Liquidity and Asset Pricing. Evidence on the role of Investor Holding Period.

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Holding period

This paper: *Holding periods* of individual investors.
Relate to:

- Asset pricing.
- Liquidity/Market microstructure.

Asset pricing

Determinants of the price of financial assets.
Best known example
Capital Asset Pricing Model (CAPM).

Asset Price $P_i = f(\text{cov}(r_i, r_m))$

r_i – asset return
r_m – market return
Empirically – not sufficient
Other factors also important for asset prices

- Firm size
- Book/Market ratio
- Stock Market Liquidity

Asset pricing

Theoretical Asset Pricing:
What is the mechanism for moving asset prices toward equilibrium?
Prices align to make investors indifferent between trading / not
trading.
Does the mechanism for moving prices involve trading?
(The microstructure view)
Whose trades are then important?

- ▶ Those that buy/sell?
- ▶ Those that do *not* buy/sell?
    - ▶ (The silent majority)

Market Microstructure

Explicit modelling of interaction between market participants.

- ▶ Information (Informed/Noise traders)
- ▶ Liquidity (Number of potential traders)
- ▶ Market design (Mechanism for moving prices)

Can these effects be viewed as second order?
Difference many other markets: Importance of information.

Empirically - Market microstructure affects asset prices

Empirical evidence – Variables related to microstructure/liquidity important for asset prices

US data

- ▶ Amihud and Mendelson [1986]
- ▶ Pastor and Stambaugh [2003]
- ▶ Acharya and Pedersen [2005]
- ▶ Korajczyk and Sadka [2007]

UK

- ▶ Datar, Naik, and Radcliffe [1998]

Norway (Oslo Børs)

- ▶ Næs, Skjeltorp, and Ødegaard [2007]

Measuring liquidity

Theoretically / Empirically:
Liquidity - difficult concept.

- ▶ How much must prices move to effectuate an order?
- ▶ Depth of order book

Many different liquidity proxies,

- ▶ Bid/Ask Spread (Quoted/Effective)
- ▶ Turnover (Fraction of shares outstanding traded)
- ▶ What is the cost implicit in the market moving and a stock not moving? ($r_i = a + br_m$) Lesmond, Ogden, and Trzcinka [1999]
- ▶ How much volume is needed to move prices? (return) Amihud [2002]
- ▶ ...

Liquidity - why does it matter?

Liquidity matters for asset pricing.
But: Still unclear what aspect of liquidity is important
(What moves this from second to first order)
Disputed - No single model
Why we want to consider holding periods - can they add
information?

Amihud and Mendelson [1986] model

Often cited link asset pricing - microstructure:
The Amihud and Mendelson [1986] model.
Investors choose assets depending on the spread.
Expect to hold the stocks for a long period
– Willing to buy high spread stocks.
(Higher cost distributed over longer time)
Result:
Link between

- ▶ Expected return and spread
- ▶ Expected return and turnover
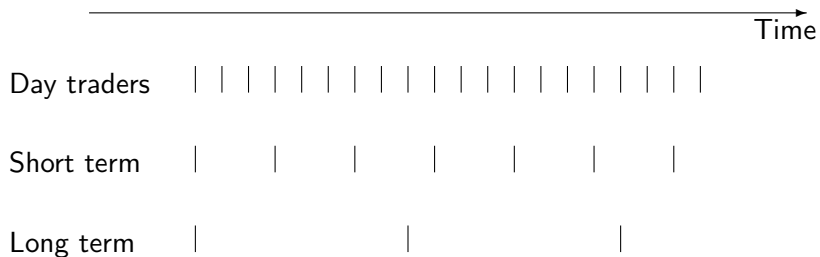 (reflecting holding period differences)

Bottom line

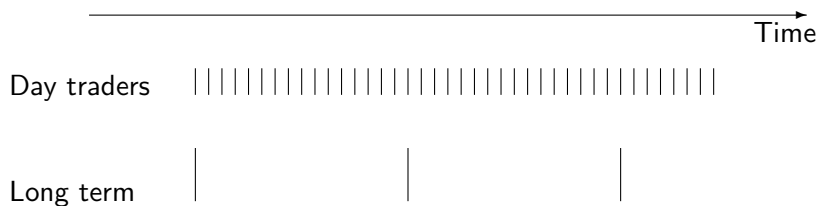The whole distribution of how long owners hang on to their stocks likely to be important for asset pricing.
However: We have no explicit model we are testing.
Analysis in this paper exploratory.

A possible distribution of equity owners

Another possible distribution of equity owners

This paper

Source of contribution of this paper:
Data on holding periods of

- ▶ All owners in a stock market
- ▶ Over a long time period (10 years).

