
Creating Greater Efficiency and Reduced Costs with Broad-Based Equity Portfolios

Tracking the S&P Europe 350

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Agenda

- Paper **Highlights**
- Replicating Equity Indices with **Baskets**
- The **Dynamic Index Tracking** Approach
- Optimal Tracking from a **High Liquidity Subset**
- The **S&P Europe 350** Data Set
- **Tracking Results**
- **Trade-Offs** in Index Tracking

Highlights

- Using the S&P Europe 350 as an example, we explore two different ways of index replication, **capitalization weighting** and **stepwise optimization**.
- All strategies are based on a **liquidity pre-filter**.
- We introduce a **modified stepwise optimization** approach that allows to control for turnover.
- Optimization yields **superior high liquidity small trading baskets** with comparable turnover and much lower tracking error than cap weighting.
- Both approaches control well for **sector risk**.

Why use a Subset Replication?

- Full replication strategy:
 - Asset managers with **lowest tolerance for tracking error**
 - Largest diversification and the best tracking quality
 - Some minor tracking error due to cash management purposes, transaction costs, legal restrictions etc.
- Basket replication:
 - Asset managers accepting **moderate levels of tracking error**
 - Manageability and liquidity of the portfolio increase
 - Transaction costs and market impact costs decrease
 - For hedging activities and managing derivatives products, a basket approach is needed to meet trading requirements

