



CROWDED TRADES: IMPLICATIONS FOR SECTOR ROTATION AND FACTOR TIMING

NORTHFIELD ANNUAL RESEARCH CONFERENCE

2018

MARK KRITZMAN*

*JOINT RESEARCH WITH WILL KINLAW AND DAVID TURKINGTON

These materials are intended only for the use of the recipient for their consideration of engaging Windham as an investment adviser. These materials may not be retransmitted to any other person without the prior written consent of Windham. Use of these materials by any other person or for any other reason is prohibited.



Asset Centrality

Relative Value

Asset Centrality and Relative Value during Well-Known Bubbles

Conditional Sector Performance

Conditional Factor Performance



THE ABSORPTION RATIO

- The absorption ratio quantifies the level of concentration among a group of assets.
- The absorption ratio is equal to the proportion of variation in asset returns that is explained or “absorbed” by a fixed number of factors in a principal components analysis.
- When the absorption ratio is elevated, shocks tend to propagate quickly and broadly.

$$AR = \frac{\sum_{i=1}^n \sigma_{E_i}^2}{\sum_{j=1}^N \sigma_{A_j}^2}$$

AR: absorption ratio

N: number of assets

n: number of eigenvectors used to calculate AR

$\sigma_{E_i}^2$: variance of the i -th eigenvector

$\sigma_{A_j}^2$: variance of the j -th asset

For details, see: Kritzman, M., Y. Li, S. Page and R. Rigobon. 2011. “Principal Components as a Measure of Systemic Risk.” *Journal of Portfolio Management*. Source: State Street Global Exchange.



Centrality measures the extent to which a particular group of assets, such as a sector, drives the variability of returns:

Centrality is higher to the extent:

- The sector is relatively more volatile.
- The sector is connected to other assets.

$$C_i = \frac{\sum_{j=1}^n (AR^j \cdot |w_i^j|)}{\sum_{j=1}^n AR^j}$$

C_i = centrality of asset i

AR^j = absorption ratio of the j -th eigenvector

w_i^j = weight of i -th asset within j -th eigenvector

n = number of eigenvectors used to compute AR

For details, see: Kinlaw, W., M. Kritzman and D. Turkington. 2012. "Toward Determining Systemic Importance." *Journal of Portfolio Management*. Source: State Street Global Exchange.

