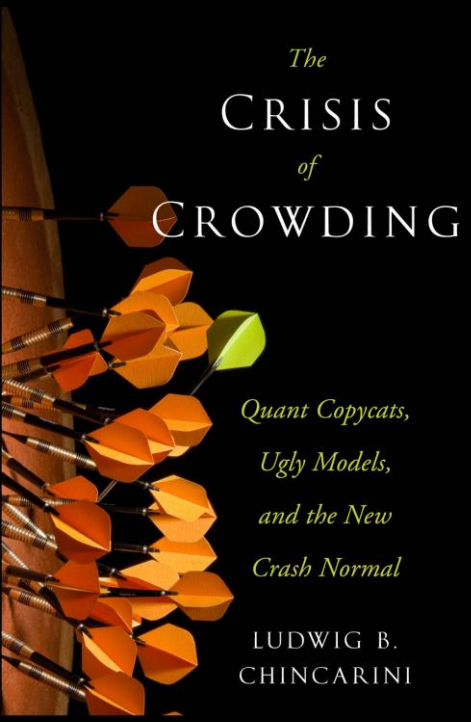
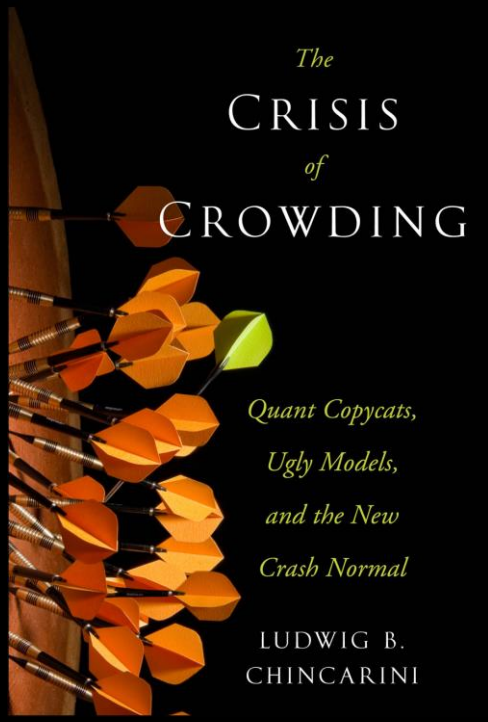


The Crisis of Crowding
Stories and New Findings

March 03, 2016



Ludwig B. Chincarini, Ph.D., CFA
University of San Francisco
United States Commodity Funds

THE TRADING SHOW - WEST COAST
MARCH 03, 2016

- Thank you for coming.

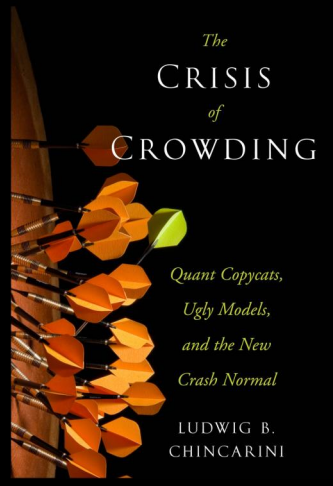
- Thank you for coming.

Outline

1. *The Crisis of Crowding* (2012)
2. Intro to Crowding
3. Market Acknowledging New Risk
4. Recent Discoveries in Crowding
5. A Story about Crowding – Quant Crisis
6. Crowded Spaces and Portfolio Construction
   - Risk management might ironically create crowding
7. Did transaction costs contribute to the Quant Crisis and what role do they play?
8. Conclusions/Discussion

Bottom Line: Crowding is a new risk that must be considered.

New Idea of Crowding



- *The Crisis of Crowding* by Ludwig Chincarini.
- The book tells the real stories of the financial crisis of 2008 and beyond how they are all connected by elements of crowding.
- The book is easy to read and informative with lots of interviews with insiders, including Goldman Sachs executives, Jimmy Cayne, Myron Scholes, John Meriwether, Vice Chairman of Citibank, government regulators, and others.

2. Intro to Crowding

Crowding takes place when multiple market participants begin to follow the same trade to such an extent the space that liquidity is fragile and it alters the risk and return dynamics of the trade.

- Not always east to detect – holders matter
- Risk will be incorrectly measured if not accounted for, both market and liquidity risk.
- Can lead to levered firms failing rapidly.

2. Intro to Crowding

How does crowding differ from herding?

They are similar. However, herding represents many similar investors following the same strategy and liquidity may not be fragile.

Crowding represents similar and/or different investors following the same or different, but correlated strategies to an extent that the opportunity or trading space is crowded/saturated. When the saturation is severe, the return and risk of the space is no longer determined by fundamentals, but determined by the behavior of the participants in the space. Exit is difficult. This makes all historical return and risk calculations less useful.

2. Intro to Crowding

How Crowding Typically Happens

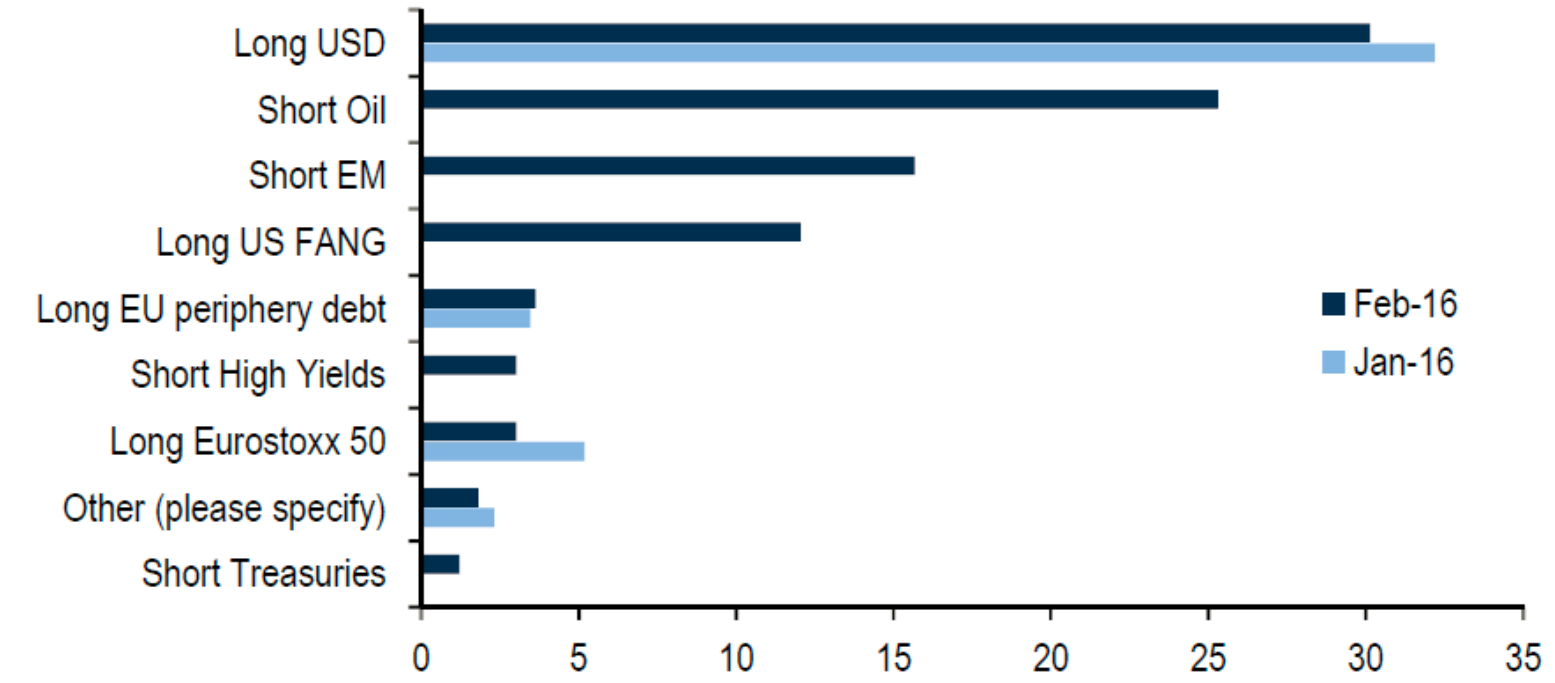
1. Attractive Trading Opportunity Develops
2. Copycats rush to follow the leader (even if it's not their core business)
3. Herding occurs, but sometimes very hidden (not obvious)
4. The trading space becomes crowded
5. Not all crowded spaces are similar.
   a. 1 type of holder (all traders similar)
   b. N types of holders (different motivations and behaviors to risk)
   c. Holders can have exactly same position or slightly different positions, still leading to crowded behavior.
   d. Inadvertent Crowding (see Bruno, Chincarini & Davis (2015)).
   e. Transaction costs and crowding (Chincarini (2016)).


