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Illiquidity pricing and the drivers of market liquidity

Evidence from the Swedish stock market

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ABSTRACT

This thesis has a twofold stock liquidity related purpose. The study is based on Amihud's *ILLIQ*, an illiquidity measured defined as the average ratio of the daily absolute stock excess return to SEK volume. In Part I, we test the proposition that illiquidity is priced in the Swedish stock market. Monthly cumulative stock excess returns for OMXS stocks are regressed on *ILLIQ* and a number of stock characteristics, including beta, size and the book-to-market ratio. All stock characteristics are computed in year $y - 1$ and are constant over the twelve monthly regressions in year y. First, the monthly regressions are run separately, generating sets of stock characteristic slope coefficients. Then, the null hypotheses of zero mean of the characteristics' coefficients are tested. The results support the proposed pricing of illiquidity in Swedish stocks over the period from mid 1994 to 2008. In part II, we investigate the drivers of Swedish overall market liquidity over time, defining market liquidity as the average *ILLIQ* of OMXS stocks. The results support the effect of most of the suggested liquidity drivers on market liquidity, including Swedish and US consumer confidence, implied and realized volatility and foreign capital flow to the Swedish stock market.

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1. Introduction

The relationship between liquidity and stock excess return has been researched thoroughly, starting with Amihud and Mendelson (1986), followed by Hasbrouck (1991), Brennan and Subrahmanyam (1996), Eleswarapu (1997), Chalmers and Kadlec (1998), Easley et al. (1999) and Amihud (2002). They all confirm a positive relationship for US stocks. The empirical evidence for non-US markets is less abundant – we identify Fang et al. (2006), Lorder and Roth (2005) and Hu (1997). If illiquidity is indeed priced, the tests should be robust to change in market and time period.

This study consists of two parts. Part I examines the excess stock return and liquidity relationship in the Swedish stock market. We propose that *across firms and over time, stock excess returns increase with illiquidity*.

In Part II, we examine the drivers of market liquidity. Even though market liquidity varies considerably over time, this aspect of liquidity is little covered in academic research. With a number of macroeconomic and market-related factors, we try to explain some of the time variation in market liquidity in the Swedish market.

In Part I, we follow the method suggested by Amihud (2002). He introduced a measure of illiquidity, *ILLIQ*, which is the ratio of daily absolute stock return to its monetary volume, averaged over some period. In addition to other stock characteristics, including *BETA*, *SIZE* and *B/M*, *ILLIQ*'s relation to stock returns is tested using the Fama and MacBeth (1973) two-step procedure.

Liquidity is a versatile concept with several dimensions. Ergo, there are several measures of illiquidity. There are more sophisticated and accurate measures than *ILLIQ*, which capture more of the liquidity concept. These are generally microstructure-based and require trade-by-trade information that, for most stock markets, is available for limited time periods at best. Using *ILLIQ*, we can test the relationship between liquidity and stock excess return for a longer time period, using standard daily price and volume data.

In Part II, we use the across stock average *ILLIQ* as a measure of market illiquidity. With time-series regressions, we test how well the variation in *ILLIQ* is explained by factors including Swedish GDP and consumer confidence, US consumer confidence, the VIX index, stock market momentum and realized volatility.

Part I results confirm the US findings. Over the time period from mid 1994 to 2008, OMXS stock returns are positively and significantly affected by illiquidity. The effect remains significant when the time period is expanded to Q1 2010 and when various stock characteristics are included and omitted from the model. Further, we are unable to reject the null hypothesis of no effect of beta on stock return.

The Part II results confirm most of the suggested liquidity drivers' effect on market liquidity. US consumer confidence and the momentum variables are statistically significant and positively related to liquidity, whereas the VIX index and the 250 days realized volatility measure are significant and negatively related to liquidity. Swedish consumer confidence is significantly and positively related to liquidity when its US counterpart is excluded from the model.

The main contribution of our work is the confirmed pricing of illiquidity in the Swedish market and a suggested model of market liquidity drivers that significantly explain a great proportion of time variations in market liquidity.

The paper is organized as follows. Section 2 describes the liquidity concept, its measures and relevant previous findings in the area. Section 3 explains the method employed in Part I. In section 4, the Part I results are reported. Section 5 explains the method used in Part II, and the corresponding results are reported in section 6. Section 7 contains concluding remarks and section 8 suggested further research.

2. Background

2.1 The liquidity concept

Liquidity is the ease of trading a security (Amihud et al., 2005). Most standard asset pricing models, such as Sharpe (1964), Lintner (1965) and Mossin's (1966) Capital Asset Pricing Model (CAPM), assume frictionless markets, where every security can be traded at zero cost at all times and where assets with identical future cash flows have identical prices. In such a friction free setting, securities would be infinitely liquid.

Market friction is however a fact. The mere existence of bid ask spread, the difference in bid and ask prices, confirms this. Friction also comes in form of trade free days, time delays from order placement to execution, contractual trading restrictions, etc. Silber (1991) finds shares that are restricted from trade for two years average a 30 percent discount relative to non-restriction shares of the same company. Similarly, Chen and Xiong (2001) show an 80 percent discount of privately traded restricted institutional shares to their exchange-traded counterpart.

Academics diverge when defining the liquidity concept. Mainelli (2007) defines liquidity as the probability that an asset can be converted into an expected amount of value within an expected amount of time, whereas Keynes (1971) considers an asset more liquid if it is more certainly realizable at a short notice without incurring additional cost. Fernandez (1999) regards liquidity as the degree of which large size transactions can be carried out in a timely fashion, with a minimal impact on prices. Kyle (1985) addresses this divergence and states that liquidity is a slippery and elusive concept, motivated by how liquidity encompasses a number of transactional properties of markets. These properties, or dimensions, are depth, resiliency and tightness. Upper (2001) adds a fourth dimension, immediacy.

Depth refers to the stock volume that can be traded without significantly affecting asset prices. Researchers agree that depth is a dimension of liquidity but debate how to define it. Kyle (1985) regards depth as the size of order flow innovation required to change prices a given amount, while Fernandez (1999) defines depth as the volume of trade possible without affecting market prices. Kyle and Fernandez do, however, agree that in a deep market or stock, large trading volumes can pass without significantly affecting prices, and vice versa applying in a shallow market or stock.

If a large trade significantly moves the security price, the price should, ceteris paribus, return to the pre-trade equilibrium price when the price moving trading activity dissipates. Resiliency is the speed at which equilibrium is recovered (Garbade, 1982). Liquidity increases in resiliency.

Tightness is the size of the observable bid ask spread. On an order-driven market[1], such as the Stockholm Stock Exchange, it is the difference between the highest buy order and the lowest sell order in the consolidated order book (Gårdängen, 2005). The true asset value is somewhere between the bid and ask prices. Liquidity increases in tightness.

Immediacy refers to how soon an asset can be traded (Gårdängen, 2005). In order for a transaction to be completed instantaneously, a seller and a buyer must place matching orders at the exact same time. Immediacy is related to the probability of an instantaneous match, i.e. the short-term aspect liquidity. Impatient traders are forced to sell to a dealer (if present) at a discount and buy at a premium (Demsetz, 1968).

2.2 Illiquidity drivers and theoretical implication

In organized securities markets, investors are subject to both instantaneous and future trading costs. The components of trading cost of an asset include (i) brokerage cost, (ii) bid ask spread, (iii) price impact and (iv) opportunity cost (Damodaran, 2006 and Tinic, 1972). The discounted value of this cost stream is a proxy for the value loss due to illiquidity (Amihud and Mendelson, 1991). In this section, we describe what drives trading cost and, consequently, liquidity cost.

(i) Brokerage cost includes fixed and variable brokerage fees. This tangible transaction cost can attenuate liquidity (Amihud et al., 2005). The rationale is that investors, if possible, will restrain their trading activity when transaction cost rises. For example, the benefit of frequently rebalancing a portfolio is confined by the cost of rebalancing. If the transaction cost increase, less frequent rebalancing follows. Hence, brokerage cost is a disincentive to trade and an illiquidity driver. Jones (2002) however notes that brokerage costs have declined steadily since the seventies and averaged less than 0.10 percent of the traded value in 2000 in the US. According to Damodaran (2006) brokerage cost is the least significant illiquidity driver in modern securities markets.

[1] The alternative is a dealership market, where the bid ask spread is the difference between the bid and ask prices of the market makers.

(ii) The bid ask spread is intended to compensate the dealer for order processing cost, cost of informed traders and inventory cost (Gårdängen, 2005). Order processing cost is compensation to dealers for the fixed cost associated with maintaining presence in the market (Pagano and Roell, 1990).

If markets are efficient, all investor have access to every piece of information concerning all traded assets. If this efficiency is breached, the counterparties of a transaction might be unevenly informed. In such an environment, investors will not only trade for reasons associated with an efficient market, such as portfolio rebalancing. Instead, there will be a group of information traders who act on superior information. Information traders will buy undervalued securities and vice versa. Hence, dealers will seek to protect themselves against the probability of being the less informed party in an information trade. This protection comes in form of wider spreads.

In the same way private information about the fundamental value of a company can lead to excess return and widened spreads, private information concerning order flow can lead to excess return for the information holder. The rationale here is that if a trade is executed and the market is not deep enough to preserve equilibrium price, an informed investor can trade beyond equilibrium until the exogenous shock dissipates and equilibrium is reestablished (Brunnermeier and Pedersen, 2005).

Inventory cost is associated with the risk a dealer takes when providing immediacy to the market by holding an inventory of securities. Buyers and sellers, who are unlikely to prevail in the market the exact same time, demand this service. The dealers are compensated with increased spread and can secure a profit by selling at the ask price and buying at the bid price (Stoll, 1978).

(iii) Trading activity leading to deviation from equilibrium price has another implication. If an order drives price beyond equilibrium, parts or all of the order will be filled at a premium when buying and at a discount when selling. The result is an indirect trading cost, referred to as price impact (Damodaran, 2006).

(iv) An investor might consider delaying a trade instead of accepting the dealer's bid and ask prices. The opportunity cost associated with waiting is made up of the risk of value deprecation and the search cost of finding a party offering a more favorable price. In essence, the investor has switched one trading cost for another. Weill (2002) and Vayanos and Wang (2007) have confirmed the trade-off between speed of execution and favorable price.

If investors require compensation for the illiquidity costs (i) – (iv), a reflection of these costs in asset prices should follow (Amihud et al., 2005). Assuming rational investors, the costs will indeed be priced. Given that the costs (i) – (iv) are not identical to all securities, the cost of illiquidity will vary between securities.

2.3 Measures of liquidity

As described, liquidity is a versatile concept of several dimensions. Consequently, measuring liquidity is far from straightforward. Even though the dimensions are interrelated, academics have been unsuccessful in capturing them all in a single measure (Amihud et al., 2005). For standard size transactions, the bid ask spread is a suitable illiquidity cost proxy, whereas for larger transaction, the price impact dominates illiquidity cost (Kraus and Stoll, 1972 and Keim and Madhavan, 1996).

The most fine-tuned and sophisticated liquidity measures are all based on microstructure (trade-by-trade) data (Amihud et al., 2005). Brennan and Subrahmanyam (1996), Easley et al. (1999) and Kyle (1985) all construct or use microstructure measures. Inspired by Kyle (1985), Brennan and Subrahmanyam (1996) regress trade-by-trade price change on the signed order size, a method referred to as Kyle's λ. Kyle's λ captures several of the trading costs affecting liquidity, including brokerage fee and price impact. Easley et al. (1999) focus on the adverse selection of informed investors, and suggest the measure PIN, probability of information based trading. Based on the imbalance of buy and sell orders, PIN measures the fraction of information-based orders.

Kyle's λ, the PIN and other microstructure measures are all limited by the extensive data required to compute them. For many exchanges, the data is available over short time periods at best. Hence, other, less data intensive, measures are widely adopted.

Measures of trading volume aim at the depth dimension of liquidity and are used by Brennan et al. (1998), Kothare and Laux (1995) and Chalmers and Kadlec (1998). The rationale behind these, far from perfect proxies, is that liquidity increases in volume (Fernandez, 1999 and Upper, 2001). Their main limitation is how they not only detect price impact, but are also affected by volatility in prices. To tackle this problem, Datar et al. (1998) use stock turnover, the ratio of stocks traded to total stocks outstanding. But this too is a blunt instrument, since it scantily accounts for changes in free float and the price impact from large trades.

Several studies use the bid ask spread to measure liquidity. Amihud and Mendelson (1986 and 1989) and Eleswarapu (1997) note that under certain assumptions, the bid ask spread captures several liquidity dimensions. The main assumptions are availability of intra-day data and uniform trading flow, i.e. that trades come in standard size. Jang and Lee (1995) find that, if the closing bid and ask prices are used to compute the spread, instead of the average intra-day bid ask prices, the spread is significantly biased. They explain the bias with the dynamics of the exchange and the nature of the closing call. Regarding trade size, Upper (2001) stress that the only small or standard size trades can be filled at the observed spread. Larger buy and sell orders drive ask and bid respectively, resulting in an effective, unobserved spread that exceeds the observed spread.

