Relative and Absolute Momentum in Times of Rising/Low Yields: Bold Asset Allocation (BAA)

Wouter J. Keller, July 18, 2022, v0.98[1]

Abstract

Our aim is to develop a very offensive ('aggressive') tactical asset allocation strategy, by combining some of our previous models like Protected- (PAA), Vigilant- (VAA) and Defensive (DAA) Asset Allocation. We will call this new strategy the '*Bold* Asset Allocation' (BAA). BAA combines a slow relative momentum with a fast absolute momentum and crash protection, based on the concept of the 'canary' universe, where we switch from our offensive to the defensive universe when any of the assets in the canary universe has negative absolute momentum. As a result, BAA spends ca 60% in the defensive universe. By enhancing this defensive universe beyond cash, we find very impressive returns (>=20%) with low monthly max drawdowns (<=15%) over Dec 1970 – Jun 2022.

1. Introduction

Momentum of *stocks* was (re)discovered in the academic investment literature by Jegadeesh (1993). Since Faber (2010), there is also a lot of practical interest in tactical *asset* allocations (or strategies) based on simple momentum models, like the SMA10 trend filter. With the arrival of ETFs (like SPY and IEF[2]) as asset classes, this approach has become very popular, see also Faber (2013) and Antonacci (2014) and some of the other literature in section 7.

In case of our SMA10 example, the trendline is defined as the average of the last 10 monthly prices. Now, momentum is zero when the current (total return) price equals the trendline, positive when it is higher and negative (or 'bad' momentum) when it is below.

The core of these momentum models is a switch from an 'offensive' (or risky) single asset (like SPY) or universe to a 'defensive' (or risk-off) single asset (like IEF) or universe, depending on the number of 'bad' assets in the offensive universe. This is called trendfollowing or *absolute* momentum. Since it is effective in limiting drawdowns, we will also call this 'crash protection'.

The choice of the best assets *within* an universe is often based on *relative* momentum: the assets with the highest momentum form, say, the Top3 assets, often equally weighted. This holds for both the offensive as well as the defensive universe. When both universes consists of only one asset (eg SPY as offensive and IEF as defensive), only absolute momentum matters.

Our strategies PAA (Protective Asset Allocation, see Keller 2016), VAA (Vigilant Asset Allocation, see Keller 2017) and DAA (Defensive Asset Allocation, see Keller 2018) all added some new momentum filters, eg. a *slower* SMA12 from PAA for relative momentum and a *faster* filter called 13612W from VAA and DAA for absolute momentum. Plus so-called 'breadth momentum'. With this *breadth momentum,* the fraction defensive assets (risk-off) is determined by the breadth of a portfolio, ie. the number of assets with a 'bad' momentum. It replaces the traditional absolute momentum rule, where often each of the selected offensive assets (in, say, the Top3) were replaced by a defensive asset (like IEF) when it had a negative trend.

With the traditional absolute momentum rule, when choosing eg. the Top3 best assets from an offensive universe of say 12 assets, switching to defensive (ie. 'crash protection') only occurs very late, ie. when at least 10 assets are bad. With our 'breadth momentum' parameter eg. B=6,

[1] I thank Jos vd Berkmortel, Jan Willem Keuning, and Bas Nagtzaam for comments. All errors are mine.

[2] SPY is the ETF for the US SP500 index, IEF the ETF for the US 7-10y Treasuries index.

switching to defensive occurs for 100% when at least 6 out of 12 assets are bad, and eg for 50% when 3 assets are bad, etc.

In addition, we introduced a 'canary' or protective universe in DAA, separate from the offensive universe. Now switching is determined by the number of bad assets in the canary universe (see breadth example above, now applied to the protective universe). So, we distinguish three different universes: offensive, defensive and protective.

The BAA (Bold Asset Allocation) strategy discussed below is based on a mix of all these techniques:

1. Different momentum filters: slow for relative momentum for the offensive and defensive universes and very fast for absolute momentum for the protective (or canary) universe.
2. Very fast 'crash protection', based on the concept of the 'canary' universe, where we switch from our offensive to the defensive universe when *any* of the assets in the canary universe has negative abs momentum (B=1). As a result, BAA spends around 60% in defensive mode.
3. Enhancement of this defensive universe beyond 'cash' is done by adding Commodities (DBC) to all available bonds (including inflation-linked TIP and excluding risky HYG) in the defensive universe in order to provide some sort of 'save heaven' for times with low/rising yields and ditto inflation.

2. From PAA to BAA

Our new BAA (Bold Asset Allocation) strategy is inspired by our previous asset allocation strategies, like PAA, VAA and DAA. To understand the basic concepts needed for our new BAA strategy, we first look at our PAA-G12 model (with G12 standing for the Global offensive universe with 12 assets, see Keller, 2016) as an example (see fig 1).[3]

Period	Start	Stop	R	D	V	K	UPI	SR	DF	R6040
IS1	Dec 70	Dec 80	16.7%	8.0%	7.3%	**13.5%**	5.42	1.33	43.9%	7.3%
IS2	Jun 12	Jun 22	5.8%	4.6%	5.7%	**5.2%**	2.64	0.92	54.0%	8.8%
OS	Dec 80	Jun 12	12.7%	11.2%	7.8%	**9.0%**	2.70	0.98	51.8%	10.4%
RS	Jun 02	Jun 22	8.9%	7.0%	7.5%	**7.5%**	3.24	1.03	48.2%	7.6%
FS	Dec 70	Jun 22	12.1%	11.2%	7.4%	**8.6%**	3.03	1.02	50.7%	9.5%
SelO=	**SPY, QQQ, IWM, VGK, EWJ, VWO, VNQ, DBC, GLD, TLT, HYG, LQD**								D6040=	29.5%
SelD=	**BIL, IEF**								TOver=	284%
SelP=	**SPY, QQQ, IWM, VGK, EWJ, VWO, VNQ, DBC, GLD, TLT, HYG, LQD**								TrM/y=	8.6
NO=12, ND=2, NP=12, LO=12, LD=12, LP=12, B=6, TO=6, TD=1, TC%=0.1									**K/IS=**	9.4%

