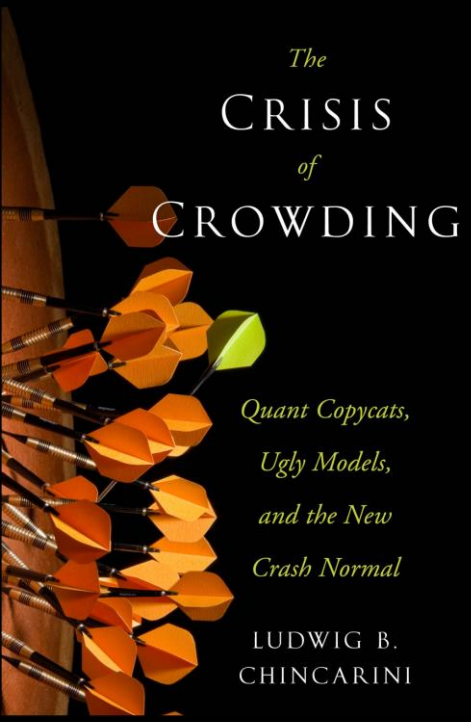
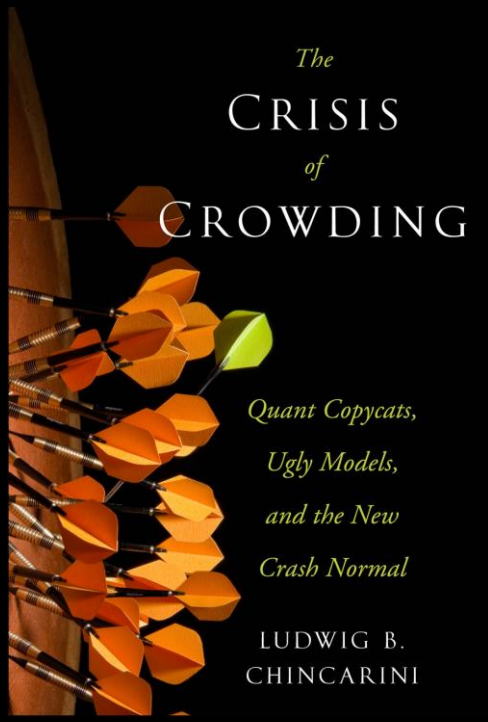


The Crisis of Crowding
The Latest Findings

Key Note Address

November 7, 2016



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

THE SIXTH PUBLIC INVESTOR'S CONFERENCE BY BIS, WORLD BANK, AND BANK OF CANADA
NOVEMBER 7, 2016

- Thank you for coming. Thanks to Gabriel Baracat for his continued correspondence on crowding.

Thanks for Joachim Coche and Pierre Cardon.

A moment to remember Angus Butler and Andrew Crockett.

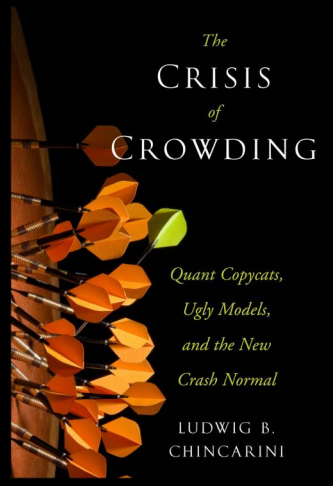
Outline

The Crisis of Crowding (2012)

This discussion is based on my book and other research on the issue of crowding.

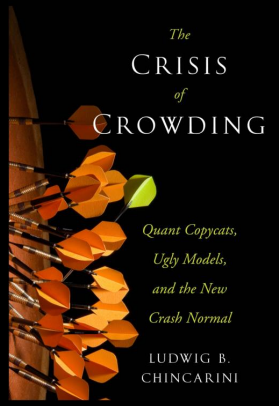
Crowding is a new risk that must be considered by market participants.

1. 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.

1. New Idea of Crowding



- *To my knowledge one of the earliest mentions of the concept of crowding in Chincarini (1998):*

"…may not have estimated the effect that this could have on stable relationships across strategies when other players where placing the same types of trades. In particular, a shock to the market…could lead to a trigger effect, where all the [copycats] began closing positions. A self fulfilling crisis emerged…the correlations across strategies drastically changed because there were too many…playing the same game."

2. Intro to Crowding

Crowding takes place when multiple market participants begin to follow the same trade in such a concentration that liquidity becomes 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

Measuring Crowding Empirically

Return-Based Measures

- Can statistical characteristics of returns within an investment universe signal potential crowding?
- Timely and usually easy to get access to. Not clear its crowding.

Example 1: Take a factor (e.g. momentum), divide into deciles, compute cross-sectional residual return to each stock (i.e. Fama-French decoupled), then compute pair-wise correlation between stocks in each decile. If pair-wise correlation grows, maybe a signal that large portion of return movement is due to crowding by some group of investors following momentum.

Example 2: Recent large returns to a trade not explained by fundamentals.

2. Intro to Crowding

Measuring Crowding Empirically

Holding-Based Measures

- Can we detect crowding by measuring the holdings of an actual group of investors relative to the available liquidity in the market?
- Not as timely (delays in reporting) and difficult to gather.

Example 1: Take the individual holdings of all hedge fund managers of type A, the compute a similarity matrix and measure average similarity over time. Increased average similarity indicates crowding (with or without adjustment for correlation).

Example 2: Take the percentage of each stock owned by a group of hedge funds of type A and divide that by average share turnover. High values of this variable indicates stocks that might be crowded.

2. Intro to Crowding

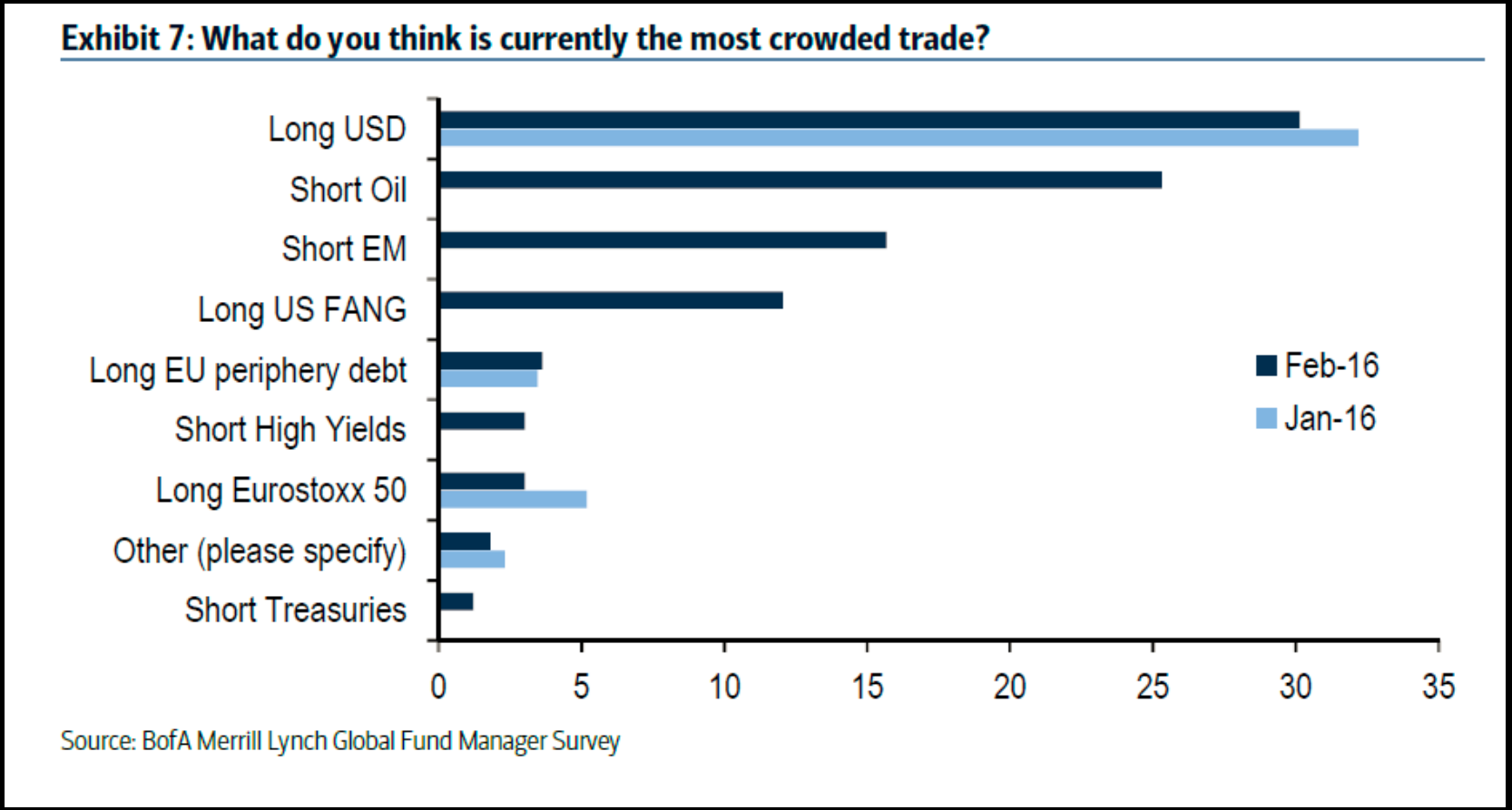
How Crowding Typically Happens

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 (2016)).
   e. Transaction costs and crowding (Chincarini (2016)).


