NORTHFIELD | modeling financial markets worldwide

Smart Beta
Corporate Bond Portfolios

Jason MacQueen & Daniel Mostovoy

QWAFAFEW Seminar New York

27th March 2018

Revisiting Smart Portfolios - 1

- In a November 2014 webinar, we introduced the idea of Smart Portfolios for Smart Beta-type equity investment
- The essential idea was that, while Smart Beta ETFs were a good idea, the way in which they were typically constructed made them very inefficient
- In an equal-weighted or cap-weighted ETF, for example, there is no guarantee that the targeted Style factor would be a significant determinant of the performance
- If an investor buys a VALUE ETF, then surely its performance should reflect the VALUE risk premium as closely as possible, subject to the usual long-only constraint?

Revisiting Smart Portfolios - 2

- We designed a simple investment strategy, from first principles, to create and rebalance a Smart Beta Dividend Yield portfolio
- In summary, this consisted of starting with the 1,000 largest stocks by capitalisation, and filtering out those with very high volatility or very low R-Squareds (in order to increase our overall confidence in the risk estimates)
- We then ran a simple Markowitz optimisation to maximise exposure to Dividend Yield, while minimising portfolio risk as far as possible, subject to the constraint that each holding should be between 0% and 3%

Revisiting Smart Portfolios - 3

- A Performance Attribution analysis on this Smart Portfolio, run over ten years from the beginning of 2005 to the end of 2014, showed that the return to the Dividend Yield factor was the major contributor to the performance of the fund
- We then used exactly the same investment strategy to create and rebalance Smart Portfolios for other Styles, such as QUALITY and VALUE
- In each case, Performance Attribution analyses showed that the targeted Style factor premium was a major component of the portfolio's performance

Can we apply this Idea to Corporate Bonds?

- Could this idea somehow be extended to Corporate Bonds?
- The Merton model, used in our Everything Everywhere multi-asset class risk model, effectively treats all Corporate Bonds as being equivalent to a combination of an exposure to the company's underlying (risky) equity, and an exposure to (risk-less) Treasury Bonds (T-Bonds)
- Conceptually :

Corporate Bond = x * Equity + (1 - x) * T-Bond

- Further details on this derivation can be found in http://www.northinfo.com/emailimages/eerevision.pdf

Applying the Idea to Corporate Bonds

- This suggests that we could create a Smart Corporate Bond portfolio by substituting a long-short pair of Bond positions for each equity position in the portfolio
- Rearranging the formula, we get :

Equity = { Corporate Bond – (1 - x) * T-Bond } / x

- This is basically saying that for any long Equity holding in a portfolio, we could substitute a long holding of a Corporate Bond and a short position in T-Bonds
- Since **x** is between 0 and 1, the Corporate Bond holdings will typically be larger than the associated Equity holdings

Corporate Bond Portfolios from Equity Portfolios

- From a portfolio construction point of view, there are two immediate problems here:
  - (a) the Bond holdings are likely to sum more than 100%
  - (b) the portfolio is leveraged by the short T-Bond holdings
- We can deal with these problems first, by simply scaling the Corporate Bond holdings to sum to 100%, and second, by just removing the (risk-less) T-Bond holdings
- This gives us a method for converting any long-only Smart Equity Portfolio into a corresponding long-only Smart Corporate Bond Portfolio

Why Not Just Substitute Bonds for Stocks?

- There is, of course, a much simpler way to create a corresponding Corporate Bond portfolio
- Rather than using the Merton model approach, we could just simply substitute an appropriate Corporate Bond holding for each of the Equity holdings
- For instance, a 3.52% holding of Apple Equity could be replaced by a 3.52% holding of an Apple Corporate Bond
- In this case, there is no scaling required, and no short positions in T-Bonds to worry about
- We believed that the Merton model approach was likely to create more efficient portfolios, but we tried both methods

Methodology - 1

- It was necessary to adapt the original methodology, because we had to limit ourselves to stocks which actually had corresponding Corporate Bonds
- We therefore filtered the equity universe for stocks that did have Corporate Bonds, and then took the top 800 by capitalisation as our starting universe for optimisation
- Note that not all of these stocks were also in the original "top 1,000 by MktCap" Smart Portfolio universe
- Since we had a smaller universe, we did not filter out any high risk or low R-Squared stocks
- We also set the maximum stock holding size at 5%

Methodology - 2

- In the original exercise, we had initially created a set of quite low risk Smart Portfolios
- Although we were able to show that much of their performance came from the Target Style factor premium, and that these portfolios out-performed the market benchmark, it was suggested that perhaps we had unwittingly introduced a low volatility bias, so we re-ran the exercise at a point higher up the efficient frontier
- These higher risk portfolios had higher exposure to the Target Styles, and again the Performance Attribution analyses showed that this was a large part of the return

Methodology - 3

- In this Corporate Bond exercise, we also ran optimisations at two different points on the efficient frontier
- In the Northfield optimiser we can set a Risk Acceptance Parameter (RAP), expressed in units of variance/return (i.e. the inverse of a Risk Aversion Parameter)
- A low value means we are low on the efficient frontier, while a higher value implies we are higher up the frontier
- Accordingly, we ran two sets of Smart Equity Portfolios, using values of RAP = 10 and RAP = 75
- We used the same XRD US risk model as in the original exercise, and rebalanced the portfolios monthly

Methodology - 4

- It should be noted that this exercise is not, therefore, an exact replica of the original exercise
- Of necessity, we used a smaller, and somewhat different universe of stocks that did have Corporate Bonds
- We were also restricted by data availability issues to a shorter look-back period, and were only able to run the analysis over 4 years, from June 2013 up to June 2017
- While preserving the spirit of the original methodology, our main purpose here is to see whether efficient equity portfolios can be used to derive corresponding efficient Corporate Bond portfolios

