Granularity and (Downside) Risk in Equity Markets

Eric Ghysels   Hanwei Liu   Steve Raymond
University of North Carolina at Chapel Hill

Derivatives and Volatility 2017: The State of the Art
NYU Stern School of Business, April 27-28, 2017

New York Times, April 16, 2017 - **Vanguard Versus Everybody Else**

> In the last three calendar years, investors sank $823 billion into Vanguard funds ... The scale of that inflow becomes clear when it is compared with the rest of the mutual fund industry - more than 4,000 firms in total. All of them combined took in just a net $97 billion during that period ... Vanguard, in other words, scooped up about 8.5 times as much money as all of its competitors.
>
> Vanguard's AUM have skyrocketed to $4.2 trillion from $1 trillion seven years ago ... $3 trillion of this is invested in passive index-based strategies, with the rest in funds that rely on an active approach to picking stocks and bonds.

Annecdotal Evidence

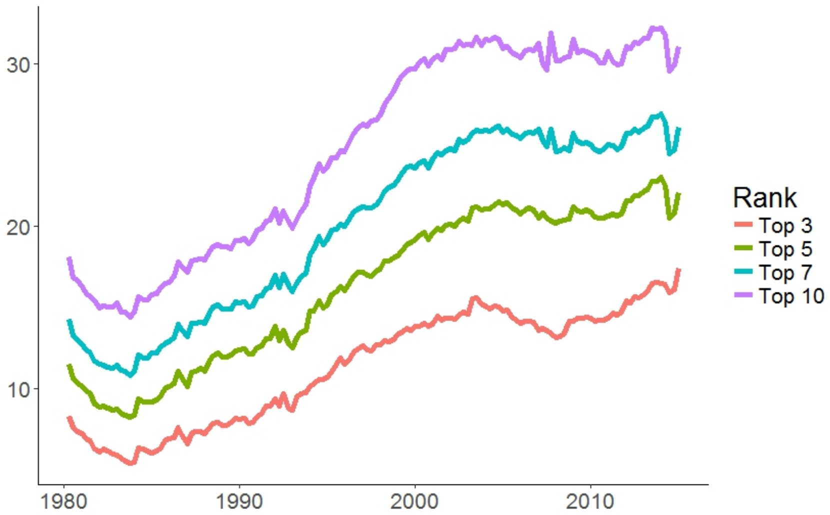
- Drop in liquidity of stocks held by hedge funds that had brokerage relations with Lehman
- A glitch in an untested trading program led to 4 million order executions in 148 stocks and losses of $440 million to Knight Capital
- Sudden departure of co-founder Bill Gross caused unprecedented large withdrawals from Pimco and massive fire sales.

Annecdotal Evidence

- Drop in liquidity of stocks held by hedge funds that had brokerage relations with Lehman
- A glitch in an untested trading program led to 4 million order executions in 148 stocks and losses of $440 million to Knight Capital
- Sudden departure of co-founder Bill Gross caused unprecedented large withdrawals from Pimco and massive fire sales.

Are shocks to a large asset manager (LAM) not as diversifiable as shocks to collection of smaller managers $\Rightarrow$ does granularity matter?

Top Institutional Investors Shares (13-F filings)



Some Literature

- Gabaix (2011): idiosyncratic movements in the production of the largest 100 firms explain about one third of the variations in output
- Ben-David et al. (2015): large institutional investors increase volatility of prices – act through large trades, different effect than random set of smaller independent entities aggregated
- Massa et al. (2016): negative effect on returns, liquidity, and volatility for stocks that had increase in ownership concentration due to BlackRock-Barclays merger

Data

- Quarterly/daily returns and quarterly accounting data from CRSP and COMPUSTAT from 1Q1980-4Q2014 (140 quarters)
- Institutional ownership data from quarterly 13-F SEC filings - Asset managers with over $100MM equity assets have to provide long positions
- Options data from 1Q1996-4Q2013 from OptionMetrics