Fig 1 PAA-G12

To prevent information overload, we will gradually explain all the parameters in these 'heavy' figs in our discussion of PAA-G12 and its BAA siblings. Notice that we have changed our original PAA terminology (see Keller, 2016) slightly (eg. Offensive/Defensive instead of Risky/Cash universes).

[3] In our PAA paper we focussed on PAA2 IEF, here we added BIL ('Cash') for didactical reasons (and instead of SHY which might not be an appropriate asset for today's low yield market).

But before discussing the universes in more detail, we should mention the assets (or ETF's) in these universes. In fig 2 we show the list of all our 17 ETF's discussed in this paper for which we have monthly total return proxies available from Dec 1969 (including 1y lag for momentum)[4]. As is shown in fig 1, for PAA-G12 we use all these 17 assets/ETFs (7 stocks, 3x alternatives or alts, and 7x bonds).

7x Stocks: SPY (US SP500), QQQ (US Nasdaq), IWM (US Small Cap), VGK (Europe), EWJ (Japan), VWO (Emerging), VEA (Developed Markets)
3x Alts: VNQ (US Real Estate), DBC (Commodities), GLD (Gold)
7x Bonds: BIL (US 1-3m T-Bill), IEF (US 7-10y Treasuries), TLT (US 20y Treas.), LQD (US Inv. Grade), HYG (US High Yield), TIP (US Inflation-Protected Treas.), BND (Total Bond Market)

Fig 2 ETFs used (with monthly data from Dec 1969)

There are always three universes (*Offensive, Defensive* and *Protective*), where we switch between the Offensive and the Defensive universe. This switching is based on the '*breadth momentum'* of the Protective (or 'canary') universe (see Keller 2018). For PAA-G12, the Offensive and Protective universe are equal and contains 12 assets (so NO=NP=12, see SelO and SelP in fig 1). The so-called breadth parameter B equals six (B=6).

This implies that the switching is 100% to defensive when at least six of the canary assets show negative (or 'bad') *absolute momentum*, no switching (so 0% defensive) with no canary assets 'bad', and so on, proportionally for 0<#bad<6. The Defensive universe of PAA-G12 only holds two assets, BIL and IEF (see SelD), so ND=2. All our assets are ETFs, traded at month end.

Besides absolute momentum, we will also use *relative momentum* in order to determine the selection of the best assets in the Offensive and Defensive universe. For PAA-G12, we select the best Top6 offensive assets (TO=6) and the single best Defensive asset (TD=1) with the same (rather slow) momentum measure, ie. SMA(12). This momentum filter is used in PAA for both absolute and relative momentum for all three universes (see LO=LD=LP=12 in fig 1). The SMA(12) momentum stands for a momentum based on the Simple Moving Average with max lag 12 months (also represented as SMA13 for the average of the last 13 prices pt,..,pt-12, including the present at month t).[5]

All our strategies rebalances at a monthly frequency with equal asset weighting per universe. To give an example, with TO=6, TD=1, B=6 and 3 'bad' canary assets, the PAA-G12 strategy chooses a mix of 50% of the best defensive asset (eg. IEF as Top1) and divide the rest equally over the best Top6 offensive assets (each 8,33%), for a total of 1x50% + 6x8,33 = 100% total, for 7 assets.

For each of the 5 periods (IS1, .., FS), fig 1 displays R which is the yearly compounded return (CAGR), D is the maximum (monthly) drawdown, V is yearly volatility, while DF is the Defensive Fraction, ie. the fraction of months the strategy is in defensive mode. So for PAA-G12 the return over Full Sample (FS: Dec 1970 – Jun 2022) equals R=12.1% per year, while the maximum (monthly) drawdown and yearly volatility equals D=11.2% and V=7.4%, resp., and the average Defensive Fraction equals DF= 50,7% over the full sample FS. The (one sided) annual turnover for PAA-G12 equals TOver=284%. For

[4] See Appendix A in our PAA paper (Keller, 2016) for our data construction methodologies for ETF proxies.
[5] The SMA(12) momentum (with lag 12 months) equals the present price pt divided by the average of the last 13 asset prices including the present (also noted as SMA13), minus 1. So our SMA(12) momentum is negative when pt < SMA(12) = SMA13.

the Recent Sample (RS: Jun 2002 -Jun 2022) the return R equals 8.9% per year. We also distinguish in fig. 1 two 'in-sample' periods IS1 (first 10 years) and IS2 (last 10 years) with low/increasing rates and inflation, plus the 'out-of-sample' period OS, which are used in combination with our own return/risk indicator K (see section3 and notes 6 and 9).

