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ESG in Strategic Asset Allocation (SAA): A practical implementation framework

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Much research has been made in the past few years about how to integrate ESG in various asset classes; however, ESG research on a total portfolio level—or strategic asset allocation (SAA) level—is still very limited. As a 2019 PRI publication put it, the integration of ESG aspects in SAA "is an area that has received relatively little coverage about what it should mean in practice"[1].

This study seeks to address the current blind spot of research to further facilitate ESG integration comprehensively at an overall multi-asset portfolio level. The specific objective is on (i) understanding the potential impact of integrating ESG factors on risk adjusted returns, (ii) what is the best approach to pursue to minimise impact. **Our analysis concludes that it is possible to have portfolios that reduce significantly ESG risks without meaningfully different risk-adjusted returns vs traditional index SAAs at relatively low levels of tracking error ("TE").** We estimate that the optimal ESG impact can be achieved for TEs between 75 and 100bps, although an investor's preference between their risk budget and ESG utility function will determine their appropriate trade-off between these two measures. Other findings:

- ESG integration can be run for either individual asset classes or at a total portfolio level. The combined approach (optimizing the SAA and implementing via ESG indices) is the most efficient approach from the standpoint of total ESG utility versus tracking error.
- Basic integration optimized across regional indices, sector indices and ESG Indexes provides different levels of ESG improvement that depend highly on index/fund selection. The impact can vary from a reduction of 10% to F-rated (highest risks) stocks and carbon intensity to as much as 80% and 50% respectively for the same tracking error of 25bps.
- Changes in regional weights (e.g. having much more Europe vs US than in the standard market cap-weighted portfolio) improves the portfolio ESG characteristics only slightly.
- Better (ESG) results can be achieved constructing the SAA with traditional sector indexes instead of regional ones.
- Much better results can be achieved overall with allocating to ESG indexes. In this latter case, the share of worst ESG-rated securities[2] can be reduced by ca. 80% and the carbon footprint by 50% vs the traditional SAA – for tracking errors as low as 0.25%.

In the spirit of simplicity and wide applicability, our work has been focused primarily on liquid global asset classes for which there exist a replicable set of underlying indices. As such, we established this framework by leveraging readily available passive ESG indices, which we find sufficient in achieving the various parameters such as climate risk alignment. While we recognize that alternative asset classes and instruments can play a significant role in enhancing the ESG characteristics of a strategic portfolio, this framework is focused on presenting an intuitive, implementable solution for liquid asset allocations.

Literature Review

The existing work on ESG in SAA correctly identifies most of the principal issues for comprehensive ESG integration into asset allocations; however discussions remains at a preliminary stage, stopping short of providing a simple enough, yet widely applicable toolkit for effective ESG multi-asset portfolios. Much research on this topic has focused on highlighting the peculiarities one would have to consider for a more ESG-advanced SAA for different types of investors: e.g. how this exercise can be applied to Liability Driven investments, across different optimization techniques and/or to factors/more systematically driven portfolios[1]. Furthermore, both empirical and forward-looking research suggest a sanguine outlook for ESG investing in terms of

[1] Principles for Responsible Investment. (September 2019). "Embedding ESG Issues into strategic asset allocation frameworks: Discussion paper."
[2] Ratings are based on the DWS ESG Engine. See appendix for more details.

financial performance. DWS [2020][3] demonstrates ex post alpha across regional ESG indices was positive, and in some cases, statistically robust. Blackrock [2020][4] argues on how new ESG trends and asset flows have been impacting existing returns and will possibly result in newly emerging risk premia across asset classes. Aberdeen Standard [2019][5] posits on how a well-constructed SAA ESG aligned portfolio would not necessarily result in lower expected returns and/or worse risk adjusted outcomes. Mercer [2019][6] specifically highlights the importance of analysing and mitigating Climate Change risks in asset allocation decision making, which we have also considered in our work via measuring a few different climate change-related ESG impact criteria. Finally, we also reviewed in depth the more inclusive ESG SAA approaches vs those targeting the exclusions of some specific asset classes, which might still be lagging in terms of ESG quality, from the asset allocation mix, a question similarly posed by Schroders [2019][7].

DWS Approach to ESG in SAA

On the aforementioned point of inclusive versus exclusive ESG SAA approaches, we take the more inclusive approach. First, 'ESG integration' as for PRI is primarily a risk management approach, i.e. the purposes is to ensure that the materiality of ESG risk is properly taken into account and the impact on risk adjusted returns is properly considered. Second, we demonstrate that, with appropriate ESG Indexes and tilts, most of the traditional asset classes can be still present within a very ESG-ambitious SAA framework. We have also taken stock of all the other issues discussed in our literature review, and while deferring the more macro considerations and work on strategic ESG risk premia to a future paper, it is worth mentioning an additional and important aspect which we have added to the discussion here. Specifically, we found that most of the proposed solutions did not delve enough into the practicalities of such ESG-integrated SAAs and how these would be different versus the more traditional SAAs and, ultimately, on what this would mean in terms of risk budget and tracking error for the average investor.

DWS' participation into the Paris Alignment Investment Initiative (PAII) and into its SAA work stream, more specifically, has been another crucial milestone informing our work. The PAII is a program spearheaded by the Institutional Investors Group on Climate Change (IIGCC), with over 70 global investors (AMs and institutions) representing more than $16 trillion in assets. In particular, we have fully factored in the strategic prescription of the PAII of including specific ESG metrics (and carbon emissions metrics, more specifically) in the optimization process alongside the more traditional portfolio risk, return, and correlation parameters. We will explain in the following how the SAA portfolio carbon footprint has indeed been a key optimization metric across all the various scenarios considered.

