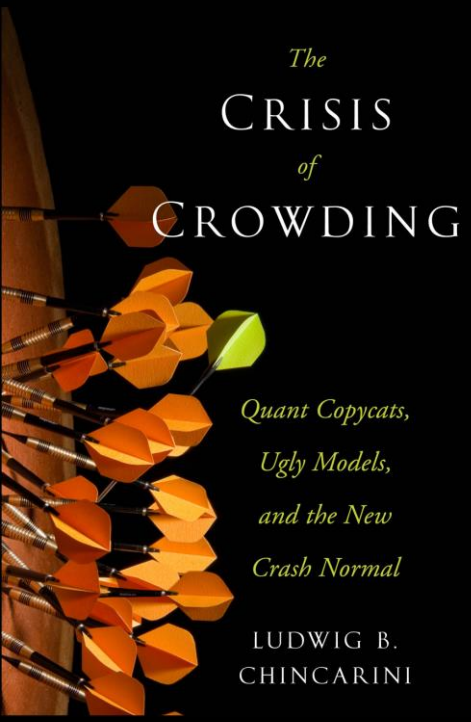
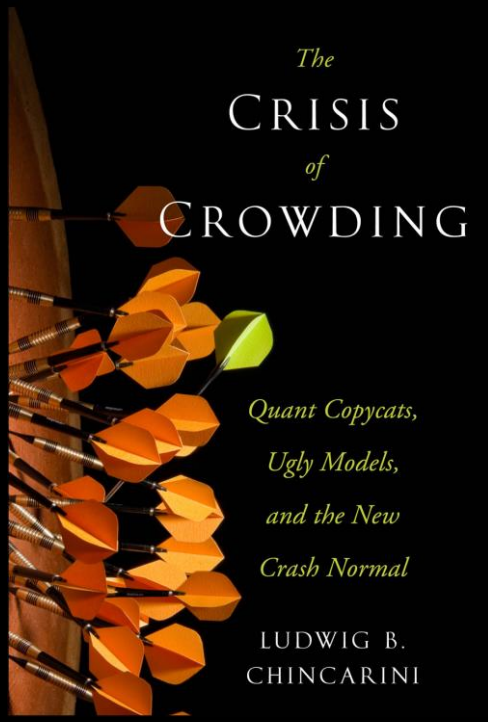


Portfolio Construction and Crowding

March 10, 2017



Ludwig B. Chincarini, Ph.D., CFA
University of San Francisco
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SOUTHWESTERN FINANCE ASSOCIATION
ANNUAL CONFERENCE
MARCH 10, 2017

- Thank you for coming. Thanks to the SWFA for accepting this paper and Prof. Peter Ren for discussing it.

Outline

The Crisis of Crowding (2012)