To arrive at the new BAA-G12 strategy, we will change PAA in three steps

1. First, we will use a different Protective (or 'canary') universe (like we did in our DAA strategy) with its own absolute momentum, based on our aggressive VAA-G4 strategy (see Keller 2017). So the canary universe equals four assets (SPY, VWO, VEA and BND), while switching between the Offensive and the Defensive universe is based on the breadth parameter B=1 and the number of 'bad' assets of the canary universe: with B=1 we simply switch 100% to defensive when at least one canary asset is bad, ie. has negative *absolute* momentum[6]. Like VAA and DAA, we use the so-called '13612W' filter for absolute canary momentum. This 'fast' 13612W momentum is based on the weighted average of the 1, 3, 6 and 12 months returns, where we use heavier weights for 'shorter' returns.[7]
2. Since the combination of this 'fast' canary momentum, B=1 and the four-asset canary (or Protective) universe (see SelP in fig 3), the strategy will spend nearly 60% of its months in the defensive universe. Therefore we will allow for a richer Defensive universe, consisting of all our bonds excluding risky HYG but including inflation-linked TIP (see fig 2) plus DBC as an hedge for future times of possible rising yields and inflation[8], for a total of 7 defensive assets (ND=7).
3. In addition, we will choose the Top3 defensive assets (instead of the Top1 for PAA) based on the same relative momentum, SMA(12), as for the offensive universe in PAA above. In addition, we will add absolute momentum here, such that defensive assets in the Top3 with bad momentum (less than BIL) will be replaced by BIL. Notice that, like for PAA, we don't use absolute momentum for the Top6 selection of the Offensive universe, only relative momentum.

3. The 'balanced' BAA-G12 strategy

The results of the above three steps (starting at PAA-G12) is BAA-G12 shown in fig 3. We will call this BAA-G12 strategy the *balanced* BAA strategy.

Notice that for BAA-G12, we use the same offensive universe, with the same Top6 selection based on the same (slow) SMA(12) momentum as in PAA-G12 but now with the Protective (canary) universe from VAA-G4 with B=1 and (fast) 13612W momentum. In addition, we apply both relative *and* absolute SMA(12) momentum for a Top3 selection from our enhanced defensive universe with nearly all bonds (excluding only risky HYG) plus DBC (so ND=7).

[6] As we will show in section 5, the combination of slow relative momentum SMA(12) from PAA and fast absolute momentum 13612W from VAA also turns out to be in-sample optimum for K/IS, where K/IS equals the average of our own return/risk indicator K over IS1 (first 10 years: rising yields/inflation) and IS2 (last 10 years: low yields/inflation except for 2021/22). So K/IS= (K/IS1 + K/IS2)/2, with IS1+IS2 being our combined in-sample (IS) period.

[7] 13612W stands for a momentum based on the weighted average of the 1, 3, 6, 12 months returns with weights 12, 4, 2, 1 resp., so the 13612W momentum equals this weighted average of these 4 past returns. So our 13612W momentum is negative when 12*RET(1)+4*RET(3)+2*RET(6)+1*RET(12) < 0. This implies that the combined weight (over all 4 terms) for RET(1) in this momentum equals 40%.

[8] The addition of DBC was also in-sample optimal on K/IS (see note 6).

Period	Start	Stop	R	D	V	K	UPI	SR	DF	R6040
IS1	Dec 70	Dec 80	19.2%	4.8%	8.5%	**17.1%**	9.81	1.44	59.5%	7.3%
IS2	Jun 12	Jun 22	7.8%	7.2%	6.5%	**6.5%**	2.85	1.12	59.5%	8.8%
OS	Dec 80	Jun 12	15.3%	8.7%	8.9%	**12.1%**	4.78	1.15	55.4%	10.4%
RS	Jun 02	Jun 22	12.2%	8.7%	8.7%	**9.6%**	4.30	1.27	53.5%	7.6%
FS	Dec 70	Jun 22	14.6%	8.7%	8.5%	**11.6%**	4.81	1.19	57.2%	9.5%
SelO=	**SPY, QQQ, IWM, VGK, EWJ, VWO, VNQ, DBC, GLD, TLT, HYG, LQD**								D6040=	29.5%
SelD=	**TIP, DBC, BIL, IEF, TLT, LQD, BND**								TOver=	472%
SelP=	**SPY, VWO, VEA, BND**								TrM/y=	8.2
NO=12, ND=7, NP=4, LO=12, LD=12, LP=0, B=1, TO=6, TD=3, TC%=0.1									**K/IS=**	11.8%

Fig 3 The BAA-G12 model

Besides R, D, CF and TOver (discussed above) and our own return/risk indicator K (to be discussed below), we see in fig 3 two other return/risk indicators SR and UPI, where UPI stands for the Ulcer Performance Index (see Martin, 1987) and SR stands for the well-known Sharpe Ratio. UPI is similar to the Sharpe Ratio but with the Ulcer index (based on the drawdown pattern) instead of the volatility in the nominator and (as SR) the excess return over risk-free in the denominator.

Beside UPI and SR, we will use our own return/risk measure K25, or K for short. This measure [9] lowers return R only a little bit for small max drawdowns D and more than proportionally for larger drawdowns, up to K=0 when D>25%. See also Keller (2017, 2018) and TrendXplorer (2018) for a discussion why the particular formula for K was chosen. We sometimes prefer K (over the ratio's UPI and SR) since K has the same dimension (%) as R and can therefore be interpreted as a return (CAGR) corrected for drawdown.

So for our BAA-G12 strategy over the full sample FS (Dec 1970 – Jun 2022), the return R equals R=14.6% (12.1% for PAA in fig 1), while the maximum (monthly) drawdown and yearly volatility equals D=8.7% and V=8.5%, resp., with UPI=4.81 and Sharpe Ratio SR=1.19. The average Defensive Fraction equals DF= 57.2%, the (one sided) annual turnover equals TOver=472%, so nearly double that of PAA (284%), while the average number of 'Trading Months' per year equals TrM/y=8.2, compared to 8.6 for PAA. LP=0 and LO=LD=12 refers to 13612W and SMA(12) momentum, resp. Finally, we assume a one-way transaction costs of 0.1% (=TC) for all our strategies.

