Horizon Pricing

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Motivation

- Should assessment of risk be related to the underlying investment horizon?
  - Delayed price reaction
  - Factor dynamics
  - Heterogeneous investor horizon

    (Pension funds, endowments, hedge funds, FoF)

Outline and Key Findings

- Some risks require a premium over some horizons and not others
- Pricing of factors of various horizons (portfolios and regression approach)
  - LIQ: short-run factor
  - MKT: intermediate-run factor
  - HML: long-run factor
  - SMB and UMD: not priced risk factors
- Beta or characteristic?
- There is evidence of time-varying risk premia

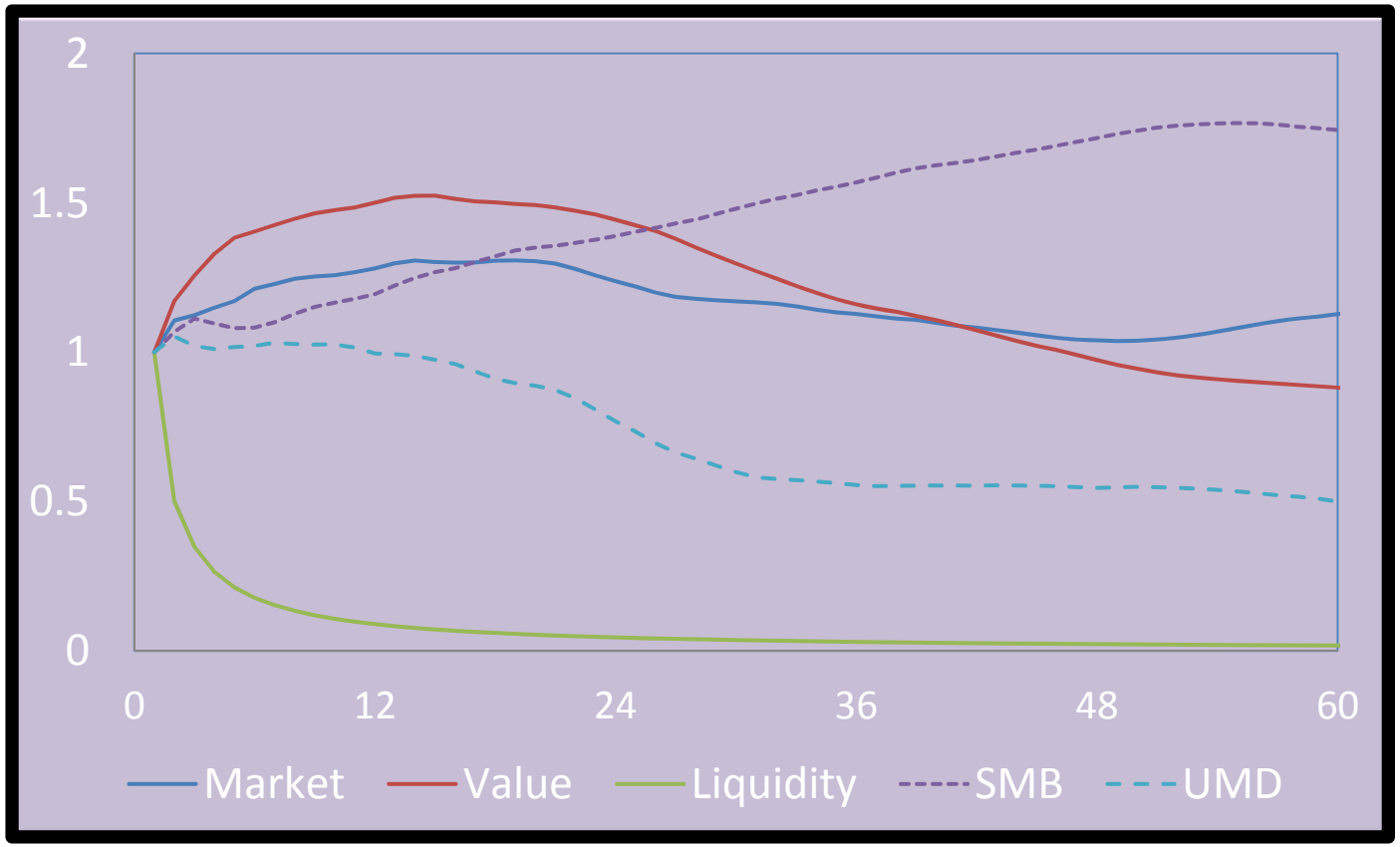
Data and Measures

- NYSE/AMEX/NASDAQ, 1963–2010
- Factors
  - MKT, SMB, HML, UMD, LIQ
- Factors of horizon q
  - Constructed from monthly factor
  - Excess return factors