The limited sensitivity of previous non-microstructure measures of liquidity to market depth has called for new liquidity measures. Amihud (2002) filled the shortage by adding the *ILLIQ* to the arsenal of measures. The *ILLIQ* is the average ratio of the daily absolute stock return to dollar volume, and captures the daily price impact of the order flow. In addition to the cost associated with bid ask spread, *ILLIQ* captures price impact of (small and) large trades. *ILLIQ* is strongly related to the Brennan and Subrahmanyam's (1996) microstructure measure of price impact (Amihud, 2002). Further, Hasbrouck (2006) reviews and confirms the connection between *ILLIQ* and microstructure based measures. Several researchers have used *ILLIQ* in its novel or in a modified form (Edision and Warnock, 2003, Manzler, 2005, Hashbrouck, 2006, Acharya and Pedersen, 2005, Fang et al., 2006 and Choi and Cook, 2007).

For the purpose of this study, we define illiquidity as Amihud's (2002) *ILLIQ* measure.

2.4 Previous findings

An early liquidity related cross-sectional study is Amihud and Mendelson's (1986). They find support for a positive effect of bid ask spread on stock return for NYSE and AMEX stocks from 1961 to 1980. This approach has since been revisited and modified. Eleswarapu (1997) finds similar results for NASDAQ stocks. Lorder and Roth (2005) use bid ask spread to explain difference in stock valuation in terms of price-to-earnings ratio in the Swiss market.

Brennan et al. (1998) and Datar et al. (1998) use different volume measures as liquidity proxies and find significant explanatory power of their measures on US stock return. Hu (1997) finds similar results for Japanese stocks.

Kyle (1985), Brennan and Subrahmanyam (1996), Easley et al. (1999) and Hasbrouck (2006) find support for the proposed pricing of illiquidity cost, based on their microstructure measures.

Amihud (2002) state that the *ILLIQ* measure significantly explains stock return for NYSE stocks from 1963 to 1997, based on the two-step Fama and MacBeth (1973) procedure. Fang et al. (2006) replicate Amihud's method on the Japanese market, and conclude that illiquidity is not consistently priced in Japan, especially during the period from 1990 to 1999.

Acharya and Pedersen (2005) use an *ILLIQ*-based illiquidity factor in an attempt to improve the explanatory power of Sharpe (1964), Lintner (1965) and Mossin's (1966) CAPM. When adding the illiquidity factor to the model, R^2 rises from 0.32 to 0.83, using US stocks from 1963 to 1999.

PART I

3. Method

3.1 Outline and data

The method is based on the *ILLIQ* measure of illiquidity and the econometric set-up of Amihud (2002). First, we regress cumulative stock excess return on stock characteristics, calculated the previous year, for a set of companies. We execute separate regressions each month during a time period. The characteristics include *ILLIQ*, stock beta, size, book-to-market ratio, standard deviation of returns, dividend yield, stock return momentum, number of stocks traded and stock turnover. Second, the set of monthly coefficients for each characteristic are averaged, and we test the null hypothesis of zero mean.

We use data for stocks listed on OMX Sweden (OMXS), at the Stockholm Stock Exchange (SSE), from Thomson Reuters Datastream, with 289 members at the end of April 2010. The time period goes from mid 1994 to end of 2008. The data consist of daily observations of closing price, intra-day high, intra-day low, number of shares traded and market capitalization, and yearly observations of common equity and dividends per share for each company. The data also includes daily observations of the OMXS index and Swedish 30 day T-bills ("Statsskuldväxlar")

Following Amihud (2002), we only admit stocks to the cross-section estimation procedure in month *m* of year *y* if they satisfy the following criteria:

(i) The stock must have valid observations of both daily return and turnover volume for at least 200 days in year $y-1$. Further, the stock must be listed at year-end $y-1$. The intention is to make more reliable estimators.

(ii) Outliers, defined as stocks whose average *ILLIQ* in year $y-1$ is at the highest or lowest one percent of the distribution, are eliminated, assuming that criteria (i) is fulfilled. In this way, extraordinary returns, driven by exogenous shocks such as earnings announcements and profit warnings, are excluded.

In addition to the criteria above, we exclude outliers in trade volume at a company specific level. For each company and year, we remove the one percent days of highest volume. The rationale is to eliminate extraordinary trade volume resulting from exogenous shocks, e.g. change of ownership of minority interests. Relaxing this assumption does not affect our conclusions.

A difference in market structure between Amihud's (2002) US sample and the OMXS is the existence of two classes of stock (frequently A- and B-stocks). The two classes of stock of the same company generally grant different voting right at the Annual General Meeting. One of the classes is generally traded much less than the other (in our sample, averaging less then one percent to a few percent), but its daily return generally closely tracks the return of the more traded counterparty. To include the less liquid class would contaminate our regressions, since the volume traded does not drive the return of the class. Hence, we have excluded all less liquid class in case of multiple classes listed. At the end of April 2010, there were 33 such listings.

3.2 ILLIQ

Stock illiquidity, denoted *ILLIQ*, is defined as the average ratio of the daily absolute stock excess return to daily (monetary, here SEK) trading volume. This is the absolute percentage price change per SEK of trading volume, the price impact of the order flow (Amihud, 2002). In the empirical study, the annual average of stock illiquidity, $ILLIQ_{iy}$, is used, following

$$ILLIQ_{iy} = 1/D_{iy}\sum_{t=1}^{Diy}\left|R_{iyd}\right|/VOLD_{iyd},$$

where R_{iyd} is the daily absolute excess return of stock i in year y, $VOLD_{iyd}$ the daily SEK trading volume and D_{iy} is the number of trading days with available data for stock i in year y. The $ILLIQ_{iy}$ later used is multiplied by 10^4.

To obtain $VOLD_{iyd}$ for a specific day, the value of all individual trades that day should be summed up. The Datastream database lacks such data for Sweden and the US. Amihud (2002) uses (i) the daily total volume multiplied by closing price as a proxy for trading volume. We have considered this together with two other proxies for trading volume. These are

(ii) $V_{proxy2} = \dfrac{(P_{t-1} + P_t)}{2}\cdot NT_t$, and

(iii) $V_{proxy3} = \dfrac{(P_{t-1} + P_t + P_H + P_L)}{4}\cdot NT_t$,

where P_t is the closing price, P_{t-1} is the closing price the previous day, P_H is the intraday high, P_L is the intraday low and NT_t is the number of shares traded in day t. We tested the three proxies for ten[2] Japanese companies. Of the markets for which Datastream reports trading volume, Japan has the highest total market capitalization. We test the correlation between the three proxies (i), (ii) and (iii) on one side and the true $VOLD_{id}$ one the other side. The correlation coefficients are 0.9992, 0.9990 and 0.9997 respectively, suggesting that all three proxies are highly satisfactory. Proxy (iii), however, stands out and we use this version when computing *ILLIQ*.

R_{iyd}, the daily excess return, is defined as

$$R_{iyd} = r_{iyd} - rf_{yd},$$

where r_{iyd} is the return of stock i on day d and rf_{yd} is the unobserved risk free interest rate that day. We use 30 day Swedish T-bills to represent rf_{yd}.

[2] Toyota Motor, NTT Docomo Inc, Nippon Telg. & Tel., Honda Motor ,OJI Paper, Nippon Express, Kuraray, Heiwa Real Estate, Mitsubishi Paper Mills and Unitika. These were the, by market capitalization, the four largest, three middle and three smallest components of the Nikkei 225 on 21 April 2010. Limited by data availability, the period covers August 2008 to April 2009.

ILLIQ should increase in other measures of illiquidity. To test this proposed relationship, we employ a cross-sectional regression of *ILLIQ* on relative bid ask spread and stock turnover. The relative bid ask spread, $SPREAD_i$, is computed using daily closing bid and ask prices, dividing $P_{ASK} - P_{BID}$ by P_t, the closing price. There are, as previously pointed out, significant limitations of using the closing spread. Please refer to section 2.3. Stock turnover, $TURN_i$, is computed using daily number of stocks traded, divided by total stocks outstanding. In line with expectations, *ILLIQ* is strongly and positively related to $SPREAD_i$ and negatively related to $TURN_i$:

$$ILLIQ_i = -0.069 + 18.51 \cdot SPREAD_i - 0.0052 \cdot TURN_i$$
$$(t =) \quad (-7.85) \quad (93.89) \qquad\qquad (-5.21)$$

$ILLIQ_{iy}$ is averaged yearly to obtain the market average illiquidity, $AILLIQ_y$:

$$AILLIQ_y = 1/N_y \sum_{t=1}^{N_y} ILLIQ_{iy},$$

where N_y is the number of stocks that meet the criteria (i) and (ii) in section 3.1 in year y. We find that *ILLIQ* varies considerably over time for Swedish stocks. In Figure III in the Appendix, yearly average *AILLIQ* along with stock specific *ILLIQ* is plotted. Considerable peaks occur in 1993, 2000 to 2003 and 2008.

3.3 Empirical methodology

The test follows the Fama and MacBeth (1973) two-step procedure. First, we estimate a cross-sectional model, where monthly stock returns are a function of multiple stock characteristics:

$$R_{imy} = k_{0my} + \sum_{j=1}^{J} k_{jmy} X_{ji,y-1} + U_{imy}, \qquad (1)$$

where R_{imy} is the cumulative excess return of stock i in month m of year y, $X_{ji,y-1}$ is stock characteristic j of stock i, computed on year $y - 1$ data, k_{jmy} is the corresponding coefficients and U_{imy} the residuals. The reason for lagging the characteristics is that investors are assumed to make their investment decision at the beginning of the year (Amihud, 2002). We run the cross-sectional model each month from mid 1994 to 2008, a total of 174 months, and hence generate 174 estimates of each of the coefficients of k_{jmy}, $j = 0, 1, 2, \ldots, J$. In the second step, the null hypothesis of zero mean of coefficient k_j is tested.

Fama and MacBeth's (1973) procedure is advantageous when analyzing panels where the time series is considerably larger than the cross sections. The procedure is widely employed and found to perform well in simulations and produce reliable t-statistics (Skoulakis, 2006). To implement the procedure, we utilize the `xtfmb` code, version 1.0.2, for

STATA (Hoechle, 2007). In the second step, where the null hypotheses of zero coefficient means are tested, instead of computing simple standard deviations of the coefficients, Hoechle uses Zellner's Seemingly Unrelated Regressions to create unbiased t-statistics for the estimates.

Following Amihud (2002), we use mean adjusted $ILLIQ_{iy}$ to limit the effect of the considerable variation of average $ILLIQ_y$ over the period:

$$ILLIQMA_{iy} = ILLIQ_{iy} / AILLIQ_y .$$

3.4 Stock characteristics

The following stock characteristics, X_{jiy}, are in addition to $ILLIQMA_{iy}$, independent variables in model (1). Amihud (2002) included all but B/M_{iy}, $VOLMA_{iy}$ and $TURNMA_{iy}$. Summery statistics for all variables, including *ILLIQ*, are reported in Table I.

$BETA_{iy}$ is measure of risk and is calculated as follows. At the end of every year, stocks are ranked by their size (market capitalization) and divided into ten equal size portfolios. Then, the portfolio return, R_{pty}, is calculated as the equally weighted mean of stock excess returns in portfolio *p* on day *t* in year *y*. The market model is then estimated for each portfolio *p*, *p* = 1, 2, …, 10, using ten time-series regressions per year, with heteroskedasticity robust standard errors, following White (1980)[3]:

