Time-Series versus Cross-Sectional Momentum

Seminar Financial Markets

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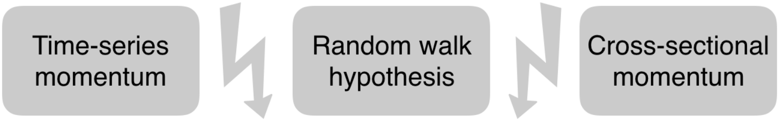
What Motivates Research on the Topic?

Cross-sectional momentum (CS)

A stock outperforming its peers in the past is likely to continue to outperform them in the future

Time-series momentum (TS)

Strategy focuses on the stock's individual performance and not on the peers' performance



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Exemplary Overview of Literature on Momentum

- Effects of market conditions on momentum
  - Cooper et al. (2004): A momentum portfolio after 6 months is only successful after good market conditions; also: reversal haves other reasons beside momentum
  - Daniel and Moskowitz (2016): In times of bad market conditions, momentum works inversely
- Profitability after inclusion of market frictions
  - Korajczyk and Sadka (2004): Even after trading costs, the majority of the studied strategies is still profitable

Jegadeesh and Titman (1993): Evidence for CS Momentum in the United States

- Data: New York and American Stock Exchange
- Sample period: 1965- 1989
- Average returns of up to 12.01%
- Methodology:
  - Rank sample stocks by returns in ranking period
  - Go long in the top decile portfolio in the holding period
  - Short the bottom decile portfolio in the holding period

Moskowitz et al. (2012): Evidence for TS Momentum

- Data: 12 cross-currency pairs, futures prices for 24 commodities, 9 developed equity indices, 13 developed government bond futures
- Sample period: January 1965 to December 2009

- Methodology:

Application of threshold strategy

The classification as a "winner" depends on whether they achieve returns above 0.

- Portfolio achieves significant alphas of up to 6.61%

Kim et al. (2016): Is Volatility Scaling the True Success Factor?

- Dataset of Moskowitz et al. (2012)
- Volatility scaling and not TS momentum accounts for the abnormal returns!

Volatility Scaling

Scale the returns of each asset in the portfolio inversely to its volatility.

- Better performance of TS strategies than CS strategies found by Menkhoff et al. (2012) can be explained by the lack of volatility scaling
- Also: During financial crisis, TS momentum does not offer an explanation for returns

Further Results regarding Volatility Scaling

- Barroso and Santa-Clara (2015): Strategy with constant volatility manages risk of momentum
- Asness et al. (2012): Success of Risk Parity investing due to overproportional share of safer assets in portfolios
  - RP investing means to balance the portfolios in terms of risk
  - Compare total cumulative returns of different strategies and find out that RP investing is superior to the market portfolio

Goyal and Jegadeesh (2017): Net-Long Positions of TS Strategies as the True Success Factor?

- Data: American stock prices for a period of 1946-2013 and like Moskowitz et al. (2012) daily settlement prices for 55 futures markets

Net-long position

Difference of the risky long and short side of a portfolio

$\Rightarrow$ Construction of a cross-sectional momentum strategy with a time-varying investment into the market (CS^{TVM})

- Adjusted difference between TS and CS momentum strategies is only 0.51% for the 60×60 constellation

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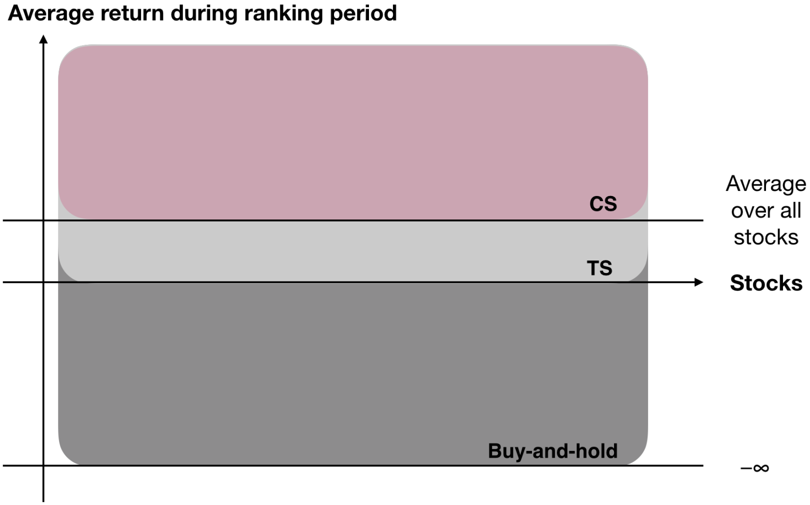
Data and Methodology

- Daily adjusted prices of stocks listed on the Prime All Share Index for the period from the 31^{st} December 1996 to the 30^{th} April 2018
- Risk-free rate estimated by the three-months benchmark government bond yields
- Ranking and holding period of 1, 6 and 12 months
- CS, TS and buy-and-hold portfolios
  - Long stocks in the holding period that have a return above the threshold in the ranking period, short the other stocks

