Is high active share always good?

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September 2014

Active share

- Given portfolio weights w_i^P and benchmark weights w_i^B, active share is defined as (Cremers and Petajisto, 2009)

$$AS = \frac{1}{2}\sum_{i=1}^{n}\left|w_i^P - w_i^B\right|$$

- Assume that the portfolio is fully invested
- Active share is equal to:
  zero if the portfolio replicates its benchmark exactly
  one if none of the stocks held in the portfolio is a constituent of the benchmark
- In all other cases it can be thought of as *the proportion of the portfolio that is not equal to the benchmark*

Active share targets are becoming common

Examples of **explicit active share targets**:

- An ING fund, benchmarked against MSCI Emerging Europe, targeted an active share of more than 50% while having no explicit tracking error target
- Pyramis Small Cap Core targeted an active share of more than 90%
- A Robeco fund with a tracking error limit of 6% and an active share target of 75%-85%

Sources: ING, http://emerging-markets.ing-investments.de/ (downloaded on April 24, 2014). Pyramis (data as of December 31, 2013). Robeco, *Asian Equities: Ugly is the new beautiful*, Fundsevent, April 3, 2014.

Why an active share target?

- In the current debate about passive vs. active management, some have argued that managers with high active share do tend to outperform (controlling for other variables such as fund characteristics)
- Cremer and Petajisto (2009) and Petajisto (2013) found that *funds with the highest active share significantly outperform their benchmark indices* and exhibit strong performance persistence
- As a result, more and more asset managers are reporting the active share of their funds and mentioning a high active share bias in their prospectuses and white papers

Our contribution

1. We develop a methodology to *build portfolios that meet the target active share* given expected returns and a covariance matrix
2. We investigate how imposing an active share target affects portfolio construction

Related questions:

➔ Is there an optimal active share target? Should targets change over time?

➔ Starting with an initial portfolio, is there an optimal way to achieve a given active share target?

Return, risk and active share

➔ We consider a long only portfolio manager with a passive benchmark

➔ The goal is to choose the optimal alpha / active risk combination given a set of views (alphas), while targeting the desired level of active share $0 \leq \xi \leq 1$:

$$\min_{w^P} \left(w^P - w^B\right)' \Sigma \left(w^P - w^B\right) - \lambda \alpha' \left(w^P - w^B\right) \quad \text{s.t.}$$

$$w^P \geq 0$$

$$\sum_{i=1}^{n} w_i^P = 1$$

$$\frac{1}{2} \sum_{i=1}^{n} \left| w_i^P - w_i^B \right| = \xi$$

(Squared) TE

Expected active return

Risk tolerance

Active share target

➔ The risk tolerance parameter λ controls the active risk / expected return tradeoff

Fixed target or inequality constraint?

- The active share constraint can be formulated in three alternative ways

$$\frac{1}{2}\sum_{i=1}^{n}\left|w_i^P - w_i^B\right| \le \xi, \qquad \text{Upper bound}$$

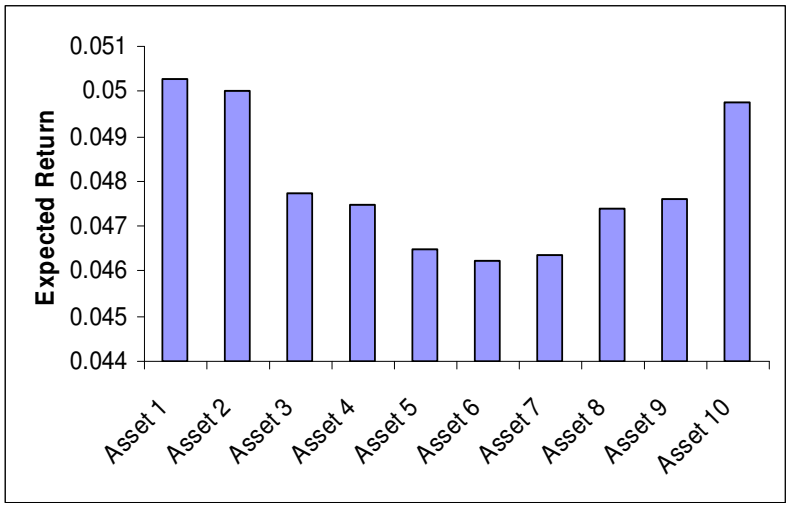
$$\frac{1}{2}\sum_{i=1}^{n}\left|w_i^P - w_i^B\right| = \xi \quad or \qquad \text{Fixed target}$$

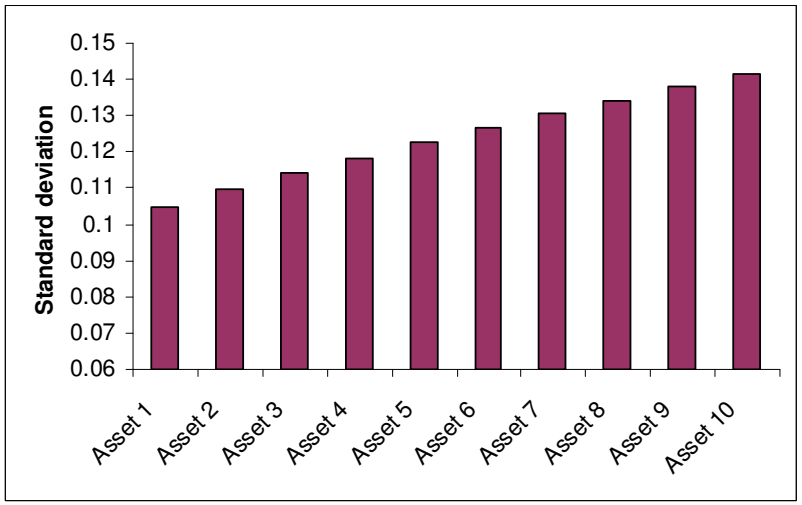
$$\frac{1}{2}\sum_{i=1}^{n}\left|w_i^P - w_i^B\right| \ge \xi \qquad \text{Lower bound}$$

- Mathematically, the upper bound case results in a quadratic programming problem with linear constraints which is standard, a simple modification of one of the *lasso* algorithms introduced by Tibshirani (1996)
- More recently, James et al. (2013) have devised an efficient optimisation procedure termed *classo* (i.e. constrained lasso), which can deal with large dimensional problems
- Both the fixed target and the lower bound end up generating an admissible region that is not a convex polyhedron and therefore can have multiple solutions

