Crowding of International Mutual Funds

Tanja Artiga Gonzalez[1,2] Teodor Dyakov[1,2] Justus Inhoffen[1,3]
Evert Wipplinger[1]

[1]Vrije Universiteit Amsterdam

[2]Tinbergen Institute

[3]DIW Berlin

April 19, 2021

HU Finance Brownbag Seminar

Crowding of Mutual Funds

- Actively managed fund industry accounts for USD 30 trillion of AuM
- As funds grow larger, strategies likely become correlated resulting in overlapping portfolios ("**crowding**")
- This should create zero equilibrium net alpha (Berk and Green (2004); Pastor and Stambaugh (2012))

Take-away

We study the effect of fund-level crowding on future performance

- Crowding measure based on portfolio holding overlaps
- Crowding and subsequent performance are negatively correlated
- Performance of funds in most crowded space is negative
- Effect of crowding has explanatory power beyond size
- Explanations for deteriorating performance
  - Preference for liquidity
  - Negative externalities through shock propagation
  - Coordination externalities

Sample of funds

We merge (a) fund holdings (Factset), (b) fund performance and characteristics (Morningstar), (c) stock level data (Datastream and Worldscope)

Fund region	Funds count	TNA mean	Holdings mean	Stock region (%)					
				NAM	EUR	APA	JPN	EM	FM
NAM	6,487	1,131	170	78.2	10.9	3.2	4.0	2.9	0.9
EUR	9,843	290	140	32.5	44.3	6.3	9.7	6.2	0.9
APA	138	152	97	16.8	11.0	29.8	21.0	21.0	0.4
JPN	84	553	128	20.4	16.4	4.7	52.7	5.3	0.5
EM	519	155	71	9.4	8.7	4.8	1.4	74.8	0.8
FM	293	118	123	30.9	27.3	9.2	10.2	8.2	14.3
All domiciles	17,364	691	153	54.3	27.3	5.0	6.8	5.6	1.0

Crowding measure: overlapping positions

Construction in two steps

1. Degree of portfolio overlap for any pair of funds i and j

$$e_{ij} = \sum_{k \in P_i \cap P_j} \min(\omega_i^k, \omega_j^k) \tag{1}$$

2. Sum of pairwise overlaps with all other funds

$$\text{crowd}_i = \sum_{\substack{j \in Q \\ j \neq i}} e_{ij} \tag{2}$$

Fund performance

- **Gross and net alpha** using traded benchmark funds (Berk and van Binsbergen (2015); Dyakov et al. (2020))

$$\alpha_{i,t} = R_{i,t} - \sum_{j=1}^{n(t)} \beta_f^b R_t^b \tag{3}$$

- **Dollar Value Added** (Berk and van Binsbergen (2015))

$$V_{it} = q_{i,t-1}\alpha_{i,t}^{net} \tag{4}$$

- **DGTW** using characteristic-based benchmark portfolios (Daniel et al. (1997); Dyakov and Wipplinger (2020))

$$\alpha_{k,t}^{\text{DGTW}} = R_{k,t} - R_{k,t}^b \tag{5}$$

Crowding and future performance

Performance is decreasing in crowding.
Funds in the top decile of crowding have negative performance.

	1 (low)	2	3	4	5	6	7	8	9	10 (high)	10 – 1
Net Alpha	0.102*	0.042	0.002	-0.034	-0.030	−0.098***	−0.100***	−0.108***	−0.116***	−0.114***	−0.215***
	(1.66)	(1.21)	(0.07)	(-0.90)	(-0.91)	(-3.43)	(-3.66)	(-4.61)	(-4.57)	(-4.54)	(-3.31)
Dollar Value Added	-0.009	0.611**	0.058	0.228	0.407	−0.921*	-0.037	-0.216	-0.687	−1.855**	−1.846*
	(-0.02)	(2.43)	(0.21)	(0.68)	(1.18)	(-1.76)	(-0.08)	(-0.44)	(-1.20)	(-2.19)	(-1.83)
Gross Alpha	-0.065	−0.063*	−0.071*	−0.109***	−0.096***	−0.115***	−0.141***	−0.160***	−0.161***	−0.156***	−0.092***
	(-1.50)	(-1.72)	(-1.89)	(-2.96)	(-2.87)	(-3.74)	(-4.83)	(-5.45)	(-5.82)	(-5.89)	(-3.08)
Gross DGTW	0.090	0.088	0.089	0.032	0.034	-0.018	-0.020	-0.034	−0.057*	−0.046*	−0.136**
	(1.44)	(1.21)	(1.32)	(0.55)	(0.73)	(-0.38)	(-0.55)	(-1.09)	(-1.94)	(-1.92)	(-2.49)

But: Crowding likely to partly reflect size

Fund characteristics | Portfolio characteristics | Persistence

Crowding and size: IV regression

$$r_{it} = a_i + \beta_1 \log \text{crowd}_{i,t-1} + \beta_2 \log q_{i,t-1} + \epsilon_{it} \tag{6}$$

