ING 🦁 Memo

INVESTMENT MANAGEMENT

Van
G Baltussen, PhD
Afdeling
Structured Investment
Strategies
Locatiecode
HP
Pagina
1/36

Onderwerp
Market directional strategy: Trend signal

Datum
1 Mei 2012

I. Overview

This document describes the fundamental idea and definition (Section II), performance (Section III), robustness (Section IV), turnover and net performance (Section V), other aspects (Section VI), and the added value over other signals (Section VII) for the Equity Market *Momentum* signals (both *long-term* and *short-term*) in the active RBI equity market timing (MRP) strategy. The document concludes with a proposal (Section VIII) and the strategy scorecard (Section IX).

II. Idea and definition

Long-term equity market investor herding (long-term momentum)

Economic rationale:
In general, information tends to come in successive strings of good or bad news and investors underreact to this persistence in information flow, as well as to trends. Moreover, form their expectations based on spotted patterns in past returns (representativeness) and investors tend to flock together in their expectations and behaviour (herding).

Empirical measure:
Equity futures return over the past 12 months minus the past 3 months. We take the magnitude of this trend, the reliability of this trend (t-value), and the consistency of this trend (number of up minus number of down days). A positive (negative) value signals that we expect markets to move up (down).

Performance expectations:

Schenkkade 65, Postbus 90470, 2509 LL Den Haag
T (070) 378 18 61
E Guido.Baltussen@ingim.com

Memo vervolg

Onderwerp
Market directional and volatility strategies

Pagina
2/36

Datum
20 april 2012

We expect a good performance of this variable as long as investor herd, extrapolate past trends, or underreact to news flows that come in a successive string, and the resulting opportunities are not arbitraged away. Since behaviour of investors tend to be quite persistent, and arbitrage trades tend to be very risky in this strategy we continue to expect a good performance going forward during trending markets. Due to the nature of this theme and the rigidness in the empirical measure we may expect underperformance during turbulent ranging or during turning markets.

References (containing additional evidence):
Asness, Moskowitz and Pedersen, 2010
Moskowitz, Ooi, and Pedersen, 2010
Jegadeesh and Titman, 1993

Short-term equity market investor herding (short-term momentum)

Economic rationale:
In general, information tends to come in successive strings of good or bad news and investors underreact to this persistence in information flow, as well as to trends. Moreover, form their expectations based on spotted patterns in past returns (representativeness) and investors tend to flock together in their expectations and behaviour (herding).

Empirical measure:
Equity futures return over the past 2 months minus the past week. We take the magnitude of this trend, the reliability of this trend (t-value), and the consistency of this trend (number of up minus number of down days). A positive (negative) value signals that we expect markets to move up (down).

Performance expectations:
We expect a good performance of this variable as long as investor herd, extrapolate past trends, or underreact to news flows that come in a successive string, and the resulting opportunities are not arbitraged away. Since behaviour of investors tend to be quite persistent, and arbitrage trades tend to be very risky in this strategy we continue to expect a good performance going forward during trending markets. Due to the nature of this theme and the rigidness in the empirical measure we may expect underperformance during turbulent ranging or during turning markets.

References:
Asness, Moskowitz and Pedersen, 2010
Moskowitz, Ooi, and Pedersen, 2010

Onderwerp
Market directional and volatility strategies

Pagina
3/36
Datum
20 april 2012

III. Main strategy results

The results in this section are based on volatility-weighted bet sizes (based on a EWMA on weekly data with $\lambda=0.97$). We translate each momentum measure in -1, 0 or +1 signals to exploit the direction of the signal using neutral zones of -0.2 to +0.2 and based on ranking of the trend variable over the past 5 years. The magnitude, reliability and consistency of trend are averaged by weighting them in the ratio 1:1:2. We apply the backtest methodology, settings and criteria of the 'SIS active call overwriting strategies'.[1] This implies that most tables and figures in this document display the results of the strategies based on ranking the variable and translating these to -100% to +100% (Ranks), the sign of the variable (Dummies) and the sign of the ranks (Long-Short). The sample period runs from January 1996 to July 2010.
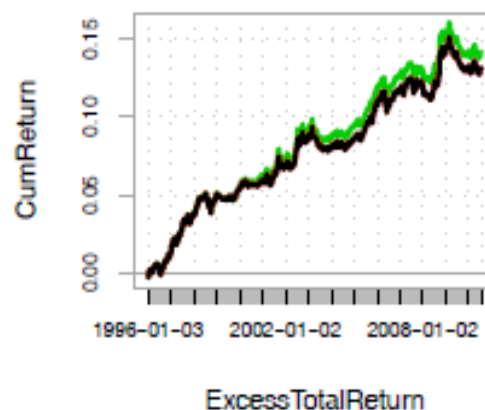
<u>Long-term equity market investor herding (long-term momentum)</u>
The main performance statistics and results are summarized below:

Main performance statistics

Results	MRP
Sharpe Ranks	0.81
Sharpe Dummies	**0.81**
Sharpe Long-Short	0.89
HitRatio Ranks	56%
HitRatio Dummies	**56%**
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	11
Expected Effect	**++**
Pass/Fail level	3

Cumulative performance

ExcessTotalReturn

---

[1] See the documents in \\Sadnl\dfsnl\GRNL01\1739\Strategies\PDF\Reports.

Onderwerp
Market directional and volatility strategies

Pagina
4/36
Datum
20 april 2012
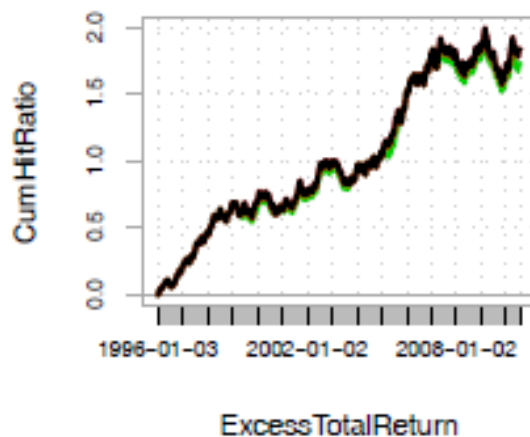
Cumulative hitratio

ExcessTotalReturn

Short-term equity market investor herding (long-term momentum)

The main performance statistics and results are summarized below:

Main performance statistics

Results	MRP
Sharpe Ranks	0.42
Sharpe Dummies	0.42
Sharpe Long-Short	0.38
HitRatio Ranks	55%
HitRatio Dummies	55%
Universa (Sh>0)	3
Subperiods (Sh>0)	3
Scenarios (Sh>0)	11
Expected Effect	+ +
Pass/Fail level	3

Cumulative performance

ExcessTotalReturn

Memo vervolg
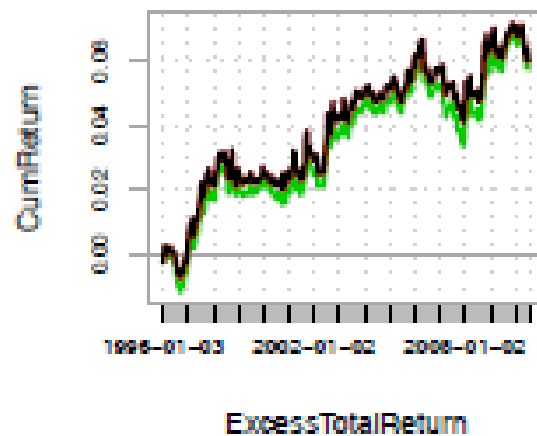
Onderwerp
Market directional and volatility strategies

Pagina
5/36
Datum
20 april 2012

Cumulative hitratio
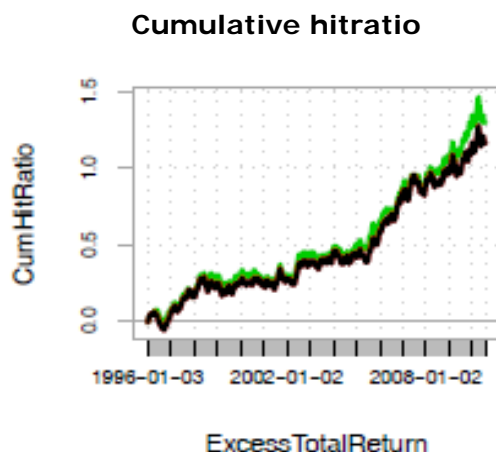
More detailed results can be found in 'Predictive Analyses EquityFutureLTTrendSignalWEEKLYSTRATEGYVolweighted.pdf' and 'Predictive Analyses EquityFutureSTTrendSignalWEEKLYSTRATEGYVolweighted.pdf'. Note that more results (e.g. non-volatility adjusted, the January 1980 to August 2011 sample period, results for the Eurostoxx 50 index only, additional statistics and criteria (e.g. Timing Information Ratio, Sortino, Maximum Drawdown, Stability)) and explanations of the testing framework, data, variables and methodology can be found in earlier strategy documents and presentations.[2]

IV. Robustness

<u>Long-term equity market investor herding (long-term momentum)</u>
The results are similar: when using raw (meaning non-volatility controlled) positions, as displayed below.

Main performance statistics

Results	MRP
Sharpe Ranks	0.82
Sharpe Dummies	**0.69**
Sharpe Long-Short	0.65
HitRatio Ranks	59%
HitRatio Dummies	**56%**
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	11
Expected Effect	**++**
Pass/Fail level	3

Cumulative performance

ExcessTotalReturn

---
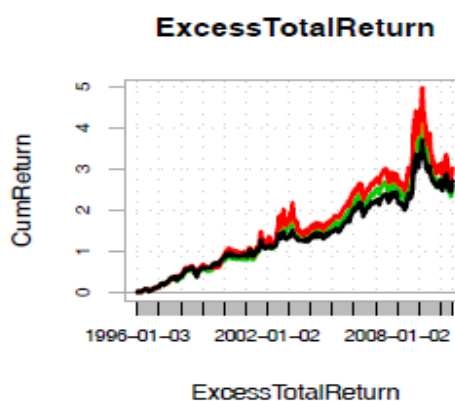
[2] See the documents in \\Sadnl\dfsnl\GRNL01\1739\Strategies\PDF\Reports and
\\Sadnl\dfsnl\GRNL01\1739\Strategies\PDF\ActiveCO\Development\Research Reports and its subfolders.

ING 🦁

Memo vervolg

Onderwerp
Market directional and volatility strategies

Pagina
6/36
Datum
20 april 2012

Moreover, we obtain similar results when we consider each trend variable (magnitude, reliability, and consistency) in isolation, when we consider only the ranks or dummy signals of the trend variable, or when we consider daily rebalancing over an extended (Jan1980-Aug2011) sample period (shown are the results of the magnitude of a trend, but results for the reliability and consistency are comparable), as can be seen below and in 'Active Option Strategy Development_main results_weekly TREND.pdf'. Note that all results impose non-volatility controlled bets.