Example: Portfolio of ten assets

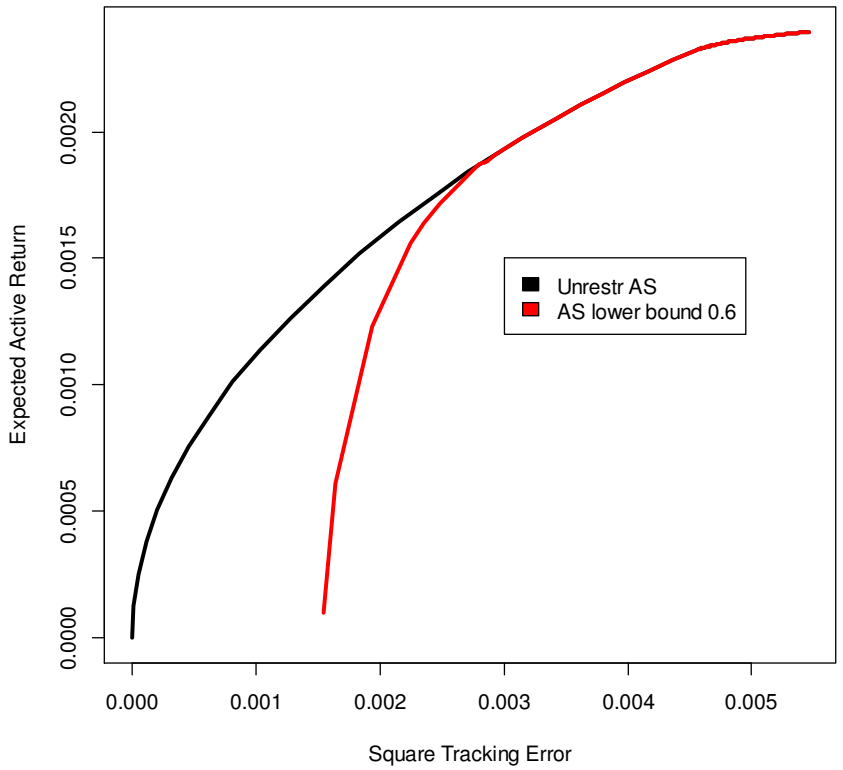
- Ten assets are available
- The benchmark is an equally weighted basket of assets 2 through 10 (w_i=11%)
- Asset 1, the one with the best risk/return profile, is off benchmark