- Problem: $q_{i,t-t}$ and ϵ_{it} are positively correlated
- Solution: forward-demeaned variables and instrument $q_{i,t-1}$ (following Pastor et al. (2015))
- Instruments: backward-demeaned $q_{i,t-1}$ and $q_{i,t-1}$ (Zhu (2018); Dyakov et al. (2020))

Crowding and size: IV regression

	Model 1	Model 2	Model 3	Model 4	Model 5
Ln(crowd)	-0.0023^{***}			-0.0020^{***}	
	(-3.31)			(-2.68)	
Ln(PeerSize)		-0.0024^{***}			-0.0021^{**}
		(-2.60)			(-2.43)
Ln(FundSize)			-0.0010	-0.0011	-0.0009
			(-1.35)	(-1.43)	(-1.17)
Number of Observations	450,387	450,387	450,387	450,387	450,387

$$\text{PeerSize}_{i,t-1} = \sum_{\substack{j \in Q \\ j \neq i}} e_{ij,t-1} q_{j,t-1}$$

Crowding and size: double sort

Large funds in less crowded space outperform small funds in a crowded space

Portfolio size Crowding	1 (low)	2	3	4	5	6	7	8	9	10 (high)	10 – 1
High	−0.194***	−0.150***	−0.147***	−0.133***	−0.131***	−0.102***	−0.100***	−0.107***	−0.073***	−0.074***	0.119***
	(-6.03)	(-6.04)	(-5.18)	(-5.07)	(-4.83)	(-4.02)	(-4.04)	(-3.93)	(-3.39)	(-3.51)	(4.72)
Medium	−0.145***	−0.062**	−0.087**	−0.074**	−0.079**	−0.062**	−0.070**	−0.062**	-0.021	-0.020	0.125***
	(-4.31)	(-2.00)	(-2.42)	(-2.21)	(-2.17)	(-2.04)	(-2.03)	(-2.19)	(-0.71)	(-0.86)	(4.41)
Low	−0.068*	0.000	0.049	0.031	0.020	0.033	0.066*	0.074*	0.063**	0.104***	0.171***
	(-1.71)	(0.00)	(1.18)	(0.70)	(0.44)	(0.68)	(1.68)	(1.89)	(2.05)	(3.72)	(4.06)
High – Low	−0.126**	−0.150***	−0.196***	−0.165***	−0.151***	−0.135**	−0.165***	−0.181***	−0.136***	−0.178***	
	(-2.56)	(-3.50)	(-4.56)	(-3.40)	(-3.04)	(-2.59)	(-3.73)	(-3.72)	(-4.06)	(-5.35)	

Crowding and performance: explanations

- Crowding
  - negatively affects performance
  - is distinct from size
- Possible explanations
  1. Preference for liquid stocks (Pastor et al. (2015))
  2. Externalities from peers' fund flows (Coval and Stafford (2007))
  3. Coordination externalities (Stein (2009))

Preference for liquid stocks: stock demand

- Crowded funds have a higher demand for liquidity
  - Offset trading costs (Pastor et al. (2020))
  - Allocation of excess capital
- This should lead to relatively lower expected returns
- Estimate effect of stock characteristics on standardized stock demand (Sias (2004))

$$\text{BR}_{kt} = \frac{\#\text{ funds buying stock } k}{\#\text{ funds buying stock } k + \#\text{ funds selling stock } k}$$

Preference for liquid stocks: stock demand

	Dependent Variable: Demand$_{t+1}$									
	Crowding									
	1 (low)	2	3	4	5	6	7	8	9	10 (high)
Demand$_t$	0.500***	0.466***	0.439***	0.391***	0.421***	0.417***	0.361***	0.381***	0.381***	0.394***
	(18.72)	(18.05)	(21.59)	(15.79)	(21.73)	(20.98)	(11.63)	(12.19)	(11.86)	(11.87)
Size$_t$	0.007*	0.011	0.027***	0.029***	0.009	0.015*	0.031***	0.001	0.012	0.033***
	(1.95)	(1.61)	(4.04)	(4.89)	(1.51)	(1.94)	(4.43)	(0.09)	(1.10)	(4.24)
Btm$_t$	0.014***	0.010***	0.018***	0.007***	0.009***	0.010***	0.001	0.008**	0.009***	0.000
	(3.36)	(3.29)	(5.47)	(3.46)	(3.44)	(3.66)	(0.61)	(2.43)	(2.87)	(-0.11)
Momentum$_t$	−0.006	0.044***	0.045***	0.056***	0.043***	0.069***	0.099***	0.088***	0.098***	0.120***
	(-1.26)	(6.38)	(3.68)	(6.35)	(3.52)	(4.57)	(8.98)	(7.34)	(8.60)	(8.54)
Amihud Illiquidity$_t$	−0.207	−0.732*	−0.421	−3.789**	−2.743**	−9.628***	−9.084***	−4.671***	−8.916***	−20.666***
	(-1.36)	(-1.85)	(-0.55)	(-2.32)	(-2.58)	(-2.73)	(-3.51)	(-2.72)	(-2.69)	(-3.63)
Volatility$_t$	−0.064***	−0.098***	−0.093***	−0.113***	−0.204***	−0.152***	−0.112**	−0.124***	−0.088**	−0.038
	(-3.52)	(-3.14)	(-3.40)	(-3.04)	(-5.46)	(-4.72)	(-2.60)	(-3.32)	(-2.11)	(-1.07)
Analysts$_t$	−0.003***	−0.002***	−0.002***	−0.002***	−0.002***	−0.001***	−0.001**	−0.001***	−0.001**	−0.002***
	(-4.53)	(-3.61)	(-6.14)	(-4.22)	(-3.82)	(-5.87)	(-2.41)	(-5.03)	(-2.06)	(-4.79)
Dividend Yield$_t$	0.003***	−0.002**	0.002*	0.002	0.003***	0.000	−0.002*	−0.007***	−0.012***	−0.007***
	(2.69)	(-2.31)	(1.68)	(1.01)	(2.68)	(-0.14)	(-1.69)	(-3.44)	(-5.16)	(-3.93)
MSCI$_t$	−0.077***	−0.040***	−0.055***	−0.028**	−0.007	0.008	−0.002	0.009	0.008	0.027*
	(-5.99)	(-3.08)	(-4.68)	(-2.15)	(-0.64)	(0.79)	(-0.12)	(0.77)	(0.48)	(1.85)
Observations	408,398	352,701	319,817	276,809	253,365	219,969	203,281	230,517	246,310	234,167
R2	0.28	0.25	0.22	0.19	0.22	0.21	0.18	0.20	0.22	0.23