    - $f_{q,t}^{MKT} = \prod_{i=0}^{q-1}(1 + r_{m,t-i}) - \prod_{i=0}^{q-1}(1 + r_{f,t-i})$
    - $f_{q,t}^{SMB} = \prod_{i=0}^{q-1}(1 + r_{s,t-i}) - \prod_{i=0}^{q-1}(1 + r_{B,t-i})$
  - How do we treat the liquidity factor?

$$LIQ_{t,q} = Liquidity_t - E_{t-q}[Liquidity_t]$$

Variance Ratio Tests

$$VR(q) = \frac{Var(r_{q,t})}{q \cdot Var(r_t)}$$



- $VR(q)=1$ independence
- $VR(q)>1$ persistent
- $VR(q)<1$ transitory

- Some factors exhibit long-run risks

Price Delay and Systematic Risk

- Example: One factor model, one period delay
- Relation between one-period horizon risk and q-period horizon risk

$$\beta_q = \beta_1 + \frac{q-1}{q}\frac{1}{VR(q)Var(f_1)}Cov(\varepsilon_{1,t}, f_{1,t-1})$$

- Additional effects
  - Longer delays
  - Discrete compounding
- What horizon is relevant for investors?

Pricing of Horizon Betas

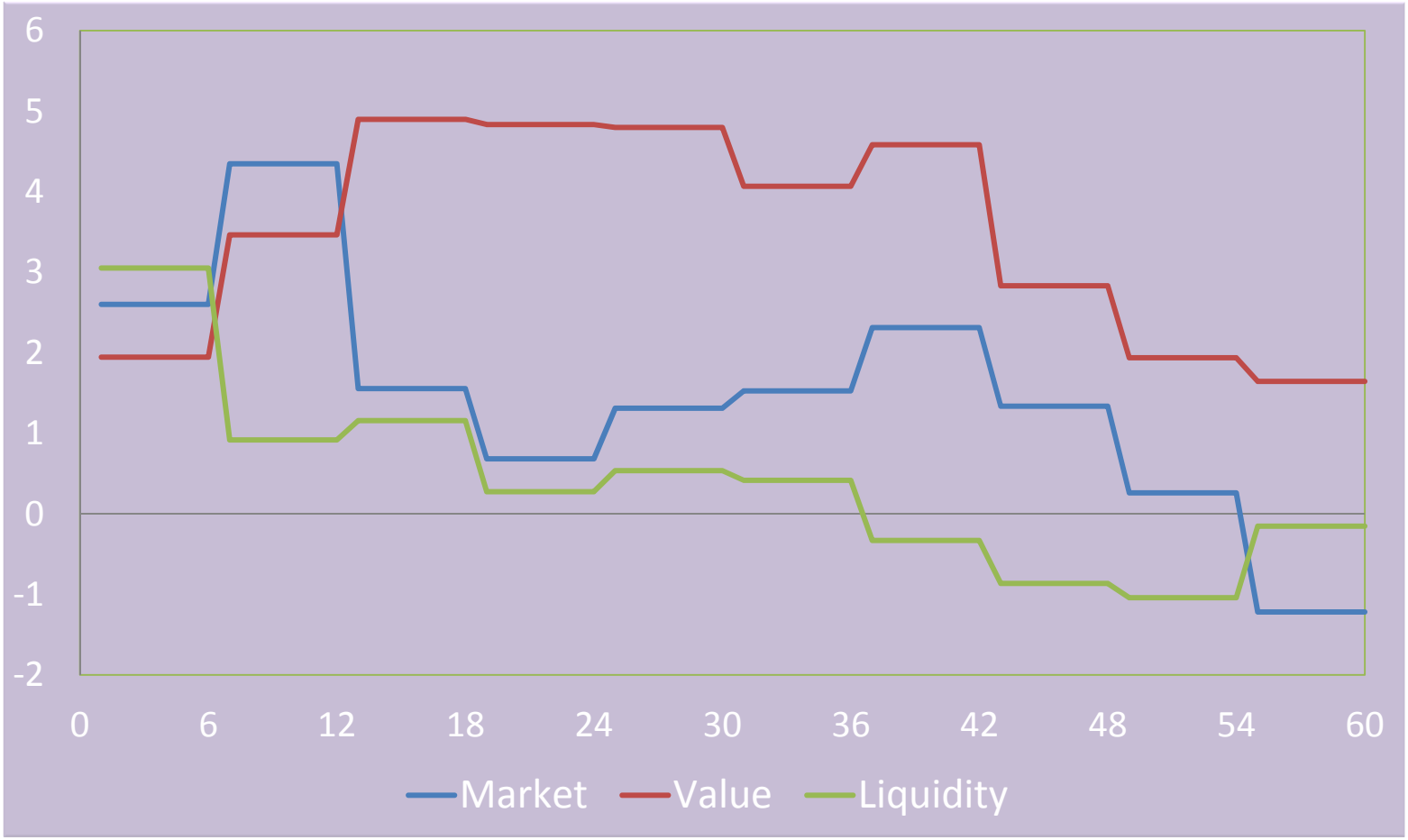
Return Spread of High Beta vs. Low Beta Portfolios