Further elaborating on these research pieces and the PAII, we wanted to add to the discussion more defined targets and very practical outputs and implementable solutions. By developing this work, as per the summary/conclusions above, we find that not only do the final proposed portfolios achieve the desired ESG characteristics and substantial improvements, but that they also do so within a reasonable tracking error budget, which we can break down transparently by scenario and asset class.

With this framework, we are explicitly targeting alignment between best-in-class Multi-Asset ESG integration and the DWS CIO framework, resulting in applicability in a variety of contexts. The aim is strategic, as ESG trends and implication for the various asset classes are mostly long-term and structural in nature. As such, we choose not to focus on ESG tactical asset allocation (TAA) implications at this juncture.

Starting points and potential challenges

If investors want to assess the ESG implications on a strategic asset allocation level, they have to overcome several restrictions, as the ESG impacts, because of complexity, are often only measured on a portfolio sub-component basis. Therefore a holistic view of portfolio ESG impact is essential for comprehensive portfolio construction of ESG portfolios.

The impact varies in dependency of the recalibration approach, the selected indices/universe, data availability, degrees of freedom, the ESG restrictions and different ESG target functions, the traditional risk/return restrictions, and the potential trade-offs between ESG and financial metrics. As such, exploring this trade-off across a few simulated approaches allows investors to determine the appropriate ESG SAA construction methodology by the comparing empirical output of both financial and ESG metrics for a variety of possible steps of ESG optimization.

Last but not least, it is necessary to assess a representative global investment universe not only on an ex-post basis, but also on and ex-ante basis which requires a sophisticated return forecasting model like the DWS Long Term Capital Markets Assumptions (LTCMA) framework.

Methodology

Our methodology for ESG SAA constructions follows a few steps:

1. **Define the subset of appropriate asset classes and ESG indices on which to construct ESG SAAs**. ESG implementation can take on a variety of different characteristics. Therefore, for the purposes of transparency, investability, and liquidity of our ESG SAAs, we chose the list of indices highlighted in the following section on which to run our analysis.
2. **Define and quantify ESG metrics**. In order to properly account for various ESG metrics, we utilize a step-by-

[3] DWS Research Institute, (March 2020). 'ESG investing – getting under the hood'.
[4] Sustainability: The tectonic shift transforming investments- BlackRock, February 2020
[5] Aberdeen Standard Inv. (October 2019). "Strategic Asset Allocation: ESG's new frontier"
[6] Mercer (2019). "Investing in a Time of Climate Change – The Sequel"
[7] Schroders, (May 2019). "The practical considerations of ESG in multi asset portfolios"

step optimization of which each step incorporates an additional ESG metric on which to optimize our SAAs. In addition, we illustrate how investors can increase the impact across ESG metrics if they have increased flexibility in their mandates in terms of tracking error.

3. **Establish risk parameters** for initial optimizations. Maximum deviations of regions/sectors/sub-asset classes of maximum 4x weight/minimum 1/4 weight of the traditional SAA. Absolute portfolio risk is controlled to match the volatility of the reference allocation of 50/50 Equity/Fixed Income.
4. **Define our target scenarios** based on ESG metrics and risk parameters. See Figure 2.
5. **Run the optimizations** for every scenario S1 to S4 for traditional indices, sector indices, and ESG indices for tracking errors ranging from 25bps to 250bps in 25bps increments. In each of the scenarios, we maximize the ESG composite score[8] subject to the risk constraints.

For our methodology, we ran each of the three following iterations in order to compare results across different initial approaches:

1. Optimization within traditional regions/sectors/asset classes
2. Replacement of traditional regions/asset classes with ESG version
3. Combined optimizations (main results section)

Defining the index universe

ESG investing can take many forms, through either active or index-based investing, through liquid public markets or through illiquid private investments, through exclusion criteria or via impact scores. For the purpose of this analysis which details DWS' approach to creating liquid global strategic asset allocations, our empirical studies leverage a set of ESG market indices that are: investible, liquid, and transparent.

FIGURE 1. EMPIRICAL RISK, RETURN, AND TRACKING ERROR OF ESG INDICES

Index	Compound Annual Growth	Annualised Monthly Volatility	TE of ESG vs. standard index
MSCI USA ESG	13.4%	14.2%	1.7%
MSCI USA	14.2%	14.7%	
MSCI Europe ESG	4.9%	13.0%	1.8%
MSCI Europe	3.4%	13.4%	
MSCI Japan ESG	9.9%	13.9%	1.5%
MSCI Japan	9.4%	13.7%	
MSCI EM ESG	9.5%	14.9%	2.7%
MSCI EM	6.6%	14.8%	
Euro Govt. ESG	3.8%	4.1%	0.1%
Euro Govt.	3.8%	4.2%	
US Treasury ESG	2.0%	3.8%	0.0%
US Treasury	2.0%	3.8%	
Euro Corp ESG	2.6%	3.8%	0.2%
Euro Corp	2.7%	4.0%	
US Corp ESG	5.9%	6.2%	1.1%
US Corp	3.3%	5.5%	
Euro HY ESG	3.3%	7.0%	0.5%
Euro HY	3.5%	7.3%	
US HY ESG	7.6%	9.2%	1.0%
US HY	7.4%	9.1%	
EM Sovereign ESG	8.4%	9.2%	1.5%

Source: DWS Investments UK Limited. Data from April 30 2014 to September 30 2020. Past performance is not a reliable indicator of future returns.