Market is
Acknowledging
this New Risk

2. Intro to Crowding

A. Examples bank reports from BofA

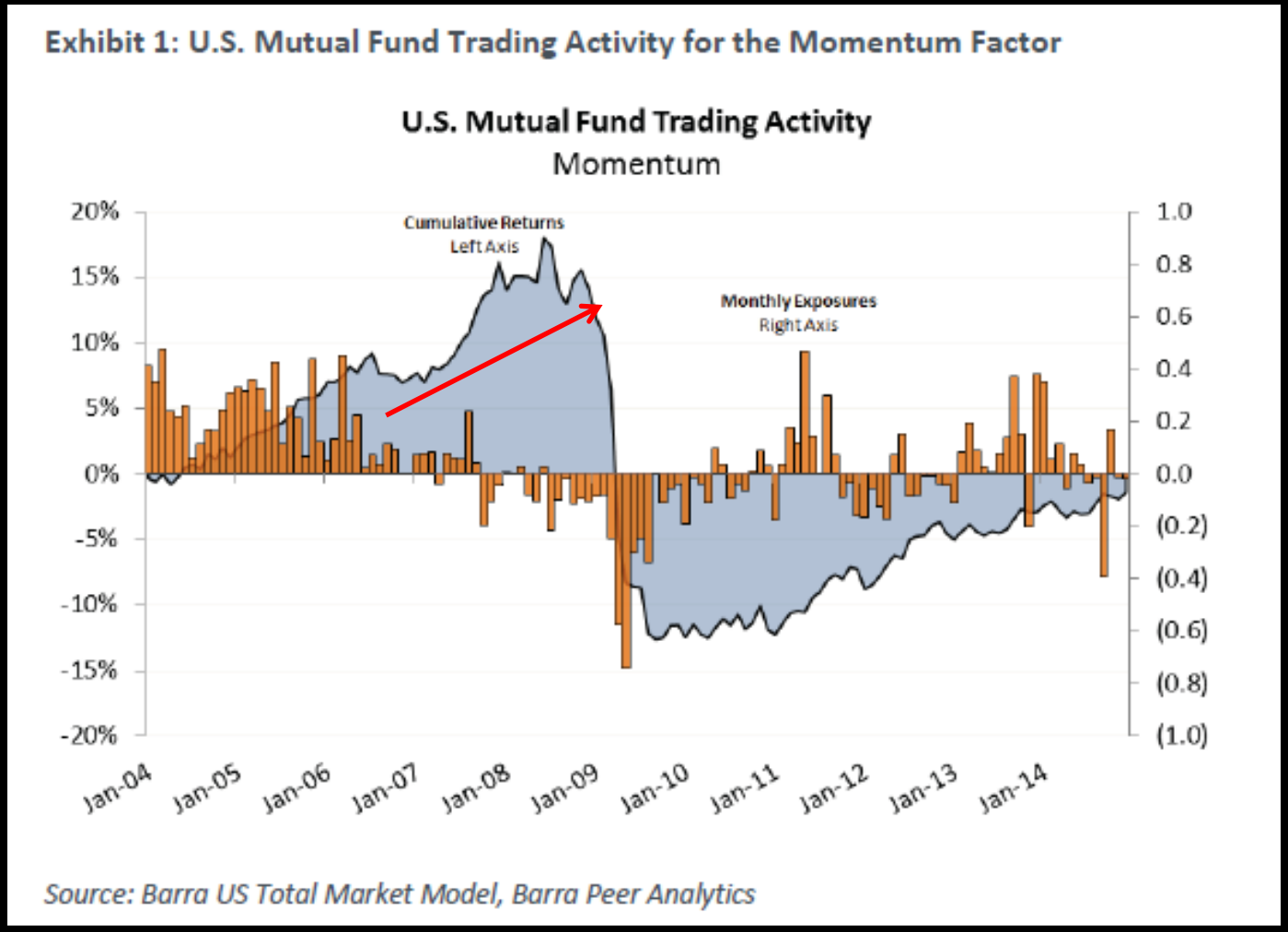
Exhibit 7: What do you think is currently the most crowded trade?



Source: BofA Merrill Lynch Global Fund Manager Survey

2. Intro to Crowding

A. Examples bank reports from MSCI Barra



2. Intro to Crowding

A. Examples bank reports from Bank of America/Merrill Lynch

Buying neglect and selling the crowds has worked YTD

Buying the ten most underweight stocks and selling the ten most overweight stocks by large cap active fund list as of 12/2014 has produced a spread of 10ppt YTD, outperforming the average long-short equity hedge fund performance of -2bp. This strategy has delivered consistent positive spreads over the last several years given outflows from active to passive which look likely to continue. Why? Passive funds still only make up about one-third of the US large cap space, far from critical mass. So what's the analogous trade for 2016? We believe U/W stocks will continue to outperform O/W stocks. For reference, we include a list of the current most O/W and U/W stocks held by managers (Table 4).

Table 4: Current 10 most O/W and U/W stock list

Top 10			Bottom 10		
Ticker	Name	Rel. Weight	Ticker	Name	Rel. Weight
NTAP	NetApp, Inc.	2.99	VNO	Vornado Realty Trust	0.04
TXN	Texas Instruments Incorporated	2.88	HPE	Hewlett Packard Enterprise Co.	0.02
KLAC	KLA-Tencor Corporation	2.49	MAC	Macerich Company	0.02
ALXN	Alexion Pharmaceuticals, Inc.	2.47	LEG	Leggett & Platt, Incorporated	0.02
SCHW	Charles Schwab Corporation	2.46	OKE	ONEOK, Inc.	0.01
STT	State Street Corporation	2.39	TE	TECO Energy, Inc.	0.01
ADBE	Adobe Systems Incorporated	2.39	CINF	Cincinnati Financial Corporation	0.01
NDAQ	Nasdaq, Inc.	2.36	O	Realty Income Corporation	0.01
TYC	Tyco International PLC	2.35	NWS	News Corporation Class B	0.01
DHR	Danaher Corporation	2.33	CSRA	CSRA, Inc.	0.00

Source: Lionshares, BofA Merrill Lynch US Equity & US Quant Strategy. The screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decision. The

2. Intro to Crowding

A. Examples bank reports from Goldman Sachs, Bank of America, Bernstein, JP Morgan Chase, and many others.

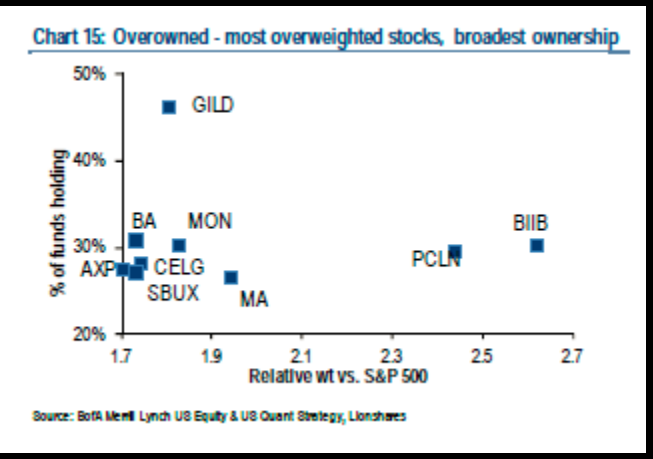


Exhibit 9: The 20 most concentrated stocks in the S&P 500 <Bloomberg: GSTHHFHI>
Holdings as of September 30, 2012; Pricing as of November 15, 2012

S&P 500: Twenty MOST CONCENTRATED Hedge Fund Holdings (Bloomberg Ticker: GSTHHFHI)

