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Do Exclusions Have an Effect on the Risk Profile of Equity Portfolios?

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Abstract

Exclusion/negative screening is the most popular filter used to integrate environmental, social, and governance (ESG) criteria into investment strategies. It consists of excluding from the investment universe the instruments issued by companies that don't meet the criteria defined in the manager's investment policy. This method is often applied in the passive investment space, where exclusion criteria are combined with index replication. In this paper, we perform an extensive study of the impact of exclusion policies on the financial risks of 493 indices from developed Europe and the US. To address the lack of consensus on ESG criteria, we built three screens based on typical investment policies: a screen based on a few consensus criteria, a more comprehensive screen that incorporates additional climate net zero criteria, and finally an ambitious screen eliminating all companies that have a negative contribution to any of the United Nations sustainable development goals. We show that the effects of the first two exclusion policies on index risks are often very limited, especially when using an optimised reallocation method.

Key Takeaways

- On a sample of 128 European indices, screening leads to an average excluded weight of 9%, 10% and 58% of the portfolio depending on the screen; on a sample of 365 US indices, screening results in an average exclusion of 19%, 23% and 67% depending on the screen.
- We find that applying screens with a naïve (pro rata) reallocation leads to a median tracking error between 0.9% and 4.7% depending on the screen and the sample region. Sector deviations occur mainly in the "Energy" and "Utility" sectors. In terms of fundamentals, exclusions increase exposure to the Fama and French (2015) "profitability" factor, while slightly reducing exposure to "investment" and "value" factors. Applying screens using an optimised reallocation method leads to a median reduction of the tracking error between 0.3% and 1.6%, depending on the screen and the sample region, while also reducing the deviation of factor exposure.
- ESG screening often reduces carbon intensity, but not always. The screening followed by a naïve reallocation scheme results on average in a reduction in the carbon intensity of the indices, up to 54% after the PAB screening on the US sample. However, this systematic reduction does not occur when screening is followed by the optimised reallocation.

Keywords: ESG screening, exclusion, risk, sustainable investment, tracking error.

JEL codes: G11, G23, Q54.

I. Introduction

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Exclusion is the oldest practice related to sustainable finance (Schueth, 2003) and remains very popular, with about USD3,840 billion of asset under management (AUM) subject to negative screening, and USD1,807 billion subject to norm-based screening (out of a total of USD30,321 billion of sustainable AUM; GSIA, 2023). Exclusion is indeed a common foundation for several sustainable strategies. Based on a review of the academic literature, Bouchet and Safaee (2024) highlight that the main building blocks that investors ought to consider – themes, levers (including exclusion, allocation, and engagement) and data – are interdependent and propose four families of coherent sustainable investment strategies. Although each strategy targets a specific type of extra-financial impact, they all rely on the lever of exclusion (Figure 1).

Exhibit 1: Exclusion as a foundation for coherent sustainable strategies

			Levers		
Strategy	Targeted companies	Themes	Exclusion	Allocation	Shareholders engagement & field building
Sustainable	Companies whose behaviour and activities "do no harm" to any of the SDGs	All	**Covering all SDGs, based on revenues, physical metrics, controversies**	Optimising risk and return under exclusion constraints	Publication of exclusion list
Transition	Companies whose behaviour and activities "do harm" to certain SDGs, but where change is possible	Specific	**Companies not prioritised for engagement + Companies where engagement has failed**	Optimising risk and return under exclusion and sustainability exposure (min./max. share of "transition companies") constraints	Systematically engaging on issues related to the specific theme chosen. Publication of targets, engagement outputs, and exclusion lit
Solutions	Companies whose activities contribute positively to specific SDGs	Specific	**Covering all SDGs, based on revenues, physical metrics, controversies**	Optimising risk and return under exclusion and sustainability exposure (min. share of "positive contribution companies") constraints	Focusing on engagement related to activities (strategy, investments)
Ethical	Companies whose behaviour and activities are in line with ethical choices	All	**Based on subjective preferences**	Optimising risk and return under exclusion constraints	-

This table summarises four types of coherent sustainable strategies for equity portfolios. The "sustainable" strategy ambition is to ensure alignment of the portfolio's stocks with the original definition of sustainable development, i.e., to hold only stocks corresponding to companies that "do no harm" with regards to environmental and social issues. The "transition" strategy ambition is to transform companies that have a negative impact on certain environmental or social issues in order to make them sustainable. The "solutions" strategy ambition is to align a substantial part of the portfolio with solutions that address specific environmental or social issues, and to reinforce these positive contributions within companies. Finally, the "ethical" strategy ambition is to comply, for example, with religious or personal values.
Source: Bouchet and Safaee (2024)

From an extra-financial point of view, the exclusion lever presents several interesting effects. The main theoretical mechanism is that exclusion of a stock reduces the offer of capital for the corresponding company and causes a rise in its market-implied cost of equity capital, observed in a fall in share price.

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The excluded company will then have an incentive to reform its activity if the reform cost is lower than the share price loss[1] (Heinkel et al., 2001, Pástor et al., 2021 and De Angelis et al., 2022). The effects of exclusion are also indirect: Bergman (2018) highlights for example the effect in terms of public discourse shift over the low-carbon transition and Braungardt et al. (2019) show that the divestment movement has had positive effects on the development of effective climate policies. Bouchet and Safaee (2024) conclude that exclusion is relevant in three main situations: for consensus non-sustainable activities or behaviour such as human rights violations, for companies where other levers, in particular shareholder engagement, have failed, or when it is a moral imperative for investors.

Whatever the extra-financial motivation, asset-owners need to anticipate the financial impact of exclusion. However, the existing literature presents contradictory results. Capelle-Blancard and Monjon (2014) find for example that some exclusion screens reduce financial performance for 116 "socially responsible" mutual funds[2] over the period 2001-2007. These results at fund level are consistent with the results at stock level from Trinks and Scholtens (2017), who show that stocks involved in controversial activities[3] have higher risk-adjusted returns and that excluding them from a portfolio therefore reduces financial performance. On the other hand, Khajenouri and Schmidt (2021) find for example that ESG screened indices[4] have provided better risk-adjusted returns than their references over the period 2013-2020. This lack of consensus on the relation between exclusion and financial performance might be explained by differences in sample characteristics (region, period, size) and the diversity of exclusion criteria. This is supported by Plagge (2023), who shows that the direction of the financial impact of exclusions on portfolio returns depends on both the exclusion criteria and the region sample to which they are applied. More recently, Porteu de la Morandière et al. (2024) analysed the effects of exclusion on risks rather than short-term performance, arguing that the risk profile of a fund is responsible for its long-term performance, and should thus be a primary concern for asset owners. Focussing on a sample of sustainable funds according to the European Union (EU) sustainable finance disclosure regulation (SFDR), their results suggest that excluding climate-related controversial stocks would have a very limited impact on the tracking error, sector exposure or factor exposures of these funds.

Our study aims to extend the work of Porteu de la Morandière et al. (2024) on two levels. Firstly, the sample of the present study is not limited to sustainable financial instruments: we analyse a sample of 493 indices domiciled in Europe and the US including conventional and sustainable instruments. Secondly, the exclusion criteria are not limited to climate change-related activities. We consider three exclusion screens, with increasing impacts, that correspond to commonly found investment policies. The first screen, which we refer to as "consensus", involves consensus exclusion criteria; the second screen incorporates additional climate net criteria defined in the Paris-aligned benchmarks (PAB) standards; the third screen excludes stocks that contribute negatively to sustainable development goals (SDG).

We find that, on a sample of 128 European indices, screening can lead to exclusions ranging from about 10% to 60% of the weights depending on the screen, and on a sample of 365 American indices, screening can result in excluding approximately 20-70% of the weights. A naïve (pro rata) reallocation

1 - Bouchet and Safaee (2024) show however that this mechanism might be challenged by the fact companies might be able to finance their growth without being dependent on equity capital markets.
2 - More precisely, they find that financial performance is only affected by screens targeting certain activities. Screens related to behavior, such as controversies related to UN Global Compact and the Rights at Work principles, have no effect on performance.
3 - Defined as stocks of companies involved in the following activities: abortion, adult entertainment, alcohol, animal testing, contraceptives, controversial weapons, fur, gambling, genetic engineering, meat, nuclear power, pork, embryonic stem cells, and tobacco.
4 - These ESG screened indices exclude companies involved in controversial, civilian and nuclear weapons, tobacco, thermal coal and oil sands extraction, and companies that are not compliant with the United Nations Global Compact principles

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leads to a sample median tracking error between 0.9-4.7% depending on the screen and the sample region. As a rule of thumb, every 10% of excluded weights results in a tracking error increase of 1.5%. Sector deviations occur mainly in the "Energy" and "Utility" sectors. Exclusions also tend to increase exposure to the "profitability" factor, whereas exposure to "investment" and "value" factors is slightly reduced depending on the screen and the sample region. We then show that the reallocation method used to apply screens has a large impact on the resulting tracking error and factor deviations. The optimised reallocation method allows a median reduction of the tracking error between 0.3-1.6% depending on the screen and the sample region. With this reallocation method, every 10% of excluded weights results in a lower tracking error increase of 1.1%, and factor deviations are significantly reduced. Finally, we observe that the screening followed by a naïve reallocation leads systematically to an average reduction in the carbon intensity of the indices (up to 54% after the PAB screening on the US sample) while the screening followed by an optimised reallocation has no significant impact on carbon intensity reduction.

These results suggest that reducing the investment universe to build a sustainable index can lead to a relatively low impact on its financial risk profile, which can be further reduced with an optimised reallocation method. However, if the sustainable strategy of the index is to reduce its carbon intensity, the optimised reallocation should be constrained to reduce risk while maintaining maximum carbon intensity reduction.

2. Data and Model

2. Data and Model

Our analysis is based on a sample of 493 indices, to which we applied three ESG screens. For each screen, we analyse the tracking error between the screened and the initial index, the sector deviations and changes in exposure to risk factors using two reallocation methods: a naïve (pro-rata) allocation and an optimised reallocation. In order to optimise the reallocations and evaluate tracking errors, we use a covariance matrix estimated using stocks total returns over the past five years (December 2018 – December 2023).

2.1 Sample of Financial Instruments

Our sample is composed of 128 indices from developed Europe (that contain 208 equities in average) and 365 indices from the US (that contain 306 equities in average). This sample was constructed from an initial sample of 517 indices[5], from which we removed the indices with historical tracks of less than a year, the indices with more than 1% of their holdings in emerging countries, and the indices whose composition was not available or accounted for less than 85% of the capital invested.

2.2 Environmental, Social, and Governance Screens

We define three ESG screens to take account of the heterogeneity of the exclusion strategies implemented by investors.

The "Consensus" screen is based on an analysis of the exclusion policies of the world's 100 largest asset owners (methodology available in Appendix). This analysis resulted in a set of four criteria most frequently used by asset owners that define the screen: the controversial weapons industry, the tobacco industry, the coal industry and controversies related to the United Nations Global Compact (UNGC) 10 principles[6].

The PAB screen is based on the minimum standards[7] that define EU Climate Transition Benchmarks and Paris-aligned Benchmarks. In addition to minimum reduction of greenhouse gas intensity (not considered in this article), these standards define exclusion criteria related to climate change (coal and fossil fuels industries) and to sustainable development (tobacco and controversial weapons industries, controversies related to the UNGC principles (methodology available in Appendix).

Finally, the "sustainable development goals" or SDG screen is based on the United Nations sustainable development goals framework adopted in 2015. This framework consists of 17 goals and 169 targets to be achieved by 2030, covering social, environmental, and economic issues. The exclusion criteria of the corresponding screen cover any activities or behaviour that would hinder the achievement of these goals and targets (methodology available in Appendix).

2.3 Risk Metrics and Sustainability Indicator

The impact of exclusions on the indices' risk profile is assessed with several risk metrics: the estimate of the tracking error between the screened and the initial portfolio, sectors deviations, and deviations in exposure to the financial risk factors developed by Fama and French (2015) including momentum

5 - We approximate the indices compositions by using those of physical ETFs that closely track them (annualised tracking error < 5-10 bps)
6 - The ten principles are available at: https://unglobalcompact.org/what-is-gc/mission/principles.
7 - Commission Delegated Regulation (EU) 2020/1818.

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as an additional factor to the five traditional factors. On the extra-financial dimension, we analyse the impact of exclusions on the portfolio weighted average carbon intensity.

2.4 Naïve and Optimised Reallocation

We apply two methods to reallocate the weights of the excluded stocks. First, the naïve method corresponds to a pro-rata reweighting of the index remaining stocks[8]. This method assumes that an investment manager sells the controversial equities and reinvests the proceedings in the remaining equities proportionally to their initial weight.

Second, the optimised method relies on a tracking error minimisation between the original portfolio w_{old} and the new portfolio w_{new}. The reallocation is the solution to the minimisation program:

$$w_{new} = argmin_w \, (w - w_{old})^T \Omega (w - w_{old})$$

where the covariance matrix (Ω) is the same sample covariance matrix normalised with the methodology proposed by Ledoit and Wolf (2003) that we use to measure the ex-post tracking error[9]. Portfolios are long-only and their budget constraint is set so that the old and new portfolio have the same amount of capital invested. The resulting portfolios correspond to the action of an investment manager who would sell the controversial equities and reinvest the proceeds in a way that reduces the impact of the exclusions on the risk of the portfolio. It will therefore favour re-investments in stocks with risk profiles as close as possible to the excluded ones.

8 -During this reallocation, however, we keep the equity portion of the fund constant, so that the tracking errors and factor exposures are consistent to the indices behaviour. If, for example, a fund has 85% equity and 15% has to be excluded, this 15% will be distributed in proportion to the remaining 70% of equity stocks, but in such a way that the sum of equity is still equal to 85%.
9 - All prices are in US dollars.