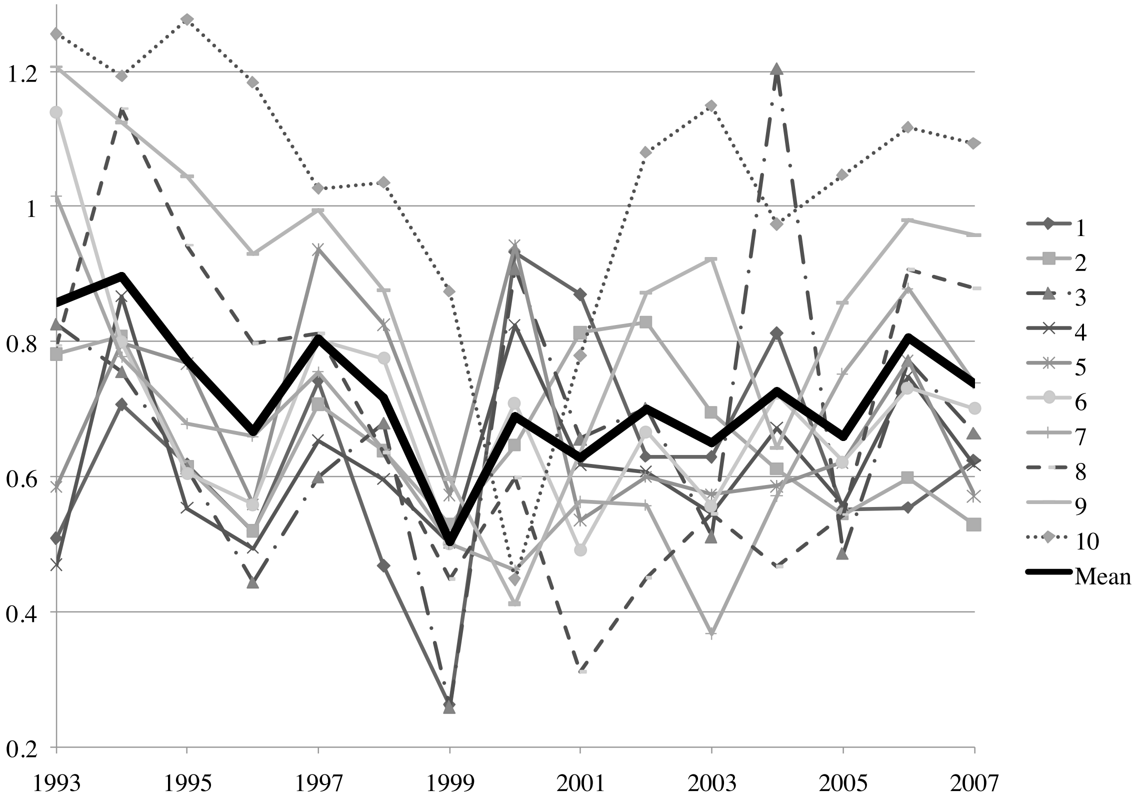
$$R_{pty} = \alpha_{py} + BETA_{py} \cdot RM_{ty} + e_{pty} , \qquad (2)$$

where RM_{ty} is the excess return of the OMXS index on day *t* in year *y* (still, using 30 day Swedish T-bill interest rate). $BETA_{iy}$ of stock *i* in year *y* is the $BETA_{py}$ of the portfolio to which it belongs in year *y*. Note that the portfolios are only used for computing *BETA*. Fama and French (1992) suggest that this pooling method increases the precision of portfolio *BETA* to an extent that more than compensates for the weakness of using uniform yearly $BETA_{iy}$ within the portfolios. Figure I portrays the size-portfolios' *BETA* and average *BETA* over time. The portfolio's *BETA*s differ considerably year-on-year. The drastic fluctuations in portfolio *BETA* when computing on rolling yearly data have, however, been documented previously (Rink, 2008). The graph suggests that over time, smaller companies on average seem to have lower *BETA*. This is unexpected. Further, average equally weighted *BETA* is throughout less than one. This is however a result of equal weighting; the lower *BETA* small portfolios are overrepresented.

$SIZE_{iy}$, here measured as market capitalization at the end of year *y*, has a documented negative relation to stock return (Banz, 1981, Reinganum, 1981 and Fama and French, 1992). There are several explanations of this so-called size effect. Amihud and Mendelson (1986 and1989) and Berk (1995) argue that small firms are generally less traded than big firm, and that size in

[3] Using ordinary least squares regressions does not affect our conclusions.

Figure I
***BETA* over time**
The chart shows the ten portfolios' *BETA* and the across portfolio equally weighted average *BETA* (bold black line) over time. *BETA* is the slope coefficient in the time-series regression of one of ten portfolios' equally weighted daily excess return on daily market excess return (using heteroskedasticity robust standard errors). The portfolios are formed yearly based on the stocks' end of year market capitalization, with 1 being lowest market capitalization. Stocks that were traded less than 200 days in the year are excluded.



this way captures a dimension of liquidity. In our sample, this suggested negative relationship between size and illiquidity is confirmed, with the correlation of $ILLIQMA_i$ and $lnSIZE$ at –0.57. In model 1, we use the natural logarithm of $SIZE_{iy}$, $lnSIZE_{iy}$.

$SDRET_{iy}$ is the standard deviation of daily stock excess return for stock *i* in year *y*. The inclusion of the variable is motivated by Levy (1978) and Merton's (1987) suggested pricing of standard deviation of return for US stocks. They argue investor portfolios are constrained and not fully diversified and that, hence, standard deviation of return, and not only beta, should affect excess return. Another explanation is provided by Constantinides (1986), who argue that higher standard deviation of returns implies more frequent rebalancing, and that that the investor wants compensation for the higher cost of rebalancing.

$DivY_{iy}$, the dividend yield, is calculated as the sum of all dividends per share during year *y* divided by the closing price at the end of year *y*, following Brennan et al. (1998). The inclusion of $DivY_{iy}$ is based on Redding's (1997) finding that large investors may prefer higher dividends. Amihud (2002) provides a further example, based on differences in tax rate on dividend and on capital gains. This explanation does not apply in Sweden, where the tax rate on dividend and capital gains are the same since the 1990-91 taxation reform (Prop., 1997). We hence expect weak explanatory power of $DivY_{iy}$ but include it in the model to stay comparable to Amihud (2002).

$R100_{iy}$ and $R100YR_{iy}$ are cumulative return of stock *i* of the final 100 days of year *y* and the cumulative return of the rest of year *y* respectively. These past return effects on future return are referred to as stock return momentum. Amihud (2002) include these momentum variables based on the findings of Brennan et al. (1998). The momentum variables *R100* and *R100YR* are also related to the serial correlation in stock return of Conrad and Kaul (1988) and Loo and MacKinlay (1998) suggested. Further, Jegadeesh and Titman (1993) find a momentum effect in how recent good or bad performance continues over time horizons of 3 to 12 months.

B/M_{iy} is the book-to-market ratio and is here calculated as the total common equity divided by the market capitalization of stock *i* at the end of year *y*. Amihud does not include this variable, referring to Easley et al. (1999) and Loughran (1997), who are unable to reject the null hypothesis of zero effect of *B/M* on stock returns for NYSE stocks. We are however not aware of such conclusive results for Swedish stocks, and include the variable, inspired by Fama and French (1992).

$VOLMA_{iy}$ is the mean adjusted average daily number of stocks traded for stock *i* in year *y*. $TURNMA_{iy}$ is the mean adjusted average daily stock turnover, calculated as the mean adjusted average of the ratio of daily number of stocks traded to total stocks outstanding of stock *i* in year *y*. Hence, the two measures are closely related. The use of $VOLMA_{iy}$ is inspired by Brennan et al. (1998), Kothare and Laux (1995) and Chalmers and Kadlec (1998), who all include a measure of trading volume as liquidity proxy. $VOLMA_{iy}$ is however a blunt liquidity measure, since it neither takes the monetary value of the volume nor the number of outstanding shares into account. According to Amihud and Mendelson (1986), investors' holding period increase in illiquidity. With holding period inversely related to stock turnover, stock turnover should be positively related to liquidity. Atkins and Dyl (1997) confirm this relationship, why we include $TURNMA_{iy}$ as an independent variable.

Table I
Variable statistics

$ILLIQ_{yi}$, the illiquidity measure, is the average *ILLIQ* for company *i* in year *y*. *ILLIQ* is the ratio of daily absolute returns to daily volume in SEK (multiplied by 10^4). $BETA_{yi}$ is the slope coefficient in the time-series regression of one of ten portfolios' equally weighted daily excess return on daily market excess return (using heteroskedasticity robust standard errors). $BETA_{yi}$ for company *i* is the *BETA* of the portfolio to which it belongs in year *y*. $SIZE_{yi}$ is the market capitalization for company *i* at the end on year *y*. B/M_{yi} is the book to market ratio, defined as common equity divided by market capitalization, for company *i* at the end of year *y*. $R100_{yi}$ is the cumulative return over the last 100 days of year *y* for company *i* and $R100YR_{yi}$ is the return over the rest of the period. $SDRET_{yi}$ is the standard deviation of the daily percentage excess returns for company *i* in period in period *y*. $DivY_{yi}$ is the dividend yield in year *y*, and is defined as company *i*'s per share dividend in year *y* divided by the year end price. $TURNMA_{yi}$ is the average stock turnover and is defined as daily volume for company *i* divided by the number of outstanding shares. Stocks that were traded less than 200 days in the year are excluded. So are stocks with $ILLIQ_{yi}$ at the top and bottom 1% each year. Data is from mid 1993 to 2007 (For *R100* and *R100YR*, from mid 1994 to 2008).

Variable	Mean of annual means	SD of annual means	Median of annual means	Skewness of annual means
ILLIQ	1.231	2.904	0.215	6.166
BETA	0.698	0.194	0.194	0.553
SIZE (SEK MM)	11824.8	43875.7	1044.5	10.9
B/M	0.685	2.701	0.510	44.275
R100	0.1063	0.3417	0.0800	4.2359
R100YR	0.0914	0.5259	0.0345	4.6432
SDRET (%)	3.001	1.885	2.408	4.127
DivY	0.0183	0.0252	0.0119	3.8265
TURNMA	0.9889	0.9984	0.7430	8.6174
Variable	**Lower quartile of annual means**	**Upper quartile of annual means**	**Min. of annual means**	**Max. of annual means**
ILLIQ	0.024	1.131	0.000	41.920
BETA	0.558	0.824	0.259	1.277
SIZE (SEK MM)	297.6	5550.6	9.9	984734
B/M	0.275	0.828	-0.433	124.882
R100	-0.0611	0.2235	-0.8842	5.0274
R100YR	-0.1673	0.2758	-0.9393	9.7692
SDRET (%)	1.893	3.510	0.738	36.002
DivY	0.0000	0.0300	0.0000	0.3333
TURNMA	0.4075	1.2756	0.0168	25.1356

4. Part I results

The cross-sectional model 1 is a regression of monthly cumulative excess stock returns on stock characteristics from the previous year. The model is estimated for 174 periods, generating 174 sets of coefficients k_{jmy} from mid 1994 to 2008. The means and standard deviations for these 174 regressions are computed and used in a second cross-sectional regression, where the null hypothesis of zero mean is tested for each of the *j* stock characteristics, following the Fama and MacBeth (1973) procedure.

The results are reported in Table II and Tables V and VI in the Appendix. The tables contain various configurations of omitted stock characteristics. The first number column in Table II is the Sharpe (1964), Lintner (1965) and Mossin (1966) CAPM setting with only *BETA* is included. In the second column, the illiquidity measure *ILLIQ* is added to this setting. The third column is the Fama and French (1992) setting where *BETA*, *lnSIZE* and *B/M* are included. In the forth column, *ILLIQ* is added to this configuration. The fifth column is the one of the configurations suggested by Amihud (2002) with *ILLIQMA*, *BETA*, *R100* and *R100YR*. The seventh column is the second configuration suggested by Amihud (2002) plus *B/M*. Columns eight and nine include *VOLMA* and *TURNMA* respectively, in addition to *ILLIQMA* and *BETA*. Tables V and VI in the Appendix present additional configurations. To test robustness, table VI includes the results when the time period is extended to the first quarter of 2010.

The results in the three tables support the hypothesis that illiquidity is priced in the Swedish stock market. Of the 23 configurations with *ILLIQ* present, *ILLIQ* is statistically significant at the 1% confidence level (two-sided) in two cases, at the 5% level in 15 cases and at the 10% level in six cases. The robustness of *ILLIQ* to different combinations of control variables enhances the finding that illiquidity is priced. The pricing of illiquidity is in line with previous research. The coefficients range from 0.00188 to 0.00294 over the 23 configurations. The serial correlation of $k_{ILLIQmy}$ is weak (0.09), indicating low probability of underestimated standard errors.

ILLIQ remains significant when the time period is expanded to Q1 2010, including most of the credit crisis. Two of these configurations are significant at the 5% level, and the remaining significant at the 10% level.

Compared to Amihud (2002), our *ILLIQ* is statistically less significant. With a shorter time period (174 months versus 408) and a significantly smaller sample (OMXS versus S&P 500) the lower significance is not surprising.

BETA is insignificant in all of the configurations. The slope coefficients range from –0.0076 to 0.0081. This finding contradicts expectations and Sharpe's (1964) proposition. However, previous researchers have come to similar conclusions when testing *BETA* following a procedure similar to Fama and MacBeth's (1973), including Reinganum (1982), Lakonishok and Shapiro (1986), Ritter and Chopra (1989) and Fama and French (1992). A weakness of the method that could influence *BETA* is that companies are equally weighted when the ten yearly portfolios are constructed, making small companies overrepresented. Rolls's (1977) critique of the proxy for market returns, here the OMXS, poorly representing the unobservable market portfolio is also applicable – Sweden has, relative to the US, less of its corporate value listed on exchanges (Correira da Silva, 2004). Note that the $BETA_{yi}$ used are obtained from the time-series model 2 using heteroskedasticity robust standard errors, following White (1980). The conclusions are unaffected when using ordinary least squares regressions.

lnSIZE is insignificant in all of the configurations. The coefficients range from –0.0014 to 0.0004. Of the 13 configurations with *lnSIZE*, the coefficient is negative in 11 cases. Based on Fama and French (1992), a negative coefficient is expected.

The significance of *B*/*M* alters depending on configuration. It is significant at the 5% level in two cases, at the 10% level in six cases and insignificant in eight cases. The coefficient is however always, and as expected from Fama and French (1992), positive, ranging from 0.0129 to 0.0534. Further, *B*/*M* is only significant when *R100* and *R100YR* are included in the model.

R100, the cumulative return over the final 100 days of year y – 1, is significant at the 1% level in ten of the 13 configurations in which it is included. The coefficient is low and ranges from 0.018 to 0.027, suggesting that each +1% of return over the 100 days will increase excess return of any month in year y with 0.02 percentage point.

R100YR, the cumulative return over the rest of year y – 1, is insignificant. The coefficient is however exclusionary positive. *SDRET* too insignificant, with, counterintuitively, negative slope coefficients in all cases.

DivY is statistically insignificant with negative coefficients. There is hence, in accordance with expectations, no indication that dividend yield is priced in the Swedish stock market.

VOLMA and the to *ILLIQ* competing volatility measure *TURNMA* are included separately in six configurations each. *VOLMA* is significant at the 5% level in three cases and at 10% level in one, all with positive coefficients. *TURNMA* is however never statistically significant. The *VOLMA* coefficients range from 0.0007 to 0.0014, implying that high returns in year y are associated with high average trading volume in year y – 1. With low volume associated with illiquidity, the positive coefficients contradict that illiquidity is compensated with high returns. *VOLMA* is however a blunt liquidity measure, since it neither takes the monetary value of the volume nor the number of outstanding shares into account. *VOLMA* could hence readily capture other effects. As an example, penny stocks would, ceteris paribus, have higher *VOLMA* than other stocks. If penny stocks of average have a relatively low market capitalization, *VOLMA* would capture a size effect, and the positive coefficients would be in line with expectations.

Table II

Cross-section regressions of excess stock returns on *ILLIQ* and other stock characteristics

The table contains average coefficients and corresponding t-statistics for cross-sectional regressions of monthly excess returns on the respective variables. In each month of year mid 1994 to 2008, cumulative stock returns are regressed on the stock characteristics from year $y-1$ according to the Fama MacBeth 1973 procedure. *ILLIQ*, the illiquidity measure, is the average ratio of daily absolute returns to daily volume in SEK (multiplied by 10^4). *ILLIQMA* is the mean adjusted version of the measure. *BETA* is the slope coefficient in the time-series regression of one of ten portfolios' equally weighted daily excess return on daily market excess return (using heteroskedasticity robust standard errors). *BETA* for company *i* is the *BETA* of the portfolio to which it belongs in year *y*. ln*SIZE* is the natural logarithm of the market capitalization at the end of the year. *B/M* is the book to market ratio, defined as common equity divided by market capitalization, at the end of the year. *R100* is the cumulative return over the last 100 days of the year and *R100YR* is the return over the rest of the period. *SDRET* is the standard deviation of the daily percentage excess returns in the period. *DivY* is the dividend yield in the year, and is defined as per share dividend divided by the year end price. *TURNMA* is the average stock turnover and is defined as daily volume divided by the number of outstanding shares. *VOLMA* is the average daily volume in the year. Stocks that were traded less than 200 days in the year are excluded. So are stocks with $ILLIQ_{yi}$ at the top and bottom 1% each

constant	0.00799 (1.10)	0.00335 (0.43)	0.00905 (0.78)	-0.00149 (-0.11)	0.00174 (0.22)	0.00117 (0.16)	0.00372 (0.33)	0.00434 (0.56)	0.00212 (0.31)
ILLIQMA		0.00282 (2.66)		0.00261 (2.12)	0.00242 (2.49)	0.00268 (2.51)	0.00221 (1.77)	0.00294 (2.75)	0.00262 (2.49)
BETA	-0.00631 (-0.75)	-0.00398 (-0.44)	0.00260 (0.28)	0.00186 (0.20)	-0.00069 (-0.08)	-0.00032 (-0.04)	0.00811 (0.92)	-0.00643 (-0.67)	0.00006 (0.01)
lnSIZE			-0.00099 (-0.78)	0.00018 (0.12)			-0.00086 (-0.72)		
B/M			0.00304 (0.98)	0.00275 (0.88)		0.00446 (1.85)	0.00534 (2.21)		
R100					0.01904 (2.01)	0.02577 (3.82)	0.02643 (3.89)		
R100YR					0.00020 (0.04)	0.00369 (0.91)	0.00503 (1.22)		
SDRET						-0.00138 (-0.67)	-0.00115 (-0.54)		
DivY							-0.02357 (-0.43)		
VOLMA								0.00066 (1.11)	
TURNMA									-0.00152 (-0.59)

PART II

5. Method

5.1 Time-series model and data

The aim of this part is to examine the drivers of variations in across stock average *ILLIQ*. Average *ILLIQ* is here regarded as a proxy for market illiquidity. One could consider other proxies, such as averaged bid ask spread or averaged stock turnover. Please refer to Part I for a more detailed discussion on alternative measures and the advantages of *ILLIQ*.

The method is based on a time-series regression of *AILLIQ* on a set of suggested (il)liquidity drivers. All data is downloaded from Thomson Reuters Datastream or retrieved directly from Statistics Sweden's (SCB, 2010), the Swedish governmental statistics agency. SCB data is only used to compute $FLOW_m$, defined below. The time-series starts in 1993 and ends in October 2006, limited by data availability.

To increase the number of observations, *ILLIQ* is calculated monthly instead of yearly for each stock, following the method from Part I, as

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

where D_{im} is the number of days with available data for stock i in month m, $VOLD_{imd}$ is the daily SEK volume of stock i in month m and R_{imd} is the daily excess return of stock i in month m. These company specific illiquidity measures are then averaged each month as

$$AILLIQ_m = 1/I_m\sum_{i=1}^{I} ILLIQ_{im},$$

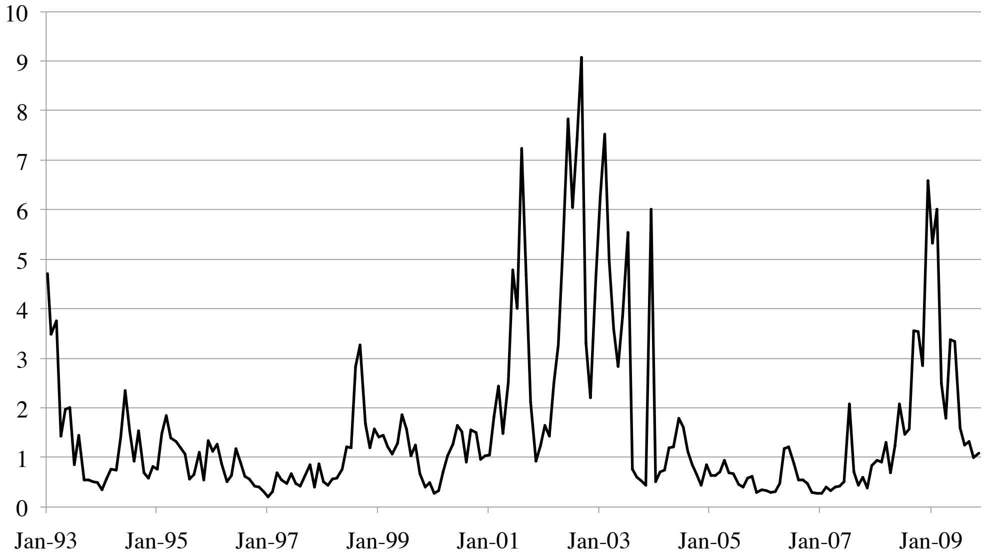
where I_m is the number of companies with recorded *ILLIQ* in the month. *AILLIQ* varies considerably over time, portrayed in Figure II, with considerable peaks in crisis periods of 1993, 2000 to 2003 and 2008 to 2010.

We apply the same stock criteria as in Part I, using only stocks that are traded 200 days or more in a given year and removing the observations with the lowest 1% tail of $ILLIQ_i$ on a yearly basis. The time-series regression follows the model

$$AILLIQ_m = k_0 + \sum_{j=1}^{J} k_j X_{j,m} + \sum_{l=1}^{L} k_l X_{l,m-1} + \sum_{p=1}^{P} k_i X_{i,m-2} + U_m \quad , \qquad (3)$$

where $X_{j,m}$ are the liquidity drivers that are not lagged, $X_{j,m-1}$ are the one-month lagged liquidity drivers and $X_{j,m-2}$ are the two-month lagged liquidity drivers. k_j, k_l and k_i are the corresponding slope coefficients. The model 3 is run with different lag structures. Hence, any liquidity driver could be lagged one month, two months or not lagged. In one lag structure, none of the liquidity drivers are lagged and only the first summation, the constant and the error term remain in model 3.

Figure II
Monthly *ILLIQ* over time
The chart shows monthly across firm equally weighted *ILLIQ* over time. *ILLIQ* is the ratio of daily absolute returns to daily volume in SEK (multiplied by 10^4). Stocks that were traded less than 200 days in the year are excluded.



5.2 Liquidity drivers

Drivers of market liquidity have been little covered in academic research, and most studies have focused on cross-country differences in market liquidity (Levin and Zervos, 1998). The macroeconomic and market related factors explained below are our suggested drivers of (il)liquidity. The set of variables is not considered exhaustive, and we are aware that other factors most likely affect market liquidity. The macroeconomic drivers are Swedish real gross domestic product, Swedish consumer confidence indicator, US consumer confidence index and foreign capital flow to Swedish stocks. The market related factors are the CBOE implied volatility index (VIX), a set of Swedish stock market momentum variables and two Swedish realized volatility measures. The factors are all believed to affect investors' willingness and ability to remain or increase their activity in the market, either by increased trading intensity or by adding capital to the market. Summary statistics are reported in Table III and the factors are plotted over time in Figure IV and V in the Appendix. The factors we consider to have a lagged effect on liquidity are the macroeconomic variables, following Rösch and Scheule (2004) and Ramey and Ramey (1995). We also consider lagging the VIX, arguing that non-domestic risk potentially has a less immediate effect than domestic factors.

ΔGDP_SWE_m is the percentage change in Swedish real GDP from month $m - 1$ to month m. High economic activity has over time been a source of market liquidity (Warsh, 2007). The expected return of risky assets, such as stocks, increase in GDP growth. The higher expected return attracts investors and increases trading activity, leading to increased liquidity (Eisfeldt, 2004). Levin and Zervos (1998) have found a significant positive relationship between GDP growth and stock market liquidity. In a cross-country study by Ash et al. (2002), their findings could, however, not be confirmed. We argue that GDP growth, as a measure of change in economic activity in a country, should act as a proxy for capital market attractiveness. We hence predict that market liquidity increases in domestic GDP growth. Real GDP is reported quarterly and is linearly interpolated for months between the quarterly reports. ΔGDP_SWE_m is based on these interpolated monthly observations. We also considered using constant growth over the three-month period from one report to the next. The results were close to identical.

The Federal Reserve board member Kevin Warsh (2007) stated, at the International Bankers Annual Conference, that liquidity is driven by investors' confidence in their ability to transact and that liquidity is high where risk is quantifiable. Chordia et al. (2001) show that an increase in perceived risk decreases liquidity due to raised expected opportunity and inventory costs. Baker and Wurgler (2006) further argue that trading activity and demand for stocks by investors increase in investor sentiment. All this demonstrates the importance of market confidence in liquidity. One dimension of confidence is captured in consumer confidence indices. Even though consumer confidence is not a measure of investor confidence per se, we argue that investor and consumer confidence are interrelated. Jansen and Niek (2003) find some support for such an interrelation. $CONF\_SWE_m$ is the Swedish consumer indicator in month *m*. We also include US consumer confidence, $CONF\_US_m$. The rationale of including *CONF_US* is to capture both the direct effect of US investor sentiment on Swedish liquidity but also capture the effect of US confidence as a proxy of worldwide economic sentiment.

Other measures of market confidence and market risk are realized and implied volatility. Benston and Hagerman (1974), Amihud and Mendelson (1989) and Brunnmeier and Pedersen (2008) show that illiquidity increases in market volatility. Further, Baker and Stein (2004) explain that volatility raises inventory risk and therefore limits volatility. Wald and Horrigan (2005) argue that increased volatility increases the cost of informed traders. This drives bid ask spreads and hence also illiquidity, as described in section 2.2. To capture overall international implied volatility, we use the widely cited Chicago Board Options Exchange Volatility Index of S&P 500 index options' implied volatility, here VIX_US_m, following Ciarlone et al. (2009) and Campbell et al. (2008). VIX_US_m is observed monthly. Domestic volatility is captured in *VOL30D* and *VOLD250D*. The two factors are the annualized realized volatility of the Swedish stock market over the 30 and 250 days period prior to month *m* respectively. Realized volatility data is downloaded directly from Thomson Reuters Datastream and is based on daily OMXS prices.

Table III
Variable statistics
All variables, except *GDP_SWE*, are observed monthly over the period 1993 – October 2006. $CONF\_SWE_m$ is the Swedish Consumer Confidence Indicator. $CONF\_US_m$ is the US Consumer Confidence Index. ΔGDP_SWE is the monthly Swedish real Gross Domestic Product growth. VIX_US_m is the CBOE implied volatility index of S&P 500 index options. $R1M_m$ is the past month cumulative excess return of OMXS, $R3M_m$ the corresponding past three months return and $R6M_m$ the past six months return. $VOL30D_m$ is the annualized volatility of OMXS during the 30 days prior to month m and $VOL250D_m$ the corresponding measure for the 250 days period prior to month m. $FLOW_m$ is the net flow of foreign capital to the Swedish stock market in month m.