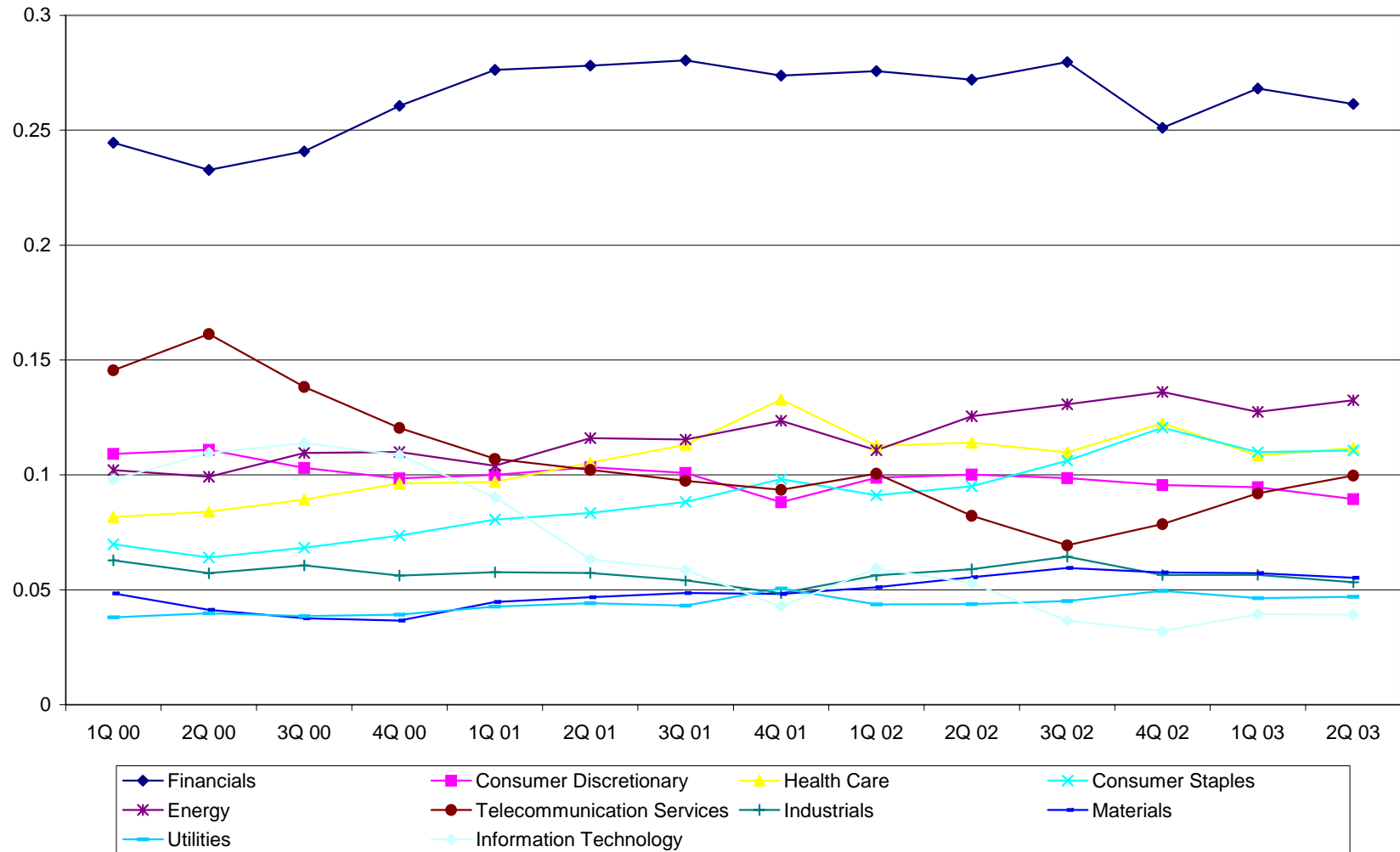
The Stepwise Index Tracking Approach

- Two-step approach:
 - **Subset Selection**: stepwise regression approach with the technique of forward selection. We improve the standard forward selection procedure by a threshold stepwise selection method.
 - **Weights selection**: least squares optimization.
- Based on reliable statistical methods, a 0 to 10% **threshold** tolerance to leave old stocks in the tracking portfolio allows to control for turnover during subsequent stepwise rebalancing transactions
- Algorithm was implemented in the statistical computing language R yielding the *IndexSys Optimization and Backtesting-Tool*.

The Data Set

- We use the S&P Europe 350 index
 - covers the largest stocks within the European investment universe
 - broad representation of the European equity market
 - investable and manageable
- Six year period from June 30, 1998 to June 30, 2003
 - challenging backtesting period

Index Sector Weights 1st Q 2000 to 2nd Q 2003



High Liquidity Subset 1st Q 1998 to 3rd Q 2003

- Number of stocks ranked by their cumulative value-weighted turnover:

	1Q98	2Q98	3Q98	4Q98	1Q99	2Q99	3Q99	4Q99	1Q00	2Q00	3Q00	4Q00
90%	170	169	169	168	166	166	166	168	174	178	180	185
95%	219	217	216	215	213	213	213	215	222	227	229	234
97%	248	246	245	245	242	242	242	243	250	254	257	261
99%	293	291	291	291	288	289	290	290	293	296	299	302
	1Q01	2Q01	3Q01	4Q01	1Q02	2Q02	3Q02	4Q02	1Q03	2Q03	3Q03	Average
90%	185	183	187	188	189	187	191	191	194	192	200	180
95%	235	231	236	236	237	235	237	239	242	240	249	228
97%	261	259	263	263	264	262	263	265	268	267	275	256
99%	302	300	304	303	303	301	301	303	305	305	310	298

- For the sample period, a fixed number of 180 index members is a **well suited and stable subset** to represent 90% of the most liquid stocks in the S&P Europe 350, we will use this **180 universe** in the following.