Preference for liquid stocks: liquidity factor loadings

- Add liquidity factor to Fama French 3 factor model (Pastor and Stambaugh (2003))
  - Liquidity factor loadings decrease with crowdedness
  - 25% smaller spread in alpha

Panel A: Fama French 3 factor

	Crowding										
	1 (low)	2	3	4	5	6	7	8	9	10 (high)	10 – 1
Alpha	0.098	−0.003	0.009	0.001	−0.004	−0.074	−0.062	−0.098	−0.129**	−0.116***	−0.214***
	(1.01)	(-0.05)	(0.08)	(0.01)	(-0.03)	(-0.88)	(-0.81)	(-1.51)	(-2.50)	(-3.51)	(-2.79)

Panel B: Fama French 3 factor + Liquidity

	Crowding										
	1 (low)	2	3	4	5	6	7	8	9	10 (high)	10 – 1
Alpha	0.040	−0.048	−0.057	−0.076	−0.086	−0.118	−0.101	−0.126**	−0.139***	−0.126***	−0.166**
	(0.43)	(-0.67)	(-0.59)	(-0.60)	(-0.80)	(-1.48)	(-1.40)	(-1.96)	(-2.62)	(-3.70)	(-2.27)
Liquidity beta	0.094***	0.073***	0.106***	0.124***	0.132***	0.072***	0.063***	0.046***	0.017	0.017*	−0.077***
	(4.40)	(3.39)	(5.35)	(4.64)	(5.11)	(3.65)	(3.67)	(2.75)	(1.07)	(1.67)	(-4.86)

Externalities from peers' flows

Funds are forced to trade in response to flows induced by peers' performance (Coval and Stafford (2007))

- A has outflow due to poor performance
- A sells stocks to meet redemptions
- B – having highly overlapping positions with A – has lower performance
- B has outflow, sells stocks
- Propagation to B's peers, including A

Externalities from peers' flows

Fund flows of peers that have very similar positions receive larger weights

$$PeerFlow_{i,t} = \sum_{j \neq i} e_{i,j} Flow_{j,t} \tag{7}$$

- Predictive regressions of returns on PeerFlow
- Contemporaneous regressions of returns on PeerFlow
  - Returns and PeerFlow are endogenous
  - Solution: use lagged PeerFlow as instrument (Blocher (2016))

Externalities from peers' flows

Panel A: Predictive relationship						
	$NetAlpha_{t+1}$		$GrossAlpha_{t+1}$		$DGTW_{t+1}$	
$PeerFlow_t$	17.2139	10.3426	−11.8694	−19.0413	−6.8134	−22.9517
	(0.39)	(0.23)	(-0.31)	(-0.47)	(-0.12)	(-0.39)
$PeerFlow_t \times TopCrowd_t$		45.9080		47.7870**		106.4876***
		(1.63)		(2.26)		(3.32)
$TopCrowd_t$		0.0014		0.0014*		0.0020*
		(1.65)		(1.94)		(1.97)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	94,056	94,056	94,587	94,587	104,911	104,911
R2	0.11	0.11	0.12	0.12	0.16	0.16
Method	OLS	OLS	OLS	OLS	OLS	OLS

Externalities from peers' flows

Panel B: Contemporaneous relationship

	$NetAlpha_t$		$GrossAlpha_t$		$DGTW_t$	
$PeerFlow_{t+1}$	67.8172	60.7656	7.9489	−1.0499	45.9536	27.3012
	(0.79)	(0.70)	(0.11)	(-0.01)	(0.42)	(0.24)
$PeerFlow_{t+1} \times TopCrowd_t$		65.9361		84.1325*		175.9613**
		(1.22)		(1.86)		(2.49)
$TopCrowd_t$		0.0019*		0.0024***		0.0043***
		(1.85)		(2.78)		(3.49)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	97,611	97,611	97,908	97,908	108,193	108,193
R2	0.11	0.11	0.12	0.12	0.16	0.17
Method	IV	IV	IV	IV	IV	IV