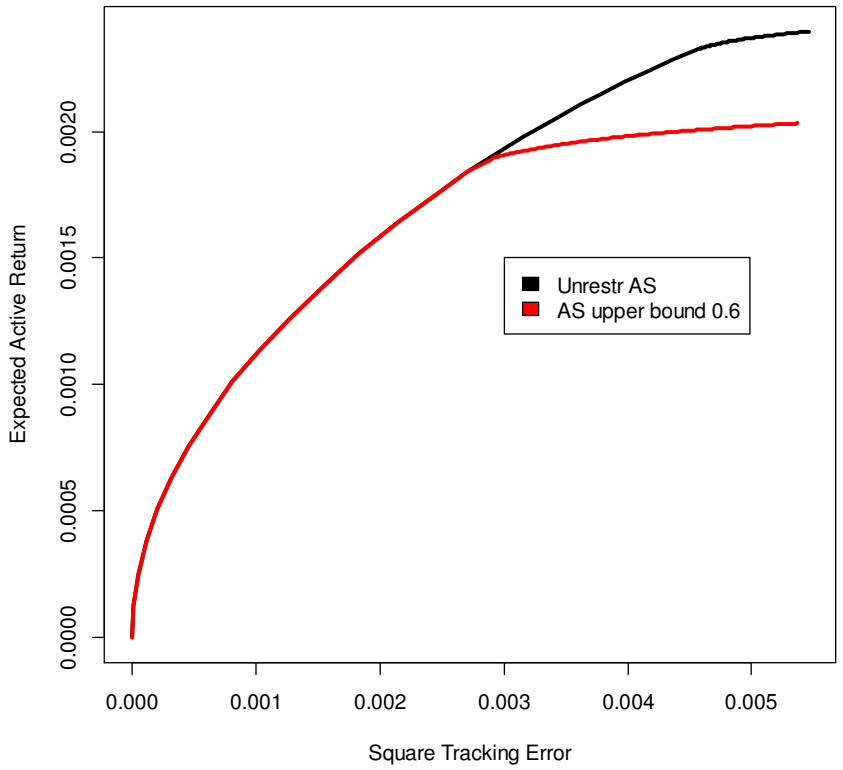




Source: Macquarie Quantitative Research, June 2014

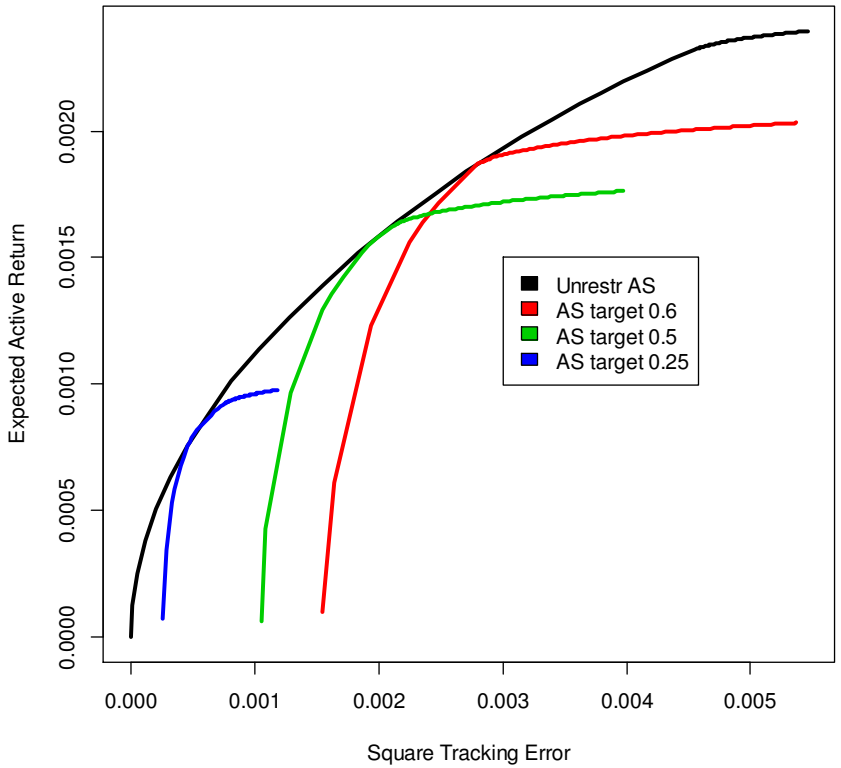
Bounds on active share





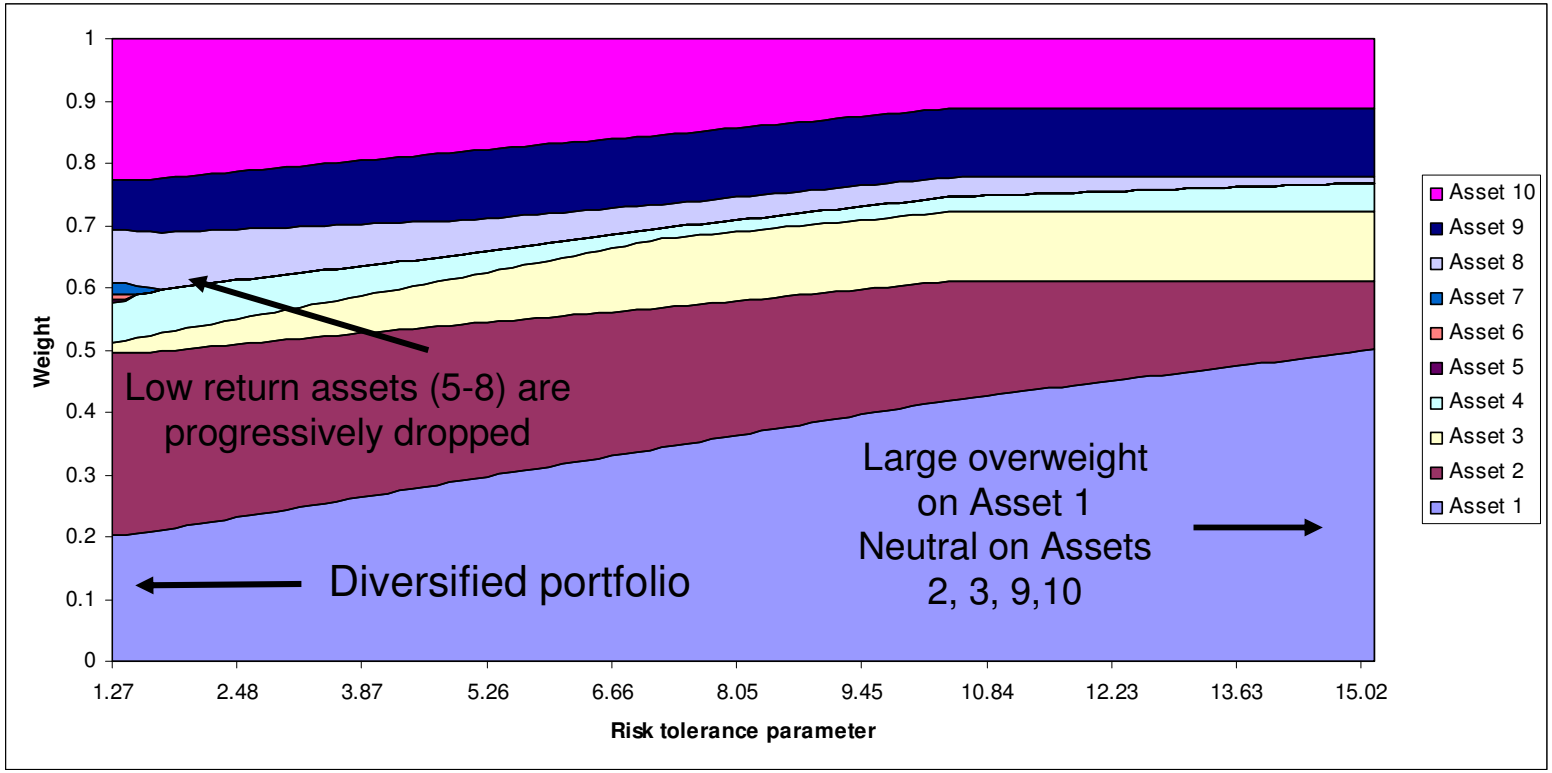
Source: Macquarie Quantitative Research, June 2014

Fixed active share targets



Source: Macquarie Quantitative Research, June 2014

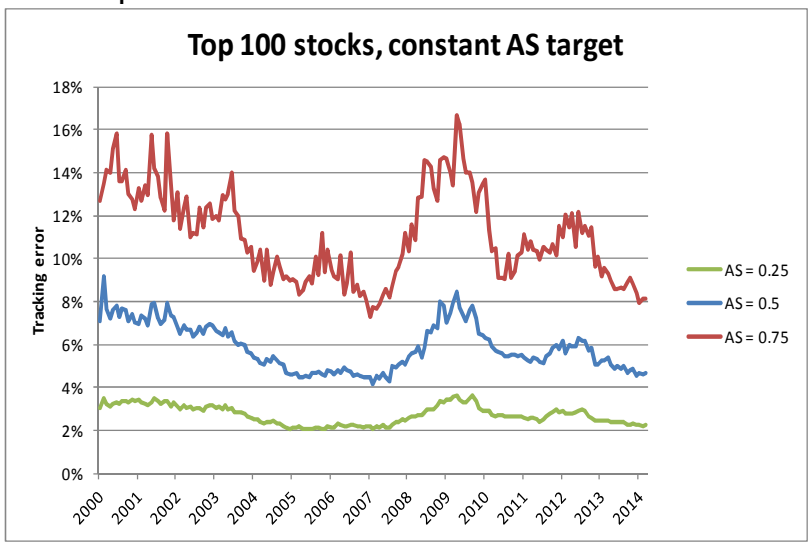
Optimal weights as a function of λ under the constraint AS≤50%