Tracking Strategies

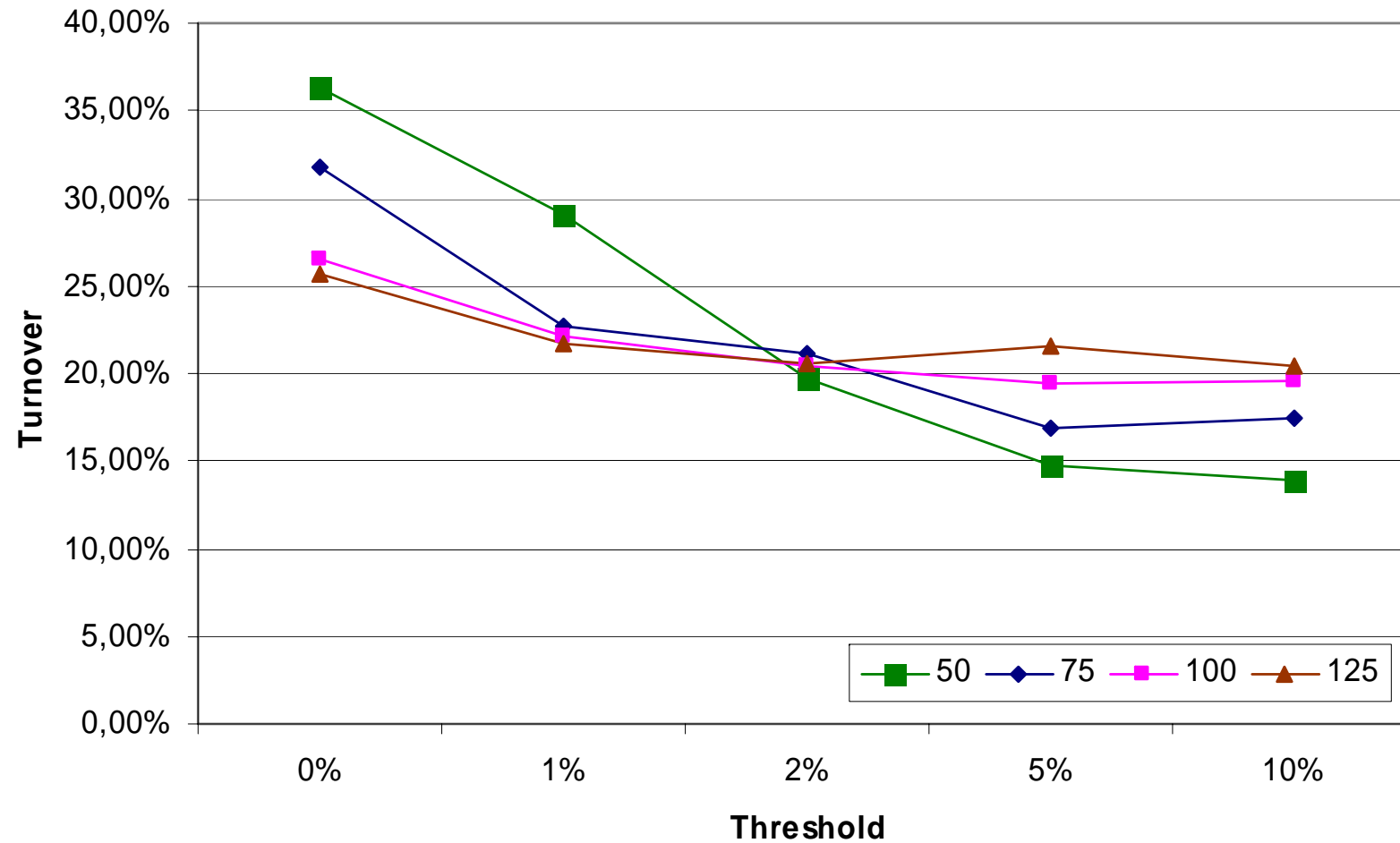
Variable settings in the backtesting procedure:

- Use 50, 75, 100 and 125 stocks,
- **Capitalization weighting** with quarterly rebalancing (CAP-method) as our hard-to-beat, low tracking error benchmark strategy,
- **Stepwise optimization** with annual rebalancing (STEPW-approach, 12 months) and
- **Stepwise optimization** with 18 months rebalancing (STEPW-approach, 18 months).

Tracking Results

number of stocks	CAP-method		rebalancing frequency in month	STEPW-approach		
	TE	TO		Threshold in %	TE	TO
50	3,40%	16,63%	12	1%	2,48%	29,04%
				2%	2,48%	19,66%
				5%	2,62%	14,77%
				10%	2,65%	13,96%
			18	1%	2,80%	15,32%
				2%	2,96%	12,19%
				5%	2,83%	9,25%
				10%	2,77%	8,23%
75	2,56%	14,62%	12	1%	1,88%	22,69%
				2%	1,82%	21,20%
				5%	1,87%	16,85%
				10%	1,97%	17,46%
			18	1%	1,92%	14,88%
				2%	1,99%	12,84%
				5%	2,04%	8,40%
				10%	2,04%	8,40%
100	2,04%	14,09%	12	1%	1,62%	22,14%
				2%	1,69%	20,39%
				5%	1,72%	19,44%
				10%	1,71%	19,62%
			18	1%	1,55%	13,88%
				2%	1,76%	12,35%
				5%	1,86%	10,60%
				10%	1,86%	10,60%
125	1,55%	13,13%	12	1%	1,39%	21,64%
				2%	1,41%	20,59%
				5%	1,89%	21,62%
				10%	1,45%	20,38%
			18	1%	1,42%	12,78%
				2%	1,49%	11,74%
				5%	1,56%	11,67%
				10%	1,56%	11,67%