Magnitude of the LT trend

Results	MRP
Sharpe Ranks	0.49
Sharpe Dummies	0.65
Sharpe Long-Short	0.53
HitRatio Ranks	56%
HitRatio Dummies	56%
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	10
Expected Effect	++
Pass/Fail level	3

Magnitude of the LT trend (ranks/dummy)

Results	MRP	
Sharpe Ranks	0.79	
Sharpe Dummies	0.62	
Sharpe Long-Short	0.64	
HitRatio Ranks	57%	
HitRatio Dummies	57%	
Universa (Sh>0)	4	
Subperiods (Sh>0)	4	
Scenarios (Sh>0)	11	
Expected Effect	++	
Pass/Fail level	3	

Reliability of the LT trend

Results	MRP
Sharpe Ranks	0.47
Sharpe Dummies	0.65
Sharpe Long-Short	0.48
HitRatio Ranks	56%
HitRatio Dummies	56%
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	9
Expected Effect	++
Pass/Fail level	3

Reliability of the LT trend (ranks/dummy)

Results	MRP
Sharpe Ranks	0.78
Sharpe Dummies	0.60
Sharpe Long-Short	0.65
HitRatio Ranks	58%
HitRatio Dummies	57%
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	11
Expected Effect	++
Pass/Fail level	3

Consistency of the LT trend

Results	MRP
Sharpe Ranks	0.58
Sharpe Dummies	0.71
Sharpe Long-Short	0.60
HitRatio Ranks	58%
HitRatio Dummies	56%
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	11
Expected Effect	++
Pass/Fail level	3

Consistency of the LT trend (ranks/dummy)

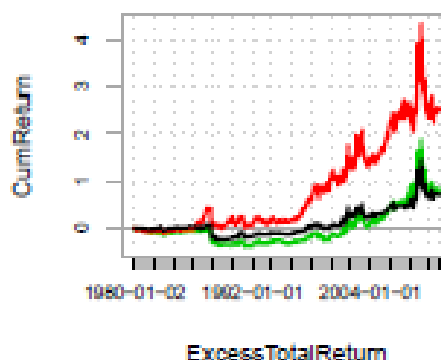| Results	MRP
Sharpe Ranks	0.83
Sharpe Dummies	0.69
Sharpe Long-Short	0.69
HitRatio Ranks	59%
HitRatio Dummies	56%
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	11
Expected Effect	++
Pass/Fail level	3

Onderwerp
Market directional and volatility strategies

Pagina
7/36
Datum
20 april 2012

Jan1980-Aug2011 sample period

Results	MRP
Sharpe Ranks	0.22
Sharpe Dummies	0.39
Sharpe Long-Short	0.20
HitRatio Ranks	52%
HitRatio Dummies	53%
Expected Effect	++

Jan1980-Aug2011 sample period

ExcessTotalReturn

Further, the results are slightly worse when using returns up to 9 months ago instead of returns up to 12 months ago for the long-term trend variable (see below). Moreover, qualitatively a 12-month horizon (i.e. past year) seems more consistent with the way investors look at markets then a 9-month horizon (i.e. past 3 quarters), and a longer lag generally reduces turnover.

Main performance statistics (magnitude 12m-3m)

Results	MRP
Sharpe Ranks	0.49
Sharpe Dummies	0.65
Sharpe Long-Short	0.53
HitRatio Ranks	56%
HitRatio Dummies	56%
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	10
Expected Effect	++
Pass/Fail level	3

Main performance statistics (magnitude 9m-3m)

Results	MRP
Sharpe Ranks	0.39
Sharpe Dummies	0.37
Sharpe Long-Short	0.28
HitRatio Ranks	53%
HitRatio Dummies	55%
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	10
Expected Effect	++
Pass/Fail level	3

Main performance statistics (reliability 12m-3m)

Results	MRP
Sharpe Ranks	0.47
Sharpe Dummies	0.65
Sharpe Long-Short	0.48
HitRatio Ranks	56%
HitRatio Dummies	56%
Universa (Sh>0)	4
Subperiods (Sh>0)	4

Main performance statistics (reliability 9m-3m)

Results	MRP
Sharpe Ranks	0.36
Sharpe Dummies	0.37
Sharpe Long-Short	0.20
HitRatio Ranks	52%
HitRatio Dummies	55%
Universa (Sh>0)	4
Subperiods (Sh>0)	3

Onderwerp
Market directional and volatility strategies

Scenarios (Sh>0)	9
Expected Effect	++
Pass/Fail level	3

Scenarios (Sh>0)	9
Expected Effect	++
Pass/Fail level	3

Main performance statistics (consistency 12m-3m)

Results	MRP
Sharpe Ranks	0.58
Sharpe Dummies	0.71
Sharpe Long-Short	0.60
HitRatio Ranks	58%
HitRatio Dummies	56%
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	11
Expected Effect	++
Pass/Fail level	3

Main performance statistics (consistency 9m-3m)

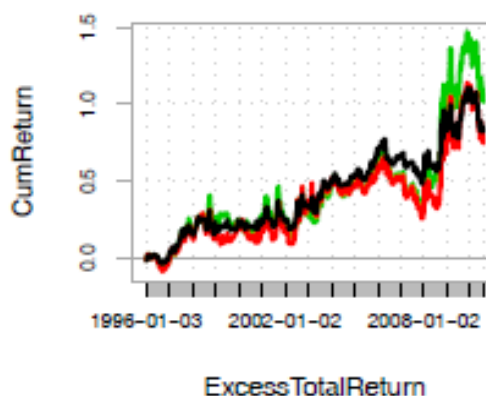| Results	MRP
Sharpe Ranks	0.52
Sharpe Dummies	0.61
Sharpe Long-Short	0.50
HitRatio Ranks	55%
HitRatio Dummies	56%
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	10
Expected Effect	++
Pass/Fail level	3

Short-term equity market investor herding (long-term momentum)
The results are similar: when using raw (meaning non-volatility controlled) positions, as displayed below.

Main performance statistics

Results	MRP
Sharpe Ranks	0.44
Sharpe Dummies	**0.33**
Sharpe Long-Short	0.39
HitRatio Ranks	57%
HitRatio Dummies	**54%**
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	11
Expected Effect	**++**
Pass/Fail level	3

Cumulative performance

ExcessTotalReturn

Moreover, we obtain similar results when we consider each trend variable (magnitude, reliability, and consistency) in isolation, when we consider only the ranks or dummy signals of the trend variable, or when we consider daily rebalancing over an extended (Jan1980-Aug2011) sample period (shown are the results of the magnitude of a trend, but results for the reliability and consistency are comparable), as can be seen below and in 'Active Option Strategy Development_main results_weekly TREND.pdf'. Note that all results impose non-volatility controlled bets.

ING 🦁

Memo vervolg

Onderwerp
Market directional and volatility strategies

Pagina
9/36

Datum
20 april 2012

Magnitude of the ST trend

Results	MRP
Sharpe Ranks	0.34
Sharpe Dummies	0.30
Sharpe Long-Short	0.42
HitRatio Ranks	54%
HitRatio Dummies	53%
Universa (Sh>0)	4
Subperiods (Sh>0)	3
Scenarios (Sh>0)	11
Expected Effect	++
Pass/Fail level	3

Magnitude of the ST trend (ranks/dummy)

Results	MRP
Sharpe Ranks	0.41
Sharpe Dummies	0.31
Sharpe Long-Short	0.26
HitRatio Ranks	54%
HitRatio Dummies	54%
Universa (Sh>0)	3
Subperiods (Sh>0)	3
Scenarios (Sh>0)	11
Expected Effect	++
Pass/Fail level	3

Reliability of the ST trend

Results	MRP
Sharpe Ranks	0.30
Sharpe Dummies	0.30
Sharpe Long-Short	0.40
HitRatio Ranks	54%
HitRatio Dummies	53%
Universa (Sh>0)	3
Subperiods (Sh>0)	3
Scenarios (Sh>0)	10
Expected Effect	++
Pass/Fail level	3

Reliability of the ST trend (ranks/dummy)

Results	MRP
Sharpe Ranks	0.42
Sharpe Dummies	0.31
Sharpe Long-Short	0.28
HitRatio Ranks	56%
HitRatio Dummies	55%
Universa (Sh>0)	3
Subperiods (Sh>0)	3
Scenarios (Sh>0)	11
Expected Effect	++
Pass/Fail level	3

Consistency of the ST trend

Results	MRP
Sharpe Ranks	0.37
Sharpe Dummies	0.39
Sharpe Long-Short	0.36
HitRatio Ranks	55%
HitRatio Dummies	55%
Universa (Sh>0)	4
Subperiods (Sh>0)	3
Scenarios (Sh>0)	10
Expected Effect	++
Pass/Fail level	3

Jan1980-Aug2011 sample period

Consistency of the ST trend (ranks/dummy)

Results	MRP
Sharpe Ranks	0.52
Sharpe Dummies	0.38
Sharpe Long-Short	0.47
HitRatio Ranks	57%
HitRatio Dummies	55%
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	11
Expected Effect	++
Pass/Fail level	3

Jan1980-Aug2011 sample period

Onderwerp
Market directional and volatility strategies

Results	MRP
Sharpe Ranks	0.14
Sharpe Dummies	0.24
Sharpe Long-Short	0.22
HitRatio Ranks	51%
HitRatio Dummies	51%
Expected Effect	++

ExcessTotalReturn
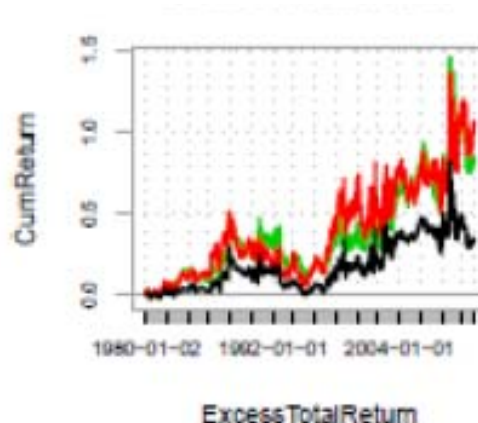
Further, the results are slightly worse when using returns up to 1 month ago instead of returns up to 3 months ago for the long-term trend variable (see below). Moreover, a longer lag generally reduces turnover.

Main performance statistics (magnitude 3m-1w)

Results	MRP
Sharpe Ranks	0.34
Sharpe Dummies	0.30
Sharpe Long-Short	0.42
HitRatio Ranks	54%
HitRatio Dummies	53%
Universa (Sh>0)	4
Subperiods (Sh>0)	3
Scenarios (Sh>0)	11
Expected Effect	++
Pass/Fail level	3

Main performance statistics (magnitude 1m-1w)

Results	MRP
Sharpe Ranks	0.27
Sharpe Dummies	0.19
Sharpe Long-Short	0.19
HitRatio Ranks	52%
HitRatio Dummies	52%
Universa (Sh>0)	3
Subperiods (Sh>0)	3
Scenarios (Sh>0)	10
Expected Effect	++
Pass/Fail level	3

Main performance statistics (reliability 3m-1w)

Results	MRP
Sharpe Ranks	0.30
Sharpe Dummies	0.30
Sharpe Long-Short	0.40
HitRatio Ranks	54%
HitRatio Dummies	53%
Universa (Sh>0)	3
Subperiods (Sh>0)	3
Scenarios (Sh>0)	10
Expected Effect	++
Pass/Fail level	3

Main performance statistics (reliability 1m-1w)

Results	MRP
Sharpe Ranks	0.19
Sharpe Dummies	0.19
Sharpe Long-Short	0.10
HitRatio Ranks	51%
HitRatio Dummies	52%
Universa (Sh>0)	3
Subperiods (Sh>0)	2
Scenarios (Sh>0)	10
Expected Effect	++
Pass/Fail level	1

Onderwerp
Market directional and volatility strategies

Main performance statistics (consistency 3m-1w)

Results	MRP
Sharpe Ranks	0.37
Sharpe Dummies	0.39
Sharpe Long-Short	0.36
HitRatio Ranks	55%
HitRatio Dummies	54%
Universa (Sh>0)	4
Subperiods (Sh>0)	3
Scenarios (Sh>0)	10
Expected Effect	++
Pass/Fail level	3

Main performance statistics (consistency 1m-1w)

Results	MRP
Sharpe Ranks	0.29
Sharpe Dummies	0.18
Sharpe Long-Short	0.16
HitRatio Ranks	50%
HitRatio Dummies	51%
Universa (Sh>0)	3
Subperiods (Sh>0)	4
Scenarios (Sh>0)	10
Expected Effect	++
Pass/Fail level	0

V. Net performance and turnover analysis

Each variable induces a certain turnover, which limit its net profitability. Therefore, it may be optimal to smooth a variable and include buffers around a signal to reduce its turnover.