Notice that for BAA-G12, the results are also impressive for the most Recent Sample of 20 years (RS: Jun 2002 – Jun 2022): see, eg. R=12.2% (8.9% for PAA), D= 8.7% (7.0%), K=9.6% (7.5%), UPI= 4.30 (3.24), and SR= 1.27 (1.03).

R6040/FS= 9.5% and D6040=29.5% refers to the return and max drawdown of the 60/40 (SPY/IEF) benchmark for the full-sample (FS), compare this with R/D= 14.6/8.7% for BAA-G12. Btw, the YTD 2022 (at ultimo Jun 2022) performance of the 60/40 benchmark equals -16%, and +6.4% for BAA-G12.

Below (see figs 4 and 5) we show the equity line and max drawdowns of BAA-G12 as compared to our 60/40 benchmark. The yellow line shows the relative price of BAA/6040, when this decreases

[9] K = R(1-2D/(1-2D)) when max drawdown D<25% and R>0%, else K=0% (see also K25 in Keller, 2017).

60/40 wins, when this increases BAA wins and when it is flat the performance is similar. Notice that the yellow line increases or stays flat in most years, except moving slightly lower in the nineties and the most recent decade.

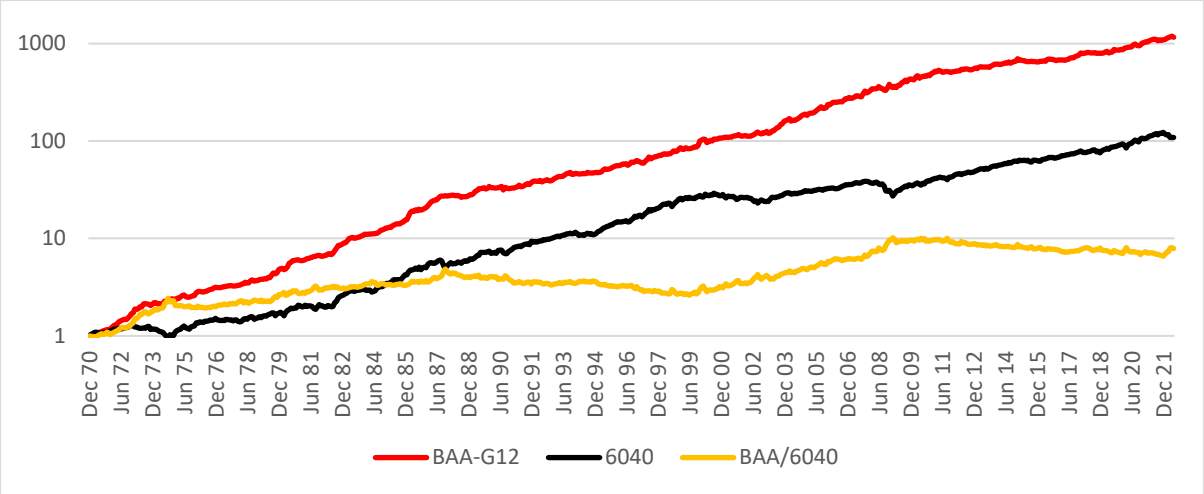

Fig 4 Equity line of BAA-G12 vs 60/40 benchmark (and relative price)

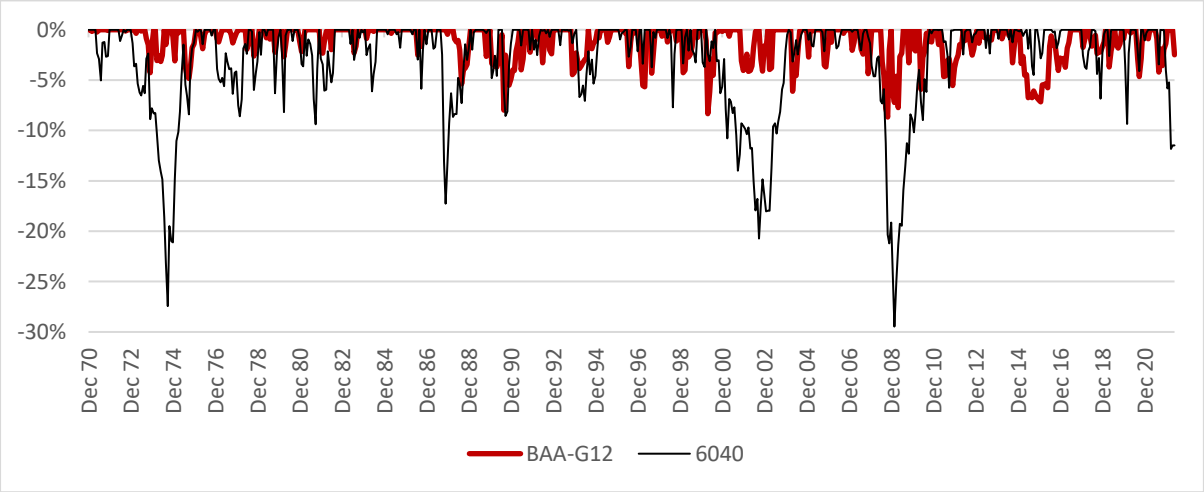

Fig 5 Max (monthly) drawdown of BAA-G12 and the 60/40 benchmark

4. The BAA-G4 strategy

In this section we will look at the most aggressive BAA strategy called the BAA-G4 strategy. Although most characteristics are the same as BAA-G12, we now change the offensive universe to the aggressive VAA-G4 universe (with 4 Global assets, see Keller 2017) - plus one small change - and select only the Top1 offensive asset as with VAA-G4 (instead of the Top6 for PAA-G12). The change is that we substituted QQQ for SPY[10], yielding a global offensive universe of four assets: QQQ, VEA,

[10] This change of QQQ for SPY was also in-sample optimal for K/IS (see note 6).