Variable	Mean of annual means	SD of annual means	Median of annual means	Skewness of annual means
CONF_SWE	5.02	12.53	7.10	-0.354
CONF_US	105.69	21.56	103.60	-0.063
ΔGDP_SWE	0.0020	0.0029	0.0025	-2.905
VIX_US	19.34	6.80	18.51	1.236
R1M	0.0105	0.0599	0.0106	-0.240
R3M	0.0330	0.1101	0.0513	-0.153
R6M	0.0703	0.1743	0.0839	0.056
VOL30D (%)	18.10	8.25	15.58	1.406
VOL250D (%)	19.42	6.44	17.91	0.314
FLOW (SEK MM)	-1459	13007	-800	3.171

Variable	Lower quartile of annual	Upper quartile of annual means	Min. of annual means	Max. of annual means
CONF_SWE	-3.10	12.40	-31.60	30.00
CONF_US	92.50	126.30	58.60	144.70
ΔGDP_SWE	0.00090	0.00397	-0.01510	0.00621
VIX_US	13.88	23.44	10.96	43.51
R1M	-0.0216	0.0503	-0.1263	0.1269
R3M	-0.0280	0.0941	-0.2700	0.3998
R6M	-0.0203	0.1864	-0.4291	0.6471
VOL30D (%)	12.18	20.95	8.07	49.18
VOL250D (%)	13.62	25.93	10.03	30.94
FLOW (SEK MM)	-3952	1792	-71739	117000

The inclusion of the three momentum variables *RM1*, *RM3* and *RM6* is based on the prediction that market liquidity increases in past market return. Statman et al. (2006) notes a significant relationship between turnover volume and past market return. Griffin et al. (2007) supply similar support in a cross-sectional study of past return and trading activity in 46 countries. Further, Chordia et al. (2001) states that liquidity drops significantly in a down-market. Explanations for this relationship are the disposition effect and the flight to quality effect. Regarding the disposition effect, Kahneman and Tversky (1979) explain that investors experiencing losses tend to reduce their trading activity, consequently dampening market liquidity. Vayanos

(2004) state the flight to quality concept – in periods of significant market decline, investors shift from investing in risky assets, such as stocks, to safer assets. This leads to a decline in stock market liquidity. $RM1_m$, $RM3_m$ and $RM6_m$ are the cumulative excess of return of the OMXS index during one, three and six months prior to month *m* respectively, still using 30 days Swedish T-bills as risk free rate.

Turner (2008) finds a strong relationship between capital inflow and market liquidity in emerging markets. The rationale is that capital inflow increases overall funds to be allocated and reallocated and, hence, ceteris paribus, increases market liquidity. To account for this effect, we include $FLOW_m$, which is the monthly net inflow of foreign capital to Swedish stocks, measured in million SEK.

6. Part II results

The time-series model 3 is a regression of monthly average market illiquidity on the explanatory variables from the same month, the previous month or the month before that. The model is estimated over the 166 months period from 1993 to October 2006.

The results are reported in Table IV and Tables VII and VIII in the Appendix. The tables contain various configurations of lags and omitted explanatory variables. In the first three columns in Table IV, all variables are included and *CONF_SWE*, *CONF_US*, *ΔGDP_SWE*, *VIX_US* and *FLOW* are lagged zero, one and two months. In the remaining columns of Table IV, the results of the same configurations, but with regressions using heteroskedasticity robust standard errors, following White (1980), are presented. The adjustment does not effect our conclusions. Table VII contains the results when the *VIX_US* is not lagged and when some variables are omitted. The intention is to test the robustness of the model and to limit the effects of possible multicollinearity at hand in our 166 observations sample. For example, *CONF_SWE* and *CONF_US,* and *ΔGDP_SWE* and *CONF_SWE* have correlation coefficients of 0.66 and 0.43 respectively. Table VII also contains the results when the time period is expanded to 2007 and 2009, to further test for robustness. Here, *FLOW* is omitted, due to lack of data.

Independent of lag structure and exclusion of explanatory variables, most of the suggested liquidity drivers are statistically significant, suggesting that they explain some of the variation in average market *ILLIQ* in Sweden over time. The R^2 of the ten regressions that end in 2006 range from 0.53 to 0.63. The highest explanatory power is achieved when all variables are included and when *CONF_SWE*, *CONF_US*, *ΔGDP_SWE,* *VIX_US* and *FLOW* are lagged one month.

CONF_SWE is insignificant in all but two of the regressions (ending in 2006, henceforward assumed unless explicitly stated). The slope coefficients are however negative, ranging from –0.033 to –0.006 over the configurations, suggesting that lowered consumer confidence is associated with higher illiquidity. When *CONF_US* is omitted (Table VII), *CONF_SWE* is significant at the 1% level and the coefficient increases considerably, indicating a problem of multicollinearity and a de facto positive relationship between market liquidity and Swedish consumer confidence.

CONF_US too has negative slopes, ranging from –0.029 to –0.015, and is significant at the 1% level in all but one regression, implying a stronger effect on market liquidity than domestic consumer confidence's. The *CONF_US* significance decreases with increased overall lag. A plausible explanation is that *ILLIQ* is immediately responsive to *CONF_US*.

ΔGDP_SWE is insignificant in all configurations. Contradicting our expectations, the coefficients are positive, ranging from 44.5 to 91.9. The coefficients imply that high real gross domestic product growth is associated with lowered liquidity. The lack of significance however limits the obscurity of this finding.

VIX_US is significant at the 1% level in all regressions but three. In the remaining regressions, the significance is close to 1%. The slope coefficients range from 0.047 to 0.117, suggesting that high US implied volatility and low Swedish stock market liquidity go hand-in-hand. The coefficient and significance decreases with increased lag.

Of the three stock market momentum variables, only *RM1* and *RM3* are significant. *RM1* is throughout negative and significant at the 1% level in all but three cases. The significance is lowest when the variable is not lagged. Both coefficient and significance of *RM1* increases markedly when the other momentum variables are dropped (Table VII). This is expected, given that the three variables to some extent capture the same effect. *RM3* is too throughout negative and significant at the 10% level or higher in six of the ten regressions where the variable is included. The *RM1* and *RM3* coefficients range from –9.94 to –2.51 and –2.85 to –1.92 respectively. Hence, assuming average monthly returns, *RM1* impacts *ILLIQ* less than *RM3*. The negative coefficients suggest that liquidity increases in positive stock market momentum.

VOL30D is insignificant in eight of the eleven configurations where the variable is included. The past 250 days OMXS volatility, *VOL250D*, is however significant at the 1% level in all configurations. The slope is positive, ranging from 0.074 to 0.100, suggesting that realized volatility and liquidity are negatively related. Both coefficient and statistical significance of *VOLD250D* are nearly unaffected when *VOL30D* is dropped from the model.

FLOW is significant at the 10% level in only two out of eleven regressions. However, the slope coefficients are throughout negative, giving some support for the suggested positive effect of foreign capital flow to Swedish stocks and market liquidity.

Table IV
Time-series regressions of *ILLIQ*

The table contains coefficients and corresponding t-statistics for time-series regressions of market illiquidity measure on the respective variables. R-squared values are displayed in the bottom row. In each month of year 1993 to 2006, *ILLIQ* is regressed on the stock characteristics from month *m*, *m* – 1 or *m* – 2. Single underlined coefficient and t-statistic indicate a one-month lag (*m* – 1) of the independent variable. Double underlined coefficient and t-statistic indicate a two-month lag (*m* – 2) of the independent variable. The "R" in the top row indicates regression with heteroskedasticity robust standard errors. *CONF_SWE* is the Swedish Consumer Confidence Indicator. *CONF_US* is the US Consumer Confidence Index. Δ*GDP_SWE* is the monthly Swedish real Gross Domestic Product growth. *VIX_US* is the CBOE implied volatility index of S&P 500 index options. *R1M* is the past month cumulative excess return of OMXS, *R3M* the corresponding past three months return and *R6M* the past six months return. *VOL30D* is the annualized volatility of OMXS during the 30 days prior to the month and *VOL250D* the corresponding measure for the 250 days period prior to the month. *FLOW* is the net flow of foreign capital to the Swedish stock market.

				R	R	R
constant	1.6335	1.0951	0.7747	1.6335	1.0951	0.7747
	(2.55)	(1.62)	(1.13)	(3.06)	(1.86)	(1.45)
CONF_SWE	-0.00605	-0.01141	-0.01400	-0.00605	-0.01141	-0.01400
	(-0.64)	(-1.12)	(-1.33)	(-0.74)	(-1.36)	(-2.11)
CONF_US	-0.02919	-0.02009	-0.01470	-0.02919	-0.02009	-0.01470
	(-5.42)	(-3.49)	(-2.53)	(-5.13)	(-3.23)	(-2.76)
ΔGDP_SWE	4.82E+01	8.07E+01	4.52E+01	4.82E+01	8.07E+01	4.52E+01
	(0.89)	(1.41)	(0.77)	(0.86)	(1.33)	(0.76)
VIX_US	0.1103	0.0746	0.0471	0.1103	0.0746	0.0471
	(5.59)	(3.22)	(2.37)	(4.54)	(2.82)	(2.18)
RM1	-2.5070	-6.6757	-6.0734	-2.5070	-6.6757	-6.0734
	(-1.43)	(-3.49)	(-3.09)	(-1.45)	(-3.57)	(-2.94)
RM3	-2.6076	-2.3477	-2.7871	-2.6076	-2.3477	-2.7871
	(-1.90)	(-1.59)	(-1.85)	(-1.87)	(-1.53)	(-1.71)
RM6	-0.6894	-1.1193	-1.2889	-0.6894	-1.1193	-1.2889
	(-0.90)	(-1.34)	(-1.44)	(-1.00)	(-1.57)	(-1.79)
VOL30D	-0.0283	-0.0273	-0.0051	-0.0283	-0.0273	-0.0051
	(-1.84)	(-1.59)	(-0.31)	(-2.03)	(-1.58)	(-0.28)
VOL250D	0.0745	0.0863	0.0860	0.0745	0.0863	0.0860
	(3.95)	(4.16)	(3.97)	(3.73)	(3.71)	(3.35)
FLOW	-0.000005	-0.000009	-0.000007	-0.000005	-0.000009	-0.000007
	(-0.80)	(-1.35)	(-0.93)	(-1.16)	(-1.65)	(-1.37)
R^2	0.63	0.57	0.54	0.63	0.57	0.54

The previously significant variables remain significant when *FLOW* is dropped and the time period is extended to include 2007. When extending to 2009 to include some of the financial crisis, *CONF_US* loses significance, whereas *CONF_SWE* is significant at the 5% level. The

ΔGDP_SWE slope coefficient, that, contrary to expectations, is positive when not including the crisis-years, is now statistically significant. The R^2 drops slightly to 0.54 and 0.52 for 2007 and 2009 respectively.

The Durbin-Watson and the Breusch-Godfrey LM tests for autocorrelation both indicate autocorrelation of the error term. When applied to the no-lag regression (see first number column, Table IV) the Durbin-Watson d-statistic is 1.201 and one lag Breush-Godfrey χ^2 is 27.82. To control for the indicated autocorrelation's potential effect on t-statistics, we ran the no-lag regression with Newey-West standard errors with lag order of autocorrelation of one, two and three. The results are presented in Table VIII in the Appendix. The t-statistics change slightly, but our conclusions remain.

7. Conclusions

This thesis has a twofold stock liquidity related purpose. The first part is to test the proposition that illiquidity is priced in the Swedish stock market. The second part is to explain some of the variation in overall Swedish stock market liquidity over time.

Liquidity is an elusive concept with many dimensions. Measuring liquidity is therefore difficult, and many alternative methods exist. This study is based on Amihud's (2002) illiquidity measure, *ILLIQ*, defined as the average ratio of the daily absolute stock return to SEK volume averaged over some period. *ILLIQ* has the advantage of capturing many of the dimensions of liquidity, using only standard stock price and volume data. There are more sophisticated and potentially more accurate measures of liquidity. These measures are however limited by the vast amount of data that is required for computation. Further, *ILLIQ* has been proven closely related to these measures.

The procedure of Part I is based on Fama and MacBeth's (1973) two-step regressions. In the first step, monthly cumulative excess stock returns for OMXS stocks are regressed on *ILLIQ* and a number of stock characteristics, including beta, size and the book-to-market ratio. All stock characteristics are computed in year $y - 1$ and are unchanged for the twelve monthly regressions in year y. The monthly regressions are run separately from mid 1994 to 2008, generating 174 sets of stock characteristics slope coefficients. In the second step, the coefficients are tested with null hypothesis of zero mean.

The results in Part I give strong support for the proposed pricing of illiquidity in Swedish stocks. The results remain significant when including or omitting different stock characteristics and when extending the time period to include most of the recent financial crisis. Compared to Amihud (2002), the pricing of illiquidity is less significant.

The results do not support rejection of the null hypothesis of zero mean of stock beta. In other words, we find no support for pricing of systematic risk in Swedish stocks over the period. The book-to-market ratio is however priced, suggesting the high stock return is associated with high book-to-market ratio. Amihud (2002) excluded this variable in his study.

Part II is based on a time-series model, where monthly average market illiquidity is regressed on a number of liquidity drivers. The drivers include macroeconomic and market-related factors, such as GDP, consumer confidence indices, volatility measures and stock market momentum. Regressions are run where some of the liquidity drivers are lagged one month, two months or not lagged. Average market illiquidity is defined as average *ILLIQ* of OMXS stocks. We note that liquidity, measured in this way, varies considerable over the period from 1993 to October 2006.

Independent of lag structure, the regressions suggest significant effect of most of the variables on market liquidity. At best, the model explains 63% of the variation in average market *ILLIQ*. Domestic consumer confidence is insignificant when the closely correlated US counterpart is included in the model. The variable however gains significance when US confidence is dropped, suggesting a multicollinearity problem. The effect of domestic GDP is surprising; the results, even though insignificant, suggest that illiquidity increases in GDP growth. This effect becomes significant when the time period is extended to 2009.

The main contribution of our work is the confirmed pricing of illiquidity in the Swedish stock market and a suggested model of market liquidity drivers that significantly explain a great proportion of time variations of market liquidity.

8. Further research

This paper supports the proposed pricing of illiquidity in Swedish stocks. A similar relationship for US stocks has been tested and confirmed by several academics. We would like to see a further application of the tests on non-US stocks. If the stock excess return indeed increases in illiquidity, the tests should hold on stock markets around the world. Extended applications would also allow for tests of variations of illiquidity pricing across countries and exchanges. Theory suggests that differences in investor characteristics, e.g. in terms of holding period, could affect the pricing of illiquidity. Further, we suggest test on longer time periods, partly to test for robustness but also to study time variations in the pricing of illiquidity.

Regarding liquidity drivers (Part II), potential additional liquidity drivers should be added to the model and tested, attempting to increase the explanatory power of the model. The robustness of the factors should be tested in other markets, to determine whether the liquidity drivers are exclusive to Swedish OMXS stocks. Finally, we suggest further research of the significant and counterintuitive relationship between domestic GDP and liquidity.

References

Acharya, V. V. and Pedersen, L. H., 2005. Asset pricing with liquidity risk. Journal of Financial Economics 77, 375–410.

Amihud, Y. and Mendelson, H., 1986. Asset pricing and the bid–ask spread. Journal of Financial Economics 17, 223–249.

Amihud, Y. and Mendelson, H., 1989. The effects of beta, bid–ask spread, residual risk and size on stock returns. Journal of Finance 44, 479–486.

Amihud, Y. and Mendelson, H., 1991. Liquidity, maturity and the yields on U.S. government securities. Journal of Finance 46, 1411–1426.

Amihud, Y. 2002. Illiquidity and stock returns: cross-section and time-series effects. Journal of Financial Markets 5, 31–56.

Amihud, Y., Mendelson, H., Pedersen, L.H., 2005. Liquidity and asset prices. Foundations and Trends in Finance 1, 269–364.

Ash, M., Pollin, R., Zhu, A., 2002. Stock Market Liquidity and Economic Growth: A Critical Appraisal of the Levine/Zervos, Working Paper, University of Massachusetts

Atkins, A.B. and Dyl, E.A., 1997. Transactions costs and holding periods for common stocks. Journal of Finance 52, 309–325.

Baker, M. and Stein, J.C., 2004. Market liquidity as a sentiment indicator. Journal of Financial Markets 7, 271–299.

Baker, M and Wurgler, J., 2006. Investor Sentiment and the Cross-Section of Stock Returns. Journal of Finance 61, 1645–1680.

Banz, R. W., 1981. The relationship between return and market value of common stocks. Journal of Financial Economics 9, 3–18.

Benston, G.J. and Hagerman, R.L., 1974. Determinants of bid-asked spreads in the over-the-counter market. Journal of Financial Economics 4, 353–364.

Berk, J., 1995. A critique of size-related anomalies. Review of Financial Studies 8, 275–286.

Brennan, M.J. and Subrahmanyam, A., 1996. Market microstructure and asset pricing: on the compensation for illiquidity in stock returns. Journal of Financial Economics 41, 441–464.

Brennan, M. J., Chordia, T., Subrahmanyam, A., 1998. Alternative factor specifications, security characteristics, and the cross-section of expected stock returns. Journal of Financial Economics 49, 345–373.

Brunnermeier, M. and Pedersen, L. H., 2005. Predatory trading. Journal of Finance 60, 1825–1863.

Campbell, J.Y., Hilscher, J., Szilagyi,J., 2008. In Search of Distress Risk. Journal of Finance 63, 2997–3030.

Chalmers, J.M.R. and Kadlec, G.B., 1998. An empirical examination of the amortized spread. Journal of Financial Economics 48, 159–188.

Chen, Z. and Xiong, P. 2001, Discounts on illiquid stocks: Evidence from China. Working Paper, Yale University.

Choi, W.G. and Cook, D., 2007 Financial Market Risk and U.S. Money Demand, Working Paper International Monetary Fund

Ciarlone, A., Piselli, P., Trebeschchi, G,. Emerging markets' spreads and global financial conditions. Int. Fin. Markets, Inst. and Money 19, 222–239.

Conrad, J. and Kaul, G., 1988 Time-Variation in Expected Returns The Journal of Business 61, 409–425

Chordia, T. Roll, R , Subrahmanyam,A., 2001 Market Liquidity and Trading Activity. Journal of finance 56, 501–530

Constantinides, G.M., 1986. Capital market equilibrium with transaction costs. Journal of Political Economy 94, 842–862.

Datar, V.T., Naik, N.Y., Radcliffe, R., 1998. Liquidity and stock returns: an alternative test. Journal of Financial Markets 1, 205–219.

Demsetz, H., 1968. The cost of transacting. Quarterly Journal of Economics 82, 33–53.

Easley, D., Hvidkjaer, S., O'Hara, M., 1999. Is information risk a determinant of asset returns. Journal of Finance 57, 2185–2221

Edison, H. J. and Warnock, F. E., 2003. A simple measure of the intensity of capital controls. Journal of Empirical Finance 10, 81–103.

Eisfeldt, A., 2004. Endogenous liquidity in asset markets. Journal of Finance 59,1–30.

Eleswarapu, V.R., 1997. Cost of transacting and expected returns in the NASDAQ market. Journal of Finance 52, 2113–2127.

Fang, J., Sun, Q., Wang, C., 2006. Illiquidity, Illiquidity Risk and Stock Returns: Evidence from Japan

Fama, E. F. and MacBeth, J. D. , 1973. Risk, return and equilibrium: Empirical tests. Journal of Political Economy 81, 607–636.

Fama, E. F. and French, K. R., 1992. The Cross-Section of Expected Stock Returns. Journal of Finance 47, 427–465.

Fernandez, F. A., 1999. Liquidity risk: New approaches to measurement and monitoring. Working paper, Securities Industry Association (SIA).

Griffin, J.M., Nardari, F., Stulz, R.M., 2007. Stock market trading and market conditions. Working Paper, National Bureau of Economic Research.

Hasbrouck, J., 1991. Measuring the information content of stock trades. Journal of Finance 46, 179–207.

Hasbrouck, J., 2006. Trading Costs and Returns for US Equities: Estimating Effective Costs from Daily Data. Working Paper, NYU Stern.

Hu, S. Y., 1997. Trading turnover and expected stock returns: The trading frequency hypothesis and evidence from the Tokyo Stock Exchange. Working Paper, National Taiwan University and University of Chicago.

Jagadeesh, N. and Titman, T., 1993. Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency. Journal of Finance 48, 65–91

Jang, H. and Lee, J. H., 1995. Window Dressing of Daily Closing Bid-Ask Spreads: Evidence from NYSE Stocks. Financial Analysts Journal 51, 61–67.

Jansen, W. J and Niek J.N,, 2003. The stock market and consumer confidence: European evidence. Economics Letters 79, 89–98.

Jones, C. 2002, A century of stock market liquidity and trading costs. Working Paper, Columbia University.

Kahneman, D. and Tversky, A., 1979. Prospect Theory: An Analysis of Decision Under Risk. Econometrica 47, 263–291

Kraus, A. and Stoll, H.R., 1972. Price impacts of block trading on the New York Stock Exchange. Journal of Finance 27, 569–588.

Keim, D.B. and Madhavan, A., 1996. The upstairs market for large-block transactions: analysis and measurement of price effects. Review of Financial Studies 9, 1–36.

Kothare, M. and Laux, P. A., 1995. Trading costs and the trading systems for Nasdaq stocks. Financial Analysts Journal 51, 42–53.

Kyle, A. S. 1985, Continuous auctions and insider trading. Econometrica 53, 1315–1335.

Lakonishok, J. and Shapiro, A.C., 1986. Systematic Risk, Total Risk and Size as Determinants of Stock Market Returns. Journal of Banking and Finance 10, 115–132.

Levine, R. and Zervos, S., 1998. Stock Markets, Banks and Economic Growth. American Economic Review 88, 537–558

Levy, H., 1978. Equilibrium in an imperfect market: constraint on the number of securities in the portfolio. American Economic Review 68, 643–658.

Lintner, J., 1965. The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. Review of Economics and Statistics 47, 13–37.

Loderer, C. and Roth, L., 2005. The pricing discount for limited liquidity: Evidence from SWX Swiss Exchange and the Nasdaq. Journal of Empirical Finance 12, 239–268.

Loughran, T., 1997. Book-to-market across firm size, exchange and seasonality: is there an effect? Journal of Financial and Quantitative Analysis 32, 249–268.

Loo, A.W. and Mackinlay, C.A., 1988. Stock Market Prices do not Follow Random Walks: Evidence from a Simple Specification Test. The Review of Financial Studies, 41–66

Manzler, D., 2005. Liquidity, liquidity risk and the closed-end fund discount. Working Paper, University of Cincinnati

Merton, R.C., 1987. A simple model of capital market equilibrium with incomplete information. Journal of Finance 42, 483–511.

Mossin, J., 1966. Equilibrium in a capital asset market. Econometrica 35, 768–783.

Pagano, M. and Roell, A.,1990. Trading systems in European stock exchanges: current performance and policy options. Economic Policy 5, 65–115

Redding, L.S., 1997. Firm size and dividend payouts. Journal of Financial Intermediation 6, 224–248.

Reinganum, M.R., 1982. A Direct Test of Roll's Conjecture on the Firm Size Effect. Journal of Finance 37, 27–35.

Ritter, J.R. and Chopra, N., 1989. Portfolio Rebalancing and the Turn-Of-The-Year Effect. Journal of Finance 44, 149–166.

Ramey,G. and Ramey, V.A., 1995. Cross-Country evidence on the Link Between Volatility and Growth. American Economic Review 85, 1138–1151

Rösch,D. and Scheule, H., 2004. Forecasting retail portfolio credit risk. Journal of Risk Finance 5, 16–32.

Roll, R., 1977. A Critique Of The Asset Pricing Theory's Tests: Part I: On Past and Potential Testability of the Theory. Journal of Financial Economics 4, 129–176.

Skoulakis, G., 2006. Panel Data Inference in Finance: Least-Squares vs Fama-MacBeth. Working Paper University of Maryland.

Silber, W. L. 1991, Discounts on restricted stock: The impact of illiquidity on stock prices. Financial Analysts Journal 47, 60–64.

Sharpe, W., 1964. Capital asset prices: a theory of capital market equilibrium under conditions of risk. Journal of Finance 19, 425–442.

Statman,M., Thorley, S., Vorkink,K., 2006. Investor Overconfidence and Trading Volume . Review of Financial Studies 19, 1531–1565.

Stoll, H.R., 1978. The pricing of security dealers services: an empirical study of NASDAQ stocks. Journal of Finance 33, 1153–1172.

Tinic, S.H., 1972., The economics of liquidity services. Quarterly Journal of Economics 86, 79–93

Turner, P., 2008. Financial globalisation and emerging market capital flows. Working paper (BIS) Bank for International Settlements.

Upper, C., 2001. How safe was the "Safe Haven"? Financial market liquidity during the 1998 turbulences. BIS Papers, No. 2, April 2001, 241–266.

Vayanos, D., 2004. Flight to quality, flight to liquidity, and the pricing of risk. LSE Working Paper.

Vayanos, D. and T. Wang (2007), Search and endogenous concentration of liquidity in asset markets. Journal of Economic Theory 136, 66–104

Wald, J. K. and Horrigan, H. T., 2005. Optimal Limit Order Choice. Journal of Business 78, 597–620.

Weill, P.-O. 2002, The liquidity premium in a dynamic bargaining market. Working Paper, Stanford University.

White, H., 1980. A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. Econometrica 48, 817–838.

Books

Correira da Silva, L., Goergen, M., Renneboog, L., 2004. Dividend Policy and Corporate Governance. Oxford, United Kingdom: Oxford Universtiy Press.

Keynes, J. M., 1971. 'A treatise on money', in The collected writings of John Maynard Keynes. London: Macmillan.

Garbade. Kenneth. 1982. Securities markets. New York: McGraw-Hill.

Gårdängen, M., 2006. Share liquidity and corporate efforts to enhance it : a study on the Swedish Stock Exchange. Lund: Lund Business Press.

Rink, K., 2008. The Influence of Sample Size on the Dynamics of Beta Factors, Seminar paper. Munich: Grin Verlag

Speeches

Mainelli, M., 2007 September. Liquidity: Finance In Motion or Evaporation? Speech presented at Gresham College, Holborn, London. Retrieved 2010-03-10, http://www.gresham.ac.uk/event.asp?EventId=640&PageId=45.