Methodology - 5

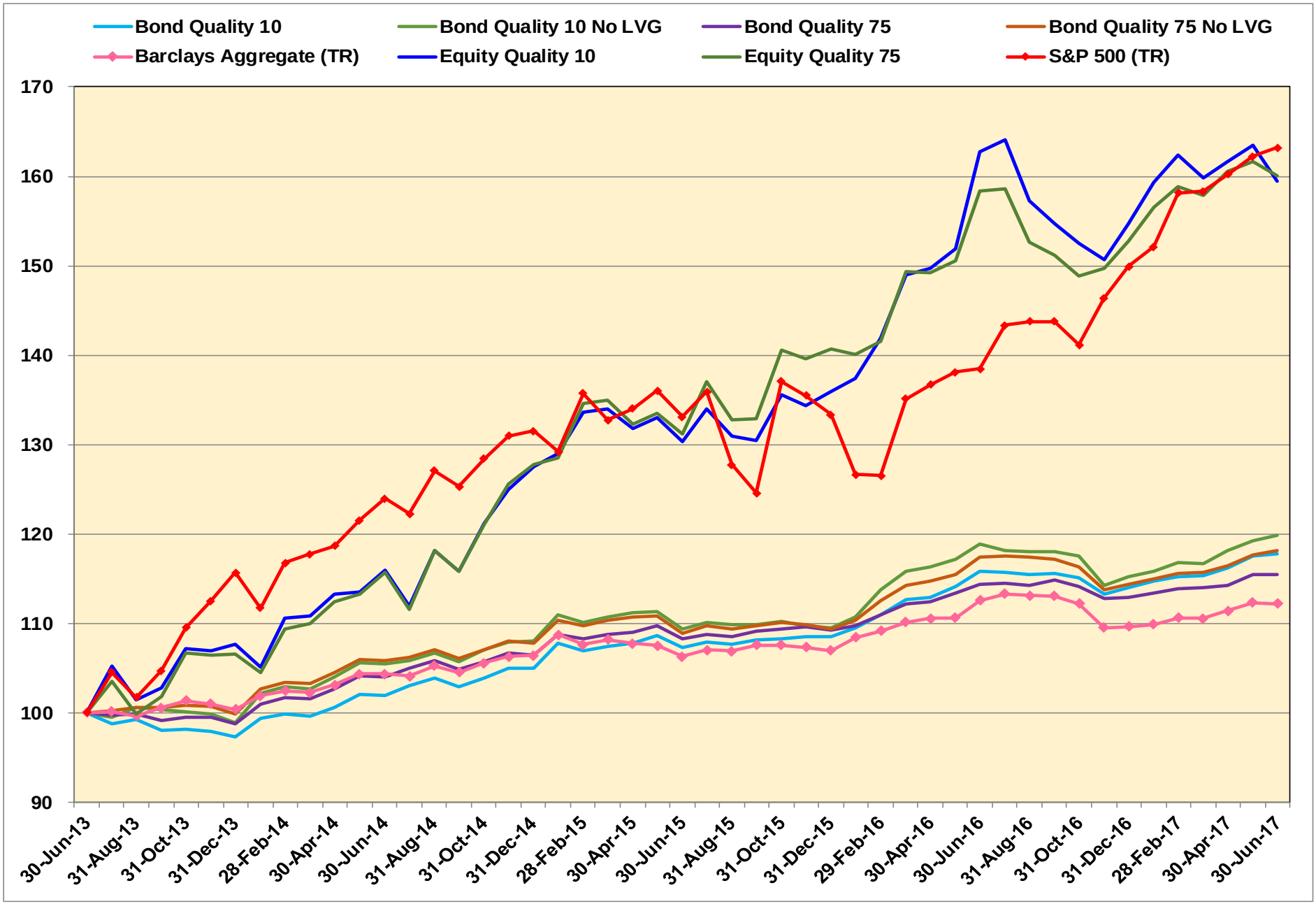
- When choosing which Corporate Bond to substitute for a particular equity issue, we chose the largest bond in issue, presuming this would probably have the most liquidity
- We did not control for Duration in the Bond portfolios, as this was just an initial research exercise to see whether there was any value in using the efficient equity portfolio composition to create an efficient corporate bond portfolio
- Similarly, we did not take transaction costs into account in running these simulations