Horizon (q)	Market Beta Return	Market Beta Spread	SMB Beta Return	SMB Beta Spread	HML Beta Return	HML Beta Spread	UMD Beta Return	UMD Beta Spread	Liq Beta Return	Liq Beta Spread	Liq Beta FF4 Alpha	Liq Beta FF4 Alpha Spread
1	1.50	[0.58]	-1.20	[-0.35]	1.82	[0.65]	-2.74	[-1.17]	3.35	[1.73]	4.67	[2.33]
[5,6,7]	4.56	[2.34]	-1.41	[-0.48]	2.54	[1.05]	0.46	[0.23]	4.17	[2.33]	4.81	[2.63]
[11,12,13]	3.51	[1.94]	-1.13	[-0.41]	3.81	[1.69]	-0.58	[-0.29]	-0.23	[-0.14]	0.02	[0.01]
[23,24,25]	0.73	[0.39]	1.73	[0.74]	4.95	[2.29]	0.41	[0.22]	-0.68	[-0.44]	-0.83	[-0.52]
[35,36,37]	2.22	[1.14]	0.50	[0.24]	4.53	[2.17]	-0.94	[-0.48]	0.89	[0.54]	0.94	[0.55]
[47,48,49]	1.83	[0.94]	1.39	[0.65]	2.02	[1.13]	-3.04	[-1.57]	0.27	[0.17]	0.40	[0.25]
[59,60,61]	0.19	[0.09]	1.88	[0.89]	1.56	[0.81]	-2.63	[-1.44]	0.53	[0.34]	0.47	[0.30]

- Liquidity is a short-run factor
- Market is a medium-run factor
- HML is a long-run factor
- SMB and UMD are not priced risk factors

Summary of Risk Premia

Figure 3 – Annual Risk Premium (%) vs. Investment Horizon (months)



- Liquidity is a short-run factor
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Fama-MacBeth Regressions

Table 4 – Monthly Returns – regression of returns on beta

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
MKT(1)	0.03									-0.05			
	[0.42]									[-0.76]			
MKT(6)		0.09								0.01			
		[1.44]								[0.09]			
MKT(12)			0.10							0.08			0.09
			[1.96]							[1.34]			[1.48]
HML(1)				0.13							0.07		
				[1.80]							[0.98]		
HML(12)					0.16						-0.01		
					[2.44]						[-0.15]		
HML(24)						0.19					0.14		0.18
						[3.28]					[2.67]		[2.85]
LIQ(1)							0.09					0.10	0.08
							[2.06]					[1.92]	[1.65]
LIQ(3)								0.08				0.03	
								[1.72]				[0.52]	
LIQ(6)									0.05			0.00	
									[1.14]			[0.00]	

Beta or Characteristic?