What do we do?

At the level of individual investors.

1) Describe holding period distribution for individual investors. Investigate determinants of holding period.
2) Relate actual holding periods to existing proxies for holding period.

At the level of stocks.

3) Look at the link between holding periods and liquidity measures.
4) Ask whether aspects of holding period explain asset prices better than liquidity measures.

Market and Data

All firms listed at the Oslo Stock Exchange (OSE) in the period 1992-2003

Data Sources

- Norwegian Securities Registry (VPS)
    - equity holdings of the complete stock market
    - can distinguish between investor types
- Oslo Stock Exchange Data Service (OBI)
    - stock prices and accounting data
- Central Bank of Norway
    - interest rates

Individual Decisions on Holding Period

- ▶ Describe the holding periods of all equity investors in the Norwegian stock market using duration analysis
- ▶ Study what variables might affect holding period decisions
  - ▶ Direct test of the spread-holding period relationship in Amihud and Mendelson (1986)
- ▶ Compare with results from existing literature using turnover as a proxy for holding period

Duration Analysis

- The main tool for analyzing length of time spent in a particular state (economic, social, health)
- The probability distribution of duration can be specified by a distribution function
  - $F(t) = Pr(T < t)$

  which specify that a random variable T is less than some value t

- Models the decision to terminate a relationship
  - Here, the decision to liquidate the equity holding in a firm

Duration Analysis (2)

- Several ways to characterize the probability distribution of the termination decision:
  - **The survival function**; the unconditional probability of surviving beyond a given date
    - $S(t) = 1 - F(t) = Pr(T \geq t)$
  - **The hazard function**; the probability of termination, conditional of having survived so far
    - $\lambda(t) = \frac{f(t)}{S(t)}, f(t) = dF(t)/dt$

The Truncation Problem
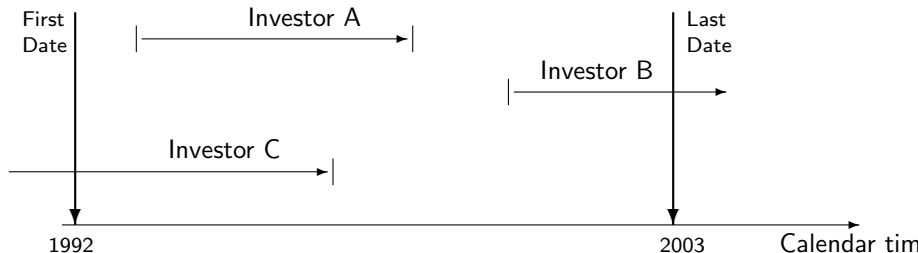
- ▶ Investor A: correctly estimated
- ▶ Investor B: right truncated
- ▶ Investor C: left truncated

Unconditional Probability Distribution

Kaplan–Meier survival estimate

Conditional Probability Distribution

Smoothed hazard estimate
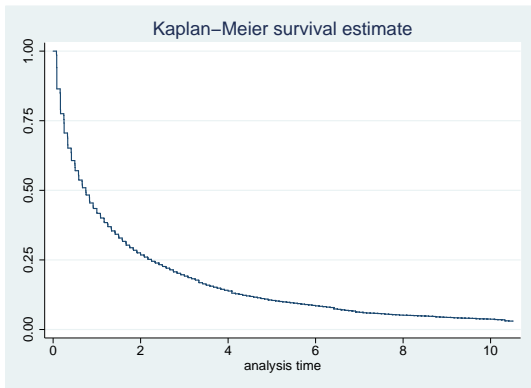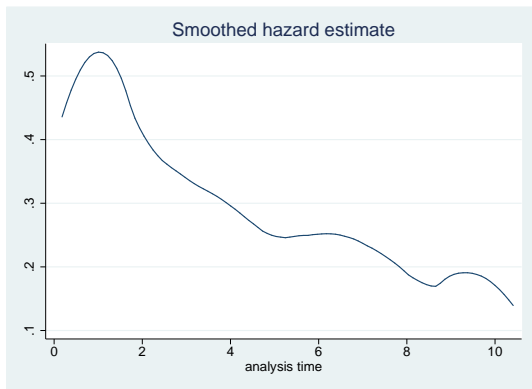
Determinants of the Hazard Function

- Hazard = f(observables at entry)
- Variables
  - spread (test of the AM-model)
  - firm characteristics (size, volatility)
  - investor types (financial, foreign, ..)
  - size of investment

Determinants of the Hazard Function (2)

Variable	Hazard ratio	pvalue	Prob of exit
Spread	0.0034	(0.00)	↓
Ln(Firm size)	1.0097	(0.00)	↑
Ln(Volatility)	1.4317	(0.00)	↑
Financial	1.1916	(0.00)	↑
Foreign	0.9932	(0.61)	
Non-financial	1.1157	(0.00)	↑
Individual	0.7551	(0.00)	↓
Ln(Investment)	0.9829	(0.00)	↓
n	1038170		

Contribution to the hazard function:

- coefficient $= 1$, no contribution
- coefficient > 1, higher conditional probability
- coefficient < 1, lower conditional probability

2) Existing proxies for holding period

How does the estimates from actual individual owners compare to existing estimates.