Company	Ticker	Sector	Sub-sector	Equity Cap ($ bil)	Total Return During 3Q	Total Return 2012 YTD	% of equity cap owned by Hedge Funds 30-Sep-12
TripAdvisor	TRIP	Consumer Discretionary	Internet Retail	5	(26)	45	50%
AutoNation	AN	Consumer Discretionary	Automotive Retail	5	24	9	45
LyondellBasell Industries N.V.	LYB	Materials	Specialty Chemicals	26	29	53	34
E*TRADE Financial	ETFC	Financials	Investment Banking & Brokerage	2	9	(1)	32
J.C. Penney	JCP	Consumer Discretionary	Department Stores	4	4	(53)	29
Tenet Healthcare	THC	Health Care	Health Care Facilities	3	20	23	23
Yahoo! Inc.	YHOO	Information Technology	Internet Software & Services	21	1	11	23
VeriSign Inc.	VRSN	Information Technology	Internet Software & Services	7	12	16	23
Beam Inc	BEAM	Consumer Staples	Distillers & Vintners	8	(8)	6	21
MetroPCS Communications	PCS	Telecommunication Servic	Wireless Telecommunication Services	4	94	20	20
Ralph Lauren Corp.	RL	Consumer Discretionary	Apparel Accessories & Luxury Goods	14	8	9	20
Life Technologies	LIFE	Health Care	Life Sciences Tools & Services	8	9	20	19
American Intl Group	AIG	Financials	Multi-line Insurance	46	2	35	19
CBRE Group Inc	CBG	Financials	Real Estate Services	6	13	14	19
WPX Energy	WPX	Energy	Oil & Gas Exploration & Production	3	3	(17)	19
Family Dollar Stores	FDO	Consumer Discretionary	General Merchandise Stores	8	0	15	18
priceline.com	PCLN	Consumer Discretionary	Internet Retail	31	(7)	32	18
Coca-Cola Enterprises	CCE	Consumer Staples	Soft Drinks	9	12	17	18
BMC Software	BMC	Information Technology	Systems Software	6	(3)	19	18
Motorola Solutions	MSI	Information Technology	Communications Equipment	15	6	16	17

Top 50 Holdings: Top 50 Hedge Funds

Market value is in millions of dollars and represents the market value held by the top 50 hedge funds at the end of the quarter. The market value change measures the total position change of each security multiplied by its quarter-end price. "% Port" indicates the weight of the stock in an aggregated equity portfolio of the top 50 hedge funds. "% Shares Out" indicates the proportion of the shares outstanding of the stock owned by the aggregated portfolio of the top 50 hedge funds and the "Total" and "50 Highest" lines show the average for this item*. "# of companies" indicates the number of funds (out of the top 50) holding the stock.

High/Low - %Portfolio	GICS Sector	Qtr End Market Value	Mkt Val Chg - 3 mo ($millions)	Mkt Val Chg 3mnth	% Port	%Shrs Out*	# Of Co's
Total							
55 Highest							
LyondellBasell Industries N.V. Cl A							
Google Inc. Cl A							
Realogy Holdings Corp.							

Highlights

In this report we extend the definition of crowding to include breadth of high conviction overweights by active managers, as well as persistence of accumulation by active managers. We also demonstrate that crowding is an important risk factor at the stock level (with neutral performance profile), but tends to be a useful contrarian performance indicator at the aggregate sector, region level.

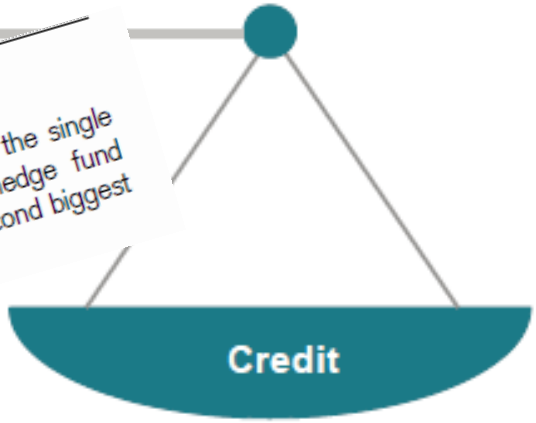
2. Intro to Crowding

A. Examples bank reports from Goldman Sachs, Bank of America, Bernstein, Credit Suisse, JP Morgan Chase, and many others.

Crowded Trades: The Bank Loan Story

1. Sources of Risk to the Hedge Fund Industry in 2014

As with the last three surveys, investors have continued to express crowded trades and herd mentality as the single biggest threat to the industry in 2014, given the increasing challenge they pose in differentiating hedge fund performance. Given the low market volatility over the past year, risk complacency was highlighted as the second biggest threat.



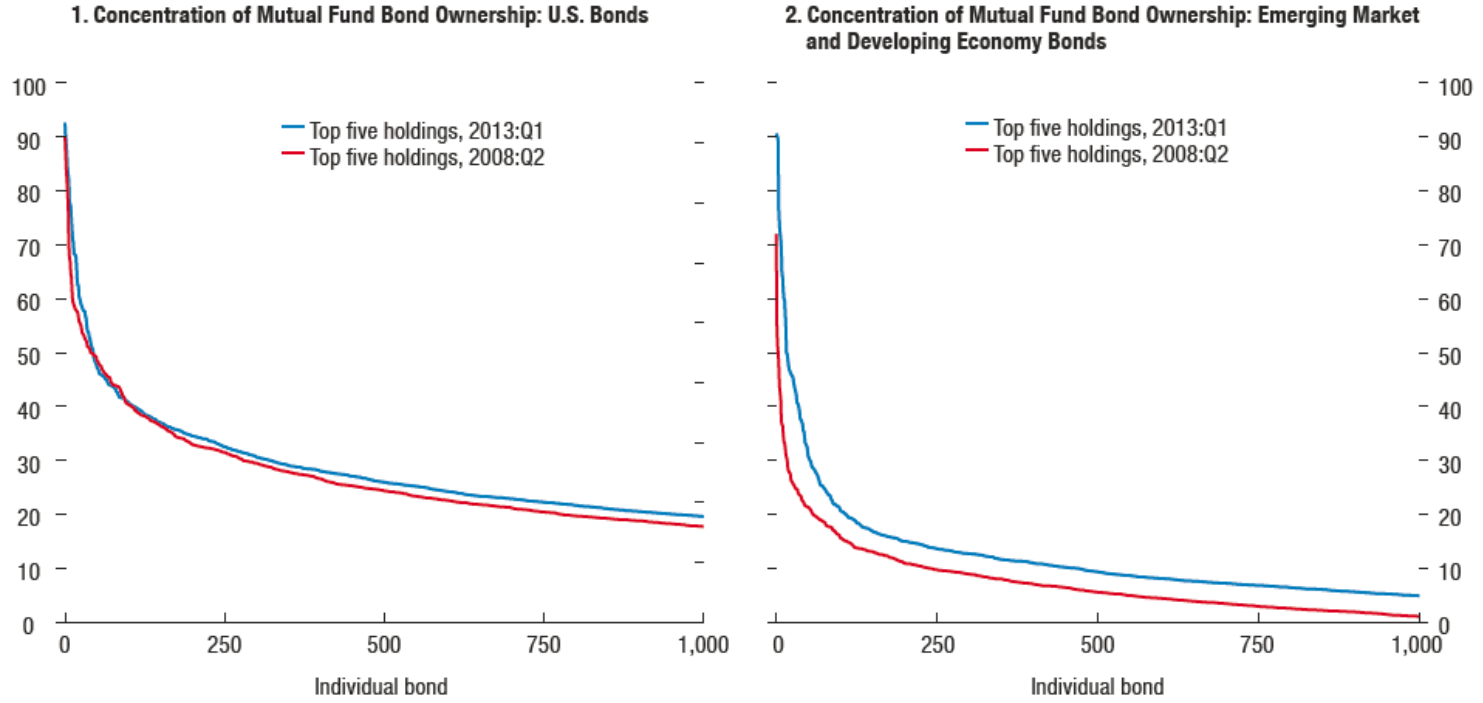
- Avoid crowded trades
  - Loans
  - CCC-rated bonds
- Alternative strategies: understand your exposure
- Consider municipal credit

2. Intro to Crowding

A. Examples IMF Report "The Asset Management Industry and Financial Stability" April 2015.

Figure 3.7. Bond Ownership Concentration and Its Effects on Credit Spreads

Mutual fund concentration in bond markets has increased somewhat since the global financial crisis.
(Share of individual bonds held by the five largest mutual funds in 2008 and 2013, percentage points)