We prefer using a EWMA of the variable with a decay factor of 0.40 on a daily signal to reduce noise and outliers or data errors in a signal. This EWMA smoothing assign all weight to the signal over the past 2 weeks, with 40% assigned to today's signal. Since reliable backtesting on the effectiveness of this approach is hard, we made this choice based on its qualitative properties (short-term smoothing with most weight assigned to the recent observations).

For analysing the effect of buffers we take the following approach. First, we estimate the gross IR of the strategy based on the ranks (or another transformation of the variable that results in positions distributed between -100% and +100%). Second, we estimate the correlation between the strategy returns on the buffered positions and this rank signal strategy. Then our estimated of the gross IR of the buffered strategy equals the correlation times the gross IR of the rank signal strategy. The advantage of this approach over computing the 'actual' gross IR of the buffered strategy is that we avoid that noise in the buffered strategy improves the gross IR of that strategy. A buffered strategy is by definition a worse way to capture an idea then the rank signal strategy, and an improvement of the gross IR would as a consequence reflect pure noise. Third, we estimated the turnover (single-trip) on the buffered strategy, compute its total annual transaction cost, and divided this by the volatility of the buffered strategy to get the hurdle ratio. Finally, we compute the net IR as the difference between the gross IR and this hurdle ratio.

Onderwerp
Market directional and volatility strategies

The table below contains the results of this approach when applied to the Long-Term (LT) and Short-Term (ST) trend variables in the MRP strategy, where Signal stand for the rank based signal strategy (which is actually constructed using the p-values belonging to a Z-score), and Position stand for the translation of the Signal into a -1 position if the signal is below -20%, a 0 position if the signal is between -20% and +20%, and a +1 position if the signal is above +20%. "Expected Net IR" contains the net IR of this strategy using the approach outlined above. The subsequent columns apply a buffer to the Positions and show also the net IR.

Long-term equity market investor herding (long-term momentum)

LT TREND

OVERVIEW OF RESULTS

IR					Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer
EquityFutureTrend52w3m	Gross (Signal)	Gross (Position)	Net (Position)	Expected Net IR	5.00%	10.00%	15.00%	20.00%	25.00%	30.00%	35.00%	40.00%
EW	0.49	0.56	0.53	0.43	0.45	0.45	0.45	0.45	0.46	0.46	0.45	0.45
SPX	0.33	0.35	0.32	0.29	0.30	0.31	0.31	0.31	0.31	0.31	0.31	0.31
FTSE	0.32	0.29	0.26	0.26	0.28	0.28	0.28	0.29	0.29	0.29	0.29	0.28
E50	0.53	0.63	0.61	0.49	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
N225	0.22	0.31	0.29	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19

40-20-40 =>

OVERVIEW OF RESULTS

IR					Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer
EquityFutureRATrend52w:	Gross (Signal)	Gross (Position)	Net (Position)	Expected Net IR	5.00%	10.00%	15.00%	20.00%	25.00%	30.00%	35.00%	40.00%
EW	0.59	0.57	0.53	0.53	0.54	0.55	0.55	0.55	0.55	0.55	0.55	0.54
SPX	0.36	0.36	0.33	0.32	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
FTSE	0.42	0.42	0.39	0.36	0.37	0.38	0.38	0.38	0.38	0.38	0.38	0.37
E50	0.64	0.50	0.49	0.59	0.59	0.59	0.59	0.59	0.59	0.58	0.58	0.58
N225	0.25	0.34	0.31	0.21	0.22	0.22	0.23	0.22	0.22	0.22	0.22	0.22

40-20-40

OVERVIEW OF RESULTS

IR					Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer
EquityFutureFlame52w3m	Gross (Signal)	Gross (Position)	Net (Position)	Expected Net IR	5.00%	10.00%	15.00%	20.00%	25.00%	30.00%	35.00%	40.00%
EW	0.60	0.62	0.58	0.55	0.56	0.57	0.57	0.57	0.57	0.57	0.57	0.56
SPX	0.38	0.46	0.43	0.33	0.35	0.35	0.35	0.35	0.35	0.34	0.34	0.34
FTSE	0.29	0.36	0.32	0.24	0.25	0.26	0.26	0.26	0.26	0.26	0.25	0.25
E50	0.69	0.54	0.52	0.63	0.64	0.64	0.64	0.63	0.63	0.63	0.63	0.62
N225	0.27	0.35	0.32	0.23	0.24	0.24	0.25	0.25	0.25	0.25	0.25	0.24

40-20-40

Onderwerp
Market directional and volatility strategies

Pagina
13/36
Datum
20 april 2012

Short-term equity market investor herding (long-term momentum)

ST TREND

OVERVIEW OF RESULTS

IR

EquityFutureTrend3r	Gross (Signal)	Gross (Position)	Net (Position)	Expected Net IR	Buffer 5.00%	Buffer 10.00%	Buffer 15.00%	Buffer 20.00%	Buffer 25.00%	Buffer 30.00%	Buffer 35.00%	Buffer 40.00%
EW	0.23	0.28	0.18	0.12	0.15	0.16	0.17	0.17	0.17	0.18	0.18	0.17
SPX	0.05	-0.01	-0.08	-0.02	-0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.00
FTSE	-0.09	-0.01	-0.10	-0.18	-0.15	-0.14	-0.14	-0.13	-0.12	-0.12	-0.12	-0.12
E50	0.37	0.44	0.38	0.29	0.31	0.31	0.32	0.32	0.32	0.32	0.31	0.31
N225	0.32	0.32	0.25	0.23	0.25	0.26	0.26	0.26	0.27	0.27	0.27	0.26

40-20-40

OVERVIEW OF RESULTS

IR

EquityFutureRATren	Gross (Signal)	Gross (Position)	Net (Position)	Expected Net IR	Buffer 5.00%	Buffer 10.00%	Buffer 15.00%	Buffer 20.00%	Buffer 25.00%	Buffer 30.00%	Buffer 35.00%	Buffer 40.00%
EW	0.28	0.27	0.17	0.17	0.20	0.21	0.22	0.22	0.22	0.22	0.22	0.22
SPX	0.04	-0.04	-0.12	-0.04	-0.02	-0.01	0.00	0.01	0.01	0.01	0.01	0.00
FTSE	-0.10	0.03	-0.06	-0.18	-0.15	-0.14	-0.14	-0.13	-0.13	-0.12	-0.12	-0.12
E50	0.44	0.44	0.38	0.35	0.37	0.38	0.38	0.38	0.37	0.37	0.37	0.36
N225	0.40	0.29	0.22	0.31	0.32	0.33	0.34	0.34	0.34	0.33	0.33	0.33

40-20-40

OVERVIEW OF RESULTS

IR

EquityFutureFlame3r	Gross (Signal)	Gross (Position)	Net (Position)	Expected Net IR	Buffer 5.00%	Buffer 10.00%	Buffer 15.00%	Buffer 20.00%	Buffer 25.00%	Buffer 30.00%	Buffer 35.00%	Buffer 40.00%
EW	0.34	0.37	0.26	0.22	0.25	0.27	0.28	0.28	0.28	0.28	0.28	0.27
SPX	0.00	0.01	-0.08	-0.09	-0.06	-0.05	-0.04	-0.04	-0.04	-0.03	-0.04	-0.04
FTSE	0.03	0.01	-0.08	-0.06	-0.03	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01
E50	0.52	0.56	0.50	0.43	0.46	0.46	0.46	0.46	0.46	0.46	0.45	0.44
N225	0.31	0.33	0.28	0.24	0.25	0.26	0.27	0.27	0.27	0.26	0.26	0.26

40-20-40

The effects of turnover reduction and the buffer are further depicted below (the upper lines apply to the short-term trend strategies and the lower lines to the long-term trend strategies):

Onderwerp
Market directional and volatility strategies

Pagina
14/36
Datum
20 april 2012

Trend signals Turnover vs Buffer
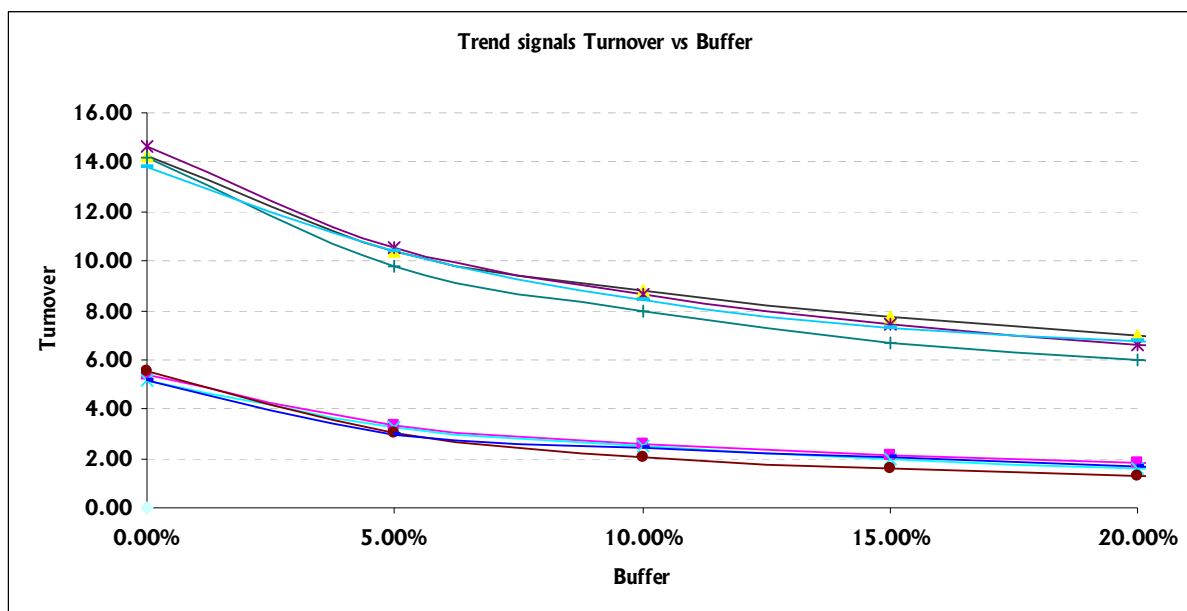
In short, the strategies remain profitable after transaction costs. Furthermore, applying a 5% or higher buffer reduces turnover (and hence transaction costs) substantially without sacrificing much performance. The expected net IR is similar for the various buffers.