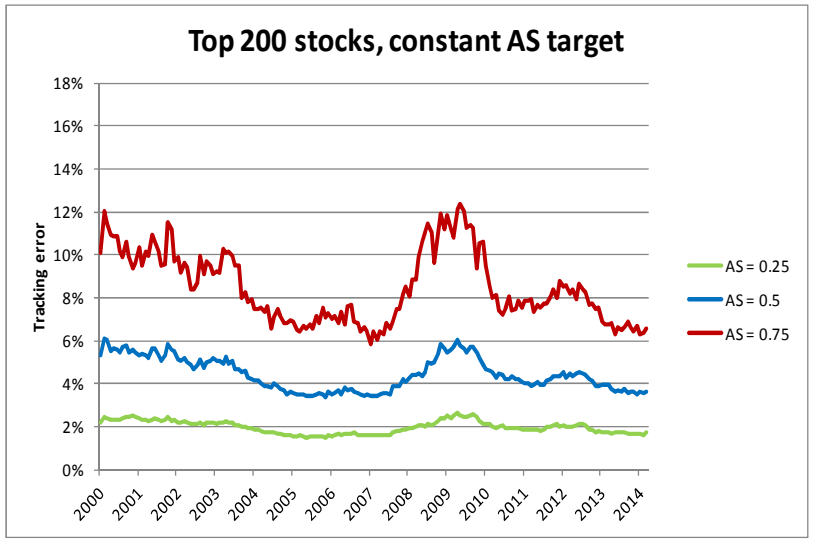


Source: Macquarie Quantitative Research, June 2014

Risk and active share over time

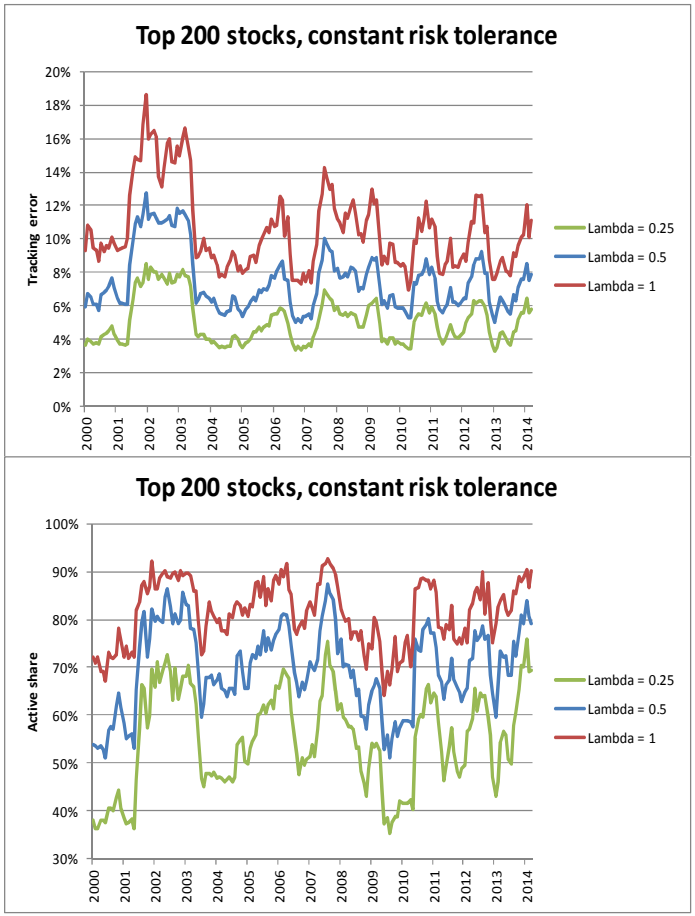
- Using our Alpha Model and statistical risk model, we calculate at the end of each month *the ex ante tracking error of a portfolio with constant active share*
- The benchmark is a cap-weighted index of the largest 100 and 200 stocks in Europe

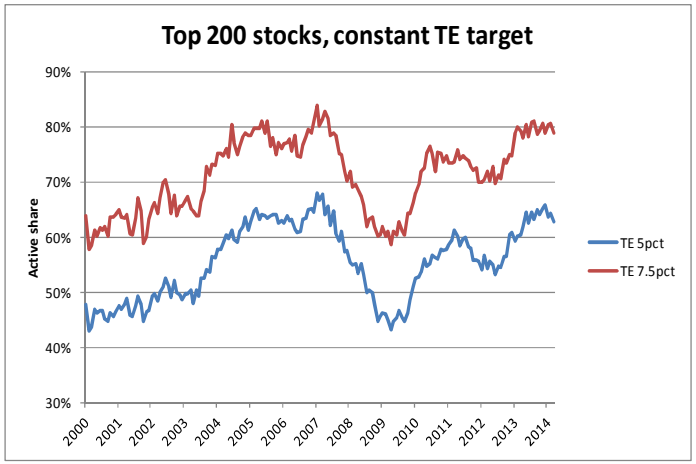




Source: FactSet, Macquarie Quantitative Research, June 2014

Risk and active share over time





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Active share targets and portfolio construction

- In a paper titled *Why Imposing the Wrong Constraints Helps,* Jagannathan and Ma (2003) showed that imposing nonnegativity constraints and upper bounds on the weights is equivalent to shrinking the estimate of the covariance matrix
- Recent literature shows that *gross exposure* constraints have a similar interpretation: De Miguel et al. (2009, MS), Broadie et al. (2009), Fan et al. (2012, JASA)
- Intuitively, by constraining the region of admissible weights we prevent the optimiser from taking extreme positions in opposite directions on stocks that appear to display high correlation (*error maximisation*)

Active share targets and regularisation (1)

➔ Consider the simple case where we minimise TE subject to an expected *active* return target $\underline{\mu}$ and an active share constraint

$$\min_{w^P}\left(w^P - w^B\right)'\Sigma\left(w^P - w^B\right) \quad \text{s.t.}$$
$$\left(w^P - w^B\right)'\mu = \underline{\mu} \qquad (1)$$
$$\frac{1}{2}\sum_{i=1}^{n}\left|w_i^P - w_i^B\right| \le \xi$$

➔ We show that solving (1) is equivalent to regularising Σ and solving

$$\min_{w^P}\left(w^P - w^B\right)'\Sigma_C\left(w^P - w^B\right) \quad \text{s.t.}$$
$$\left(w^P - w^B\right)'\mu = \underline{\mu} \quad \text{where } \Sigma_C \text{ is the regularised version of } \Sigma \qquad (2)$$