The reference universes for the analysis are the MSCI AC World for equities and the Barclays Global Multiverse for bonds. The default allocation is determined by the current weights of regions, sectors or sub-asset classes in these indices. The equity/bond allocation is set at a static 50/50 ratio. We have also calculated all scenarios with a dynamic equity/bond weighting. However, since the ESG effect is, in this case, potentially distorted by allocation shifts, we apply a static asset class weighting. The ESG optimization is performed separately within the equity and fixed income components. The ESG metrics for the full index reference universe for the traditional index components, as well as the ESG equivalents is displayed in the appendix (Figure 10).

On the equity side, the MSCI ESG Leaders indexes were identified as ensuring good ESG characteristics while at the same time keeping the tracking error to the original/non-ESG indexes within a reasonable range. For these indexes, the top 50% of companies in the ESG distribution are selected and there is a further emphasis on low carbon emitters which a theme of outmost importance at DWS. Furthermore, when looking at the exclusions and UN norms alignment embedded into these indexes, we found a good degree of homogeneity with the DWS ESG assessments.

On the FI corporate (European IG) side, we chose the Bloomberg Barclays MSCI Euro Sustainable and SRI TR, and the Bloomberg Barclays MSCI US Liquid Corp Sustainable Index for the US IG Corporates asset class.

In conjunction with these indices, DWS offers a broad set of best-in-class passive ESG solutions that can be used to practically construct these SAAs with relative ease.

[8] For the indices of the asset class universe the quantified ESG scores (step 2) are joined in an ESG raw data matrix. By using the median[8] score of each metric and by using the weights of a reference allocation (benchmark), the raw data is normalized to ensure comparability. A scenario-specific scaling vector (step 4) is then applied to the normalized ESG score matrix in order to assign the relative importance to each metric in the corresponding scenario. Finally, the *ESG Composite Score* is defined as weighted average of this normalized and scaled ESG score matrix and a portfolio allocation.
By comparing the ESG Composite Score of two different allocations, a higher ESG Composite Score indicates a better ESG profile in the specific scenario (and vice versa). The optimization process aims to find the allocation that yields the maximum ESG Composite Score, i.e. the best ESG profile in the corresponding scenario.

Defining and quantifying ESG metrics

For our analysis, we find that the above subset of ESG indices can be used to establish a deep, impactful approach that is consistent with our firm wide policy, which places significant focus on the climate change and engagement topics along the lines of the UN Sustainable Development Goals (SDGs). Certain exclusions are also enforced across these indices and, by consequence, our ESG SAAs (e.g. controversial weapons exclusion "CCW").

We recognize that our findings are based on parameters we've established as meaningful but not absolute levels of ESG compliance; therefore, investors can toggle the ESG goals we're using as they deem fit. For our purposes, we define the below three methods of application for our ESG SAAs.

Establishing risk parameters

As with ESG metrics, we recognize that investors can toggle their relative and absolute risk criteria based on desired outcomes. In combination with ESG metrics, utilizing our optimization framework, one should be able to establish the trade-off between risk and ESG efficacy.

For the purposes of our analysis, we establish a simple set of relative risk parameters. First, we limit the maximum deviations of the regions, sectors, and asset classes at a maximum of 4 times and minimum of ¼ times the weight of the traditional reference SAA. Absolute portfolio risk is made equivalent to the reference allocation of a static 50/50 traditional equity/fixed income allocation. We control the relative portfolio risk - the expected tracking error of the optimized vs. reference allocation - to not exceed the defined TE limits.

Defining the target scenarios based on ESG metrics and risk parameters

Once we've established the appropriate index universe, the ESG proper metrics, and clear parameters around relative SAA risk, we define our target scenarios around those definitions as shown in Figure 2.

FIGURE 2. DEFINITION OF TARGET SCENARIOS BASED ON ESG METRICS AND RISK PARAMETERS

Scenarios

S1: Minimize Climate Transition Risks ("CTR") and UN Global Compact ("UNGC") risks via excluding F-rated securities in the respective categories (Basic ESG Integration)

S2: (additionally) Minimize DWS Overall ESG Score F-rated securities (S1+S2)

S3: (additionally) Minimize CO2 intensity, maximize Solutions Provider (A and B-rated securities for SDG-Ratings and CTR-Ratings (S1+S2+S3)

S4: (additionally) Minimize controversial sectors + minimize DWS Overall ESG Score for E-rated securities (S1+S2+S3+S4)

Source: DWS Investments UK Limited.

We concentrate in the presentation of the results section on scenario 1—the basic optimization—and scenario 4. Scenario 4, as the most comprehensive ESG optimization, includes minimizing the carbon footprint, controversial activities, and further weak ESG-rated securities and also optimizes positive criteria such as the share of solution providers.

For the calculation of the ESG utility in the various scenarios we normalize the respective ESG values. For the presentation of the partial ESG utility (e.g. the share in F-ratings, CO2 intensity) and the total ESG utility (improvements across different ESG criteria) we show the weighted overall improvements in percentages.

This analysis is three-fold. First, assessing the ESG quality of the unconstrained asset allocation along standard ESG parameters, the level of carbon risks and compliance with the UN Global Compact norms. This analysis is carried out on a look-through basis across the incorporated index holdings.

As a second step, we perform a trim-and-fill analysis where we underweight asset classes or regions with insufficient ESG performance. We fill the allocation gaps pro rata with the remaining assets classes/regions. We also assess relative overweights and underweights against the traditional 50/50 allocation based on various constraints.

Third, we remodel our standard asset allocation based on ESG-index solutions, while considering implementation requirements such as sufficient liquidity. The overall goal is to design an ESG-aware asset allocation, which represents a relative optimum of tracking error (compared to the default SAA) while at the same time maximizing the ESG quality. We outline different scenarios and trade-offs.