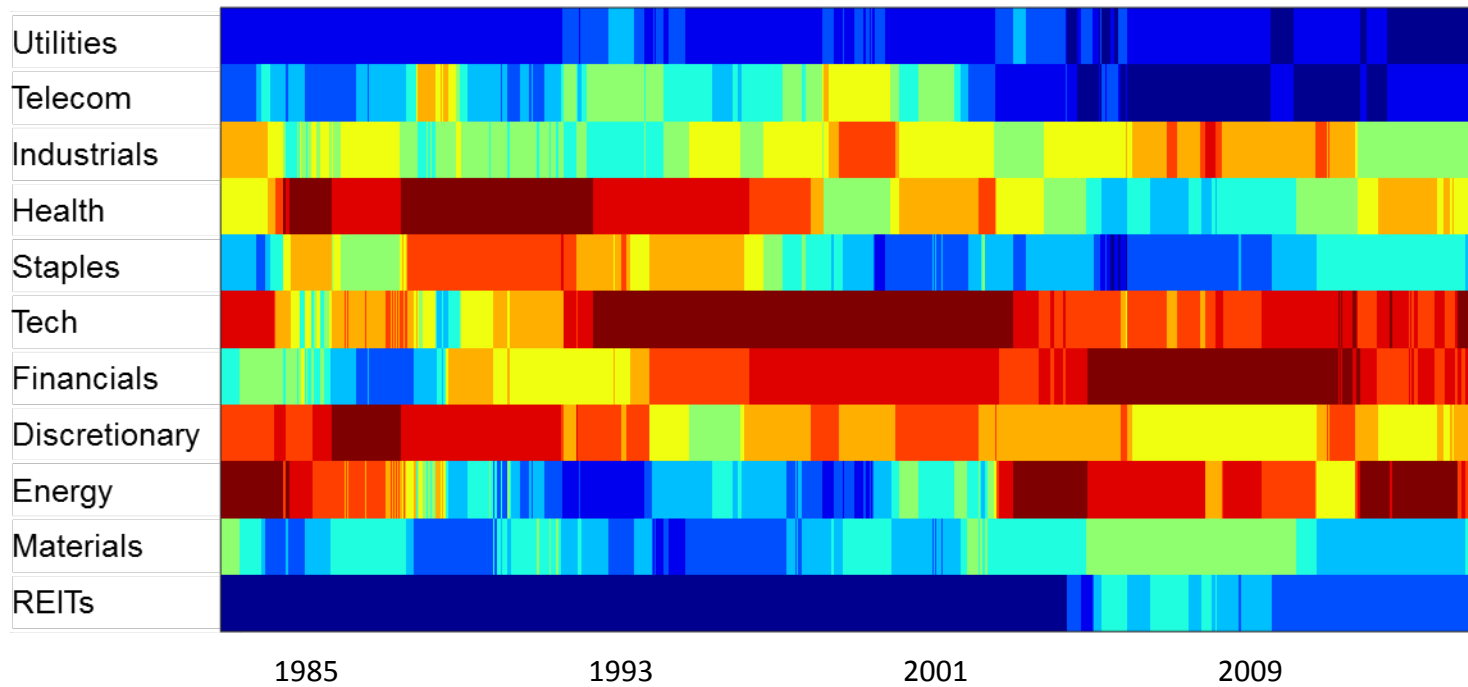


Why is centrality indicative of crowded trading?

- Centrality is characterized by high volatility and greater connectivity.
- Crowded trading leads to large order imbalances and therefore large price adjustments, which increases volatility.
- Crowding into a sector raises the correlation among the companies within the sector, which raises the sector's volatility.
- Investors crowd toward sectors that are bellwethers, which tend to drive the behavior of other sectors, thus raising the connectivity of the bellwether sector.



SECTOR CENTRALITY THROUGH TIME



Heat map shows cross-sectional percent ranks of sector centrality scores through time; blue indicates a low centrality score and red indicates a high centrality score. Source: State Street Global Exchange.



- To determine the relative value of a sector, we first compute its price-to-book value ratio.
- We then normalize this valuation measure by dividing it by its long-term average, because some sectors have consistently higher price-to-book value ratios than others.
- We then divide each sector's normalized price-to-book value ratio by the average of the normalized price-to-book value ratios of all the other sectors to arrive at a cross-sectional measure of relative value.



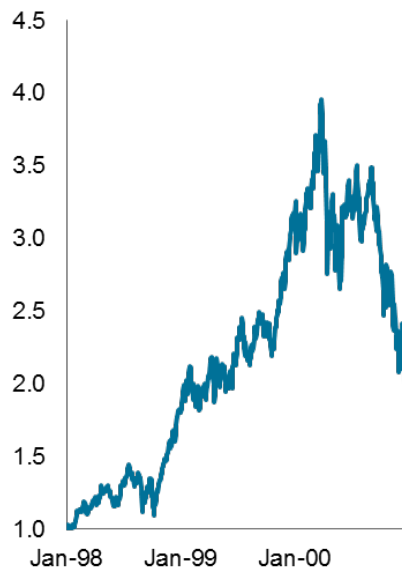
THE POWER OF CENTRALITY AND RELATIVE VALUE TOGETHER

- Centrality is indicative of crowded trading.
- Crowded trading helps to locate bubbles by distinguishing price behavior that is induced by investor psychology from price behavior that is induced by shifting fundamentals.
- However, crowded trading occurs throughout the entire cycle of a bubble.
- Relative value is critical because it separates crowded trading that occurs during the run-up of a bubble from crowded trading that occurs during a bubble's sell off.

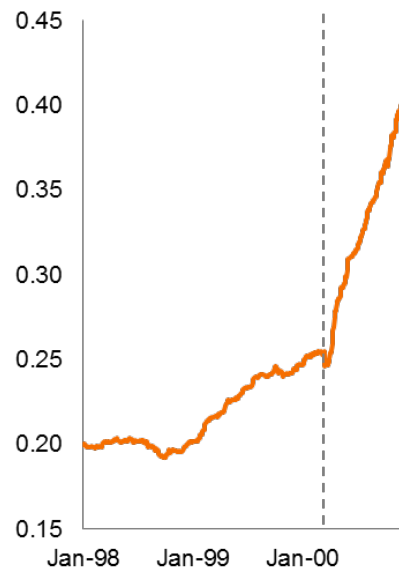


THE TECH BUBBLE (1998 – 2000)