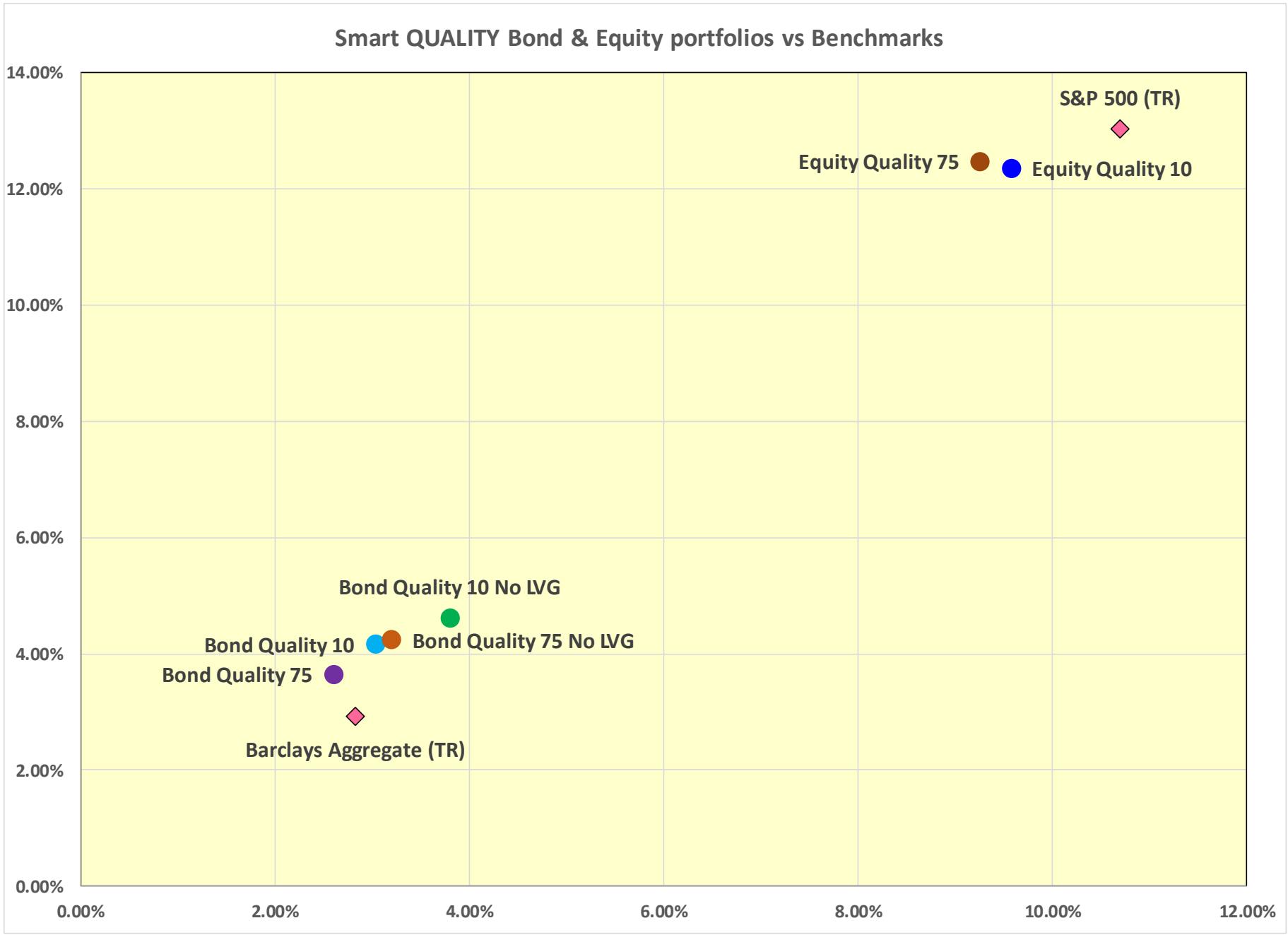
The Style Factors

- We used four different Style factors, namely, Quality, Value, Dividend Yield and Long-Term Momentum
- Quality is a composite of normalised Sustainable Growth, Cash Flow/Sales, Return on Equity and Return on Assets
- Value is a composite of normalised Book/Price ratio, Cash-flow/Price ratio and Earnings/Price ratio
- Dividend Yield is the trailing 12-month Dividend Yield
- Long-Term Momentum is defined as the slope of thirteen stock prices at 4-week intervals, beginning 4 weeks ago; it is therefore effectively the return over the past year, up to one month ago – the standard definition of Momentum

Presentation of the Results

- We are using the S&P 500 index as the equity benchmark, and the Barclays Aggregate index as the bond benchmark
- For each of the Target Styles, we show three things
- First, there is a simple chart showing the performance over four years of each of the equity and bond portfolios, together with their respective benchmark indices
- Second, we show a plot of annualised return against risk, to get a sense of the relative efficiency of the portfolios
- Finally, there is a table summarising the return and risk, the beta to benchmark and Sharpe Ratio of each portfolio, assuming an average risk-free rate of 0.15% p.a.


Bond Quality 10
Bond Quality 10 No LVG
Bond Quality 75
Bond Quality 75 No LVG
Barclays Aggregate (TR)
Equity Quality 10
Equity Quality 75
S&P 500 (TR)
170
160
150
140
130
120
110
100
90
30-Jun-13
31-Aug-13
31-Oct-13
31-Dec-13
28-Feb-14
30-Apr-14
30-Jun-14
31-Aug-14
31-Oct-14
31-Dec-14
28-Feb-15
30-Apr-15
30-Jun-15
31-Aug-15
31-Oct-15
31-Dec-15
29-Feb-16
30-Apr-16
30-Jun-16
31-Aug-16
31-Oct-16
31-Dec-16
28-Feb-17
30-Apr-17
30-Jun-17

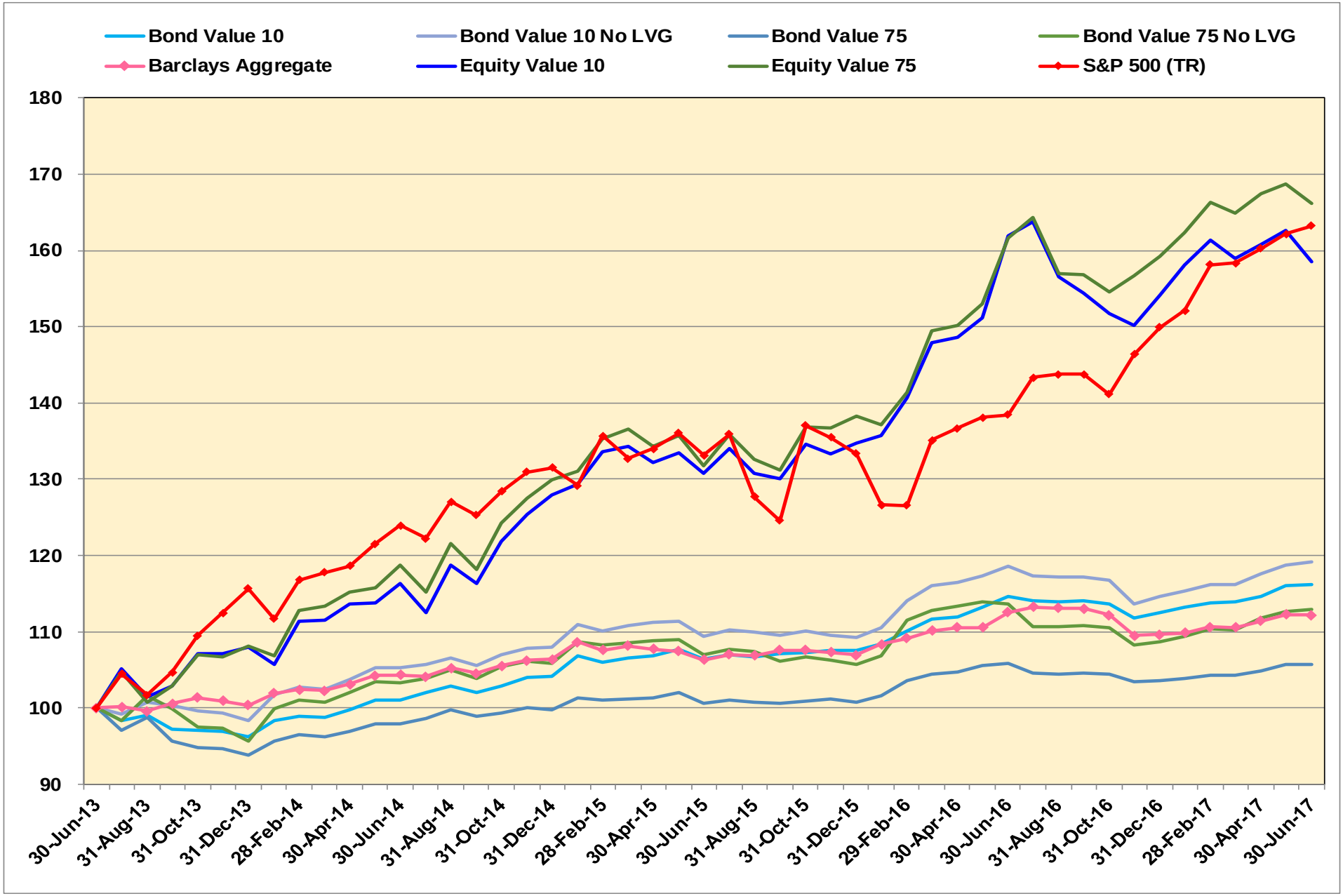

Smart QUALITY Bond & Equity portfolios vs Benchmarks
14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
0.00%
2.00%
4.00%
6.00%
8.00%
10.00%
12.00%
S&P 500 (TR)
Equity Quality 75
Equity Quality 10
Bond Quality 10 No LVG
Bond Quality 10
Bond Quality 75 No LVG
Bond Quality 75
Barclays Aggregate (TR)