The first scenario/optimization framework taken into consideration targets the minimization of exposures to

controversial sectors and F-rated UN Global Compact companies (according to the DWS ESG Engine methodology). In the second scenario, the minimization of such F-rated (DWS Overall ESG Score) names is also sought. The third iteration consists of also minimizing the carbon intensity of the resulting portfolio and seeking max SGDs and climate solutions (positive) impact. The final and most restrictive framework additionally includes constraints around minimizing E-rated companies and controversial sectors across the board.

Running the optimizations

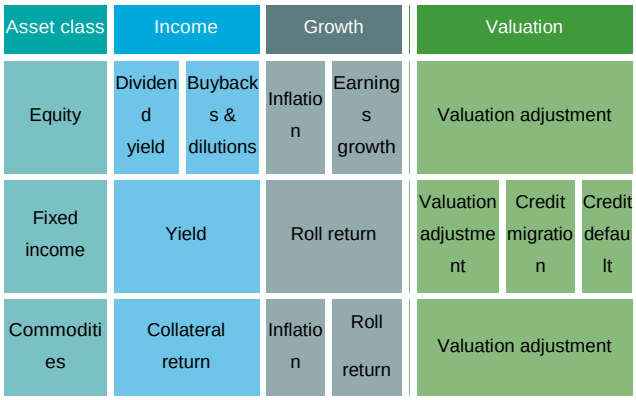
The central optimization parameter is the maximization of the combined ESG Composite Score in the respective scenario, subject to the tracking error restriction. We finally run the optimizations for every scenario S1 to S4, first using the traditional regional indices we highlighted, then using sector indices, and finally using the ESG indices we had earlier defined. We then maximize the aforementioned "ESG Composite Score" on tracking error allowances ranging from 25bps to 250bps, run in 25bps increments (i.e. 25bps, 50bps, 75bps, etc…). In total, we calculated 240 optimizations for the 4 scenarios, the different optimizations within the asset classes and for the defined tracking error steps.

The Long View: ESG Forecasts

The financial metrics previously illustrated are empirical calculations of our ESG-optimized scenarios. As with all financial analysis, empirical data is only helpful insofar as baseline expectations can be anchored in historical observation. As the landscape specifically for ESG investing continues to shift dramatically, forward looking expectations of risk and return that properly account for the financial impact of ESG is tantamount to optimal portfolio construction. Look-through ESG metrics are more likely to be stable, although investors should consider the ESG impact of potential broad shifts in capital allocation behaviours.

In order to construct optimized asset allocations, DWS relies heavily on the DWS Long View, our firm-wide methodology for forecasting strategic, 10-year returns, correlations, and volatilities across a breadth of public and private investment universes. The DWS Long View leverages a consistent and transparent building block approach that aggregates fundamental return drivers across three pillars: income, growth, and valuation. Figure 3 illustrates our building blocks across traditional asset classes.

FIGURE 3. PILLAR DECOMPOSITION FOR TRADITIONAL ASSET CLASSES IN DWS LONG VIEW



Source: DWS Investments UK Limited.

For the purposes of this publication, we will not present any ex-ante ESG-specific asset class return forecasts. The literature on the expected return impact of an ESG index, especially relative to the more broadly used market cap weighted equivalent index, is a hotly debated topic. While empirical studies suggest the prevalence of statistically significant alpha generation across certain regional markets, the persistence of this empirical alpha in the coming years is a challenging problem.

In a future publication, we will highlight in detail, through the same bottom-up return forecasting methodology, our returns for the broad spectrum of ESG indices of the next decade. By forecasting ESG return expectations through aggregating fundamental building block drivers of returns, we can generate an expectation of how our ESG SAA might perform in terms of risk and return over the next ten years.

Results

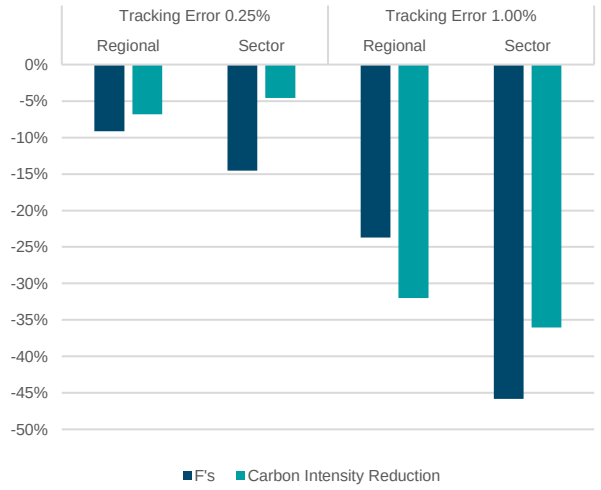
1. Optimization within the traditional asset allocation. First, we investigate to how regional changes in the traditional asset allocation can lead to an improvement in the ESG profile and if so, to what extent. In doing so, we optimize the ESG benefit in each defined scenario depending on the respective tracking error restriction. The ESG effects that can be achieved are very limited. For scenario 1 and with a tracking error budget of 0.25%, the share of most severe norm violations and companies with the highest carbon risk can be reduced relatively by 9% compared to the traditional SAA. The CO2 intensity, as an accompanying effect of the optimization, can be reduced by 7%. For a tracking error allowance of 1.0% the share of F-rated securities can be reduced by 24% and the carbon intensity by 32%.

In scenario 4, the allocation is optimized according to additional positive and negative screening criteria (e.g. the CO2 intensity is additionally optimized). However, the effect for S4 is marginal for the optimization within the regionally-oriented SAA, since the remaining optimization potential is limited with the given regional indices.

