The impact of illiquidity risk for the Nordic markets

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Abstract

In this study we propose a new measure of illiquidity for small, open stock markets; *dollar zero-returns*. Compared with other commonly used measures of illiquidity, the dollar zero-return produces the highest anomalous return across all four Nordic markets. In testing the pricing implication of the proxies of illiquidity, we use Acharya and Pedersen's (2005) liquidity adjusted capital asset pricing model (LCAPM) and nests the Liu (2006) model for a panel of twenty-five size related portfolios for the Nordic markets. Our results show that the only illiquidity measure that gives a significant positive effect across all Nordic markets is the dollar zero-return. Our results also show that the illiquidity mimicking portfolio factor, constructed through dollar zero-return, is the only factor showing a significant premium across different specifications, and its pricing remain significant also when the effect of the level of illiquidity (constructed through all measure of illiquidity) and of size is netted out.

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1. Introduction

Numerous studies have documented a link between illiquidity and asset pricing. Recently, however, the systematic aspect of illiquidity has been more closely examined than its asset specific characteristics. One of the first studies to employ this approach is Amihud (2002), where it is shown that unexpected changes in market illiquidity have a significant bearing on returns. This finding is further elaborated in other studies (see, e.g., Acharya and Pedersen (2005), Pastor and Stambaugh (2003), Sadka (2006) among others), which show that explanations of returns in terms of illiquidity risk are robust across many asset pricing anomalies. However, much of this evidence is from the U.S. market, which is supposedly one of the most liquid financial markets.

Conversely, illiquidity risk is expected to be priced in illiquid markets, as suggested in Bekaert et al. (2007). As a vindication of this point, a number of recent studies focusing on the illiquidity effect in a panel of global markets (Bekaert et al. (2007), Lee (2011) and Amihud et al. (2015)), find that there is a higher illiquidity premium for emerging markets in comparison to the developed markets. However, also a developed market can be, at least partly, classified as illiquid. There are many developed markets whose market capitalization is quite small, and where a significant amount of the listed companies are small and less frequently traded. The stock markets in the Nordic countries are good examples of this type of market, i.e., a developed market with a quite large fraction of less frequently traded companies. Hence, the purpose of this study is to analyze the illiquidity premium for small developed stock markets by looking at four Nordic markets, namely Denmark, Finland, Norway, and Sweden.

One of the most crucial aspects of illiquidity related studies is the selection of a proxy measure of illiquidity for an asset. There is an extensive literature available on possible proxies for measuring illiquidity. Unfortunately, there is no specific study that indicates which among these illiquidity measures is the most suitable for a specific country given its peculiar market micro-structure, especially in term of its pricing implication. Resultantly, this important point is left at the discretion of the researcher. Hence, in this study we adopt several proxies to measure illiquidity to reduce this selection bias.

We use four different measures of illiquidity proposed in previous studies, namely the measures proposed by Amihud (2002), Lesmond et al. (1999), Roll (1984) and Fong et al. (2017). All of these illiquidity measures are shown to be appropriate measures of illiquidity (see, e.g., Goyenko et al. (2009) and Fong et al. (2017)), such that they correlate significantly with their counterpart measures estimated through high frequency data. In addition, these measures have also been extensively used in studies of the pricing of illiquidity risk in numerous markets (e.g., Amihud (2002), Acharya and Pedersen (2005), Amihud et al. (2015), Bekaert et al. (2007), Lee (2011) among others).

Furthermore, we also propose a new measure of illiquidity; *dollar zero-returns*. According to Lesmond et al. (1999) a zero-return for a stock is recorded when the price change of the stock is smaller than the transaction cost of trading the stock in the market. Hence, the stock return and the possible recorded zero-return is calculated in the local currency. However, when dealing with small, open markets as the Nordic markets with a lot of foreign ownership (e.g., in Denmark (53%), Finland (45%), Norway (36%) and for Sweden (41%) of the market capitalization is held by non-residents), a local currency zero-return may not be a good proxy for illiquidity. So, instead of measuring the zero-return in the local currency we use the dollar zero-return as a proxy for illiquidity.

As a first check of the proposed illiquidity measures we test their ability to explain the return spread between the most illiquid and liquid stocks in the four Nordic markets. Of the measures used as a proxy for illiquidity, the dollar zero-return produces the highest anomalous return across all four Nordic markets. In testing the pricing implication of the proxies of illiquidity, we use Acharya and Pedersen's (2005) liquidity adjusted capital asset pricing model (LCAPM) and also nest Liu (2006) model into it by constructing illiquidity mimicking portfolio. These models are tested for the panel of twenty-five size related portfolios for the Nordic markets. Furthermore, we take out the size effect from illiquidity mimicking portfolio. Our results show that the only illiquidity measure that gives a significant positive effect across all Nordic markets is the dollar zero-return. Our results also show that the illiquidity mimicking portfolio factor is the only factor showing a significant premium across different specifications, and its pricing remain significant also when the effect of the level of illiquidity (constructed through all measure of illiquidity) and of size is netted out.

The reminder of the paper is organized as follows. Section 2 discusses the different illiquidity measures, and. Section 3 describes the methodology and the data. Section 4 presents the characteristics of the new measure of illiquidity, while the empirical findings are presented in Section 5. Section 6 concludes the study.

2. Illiquidity Measures

There is an extensive amount of literature on possible proxies for measuring illiquidity. In this study we use four alternative measures, and also propose an additional measure for a small, open stock market as the Nordic markets.

2.1. *Amihud measure*

The first measure is the Amihud measure ("Amihud"). This measure, which takes into account the impact of trade orders on returns, is most likely the most commonly used measure of illiquidity. Proposed by Amihud (2002), it intrinsically conforms to Kayle's (1985) concept of illiquidity and is used by Acharya and Pedersen (2005), among others. It is estimated as

$$ILLIQ_{im} = 1/D_{im}\sum_{d=1}^{Dim}\left|R_{imd}\right|/VOLD_{imd} \ , \tag{1}$$

where D_{im} is the number of days for which data are available for stock *i* in month *m*. The absolute return, $\left|R_{imd}\right|$, on stock *i* on day *d* of month *m* is divided by its corresponding day traded volume in local currency, $VOLD_{imd}$. The daily traded volume is the number of shares of stock *i* traded multiplied by the end-of-day price for the stock. The ratio $\left|R_{imd}\right|/VOLD_{imd}$ gives the absolute change in return per unit of local currency traded, or the daily price impact. Naturally, $ILLIQ_{im}$ is higher for an illiquid stock than for a liquid stock. To construct a market measure of illiquidity, we average the estimated Amihud measures for all stocks during a month. One of the criteria used by Amihud (2002) is that a stock should be traded for at least 15 days during the month to be included in the market measure of illiquidity. This condition, however, excludes a large number of stocks listed in the four Nordic markets. In addition, the stocks that are omitted as a result of this condition are mostly illiquid stocks. Therefore, to get a more representative market illiquidity measure, we also use a specification where we waive this restriction.