VI. Other research questions

Long-term equity market investor herding (long-term momentum)

Expanding window vs. rolling window ranking:
To translate the raw variable to a signal we have to apply a rank or z-score transformation over a specific time period. In the framework so far we choose for a rolling 5-year period to select a long, stationary time period, but still be dynamic to capture changes in the behaviour of a variable over time. The figure below depicts the distribution of the values of the magnitude of the long-term momentum variable used in the rank or z-score transformation at each point in time (the lines represent various percentiles of the distribution at each point in time with the corresponding values that belong to that percentile on the y-axis).
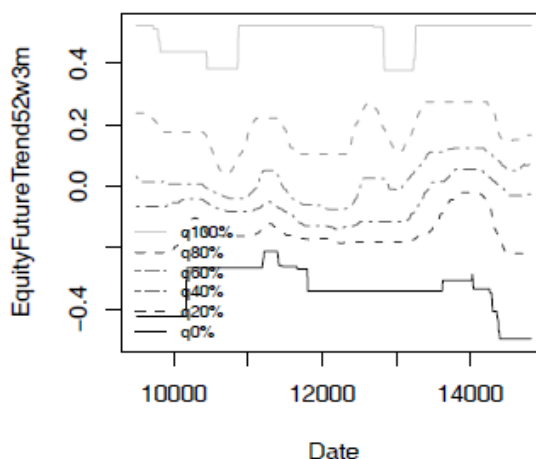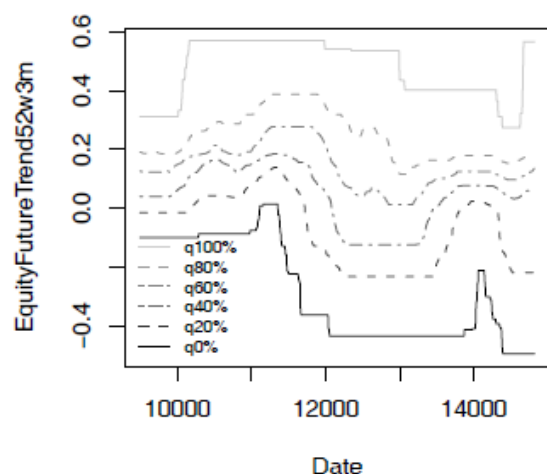
Onderwerp
Market directional and volatility strategies
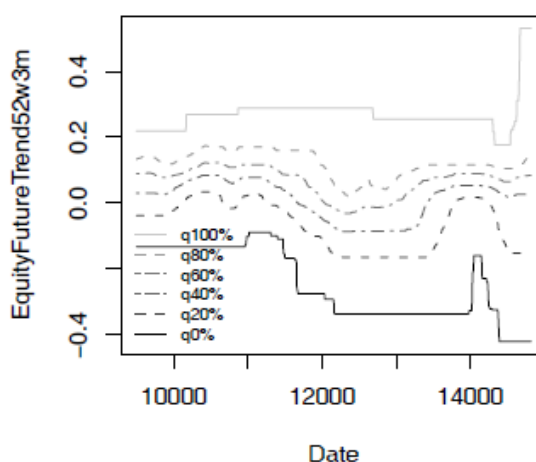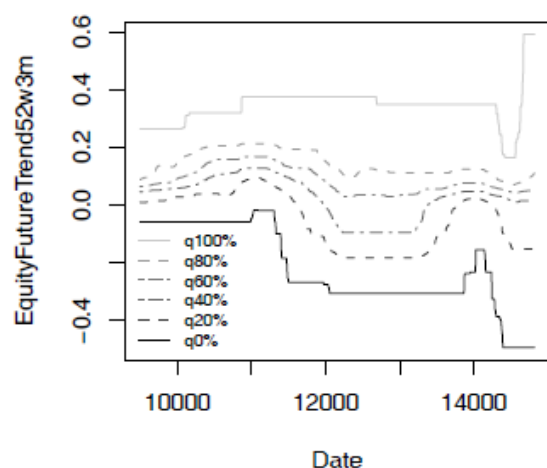
We can observe that the distribution seems quite stable, but that it also displays some variability over time. This variability introduces noise in the construction of the variable, so we may question if using a longer time period is not better. The figure below depicts the distribution of the variable used in the rank or z-score transformation at each point in time when we use an expanding window.
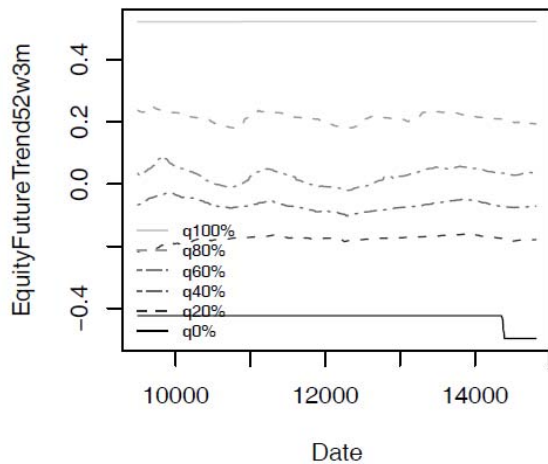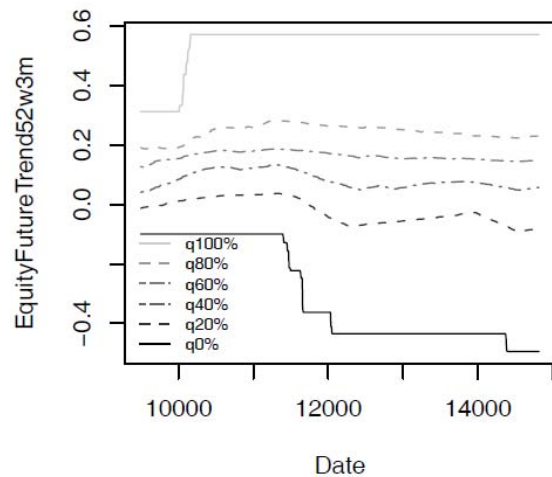
![ING logo]

Memo vervolg

Onderwerp
Market directional and volatility strategies

Pagina
16/36
Datum
20 april 2012

TS_RankDistribution_EquityFutureTrend52v TS_RankDistribution_EquityFutureTrend52
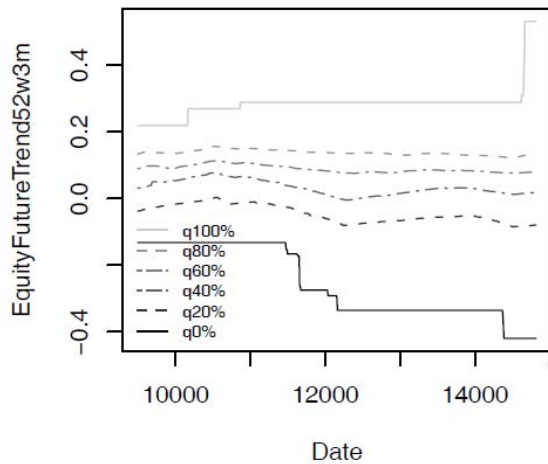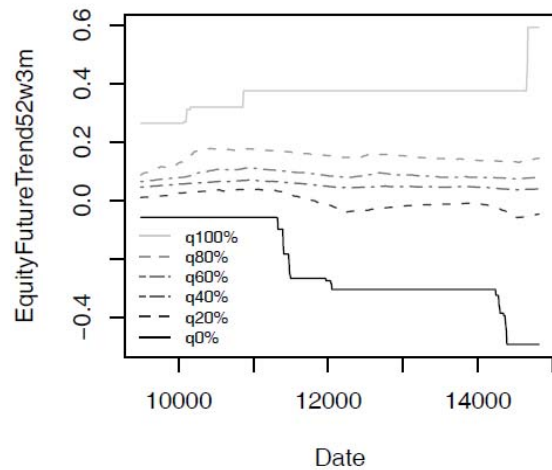
TS_RankDistribution_EquityFutureTrend52v TS_RankDistribution_EquityFutureTrend52

Clearly, the distribution is more stable than before. When studying the distribution of the reliability or consistency of the long-term trend we obtain a similar picture.

What is the effect of the neutral threshold choice?
We translate the equity market momentum variables in -1, 0 or +1 signals to exploit the direction of the signal using neutral zones of -0.2 to +0.2. This translates into taking long or short positions 40% of time and neutral positions 20% of time. We may however opt for other neutral thresholds, like 10%, 25%, 30% or 40%. Gross performances (unreported) for these alternative thresholds are comparable (that is, they are statistically indistinguishable from each other at

Onderwerp
Market directional and volatility strategies

even low levels of statistical significance), while turnover tends to increase with the threshold (for example turnover for the magnitude variable equals 4.97 per annum for a 10% threshold, 5.37 for a 20% threshold, 6.07 for a 30% threshold and 6.42 for a 40% threshold). The same holds for the correlation between the strategy returns on the positions and the rank signal strategy, resulting in a net expected IR that is more or less similar when we apply the procedure outlined in the "Net performance and turnover analysis" Section.

Do we need to de-trend the trend variable?
The use of the sign of a trend strategy, or alternatively not demeaning the trend signal, may cause a long-short bias in the positions. In fact, the long-term trend strategy has a long position 54% of time, and a short position 38% of time over our sample period. This decreases the Sharpe from 0.81 to a Timing IR of 0.78. As an alternative we might transform each component of the long-term trend signal into a z-score (as before) that we demean (to detrend, unlike before), translate these to a score between -100 and +100, and apply the cut-offs of -20 and +20 to this strategy. This results in positions that are long 47% of time and short 48% of time. Moreover, the performance is similar, as displayed below:

Main performance statistics

Results	MRP
Sharpe Ranks	0.81
Sharpe Dummies	**0.81**
Sharpe Long-Short	0.81
HitRatio Ranks	56%
HitRatio Dummies	**56%**
Universa (Sh>0)	4
Subperiods (Sh>0)	4
Scenarios (Sh>0)	11
Expected Effect	**++**
Pass/Fail level	3

Cumulative performance

ExcessTotalReturn
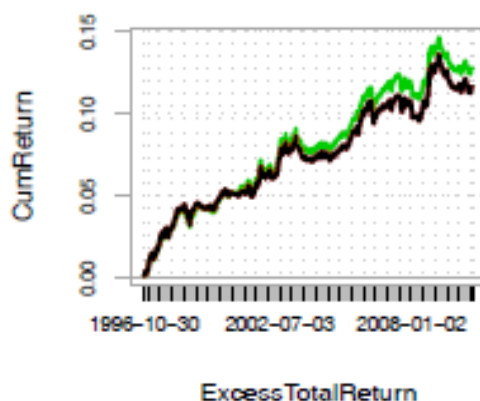
What is the relationship between magnitude, reliability and consistency?
The table below shows the correlations averaged over the 4 universa between the raw variables of the various long-term equity trend measures. As expected, all measures are highly correlated with each other, but the correlation of magnitude or reliability with consistency is relatively low (0.79-0.80) as compared to the correlation between magnitude and reliability (0.94). When we assume equal expected returns and risks of each long-term equity momentum measure than, given the correlations in the table below, an allocation of roughly 0.25-0.25-0.50 to magnitude-reliability-consistency is optimal.

	Magnitude	Reliability	Consistency
Magnitude	1.00		
Reliability	0.94	1.00	
Consistency	0.79	0.81	1.00

When does the strategy perform?
The Sharpe in the various sub-periods and scenarios we defined are given in the table below:

	MRP
Ranks Sharpe_1996-1999	1.04
Ranks Sharpe_2000-2003	0.50
Ranks Sharpe_2004-2007	0.64
Ranks Sharpe_2008-2010	0.28
Ranks Sharpe_Bear	0.62
Ranks Sharpe_Bull	0.55
Ranks Sharpe_HighVol	0.43
Ranks Sharpe_MedVol	0.09
Ranks Sharpe_LowVol	0.57
Ranks Sharpe_Rec	0.47
Ranks Sharpe_Exp	0.77
Ranks Sharpe_LowSent	0.48
Ranks Sharpe_HighSent	0.78
Ranks Sharpe_Unliquid	0.74
Ranks Sharpe_Liquid	0.53

In short, performance is positive over all sub-periods and scenarios, with the medium volatility environments being the weakest periods. Moreover, by construction we expect this variable to underperform during turning or ranging markets.