Coordination externalities

- Stein (2009)
  - Investors' demand not based on a fundamental anchor, but driven by prices
  - Investors unaware of the amount of capital chasing the same investment
  - Unexpected large number of competing investors adopting the same strategy leads to price overreaction
- Use Momentum to test prediction

Coordination externalities

	Dependent Variable: $Demand_{t+1}$									
	Crowding									
	1 (low)	2	3	4	5	6	7	8	9	10 (high)
$Demand_t$	0.500***	0.466***	0.439***	0.391***	0.421***	0.417***	0.361***	0.381***	0.381***	0.394***
	(18.72)	(18.05)	(21.59)	(15.79)	(21.73)	(20.98)	(11.63)	(12.19)	(11.86)	(11.87)
$Size_t$	0.007*	0.011	0.027***	0.029***	0.009	0.015*	0.031***	0.001	0.012	0.033***
	(1.95)	(1.61)	(4.04)	(4.89)	(1.51)	(1.94)	(4.43)	(0.09)	(1.10)	(4.24)
Btm_t	0.014***	0.010***	0.018***	0.007***	0.009***	0.010***	0.001	0.008**	0.009***	0.000
	(3.36)	(3.29)	(5.47)	(3.46)	(3.44)	(3.66)	(0.61)	(2.43)	(2.87)	(-0.11)
$Momentum_t$	−0.006	0.044***	0.045***	0.056***	0.043***	0.069***	0.099***	0.088***	0.098***	0.120***
	(-1.26)	(6.38)	(3.68)	(6.35)	(3.52)	(4.57)	(8.98)	(7.34)	(8.60)	(8.54)
$Amihud\ Illiquidity_t$	−0.207	−0.732*	−0.421	−3.789**	−2.743**	−9.628***	−9.084***	−4.671***	−8.916***	−20.666***
	(-1.36)	(-1.85)	(-0.55)	(-2.32)	(-2.58)	(-2.73)	(-3.51)	(-2.72)	(-2.69)	(-3.63)
$Volatility_t$	−0.064***	−0.098***	−0.093***	−0.113***	−0.204***	−0.152***	−0.112**	−0.124***	−0.088**	−0.038
	(-3.52)	(-3.14)	(-3.40)	(-3.04)	(-5.46)	(-4.72)	(-2.60)	(-3.32)	(-2.11)	(-1.07)
$Analysts_t$	−0.003***	−0.002***	−0.002***	−0.002***	−0.002***	−0.001***	−0.001**	−0.001***	−0.001**	−0.002***
	(-4.53)	(-3.61)	(-6.14)	(-4.22)	(-3.82)	(-5.87)	(-2.41)	(-5.03)	(-2.06)	(-4.79)
$Dividend\ Yield_t$	0.003***	−0.002**	0.002*	0.002	0.003***	0.000	−0.002*	−0.007***	−0.012***	−0.007***
	(2.69)	(-2.31)	(1.68)	(1.01)	(2.68)	(-0.14)	(-1.69)	(-3.44)	(-5.16)	(-3.93)
$MSCI_t$	−0.077***	−0.040***	−0.055***	−0.028**	−0.007	0.008	−0.002	0.009	0.008	0.027*
	(-5.99)	(-3.08)	(-4.68)	(-2.15)	(-0.64)	(0.79)	(-0.12)	(0.77)	(0.48)	(1.85)
Observations	408,398	352,701	319,817	276,809	253,365	219,969	203,281	230,517	246,310	234,167
R2	0.28	0.25	0.22	0.19	0.22	0.21	0.18	0.20	0.22	0.23

Coordination externalities

Panel A: 3-months alpha										
Demand for Momentum						Crowding				
	1 (low)	2	3	4	5	6	7	8	9	10 (high)
1 (low)	0.474***	−0.119	0.035	−0.113	0.091	−0.167	−0.209	−0.250***	−0.151*	−0.291***
	(3.27)	(-0.72)	(0.21)	(-1.33)	(0.98)	(-1.73)	(-1.73)	(-3.10)	(-1.90)	(-3.00)
2	0.259	0.373	0.379***	0.289*	−0.089	−0.228	−0.228**	−0.249**	−0.309***	−0.386***
	(0.90)	(1.24)	(3.05)	(1.93)	(-0.60)	(-1.54)	(-2.38)	(-2.46)	(-5.95)	(-10.39)
3 (high)	0.438*	0.405***	−0.163	−0.163	0.059	−0.247***	−0.181	−0.299***	−0.418**	−0.247*
	(1.91)	(3.10)	(-1.54)	(-0.80)	(0.64)	(-3.35)	(-1.59)	(-3.46)	(-2.84)	(-1.83)
Panel B: 12-months alpha										
Demand for Momentum						Crowding				
	1 (low)	2	3	4	5	6	7	8	9	10 (high)
1 (low)	2.072***	0.279	0.594**	−0.085	−0.374	−0.692	−1.186***	−1.182***	−1.471***	−1.335***
	(6.62)	(0.80)	(2.33)	(-0.16)	(-1.10)	(-1.37)	(-5.44)	(-7.37)	(-13.07)	(-5.83)
2	0.680	0.510	0.762**	0.872*	−0.597	−0.904**	−0.786***	−0.857***	−1.184***	−1.226***
	(0.90)	(1.27)	(2.30)	(1.96)	(-1.74)	(-2.39)	(-4.24)	(-9.43)	(-8.80)	(-5.07)
3 (high)	1.944	0.671**	−0.272	−0.930**	0.267	−0.773***	−0.695***	−0.800***	−1.068**	−1.046***
	(1.68)	(2.50)	(-1.01)	(-2.20)	(0.66)	(-4.07)	(-3.38)	(-5.18)	(-2.83)	(-3.55)