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

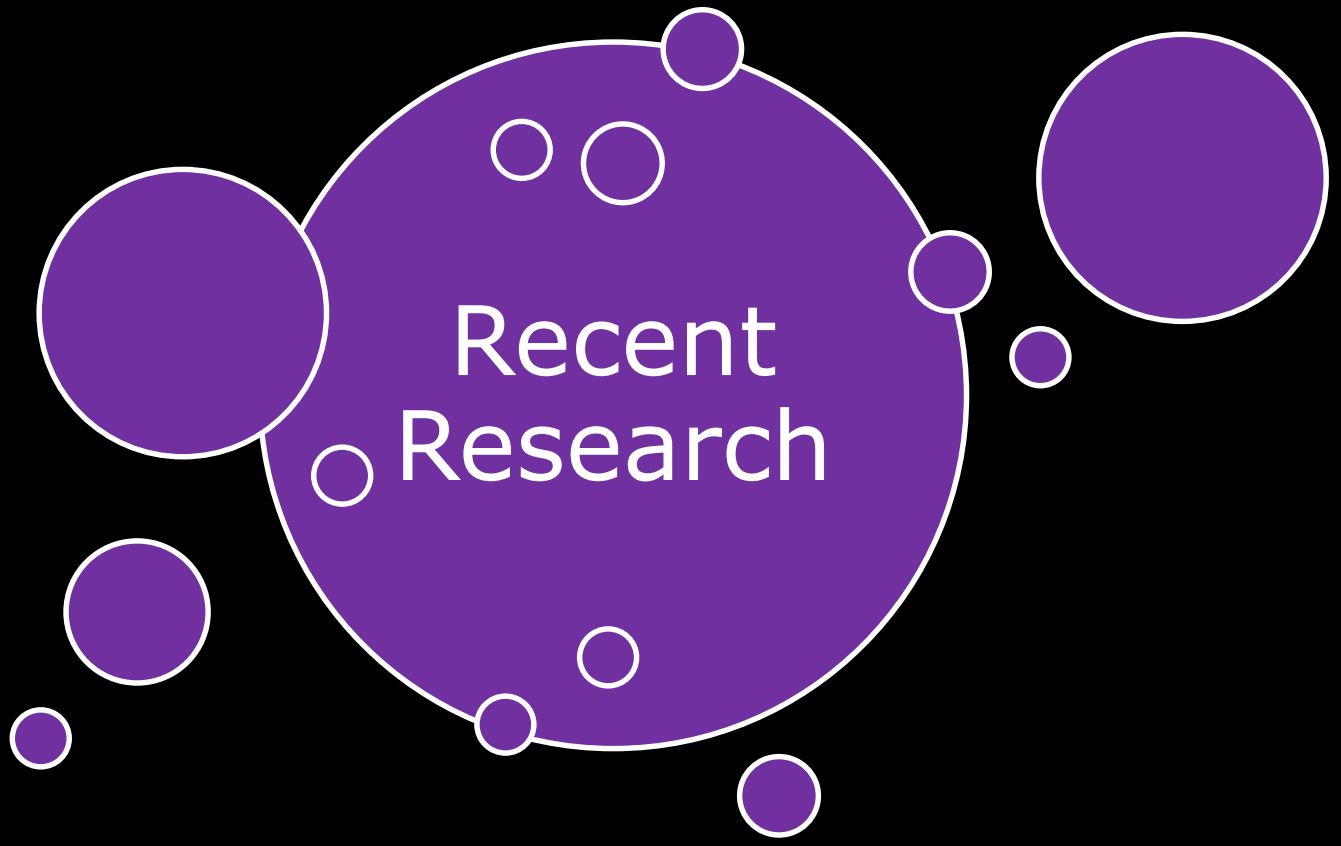
The research on crowding has really taken off in the last couple of years.

1. Intro to Crowding

How does crowding differ from herding?

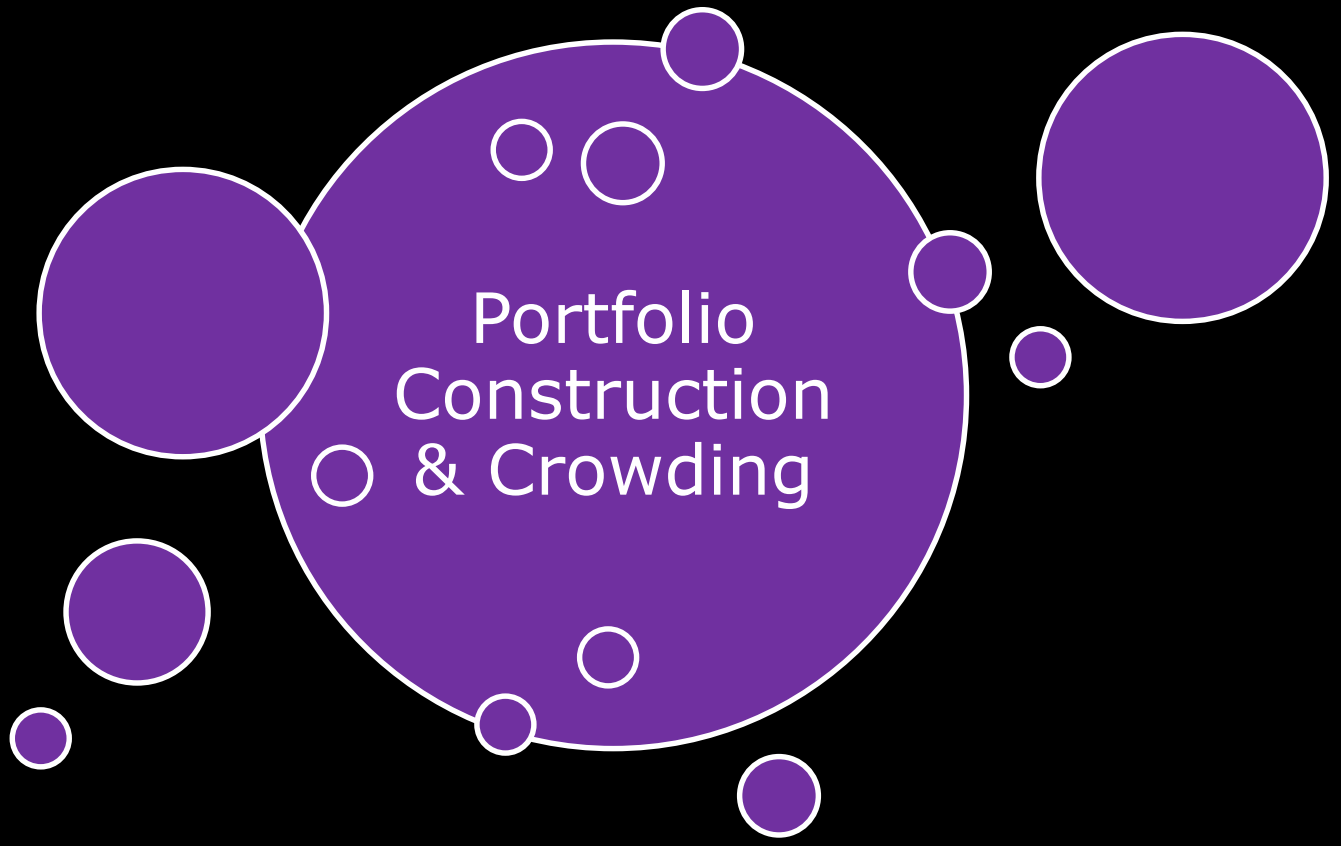
They are similar. However, herding represents many similar investors following the same strategy and liquidity may not be fragile.

