ON THE VALUE OF PORTFOLIO CONSTRUCTION

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SMART
PORTFOLIO
STRATEGIES

ACTIVE PORTFOLIO MANAGEMENT - 1

Active Portfolio Management essentially consists of two things:

STOCK SELECTION + PORTFOLIO CONSTRUCTION

- Many fund managers spend the majority of their time and effort on Stock Selection, and relatively little on Portfolio Construction

- Finance theory tells us to optimise, trading off Expected Returns against Risks, to create and maintain efficient portfolios. Harry Markowitz was given a Nobel prize for having this idea, and to my knowledge, no-one has come up with a better portfolio construction paradigm since

- Despite this fact, many Portfolio Managers still prefer to use simple heuristic methods to create and rebalance their portfolios

ACTIVE PORTFOLIO MANAGEMENT - 2

The explosive growth of Style factor ETFs over the past decade is effectively a case study of this phenomenon, since almost all these ETFs use one of the common heuristic methods of portfolio construction. These include :

- **Equal-weighting**
- **Capitalisation-weighting**
- **Attribute-weighting**
- **Inverse Volatility weighting**
- **Risk Parity weighting**

Note that NONE of these methods make any attempt to trade-off Expected Return against Risk, so NONE of them create efficient portfolios

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PORTFOLIO MANAGEMENT vs STOCK SELECTION

- Many managers will happily describe themselves as ‘stock pickers’; their focus is very much on the individual stocks in a portfolio
- If they are asked why a particular stock is being held, they will usually respond with a story about the attractive features of that stock
- On the other hand, managers rarely say they are holding a particular stock because it helps to manage their portfolio risk . . . .
- Analysts are paid to pick individual stocks, (i.e. to forecast expected returns) while Portfolio Managers are paid (more!) to manage portfolios
- Portfolio Managers should therefore consider both the expected returns of their stocks and their effects on the risk structure of their portfolio

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EVERYONE DOES IT, SO WHAT'S THE PROBLEM?

- There has been an on-going debate in the finance literature (it seems like forever!) about whether active managers have "Skill"
- The essential argument is that if managers did have Skill, then surely their portfolios would outperform their benchmarks?
- Since this usually doesn't happen, finance academics conclude that active managers either don't (or can't, if anyone still believes in the more extreme form of the Efficient Market Hypothesis!) have any Skill
- In fact, there is a perfectly sensible alternative explanation, namely, that while these managers may well have Stock Selection Skill, they do not create portfolios which efficiently reflect this Skill, allowing the returns from the portfolio inefficiencies to dominate their Skill returns

WHY DO MANAGERS PREFER HEURISTIC METHODS?

1. Optimisers are notorious for giving counter-intuitive results, which is really just a polite way of saying that they often generate very strange portfolios that managers wouldn't touch with a bargepole!

2. Unless they are heavily constrained, they always tend to do lots of trading, and incur lots of transaction costs (more on this later)

3. The biggest difficulty with optimisation is that the manager has to provide a set of Expected Returns – and despite their avowed Stock Selection prowess, most managers are very reluctant to do so . . .

. . . It is a curious fact, however, that even though they won't commit themselves to actual Expected Return forecasts, managers can always tell you which of two stocks in their portfolio they prefer. Go figure!

DEFINITIONS OF PORTFOLIO EFFICIENCY

- Formally, rational investors ($0 < \lambda < \infty$) seek to maximise return and minimise risk, subject to the usual Budget constraint, thus:-

$$\textbf{Max } U = R_P - \lambda * V_P \quad \textbf{such that} \quad \sum x_i = 1 \qquad (a)$$

- However, efficiency also means that the effects of a manager's Skill should be maximised, while the effects of noise, or unwanted bets, sould be minimised as far as possible, given the long-only constraint

- Many fund managers operate within a risk budget. In an inefficient portfolio a significant part of this may be taken up with unintended bets. If these are minimised in a more efficient portfolio, it creates more scope for the manager to make bigger Skill bets, and, if they do have Skill, thereby improve their portfolio performance

THE VALUE OF PORTFOLIO CONSTRUCTION

- In order to show that the method of Portfolio Construction used can make a significant difference to the performance of a portfolio, we first adopt a simple Stock Selection rule, as used in the construction of a number of existing Style factor ETFs

