Monitoring systemicness in the MMF sector

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Risk monitoring – MMF research
Agenda

1. Snapshot of main results

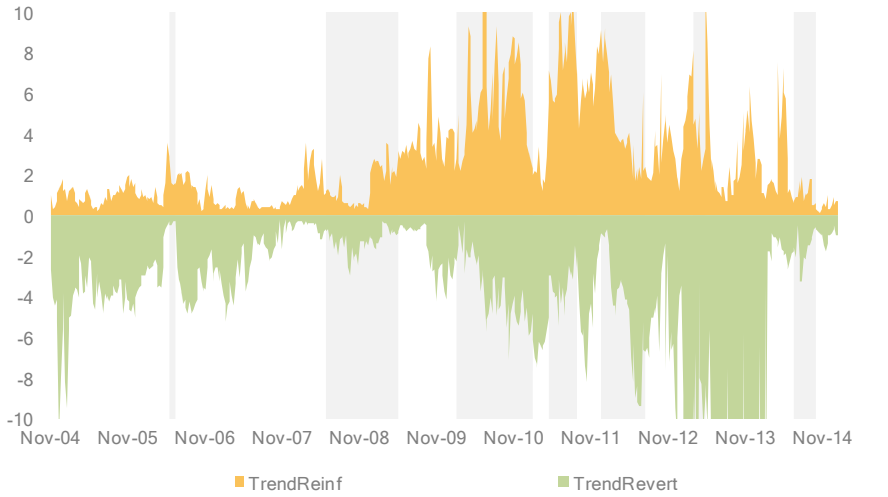
2. Why to monitor systemic risks/interconnectedness in MMF sector?

3. Research strategy for systemic risk monitoring
   - Choice of econometric model form
   - Construction of Risk Indicator
   - Model specification

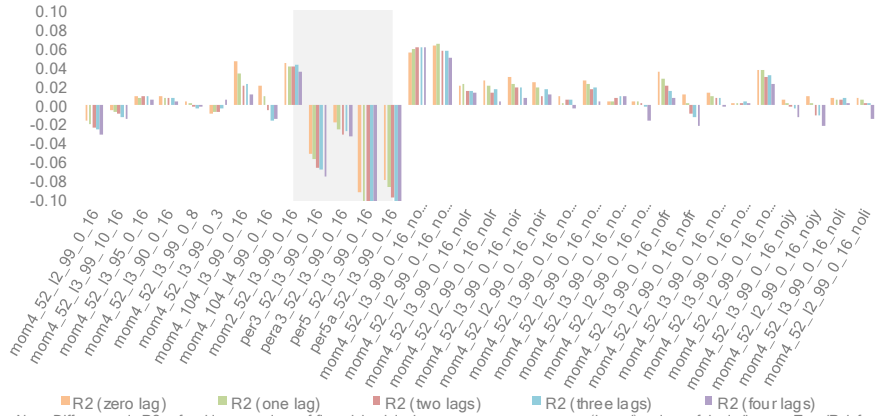
4. Results

5. Conclusions

Risk monitoring – MMF research
Summary of main results

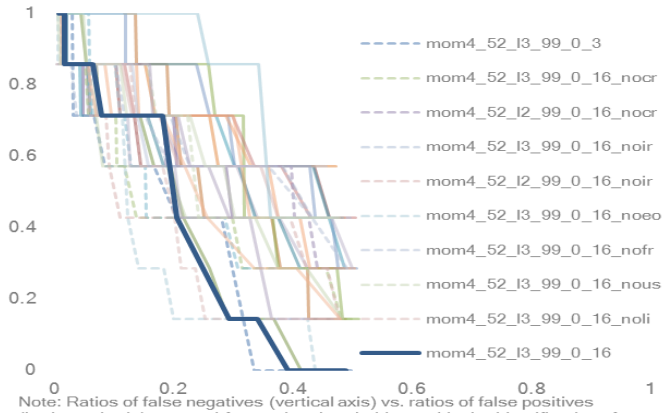


Note: Fractions of regressions with positive (negative), significant, at 99% level, estimates for first element of b_{21} in equation (1) multiplied by average value of respective estimators. Shaded areas highlight financial crisis periods identified from prior common knowledge about market conditions or by massive jumps in the money market component of the ECB's CISS indicator. Last data point is the last week of March 2015.
Sources: Thomson Reuters Lipper, Thomson Reuter Datastream, ECB, ESMA.



Note: Differences in R2s of probit regressions of financial crisis dummy on contemporaneous (lagged) values of the indicators TrendReinf and TrendRevert in between respective model version and baseline model 4MOM. Shaded areas highlight models discussed in Section 4 as potential contenders to baseline model.

- 2 indicators for interconnectedness of MMF and related systemic risk
  - TrendReinf (TrendRevert) tends to jump up (down) around crisis starts
- TrendReinf and TrendRevert help to explain crisis dummy (9-14%) better than closest contending models
- Lenient trade-off for % mis-identified vs. missed crises for TrendReinf



Note: Ratios of false negatives (vertical axis) vs. ratios of false positives (horizontal axis) reported for varying thresholds used in the identification of financial crisis periods by TrendReinf. Thresholds are varied over multiples of means of the centred MAs of purely positive 4-period average growth rates around the start of all financial crisis periods in the sample. Dotted lines denote models with a at least partially better trade-off than the baseline model.
Sources: Thomson Reuters Lipper, Thomson Reuters Datastream, ESMA.

Why to monitor systemic risks/interconnectedness in MMF sector?