2. Intro to Crowding

A. Bloomberg Story on June 23, 2015.

BloombergBusiness

How to Spot Crowded Trades That the Shoeshine Boy Missed

by Michael P Regan
June 23, 2015 — 8:56 AM PDT

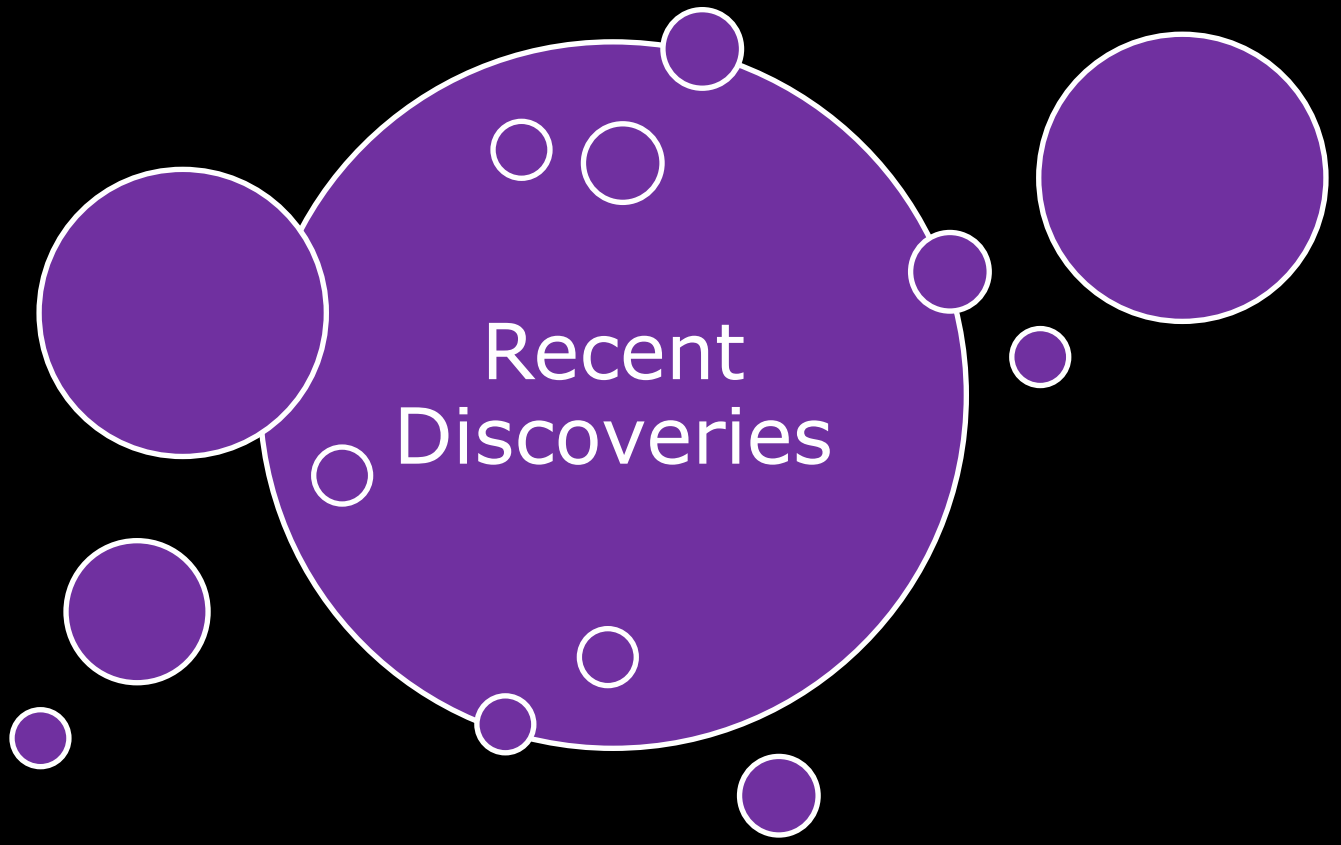
The way that the famous yarn is usually told, Joe Kennedy got out of the market before the 1929 crash because a shoe-shine boy was offering him stock tips, and that just didn't seem right.

Almost nine decades later, markets seem to be no less vulnerable to the proverbial "crowded trade" that lures investors like lemmings over the edge of a cliff. Exhibit A could be the crowds that bid the yield on German 10-year bunds down to almost zero a few months ago, only to later flee like a flock of scared birds.

BASEBALL HALL OF FAMER "Wee Willie" Keeler once said he was successful because he "hit 'em where they ain't." Going where the crowd isn't could be a recipe for investment success as well.

October 3, 2015

Big pharmaceutical stocks don't seem to have many friends, despite our prior assertion that the health-care sector is too crowded. But while mutual fund managers were busy buying biotechs, they generally shunned major pharma companies such as Eli Lilly (LLY), Merck (MRK), and Pfizer (PFE), notes Bank of America Merrill Lynch analyst Colin Bristow.


Recent
Discoveries

3. Recent Discoveries in Crowding

A. Starting points matter – similar portfolios lead to similar trading (Bohlin and Rosvall (2014), Chincarini (2012)).

B. Peer or copycat flows of mutual funds influence returns due to crowded holdings (Blocher (2013), Chincarini (2012)).

C. Quant Crisis of 2007 may have been associated with crowded factors (Cahan and Luo (2013), Chincarini (2012)).

D. Exchanges or central clearing parties (CCPs) may underestimate margin requirements because they fail to account for crowding. Could cause systemic risk. (Menkveld (2014)).

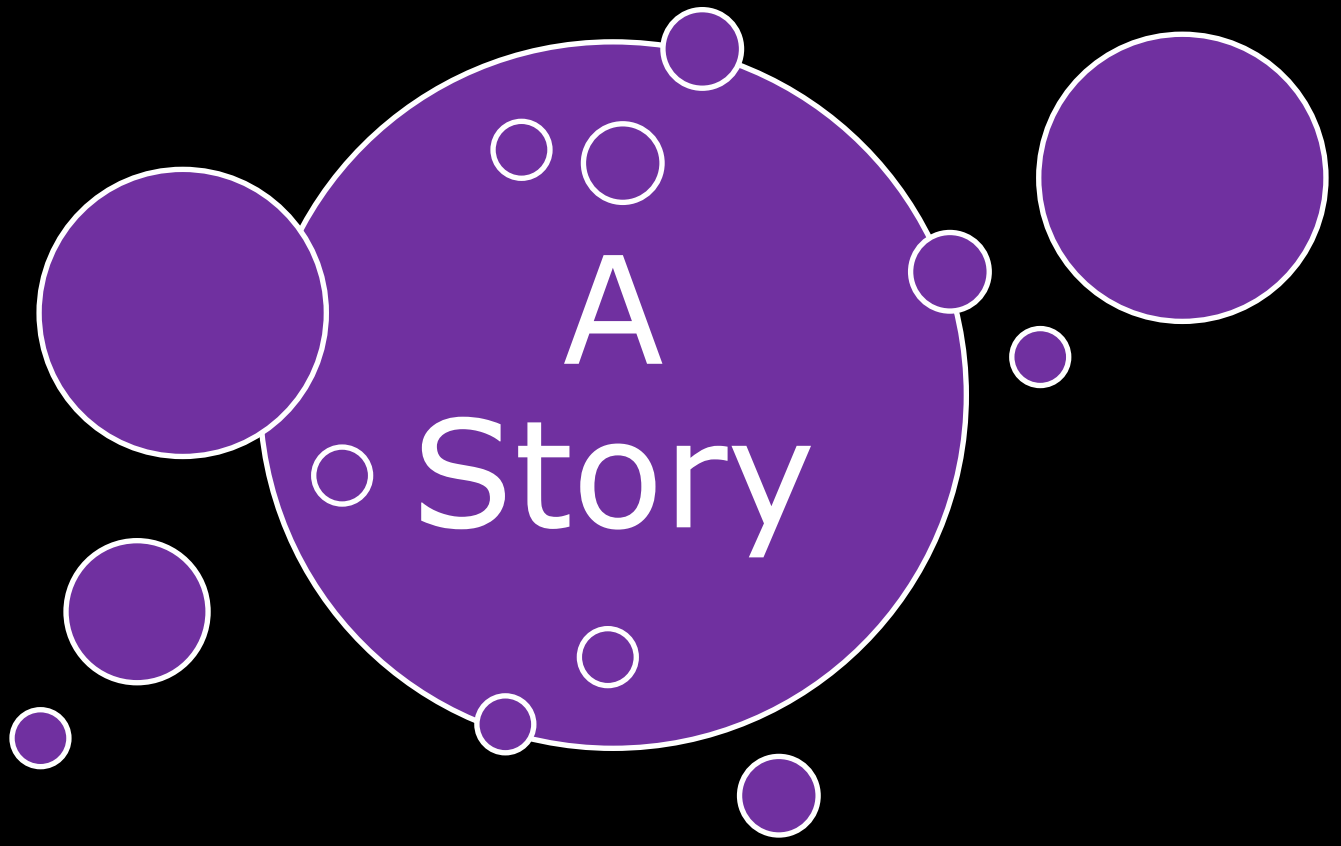
3. Recent Discoveries in Crowding

E. Stocks with relatively more trading versus market capitalization tend to have worse risk-adjusted returns (Ibbotson and Idsorek (2014)).
F. Momentum strategy that is exposed to crowded losers is more crash prone than non-crowded losers. Refining momentum strategies to non-crowded losers improves the performance of momentum strategies (Yan (2014)).
G. Among mutual funds with similar past alphas, those that had co-moved with past losers have future alphas that exceed those that had co-moved with past winners (Chue (2015)).