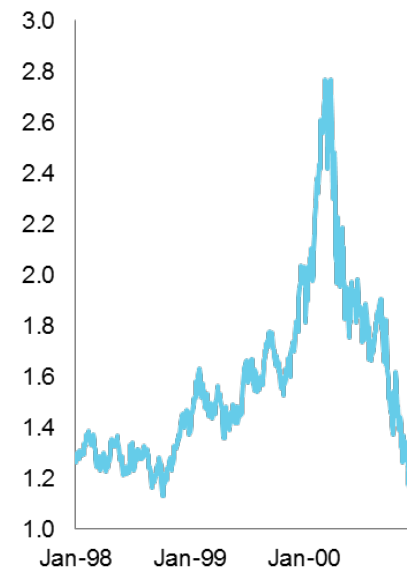
Price



Centrality



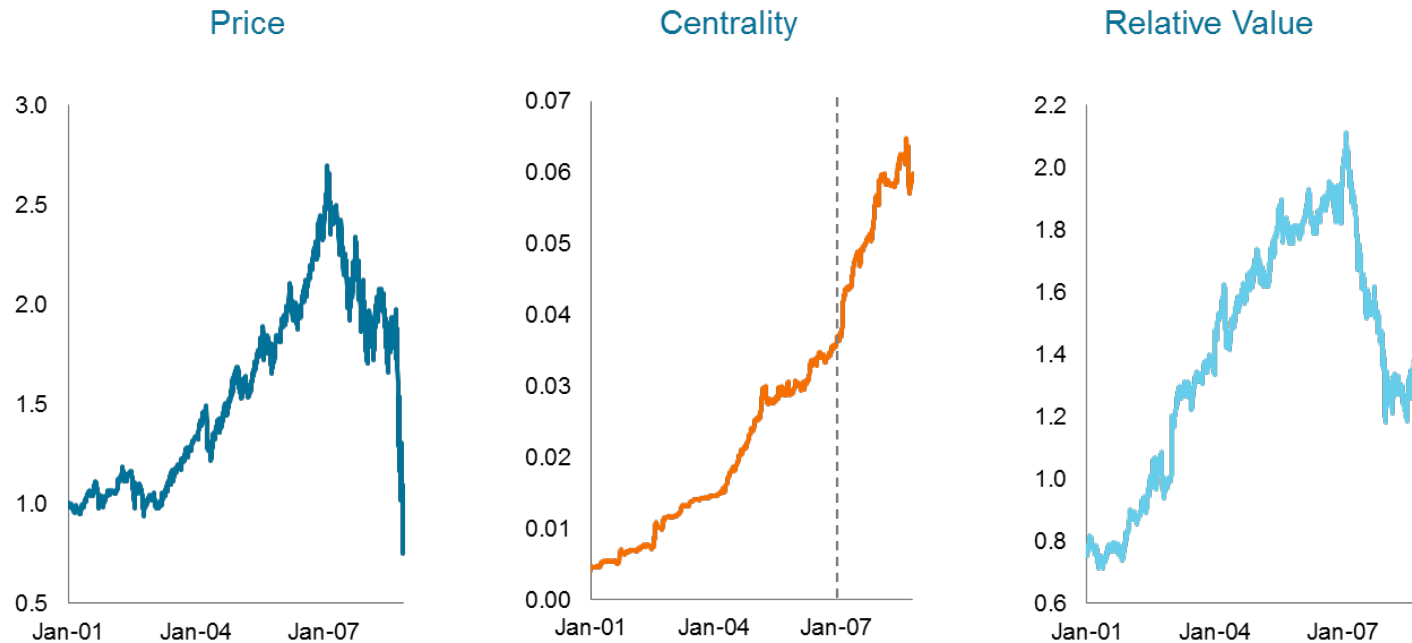
Relative Value



Centrality for the U.S. Technology sector is computed across a universe of 11 U.S. sector indices from DataStream. Centrality and relative value are calculated using the methodology described on the "Asset Centrality and Relative Value" slide. Source: DataStream, State Street Global Exchange.