- MMFs might be systemic since they are:
  - Highly correlated in terms of risk exposure: Kacperczyk et. al. (2012), Duygan-Bump et al. (2010), Chernenko et al. (2014),…,
  - Exposed to potential of jumps in valuation: CNAVS, Gorton et al. 2013
  - Reacting pro-cyclical (McCabe (2010)), in particular in stress periods (Schmidt et al. (2014)),
  - Characterised by strategical behaviour of investor bases: Schmidt et al. (2014), Gallagher et al. (2015),
  - Intertwined with the financial system through:
    - Whole-sale funding markets,
    - Collateral networks (e.g. with hedge funds),
    - Sponsorship relations: Kim (2012), Kacperczyk et. al. (2012), Brady et al. (2013),…,
    - Horizontal and vertical integration,
    - Institutional investor base.
- Systematic approaches to detect systemicness associated with:
  - Inter-sectoral links of MMF industry with financial system,
  - Intra-sectoral links.
- ESMA has mandate to monitor systemicness and associated risks.

Research strategy for systemicness monitoring
Choice of model form

- Data available
  - Fund returns
- Individual fund's impact on sector to be identified
  - Multi-variate set-up relating sector distribution and individual funds;
  - Fund returns auto-correlated -> AR structure
- MMF returns correlated and non-stationary in short samples
  - EC form;
- Exogenous variables:
  - Proxies for interest rate risk, liquidity risk, maturity risk, term structure risk, credit risk and exchange rate risks
  - Interest rate level and LIRE proxy

- VEC model recast as VAR:

$$\begin{pmatrix} IFR_t \\ SM_t \end{pmatrix} = \sum_{j=1}^{n} \begin{pmatrix} b_{11t-j} & b_{12t-j} \\ b_{21t-j} & b_{22t-j} \end{pmatrix} \begin{pmatrix} IFR_{t-j} \\ SM_{t-j} \end{pmatrix} + AX_t + \begin{pmatrix} e_{1t} \\ e_{2t} \end{pmatrix}.$$

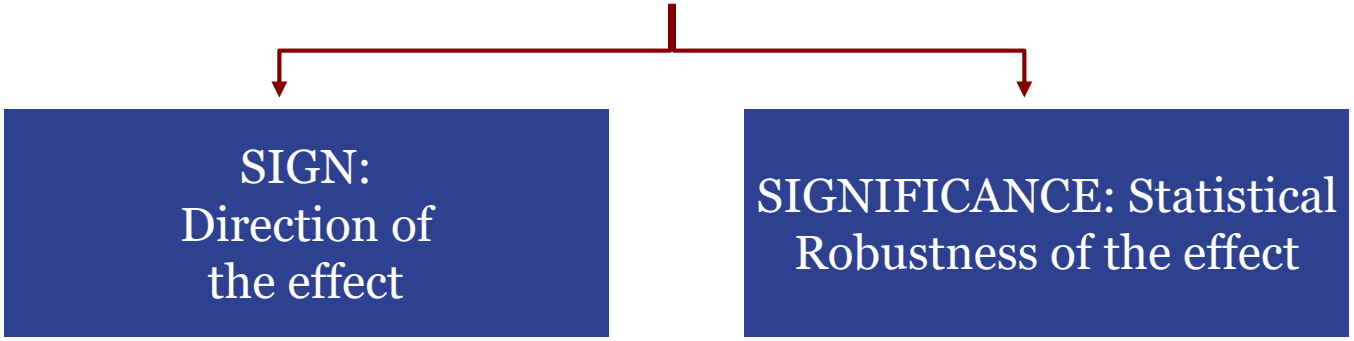
- *IFR:* Weekly EU Individual fund returns from Thomson Reuters Lipper
- *SM:* Sector moments measured as cross-section moments: mean, standard deviation, skewness, kurtosis, or, alternatively, various set of percentiles.
- *Control variables X*:
  - Risk proxies: yield spread of Barclays 1Y and 1M FRA, spread of 3M Euro $ rate to 3M US TBILL, 6M Euro bank deposit rate – 3M equivalent, 2Y US TBOND – 3M US TBILL, 3M OIS – 3M US TBILL, USD/EUR, GBP/EUR, JPY/EUR,
  - Interest and LIRE proxies: EONIA, % spread of EIONA vs. ECB MFR, all orthogonalised by PCA
- *Samples*: 52W2003 – 12W2015 EU industry (N_{min}=814, N_{max}=2234)

Research strategy for systemicness monitoring
Hypotheses and empirical model

- Hypotheses 1 and 3:
  - Sectorally relevant funds affect sector trends;
  - H1: $b_{21} \neq 0$
    - 1st element: trend reinforcing (reverting) funds for $b_{21} > 0$ ($b_{21} < 0$)
    - 2nd element: dispersion amplifying (mitigating) funds for $b_{21} > 0$ ($b_{21} < 0$)
- Hypotheses 2 and 4:
  - Sectorally vulnerable funds are affected by sector trends;
  - H1: $b_{12} \neq 0$
    - 1st element: hedged (exposed) funds for $b_{12} > 0$ ($b_{12} < 0$)
    - 2nd element: speculating (risk hedging) funds for $b_{12} > 0$ ($b_{12} < 0$)
- Hypotheses 5 and 6:
  - Systemic risks persist through positive autocorrelation in sector; trends
  - H1: b22 ≠ 0
    - 1st element: funds indicating sector persistence
    - 2nd element: funds indicating sector dispersion persistence

Research Strategy for systemicness monitoring Hypotheses and empirical model

- Trends in systemic risk generation/transmission can be visualised as distribution of t-statistics, $t_{ij} = \frac{b_{ij}}{se_{ij}}$,derived from individual regressions.