Atkins and Dyl [1997]: Estimating holding period using turnover.

$$\text{Average holding period} = \frac{1}{\text{Turnover}}$$

Compare:

	NYSE	Nasdaq	OSE
	1975-1989	1983-1991	1992-2003
Average	6.99	4.01	3.33
Median	3.38	2.43	1.96

Considerably longer average holding period than the one year suggested by our duration analysis

Individual Decisions on Holding Period - Summary

- The average holding period is around 1 year
- Considerable time variation in the conditional probability of exit
- Liquidity is important for the holding period decision
- Estimating holding period from turnover seriously overstates average holding period

Stock Level Analysis

Comparing holding period and standard measures of liquidity.
Problem: Holding period is an individual owner decision.
Liquidity is measured at the level of a stock
(aggregates many individuals)
Construct a stock level measure of holding period:
`hpi` – Holding period index.

- ▶ What are the determinants of the holding period index?
- ▶ How is the holding period index related to other liquidity measures
- ▶ Does the holding period index explain the cross section of stock returns better than alternative liquidity proxies?

Holding Period Index (hpi) - Construction
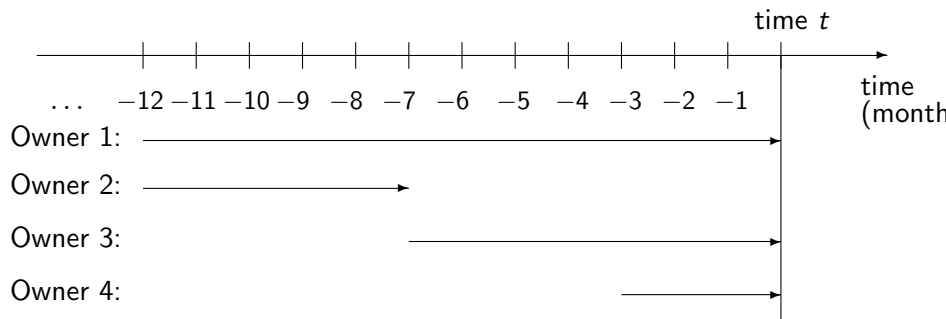
Let w_i = weight for owner $i \Rightarrow$

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

The Distribution of Holding Period Indices
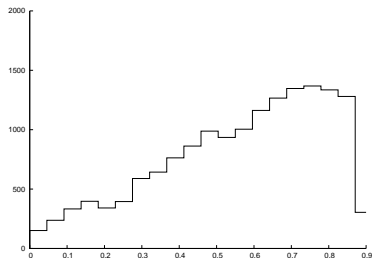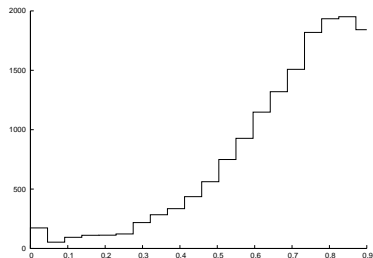
hpi(ew)   hpi(vw)

▶ Tendency that large owners have longer holding periods than small owners

3) The Link between hpi and Liquidity

| | Correlation | | Rank correlation | |
	hpi(vw)	hpi(ew)	hpi(vw)	hpi(ew)
Annual turnover	-0.51	-0.51	-0.48	-0.43
Annual relative spread	0.17	0.32	0.15	0.23

- ▶ Correlations have expected signs
- ▶ Turnover is an imperfect measure of holding period
- ▶ Spread even less linked to holding period.

The Determinants of Holding Period Indices

| | 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	

► hpi ↑ ⇒ smaller firm (ew), value firm, older firm, large owner larger

► Variables related to information have no effects

The Determinants of hpi - Including Liquidity

	hpi(ew)		hpi(ew)		hpi(vw)	
Variable	coeff	pvalue	coeff	pvalue		
Constant	0.719	(0.00)	-0.128	(0.20)		
Ln(Firm size)	-0.013	(0.00)	0.021	(0.00)		
Stock volatility	0.695	(0.01)	-2.765	(0.00)		
BM ratio	0.036	(0.00)	0.063	(0.00)		
Ln(Firm listing age)	0.097	(0.00)	0.079	(0.00)		
Primary insider fraction	-0.099	(0.09)	-0.124	(0.04)		
Largest owner	-0.043	(0.13)	-0.012	(0.69)		
Annual turnover	-0.153	(0.00)				
Annual relative spread			4.776	(0.00)	2.622	(0.00)
n	1118		1118			
R^2	0.50		0.46			

► Turnover and spreads affects hpi in expected ways

4) Asset pricing with holding period measures

If what is important for asset prices is holding period, then a measure of holding period should do better in explaining asset returns.