Active share targets and regularisation (2)

- It is well known that, because of model uncertainty, optimisers tend to generate portfolios with extreme positions (Jobson and Korkie, 1981; Jorion, 1992; Broadie, 1993; Michaud, 1989, Best and Grauer, 1991; Chopra and Ziemba, 1993)
- Because of the large number of parameters that need to be estimated, some of the variances and covariances in Σ will be estimated imprecisely
- The optimiser in (1) typically takes extreme positions in two stocks that purport to have strong covariation: Long the stock with higher expected return, short the one with less upside
- We show that the regularised covariance matrix Σ_c counters this effect by shrinking back towards zero the relevant covariances

Active share targets and robust regression (1)

➔ It is well known (Britten-Jones, 1999) that, in the special case where the covariance matrix and expected returns are estimated from sample moments, the problem

$$\min_{w^A} w^{A\prime}\Sigma w^A \quad \text{s.t.}$$

$$w^{A\prime}\mu = \underline{\mu} \qquad \left(\text{where } w^A = w^P - w^B\right)$$

can be solved (up to a constant) by *regressing a constant on a matrix of historical returns without an intercept*

$$e_T = Rw^A + \varepsilon$$

where e_T is a Tx1 vector of ones, R a Txn matrix of observed returns, w the nx1 vector of weights we want to estimate, ε an error term

➔ The constraint can be imposed by rescaling the OLS estimate

Active share targets and robust regression (2)

➔ Constraining the active share corresponds to *running a lasso regression* instead of OLS:

$$\min_{w^A}\left(e_T - Rw^A\right)'\left(e_T - Rw^A\right) \text{ s.t.}$$

$$\sum_{i=1}^{n}\left|w^A\right| \leq 2\xi$$

➔ The estimates w^A are shrunk towards zero (i.e. towards the benchmark)

➔ In statistical terms, 2ξ is the tuning parameter which controls the amount of shrinkage

➔ As ξ decreases, some of the optimal active weights will be set to zero

Active share targets and robust regression (3)

- In this simplified setup, the intuition is clear:
  - The mean variance approach seeks to estimate the weights of a mean / TE efficient portfolio
  - By using lasso we obtain a robust estimate which mitigates the effects of model uncertainty
- In other words, the more uncertainty around alphas and covariances, the more we need to shrink the estimated optimal weights towards the benchmark (lower ξ)
- Conversely, *the more conviction we have in the expected returns and risk estimates, the higher the active share target should be*
- An intriguing consequence of the equivalence between estimation and portfolio construction is that the active share target (or equivalently the lasso tuning parameter 2ξ) may be estimated from the data

Monte Carlo experiments

- Can an active share target make portfolio construction more robust?
- We use the same setup as Ceria and Stubbs (2006), a paper on robust portfolio construction
- A universe of 30 stocks with given expected returns and covariance matrix
- Simulate *T* months of returns and estimate the mean from the data
- Given the estimates solve for the efficient frontier

Efficient frontiers

➔ For all λ>0 we solve

$$\min_{w^P}\left(w^P-w^B\right)'\Sigma\left(w^P-w^B\right)-\lambda\hat{\alpha}'\left(w^P-w^B\right) \quad \text{s.t.}$$

$$w^P \geq 0$$

$$\sum_{i=1}^{n} w_i^P = 1$$

$$\frac{1}{2}\sum_{i=1}^{n}\left|w_i^P - w_i^B\right| \leq \xi$$

Estimated efficient frontier with active share target

and

$$\min_{w^P}\left(w^P-w^B\right)'\Sigma\left(w^P-w^B\right)-\lambda\hat{\alpha}'\left(w^P-w^B\right) \quad \text{s.t.}$$