Market is
Acknowledging
this New Risk

3. Market Acknowledges Crowding

A. Examples bank reports from BofA (March 2016)



3. Market Acknowledges 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

3. Market Acknowledges Crowding

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

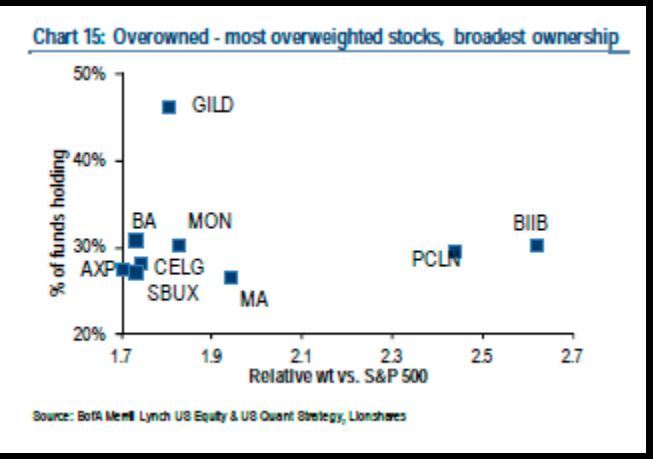


Exhibit 9: The 20 most concentrated stocks in the S&P 500 <Bloomberg: GSTHHFHI>
Holdings as of September 30, 2012; Pricing as of November 15, 2012

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

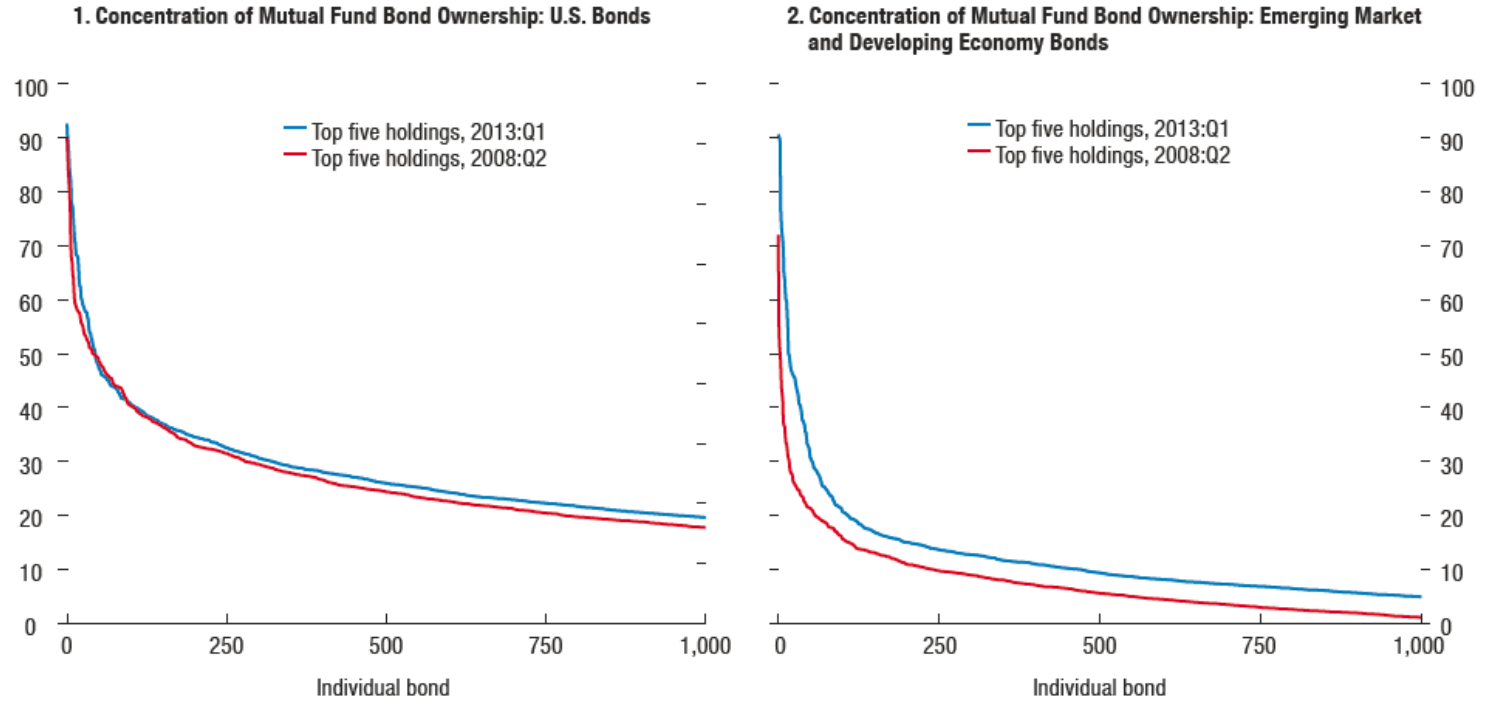
In this report we extend the definition of crowding to include breadth of high conviction overweights by active managers, as well as persistence of accumulation by active managers. We also demonstrate that crowding is an important risk factor at the stock level (with neutral performance profile), but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

3. Market Acknowledges 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)



3. Market Acknowledges Crowding

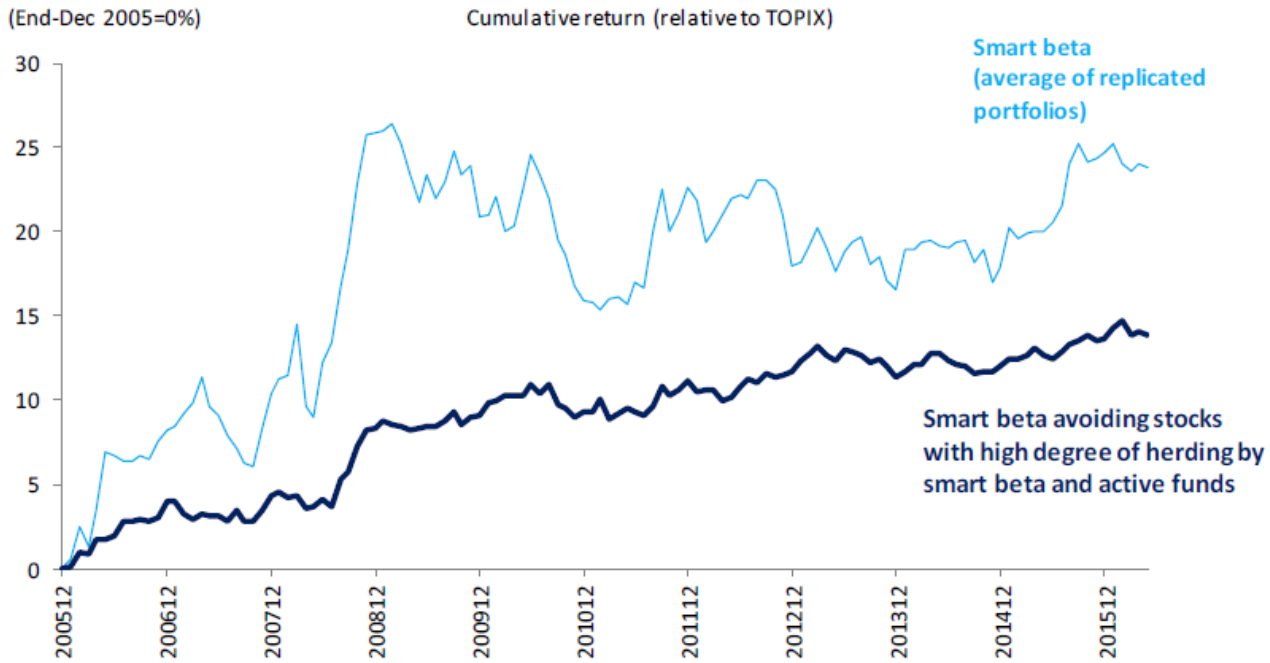
A. Examples Nomura Securities (June 2016).