Measuring LAM Concentration - Aggregate Level

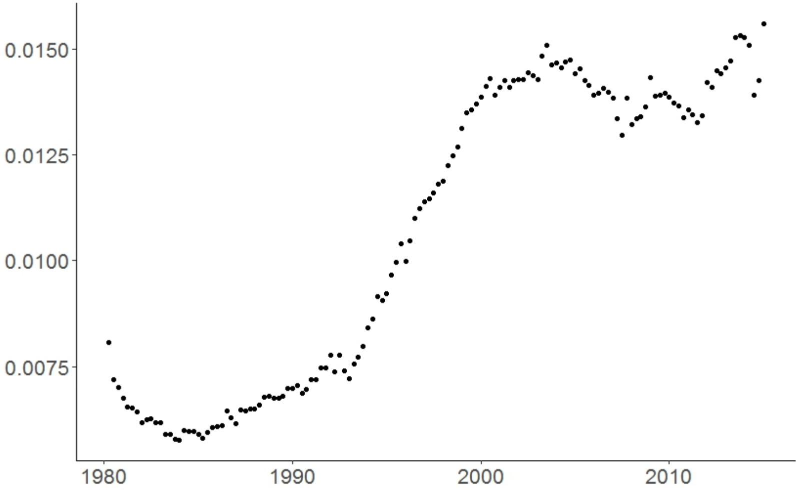
- We start with the Herfindahl-Hirschman Index (HHI), at the aggregate level, defined as:

$$HHI_t = \sum_{i=1}^{N_t} s_{it}^2,$$

where s_{it} is the \$ share of institution i in total of 13-F filings, and N_t is the quarter t number of institutional investors.

- High/low HHI $\rightarrow$ high/low concentration
- $1 \geq HHI_t \geq 0, \forall$ t

Aggregate Quarterly HHI



Measuring LAM Concentration - Individual Stock Level

- For each listed security e, we catalog the investment managers that are long in the stock and compute:

$$HHI_t^e = \sum_{i=1}^{N_t^e} [s_{it}^e]^2, \qquad e = 1, \ldots, E_t$$

  where s_{it}^e is the share of institution i for stock e, and N_t^e the total number holding e in quarter t, E_t, the total of equities in quarter t.

- HHI of a stock is equal to 1 if it is held by only one investment manager at the time of the 13-F filings.

Portfolio Sorts on HHI

- Construct HHI at the stock-level and form portfolios using sorted quintiles. Define portfolio HHI as the average across its constituents:

$$\overline{HHI}_{i,t} = \frac{1}{N^p_{i,t}} \sum_{j=1}^{N^p_{i,t}} HHI^e_{j,t}, \quad i = 1, ..., 5$$

  where $N^p_{i,t}$ is the number of stocks in portfolio i at quarter t.
- Re-balance quarterly

Portfolio HHI Summary Statistics

Portfolio	1	2	3	4	5
Mean	0.9617	0.6228	0.2830	0.1241	0.0465
Median	1	0.6699	0.2748	0.1171	0.0471
Std. Dev.	0.0510	0.1512	0.0535	0.0261	0.0067
Max	1	0.8536	0.4188	0.2007	0.0610
Min	0.8299	0.3900	0.2130	0.0915	0.0351
AC(1)	0.9769	0.9732	0.9450	0.9425	0.9603

Annualized HHI Low-High Portfolio Returns

Mean	Median	Std. Dev.	Skew	Kurt.	25 %	75 %
5.57	7.76	11.04	-5.99	57.33	-0.75	14.25

Annualized HHI Low-High Portfolio Returns

Mean	Median	Std. Dev.	Skew	Kurt.	25 %	75 %
5.57	7.76	11.04	-5.99	57.33	-0.75	14.25

Portfolio	1	2	3	4	5
Mean	-2.50	-2.33	-1.31	0.35	3.07
Median	-2.48	-1.68	-1.08	1.15	4.69
Std. Dev.	12.69	8.19	8.04	8.01	7.08
Skewness	2.88	-0.51	-0.51	-0.53	-0.61
Kurtosis	24.79	4.22	4.17	4.15	3.78

Annualized HHI Low-High Portfolio Returns

Mean	Median	Std. Dev.	Skew	Kurt.	25 %	75 %
5.57	7.76	11.04	-5.99	57.33	-0.75	14.25