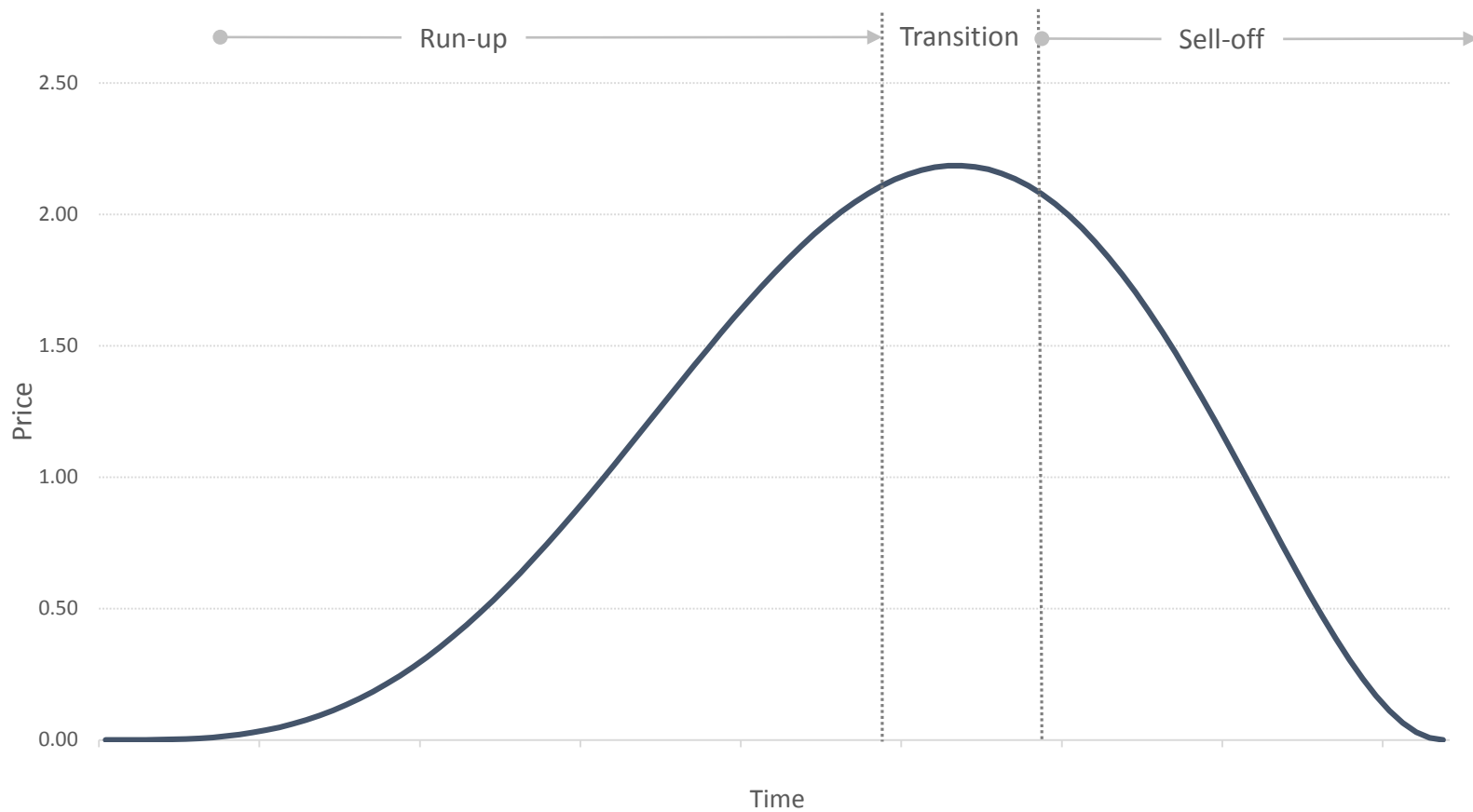
THE HOUSING BUBBLE (2001 – 2008)



Centrality for the U.S. REITs sector is computed across a universe of 11 U.S. sector indices from DataStream. Centrality and relative value are calculated using the methodology described on the "Asset Centrality and Relative Value" slide. Source: DataStream, State Street Global Exchange.