3. Results

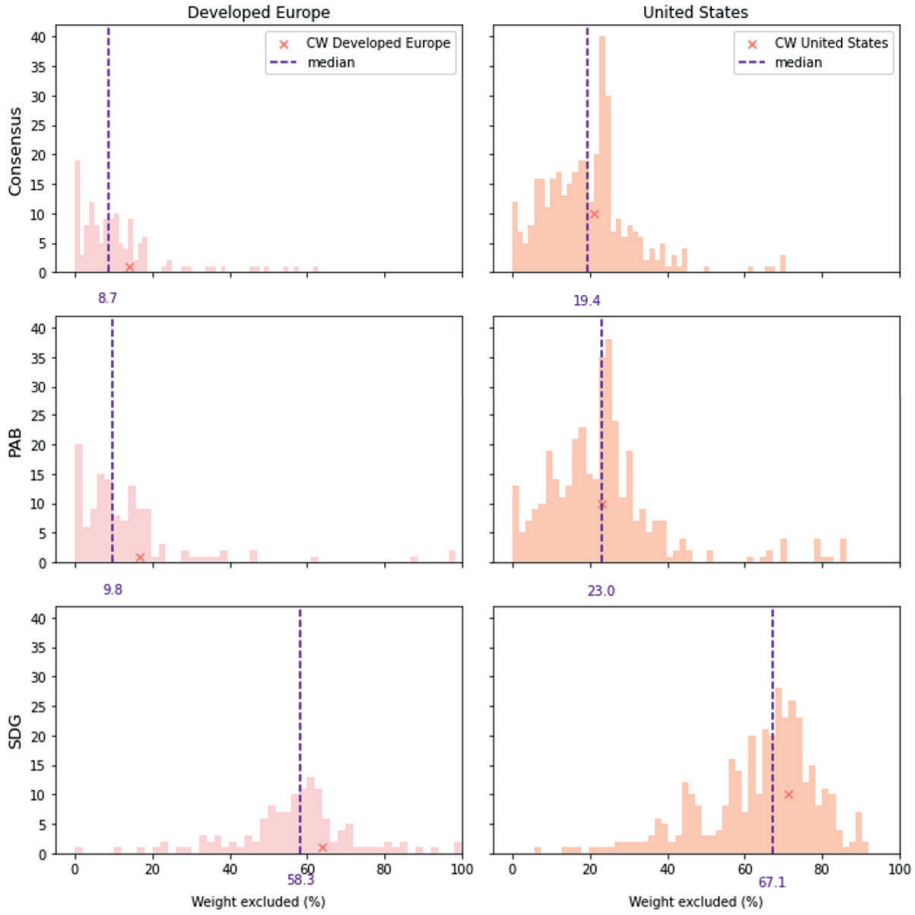
3. Results

In this section, we first present the impact of the three screens in terms of excluded weights within the indices. We then present the impact of these exclusions on the risk profile of indices in terms of tracking error, sector deviation, factor exposure using a naïve reallocation. We then show that these impacts can be reduced by using an optimised reallocation. Finally, we show the variable impact of exclusions on the carbon intensity of indices depending on the reallocation method.

3.1 Excluded Weight of the Indices

The impact on the indices in terms of excluded weight depends on both the region (Developed Europe, US), and the screens (Consensus, PAB, SDG). For Developed Europe indices, the Consensus and PAB screens have similar impact (median excluded weight around 9%) while the SDG screen have a much larger impact (median excluded weight of 58%). For US indices, the impact of the Consensus and the PAB screens are twice as large as for Developed Europe indices (median excluded weight around 20%) while the impact of the SDG screen is similar (median excluded weight of 67%) (Exhibit 2).

Exhibit 2: Distribution of indices weight excluded by screen and region



Source: Authors' calculation. The red marks represent the reference index for each region. For Developed Europe, it consists of the 410 largest companies weighted by their capitalisation. For the US, it consists of the 500 largest companies weighted by their capitalisation.

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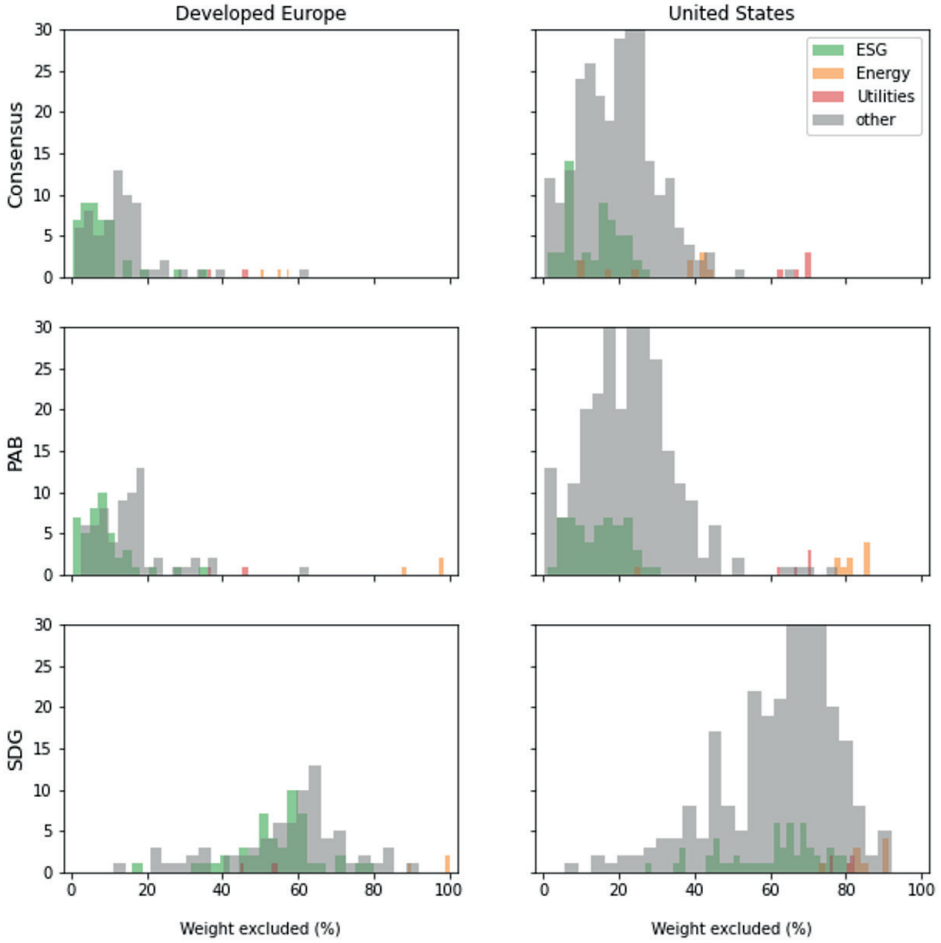
The impact also depends on the initial thematic of the index (ESG, Energy, Utilities, or other) (See Exhibit J in Appendix for initial indices thematics repartition). Whatever the region, indices targeting the Energy or Utilities sectors are on average more affected than the rest of the indices by the Consensus and PAB screens. This can be explained by the importance of exclusion criteria related to fossil fuels in these two screens (Exhibit A in Appendix). Conversely, ESG indices are on average less impacted by these two screens than the rest of the sample. By contrast, the impact of the SDG screen does not depend on the thematic of index: ESG indices do not have less weight excluded by the SDG screen than other indices. This might be explained by the fact that most of the current exclusion strategies, including those of ESG indices, do not cover all the sustainable development goals and targets (Exhibit 3).

Exhibit 3: Distribution of indices weight excluded by screen, region, and type



Source: Authors' calculation. The index themes shown in this graph are based on their names exclusively. The ESG thematic includes all names with the words (or abbreviations): "ESG", "screen", "climate", "transition", "change", "SRI", "PAB", "sustainability".

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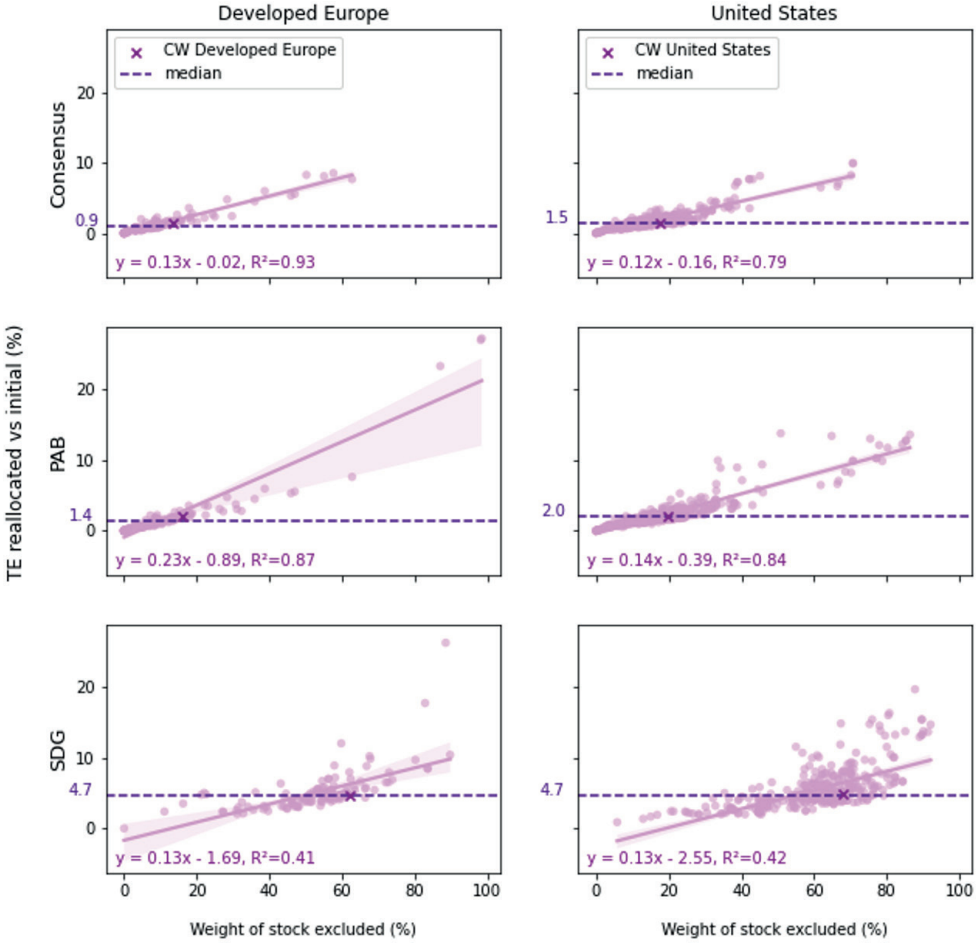
3.2 Impact of Exclusions on the Risk Profile of Indices with Naïve Reallocation

The exclusion of stocks from the indices followed by a naïve reallocation leads to a tracking error relative to the initial indices. For Developed Europe indices, the median tracking error is 0.9% for the Consensus screen and reaches 4.7% for the SDG screen. As the excluded weights are on average larger for US than for Developed Europe indices, the impact on tracking error is also more important: the median tracking error varies between 1.5% (Consensus screen) and 4.7% (SDG screen) for US indices. Whatever the region or screen, the relationship between excluded weight and tracking error is increasing and relatively linear. An addition of 10% in excluded weight leads on average to an increase in tracking error of 1.5% (Exhibit 4).

Exhibit 4: Impact of exclusions on the tracking error between the screened and original index portfolio (naïve reallocation)



Note: Tracking Errors of reallocated indices versus initial indices are calculated using a sample covariance matrix normalised with the methodology proposed by Ledoit and Wolf (2003).

As for the index tracking error relative to the regional cap-weighted benchmark, the impact of exclusions is more uncertain. The median increase in tracking error is 0.2% for the Consensus screen (for both Developed Europe and US indices) and reaches 2.3% for the SDG screen for Developed Europe indices

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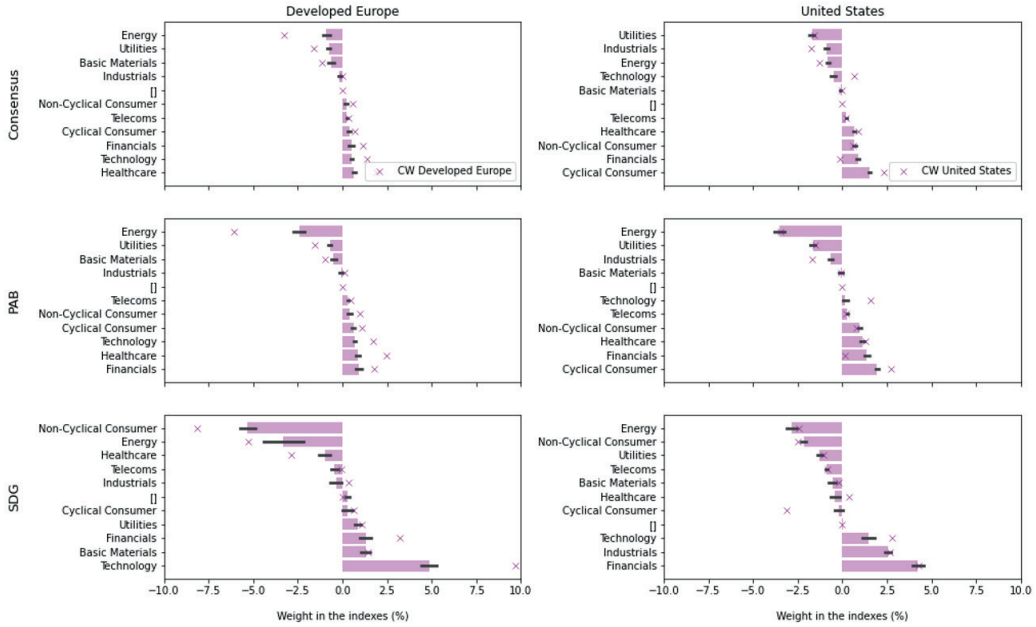
(but "only" 1.7% for US indices). Unlike the tracking error relative to the initial index, the relationship between the excluded weight and the difference in tracking error relative to the regional cap weighted benchmark is not significantly increasing (Exhibit D in Appendix). This might be explained by the large distribution of the initial tracking error of indices relative to their regional cap weighted benchmarks (Exhibit 5 and Exhibits E and K in Appendix).

The impact of exclusions on the tracking error, whether relative to the initial index or to the benchmark, can be explained by sector deviations, as well as deviations in exposure to traditional factors.

Regarding sector deviations, we observe that, whatever the regions and the screens, the Energy and Utilities sectors are always among those with the most important negative deviations. The SDG screening also results in an important negative deviation for the Non-cyclical Consumer sector in both regions (Exhibit 5). Deviations in the Energy and Utilities sectors are explained by coal and other fossil-fuels related exclusion criteria while deviations on the Non-Cyclical Consumer sectors are explained by criteria: controversies related to the environment, human rights and business ethics, and companies involved in the Tobacco and Alcohol industries (Exhibit B in Appendix). However, the sector deviations do not present a linear relation with the total weight excluded. For Developed Europe indices for example, the median excluded weight with the PAB screen is 10% and the maximum median sector deviation is 2.5% (Energy sector), while for the SDG screen, the median excluded weight is 60% and the maximum median sector deviation is "only" 5% (Non-Cyclical Consumer). Finally, the positive sector deviations are explained by the naïve reallocation method. The sectors with the highest initial weight (Exhibit F in Appendix) are those with the largest positive deviations (Exhibit B in Appendix).

Exhibit 5: Impact of exclusions on sector deviations after naïve reallocation



Note: The purple bars represent the distribution mean. Black bars represent the standard error of the mean. The standard error of the mean equals the standard deviation divided by the square root of the sample sise. In other words, the standard error of the mean is a measure of the dispersion of sample means around the population mean.