- For each of seven different Style factor investment strategies, we create initial portfolios of $100 million at the end of December 2004

- Each portfolio is then rebalanced every 12 weeks (think quarterly), and they are run for almost 16 years, up to November 2020

- The Performance results shown below are net of assumed round-trip transaction costs of 30 bps, and an annual management fee, payable quarterly, of 20 bps, which is fairly typical for Style factor ETFs

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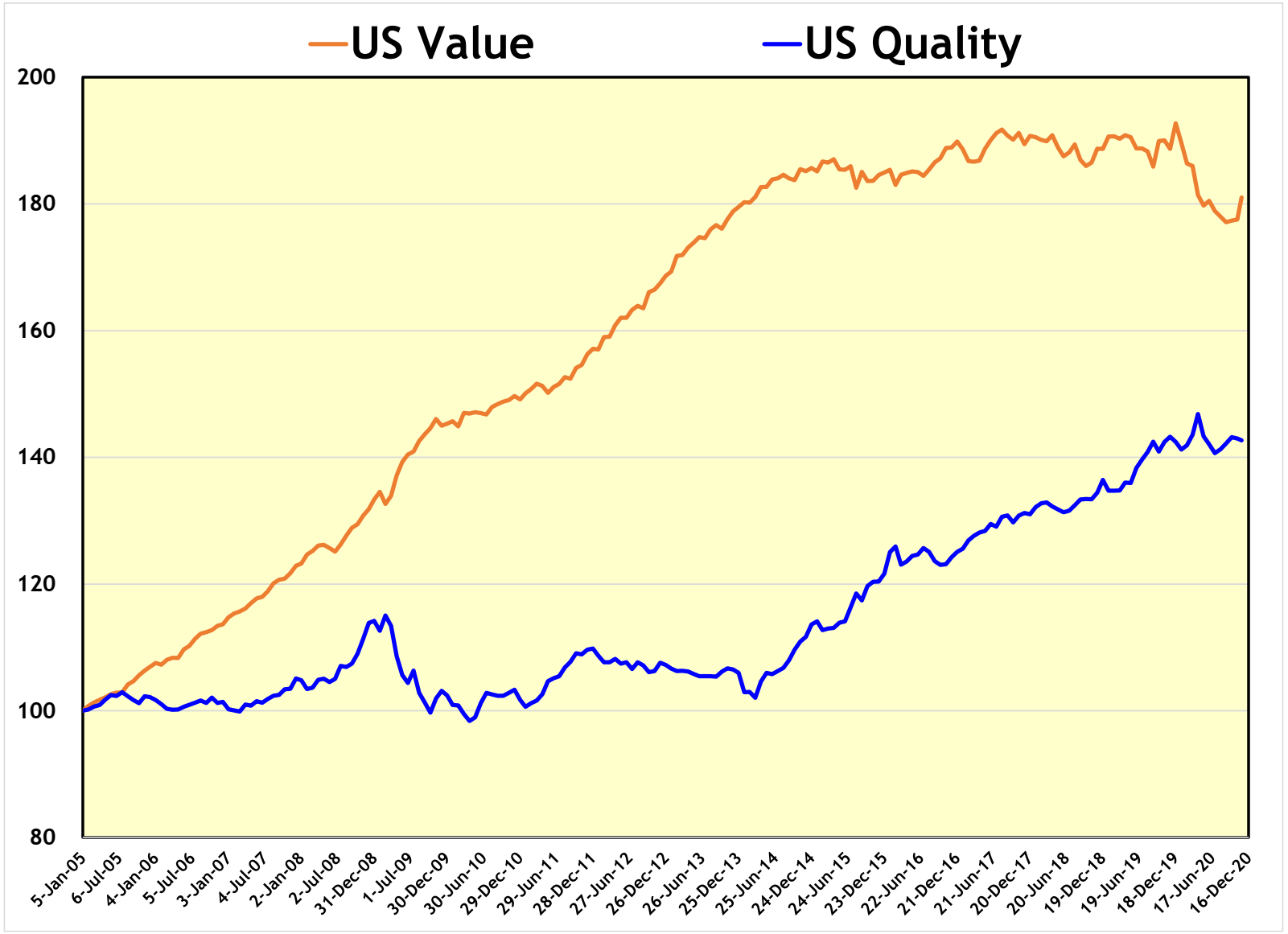
STYLE FACTOR PORTFOLIOS