Additional tests

- Does crowding simply capture deviations from the market?
  - No, as revealed by double sorts on active share and crowding double sort
- Crowded funds overinvest in the U.S. market Portfolio characteristics
- Informational disadvantage of foreign funds?
  - No, pattern is robust to sample restriction to US domiciled funds Fama-MacBeth regression
- Does crowding capture competition effects?
  - Crowding is distinct from competition measure of Hoberg et al. (2017) Fama-MacBeth regression
- Results are robust to Fama-MacBeth regressions, value-weighting of funds, and factor regressions single sort and factor model

Additional tests: indirect fund connections

Crowding could propagate from funds that are not directly connected

- Fund A: value stocks
- Fund B: value stocks, small stocks
- Fund C: small stocks

Fund C increases competitive pressure on fund B and fund B on fund A

Additional tests: indirect fund connections

Alternative measure of crowding: eigenvector centrality of funds

$$\text{crowd}_i^e = \frac{1}{\lambda} \sum_{j=1}^{n} A_{j,i} \text{crowd}_j^e \tag{8}$$

where $A_{j,i}$ is the edge from j to i ($A_{i,i} = 0$) and λ the largest eigenvalue.

Results are qualitatively similar single sort

Conclusion

Too much active capital translates to losses to investors

- Crowding can drive performance negative
- Crowding is associated with diseconomies that are different from the ones related to fund size
- Preference for liquid stocks and sensitivity to fund flows of connected funds contribute to the effect of crowding on performance

References I

Jonathan Berk and Robert Green. Mutual Fund Flows and Performance in Rational Markets. *Jounal of Political Economy*, 112(6):1269–1295, 2004.

Jonathan Berk and Jules van Binsbergen. Measuring skill in the mutual fund industry. *Journal of Financial Economics*, 118(1):1–20, 2015.

Jesse Blocher. Network externalities in mutual funds. *Journal of Financial Markets*, 30:1–26, 2016.

Joshua Coval and Erik Stafford. Asset fire sales (and purchases) in equity markets. *Journal of Financial Economics*, 86(2):479–512, 2007.

Kent Daniel, Mark Grinblatt, Sheridan Titman, and Russ Wermers. Measuring mutual fund performance with characteristic-based benchmarks. *The Journal of Finance*, 52(3): 1035–1058, 1997.

Teodor Dyakov and Evert Wipplinger. Institutional ownership and future stock returns: an international perspective. *International Review of Finance*, 20(1):235–245, 2020.

Teodor Dyakov, Hao Jiang, and Marno Verbeek. Trade less and exit overcrowded markets: Lessons from international mutual funds. *Review of Finance*, 24(3):677–731, 2020.

Gerard Hoberg, Nitin Kumar, and Nagpurnanand Prabhala. Mutual fund competition, managerial skill, and alpha persistence. *The Review of Financial Studies*, 31(5):1896–1929, 2017.

References II

Lubos Pastor and Robert Stambaugh. On the Size of the Active Management Industry. *Journal of Political Economy*, 120(4):740–781, 2012.

Lubos Pastor and Robert F Stambaugh. Liquidity risk and expected stock returns. *Journal of Political economy*, 111(3):642–685, 2003.

Lubos Pastor, Robert Stambaugh, and Lucian Taylor. Scale and Skill in Active Management. *Journal of Financial Economics*, 116(1):23–45, 2015.

Lubos Pastor, Robert Stambaugh, and Lucian Taylor. Fund tradeoffs. *Journal of Financial Economics*, 2020.

Richard Sias. Institutional herding. *The Review of Financial Studies*, 17(1):165–206, 2004.

Jeremy Stein. Presidential Address: Sophisticated Investors and Market Efficiency. *The Journal of Finance*, 64(4):1517–1548, 2009.

Min Zhu. Informative fund size, managerial skill, and investor rationality. *Journal of Financial Economics*, 130(1):114–134, 2018.