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.


Recent
Research

2. Recent Research

1. Macquerie Research, De Rossi, Brar, Kolodziej, Rudolph, Conomos, Lamplough, Chen, Schloegel, Palmber, Chan, Gullberg, Deng. "Quantamentals: Crowding, Herding, and Liquidity". January 27, 2017.
2. A list of related crowding articles can be found in other presentations of mine at www.ludwigbc.com.


Portfolio
Construction
& Crowding

3. Portfolio Construction and Crowding

A. Summary of Paper

- The paper finds that portfolio construction techniques shared across portfolio managers can cause crowding even if they have uncorrelated alpha/expected return models.
- The crowding is more of a concern for long-only portfolio managers and when managers use the same risk model.
- There are simple techniques to reduce the crowding (e.g. Marchenko-Pasteur adjustment).

3. Portfolio Construction and Crowding

B. Risk Management and Crowding

- The basic intuition and mathematics of what is causing the crowding is contained in the paper and other presentations of mine.

- Today, I'll focus on the empirical simulations.

3. Portfolio Construction and Crowding

C. Empirical Investigation of Problem: Data

- In order to examine whether risk-model induced crowding is an issue in the financial industry, we focus on the equity portfolio management world.
- We obtain risk model data from leading risk model providers – BARRA, Northfield, and Axioma.
- We also obtain fundamental and stock return data from Factset.
- Data from 1992 to 2013, but we present results only for 2006-2013.

3. Portfolio Construction and Crowding

C. Empirical Investigation of Problem: Alphas

- Random: We generate 100 random alphas for each stock in 3000 stock universe every month. For each stock:

$$\alpha \sim N(0, \Sigma_\alpha)$$

3. Portfolio Construction and Crowding

C. Empirical Investigation of Problem: Methodology

- **Step 1**: Match stocks from all 3 professional risk models.
- **Step 2**: Every month, create 100 random alphas or 3 non-random.
- **Step 3**: Construct portfolio optimization (a) Long Only; (b) Market Neutral w/o Liquidity; (c) Market Neutral w/ Liquidity. Constraints: Sectors, Beta, Max/Min weights, Dollar Neutral, Leverage=2.
- **Step 4**: Do this for all risk models and all portfolio construction techniques. *Includes MP risk models*
- **Step 5**: Compare the resulting portfolios for crowding.

Note: Some optimizations took 21 days on a 12 core supercomputer for one year of data.