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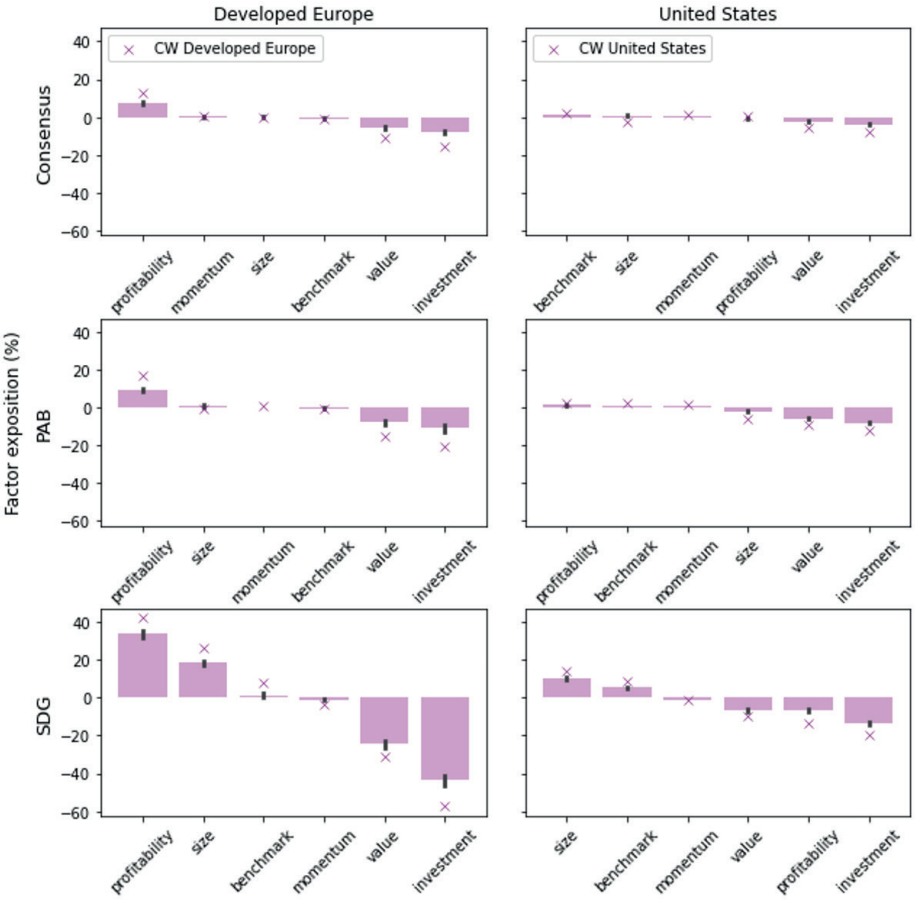
Regarding factor exposure, exclusions tend to increase exposure to higher "profitability" stocks, and to reduce exposure to "investment" and "value" stocks, whatever the region and the screen (Exhibit 6, Exhibit I in Appendix, see also Exhibit G in Appendix for initial indices' exposure to factors). Indeed, if we look at the factor exposure of the excluded stocks of the benchmark according to the different issues composing the three screens, we observe that there are more exposed to the "value" and "investment" factors than the overall index and have more negative exposures to the "profitability" factor than the overall index. Thus, the screened index gains exposure to the "profitability" factor and loses exposure to the "value" and "investment" factors (Exhibit C in Appendix). These results are consistent with Porteu de la Morandière et al. (2024). Also, they are statistically significant over the universe of funds considered (Exhibit H in Appendix), which means that the risk exposures resulting from exclusions are indeed very consistently affecting indices.

Exhibit 6: Impact of exclusions on factor deviations after naïve reallocation



Note: The purple bars represent the distribution mean, and black bars represent the standard error of the mean. The standard error of the mean equals the standard deviation divided by the square root of the sample size. In other words, the standard error of the mean is a measure of the dispersion of sample means around the population mean.

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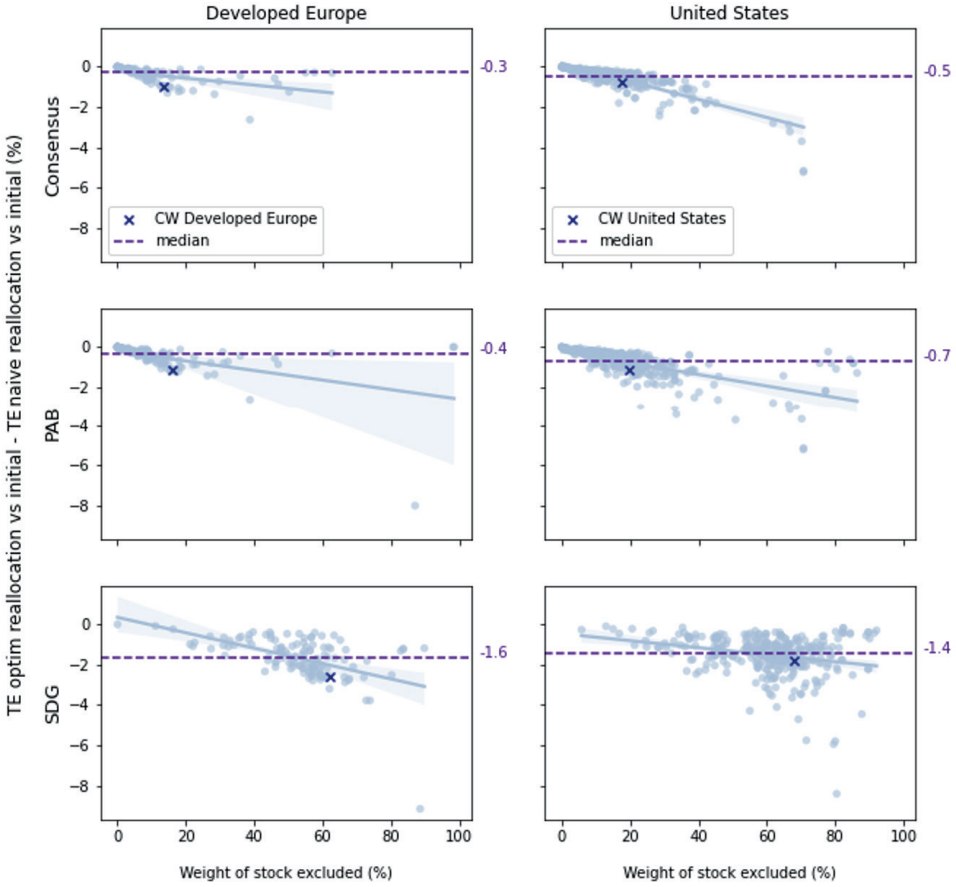
3.3 Impact of Exclusions on the Risk Profile of Indices with Optimised Reallocation

In the previous subsection, we have highlighted that the impact on the risk profile of the indices is relatively limited for the Consensus and PAB screens when using a naïve reallocation. The application of the Consensus screen results in a median tracking error of 0.9% for Developed Europe and 1.5% for the US. However, for some indices, such as indices with large allocation to sectors especially affected by exclusions, the tracking error can reach levels beyond 10%. For example, 2% of the Developed Europe and 3% of the US indices have a tracking error greater than 10% following the PAB screen. The impact of exclusions on the tracking error is also larger when using the SDG screen, for which the median tracking error is 4.7%. In this subsection, we run the same analysis but using the optimised reallocation method. We find that this reallocation method significantly reduces the tracking error and factor exposure deviations. However, it does not necessarily reduce sector deviations. The ability to materially reduce factor exposure deviations is a particularly welcome benefit of the optimised reallocation method. Indeed, applying analogous exclusion criteria, Plagge (2023) finds no significant alphas created by ESG exclusions in equity portfolios once Fama and French (2015) factor exposures are controlled for. Investors with a fiduciary duty may therefore find the optimised reallocation method more appealing to the extent it helps minimise the effects of ESG exclusions on long-term expected returns.

Exhibit 7: Reduction in tracking error between optimised and naïve reallocation



Note: The annualised tracking errors of reallocated indices versus initial indices calculated using a sample covariance matrix normalised with the methodology proposed by Ledoit and Wolf (2003).

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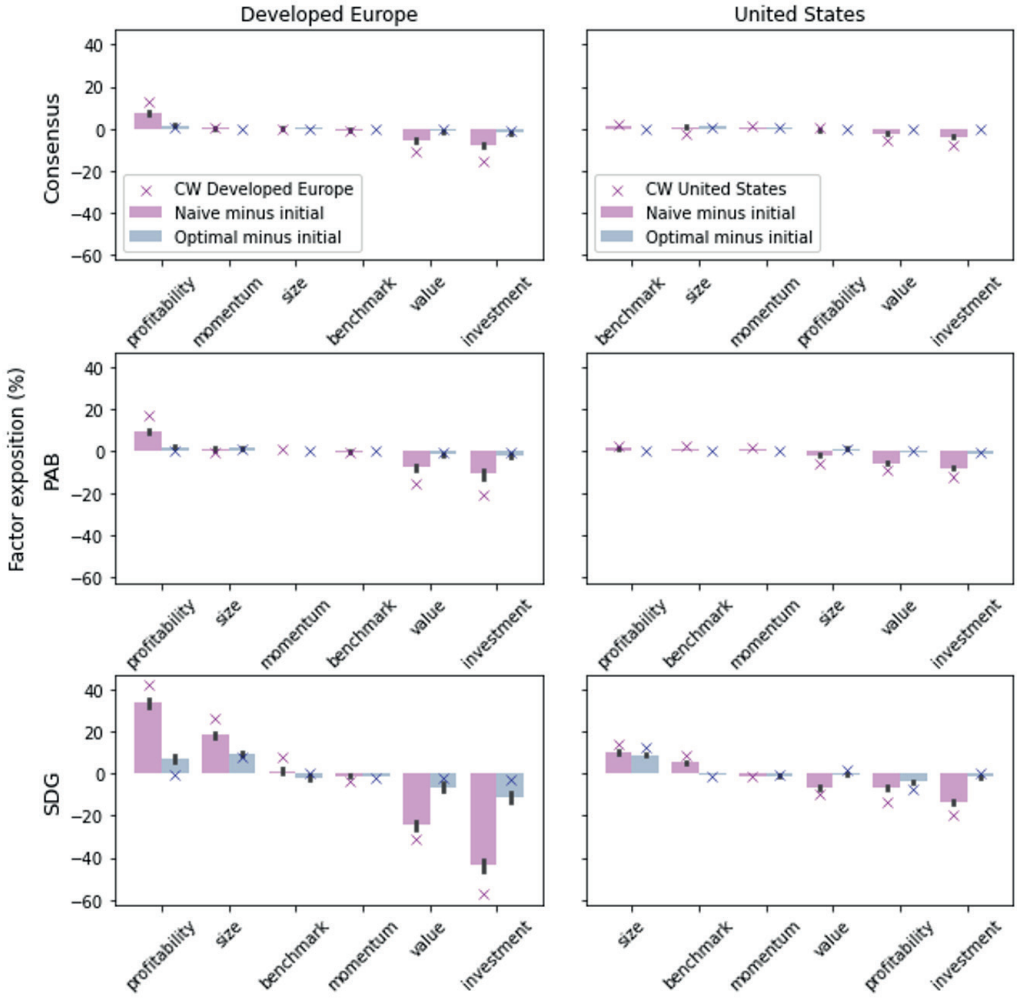
For Developed Europe indices, the optimised reallocation reduces the tracking error between -0.3%[10] (Consensus screen) and -1.6% (SDG screen) compared to the tracking error obtained with naïve reallocation (respectively -0.5% and -1.4% for the US indices, Exhibit 7) (See also Exhibit L and M in Appendix for more details). The coefficient of the relationship between excluded weight and tracking error is also reduced: an addition of 10% in excluded weight leads on average to an increase in tracking error of 1.2% versus 1.5% for the naïve reallocation. These tracking error reductions are mostly explained by reductions in factor exposure deviations (Exhibit 8). By contrast, sector deviations are not specifically reduced (Exhibit N in Appendix).

Exhibit 8: Reduction in factor deviation between optimised and naïve reallocation



Note: The black bars represent the standard error of the mean. The standard error of the mean equals the standard deviation divided by the square root of the sample size. In other words, the standard error of the mean is a measure of the dispersion of sample means around the population mean.

10 - Median.

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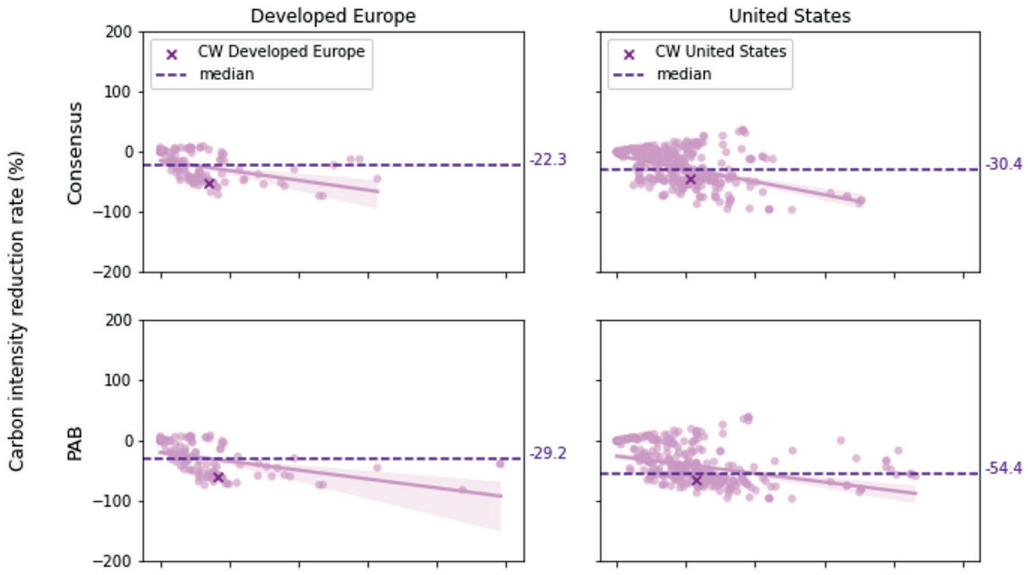
3.4 Impact of Exclusions on the Carbon Intensity of Indices

We have shown the impact of exclusions on the financial risk profile of portfolios, as well as an optimised reallocation method to limit this impact. In this subsection, we show that exclusions tend to reduce portfolio weighted average carbon intensity with naïve reallocation, but not necessarily with optimised reallocation.