- ▶ What is the relationship between holding period indices and returns?
- ▶ Simple portfolio sorting on excess returns
  - ▶ Excess return = Portfolio return − Risk free return
- ▶ Standard Fama Macbeth asset pricing tests
  - ▶ one-factor model
  - ▶ three-factor specification

Excess Returns on Sorted Portfolios

10 portfolios sorted on hpi and liquidity measures

	hpi(ew)	hpi(vw)	Turnover	Spread
1	1.11	1.26	2.04	0.51
2	1.36	1.44	1.20	1.48
3	1.16	1.04	1.37	0.95
4	1.44	0.91	1.41	1.86
5	1.15	1.01	1.94	1.85
6	0.80	1.28	1.86	1.62
7	0.58	1.03	1.61	1.60
8	1.18	0.95	1.78	1.75
9	1.15	0.57	1.39	2.06
10	0.68	1.16	1.63	2.35

Fama Macbeth Analysis

Adding hpi/liquidity to an asset pricing model.
Method: Fama and MacBeth [1973]

Time:	$t-1$		t	$t+1$		$\ldots$	
Stock	1	$r_{1,t}$	$\mathbf{X}_{1,t}$	$r_{1,t+1}$	$\mathbf{X}_{1,t+1}$	$\ldots$	
	2	$r_{2,t}$	$\mathbf{X}_{2,t}$	$r_{2,t+1}$	$\mathbf{X}_{2,t+1}$	$\ldots$	
		$\vdots$			$\vdots$		
	n	$r_{n,t}$	$\mathbf{X}_{n,t}$	$r_{n,t+1}$	$\mathbf{X}_{n,t+1}$	$\ldots$	
		$r_t = \mathbf{X}_t\hat{\mathbf{b}}_t$		$r_{t+1} = \mathbf{X}_{t+1}\hat{\mathbf{b}}_{t+1}$		$\ldots$	$\rightarrow$ average

Elements of **b**

1. β_i + Liqudity/hpi.
2. β_i, Firm Size, B/M + Liqudity/hpi.

Fama Macbeth Analysis Results (1)

	hpi(ew)	hpi(vw)	Turnover	Spread
Constant	-0.0016 (0.89)	-0.0110 (0.28)	**0.0088 (0.04)**	-0.0063 (0.25)
Stock beta	-0.0025 (0.45)	-0.0018 (0.61)	-0.0007 (0.85)	0.0023 (0.56)
hpi(ew)	0.0148 (0.27)			
hpi(vw)		**0.0249 (0.02)**		
Turnover			-0.0027 (0.29)	
Rel Spread				**0.2559 (0.00)**
n	114	114	115	115

Fama Macbeth Analysis Results (2)

Adding `hpi` and liquidity measures to a three-factor specification

	hpi(ew)		hpi(vw)		Turnover		Spread	
Constant	**0.0867**	**(0.02)**	**0.0843**	**(0.01)**	**0.0861**	**(0.01)**	0.0358	(0.37)
Stock beta	0.0027	(0.47)	0.0033	(0.36)	0.0025	(0.44)	0.0039	(0.29)
ln(Firm size)	**-0.0045**	**(0.00)**	**-0.0047**	**(0.00)**	**-0.0041**	**(0.00)**	-0.0021	(0.25)
BM ratio	0.0004	(0.93)	0.0007	(0.87)	0.0013	(0.76)	0.0012	(0.79)
hpi(ew)	0.0083	(0.55)						
hpi(vw)			0.0163	(0.13)				
Turnover					-0.0004	(0.88)		
Rel Spread							**0.1630**	**(0.02)**
n	114		114		115		115	

Summarizing

Explored a dataset with detailed data on individual investor holding periods.

At the level of individuals

- ▶ Individual owners tend to hold stock for less than a year.
  Holding period duration dependent.
  Liquidity affects holding period decision
  (Amihud and Mendelson [1986] prediction.)

- ▶ Using turnover as a proxy for holding period over-estimates holding period.

Stock characteristica

- ▶ Standard liquidity measures / turnover only imperfectly linked to holding period.

- ▶ Liquidity measures based on trading more related to asset prices than holding periods.

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