3. Portfolio Construction and Crowding

C. Empirical Investigation of Problem: Measures of Crowding

1. Cosine Similarity amongst portfolios.

$$s_{ij} = \frac{\mathbf{w}_i' \mathbf{w}_j}{|\mathbf{w}_i||\mathbf{w}_j|}$$

$$S = (H'H) \circ \hat{\hat{H}}$$

2. Crowding

$$C = \frac{\sum_{i=1}^{m}\sum_{j=1}^{m} S_{p:i,j} - m}{m^2 - m}$$

3. Relative Crowding (before and after)

$$\Omega = \frac{C_p}{C_\alpha}.$$

3. Portfolio Construction and Crowding

D. Empirical Results

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

	Risk Model 1			Risk Model 2			Risk Model 3		
	C	Ω	S.D.R.	C	Ω	S.R.	C	Ω	S.D.R.
Alpha	0.00		0.14			0.14			0.14
Long Only									
Regular	0.85†	1251.17	0.438	0.86†	1140.19	0.407	0.86†	1250.08	0.434
MPA	0.73††	1123.99	0.881	0.73††	872.10	0.892	0.72††	976.13	0.891
Market Neutral									
Regular	0.00	1.65	1.016	0.00	1.76	1.020	0.00	1.10	1.029
MPA	0.00	1.24	1.000	0.00	1.23	1.000	0.00	1.05	1.000
Market Neutral Liq.									
Regular	0.00	2.02	1.038	0.00	4.23	1.056	0.00	1.20	1.070
MPA	0.00	0.78	1.008	0.00	0.73	1.009	0.00	0.84	1.008