- We use two different Style factors to build Style factor ETF-type portfolios, namely :-

Value	B/P, E/P and CF/P
Quality	ROA, ROE, CF/Sales

- The Stock Selection rule is very simple: at each rebalancing date we rank the S&P 500 stocks high to low by the corresponding Style beta, and then select the top 100 stocks

STYLE FACTOR RETURNS



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SEVEN INVESTMENT STRATEGIES

- In addition to the five heuristic portfolio construction methods given above, we also include standard Markowitz Optimisation (warts and all!), and a new method called Smart Portfolio Optimisation (SPO)

- In essence, SPO first identifies the most inefficient holdings in a portfolio, and whether they are too large or too small; if they are too large they become possible Sells, if too small, they become possible Buys

- Any holding that is considered efficient enough, given the limits on our stock return forecasting ability, become Holds. Once these constraints are set, the Optimiser is then set loose to decide which trades to make to improve the overall efficiency of the current portfolio

SMART PORTFOLIO OPTIMISATION - 1

- In order to identify inefficient holdings, we first derive a set of Implied Returns that would make the current portfolio efficient.

- These are given by the following equation :-

$$\mathbf{IR_I = R_P + \varphi * S_P * (Beta_{iP} - 1)} \qquad \text{(b)}$$

where

$\mathbf{R_P}$ = Portfolio Expected Return

$\mathbf{S_P}$ = Portfolio Risk

$\mathbf{Beta_{iP}}$ = Beta of the Stock to the Portfolio

$\boldsymbol{\varphi}$ = Return/Risk trade-off $\qquad (\mathbf{0 < \varphi < \infty})$

- Clearly, there are many different solutions as $\boldsymbol{\varphi}$ varies. We need to find a solution in which the Implied Returns are on the same scale as the Expected Returns, so that we can do a fair comparison.

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SMART PORTFOLIO OPTIMISATION - 2

- We do this SIMPLY by minimising the sum of squared differences between the Implied and Expected Returns :-

$$\textbf{Min } Z = \textbf{Sum}_i(IR_i - ER_i)^2 \qquad \text{(c)}$$

- Substituting equation (b) for the Implied Returns $\mathbf{IR_i}$ in equation (c), and then solving and re-arranging, we obtain the following :-

$$\text{Min } \varphi = \frac{\textbf{Sum}_i\{(ER_i - R_P)*(Beta_{iP} - 1)\}}{S_P * \textbf{Sum}_i\{(Beta_{iP} - 1)^2\}} \qquad \text{(d)}$$

- Note that the denominator is a sum of squared terms, and must therefore be positive. The sign of Min φ (that makes the portfolio seem as efficient as possible) is therefore determined by the numerator.

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WHAT EXACTLY IS $Beta_{iP}$?

- Portfolio risk (as variance) is given by $\mathbf{V_P = Sum_i\{Sum_j(x_i * x_j * C_{ij})\}}$
  where $\mathbf{x_i}$, $\mathbf{x_j}$ are holdings of **i** and **j**, $\mathbf{C_{ij}}$ is the full covariance matrix

- Hence the % contribution of risk (variance) from holding **i** is given by :-

$$\mathbf{PCV_{iP} = [100 * Sum_j\{x_i * x_j * C_{ij}\}] / V_P}$$

$$\mathbf{= [100 * x_i * Sum_j\{x_j * Cov(R_i, R_j)\}] / V_P}$$

$$\mathbf{= [100 * x_i * Cov(R_i, Sum_j\{x_j * R_j\})] / V_P}$$

$$\mathbf{= [100 * x_i * Cov(R_i, R_P)] / V_P}$$

- Dividing the % contribution of risk by the % holding size, we get :-

$$\mathbf{PCV_{iP} = \frac{[100 * x_i * Cov(R_i, R_P)]}{100 * x_i * V_P} = \frac{Cov(R_i, R_P)}{V_P} = Beta_{iP}}$$