VWO, BND. We will use the same defensive and protective (canary) universes as with BAA-G12, and use again SMA(12) for the relative momentum in the offensive and defensive selection (as well as for the absolute defensive momentum), and 13612W for absolute 'breadth' momentum for the protective (or canary) universe. So the only change from BAA-G12 is the much smaller offensive universe with four risky assets (see SelO with NO=4) and the offensive Top1 selection (TO=1).

Fig 6 shows the final BAA-G4 result, which we will call our *aggressive* BAA strategy.

Period	Start	Stop	R	D	V	K	UPI	SR	DF	R6040
IS1	Dec 70	Dec 80	25.0%	5.9%	14.4%	**21.7%**	11.12	1.26	59.5%	7.3%
IS2	Jun 12	Jun 22	10.9%	8.7%	9.4%	**8.6%**	3.74	1.11	59.5%	8.8%
OS	Dec 80	Jun 12	22.8%	14.6%	14.4%	**13.4%**	4.93	1.23	55.4%	10.4%
RS	Jun 02	Jun 22	16.7%	9.5%	11.8%	**12.8%**	5.12	1.32	53.5%	7.6%
FS	Dec 70	Jun 22	21.0%	14.6%	13.6%	**12.3%**	5.20	1.21	57.2%	9.5%
SelO=	**QQQ, VWO, VEA, BND**								D6040=	29.5%
SelD=	**TIP, DBC, BIL, IEF, TLT, LQD, BND**								TOver=	523%
SelP=	**SPY, VWO, VEA, BND**								TrM/y=	6.6
NO=4, ND=7, NP=4, LO=12, LD=12, LP=0, B=1, TO=1, TD=3, TC%=0.1									**K/IS=**	15.1%

Fig 6 BAA-G4

Let's start with the BAA-G4 statistics for the Full Sample (FS, Dec 1970- Jun 2022): return (CAGR) and max (monthly) drawdown at FS are R/D= 21.0/14.6% compared to 9.5/29.5% for the 60/40 benchmark and 14.6/8.7% for BAA-G12. So roughly twice the return and half the (drawdown) risk compared to the benchmark and nearly half more return and twice the drawdown compared to BAA-G12. The return/risk statistics for the full sample (FS) are K=13.6% and UPI/SR= 5.20/1.21, which are all great statistics.

Similar results holds for the last 20 years (RS): return R= 16.7% and max drawdown D=9.5%, with return/risk stats K=12.8%, UPI=5.12 and SR= 1.32. Finally, from fig 6 we learn that turnover is high (TOver= 523%, so slightly higher than BAA-G12 with 472%), while trading on average is done 6.6 times per year (less than BAA-G12 with 8.2x).

Below (see figs 7 and 8) we show the equity line and max drawdowns of BAA-G4 as compared to our 60/40 benchmark. The yellow line shows the relative price of BAA/6040, when this decreases 60/40 wins, when this increases BAA wins and when it is flat the performance is similar. Notice that the yellow line increases or stays flat in most years.

The YTD 2022 performance of BAA-G4 per ultimo Jun 2022 is +6,4% (and -15% for the 60/40 benchmark). This return of 6.4% is the same as BAA-G12 since both strategies where completely defensive (with 33% DBC and 67% BIL) in Jan 2022 – Jun 2022. The same holds for *any* BAA strategy (with the same defensive and protective characteristics).

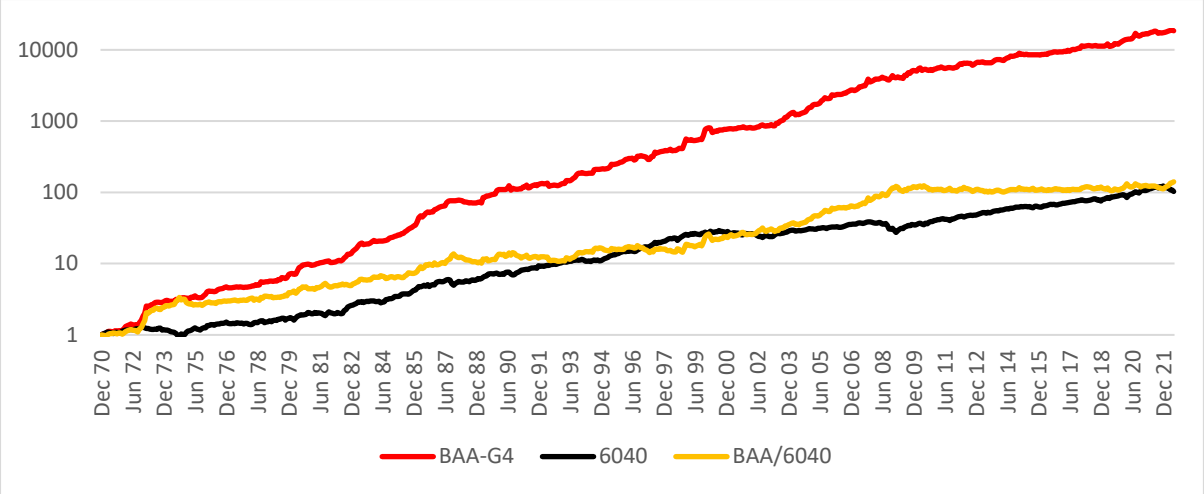

Fig 7 Equity line of BAA-G4 vs 60/40 benchmark (and relative price)