- Aggregating across funds we compute, for each parameter:
  1. Fraction of fund (regressions) with a) significantly positive and b) significantly negative estimators (99% significance level used),
  2. Average size of estimators found to be a) positively and b) negatively significant,
  3. Product of fraction of significant estimators (1) and average size of estimators (2).

- Dynamic profiles reported for 2005-2015 using 52W rolling windows

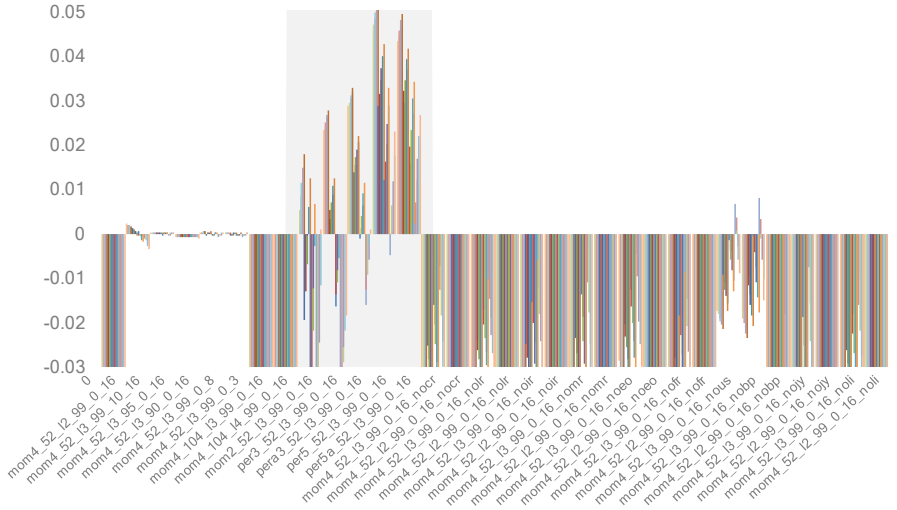
Research Strategy for systemicness monitoring Model specification

- Cointegration structure:
  - Impose correlation between IFR and 1st MOM of return distribution as coefficient
  - Use AIC (alternatively SIC) to determine # of cointegration equations and type of cointegration system in Johansen test
  - If estimation problems appear: step-wise reduction of type of cointegration system until either estimation possible or simplest type reached (switch to VAR)
- Exogenous variables: include only principal components > 10^{-14}
- Parameters for model specification:
  - Set of endogenous variables, lag length, # of missing observations allowed, sample size and significance level
  - Vary and compare results visually, with respect to test statistics and explanatory contributions to financial crisis dummy

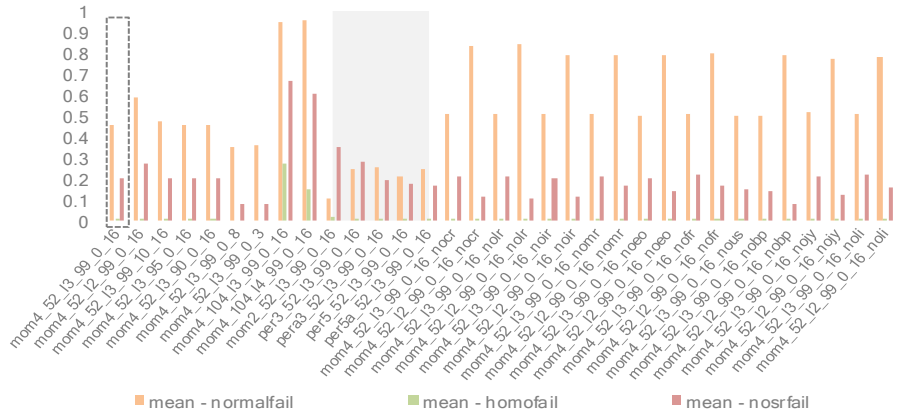
Research Strategy for systemicness monitoring Ex-post model choice and robustness

- Employ test statistics:
  - % of regressions failing tests for no serial correlation, homoscedasticity and normality of residuals
  - Average max. (adj.) and min (adj.) R^2s found in individual VARs
  - Average correlation between IFR and 1st MOM of return distribution
- Aggregate statistics into combined score using varying weight schemes
- Ex post PROBIT regression of crisis dummy on indicators for H1 (1st moment)
  - R^2s and p-values as additional model performance scores
- Quality of trade off of false pos. vs. false neg. in crisis identification
  - Modified ROC curves
- Include expert judgment into decision:
  - Preferences for symmetric models
  - Limited sample size and avoiding seasonality => 52 weeks

Research Strategy for systemicness monitoring
Ex-post model choice and robustness



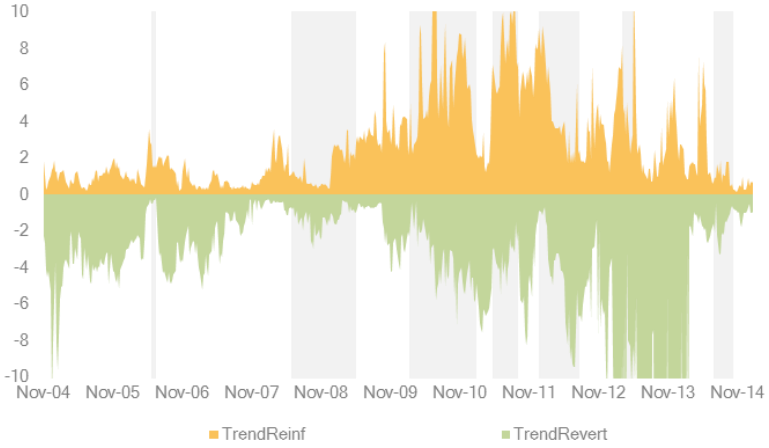
Note: Absolute differences between aggregate test statistics of various alternative model versions and the baseline model *4MOM*. Aggregate test statistics include fractions of regressions, for which normality, the absence of serial correlation and homoscedasticity of residuals have been rejected on 95% significance level, as well as cross-sectional averages of minimal and maximal values for R^2s found within the set of equations for each individual regression, both on adjusted and non-adjusted basis. The aggregation across individual test statistics is linear employing alternative weight schemes (reported in different colours) detailed in Section 3. Potential contenders to the baseline model are highlighted with grey background.
Sources: Thomson Reuters Lipper, Thomson Reuters Datastream, ESMA.