Portfolio characteristics

Panel A: Fund characteristics												
Crowding decile	1 (low)	2	3	4	5	6	7	8	9	10 (high)	10-1	
Centrality	28.59	65.52	110.17	164.08	238.13	316.47	389.95	460.75	534.89	649.18	620.59***	(0.000)
TNA	302	481	531	572	620	702	822	1,024	994	859	557.06***	(0.000)
# Firms	107	168	125	115	118	109	118	148	194	322	214.88***	(0.000)
# Countries	6	8	8	9	10	11	11	11	12	13	6.21***	(0.000)
# Industries	8	9	9	9	9	9	9	10	10	10	1.49***	(0.000)
# Supersector	15	15	15	16	15	15	16	17	17	18	3.41***	(0.000)
Inverse normalized HFI (industries)	14.86	21.69	22.12	16.61	58.61	35.36	24.62	26.29	27.47	31.00	16.15***	(0.000)
Panel B: Weights for stock region												
Crowding decile	1 (low)	2	3	4	5	6	7	8	9	10 (high)	10-1	
NAM	51.9	61.0	50.3	43.6	44.4	48.7	55.1	59.1	60.6	68.1	16.19***	(0.002)
EUR	22.6	15.1	11.5	17.1	35.2	42.0	36.9	33.4	32.7	26.3	3.71	(0.355)
APA	3.8	7.7	11.7	9.9	6.4	2.6	2.3	2.0	1.8	1.5	−2.33***	(0.000)
JPN	6.1	4.6	13.0	16.7	7.3	4.9	4.2	4.1	3.8	3.5	−2.63***	(0.000)
EM	13.0	9.3	11.9	11.4	5.9	1.3	1.1	0.9	0.7	0.5	−12.46***	(0.000)
FM	2.7	2.3	1.6	1.4	0.8	0.5	0.4	0.3	0.3	0.2	−2.48***	(0.000)

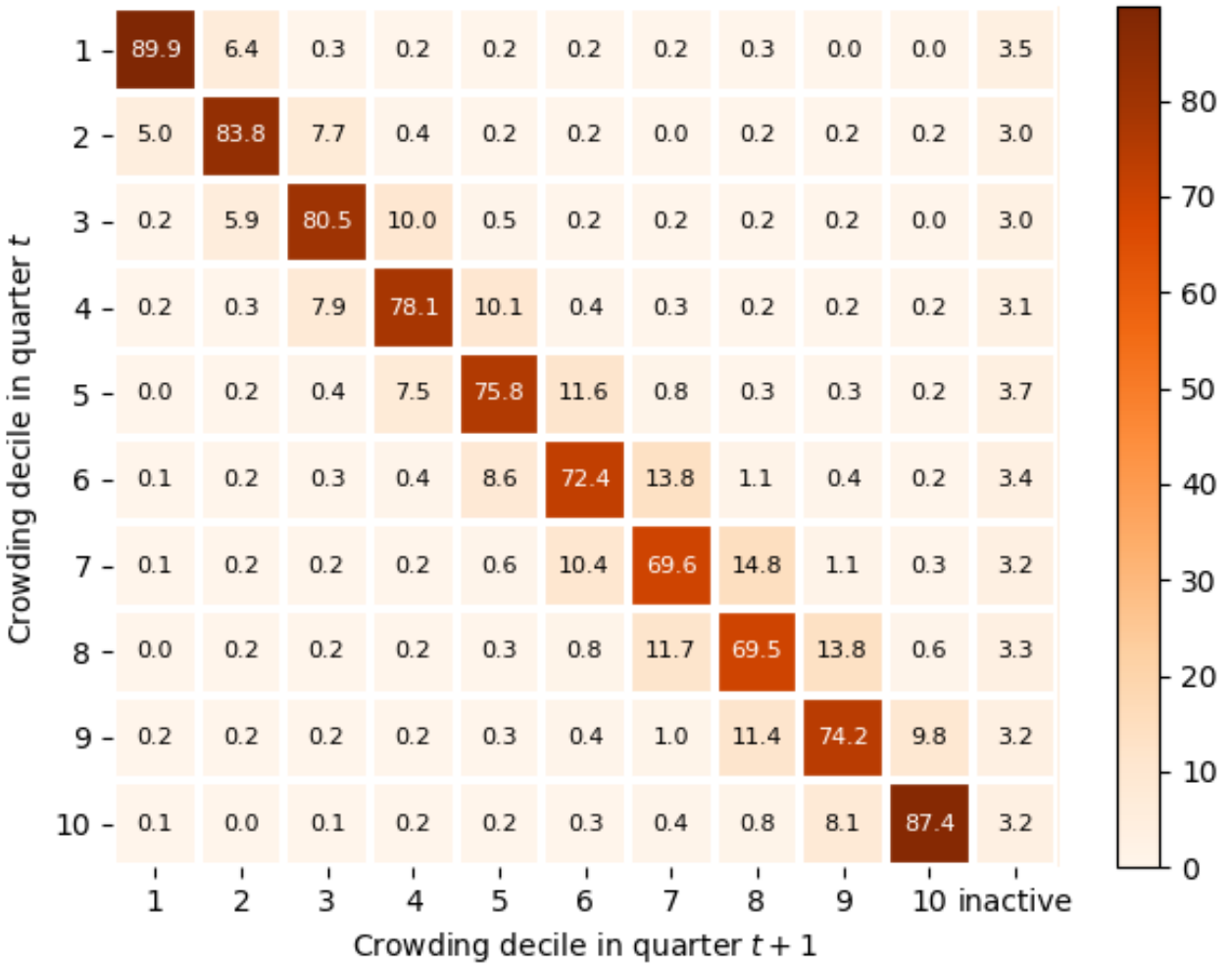
Performance and crowding | Additional tests