3. Portfolio Construction and Crowding

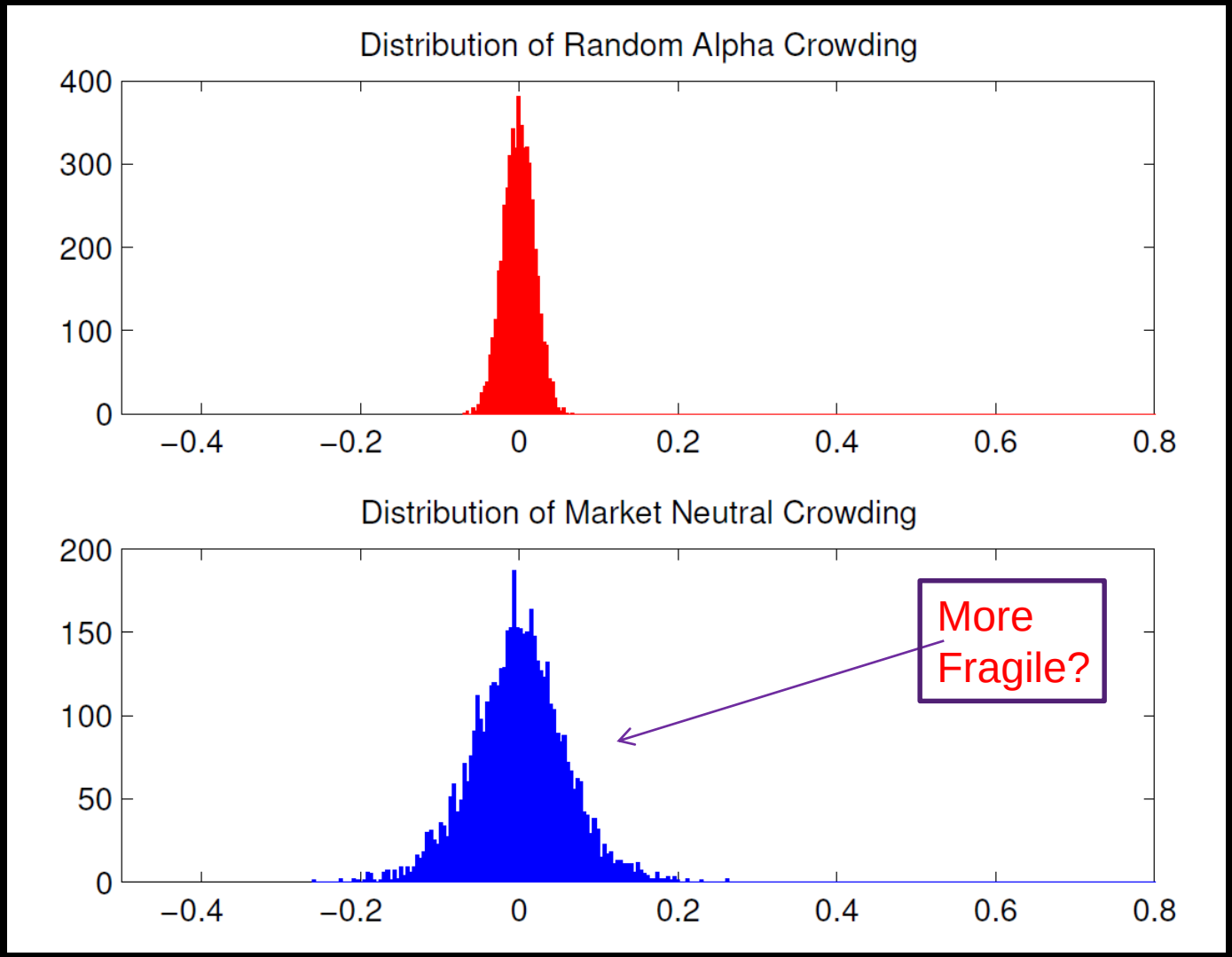
D. Empirical Results

Table 3: Summary of Crowding of Random Alpha Models from 2010 to 2013

	Risk Model 1			Risk Model 2			Risk Model 3		
	C	Ω	S.D.R.	C	Ω	S.D.R.	C	Ω	S.D.R.
Alpha	-0.00		0.14			0.14			0.14
Long Only									
Regular	0.71†	1101.07	0.742	0.71†	617.27	0.705	0.70†	689.01	0.753
MPA	0.57††	822.54	1.045	0.57††	711.50	1.035	0.56††	607.04	1.063
Market Neutral									
Regular	-0.00	-0.80	1.027	-0.00	3.80	1.048	-0.00	5.50	1.053
MPA	0.00	1.82	1.000	0.00	-1.18	1.001	0.00	0.34	1.000
Market Neutral Liq.									
Regular	-0.00	1.61	1.045	-0.00	5.04	1.083	-0.00	1.50	1.084
MPA	-0.00	1.49	1.016	0.00	-0.51	1.017	0.00	-0.30	1.016