Short-term equity market investor herding (long-term momentum)

*Expanding window vs. rolling window ranking:*
To translate the raw variable to a signal we have to apply a rank or z-score transformation over a specific time period. In the framework so far we choose for a rolling 5-year period to select a long, stationary time period, but still be dynamic to capture changes in the behaviour of a variable over time. The figure below depicts the distribution of the values of the magnitude of the short-term momentum variable used in the rank or z-score transformation at each point in

Onderwerp
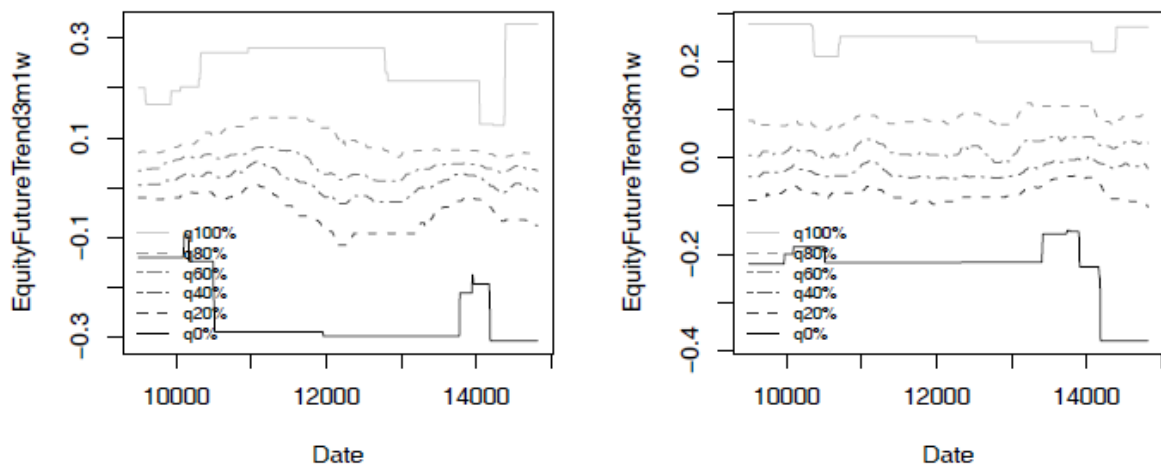Market directional and volatility strategies

Pagina
19/36
Datum
20 april 2012

time (the lines represent various percentiles of the distribution at each point in time with the corresponding values that belong to that percentile on the y-axis).
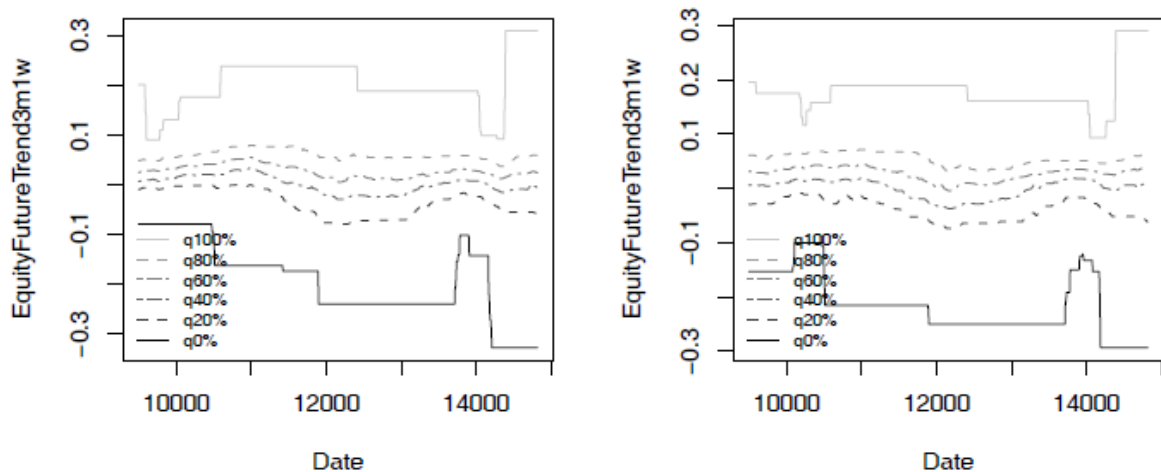
We can observe that the distribution seems quite stable, but that it also displays some variability over time (although it is very little). This variability introduces noise in the construction of the variable, so we may question if using a longer time period is not better. The figure below depicts the distribution of the variable used in the rank or z-score transformation at each point in time when we use an expanding window.

Memo vervolg

Onderwerp
Market directional and volatility strategies

Pagina
20/36
Datum
20 april 2012

TS_RankDistribution_EquityFutureTrend3m **TS_RankDistribution_EquityFutureTrend3m**

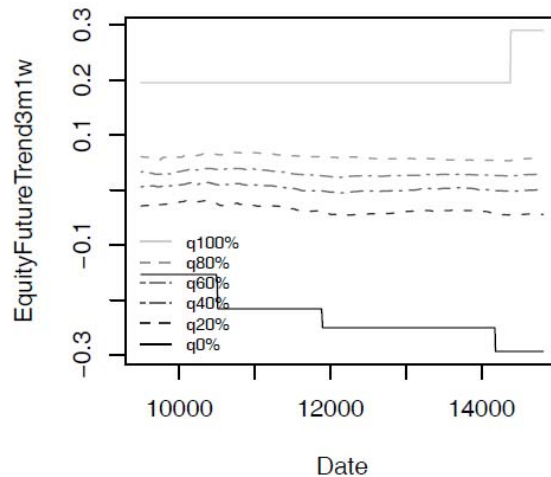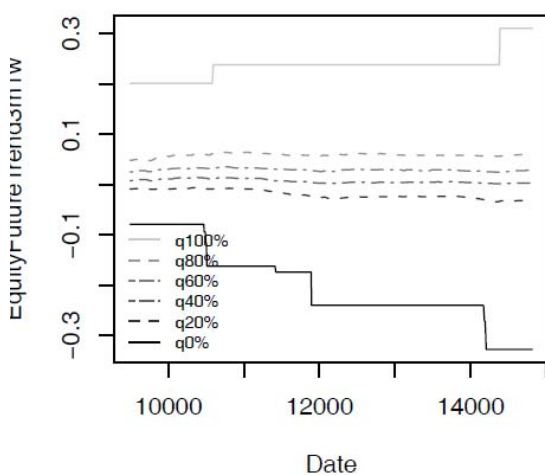**TS_RankDistribution_EquityFutureTrend3m** **TS_RankDistribution_EquityFutureTrend3m**
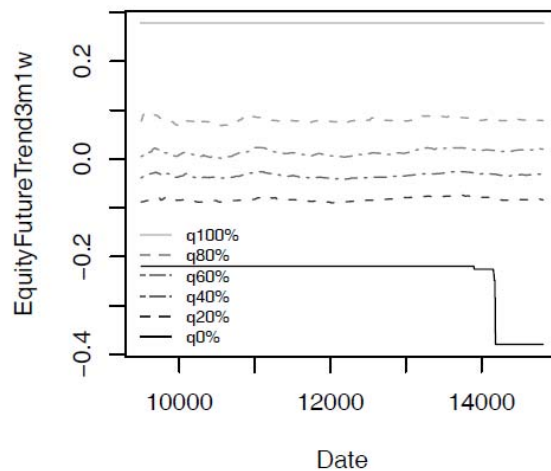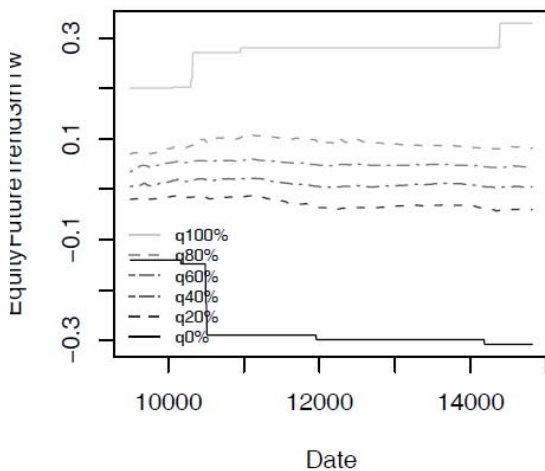
Clearly, the distribution is more stable than before. When studying the distribution of the reliability or consistency of the short-term trend we obtain a similar picture.

What is the effect of the neutral threshold choice?
We translate the equity market momentum variables in -1, 0 or +1 signals to exploit the direction of the signal using neutral zones of -0.2 to +0.2. This translates into taking long or short positions 40% of time and neutral positions 20% of time. We may however opt for other neutral thresholds, like 10%, 25%, 30% or 40%. Gross performances (unreported) for these alternative thresholds are comparable (that is, they are statistically indistinguishable from each other at

Onderwerp
Market directional and volatility strategies

Pagina
21/36
Datum
20 april 2012

even low levels of statistical significance), while turnover tends to increase with the threshold (for example turnover for the magnitude variable equals 14.12 per annum for a 10% threshold, 14.22 for a 20% threshold, 14.72 for a 30% threshold and 14.22 for a 40% threshold). The same holds for the correlation between the strategy returns on the positions and the rank signal strategy, resulting in a net expected IR that is more or less similar when we apply the procedure outlined in the "Net performance and turnover analysis" Section.

Do we need to de-trend the trend variable?
The use of the sign of a trend strategy, or alternatively not demeaning the trend signal, may cause a long-short bias in the positions. In fact, the short-term trend strategy has a long position 49% of time, and a short position 39% of time over our sample period. This decreases the Sharpe from 0.42 to a Timing IR of 0.38. As an alternative we might transform each component of the long-term trend signal into a z-score (as before) that we demean (to detrend, unlike before), translate these to a score between -100 and +100, and apply the cut-offs of -20 and +20 to this strategy. This results in positions that are long 44% of time and short 47% of time. Moreover, the performance is similar, as displayed below:

Main performance statistics

Results	MRP
Sharpe Ranks	0.43
Sharpe Dummies	**0.43**
Sharpe Long-Short	0.45
HitRatio Ranks	55%
HitRatio Dummies	**55%**
Universa (Sh>0)	4
Subperiods (Sh>0)	3
Scenarios (Sh>0)	11
Expected Effect	**++**
Pass/Fail level	3

Cumulative performance
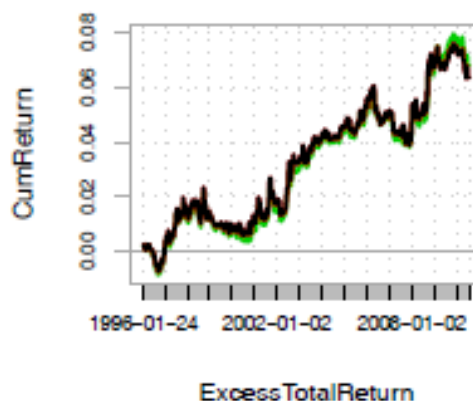
What is the relationship between magnitude, reliability and consistency?
The table below shows the correlations averaged over the 4 universa between the raw variables of the various short-term equity trend measures. As expected, all measures are highly correlated with each other, but the correlation of magnitude or reliability with consistency is relatively low (0.71-0.76) as compared to the correla   tion between magnitude and reliability (0.91). When we assume equal expected returns and risks of each long-term equity

![ING logo]

Memo vervolg

Onderwerp
Market directional and volatility strategies

Pagina
22/36
Datum
20 april 2012

momentum measure than, given the correlations in the table below, an allocation of roughly 0.25-0.25-0.50 to magnitude-reliability-consistency is optimal.