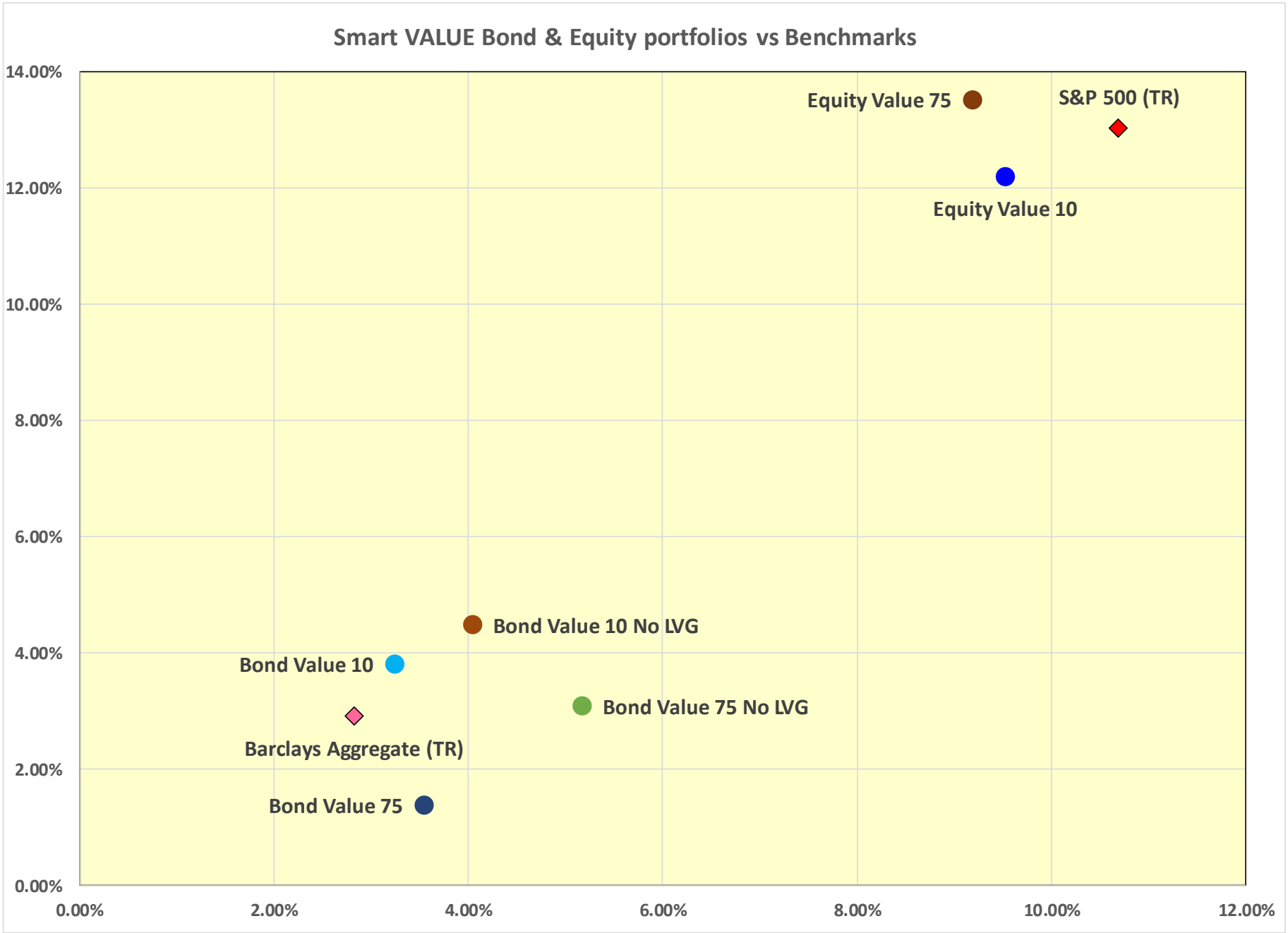
The Results for QUALITY

QUALITY	Annualised Return	Annualised Risk	Beta to Benchmark	Sharpe Ratio
EQUITIES				
Equity Quality 10	12.36%	9.57%	0.539	1.28
Equity Quality 75	13.53%	9.19%	0.601	1.46
S&P 500 (TR)	13.03%	10.69%	1.000	1.20
BONDS				
Bond Quality 10	4.17%	3.03%	0.796	1.33
Bond Quality 10 No LVG	4.62%	3.80%	1.079	1.18
Bond Quality 75	3.65%	2.60%	0.710	1.35
Bond Quality 75 No LVG	4.25%	3.20%	0.983	1.28
Barclays Aggregate	2.91%	2.83%	1.000	0.98

Comment on QUALITY Results

- Clearly, the actual performance of any Smart Beta Style factor portfolio will depend on the Style factor premium over the back test period
- While certain Style factors tend to have positive factor premia, ***ON AVERAGE OVER TIME***, there is no guarantee that a premium will be positive in any particular period
- The issue, then, is not whether the portfolio out-performed its benchmark, but whether it was more efficiently constructed in return/risk terms, with a higher Sharpe Ratio
- These QUALITY portfolios, both Equity and Corporate Bond, seem to meet this criterion