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SMART PORTFOLIO OPTIMISATION - 3

- So $\mathbf{Beta_{iP}}$ shows whether a holding is more or less risky than average in the context of this particular portfolio. To remind you, we have :-

$$\text{Min } \boldsymbol{\varphi} = \frac{\mathbf{Sum_i\{(ER_i - R_P)*(Beta_{iP} - 1)\}}}{\mathbf{S_P * Sum_i\{(Beta_{iP} - 1)^2\}}} \qquad \text{(d)}$$

- Re-arranging equation (b) slightly, we see that for portfolio efficiency :-

$$\mathbf{(IR_i - R_P) = \varphi * S_P * (Beta_{iP} - 1)} \qquad \text{(e)}$$

- Which makes it clear that, in an efficient portfolio, the more attractive stocks ($\mathbf{IR_i > R_P}$) will also be the more risky holdings ($\mathbf{Beta_{iP} > 1}$), and that there is a constant return/risk trade-off $\boldsymbol{\varphi}$ throughout the Portfolio

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A PERSPECTIVE ON INEFFICIENT PORTFOLIOS

- The numerator, which determines the sign of **Min φ**, is :-

$$\mathbf{Sum_i\{(ER_i - R_P)*(Beta_{iP} - 1)\}}$$

- We would like this to be positive, which would imply that the manager is a rational investor (**$0 < \varphi < \infty$**), but sometimes it turns out to be negative. What does this mean?

- The only way this can happen (unless there are binding holding size constraints) is if some of the less attractive stocks (**$ER_i < R_P$**) are also the more risky holdings, and so have (**$Beta_{iP} > 1$**), and *vice versa*

- This, in turn implies a negative **φ**; we would surely have to call these irrational portfolios . . . .

SMART PORTFOLIO STRATEGIES

VALUE STRATEGIES RESULTS - 1

PORTFOLIO CONSTRUCTION METHOD		Average number of holdings	Annual Turnover	Average Annual Costs	Annualised Return after costs	Annualised Risk after costs	Return/Risk Ratio	Beta to S&P 500 (TR)	Annualised Alpha	Annualised Tracking Error	Information Ratio
AW	Attribute-weighted	101	150.7%	-0.65%	13.91%	23.17%	0.600	1.336	2.09%	10.39%	0.201
CW	Capitalisation-weighted	101	128.3%	-0.58%	10.15%	17.40%	0.583	1.044	0.91%	4.90%	0.187
EW	Equal-weighted	101	140.0%	-0.62%	11.50%	22.32%	0.515	1.306	-0.05%	9.20%	-0.006
IV	Inverse Volatility	101	134.8%	-0.60%	11.62%	20.37%	0.571	1.200	1.00%	7.46%	0.135
RP	Risk Parity	101	139.3%	-0.61%	11.96%	19.94%	0.600	1.174	1.57%	7.21%	0.218
MKZ	Markowitz Optimisation	60.5	161.6%	-0.68%	11.30%	17.78%	0.635	1.072	1.81%	4.78%	0.379
SPO	Smart Portfolio Optimisation	37.0	117.2%	-0.55%	13.19%	18.64%	0.708	1.097	3.48%	6.41%	0.543
S&P	S&P 500 (TR) index	502.4			8.85%	16.01%	0.553	1.000	0.00%	0.00%	
	AVERAGES (excluding S&P 500)		138.9%	-0.61%	11.95%	19.94%	0.602	1.176	1.55%	7.19%	0.237