2.2. *Local currency and dollar zero-return*

Lesmond et al. (1999) crystallized Rosett's (1959) notion of friction in the economy, i.e., the idea that if an asset has a small market return (absolute)[1], holdings of that asset may remain unchanged because of transaction costs. This lack of change in stock holdings is manifested in zero-returns. The larger the number of an asset's zero-return days, the higher is the anticipated transaction cost of the asset. The zero-return measure has been used as a measure of illiquidity

[1] Absolute market returns as profitability of trade can be through buying and selling, as investor benefits neither from buying nor from selling if absolute change in market return is small.

in a number of recent studies[2]. In all previous studies these zero-returns for stocks are calculated as local currency returns. This measure of illiquidity (ZR) is estimated as,

$$ZR = \text{Total number of zero return days} / \text{Total number of trading days.} \qquad (2)$$

We also propose an alternative measure that we think can be a more appropriate measure of illiquidity for small open stock markets as the Nordic markets, namely the dollar zero-return (ZR$). When dealing with small, open markets as the Nordic markets with a lot of foreign ownership (e.g., in Denmark (52%), Finland (42%), Norway (35%) and for Sweden (56%) of the market capitalization is held by non-residents)[3], a local currency zero-return may not be a good proxy for illiquidity. A non-resident investor can benefit not only from a change in the local price of a stock, but also from a change in the exchange rate[4]. So instead of measuring the zero-return in the local currency we use the dollar zero-return as a proxy for illiquidity[5]. Hence, according to this measure, a zero-return is recorded when the local stock return is zero and this event is accompanied by no change[6] in the $/local exchange rate (hence, there are implicit zero returns from trading it in the Forex market). The measure is calculated as,

$$ZR\$ = \text{Total number of zero dollar returns in a month} / \text{Total number of trading days.} \qquad (3)$$

Therefore, dollar zero-return means that there is no change in an investment of one dollar made in any firm for a given day. Other economic intuitions also follow once we look into the definition of the dollar zero-return. That is, dollar zero-return for any firm means that it is not traded in local market due to lesser change in absolute returns in market index, this part

[2]Bekaert et al. (2007) used this monthly zero-return measure to examine the pricing implications of illiquidity risk. In addition, Goyenko et al. (2009) showed that this zero-return measure is related to a finer measure of illiquidity when estimated using high frequency data.

[3] The data is taken from IMF website on 9/22/2017; the data source is Coordinated Direct Investment Survey CDIS. The provided estimates are the annual average of ratio of non-resident investment in dollar over total market capitalization of the respective markets for the time series of 2009-2015.

[4] Even for local investors the dollar zero-return is better measure of illiquidity, as it gives higher value of illiquidity to the consecutively non-trading stocks. As the consecutive non-trading reduces a chance of getting higher returns through random exchange rate fluctuations.

[5] There is another additional benefit of measuring illiquidity is dollar zero-returns, as explained in Bekaert et al. (2007) that if the number of days of zero returns (non-trading) are the same for two stocks, then the illiquidity is more pronounced for the stock with consecutive non-trading days.

[6] We define a no change to be when the prices in dollars of the stock are same till two decimals for two consecutive days. Whereas, prices in dollars for two consecutive days are same for that stock which has zero-return in local market and this event is accompanied with almost no change in $/local exchange rate.

incorporates the Lesmond et al. (1999) definition. Then there is another condition that for the same day when the firm is not traded in local market, the change in the exchange rate $/local is also approaching zero. Therefore, a firm which is more often encountering minimum returns in local market and negligible movements in exchange rates, will have higher dollar zero-returns, as dollar price will remain the same that day. This we conjecture is a bigger instance for illiquidity as it also takes into account the length of non-trading intervals.

Such that if currency fluctuations are random and the stock is not traded for prolong period in local market then there are more chances of zero returns in both markets. Thus for these firms' dollar-zero returns are higher and it makes difficult for an investor to liquid her position from equity market to attain better returns through currency conversion. Investors therefore require compensation for investing in such stocks with which they get lock up and can't exit to fulfil their liquidity related requirements. The fulfilment of this conjecture requires the independence of average zero returns in local markets from the fluctuations in the exchange rate.

The absolute return of one dollar invested in any Nordic market is equal to the absolute return in local currency plus a change in the local currency versus dollar. For the dollar zero-return to be a meaningful measure, the change in the exchange rate should be independent from the average number of zero returns in the equity market. It is important, because if for any given day the zero-returns in the equity market are higher due to lesser absolute market returns (Lesmond et al (1999)), and this correlates strongly with the exchange rate, then both the ZR and ZR$ measures will be the same. In essence for ZR$ to be meaningful measure of illiquidity the zero-returns in stock markets should be independent from the change in $/local exchange rate.

As a first check, we calculated the daily average of zero-returns for all stocks, the absolute average market returns, and the absolute currency return for each of the four markets for the time period of 1988:4 to 2013:9 (a description of the data will be presented in Section 3). We grouped the returns in quintiles according to the average number of local zero-return days. In Figure 1, the first bar is the average number of zero-returns in the first quintile, whereas the second bar shows the average absolute market return. In higher quintiles, with a higher average number of zero-returns, the absolute average return is lower in all four Nordic equity markets. In the fifth quintile, when the zero-return is the highest, the absolute market return is the lowest. These results are in line with Lesmond et al. (1999) findings.

[Insert Figure 1 here]

That is, when the market return is high in absolute terms, the average number of zero-return is low, since the profits of trading far exceed the transaction costs of trading. The third bar in each quintile is the absolute rate of return on one dollar invested in local currency. This return on one dollar invested in local currency seems to be independent of the average zero-return and the average market return, indicating that the ZR and ZR$ measures will measure illiquidity differently. Resultantly, ZR$ allocate higher illiquidity in comparison to ZR, for the firm which is not traded for prolonged time period[7].

2.3. *FTH measure*

Fong et al. (2017) followed the intuition of Lesmond et al. (1999) limited dependent model for extracting the transaction cost for a given stock. The study indicates that their measure (FTH measure) dominates globally all prior illiquidity related cost proxies[8]. The basic idea is that the true return (R^T) differ from the observed return (R^O) due to transaction cost. Three different regions were demarcated in Lesmond et al. (1999), two in which the threshold of transaction cost due to the cost of buying and the cost of selling are breached by the true return R^T. In one region the bounds are not breached, which results in a zero-return, that is, the stock is not traded due to the transaction cost. Fong at al. (2017) assume that these costs of buying and selling are symmetric for any stock, and can be represented by $S/2$ and $-S/2$, respectively. Hence, the total round trip relative transaction cost for a given stock is S. Under these transaction costs, the Lesmond et al. (1999) model can be represented as

$$R^o = R^T + S/2 \quad \text{when } R^T < -S/2, \tag{4}$$

[7] This independence means that zero return in dollar denomination is a product of probability of zero return in local equity market and of no currency return. This observation allocates higher illiquidity to those stocks which have continuous long period of non-trading. To illustrate this point, we take a hypothetical example of two stocks that are not traded for 10 days, wherein the first case of non-trading days is randomly distributed and in the second case non-trading days are consecutive. For an ease of exposition we suppose that the probability of zero returns in the equity market for any given day and of the incidence of no change in currency return is 1/2 .As these events are independent, as per Figure 1, then the probability of zero returns in both markets is 1/4 and the simple expectation of 10 zero return days in both markets for the first stock will be 10 x 1/4 = 2.5. For second stock, on the other hand, the expectation of 10 zero return days in both markets will be 10 x 1/2 = 5, because in the equity market these zero return days occur consecutively and we know that already with probability 1, therefore zero returns on both markets is just the expectation of no change is local/$ exchange rates. As these expected numbers of zero return days are found in the numerator of equation (2), the second stock, with a longer non-trading period, is the more illiquid of the two stocks. So, to estimate the equation (2) we download the day end prices in dollar denomination for each Nordic market till two decimal points and no change in these prices for two days mean zero dollar return for that day.