Note: Time series means of fractions of individual regressions, for which normality, the absence of serial correlation and homoscedasticity of residuals have been rejected on 95% significance level. Shaded areas highlight models discussed in Section 4 as potential contenders to baseline model. Baseline model highlighted by dashed frame.
Sources: Thomson Reuters Lipper, Thomson Reuters Datastream, ESMA.

- # of lags limited to 3, as higher values yield only marginal test score improvements
- Potential superior contenders: models with 2 moments and 3 or 5 percentiles yield higher test scores
- Superior contenders plagued by
  - High serial correlation in residuals
  - Low contribution to explanation of financial crises dummy (✋)
- Lenient trade-off for false and neg. positives (✋)
- Indicators of alternative model versions correlate pos. with those of baseline model (✋)

Main results, Hypotheses 1 and 3: Relevant funds affect sector trend and dispersion



Note: Fractions of regressions with positive (negative), significant, at 99% level, estimates for first element of b_{21} in equation (1) multiplied by average value of respective estimators. Shaded areas highlight financial crisis periods identified from prior common knowledge about market conditions or by massive jumps in the money market component of the ECB's CISS indicator. Last data point is the last week of March 2015.
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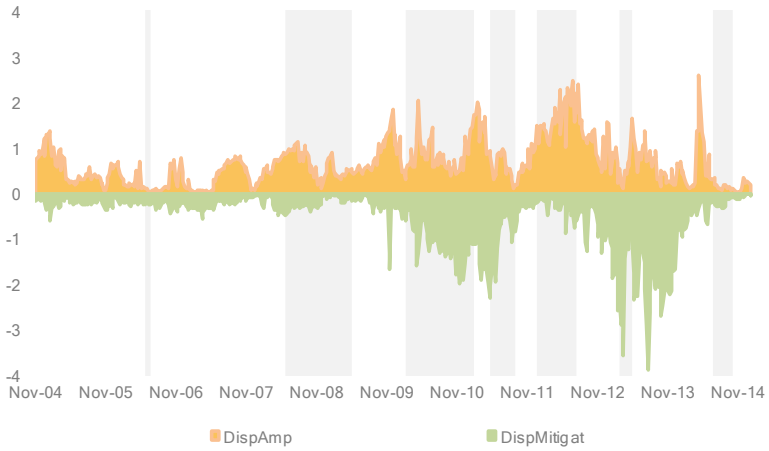


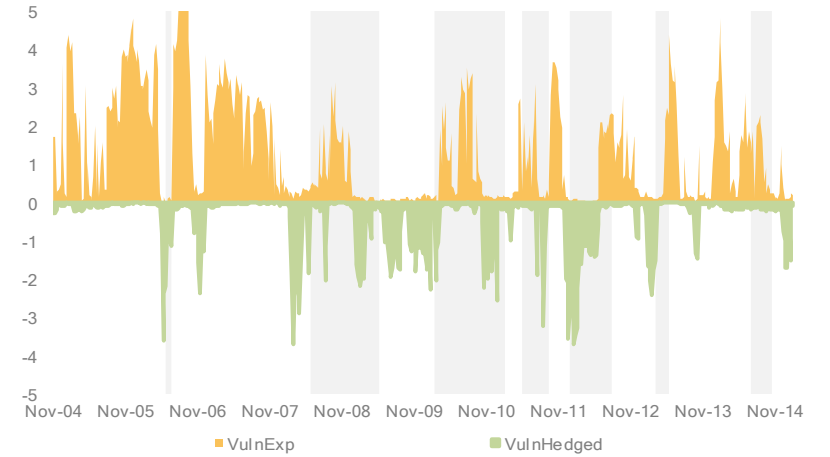
Note: Fractions of regressions with positive (negative), significant, at 99% level, estimates for second element of b21 in equation (1) multiplied by average value of respective estimators. Shaded areas highlight financial crisis periods identified from prior common knowledge about market conditions or by massive jumps in the money market component of the ECB's CISS indicator. Last data point is the last week of March 2015.
Sources: Thomson Reuters Lipper, Thomson Reuter Datastream, ECB, ESMA

- Systemic risk indicator qualities:
  - ***TrendReinf***
    - up before/early in 6 out of 7 crises
    - Correl. with CD 0.32
    - Equality in crisis and off-crisis periods (TE) rejected
    - Ø Impact: 2.7 x idios. return shock
  - ***TrendRevert***
    - simultaneously/slightly delayed up
    - Correl. with CD 0.09
    - TE rejected
    - Ø Impact: -4.1 x idios. return shock
  - *DispAmp (DispMitigat)*
    - up early in 5 (3) out of 7 crisis
    - Correl. with CD 0.26 (-0.05)
    - TE rejected (not rejected)
    - Ø Impact: 0.66 (-0.55) x idios. Shock
- *TrendRevert* and *DispMitigat*:
  - Strong increases in indicators in 12/13.