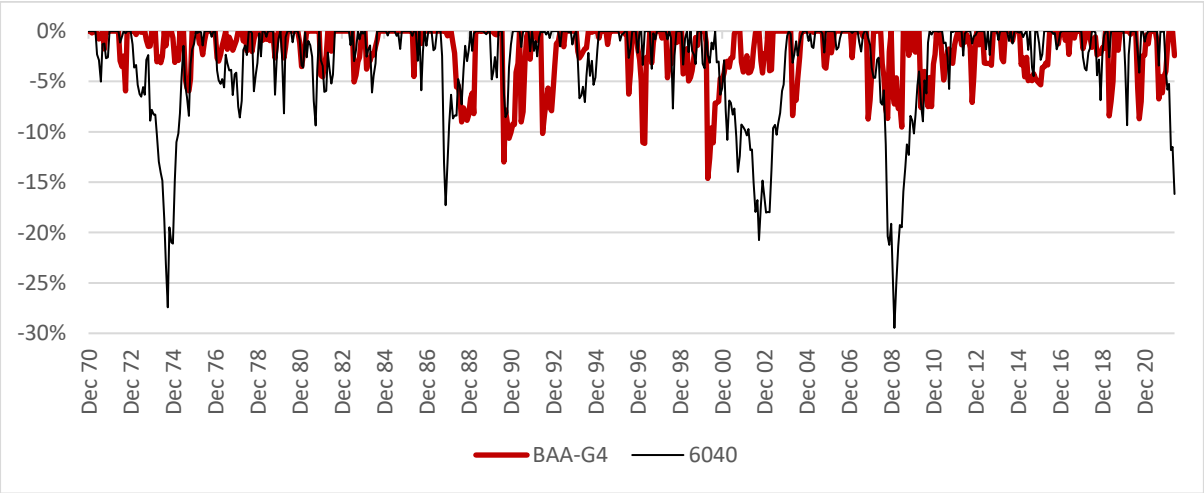

Fig 8 Max (monthly) drawdown of BAA-G4 and the 60/40 benchmark

5. BAA variations

In this section we consider some variations on the BAA theme, in particular wrt. the (diversification of the) offensive selection (TO) and universe, and wrt. both momentum filters used in BAA. This might give the reader some information of the 'robustness' of the various BAA strategies. We start with the 'offensive' diversification.

Although BAA-G4 looks very impressive, some might call it 'too concentrated' with only one offensive asset chosen (TO=T=1) when not in defensive mode. Something similar (but opposite) might be said for the 'very diversified' offensive selection (TO=T=6) for BAA-G12.

Therefore, we will consider here a slightly less *diversified* version of BAA-G12 with TO=3 (instead of TO=6 in section 3) and a less *concentrated* version of BAA-G4 with TO=2 (instead of TO=1 in section 4). We will name these variations BAA-G12/T3 and BAA-G4/T2. Notice that we only change TO in both cases, and keep all the universes and other parameters constant. See fig 9 and 10 below.

Period	Start	Stop	R	D	V	K	UPI	SR	DF	R6040
IS1	Dec 70	Dec 80	22.6%	5.9%	11.1%	**19.6%**	10.17	1.41	59.5%	7.3%
IS2	Jun 12	Jun 22	6.6%	7.4%	7.5%	**5.4%**	1.81	0.80	59.5%	8.8%
OS	Dec 80	Jun 12	17.6%	11.4%	10.9%	**12.4%**	4.28	1.15	55.4%	10.4%
RS	Jun 02	Jun 22	12.1%	10.6%	9.9%	**8.8%**	3.12	1.10	53.5%	7.6%
FS	Dec 70	Jun 22	16.4%	11.4%	10.4%	**11.6%**	4.23	1.13	57.2%	9.5%
SelO=	**SPY, QQQ, IWM, VGK, EWJ, VWO, VNQ, DBC, GLD, TLT, HYG, LQD**								D6040=	29.5%
SelD=	**TIP, DBC, BIL, IEF, TLT, LQD, BND**								TOver=	513%
SelP=	**SPY, VWO, VEA, BND**								TrM/y=	8.0
NO=12, ND=7, NP=4, LO=12, LD=12, LP=0, B=1, TO=T=3, TD=3, TC%=0.1									**K/IS=**	12.5%

Fig 9 BAA-12/T3

Period	Start	Stop	R	D	V	K	UPI	SR	DF	R6040
IS1	Dec 70	Dec 80	20.7%	8.9%	10.9%	**16.3%**	7.47	1.26	59.5%	7.3%
IS2	Jun 12	Jun 22	9.2%	8.0%	7.8%	**7.5%**	2.88	1.12	59.5%	8.8%
OS	Dec 80	Jun 12	19.4%	12.7%	11.1%	**12.8%**	5.43	1.29	55.4%	10.4%
RS	Jun 02	Jun 22	14.5%	8.7%	10.0%	**11.5%**	4.42	1.34	53.5%	7.6%
FS	Dec 70	Jun 22	17.7%	12.7%	10.6%	**11.7%**	5.08	1.25	57.2%	9.5%
SelO=	**QQQ, VWO, VEA, BND**								D6040=	29.5%
SelD=	**TIP, DBC, BIL, BIL2, BIL3, IEF, TLT, LQD, BND**								TOver=	502%
SelP=	**SPY, VWO, VEA, BND**								TrM/y=	6.8
NO=4, ND=9, NP=4, LO=12, LD=12, LP=0, B=1, TO=T=2, TD=3, TC%=0.1									**K/IS=**	11.9%

Fig 10 BAA-G4/T2

Interestingly, our in-sample return/risk indicator K/IS is slightly better for the BAA-G12/T3 strategy than the BAA-G4/T2 (K/IS=12.5 vs 11.9%) mainly because of its excellent IS1 performance (ie over the first 10 years), but the BAA-G4/T2 strategy wins hands-down in the periods after Dec 1980 on R and return/risk (see K, UPI and SR).