Stocks characteristics

Panel A: all stocks												
Centrality decile	1 (low)	2	3	4	5	6	7	8	9	10 (high)	10 - 1	
Size	3.22	6.67	14.93	25.98	39.43	49.23	55.89	65.04	75.72	85.28	82.06***	(0.001)
BTM (industry-adjusted)	0.08	-0.07	-0.18	-0.19	-0.19	-0.22	-0.24	-0.26	-0.26	-0.26	-0.34***	(0.001)
Momentum	0.24	0.25	0.22	0.20	0.15	0.15	0.15	0.14	0.13	0.12	-0.12***	(0.001)
# Analysts	10.08	12.79	16.68	19.38	23.44	25.73	26.47	26.80	27.81	28.58	18.50***	(0.001)
Dividend Yield	1.54	1.47	1.68	1.86	2.15	2.05	2.16	2.16	2.15	2.16	0.62***	(0.001)
Amihud Illiquitidy	0.51	0.10	0.37	0.13	0.03	0.03	0.03	0.02	0.02	0.02	-0.49**	(0.012)
Volatility	0.39	0.37	0.34	0.32	0.30	0.30	0.28	0.28	0.27	0.26	-0.12***	(0.001)
Turnover	0.16	0.18	0.17	0.15	0.13	0.14	0.14	0.14	0.14	0.13	-0.03***	(0.006)
Price	47.74	64.65	102.32	163.33	303.58	436.14	269.09	293.19	297.58	190.84	0.14***	(0.001)
ADR	0.02	0.03	0.04	0.05	0.05	0.04	0.03	0.03	0.02	0.02	0.00	(0.696)
MSCI	0.10	0.22	0.44	0.54	0.68	0.78	0.83	0.85	0.88	0.91	0.81***	(0.001)
English Legal Origin	0.79	0.82	0.76	0.73	0.74	0.76	0.79	0.82	0.83	0.86	0.07***	(0.001)
Anti-Director Index	3.41	3.31	3.44	3.55	3.53	3.42	3.32	3.27	3.22	3.19	-0.22***	(0.000)
Foreign Ownership	0.40	0.48	0.57	0.61	0.61	0.63	0.59	0.59	0.64	0.68	0.28***	(0.001)
Panel B: foreign stocks												
Centrality decile	1 (low)	2	3	4	5	6	7	8	9	10 (high)	10 - 1	
Cultural Proximity	0.34	0.33	0.32	0.30	0.32	0.33	0.34	0.34	0.31	0.27	-0.06***	(0.002)
Geographic Proximity	3.85	4.41	5.39	5.35	4.51	4.03	4.01	4.11	4.08	4.13	0.28**	(0.045)
Economic Proximity	9.26	8.31	9.33	10.67	11.74	11.79	10.60	10.03	9.84	8.50	-0.76	(0.262)

Performance and crowding

Crowding persistence



Crowding and deviations from the market

Crowding	Active Share										
	1 (low)	2	3	4	5	6	7	8	9	10 (high)	10 – 1
High	−0.102***	−0.157***	−0.177***	−0.165***	−0.178***	−0.078*	0.027	-0.018	0.018	0.074	0.176***
	(-4.01)	(-5.48)	(-5.36)	(-3.83)	(-3.95)	(-1.85)	(0.57)	(-0.26)	(0.23)	(1.54)	(3.07)
Medium	−0.087***	−0.112***	−0.128***	−0.134***	−0.116***	−0.054*	−0.065**	-0.009	0.089**	0.003	0.090*
	(-3.54)	(-5.26)	(-4.76)	(-4.36)	(-3.41)	(-1.76)	(-2.19)	(-0.26)	(2.02)	(0.07)	(1.90)
Low	-0.021	-0.036	−0.059**	−0.088***	−0.070***	−0.075**	-0.055	0.056	0.119*	0.181*	0.202*
	(-0.62)	(-1.46)	(-2.50)	(-3.76)	(-2.76)	(-2.13)	(-1.56)	(1.10)	(1.69)	(1.69)	(1.89)
High – Low	−0.081***	−0.121***	−0.118***	−0.077*	−0.108**	-0.003	0.083*	-0.074	-0.101	-0.107	
	(-3.01)	(-4.52)	(-4.40)	(-1.92)	(-2.53)	(-0.08)	(1.78)	(-0.91)	(-0.93)	(-0.97)	