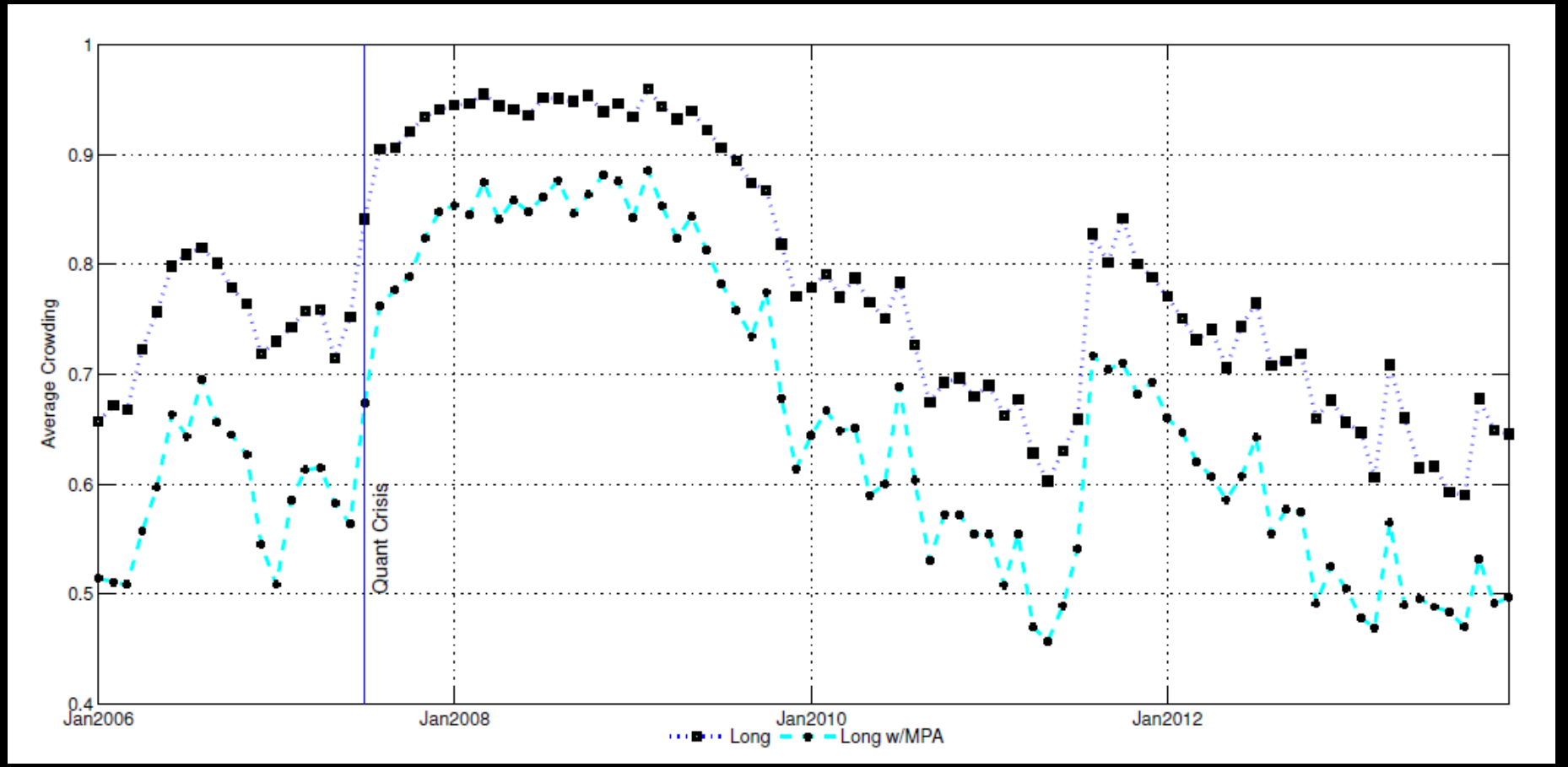
3. Portfolio Construction and Crowding

D. Empirical Results



3. Portfolio Construction and Crowding

D. Empirical Results



3. Portfolio Construction and Crowding

D. Empirical Results

Less Crowding – but still MPA helps

Weight const. generates most of crowding

Table 8: Crowding from Various Optimization Constraints

	Risk Model 1			Risk Model 2			Risk Model 3		
	C	Ω	S.D.R.	C	Ω	S.D.R.	C	Ω	S.D.R.
Scenario 1: No Constraints									
Alpha	0.00		0.05			0.05			0.05
Long Only									
Regular	0.03†	2155.92	1.96	0.04†	3296.43	1.95	0.05†	3810.21	2.35
MPA	0.01††	1062.38	2.24	0.02††	1801.67	2.43	0.04††	3076.09	3.54
Market Neutral									
Regular	0.00	2.41	1.29	0.00	-0.25	1.53	0.00	8.74	1.58
MPA	0.00	1.08	1.00	0.00	1.44	1.00	0.00	1.13	1.00
Scenario 2: Sum of Weights									
Alpha	-0.00		0.05			0.05			0.05
Long Only									
Regular	0.91†	-18653.55	1.08	0.91†	-18539.17	0.98	0.92†	-18859.92	1.05
MPA	0.70††	-13882.32	5.16	0.75††	-14646.39	4.04	0.75††	-14668.99	4.64
Market Neutral									
Regular	-0.00	0.48	1.28	-0.00	-1.91	1.47	-0.00	-0.61	1.56
MPA	-0.00	0.70	1.02	-0.00	0.77	1.02	-0.00	0.95	1.01
Scenario 3: Sector Weights									
Alpha	-0.00		0.05			0.05			0.05
Long Only									
Regular	0.89†	-80198.27	1.21	0.89†	-80267.64	1.20	0.89†	-80795.61	1.18
MPA	0.77††	-70544.77	2.31	0.76††	-69363.29	2.64	0.78††	-70837.40	2.29
Market Neutral									
Regular	-0.00	8.07	1.29	-0.00	12.96	1.47	-0.00	16.28	1.58
MPA	-0.00	0.85	1.01	-0.00	0.51	1.01	-0.00	0.98	1.01
Scenario 4: Max Weights									
Alpha	0.00		0.05			0.05			0.05
Long Only									
Regular	0.89†	15344.92	1.22	0.89†	15313.87	1.20	0.89†	15416.11	1.20
MPA	0.78††	13400.08	2.26	0.78††	13245.92	2.27	0.78††	13751.99	2.20
Market Neutral									
Regular	0.00	1.44	1.25	-0.00	2.26	1.46	-0.00	1.17	1.54
MPA	0.00	0.96	1.01	0.00	1.06	1.01	0.00	1.09	1.01