The Consensus and PAB screens lead on average to a portfolio weighted average carbon intensity (carbon intensity thereafter) reduction when using a naïve reallocation, which is consistent with their coal and fossil fuels exclusion criteria. For Developed Europe indices, the carbon intensity is reduced by 22% with the Consensus screen, and by 29% with the PAB screen. For US indices, the carbon intensity reduction is even more pronounced (respectively 30% and 54%). This can be explained by the fact that these two screens exclude more weight in the US than in the Developed Europe indices. These reductions are however mostly explained by sector deviations (Energy and Utilities), which might not be the most efficient way to decarbonise indices (Bouchet, 2023). From the perspective of a "Transition" or "Solutions" investment strategy, this first lever of exclusion should therefore be supplemented by other allocation constraints designed to guarantee a minimum of sustainable exposure (Exhibit 1).

The SDG screen does not significantly contribute to carbon intensity reduction (Exhibit 9). This screen includes as many climate-related criteria as the PAB screen, but the fact that it also includes criteria related to social and governance issues (e.g. social controversies) means that companies with very low carbon intensities are also excluded. The resulting impact on the portfolio weighted average carbon intensity is therefore more variable depending on the index, and there is no significant trend towards a reduction in carbon intensity (Exhibit 9).

Exhibit 9: Reduction of the Carbon Footprint of screened indices after the naïve reallocation by the weight of stock excluded



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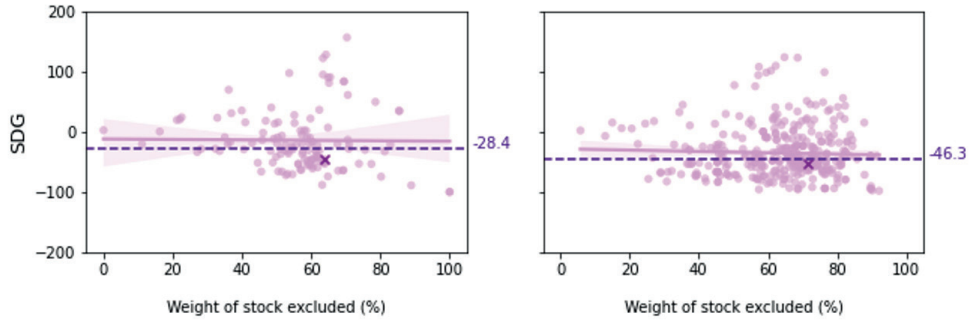

Note: The Carbon Footprint of one index is the weighted sum of the equities carbon footprint. One equity carbon footprint is calculated based on the company carbon emissions of scope 1 and 2 in relation to the enterprise value.

While optimised reallocation reduces the impact of exclusions on the financial risk profile of indices, it results in a smaller reduction in carbon intensity compared to naïve reallocation. For US indices with the Consensus screen for example, the carbon intensity is reduced by 30% on average with the naïve reallocation but only by 22% with the optimised reallocation (Exhibit O in Appendix). This effect can be explained by the fact that the optimised reallocation tends to replace excluded stocks by their closest equivalent in terms of risk profile. This differs from the naïve scheme that redistributes the excluded weights on the index largest capitalisation. In the US and in Developed Europe, the largest capitalisations are located in the Technology and Financials sectors, two sectors that have much lower carbon intensity than the benchmark average. Thus, we find an over-representation of more carbon-intensive sectors in the indices screened after optimised reallocation than after naïve reallocation. For example, 50% of the Developed Europe indices screened with the PAB screen followed by an optimised reallocation are more exposed to the Energy sector than these indices after a naïve reallocation (Exhibit N in Appendix).

4. Conclusion

4. Conclusion

Excluding stocks issued by companies involved in controversial activities is a common step in several sustainable investment strategies. However, asset-owners need to anticipate the financial impact of such exclusions. This article seeks to provide them with some answers and to contribute to the literature on the impact of ESG exclusions on financial risks (e.g. Capelle-Blancard and Monjon, 2014; Trinks and Scholtens, 2017; Khajenouri and Schmidt, 2021; Porteu de la Morandière et al., 2024).

First, we propose three exclusion screens with increasingly stringent criteria which can support different sustainable investment strategies: the "Consensus" screen based on the most common criteria used by asset owners; the "PAB" screen based on criteria defined in the EU PAB standards; the "SDG" screen based on criteria related to the 17 sustainable development goals defined by the United Nations.

Second, we analyse the impact of these exclusion screens on the tracking error (relative to the performance without exclusion), the sector allocation, the exposure to traditional risk factors, and the carbon intensity of 493 indices domiciled in Developed Europe and the US. This analysis is carried out twice, using two reallocation methods: a naïve method based on the initial weights, and an optimised method designed to minimise the tracking error.

We show that the three screens lead to very different excluded weights, ranging on average from about 10% to 70% depending on the screen and the sample region. A naïve reallocation leads to a sample median tracking error between 0.9% and 4.7%. Sector deviations occur mainly in the "Energy" and "Utility" sectors and exclusions tend to increase exposure to the "profitability" factor, whereas exposure to "investment" and "value" factors is slightly reduced. For the indices most affected, we show that an optimised reallocation can materially reduce both tracking error and factor exposure deviations. The ability to minimise factor deviations is, according to Plagge (2023), an effective way to control the effects of exclusions on expected returns, thus making the optimised reallocation more attractive to investors subject to fiduciary responsibilities. Finally, the screening followed by a naïve reallocation systematically leads to an average reduction in the carbon intensity of the indices while the screening followed by an optimised reallocation has no significant impact on carbon intensity reduction.

These results suggest that reducing the investment universe by applying exclusions either based on consensus criteria among institutional asset owners or based on climate net zero criteria can have a relatively low impact on the financial risk profile of indices and that this impact can be further reduced with an optimised reallocation method. However, if the goal is also to reduce its carbon intensity, the use of optimised reallocation needs to be made in conjunction with constraints to avoid an unwanted collateral effect. An interesting line of research would therefore be to investigate the impact of other sustainable constraints than exclusions, such as reducing emissions or financing solutions that contribute to achieving sustainable development goals, on the risk profile of indices.

Appendix

Appendix

1. Exclusion Screen Construction

1.1 Consensus screen

The "Consensus" screen is based on a review of the exclusion criteria most commonly used by asset owners. To identify these criteria, we systematically analysed the ESG policies of the world's 100 largest asset owners (AO) in terms of assets under management as of 2021 according to the Thinking Ahead Institute[11]. The identification of ESG policies of AOs was carried out in the following way. First, we used different keyword combinations on a search engine (Table 1) and reviewed the first 5 links proposed, leading to the identification of 38 policies. When no document was found in this way, we searched the official AO website for an ESG policy, leading to the identification of 29 additional policies. For 33 AOs, no ESG policy was found.

Table 1: Asset owners ESG policies research

Number of asset owners analysed	100
Step 1: Analysis of the five results for the search of the following keywords on a search engine	38
"(AO name) + ESG + exclusion + policy"	31
"(AO name) + ESG + exclusion + list + policy"	2
"(AO name) + ESG + policy"	2
"(AO name) + exclusion + policy"	1
"(AO name) + pension + ESG + policy"	1
"(AO name) + Pension Fund + ESG + exclusion + policy"	1
Step 2: Search of an official statement in the AO's website	29
AO's main website	28
AO's other website	1
Nothing found	33

Out of the 67 ESG policies identified, 37 include criteria for exclusion. Within these 37 exclusion policies we have identified 11 different exclusion criteria (Table 2) and the criteria most frequently included are controversial weapons (24 AOs), tobacco (22 AOs) and coal (19 AOs).

Table 2: Criteria found in the asset owners exclusion policies

Criteria	Number of exclusion policies including the criteria
Controversial Weapons*	**24**
Tobacco*	**22**
Coal*	**19**
Fossil Fuels (unconventional or conventional)	17
Controversial countries: Human rights violating countries, Public Sanction Lists, Corruption, Tax heaven, right in war and conflict	9
Social: Human rights, Labor rights, Modern Slavery, other ethical norms, **business ethics***	8
Environment: Environment, Polluting energy facilities, waste management, fossil fuels (unspecified), nuclear power, housing sector	6
Ethic: Gambling, Adult content, Alcohol, Recreational drugs	5
Military: Civilian Weapons, militaries activities, military equipment and activities	5
Farming: Industrial agriculture and livestock practices	2

**Criteria included in the "Consensus" screen.*

11 - Thinking Ahead Institute is a global not-for-profit research and innovation group formed in 2015 whose aim is to mobilise capital for a sustainable future. The list of the 100 asset owners, AUM of the top 100 asset owners, which represent more than USD23.5 trillion at the end 2020, is available at : https://www.thinkingaheadinstitute.org/research-papers/the-asset-owner-100-2021

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For the three most frequent criteria, we also analysed the associated exclusion thresholds. In most exclusion policies, however, these thresholds are not specified (Table 3).

Table 3: Thresholds found in the asset owners exclusion policies

Criteria / threshold	Number of exclusion policies with threshold
Controversial Weapons	24
not specified	23
20% (holdings), 50% (held)	1
Tobacco	22
not specified	20
5% (revenues)	1
50% (revenues)	1
Coal	19
not specified	9
5%	1
5% (revenues)	2
5% (revenues) or 10,000 MW or 20 Mt coal / year (mining)	1
10% (revenues)	1
10% (revenues) or 10 Mt or 10 GW	1
25% (revenues)	2
30% (revenues), 30 % (OPEX), 20 Mt coal / year, 10,000 MW	1
10% (revenues) or 0.3GtCO2	1

Based on this analysis, the "Consensus" screen includes companies that are involved in activities related to controversial weapons, tobacco and coal[12]. The "Consensus" screen also includes companies that do not comply with the UN Global Compact principles[13]. We assume that this referential might be less mentioned in exclusion policies because government regulations prohibiting investment in these companies may already be established in some countries.

Table 4: Criteria and thresholds of the "Consensus" screen

Criteria	Threshold
Controversial Weapons manufacturing*	Involvement
Tobacco industry*	Revenue > 5%
Coal industry*	Revenue > 5%
Controversy concerning a violation of UN Global Compact Principles*	Severity level of the controversy above the level "Critical" ***

**Data provider: Moody's.*
****The controversies severity levels are ordered in a range of four levels: "Minor", "Significant", "High" and "Critical".*

1.2 Paris-Aligned Benchmark Screen

The PAB screen is based on minimum standards for EU Climate Transition Benchmarks and EU Paris-aligned Benchmarks[14]. More specifically, the screen is based on the exclusion criteria defined in Article 12 of the Delegated Regulation 2020/1818:

12 - Despite relatively frequent, we have decided not to include companies involved in activities related to fossil fuels, as the scope of these activities is not sufficiently precise in the exclusion policies analysed (e.g. conventional vs non-conventional fossil fuels).
13 - More information available at: https://unglobalcompact.org/what-is-gc/mission/principles
14 - Commission Delegated Regulation (EU) 2020/1818 of 17 July 2020 supplementing Regulation (EU) 2016/1011 of the European Parliament and of the Council.

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"Administrators of EU Paris-aligned Benchmarks shall exclude all of the following companies from those benchmarks:
(a) companies involved in any activities related to controversial weapons;
(b) companies involved in the cultivation and production of tobacco;
(c) companies that benchmark administrators find in violation of the United Nations Global Compact (UNGC) principles or the Organisation for Economic Cooperation and Development (OECD) Guidelines for Multinational Enterprises;
(d) companies that derive 1 % or more of their revenues from exploration, mining, extraction, distribution or refining of hard coal and lignite;
(e) companies that derive 10 % or more of their revenues from the exploration, extraction, distribution or refining of oil fuels;
(f) companies that derive 50 % or more of their revenues from the exploration, extraction, manufacturing or distribution of gaseous fuels;
(g) companies that derive 50 % or more of their revenues from electricity generation with a GHG intensity of more than 100 g CO_2 e/kWh."

The "PAB" screen includes all these criteria with their respective thresholds, except "*companies that derive 50 % or more of their revenues from electricity generation with a GHG intensity of more than 100 g CO2 e/kWh*" as we the data coverage for this criterion was insufficient.

Table 5: Criteria and thresholds of the PAB screen

Criteria	Threshold
Manufacturing of Controversial Weapons*	Involvement
Production or distribution of Tobacco*	Revenue > 5%
Controversy concerning a violation of UN Global Compact Principles*	Severity level of the controversy above the level "Critical" ***
Thermal coal industry (thermal coal mining, thermal coal mining power generation or coal fuelled power generation) *	Revenue > 1%
Coal in electricity fuel mix*	> 1%*
Extraction or refining of oil fuels**	Revenue > 10%
Extraction or refining of gaseous fuels**	Revenue > 50%

**Data provider: Moody's.*
***Data provider: ISS Energy and Extractives.*
****The controversies severity levels are ordered in a range of 4 levels: "Minor", "Significant", "High" and "Critical".*

1.3 SDG Screen

The Sustainable Development Goals or SDG screen includes all the criteria that could compromise the achievement of the United Nations (UN) SDGs. The SDGs are organised into three levels: 17 goals, 169 targets, and 254 indicators. To define the criteria included in the screen, we mapped, for each of the 169 targets, the activities or behaviour that might compromise their achievement[15]. For each target, we have tried to answer two questions:
1. Does this target concern companies? That is, can companies make a significant contribution (positive or negative) to achieving this target? This first step aimed to remove from our scope, especially targets that only concern public authorities. This first step results in 138 relevant targets for companies.

15 - The target level seems to be the most relevant for our framework: on the first hand, it is more precise than the 17 goals and allows investors to identify issues on which they can have a real effect; on the other hand, the 254 indicators are mainly macro indicators (e.g., number of countries) on which an investor might not have an impact.

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2. If the answer to the first question is yes, can a company, through its activity or behaviour, contribute negatively to this target? It did indeed appear to us that it was sometimes possible for companies to make a positive contribution but not a negative one. This first step results in 78 targets to which companies might have a negative contribution.

For each of the 78 remaining targets, we defined criteria related to company activities or behaviour that might compromise their achievement based on a review of the academic and institutional literature. For example, the link established between target 3.4 and the gambling industry is supported by Abbott (2020) who examines the attention given to gambling-related harm within a public health framework. This approach is intended to be as systematic and objective as possible but leaves room for our subjectivity. This depends in particular on whether or not the indirect effects of some activities and behaviour are considered. Indeed, the UN SDG framework emphasises the links between several goals and targets. It may therefore be tempting to consider that an issue that contributes negatively to one target has, in fact, indirect repercussions on many. For the sake of clarity, we have only considered direct impacts, especially if the activity or behaviour is already covered by another target (Table 4).