[8] For interested readers we refer to the paper of Fong et al. (2017) for a detailed analysis of the FTH measure in comparison to other proxy measure of liquidity.

$$R^o = 0 \qquad \text{when } -S/2 < R^T < S/2\,, \tag{5}$$

$$R^o = R^T - S/2 \qquad \text{when } S/2 < R^T\,. \tag{6}$$

Moreover, it is assumed that true return, R^T for any individual stock follows a normal distribution with mean zero and variance σ_m^2 for any month. Evidently, the probability that R^T lies between the lower and upper bounds of $-S/2$ and $S/2$ is

$$P(-S/2 < R^T < S/2) = P(R^T < S/2) - P(R^T < -S/2)\,,$$

which can be written as

$$\phi(S/2\sigma_m) - \phi(-S/2\sigma_m)\,. \tag{7}$$

The observed probability of zero-return (probability of the middle region) is shown in equation (7). Hence, by equating the theoretical and observed probabilities and using the properties of the normal distribution, Fong et al. (2017) derived the following relationship for the transaction cost of any stock

$$FHT \equiv S = 2\sigma_m \phi^{-1}\left(\frac{1+ZL}{2}\right), \tag{8}$$

where, σ_m is the monthly volatility of the daily returns, and ϕ^{-1} is an inverse function of the cumulative normal distribution. Thus, FHT (2017) relates the transaction cost for a stock to the number of monthly zero-returns and the volatility of the return distribution.

2.4. Roll-Spread

Roll (1984) observed that the first-order auto covariance of changes in prices proxies trading costs. This measure has been used in many studies as a standard measure of illiquidity[9]. Roll shows, for a given level of market efficiency, that the effective bid-ask spread can be estimated as

$$S = 2\sqrt{-Cov(\Delta P_t, \Delta P_{t-1})}\,. \tag{9}$$

However, as observed for many stocks, the above measured covariance is positive and is, thus, undefined. We therefore used equation (9) to estimate the Roll-Spread for each firm only when

[9] Lesmond et al. (1999), Hasbrouck (2009), Corwin and Schultz (2012) propose new measures of illiquidity and show the effectiveness of their constructed measure by comparing it with a proxy measure of the effective spread proposed by Roll (1984).

the above covariance term is negative. Specifically, positive covariance terms were set to zero[10]. The Roll-Spread is then averaged across all firms.

3. Methodology and data

In this section we discuss the model and the data that is used in the study. We discuss the construction of illiquidity risk through different measures of illiquidity, the test portfolios, and the model used for the pricing of illiquidity risk.

3.1. Illiquidity Risk measures

The illiquidity measure is estimated for the Nordic markets using five alternative specifications. The Amihud measure is estimated using equation (1), the ZL and ZL$ are estimated using equations (2) and (3), the FTH is estimated using equation (8), and the Roll-Spread is estimated according to equation (9). These measures are estimated for all four markets as well as for 25 size related portfolios for the Nordic market. Instead of working with the illiquidity series directly, the innovation in the illiquidity related series are used as in previous studies. Therefore, we also imply the following *AR(2)* model,

$$L_t^i = c + \sum_{i=1}^{2} \Psi_i L_{t-i}^i + \varepsilon_t^i \ , \tag{10}$$

where, L_t^i represents the respective illiquidity series, and Ψ_i is the coefficients on the lag i. More importantly, ε_t^i is the innovation in the illiquidity series. These innovations for each illiquidity series, that is for market and test portfolios are collected from estimating equation (10).

In addition to the above market-wide illiquidity series, we also construct the illiquidity mimicking portfolios for each Nordic market. The construction of these factors follow the same approach as in Fama and French (1993) size and value related market strategies. The stocks for each country are split into small (S) and big (B) portfolios on the basis of size, and into three portfolios of low (L), medium (M) and high (H) on the basis of the monthly illiquidity measure. This results in six portfolios; SL, SM, SB, BL, BM and BH. The illiquidity factor (illiquidity mimicking portfolio) is the monthly return calculated as the average (SH, BH)-average (SL, BL), whereas the size factor (size mimicking portfolio) is calculated as the average (SL, SM, SH)-average (BL, BM, BH). It may be added that ZL$ is the only measure with which

[10] In the literature, many authors have converted a positive covariance into a negative one (see, for example, Harris (1990) and Lesmond et al. (1999)). Doing the same in our analysis would produce some counterintuitive results.

illiquidity mimicking portfolio has a series of positive returns. Resultantly, the results in the coming section are only presented with illiquidity mimicking factor, when it is constructed with ZL$.

We construct a total of 25 portfolios based upon firm size measured as the market capitalization[11]. Five portfolios are constructed for Denmark, Finland and Norway, respectively. However, for Sweden we use ten size related portfolios, since the average number of listed stocks in Sweden is about twice as many as in the other Nordic markets. A monthly sorting procedure is adopted. To give sufficient time for investors to formulate the size related strategy, one month is skipped between access to size related information and the portfolio formation.

3.2. The model

We use Acharya and Pedersen (2005) illiquidity adjusted capital asset pricing model (LCAPM), and extended it with two factor mimicking portfolios; *illiquidity* and *size*. The detailed economic intuition and assumptions for the derivation of LCAPM are discussed in detail in Acharya and Pedersen (2005), and this model has been used extensively in illiquidity related studies, see, i.e., Lee (2011). Therefore, we discuss only the unconditional and the testable version of the LCAPM which is presented as follows,

$$E(R_i - R_f) = \delta_c E(C_i) + \lambda_1\beta_1 + \lambda_2\beta_2 - \lambda_3\beta_3 - \lambda_4\beta_4 + \lambda_5\beta_5 + \lambda_6\beta_6 + \varepsilon_i, \tag{11}$$

where, $E(R_i - R_f)$ is the expected excess return on some portfolio, and $E(C_i)$ is its expected level of illiquidity. The β_i of the model are defined as,

$$\begin{aligned}
&\beta_1 = Cov(R_{i,t}, R_{m,t}) / Var(R_{m,t}, - C_{m,t}) && \beta_2 = Cov(C_{i,t}, C_{m,t}) / Var(R_{m,t} - C_{m,t}) \\
&\beta_3 = Cov(R_{i,t}, C_{m,t}) / Var(R_{m,t} - C_{m,t}) && \beta_4 = Cov(C_{m,t}, R_{m,t}) / Var(R_{m,t} - C_{m,t}) \\
&\beta_5 = Cov(R_{i,t}, L_{m,t}) / Var(R_{m,t} - C_{m,t}) && \beta_6 = Cov(R_{i,t}, S_{m,t}) / Var(R_{m,t} - C_{m,t}).
\end{aligned} \tag{12}$$

The market return over time is $R_{m,t}$, while $C_{m,t}$ is a proxy for market related illiquidity cost, and $L_{m,t}$ is the illiquidity mimicking portfolio from which the size effect is eliminated. Consequently, $S_{m,t}$ is a size mimicking portfolio. Lastly, $R_{i,t}$ and $C_{i,t}$ are stock/portfolio related returns and illiquidity costs over time.

[11] Size is defined as the number of shares outstanding multiplied by the day end prices.