We then calculate the effect of replacing the traditional regional asset allocation on the equity side with a global

sector allocation instead. The ESG optimization effect in relation to the given tracking error is thus further improved in relation to the regional view. For S1 and with a tracking error of 0.25%, the proportion of companies that violate norm standards and companies with the highest carbon risk (F-ratings) can be reduced by ca. 14% compared to the unconstrained SAA. The CO2 intensity can be reduced correspondingly by 5%. However for higher TE allowances (TE 1.0%) F-rated securities can be reduced by more than 45% and the carbon intensity by 36%. In comparison to the respective regional optimizations, the sector optimizations demonstrate, on average, slight advantages vis-à-vis regional. Figure 4 shows the relative improvement effect for regional and sector optimizations for tracking errors 0.25% and 1.00% for scenario 1.

FIGURE 4. RELATIVE ESG-IMPROVEMENTS FOR REGIONAL AND SECTOR OPTIMIZATION FOR TRACKING ERROS 0.25% AND 1.00% SCENARIO 1



Source: DWS Investments UK Limited. Data as of 30 September.

2. Replacement of traditional indices with ESG indices. After the optimization of the ESG utility with non-ESG instruments within the SAA, we now exchange the traditional indices with their respective ESG versions. The weightings within the equity and bond components remain identical in this case. Like the traditional indices the ESG indices used for the calculation are liquid investments with corresponding ETFs. The aim of the analysis is to determine the effect on the ESG benefit and the tracking error when the SAA is completely replaced by ESG instruments while holding the traditional weights constant.

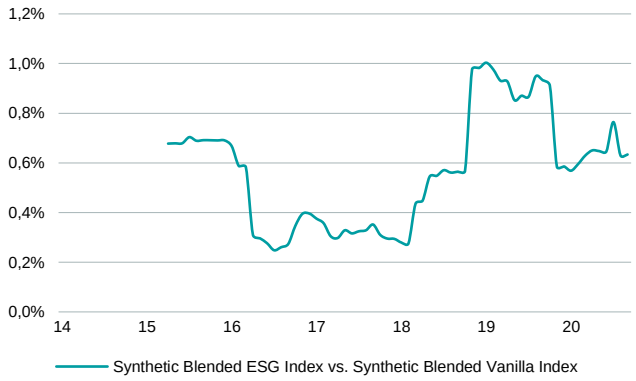
We determine an average tracking error of 0.6% with a complete switch to ESG instruments but unchanged weighting of the SAA. The TE fluctuates in the back-tested period (from 2015 to 2020) between 0.2% and 1.0%. The ESG benefit achieved is quite remarkable for this level of tracking error. The proportion of F-ratings can be reduced relatively by 70% compared to the traditional SAA. The CO2 intensity can be reduced by 44%. The share of solutions providers (A and B-rated securities) improves to 25%. For the analysed time horizon, which was constrained by data availability, the empirical Sharpe Ratio of the ESG SAA was even slightly higher compared to the Traditional SAA.

FIGURE 5. EMPIRICAL RISK AND RETURN STATISTICS FOR ESG SAA (ESG INDEX IMPLEMENTATION) AND TRADITIONAL ASSET ALLOCATION (TRADITIONAL REGIONAL INDEX IMPLEMENTATION)

30 Apr. 2014 - 30 Sep. 2020	ESG SAA	Traditional SAA
Compounded Annual Growth	7.5%	7.3%
Annualised Monthly Volatility	7.2%	7.3%
Sharpe Ratio	1.09	1.03
Worst drawdown	-18.2%	-18.2%
Median monthly return	1.0%	0.9%
Best monthly return	5.7%	5.8%
Worst monthly return	-6.9%	-7.2%
% of months with gains	68.8%	67.5%
Correlation	1.00	
Ann. Monthly Tracking Error	0.6%	
Information Ratio	0.48	

Source: DWS Investments UK Limited. Data from April 30 2014 to September 30 2020.

FIGURE 6. ROLLING 12M TRACKING ERROR OF ESG ASSET ALLOCATION VERSUS TRADITIONAL ASSET ALLOCATION



Source: DWS Investments UK Limited. Data from April 30 2014 to September 30 2020.

FIGURE 7. COMPARISON OF ESG DATA FOR ESG SAA AND TRADITIONAL ASSET ALLOCATION

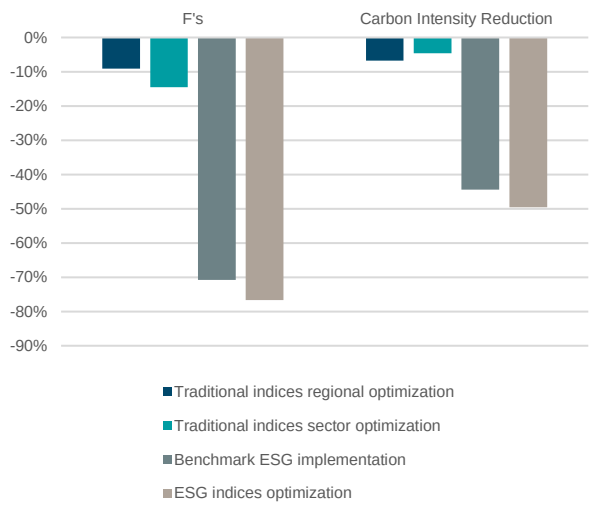
Share	ESG SAA	Traditional SAA
Controversial Sectors	0.006	0.029
F Ratings	0.018	0.060
E Ratings	0.110	0.179
AB Ratings	0.252	0.207
Carbon Intensity	124	223
Carbon Intensity (adjusted)	844	1,034

Source: DWS Investments UK Limited. Data as of 30 September.