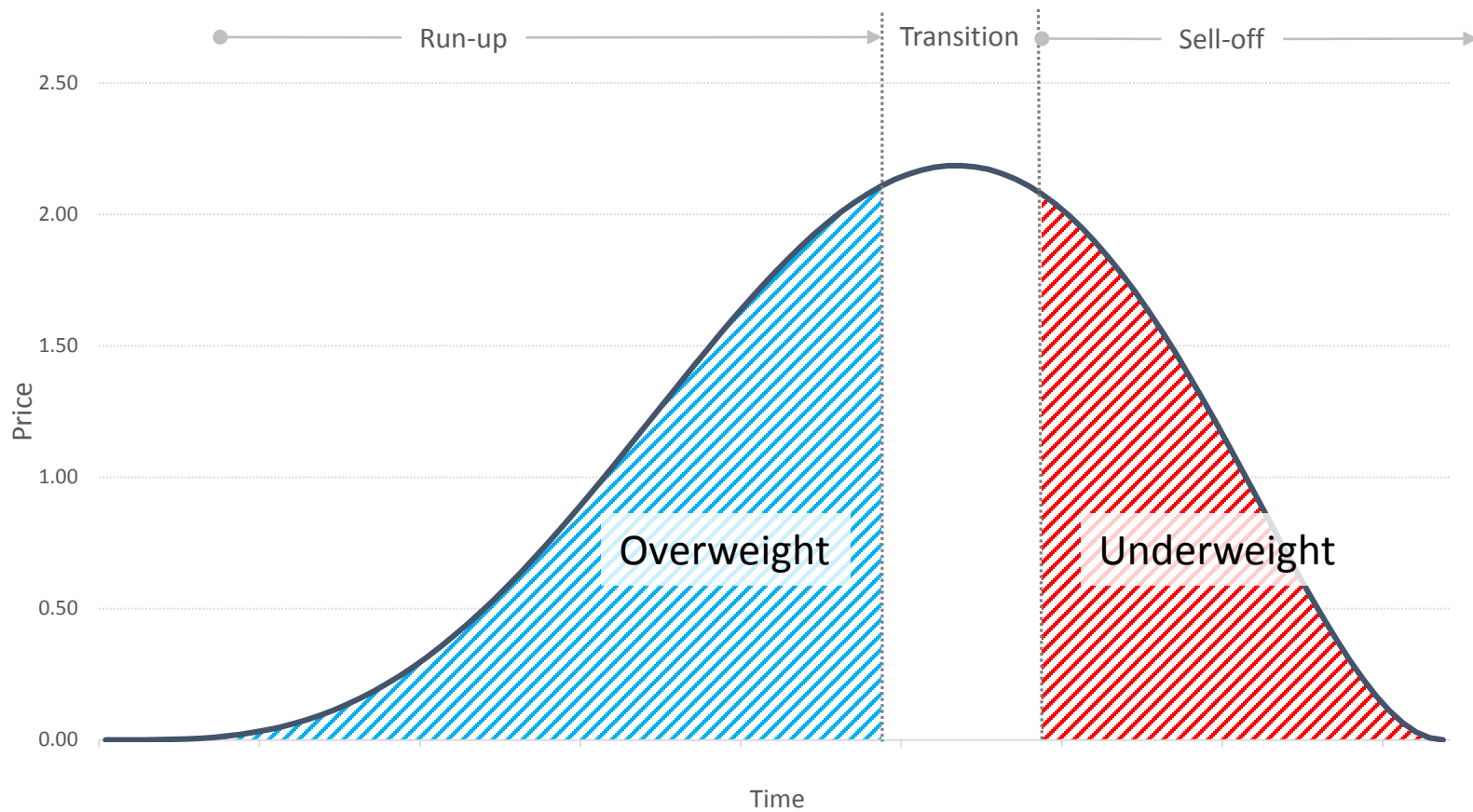


STYLIZED BUBBLE





STYLIZED BUBBLE





CONDITIONAL SECTOR PERFORMANCE

Proof of Concept:

1. Rank all sectors by their centrality and relative value scores, as defined previously.
2. Identify the sectors that rank in the top three by both measures.
3. Form portfolios for four combinations of crowding and relative value:
 - not top three overvalued, not top three crowded (no bubble)
 - not top three overvalued, top three crowded, increase in price over the prior year (bubble run up)
 - top three overvalued, not top three crowded (no bubble)
 - top three overvalued, top three crowded (bubble sell off)
4. Record the performance of each portfolio.
5. Move to the next day and repeat.



CONDITIONAL SECTOR PERFORMANCE RELATIVE TO S&P 500

When there is no crowding, we should not expect much separation between sectors that are not overvalued and those that are. However, when there is crowding, we should expect sectors that are not overvalued to outperform sectors that are overvalued.