Bond Value 10
Bond Value 10 No LVG
Bond Value 75
Bond Value 75 No LVG
Barclays Aggregate
Equity Value 10
Equity Value 75
S&P 500 (TR)
180
170
160
150
140
130
120
110
100
90
30-Jun-13
31-Aug-13
31-Oct-13
31-Dec-13
28-Feb-14
30-Apr-14
30-Jun-14
31-Aug-14
31-Oct-14
31-Dec-14
28-Feb-15
30-Apr-15
30-Jun-15
31-Aug-15
31-Oct-15
31-Dec-15
29-Feb-16
30-Apr-16
30-Jun-16
31-Aug-16
31-Oct-16
31-Dec-16
28-Feb-17
30-Apr-17
30-Jun-17

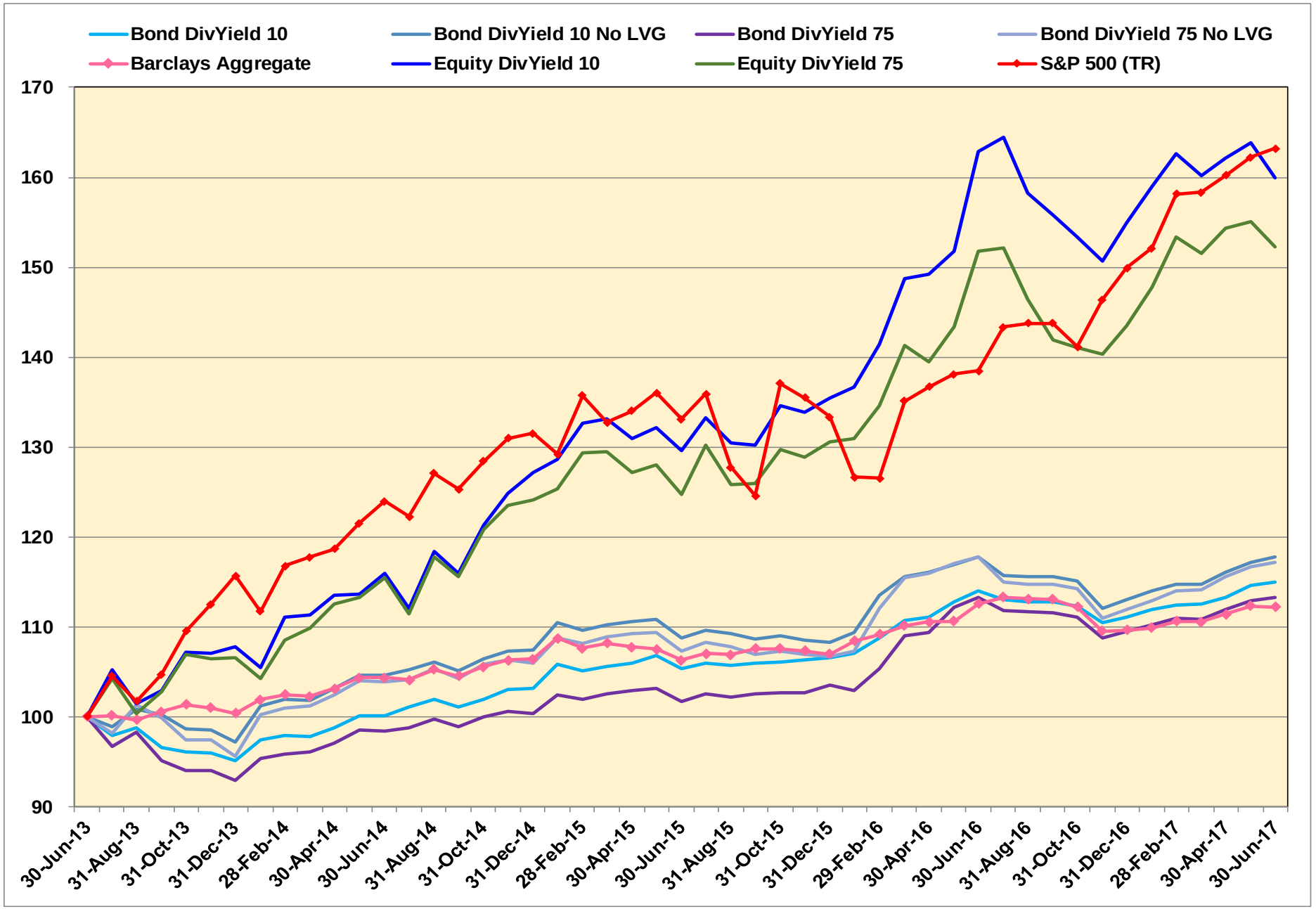

Smart VALUE Bond & Equity portfolios vs Benchmarks
14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
0.00%
2.00%
4.00%
6.00%
8.00%
10.00%
12.00%
Equity Value 75
S&P 500 (TR)
Equity Value 10
Bond Value 10 No LVG
Bond Value 10
Bond Value 75 No LVG
Barclays Aggregate (TR)
Bond Value 75