SMART PORTFOLIO STRATEGIES

VALUE STRATEGIES RESULTS - 2

PORTFOLIO CONSTRUCTION METHOD		Annualised Return after costs	Annualised Risk after costs	Return/Risk Ratio	Average VALUE beta	VALUE ABS Return	As % of ABS Return	VALUE REL Return
AW	Attribute-weighted	13.91%	23.17%	0.600	1.114	4.98%	35.0%	4.64%
CW	Capitalisation-weighted	10.15%	17.40%	0.583	0.589	2.66%	25.4%	2.32%
EW	Equal-weighted	11.50%	22.32%	0.515	0.646	2.90%	24.6%	2.57%
IV	Inverse Volatility	11.62%	20.37%	0.571	0.653	2.98%	24.9%	2.65%
RP	Risk Parity	11.96%	19.94%	0.600	0.650	2.93%	23.7%	2.60%
MKZ	Markowitz Optimisation	11.30%	17.78%	0.635	0.996	4.67%	39.3%	4.33%
SPO	Smart Portfolio Optimisation	13.19%	18.64%	0.708	1.222	5.71%	42.0%	5.37%
S&P	S&P 500 (TR) index	8.85%	16.01%	0.553	0.049	0.33%	3.8%	
	AVERAGES (excluding S&P 500)	11.95%	19.94%	0.602	0.839			
	VALUE factor return				1.000	3.73%		

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VALUE STRATEGIES RESULTS - 3

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QUALITY STRATEGIES RESULTS - 1

PORTFOLIO CONSTRUCTION METHOD		Average number of holdings	Annual Turnover	Average Annual Costs	Annualised Return after costs	Annualised Risk after costs	Return/Risk Ratio	Beta to S&P 500 (TR)	Annualised Alpha	Annualised Tracking Error	Information Ratio
AW	Attribute-weighted	101	134.9%	-0.60%	9.27%	17.58%	0.527	1.066	-0.16%	4.36%	-0.036
CW	Capitalisation-weighted	101	112.8%	-0.53%	10.15%	15.33%	0.662	0.915	2.05%	4.72%	0.435
EW	Equal-weighted	101	132.8%	-0.59%	9.19%	17.61%	0.522	1.070	-0.28%	4.24%	-0.065
IV	Inverse Volatility	101	129.9%	-0.59%	9.39%	16.18%	0.580	0.987	0.66%	3.50%	0.188
RP	Risk Parity	101	132.2%	-0.59%	9.07%	15.66%	0.579	0.949	0.67%	3.83%	0.174
MKZ	Markowitz Optimisation	63.3	157.7%	-0.67%	8.98%	15.03%	0.597	0.923	0.81%	2.95%	0.274
SPO	Smart Portfolio Optimisation	37.2	103.9%	-0.51%	10.48%	15.48%	0.677	0.928	2.27%	4.50%	0.505
S&P	S&P 500 (TR) index	502.4			8.85%	16.01%	0.553	1.000	0.00%	0.00%	
	AVERAGES (excluding S&P 500)		129.2%	-0.58%	9.50%	16.12%	0.592	0.977	0.86%	4.02%	0.211

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QUALITY STRATEGIES RESULTS - 2

PORTFOLIO CONSTRUCTION METHOD		Annualised Return after costs	Annualised Risk after costs	Return/Risk Ratio	Average Quality beta	Quality ABS Return	As % of ABS Return	Quality REL Return
AW	Attribute-weighted	9.27%	17.58%	0.527	1.106	2.62%	26.66%	1.70%
CW	Capitalisation-weighted	10.15%	15.33%	0.662	1.019	2.38%	22.15%	1.46%
EW	Equal-weighted	9.19%	17.61%	0.522	0.993	2.35%	24.17%	1.43%
IV	Inverse Volatility	9.39%	16.18%	0.580	0.997	2.36%	23.75%	1.43%
RP	Risk Parity	9.07%	15.66%	0.579	1.001	2.34%	24.23%	1.42%
MKZ	Markowitz Optimisation	8.98%	15.03%	0.597	1.127	2.72%	28.19%	1.80%
SPO	Smart Portfolio Optimisation	10.48%	15.48%	0.677	1.255	3.01%	27.49%	2.08%
S&P	S&P 500 (TR) index	8.85%	16.01%	0.553	0.436	0.93%	10.54%	
	AVERAGES (excluding S&P 500)	9.50%	16.12%	0.592	1.071			
	Quality factor return				1.000	2.23%		