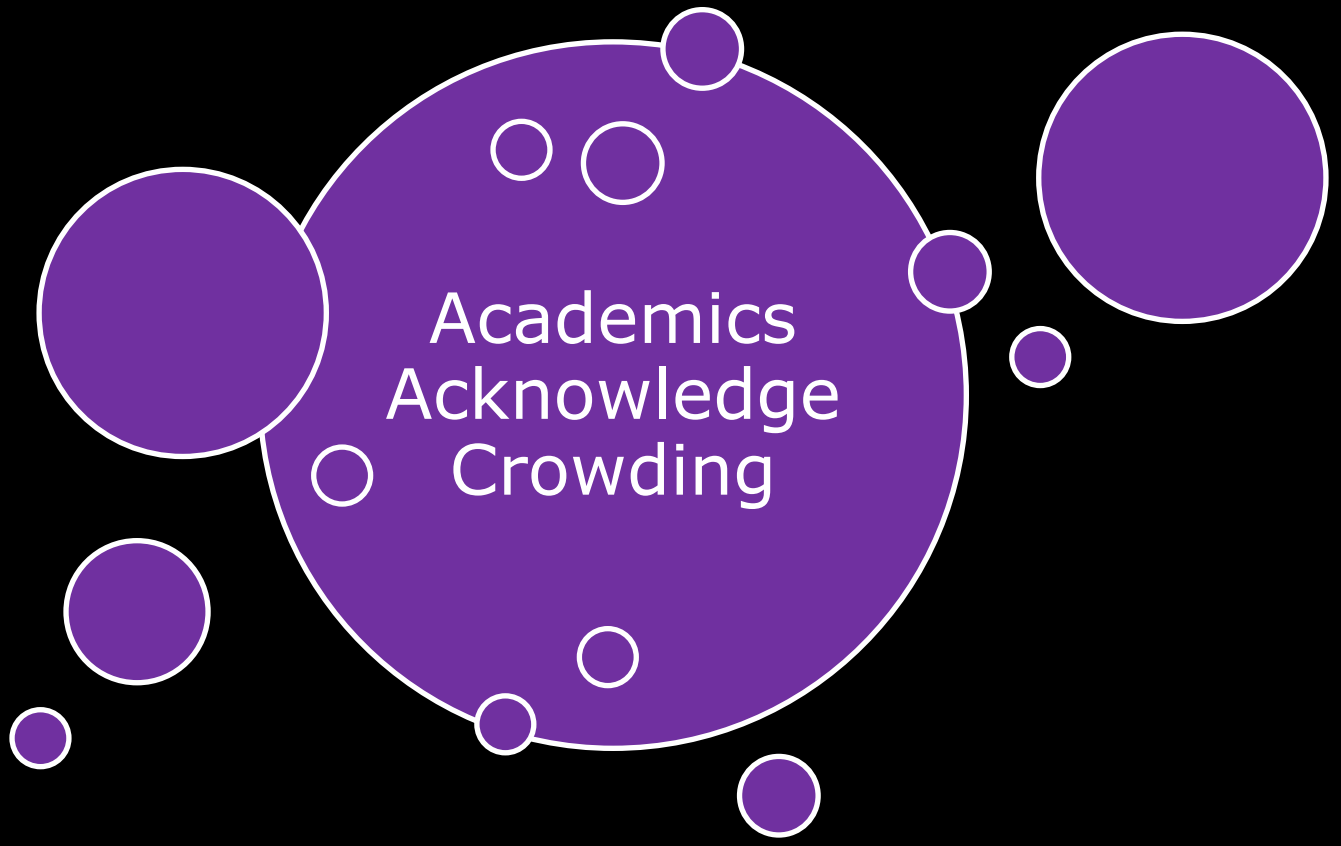
Strategies to avoid herding by "smart beta" and "active funds" in Japan equities

NOMURA

- Smart beta avoiding overcrowded stocks might be effective when concentrated positions unwind

Performance of smart beta including and avoiding stocks with high degree of herding by smart beta and active funds




Academics
Acknowledge
Crowding

4. Academic Studies on Crowding

- Three areas of contribution:

A. Portfolio Construction
   - Copycat Techniques
   - Copycat Alpha
B. Impact of Crowding
C. Implications

4. Academic Studies on Crowding

A. "The Failure of LTCM," Chincarini (1998)
B. "Sophisticated Investors and Market Strategy," Stein (2009)
C. *The Crisis of Crowding*, Chincarini (2012)
D. "The Externalities of Crowded Trades," Blocher (2013)
E. "Standing out from the Crowd. Measuring Crowding in Quantitative Strategies," Cahan and Luo (2013)
F. "Stock portfolio structure of individual investors infers future trading behavior," Bohlin and Rosvall (2014)

4. Academic Studies on Crowding

G. "Dimensions of Popularity," Ibbotson and Idsorek (2014)).

H. "Crowded Trades: An Overlooked Systemic Risk for Central Clearing Counterparties," Menkveld (2014)

I. "The Effects of Short Sales and Leverage Constraints on Market Efficiency," Yan (2014).

J. "Omitted Risks or Crowded Strategies: Why Mutual Fund Comovement Predicts Future Performance," Chue (2015).

K. "Fire, Fire. Is Low Volatility a Crowded Trade," Marmar (2015)

L. "Days to Cover and Short Interest," Hong et al. (2015)

4. Academic Studies on Crowding

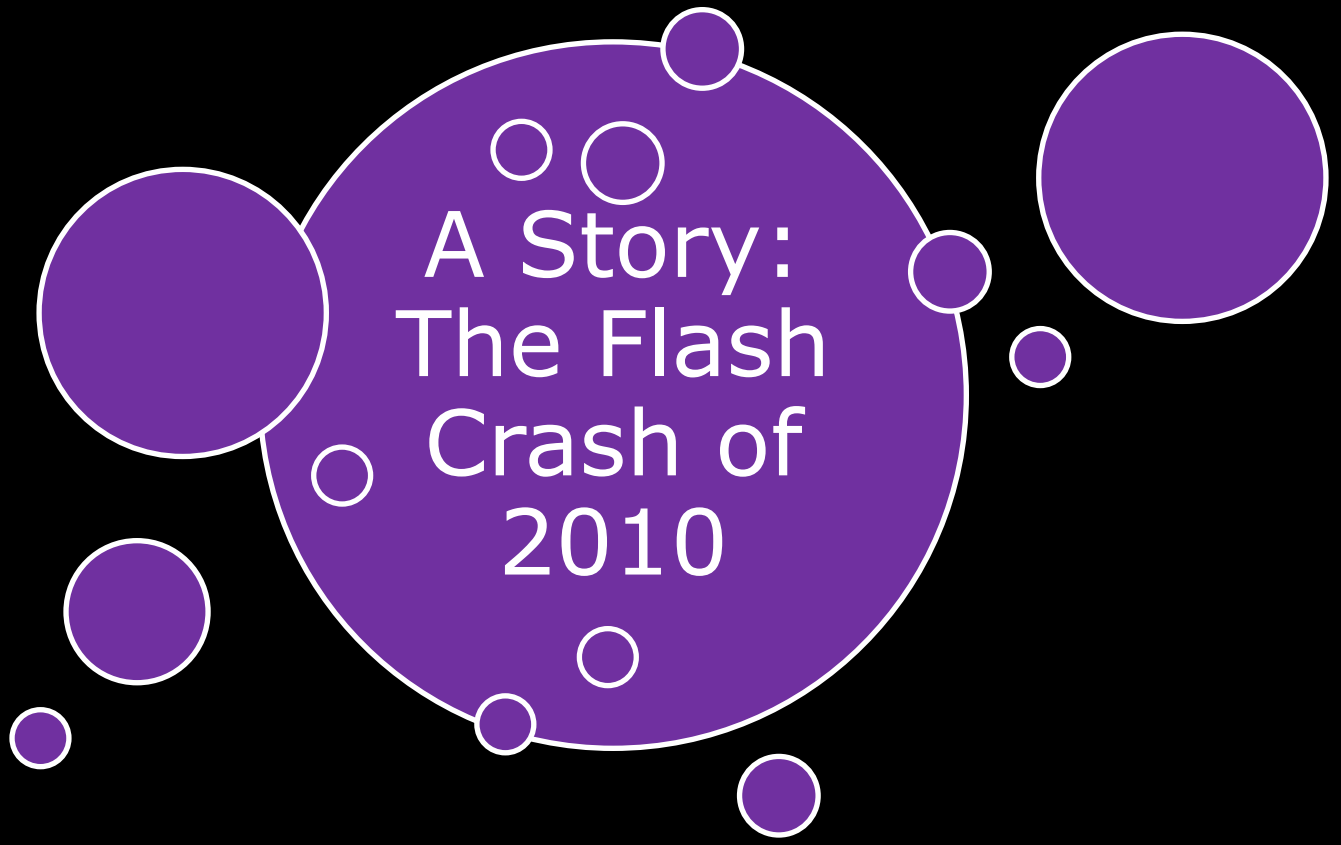
M. "Portfolio Construction and Crowding" Bruno, Chincarini, Davis, and Ohara (2016).

N. "Transaction Costs and Crowding" Chincarini (2016)

O. "Mutual Fund Crowding and Stock Returns," Tay et al. (2016)

P. "Hedge fund crowds and mispricing," Sias et al. (2016)

R. "Individual stock Crowded Trades, Individual Stock Investor Sentiment, and Excess Returns," Yang and Zhou (2016)


A Story:
The Flash
Crash of
2010

A Story from *The Crisis of Crowding*:

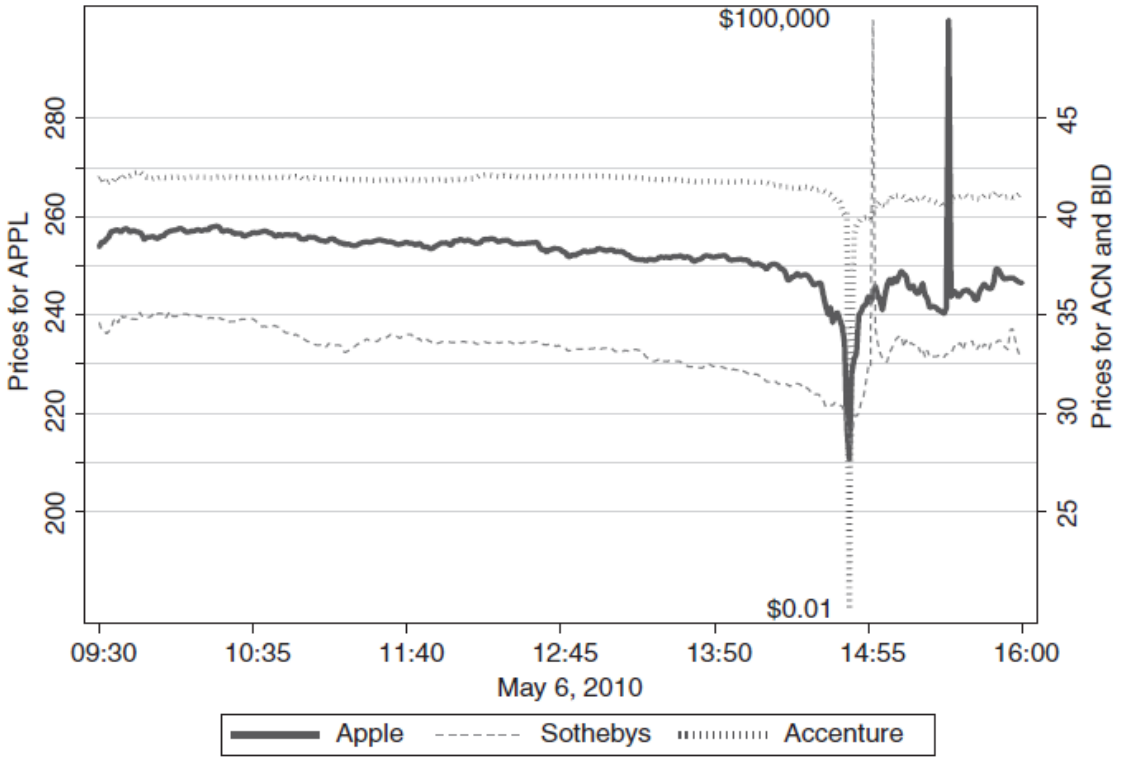
- The Flash Crash

- How does AAPL trade at $100,000 per share?
- How does Accenture trade at 1 cent per share?

