

## Article

# Long-Term Sustainable Investment for Retirement

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**Abstract:** We consider whether sustainable investment can deliver performance comparable to conventional investment in investors' long-term retirement plans. On the capital markets, sustainable investment can be achieved through various instruments and strategies, one of them being investment in mutual funds that subscribe to ESG (environmental, social, and governance) principles. First, we compare the investment performance of ESG funds with matched conventional funds over the period 1994–2020, in Europe and the U.S. We find no significant evidence of differing performance (at 5% level) despite using a number of investment performance metrics. Second, we perform a historical backtest to model a UK personal retirement plan from 2000 till 2020, taking full account of investment management fees and transaction costs. We find that investing in an index-tracker fund overlaid with ESG screening delivers a pension which is 10.4% larger than is achieved if the index-tracker fund is used without screening. This is also 20.2% larger than is achieved by investing in a collection of actively managed funds with a sustainable purpose. We conclude that an ESG-screened long-term passive investment approach for retirement plans is likely to be successful in satisfying the twin objectives of a secure retirement income and of sustainability.

**Keywords:** environmental; social and governance (ESG); ethical investment; socially responsible investment; performance evaluation



**Citation:** Owadally, I.; Mwizere, J.-R.; Kalidas, N.; Murugesu, K.; Kashif, M. Long-Term Sustainable Investment for Retirement. *Sustainability* **2021**, *13*, 5000. <https://doi.org/10.3390/su13095000>

Academic Editor: Fernando García

Received: 1 April 2021  
Accepted: 26 April 2021  
Published: 29 April 2021

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## 1. Introduction

Sustainable investment is an investment approach that focuses on environmental, social, governance (ESG) and values-based considerations when making investment decisions. This is becoming increasingly important to investors. Assets under sustainable investment worldwide stood at USD\$30.7 tn in 2018 [1]. Europe is the largest market for sustainable investing, growing by 11% to USD\$14.1 tn in 2018 [1,2]. Sustainable investment in the U.S. grew by 38% between 2016 and 2018 to USD\$12.0 tn [1]. ESG funds worldwide received USD\$350 bn of new money in 2020, compared with USD\$165 bn in 2019 while, in the UK, the net asset value of ESG funds grew from £29bn to £71bn over 4 years till the end of 2020 [3].

The key difference between sustainable investment and conventional investment lies in the universe of assets from which the investment portfolio is constructed. Stocks in sustainable funds subscribe to various environmental, social, and governance (ESG) prescriptions, as well as ethical guidelines, based on personal or political beliefs. Investors, both individual and institutional, have become increasingly conscious of ESG issues and ethical considerations, and the professional investment community has had to respond to this. Over the years, sustainable investment has evolved with different varieties being used. These include ethical investment, impact investment, and socially responsible investment (SRI) [1]. Globally, there are several international associations and charters including the

United Nations Principles for Responsible Investment (UN PRI) and the Social Investment Forum that help implement sustainable investment practice and act as promoters of such an approach.

By virtue of its long-term perspective, sustainable investment is of critical importance to institutional investors, such as pension funds, as well as individual investors saving in retirement investment accounts. They will invest assets over a working lifetime of 4 decades, typically, and then draw pension income for a further 2–3 decades post-retirement from their accumulated pension wealth. Issues, such as climate risk, have long-term consequences for the long stream of cash flows which concern these investors. Generating sustainable, long-term returns whilst managing the level of investment risk in a portfolio is, therefore, crucial in investment for retirement.

Pension funds and individual retirement accounts are not only active participants in sustainable investment but they are also large investors in the global financial markets. For example, the Government Pension Investment Fund (GPIF) in Japan has assets of USD\$1.6 tn and it signed up to the UN PRI in 2015 [1]. Norway has USD\$1.2 tn in funds which are signatories to the UN PRI in 2018 [2]. Its long-standing SRI tradition is led by the Norwegian Government Pension Fund Global, which enjoys public support and political legitimacy partly because of the integration of long-term SRI in its investment strategy [4]. In the UK, total assets in pension funds and all retirement vehicles are estimated at USD\$2.8 tn in 2018 [5]. The UK pension sector has been an early leader in sustainable investment. Already in 1995, the UK Government Department of Social Security (DSS) issued a regulation, under section 35 of the Pensions Act, which made it a requirement for all private pension schemes to consider and disclose their policy about environmental and social issues in their investment strategy. This was consolidated in the Pensions Act 2004 and the Pensions Act 2008 [6,7]. UK pension funds must now publish how they take account of their membership's ethical views, including ESG considerations [8]. The long intertwining history of pension investment and sustainable investment is also present in many other countries. For example, the 2003 Supplementary Pensions Law in Belgium required disclosure of ESG factors in investment [2].

The purpose of this article is to determine whether there is a difference in long-term sustainable investment performance, relative to conventional investment, particularly in the context of retirement. We make two original contributions. First, we analyze a long period (26 years) of mutual fund return data in Europe and in the U.S., and we test statistically for a difference in performance between ESG funds and their conventional counterparts. Second, we carry out a historical backtest on a personal pension plan invested either (a) passively and conventionally, or (b) in a collection of actively managed but sustainable funds, or (c) in a passive but ESG-screened portfolio. In the first analysis, we find that there is no statistically significant difference in long-term investment performance between sustainable and conventional mutual funds. In the second analysis, we find that the conventional and passive strategy outperforms the sustainable and active strategy, but that they are both outperformed by the ESG-screened passive strategy.

The remainder of this article is organized as follows: Section 2 provides the background and literature review on sustainable investment. Sections 3 and 4 present the statistical testing and the historical backtesting, respectively. A further discussion of the results is provided in Sections 5 and 6 concludes.

## 2. Related Literature

A key research issue on sustainable investment is whether there exists a difference in investment performance between sustainable and conventional funds. Early research in the 90 s on ethical funds in both the U.S. and the UK points to a small and statistically insignificant difference in performance [9–11]. These results are based on short investment horizons and may be sensitive to numerous factors including a difference in methodologies and markets. Mallin et al. [12] use a matched sample approach to pair 29 ethical and conventional equity funds, by fund size and inception date, over a 7-year period till 1993.

This pairing is intended to ameliorate the biases created by the relatively shorter lifetimes of ethical funds and their overweight portfolios in small-cap stocks. Mallin et al. [12] find that ethical funds outperform their conventional counterparts based on the Jensen, Treynor and Sharpe risk-adjusted performance measures. Gregory et al. [13] argue that the fund size matching criterion does not offset the small-cap bias of ethical funds but also find that there is no statistically significant difference between the financial performance of ethical and conventional funds. Kreander et al. [14] extend the analysis of Mallin et al. [12] by studying 60 European funds using the matched pair approach. They also suggest that there is no difference between ethical and non-ethical fund performance. A similar result is obtained by Bauer et al. [15] on a large international sample of 103 ethical funds from Germany, the UK and the U.S. from 1990 to 2001. This is further supported by more recent results on Canadian, Spanish, and U.S. data [16–18].

A number of research studies investigate socially responsible investment (SRI) funds, without distinguishing them from ethical funds. Statman [19] follows a similar methodology to Mallin et al. [12] and compares SRI funds to conventional funds in the U.S. between 1990 and 1998. He finds a small and statistically insignificant outperformance of SRI funds over conventional funds. Jones et al. [20] report a statistically significant but small (0.88%) underperformance of 89 Australian SRI funds between 1986 and 2005, relative to market using Jensen's alpha. By contrast, Cortez et al. [21] report neutral risk-adjusted performance of 88 European SRI funds in the 1996–2007 period, while other studies report risk-adjusted outperformance of SRI portfolios over different periods and investment horizons [22–24]. More recently, Capelle-Blancard and Monjon [25] hypothesize that the type of screening used by SRI funds influences their investment performance. Screening refers to the process by which companies are either excluded (negative screening) or included (positive screening) in a portfolio based on the investor's values. Their sample consists of 175 French SRI mutual funds. They find that greater negative screening has an adverse effect on the risk-adjusted performance of these funds. This is consistent with mean-variance portfolio theory in the sense that excluding assets reduces the opportunity set. Nofsinger and Varma [26] investigate SRI fund performance during the 2008 financial crisis and outside this period. They match conventional and SRI funds and find that SRI funds outperform conventional funds during the period of market crisis but underperform during the non-crisis periods. This agrees with the results of Wu et al. [27] who consider the performance of general SRI funds at different points in the economic cycle. Wu et al. [27] show that SRI funds are more resilient to economic and market downturns. A similar result is obtained by Arefeen and Shimada [28]: Japanese SRI funds provide additional downside risk protection to investors compared to conventional funds in times of economic distress without any loss in terms of investment performance. In addition, see Reference [29] for portfolio risk management through internationally diversified SRI.

A parallel line of research focussing on environmental investing comes to generally similar conclusions. Climent and Soriano [30] use matched pair analysis and data from 1987 to 2009 on green funds versus conventional funds. Over the whole of the 1987–2009 period, green funds perform worse than conventional funds with similar characteristics (fund size and age), but the difference is insignificant in the later 2001–2009 period. Munoz et al. [31] performs a similar analysis and find that green funds underperform conventional funds, but not during financial crisis periods. Fernandez et al. [32] also find that the comparative performance of green funds depends on the historical period considered and varies particularly in the presence of financial crises. More recently, Chiappini et al. [33] find no significant difference between the returns on sustainable and on conventional market indices during the Covid-19 lockdowns. The results of Derwall et al. [34] are also noteworthy in that they use corporate eco-efficiency scores, balancing economic value added against waste generated, to create portfolios: a highly eco-efficient portfolio significantly outperforms a low eco-efficient portfolio.

A number of recent studies specifically on ESG investing stand out. Friede et al. [35] conduct a large-scale review and aggregate the results of some 2200 individual studies: 90%

of these studies uncover a non-negative relationship between ESG and corporate financial performance. A more recent review of the literature is carried out by Talan and Sharma [36]. Limkriangkrai et al. [37] investigate the effect of separate E, S, and G ratings, as well as composite ESG ratings, on the performance of Australian stocks between 2009 and 2014. Although the separate ratings may influence corporate financing decisions, risk-adjusted performance is not significantly different based on ESG factors. On the other hand, Aw et al. [38] find that filtering stocks by ESG ratings does reduce investment performance (based on a large sample of global large-cap stocks between 2009 and 2016), but that this can be tempered through active portfolio management. Based on a small sample of 30 ESG and 30 conventional funds, Yue et al. [39] find that the ESG funds have less systematic risk than the conventional funds, but there is no significant evidence that the former perform better than the latter. Likewise, Humphrey et al. [40] uncover no significant difference in the risk-adjusted performance of portfolios consisting of stocks with higher corporate social performance, based on ESG criteria, versus portfolios with lower corporate social performance. The study of Badía et al. [41] is original in that it investigates the investment performance of government bonds rather than stocks: high ESG-rated government bonds appear to outperform low-rated bonds, although this is not statistically significant. The inconsistency between different ESG ratings agencies is highlighted by Berg et al. [42], and this may call into question previous research based on a unique ESG rating.

As discussed in Section 1, pension funds have a long history of implementing sustainable investment practices, and there are several noteworthy studies on sustainable investment in the context of pensions. Ferruz et al. [43] conclude that there is a difference in the investment style and use of information between SRI and conventional pension funds in the UK. Conventional pension funds use superior information for stock picking whereas SRI pension funds use it for market timing strategies. In a daily simulation over a 3-year horizon, Torre-Torres et al. [44] observe that Mexican public pension funds are just as mean-variance efficient whether they invest in a sustainable index or in a conventional index, but that they perform better in the former case during economic shocks. Sievanen et al. [45] find that European pension funds which use SRI tend to be large, public-sector, with defined benefit pensions. Cox and Schneider [46] observe that U.S. pension plans which invest overseas in the UK tend less towards SRI than UK pension plans themselves; US pensions plans appear to seek diversification and financial performance, rather than ethical investing, when investing overseas. SRI pension funds have a positive influence on the corporate sustainability of the firms in which they invest and they encourage good environmental practice, according to Alda [47]. Sethi [48] goes further and suggests that pension fund managers have a fiduciary duty to focus on long-term growth and survival of the fund, rather than short-term financial performance, and SRI practices are imperative to achieve long-term goals in changing economic and environmental conditions. Eldridge [49] investigates how fund managers can incorporate pension fund trustees' views and implement sustainable investment accordingly. Heal [50], Berghe and Louche [51], and Scholtens [52] take a broader view and discuss corporate social responsibility (CSR) in insurance. In particular, Scholtens [52] finds that insurers, from 20 different countries, are more actively engaged in the social and governance aspects of CSR than in the environmental aspects.

The literature so far tends to suggest that sustainable investment should not have adverse financial consequences for pension investors, relative to conventional investment. However, many studies are based on short-horizon investment data. Furthermore, they do not account for the costs and portfolio rebalancing that occur in long-term pension investment. The rest of this article seeks to build on the literature to fill this gap.

### 3. Statistical Testing

#### 3.1. Methodology and Data

In this part of the paper, we evaluate the performance of sustainable mutual funds compared to conventional ones. For consistency, we consider sustainable investment as

being synonymous with ESG investment, as defined in the Morningstar Direct database (although wider definitions of sustainable investment are regularly used [1,2,53]). We separately consider funds based in the U.S. and in Europe. We employ the “matched sample” methodology used in the literature to directly match sustainable funds to conventional ones [12,14,15,19,26,30]. Compared to the extant literature, our study benefits from longer investment horizons which are appropriate for retirement purposes. The performance of these funds is then compared statistically on standard investment metrics. Given the ever-increasing importance of sustainable investment, the performance of ESG funds is likely to be of topical interest to pension fund managers, as well as to individuals investing in private personal pension plans.

Funds were identified on the Morningstar Direct database where returns data was collected. This was cross-referenced with the Thomson Reuters Eikon database in order to ensure that the data was up to date. The funds had to be domiciled either in the U.S. or in Europe with an inception date prior to 1 January 2016. By filtering using relevant Morningstar categories, we restricted the funds to equity funds. To identify sustainable funds, the criterion of ESG was chosen for the focus of the fund.

Subsequently, a matched sample was established by pairing non-ESG funds with ESG funds based on the inception date (month and year) and the size of the fund at the end of the evaluation period. As Statman [19] states, matching by fund size means that there is an overlap in many fund characteristics, such as costs and small-cap investment bias. This means that an effective comparison of sustainable and conventional fund performance can be made. 44 pairs of U.S. funds and 43 pairs of European funds were, thus, established. The names of the paired funds and their inception dates are collected for the U.S. and Europe, respectively in Tables A1 and A2 in Appendix A. Tables A3 and A4 in Appendix A display the fund size in the base currency.

For each fund, monthly total returns (i.e., including dividends) were obtained from Thomson Reuters Eikon. The price data included in the return calculations is from the later date of the inception of the two funds in each pair until 31 January 2020 and from the overlapping timeframe for which the price data were available. The U.S. data ranges from mid-1994 to early 2020, while the European data ranges from late 1998 to early 2020. The mean monthly return on each fund is then the simple average of monthly returns throughout the observation period. The mean annualized return is computed as the geometric average of annualized monthly returns. For each fund, the Sharpe, Treynor, and information ratios, as well as Jensen’s alpha, for the period 31 January 2017 to 31 January 2020 were also obtained from the Morningstar database.

First, a paired two-sample *t*-test is carried out on the data for each fund pair. Second, we test for equality of distributions in monthly returns by means of a two-sample Kolmogorov-Smirnov test. Finally, a Wilcoxon signed-rank test is also performed to test for equality of distributions. This is a non-parametric version of the *t*-test which allows for non-normality in the data, given that returns on financial markets are known to be skewed [54,55].

### 3.2. Results

The percentages of ESG funds which outperform their non-ESG matched counterpart under various investment performance measures, as well as the results of paired *t*-tests, are shown in Table 1. ESG funds have a slight edge on their conventional counterparts in terms of all the metrics, both in Europe and in the U.S. However, the *p*-values are all greater than 5%, so we fail to reject the null hypothesis that there is no difference between ESG and non-ESG investment performance. In other words, there is no significant difference in performance between ESG funds and non-ESG funds.

**Table 1.** Percentage of ESG funds outperforming their conventional counterpart according to various metrics, with *p*-values of paired *t*-tests in parentheses.

	US	Europe
Mean monthly return	54.5% (0.125)	53.5% (0.245)
Mean annualized return	54.5% (0.112)	53.5% (0.993)
Sharpe ratio	52.3% (0.951)	53.5% (0.149)
Treynor ratio	56.8% (0.891)	55.8% (0.931)
Information ratio	54.5% (0.601)	58.1% (0.264)
Jensen's alpha	61.4% (0.791)	58.1% (0.162)

We also perform two-sample Kolmogorov-Smirnov tests and Wilcoxon signed-rank tests on the monthly return distributions for each pair of ESG and non-ESG fund. A *p*-value greater than 5% means that we cannot reject the null hypothesis that an ESG fund and its non-ESG counterpart have the same distribution of monthly returns. The *p*-values are tabulated in Table A5 in Appendix A. 89% of the U.S. pairs of funds and 95% of the European pairs of funds have a *p*-value greater than 5% in the Kolmogorov-Smirnov tests. 84% of the U.S. fund pairs and 88% of the European fund pairs have a *p*-value greater than 5% in the Wilcoxon signed-rank tests.

This confirms the paired Student *t*-test results that investment performance is not significantly different between ESG and non-ESG funds. In turn, this should give greater confidence to pension fund managers and individuals investing for retirement that sustainable investment will not reduce the performance of their pension portfolios.

#### 4. Historical Backtesting

##### 4.1. Aim

The previous analysis suggests that long-term sustainable investment does not detract from performance in investment for retirement. However, it fails to allow for investment management fees and for transaction costs related to portfolio rebalancing. Furthermore, whether they receive an employer-sponsored pension or a personal pension, individuals derive utility from consumption out of their retirement income. The success of sustainable investment should, therefore, be judged based on the level of retirement income that it delivers. We address these issues in this section.

We consider the long-term investment in a personal pension plan of a UK investor's savings towards retirement. The investor contributes a fixed proportion of his salary, which grows in line with the UK earnings index. He starts investing in January 2000 and retires in January 2020. Two asset classes, equities and bonds, are allowed and a linear glide path switching out of equities into bonds as retirement approaches is applied. The bond portion of the portfolio tracks UK government bonds (gilts). The equity portion of the portfolio can be invested in either a FTSE 100 index tracker fund, or a collection of actively managed funds with a sustainable purpose, or a FTSE 100 portfolio screened using a publicly available ESG score. The hypothesis that we investigate is that sustainable long-term investment for retirement delivers a pension that is at least comparable to conventional investment.

##### 4.2. Model Assumptions and Data

We build a cash flow model to capture the savings and investment of a personal retirement plan. We consider an individual who is 45 years old in January 2000 and retires at the age of 65 in January 2020. He has a starting salary of £50,000 in January 2000. His

salary grows every year in accordance with the UK earnings index provided by the Office for National Statistics in the UK [56]. The investor pays a fixed proportion (15%) of his salary into his pension plan at the start of every year. He also makes a one-off contribution of £50,000 at the inception of the plan.

We assume that investment occurs only in equities and bonds, these being the two main asset classes in which pension plans are invested [57,58]. Asset allocation proceeds according to a linear glide path so that bond investment increases as retirement approaches. Bond investment prior to retirement hedges post-retirement annuity purchases to provide secure life-contingent income. Glide paths are typically used by target retirement funds, such as those managed by Vanguard [59]. The pension fund is invested entirely in equities in the first 10 years. In the last 10 years of the plan, the proportion invested in bonds increases by 10% every year until it is fully invested in bonds in the final year. The portfolio is rebalanced annually, at the start of every year.

The bond portion of the portfolio is invested in the iShares “Core UK Gilts All Stocks A Acc” ETF. Total returns on this ETF are published in the Morningstar database. (“Total returns” means that all income is reinvested within the fund). Morningstar also states that this ETF has an overall charge figure (OCF) of 0.51% p.a. (October 2020). Note that, in the European Union, fund costs are disclosed using the overall charge figure (OCF) on funds. This is analogous to the expense ratio used in the U.S.

As regards equity investment, we construct three different scenarios:

1. “FTSE 100 tracker” involving an equity index tracker fund;
2. “Active funds” involving actively managed sustainable funds;
3. “FTSE 100 RR ESG” involving an equity index tracker with ESG overlay using the RepRisk ESG score.

In the first “FTSE 100 tracker” scenario, equity investment consists of buying an index tracker fund, the HSBC FTSE 100 Index Retail Acc fund. Total returns data are available on Morningstar, and the OCF of this fund amounts to 0.27% p.a. (October 2020).

In the second “Active funds” scenario, we invest *equally* in actively managed UK-domiciled funds which exist in the year 2000 and which are reported in the Morningstar database to be primarily invested in stocks and to have an ESG focus. There are 33 such funds shown in Table A6 in Appendix A. Some of these funds close down in the period 2000–2020. When this happens, we reinvest equally in the remaining funds. By starting with all the funds available in the year 2000, rather than only the 14 funds that survive till 2020, we avoid survivorship bias [60,61]. This scenario captures the representative performance of actively managed sustainable funds. In practice, investors will not invest in more than a few actively managed funds at any one time. An alternative is to choose the fund with the median investment performance every year but this has the undesirable implication that an investor can identify the median fund in advance at the start of every year.

Total returns data are available in the Morningstar database. We only have overall charge figure (OCF) data for the funds that have survived till 2020. A working assumption that we make is that the OCF on the equally invested portfolio of actively managed sustainable funds is the average of the OCF in 2020 of the 14 funds which survive until 2020, and this amounts to 1.24% p.a. (The OCF calculation methodology only came into use in about 2012 but closely resemble the total expense ratio (TER) that was previously quoted by funds. OCFs are likely to vary over time, so it is consistent with the OCF used for the FTSE 100 index tracker fund and the iShares Core UK Gilts ETF that we use the 2020 figures).

In the third “FTSE 100 RR ESG” scenario, a FTSE 100 index tracker with ESG overlay is constructed. Stock selection is a subset of the FTSE 100, in that stocks are screened out based on a publicly available ESG score (discussed below). Equity investment is market capitalization-weighted so that stocks that are larger receive proportionally more weight in the portfolio, consistent with the value-weighted construction of the FTSE 100 itself. Rebalancing takes place at the start of every year.

To operationalize this equity investment strategy, we use the following data:

1. Data from the FTSE Russell company on the constituents of the FTSE 100 index, and their market capitalization, between 2000 and 2020. This is verified against the Datastream database.
2. Total return data on individual stocks in the FTSE 100 between 2000 and 2020, from the Morningstar database and checked against the Datastream database.
3. Data on the RepRisk ESG score made available by RepRisk AG. This score is available for all companies in the FTSE 100. It ranges from 0 to 100: the lower the value, the more ESG-compliant the company is perceived to be. Stocks with an ESG score above 75 are screened out every year, but re-introduced if their score is at or below 75 the following year. Screening out stocks with an ESG score above 75, therefore, means that stocks which are the least sustainable are divested. The RepRisk ESG score starts from 2007, so we use the average scores in the period 2007–2020 for the pre-2007 period.

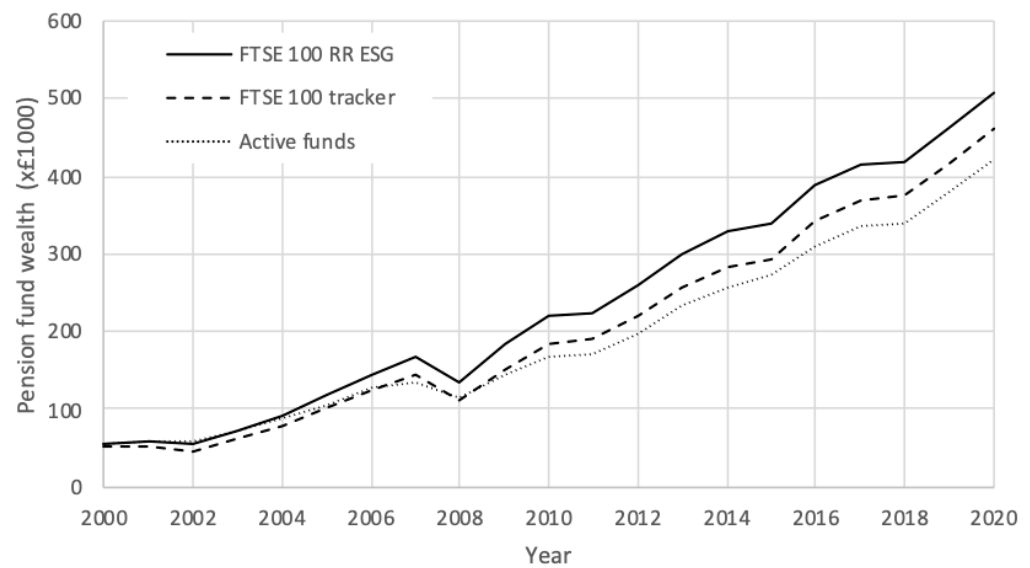
Transaction costs and investment management fees are known to have a significant impact on long-term investment returns [57] (p. 101) [58] (p. 124). We evaluate costs, fees, and charges carefully in our model.

1. Net returns on funds. On all funds and ETFs, we use the overall charge figure (OCF) quoted in the Key Investor Information Document (KIID) of the fund or ETF and as listed on the Morningstar database. The net return can be calculated from the total return using the OCF.
2. Dealing charges. The charges levied by Hargreaves Lansdown in October 2020 are replicated in our study. Hargreaves Lansdown is one of the UK's most popular provider of self-invested personal pension plans (SIPPs). A dealing charge of £11.95 is applied as a flat charge for every trade of stocks or ETFs irrespective of the amount or value of the trade. New money is available every year, through labor income, and the portfolio is rebalanced every year, so the dealing charge is payable on every stock or ETF that is traded. (We use total returns on stocks, i.e., returns inclusive of capital appreciation and dividend income, but we assume that dividends are reinvested annually although they are usually paid semi-annually. This means that there is no dealing charge mid-year for the reinvestment of dividends). There is no dealing charge related to the purchase or redemption of shares in open-end funds. Further, we assume zero entry and exit fees for these funds, as these are usually defrayed by the platform provider. (Large investment platforms in the U.S. and the UK typically negotiate bulk discounts with fund managers since they direct a large amount of wealth to these funds. Note that this means that there is no dealing charge in the "Active funds" strategy, irrespective of the number of funds in the investor's portfolio).
3. Platform management fee. Hargreaves Lansdown charges annual account (management) charges on self-invested personal pension plans as follows. First, on the value of all stocks, ETFs and bonds in the pension plan, it charges 0.45% p.a. on this value, capped at £200. Second, on the value invested in funds, it charges 0.45% p.a. on the first £250,000, then 0.25% p.a. on the next £750,000. We use the same charging structure in our model.

#### 4.3. Results

Figure 1 shows the evolution from January 2000 to January 2020 of pension plan wealth under the three different scenarios: "FTSE 100 tracker", "Active funds", and "FTSE 100 RR ESG", as described in Section 4.2. Relevant numbers are displayed in Table 2, in which the last three columns are plotted in Figure 1. It is immediately apparent that investing passively with an ESG overlay outperforms conventional passive investment, and this itself outperforms active investment in funds with sustainability objectives.





**Figure 1.** Evolution of pension plan wealth under three different scenarios of equity investment.

**Table 2.** Salary, pension saving, portfolio weights, and pension plan wealth from year 2000 till retirement, under three different scenarios of equity investment.

Year	Earning Index	Salary (£)	Pension Saving (£)	Portfolio		Pension Plan Wealth (£)		
				Equity (%)	Bond (%)	FTSE 100 Tracker	Active	FTSE 100 RR ESG
2000	4.50	50,000.00	57,500.00	100	0	51,511.23	56,412.59	55,943.49
2001	5.00	52,500.00	7875.00	100	0	50,128.08	59,239.56	58,515.32
2002	4.80	55,020.00	8253.00	100	0	44,484.34	58,740.07	54,684.71
2003	4.80	57,660.96	8649.14	100	0	61,402.88	72,559.84	72,851.69
2004	4.30	60,140.38	9021.06	100	0	76,752.82	86,297.81	90,228.17
2005	5.90	63,688.66	9553.30	100	0	102,063.37	103,934.32	119,139.56
2006	4.10	66,299.90	9944.98	100	0	125,857.94	125,915.96	144,377.97
2007	4.30	69,150.79	10,372.62	100	0	143,623.08	134,706.06	165,790.90
2008	4.10	71,985.98	10,797.90	100	0	109,623.68	114,962.02	132,986.59
2009	3.80	74,721.44	11,208.22	100	0	151,701.11	143,507.38	183,674.36
2010	2.00	76,215.87	11,432.38	100	0	183,646.33	168,131.46	219,587.95
2011	2.30	77,968.84	11,695.33	90	10	190,890.12	171,057.28	223,640.59
2012	2.40	79,840.09	11,976.01	80	20	219,577.85	195,964.86	258,319.38
2013	2.00	81,436.89	12,215.53	70	30	256,708.16	231,666.24	298,336.80
2014	2.10	83,147.07	12,472.06	60	40	282,394.88	256,565.91	327,605.84
2015	2.60	85,308.89	12,796.33	50	50	292,000.21	272,187.08	340,369.43
2016	2.80	87,697.54	13,154.63	40	60	342,550.26	307,893.14	387,167.78
2017	2.90	90,240.77	13,536.12	30	70	369,673.36	335,077.02	414,271.78
2018	3.10	93,038.23	13,955.73	20	80	374,630.08	338,990.44	418,336.86
2019	3.40	96,201.53	14,430.23	10	90	415,129.83	380,266.68	460,847.02
2020	3.20	99,279.98	14,892.00	0	100	460,345.66	423,006.88	508,233.72

The purpose of investing for the long term in a retirement plan is, of course, to provide income in retirement. For this purpose, we assume that the investor annuitizes all of his wealth at retirement. Hargreaves Lansdown's annuity tool searches the UK annuity market for the best annuity rates. In August 2020, its best quote for a 65-year old non-smoker was an annuity that pays a life-contingent income of £4796 p.a. in exchange for £100,000. (The annuity pays a fixed amount while the annuitant is alive. The quote is for a single life, i.e., not contingent on the life of a partner. The amount is fixed nominally, without inflation indexation or other escalation, and without guarantees in the event of early death).

Table 3 displays the retirement income that the investor would receive under the three different scenarios of equity investment. Conventional passive investment outperforms active sustainable investment by 8.8%, which may initially be discouraging for investors for

whom sustainable investment matters. However, we also find that passive investment with ESG screening itself outperforms conventional passive investment by 10.4%. Table 3 also shows the replacement ratio. This is defined as the investor's annual retirement income expressed as a proportion of the investor's final salary p.a. received in the year before retirement. It is an important measure of the continuity of lifestyle that the investor can expect in retirement. (Individuals may also be in receipt of social security and employer-sponsored pensions when they retire).

Our historical backtest, therefore, shows that long-term sustainable investment for retirement is best achieved by means of an ESG score-based index-tracking investment, using both market indices and the RepRisk ESG score, for long-term investors saving for retirement.

**Table 3.** Pension plan wealth, retirement income, and income replacement ratio at retirement when wealth is fully annuitized, under three different scenarios of equity investment.

At Retirement	FTSE 100 Tracker	Active Funds	FTSE 100 RR ESG
Pension plan wealth	£460,345.66	£423,006.88	£508,233.72
Retirement income	£22,078.18	£20,287.41	£24,374.89
Replacement ratio	22.24%	20.43%	24.55%

## 5. Discussion of Results

### 5.1. Statistical Analysis

The statistical analysis performed in Section 3 compares the returns on ESG and non-ESG funds over a long period. It suggests that ESG investment delivers long-term investment performance that is not different from conventional investment. It did not allow for investment management fees and transaction costs. It did not look at the pension outcome for investors, but rather at the investment return. It also did not address survivorship bias as only funds in existence in January 2020 were considered (although all fund pairs comprised only surviving funds, and hence were consistent). These shortcomings are addressed, however, in the financial modeling in Section 4.

### 5.2. Portfolio Rebalancing Frequency and Full Annuitization

In the historical backtest of Section 4, we assume that portfolio rebalancing occurs annually, both in terms of asset allocation in all three scenarios, and in terms of stock selection after ESG screening in the third "FTSE 100 RR ESG" scenario. In practice, it is likely that portfolio rebalancing would be done on a quarterly basis, both to minimize tracking error with the stock market index and to avoid stocks with poor ESG performance. On the other hand, frequent rebalancing incurs costs which depress net returns.

We also assume that the investor will expend all of his pension plan wealth at retirement to buy a life annuity providing income in retirement. Annuitization was the norm in the UK until the Pension Schemes Act 2015 liberalized the decumulation of pension wealth. Investors have greater freedom than the full annuitization that we assume here: they will take out a cash lump sum at retirement; they will preserve some wealth for bequest purposes; they may find annuities financially unattractive because of low interest rates and high annuity loadings charged by life insurers; and they will generate income in retirement by drawing down on their wealth until a late age when longevity risk may become a concern and annuitization becomes valuable.

### 5.3. Market Downturns

It is interesting to consider which of the three equity investment strategies, in the financial model of Section 4, fare better in terms of final pension outcome when market downturns occur. The January 2000–January 2020 historical period encompasses two major stock market crashes: the 2001–2 dot-com crash and the 2008 financial crisis. (Note that the Covid crash of 2020 is not included. In any case, there is no stock market exposure by

2020 because the glide path that determines asset allocation de-risks the pension plan as retirement approaches. This underscores the importance for long-term investors of such age-phased de-risking).

Table 4 compares the losses faced in the pension plan under the three different equity investment scenarios. (For comparison, the Table also displays the decline in the FTSE 100, which is greater than the declines in pension plan wealth because of labor income being invested). Table 4 shows that the actively managed funds weather such market shocks the best, possibly because active managers have the latitude to rotate out of stocks and into cash and bonds in order to limit losses. Interestingly, the “FTSE 100 RR ESG” strategy performs better than the conventional passive “FTSE 100 tracker” strategy. Stocks with poor ESG performance appear to be worse-hit in market downturns. It is worth noting that this result is consistent with, and provides further support for, the studies reviewed in Section 2 [26–32].

**Table 4.** Effect of market downturns on pension plan wealth under three different scenarios of equity investment.

Event	Decline in Pension Plan Wealth (%)			
	Decline in FTSE 100 (%)	FTSE 100 Tracker	Active Funds	FTSE 100 RR ESG
2001–2002 Dot.com crash	22.17	11.26	0.84	6.55
2007–2008 Financial crisis	28.33	23.67	14.66	19.79

#### 5.4. Large-Cap Dominance and ESG Screening

In the first and third scenarios that we consider in Section 4, the equity component of the pension plan portfolio is invested in the FTSE 100 or a subset thereof. Mid-cap and small-cap stock investment is, therefore, disregarded, although it is presumably included in some of the actively managed sustainable funds in the second scenario. The large-cap focus of our study is made to facilitate ESG screening of stocks, because only the stocks present in the FTSE 100 need to be assessed using their RepRisk ESG score. There are around 100 stocks in the FTSE 100 at any one time, but stocks move in and out every quarter. Furthermore, the constituents of the FTSE 100 have changed significantly over the 20-year period that our study encompasses. Furthermore, the market capitalization of each stock relative to the FTSE 100 aggregate varies over this period and is required so that the portfolio that we synthesize in the third “FTSE 100 RR ESG” scenario remains value-weighted.

In the third “FTSE 100 RR ESG” scenario, an ESG score threshold of 75 is used to screen out the least sustainable stocks from the FTSE 100. Table 5 shows the number of stocks that are screened out every year from 2010 till 2019 assuming different thresholds. A threshold of 75 may appear to be fairly lax since only up to 5 stocks are excluded every year, according to the last column of Table 5. However, these excluded stocks are some of the largest stocks by market capitalization in the FTSE 100. This may be observed in the last column of Table 6, which shows that the mega-cap UK oil companies (Shell and BP) and the large banks (HSBC and Barclays) are regularly screened out. Their divestment removes support from a large portion of economic activity which is deemed unsustainable. The last three columns of Table 5 show that more stocks are excluded as the ESG threshold falls, i.e., the stricter ESG standards are. The last three columns of Table 6 indicate that the largest companies that are excluded are not very different irrespective of the ESG threshold.

Figure 2 displays the evolution from January 2000 to January 2020 of pension plan wealth under four different scenarios: the “FTSE 100 RR ESG” with three different ESG thresholds (25, 50, 75), and the unscreened “FTSE 100 tracker” scenario. This demonstrates that, even if the ESG screening is very strict (threshold of about 25), the ESG-screened index-tracking strategy still performs about, as well as a passive but non-sustainable index-tracking strategy. It could be anticipated that, the stricter the ESG screening (the lower the

threshold), the fewer stocks would be in the portfolio, and hence the lower transaction costs would be, and the higher the terminal wealth. Figure 2 shows that this is not the case: as the threshold decreases from 100 (unscreened) to 25, terminal pension wealth initially increases, then decreases. Dealing charges appear to have little effect here. Table 5 shows that the “FTSE 100 RR ESG threshold 25” portfolio contains 20 stocks fewer than the “FTSE 100 RR ESG threshold 75” portfolio in 2019. This corresponds to a difference in dealing charges of  $20 \times £11.95 = £239$ , which is small compared to the terminal pension wealth of about £450,000.

**Table 5.** Number of stocks screened out of the FTSE 100 at different RepRisk ESG score thresholds. The lower the threshold, the stricter the requirement for ESG compliance.

Year	RepRisk ESG Threshold		
	25	50	75
2010	12	3	0
2011	16	3	2
2012	16	6	2
2013	18	7	2
2014	21	9	4
2015	24	10	5
2016	19	9	4
2017	22	8	2
2018	25	8	2
2019	21	7	1

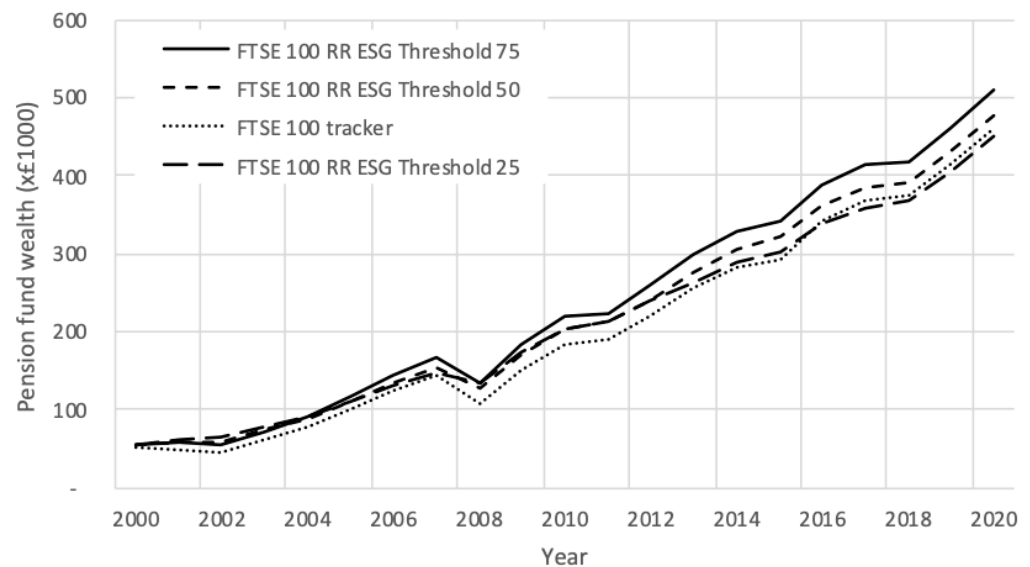
**Table 6.** The three largest stocks by market capitalization which are screened out of the FTSE 100 at different RepRisk ESG score thresholds. The lower the threshold, the stricter the requirement for ESG compliance.

Year	RepRisk ESG Threshold		
	25	50	75
2010	BP, RDSA, HSBC	BP, RDSA, RBS	
2011	RDSA, HSBC, VOD	RDSA, HSBC, BP	RDSA, BP
2012	RDSA, HSBC, BP	RDSA, HSBC, BP	RDSA, BP
2013	RDSA, HSBC, BP	RDSA, HSBC, BP	RDSA, HSBC
2014	RDSA, HSBC, BP	RDSA, HSBC, BP	RDSA, HSBC, BARC
2015	RDSA, HSBC, BP	RDSA, HSBC, BP	RDSA, HSBC, BP
2016	RDSA, HSBC, BAT	RDSA, HSBC, GSK	RDSA, HSBC, BP
2017	RDSA, HSBC, BAT	RDSA, HSBC, BP	RDSA, HSBC
2018	RDSA, HSBC, BAT	RDSA, HSBC, BP	RDSA, HSBC
2019	RDSA, HSBC, BP	RDSA, HSBC, BP	RDSA

Legend: BARC = Barclays. BP = BP, formerly British Petroleum. BAT = British American Tobacco. GSK = GlaxoSmithKline. RBS = Royal Bank of Scotland. RDSA = Royal Dutch Shell. VOD = Vodafone.

### 5.5. Charges in the ESG-Screened Index-Tracking Strategy

As discussed in Section 4.2, investment performance is materially eroded by costs, fees, and charges: [57] (p. 101) [58] (p. 124). In the “FTSE 100 RR ESG” scenario, a stock portfolio was set up which tracked the FTSE 100 but with the exclusion of stocks that scored more than 75 on the RepRisk ESG score. This is a do-it-yourself portfolio which requires annual rebalancing with individual stocks being bought or sold depending on their passage into or out of the FTSE 100 index, and depending on their RepRisk ESG score. Such frequent trading incurs dealing charges as set out in Section 4.2.



**Figure 2.** Evolution of pension plan wealth under ESG-screened FTSE 100-tracking scenarios at three different ESG threshold scores (the smaller the threshold, the stricter the ESG standards), as well as an unscreened FTSE 100 tracker scenario.

It is conceivable that a fund or ETF, which pools investors' wealth, can make significant economies of scale. The Morningstar database provides the expense ratios on two sister ETFs: the SPDR S&P 500 ETF (0.095%) and a newly launched SPDR S&P 500 ESG Screened ETF (0.1%). (The expense ratio is the U.S. version of the European Union's overall charge figure (OCF) on funds). The latter uses ESG screening based on the RepRisk ESG score, as well as Sustainalytics data. The difference between these expense ratios suggest that the application of ESG screening is not expensive, and it only adds 0.005% to ongoing charges.

The conventional passive "FTSE 100 tracker" scenario that we consider earlier assumes an overall charge figure (OCF) of 0.27% p.a. No FTSE 100 index tracker or ETF with ESG screening exists in the UK. Were one to exist, it is reasonable that it would have an OCF of 0.275% p.a., with the same differential as the SPDR ETFs in the U.S.

Table 7 shows that such a hypothetical ETF would outperform the "FTSE 100 RR ESG" outlined earlier by 4.3% and the conventional passive "FTSE 100 tracker" strategy by 15.2%. (The middle two columns of Table 7 repeat corresponding results from Table 3 for ease of comparison). This underscores the importance of low charges and fees, which can be achieved with passive index-tracking, as well as ESG score-based screening.

**Table 7.** Pension plan wealth, retirement income and income replacement ratio at retirement. "FTSE 100 tracker" and "FTSE 100 RR ESG" are as in Table 3. "FTSE 100 RR ESG ETF" represents a variation of "FTSE 100 RR ESG" within a hypothetical ETF with corresponding charges.

At Retirement	FTSE 100 Tracker	FTSE 100 RR ESG	FTSE 100 RR ESG ETF
Pension plan wealth	£460,345.66	£508,233.72	£530,104.03
Retirement income	£22,078.18	£24,374.89	£25,423.79
Replacement ratio	22.24%	24.55%	25.61%

## 6. Conclusions

This paper seeks to extend research on long-term sustainable investment for retirement purposes. First, we compare the returns on matched ESG and non-ESG mutual funds. The funds are identified on the Morningstar database and cross-checked on the Thomson Reuters Eikon database. ESG and non-ESG funds are matched so that an effective comparison of their investment performance can be made, allowing for an overlap in fund characteristics, such as expenses and small-cap investment bias. Compared to

the literature, we consider long-term horizons which are appropriate for investment for retirement purposes. Funds based in the U.S. and in Europe are considered separately. Paired *t*-tests on a number of performance metrics show that ESG and non-ESG funds do not differ significantly in investment performance. This is confirmed with two-sample Kolmogorov-Smirnov and Wilcoxon signed-rank tests. This analysis provides support for the use of sustainable investment in long-term retirement funds.

This initial analysis has a number of limitations. Firstly, survivorship bias is not accounted for because we disregarded funds which did not survive until 31 January 2020 and we did not use a survivorship-bias free database to select and match the ESG funds with non-ESG funds. Nonetheless, as all the fund pairs consist of surviving funds, the analysis is fair. Secondly, investment management fees are not included in the analysis of the U.S. and European funds. Transaction costs from portfolio rebalancing are also excluded. Thirdly, the analysis is based on investment returns but fails to focus on pension income which is the principal concern of pension funds as well as individual investors when they retire.

In the second part of this paper, we address these issues by building a simplified and yet realistic financial model of a personal pension plan. We consider an individual who saves a fixed proportion of his salary and invests in the pension plan for a 20-year period till retirement in the year 2020. His salary, and, thus, his savings, increase in line with average earnings in the UK. The plan is invested in UK stocks and bonds only. Asset allocation follows a linear glide path with full equity investment in the first 10 years, and a phased switch into bonds in the remaining 10 years with no equity investment in the final year. This mirrors glide paths which are used by investment managers in practice and which gradually reduce investment risk prior to retirement. We study three scenarios for stock investment: a “FTSE 100 tracker” strategy involves investment in a stock market tracker fund; an “Active funds” strategy involves investment in actively managed funds with a sustainable purpose as reported in the Morningstar database; and a “FTSE 100 RR ESG” strategy involves investment in the index tracker but with the exclusion of stocks which fail to meet a threshold based on the RepRisk ESG score. Investment charges, costs and fees are modeled exactly as those charged by Hargreaves Lansdown, with the overall charge figure (OCF) of funds and ETFs supplying net returns. Survivorship bias is avoided in the “Active funds” strategy by investing in all the funds available in the year 2000, rather than only funds in existence in 2020, and redistributing wealth equally to surviving funds in the event of a fund closing down. Our principal result is that a passive strategy with ESG screening delivers a pension that is 10.4% larger than a conventional passive strategy, and also 20.2% larger than a strategy based on actively managed ESG funds. This result—in combination with the statistical analysis which did not reveal significant underperformance of sustainable investment in the long term—allows us to conclude that index investing with ESG score-based screening is a key sustainable strategy which should be considered for pension planning.

Further work can be done to extend the modeling presented here. Sensitivity analysis on the transaction costs, fees, and charges should be performed to test the robustness of our main result. The study can also be repeated on a broader stock market index, such as the FTSE 350, which would include mid-cap stocks. It would be useful to compare pension plan performance when stricter ESG screening thresholds are used. The assumptions of a linear glide path and of full annuitization at retirement can be altered, again to test whether our main result holds in a wider variety of circumstances. Finally, portfolio rebalancing more frequently than annually, with consequential dealing charges, can be implemented.

**Author Contributions:** Conceptualization, I.O.; methodology, I.O. and M.K.; software, J.-R.M., N.K. and K.M.; validation, J.-R.M., N.K., and K.M.; formal analysis, I.O.; investigation, J.-R.M., N.K., and K.M.; resources, I.O.; data curation, J.-R.M., N.K., and K.M.; writing—original draft preparation, I.O., J.-R.M., N.K., K.M., and M.K.; writing—review and editing, I.O. and M.K.; visualization, J.-R.M.; supervision, I.O.; project administration, I.O. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Data Availability Statement:** Data on funds is available on the Morningstar Direct database: <https://www.morningstar.co.uk/uk/> (accessed on 1 May 2020). Data on the constituents of the FTSE 100 index and their market capitalization is available from FTSE Russell: <https://www.ftserussell.com> (accessed on 1 May 2020). This can be verified against the Datastream database, owned by Refinitiv: <https://www.refinitiv.com/en/products/datastream-macroeconomic-analysis> (accessed on 1 May 2020). The RepRisk ESG score is available from RepRisk AG: <https://www.reprisk.com> (accessed on 1 May 2020). The charges levied by Hargreaves Lansdown and the annuity rates that they offer are available at: <https://www.hl.co.uk/> (accessed on 1 May 2020).

**Acknowledgments:** I.O. wishes to thank Heiko Bailer for useful discussions and for his help and advice with RepRisk ESG score data.

**Conflicts of Interest:** The authors declare no conflict of interest. The opinions expressed in this paper are our own and not necessarily those of our employers.

## Appendix A. Tables

**Table A1.** Matched U.S. ESG focused and conventional mutual funds with inception date. Source: Morningstar Direct.

ESG Funds			Conventional Funds		
Fund	Fund Name	Inception Date	Fund	Fund Name	Inception Date
(1A)	Aberdeen Focused U.S. Equity Instl	June 2004	(1B)	ICON Long/Short S	May 2004
(2A)	Aberdeen U.S. Multi-Cap Equity C	March 2001	(2B)	Nuveen Mid Cap Growth Opps R3	December 2000
(3A)	Aberdeen U.S. Small Cap Equity R	December 2003	(3B)	Gabelli Growth A	December 2003
(4A)	Alger Responsible Investing C	September 2008	(4B)	BNY Mellon Large Cap Growth C	September 2008
(5A)	AllianzGI Focused Growth P	July 2008	(5B)	Emerald Growth Institutional	October 2008
(6A)	American Century NT Disciplined Gr Inv	March 2015	(6B)	Frontier MFG Global Plus Institutional	March 2015
(7A)	American Century NT Heritage G	May 2006	(7B)	American Century Focused Dynamic Gr Adv	May 2006
(8A)	BMO Large-Cap Growth I	January 2008	(8B)	Voya SmallCap Opportunities W	December 2007
(9A)	Boston Common ESG Impact U.S. Equity	April 2012	(9B)	Logan Capital Large Cap Grth Instl	June 2012
(10A)	Brown Advisory Growth Equity Inv	June 1999	(10B)	Wells Fargo Premier Large Co Gr Inst	June 1999
(11A)	City National Rochdale U.S. Cor Eq Instl	December 2012	(11B)	Columbia Acorn USA Adv	November 2012
(12A)	ClearBridge Aggressive Growth R	December 2006	(12B)	Voya Large Cap Growth Port A	December 2006
(13A)	ClearBridge Mid Cap Growth A2	December 2013	(13B)	Segall Bryant & Hamill Small Cap Gr Ret	December 2013
(14A)	ClearBridge Select FI	November 2012	(14B)	Columbia Small Cap Growth I Adv	November 2012
(15A)	ClearBridge Sustainability Leaders A	November 2015	(15B)	Dana Small Cap Equity Institutional	November 2015
(16A)	Columbia Large Cap Growth Opp A	December 1997	(16B)	Lord Abbett Developing Growth I	December 1997
(17A)	Driehaus Micro Cap Growth	November 2013	(17B)	AB Core Opportunities Z	October 2013
(18A)	DWS Capital Growth Institutional	August 2002	(18B)	Wells Fargo Opportunity Admin	August 2002
(19A)	DWS Large Cap Focus Growth C	December 2000	(19B)	MassMutual Premier Disciplined Gr Svc	December 2000
(20A)	Eventide Gilead N	July 2008	(20B)	Invesco Mid Cap Growth R	July 2008
(21A)	Green Century Equity Individual Investor	September 1995	(21B)	LKCM Equity Instl	January 1996
(22A)	Hartford Growth Opportunities HLS IB	May 2002	(22B)	JHancock U.S. Global Leaders Growth B	May 2002
(23A)	Hartford MidCap HLS IA	July 1997	(23B)	Great-West T. Rowe Price Mid Cp Gr Inv	July 1997
(24A)	Hartford Small Company A	July 1996	(24B)	Thrivent Small Cap Stock A	July 1996
(25A)	Highland Socially Responsible Equity A	December 1996	(25B)	AMG Managers Cadence Mid Cap N	January 1997
(26A)	Invesco Summit R5	October 2008	(26B)	Invesco Small Cap Growth Y	October 2008
(27A)	Jensen Quality Growth I	July 2003	(27B)	American Century Growth R	August 2003
(28A)	JPMorgan Intrepid Growth A	February 2005	(28B)	AB Growth I	March 2005
(29A)	JPMorgan Tax Aware Equity A	March 2011	(29B)	PGIM Jennison 20/20 Focus R6	March 2011
(30A)	MainStay Large Cap Growth B	April 2005	(30B)	Invesco American Franchise A	June 2005
(31A)	MFS Blended Research Growth Eq A	September 2015	(31B)	Leland Thomson Reuters Vntr Cptl Idx C	September 2015
(32A)	MFS New Discovery A	January 1997	(32B)	Hennessy Focus Investor	January 1997
(33A)	Morgan Stanley Inst Advantage IS	September 2013	(33B)	Nationwide Geneva Mid Cap Gr R6	September 2013
(34A)	Morgan Stanley Inst Discovery A	January 1997	(34B)	Wells Fargo Omega Growth Admin	January 1997
(35A)	Nuveen Winslow Large-Cap Growth ESG A	May 2009	(35B)	Voya Russell Mid Cap Growth Idx Port I	May 2009
(36A)	Praxis Growth Index A	May 2007	(36B)	Victory RS Growth Y	May 2007
(37A)	Quaker Impact Growth I	July 2000	(37B)	Victory RS Small Cap Equity C	August 2000
(38A)	RBC Small Cap Core A	April 2004	(38B)	RMB C	April 2004
(39A)	RBC SMID Cap Growth A	June 1994	(39B)	Sit Small Cap Growth	July 1994
(40A)	Tarkio	June 2011	(40B)	JHancock Fundamental All Cap Core A	June 2011
(41A)	Timothy Plan Aggressive Growth A	October 2000	(41B)	Sparrow Growth No-Load	November 2000
(42A)	Timothy Plan Large/Mid Cap Growth C	February 2004	(42B)	Rydex S&P 500 Pure Growth C	February 2004
(43A)	Trillium ESG Small/Mid Cap Inst	August 2015	(43B)	Goldman Sachs Flexible Cap R6	July 2015
(44A)	Zevenbergen Genea Institutional	August 2015	(44B)	Loomis Sayles Small/Mid Cap Growth Instl	June 2015

**Table A2.** Matched European ESG focused and conventional mutual funds with inception date. