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by

Randi Næs and Bernt Arne Ødegaard

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Liquidity and Asset Pricing: Evidence on the Role of Investor Holding Period

Randi Næs and Bernt Arne Ødegaard*

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Abstract

We use data on actual holding periods for all investors in a stock market over a 10 year period to investigate the links between holding periods, liquidity, and asset returns. Microstructure measures of liquidity are shown to be important determinants of the holding period decision of individual investors. We also find evidence that the average holding period is different for different investor groups. Interestingly, we find that turnover is an imperfect proxy for holding period. Moreover, while both turnover and spread are related to stock returns, holding period is not. Our results suggest that the link between liquidity and asset prices found in numerous empirical studies cannot be explained by models such as Amihud and Mendelson (1986) where investors merely want to be compensated for exogenous trading costs.

Keywords: Market microstructure, Liquidity, Holding period

JEL Codes: G10

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Introduction

Numerous empirical studies find that liquidity matters for asset returns. On the theoretical side, there is however little agreement on what aspects of liquidity can generate large cross-sectional effects in asset returns. A number of theoretical models use the concept of *expected holding period* to link liquidity to asset prices.[1] While such theories concern expected holding periods, empirical studies typically employ proxies of investor holding periods constructed from turnover. In the present paper we use data on actual holding periods to take a closer empirical look at holding periods and how this is related to stock liquidity and asset prices.

We look at three issues. First, we describe individual holding period decisions, and evaluate the determinants of these decisions. Second, we ask to what degree typical proxies of holding periods measure actual holding periods. Third, we consider asset pricing, and ask whether the observed empirical link between liquidity and asset prices can be explained by liquidity being a proxy for holding period.

The source of our contribution is an access to the complete holdings for all investors at the Oslo Stock Exchange (OSE) over a 10 year period.[2] Our ability to measure holding periods from data on actual trading decisions at the level of individual investors, observed over a substantial period of time, is quite exceptional. To our knowledge ours is also the first paper to use duration analysis in this context, which is the proper econometric framework for analyzing questions about the length of time an investor chooses to keep his or her stake in a company.

The standard way of incorporating market frictions into asset pricing models is to assume that trading involves some *exogenous* trading cost (or illiquidity cost).[3] This implies that investors' expected holding period is crucial for the effect of illiquidity on required returns, i.e. the more often investors plan to trade, the more important are the trading costs. The importance of illiquidity costs therefore depends on the assumed structure of holding periods in a model. The simplest assumption possible is that the expected holding period is exogenous and identical for all investors. Assuming risk neutrality, these assumptions imply that the required return on assets is equal to the risk free rate plus the per period percentage transaction cost, see Amihud et al. (2005).[4]

In the model of Amihud and Mendelson (1986), risk neutral investors are assumed to have *different* exogenous holding periods and limited capital. These assumptions introduce a clien-

[1]Amihud and Mendelson (1986) is an early model where the expected holding period enters.

[2]Current evidence on investor trading activity is typically based on small samples of investors, such as the the single broker customers of Barber and Odean (2000). The only exception is data from Finland, where for example Perttunen and Kyrolainen (2006) looks at some of the issues we consider in our analysis, but their focus is not on the asset pricing implications.

[3]In fact, even the simple assumption that illiquidity is as exogenous trading costs seriously complicates standard asset pricing models. This is because it precludes the existence of a pricing kernel that can price all securities. Explicit pricing rules can then only be derived under special assumptions, see Amihud, Mendelson, and Pedersen (2005).

[4]Risk neutrality implies that all assets are identical. Huang (2003) extends this analysis and studies the premium for liquidity risk assuming exogenous holding periods and risk averse investors.

tele effect into the solution whereby investors with long expected holding periods select stocks with high trading costs. The required return will then differ for different classes of investors, and the expected gross return becomes an increasing and concave function of the relative transaction cost. Amihud and Mendelson find empirical support for this hypothesis using spreads and stock returns from the NYSE over the 1961-80 period.[5]

On the other hand, more realistic models with endogenous holding periods and risk averse investors find that an exogenous liquidity cost has only miniscule effects on the level of asset returns. In a continuous-time model with exogenous asset prices, Constantinides (1986) shows that the optimal investment policy for risk averse investors involves a trade off between high trading costs from frequent portfolio rebalancing and utility costs from having a suboptimal asset allocation. While trading costs have a first-order effect on the demand for the asset, they only have a second-order effect on equilibrium asset returns. Vayanos (1998) extends this analysis to a general equilibrium model with endogenous holding periods. A calibration of the model gives a similar result; the effects of trading costs on equilibrium asset returns are small. Hence, we have the intriguing result that more realistic models assuming risk aversion and endogenous holding periods seem to do considerably worse in explaining empirical findings than less realistic models with risk neutrality and exogenous holding periods.

Huang (2003) notes that an important reason behind the discrepancy between theory and empirical findings regarding the effect of liquidity on asset prices is that asset pricing models in general cannot explain the observed high market trading volume. The strong dependence of liquidity premia on investor holding periods implies that theories that cannot account for observed high trading volume cannot explain observed liquidity premia either. In a model with *uncertain* exogenous holding periods, Huang shows that the premium for liquidity risk can be large if investors face liquidity shocks and are constrained from borrowing.[6]

Another and potentially related explanation is the restriction in asset pricing models that liquidity costs are exogenous. The market microstructure literature divides market frictions into asymmetric information costs and coordination costs (inventory risk and search problems), and shows that prices can diverge from long-term equilibrium values due to strategic trading behavior of investors. Thus, models that do not specify the ultimate source of trading cost differences cannot really explore how a full equilibrium will look like. For instance it is not obvious that investors with long expected holding periods will select stocks with high trading costs since holding "long term" stocks reduces the value of the option to sell the stocks early.

[5]Several other papers attempt to test the model using turnover as a proxy for holding period. Atkins and Dyl (1997) find evidence consistent with the spread-holding period relationship using the inverse of turnover as a proxy for the average holding period. Datar, Naik, and Radcliffe (1998) show that turnover is negatively related to stock returns in the cross-section, while Hu (1997) finds support for both an increasing and concave return-holding period relationship using data on returns and turnover from the Tokyo Stock Exchange. In the empirical test of their liquidity-adjusted CAPM, Acharya and Pedersen (2005) find a significant effect on prices from liquidity cost, also using turnover as proxy for investors average holding periods.

[6]Introducing additional motives for trade, Getmansky, Lo, and Makarov (2004) also find that the liquidity premium can be large when investors have high frequency trading needs.

Obviously, more knowledge about how and why expected holding periods differ among investors is highly valuable. However, it has so far been hard to investigate these questions empirically. While some attempts have been made they all suffer from lack of data on actual holding periods. Instead they rely on estimates of holding period using data on stock turnover, which may not be a good proxy. Even though a high-turnover stock necessarily have many of the stock's investors buying and selling the stock, it is by no means certain that *all* owners of the stock have short holding periods. The stock may have a group of very long holding period owners, but high turnover among the remaining investors. The core of this problem is that turnover is a characteristic of a stock, while holding period is a decision made by individual investors. Thus, turnover may be linked to returns and spreads for other reasons than through its correlation with holding period. It is therefore an interesting empirical question to what degree turnover and holding period are related.

In our analysis we consider several issues. First we study holding periods at the level of individual investors. The typical holding period is found to be about one year, but the probabilities of liquidating an equity position, conditional on the length of time the ownership has lasted, shows considerable time variation. Relative to existing evidence, holding periods seem shorter than previously thought. We also ask what determines the holding period of individual investors and find that typical measures of liquidity, such as the bid ask spread and turnover, are important determinants. We also find clear differences in average holding periods across investor types.

Second, to the extent that alternative measures of liquidity reflects holding period, it is interesting to relate actual holding period data to other extant measures of holding periods and liquidity in the literature. We both compare actual holding period estimates to alternatives provided in the literature, and investigate the extent to which, in the cross-section of equities, holding periods and liquidity measures covary. To do such comparisons it is necessary to construct a measure of average holding period at the stock level.

If the relationship between liquidity and asset returns reflects a compensation for exogenous trading costs, then investors' expected holding periods should also be able to explain the cross-section of stock returns. We look at this issue in the third part of the paper. While the average holding period measure is related to other measures of liquidity in the expected directions (e.g. positively to spread and negatively to turnover), it does a worse job in explaining the cross-section of stock returns than more standard measures of liquidity. There may be several explanations for this result. Our measure of average holding period may not be measuring the salient features of holding period.[7] Alternatively, the more standard measures of liquidity may be reflecting more than just an exogenous cost of trading. They may for example reflect information risk.

The paper is structured as follows. Section 1 describes the market and the data set. In

[7] We may not be capturing the "marginal investor" which is important for pricing.

section 2 we investigate the individual owners' holding period decisions. In section 3 we see how our actual holding periods compare to alternative proxies for holding periods suggested in the literature. We also relate holding periods to standard measures of liquidity. In section 4 we compare the asset pricing implications of holding period measures and liquidity measures. Section 5 concludes.

1 Market and Data

The firms in the sample are listed on the Oslo Stock Exchange (OSE), which is a moderately sized exchange by international standards. In 1997 (about the midpoint of our sample), the 217 listed firms had an aggregate market capitalization which ranked the OSE twelfth among the 21 European stock exchanges for which comparable data is available. The number of companies on the exchange has increased from 141 in 1989 to 212 in 2003. For some information about the structure of the Norwegian Stock Market we refer to Bøhren and Ødegaard (2000, 2001), Ødegaard (2007), and Næs, Skjeltorp, and Ødegaard (2007).

This paper uses monthly data from the Norwegian equity market for the period 1992:12 to 2003:6. From the Norwegian Securities Registry (VPS) we have monthly observations of the equity holdings of the complete stock market. At each date we observe the number of stocks owned by every owner. Each owner has a unique identifier which allow us to follow the owners' holdings over time. For each owner the data include a sector code that allows us to distinguish between such types as mutual fund owners, financial owners (which include mutual funds), industrial (nonfinancial corporate) owners, private (individual) owners, state owners and foreign owners. In addition to this anonymous data set, we use public reports on individual owners inside transactions to construct measures of insider ownership.[8] A third data source is the Oslo Stock Exchange Data Service (OBI). This source provides stock prices and accounting data. Finally, we use interest rate data from Norges Bank, the Central Bank of Norway.

2 What affects holding periods for individual investors?

In this section, we use duration analysis to describe actual holding periods and to study what variables might affect holding period decisions. By investigating if the spread is an important determinant of investors' holding periods, we are the first to perform a *direct* test of the spread-holding period relationship in Amihud and Mendelson (1986).[9]

[8] For more details on this insider trading data see Eckbo and Smith (1998) and Bøhren and Ødegaard (2001).

[9] Using similar data to ours, Perttunen and Kyrolainen (2006) looks at some of the same issues, but they do not use the correct econometric framework of duration analysis. They also have a much shorter sample period.

2.1 Duration analysis

The econometric framework suited for analyzing questions about the length of time an investor chooses to keep his or her stake in a company, and what economic factors affect this decision, is duration (or survival) analysis. In duration analysis, one models the decision to terminate a relationship. In economics, such methods are used on e.g. labor market data to analyze determinants of the time spent unemployed, in which case the pertinent termination is movement between employment and unemployment.[10] Here, we analyze the decision of an individual investor to buy equity in a particular company, where termination is the decision to liquidate the equity holding in that company.

Duration analysis involves estimation of the probability distribution of the termination decision. This probability distribution can be characterized in a number of ways, for example by the *survival function*; the probability of surviving beyond a given date, or the *hazard function*; the probability of termination, conditional on having survived so far. The most common way of characterizing the probability distribution is through the hazard function, and modeling the hazard function directly has been shown to be the best way of estimating duration data.

A particular concern in duration analysis is the truncation problem. In our setting, the truncation problem stems from the fact that we only observe investors for a limited period of time. Figure 1 illustrates the problem. It is only the holding period of investor A which will be measured correctly. The holding period of investor B will be *right truncated*, all we see is that the investor was present at the last date, we do not know the final termination date. For investor C we correctly observe the terminal date, but we do not observe when the relationship is initiated, which is termed *left truncation*. The estimation of the hazard function is done adjusting for the right truncation problem.

2.2 Estimated hazard and survival functions

We apply duration analysis to the holding periods of individual investors using monthly data for all investors at the OSE over the period 1992-2003. To reduce noise investors with less than five hundred shares are removed from the sample. Thus, we count as initiation the first time an investor is observed holding 500 or more shares, and termination when he or she reduces the stake to less than 500 shares.[11] This leaves about 1.4 million observations of investor-company durations.[12] Using these observations we estimate the hazard function of holding periods. Figure 2 illustrates estimated survival and hazard function for the complete sample of investors.

[10]See Lancaster (1979) and Nickell (1979) for examples and Kiefer (1988) and van den Berg (2001) for surveys.

[11]This is a simple definition of termination. One could think of alternatives, such as a stake decrease by a given percentage.

[12]An investor can have several durations, both in the same and in other stocks.

From the unconditional probabilities of surviving we can see that the median holding period is less than one year. This is found where the survival function crosses the 0.5 line. Other interesting properties of the holding period are better illustrated by the estimated hazard function, shown in the right panel of figure 2.

If the probabilities of liquidating an equity position, conditional on the length of time the ownership has lasted, are time independent, the hazard function will be flat. This is not the case in our sample. Instead, we see a clear and systematic time variation. The conditional probability of exit starts around 0.45, increasing to a maximum slightly above 0.5 around 1 year, and then decreases steadily, reaching 0.2 after 8 years, and keeps decreasing. The decreasing part of the curve after 1 year means that if an owner has held the stock for one year, he or she is less and less likely to terminate as time passes. The high probability of exit at the short horizon is the prime contributor to stock turnover. Over the same time period, the average annual stock turnover was about 60%.

It should be mentioned that there are some problems with the analysis at the very short end, induced by the fact that the minimum possible observation of holding period is one month. Since we only have monthly observations of holding period our minimal estimate of holding period is one month, found when we have only two consecutive observations of stock holdings.[13]

2.3 Determinants of the hazard function

Having described holding periods we now turn to investigating what variables might affect the holding period decision. Duration analysis let us ask this question by estimating the effect of a variable on the hazard function. In the standard specification of duration analysis, the hazard function is a constant function of the explanatory variables. In our analysis we will use time-varying explanatory variables such as firm size, stock volatility and spread. To implement estimation we use the observed values of an explanatory variable at the time when a stake is first entered into as the input to the estimation. In economic terms this can be viewed as the holding period decision being based on observable variables when the stake is first acquired.

By including spread as an explanatory variable, we perform a direct test of the spread-holding period relationship in Amihud and Mendelson (1986). Earlier empirical analysis, such as Atkins and Dyl (1997), test this relationship using turnover as a proxy for holding period. Our paper improves on this analysis in two respects. First, we base the analysis on actual holding periods at the individual investor level. Second, we use the correct econometric framework for testing. The question of whether spread affects holding periods should be asked by testing whether the spread at the time when the stock position is entered into affects the hazard for holding periods. For comparison, we will in the next section perform a similar test using turnover as an alternative measure of liquidity.

[13]Cases where we only have one observation, with no observation of holdings for that owner either the month prior or the month after, is rounded down to a duration of zero. Zero durations are not used in the estimation.

In Amihud and Mendelson (1986), investors coming to the market have different expected holding periods. One rationale for this assumption could be that different groups of investors have distinct different trading motives, for instance long term pension saving versus short term speculation. It is also possible that an investor's planned holding period is influenced by the size of the investment. To account for these possibilities we also include owner type and investment amount as explanatory variables. We use dummy variables for four owner types; financial, foreign, individual and non-financial (corporate) owners. To avoid multi-collinearity we do not include a dummy for the last owner category, state owners. Since we only have monthly observations of holdings, we estimate the investment amount as the stock price at the end of the month multiplied with the number of shares. To avoid numerical difficulties we use the log of the investment.

In panel A of table 1 we show the results from estimating the contributions to the hazard function of the variables at the owner level, and two different liquidity measures, relative spread (columns 2-3) and turnover (columns 4-5). Let us first look at the estimated relationship between spread and holding period. The coefficients in the table measures contributions to the hazard function. If a coefficient equals one it does not contribute. If a coefficient is less than one it lowers the conditional probability of exit. If a coefficient is less than one it therefore implies a longer holding period. As seen in the table, the coefficient is significantly below one. We therefore confirm the posited relationship between spread and holding period. Stocks with high spreads tend to have longer holding periods.

The other variables in the regressions are all significant. The amount invested has a negative effect on the hazard function. This means that larger owners tend to have longer holding periods. The coefficient is very close to one, though, so the magnitude of the effect seems small. The analysis also shows clear differences across investor types in average holding periods. Financial owners are the shortest term, while individual owners have the longest holding periods. Foreign and non-financial (corporate) owners have holding periods in between these two extremes.

Atkins and Dyl (1997) include logs of stock volatility and firm size as explanatory variables in their estimation of determinants of holding period. In panel B of table 1 we show the results when these two variables are added for two different analyzes of determinants of the hazard function, one using the spread as a liquidity measure, the other using turnover. In both specifications volatility and firm size are significantly related to holding period. The holding periods tend to be shorter in firms with high volatility and large size.

3 Proxies of holding periods

The literature has considered a number of empirical measures of holding periods, and argued that liquidity proxies for holding periods. It is therefore of interest to see to what extent such usage is justified. We use our data on holding periods to shed light on this issue in two ways. First, we look at a measure of individual owner holding periods suggested by Atkins and Dyl (1997). We show that their measure seriously overstates actual holding periods of individual investors. Second, we consider ranking of the cross-section of equities by measures of holding periods, and ask to what extent this ranking is related to the rankings suggested by liquidity measures used to proxy for holding period. To perform such an analysis it is necessary to construct a measure that aggregates individual holding periods into a measure of holding periods at the stock level.

3.1 Other estimates of individual owners holding periods

The best known estimate of individual owners' holding periods is from Atkins and Dyl (1997). Atkins and Dyl estimate the average holding period as the number of shares outstanding divided by number of stocks traded per year, which is the inverse of annual turnover. Based on a sample of US firms, they estimate an average (median) holding period of 6.99 (3.38) for NASDAQ firms and 4.01 (2.43) for NYSE firms. Table 2 shows the results when we calculate the same estimate of holding period for our sample of stocks. Compared to duration analysis, the method based on turnover seriously overstates average holding period. The Atkins and Dyl method gives an estimated mean holding period of 3.33. As illustrated by the histogram, the distribution of estimates is very skewed, though, so the median of 1.96 years is a better indication of the typical holding period. This can be compared to the results shown in the survival function of figure 2, which puts the average holding period at about one year.

Atkins and Dyl (1997) also investigate whether liquidity, as measured by the bid ask spread, is important for (their estimate of) holding period. We replicate their study for our data, with the resulting estimates shown in table 3. This estimation confirms the positive relation between holding periods and spreads, stocks with higher spreads tend to have longer holding periods.

3.2 What is the relationship between holding periods and measures of liquidity?

We now shift focus from the holding period of individual owners to holding periods as an aggregate property of all the owners of a stock. The impetus for these analyzes comes from the empirical asset pricing evidence of a positive relationship between asset prices and microstructure measures of liquidity. If liquidity is an exogenous trading cost, as assumed in the theoretical asset pricing literature, then the link between liquidity and asset prices must be one of cost compensation. This cost compensation will vary with investors' expected holding period. We therefore want to investigate whether liquidity co-vary with holding periods as such theories suggest. To investigate this we need a measure of average holding period at the stock level.

3.2.1 An index of average holding period at the stock level

To get a measure of holding period that we can relate to measures of stock liquidity, that are measured over short time intervals, we construct a holding period index. The measure is constructed as a "snapshot", where we take the owners at a given date, measure the holding period for each owner, and aggregate these individuals into one measure per stock. To lessen time series overlap we truncate the measurement interval to one year at a time.[14]

Figure 3 illustrates our method for creating the index. At a given date t we use data for the holdings in the previous year. We take all owners with an equity stake at time t.[15] In the figure it means that we use owners 1, 3 and 4. Owner 2 has sold out her stake 6 months before, and is not present in the company at date t. The holding period index for each owner is the holding period in fractions of a year. The index for the company is a weighted sum of the individual owners' indices. In the example in figure 3 the holding period index is

$$\mathtt{hpi} = w_1 1 + w_3 \frac{7}{12} + w_4 \frac{3}{12},$$

where w_i is the weight for owner i. The weight for each individual can vary. If we want to put more weight on the large owners we use value weights where the fraction of the company held by each owner at time t is the weight. This index is termed `hpi(vw)`. If we are more interested in the typical owner we use equal weights $1/n$, where n is the number of owners in the sample at time t. This index is termed `hpi(ew)`.

We calculate holding period indices for each equity in the sample. We do it for both the equally weighted index `hpi(ew)` and the value weighted index `hpi(vw)`. Figure 4 shows the distribution of the two.

Note the difference between the value weighted and equally weighted. That the value weighted index is more concentrated on the longer period must be caused by the larger owners tending to stay longer. This suggests a tendency that large owners have longer holding periods than small owners.

3.2.2 What determines the holding period indices?

A simple way of evaluating how the holding period index varies with other firm properties is by stratifying the sample of firms based on the characteristic we want to investigate, and calculate averages for each group.

Panel A of table 4 implements this for a number of different firm characteristics: firm size, stock volatility, book-to-market (B/M) ratio, firm age, insider ownership and ownership concentration. The average holding periods seem higher for the smallest and largest quartiles

[14] All holding periods above 1 are therefore truncated. One way to think about this is that we say any holding period more than one year is "long term," without distinguishing further. This is justified by the results on individual owners, where more than half of the owners had holding period of less than one year.

[15] To reduce noise we require that the number of shares is above a threshold of 500 shares.

of the firms. A similar pattern is true for volatility. The average holding period for value stocks (high B/M) seems to be longer than the average holding period for growth stocks. Firm age also seems important, the older the firm, the longer the average holding period. The last two variables, insider ownership and ownership concentration, shows no obvious systematic patterns.

To more formally test the importance of the explanatory variables, we also run a multivariate regression for each of the two holding period indices. Panel B of table 4 shows the results for this estimation. Old firms and value stocks tend to have owners with longer average holding periods than young firms and growth stocks. Surprisingly, we find a negative coefficient on the firm size (though only significant for the equally weighted index). Thus, we find weak evidence that larger firms have shorter duration than smaller firms. This finding is at odds with the evidence in Atkins and Dyl (1997) as well as with several suggested explanations for the opposite result that large firms should have long duration owners than smaller firms (including less risk, reduced divergence of investors' expectations, and less need for portfolio rebalancing due to more stable return distribution parameters). The two variables thought to be related to asymmetric information, stock volatility and insider ownership, do not seem to explain firms' average holding period. Finally, the size of the largest owner does seem important; the larger this owner, the longer the average holding period.

3.2.3 The relation between holding period index and other liquidity measures

We now turn to the question of to what degree liquidity proxies for holding periods. We look at a number of liquidity measures, and compare these liquidity measures to the holding period indices we just calculated. We look at the covariability of these measures, and compare the properties of liquidity, such as liquidity's determinants, to similar estimations for holding period indices.

We consider three different measures of liquidity: turnover, relative spread, and amortized spread. The turnover and relative spread are standard measures, and will not be discussed further. The amortized spread is particularly interesting for our purposes, as it attempts to measure an expected cost of trading equity that takes into account the holding period of a position. As such it can be viewed as an attempt to make trading costs across stocks comparable by looking at expected costs over a defined time interval, such as a year. The amortized spread measure was introduced in Chalmers and Kadlec (1998), and is roughly equal to the bid ask spread multiplied with the turnover.[16]

[16] Chalmers and Kadlec (1998) used trading data to calculate the amortized spread for date T as

$$AS_T = \frac{\sum_{t=1}^{T} |P_t - M_t| V_t}{P_T \times SharesOut_T}$$

where AS_T is the amortized spread, P_t is the transaction price, M_t the midpoint price, V_t the trade quantity and $SharesOut$ is the number of shares outstanding. Since we do not have transaction data we approximate the

Panel A in table 5 shows stratified averages of holding period indices. We see that stocks with low turnover have longer holding period indices and that holding period is increasing in the spread. These observations are confirmed by the correlation coefficients in panel B of the table. All the coefficients have the expected signs. In the cross-section, the correlation between turnover and the holding period indices are around -0.5. This shows that turnover is only an imperfect measure of holding period. Interestingly, the amortized spread has a very low correlation with the holding period indices. However, when we look at the quartiles of `hpi` there seems to be some systematic covariation between `hpi` and amortized spread.

To further investigate the links between the holding period indices and the liquidity measures we analyze the determinants of turnover and spreads in the same way as we did for the holding period indices, cf table 4. The results from this analysis are presented in table 6. As the tables show, the liquidity variables seem to have similar determinants as the holding period indices; firm size, B/M ratio, and the largest owner are all significant determinants of both turnover and spread.

We also show, in table 7, results from adding liquidity variables to the series of explanatory variables used in the regressions presented in panel B of table 4. The liquidity variables are clearly significant determinants of the holding period indices, but most of the other variables are still significant.

4 The role of holding period for asset pricing

In this section we look at the differences between liquidity and holding period in a more indirect manner. It has been shown that microstructure variables such as the bid/ask spread and turnover are important determinants of stock returns in the cross section. In some papers, such as Amihud and Mendelson (1986), it is argued that this is because the microstructure variables are proxying for holding period. If this is the case we should find that our holding period indices explain the cross-section of stock returns better than the variables argued to proxy for holding period.

In table 8 we show the results for two different analyzes of the cross section of stock returns. We first look a portfolio sorts. We sort the stocks into portfolios based on five criteria: Turnover, bid/ask spread, amortized spread, and the two holding period indices `hpi(ew)` and `hpi(vw)`. Panel A of table 8 shows the results. The is no clear pattern for the holding period indices, but

daily Amortized Spread as

$$AS \approx \text{Relative Quoted Spread} \times \frac{1}{\text{Holding Period}}$$

or

$$AS \approx \text{Relative Quoted Spread} \times \text{Turnover}$$

Multiplying this with 252 gives a daily estimate of the Annualized Amortized Spread. We then calculate averages of this measure over a time period in most of our analysis.

for both turnover and in particular bid/ask spread there is a clear relation between the level of the liquidity variable and excess returns.

We confirm this impression by two asset pricing investigations in a Fama and MacBeth (1973) framework. In the first we add a microstructure variable to stock beta, i.e. we ask whether a microstructure variable has additional explanatory power to the CAPM. Of the four alternative specifications the more convincing ones are those using spread measures, not the holding period indices. The same pattern is apparent in panel C, where we also include the Fama and French (1992) variable firm size.[17] With this two factor specification neither of the liquidity nor holding period measures have any additional explanatory power, which may be due to the correlation between firm size and liquidity/holding periods.

5 Conclusion

Our paper is the first to use a data set of the complete holdings of all investors in a stock market to look at expected holding periods for individual investors. We show how these decisions of individual investors sum up to a measure of average holding periods at the stock level, and the links between stock liquidity, holding periods, and asset returns.

We make a number of important contributions to the literature. First, in our analysis of the holding period decisions of individual investors, we show that liquidity is an important determinant of holding periods for individual investors. We show that, controlling for various aspects of investor type and importance, low liquidity (high bid/ask spread and/or low turnover) of a stock when the investor enters into a stock position, tends to result in longer holding periods.

Current empirical literature on the links between holding periods and asset returns has used (the inverse of) turnover at the stock level as a proxy for expected holding periods for the individual investors of the stock (Atkins and Dyl, 1997). Based on the finding that the correlation coefficient between turnover and holding period indices constructed from data on actual holding periods lies around -0.5, we argue that turnover is only an imperfect measure of expected holding periods.

Amihud and Mendelson (1986) suggest that the link between transaction costs (spreads) and returns works through investors' selection of stocks based on their expected holding periods. If this is the case we should see that average holding periods for investors in a stock are important determinants of the cross-section of stock returns. However, when we run a horse-race between our measures of average holding and more traditional measures of liquidity, such as the spread, as determinants of the cross-section of stock returns, we find that holding period is only weakly related to asset returns, while the more traditional liquidity measures, spread and turnover, are strongly related to asset returns.

[17] Evidence in Næs et al. (2007) suggest that the B/M ratio is not important for the crossection of Norwegian assets. We therefore leave the B/M ratio out. Results also including the B/M ratio is available on request.

While our results are still preliminary, there are some interesting avenues for further research. As discussed in the introduction, the Amihud and Mendelson model does not explain why there is a spread, just that different spreads can be sustainable when investors select stocks with different spreads based on their expected holding periods. A more complete model would also incorporate the cause of liquidity (spread) differences. A typical microstructure model would attribute these causes to information risk. We find that liquidity strongly affect holding periods. At the same time, we find little evidence of a link between holding periods and returns, and a strong link between returns and traditional microstructure liquidity variables. A possible explanation for these results is that the cause of the first effect is the Amihud and Mendelson intuition, investors reacting to spreads, while returns and microstructure liquidity is linked through the *cause* of spread differences. Trying to disentangle these effects seems a promising direction to go.

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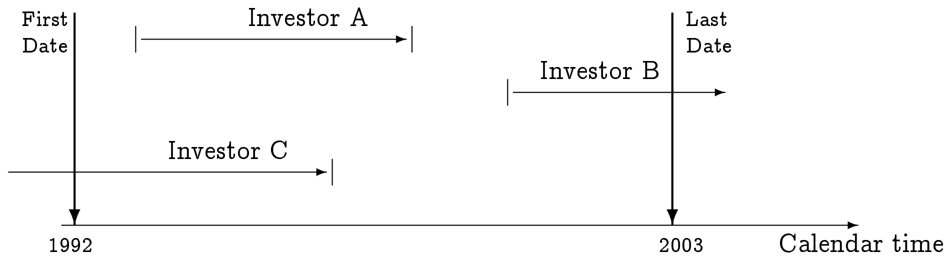
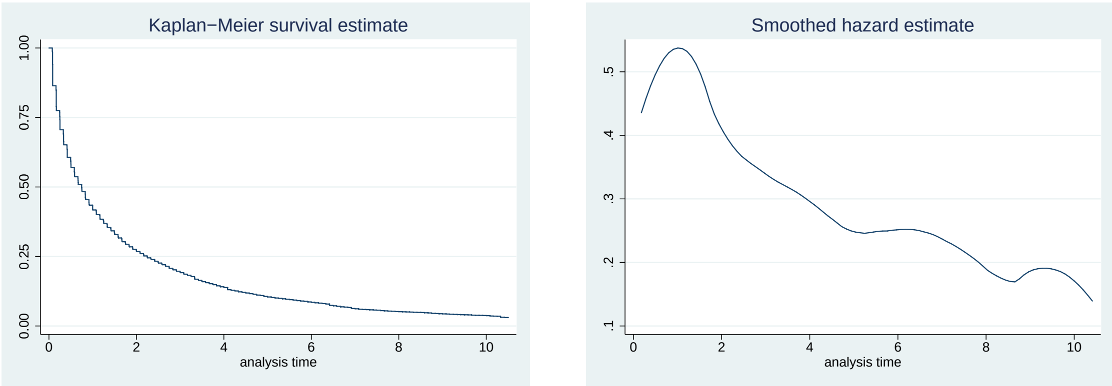
Figure 1 Illustrating the truncation problem



The figure illustrates some conceptual problems in our estimation of holding periods using monthly observations. In calendar time our sample starts in 1992:12 and ends in 2003:6. We illustrate the holding periods of 3 example investors, A, B and C. For investor A the holding period is contained within 1992–2003, and therefore estimated correctly. For investor B we correctly observe the initial date but as the investor keeps his stake till after the last date, all we know is that we observe the stake on the last date. The holding period of this owners is underestimated due to right truncation. For owner C we correctly observe the terminal date, but since we do not observe the first date, only that this owner was present in the first date of the sample, in 1992:12. The holding period is underestimated due to left truncation.

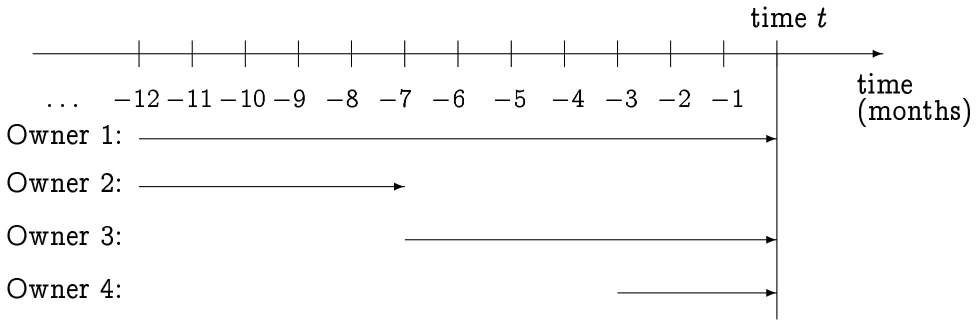
Figure 2 Estimated hazard and survival functions

Survival function | Hazard function



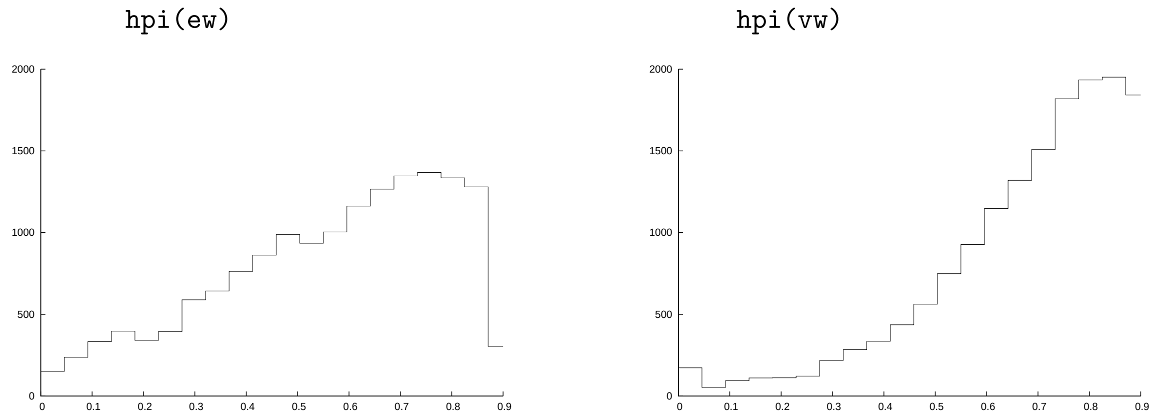
Estimated survival and hazard functions using all investor-company holding periods at the OSE in the period. The plots are adjusted for right truncation. Analysis time in years. The figure on the left is the estimated survival function. The figure on the right is the estimated hazard function. The analysis is based on 1,417,186 observations. The estimates are corrected for right truncation. The analysis is performed using Stata9. The analysis uses monthly data from the Oslo Stock Exchange over the period 1992:12 to 2003:6.

Figure 3 Illustrating the method for creating a holding period index



The figure illustrates our method for creating an holding period index. We illustrate four example owners, 1–4. We look at all owners during the year, and calculate each owner's holding period in fractions of the year. For owner 1 the holding period is 1, for owner 2 it is 5/12, for owner 3 it is 7/12, and for owner 4 it is 3/12. An holding period index is calculated at time t. We only use the owners present at time t, and calculate the weighted average of holding periods for the individual owners as $\texttt{hpi} = w_1 1 + w_3 \frac{7}{12} + w_4 \frac{3}{12}$. We use two different weights. The first is equal weights. The resulting index is denoted `hpi(ew)`. The second is value weights, each owner receive weights based on the faction of the company that owner holds at date t. The resulting index is denoted `hpi(vw)`.

Figure 4 The distribution of holding period indices



Histograms of the holding period indices hpi(ew) and hpi(vw). The indices are calculated for each company at year end. The variables hpi(ew) and hpi(vw) are averages of holding period length at the stock level calculated over a period of one year by taking all owners observed at the final date and taking the average holding period over the period for these owners. The index hpi(ew) is an equally weighted average and the index hpi(vw) is a value weighted average. The analysis uses monthly data from the Oslo Stock Exchange over the period 1992:12 to 2003:6.

Table 1 Determinants of the hazard function

Panel A: Investor specific variables and liquidity

Variable	Haz. Ratio	pvalue	Haz. Ratio	pvalue
ln(Investment)	0.9773	(0.00)	0.9915	(0.00)
Financial	1.1770	(0.00)	1.1579	(0.00)
Foreign	0.9462	(0.00)	0.9362	(0.00)
Nonfinancial	1.0851	(0.00)	1.0741	(0.00)
Individual	0.7165	(0.00)	0.7114	(0.00)
Bid Ask Spread	0.5221	(0.00)		
Turnover			1.1952	(0.00)
n	1417186		1417186	

Panel B: Investor specific variables, firm specific variables, and liquidity

Variable	Haz. Ratio	pvalue	Haz. Ratio	pvalue
ln(Investment)	0.9829	(0.00)	0.9887	(0.00)
Financial	1.1916	(0.00)	1.2069	(0.00)
Foreign	0.9932	(0.61)	0.9993	(0.95)
Nonfinancial	1.1157	(0.00)	1.1356	(0.00)
Individual	0.7551	(0.00)	0.7598	(0.00)
ln(Volatility)	1.4317	(0.00)	1.2192	(0.00)
ln(Firm Size)	1.0097	(0.00)	1.0411	(0.00)
Bid Ask spread	0.0034	(0.00)		
Turnover			1.2288	(0.00)
n	1038170			

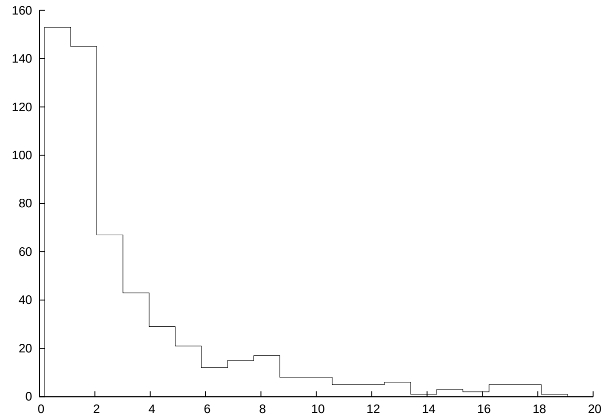
The tables show the results for two separate analysis of contributions to the hazard function illustrated in figure 2. In Panel A, the explanatory variables include investment size, owner type, and liquidity. In Panel B, we include volatility and firm size as explanatory variables in addition to investment size, owner type, and liquidity. Columns 2 and 3 show the results when we use the bid ask spread as our measure of liquidity, while columns 4 and 5 show the results when we measure liquidity by turnover. *Investment*: The amount invested in that stock by the given owner, *Financial*: Dummy variable equal to one if the given owner is a financial corporation, *Foreign*: Dummy variable equal to one if the given owner is foreign, *Individual*: Dummy variable equal to one if the given owner is an individual (family) owner, *NonFinancial*: Dummy variable equal to one if the given owner is a nonfinancial corporation, *Stock Volatility*: Volatility of the stock's returns, estimated using one year of returns, *Firm Size*: The value of the company's equity, *Bid/Ask spread*: Relative bid/ask spread $(P_a - P_b)/P_t$, averaged over a year and *Turnover*: Number of shares traded in the stock during one year divided by number of shares outstanding. The analysis is performed using Stata9. The analysis uses monthly data from the Oslo Stock Exchange over the period 1992:12 to 2003:6.

Table 2 Average holding periods estimated as in Atkins and Dyl (1997)

Panel A: Describing the Atkins and Dyl (1997) holding period measure

	Holding Period (years)			
Period	Mean	Med	StDev	n
93–03	3.33	1.96	3.55	1554

Panel B: Distribution of the Atkins and Dyl (1997) holding period measure



Panel A: The table describes estimates of the average holding period of investors using the method of Atkins and Dyl (1997). Panel B: The histogram shows the distribution of estimates of the average holding period of investors. Holding period is estimated as one divided by annual turnover. The analysis uses monthly data from the Oslo Stock Exchange over the period 1992:12 to 2003:6.

Table 3 How is the Atkins and Dyl (1997) measure related to spreads?

	coeff	[pvalue]
Constant	-2.555	[0.00]
Annual avg rel spread	23.677	[0.00]
ln(Firm Size)	0.006	[0.79]
ln(Stock Variance)	-0.340	[0.00]
n	1408	
$\bar{R}^2$	0.12	

The table shows results of estimation of the regression (1) in the system of equations defined by the two equations (1) and (2) below.

$$HldPer_{iT} = \alpha^1 + \beta_1 Spread_{iT} + \quad \beta_2 MktVal_{iT} + \beta_3 VarRet_{iT} \tag{1}$$

$$Spread_{iT} = \alpha^2 + \quad \gamma_1 HldPer_{iT} + \gamma_2 MktVal_{iT} + \gamma_3 VarRet_{iT} \tag{2}$$

The estimation is done using 2SLS with lagged spread ($Spread_{i,T-1}$) as an instrument for the spread ($Spread_{i,T}$). In this specification we follow the notation of Atkins and Dyl (1997), where $HldPer$ is the log of their estimate of holding period, the inverse of the annual turnover, $Spread$ is the relative bid ask spread, $MktVal$ the log of the market value of the firm, and $VarRet$ the log of the average daily variance of stock returns. *Stock Volatility*: Volatility of the stock's returns, estimated using one year of returns, *Firm Size*: The value of the company's equity, *Bid/Ask spread*: Relative bid/ask spread $(P_a - P_b)/P_t$, averaged over a year and *HldPer*: The Atkins and Dyl estimate of Holding period, the inverse of the annual turnover The analysis uses monthly data from the Oslo Stock Exchange over the period 1992:12 to 2003:6.

Table 4 Determinants of holding period indices

Panel A: Stratified quartiles

	hpi(ew)					hpi(vw)				
	All	1	2	3	4	All	1	2	3	4
Firm Size	0.580	0.629	0.558	0.543	0.595	0.674	0.685	0.658	0.674	0.697
Stock Volatility	0.570	0.630	0.548	0.522	0.579	0.682	0.714	0.667	0.664	0.684
BM Ratio	0.577	0.463	0.565	0.599	0.651	0.685	0.640	0.690	0.695	0.706
Firm listing age	0.579	0.477	0.554	0.610	0.642	0.672	0.616	0.657	0.680	0.717
Primary insider fraction	0.577	0.580	0.590	0.588	0.562	0.672	0.671	0.670	0.672	0.672
Largest owner	0.580	0.582	0.539	0.603	0.599	0.678	0.663	0.645	0.713	0.691

Panel B: Regression models

	hpi(ew)		hpi(vw)	
Variable	coeff	pvalue	coeff	pvalue
constant	0.767	(0.00)	0.548	(0.00)
ln(Firm Size)	-0.023	(0.00)	-0.000	(0.98)
Stock Volatility	0.579	(0.07)	0.414	(0.14)
BM Ratio	0.059	(0.00)	0.036	(0.00)
ln(Firm listing age)	0.102	(0.00)	0.038	(0.00)
Primary insider fraction	-0.122	(0.07)	0.056	(0.36)
Largest owner	0.112	(0.00)	0.130	(0.00)
n	1118		1118	
R^2	0.30		0.11	

The tables show how the holding period indices covary with firm characteristics. The top table (panel A) shows averages of holding period indices in stratified samples. For each line we group the stocks in the sample in four quartiles by the criterion listed on the left. We then calculate averages of holding period indices for each of the four groups. The quartiles are sorted in increasing value. So for example in the first line quartile 1 is the group with the smallest companies, and quartile 4 contains the largest firms. The bottom table (panel B) shows results of two independent regressions showing how the holding period indices listed at the top of each column are determined by the explanatory variables listed in the rows. The variables hpi(ew) and hpi(vw) are averages of holding period length at the stock level calculated over a period of one year by taking all owners observed at the final date and taking the average holding period over the period for these owners. The index hpi(ew) is an equally weighted average and the index hpi(vw) is a value weighted average. *Firm Size*: The value of the company's equity, *Stock Volatility*: Volatility of the stock's returns, estimated using one year of returns, *B/M ratio*: Book/Market Ratio, *Listing age*: Number of years on the stock exchange, *Insider fraction*: Fraction of the company held by insiders and *Largest owner*: Fraction of the company owned by the firm's largest owner. The analysis uses monthly data from the Oslo Stock Exchange over the period 1992:12 to 2003:6.

Table 5 The link between holding period indices and liquidity

Panel A: Correlations between liquidity and holding periods

	Correlation		Rank Correlation	
	hpi(vw)	hpi(ew)	hpi(vw)	hpi(ew)
Annual Turnover	-0.509	-0.511	-0.478	-0.430
Annual Avg Rel BA Spread	0.207	0.380	0.185	0.268
Amortized Spread	-0.079	-0.010	-0.118	-0.068

Panel B: Stratified quartiles

	hpi(ew)					hpi(vw)				
	All	1	2	3	4	All	1	2	3	4
Annual Turnover	0.579	0.723	0.636	0.552	0.426	0.674	0.793	0.737	0.666	0.515
Annual Avg Rel BA Spread	0.576	0.515	0.550	0.573	0.690	0.671	0.642	0.649	0.672	0.735
Annual Amortized Spread	0.576	0.647	0.562	0.534	0.559	0.673	0.727	0.671	0.648	0.643

The table in Panel A shows Pearson's correlation coefficients and Kendall's rank correlation coefficients between holding period indices and liquidity measures. The table in Panel B splits the sample into four quartiles based on the two liquidity measures and show how the holding period indices vary. The variables hpi(ew) and hpi(vw) are averages of holding period length at the stock level calculated over a period of one year by taking all owners observed at the final date and taking the average holding period over the period for these owners. The index hpi(ew) is an equally weighted average and the index hpi(vw) is a value weighted average. *Turnover*: Number of shares traded in the stock during one year divided by number of shares outstanding and *Bid/Ask spread*: Relative bid/ask spread $(P_a - P_b)/P_t$, averaged over a year. The analysis uses monthly data from the Oslo Stock Exchange over the period 1992:12 to 2003:6.

Table 6 Determinants of turnover and bid ask spread

Panel A: Stratified quartiles

Turnover:

	All	Quartiles of Annual Turnover 1	2	3	4
Firm Size	301	136	222	515	334
Stock Volatility	3.5	4.3	3.5	3.1	3.3
BM Ratio	1.02	1.13	1.56	0.72	0.70
Firm listing age	7.3	7.5	7.1	7.2	7.3
Primary insider fraction	1.8	2.1	1.8	1.8	1.7
Largest owner	26.9	32.8	28.9	23.1	23.2

Relative Bid/Ask spread:

	All	Quartiles of Annual Avg Rel BA Spread 1	2	3	4
Firm Size	873	1224	1030	695	537
Stock Volatility	3.5	2.4	2.9	4.0	5.9
BM Ratio	0.97	0.63	1.38	0.92	0.97
Firm listing age	7.9	9.1	7.9	6.9	7.9
Primary insider fraction	1.8	1.1	1.5	1.9	2.5
Largest owner	26.3	22.6	24.9	27.7	30.5

Amortized Spread

	All	Quartiles of Annual Amortized Spread 1	2	3	4
Firm Size	308	892	234	84	27
Stock Volatility	3.5	2.7	3.1	3.8	5.3
BM Ratio	0.99	0.68	0.79	1.48	0.99
Firm listing age	7.3	9.7	7.7	6.0	5.8
Primary insider fraction	1.9	1.5	1.8	2.3	1.8
Largest owner	26.6	32.2	25.4	23.1	25.5

Panel B: Regression models

	Annual Turnover		Annual Avg Rel BA Spread		Amortized Spread	
Variable	coeff	pvalue	coeff	pvalue	coeff	pvalue
constant	-0.166	(0.51)	0.200	(0.00)	0.032	(0.00)
ln(Firm Size)	0.052	(0.00)	-0.009	(0.00)	-0.001	(0.00)
Stock Volatility	-0.259	(0.72)	0.530	(0.00)	0.056	(0.00)
BM Ratio	-0.115	(0.00)	-0.001	(0.01)	0.000	(0.49)
ln(Firm listing age)	0.006	(0.69)	0.003	(0.00)	-0.000	(0.00)
Primary insider fraction	0.249	(0.23)	0.005	(0.42)	0.002	(0.20)
Largest owner	-0.869	(0.00)	0.024	(0.00)	-0.003	(0.00)
n	1639		1639		1639	
R^2	0.11		0.63		0.44	