	Not Crowded	Crowded
Not Overvalued	No Bubble	Bubble Run Up*
Overvalued	No Bubble	Bubble Sell Off

*Filtered for sectors that have experienced an increase in price over the prior year.



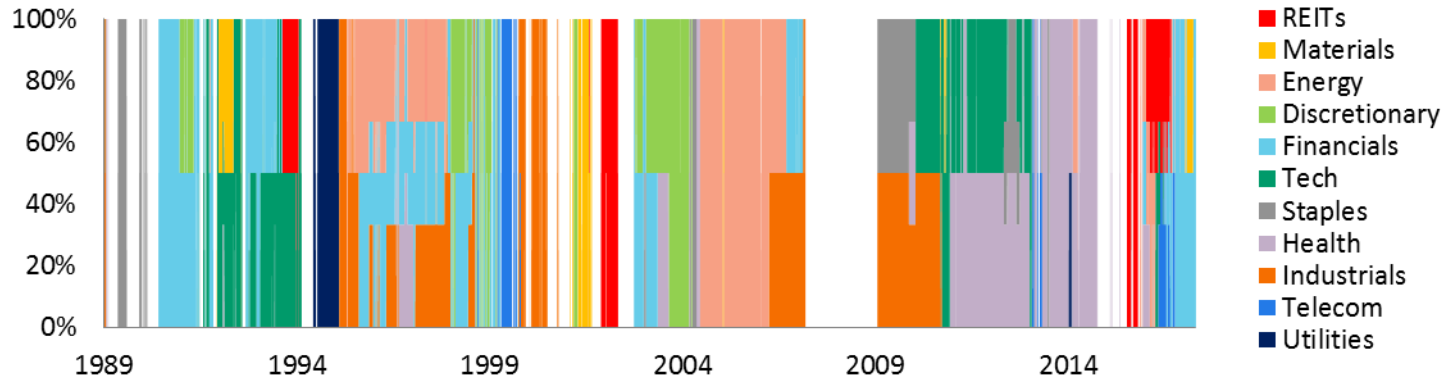
CONDITIONAL SECTOR PERFORMANCE RELATIVE TO S&P 500

	Not Crowded	Crowded
Not Overvalued	No Bubble 0.5%	Bubble Run Up* 7.4%
Overvalued	No Bubble 1.4%	Bubble Sell Off -6.5%

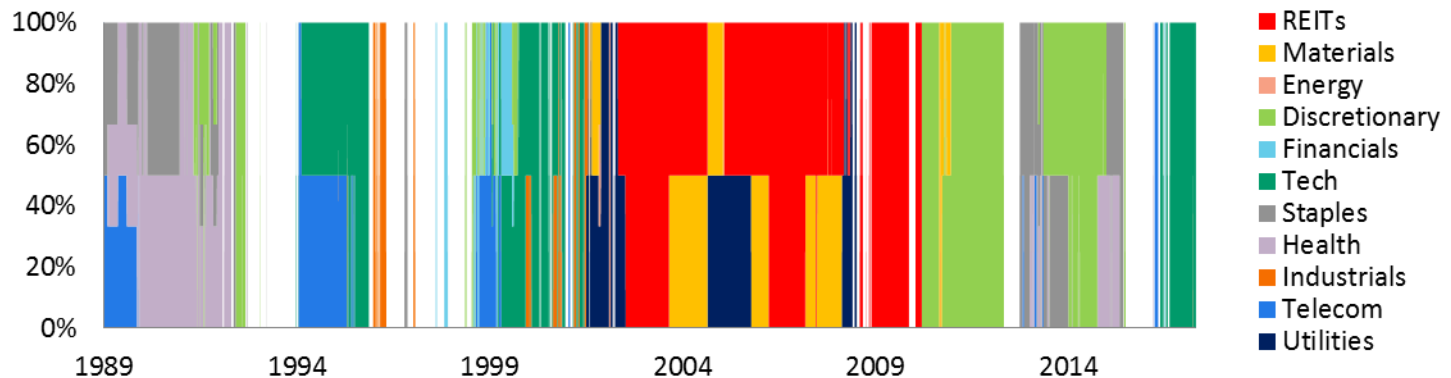
*Filtered for sectors that have experienced an increase in relative value during the previous three months.