3. Recent Discoveries in Crowding

H. To capture crowding, measure as the percentage of shares held by equity mutual funds divided by the average share turnover for the stock. A high (low) percentage of mutual fund holdings in low- (high)-turnover stocks is associated with a high (low) degree of crowding. A long-short trading strategy based on this crowding measure (long least crowded stocks and short most crowded stocks) can generate an annualized alpha of 13% after controlling for the four standard risk factors—beta, size, book-to-market and momentum (Tay et al (2016)).

MORE INFO:
http://ludwigbc.com/pres/behavioral_finance_conference_11_08_2014_final


A
Story

4. A Story from the Financial Crisis

- The Quant Crisis of 2007

- What are Quants?

- Some well known firms: Barclays Global Investors, GSAM, State Street, Morgan Stanley PDT, AQR, Panagora, Mellon Capital, etc.

4. A Story from the Financial Crisis

- The Quant Crisis of 2007

- What are factors?

- Example: The Value Factor.

4. A Story from the Financial Crisis

- The Quant Crisis of 2007

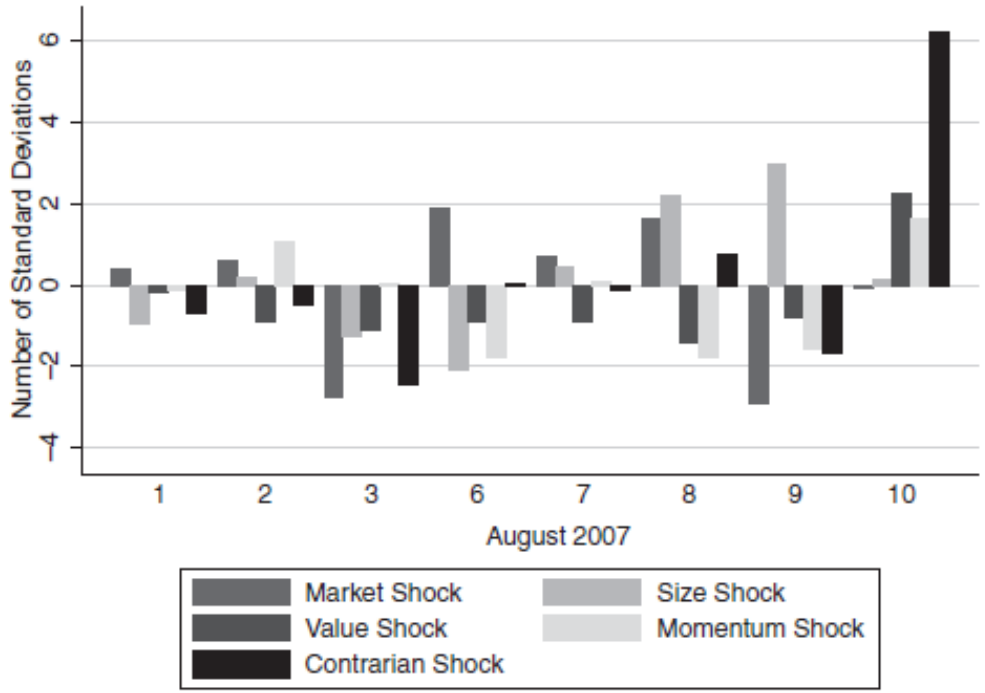
- In August 2007, even standard factors behaved erratically.

- For example, value factor moved 0.75% in one day – unheard of – with 8x leverage moved 6%. August 2 – August 8, every day was within worst 5% moves in 20 years.

4. A Story from the Financial Crisis

- The Quant Crisis of 2007

FIGURE 8.4 Ratio of Daily Returns of Common Factors Divided by Historical Standard Deviations



Source: Chapter 8 The Crisis of Crowding

4. A Story from the Financial Crisis

- The Quant Crisis of 2007

- Quant copycats everywhere…
- Factors different, but correlated…
- Transaction costs models similar
- Result→Similar small portfolios

- A seemingly liquid space became very illiquid…risk mis-measured. Exit path was crowded.

4. A Story from the Financial Crisis

- The Quant Crisis of 2007

We saw the growth of quant assets under management, but didn't see how far these strategies had extended into statistical arbitrage desks and hedge funds. We felt our proprietary factor specifications and weightings would provide differentiation, and this was supported by historical correlations plus low exposures of other quant managers to our factors. Our individual equity positions were small, liquid, and diversified—we didn't foresee a significant liquidation event focused on similar portfolios.

—Goldman Sachs analyst statement, December 13, 2007
(GSAM 2007)

Source: Chapter 8 The Crisis of Crowding

4. A Story from the Financial Crisis

- The Quant Crisis of 2007

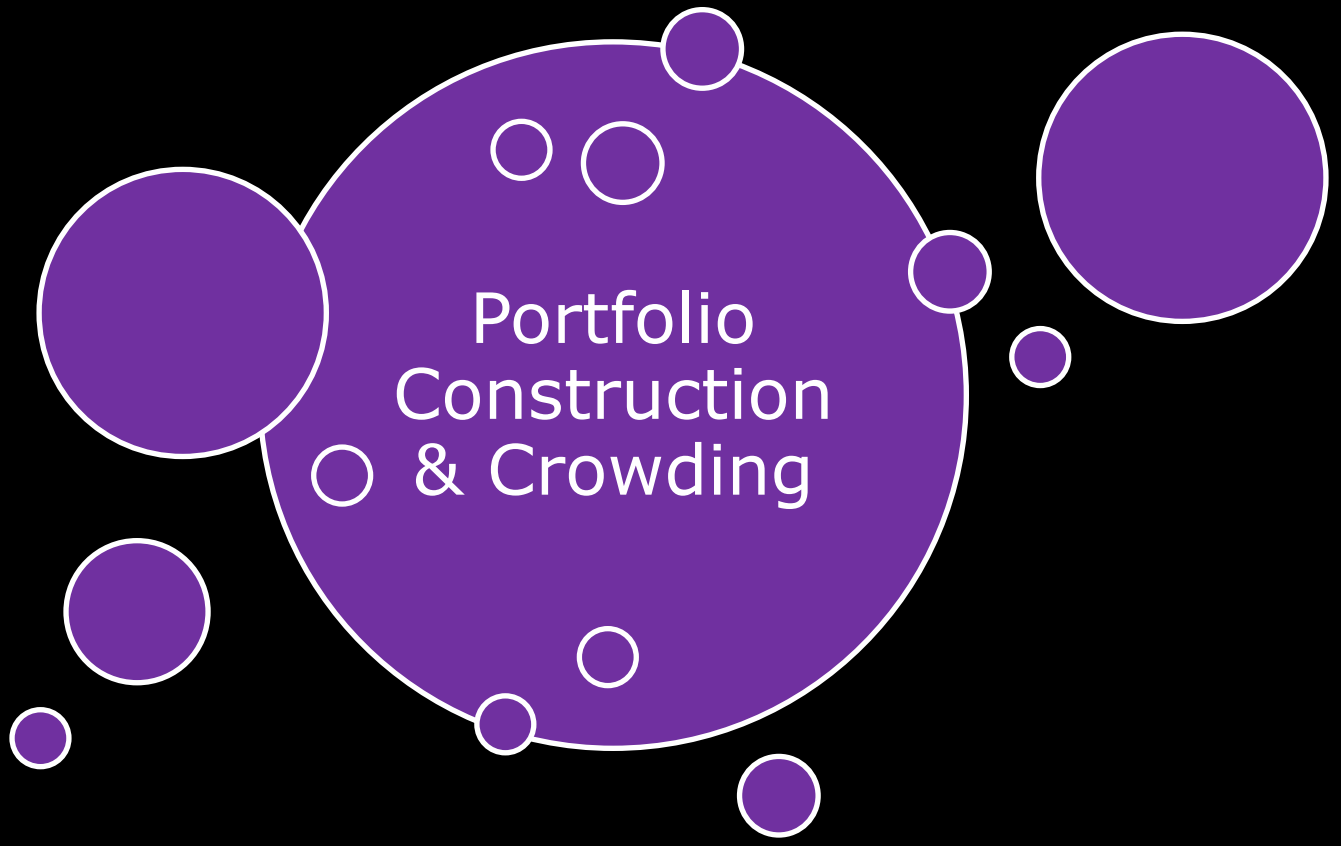
> Crowding among quants happens for several reasons, but the transaction costs model was of primary importance, as it caused us to trade similar securities at each point in time.
>
> —Mark Carhart interview, former co-CIO of Quantitative Strategies at GSAM and Founder of Kepos Capital, October 11, 2011