$$w^P \geq 0$$

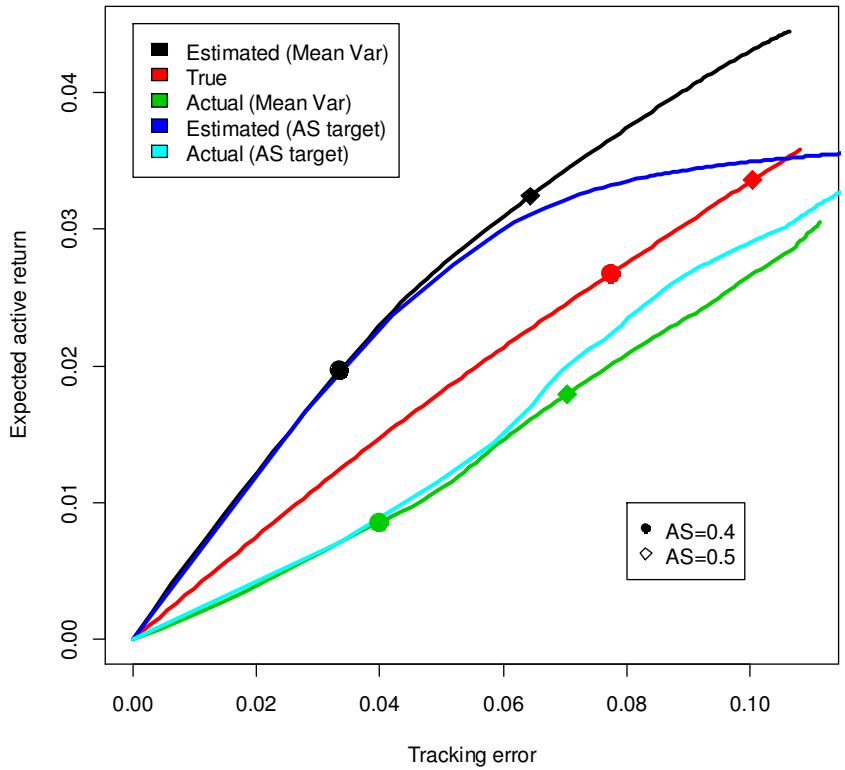
$$\sum_{i=1}^{n} w_i^P = 1$$

Estimated mean variance efficient frontier

Efficient frontiers

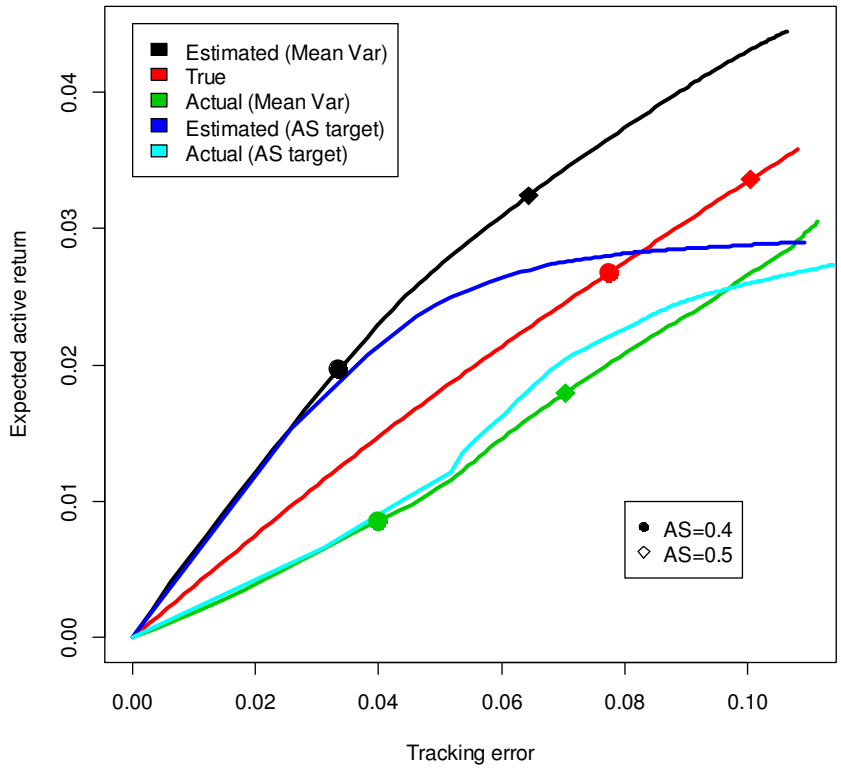
- If we substitute the true α in the optimisation problem we get the *true* frontier
- We can also compute an *actual* frontier for each of the estimated ones
- This is done by calculating tracking error and expected return of the portfolios on the estimated frontier using the true covariance matrix and stock alphas

Estimated and actual frontiers, target 0.4



Source: Macquarie Quantitative Research, June 2014

Estimated and actual frontiers, target 0.3



Source: Macquarie Quantitative Research, June 2014

A Monte Carlo experiment

- Generate T=60 months of returns for the 30 stocks
- Estimate the optimal AS target by using *leave one out cross validation*
- For the next 60 months, reoptimise the portfolio using the same target out of sample
- We choose λ=0.3 which gives a TE of 5% for the true efficient portfolio
- We then compute, out of sample, the objective function, TE and mean active return
- 500 Monte Carlo replications

Simulation results

- A lower value of the objective function indicates higher value added by the PM
- Using an active share target improves on the unconstrained mean variance portfolio

	True (unfeasible)	Mean Var	AS target
Objective Function (Q1)	-0.648	0.472	-0.082
Objective Function (mean)	-0.237	1.624	0.629
Objective Function (Q3)	0.159	2.884	1.167
Active Share	0.29	0.74	0.31
Mean active return	1.61%	0.40%	0.29%
TE	4.93%	13.03%	7.62%

Source: Macquarie Quantitative Research, June 2014

Adding skill

➔ We generate return forecasts with hindsight:

$$\hat{\alpha}_{it} = \kappa r_{it} + (1-\kappa)\frac{1}{T}\sum_{s=t-T}^{t-1} r_{is}$$

where α_t is the forecast and r_t the realised return

➔ The parameter κ represents the stock picker's skill

➔ We choose three values of which correspond to ex ante unconstrained information ratios of 0.5, 0.9 and 1.5

Adding skill

➔ For the lower values of κ we find the same result as before, i.e. imposing an active share target leads to a better outcome

➔ At the highest level of skill, however, the unconstrained approach is preferable

	k=0.0025		k=0.005		k=0.01	
	Mean Var	AS target	Mean Var	AS target	Mean Var	AS target
Objective Function (Q1)	-0.254	-0.459	-1.179	-0.991	-2.640	-2.325
Objective Function (mean)	0.861	0.308	-0.168	-0.350	-1.718	-1.591
Objective Function (Q3)	2.045	0.906	0.829	0.274	-0.754	-0.708
Active Share	0.74	0.37	0.73	0.39	0.75	0.52
Mean return	2.89%	1.83%	6.34%	4.23%	12.37%	9.77%
TE	12.97%	8.45%	13.00%	8.88%	13.93%	11.06%

Source: Macquarie Quantitative Research, June 2014

Conclusion

- We have developed a simple tool to manage risk, return and active share in an equity portfolio
- In our framework, imposing an active share target mitigates the effects of model uncertainty and results in more robust portfolios
- Evidence from simulated data supports the theoretical results
- Our findings suggest that active share targets should
  1) depend on the predictive ability of the signal (skill)
  2) depend on the number of stocks and concentration of the universe
  3) change over time

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Appendix: Proof of the regularisation result

➔ Consider the problem

$$\min_{w^A} w^{A\prime}\Sigma w^A \quad \text{s.t.}$$

$$w^{A\prime}\mu = \underline{\mu} \qquad \text{(A1)}$$

$$\frac{1}{2}\sum_{i=1}^{n}\left|w^A\right| \le \xi$$

➔ We show that it is equivalent to

$$\min_{w^A} w^{A\prime}\Sigma_C w^A \quad \text{s.t.}$$

$$w^{A\prime}\mu = \underline{\mu} \qquad \text{(A2)}$$

$$\text{where } \Sigma_C = \Sigma + \frac{\theta_1}{2\underline{\mu}}(\mu g' + g\mu')$$

θ_1 is a Lagrange multiplier for (A1), g is the subgradient vector of $\sum_{i=1}^{n}\left|w^A\right|$ at the solution of (A1)

Appendix: Proof

➔ The Kuhn-Tucker conditions for (A1) are

$$\Sigma w^A + 0.5\theta_1 g - \theta_2 \mu = 0$$

$$w^{A\prime}\mu = \underline{\mu}, \quad \frac{1}{2}\sum_{i=1}^{n}\left|w^A\right| \le \xi, \quad \theta_1, \theta_2 \ge 0$$