Table 6: Mapping between targets and the activities or behaviours that constitute the SDG screen

	Criteria (activity or behaviour)	Supporting literature and online resources
SDG 1		
Target 1.4	Controversy concerning predatory lending	Engel and McCoy (2021), Stein (2001), Renuart (2004).
SDG 2		
Target 2.4	Revenue from pesticides	European Commission – The EU framework for the sustainable use of pesticides, United States Environmental Protection Agency – Pesticide Science and Assessing Pesticide Risks.
SDG 3		
Target 3.4 Target 3.5	Revenue from tobacco, revenue from gambling Revenue from alcohol, revenue from cannabis	Tobacco: World Health Organization (2015), World Health Organization (2019), "STOP" (2019). Gambling: Abbott (2020). Alcohol: World Health Organization Regional Office for Europe (2020), Pan American Health Organization (2022). Cannabis: United Nations Office on Drugs and Crime (UNODC) (2019), UNODC (2022), Riboulet-Zemouli et al. (2019).
Target 3.9	Revenue from power coal generation, unconventional fossil fuels, oil, gas, pesticides, controversial and hazardous chemicals or controversies concerning pollution	Fossil Fuels: Daley and Lawrie (2022). Pesticides: European Commission – The EU framework for the sustainable use of pesticides, United States Environmental Protection Agency – Pesticide Science and Assessing Pesticide Risks Chemicals: World Health Organization Regional Office for Europe (2017), Strategic Approach to International Chemicals Management (United Nations Environment Programme). Chemicals and waste management: essential to achieving the Sustainable Development Goals. Pollution: World Health Organization – Air quality and health, UNESCO International Initiative on Water Quality – The global water quality challenge & SDGs.

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SDG 5		
Target 5.2	Revenue from adult entertainment	Wright et al. (2016), Bridges (2019).
SDG 6		
Target 6.1 Target 6.3	Controversy concerning water Revenue from pesticides or controversial and hazardous chemicals	Pesticides: European Commission – The EU framework for the sustainable use of pesticides, United States Environmental Protection Agency – Pesticide Science and Assessing Pesticide Risks. Chemicals: World Health Organization Regional Office for Europe (2017), Strategic Approach to International Chemicals Management (United Nations Environment Programme) – Chemicals and waste management: essential to achieving the Sustainable Development Goals.
SDG 7		
Target 7.2 Target 7.3 Target 7.b	Revenue from power coal generation, unconventional fossil fuels, oil, gas Controversy concerning energy consumption and green gas emissions Revenue from power coal generation, unconventional fossil fuels, oil, gas	Daley and Lawrie (2022). Zakari et al. (2022). Daley and Lawrie (2022).
SDG 8		
Target 8.3 Target 8.5 Target 8.7 Target 8.8	Controversy concerning anti-competition Controversy concerning labor rights violation, discrimination and remuneration Controversy concerning child and forced labour Controversy concerning labour rights violation14, discrimination and revenue from adult entertainment	Andreoni and Miola (2016), World Trade Organization (2018). Labor rights: International Labour Organization – Relevant SDG Targets related to Labour Standards. Discrimination: International Labour Organization – Relevant SDG Targets related to Gender Equality and Non-Discrimination. International Labour Organization, Relevant SDG Targets related to Forced Labour. Labor rights: International Labour Organization, Relevant SDG Targets related to Labour Standards. Discrimination: International Labour Organization, Relevant SDG Targets related to Gender Equality and Non-Discrimination. Adult Entertainment: Wright et al. (2016), Bridges (2019).
SDG 9		
Target 9.1 Target 9.4	Revenue from power coal generation, unconventional fossil fuels, oil, gas Revenue from power coal generation, unconventional fossil fuels, oil, gas	Daley and Lawrie (2022). Daley and Lawrie (2022).
SDG 10		
Target 10.2 Target 10.3	Controversy concerning discrimination Controversy concerning discrimination or remuneration	International Labour Organization – Relevant SDG Targets related to Gender Equality and Non-Discrimination. International Labour Organization – Relevant SDG Targets related to Gender Equality and Non-Discrimination.

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SDG 12		
Target 12.4	Revenue from pesticides or controversial and hazardous chemicals	Pesticides : European Commission – The EU framework for the sustainable use of pesticides – United States Environmental Protection Agency – Pesticide Science and Assessing Pesticide Risks. Chemicals: World Health Organization Regional Office for Europe (2017), Strategic Approach to International Chemicals Management (United Nations Environment Programme). Chemicals and waste management: essential to achieving the Sustainable Development Goals.
Target 12.5	Controversy concerning waste	United Nations Environment Programme – Sustainable Development Goals Waste Indicators.
SDG 13		
Target 13.2	Revenue from power coal generation, unconventional fossil fuels, oil, gas	Daley and Lawrie (2022).
SDG 14		
Target 14.2	Controversy concerning biodiversity footprint	Convention on Biological Diversity – Biodiversity and the 2030 Agenda for Sustainable Development.
SDG 15		
Target 15.3	Revenue from pesticides	European Commission – The EU framework for the sustainable use of pesticides, United States Environmental Protection Agency – Pesticide Science and Assessing Pesticide Risks.
Target 15.5	Revenue from pesticides or controversy concerning biodiversity footprint18	Pesticides : European Commission – The EU framework for the sustainable use of pesticides, United States Environmental Protection Agency – Pesticide Science and Assessing Pesticide Risks. Biodiversity footprint: Convention on Biological Diversity – Biodiversity and the 2030 Agenda for Sustainable Development.
SDG 16		
Target 16.1	Revenue from controversial weapons or civilian firearms or controversy concerning human rights violations	Controversial Weapons: United Nations Office for Disarmament Affairs – Disarmament and Sustainable Development, Moody's ESG – Controversial Weapons in focus : adapting to evolving norms and regulations. Civilian firearms: United Nations Human Rights Office of the High Commissioner – Arms and human rights, Patel et al. (2022)
Target 16.2	Controversy concerning child and forced labour or human rights violations	Child and forced labour: International Labour Organization – Relevant SDG Targets related to Forced Labour. Human rights: United Nations Human Rights Office of the High Commissioner (2015), Danish Institute for Human Rights – The Human Rights Guide to the Sustainable Development Goals, United Nations (1948).
Target 16.3	Controversy concerning labour rights violations, or human rights violations	Labor rights: International Labour Organization, Relevant SDG Targets related to Labour Standards. Human rights: United Nations Human Rights Office of the High Commissioner (2015), Danish Institute for Human Rights – The Human Rights Guide to the Sustainable Development Goals, United Nations (1948).

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Target 16.4	Controversy concerning corruption	Transparency International – Tracking corruption across the sustainable development goals.
Target 16.5	Controversy concerning anti-competition or corruption or lobbying	Anti-competition: Andreoni and Miola (2016), World Trade Organization (2018). Lobbying: Organization for Economic Co-operation and Development – Transparency and integrity in lobbying, Nest and Mullard (2021)
Target 16.6	Controversy concerning internal governance or corruption or lobbying	Corruption: Transparency International – Tracking corruption across the sustainable development goals. Lobbying: Organization for Economic Co-operation and Development– Transparency and integrity in lobbying, Nest and Mullard (2021)
Target 16.7	Controversy concerning internal governance or lobbying	Organization for Economic Co-operation and Development – Transparency and integrity in lobbying, Nest and Mullard (2021)
Target 16.10	Controversy concerning corruption or lobbying	Corruption: Transparency International – Tracking corruption across the sustainable development goals. Lobbying: Organization for Economic Co-operation and Development – Transparency and integrity in lobbying, Nest and Mullard (2021)
Target 16.b	Controversy concerning discrimination	International Labour Organization – Relevant SDG Targets related to Gender Equality and Non-Discrimination.
SDG 17		
Target 17.10	Controversy concerning anti-competition	Andreoni and Miola (2016), World Trade Organization (2018).
Target 17.17	Controversy concerning lobbying	Organization for Economic Co-operation and Development – Transparency and integrity in lobbying, Nest and Mullard (2021).

Table 7: Criteria and thresholds of the PAB screen

Criteria	Threshold
Manufacturing of Controversial Weapons*	Involvement
Production or sale of Civilian Firearms*	Revenue > 5%
Production or distribution of Alcohol*	Revenue > 5%
Tobacco industry*	Revenue > 5%
Cannabis industry*	Revenue > 5%
Production of controversial or restricted chemicals*	Involvement
Manufacturing or distribution of pesticides*	Revenue > 10%
Gambling operations or products*	Revenue > 5%
Pornography and Adult Entertainment services or facilitating access	Revenue > 3%
Controversy concerning a violation of UN Global Compact Principles*	Severity level of the controversy above the level "Critical"***
Thermal coal industry (thermal coal mining, thermal coal mining power generation or coal fuelled power generation)*	
Coal in electricity fuel mix*	> 1%*
Extraction or refining of oil fuels**	Revenue > 10%
Extraction or refining of gaseous fuels**	Revenue > 50%
Extraction or services of tar sands and oil shale*	Revenue > 5%
Alternative financial services subprime lending*	Revenue > 5%
High interest rate lending	Revenue > 5%

**Data provider: Moody's.*
***Data provider: ISS Energy and Extractives.*
****The controversies severity levels are ordered in a range of 4 levels: "Minor", "Significant", "High" and "Critical".*

Appendix

2. Additional Results

Exhibit A: Average proportion of the mean weight excluded relative to the issues Coal, Oil and Gas or other according to the index type

Exhibit B: Weight of the stocks in the cap-weighted index according to their sectors and the issues that exclude them

Exhibit C: Cap-weighted indices factors exposure of their stocks according to the issue that exclude them

Exhibit D: Impact of exclusions on the difference (a)-(b) between (a) the tracking error of the indices after naïve reallocation versus the regional benchmark, and (b) the tracking error of the original indices versus the regional benchmark

Exhibit E: Distribution of the initial indices TE (vs the Cap-Weighted regional index)

Exhibit F: Average sector repartition of the initial indices

Exhibit G: Average factor exposition of the initial indices

Exhibit H: Factors deviations after naïve reallocation (p-value)

Exhibit I: Average factor exposition of screened indices after the naïve reallocation

Exhibit J: Initial indices thematics repartition

Exhibit K: Initial tracking error relative to the weight excluded by the screens

Exhibit L: Tracking error of indices after optimised reallocation relative to the weight excluded after the application of the screens

Exhibit M: Zoom on the tracking error of indices after optimised reallocation relative to the weight excluded after the application of the screens

Exhibit N: Average sectors repartition of reallocated screened indices

Exhibit O: Reduction of the Carbon Footprint of screened indices after the naïve and the optimised reallocation by the weight of stock excluded

Exhibit P: Statistics on the Carbon Footprint of the stocks of the universe according to their exclusion issues

Appendix

Exhibit A: Average proportion of the mean weight excluded relative to the issues Coal, Oil and Gas or other according to the index type

			Coal	Oil & Gas	Environment related controversies	Tobacco & Alcohol	Other	Total weight excluded	Number of indices excluded
Developed Europe	Energy	Consensus	0	0	100	0	58	56	2
		PAB	0	100	57	0	33	98	2
		SDG	0	98	92	0	90	100	2
	Utilities	Consensus	100	0	0	0	0	43	3
		PAB	100	0	0	0	0	43	3
		SDG	84	0	14	0	32	51	3
	ESG	Consensus	59	0	11	3	35	8	44
		PAB	49	18	9	2	34	9	44
		SDG	7	3	39	8	86	54	48
	Other	Consensus	35	0	25	11	51	14	67
		PAB	27	21	21	10	53	16	67
		SDG	7	6	39	8	89	58	75
United States	Energy	Consensus	3	0	91	0	49	33	9
		PAB	3	89	38	0	23	76	9
		SDG	1	84	52	0	76	85	9
	Utilities	Consensus	94	0	0	0	9	68	5
		PAB	94	0	0	0	9	68	5
		SDG	81	0	41	0	14	79	5
	ESG	Consensus	7	0	15	0	83	14	56
		PAB	6	13	14	0	76	15	56
		SDG	2	3	23	1	94	61	56
	Other	Consensus	20	0	25	6	61	20	290
		PAB	17	19	20	4	56	23	290
		SDG	7	8	31	2	88	63	295

Note: This table shows the average proportion of the weight excluded by the different issues relative to the total weight excluded. Energy indices are particularly affected by PAB and SDG screens (European indices show 56% and 100% of excluded weight by PAB and SDG respectively, and US indices show 76% and 85% respectively). We observe that 100% and 98% of the weight excluded respectively by PAB and SDG screens for European indices and 89% and 84% respectively for US indices are explained by the oil & gas issue. Utilities indices are also very affected by the three screens (European indices show an average excluded weight of 43%, 43% and 51% respectively by PAB, Consensus and SDG and US indices show 68%, 68% 79% respectively). These exclusions are mainly explained by the coal issue that represents 100%, 100% and 84% resp. of the weight excluded in European indices and 94%, 94% and 81% in US indices. Thus, as explained in the result part, the energy and utilities indices show high average weight excluded explained mainly by the fossil fuels industry

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Appendix

Exhibit B: Weight of the stocks in the cap-weighted index according to their sectors and the issues that exclude them

(a) Cap-weighted Developed Europe index

		Weight excluded by the issue	Technology	Financials	Industrials	Healthcare	Cyclical Consumer	Energy	Non-Cyclical Consumer	Basic Materials	Utilities	Telecoms
SDG	Coal	5%	0.0%	0.0%	1.2%	0.0%	0.8%	0.6%	0.0%	0.9%	2.0%	0.0%
	Oil & Gas	6%	0.0%	0.0%	0.0%	0.0%	0.0%	5.6%	0.0%	0.0%	0.0%	0.0%
	Environment related controversies	27%	0.0%	8.0%	1.4%	0.7%	0.8%	5.9%	7.1%	2.3%	0.3%	0.7%
	Tobacco & Alcohol	6%	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%	3.5%	0.0%	0.0%	0.0%
	Controversial Weapons	2%	0.0%	0.0%	0.9%	0.5%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%
	Chemicals	8%	0.0%	0.0%	0.1%	0.2%	0.0%	5.8%	0.0%	1.8%	0.0%	0.0%
	Human Rights	33%	0.2%	6.5%	2.5%	4.0%	6.3%	5.0%	5.7%	1.4%	0.6%	0.8%
	Business Ethics	42%	2.1%	7.4%	5.6%	10.5%	3.6%	2.0%	8.0%	1.8%	0.1%	1.4%
	Other	1%	0.0%	0.0%	0.0%	0.5%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total		0%	18%	14%	17%	12%	7%	12%	6%	4%	2%

(b) Cap-weighted United States index

		Weight excluded by the issue	Technology	Financials	Industrials	Healthcare	Cyclical Consumer	Energy	Non-Cyclical Consumer	Basic Materials	Utilities	Telecoms
SDG	Coal	4%	0.0%	2.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	0.0%
	Oil & Gas	4%	0.0%	0.0%	0.0%	0.0%	0.0%	3.7%	0.0%	0.1%	0.0%	0.0%
	Environment related controversies	18%	0.4%	6.6%	1.8%	0.6%	1.0%	2.6%	2.8%	0.8%	0.8%	0.8%
	Tobacco & Alcohol	1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	0.1%	0.0%	0.0%
	Controversial Weapons	3%	0.1%	0.0%	2.8%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%
	Chemicals	7%	0.0%	2.6%	0.7%	0.6%	0.0%	2.4%	0.0%	0.9%	0.0%	0.0%
	Human Rights	49%	22.6%	6.2%	2.8%	2.5%	9.0%	2.1%	3.3%	0.4%	0.0%	0.8%
	Business Ethics	50%	25.2%	6.1%	0.7%	8.4%	4.2%	2.5%	1.5%	0.8%	0.2%	0.8%
	Other	0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%
	Total		38%	13%	8%	13%	13%	4%	6%	2%	2%	1%

Note: This table shows the weight of the stocks in the cap-weighted index according to their sectors and the issues that exclude them. Deviations in Utilities sector is explained by coal related exclusion criteria (2.0% for the Developed Europe index and 1.6% for the US index) and deviations in the Energy sector is explained by other fossil-fuels related exclusion criteria (5.6% for the Developed Europe index and 3.7% for the US index) or by environmental related controversies (5.9% for the Developed Europe index and 2.6% for the US index). Deviations on the Non-Cyclical Consumer sectors are explained by criteria: controversies related to the environment (7.1% for the Developed Europe index and 2.8% for the US index), human rights (5.7% for the Developed Europe index and 3.3% for the US index) and business ethics (8% for the Developed Europe index and 1.5% for the US index), and companies involved in the Tobacco and Alcohol industries (3.5% for the Developed Europe index and 0.8% for the US index).