Source: Chapter 8 The Crisis of Crowding

4. A Story from the Financial Crisis

- The Quant Crisis of 2007

- Many hedge funds completely wiped out.


Portfolio
Construction
& Crowding

5. Crowded Spaces and Copycat Risk Management

A. Risk Management and Crowding

- If portfolio managers use similar risk models, these risk models might cause positions to become crowded.

- Could occur if models are similar or even slightly different.

5. Crowded Spaces and Copycat Risk Management

B. A Simple Demonstration

- This portfolio is indistinguishable from random noise.

- Conjecture 1 (Convergence to Noise): In the limit, not only do expected returns of managers not matter for portfolio formation, and not only does just a small slice of the covariance matrix govern the portfolio that all managers will converge to, but that small slice of the covariance matrix is governed by something that is indistinguishable from random.

5. Crowded Spaces and Copycat Risk Management

B. A Simple Demonstration

- Conjecture 2 (Simple Risk Variation and Crowding): Even if managers use different simple empirical covariance matrices, the risk model induced crowding problem seems unavoidable.

5. Crowded Spaces and Copycat Risk Management

E. Empirical Results

Summary:

1. Crowding occurs from the use of standard risk models in the industry – even when crowding is absent in alpha models.
2. Crowding seems to be more severe for long-only equity managers.
3. The Marchenko-Pasteur procedure we suggest reduces crowding amongst portfolio managers.
4. Crowding would be less in a financial system where there is a diversification of risk model usage.

5. Crowded Spaces and Copycat Risk Management

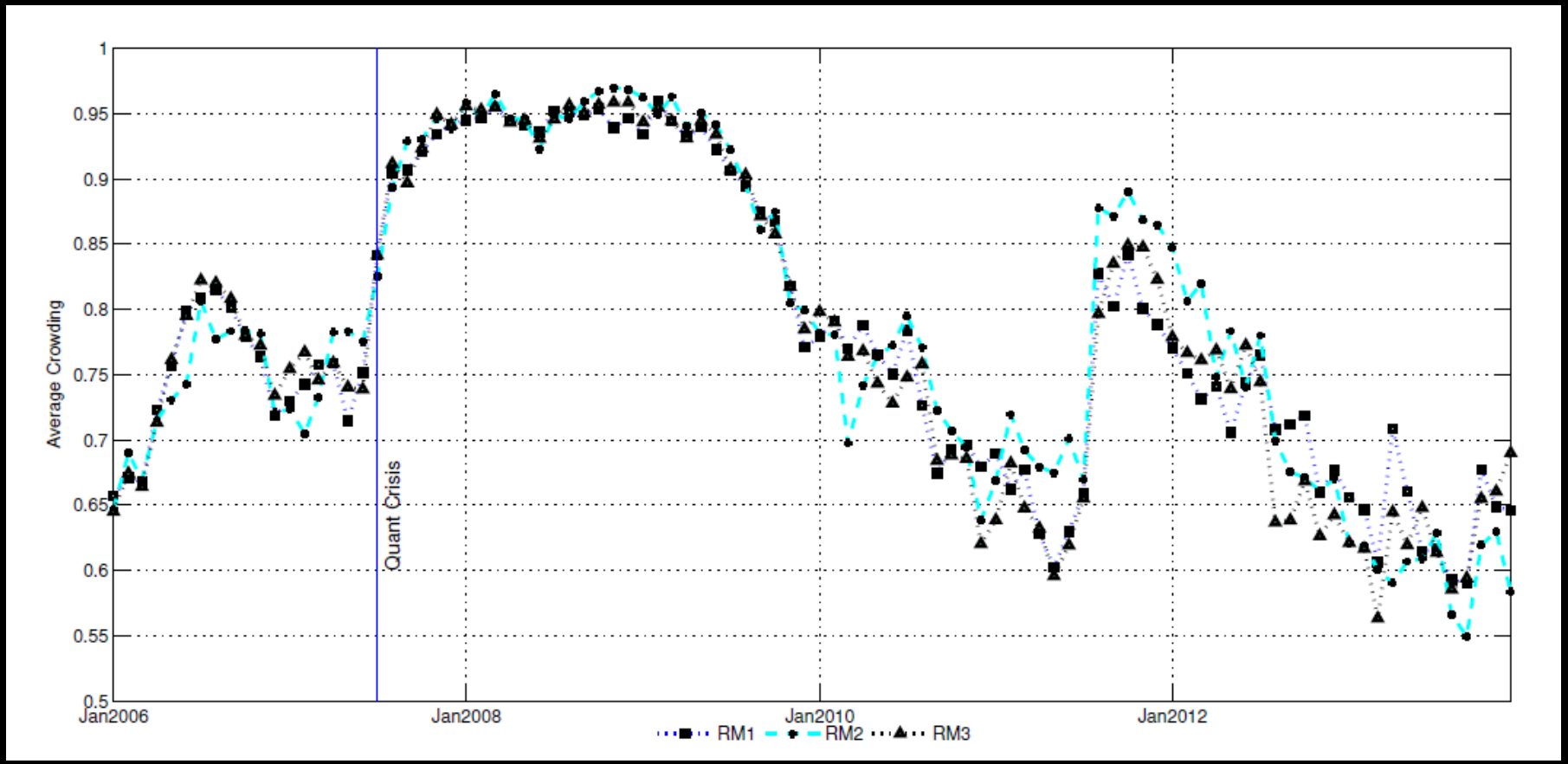
E. Empirical Results

Exhibit 2: Summary of Crowding of Random Alpha Models from 2006 to 2009

	Risk Model 1			Risk Model 2			Risk Model 3		
	C	Ω	S.R.	C	Ω	S.R.	C	Ω	S.R.
Alpha	0.00								
Long Only									
Regular	0.85	1251.17	0.007	0.86	1140.19	-0.001	0.86	1250.08	0.005
MPA	0.73	1123.99	0.006	0.73	872.10	-0.003	0.72	976.13	0.002
Market Neutral									
Regular	0.00	1.65	-0.017	0.00	1.76	-0.006	0.00	1.10	-0.002
MPA	0.00	1.24	-0.011	0.00	1.23	0.020	0.00	1.05	0.006
Market Neutral Liq.									
Regular	0.00	2.02	-0.023	0.00	4.23	0.029	0.00	1.20	-0.004
MPA	0.00	0.78	-0.007	0.00	0.73	0.034	0.00	0.84	0.011

5. Crowded Spaces and Copycat Risk Management

E. Empirical Results



5. Crowded Spaces and Copycat Risk Management

E. Empirical Results

- Risk models all seem to have similar amounts of crowding.

- Does it make any difference whether the universe uses one risk model versus another?