Main results: Hypotheses 1 and 3: Interpreting sectorally relevant effects

- *TrendReinf* and *TrendRevert*:
  - Oct 2008: RPMF broke the buck, *TrendRevert* at local trough, *TrendReinf* on decreasing trend: EU MMF struck by losses due to materialising counterpart/credit risks, reduced collateral value and reduced liquidity on market (money markets down) and funding side (outflows)
  - Intra-sectoral return sensitivity increased after 08 crisis: momentum strategies increased as use of benchmarks more frequent; market liquidity down;
  - Supporting effects for sector trend and dispersion increase in crisis: trend preservation and related risk up
  - Proximity of peaks in *TrendReinf* to starts of financial crises resonates with better informed institutional investors detecting the crisis and retail ones following (strategically interdependent outflows following returns)
- *DispAmp* and *DispMitigat* add to herding in challenging markets:
  - Successful *DispAmp*s reap speculation gains attracting more speculation momentum, unsuccessful ones underperform, transmit price pressure through sell-offs => both increase sector return dispersion
  - Unsuccessful *DispMitigat*s suffer from market trend and sustained speculation; successful ones drag on profits of speculators, lowering their sustainability

Hypothesis 2 and 4: Funds vulnerable to sector trend and dispersion.



Note: Fractions of regressions with positive (negative), significant, at 99% level, estimates for first element of b_{12} in equation (1) multiplied by average value of respective estimators. Shaded areas highlight financial crisis periods identified from prior common knowledge about market conditions or by massive jumps in the money market component of the ECB's CISS indicator. Last data point is the last week of March 2015.
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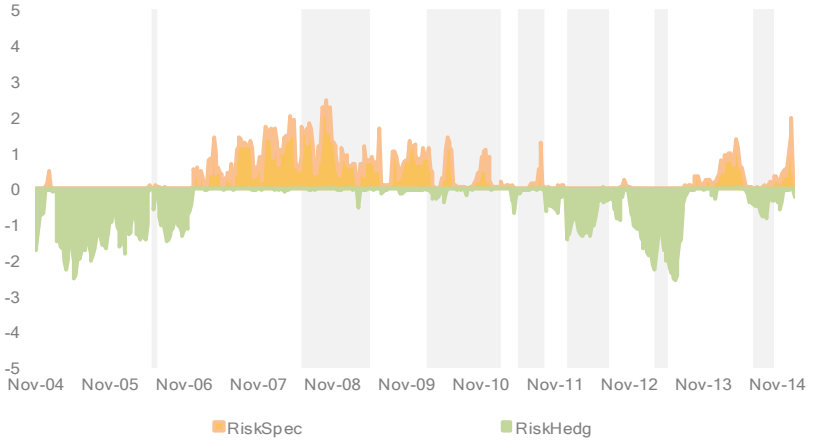
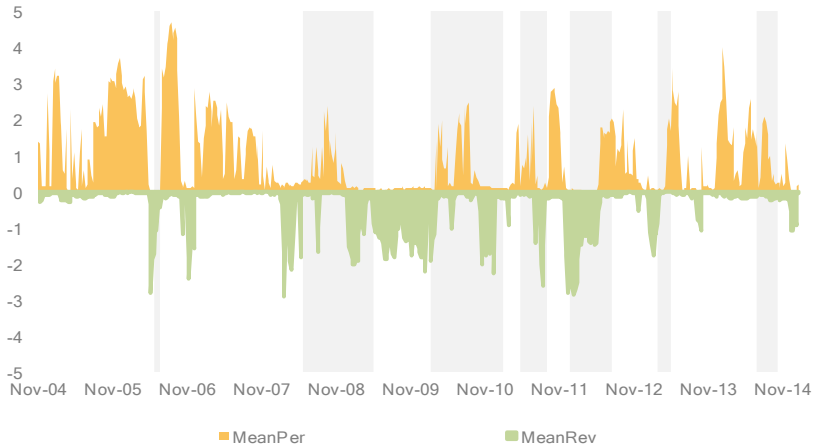


Note: : Fractions of regressions with positive (negative), significant, at 99% level, estimates for second element of b12 in equation (1) multiplied by average value of respective estimators. Shaded areas highlight financial crisis periods identified from prior common knowledge about market conditions or by massive jumps in the money market component of the ECB's CISS indicator. Last data point is the last week of March 2015.
Sources: Thomson Reuters Lipper, Thomson Reuter Datastream, ECB, ESMA.

- *VulnExp and VulHedged*
  - Muted correlations with CD;
  - Alternating patterns;
  - Ø impact of VulnExp (1.29) dominates that of VulnHedged (-0.42);
    - momentum-oriented fund strategies not contained by hedged ones;
    - sector acts on margin as net amplifier of systemic risk.
- *RiskSpec and RiskHedg:*
  - Weak signalling power of RiskHedg;
  - Limited gross Ø impacts: 0.37 and 0.45;
  - RiskHedgs drag on return of sponsors (support) and competitors (asset prices);
  - (Un-)successful RiskSpecs attract (chase away) competitors and boost/document search for yield.
- *No additional signalling power for financial crises*

Hypotheses 5 and 6: Sector trend and dispersion are persistent.