3. Portfolio Construction and Crowding

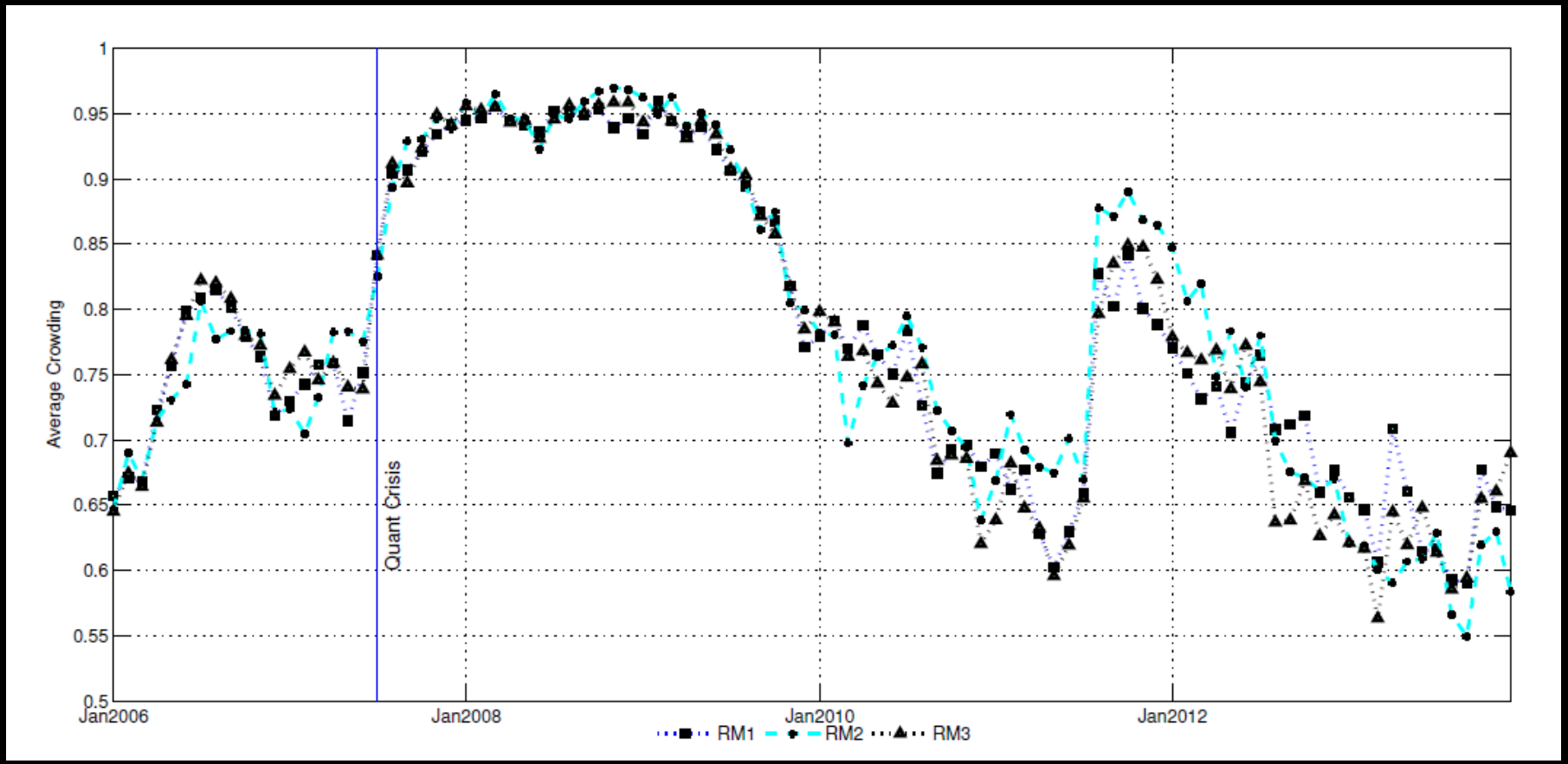
D. Empirical Results

- Risk models all seem to have similar amounts of crowding (see next slide).