Additional tests

Fama-MacBeth regression for US domiciled funds

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	0.303*	0.256**	0.237***	0.204***	0.228***	0.201**	0.228***	0.201**
	(0.05)	(0.03)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)
crowd_t	−0.001***		−0.001***		−0.001***		−0.001***	
	(0.00)		(0.00)		(0.00)		(0.00)	
crowd_t^e		−0.005***		−0.005***		−0.005***		−0.005***
		(0.00)		(0.00)		(0.00)		(0.00)
$\log(\text{fund TNA})_t$			0.006	0.005	0.007	0.006	0.007	0.006
			(0.22)	(0.36)	(0.25)	(0.32)	(0.25)	(0.33)
QuarterlyFlow_t			0.001	0.001	0.001	0.001	0.001	0.001
			(0.29)	(0.28)	(0.27)	(0.27)	(0.27)	(0.28)
$\text{QuarterlyReturn}_{t-1}$			0.019	0.019	0.019	0.019	0.019	0.019
			(0.35)	(0.35)	(0.38)	(0.37)	(0.35)	(0.36)
NPeers					0.000	−0.000		
					(0.93)	(0.79)		
TSIM							−0.000	−0.000
							(0.98)	(0.72)
Number of observations	119,750	119,750	112,288	112,288	112,288	112,288	112,288	112,288

Additional tests

Eigenvector centrality

	1 (low)	2	3	4	5	6	7	8	9	10 (high)
Net Alpha	−0.162***	−0.156***	−0.194***	−0.162***	−0.150***	−0.150***	−0.188***	−0.193***	−0.141***	−0.176***
	(-3.13)	(-3.71)	(-4.37)	(-3.23)	(-2.88)	(-2.83)	(-4.05)	(-3.88)	(-3.92)	(-5.64)
Dollar Value Added	−0.036**	−0.052**	−0.114***	−0.137**	−0.200**	−0.259*	−0.568***	−1.074***	−1.224**	−7.448**
	(-2.40)	(-2.56)	(-3.33)	(-2.24)	(-2.08)	(-1.82)	(-2.98)	(-3.00)	(-3.00)	(-2.04)
Gross Alpha	-0.064	−0.089***	−0.099***	−0.096***	−0.064**	−0.086***	−0.111***	−0.112***	−0.104***	−0.155***
	(-1.51)	(-3.36)	(-3.67)	(-3.34)	(-2.05)	(-3.11)	(-3.41)	(-3.41)	(-3.59)	(-4.44)
Gross DGTW	-0.061	−0.149***	−0.127**	−0.155***	−0.137**	−0.127***	−0.168***	−0.164***	−0.139***	−0.197***
	(-1.30)	(-3.06)	(-2.49)	(-3.09)	(-2.57)	(-2.62)	(-3.44)	(-3.17)	(-2.71)	(-3.61)

Additional tests

Value-weighted returns and factor models

Panel A: Value-weighted portfolio returns

	Crowding										
	1 (low)	2	3	4	5	6	7	8	9	10 (high)	10 – 1
Net Alpha	0.049	0.070**	0.001	0.024	0.034	−0.043	−0.007	−0.016	−0.054**	−0.087**	−0.136*
	(0.82)	(2.21)	(0.01)	(0.68)	(1.08)	(−1.25)	(−0.30)	(−0.64)	(−1.99)	(−2.41)	(−1.83)
Gross Alpha	−0.032	−0.040	−0.075*	−0.039	−0.032	−0.116***	−0.078**	−0.119***	−0.132***	−0.154***	−0.123***
	(−0.59)	(−1.13)	(−1.73)	(−0.93)	(−0.99)	(−3.02)	(−2.08)	(−3.60)	(−3.96)	(−4.41)	(−2.61)

Panel B: Factor model alphas

	Crowding										
	1	2	3	4	5	6	7	8	9	10	10 – 1
CAPM	0.139	0.038	−0.000	−0.157	−0.171**	−0.203***	−0.173***	−0.200***	−0.240***	−0.233***	−0.372**
	(1.16)	(0.37)	(-0.00)	(-1.58)	(-2.57)	(-3.56)	(-3.79)	(-4.04)	(-3.88)	(-3.80)	(-2.46)
FF 3-Factor	−0.004	−0.020	−0.017	−0.150	−0.115*	−0.125***	−0.128***	−0.155***	−0.182***	−0.160***	−0.156**
	(-0.05)	(-0.22)	(-0.16)	(-1.56)	(-1.69)	(-2.94)	(-3.27)	(-4.10)	(-3.96)	(-4.01)	(-1.99)
Carhart 4-Factor	0.011	−0.013	−0.040	−0.165	−0.103	−0.113***	−0.130***	−0.163***	−0.193***	−0.161***	−0.173**
	(0.14)	(-0.14)	(-0.34)	(-1.63)	(-1.60)	(-2.75)	(-3.14)	(-4.21)	(-4.09)	(-3.92)	(-2.13)
FF 5-Factor	0.002	0.057	0.006	−0.169*	−0.092	−0.066	−0.107**	−0.152***	−0.184***	−0.143***	−0.145*
	(0.03)	(0.66)	(0.05)	(-1.68)	(-1.38)	(-1.49)	(-2.46)	(-3.63)	(-3.53)	(-3.08)	(-1.69)

Additional tests