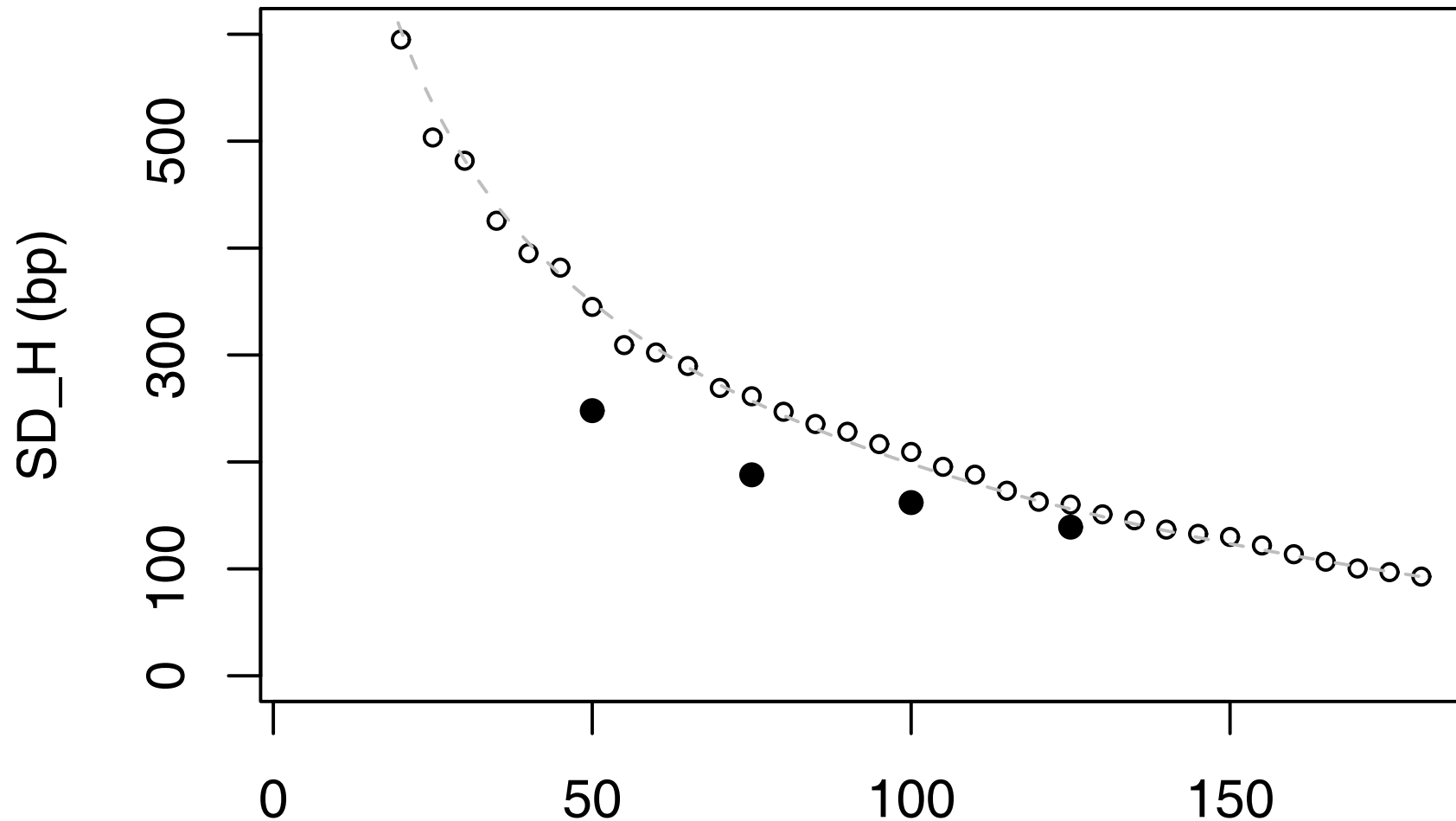
The Impact of the Threshold



The Impact of the Threshold

- The impact of the threshold
 - The **tracking error** increases only marginally
 - The **turnover** is strongly reduced to a lower level
 - An increasing threshold has a larger effect on the turnover of the smaller tracking portfolios than on larger ones