Appendix

Exhibit C: Cap-weighted indices factors exposure of their stocks according to the issue that exclude them

(a) Developed Europe cap-weighted index								
		Weight excluded by the issue	benchmark	size	value	profitability	investment	momentum
Consensus	Coal	5%	115%	-4%	34%	-36%	45%	1%
	Oil & Gas							
	Environment related controversies	5%	106%	-20%	128%	-126%	190%	0%
	Tobacco & Alcohol	1%	63%	-46%	45%	-62%	117%	6%
	Controversial Weapons	1%	111%	-4%	63%	-77%	97%	-17%
	Chemicals							
	Human Rights related controversies	3%	105%	-15%	128%	-117%	191%	7%
	Business Ethics related controversies	4%	112%	-20%	69%	-90%	103%	-6%
	Other							
PAB	Coal	5%	115%	-4%	34%	-36%	45%	1%
	Oil & Gas	6%	100%	-23%	145%	-134%	204%	3%
	Environment related controversies	5%	106%	-20%	128%	-126%	190%	0%
	Tobacco & Alcohol	1%	63%	-46%	45%	-62%	117%	6%
	Controversial Weapons	2%	103%	-12%	55%	-72%	95%	-11%
	Chemicals							
	Human Rights related controversies	3%	105%	-15%	128%	-117%	191%	7%
	Business Ethics related controversies	4%	112%	-20%	69%	-90%	103%	-6%
	Other							
SDG	Coal	5%	115%	-4%	34%	-36%	45%	1%
	Oil & Gas	6%	100%	-23%	145%	-134%	204%	3%
	Environment related controversies	27%	99%	-34%	63%	-78%	103%	-2%
	Tobacco & Alcohol	6%	100%	-64%	-10%	23%	12%	1%
	Controversial Weapons	2%	103%	-12%	55%	-72%	95%	-11%
	Chemicals	8%	105%	-24%	106%	-94%	153%	1%
	Human Rights related controversies	33%	96%	-43%	36%	-40%	67%	2%
	Business Ethics related controversies	42%	91%	-41%	19%	-26%	47%	4%
	Other	1%	104%	-1%	0%	-26%	8%	1%
Index initial exposure			**95%**	**-22%**	**5%**	**-3%**	**16%**	**0%**

Appendix

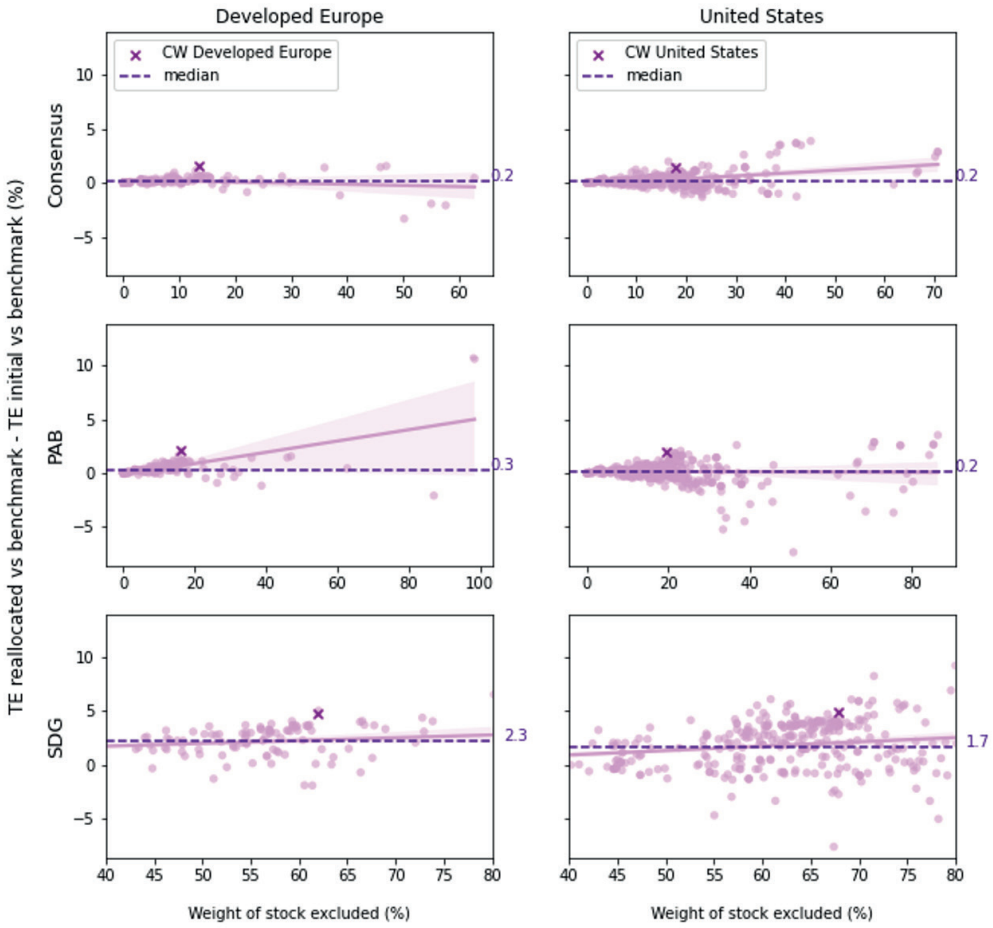
(b) US cap-weighted index								
		Average weight excluded by the issue	benchmark	size	value	profitability	investment	momentum
Consensus	Coal	4%	77%	-6%	34%	17%	58%	-6%
	Oil & Gas							
	Environment related controversies	5%	79%	27%	65%	0%	93%	-4%
	Tobacco & Alcohol	1%	60%	13%	47%	31%	82%	-3%
	Controversial Weapons	3%	89%	37%	50%	3%	73%	-7%
	Chemicals							
	Human Rights related controversies	7%	122%	-48%	-33%	10%	-53%	-12%
	Business Ethics related controversies	5%	90%	5%	35%	9%	56%	-6%
	Other							
PAB	Coal	4%	77%	-6%	34%	17%	58%	-6%
	Oil & Gas	4%	93%	91%	118%	-45%	153%	1%
	Environment related controversies	5%	79%	27%	65%	0%	93%	-4%
	Tobacco & Alcohol	1%	54%	5%	44%	34%	81%	-1%
	Controversial Weapons	3%	91%	40%	50%	2%	72%	-7%
	Chemicals							
	Human Rights related controversies	7%	122%	-48%	-33%	10%	-53%	-12%
	Business Ethics related controversies	5%	90%	5%	35%	9%	56%	-6%
	Other							
SDG	Coal	4%	77%	-6%	34%	17%	58%	-6%
	Oil & Gas	4%	93%	91%	118%	-45%	153%	1%
	Environment related controversies	18%	82%	17%	50%	8%	73%	-6%
	Tobacco & Alcohol	1%	65%	16%	43%	28%	74%	-5%
	Controversial Weapons	3%	91%	40%	50%	2%	72%	-7%
	Chemicals	7%	85%	28%	58%	-5%	81%	-4%
	Human Rights related controversies	49%	104%	-32%	-13%	21%	-14%	-1%
	Business Ethics related controversies	50%	102%	-36%	-9%	24%	-6%	0%
	Other	0%	110%	80%	43%	-39%	45%	-9%
Index initial exposure			**98%**	**-15%**	**-5%**	**12%**	**-3%**	**-1%**

Note: When excluded stocks tend to be more exposed to certain factors, the screened index will therefore be less exposed to that factor. We can see, for example, that the stocks in the European index excluded by the fossil fuel issue from the PAB screen are particularly more exposed to the "value" factor (145 vs. 5 for the index) and the "investment" factor (148 vs. 3 for the index), and are under-exposed to the "profitability" factor (-204 vs. 16). We therefore understand that, after the PAB screen, the index gains exposure to the " profitability" factor and loses exposure to the "value" and "investment" factors.

Average exposure above initial exposure
Average exposure below initial exposure

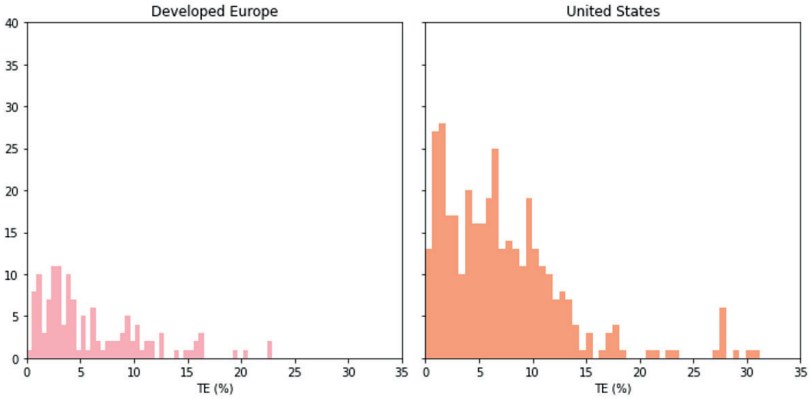
Appendix

Exhibit D: Impact of exclusions on the difference (a)-(b) between (a) the tracking error of the indices after naïve reallocation versus the regional benchmark, and (b) the tracking error of the original indices versus the regional benchmark



Note: The annualised tracking errors of the indices versus the regional cap-weighted benchmark are calculated using a sample covariance matrix normalised with the methodology proposed in Ledoit and Wolf (2003). These graphs show that the relationship between the excluded weight and the difference in tracking error relative to the regional cap weighted benchmark is not significantly increasing.

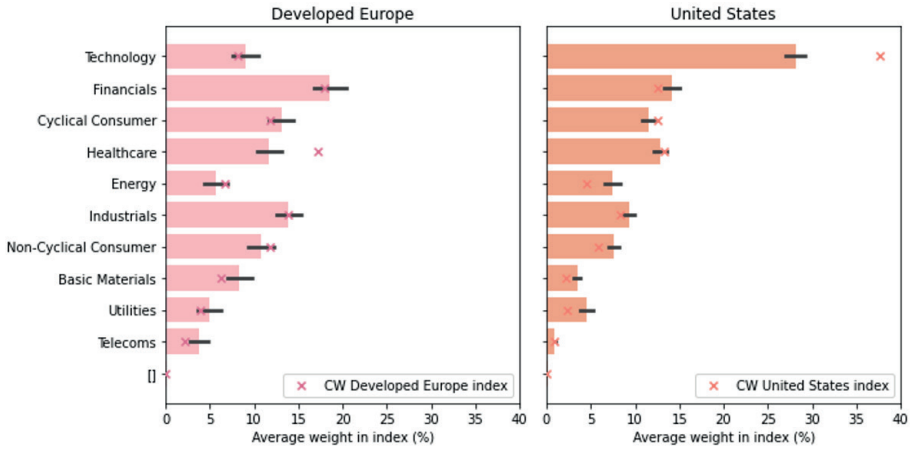
Exhibit E: Distribution of the initial indices TE (vs the Cap-Weighted regional index)



Note: Here, we are referring to the annualised Tracking Errors of the indices versus the regional cap-weighted index, calculated using a sample covariance matrix normalised with the methodology proposed in Ledoit and Wolf (2003). The distribution of TEs is fairly spread out, with 25% of European indices having a TE above 9.15% and 25% of US indices having a TE above 9.22%. On closer inspection, the 3 European indices and the 10 US indices with the highest TE are energy indices (based on their names).

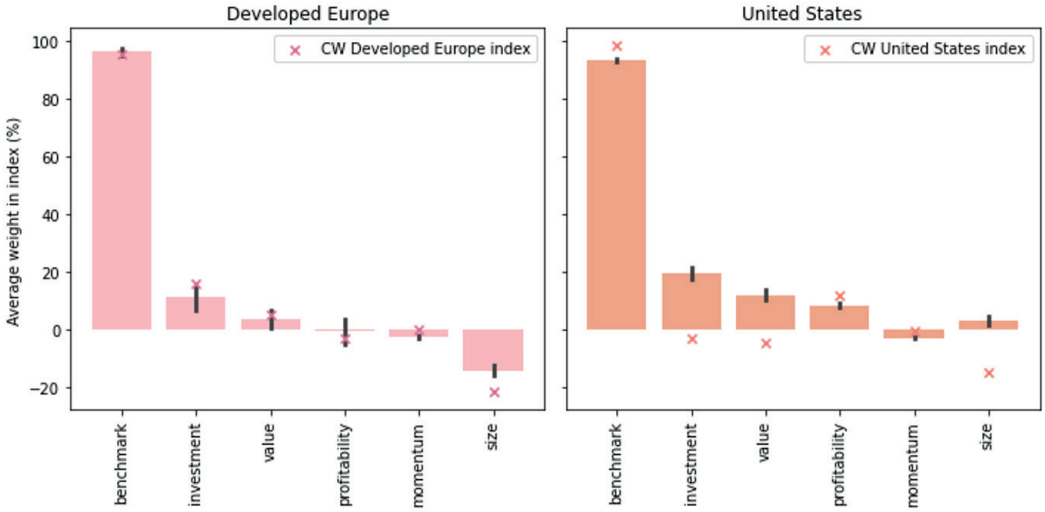
Appendix

Exhibit F: Average sector repartition of the initial indices



Note: The black bars represent the standard error of the mean. The standard error of the mean equals the standard deviation divided by the square root of the sample size. In other words, the standard error of the mean is a measure of the dispersion of sample means around the population mean. The European indices show a better distribution of companies in the different sectors with a slight overexposure in Financials (18.57%) in line with the CW Developed Europe Index. US indices have a rather uneven sector distribution, with an average overexposure to the Technologies sector (28%), in line with the CW index, where GAFAMs are over-represented.