3. Combined optimizations

Despite the already tangible ESG benefits with reasonable tracking error, we now analyse whether we can further reduce the expected tracking error for an asset allocation based on ESG indices. The regional allocation of ESG indices within the equity and bond bucket of the SAA is now optimized. Correspondingly, the optimizations for scenarios 1-4 are determined depending on the tracking error. For an expected tracking error of 0.25%, we can further optimize the ESG benefit in the different scenarios. For example in scenario 1 (or 4) the proportion of F-ratings can be reduced by 77% (79%) in relation to the traditional SAA. The CO2 intensity is reduced by 50% (53%). For a tracking error allowance of TE 1.0% the share of F-rated securities can be further reduced by 91% (S1) and 91% (S4). The carbon intensity shrinks by 70% (S1) and respectively 71% (S4).

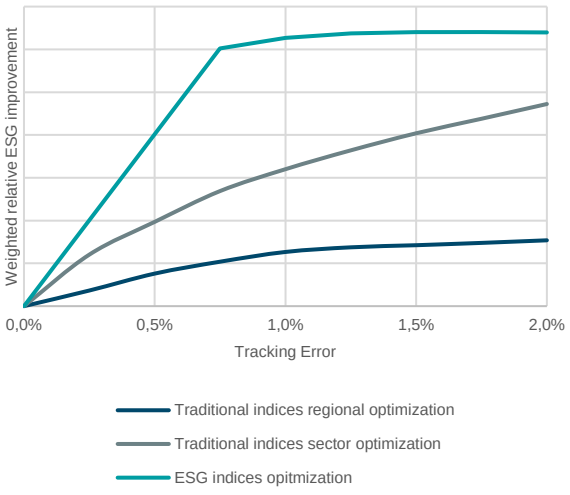
FIGURE 8. IMPROVEMENT AT TE OF 0.25% WITH DIFFERENT APPROACHES FOR CARBON- AND NORM-F'S (BASIC INTEGRATION FOCUS, S1)



Source: DWS Investments UK Limited. Data as of 30 September.

In relation to optimization step 2 with a historic TE of ~0.6%, we can thus demonstrate a further ESG benefit with an expected tracking error of TE 0.25%. In contrast to the ESG benefit of the calculations in step 1, the combined ESG benefit only increases marginally once a tracking error of ~1.0% is reached. Based on the indices used, the respective ESG properties of the indices and the defined utility function, ESG-optimal results can be achieved with a tracking error of 0.75%. The ESG improvements could be increased even further if other indices such as the SRI variants were used instead of the ESG variants of the indices. However, the tracking error-minimized solution (TE 0.25%) already demonstrates significant improvements. Even with this TE, the reduction of CO2 intensity is already very close to the level of the EU PAB (Paris Aligned Benchmark) of a 50% reduction. For many investors, the defined basic integration scenario S1 at TE 0.25% can therefore already be an important step for ESG integration in asset allocation. The deviation in tracking error appears negligible to the traditional SAA with tangible ESG benefits.

FIGURE 9. IMPROVEMENT OF ESG COMPOSITE SCORE (WEIGHTED RELATIVE ESG IMPROVEMENT) IN DEPENDENCY OF TRACKING ERROR



Source: DWS Investments UK Limited. Data as of 30 September.

Conclusion

For global investors, ESG has become an un-ignorable consideration when constructing portfolios. Continued regulatory shifts toward ESG compliance for both allocators of capital investment and users of capital assets continue to attach both ESG and financial risks to a multitude of traditional asset classes. While the universe of available ESG solutions have been growing in recent years, this sea change necessitates additional research into ESG investing at the total portfolio level.

As ESG investing takes further hold, we examine through our analysis a couple of approaches to the holistic construction of ESG-tilted strategic asset allocations using a step-wise approach. We examine in 240 different optimizations several ESG metrics like the DWS Overall ESG Rating, the DWS

Climate Transition Risk Rating, the DWS UNGC Norm Rating, the DWS SDG-Rating, the Carbon Intensity and the share of Controversial Sectors. Combined with financial constraints (magnitude of nominal portfolio deviation, tracking error constraint), we are able to construct strategic asset allocations that increase impact across these ESG metrics and examine their financial impact via empirical risk and return.

At a high level, we conclude the following:

- ESG optimization can be run for either individual asset classes or at a total portfolio level. We consider the combined approach (optimizing the SAA and implementing via ESG indices) as the most efficient approach from the standpoint of total ESG utility versus tracking error (**see Figure 9).**
- **Basic ESG integration** using indices provides differing levels of ESG improvement that depend highly on index/fund selection (**see appendix).**
    - **Basic Integration** focused approaches using traditional **regional indices** could reduce the share of **F-rated names by ~10% (relative) and the carbon intensity by less than 10%** vis-a-vis the traditional SAA at a tracking error of 25bps. Further marginal improvements within traditional regional indices are only possible with high TEs.
        - Implementation of Basic ESG Integration via traditional **sector indices** (mainly e.g. IT, HC, Financial, Staples, and Industrials) provides a slightly better entry level for investors for ESG optimization with traditional indices – in particular with higher TE's. At TE's of 1.0% **F-rated securities can be reduced by 46% and the carbon intensity by 36% (relative)**
        - In comparison, for the same tracking error of 0.25% a modelling of the SAA via **ESG indices** reduces **F's by close to 80% and the carbon intensity by ~50%** (which would already exceed the level of the EU Carbon Transition BM level). The ESG improvements rise further with **higher tracking error budgets towards 90% reduction in F's and 70% carbon intensity reduction** only using ESG indices without further single security optimization.
- For achieving **multiple ESG targets** (additionally the reduction of E's, sector exclusions, positive screening) the allocation needs to be shifted to **ESG indices**; otherwise, investors would not achieve optimal ESG utilities at given TE's. The relative improvement for carbon performance or reduction of F-ratings is in these cases are minor, but at comparable footprints the **share of CTRR and SDG-Rating A- and B-rated securities could improve by up to 27%** relative to the unconstrained SAA at a TE of 0.50%.
- The ESG/financial optimum for investors vary depending on the TEs. We determine various utility functions[9] of the composite ESG score and the TE. Tracking error averse investors could already achieve **high ESG impacts at 25bps**. For investors potentially most interesting areas **for TE / ESG Utility would be TE's of around 100bps**, as with this higher ESG improvements can be achieved. Historic simulations support that at these levels, the Information Ratio and Sharpe Ratio are relatively comparable to the unconstrained SAA. Tracking error allowances beyond 250bps could not only produce large risk/return deviations, but even may reduce the relative ESG impact.