Portfolio	1	2	3	4	5
Mean	-2.50	-2.33	-1.31	0.35	3.07
Median	-2.48	-1.68	-1.08	1.15	4.69
Std. Dev.	12.69	8.19	8.04	8.01	7.08
Skewness	2.88	-0.51	-0.51	-0.53	-0.61
Kurtosis	24.79	4.22	4.17	4.15	3.78

Annualized HHI Low-High Portfolio Returns

Mean	Median	Std. Dev.	Skew	Kurt.	25 %	75 %
5.57	7.76	11.04	-5.99	57.33	-0.75	14.25

Portfolio	1	2	3	4	5
Mean	-2.50	-2.33	-1.31	0.35	3.07
Median	-2.48	-1.68	-1.08	1.15	4.69
Std. Dev.	12.69	8.19	8.04	8.01	7.08
Skewness	2.88	-0.51	-0.51	-0.53	-0.61
Kurtosis	24.79	4.22	4.17	4.15	3.78

Double-Sorted Portfolios - Annualized Mean Returns

	Book-to-Market		Market Cap.	
HHI	Low	High	Low	High
High	-0.97	2.12	-1.26	3.39
Low	3.80	1.85	1.50	3.63
LMH	4.77	-0.27	2.75	0.23
tstat	*2.46*	*-0.13*	*1.37*	*0.18*

	Short Interest		Amihud Illiquidity	
HHI	Low	High	Low	High
High	2.29	-4.70	1.16	-3.20
Low	3.20	2.71	3.00	2.47
LMH	0.91	7.40	1.84	5.68
tstat	*0.80*	*2.80*	*1.70*	*3.07*

Double-Sorted Portfolios - Annualized Mean Returns

	Inst. 5% Thresh.		In S&P Index?	
HHI	Below	Above	No	Yes
High	1.49	-1.47	1.00	-0.17
Low	2.49	2.82	2.43	3.23
LMH	1.01	4.30	1.43	3.40
tstat	*0.79*	*2.56*	*1.36*	*2.14*

Linear Factor Models

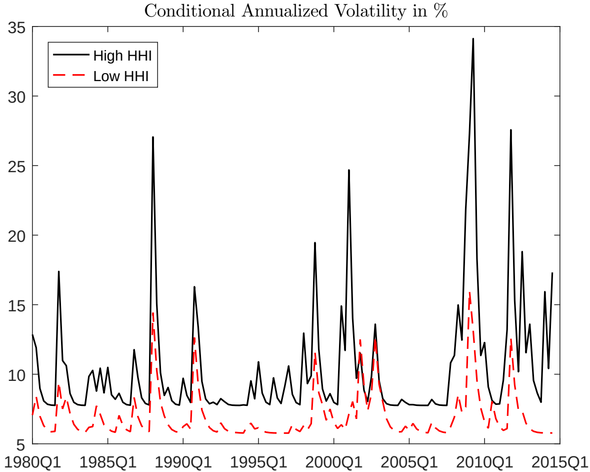
- FF3+liquidity linear factor models using Fama-Macbeth and GMM approach
- Using GRS or GMM over-identification test models rejected

	FF3+Liquidity							
HHI	Rm-Rf		SMB		HML		LIQ	
				Betas				
1 (High)	0.226	***	0.459	***	0.190	*	0.113	
	(0.086)		(0.127)		(0.108)		(0.129)	
5 (Low)	0.363	***	0.155	***	0.047	***	0.012	*
	(0.006)		(0.013)		(0.011)		(0.007)	
Price of Risk	0.044	***	-0.049	**	-0.046	**	0.134	
	(0.011)		(0.024)		(0.021)		(0.085)	
J-pval	0.00			GRS	0.00			

Conditional Volatility

Estimate GJR-GARCH(1,1) for High-HHI and Low-HHI portfolios:

$$
\begin{aligned}
r_{i,t} &= \mu_i + \sigma_{i,t}\epsilon_{i,t} \\
\sigma^2_{i,t} &= a_{i,0} + a_{i,1}\sigma^2_{i,t-1} + b_{i,1}\epsilon^2_{i,t-1} + c_{i,1}I(\epsilon_{i,t-1} < 0)\epsilon^2_{i,t-1}
\end{aligned}
$$



