 100 criteria are used. Second, analysis of an interim report is conducted. Examiners look into quarterly and semi-annual reports and base their evaluation on criteria similar to those in annual report section. The third part of evaluation concerns propensity of companies to disclose information via the stock exchange announcement system. Both content and quality are taken into consideration. Fourth, a company's website is also evaluated. Analysts mainly access what information that is important to investors is available there and how easy it is to retrieve it. The last part of evaluation is performed by professional security market analysts who are asked to rate competence of investor relations officer, quality of disclosed information and openness of management of as company to investors (NASDAQ OMX Baltic, 2012b).

In total there are several hundred criteria along which the evaluation is conducted. All of them are combined together and then rescaled to 100-points scale. Thus, every company under investigation gets a score between 0 and 100.

Table B1

Number of Companies Listed on NASDAQ OMX Baltic and Included in Investor Relations Index

	2006		2007		2008		2009		2010	
	Listed	**IRI**	**Listed**	**IRI**	**Listed**	**IRI**	**Listed**	**IRI**	**Listed**	**IRI**
NASDAQ OMX Tallinn	17	16	18	17	18	18	16	15	15	14
NASDAQ OMX Riga	11	11	42	40	36	14	35	12	34	13
NASDAQ OMX Vilnius	44	43	41	41	41	36	41	31	40	29
NASDAQ OMX Baltic	72	70	101	98	95	68	92	58	89	56

Source: Created by the authors using data from NASDAQ OMX Baltic (2012c) Website.

Appendix C: Statistical Tests

Table C1
Variance Inflation Factor (VIF) Test for Traditional Variables

Variable	*VIF*	*1/VIF*
MarketCap	2.63	0.379839
Volume	2.33	0.429426
SharePrice	2.01	0.496319
StDev	1.21	0.824049
Mean VIF	2.05	

Source: created by the authors using STATA statistical software.

Table C2
Variance Inflation Factor (VIF) Test for Traditional Variables and the Index

Variable	*VIF*	*1/VIF*
SharePrice	2.26	0.443167
Volume	1.92	0.521561
MarketCap	1.63	0.613751
Index	1.33	0.750640
StDev	1.17	0.855618
Mean VIF	1.66	

Source: created by the authors using STATA statistical software.

Table C3
VIF Test for Traditional Variables and Simple Market-Wide measure

Variable	*VIF*	*1/VIF*
MarketCap	2.70	0.370520
Volume	2.66	0.375651
SharePrice	2.02	0.495349
Simple MW measure	1.62	0.617870
StDev	1.23	0.815745
Mean VIF	2.04	

Source: created by the authors using STATA statistical software.

Table C4
VIF Test for Traditional Variables and Weighted Market-Wide Measure

Variable	*VIF*	*1/VIF*
MarketCap	2.63	0.379567
Volume	2.54	0.394385
SharePrice	2.06	0.486035
Weighted MW measure	1.32	0.755414
StDev	1.25	0.800807
Mean VIF	1.96	

Source: created by the authors using STATA statistical software.

Table C5
VIF Test for Traditional Variables and Weighted Asset Liquidity Measures

Variable	*VIF*	*1/VIF*
MarketCap	3.34	0.299231
Volume	2.57	0.389440
SharePrice	2.19	0.457235
WAL2	1.9	0.526417
WAL3	1.61	0.621803
WAL1	1.34	0.747670
StDev	1.25	0.799196
Mean VIF	2.03	

Source: created by the authors using STATA statistical software.

Table C6
Hausman test for fixed and random effects regressions

	Coefficients			
	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
MarketCap	0.3127196	-0.1000127	0.4127323	0.0688031
SharePrice	-0.86327	-0.3028438	-0.5604261	0.0849322
StDev	0.4563027	0.494674	-0.0383713	0.0138331
Volume	-0.2742041	-0.3513619	0.0771578	0.0210704

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic

chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 45.12
Prob>chi2 = 0.0000

Source: created by the authors using STATA statistical software.

Table C7
Modified Wald test for groupwise heteroskedasticity in fixed effect regression model

H0:	sigma(i)^2	=	sigma^2 for all i
	chi2 (106)	=	3.20E+32
	Prob>chi2	=	0

Source: created by the authors using STATA statistical software.

Table C8
Wald test for presence of time-fixed effects

(1)	2007. Year	=	0
(2)	2008. Year	=	0
(3)	2009. Year	=	0
(4)	2010. Year	=	0
	F(4, 332)	=	18.76
	Prob > F	=	0.0000

Source: created by the authors using STATA statistical software.

Table C9
Wald test for presence of entity-fixed effects

(1)	2. Firm	=	0
(2)	3. Firm	=	0
…			
(104)	113. Firm	=	0
(105)	116. Firm	=	0
	F(105, 332)	=	4.69
	Prob > F	=	0.0000

Source: created by the authors using STATA statistical software.

Appendix D: Transformation of Variables

After initial data was gathered we investigated whether it fulfils the basic assumption required for OLS regression, namely normality of distribution. As a result the following variables were log scaled: Volume, Market Capitalization, all three liquidity measures, all Weighted Asset Liquidity Measures, annualized standard deviation of daily stock returns and average price. As a result, the following descriptive statistics were obtained.

Table D1

Descriptive Statistics of Transformed Variables that are Used in Regressions.

	Obs	*Mean*	*Std. Dev.*	*Min*	*Max*
ILLIQ	464	-9.701	3.219	-17.898	-2.835
PBAS	469	-2.787	1.467	-5.838	0.207
QBAS	469	-2.449	1.787	-5.784	2.627
WAL1	429	-4.195	2.178	-10.830	-0.364
WAL2	429	-1.700	0.971	-6.902	-0.234
WAL3	429	-0.656	0.497	-4.052	-0.141
StDev	466	-0.477	0.548	-2.501	1.917
SharePrice	469	0.353	1.336	-3.041	5.203
Volume	466	13.323	2.949	4.450	19.810
MarketCap	450	16.819	2.102	11.658	21.456

Note. *QBAS* is the natural logarithm of the annual average of the daily quoted bid-ask spread. *PBAS* is the natural logarithm of the annual average of the daily percentage bid-ask spread. *ILLIQ* is Amihud Illiquidity measure that is calculated on monthly basis and averaged over a year. *WAL1* is the natural logarithm of Weighted Asset Liquidity measure 1 that incorporates only most liquid assets for every company in a given year. *WAL2* is the natural logarithm of Weighted Asset Liquidity measure 2 that incorporates most and relatively less liquid assets (with different weights) for every company in a given year. *WAL3* is the natural logarithm of Weighted Asset Liquidity measure 3 that incorporates most and relatively less liquid assets, as well as all tangible fixed assets (with different weights) for every company in a given year. *StdDev* is the natural logarithm of the annualized standard deviation of daily stock returns. *SharePrice* is the natural logarithm of the average annual closing price in computed on annual basis. *Volume* is the natural logarithm of the annual cumulative number of traded shares in a year. *MarketCap* is the lag of natural logarithm of annual market capitalization at the end of the year. Source: Created by the authors.