Trade-Off: Number of Stocks/Tracking Error



STEPW (filled dots):

Rebalancing Period: 12 months

Threshold: 0.01

Tracking the S&P 350

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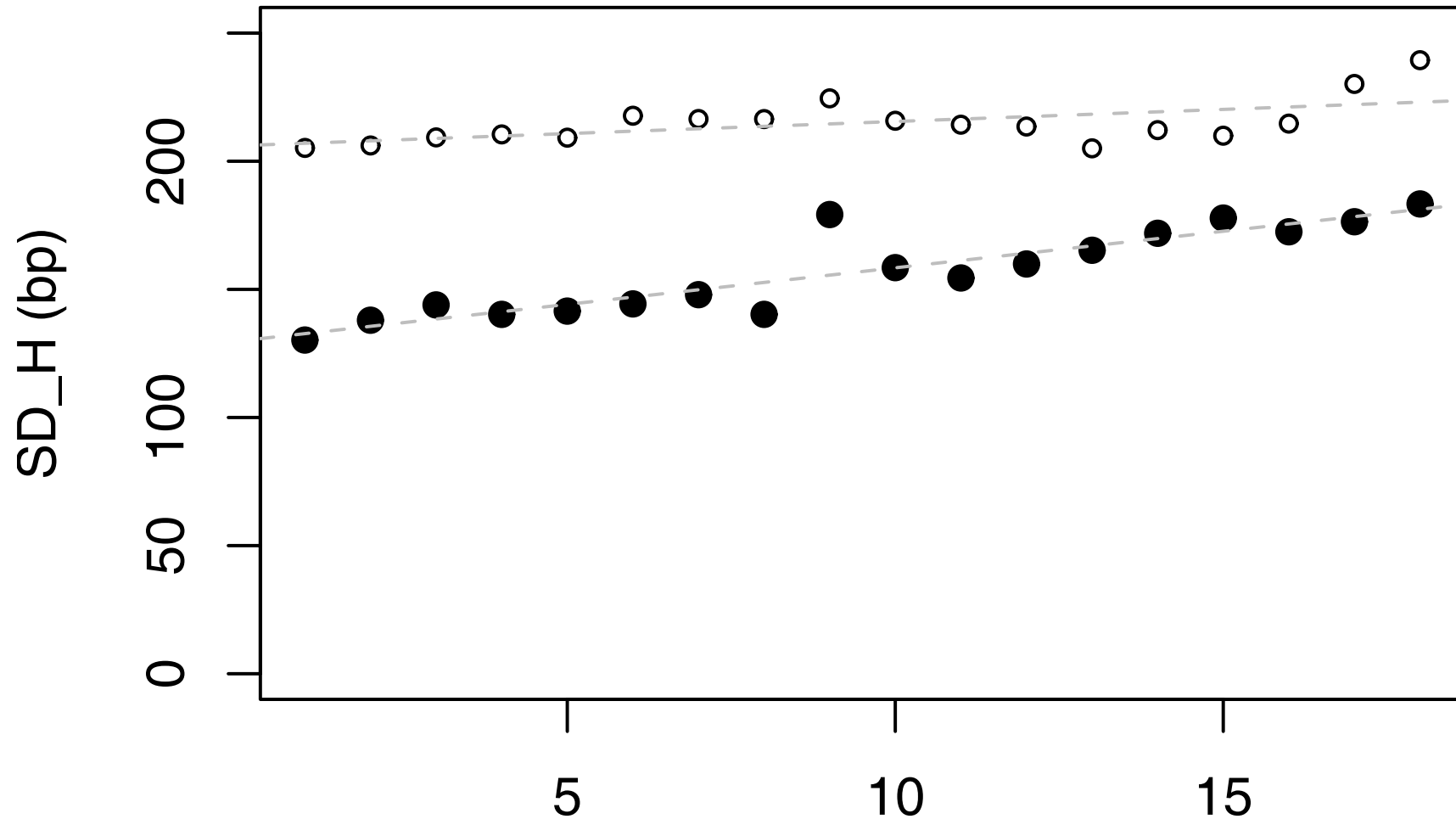
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Trade-Off: Number of Stocks/Tracking Error

- With an increasing number of stocks the tracking error is –of course– declining
- Asset managers may choose between
 - **highly liquid baskets** for trading and derivative instruments hedging with a smaller number of stocks ($N \leq 125$) and
 - portfolios for a **liquid long-term** investment with a higher number of shares and arbitrarily low levels of tracking error ($N > 125$) (e.g. lower than 100 bps for $N = 175$).