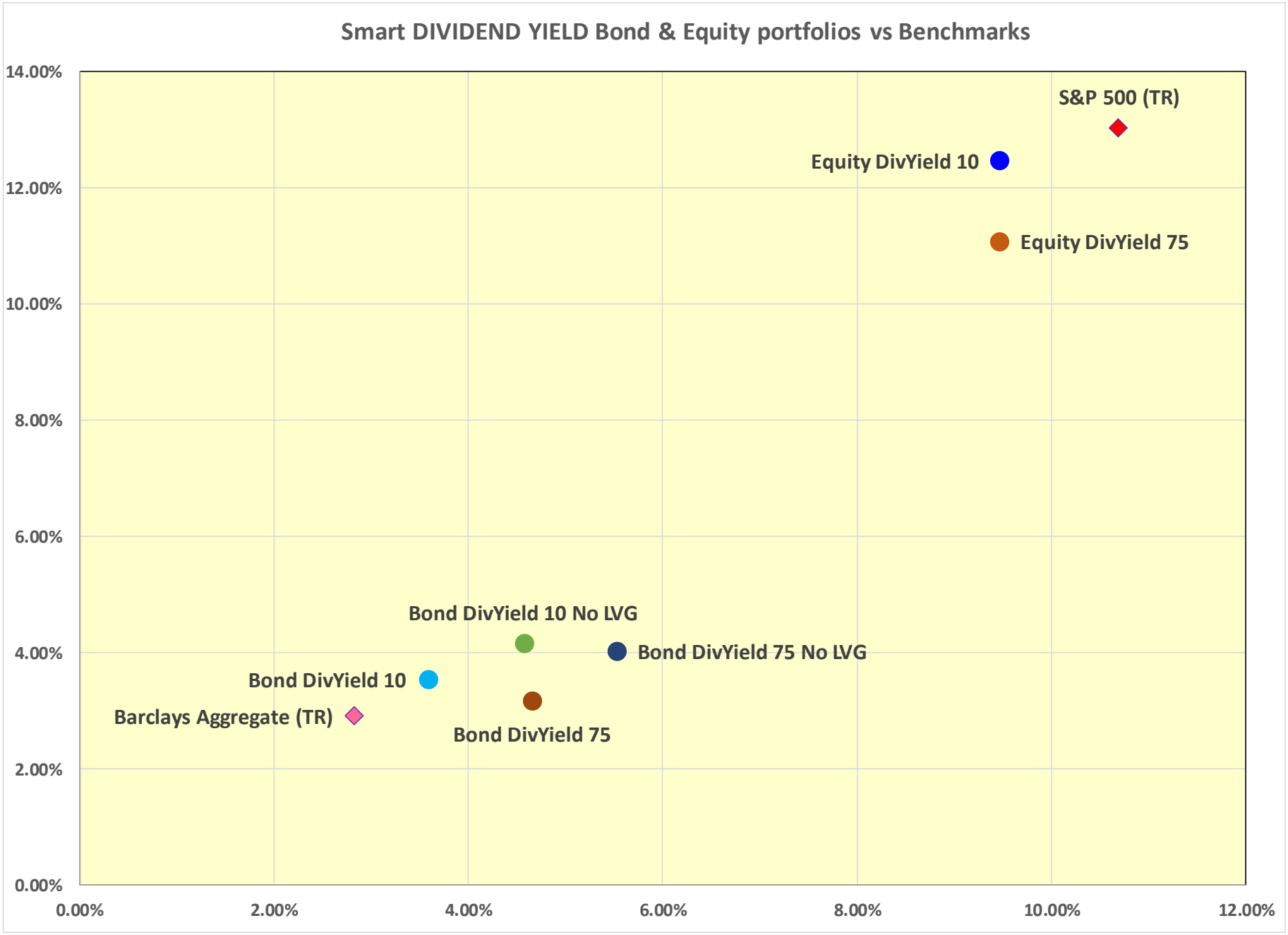
The Results for VALUE

VALUE	Annualised Return	Annualised Risk	Beta to Benchmark	Sharpe Ratio
EQUITIES				
Equity Value 10	12.20%	9.52%	0.543	1.27
Equity Value 75	13.53%	9.19%	0.601	1.46
S&P 500 (TR)	13.03%	10.69%	1.000	1.20
BONDS				
Bond Value 10	3.82%	3.24%	0.765	1.13
Bond Value 10 No LVG	4.49%	4.04%	1.037	1.07
Bond Value 75	1.39%	3.54%	0.451	0.35
Bond Value 75 No LVG	3.10%	5.17%	0.824	0.57
Barclays Aggregate	2.91%	2.83%	1.000	0.98

Comments on VALUE Results

- In these portfolios the 75 indicates a portfolio taken from higher up the efficient frontier in the equity optimisation, and the 10 is a portfolio from lower down the frontier
- In this case, the Equity VALUE 75 portfolio has a higher return, but slightly lower risk than Equity VALUE 10, while the Bond 75 portfolios are less efficient than the Bond 10s
- Note that the “No LVG” Bond portfolios are those created by simply substituting a Corporate Bond for the Equity holding, without using the Merton model adjustment
- Note that the ‘straight substitution’ portfolios are always less efficient than those built using the Merton model


Bond DivYield 10
Bond DivYield 10 No LVG
Bond DivYield 75
Bond DivYield 75 No LVG
Barclays Aggregate
Equity DivYield 10
Equity DivYield 75
S&P 500 (TR)
170
160
150
140
130
120
110
100
90
30-Jun-13
31-Aug-13
31-Oct-13
31-Dec-13
28-Feb-14
30-Apr-14
30-Jun-14
31-Aug-14
31-Oct-14
31-Dec-14
28-Feb-15
30-Apr-15
30-Jun-15
31-Aug-15
31-Oct-15
31-Dec-15
29-Feb-16
30-Apr-16
30-Jun-16
31-Aug-16
31-Oct-16
31-Dec-16
28-Feb-17
30-Apr-17
30-Jun-17