The economic intuition and the interpretation of betas is discussed in detail in Acharya and Pedersen (2005), so here we only give a short description of them. The first beta, β_1, is the usual market beta, whereas betas β_2, β_3 and β_4 are illiquidity related betas that capture the exposure of the asset returns to illiquidity related market risk which is not captured by the market beta. The first illiquidity related beta, β_2, captures the effect of excess exposure of illiquidity of some asset to the market's illiquidity risk. A positive exposure results in higher risk, consequently, the price of this risk is positive as shown in equation (10). The second illiquidity related beta, β_3, captures the effect of market's illiquidity risk over asset returns. Hence, if market illiquidity risk increases and return on some asset also increases, then such stock is a better hedge against bad times. Accordingly, it is priced negatively in equation (10) (detailed pricing implication of β_3 is discussed in Amihud et al (2005) survey). The last illiquidity related beta, β_4, in LCAPM captures the exposure of market returns on the asset's illiquidity. The price of this illiquidity risk is negative. The pricing superiority of β_4 over other illiquidity related betas is discussed in Acharya and Pedersen (2005), and in Lee (2011). Following these studies we also define *Nbeta* = $\beta_2 - \beta_3 - \beta_4$ to explore the collective evidence of pricing of these illiquidity related betas.

By incorporating β_5 in LCAPM we eliminate the intricate relationship between illiquidity and size, further through β_5 we have extended Acharya and Pedersen (2005) model while nesting Liu (2006) model. As Liu (2006) estimated the illiquidity risk with illiquidity mimicking factor portfolio. There is one additional benefit for nesting in Liu (2006) model, as the all market and illiquidity related risks of Acharya and Pedersen (2005) are highly correlated among each other[12] and such is not the case with illiquidity mimicking factor portfolio. The interpretation of the price of risk associated with β_5 is quite straightforward. The stocks whose returns increases/decreases when return on the illiquidity mimicking portfolio increases/deceases (shown as $L_{m,t}$) exposes the return structure of the stock to illiquidity risk. Resultantly, the price of this illiquidity risk is positive. Lastly, β_6 accounts for the exposure of returns on the asset to the size mimicking portfolio. The size factor (shown as $S_{m,t}$) in the LCAPM is a controlling factor to enunciate the independent pricing ability of illiquidity risk. The price of this illiquidity risk is also positive. Although the effect of illiquidity and size is isolated by

[12] High correlation between market and illiquidity related betas are reported in AP (2005) paper.

construction, through multivariate regression analysis their independence can be further established.

3.3. Data

We study a sample of public stock market listed companies from four Nordic stock exchanges during the time period from April, 1988 to September, 2013. The information about price, dollar prices, total return index and volume data is collected from DataStream, as well as from the website of NASDAQ OMX Nordic. To address the issue of survivorship bias, we also include delisted companies in the sample.

The total number of companies included is 1842, out of which 1015 are Swedish, 415 are Norwegian, 239 are Danish and 173 are Finnish firms. In terms of coverage, the most of the firms are from Sweden. The total number of companies are, however, much larger than the average number of companies traded at a specific point in time. Hence, the average number of companies traded during a month is 714, out of which 328 are Swedish, 148 are Norwegian, 139 are Danish, and 99 are Finnish firms. We also follow Griffin et al. (2010) and Ince and Porter (2006) in some cases with extreme returns and extreme fluctuations in them are excluded. This is a standard procedure adopted in numerous papers.

4. The Characteristics of the Illiquidity measures

Illiquidity is a multifaceted concept, hence, any proxy measure of illiquidity may vary in terms of its success to capture all of the features of illiquidity. In line with this, Korajczyk and Sadka (2008) constructed a new measure of illiquidity by combining information from various measures of illiquidity, and find that their new measure has more significant implications for asset pricing than do the standalone measures. With this approach one can infer that generally there should be a positive correlation among different measures of illiquidity. Hence, we first analyze if there is a positive correlation between the different proxy measures for illiquidity, and put special attention on our proposed dollar zero-return (ZR$) measure. Secondly, unlike Korajczyk and Sadka (2008), instead of extracting a common component of illiquidity from the estimated measures, we conduct a horse-race among them to find the measure that is most relevant. By relevant we mean the measure that yields the highest return spread between the most illiquid and liquid portfolios.

In Table 1, it is apparent that ZR$ is positively correlated with all different measures of illiquidity[13], and its performance is in that sense better that its counterpart measure ZR. For instance, in the case of Amihud and Amihud-15[14], ZR more often exhibits a negative correlation, whereas with ZR$ this correlation is always positive. Similarly, the correlation structure of ZR with Roll is throughout negative, whereas the correlation between ZR$ with Roll is positive in three cases out of four. Hence, the overall impression is that the proposed new measure of illiquidity, ZR$, retains the benchmark characteristic as a measure of illiquidity.

[Insert Table 1 here]

The second test for the success of the newly proposed measure of illiquidity is its relevance in pricing. For instance, to the extent that ZR$ is not correlated with other measures of illiquidity, it may be because it has some additional information which investors use to realize the risk inherent in investing in a specific stock.

In Table 2, using alternative proxies for illiquidity, we show the return spread between the most illiquid and liquid portfolios in each market individually, and collectively for all stocks traded in the four markets. As a procedure, we estimate the next month's return of a stock on the basis of its measured illiquidity in the previous month. The stocks are then divided into five quintile portfolios based upon the stock's illiquidity. The yearly return differential between the most illiquid and liquid quintiles are then calculated using different illiquidity measures.

As shown in Table 2, with the Amihud measure there is generally a positive spread between the most illiquid and liquid portfolios across all individual markets and for the total Nordic market. However, when using an alternative specification of the Amihud measure, Amihud-15, then counter intuitive spreads are seen for most of the markets. One implication is that the stocks which are traded for at least 15 days (about 50% of the sample stocks) have no illiquidity premium. With ZR, there is also a positive illiquidity premium. As a robustness check we also estimate an alternative measure (ZR80), where we only include stocks that are traded for at least five days in a given month (or alternatively, no more than 80% zero return days). With this specification the recorded return spread significantly reduces for most markets.

When using the dollar zero-return (ZR$) as a measure of illiquidity, the return spread is large for all individual markets as well as for the total market, indicating the same pricing ability

[13] Except for Finland, where ZL$ correlation with Roll is -0.0474.

[14] We also use an alternative specification of the Amihud measure where we estimate the illiquidity only for the stocks that has been traded at least 15 days in a given month.

across all markets. Using alternative specifications of the dollar zero-return measure also yields sizable return spreads. Including only stocks with at least five non-zero return days (ZR$80) yields large, positive return spreads for all markets. Including only stocks with at least 15 days of non-zero returns also gives a quite large spread for most of the markets, however, for Denmark the spread is negative. The overall impression from the results presented in Table 2 is that ZR$ is quite robust across different sub-sets of stocks traded in the Nordic markets, and that ZR$ is an appropriate measure of illiquidity which quantifies the illiquidity effect better than other measures of illiquidity.

[Insert Table 2 here]

5. Empirical results

In this section, we discuss the time series characteristics of illiquidity related betas constructed through ZR$ and, then, consequently the results from the estimation of the Acharya and Pedersen (2005) illiquidity adjusted capital asset pricing model (LCAPM).

5.1. The time series characteristics of illiquidity related betas through dollar zero-returns

Another way to analyze the performance of ZR$ as an illiquidity measure is to study the time series properties of illiquidity related betas, as well as the level of illiquidity for the size related portfolios. The level of illiquidity of the portfolios is calculated based upon the individual stocks illiquidity using equation (3), and illiquidity related betas are estimated according to equation (11) for the size related portfolios for all Nordic countries individually.