	Magnitude	Reliability	Consistency
Magnitude	1.00		
Reliability	0.91	1.00	
Consistency	0.71	0.76	1.00

When does the strategy perform?
The Sharpe in the various sub-periods and scenarios we defined are given in the table below:

	MRP
Ranks Sharpe_1996-1999	0.46
Ranks Sharpe_2000-2003	0.48
Ranks Sharpe_2004-2007	-0.14
Ranks Sharpe_2008-2010	0.38
Ranks Sharpe_Bear	0.37
Ranks Sharpe_Bull	0.41
Ranks Sharpe_HighVol	0.04
Ranks Sharpe_MedVol	0.06
Ranks Sharpe_LowVol	0.23
Ranks Sharpe_Rec	0.27
Ranks Sharpe_Exp	0.32
Ranks Sharpe_LowSent	0.24
Ranks Sharpe_HighSent	0.37
Ranks Sharpe_Unliquid	0.57
Ranks Sharpe_Liquid	0.11

In short, performance is positive over most sub-periods and scenarios, with the 2004-2007 period and liquid, or medium and high volatility environments being the weakest periods. Moreover, by construction we expect this variable to underperform during turning or ranging markets.

Which lags are driving the momentum effect?
The figures below depict the t-values (estimated suing pooled OLS and cluster-corrected standard errors) of regressing weekly returns on each equity market on the magnitude, reliability or consistency of the weekly equity returns over the past 1 to 156 weeks (so up to 3 years ago). The grey dashed lines indicate the 12 week, 52 week and 156 week values, and the red lines indicate statistical

Onderwerp
Market directional and volatility strategies

significance at the 10% and 5% levels. The return over the past week has a clear
negative effect, which turns positive up to 56 to 60 weeks (13 to 14 months),
and has no clear sign afterwards.

t-statistic by week, all universa

Volweighted (EWMA) returns (weekly) of magnitude

Memo vervolg
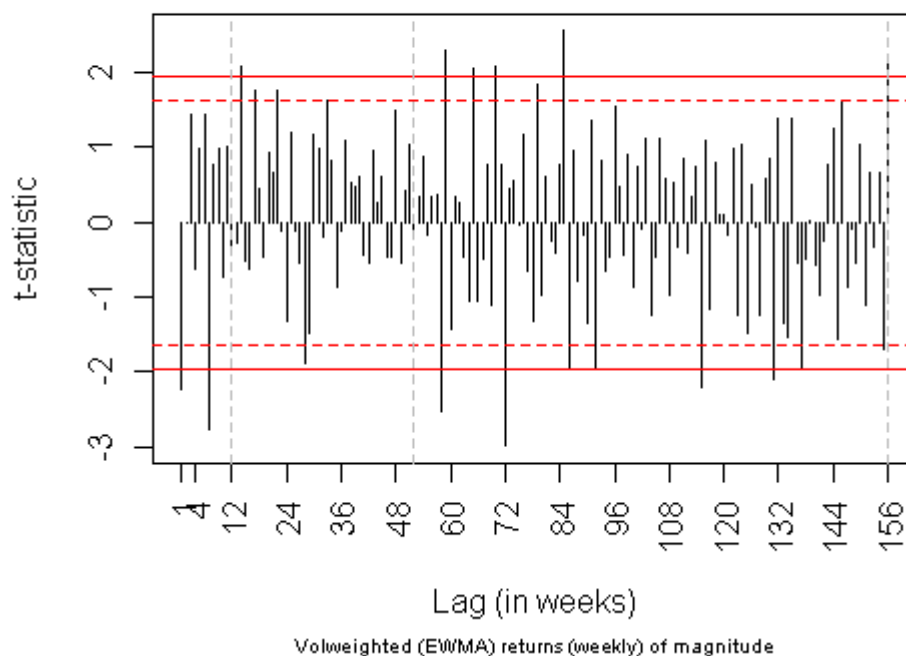
Onderwerp
Market directional and volatility strategies

Pagina
24/36
Datum
20 april 2012

t-statistic by week, all universa

Lag (in weeks)

Volweighted (EWMA) returns (weekly) of reliability

t-statistic by week, all universa

Lag (in weeks)

Volweighted (EWMA) returns (weekly) of consistency

Onderwerp
Market directional and volatility strategies

Datum
20 april 2012
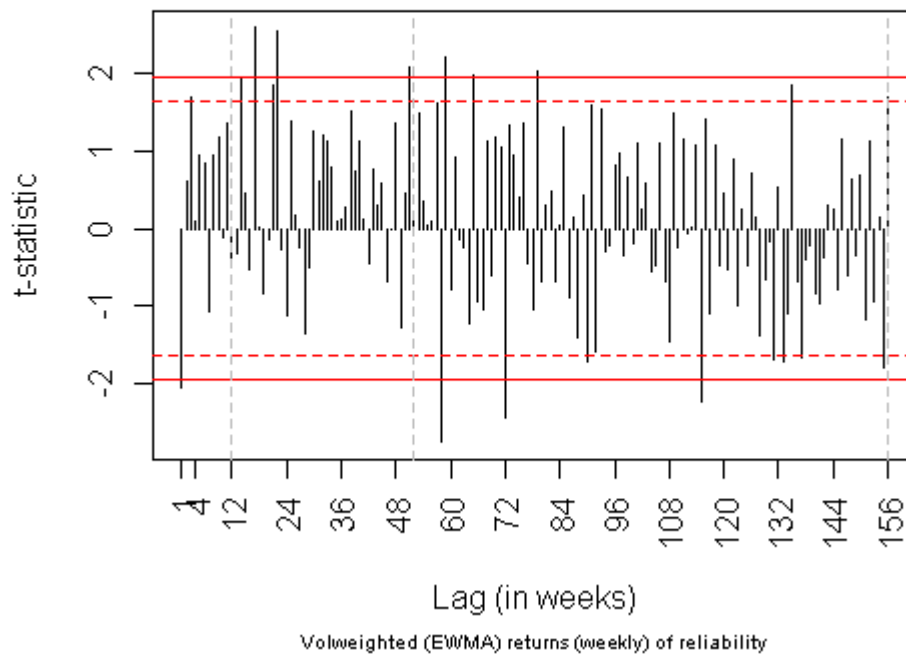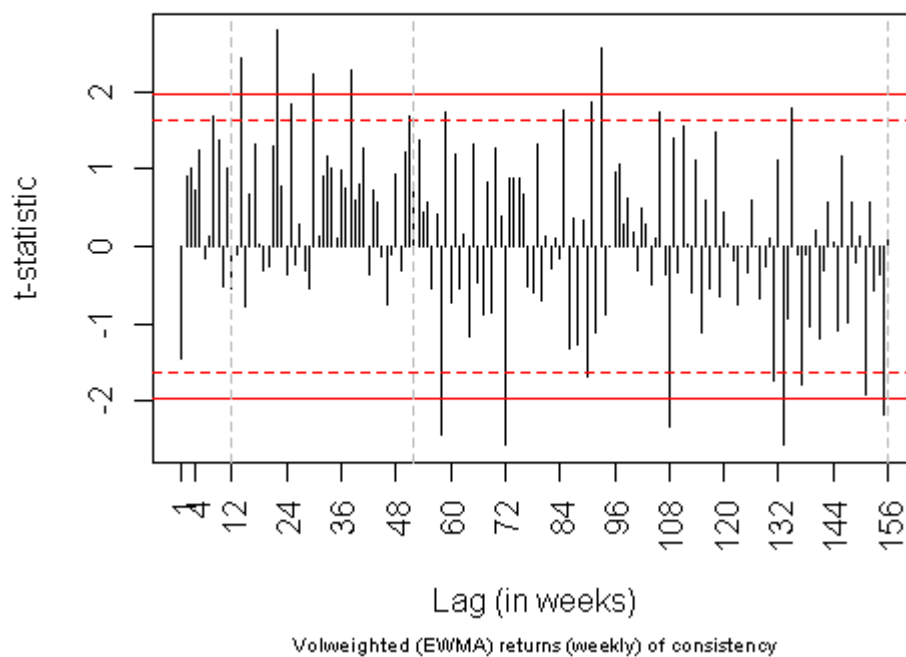
Additional evidence:
The tables and figures below shows the results for other markets, taking from own research and Moskowitz, Ooi, and Pedersen (2010).

IR (1980-2004) per Asset Class	USBOND 7-10yr	JPBOND 7-10yr	EUBOND 7-10yr	USBOND 1-3yr	JPBOND 1-3yr	EUBOND 1-3yr	USD CASH	JPY CASH
MA(5,26w)	0.47	**0.76**	**0.95**	0.50	**0.65**	**0.83**	**0.62**	0.45

Sharpe Ratio of 12 Month Trend Strategy

Memo vervolg
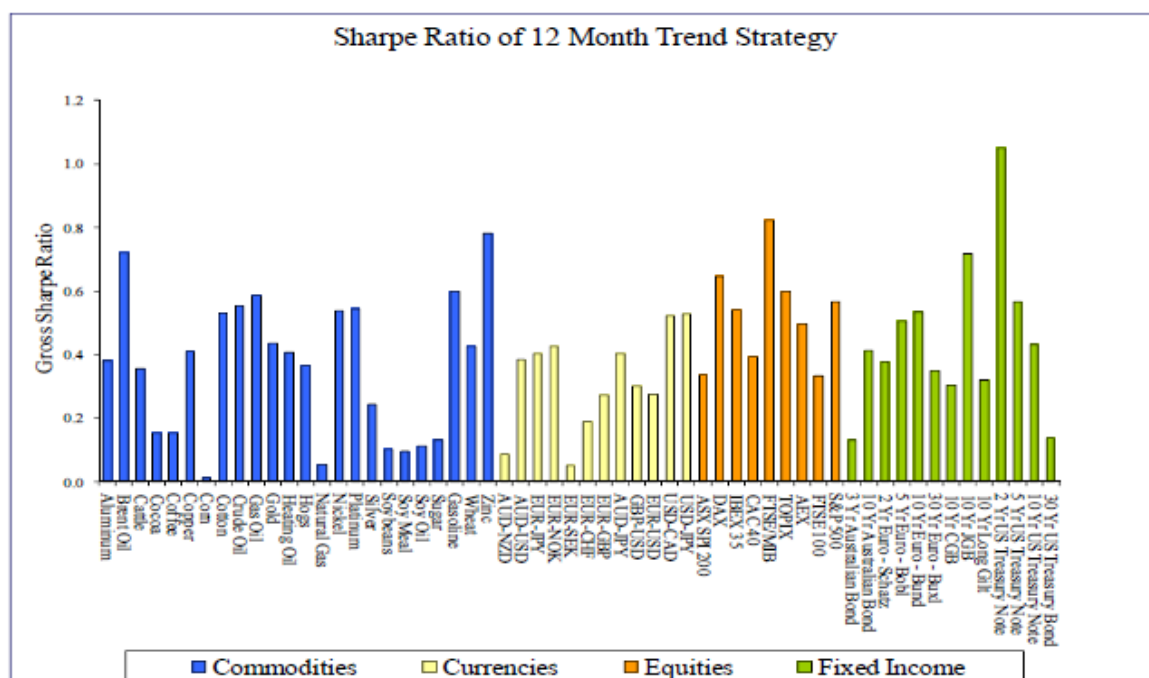
Onderwerp
Market directional and volatility strategies

Pagina
26/36
Datum
20 april 2012

Panel A: $r_t^s / \sigma_{t-1}^s = \alpha + \beta_h r_{t-h}^s / \sigma_{t-h-1}^s + \varepsilon_t^s$