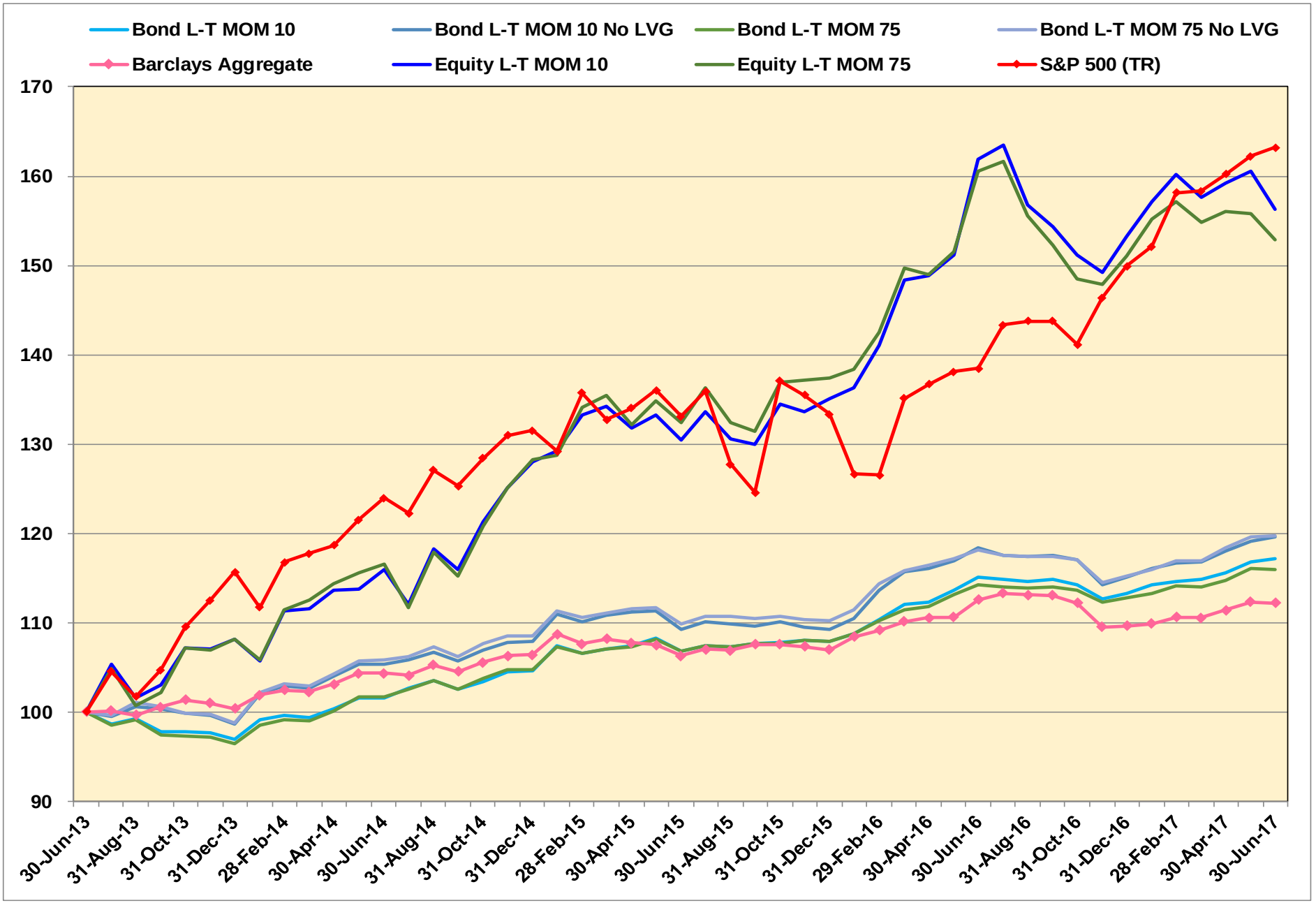

Smart DIVIDEND YIELD Bond & Equity portfolios vs Benchmarks
14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
0.00%
2.00%
4.00%
6.00%
8.00%
10.00%
12.00%
S&P 500 (TR)
Equity DivYield 10
Equity DivYield 75
Bond DivYield 10 No LVG
Bond DivYield 75 No LVG
Bond DivYield 10
Barclays Aggregate (TR)
Bond DivYield 75

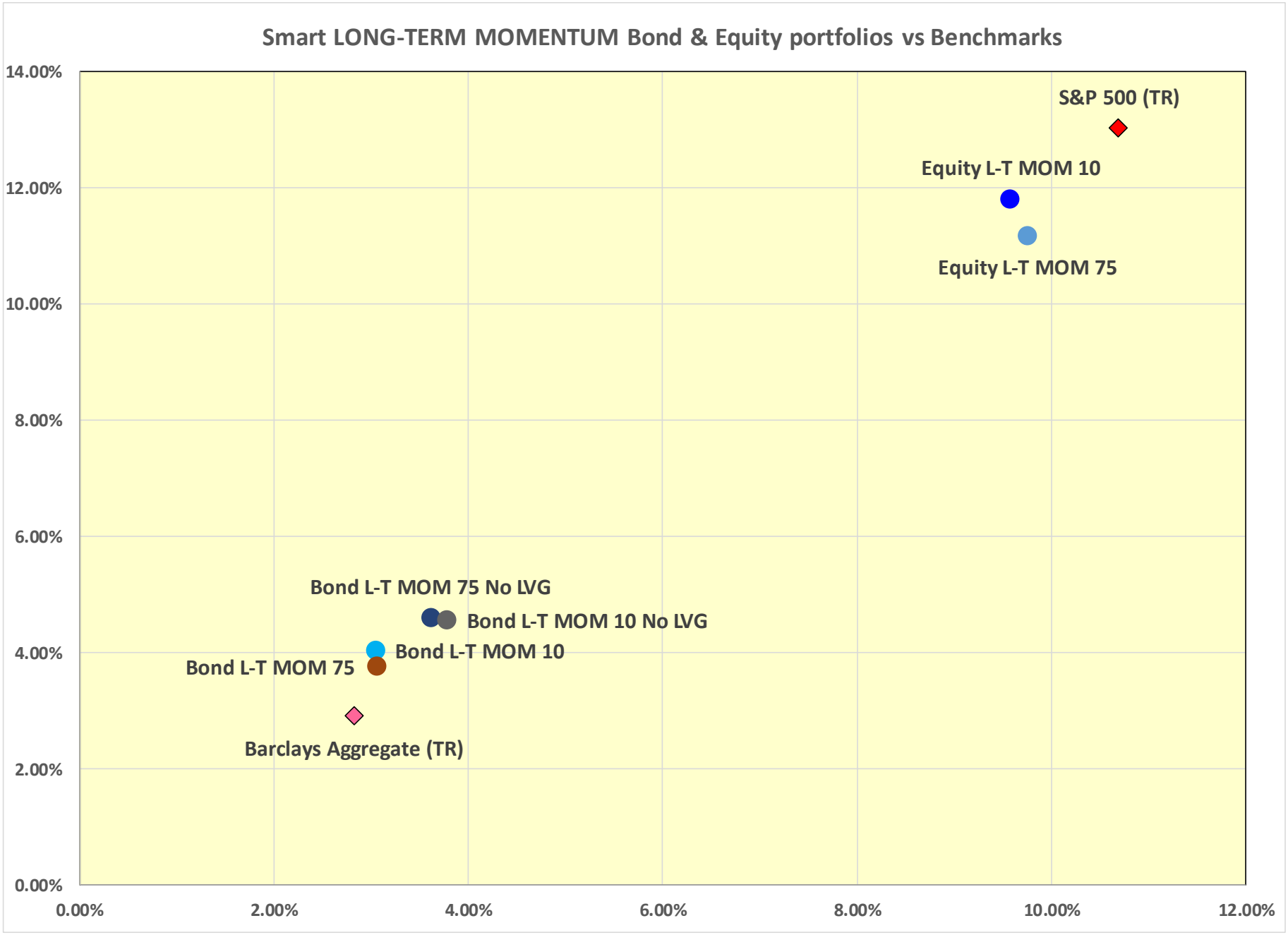
The Results for DIVIDEND YIELD

DIVIDEND YIELD	Annualised Return	Annualised Risk	Beta to Benchmark	Sharpe Ratio
EQUITIES				
Equity DivYield 10	12.47%	9.46%	0.543	1.32
Equity DivYield 75	11.08%	9.46%	0.601	1.17
S&P 500 (TR)	13.03%	10.69%	1.000	1.22
BONDS				
Bond DivYield 10	3.54%	3.58%	0.737	0.99
Bond DivYield 10 No LVG	4.16%	4.57%	1.026	0.91
Bond DivYield 75	3.16%	4.66%	0.721	0.68
Bond DivYield 75 No LVG	4.03%	5.53%	1.006	0.73
Barclays Aggregate	2.91%	2.83%	1.000	1.03