Warsh, K., 2007 March. Market Liquidity: Definitions and Implications. Speech presented at Institute of International Bankers Annual Washington Conference, Washington, D.C. Retrieved 2010-04-15, http://www.federalreserve.gov/newsevents/speech/warsh20070305a.htm.

Other sources

Damodran, A., 2006 Dec. The Cost of Liquidity. Seminar at American Institute of Certified Public Accountants Conference, New York. Retrived 2010-04-17. http://pages.stern.nyu.edu/~adamodar/.

Hoechle, D., 2007. xtfmb, version 1.0.2, STATA code. Downloaded 2010-04-0, http://ideas.repec.org/c/boc/bocode/s456786.html.

Regeringens proposition (1997/98:1). 1990-1991 års skattereform - en värdering. (Swedish Government bill)

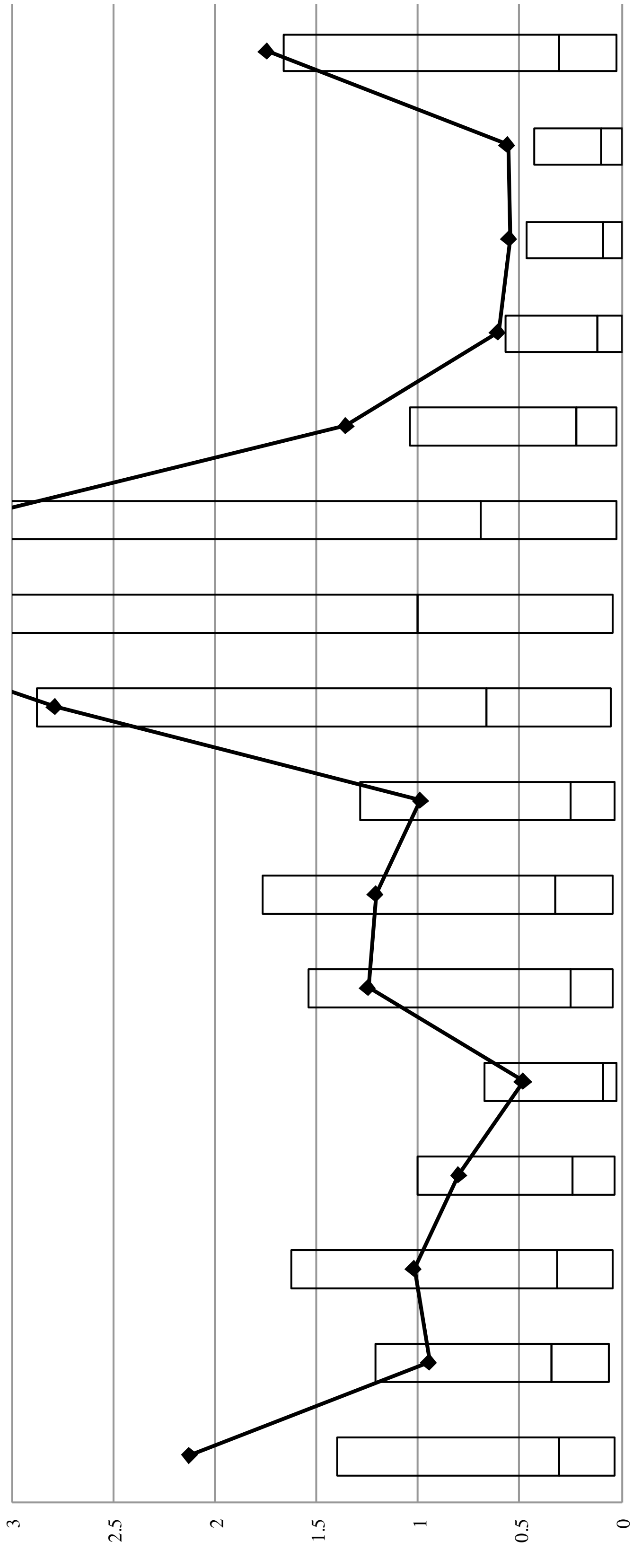
SCB, 2010. Statistics Sweden (Statistiska centralbyrån) Downloaded 2010-04-25, http://www.ssd.scb.se/databaser/makro/MainTable.asp?yp=tsrklz&xu=C0379001&omradekod=FM&omradetext=Finansmarknad&lang=1.

Appendix

Figure III

Across firm yearly average *ILLIQ* over time

The chart shows median, lower quartile, upper quartile and mean for yearly across firm *ILLIQ*. *ILLIQ* is the average ratio of daily absolute returns to daily volume in SEK (multiplied by 10^4). The top line of each bar is the upper quartile, the middle line the median and the lower line the lower quartile. The marked line is the mean *ILLIQ*. Stocks that were traded less than 200 days in the year are excluded. So are stocks with $ILLIQ_{yi}$ at the top and bottom 1% each year. Note that upper quartile and mean are out of range for 2002 and 2003.



	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Max	32.30	12.27	7.95	8.06	5.52	11.07	14.70	16.70	66.81	60.53	115.78	81.09	22.55	11.50	36.79	48.02
Min	0.00120	0.00061	0.00051	0.00045	0.00023	0.00016	0.00009	0.00005	0.00008	0.00030	0.00019	0.00006	0.00004	0.00004	0.00005	0.00015

Table V

Cross-section regressions of excess stock returns on *ILLIQ* and other stock characteristics – Additional configurations A

The table contains average coefficients and corresponding t-statistics for cross-sectional regressions of monthly excess returns on the respective variables. In each month of year mid 1994 to 2008, cumulative stock returns are regressed on the stock characteristics from year $y - 1$ according to the Fama MacBeth 1973 procedure. *ILLIQ*, the illiquidity measure, is the average ratio of daily absolute returns to daily volume in SEK (multiplied by 10^4). *ILLIQMA* is the mean adjusted version of the measure. *BETA* is the slope coefficient in the time-series regression of one of ten portfolios' equally weighted daily excess return on daily market excess return (using heteroskedasticity robust standard errors). *BETA* for company *i* is the *BETA* of the portfolio to which it belongs in year *y*. ln*SIZE* is the natural logarithm of the market capitalization at the end of the year. *B/M* is the book to market ratio, defined as common equity divided by market capitalization, at the end of the year. *R100* is the cumulative return over the last 100 days of the year and *R100YR* is the return over the rest of the period. *SDRET* is the standard deviation of the daily percentage excess returns in the period. *DivY* is the dividend yield in the year, and is defined as per share dividend divided by the year end price. *TURNMA* is the average stock turnover and is defined as daily volume divided by the number of outstanding shares. *VOLMA* is the average daily volume in the year. Stocks that were traded less than 200 days in the year are excluded. So are stocks with $ILLIQ_{yi}$ at the top and bottom 1% each year.

constant	0.00541 (0.50)	0.00602 (0.53)	0.00430 (0.40)	0.00431 (0.27)	0.00384 (0.49)	0.00545 (0.72)	0.01182 (0.99)	0.01088 (0.87)
ILLIQMA	0.00287 (2.27)	0.00277 (2.16)	0.00235 (1.91)	0.00247 (1.97)	0.00247 (2.53)	0.00279 (2.59)	0.00224 (1.81)	0.00210 (1.68)
BETA	0.00451 (0.51)	0.00403 (0.46)	0.00814 (0.92)	-0.00330 (-0.34)	-0.00474 (-0.54)	-0.00762 (-0.90)	0.00256 (0.28)	0.00268 (0.29)
lnSIZE	-0.00034 (-0.28)	-0.00028 (-0.23)	-0.00088 (-0.74)	-0.00020 (-0.12)			-0.00139 (-1.09)	-0.00138 (-1.09)
B/M	0.00129 (0.49)	0.00239 (0.94)	0.00435 (1.70)	0.00244 (0.76)		0.00426 (1.76)	0.00395 (1.50)	0.00489 (1.95)
R100			0.02644 (3.92)		0.01926 (2.03)	0.02566 (3.81)	0.02698 (4.03)	0.02698 (4.00)
R100YR			0.00496 (1.21)		0.00043 (0.10)	0.00411 (1.01)	0.00530 (1.30)	0.00538 (1.31)
SDRET	-0.00151 (-0.76)	-0.00143 (-0.68)	-0.00153 (-0.77)			-0.00143 (-0.70)	-0.00181 (-0.91)	-0.00136 (-0.64)
DivY		-0.04906 (-0.93)						-0.01396 (-0.25)
VOLMA				0.00125 (1.74)	0.00074 (1.38)	0.00137 (2.29)	0.00133 (2.11)	0.00136 (2.12)
TURNMA								

Table VI

Cross-section regressions of excess stock returns on *ILLIQ* and other stock characteristics – Additional configurations B

The table contains average coefficients and corresponding t-statistics for cross-sectional regressions of monthly excess returns on the respective variables. In each month of year mid 1994 to 2008 (Q1 2010), cumulative stock returns are regressed on the stock characteristics from year $y - 1$ according to the Fama MacBeth 1973 procedure. *ILLIQ*, the illiquidity measure, is the average ratio of daily absolute returns to daily volume in SEK (multiplied by 10^4). *ILLIQMA* is the mean adjusted version of the measure. *BETA* is the slope coefficient in the time-series regression of one of ten portfolios' equally weighted daily excess return on daily market excess return (using heteroskedasticity robust standard errors). *BETA* for company i is the *BETA* of the portfolio to which it belongs in year y. ln*SIZE* is the natural logarithm of the market capitalization at the end of the year. *B/M* is the book to market ratio, defined as common equity divided by market capitalization, at the end of the year. *R100* is the cumulative return over the last 100 days of the year and *R100YR* is the return over the rest of the period. *SDRET* is the standard deviation of the daily percentage excess returns in the period. *DivY* is the dividend yield in the year, and is defined as per share dividend divided by the year end price. *TURNMA* is the average stock turnover and is defined as daily volume divided by the number of outstanding shares. *VOLMA* is the average daily volume in the year. Stocks that were traded less than 200 days in the year are excluded. So are stocks with $ILLIQ_{yi}$ at the top and bottom 1% each year.

						Q1 2010		
constant	-0.00300 (-0.25)	0.00132 (0.19)	0.00112 (0.16)	0.00444 (0.43)	0.00424 (0.39)	0.00987 (1.27)	0.00401 (0.30)	0.00477 (0.62)
ILLIQMA	0.00266 (2.32)	0.00237 (2.48)	0.00273 (2.57)	0.00243 (2.00)	0.00232 (1.90)	0.00219 (2.18)	0.00202 (1.73)	0.00188 (2.04)
BETA	0.00206 (0.22)	0.00059 (0.07)	0.00075 (0.10)	0.00672 (0.74)	0.00612 (0.67)	-0.00718 (-0.80)	0.00240 (0.25)	-0.00202 (-0.24)
lnSIZE	0.00044 (0.32)			-0.00070 (-0.60)	-0.00067 (-0.56)		-0.00015 (-0.10)	
B/M	0.00277 (0.98)		0.00449 (1.82)	0.00439 (1.71)	0.00527 (2.15)		0.00274 (0.94)	
R100		0.01708 (1.97)	0.02553 (3.94)	0.02598 (3.99)	0.02591 (3.93)			0.01172 (1.27)
R100YR		0.00094 (0.22)	0.00399 (0.99)	0.00516 (1.28)	0.00515 (1.27)			-0.00107 (-0.25)
SDRET			-0.00183 (-0.89)	-0.00200 (-1.01)	-0.00164 (-0.78)			
DivY					-0.02157 (-0.40)			
VOLMA								
TURNMA	-0.00060 (-0.24)	-0.00071 (-0.33)	0.00007 (0.04)	0.00031 (0.16)	0.00043 (0.23)			

Figure IV
Liquidity drivers over time
The charts show monthly observations of the suggested liquidity drivers over the period 1993 – October 2006. *CONF_SWE* is the Swedish Consumer Confidence Indicator. *CONF_US* is the US Consumer Confidence Index. Δ*GDP_SWE* is the monthly Swedish real Gross Domestic Product growth. *VIX_US* is the CBOE implied volatility index of S&P 500 index options. In each chart, the market illiquidity measure, *AILLIQ*, is plotted in gray on the secondary (rightmost) vertical axis.