The tables show how the liquidity variables covary with firm characteristics. The top table (panel A) shows averages of liquidity in stratified samples. For each line we group the stocks in the sample in four quartiles by the criterion listed on the left. We then calculate averages of turnover and bid/ask spread for each of the four groups. The quartiles are sorted in increasing value. So for example in the first line quartile 1 is the group with the smallest companies, and quartile 4 contains the largest firms. The bottom table (panel B) shows results of two independent regressions showing how the liquidity variables listed at the top of each column are determined by the explanatory variables listed in the rows. *Turnover*: Number of shares traded in the stock during one year divided by number of shares outstanding, *Bid/Ask spread*: Relative bid/ask spread $(P_a - P_b)/P_t$, averaged over a year, *Firm Size*: The value of the company's equity, *Stock Volatility*: Volatility of the stock's returns, estimated using one year of returns, *B/M ratio*: Book/Market Ratio, *Insider fraction*: Fraction of the company held by insiders, *Listing age*: Number of years on the stock exchange and *Largest*

Table 7 Adding liquidity measures as determinants of holding period indices

	hpi(ew)		hpi(vw)		hpi(ew)		hpi(vw)		hpi(ew)		hpi(vw)	
Variable	coeff	pvalue	coeff	pvalue	coeff	pvalue	coeff	pvalue	coeff	pvalue	coeff	pvalue
constant	0.722	(0.00)	0.512	(0.00)	-0.127	(0.20)	0.058	(0.55)	0.998	(0.00)	0.752	(0.00)
ln(Firm Size)	-0.013	(0.00)	0.008	(0.02)	0.021	(0.00)	0.024	(0.00)	-0.033	(0.00)	-0.008	(0.07)
Stock Volatility	0.688	(0.01)	0.502	(0.04)	-2.765	(0.00)	-1.423	(0.00)	0.882	(0.01)	0.678	(0.02)
BM Ratio	0.036	(0.00)	0.017	(0.00)	0.063	(0.00)	0.038	(0.00)	0.059	(0.00)	0.036	(0.00)
ln(Firm listing age)	0.097	(0.00)	0.034	(0.00)	0.079	(0.00)	0.025	(0.00)	0.099	(0.00)	0.035	(0.00)
Primary insider fraction	-0.100	(0.08)	0.074	(0.17)	-0.125	(0.04)	0.054	(0.35)	-0.117	(0.08)	0.060	(0.32)
Largest owner	-0.042	(0.13)	0.003	(0.90)	-0.012	(0.69)	0.062	(0.03)	0.094	(0.00)	0.115	(0.00)
Annual Turnover	-0.153	(0.00)	-0.126	(0.00)								
Annual Avg Rel BA Spread					4.774	(0.00)	2.620	(0.00)				
Amortized Spread									-6.784	(0.00)	-5.976	(0.00)
n	1118		1118		1118		1118		1118		1118	
R^2	0.50		0.32		0.46		0.18		0.31		0.12	

The table shows results of four independent regressions showing how the holding period indices listed at the top of each column are determined by the explanatory variables listed in the rows. The variables hpi(ew) and hpi(vw) are averages of holding period length at the stock level calculated over a period of one year by taking all owners observed at the final date and taking the average holding period over the period for these owners. The index hpi(ew) is an equally weighted average and the index hpi(vw) is a value weighted average. *Firm Size*: The value of the company's equity, *Stock Volatility*: Volatility of the stock's returns, estimated using one year of returns, *B/M ratio*: Book/Market Ratio, *Insider fraction*: Fraction of the company held by insiders, *Listing age*: Number of years on the stock exchange, *Largest owner*: Fraction of the company owned by the firm's largest owner, *Turnover*: Number of shares traded in the stock during one year divided by number of shares outstanding and *Bid/Ask spread*: Relative bid/ask spread $(P_a - P_b)/P_t$, averaged over a year. The analysis uses monthly data from the Oslo Stock Exchange over the period 1992:12 to 2003:6.

Table 8 Cross-sectional investigations of asset prices

Panel A: Excess returns. Portfolios sorted on hpi and liquidity

	hpi(ew)	hpi(vw)	Turnover	Spread	Amortized Spread
1	1.11	1.26	1.99	0.81	1.09
2	1.36	1.43	1.23	1.19	1.07
3	1.16	1.02	1.42	1.52	1.58
4	1.44	0.91	1.43	1.59	1.03
5	1.13	1.00	1.88	1.51	1.15
6	0.80	1.28	1.87	1.65	1.21
7	0.58	1.03	1.65	1.45	1.83
8	1.17	0.94	1.77	1.74	1.98
9	1.13	0.58	1.35	2.38	1.92
10	0.69	1.16	1.63	2.28	3.26

Panel B: Fama Macbeth analysis. Adding liquidity to a one factor model

	(I)		(II)		(III)		(IV)		(V)	
constant	-0.0007	(0.94)	0.0015	(0.89)	0.0108	(0.02)	0.0017	(0.73)	0.0060	(0.28)
Stock Beta	-0.0058	(0.28)	-0.0077	(0.21)	-0.0088	(0.17)	-0.0042	(0.46)	-0.0077	(0.21)
hpi(ew)	0.0142	(0.21)								
hpi(vw)			0.0117	(0.29)						
Annual Turnover					0.0012	(0.70)				
Annual Avg Rel BA Spread							0.1752	(0.03)		
Annual Amortized Spread									0.8010	(0.15)
n	114		114		115		115		115	

Panel C: Fama MacBeth analysis. Adding liquidity to a two factor model

	(I)		(II)		(III)		(IV)		(V)	
constant	0.0646	(0.05)	0.0622	(0.06)	0.0681	(0.03)	0.0293	(0.33)	0.0495	(0.29)
Stock Beta	-0.0024	(0.67)	-0.0040	(0.53)	-0.0053	(0.41)	-0.0046	(0.43)	-0.0054	(0.39)
ln(Firm Size)	-0.0033	(0.03)	-0.0033	(0.03)	-0.0029	(0.05)	-0.0013	(0.37)	-0.0021	(0.32)
hpi(ew)	0.0146	(0.21)								
hpi(vw)			0.0162	(0.14)						
Annual Turnover					0.0007	(0.82)				
Annual Avg Rel BA Spread							0.1267	(0.13)		
Annual Amortized Spread									0.3946	(0.62)
n	114		114		115		115		115	

We here perform a number of cross-sectional investigations of asset prices. In Panel A we show excess returns of 10 portfolios sorted on either an holding period index (hpi) or a liquidity measure. For each stock we calculate the hpi indices and the two liquidity measures annual turnover and average relative bid/ask spread. We then use these numbers to group the stocks into 10 portfolios. The table describes the excess returns of these 10 portfolios, i.e. returns in excess of the risk free interest rate. Panel B and C shows results for a number of different Fama and MacBeth (1973) specifications. In panel B we add liquidity variables and holding period variables to the CAPM, in panel C we add them to the a two factor model. Each of the tables describing Fama MacBeth analysis describes four different specifications (I) to (V). The variables hpi(ew) and hpi(vw) are averages of holding period length at the stock level calculated over a period of one year by taking all owners observed at the final date and taking the average holding period over the period for these owners. The index hpi(ew) is an equally weighted average and the index hpi(vw) is a value weighted average. *Stock Beta*: Beta is calculated using five years of monthly data, *Turnover*: Number of shares traded in the stock during one year divided by number of shares outstanding, *Bid/Ask spread*: Relative bid/ask spread $(P_a - P_b)/P_t$, averaged over a year and *Amorized Spread*: . The analysis uses monthly data from the Oslo Stock Exchange over the period 1992:12 to 2003:6.

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