Trade-Off: Rebalance Period/Tracking Error



STEPW (filled dots):

$N=100$

Threshold 0.01

Rebalance Period

Trade-Off: Rebalance Period/Tracking Error

- Our algorithm consistently yields lower tracking error (filled dots) than the capitalization strategy (unfilled dots) for all rebalancing periods between 1 and 18 months ($N = 100$).
- The increase in tracking quality given for a one month reduction of the period turns out to be larger for the STEPW-approach.

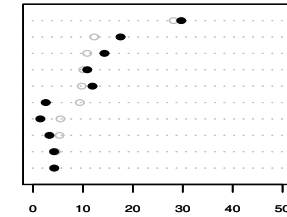
Tracking Portfolio with 75 stocks, 3 months rebalancing, CAP

Simulation Parameters

V3.5 (release) Mon Feb 9 01:46:56 2004
 Number of Assets: 75
 Basket Selection: Index Cap
 Weighting: Index Cap
 Rebalancing Frequency : 3 months
 Estimation Period : 24 months

Financials
 Energy
 Health Care
 Consumer Staples
 Telecommunication Services
 Consumer Discretionary
 Industrials
 Materials
 Utilities
 Information Technology

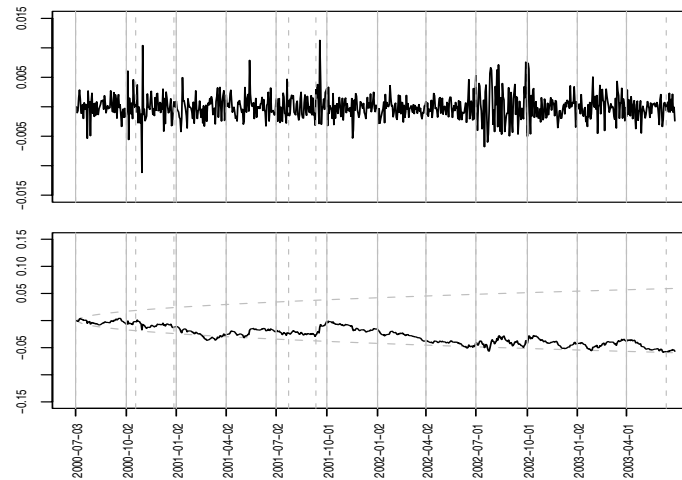
Sector Weights % (last Day)



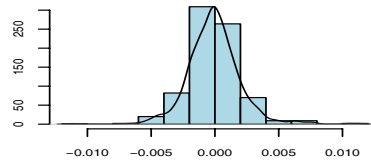
Tracking Error

Mean: -0.0000738433
 Mean Absolut Error: 0.001487
 Huber Robust SD: 0.001654 (2.56 % p.a.)
 Lower 5 % Quantile: -0.003103
 First Lower Partial Moment: -0.000782

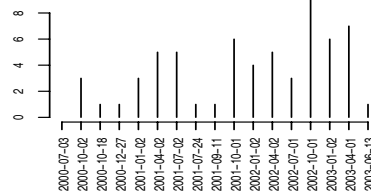
Daily And Cumulative Tracking Error



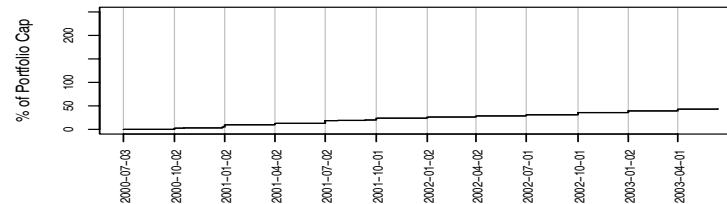
Histogram of Tracking Error



of basket member changes



Turnover AVG 14.62% p.a.