Comments on DIVIDEND YIELD Results

- In this era of near-zero interest rates, investors have been chasing any kind of Yield, and high Dividend Yield stocks have often been bid up, with the result that their subsequent total returns have often been rather poor
- A high exposure to the Dividend Yield factor premium has therefore not helped over the past 4 years, and the Equity portfolios have lower returns than the S&P 500
- Interestingly, on a risk-adjusted basis, the corresponding Bond portfolios have also performed fairly poorly, although again, the Merton model portfolios do better than the straight substitution method


Bond L-T MOM 10
Bond L-T MOM 10 No LVG
Bond L-T MOM 75
Bond L-T MOM 75 No LVG
Barclays Aggregate
Equity L-T MOM 10
Equity L-T MOM 75
S&P 500 (TR)
170
160
150
140
130
120
110
100
90
30-Jun-13
31-Aug-13
31-Oct-13
31-Dec-13
28-Feb-14
30-Apr-14
30-Jun-14
31-Aug-14
31-Oct-14
31-Dec-14
28-Feb-15
30-Apr-15
30-Jun-15
31-Aug-15
31-Oct-15
31-Dec-15
29-Feb-16
30-Apr-16
30-Jun-16
31-Aug-16
31-Oct-16
31-Dec-16
28-Feb-17
30-Apr-17
30-Jun-17


Smart LONG-TERM MOMENTUM Bond & Equity portfolios vs Benchmarks
14.00%
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
0.00%
2.00%
4.00%
6.00%
8.00%
10.00%
12.00%
S&P 500 (TR)
Equity L-T MOM 10
Equity L-T MOM 75
Bond L-T MOM 75 No LVG
Bond L-T MOM 10 No LVG
Bond L-T MOM 10
Bond L-T MOM 75
Barclays Aggregate (TR)

The Results for LONG-TERM MOMENTUM

LONG-TERM MOMENTUM	Annualised Return	Annualised Risk	Beta to Benchmark	Sharpe Ratio
EQUITIES				
Equity L-T MOM 10	11.81%	9.58%	0.533	1.22
Equity L-T MOM 75	11.19%	9.75%	0.591	1.13
S&P 500 (TR)	13.03%	10.69%	1.000	1.20
BONDS				
Bond L-T MOM 10	4.05%	3.04%	0.762	1.28
Bond L-T MOM 10 No LVG	4.57%	3.77%	1.020	1.17
Bond L-T MOM 75	3.77%	3.05%	0.720	1.18
Bond L-T MOM 75 No LVG	4.61%	3.62%	0.953	1.23
Barclays Aggregate	2.91%	2.83%	1.000	0.98

Comments on LONG-TERM MOMENTUM Results

- Over this period, Long-Term Momentum has been quite strong, but while the Bond portfolios have positive excess returns, the Equity portfolios have negative excess returns
- We suspect this is a consequence of having to limit the universe to stocks that have Corporate Bonds
- Whereas all the Equity portfolios have a low beta to their S&P 500 benchmark, the Bond portfolios generally have higher betas to the Barclays Aggregate benchmark, particularly in the case of the straight substitution (No LVG) portfolios

A Utility Perspective on the Results

- For an investor with RAP = 10, in terms of utility, we have :-
- Barclays Aggregate : $U_{10} = 2.87 - (2.79^{\wedge 2})/10 = 2.09$
- S&P 500 : $U_{10} = 12.25 - (10.16^{\wedge 2})/10 = 1.93$
- For the equity and Merton corporate bond portfolios, we have:-

		MBond	SBond	Equity
• Quality	: U_{10} =	3.25	3.18	3.20
• Value	: U_{10} =	2.77	2.86	3.13
• DivYield	: U_{10} =	2.26	2.07	3.51
• Momentum	: U_{10} =	3.13	3.14	2.64
• Averages	: U_{10} =	2.85	2.81	3.12

A Utility Perspective on the Results

- For an investor with RAP = 75, in terms of utility, we have :-
- Barclays Aggregate : $U_{10} = 2.87 - (2.79^{\wedge 2})/75 = 2.81$
  S&P 500 : $U_{10} = 12.25 - (10.16^{\wedge 2})/75 = 11.50$
- For the equity and Merton corporate bond portfolios, we have:-

		MBond	SBond	Equity
• Quality	: U_{10} =	2.98	3.22	5.09
• Value	: U_{10} =	0.13	0.43	5.09
• DivYield	: U_{10} =	0.99	0.97	2.14
• Momentum	: U_{10} =	2.84	3.30	1.69
• Averages	: U_{10} =	1.74	1.98	3.48

Further Comments on the Overall Results - 1

- Using the Merton model method generates more efficient Bond portfolios than the straight substitution method
- Nearly all the bond portfolios outperform the Barclays Aggregate index, which contains Corporate and T-bonds
- Perhaps a more appropriate benchmark would be the iShares U.S. Credit Bond ETF, which had an annualised return over this period of 4.32%, with a risk of 3.78%
- While its return is higher than most of the bond portfolios, so is its risk, and its Sharpe Ratio is only 1.10
- All the LONG-TERM MOMENTUM and QUALITY bond portfolios outperformed it on a risk-adjusted basis

Further Comments on the Overall Results - 2

- The most curious result here is that the Equity portfolios generally failed to outperform the S&P 500 index
- The last four years has been a difficult period for Dividend Yield, as previously noted, and to some extent Value
- However, we suspect that being restricted to only using stocks that have Corporate Bonds has had a significant impact on the performance of the Equity portfolios
- Perhaps we should build Smart Portfolios only out of stocks that DO NOT have Corporate Bonds?!
- As the academics like to say, more work is needed . . .!

Conclusion

- It is not possible (or wise!) to draw very general conclusions from a single piece of research
- Our motivation was to see whether using a systematic portfolio construction methodology to build efficient equity portfolios with a high exposure to a particular style factor could be used to create efficient bond portfolios
- The evidence presented here certainly suggests that there is some value to be had
- It also seems clear that using the Merton model method gives better results that straight substitution