Notice that the performance in *defensive* mode (which happens in 57% of the months, see the Defensive Fraction DF=57,2%) in *all* the four BAA models above (see fig 3,6,9,10) is similar (equal in R and V). So would this (defensive/protective) part of our BAA model also works with just SPY as offensive asset (so SO=SPY and TO=NO=1)?

In fig 11 we present this simplified BAA-SPY strategy. Notice that our combination of a defensive SMA(12) absolute and relative momentum together with an enhanced defensive universe (most bonds plus DBC) and our fast 13612W protective momentum with a good canary universe, seems able to protect for nearly all of SPY's bear markets.

Compare fig 11 with fig 12 for the *unprotected* SPY results (D/FS= 50.8% vs 16.2% for BAA-SPY). Notice also that all the return/risk parameters are greatly improved by BAA-SPY compared to SPY alone, as well as nearly all returns (except for R/IS2, ie. over the last 10 years).[11]

[11] Also compare this with the well-known SMA10 absolute momentum on SPY, switching to IEF: R/D= 11.8/23.3%, UPI/SR= 1.16/0.59 on FS (Dec 1970 – Jun 2022), so all worse (except R) than with BAA-SPY. And R/D= 9.6/20.3%, UPI/SR= 1.49/0.80 on RS (Jun 2002 – Jun 2022) are all worse than BAA-SPY in fig 11.

The above results show the robustness of our BAA results for different choices of TO (number of offensive assets selected in non-defensive mode) and for various offensive universes (G12, G4 and just SPY).

Period	Start	Stop	R	D	V	K	UPI	SR	DF	R6040
IS1	Dec 70	Dec 80	11.3%	12.6%	10.3%	**7.5%**	1.08	0.42	59.5%	7.3%
IS2	Jun 12	Jun 22	10.1%	6.6%	7.6%	**8.5%**	3.81	1.26	59.5%	8.8%
OS	Dec 80	Jun 12	11.7%	16.2%	9.8%	**6.1%**	1.75	0.69	55.4%	10.4%
RS	Jun 02	Jun 22	11.7%	10.6%	8.9%	**8.5%**	3.43	1.19	53.5%	7.6%
FS	Dec 70	Jun 22	11.4%	16.2%	9.5%	**6.0%**	1.88	0.72	57.2%	9.5%
SelO=	**SPY**								D6040=	29.5%
SelD=	**TIP, DBC, BIL, IEF, TLT, LQD, BND**								TOver=	473%
SelP=	**SPY, VWO, VEA, BND**								TrM/y=	6.0
NO=1, ND=7, NP=4, LO=12, LD=12, LP=0, B=1, TO=1, TD=3, TC%=0.1									**K/IS=**	8.0%

Fig 11 BAA-SPY

Period	Start	Stop	R	D	V	K	UPI	SR	DF	R6040
IS1	Dec 70	Dec 80	8.2%	42.5%	15.8%	**0.0%**	0.11	0.08	0.0%	7.3%
IS2	Jun 12	Jun 22	12.6%	20.0%	13.7%	**4.2%**	2.83	0.89	0.0%	8.8%
OS	Dec 80	Jun 12	10.4%	50.8%	15.4%	**0.0%**	0.36	0.35	0.0%	10.4%
RS	Jun 02	Jun 22	8.9%	50.8%	14.8%	**0.0%**	0.47	0.53	0.0%	7.6%
FS	Dec 70	Jun 22	10.4%	50.8%	15.2%	**0.0%**	0.46	0.39	0.0%	9.5%
SelO=	**SPY**								D6040=	29.5%
SelD=									TOver=	0%
SelP=									TrM/y=	0.0
NO=1									**K/IS=**	2.1%

Fig 12 SPY

To check the robustness for our momentum filters**,** we examine our BAA-G12 and BAA-G4 results when we change the momentum filter for our offensive/defensive universes and for our protective universes. We take our own return/risk indicator K at the Full Sample (FS: Dec 1970 – Jun 2022) as criterium.

Fig 13 and 14 shows the resulting K/FS for BAA-G12 and BAA-G4 when we change LO=LD=L (for the offensive and defensive universe) and LP (for the protective universe) from the very fast 13612W momentum filter to slower SMA(x), x=3,6,9, up to the slow SMA(12), and the very slow RET(12) filter. So, in both figures we order our momentum filters from very fast to very slow.

We see that the BAA combination of L/LP= SMA(12)/13612W turns out to be optimal at the Full Sample (FS) for BAA-G12 (see fig 13) and near optimal for BAA-G4 (fig 14). Notice that we did not optimize ('tune') the choice of both momentum filters, since we simply used the (offensive and defensive) momentum from PAA (ie. SMA(12)) and the (protective) momentum from VAA (ie. 13612W).[12]

[12] It turns out that the in-sample K/IS happens to be optimal for L/LP=SMA(12)/13612W for *both* BAA-G12 and BAA-G4, both with a similar pattern for other filters as we show in figs 10 and 11 for K/FS.