Note: Fractions of regressions with positive (negative), significant, at 99% level, estimates for first element of b_{22} in equation (1) multiplied by average value of respective estimators. Shaded areas highlight financial crisis periods identified from prior common knowledge about market conditions or by massive jumps in the money market component of the ECB's CISS indicator. Last data point is the last week of March 2015.
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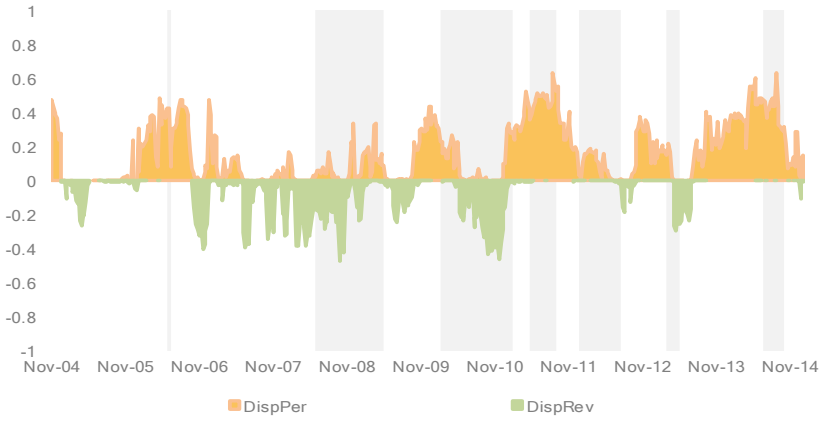

Note: : Fractions of regressions with positive (negative), significant, at 99% level, estimates for second element of b_{22} in equation (1) multiplied by average value of respective estimators. Shaded areas highlight financial crisis periods identified from prior common knowledge about market conditions or by massive jumps in the money market component of the ECB's CISS indicator. Last data point is the last week of March 2015.
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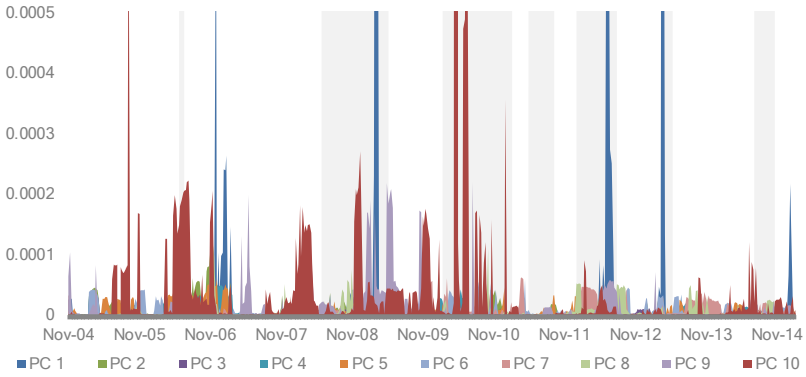
- Sector trend:
  - Pos. and neg. autocorrelation alternate, with, on ø, pos. one dominating:
    - supports VEC model;
    - allows still for mean-reversion;
    - indicates alternation of dominance of momentum and hedging/speculative strategies
- Sector dispersion:
  - Pos. and neg. autocorrelation alternate, with, on ø, pos. one dominating:
    - pro-cyclicality of vola. dominates;
    - still counter-cyclical elements assure ergodicity of sector returns
    - both indicators neg. correlated with CD: dispersion reversion tends to dominate in crises

Ancillary results: FEs and exog. factors explain level of returns.



Note: Fractions of regressions with significant, at 99% level, non-zero estimates for coefficients of principal components (PC) derived from set of exogenous variables in equation for IF in (1) multiplied by average values of respective estimators. Shaded areas highlight financial crisis periods identified from prior common knowledge about market conditions or by massive jumps in the money market component of the ECB's CISS indicator. Last data point is the last week of March 2015.
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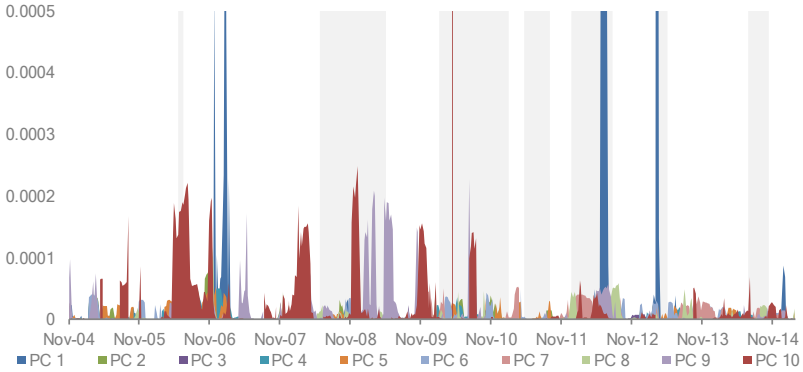


Note: Fractions of regressions with significant, at 99% level, non-zero estimates for coefficients of principal components (PC) derived from set of exogenous variables in equation for sector mean returns in (1) multiplied by average values of respective estimators. Shaded areas highlight financial crisis periods identified from prior common knowledge about market conditions or by massive jumps in the money market component of the ECB's CISS indicator. Last data point is the last week of March 2015.
Sources: Thomson Reuters Lipper, Thomson Reuter Datastream, ECB, ESMA.

- On ø across funds and time:
  - exogenous factors generate 97% (86%) of values of means of IFR and sector means;
  - exog. regressors contribute <1% to standard dev. of returns;
  - add. 3-4% contributed by FEs.
- Particular strong drivers:
  - Low interest rate proxy (1_10)
  - Maturity risk premia (1_9)
  - EONIA (1_1)
  - USD/EUR (1_8)
  - Liquidity risk premium (1_5)
  - Credit risk premium (1_2)
- Impacts of exog. variables correlate with financial market stress and CD.
- FE correlate neg. with financial stress: alpha vanishes or turns negative. (✋)

Conclusions (I)

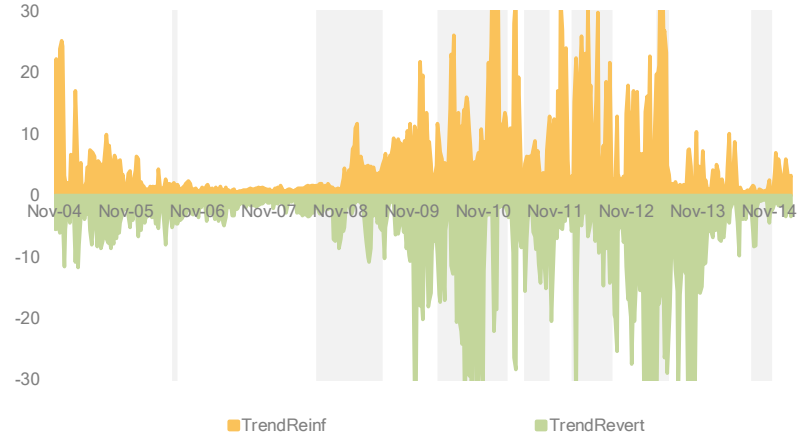
- Indicators *TrendReinf* and *TrendRevert* match financial crises events:
  - Fraction times average coefficients of funds with significant impact on industry mean return
    - 1) add to explanation of crises starts;
    - 2) differ between crises and off-crisis periods;
    - 3) comove with crisis presence and
    - 4) provide reasonable results concerning positive and false negatives.
- Indicator advantages:
  - Build on “Big Data” – entire universe of MMFs covered.
  - Use statistics similar to network analysis: significant coefficients from VAR/VEC-models.
  - Are aggregated from entity-level data: bilateral relations between individual entity and sector.
  - Enable dynamic profiling of systemicness over time.
- Indicator qualitatively robust for different model specifications varying
  - Lag lengths, rolling window lengths, size of allowed data gaps, choice of endogenous and exogenous variables.

Conclusions (II)

- Interpretation of indicator patterns: Systemicness building up after 2009.
  - Intra-sectoral sensitivity higher after 08: momentum strategies gain relevance.
  - Relevant funds:
    - *TrendReinf* and *DispPer* prevail in crisis periods: trend preservation, return externalities and systemic risk up;
    - Peaks in *TrendReinf* close to crisis starts: signalling power of institutional investors which are strategically followed by less informed retail ones;
    - Funds impacting sector dispersion: amplifiers and mitigators on opposite market sides facilitating their strategies vice versa driving thereby distributions' tails.
  - Vulnerable funds and autocorrelation:
    - No additional signaling power.
- Possible future extensions:
  - Explore network analysis in set of identified relevant funds,
  - Replicate for UCITS fund industry,
  - Link to related measures for other industries or in between different industries.

Many thanks for your attention!

Annex: Main results, Hypothesis 1: Drivers of sectorially relevant effects



Note: Average values of positive (negative), significant, at 99% level, estimates for first element of b_{21} in equation (1). Shaded areas highlight financial crisis periods identified from prior common knowledge about market conditions or by massive jumps in the money market component of the ECB's CISS indicator. Last data point is the last week of March 2015.
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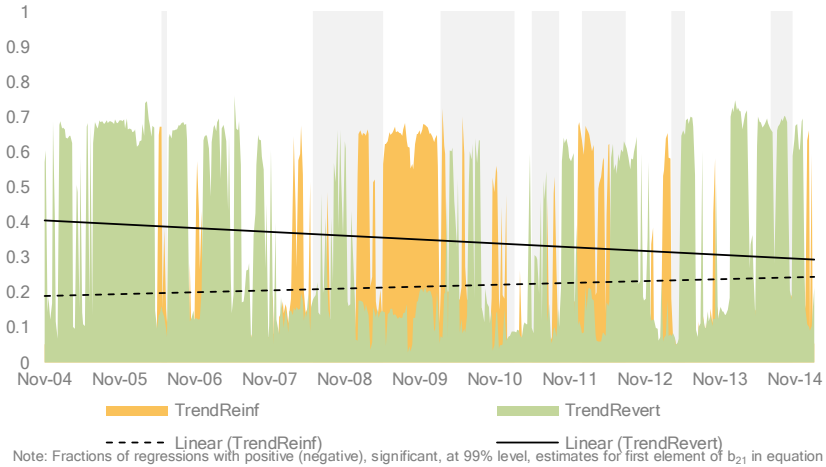

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- Indicators driven by ø strength of coefficients, with percentages acting as scaling effects;
- Changes in percentages indicate increasing relevance of *TrendReinf*;
- Interpretation
  - # of regressions with significant neg. auto-regressive effects decreases with interest rate level;
  - Size of average effects increases;
  - Reinforcing externalities gain more influence => momentum strategies rendered more important.

Annex: Result evaluation Robustness

	TrendReinf	*TrendRevert*
mom4_52_l2_99_0_16	0.85	0.78
mom4_52_l3_99_10_16	0.58	0.58
mom4_52_l3_95_0_16	0.44	0.58
mom4_52_l3_90_0_16	0.44	0.39
mom4_52_l3_99_0_8	0.48	0.35
mom4_52_l3_99_0_3	0.90	0.91
mom4_104_l3_99_0_16	0.77	0.80
mom4_104_l4_99_0_16	0.90	0.89
mom2_52_l3_99_0_16	0.71	0.79
per3_52_l3_99_0_16	0.94	0.93
pera3_52_l3_99_0_16	0.78	0.89
per5_52_l3_99_0_16	0.81	0.85
per5a_52_l3_99_0_16	0.90	0.91
mom4_52_l3_99_0_16_nocr	0.78	0.82
mom4_52_l2_99_0_16_nocr	0.95	0.93
mom4_52_l3_99_0_16_nolr	0.77	0.87
mom4_52_l2_99_0_16_nolr	0.91	0.91
mom4_52_l3_99_0_16_noir	0.72	0.85
mom4_52_l2_99_0_16_noir	0.92	0.81
mom4_52_l3_99_0_16_nomr	0.90	0.88
mom4_52_l2_99_0_16_nomr	0.79	0.86
mom4_52_l3_99_0_16_noeo	0.97	0.99
mom4_52_l2_99_0_16_noeo	0.95	0.94
mom4_52_l3_99_0_16_nofr	0.79	0.88
mom4_52_l2_99_0_16_nofr	0.96	0.89
mom4_52_l3_99_0_16_nous	0.75	0.85
mom4_52_l3_99_0_16_nobp	1.00	0.97

- Patterns of indicators do not vary substantively across different model versions, in particular not for contenders to benchmark model
- Main indicators different in crisis and off-crisis-periods

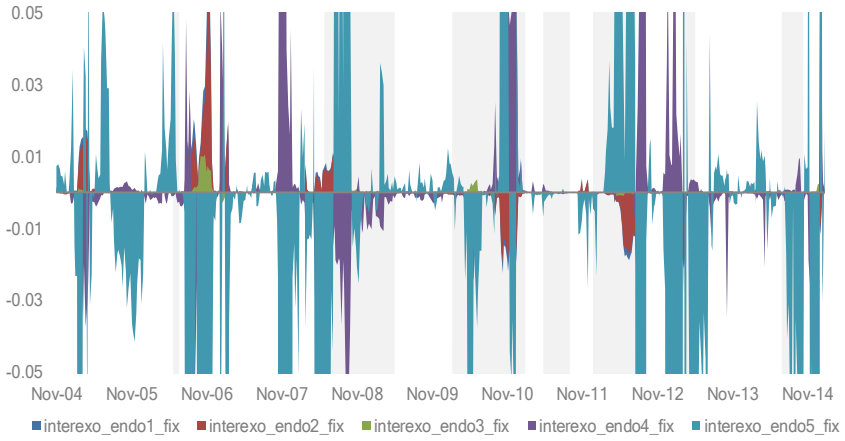
Variable	Mean coefficient	Test-type	Inequality (5% significance level)	p-value
TrendReinf in crisis	4.12	Welch F-test*	Yes	0.00
TrendReinf off crisis	2.28			
TrendRevert in crisis	-3.39	Welch F-test*	Yes	0.05
TrendRevert off crisis	-4.07			
TrendReinf (average estimates) in crisis	130.47	Welch F-test*	Yes	0.00
TrendReinf (average estimates) off crisis	78.79			
TrendRevert (average estimates) in crisis	-125.20	Welch F-test*	No	0.64
TrendRevert (average estimates) off crisis	-131.31			

*The Welch F-test is a heteroscedasticity adjusted version of the Anova based F-test.

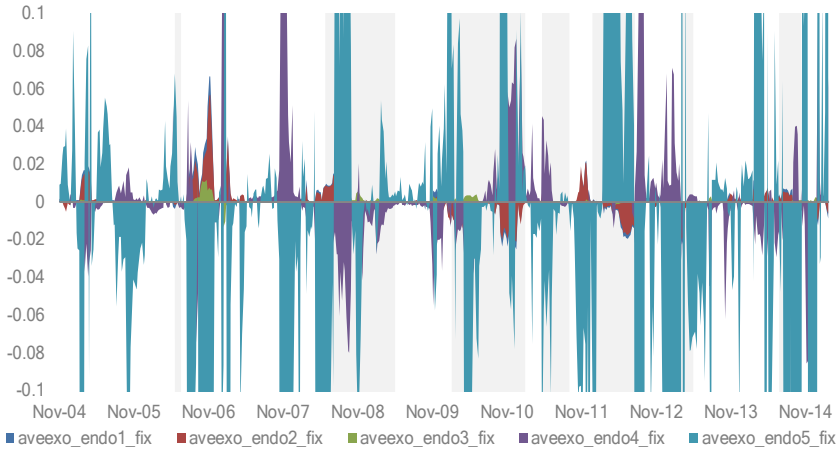
ANNEX: Future research ideas

- Use set of funds identified as relevant ones for
  - Identifying their particular characteristics as potential drivers for systemic risk;
  - Use isolated systemic risk drivers for ex ante identification of funds warranting stepped up monitoring
- Use set of funds identified as relevant ones in different fund industries
  - To analyse cross-sectorial interdependencies;
  - To isolate specific factors driving the different segments of the fund industry.
- Use asset managers managing funds identified as relevant ones
  - To run network analysis for connectivity to other financial sectors (bank, insurers, pension funds).
- Compare return-based interconnectedness indicators with exposure-based ones

Annex: Ancillary results
Fixed effects impact on individual returns, etc.



Note: Fractions of regressions with estimators reported as significant at a 99% level multiplied by average strength of respective estimators. Areas of financial crisis report....
Sources: Thomson Reuters Lipper, Thomson Reuter Datastream, ESMA.



Note: Average strength of estimators reported as significant at a 99% level . Areas of financial crisis report....
Sources: Thomson Reuters Lipper, Thomson Reuter Datastream, ESMA.

- FE matter for individual returns...
  - 3-4% of ø sector mean return explained by FE, 50% of funds with significant coefficients.
  - Occasionally FE flare up to levels able to explain (or exceed) the entire ø RoR of the industry.
  - Size of ø FE is weakly neg. correlated with financial stress periods.
- FE for individual returns and mean indicate relevance of management capacities (alphas)
- In crisis times alpha negative, implying return lowering influence of management (✋)

Annex: Structure of algorithm used