- Portfolio approach
  - Dependent double sorts on betas and characteristics
  - Examine neutral portfolio return spreads
  - Results:
    Long-horizon HML-beta is priced after controlling for book-to-market; size and momentum characteristics
- Regression approach
  - Joint pricing of horizon betas and characteristics

Fama-MacBeth Regressions
Table 7 – Add Characteristics – returns to beta and Book-to-Market

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
MKT(1)	-0.02								
	[-0.31]								
MKT(6)		0.03							
		[0.60]							
MKT(12)			0.05						
			[1.16]						
HML(1)				0.10					
				[1.54]					
HML(12)					0.13				
					[2.26]				
HML(24)						0.16			
						[3.22]			
LIQ(1)							0.09		
							[2.04]		
LIQ(3)								0.09	
								[2.11]	
LIQ(6)									0.06
									[1.36]
B/M	0.09	0.09	0.10	0.07	0.08	0.07	0.09	0.09	0.09
	[2.22]	[2.16]	[2.19]	[1.92]	[1.90]	[1.69]	[2.00]	[1.97]	[2.11]

Time-Varying Risk Premia (Mean Monthly Returns)
Regression approach: Tables 7 (all) and 9
Regression of returns on beta and characteristics

	All	1965-1980	1981-1995	1996-2010
MKT(1)				
MKT(6)				
MKT(12)	0.04	0.02	-0.088	0.181
	[0.77]	[0.29]	[-1.15]	[1.72]
HML(1)				
HML(12)				
HML(24)	0.16	0.086	0.227	0.161
	[2.98]	[1.07]	[2.58]	[1.49]
LIQ(1)	0.09	-0.01	0.048	0.198
	[1.91]	[-0.13]	[0.61]	[2.42]
LIQ(3)				
LIQ(6)				
B/M	0.073	0.14	0.09	-0.032
	[1.73]	[1.60]	[1.44]	[-0.50]

Investor Horizon

- Utilize a measure of how frequently investors roll over their portfolio positions (churn rate)
- Calculate weighted average churn rate per stock
- We expect long-run premia among stocks with low average investor turnover

Investor Turnover

- Churn rate of Investor *i* at Quarter *t*

$$CR_{i,t} = \frac{\sum_{j \in Q} \left| N_{j,i,t} P_{j,i,t} - N_{j,i,t-1} P_{j,i,t-1} - N_{j,i,t-1} \Delta P_{j,i,t} \right|}{\sum_{j \in Q} \frac{N_{j,i,t} P_{j,i,t} + N_{j,i,t-1} P_{j,i,t-1}}{2}}$$

- Investor turnover per Stock *k*

$$InvestorTurnover_{k,t} = \sum_{i \in S} w_{k,i,t} \left(\frac{1}{4} \sum_{r=1}^{4} CR_{i,t-r+1} \right)$$

The Term Structure of HML

Monthly Returns for High Beta vs. Low Beta Portfolios

Horizon (q)	Investor turnover: Low		Intermediate		High		High-Low	
1	-0.09	[-0.34]	0.05	[0.21]	0.14	[0.52]	0.23	[0.79]
3	0.10	[0.42]	0.11	[0.54]	0.21	[0.94]	0.11	[0.40]
6	0.03	[0.11]	0.08	[0.40]	0.17	[0.73]	0.14	[0.49]
12	-0.04	[-0.18]	0.07	[0.39]	-0.07	[-0.31]	-0.03	[-0.11]
24	0.61	[2.17]	0.28	[1.64]	-0.01	[-0.03]	-0.64	[-2.17]
36	0.22	[0.98]	0.32	[2.11]	-0.06	[-0.28]	-0.28	[-1.02]
48	0.02	[0.09]	0.15	[1.66]	0.06	[0.27]	0.04	[0.14]
60	-0.18	[-0.91]	0.09	[0.86]	0.08	[0.36]	0.26	[0.93]

- HML-beta premium is exhibited among long horizon investors

Implications

- Risk measurement, risk management
- Different investors are the natural bearers of different sources of risk
  - Short-term Liquidity risk
  - Long-term market and HML risk

Summary and Conclusion

We highlight the role of horizon in asset pricing

- Some risks require a premium over some horizons and not others
  LIQ: short-run factor
  MKT: intermediate-run factor
  HML: long-run factor
  SMB and UMD: not priced risk factors
- Alpha or premium for systematic risk?