Table 3, panel A, shows the results for Denmark for five, equally large, size related portfolios, where the first portfolio consists of the smallest companies (according to their market capitalization). The first column shows the average monthly return of the portfolios, and the second column the market beta. Columns 3 till 6 show the LCAPM related illiquidity betas, and column 7 and 8 the illiquidity and size related betas estimated through illiquidity and size mimicking portfolios using ZR$ and the market capitalization of the firms, respectively. Lastly, column 9 shows the level of the illiquidity measure of each size related portfolio.

Except for the market beta, β_1, there is a visible monotonicity in the illiquidity related betas and in the level of illiquidity of the portfolios. For instance, β_2, which captures commonality in illiquidity, is the highest for the smallest size portfolio and lowest for the biggest portfolio. This indicates that when market's illiquidity increases, then the illiquidity of the smallest size portfolios increases the most. Similarly, β_3, which shows the flight to liquidity effect as indicated in Amihud (2002), alludes that the prices of the most illiquid stocks depressed the most, i.e., a larger negative exposure when market illiquidity suddenly increases. Accordingly, for the small size portfolio this negative effect is the highest in comparison to the larger size portfolios.

Acharya and Pedersen (2005) showed that for the illiquid assets their illiquidity increases the most, compare to more liquid assets, given depressed market returns. Accordingly, β_4 is smaller for smaller size portfolios in comparison to larger size portfolios. Lastly, the Nbeta (defined as $\beta_2 - \beta_3 - \beta_4$), the collective exposure of all illiquidity related betas, also increases as the size of the portfolio decreases as per expectation. The result in Table 3 strengthen the impression that when illiquidity is estimated with ZR$, the performance of the illiquidity related betas is as per economic intuition laid down in Acharya and Pedersen (2005).

In addition to the Acharya and Pedersen illiquidity related betas, we also estimate the illiquidity exposure to each portfolio of the illiquidity mimicking factor ($L_{m,t}$) through β_5. This exposure is higher for the small size portfolios, which indicates that when there are higher returns in the illiquidity mimicking portfolio, then the small/illiquid portfolios gives higher returns in comparison to big/liquid portfolios, and vice versa. One advantage of estimating illiquidity related exposure this way is that it is independent of size factors by construction. The size related exposure is captured through β_6, which is higher for small portfolios and lower for large portfolios. Lastly, the average level of the illiquidity measure (ZR$) for each portfolio is shown in the last column. As expected, the small size portfolio is the most illiquid, and the level of illiquidity decreases as size increases.

The results for the other markets (Panel B to D for Finland, Norway and Sweden, respectively) are in line with the results presented for Denmark.

[Insert Table 3 here]

5.2 Estimating result for panel of 25 size related test portfolios.

An additional test of how well the new measure of illiquidity is in capturing the illiquidity risk, is to analyze how well it performs in pricing the risk in a panel of 25 size related portfolios for the Nordic markets in comparison to other measures of illiquidity[15]. We perform the test as a cross-sectional regression analysis over a panel of Nordic markets, hence, assuming that the estimated coefficients are the same for the test portfolios for these markets. However, to control

[15] We exclude the Roll-Spread measure from this analysis due to a lot of non-measurable observations.

for unknown country specific effects, each regression is run with country specific dummies. The model is estimated using equation (11). The estimation procedure is similar to that of Lee (2011), and the results are reported in Table 4.

[Insert Table 4 here]

In Panel A of Table 4, the cross-sectional models are estimated using the Amihud (2002) proposed measure of illiquidity. Models 1 to 4 are versions of Acharya and Pederson (2005) liquidity adjusted CAPM. In M1, the effect of the level of the portfolios illiquidity and the commonality of illiquidity risk estimated by β_2 is analyzed for test portfolios by netting out the effect of the market risk (β_1). Similarly, in M2, M3 and M4, we analyze the effect of the flight to quality (β_3), depressed wealth effect (β_4), and the collective effect of all illiquidity related betas (*Nbeta*). As shown in Table 4, the price of risk for all the illiquidity related betas (β_2, β_3 and β_4 from M1-M4) are small and insignificant. However, the level of illiquidity is mostly significant in the presence of market beta and illiquidity related betas. In model M5, the illiquidity risk is estimated through β_5, which is the exposure of test portfolios to illiquidity mimicking portfolio using ZR$. The estimated coefficient is statistically significant in this model. In model M6, we analyze if the level of illiquidity is priced over size related factors. The results indicate that size is more important than the level of illiquidity. Lastly, in M7, we analyze three factors, and illiquidity risk seems to be the most relevant factor. Moreover, M7 has the highest adjusted R^2 of 81.90% among all tested models. However, the illiquidity risk is only priced when effect of illiquidity is gauged by ZR$ and not by Amihud (2002)

In Panel B, we report the results from a similar analysis using the FTH measure instead. Here, the coefficient on the level of illiquidity is 0.662 with a *t-stat* of 7.10 and an adjusted R^2 of 79%. All illiquidity related betas of LCAPM are insignificant, and with signs not according to our hypothesis. For instance, for commonality in illiquidity the estimated price of risk is negative, instead of being positive. Similarly, for the depressed wealth effect, the estimated coefficient is positive instead of being negative. Also, the price of risk associated with flight to liquidity and *Nbeta* are statistically insignificant. In M5, the price of illiquidity risk estimated through ZR$ is 0.0119 with a *t-stat* of 2.16. The significance of the level of illiquidity is reduced to 0.397 with the *t-stat* of 3.12 in comparison to models M1-M4. As is evident from Panel A, the level of illiquidity and size are strongly correlated. This is tested in M6 using FTH, showing that the coefficient on the level of illiquidity is more or less the same as in models 1 to 5. Furthermore, in model M7, the price of illiquidity risk is statistically significant with a coefficient of 0.012 and a *t-stat* of 2.07. The independence of pricing of illiquidity risk in the presence of the size factor remains intact. Again illiquidity risk is priced when illiquidity is gauged through ZR$ and not by FTH (2017). In Panel C, we report the results from the analysis using ZRL as the illiquidity measure. The results for LCAPM are basically the same as for the two other measures of illiquidity.

Lastly, in Panel D, we report the results using ZR$ as the illiquidity measure. The level of illiquidity in M1 is significant. Further we see a visible improvement in illiquidity related risk factor of LCAPM, that is flight to liquidity β_3 coefficient, which is -0.0170 with a *t-stat* of -1.55, in fact it is quite near to the pricing effect of Liu (2006) illiquidity mimicking factor portfolio which has a coefficient of 0.0107 with a *t-stat* of 1.73 (given in M-5). Although this coefficient on illiquidity mimicking factor portfolio is reduced in comparison to results in panel A, B and C of M-5, but this is quite understandable as both the level of illiquidity, and the illiquidity mimicking portfolio are constructed through ZR$. However, the coefficient of the level of illiquidity has reduced to 0.0307 with a *t-stat* of 2.88, in comparison to M-1 in the presence of illiquidity mimicking portfolio factor. Indicating that with ZR$ both the level and risk associated with over all illiquidity effect are important[16].

These findings in panel D also shed a light that pricing of illiquidity effect primarily depends on the measure of illiquidity. If illiquidity measure is not associated with higher return dispersion between illiquid and liquid stocks[17], then it may result in the failure to establish a link between illiquidity effect and asset pricing, irrespective of the theoretical merits of some model like Acharya and Pedersen (2005) or empirically driven models like Liu (2006), and the same is exhibited in Panel A, B and C of Table 4. Since ZR$ measure is shown to be linked with higher illiquidity premium for Nordic markets, using different specification and we find that the both the Acharya and Pedersen (2005) and Liu (2006) models have performed well. Lastly, both the level and risk associated with an illiquidity effect are significant when captured through ZR$. Whereas, the illiquidity risk is not priced entirely with the rest of illiquidity measures. Although, the level is seemingly priced but in the specification M-7 (Panel A, B and C of Table 4) when illiquidity mimicking factor portfolio (ZR$) and size factor is included then the level of illiquidity is also rendered insignificant.