➔ The definition of Σ_C and the FOCs above imply

$$\Sigma_C w^A = \Sigma w^A + \frac{\theta_1 \xi}{2\underline{\mu}}\mu + \frac{\theta_1}{2} g$$

$$= \left(\frac{\theta_1 \xi}{2\underline{\mu}} + \theta_2\right)\mu$$

➔ Hence $\hat{w}^A_{OPT} = \left(\frac{\theta_1 \xi}{2\underline{\mu}} + \theta_2\right)\Sigma_C^{-1}\mu$

Appendix: Proof

➔ If we solve (A2) directly we get, after some algebra,

$$\tilde{w}_{OPT}^{A} = \frac{\underline{\mu}}{\mu' \Sigma_C^{-1} \mu} \Sigma_C^{-1} \mu$$

➔ The two vectors lie on the same direction and therefore, given that

$$\hat{w}_{OPT}^{A}{}' \mu = \tilde{w}_{OPT}^{A}{}' \mu = \underline{\mu},$$

they must be equal: $\hat{w}_{OPT}^{A} = \tilde{w}_{OPT}^{A}$

Appendix: Interpretation

➔ We defined the shrunk covariance matrix as

$$\Sigma_C = \Sigma + \frac{\theta_1}{2\underline{\mu}}(\mu g' + g\mu')$$

➔ Note that θ_1 an $\underline{\mu}$ are both nonnegative. A typical covariance term in Σ_C is

$$[\Sigma_C]_{ij} = [\Sigma]_{ij} + k(\mu_i g_j + \mu_j g_i) \qquad \text{(A3)}$$

where k is a nonnegative constant

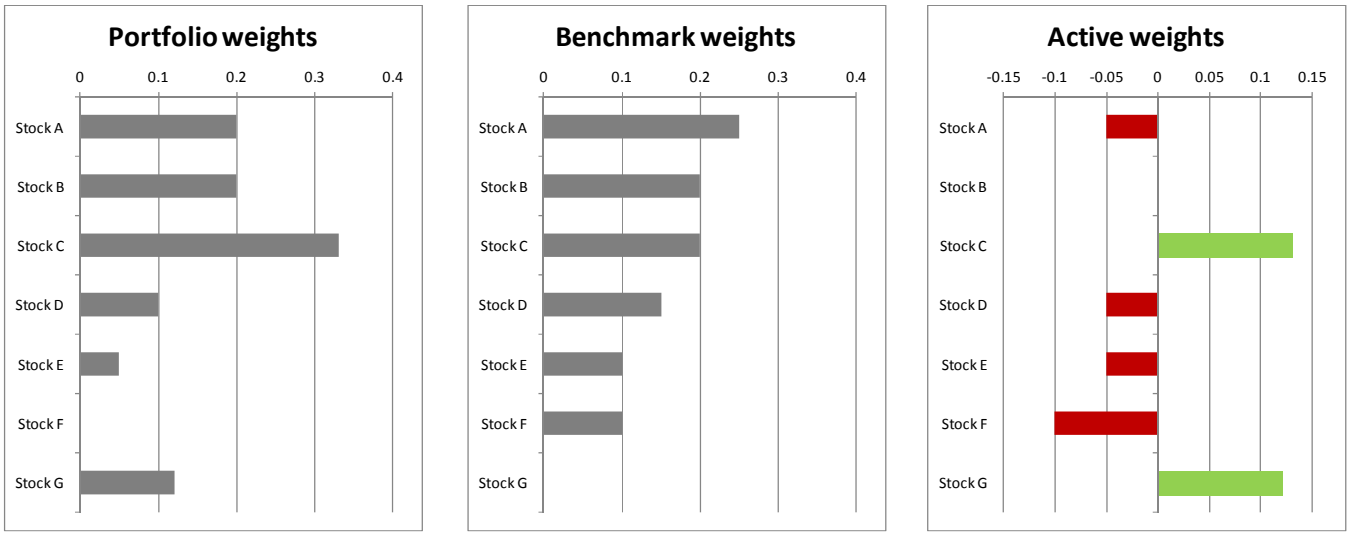
➔ Consider the case where the original estimate of the covariance *(i,j)* is positive and $\mu_i > \mu_j$. Typically, the optimiser will try to go long asset i ($w_i > 0$) and short asset j ($w_j < 0$)

➔ This implies $g_i > 0$ and $g_j < 0$. Hence the last term in (A3) is negative and the covariance is shrunk towards zero

Active share

➔ Active share = total positive active weights = - total negative active weights

➔ Hence AS can be seen as an active management budget



Source: Macquarie Quantitative Research, June 2014

A hot topic for large asset management firms

Year	Firm	Title, Authors	Main conclusions
2011	Wellington	Active Share: Predicting Alpha and Risk K. Stahl, G. Thomas, T. Simon	High active share funds tend to outperform low active share ones. However, the predictive power of active share is weaker in the US large cap growth and US small cap categories. Active share is also found to be a good predictor of portfolio risk.
2012	Vanguard	The search for outperformance: Evaluating 'active share' T. Schlanger, C. B. Philips, K. Peterson LaBarge	No evidence is found that high active share predicts outperformance. Weak evidence that funds with high active share and low expense ratios tend to outperform.
2013, 2014	Lazard	Taking a Closer Look at Active Share E. Khusainova, J. Mier	Active share does predict outperformance in a sample of international funds.
2013	PIMCO	Active Share, Tracking Error and Management Style S. Sapra, M. Hunjan	Attempts to relate active share to tracking error. The relation is found to vary with market volatility and investment style.
2014	Fidelity	Active Share: A Misunderstood Measure in Manager Selection T. Cohen, B. Leite, D. Nielson, A. Browder	Excess return seems to increase with higher active share, but so do downside risk and dispersion of returns. For large cap funds, the relation between active share and excess return appears to be mainly driven by smaller-cap bias in portfolio stock selection.

Source: Macquarie Research, August 2014.