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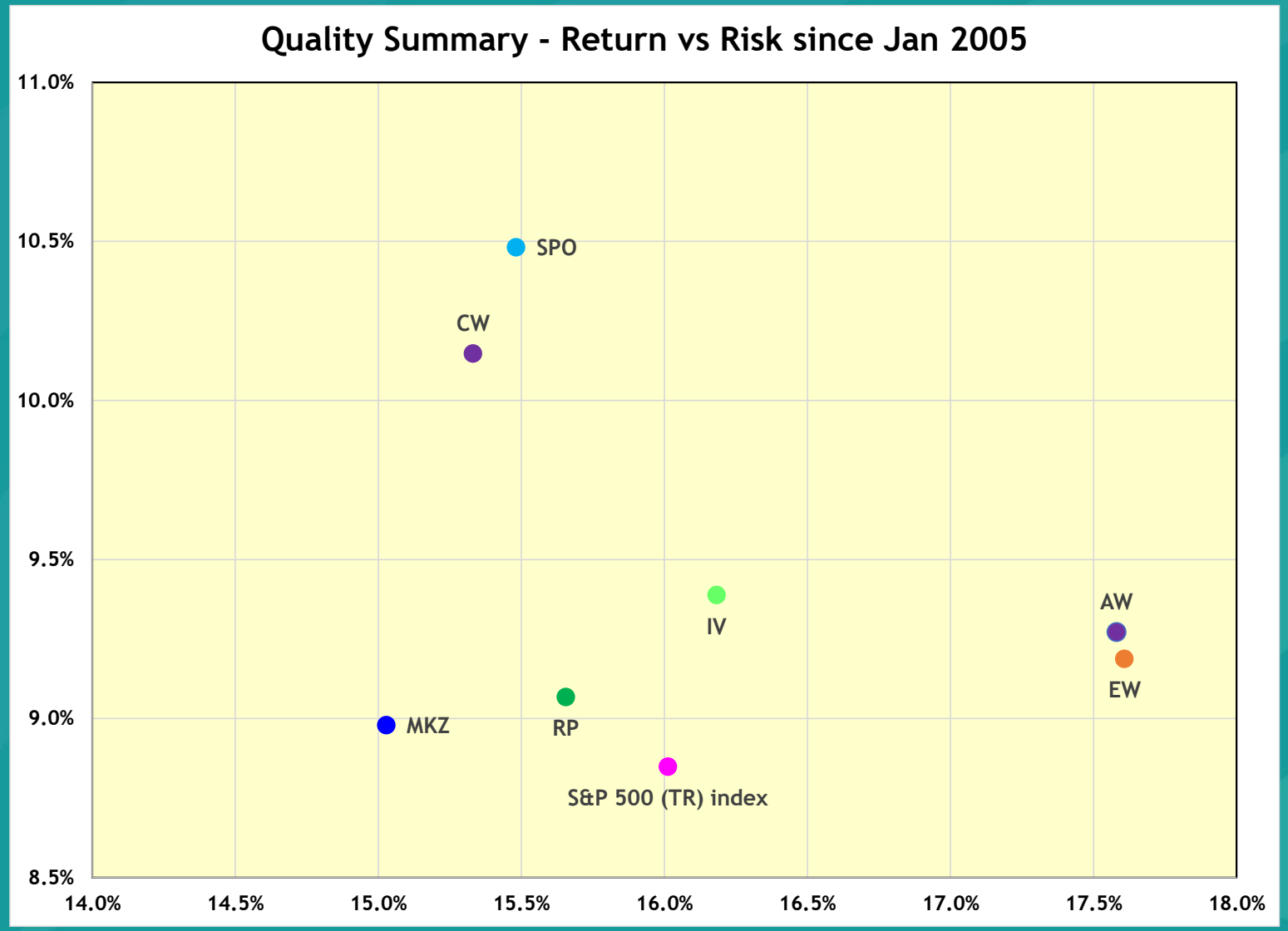
QUALITY STRATEGIES RESULTS - 3



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SUMMARY & CONCLUSIONS

- It should now be quite clear that the way in which a portfolio is constructed can make a very significant difference to its performance

- Even though we are selecting exactly the same stocks in these cases, some portfolio construction methods generate higher returns than the S&P 500, while others generate lower returns, and some have higher risk than the benchmark while others have lower risk

- This has been a **controlled experiment** in Portfolio Construction, using exactly the same stocks, transaction costs and management fees with each different portfolio construction method

- To conclude with the most important point: building more efficient portfolios leads to better performance if a manager has any Skill

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