Exhibit G: Average factor exposition of the initial indices



Note: The black bars represent the standard error of the mean. The standard error of the mean equals the standard deviation divided by the square root of the sample size. In other words, the standard error of the mean is a measure of the dispersion of sample means around the population mean. On average, indices have a very high exposure to the market (~93% both regions). US indices are more exposed to other factors (on average, "investment": 16.69%, "value": 16.11%, "profitability" -16.98%) than European indices, and thus deviate more significantly from the CW US index factors exposition.

Appendix

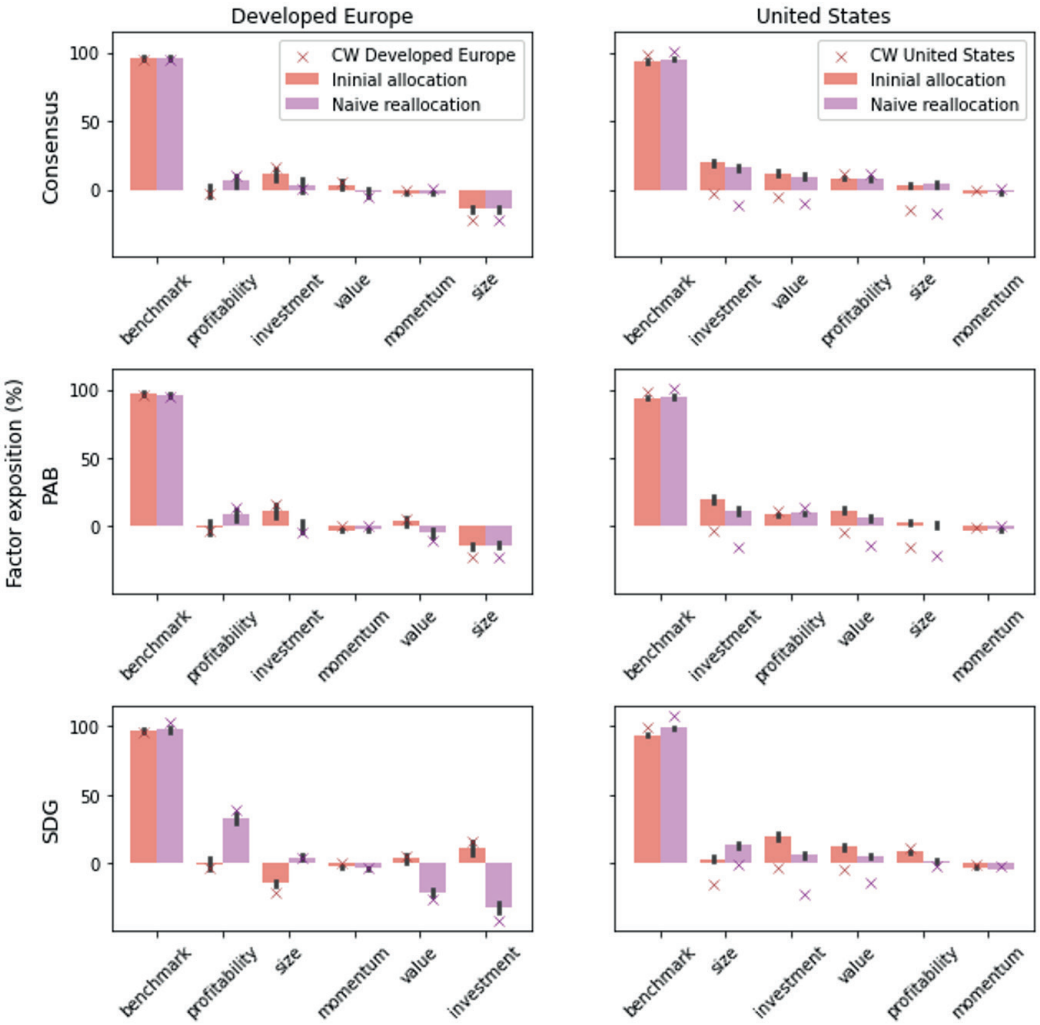
Exhibit H: Factors deviations after naïve reallocation (p-value)

		Developed Europe	United States
Consensus	benchmark	6.75E-04	3.06E-31
	size	0.55	7.83E-04
	value	1.51E-20	5.24E-27
	investment	1.86E-17	1.14E-49
	momentum	0.07	2.65E-24
	profitability	1.24E-21	2.99E-03
PAB	benchmark	0.07	3.47E-15
	size	0.36	3.24E-10
	value	3.31E-12	3.44E-52
	investment	8.55E-11	5.53E-63
	momentum	0.24	3.11E-10
	profitability	2.06E-17	1.55E-06
SDG	benchmark	0.38	1.19E-49
	size	9.81E-35	2.70E-39
	value	8.60E-25	9.77E-25
	investment	1.95E-31	1.08E-42
	momentum	3.60E-05	1.39E-17
	profitability	1.85E-34	1.66E-26

Note: The screening followed by a naïve reallocation leads to factor deviations that are statistically significant (p-value <0.05) for most of the case except on Developed Europe indices for the "benchmark" factor after PAB and SDG screenings and for the "size" and the "momentum" factors after Consensus and PAB screenings.

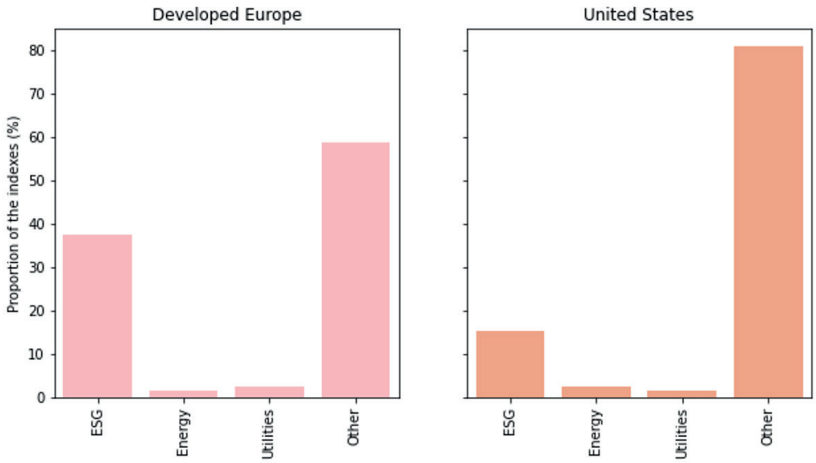
Appendix

Exhibit I: Average factor exposition of screened indices after the naïve reallocation



Note: The black bars represent the standard error of the mean. The standard error of the mean equals the standard deviation divided by the square root of the sample size. In other words, the standard error of the mean is a measure of the dispersion of sample means around the population mean.

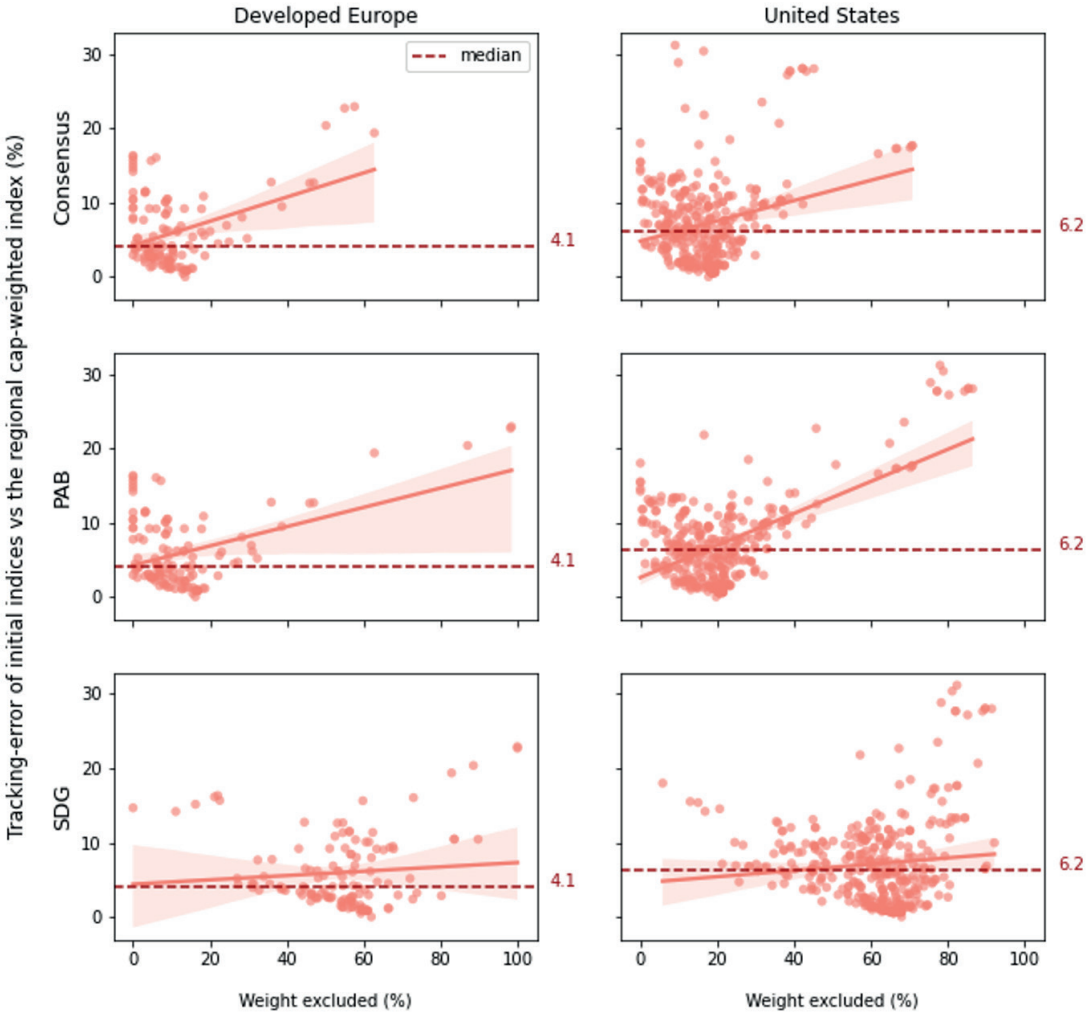
Exhibit J: Initial indices thematics repartition



Note: Among the indices sample, ESG thematic indices represent 37.5% of the Developed Europe indices and 15.3% of the US indices. Energy and Utilities thematic indices represent 1.6% and 2.3% respectively of the Developed Europe indices and 2.5%% and 1.4% respectively of the US indices.

Appendix

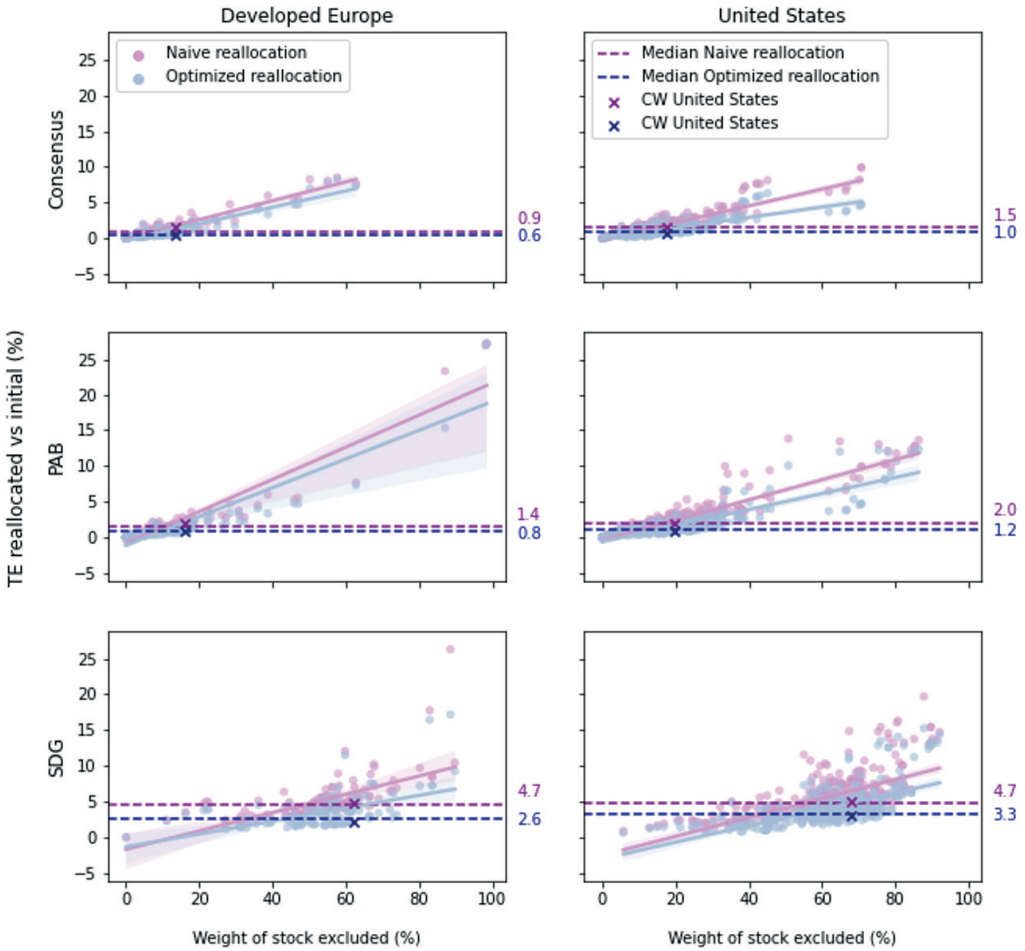
Exhibit K: Initial tracking error relative to the weight excluded by the screens



Note: Here, we are referring to the annualised Tracking Errors of the indices versus the regional cap-weighted index, calculated using a sample covariance matrix normalised with the methodology proposed in Ledoit and Wolf (2003). In the case of the PAB and Consensus screens, there appears to be a positive correlation between the indices initial TE vs the CW index and the weight excluded by these screens. However, it seems that this is mainly driven by indices with high excluded weight values, which is consistent considering that, as previously observed, indices with the highest initial TE are primarily energy indices, mainly targeted by the two screens. For the SDG screen, no correlation can be established.