5. Crowded Spaces and Copycat Risk Management

E. Empirical Results

-

Percentage of Models Used	Long Only C	Long Only Ω	Long Only S.R.	Market Neutral C	Market Neutral Ω	Market Neutral S.R.
100 - 0 - 0	**0.85**	1251.17	0.01	0.00	1.65	-0.02
0 - 100 - 0	**0.86**	1140.19	-0.00	0.00	1.76	-0.01
0 - 0 - 100	**0.86**	1250.08	0.00	0.00	1.10	-0.00
80 - 20 - 0	0.65	869.71	0.01	0.00	2.96	-0.02
80 - 0 - 20	0.76	1176.42	0.01	0.00	1.38	-0.02
20 - 80 - 0	0.65	799.36	0.00	0.00	2.37	-0.02
0 - 80 - 20	0.66	788.17	0.00	0.00	2.33	-0.02
20 - 0 - 80	0.76	1181.01	0.01	0.00	1.29	-0.02
0 - 20 - 80	0.66	859.13	0.00	0.00	2.29	-0.02
45 - 45 - 10	0.52	623.48	0.00	0.00	3.02	-0.02
10 - 45 - 45	0.52	620.27	0.00	0.00	3.03	-0.02
45 - 10 - 45	0.63	939.13	0.00	0.00	2.28	-0.01
60 - 40 - 0	0.55	672.34	0.00	0.00	3.54	-0.01
60 - 20 - 20	0.58	802.99	0.00	0.00	3.05	-0.00
40 - 60 - 0	0.55	644.00	0.00	0.00	2.74	-0.00
0 - 60 - 40	0.56	633.06	0.00	0.00	3.00	0.01
40 - 0 - 60	0.72	1152.52	0.00	0.00	1.79	-0.00
0 - 40 - 60	0.56	660.20	0.00	0.00	2.73	-0.01
33 - 67 - 0	0.58	673.88	-0.00	0.00	2.31	-0.00
67 - 0 - 33	0.58	710.80	0.00	0.00	3.12	-0.01
0 - 67 - 33	0.58	661.92	0.00	0.00	3.02	-0.00
33 - 33 - 34	**0.51**	681.27	0.00	0.00	1.92	-0.01
10 - 90 - 0	0.74	961.72	0.00	0.00	1.77	-0.01
10 - 0 - 90	0.80	1200.84	0.00	0.00	0.78	0.00
90 - 10 - 0	0.74	1028.33	0.01	0.00	2.35	-0.01
0 - 10 - 90	0.75	1029.26	0.00	0.00	1.67	-0.00
90 - 0 - 10	0.74	1032.74	0.01	0.00	2.37	-0.01

5. Crowded Spaces and Copycat Risk Management

E. Empirical Results

- Conjecture 3 (Distribution of Risk Models and Systemic Risk): Crowding in the financial system will be less when there is a diversification of risk models used in the system.

5. Conclusion/Discussion

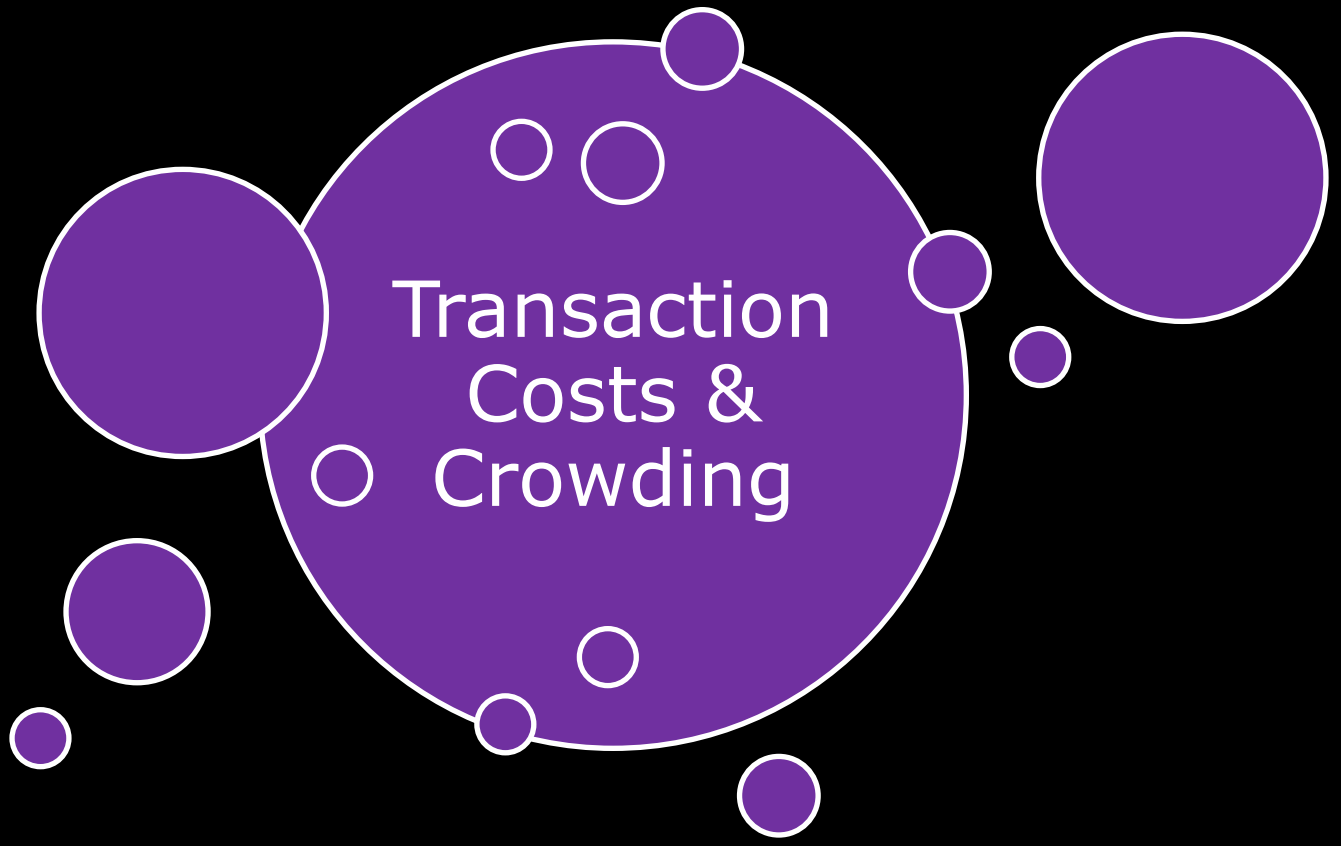
A. Crowding is a real and important phenomena that needs to be studied more.

B. Crowding is typically thought of to be generated from similar alpha models (Chincarini (2012)).

C. Crowding can also occur due to the risk model process itself.

D. Our research shows that crowding does occur from risk models.

E. Some suggestions from our research: (a) Use a MP or OGARCH implementation to reduce crowding; (b) The financial system might have less crowding when there is a diversification of risk models.


Transaction
Costs &
Crowding

6. Transaction Costs and Crowding

A. How do transaction costs and crowding interact?

B. Was the quant crisis influenced by transaction cost considerations?

C. Do portfolio managers really consider transaction costs when building portfolios?

D. How is size of a portfolio and investment horizon related?

6. Transaction Costs and Crowding

Methods

- Take typical data for portfolio construction and two reasonable transaction cost models.
- Simulate the creation of many portfolios based on a universe of 2000 stocks.
- Change the asset level of portfolios (since market impact depends on this)
- Examine how transaction costs influence the crowding of portfolios.

6. Transaction Costs and Crowding

Brief Answers

- This evidence doesn't seem to link transaction costs to crowding in quant crisis (unless managers did not explicitly consider them or ignored some constraints)

- Do portfolio managers (not just quants) really consider them explicitly and accurately?

- As a portfolio becomes larger, i.e. $20 million to $5 billion, the portfolio manager must gradually transform to a longer term investment horizon, otherwise violating reasonable constraints.