A Story from *The Crisis of Crowding*:

- The Flash Crash

FIGURE 17.1 Apple, Accenture, and Sotheby's Stock Prices



Source: Chapter 17 The Crisis of Crowding

A Story from *The Crisis of Crowding*:

- The Flash Crash

- What happened?
- SEC said it was Waddell-Reed…riiiiight.
- 75,000 e-mini futures sell order.
- Too small, happened before, and liquidity dried up later.

A Story from *The Crisis of Crowding*:

- The Flash Crash

- What happened?

- NYSE Arca had old computers on many of the stocks.

- Fast trading caused a glut and delayed quotes appeared on orders.

- Market makers saw inconsistencies in ticker tape and got scared.

A Story from *The Crisis of Crowding*:

- The Flash Crash
  - What happened? Odds bumps in price quotes.

TABLE 17.1 Consolidated Tape for Accenture on May 6, 2010

Time	Shares	Price	Exchange
2:47:25 P.M.	100	38.66	ISE
2:47:25 P.M.	100	40.22	FINRA
2:47:25 P.M.	100	40.22	FINRA
2:47:25 P.M.	100	39.06	NYSE Arca

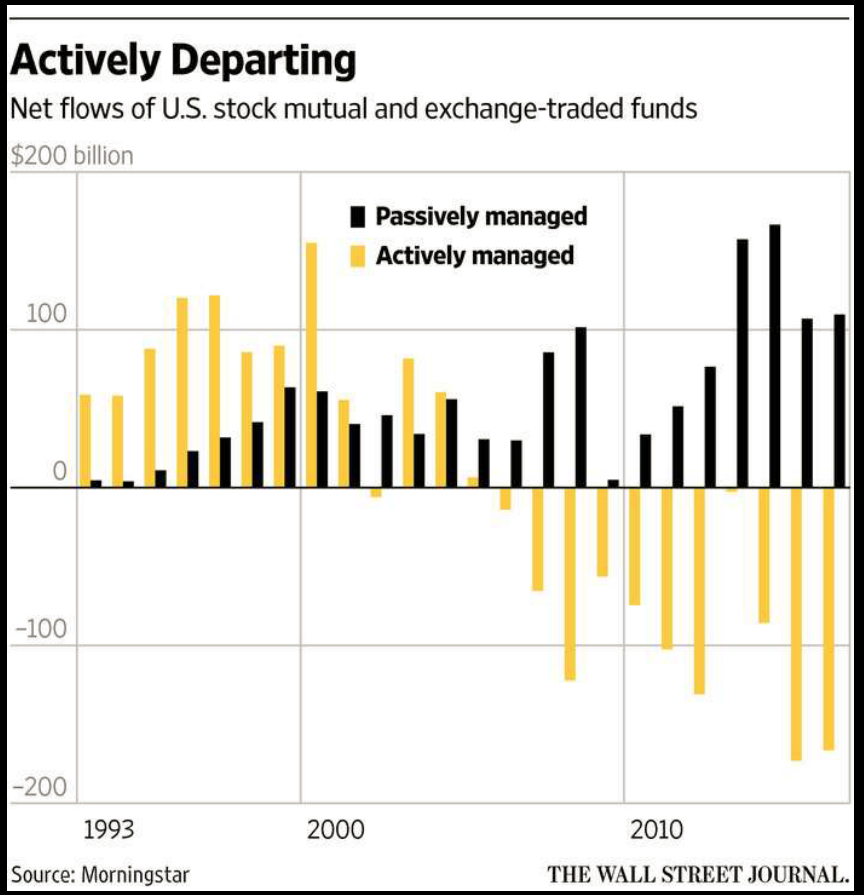
A Story from *The Crisis of Crowding*:

- The Flash Crash

- What happened?
- The market maker crowd ran for the exits.
- Left stub quotes (due to regulation)
- One major broker kept sending orders through system…catching stub quotes.
- Eventually, liquidity came back.

7. Crowded Thoughts

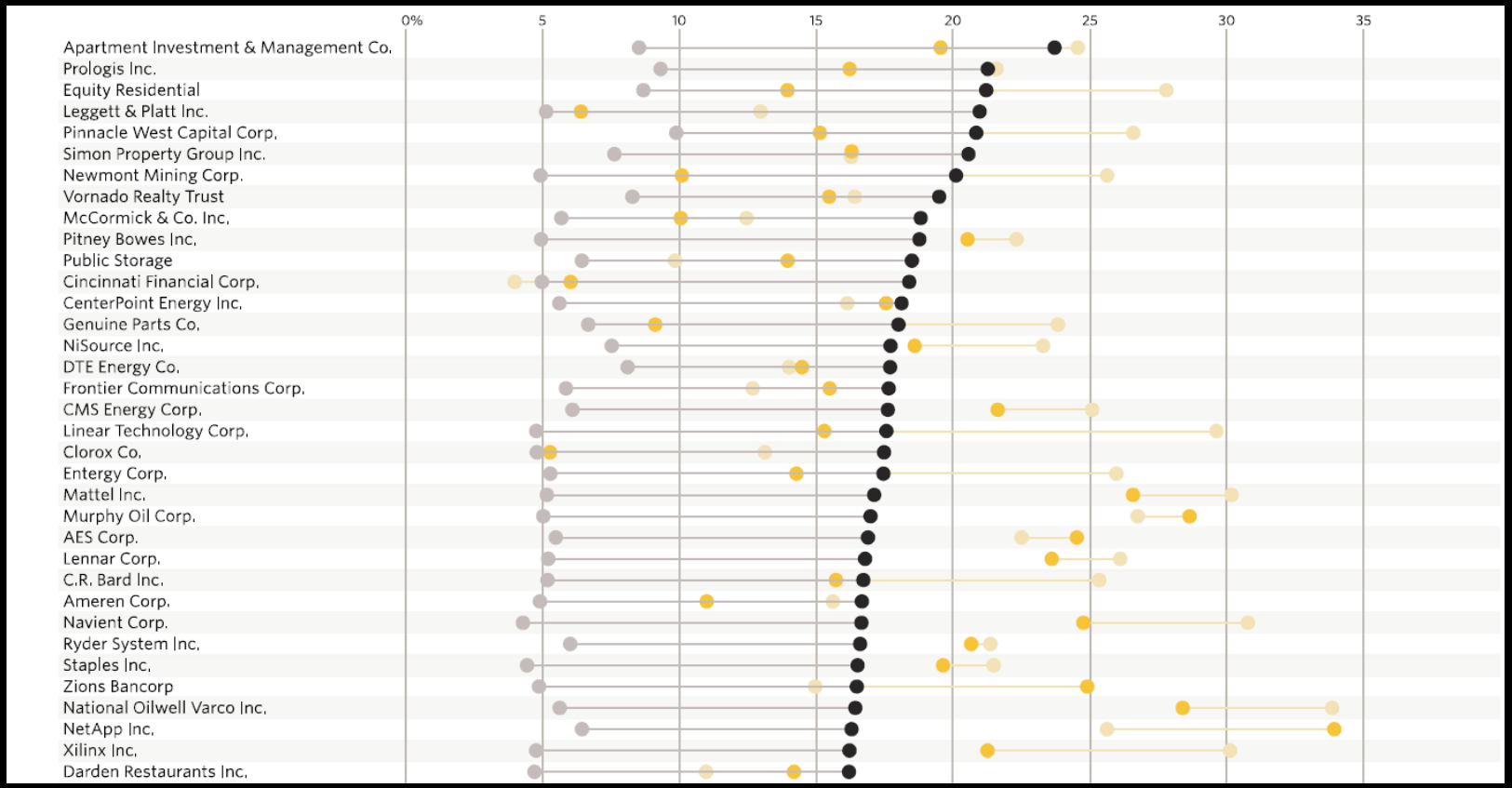
A. The Growth of Indexed Funds



7. Crowded Thoughts

A. The Growth of Indexed Funds

ETF/Passive MF majority of holdings in many S&P stocks (2005-2015)



7. Crowded Thoughts

A. The Growth of Indexed Funds

For fund categories (Source: Morningstar)

Asset Class	% of Periods Median Fund Produces Excess Return	Efficient (favoring passive) or Inefficient (favoring active) Asset Class	Market Assets (% Active / % Passive)
Large Cap Core	20%	Efficient	31% / 69%
Tax Exempt Fixed Income	40%	Mixed	95% / 5%
Large Cap Value	41%	Mixed	81% / 19%
Taxable Fixed Income	41%	Mixed	67% / 33%
Large Cap Growth	45%	Mixed	96% / 4%
High Yield Bond	47%	Mixed	88% / 12%
International Value	48%	Mixed	73% / 27%
Global Real Estate	51%	Mixed	63% / 37%
International Core	51%	Mixed	47% / 53%
International Growth	54%	Mixed	99% / 1%
Small Cap Core	63%	Inefficient	44% / 56%
Emerging Markets	64%	Inefficient	60% / 40%
Real Estate	65%	Inefficient	45% / 55%
Small Cap Value	67%	Inefficient	58% / 42%
Mid Cap Growth	68%	Inefficient	90% / 10%
Mid Cap Value	69%	Inefficient	81% / 19%
Mid Cap Core	72%	Inefficient	28% / 72%
Small Cap Growth	74%	Inefficient	86% / 14%

Source: Morningstar Direct; Baird Analysis.