Appendix

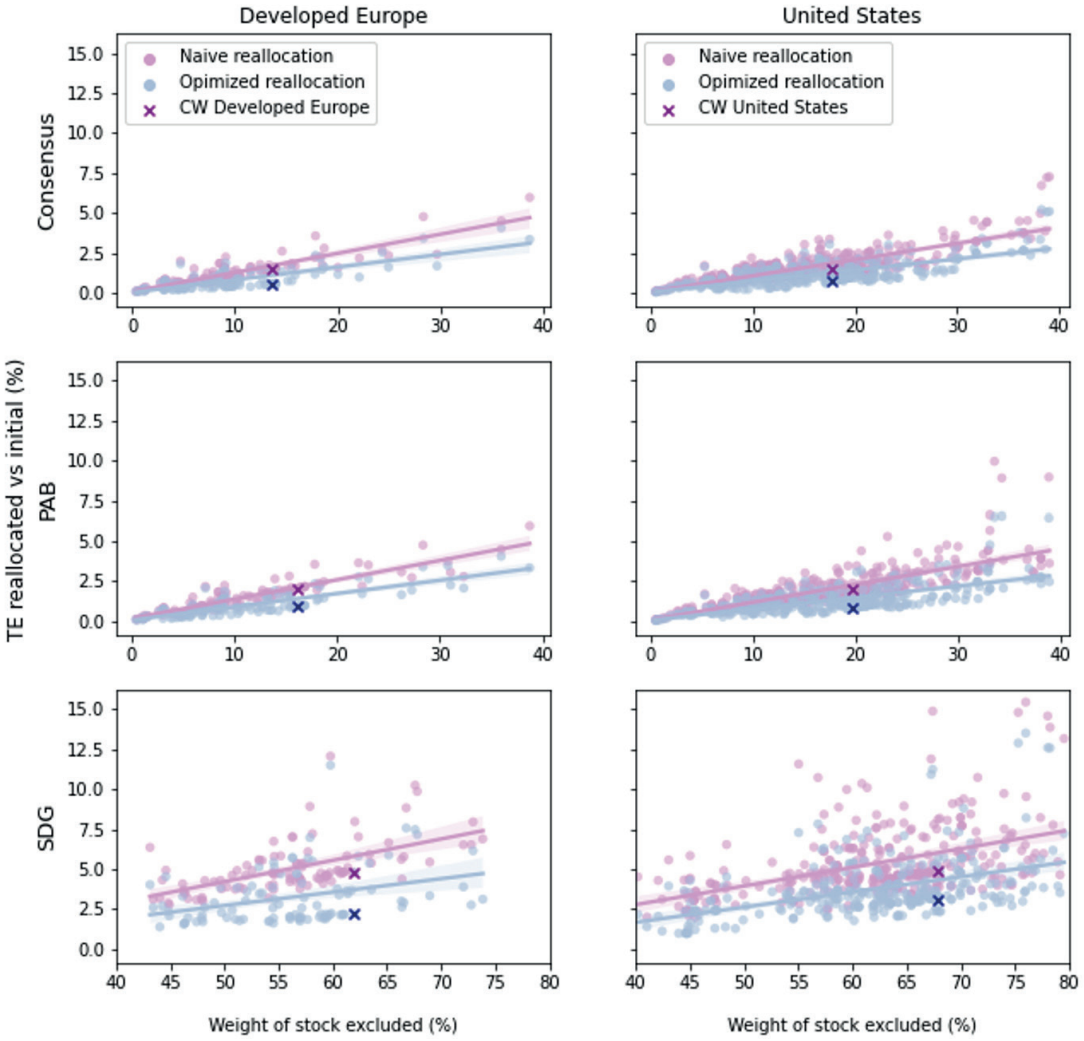
Exhibit L: Tracking error of indices after optimised reallocation relative to the weight excluded after the application of the screens



Note: Here, we are referring to the annualised Tracking Errors of the indices versus the regional cap-weighted index, calculated using a sample covariance matrix normalised with the methodology proposed in Ledoit and Wolf (2003)

Appendix

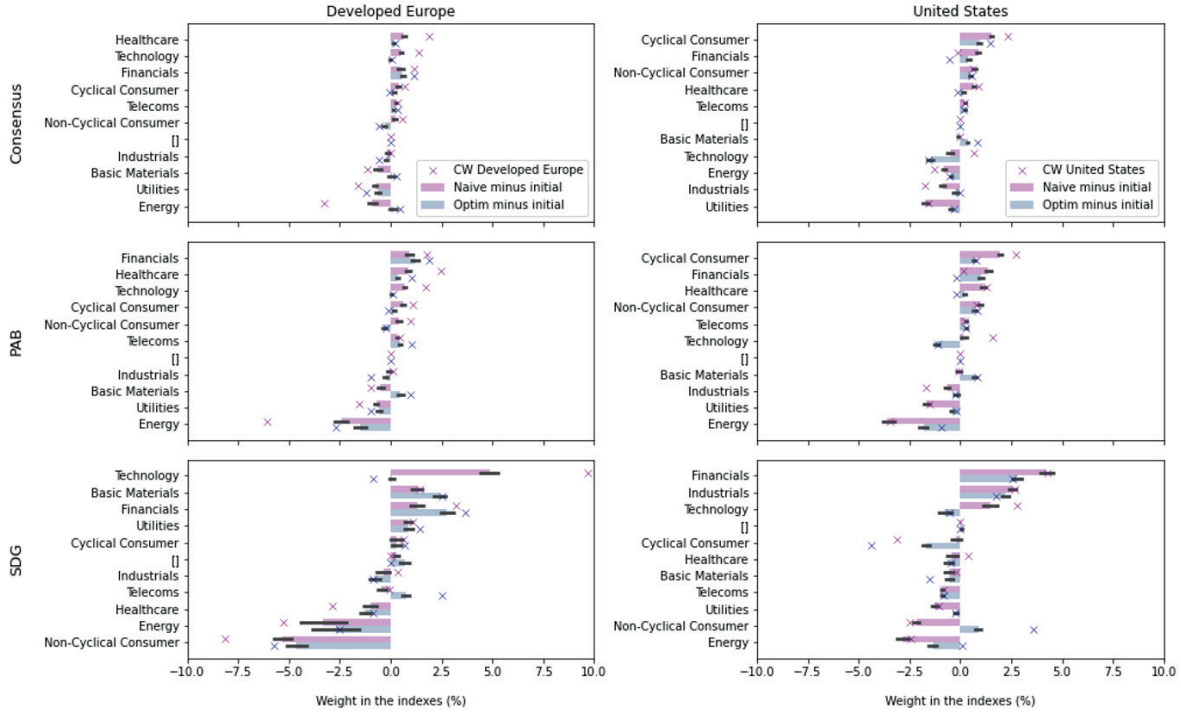
Exhibit M: Zoom on the tracking error of indices after optimised reallocation relative to the weight excluded after the application of the screens



Note: Here, we are referring to the annualised Tracking Errors of the indices versus the regional cap-weighted index, calculated using a sample covariance matrix normalised with the methodology proposed in Ledoit and Wolf (2003)

Appendix

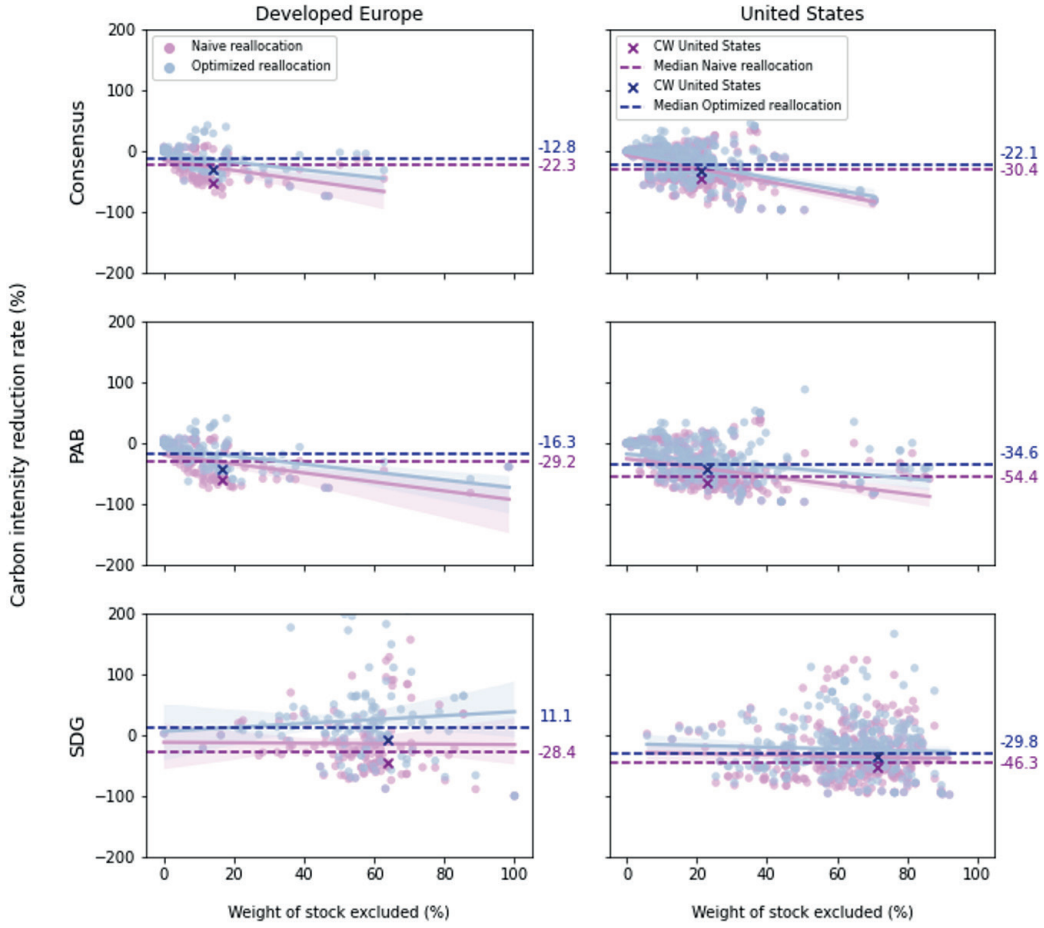
Exhibit N: Average sectors repartition of reallocated screened indices



Note: The black bars represent the standard error of the mean. The standard error of the mean equals the standard deviation divided by the square root of the sample size. In other words, the standard error of the mean is a measure of the dispersion of sample means around the population mean. Optimised reallocation does not reduce the sectors deviations.

Appendix

Exhibit O: Reduction of the carbon footprint of screened indices after the naïve and the optimised reallocation by the weight of stock excluded



Note: The carbon footprint of one index is the weighted sum of the equities carbon footprint. One equity carbon footprint is calculated based on the company carbon emissions of scope 1 and 2 in relation to the enterprise value. it results in a smaller reduction in carbon footprint compared to naïve reallocation. Optimised reallocation results in a smaller reduction in carbon footprint compared to naïve reallocation. For example, for US indices with the Consensus screen, the carbon footprint is reduced by 30% on average with the naïve reallocation but only by 22% with the optimised reallocation.

Appendix

Exhibit P: Statistics on the carbon footprint of the stocks of the universe according to their exclusion issues

(a) Stocks from Developed Europe indices											
		Developed Europe									
	Reason for exclusion	count	mean	std	min	10%	25%	50%	75%	90%	max
All equities of the sample		1500	82.2	329.1	0	0.2	0.9	5.1	24	175.1	4705.5
Equities excluded by Consensus	all	45	383.6	725.9	0	1	13.1	78.6	409.8	682	3574
	climate issue	23	565.4	842.5	0	20.2	78.7	316.7	572.8	1700.7	3574
	other issues	22	193.6	535.1	0	0.2	3.6	15.7	69.1	465.5	2486.2
Equities excluded by PAB	all	58	329.5	649.3	0	0.5	13.3	80.7	347	634.2	3574
	climate issue	36	431.7	699.5	0	11.7	65.1	232	443.8	676.8	3574
	other issues	22	162.4	530.7	0	0.2	3.6	13.5	40.2	221	2486.2
Equities excluded by SDG	all	254	131.9	378.5	0	0.2	1.5	10.8	78	350.7	3574
	climate issue	77	276.3	583.7	0	0	0.2	39.4	316.7	579.7	3574
	other issues	177	69	213.6	0	0.4	2.5	8.9	38.9	175.1	2341.4
(b) Stocks from US indices											
universe	Reason for exclusion	count	mean	std	min	10%	25%	50%	75%	90%	max
All equities of the sample		2777	65	259.3	0	0.5	1.4	4.5	21.6	132	4889.1
Equities excluded by Consensus	all	96	367.6	690.1	0	1	7.9	62.6	530.2	888.4	4292.1
	climate issue	48	688.4	861.5	0	28.4	176.8	511.4	745.2	1314	4292.1
	other issues	48	46.9	101.2	0	0.7	3.7	11.2	29.9	149.6	561.8
Equities excluded by PAB	all	132	331.3	598.7	0	1.9	12.4	110.7	452.5	724.2	4292.1
	climate issue	83	495.9	700.8	0	39.6	100.9	299.8	610.4	993.2	4292.1
	other issues	49	52.4	114.8	0	0.8	3.2	11.1	29.5	150	561.8
Equities excluded by SDG	all	365	155.6	403.6	0	0.2	1.6	15.6	132.5	488.6	4292.1
	climate issue	114	382.8	629.3	0	0.2	28.9	187.8	513.7	771	4292.1
	other issues	251	52.5	154.9	0	0.2	1.5	7.9	31.2	132.5	1902.4

Note: The Consensus and PAB screens exclude stocks based mainly on climate-related criteria and that are more carbon-intensive (23 out of 45 (resp. 36 out of 58) European stocks excluded due to climate issues with an average carbon footprint of 565 (resp. 431) by Consensus (resp. PAB) and 48 out of 96 (resp. 83 out of 132) US stocks excluded due to climate issues with an average carbon footprint of 688 tCO_2 / USDm (resp. 496 tCO2 / USDm) by Consensus (resp. PAB). The stocks excluded by SDG are mainly due to other issues that are less carbon-intensive (177 out of 254 European stocks excluded with an average footprint of 177 tCO_2 / USDm and 251 out of 365 US stocks excluded with an average footprint of 251 tCO_2 / USDm).

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- Bouchet, V., Porteu de la Morandière A., and Vaucher, B. Do Exclusions Have an Effect on the Risk Profile of Equity Portfolios? (September).
- Bouchet, V., Porteu de la Morandière A., and Vaucher, B. Do Climate-Related Exclusions Have an Effect on Portfolio Risk and Diversification? A Contribution to the Article 9 Funds Controversy (May).
- Bouchet, V., Safaee, S. Institutional Equity Portfolios: How Can Asset Owners Build Coherent Sustainable Strategies? (February).

2023 Publications

- Herzog, B., Jones, J., and Safaee, S. Remember to Diversify Your Active Risk: Evidence from US Equity ETFs (March).
- Bouchet, V. Decomposition of Greenhouse Gas Emissions Associated with an Equity Portfolio (May).
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