Conditional Quantiles

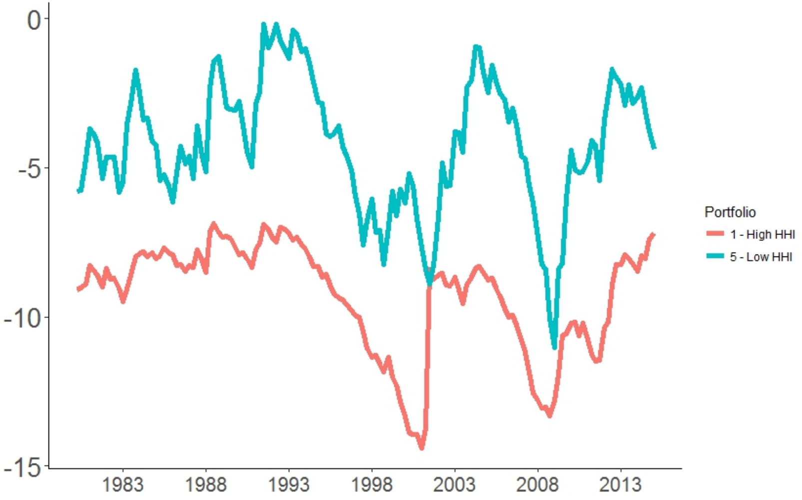


Figure: 5% Conditional Quantile - High- vs. Low-HHI Portfolio

Conditional Quantiles–Regression Models

$$\hat{q}_{i,t+1}(.05) = b_{i,0} + b_{i,1}\overline{HHI}_{i,t} + b_{i,2}LIQ_t + b_{i,3}SMB_t + v_{i,t+1}$$

where i = 1 (high HHI) and 5 (low HHI)

HHI	$\overline{HHI}$	LIQ	SMB	R^2
1 (high)	-0.1678	0.0060	0.0361	0.2138
	(0.0279)	(0.0217)	(0.0279)	
5 (low)	0.1183	-0.0236	0.0032	0.0064
	(0.2800)	(0.0288)	(0.0371)	

Downside Risk by Top Players

$$HHI_t^e = \sum_{i=1}^{N_t^e} [s_{it}^e]^2 = \sum_{i=1}^{k} [s_{it}^e]^2 + \sum_{i=k+1}^{N_t^e} [s_{it}^e]^2$$
$$= HHI(k)_{e,t} + HHI(-k)_{e,t}$$

HHI attributed to the Top k investors ($k = 3, 5, 10$)

k = 3	$\overline{HHI}_k$		$\overline{HHI}_{-k}$		LIQ	SMB	R^2
High HHI	-0.1421	**	-0.0980	***	-0.0244	0.0261	0.3547
	(0.0468)		(0.0081)		(0.0251)	(0.0321)	
Low HHI	1.3010	**	-0.1837	***	-0.0161	-0.0074	0.0823
	(0.4185)		(0.0389)		(0.0215)	(0.0276)	
k = 5							
High HHI	-0.1368	**	-0.0978	***	-0.0243	0.0251	0.3547
	(0.0421)		(0.0081)		(0.0251)	(0.0322)	
Low HHI	1.6493	**	-0.2291	***	-0.0109	-0.0054	0.1145
	(0.3776)		(0.0406)		(0.0211)	(0.0270)	

Firm-Level Analysis of Downside Risk

- Robustness check of portfolio results at the firm level - individual stock panel (quantile) regressions
- Impact of decomposed investor concentration on downside risk at the firm-level
- We do this for quantiles, downside variance, risk-neutral variance

Asset Pricing Model with endogenous HHI

- **Goal:** develop model that can rationalize and capture empirical findings
- Adopt the Koijen and Yogo (2016) framework – reduced form model that is equivalent to traditional portfolio choice problem
- Heterogeneous investor asset demands are functions of prices and asset characteristics

Summary of Empirical Findings

- Institutional investor concentration is significant factor in the cross-section of returns
- Existing factor models don't capture return spread in investor concentration sorted portfolio
- Stocks with high investor concentration:
  - Lower excess returns
  - Higher conditional volatility
  - Greater downside risk across broad set of measures
- Stronger impact of investor concentration of "top players" on increasing downside risk