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

3. Portfolio Construction and Crowding

D. Empirical Results



3. Portfolio Construction and Crowding

D. 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

3. Portfolio Construction and Crowding

D. 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.

3. Portfolio Construction and Crowding: Summary

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 portfolio construction process itself.

D. 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.

3. Portfolio Construction and Crowding

References

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

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

- *Note*: Papers are available online or from the author.

Thank you

- Dr. Ludwig Chincarini , CFA
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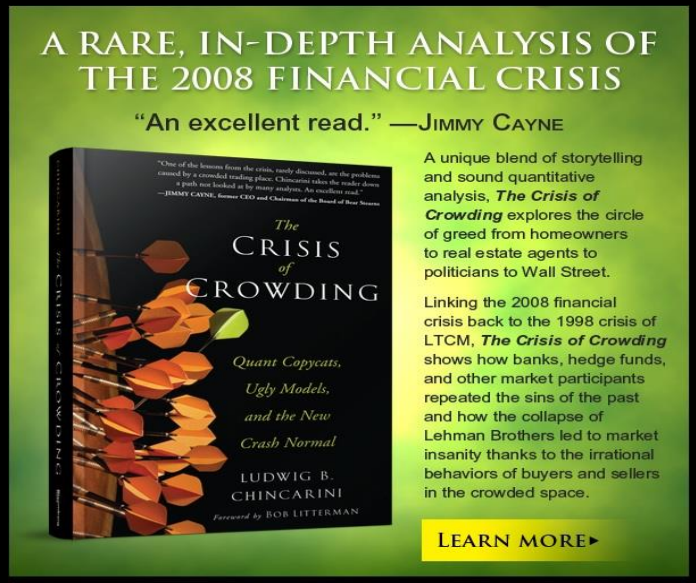
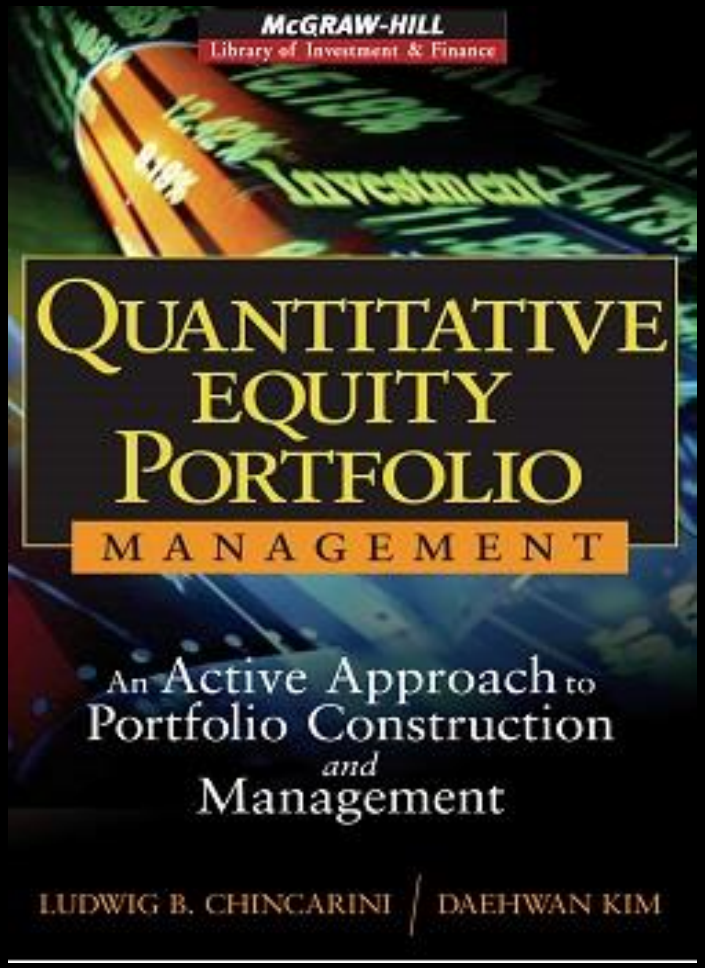
For more information: Buy the books! ;)





Open Discussion

1. TBA