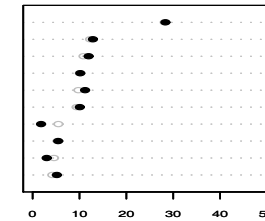
Tracking Portfolio with 75 stocks, 12 months rebalancing, STEPW

Simulation Parameters

V3.5 (release) Sun Feb 8 19:00:24 2004
 Number of Assets: 75
 Basket Selection: Weighted Step
 Weighting: Weighted Regression
 Selection Threshold: 0.050
 Rebalancing Frequency : 12 months
 Estimation Period : 24 months

Financials
 Energy
 Health Care
 Consumer Staples
 Telecommunication Services
 Consumer Discretionary
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 Information Technology

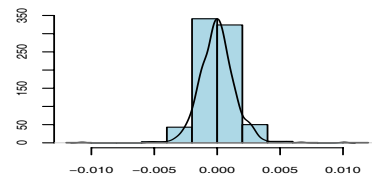
Sector Weights % (last Day)



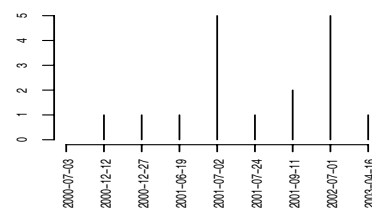
Tracking Error

Mean: 0.0000040233
 Mean Absolut Error: 0.001069
 Huber Robust SD: 0.001216 (1.87 % p.a.)
 Lower 5 % Quantile: -0.002164
 First Lower Partial Moment: -0.000532

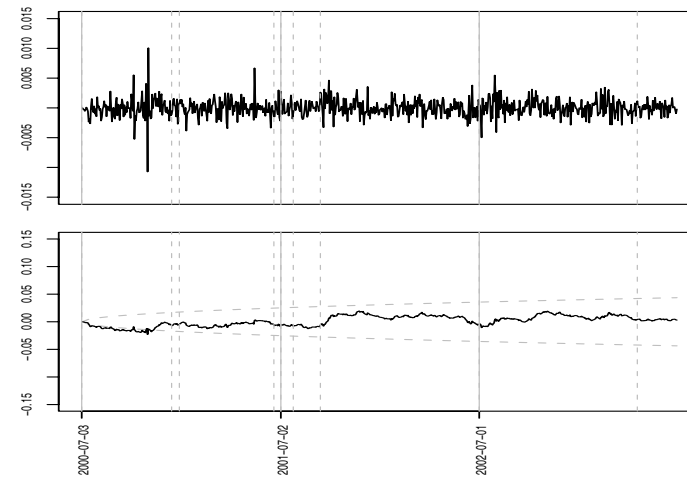
Histogram of Tracking Error



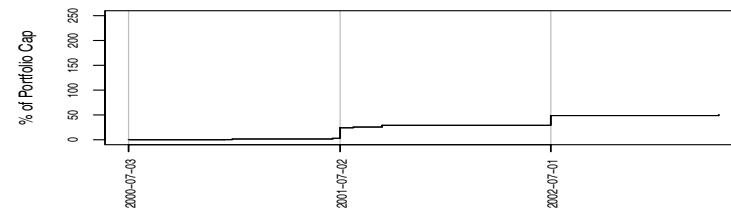
of basket member changes



Daily And Cummulative Tracking Error



Turnover AVG 16.85% p.a.



Summary I

- The stepwise optimization approach is new in that it accounts for the dynamic structure of optimal basket selection. Choosing a **threshold for optimal dynamic basket selection** substantially decreases turnover while tracking error increases only marginally.
- We find that the stepwise approach yields **superior high liquidity trading baskets** with less or equal to 125 stocks and tracking errors as low as 140 bps. The 100 stock portfolio allows for tracking errors of below 170 bps as opposed to 200 bps for cap weighting.

Summary II

- Both basket approaches **match sector weights**. The stepwise optimization approach is even better in controlling for sector risk than cap weighting yielding a closer match for the small portfolios.
- Cap weighting applies for **liquid longer-term investment portfolios** with a higher number of shares (>125). Increasing the number of stocks allows for arbitrarily low levels of tracking error, where 175 stocks yield levels below 100 bps.

More Details...

- For more details



please refer to our [Report](#).