[16] We have not conducted any comparison between level and risk associated with illiquidity effect. Our main motivation in this paper is to test the illiquidity effect by using a newly proposed measure of illiquidity.

[17] As we have seen in Table 2, that except for ZR$ there is no other measure of illiquidity which is consistent across different Nordic markets to establish higher premium linked with illiquidity effect.

6. Conclusion

This study highlighted that the illiquidity premium is intrinsically linked with the selection of the measure of illiquidity for the analysis. Such that, the commonly used measures of illiquidity are not successful in finding the sizable premium for the Nordic markets. However, we find that the larger illiquidity premium across all Nordic markets is associated with the dollar zero-return (ZR$), a new measure of illiquidity that is proposed in this study. Such that, the illiquidity premium between 5th quintile of the most illiquid firms and 1st quintile of the most liquid in all Nordic markets is 18.05% on the annual basis. On the other hand, the illiquidity premium associated with other measures of illiquidity such as Amihud (2002), Lesmond et al. (1999), Fong et al. (2017) and Roll (1984) is only 4.27%, 2.59%, 4.34% and 2.91%. In addition to that ZRS$ retains all trademark characteristics of the illiquidity measure that are suggested in the literature, such that it is positively correlated with all other measures of illiquidity estimated in this study and inversely related with the size factor. The main difference in ZRS$ with other measures of illiquidity is that it also takes into account the opportunity cost for investing in the stocks that are not traded for longer duration.

We further notice that performance of liquidity risk adjusted models such as Acharya and Pedersen (2005) and of Liu (2006) also depends on the suitability of the measure of illiquidity chosen for the analysis. For instance, AP (2005) proposed some illiquidity adjusted factor loadings in addition to market beta. Using ZR$, the combined effect of illiquidity related betas (Nbeta) for all Nordic market line up with size related portfolios. Alternatively, Liu (2006) proposed illiquidity mimicking portfolio for the pricing of the liquidity risk in the US market. In this study we imposed another condition on the illiquidity mimicking portfolio that it is independent of the size factor. We find that with ZR$ only, the illiquidity mimicking portfolio yields positive returns across all Nordic markets. To understand the pricing implication of illiquidity level, market beta, illiquidity related betas, illiquidity mimicking portfolio and size factor for the panel of 25 size related portfolios for the Nordic markets. We nest the AP (2005) and Liu (2006) model with the addition of the size factor. Our results show that the illiquidity mimicking portfolio factor, constructed through ZR$, is the only factor showing a significant premium across different specifications, and its pricing remain significant when the effect of the level of illiquidity (constructed through all measure of illiquidity) and of size is netted out.

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Table 1 Correlation among the illiquidity measures in the Nordic markets

For each month and for all stocks listed in the Nordic markets, Denmark, Finland, Norway and Sweden, six different measures of illiquidity are estimated for the time period 1988:4 to 2013:9. The Amihud measure gauges the average monthly impact of traded volume on absolute return. Amihud-15 includes only stocks that are traded for at least 15 days in a given month. ZRL is a ratio of zero-return days, with returns measured in local currency, to the total number of trading days in a month. ZR$ is the ratio of zero-return days (where zero-return refers to the combined incidence of zero returns in the equity market and of no change in the $/local exchange rate) to the total number of trading days in a month. The FTH measure is a variant of the illiquidity measure proposed in Lesmond et al (1999) and suggested by Fong et al (2014). The Roll spread refers to the autocorrelation between daily changes in prices for a firm within a month and is estimated as $S = 2\sqrt{-Cov(\Delta P_t, \Delta P_{t-1})}$. All the estimated measures are equally weighted.

Panel A:Denmark

	Amihud	Amihud-15	ZRL	ZR$	FTH	Roll
Amihud	1.0000					
Amihud-15	0.0483	1.0000				
ZRL	-0.0303	-0.2800	1.0000			
ZR$	0.1134	0.2253	0.0021	1.0000		
FTH	0.0285	0.1930	0.4196	0.3992	1.0000	
Roll	0.0569	0.5557	-0.5620	0.4141	0.3253	1.0000

Panel B:Finland

	Amihud	Amihud-15	ZRL	ZR$	FTH	Roll
Amihud	1.0000					
Amihud-15	0.0482	1.0000				
ZRL	0.0598	0.1963	1.0000			
ZR$	0.1641	0.0874	0.6357	1.0000		
FTH	0.2084	0.1855	0.7700	0.4819	1.0000	
Roll	0.0957	0.2788	-0.0502	-0.0474	0.2859	1.0000

Panel C:Norway

	Amihud	Amihud-15	ZRL	ZR$	FTH	Roll
Amihud	1.000					
Amihud-15	0.489	1.000				
ZRL	0.085	-0.127	1.000			
ZR$	0.385	0.214	0.425	1.000		
FTH	0.417	0.186	0.671	0.508	1.000	
Roll	0.415	0.539	-0.097	0.2799	0.412	1.000

Panel D:Sweden

	Amihud	Amihud-15	ZRL	ZR$	FTH	Roll
Amihud	1.0000					
Amihud-15	0.4116	1.0000				
ZRL	-0.0099	-0.0886	1.0000			
ZR$	0.5012	0.4242	0.2144	1.0000		
FTH	0.2910	0.2366	0.3215	0.4882	1.0000	
Roll	0.4045	0.4303	-0.2246	0.5138	0.6580	1.0000

Table 2 Return dispersion between extreme portfolios

The table reports the annualized return dispersion between the most illiquid and liquid quintiles of stocks, using different proxies for estimating liquidity. The dispersion in returns is first shown for each country separately, and then for the entire Nordic market. Based upon the previous month's illiquidity, stocks are sorted into five portfolios; each successive portfolio is increasing in illiquidity. Next, the monthly return for each portfolio is calculated, and the difference between the average monthly return of the most illiquid portfolio (5th quintile) and the most liquid portfolio (1st quintile) is calculated and annualized. The time period is 1988:4 to 2013:9, and the reported returns are equally weighted. The Amihud measure gauges the average monthly impact of traded volume on absolute return. Amihud-15 includes only stocks that are traded for at least 15 days in a given month. ZRL is a ratio of zero-return days, with returns measured in local currency, to the total number of trading days in a month. ZRL80 is a ratio of zero-returns with the upper bound of 80%, that is, the stocks which are too infrequently traded are removed from the sample. ZR$ is the ratio of zero-return days (where zero-return refers to the combined incidence of zero returns in the equity market and of no change in the $/local exchange rate) to the total number of trading days in a month. ZR$80 includes stocks that are traded at least 20% of days within a given month. Similarly, ZR$15 includes only stocks that are traded for at least 15 days in a given month. The Roll spread refers to the autocorrelation between daily changes in prices for a firm within a month and is estimated as $S = 2\sqrt{-Cov(\Delta P_t, \Delta P_{t-1})}$.