6. Transaction Costs and Crowding

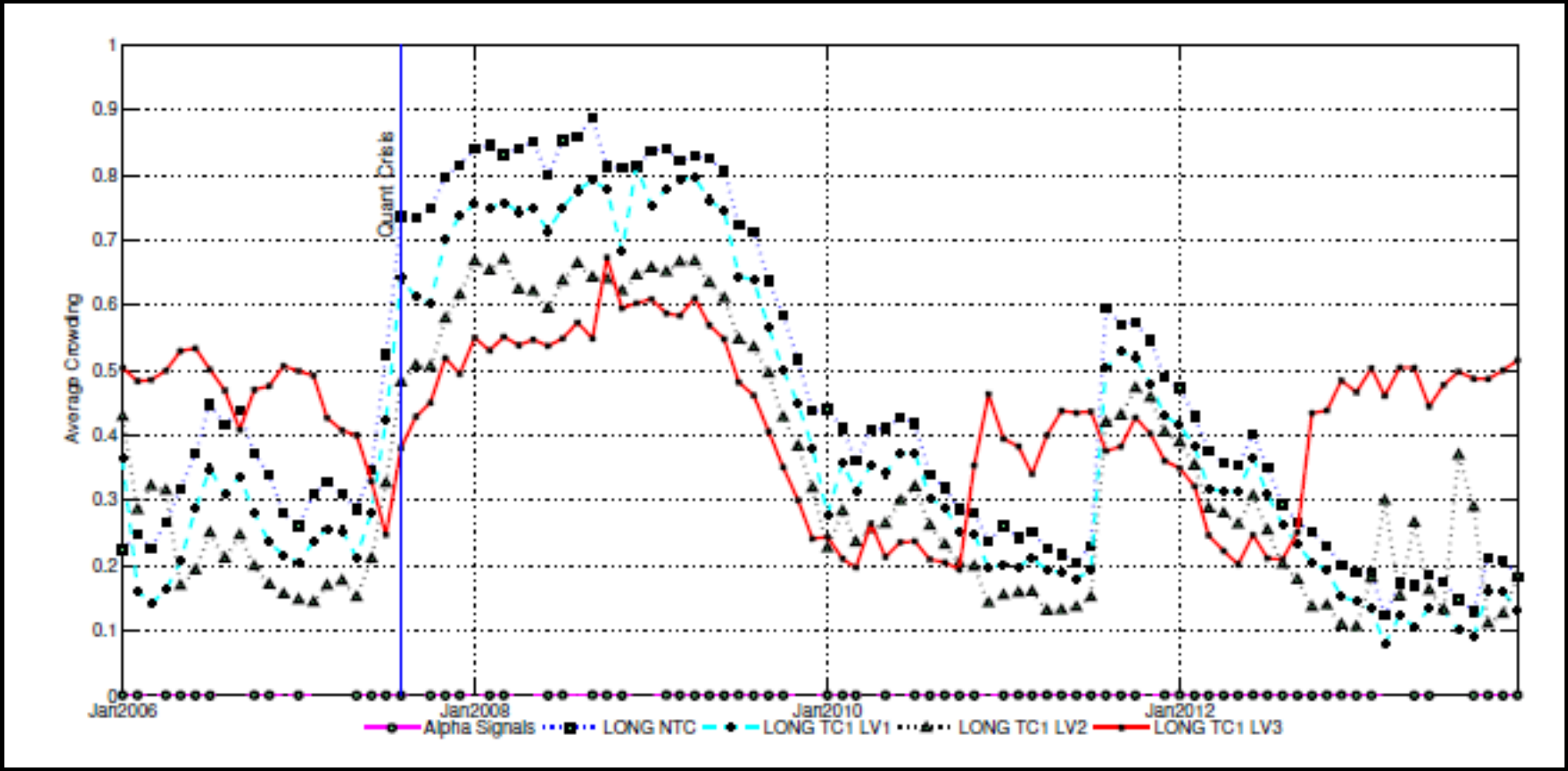
Results

Table 1: Summary of Crowding from Random Alpha Models and Transaction Costs from 2006 to February 2009

	Risk Model 1						Risk Model 2						Risk Model 3					
	C	Omega	SR	Max	Min	*N*	C	Omega	SR	Max	Min	*N*	C	Omega	SR	Max	Min	*N*
Alpha	-0.00																	
Long Only																		
MN NTC	-0.00	0.75	-3708.352	0.004	-0.004	645	-0.00	0.84	-2437.77	0.005	-0.005	611	0.00	0.50	-3296.92	0.006	-0.01	632
LONG NTC	0.58	-141.26	-140.911	0.076	0.000	63	0.60	-181.90	-175.48	0.072	0.000	75	0.59	-156.62	-184.22	0.079	0.00	64
Port. Size ($500M																		
MN TC1	-0.00	0.27	-8.171	0.007	-0.006	567	0.00	-0.04	-7.84	0.006	-0.006	543	0.00	0.11	-7.49	0.009	-0.01	556
LONG TC1	0.49	-127.77	-0.512	0.079	0.000	67	0.45**	-123.77	-1.00	0.071	0.000	89	0.46**	-116.86	-0.84	0.080	0.00	71
Port. Size ($5B)																		
MN TC1	0.00	0.63	-15.027	0.007	-0.007	527	0.00	0.10	-13.88	0.010	-0.011	514	0.00	0.47	-13.98	0.009	-0.01	519
LONG TC1	0.42***	-91.04	-1.427	0.077	0.000	102	0.38***	-113.74	-1.59	0.072	0.000	138	0.38***	-111.11	-1.71	0.077	0.00	114
Port. Size ($20B)																		
MN TC1	0.00	1.42	-21.240	0.013	-0.013	157	0.00	0.09	-20.03	0.014	-0.014	456	0.00	1.13	-20.05	0.014	-0.01	460
LONG TC1	0.50	294.63	-2.152	0.072	0.000	157	0.43***	151.19	-2.26	0.064	0.000	217	0.46***	241.19	-2.33	0.072	0.00	176

6. Transaction Costs and Crowding

Results



6. Conclusion/Discussion

- If you would like further information on my latest research (submitted for publication), I can send a draft. Please give me your card after the talk.

- Chincarini, Ludwig B. "Transaction Costs and Crowding".

- Bruno, Salvatore, Chincarini, Ludwig B., Davis, Jesse, and Frank Ohara. "Portfolio Construction and Crowding."

Thank you

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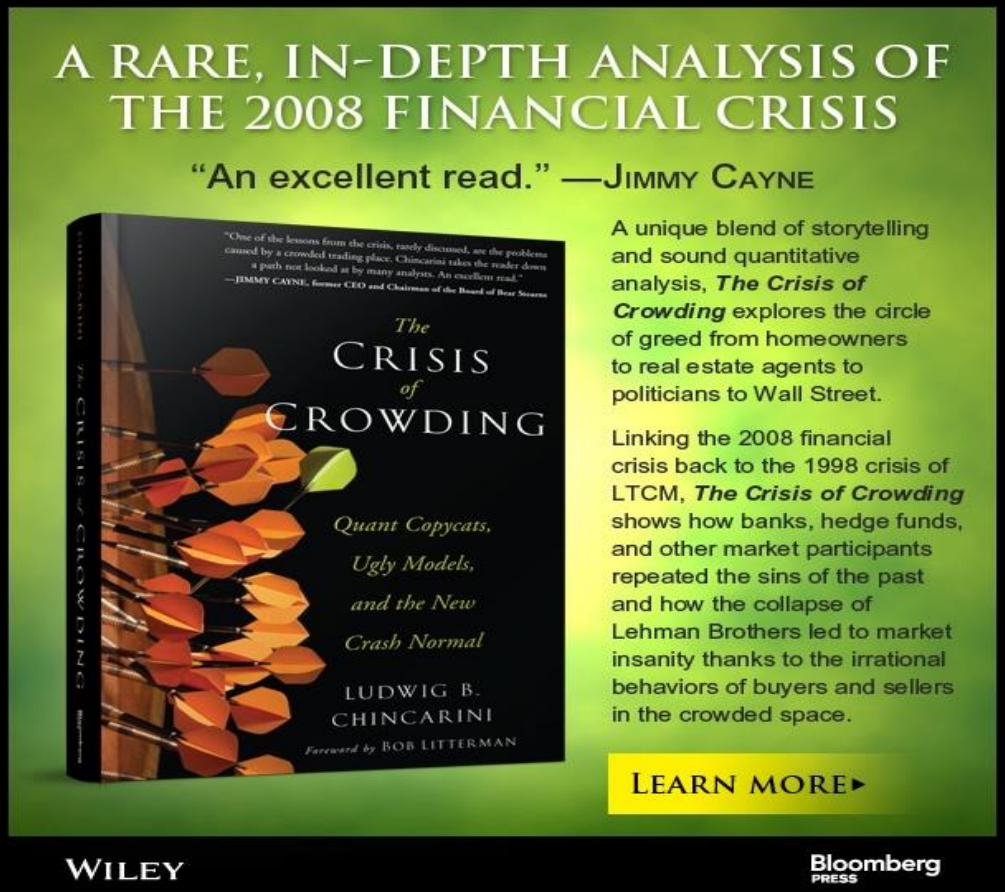
For more information : Buy the book.



Open Discussion

1. What if some managers use their own risk models, what do you think this would do to the average crowding?
2. I agree with your assessment with the tradeoffs between size and investment horizon.
3. How would the results be different from using more correlated alpha models?