Long portfolios of studied strategies



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Accumulated Returns of CS and TS Portfolio

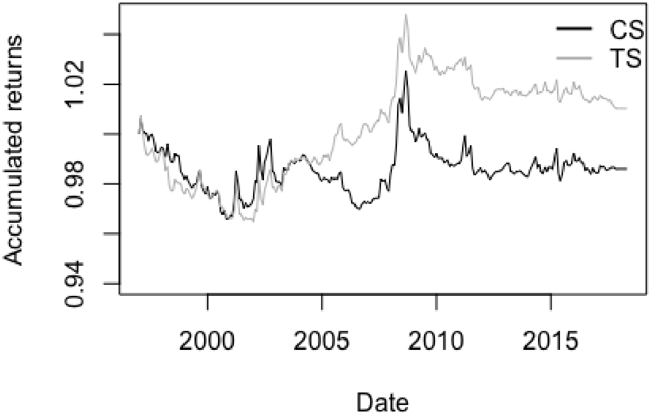


Figure: Accumulated returns of the CS and TS strategies with a ranking and holding period of 6 months

50/50 Strategies

$$R_t^{strat} = \frac{1}{N^+} \sum_{R_{it-1} \geq th_{strat}} R_{it} - \frac{1}{N^-} \sum_{R_{it-1} < th_{strat}} R_{it},$$

Table: Descriptive statistics for 50/50 CS and TS strategies

	const	1×1	6×6	12×12
CS	Mean	0.0021 (0.922)	0.0198 (3.844)	0.0266 (2.884)
	α_{CAPM}	0.0016 (0.707)	0.0199 (3.871)	0.0258 (2.763)
TS	Mean	-0.0023 (-1.626)	0.012 (3.109)	0.0181 (2.231)
	α_{CAPM}	-0.0017 (-1.152)	0.012 (3.115)	0.017 (2.079)

- Numbers in parentheses are the corresponding t-statistics

Time-Varying Net-Long Positions

$$R_t^{strat} = \frac{1}{N}(\sum_{R_{it-1} \geq th_{strat}} R_{it} - \sum_{R_{it-1} < th_{strat}} R_{it})$$

Table: Statistics for time-varying (TV) CS, TS and buy-and-hold strategies

	const	1×1	6×6	12×12
CS	Mean	-0.0014 (-0.485)	-0.0549 (-0.052)	0.0103 (1.065)
	α_{CAPM}	0.0042 (1.960)	-0.0018 (-0.377)	-0.0366 (-0.028)
	€ Long	0.1517	0.355	0.3919
TS	Mean	0.1099 (0.287)	0.0038 (0.648)	0.0099 (1.042)
	α_{CAPM}	0.0022 (1.101)	0.0029 (0.556)	0.0033 (0.364)
	€ Long	0.5133	0.5213	0.51
BAH	Mean	0.0663 (0.062)	-0.04 (-0.09)	-0.0043 (-0.063)
	α_{CAPM}	-0.0041 (-1.71)	0.0195 (3.794)	0.0541 (8.108)

Adjustment of Time-Varying Net-Long Positions

	Short	Long
50/50 CS	€0.50	€0.50
TV TS	€0.40	€0.60
CS^{TS}	€0.40	€0.60

Adjusted Time-Varying Net-Long Positions

Table: Statistics for time-varying CS with a long position equal in size to the long position of TV TS

const	1×1	6×6	12×12
Mean	0.0023 (0.997)	0.0107 (1.754)	0.016 (1.640)
α_{CAPM}	0.0037 (1.590)	0.0099 (1.763)	0.0096 (1.025)

- Positive changes in returns may be due to (1) higher returns in long positions than short positions or (2) market timing ability of the TS strategy

Table: Regression coefficients measuring market timing ability

const	1×1	6×6	12×12
β_{const}	0.0133 (1.952)	-0.0071 (-0.430)	-0.0188 (-0.830)

Adjustment of Time-Varying Net-Long Positions according to Goyal and Jegadeesh (2017)

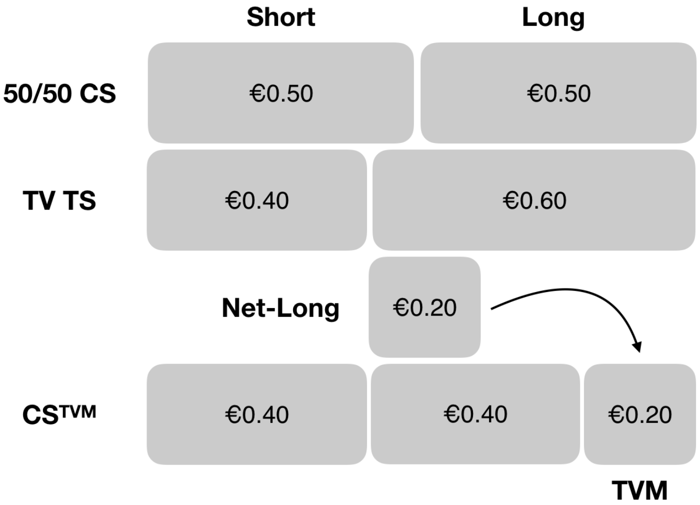
Adjusted returns according to Goyal and Jegadeesh (2017)

$$R_t^{CS_{TVM}} = R_t^{50/50\ CS} + NetLong_t^{TS} \cdot \bar{R}_t$$
$$R_t^{TS_{TVM}} = R_t^{50/50\ TS} + NetLong_t^{TS} \cdot \bar{R}_t$$

Table: Statistics for 50/50 CS and TS strategies with time-varying investment into the market

	const	1×1	6×6	12×12
CS^{TVM}	Mean	0.0050 (1.742)	0.0178 (2.630)	0.0224 (1.695)
	α_{CAPM}	0.0057 (1.987)	0.0172 (2.626)	0.0154 (1.191)
TS^{TVM}	Mean	0.0916 (0.293)	0.0101 (2.527)	0.0192 (2.670)
	α_{CAPM}	0.1099 (0.364)	0.0103 (2.631)	0.0227 (3.214)

Standardized adjustment of Time-Varying Net-Long Positions according to Goyal and Jegadeesh (2017)



Standardized adjusted returns according to Goyal and Jegadeesh (2017)

$$R_t^{CS_{TVM}} = R_t^{50/50\ CS} + NetLong_t^{TS} \cdot \bar{R}_t \quad (1)$$

$$R_t^{CS_{TVM}} = (1 - NetLong_t^{TS}) \cdot R_t^{50/50\ CS} + NetLong_t^{TS} \cdot \bar{R}_t \quad (2)$$

Table: Statistics for (1) original and (2) standardized 50/50 CS strategies with time-varying investment into the market

	const	1×1	6×6	12×12
(1)	Mean	0.0050 (1.742)	0.0178 (2.630)	0.0224 (1.695)
	α_{CAPM}	0.0057 (1.987)	0.0172 (2.626)	0.0154 (1.191)
(2)	Mean	0.0067 (1.688)	0.0225 (2.381)	0.0185 (0.966)
	α_{CAPM}	0.0074 (1.847)	0.0221 (2.352)	0.0104 (0.548)

Volatility Scaling

$$R_t^{scaled\ TS} = \frac{1}{N} \cdot \left(\sum_{R_{it-1} \geq 0} R_{it} \cdot \frac{40\%}{\sigma_{it-1}} - \sum_{R_{it-1} < 0} R_{it} \cdot \frac{40\%}{\sigma_{it-1}} \right) \text{ with}$$

$$\sigma_{it-1}^2 = 261 \sum_{s=0}^{\infty} (1-\delta) \cdot \delta^s (R_{it-1-s} - \bar{R}_{it-1})^2$$

Table: Alphas for (levered) volatility scaled strategies

Strat	1×1	6×6	12×12
50/50 CS	-0.0078 (-2.321)	0.0268 (3.520)	0.0662 (7.655)
TV CS^{TS}	0.2235 (1.670)	0.8325 (2.691)	1.3418 (2.960)
CS^{TVM}	0.0160 (1.561)	0.0606 (5.284)	0.0952 (8.662)
50/50 TS	-0.0030 (-1.768)	0.0154 (3.676)	0.0322 (3.914)
TV TS	0.0033 (1.280)	0.0088 (1.28)	0.0251 (2.227)
BAH	-0.0041 (-1.710)	0.0195 (3.794)	0.0541 (8.108)

Turnover

- Sum of absolute changes in portfolio weights

Table: Average monthly turnover of portfolio strategies

const	1×1	6×6	12×12
50/50 CS	1.0338	0.6118	0.4452
scaled 50/50 CS	1.1604	1.1157	0.8714
CS^{TVM}	1.2991	0.7278	0.5256
scaled CS^{TVM}	1.5604	1.3075	1.016
time-varying TS	0.9922	0.3549	0.2449
scaled time-varying TS	1.6818	0.8226	0.668
scaled BAH	0.3374	0.3365	0.3311

- Scaled strategies refer to the levered scaled strategy as introduced by Moskowitz et al. (2012)

Restrictions to the Empirical Analysis

- Parameters for ranking and holding periods differ from the commonly used parameters
- Variation in the sample size
- Sample is not representative for the market
- Time periods differ from the commonly used times frames
- Low cross-sectional variation of volatility

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Conclusion

- First comparison confirms superiority of the TS strategy
- With equally-sized long and short sides, CS beats TS strategy
- Volatility scaling increases returns for all strategies
- Turnover increases with volatility scaling
- Buy-and-hold strategy outperforms nearly every other strategy

$\Rightarrow$ Momentum does not challenge the random walk hypothesis in our sample

Result

We observe no significant differences between the strategies' returns, when adjusted.

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We thank you for your attention!