Example: 90% active share with 25 stocks

- We select the 25 European stocks with largest upside in our Alpha model and form a portfolio imposing an active share target of 90%
- The covariance matrix comes from our statistical risk model
- The benchmark is a cap-weighted index of the largest 200 companies
- Three levels of risk tolerance are selected to obtain different levels of risk, λ=1, 1.5, 2
- As risk increases, the portfolio becomes more concentrated with fewer (but larger) overweight positions and more neutral ones

Example: 90% active share with 25 stocks

Largest holdings	Alpha	BM weight	Weight Portfolio 1	Weight Portfolio 2	Weight Portfolio 3
CONTINENTAL AG	6.34%	0.51%	11.7%	15.2%	18.5%
A.P. MOLLER-MAERSK	5.91%	0.28%	11.6%	14.6%	17.3%
AXA	4.87%	0.68%	8.7%	10.1%	11.0%
FIAT SPA	6.35%	0.16%	7.9%	10.1%	12.1%
EDF	4.75%	0.77%	6.9%	8.0%	8.8%
GDF SUEZ	3.77%	0.66%	6.5%	6.2%	5.4%
AIRBUS GROUP NV	4.66%	0.58%	6.2%	6.9%	7.3%
SWATCH GROUP	3.50%	0.16%	5.4%	4.4%	2.8%
DEUTSCHE POST AG	4.09%	0.49%	5.0%	4.9%	4.4%
NEXT	3.55%	0.19%	4.3%	3.6%	2.5%
NOKIA OYJ	4.20%	0.30%	3.1%	3.3%	3.4%
Ex ante tracking error			10.9%	12.5%	14.1%
Active share			0.9	0.9	0.9
Overweight positions			23	16	13
Neutral positions			0	7	10

Source: FactSet, I/B/E/S, Macquarie Quantitative Research, June 2014. Data as of end May 2014.

A stock picker's active share

We simulate a stock picker's portfolio

- ➔ Draw for each industry a set of random stock picks.
- ➔ Assume high and low conviction picks with different hit rates
- ➔ The holdings are **weighted by level of conviction** in such a way that high conviction stock picks receive larger weights
- ➔ The number of stock picks from each industry is chosen so that the portfolio has **no active industry exposures**

A stock picker's active share

Example of conviction-driven weights

	Portfolio			
	A	B	C	D
Number of stocks	80	100	80	100
Total weight on high conviction picks	0.5	0.5	0.75	0.75
High conviction weight	2.50%	2.00%	3.75%	3.00%
Low conviction weight	0.83%	0.67%	0.42%	0.33%
High conviction names	20	25	20	25
Low conviction names	60	75	60	75

Source: Macquarie Quantitative Research, August 2014

The total weight assigned to high conviction names affects concentration:
Low (50%) vs. High (75%)

A stock picker's active share: Results

- We apply our methodology to a pan-European universe and to a highly concentrated one (30-40 Swiss stocks)
- Typical active share levels are driven by concentration (both in the portfolio and in the benchmark) and number of holdings

Pan-European portfolio

		Active Share		
Levels of Concentration	Number of Stocks	10%	Median	90%
Low	60	0.82	0.86	0.89
Low	80	0.78	0.82	0.86
Low	100	0.75	0.79	0.83
High	60	0.85	0.88	0.90
High	80	0.82	0.85	0.88
High	100	0.79	0.83	0.86

Swiss portfolio

		Active Share		
Levels of Concentration	Number of Stocks	10%	Median	90%
Low	10	0.66	0.78	0.88
Low	20	0.59	0.66	0.74
Low	30	0.53	0.58	0.63
High	10	0.66	0.79	0.89
High	20	0.59	0.68	0.76
High	30	0.54	0.60	0.67

Source: Macquarie Quantitative Research, August 2014

Important disclosures:

Recommendation definitions

Macquarie - Australia/New Zealand

Outperform – return > 3% in excess of benchmark return
Neutral – return within 3% of benchmark return
Underperform – return > 3% below benchmark return

Benchmark return is determined by long term nominal GDP growth plus 12 month forward market dividend yield

Macquarie – Asia/Europe

Outperform – expected return >+10%
Neutral – expected return from -10% to +10%
Underperform – expected <-10%

Macquarie First South - South Africa

Outperform – return > 10% in excess of benchmark return
Neutral – return within 10% of benchmark return
Underperform – return > 10% below benchmark return

Macquarie - Canada

Outperform – return > 5% in excess of benchmark return
Neutral – return within 5% of benchmark return
Underperform – return > 5% below benchmark return

Macquarie - USA

Outperform – return > 5% in excess of benchmark return
Neutral – return within 5% of benchmark return
Underperform – return > 5% below benchmark return

Volatility index definition*

This is calculated from the volatility of historic price movements.

Very high–highest risk – Stock should be expected to move up or down 60-100% in a year – investors should be aware this stock is highly speculative.

High – stock should be expected to move up or down at least 40-60% in a year – investors should be aware this stock could be speculative.

Medium – stock should be expected to move up or down at least 30-40% in a year.

Low–medium – stock should be expected to move up or down at least 25-30% in a year.

Low – stock should be expected to move up or down at least 15-25% in a year.

* Applicable to Australian/NZ stocks only

Recommendation – 12 months

Note: Quant recommendations may differ from Fundamental Analyst recommendations

Financial definitions

All "Adjusted" data items have had the following adjustments made:

Added back: goodwill amortisation, provision for catastrophe reserves, IFRS derivatives & hedging, IFRS impairments & IFRS interest expense
Excluded: non recurring items, asset revals, property revals, appraisal value uplift, preference dividends & minority interests

EPS = adjusted net profit /efpowa*
ROA = adjusted ebit / average total assets
ROA Banks/Insurance = adjusted net profit /average total assets
ROE = adjusted net profit / average shareholders funds
Gross cashflow = adjusted net profit + depreciation
*equivalent fully paid ordinary weighted average number of shares

All Reported numbers for Australian/NZ listed stocks are modelled under IFRS (International Financial Reporting Standards).

Recommendation proportions – For quarter ending 30 June 2014

	AU/NZ	Asia	RSA	USA	CA	EUR	
Outperform	51.67%	60.69%	34.67%	42.33%	55.41%	44.84%	(for US coverage by MCUSA, 6.76% of stocks followed are investment banking clients)
Neutral	33.00%	23.93%	38.67%	50.92%	38.51%	35.87%	(for US coverage by MCUSA, 7.25% of stocks followed are investment banking clients)
Underperform	15.33%	15.38%	26.67%	6.75%	6.08%	19.28%	(for US coverage by MCUSA, 0.48% of stocks followed are investment banking clients)

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