K/FS=11.6%	L:13612W	SMA(3)	SMA(6)	SMA(9)	SMA(12)	RET(12)
LP: 13612W	9.6%	9.6%	10.4%	10.9%	**11.6%**	6.7%
SMA(3)	8.4%	10.0%	9.7%	10.6%	11.1%	6.4%
SMA(6)	8.6%	9.7%	9.5%	10.1%	10.3%	6.2%
SMA(9)	8.4%	9.4%	8.9%	9.2%	9.4%	6.1%
SMA(12)	7.9%	8.7%	8.6%	9.5%	9.4%	6.2%
RET(12)	7.9%	8.5%	8.7%	9.2%	8.6%	5.0%

Fig 13 Robustness of BAA-G12 for the momentum filter (L, LP)

K/FS=12.3%	L:13612W	SMA(3)	SMA(6)	SMA(9)	SMA(12)	RET(12)
LP: 13612W	9.7%	9.7%	7.5%	**12.6%**	**12.3%**	9.1%
SMA(3)	5.3%	6.2%	7.2%	11.7%	11.4%	8.5%
SMA(6)	6.0%	8.6%	9.0%	11.4%	11.5%	8.3%
SMA(9)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SMA(12)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RET(12)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Fig 14 Robustness of BAA-G4 for momentum filter (L, LP)

In both momentum variations, we included the very slow RET(12) momentum filter (ie. the return over 12 months) as possible alternative, besides the very fast 13612W filter and the slow SMA(x) filter (for x=3, 6, 9, 12 months lag). Notice that our SMA(9) filter (the best L for BAA-G4) equals the often used SMA10 filter (see note 5).

From both fig 13 and 14 it is clear that momentum deviations are nearly flat around the optimum and almost everywhere monotonically decreasing farther away, which hints at a certain form of *robustness* of our BAA strategies for our momentum choices. Note that RET(12) seems clearly too slow for our (slow) non-protective momentum in BAA-G12, while the same holds for SMA(9), SMA(12) and RET(12) for our (fast) protective momentum in BAA-G4.

We hope that the robustness to all these variations provide some trust in our BAA strategy results.

6. Summary and conclusion

By combining a slow relative momentum filter (from PAA, see Keller 2016) with a fast absolute momentum filter (from VAA/DAA, Keller 2017/18) and allowing for some limited risky exposure in our defensive universe, together with a very fast crash-protection (based on a separate canary universe with breadth parm B=1, see Keller 2018), we arrived at several offensive strategies which we labelled the *Bold* Asset Allocation (BAA).

The recipe for our BAA strategies is now: on the close of the last trading day of each month t..

1. Calculate a relative momentum score for each of assets in the offensive and defensive universe, where *relative* momentum at t equals pt / SMA(12) – 1. Note that the slow SMA(12) trend is calculated based on month-end values with maximum lag 12, so as the average over pt..pt-12 representing the most recent 13 month-end prices, including today.
2. Select the defensive universe, if at least *one* of the assets in the protective (or canary) universe show negative absolute momentum, where *absolute* momentum at t is based on fast momentum 13612W, which is the weighted average of returns over 1, 3, 6 and 12 months with weights 12, 4, 2, 1, resp. Otherwise, select the offensive universe.
3. Depending on step 2, select the TopX assets with the highest relative momentum value of the offensive or the defensive universe and allocate 1/TopX of the portfolio to each. Replace the 'bad' *defensive* selections (assets with momentum less than BIL) by BIL. Hold positions until the final trading day of the following month. Rebalance the entire portfolio monthly, regardless of whether there is a change in position.

Notice that the only difference between our BAA models is the offensive universe (and TO). We summarize the results of our four BAA strategies in the following table (see fig 15, bold is best per period)[13]. It is clear that BAA-G4/T1 ('aggressive' BAA) is always (both on FS and RS) the most offensive (highest R) and also best on K and UPI, while BAA-G12/T6 ('balanced' BAA) is the least volatile (lowest on D and V). Finally, BAA-G4/T2 is best on the Sharpe Ratio (SR) in both periods.

	R	D	V	K	UPI	SR
FS (Dec 1970 - Jun 2022)						
BAA-G12/T6 (bal.)	14.6%	**8.7%**	**8.5%**	11.6%	4.81	1.19
BAA-G4/T1 (aggr.)	**21.0%**	14.6%	13.6%	**12.3%**	**5.20**	1.21
BAA-G12/T3	16.4%	11.4%	10.4%	11.6%	4.23	1.13
BAA-G4/T2	17.7%	12.7%	10.6%	11.7%	5.08	**1.25**
RS (Jun 2002 - Jun 2022)						
BAA-G12/T6 (bal.)	12.2%	**8.7%**	**8.7%**	9.6%	4.30	1.27
BAA-G4/T1 (aggr.)	**16.7%**	9.5%	11.8%	**12.8%**	**5.12**	1.32
BAA-G12/T3	12.1%	10.6%	9.9%	8.8%	3.12	1.10
BAA-G4/T2	14.5%	**8.7%**	10.0%	11.5%	4.42	**1.34**

Fig 15 A comparison of all four BAA strategies

[13] We denoted BAA-G12 (balanced BAA, see section 3) and BAA-G4 (aggressive BAA, see section 4) now as BAA-G12/T6 and BAA-G4/T1 to distinguish them from BAA-G12/T3 and BAA-G4/T2 (both in section 5).

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