Various one year, three year and five

7. Crowded Thoughts

A. The Growth of Indexed Funds

i. Passive funds grown by 73% (2009 – 2015) and represent about 19% of global AUM (compared to 11%). Some estimates have 24% of GAUM (Morningstar).

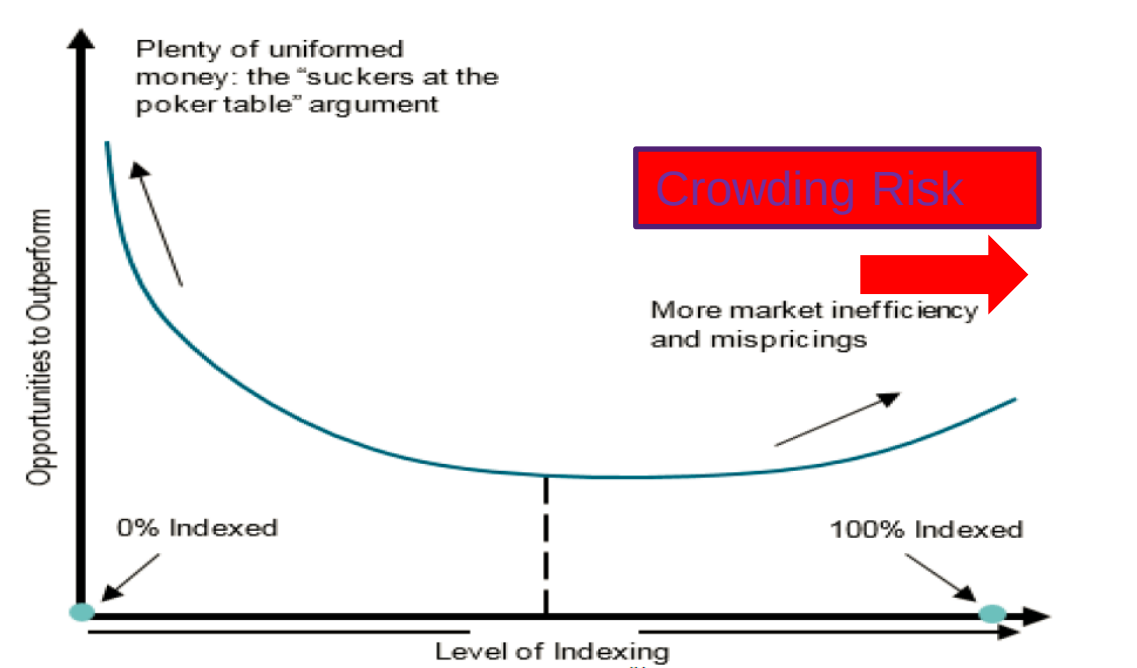
ii. Smart Beta funds have grown by 40% from 2010-2015 (versus 19% for market cap indices). Smart Beta funds gathered $54B in first 10 months of 2015. As of 03/2015, $282Billion (expected $1Trillion by 2020).

iii. There could be danger that markets become inefficient combined with crowding of positions in smart beta space. That is, if everyone is chasing similar signals, then liquidity may suffer as copycats chase each other in and out of positions.

Sources: Bloomberg and "The Rise of Indices is Changing the Face of Investing." Jacob Angana, S&P

7. Crowded Thoughts

A. The Growth of Indexed Funds



Source: S&P Dow Jones Indices LLC, abormalreturns.com.[27] Charts are provided for illustrative purposes.

Sources: Bloomberg and "The Rise of Indices is Changing the Face of Investing." Jacob Angana, S&P

7. Crowded Thoughts

A. The Growth of Indexed Funds

iv. *Quantitative Equity Portfolio Management* (Chincarini and Kim (2006)) and *The Crisis of Crowding* (2012) mentioned that price movement or returns might be an indirect measure of crowding. That is, if a strategy is making amazing returns, it might be partly because many copycats are crowding into the position.

Table. Performance of "Anomalies" for Different Periods								
	Mkt-RF	SMB	HML	MOM	Mkt-RF	SMB	HML	MOM
1964-2000	6.72%	3.47%	5.47%	12.05%	5.80%	2.38%	3.33%	11.38%
2000-2014	4.77%	5.13%	5.66%	0.20%	2.62%	4.70%	5.00%	-6.65%
2010-2014	16.20%	1.65%	-1.00%	4.75%	15.66%	1.33%	-1.12%	4.72%
1990-2014	8.41%	2.27%	3.07%	6.39%	6.64%	1.60%	2.02%	1.58%

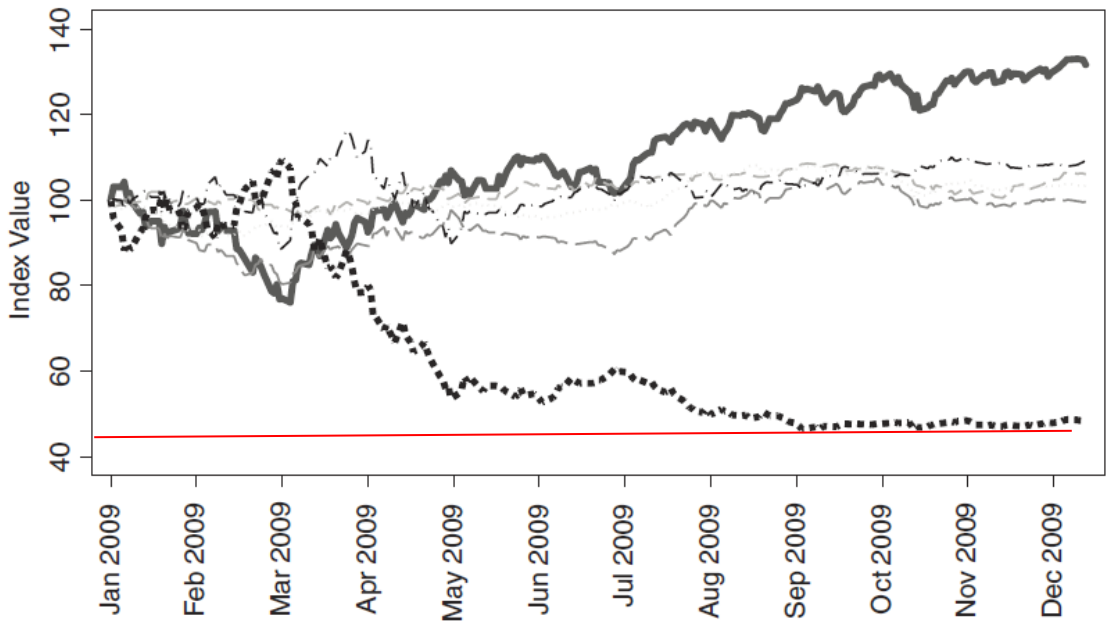
7. Crowded Thoughts

A. The Growth of Indexed Funds

Momentum was slaughtered in 2009.

Source: *The Crisis of Crowding*, Chapter 8.

FIGURE 8.5 The Returns to Standard Factors in 2009



7. Crowded Thoughts

A. The Growth of Indexed Funds

Factor Crowding Before and After

Panel B. *Factors: Before and After Publication*

Annualized Results	Value (Blend)	Value (B/P)	Momentum	Size	Illiquidity	Low Beta	Profitability	Investment	Average
Year Published	1977	1977	1993	1981	2002	1975	2013	2004	
Before Publication	9.8%	9.1%	5.4%	7.0%	2.5%	7.4%	1.2%	3.5%	5.8%
After Publication	2.3%	1.4%	3.7%	0.8%	5.0%	2.1%	5.0%	-1.0%	2.4%
Difference	-7.5%	-7.8%	-1.8%	-6.2%	2.5%	-5.4%	3.8%	-4.5%	-3.3%

Source: Research Affiliates, LLC, using CRSP/Compustat and Worldscope/Datastream data.