T-Statistic by Month, All Asset Classes
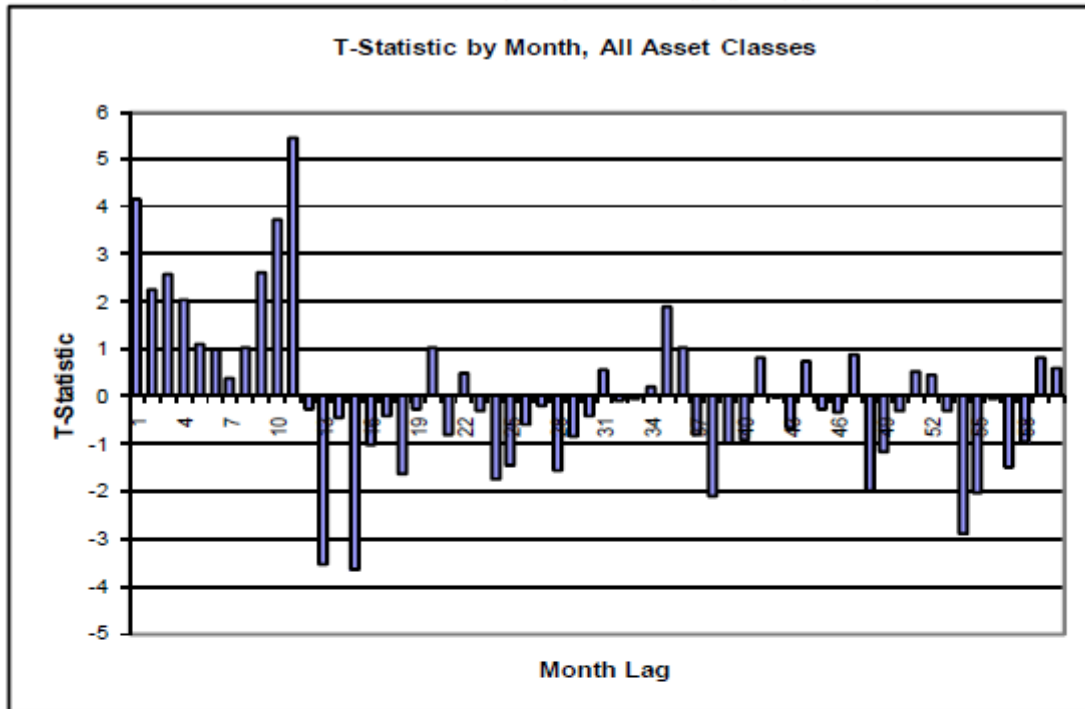
Panel B: $r_t^s / \sigma_{t-1}^s = \alpha + \beta_h \, sign\left(r_{t-h}^s\right) + \varepsilon_t^s$

T-Statistic by Month, All Asset Classes

Table 2. T-stat of the Alpha of Time Series Momentum Trend Strategies with Different Look-Back and Holding Periods

Reported are the *t*-statistics of the alphas (intercepts) from time series regressions of the returns of time series momentum or trend strategies over various look-back and holding periods on the following factor portfolios: MSCI World equity market index, Lehman Brothers bond market index, Goldman Sachs Commodity Index, and HML, SMB, and UMD Fama and French factors from Ken French's website. Panel A reports results for all asset classes, Panel B for commodity futures, Panel C for equity index futures, Panel D for bond futures, and Panel E for currency forwards.

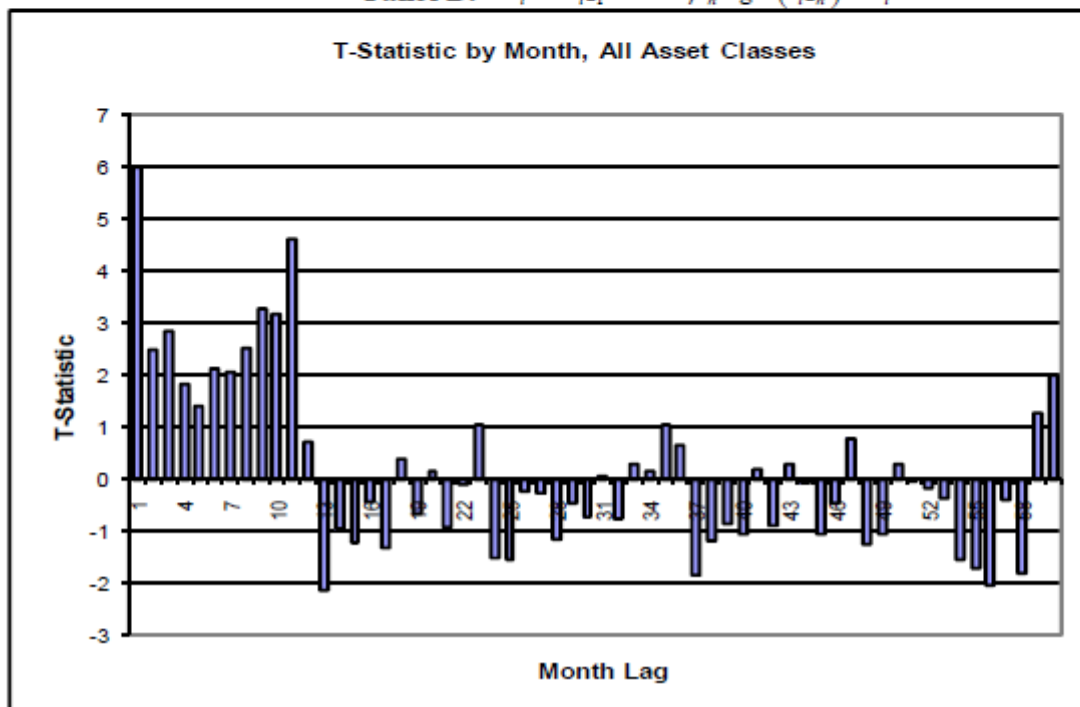| Lookback Period (Months)	Holding Period (Months)							
	1	3	6	9	12	24	36	48
Panel A: All Assets								
1	4.34	4.68	3.83	4.29	5.12	3.02	2.74	1.90
3	5.35	4.42	3.54	4.73	4.50	2.60	1.97	1.52
6	5.03	4.54	4.93	5.32	4.43	2.79	1.89	1.42
9	6.06	6.13	5.78	5.07	4.10	2.57	1.45	1.19
12	6.61	5.60	4.44	3.69	2.85	1.68	0.66	0.46
24	3.95	3.19	2.44	1.95	1.50	0.20	-0.09	-0.33
36	2.70	2.20	1.44	0.96	0.62	0.28	0.07	0.20
48	1.84	1.55	1.16	1.00	0.86	0.38	0.46	0.74
Panel B: Commodity Futures								
1	2.44	2.89	2.81	2.16	3.26	1.81	1.56	1.94
3	4.54	3.79	3.20	3.12	3.29	1.51	1.28	1.62
6	3.86	3.53	3.34	3.43	2.74	1.59	1.25	1.48
9	3.77	4.05	3.89	3.06	2.31	1.27	0.71	1.04
12	4.66	4.08	2.64	1.85	1.46	0.58	0.14	0.57
24	2.83	2.15	1.24	0.58	0.18	-0.60	-0.33	-0.14
36	1.28	0.74	0.07	-0.25	-0.34	-0.03	0.34	0.65
48	1.19	1.17	1.04	1.01	0.92	0.75	1.16	1.29
Panel C: Equity Index Futures								
1	1.05	2.36	2.89	3.08	3.24	2.28	1.93	1.28
3	1.48	2.23	2.21	2.81	2.78	2.00	1.57	1.14
6	3.50	3.18	3.49	3.52	3.03	2.08	1.36	0.88
9	4.21	3.94	3.79	3.30	2.64	1.96	1.21	0.75
12	3.77	3.55	3.03	2.58	2.02	1.57	0.78	0.33
24	2.04	2.22	1.96	1.70	1.49	0.87	0.43	0.13
36	1.86	1.66	1.26	0.90	0.66	0.34	0.02	0.08
48	0.81	0.84	0.58	0.44	0.36	0.12	0.01	0.23
Panel D: Bond Futures								
1	3.31	2.66	1.84	2.65	2.88	1.76	1.60	1.40
3	2.45	1.52	1.10	1.99	1.80	1.27	1.05	1.00
6	2.16	2.04	2.18	2.53	2.24	1.71	1.36	1.37
9	2.93	2.61	2.68	2.55	2.43	1.83	1.17	1.40
12	3.53	2.82	2.57	2.42	2.18	1.47	1.12	0.96
24	1.87	1.55	1.62	1.66	1.58	1.01	0.90	0.64
36	1.97	1.83	1.70	1.62	1.73	1.13	0.75	0.91
48	2.21	1.80	1.53	1.43	1.26	0.72	0.73	1.22
Panel E: Currency Forwards								
1	3.16	3.20	1.46	2.43	2.77	1.22	0.83	-0.42
3	3.90	2.75	1.54	3.05	2.55	1.02	0.10	-0.84
6	2.59	1.86	2.32	2.82	2.08	0.62	-0.16	-1.14
9	3.40	3.16	2.65	2.35	1.72	0.20	-0.38	-1.17
12	3.41	2.40	1.65	1.25	0.71	-0.29	-1.01	-1.67
24	1.78	0.99	0.53	0.27	-0.05	-1.15	-1.88	-2.27
36	0.73	0.42	-0.04	-0.42	-0.96	-1.67	-2.04	-2.42
48	-0.55	-1.05	-1.41	-1.62	-1.79	-2.02	-2.34	-2.32

Onderwerp
Market directional and volatility strategies

Pagina
28/36
Datum
20 april 2012

VII. Spanning test results

Next, we may question of the long-term equity and short-term equity trend strategies add value over each other and over the other variables that are in scope. In order to test this possibility we run so-called spanning tests, that test if a given strategy return is captured, or spanned, by the other strategy returns. Our starting point (null hypothesis) is that each variable adds value, given the fact that the variables we consider have survived all testing criteria we applied to its strategy signals and returns. Hence, we will test if can reject this hypothesis, and are able to state with high confidence that a variable actually destroys value when controlling for other variables in scope.

The table below shows the result of a spanning test, where the strategy returns of the variable under study are regressed on the strategy returns of all other variables that are in scope, and resulting tests on the intercept being significantly smaller than a specific value.

Onderwerp
Market directional and volatility strategies

	LT trend	ST trend
Intercept coef	0.029	-0.003
Intercept t-coef	1.91	-0.25
EquityFutureLTTrendSignal coef	NA	0.33
EquityFutureLTTrendSignal t-coef	NA	10.96
EquityFutureSTTrendSignal coef	0.42	NA
EquityFutureSTTrendSignal t-coef	10.96	NA
ResMom12m52wlocalwithCur coef	0.47	-0.18
ResMom12m52wlocalwithCur t-coef	5.68	-2.44
Halloween coef	0.01	0.00
Halloween t-coef	0.25	-0.21
TurnOfMonthL3 coef	0.04	0.00
TurnOfMonthL3 t-coef	1.20	0.00
CHANGEB1YRDIVPCorrect coef	0.73	0.19
CHANGEB1YRDIVPCorrect t-coef	13.64	3.62
EquityMinusBondValuationto4YrAvg coef	-0.05	-0.18
EquityMinusBondValuationto4YrAvg t-coef	-1.53	-5.97
GlobalRelativeLongRate coef	-0.13	0.01
GlobalRelativeLongRate t-coef	-2.39	0.11
BDI3mLNchance coef	-0.10	0.03
BDI3mLNchance t-coef	-2.70	0.92
RAIdeviation3m coef	-0.23	0.29
RAIdeviation3m t-coef	-7.91	12.06
Surprisedeviation3m coef	-0.08	0.04
Surprisedeviation3m t-coef	-1.96	1.10
GlobalVIXminRV6mewBollerslev coef	0.14	0.01
GlobalVIXminRV6mewBollerslev t-coef	3.14	0.24
R2	46%	51%
Tests on intercept being significantly smaller than X.X% (one-sided p-values):		
Ho: Intercept=0.5%	0.94	0.27
Ho: Intercept=1.0%	0.89	0.16
Ho: Intercept=1.5%	0.82	0.08
Ho: Intercept=2.0%	0.72	0.04

We find a positive intercept for the long-term trend variable and cannot reject
the hypothesis that it is smaller than 0.5 to 2.0%. For the short-term trend
variable we find a slight negative intercept. We cannot reject the hypothesis that
its performance is smaller than 0.5% or 1.0%, but we can reject the hypothesis
that its performance is smaller than 1.5% or 2.0% with 90% or 95% confidence.

ING 🦁

Memo vervolg

Onderwerp
Market directional and volatility strategies

Pagina
30/36

Datum
20 april 2012

The tables below confirms the robustness of the spanning regression test using OLS or Quantile regression and all other strategy returns (whole), or only the significant strategy returns using a general-to-specific (backw) or specific-to-general (forw) approach based on the Aikaike Information Criterion (AIC) or Bayesian Information Criterion (BIC). The table shows the intercept coefficients, the t-value of the intercept being equal to zero (shown only to compare the results across the several methodologies, not for testing purposes) and the goodness-of-fit of the OLS regression model.

Variable = LT equity trend	OLS	Quantile regression
OLS-whole alpha	2.87%	2.84%
OLS-whole t-alpha	1.91	1.84
OLS-whole R2	46%	NA
OLS-backw AIC alpha	3.09%	3.32%
OLS-backw AIC t-alpha	2.08	2.22
OLS-backw AIC R2	46%	NA
OLS-backw BIC alpha	2.85%	3.32%
OLS-backw BIC t-alpha	1.92	2.22
OLS-backw BIC R2	46%	NA
OLS-forw AIC alpha	2.87%	2.84%
OLS-forw AIC t-alpha	1.91	1.84
OLS-forw AIC R2	46%	NA
OLS-forw AIC alpha	2.87%	2.84%
OLS-forw AIC t-alpha	1.91	1.84
OLS-forw AIC R2	46%	NA

Variable = ST equity trend	OLS	Quantile regression
OLS-whole alpha	-0.33%	0.75%
OLS-whole t-alpha	-0.25	0.57
OLS-whole R2	51%	NA
OLS-backw AIC alpha	-0.19%	0.85%
OLS-backw AIC t-alpha	-0.15	0.65
OLS-backw AIC R2	51%	NA
OLS-backw BIC alpha	-0.27%	0.85%
OLS-backw BIC t-alpha	-0.21	0.65
OLS-backw BIC R2	50%	NA
OLS-forw AIC alpha	-0.33%	0.75%
OLS-forw AIC t-alpha	-0.25	0.57
OLS-forw AIC R2	51%	NA
OLS-forw AIC alpha	-0.33%	0.75%
OLS-forw AIC t-alpha	-0.25	0.57
OLS-forw AIC R2	51%	NA

Onderwerp
Market directional and volatility strategies

Pagina
31/36
Datum
20 april 2012

Besides performing spanning regression tests, we can test if the Sharpe ratio on the strategy that averages the performance of all individual variables improves when we omit a variable form the model. The table below shows the results.

	Sharpe	Sharpe change	p-value Sharpe change	Correlation with EW strategy
EW strategy	1.41			
EW minus EquityFutureLTTrendSignal	1.31	-0.10	0.97	0.97
EW minus EquityFutureSTTrendSignal	1.48	0.07	0.05	0.97
EW minus ResMom12m52wlocalwithCur	1.38	-0.03	0.97	0.99
EW minus Halloween	1.37	-0.04	0.69	0.95
EW minus TurnOfMonthL3	1.26	-0.15	1.00	0.98
EW minus CHANGEB1YRDIVPCorrect	1.38	-0.03	0.94	0.99
EW minus EquityMinusBondValuationto4YrAvg	1.27	-0.14	1.00	0.96
EW minus GlobalRelativeLongRate	1.37	-0.04	0.95	0.98
EW minus BDI3mLNchance	1.40	-0.02	0.67	0.98
EW minus RAIdeviation3m	1.50	0.08	0.08	0.96
EW minus Surprisedeviation3m	1.38	-0.03	0.88	0.98
EW minus GlobalVIXminRV6mewBollerslev	1.44	0.03	0.19	0.98

Focussing on the 2 rows with the trend variable results, we find that we cannot reject the null hypothesis that the Sharpe of the strategy without the long-term variable is smaller than the Sharpe of the strategy that includes the variable (hence that the long-term variable adds value). For the short-term trend variable we, however, can reject the null hypothesis with 90% or 95% confidence, indicating that the Sharpe improves significantly when we omit the short-term trend variable from the model.

The above conclusions for the short-term trend variable change, however, when we de-trend it, as shown in the tables below.

Memo vervolg

Onderwerp
Market directional and volatility strategies

Pagina
32/36
Datum
20 april 2012

	LT trend	ST trend
Intercept coef	0.034	0.005
Intercept t-coef	2.47	0.38
EquityFutureLTTrendSignal coef	NA	0.27
EquityFutureLTTrendSignal t-coef	NA	8.54
EquityFutureSTTrendSignal coef	0.33	NA
EquityFutureSTTrendSignal t-coef	8.54	NA
ResMom12m52wlocalwithCur coef	0.06	-0.28
ResMom12m52wlocalwithCur t-coef	0.81	-4.05
Halloween coef	-0.08	0.02
Halloween t-coef	-3.60	0.81
TurnOfMonthL3 coef	0.00	0.00
TurnOfMonthL3 t-coef	0.10	-0.01
CHANGEB1YRDIVPCorrect coef	0.63	0.31
CHANGEB1YRDIVPCorrect t-coef	12.58	6.33
EquityMinusBondValuationto4YrAvg coef	-0.15	-0.17
EquityMinusBondValuationto4YrAvg t-coef	-4.74	-5.95
GlobalRelativeLongRate coef	-0.07	-0.02
GlobalRelativeLongRate t-coef	-1.35	-0.55
BDI3mLNchance coef	-0.03	-0.05
BDI3mLNchance t-coef	-0.98	-1.44
RAIdeviation3m coef	-0.13	0.29
RAIdeviation3m t-coef	-4.87	12.51
Surprisedeviation3m coef	-0.06	0.03
Surprisedeviation3m t-coef	-1.84	0.84
GlobalVIXminRV6mewBollerslev coef	0.10	0.02
GlobalVIXminRV6mewBollerslev t-coef	2.37	0.45
R2	48%	55%
Tests on intercept being significantly smaller than X.X% (one-sided p-values):		
Ho: Intercept=0.5%	0.98	0.49
Ho: Intercept=1.0%	0.96	0.34
Ho: Intercept=1.5%	0.92	0.21
Ho: Intercept=2.0%	0.85	0.11

Onderwerp
Market directional and volatility strategies

Pagina
33/36
Datum
20 april 2012

Variable = LT equity trend	OLS	Quantile regression
OLS-whole alpha	3.40%	2.52%
OLS-whole t-alpha	2.47	1.81
OLS-whole R2	48%	NA
OLS-backw AIC alpha	3.32%	2.47%
OLS-backw AIC t-alpha	2.44	1.78
OLS-backw AIC R2	47%	NA
OLS-backw BIC alpha	3.36%	2.47%
OLS-backw BIC t-alpha	2.47	1.78
OLS-backw BIC R2	47%	NA
OLS-forw AIC alpha	3.40%	2.52%
OLS-forw AIC t-alpha	2.47	1.81
OLS-forw AIC R2	48%	NA
OLS-forw AIC alpha	3.40%	2.52%
OLS-forw AIC t-alpha	2.47	1.81
OLS-forw AIC R2	48%	NA
Variable = ST equity trend	OLS	Quantile regression
OLS-whole alpha	0.47%	0.63%
OLS-whole t-alpha	0.38	0.46
OLS-whole R2	55%	NA
OLS-backw AIC alpha	0.57%	0.85%
OLS-backw AIC t-alpha	0.46	0.66
OLS-backw AIC R2	55%	NA
OLS-backw BIC alpha	0.52%	0.85%
OLS-backw BIC t-alpha	0.42	0.66
OLS-backw BIC R2	55%	NA
OLS-forw AIC alpha	0.47%	0.63%
OLS-forw AIC t-alpha	0.38	0.46
OLS-forw AIC R2	55%	NA
OLS-forw AIC alpha	0.47%	0.63%
OLS-forw AIC t-alpha	0.38	0.46
OLS-forw AIC R2	55%	NA

Onderwerp
Market directional and volatility strategies

Pagina
34/36
Datum
20 april 2012

	Sharpe	Sharpe change	p-value Sharpe change	Correlation with EW strategy
EW strategy	1.43			
EW minus EquityFutureLTTrendSignal	1.34	-0.10	0.98	0.97
EW minus EquityFutureSTTrendSignal	1.49	0.06	0.12	0.97
EW minus ResMom12m52wlocalwithCur	1.39	-0.05	1.00	0.99
EW minus Halloween	1.40	-0.04	0.68	0.95
EW minus TurnOfMonthL3	1.27	-0.16	1.00	0.97
EW minus CHANGEB1YRDIVPCorrect	1.41	-0.02	0.88	0.99
EW minus EquityMinusBondValuationto4YrAvg	1.26	-0.17	1.00	0.96
EW minus GlobalRelativeLongRate	1.39	-0.05	0.95	0.98
EW minus BDI3mLNchance	1.43	-0.01	0.59	0.98
EW minus RAIdeviation3m	1.56	0.12	0.03	0.96
EW minus Surprisedeviation3m	1.41	-0.03	0.83	0.98
EW minus GlobalVIXminRV6mewBollerslev	1.47	0.03	0.18	0.98

Onderwerp
Market directional and volatility strategies

Pagina
35/36
Datum
20 april 2012

VIII. Proposal

The proposal is to implement both the LT and ST trend signals for timing the direction of the equity market, since (i) both have shown strong, robust and consistent predictive power for equity market returns, and (ii) having both a long-term and short-term trend component may help in improving performance when trends turn. The proposal is to use the following implementation:

- Weight the magnitude, reliability and consistency of trend in the ratio 1:1:2 to optimally benefit from the lower correlation of consistency with reliability and magnitude.
- Weight the long-term and short-term trend in the ratio 2:1 to: (i) take account of the higher turnover, (ii) weaker performance of the short-term trend variable on most of our criteria, (iii) its negative impact on the Sharpe of the combined strategy, and (iv) weight recent past months heavier as distant past months (the short-term trend uses roughly 3 months of data, while the long-term trend uses 9 months of data, so to equally weight them we might want to use a ratio of 3:1).
- De-trend both the equity trend variables using an expanding window rank, since de-trending removes a long-short bias that is desirable for a pure overlay strategy, and does not impact performance negatively. Expanding windows tend to create more stable distributions than 5-year rolling ranking windows, and ranks might be preferable over z-scores due to using the median instead of means to de-trend.
- Exploit the direction of the trend signal by means of a -1, 0 or +1 position on each component. Use a neutral zone between -20% and 20% (corresponding to roughly 20% of the observations), to not take positions when signals are relatively weak, but remain active in a substantial part of time.
- Apply a buffer of 0.05 around these cut-offs to reduce turnover and to align the buffer with the SYSFIS strategies.
- Take two-week exponential weighted moving averages with a decay factor of 0.40 to smooth outliers and possible data errors.

Onderwerp
Market directional and volatility strategies

Pagina
36/36
Datum
20 april 2012

IX. Scorecard

Long-term equity market investor herding (long-term momentum)

	Score	Motivation
Economic rationale		
Profitability		
Robustness		
Performance consistency and stability		
Expected persistence		
Feasibility		
Well-behaved risks		
Total score		

Short-term equity market investor herding (long-term momentum)

	Score	Motivation
Economic rationale		
Profitability		
Robustness		
Performance consistency and stability		
Expected persistence		
Feasibility		
Well-behaved risks		
Total score		