Forecasts are based on assumptions, estimates, views and hypothetical models or analyses, which might prove inaccurate or incorrect.

[9] **Combined Utility Function:** In the optimization process the ESG Composite Score is maximized for various tracking error budgets. The result of the optimization is the allocation that yields the best possible ESG profile for the given tracking error limit. If an investor faces the choice between two allocations with the same tracking error, it is assumed that the allocation with the higher ESG Composite Score is preferred. At the same time, we assume that an investor is averse to taking active portfolio risk: ceteris paribus, a higher tracking error will decrease the investor's utility. This preference structure is described by a combined utility function that uses the two parameters ESG Composite Score and tracking error. Both preferences are linked by an individual active risk aversion coefficient. It thereby describes the trade-off an active-risk averse investor faces upon deviating from a reference allocation in order to improve the ESG profile.

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Appendix

FIGURE 10. ESG DATA FOR DIFFERENT INDICES

		Controversial Sectors	F's	E's	AB's	Carbon Intensity	Carbon Intensity (adj)
Equities Traditional Regional	USA	4,70%	7,20%	20,00%	37,30%	148	653
	Europe	3,00%	5,50%	22,50%	30,70%	143	891
	Japan	1,00%	2,70%	14,80%	24,40%	81	751
	Emerging Markets	0,60%	8,80%	28,80%	13,20%	266	1026
Equities Traditional Sectors	Communication Services	0,00%	2,10%	29,10%	0,80%	19	237
	Consumer Discretionary	0,00%	27,40%	21,60%	16,40%	42	395
	Consumer Staples	8,80%	6,60%	30,30%	0,00%	54	769
	Energy	3,60%	21,50%	136,80%	0,00%	459	4546
	Financials	0,80%	3,30%	11,20%	13,50%	18	549
	Health Care	0,00%	4,20%	1,10%	84,10%	22	547
	Industrials	15,40%	2,10%	23,00%	17,70%	119	931
	Information Technology	0,30%	1,40%	5,20%	58,60%	21	326
	Materials	0,00%	11,30%	45,10%	18,90%	651	2226
	Utilities	41,70%	3,70%	57,30%	16,20%	2156	2205
Equities ESG	USA ESG	0,00%	0,30%	11,50%	45,70%	48	464
	Europe ESG	0,00%	0,00%	6,00%	50,80%	43	554
	Japan ESG	0,00%	0,00%	8,00%	26,80%	36	684
	Emerging Markets ESG	0,00%	1,80%	15,60%	7,70%	79	605
Fixed Income Traditional	EuroAgg Treasury	0,70%	1,60%	5,30%	2,30%	102	944
	US Aggregate Total Treasury	2,50%	2,30%	8,90%	4,20%	293	1083
	Euro Aggregate Corporate	1,90%	7,00%	24,50%	11,70%	134	947
	US Corporate	6,40%	9,30%	27,70%	10,80%	145	872
	Pan-European High Yield	2,50%	6,70%	33,60%	16,00%	208	891
	U.S. Corporate High Yield	2,30%	19,80%	41,60%	15,70%	341	1629
	Emerging Markets Sovereign	0,10%	19,80%	33,50%	6,70%	1232	4802
Fixed Income ESG	EuroAgg Treasury ESG	0,00%	0,00%	2,00%	2,80%	20	802
	US Aggregate Total Treasury ESG	2,50%	2,30%	8,90%	7,60%	293	1083
	Euro Aggregate Corporate ESG	0,00%	0,00%	16,10%	23,40%	117	933
	US Corporate ESG	1,50%	1,80%	21,00%	37,80%	155	1030
	Pan-European High Yield ESG	0,30%	1,60%	18,20%	8,70%	196	832
	U.S. Corporate High Yield ESG	0,40%	16,80%	29,10%	7,90%	250	1748
	Emerging Markets Sovereign ESG	0,20%	16,40%	26,20%	1,00%	371	3163

Source: DWS Investments UK Limited. Data as of 30 September.

Explanations: The percentages aggregate the shares across the different sub-ratings: Carbon, Norm, and Overall ESG rating (for the F- and E-rating shares), the Carbon and SDG Rating (for AB-Rating) or for different controversial sectors. The percentages are not netted for overlaps across the different sub ratings. For example, for Traditional Sectors Energy the share of E's for the Carbon Rating is 88.6%, for the Norm Rating 44.9% and for the Overall ESG rating 3.3%. We do not delimit it for calculation purposes to 100%. Further explanations to the ESG criteria can be found in the Appendix Notes.