Sectors Experiencing a Run Up



Sectors Experiencing a Sell Off





INTERNATIONAL EVIDENCE

	Bubble Run Up	Bubble Sell Off	Spread
Australia	3.8%	3.5%	0.3%
Canada	5.7%	-4.6%	10.3%
Germany	4.3%	0.8%	3.5%
Japan	2.1%	-2.7%	4.8%
UK	5.1%	0.7%	4.4%
US	7.4%	-6.5%	13.9%



Does it work with factors?



Computing Factor Portfolios:

1. Annually rank stocks by one of four attributes (size, value, quality, and low volatility) and allocate an equal number of stocks into each of 10 deciles.
2. Form a capitalization-weighted portfolio from the stocks in each decile.
3. Define a factor portfolio for a given attribute as the capitalization-weighted average of the top two deciles.



Computing Factor Centrality:

1. Obtain daily total returns for the factor portfolio for the previous two years.
2. Compute a covariance matrix using exponential decay weights with a half-life of one year.
3. Estimate centrality for each decile portfolio using the top two principal components.
4. Sum the centralities for the top two deciles that comprise the factor.
5. Compute a standardized shift of the factor's centrality based on the previous three years.



Computing Factor Relative Value:

1. Obtain daily price-to-book value ratios for each decile portfolio.
2. Compute capitalization-weighted averages for the top two deciles that define the factor.
3. Divide the current ratio by the average ratio over the previous 10 years to normalize it. (We initially use five years and grow the window to extend back the sample period.)
4. Divide the normalized ratio by the normalized ratio associated with the other eight decile portfolios.



CONDITIONAL FACTOR PERFORMANCE

	Not Crowded	Crowded
Not Overvalued	No Bubble -2.4%	Bubble Run Up* 9.7%
Overvalued	No Bubble -0.2%	Bubble Sell Off 3.8%

*Filtered for factors that have experienced an increase in price over the prior year.



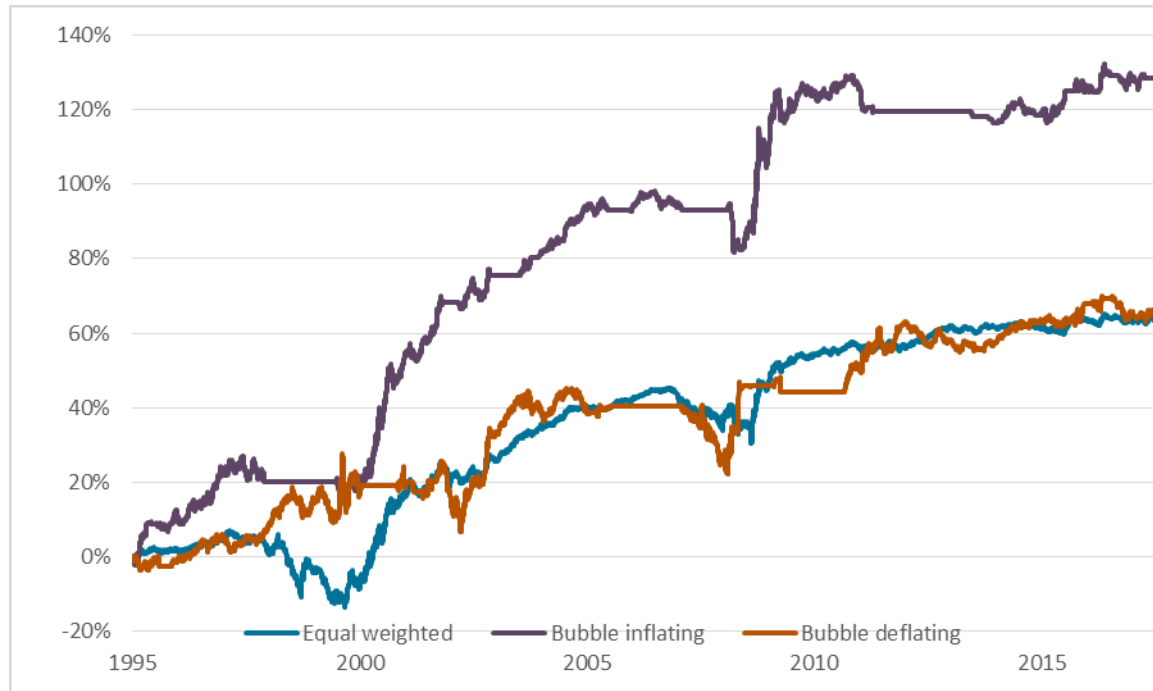
Back Test of Factor Timing Strategy:

1. Construct a baseline strategy consisting of equal allocations across the four factors (size, value, quality, and low volatility).
2. Assign ranks to each factor according to its centrality and relative value.
3. Flag factors that are among the top two most crowded factors but not among the top two most highly valued factors, and whose return relative to the market has been positive over the previous year. (Run-up phase of a bubble)
4. Flag factors that are among the top two most crowded factors and among the top two most highly valued. (Sell-off phase of a bubble)
5. Form equally weighted portfolios of whichever factors (if any) meet the conditions for inflating bubbles.
6. If no factors meet this condition, invest the portfolio in the market benchmark.
7. Do the same for factors that are in the sell-off phase of a bubble.
8. Possible weights:
 - 100% market portfolio
 - 100% in a factor
 - 50% in each of two factors



CONDITIONAL FACTOR PERFORMANCE

Performance in Excess of Market Return



Return = 5.5%
Return/Risk = 0.79

Return = 2.8%
Return/Risk = 0.42

Return = 2.7%
Return/Risk = 0.61



Summary

- Centrality, which measures crowded trading, is effective at locating bubbles.
- But centrality by itself cannot distinguish the run-up phase of a bubble from the sell-off phase of a bubble.
- Relative value by itself cannot distinguish run-ups that are justified by fundamentals from run-ups that are driven by investor psychology.
- Centrality, combined with relative value, locates bubbles and separates the run-up from the sell-off phase.
- Evidence suggests that these two measures used together can help investors manage exposure to both sectors and factors for the purpose of generating significant excess returns.



CONTACT & DISCLOSURES

DISCLOSURES: The information contained in this presentation (the “Presentation”) is highly confidential and is not to be reproduced or distributed to any other persons (other than professional advisors of the prospective investors receiving these materials). The Presentation is intended solely for the use of the persons to whom it has been delivered. This Presentation has been prepared solely for informational purposes. The Presentation is not intended to provide professional or investment advice, and you are advised to seek independent professional advice prior to investing in any products or strategies described in the Presentation or recommended by Windham Capital Management, LLC. In addition, this Presentation is neither an offer to buy or sell any securities, nor a solicitation of an offer to buy or sell interests or shares in any fund or strategy.

Historical data and other information contained herein is believed to be reliable, but no representation is made as to its accuracy, completeness, or suitability for any specific purpose. Windham accepts no liability (whether in tort or contract or otherwise) for any loss or damage arising from any inaccuracies or omissions. Past performance figures, including any projection or forecast, are not necessarily indicative of future or likely performance of any investment products. No assurance may be given that the strategies’ investment objectives will be achieved. Investments are subject to investment risks including possible loss of principal amount invested.

Simulated returns are derived from Windham's proprietary modeling of sectors and do not reflect actual trading and they may not reflect the impact that material economic and other factors might have had on Windham’s decision-making if Windham were actually managing money. Performance does not reflect any management fee, transaction fee or other expense associated with managing an investment account. They are also derived from the performance of investment models created by Windham and applied to a hypothetical account.

Opinions expressed are current opinions as of the date appearing in this material only. References to market or composite indices, benchmarks or other measures of relative market performance over a specified period of time are provided for your information only. Reference to an index does not imply that the Windham portfolio will achieve returns, volatility or other results similar to the index. The composition of a benchmark index may not reflect the manner in which a Windham portfolio is constructed in relation to expected or achieved returns, investment holdings, portfolio guidelines, restrictions, sectors, correlations, concentrations, volatility or tracking error targets, all of which are subject to change over time.

Windham Capital Management, LLC owns trademark and other intellectual property rights contained in this Presentation. You are prohibited from copying, reproducing, modifying, or distributing in any way the contents or any part of this Presentation for any purpose without our prior written consent.

Windham Capital Management, LLC does not intend for the information contained in this Presentation to be distributed to, or used by, any person or entity in any jurisdiction or country where such distribution or use would be contrary to law or regulation or would subject Windham to any registration requirement within such jurisdiction or country.

Additional information is available upon request. Windham Capital Management, LLC and its owners disclaim any and all liability relating to this Presentation, including without limitation any express or implied representations or warranties for statements contained in, and omissions from, this information.