Panel A. *Smart Beta Strategies: Before and After Index Launch*

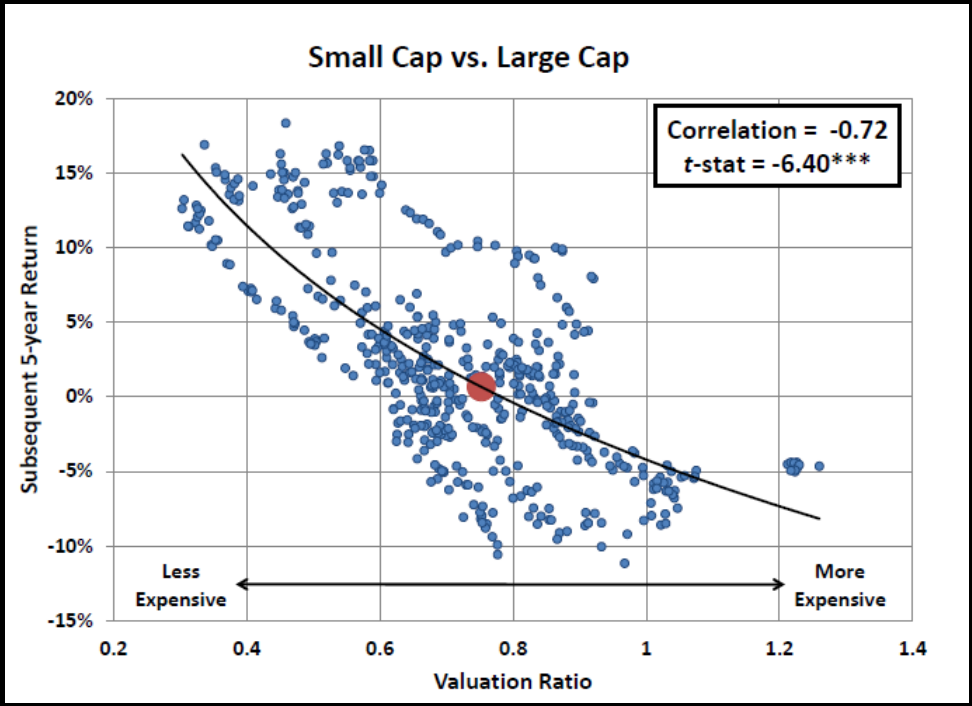
Annualized Results	Fundamental Index	Equal Weight	Low-Vol Index	FTSE RAFI Low Vol	Quality Index	Dividend Index	Risk Efficient	Maximum Diversification	Average
Year Launched	Nov-05	Jan-03	Feb-11	Apr-13	Dec-12	Nov-03	Jan-10	Nov-11	
Before Launch	2.0%	1.3%	1.2%	2.2%	0.4%	2.9%	2.7%	1.6%	1.8%
After Launch	0.4%	2.3%	2.1%	0.1%	0.1%	1.3%	0.9%	4.1%	1.4%
Difference	-1.6%	1.0%	0.9%	-2.1%	-0.4%	-1.6%	-1.9%	2.5%	-0.4%

7. Crowded Thoughts

A. The Growth of Indexed Funds

Indirectly Measuring Factor Crowding

(Measure: Relative P/B of high and low factors as ratio)



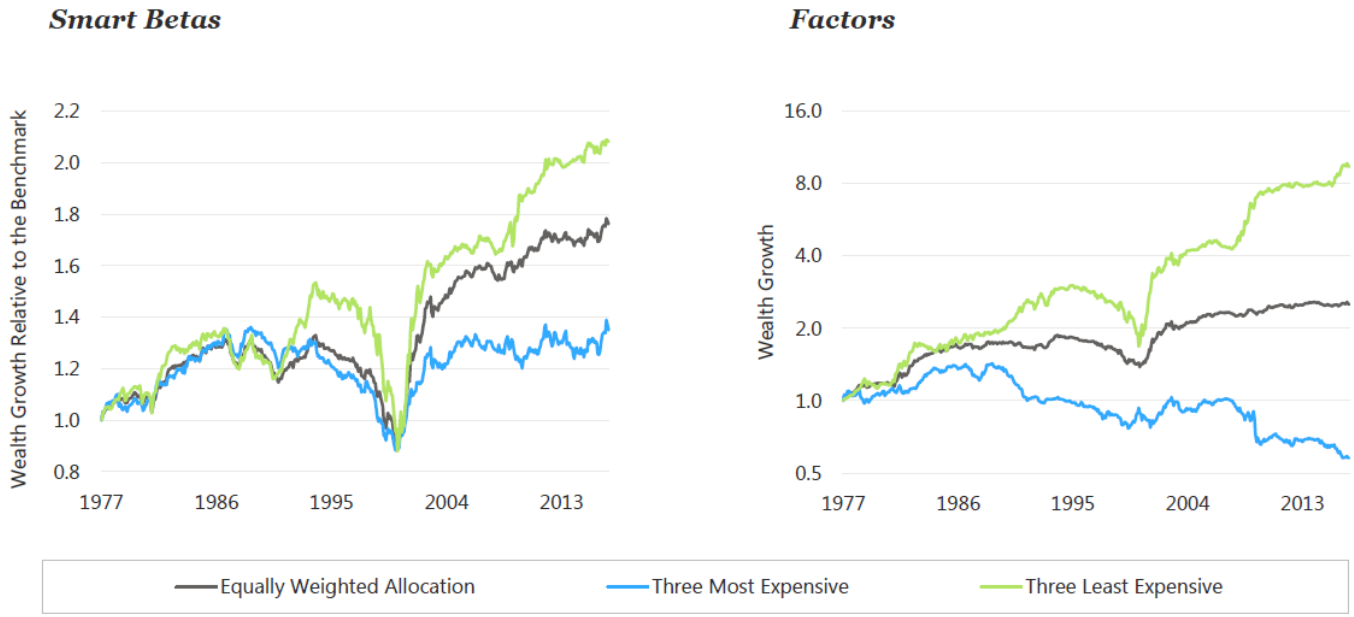
7. Crowded Thoughts

A. The Growth of Indexed Funds

Indirectly Measuring Factor Crowding

(Sorting Factors by Z-Score of relative expensiveness to their history. Yearly rebalance.)

Panel B. *Cumulative Growth in Wealth of the Most and Least Expensive Strategies and Factors*



Source: Research Affiliates, LLC, using CRSP/Compustat and Worldscope/Datastream data.

7. Crowded Thoughts

B. Low Interest Rates and Related Crowding

i. Low interest rates have led investors to seek yield in all sorts of places.

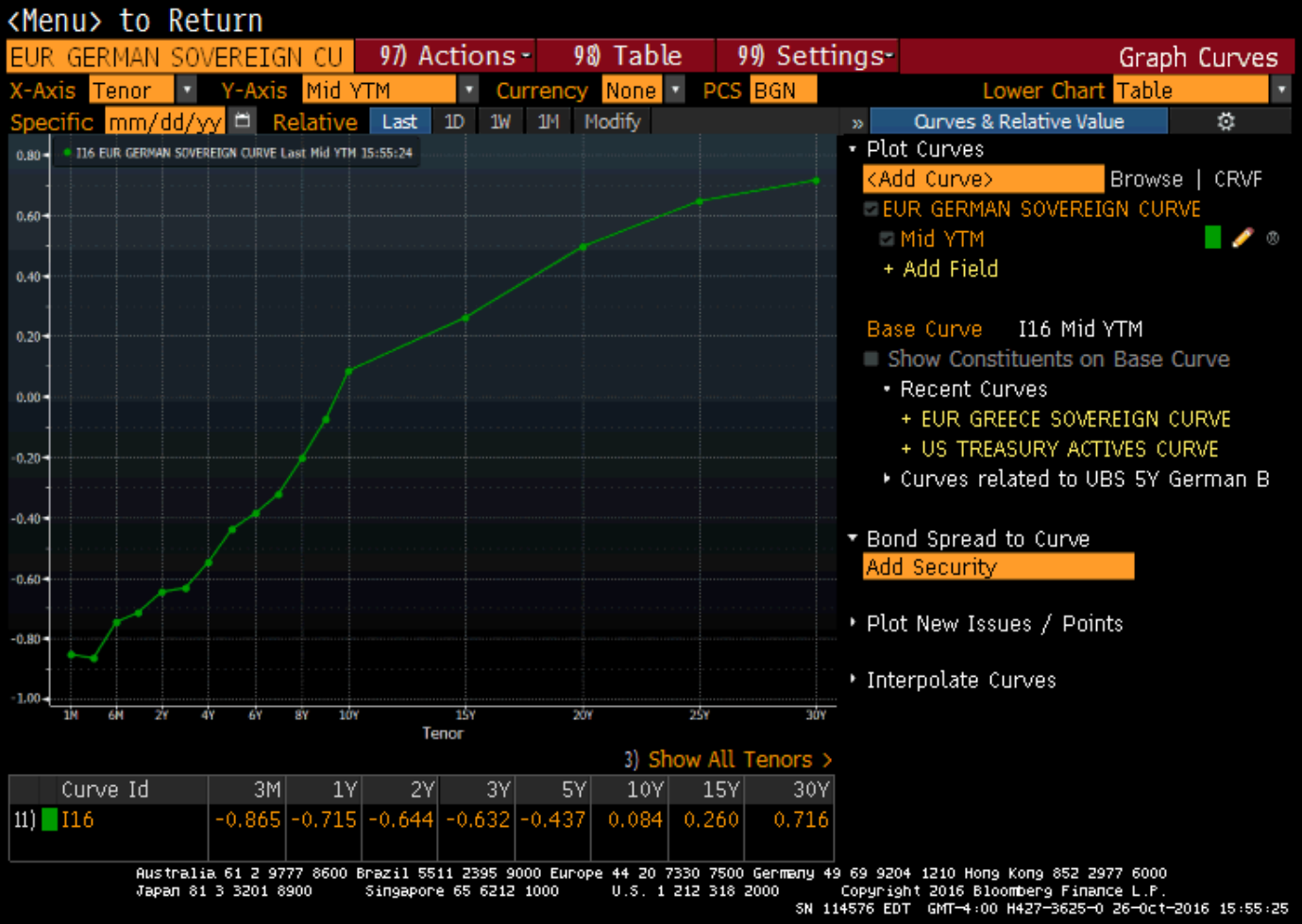
ii. Low interest rates are also a consequence of investors seeking safe-haven at all costs.

iii. These spaces could potentially be crowded.

iv. The reversal of these crowded trades could be very quick when the catalyst occurs – e.g. Federal Reserve increases interest rates.