Notes:

We used standard market indices for the traditional indices as well on the ESG side. All indices are representative, investible via ETF's, liquid, and transparent. Depending on the instruments and underlying indices the ESG data could be even further improved via SRI-versions instead of the ESG-versions of the indices. For US sovereigns we apply a conservative approach and do not replace this portfolio share for the ESG optimization. For climate-concerned investors or investors applying other ESG exclusion criteria this large portfolio bucket might be however critical. According to the current assessment of i.e. Climate Action Tracker the US is currently seen on a warming glide path of above 4° degree Celsius. This is however not incorporating any potential changes in the US climate policy. On an index/ETF level, US sovereigns might therefore be replaced by USD-denominated foreign sovereigns, USD-denominated Investment Grade Corporate bonds, or ideally by USD-denominated Supranationals. The latter would come closest in terms of the classical bond rating profile. In particular it would also significantly uplift the ESG and SDG performance and reduce norm controversies while ensuring comparable yield, rating, and currency exposure. Switching to SRI ETF's for equities and corporate bonds would further improve the ESG data and carbon efficiency of the overall allocation.

Controversial sectors. Definitions of controversial sectors are fluent and context dependent. For this analysis we included Nuclear Power, Nuclear Weapons and Tobacco.

Rating F. This represents the share of the worst ESG performers and aggregates all F Ratings (Scale A-F) for Climate Transition Risks ("CTR"), the UN Global Compact ("UNGC") Norm Ratings as well as all F-rated securities based on the DWS ESG Overall Rating.

Rating E. This represents the share of the second worst ESG performers and aggregates all E Ratings (Scale A-F) for Climate Transition Risks ("CTR"), the UN Global Compact ("UNGC") Norm Ratings as well as all E-rated securities based on the DWS ESG Overall Rating.

Rating AB's. This contains the aggregated share of potential solutions provider. It represents the share of A- and B-rated securities for the DWS SDG-Rating and the DWS CTR-Rating.

Carbon Intensity/Carbon Intensity (adj). A company's carbon intensity is its total carbon emissions divided by the total revenues (tons CO2 per mn USD revenue). For a portfolio of company holdings we calculate the weighted average of these intensities. We calculate the carbon emissions intensity as 1) a basic intensity of Scope 1 and 2 emissions like also suggested by The Institutional Investors Group on Climate Change (IIGCC) and 2) as an impact adjusted footprint, which also incorporates Scope 3 Emissions and avoided emissions.

Carbon reductions above 30% are potentially aligned with the EU Carbon Transitions Benchmark (CTB). Reductions above 50% would be potentially considered EU Paris COP Agreement aligned (PAB). Provided that the reference universes matches the asset allocation of investors and the other EU Carbon benchmark criteria are fulfilled (continuous carbon intensity reduction of 7% p.a., ratio of green versus brown revenues, Do-No-Significant-Harm Principle) some optimizations would therefore be EU carbon benchmark aligned. However, to increase data consistency we used the revenue intensity instead of the EU EV-apportioning factor for the carbon footprint. Moreover, we adjust the Scope 3 emissions additionally by avoided emissions. Individual carbon reduction targets of companies like their participation in the Science Based Targets initiative are not assessed due to the still insufficient data coverage.

ESG Engine

The DWS ESG Engine is DWS' in house business managed application software to empower DWS to meet client demand on ESG solutions. The ESG engine derives so called ESG signals, usually A-F letter coded ratings and numerical scores on a 0-100 point scale, to clearly quantify and qualify ESG risks and opportunities. That coded information is supplemented with a variety of raw ESG information as published by the vendors originally, most notably ESG specialist written narratives.

DWS purchases ESG information in the market from five leading ESG vendors, hence DWS builds its ESG excellence on trusted external ESG expertise. As of now DWS contracts with ISS-ESG (formerly known as Oekom/Ethics; sector tests, norm tests, ESG ratings, climate transition risk, green bonds), MSCI ESG (sector tests, norm tests, ESG ratings, climate transition risk), Morningstar Sustainalytics (norm tests, ESG ratings; for funds: sector tests, norm tests, ESG ratings), S&P TruCost (sector tests, climate transition risk), and Arabesque S-Ray (sector tests, norm tests, ESG ratings, climate transition risk). With this data-driven and capital intensive approach DWS is in a position to forge ESG solutions based on more than 2'500 man years of ESG experience, which is an outstanding concentration [RD1 §§2-3]. DWS' multi-vendor approach turns the multiplicity of subjective assessments into a strength: verdicts with are supported by a cross-vendor consensus are prioritized.

DWS' ESG methodology and implementation is owned by the ESG engine team under the control of the EMP (ESG methodology panel; reporting into the CIO for sustainably investments), which meets weekly [RN1]. This includes as well considerations on on- and off-boarding of new data vendors (usually driven from client demand, subject to budget).

The ESG Engine produces ESG signals for liquid securities in corporate and sovereign fixed income, equites, listed real estate, funds and ETFs (but excludes commodities and alternatives). It supports solutions in the active as well as passive mandates and is NPA-ed for DeAM/DeAMi (Germany) and DIMA/RREEF (USA) with ID 48806. The vendor licenses allow full usage of the ESG signals and raw data within DWS, but supply of such data to external 3rdparties, most notably in the framework of ESG advisory or indexing is not covered

The ESG engine, which is mainly written in SAS, consumes the raw vendor data using the official DB gateways like dbExchange. It standardizes the information, maps to the BRS keys, applies business owned and maintained For internal use only 3 The DWS ESG Engine –Reference Document RD 1 algorithms and finally produces ESG signals on a 6 week schedule. The resulting ESG signals are published into BRS Aladdin for easy and flexible consumption by and integration into the investment platform [RD16; RD22]. Furthermore is the data published onto the ESG vault [link-2] to give access to authorized DWS staff without Aladdin access and to hold data which cannot be stored in Aladdin (e.g. portfolio level analysis). It is further broadcast to IG as well as into GENi [RD29]. The ESG investment advisory and the client reporting team have set up a service to produce ad-hoc ESG analysis for existing DWS portfolios as well as for prospect holdings –this covers more detailed analysis for professional clients and summaries on ESG key performance indicators (eKPI) for the general public