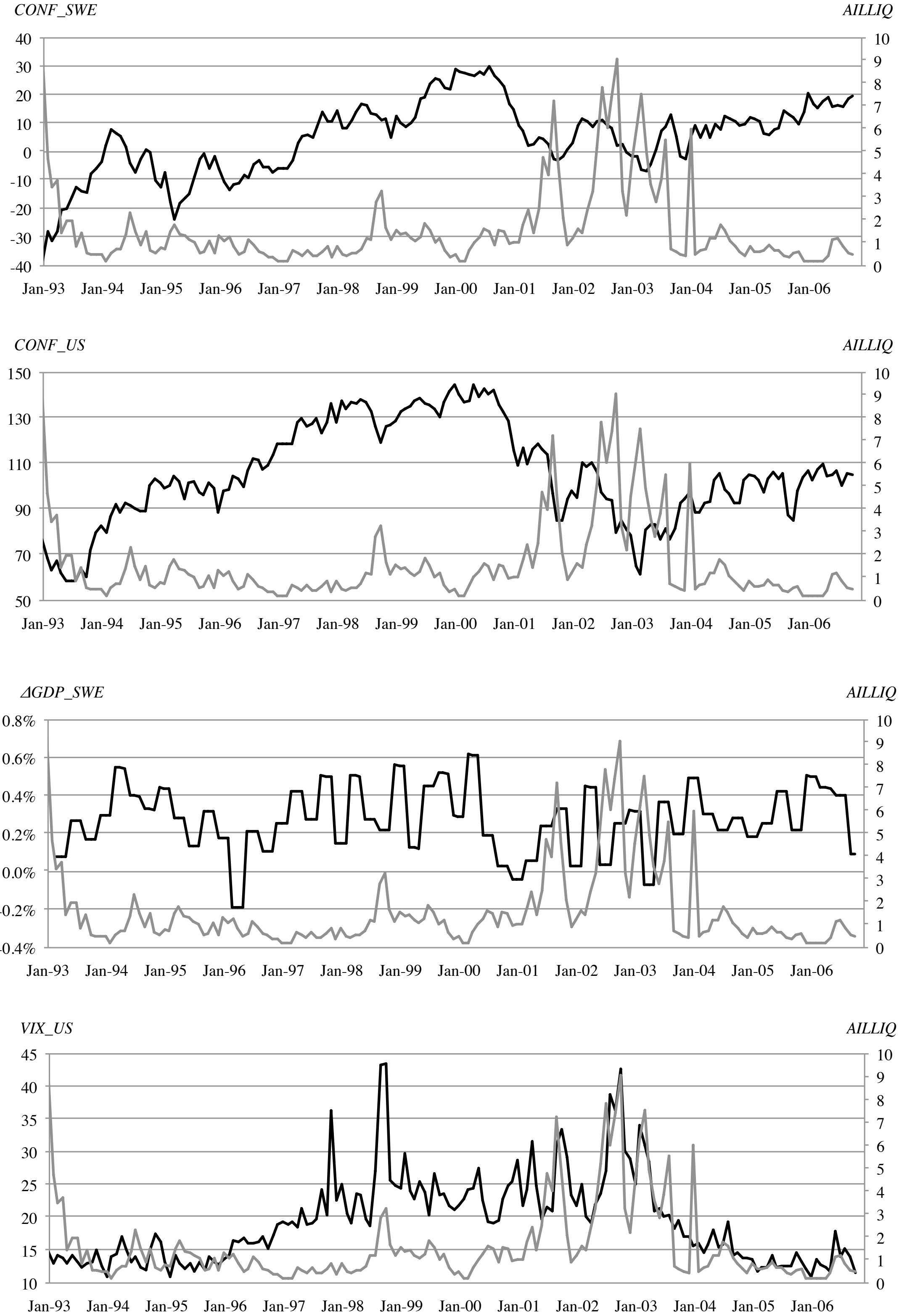


Figure V
Liquidity drivers over time

The charts show monthly observations of the suggested liquidity drivers over the period 1993 – October 2006. *R1M* is the past month cumulative excess return of OMXS. *VOL250D* is the annualized volatility of OMXS during the past 250 days. *FLOW* is the net flow of foreign capital to the Swedish stock market in the period. In each chart, the market illiquidity measure, *AILLIQ*, is plotted in gray on the secondary (rightmost) vertical axis.

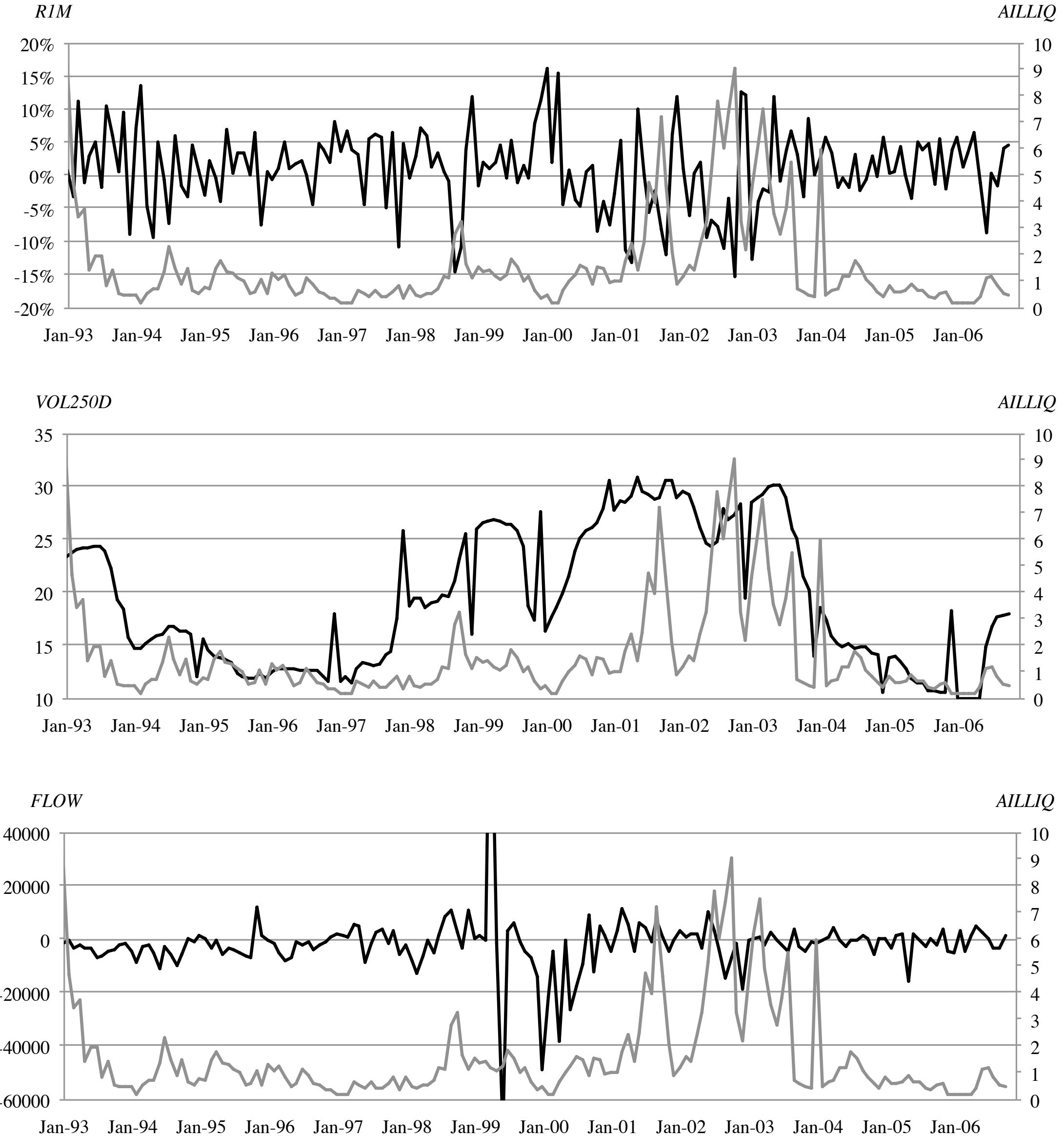


Table VII

Time-series regressions of *ILLIQ* – Additional configurations

The table contains coefficients and corresponding t-statistics for time-series regressions of market illiquidity measure on the respective variables. R-squared values are displayed in the bottom row. In each month of year 1993 to 2006, *ILLIQ* is regressed on the stock characteristics from month *m* or *m* – 1. Underlined coefficient and t-statistic indicate a one-month lag (*m* – 1) of the independent variable. In the two rightmost columns, the period is expanded to 2007 and 2009. *CONF_SWE* is the Swedish Consumer Confidence Indicator. *CONF_US* is the US Consumer Confidence Index. Δ*GDP_SWE* is the monthly Swedish real Gross Domestic Product growth. *VIX_US* is the CBOE implied volatility index of S&P 500 index options. *R1M* is the past month cumulative excess return of OMXS, *R3M* the corresponding past three months return and *R6M* the past six months return. *VOL30D* is the annualized volatility of OMXS during the 30 days prior to the month and *VOL250D* the corresponding measure for the 250 days period prior to the month. *FLOW* is the net flow of foreign capital to the Swedish stock market.

							INC. 2007	**INC. 2009**
constant	1.1372	-0.8079	1.1974	0.9313	0.8514	1.1196	0.9885	-0.1203
	(1.80)	(-1.95)	(1.84)	(1.34)	(1.24)	(1.63)	(1.53)	(-0.21)
CONF_SWE	-0.01070	-0.03306	-0.01512	-0.01011	-0.01184	-0.01028	-0.01322	-0.02227
	(-1.13)	(-3.97)	(-1.59)	(-0.97)	(-1.15)	(-1.00)	(-1.40)	(-2.45)
CONF_US	-0.02493		-0.01919	-0.02347	-0.02279	-0.02056	-0.01798	-0.00511
	(-4.59)		(-3.30)	(-4.03)	(-3.93)	(-3.55)	(-3.20)	(-1.08)
ΔGDP_SWE	8.16E+01	9.19E+01		4.45E+01	4.74E+01	8.51E+01	7.47E+01	1.34E+02
	(1.53)	(1.55)		(0.78)	(0.83)	(1.47)	(1.35)	(3.53)
VIX_US	0.1172	0.0503	0.0699	0.0945	0.0812	0.0749	0.0845	0.0488
	(5.84)	(2.20)	(3.02)	(4.11)	(4.16)	(3.20)	(3.90)	(2.81)
RM1	-2.9694	-5.9544	-6.8975	-9.9433	-9.5197	-6.7090	-6.5393	-5.9656
	(-1.69)	(-3.02)	(-3.65)	(-6.12)	(-6.03)	(-3.49)	(-3.46)	(-3.33)
RM3	-2.8520	-2.8287	-1.9150			-2.0627	-2.4121	-1.9169
	(-2.08)	(-1.86)	(-1.34)			(-1.40)	(-1.67)	(-1.40)
RM6	-1.0449	-1.3135	-0.9821			-1.1323	-1.0100	-1.6421
	(-1.34)	(-1.52)	(-1.21)			(-1.34)	(-1.22)	(-2.16)
VOL30D	-0.0374	-0.0229	-0.0227	-0.0186		-0.0252	-0.0427	-0.0283
	(-2.41)	(-1.29)	(-1.31)	(-1.09)		(-1.46)	(-2.76)	(-1.97)
VOL250D	0.0754	0.1001	0.0887	0.0840	0.0802	0.0846	0.0845	0.0849
	(4.05)	(4.75)	(4.33)	(4.01)	(3.88)	(4.06)	(4.22)	(4.80)
FLOW	-0.000012	-0.000011	-0.000010	-0.000006	-0.000006			
	(-1.85)	(-1.53)	(-1.40)	(-0.85)	(-0.79)			
R^2	0.62	0.53	0.56	0.54	0.53	0.57	0.54	0.52

Table VIII

Newey-West time-series regressions of *ILLIQ*

The table contains coefficients and corresponding t-statistics for time-series regressions with Newey-West standard errors of market illiquidity measure on the respective variables. R-squared values are displayed in the bottom row. The lag order of autocorrelation is one, two and three. In each month of year 1993 to 2006, *ILLIQ* is regressed on the stock characteristics from month *m*. *CONF_SWE* is the Swedish Consumer Confidence Indicator. *CONF_US* is the US Consumer Confidence Index. Δ*GDP_SWE* is the monthly Swedish real Gross Domestic Product growth. *VIX_US* is the CBOE implied volatility index of S&P 500 index options. *R1M* is the past month cumulative excess return of OMXS, *R3M* the corresponding past three months return and *R6M* the past six months return. *VOL30D* is the annualized volatility of OMXS during the 30 days prior to the month and *VOL250D* the corresponding measure for the 250 days period prior to the month. *FLOW* is the net flow of foreign capital to the Swedish stock market.

	LAG = 1	**LAG = 2**	**LAG = 3**
constant	1.6335	1.6335	1.6335
	(2.65)	(2.51)	(2.43)
CONF_SWE	-0.00605	-0.00605	-0.00605
	(-0.64)	(-0.62)	(-0.62)
CONF_US	-0.02919	-0.02919	-0.02919
	(-4.45)	(-4.25)	(-4.12)
ΔGDP_SWE	4.82E+01	4.82E+01	4.82E+01
	(0.78)	(0.76)	(0.75)
VIX_US	0.1103	0.1103	0.1103
	(3.96)	(3.86)	(3.86)
RM1	-2.5070	-2.5070	-2.5070
	(-1.45)	(-1.45)	(-1.50)
RM3	-2.6076	-2.6076	-2.6076
	(-1.73)	(-1.76)	(-1.79)
RM6	-0.6894	-0.6894	-0.6894
	(-0.90)	(-0.89)	(-0.87)
VOL30D	-0.0283	-0.0283	-0.0283
	(-1.89)	(-1.89)	(-1.89)
VOL250D	0.0745	0.0745	0.0745
	(3.26)	(3.10)	(3.06)
FLOW	-0.000005	-0.000005	-0.000005
	(-1.09)	(-1.03)	(-1.02)