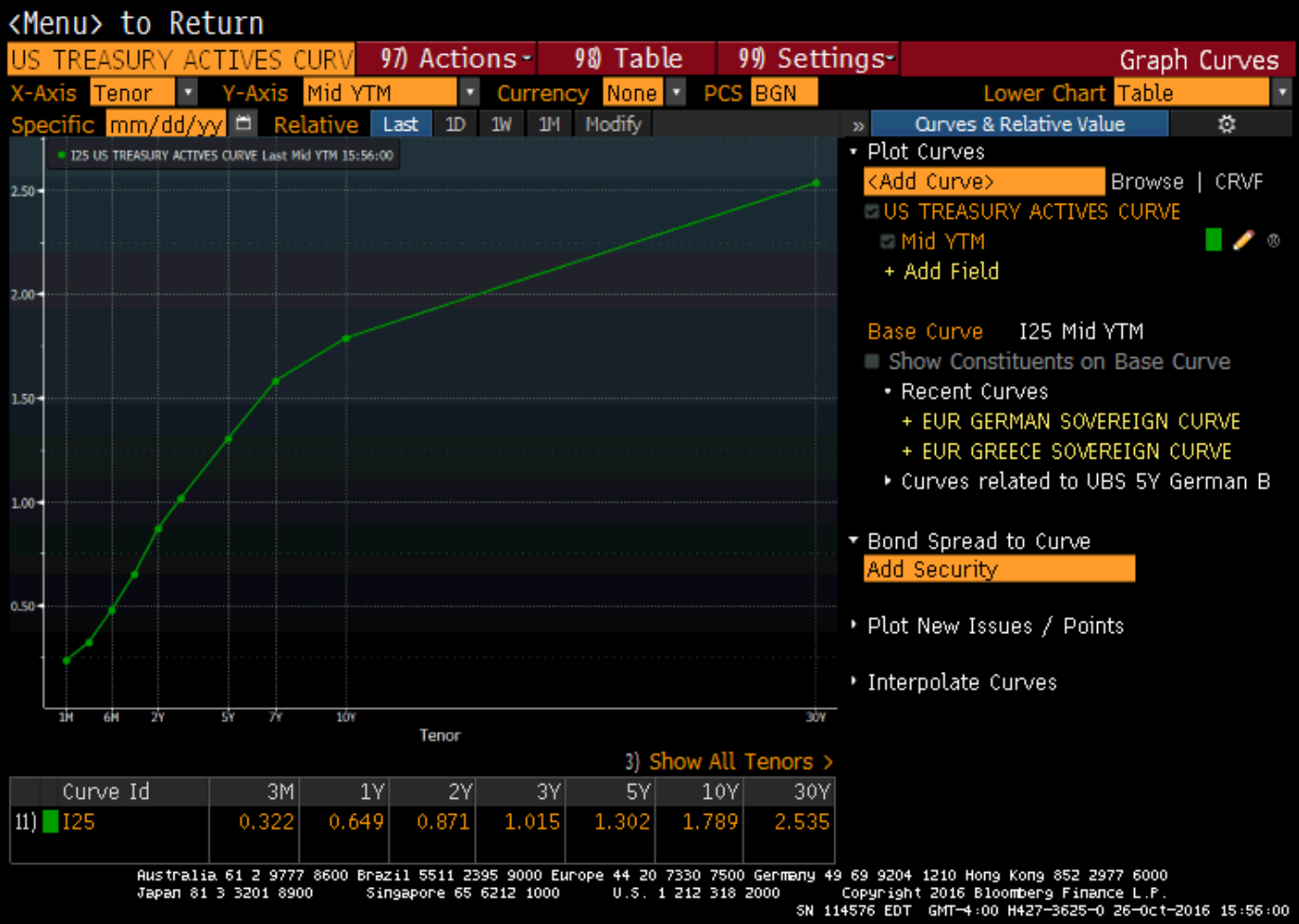
7. Crowded Thoughts

B. Low Interest Rates and Related Crowding



7. Crowded Thoughts

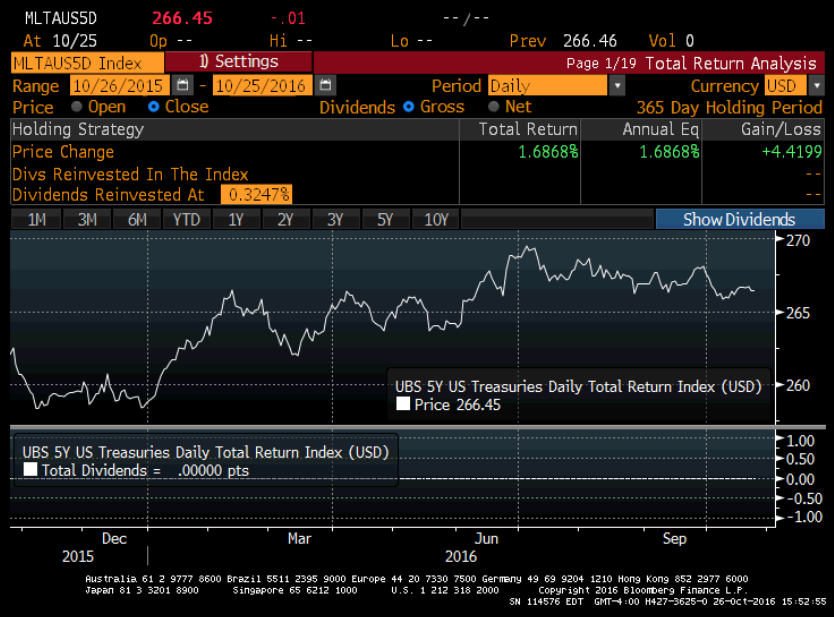
B. Low Interest Rates and Related Crowding

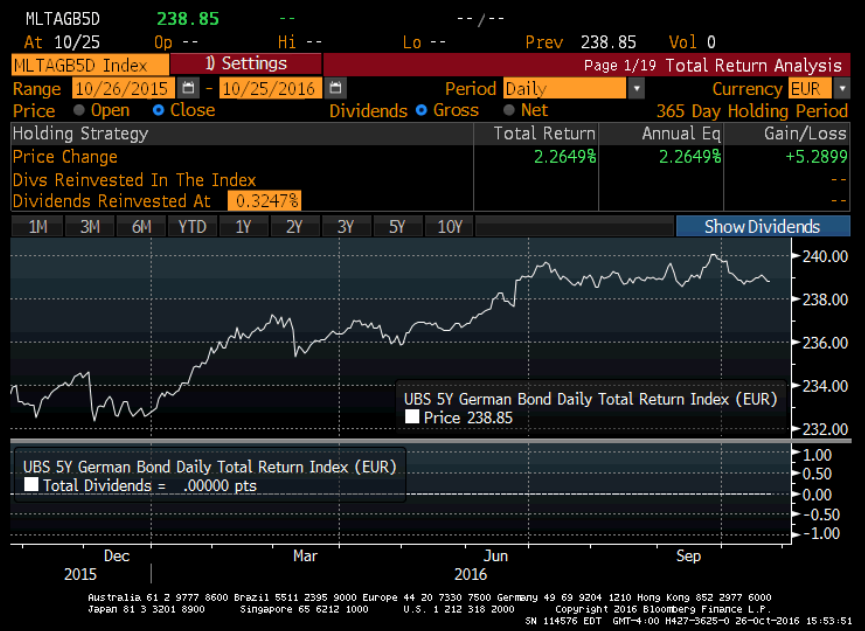


7. Crowded Thoughts

B. Low Interest Rates and Related Crowding

- Over last year, returns on negative German bunds have been 2.26% and better than cash.
- In US, 1.69% and better than cash.
- Return is levelling out – risks to crowded exit?
- Waiting for the shock – central banks?



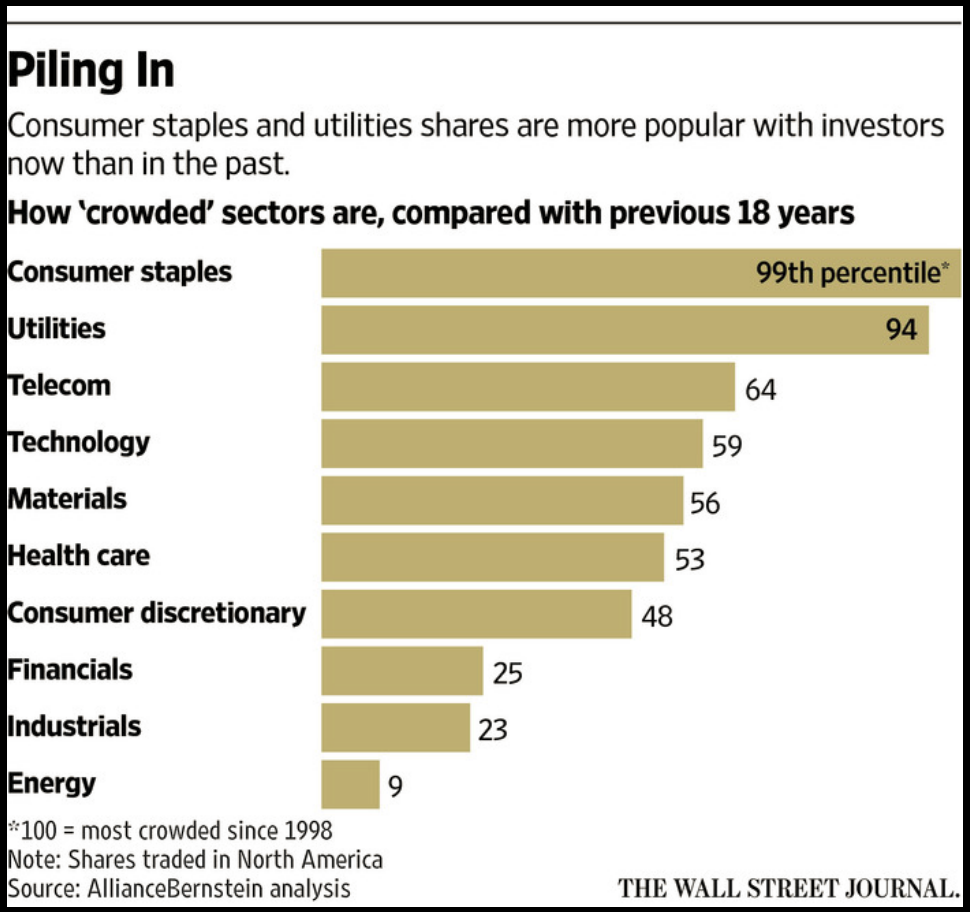


7. Crowded Thoughts

B. Low Interest Rates and Related Crowding

- Are equity sectors Staples and Utilities crowded? Real estate? Dividend stocks? (Alt sources of yield).

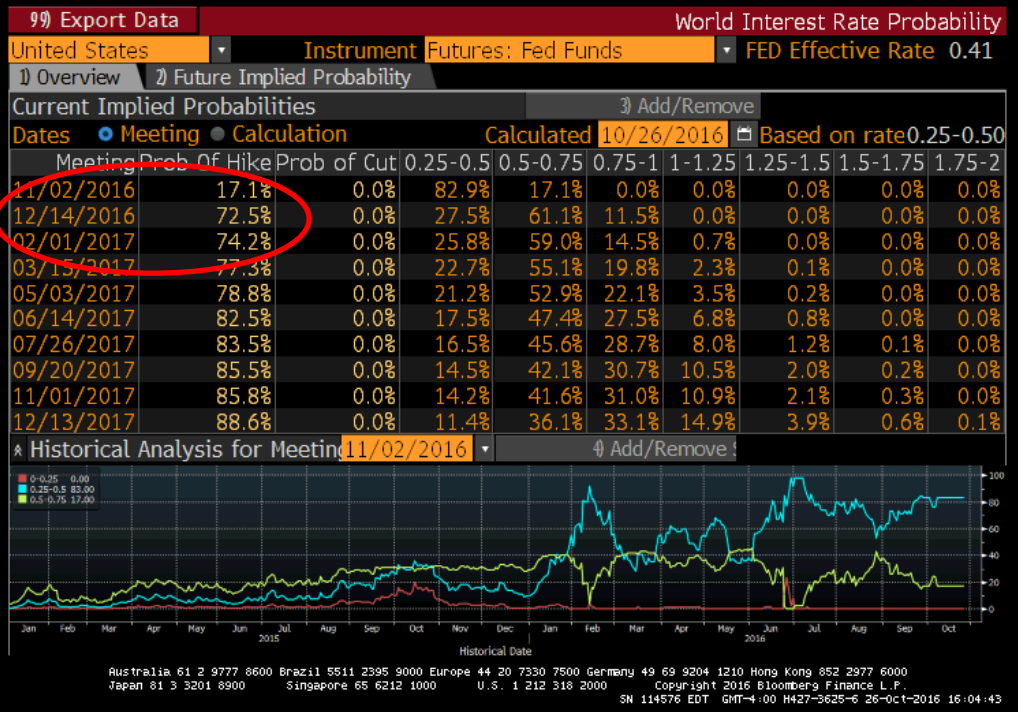
Crowding = active manager buying, buy ratings of analysts, and return movement.



7. Crowded Thoughts

B. Low Interest Rates and Related Crowding

- Rates are too low? Taylor rule says so.
- Hike is coming? Investors think in December.



Meeting	Prob Of Hike	Prob of Cut	0.25-0.5	0.5-0.75	0.75-1	1-1.25	1.25-1.5	1.5-1.75	1.75-2
11/02/2016	17.1%	0.0%	82.9%	17.1%	0.0%	0.0%	0.0%	0.0%	0.0%
12/14/2016	72.5%	0.0%	27.5%	61.1%	11.5%	0.0%	0.0%	0.0%	0.0%
02/01/2017	74.2%	0.0%	25.8%	59.0%	14.5%	0.7%	0.0%	0.0%	0.0%
03/15/2017	77.3%	0.0%	22.7%	55.1%	19.8%	2.3%	0.1%	0.0%	0.0%
05/03/2017	78.8%	0.0%	21.2%	52.9%	22.1%	3.5%	0.2%	0.0%	0.0%
06/14/2017	82.5%	0.0%	17.5%	47.4%	27.5%	6.8%	0.8%	0.0%	0.0%
07/26/2017	83.5%	0.0%	16.5%	45.6%	28.7%	8.0%	1.2%	0.1%	0.0%
09/20/2017	85.5%	0.0%	14.5%	42.1%	30.7%	10.5%	2.0%	0.2%	0.0%
11/01/2017	85.8%	0.0%	14.2%	41.6%	31.0%	10.9%	2.1%	0.3%	0.0%
12/13/2017	88.6%	0.0%	11.4%	36.1%	33.1%	14.9%	3.9%	0.6%	0.1%

Thank you

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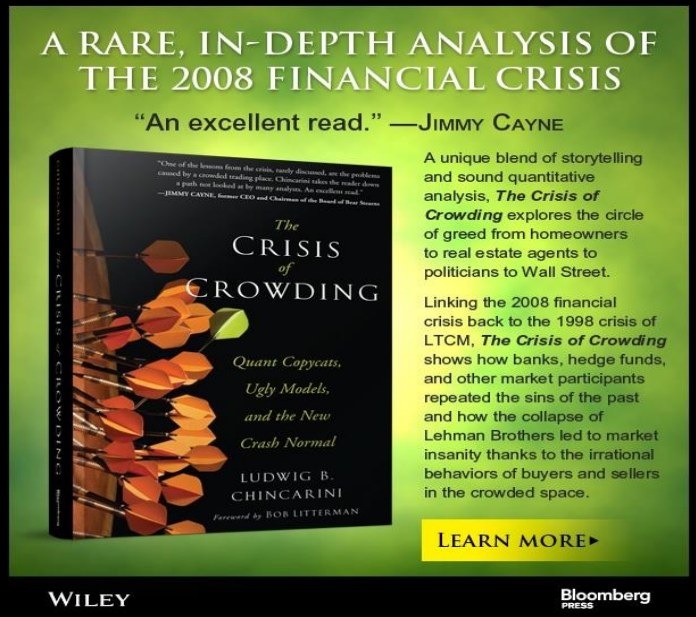
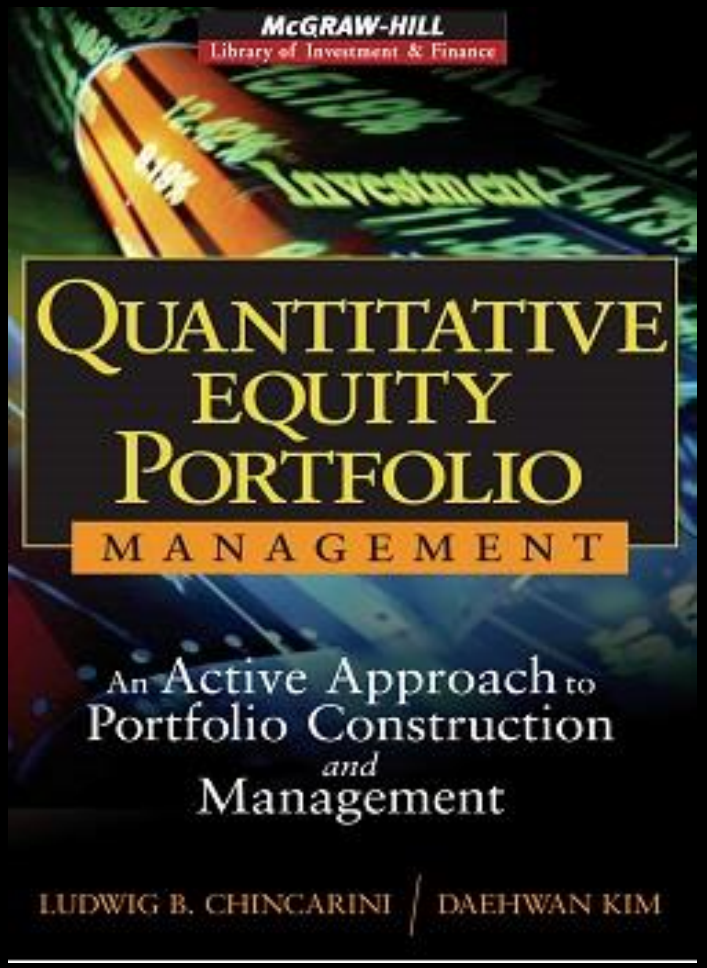
For more information: Buy the books! ;)





Thanks

1. I would like to thank United States Commodity Funds, Rob Arnott, Jason Hsu, Noah Beck, and Inigo Fraser-Jenkins.

Open Discussion

1. TBA