	Denmark	Finland	Norway	Sweden	All Markets
Amihud	1.44%	1.99%	6.11%	5.99%	4.27%
Amihud-15	-7.96%	-11.04%	3.34%	-4.41%	-2.23%
ZRL	5.08%	2.94%	1.08%	7.14%	2.59%
ZRL80	0.21%	-0.74%	5.40%	2.15%	2.41%
ZR$	8.83%	18.20%	21.28%	18.11%	18.05%
ZR$80	5.14%	14.73%	23.87%	15.62%	16.02%
ZR$15	-9.71%	17.91%	20.15%	14.43%	13.48%
FTH	5.72%	-1.95%	10.67%	4.47%	4.34%
Roll	-3.34%	-5.62%	1.70%	4.00%	2.91%

Table 3 Characteristics of the size related portfolios

The table shows the average monthly return, the beta risks, and the illiquidity level estimated using ZR$ as the proxy for illiquidity risk. The monthly return (*Ret*) is reported for five equally large (ten portfolios for Sweden) size related portfolios. The portfolios are formed based upon the firm's market capitalization. The first portfolio consists of the smallest companies. The reported betas are estimated using equation (11). β_1 is the market related beta, and β_2, β_3 and β_4 are illiquidity related betas. The *Nbeta* is calculated as *Nbeta* = $\beta_2 - \beta_3 - \beta_4$. The *Lfac* is based on an illiquidity related strategy which by construction is independent of size. The stocks for each country are split into two portfolios based upon market capitalization (small (S) and big (B)), and into three portfolios based upon the illiquidity measure ZR$ (low (L), medium (M) and high (H)). The portfolios are rebalanced every month. The intersection of stocks results in six portfolios. The liquidity factor is the monthly return on a portfolio which is constructed as average (SH, BH)-average (SL, BL), whereas the size factor is calculated as average (SL, SM, SH)-average (BL, BM, BH). The respective factor loadings on these strategies are given under *Lfac* and *Size*. Lastly, *ZR$* is the overall average of the illiquidity measure of the stocks included in the respective portfolio.

Ret	β_1	β_2	β_3	β_4	*Nbeta*	*Lfac*	*Size*	*ZR$*
Panel-A Denmark								
1.31%	1.0483	0.3774	-0.2121	-0.1070	0.6965	0.4038	0.2880	0.2512
0.65%	0.9562	0.3392	-0.1095	0.0085	0.4403	0.1775	0.1704	0.1095
0.26%	0.9730	0.3336	-0.0911	0.0157	0.4090	0.2286	-0.1217	0.0737
0.32%	1.0285	0.2426	-0.0831	0.0262	0.2995	0.2109	-0.3097	0.0485
0.56%	0.9800	0.2372	-0.0444	0.0277	0.2539	0.1546	-0.3634	0.0273
Panel-B Finland								
1.42%	1.0298	1.2673	-0.1409	-0.1360	1.5442	0.4624	0.1187	0.2535
1.03%	0.9045	1.0995	-0.0408	-0.0551	1.1954	0.1991	0.0247	0.1500
0.79%	1.0097	0.9433	-0.0558	0.0104	0.9886	0.2876	-0.2269	0.1050
0.67%	0.9836	0.8506	-0.1119	0.0221	0.9404	0.3321	-0.4060	0.0700
0.27%	1.0429	0.7607	-0.0765	0.0066	0.8306	0.2553	-0.4767	0.0458
Panel-C Norway								
1.98%	0.9026	1.0226	-0.1224	-0.0067	1.1518	0.5064	0.2082	0.3008
1.28%	0.9735	0.9567	0.1087	-0.0550	0.9029	0.4427	0.0662	0.1915
1.04%	0.9895	1.0805	0.1010	-0.0114	0.9909	0.2749	-0.2633	0.1226
0.84%	1.0139	1.0284	0.1883	0.0090	0.8311	0.3326	-0.5883	0.0845
0.23%	1.0435	1.0597	0.2518	0.0113	0.7966	0.2360	-0.6474	0.0442
Panel-D Sweden								
2.35%	1.1062	1.1068	-0.2541	-0.0874	1.4483	0.4543	1.1149	0.4670
1.01%	1.0413	1.1775	-0.1455	-0.0377	1.3608	-0.1205	0.8676	0.3274
1.04%	1.0122	1.1458	-0.0751	-0.0377	1.2586	-0.0461	0.7101	0.2367
0.92%	0.9896	1.1482	-0.0109	-0.0072	1.1662	-0.2135	0.5662	0.1733
0.94%	0.9623	1.1184	-0.0244	0.0237	1.1191	-0.2716	0.4216	0.1374
0.89%	0.9795	1.0631	0.0450	0.0076	1.0105	-0.3543	0.4548	0.1139
0.95%	0.9917	0.9365	0.0014	0.0305	0.9046	-0.4507	0.3633	0.0841
0.64%	0.9605	0.8145	0.0694	0.0275	0.7175	-0.4091	0.3096	0.0624
0.31%	0.9078	0.7668	0.1477	0.0354	0.5837	-0.4948	0.1732	0.0513
-0.13%	1.0267	0.7250	0.1686	0.0314	0.5250	-0.5830	0.3650	0.0362

Table 4 Illiquidity risk and size related portfolios

The table provides estimates related to the illiquidity level for market, illiquidity and size related risk factors using cross-sectional regressions over a panel of four Nordic markets for twenty-five size related portfolios for the time period 1988:4 to 2013:9. The model used is:

$$E(R_i) = \alpha_0 + \delta_0 E(C_i) + \lambda_1 \beta_{1,i} + \lambda_2 \beta_{2,i} + \lambda_3 \beta_{3,i} + \lambda_4 \beta_{4,i} + \lambda_5 Nbeta_i + \lambda_6 \beta_{5,i} + \lambda_7 \beta_{6,i} + \varepsilon_i \,.$$

R_i is the portfolio excess return, $E(C_i)$ is the illiquidity level of each portfolio which is estimated using Amihud, FTH, ZRL and ZR$, respectively. β_1 to β_4 is factor loadings estimated using equation (11). The *Nbeta* is calculated as $Nbeta = \beta_2 - \beta_3 - \beta_4$. *Lfac* is a market based illiquidity related strategy which is by construction independent of the size factor, and the *Size* factor is a market based size related strategy which by construction is independent of the illiquidity factor, whereas β_5 and β_6 are the factor loadings on these factors. In panel A, we report the estimated coefficients using the illiquidity measure proposed Amihud (t-values in parenthesis). In panel B, C and D the same model is estimated using FTH, ZRL and ZR$, respectively. However, the *Lfac* and *Size* based risk strategies are constructed using ZR$. Lastly, the R^2 is reported in the last column, with the adjusted R^2 reported in the parenthesis.

Panel A:Amihud

Model	*Intercept*	*E(C_i)*	β_1	β_2	β_3	β_4	*Nbeta*	β_5	β_6	R^2
M1	0.0285	0.106	-0.0220	0.0001						.612
	(1.47)	(1.64)	(-1.12)	(0.82)						(.485)
M2	0.0335	0.152	-0.0270		0.0000					.599
	(1.78)	(4.79)	(-1.42)		(0.02)					(.465)
M3	0.0354	0.164	-0.0291			0.0076				.605
	(1.87)	(4.31)	(-1.51)			(0.54)				(.474)
M4	0.0290	0.110	-0.0224				0.0006			.611
	(1.49)	(1.71)	(-1.14)				(0.75)			(.481)
M5	0.0575	0.0607	-0.0444					0.0210		.853
	(4.72)	(2.40)	(-3.72)					(5.56)		(.803)
M6	0.0112	0.0582	-0.0094						0.0117	.764
	(0.71)	(1.61)	(-0.61)						(3.55)	(.686)
M7	0.0434	0.0395	-0.0336					0.0169	0.0049	.871
	(2.95)	(1.42)	(-2.52)					(3.77)	(1.58)	(.819)

Panel B:FTH

Model	*Intercept*	$E(C_i)$	β_1	β_2	β_3	β_4	*Nbeta*	β_5	β_6	R^2
M1	0.0228	0.662	-0.0253	-0.0004						.842
	(2.04)	(7.10)	(-2.04)	(-0.37)						(.790)
M2	0.0223	0.639	-0.0244		-0.0003					.844
	(2.00)	(9.34)	(-1.95)		(-0.61)					(.792)
M3	0.0220	0.658	-0.0221			0.0298				.842
	(1.86)	(7.08)	(-1.82)			(0.64)				(.789)
M4	0.0224	0.607	-0.0220				0.0005			.845
	(2.01)	(7.22)	(-1.91)				(0.64)			(.793)
M5	0.0393	0.397	-0.0331					0.0119		.874
	(3.17)	(3.12)	(-2.97)					(2.16)		(.832)
M6	0.0260	0.704	-0.0261						-0.0018	.842
	(1.94)	(3.57)	(-1.92)						(-0.36)	(.790)
M7	0.0387	0.373	-0.0324					0.0120	0.0006	.874
	(2.81)	(1.54)	(-2.52)					(2.07)	(0.12)	(.822)

Continue from the previous page

Panel C:ZRL

Model	*Intercept*	*E(C_i)*	β_1	β_2	β_3	β_4	*Nbeta*	β_5	β_6	R^2
M1	-0.0006	0.0314	0.0054	-0.0071						.719
	(-0.03)	(4.31)	(0.34)	(-0.73)						(.626)
M2	-0.0120	0.0385	0.0080		0.0115					.717
	(-0.81)	(4.95)	(0.54)		(0.65)					(.623)
M3	-0.0221	0.0478	0.0156			0.0265				.762
	(-1.60)	(5.74)	(1.16)			(1.96)				(.682)
M4	0.0051	0.0381	0.0019				-0.0104			.749
	(0.28)	(6.85)	(0.13)				(-1.66)			(.665)
M5	0.0325	0.0153	-0.0245					0.0186		.856
	(2.16)	(2.53)	(-1.86)					(4.27)		(.809)
M6	-0.0073	0.0134	0.0061						0.0100	.740
	(-0.50)	(0.84)	(0.43)						(1.43)	(.654)
M7	0.0328	0.0083	-0.0245					0.0176	0.0027	.860
	(2.15)	(0.69)	(-1.83)					(3.82)	(0.67)	(.803)

Panel D:ZR$

Model	*Intercept*	*E(C_i)*	β_1	β_2	β_3	β_4	*Nbeta*	β_5	β_6	R^2
M1	0.0208	0.0472	-0.0199	0.0001						.845
	(1.76)	(7.29)	(-1.78)	(0.01)						(.793)
M2	0.0210	0.0322	-0.0176		-0.0170					.863
	(2.04)	(2.97)	(-1.66)		(-1.55)					(.818)
M3	0.0207	0.0475	-0.0199			0.0006				.845
	(1.80)	(5.56)	(-1.73)			(0.03)				(.793)
M4	0.0189	0.0418	-0.0197				0.0027			.848
	(1.66)	(3.93)	(-1.78)				(0.58)			(.797)
M5	0.0359	0.0307	-0.0296					0.0107		.867
	(2.68)	(2.88)	(-2.51)					(1.73)		(.823)
M6	0.0254	0.0565	-0.0242						-0.0035	.848
	(1.97)	(3.75)	(-1.88)						(-0.65)	(.798)
M7	0.0355	0.0278	-0.0290					0.0112	0.0008	.867
	(2.52)	(1.18)	(-2.27)					(1.54)	(0.14)	(.812)

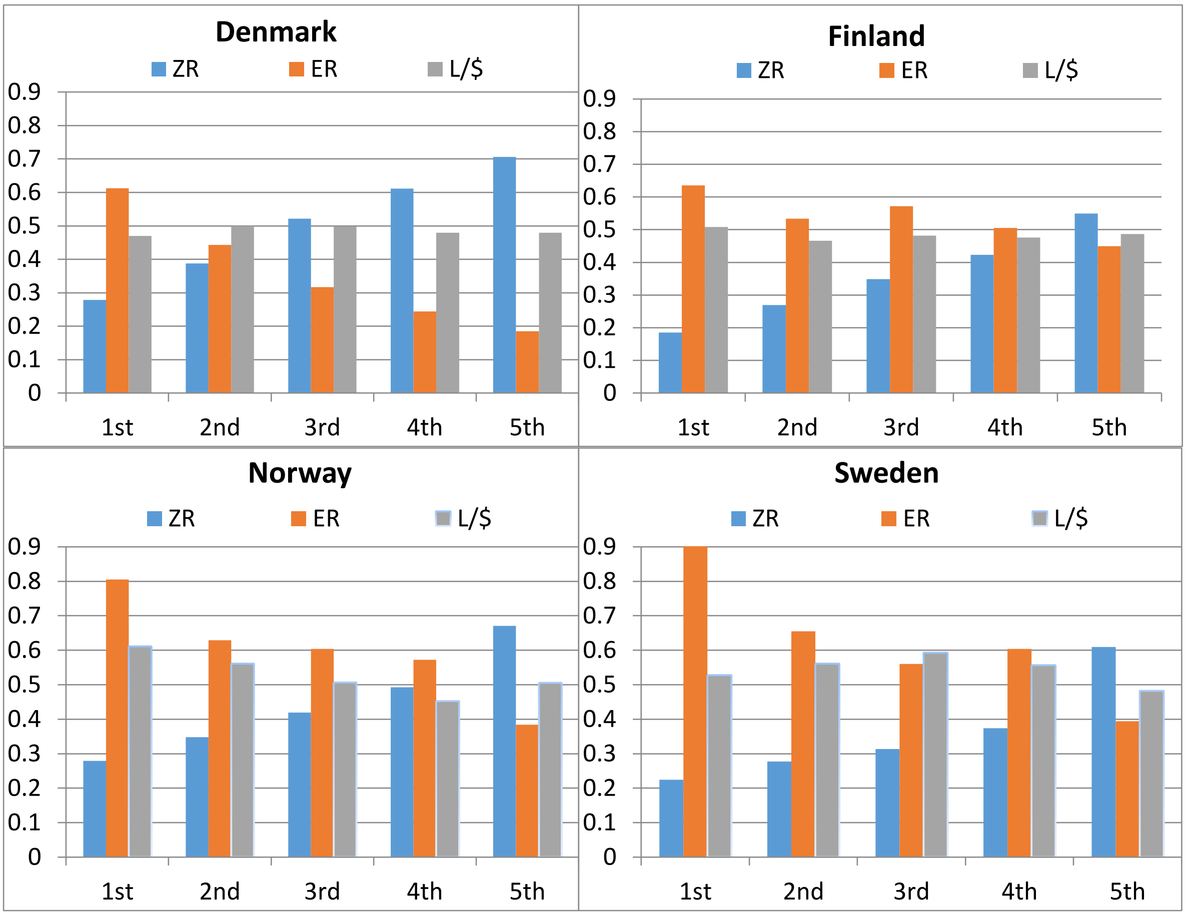

Figure 1 The fraction of zero-returns, the monthly stock market returns, and the return of the local currency to US dollar.

The figure shows the zero-returns (ZR) and the stock market (ER) and currency returns (L/$) for four Nordic markets for the time period 1988:4 to 2013:9.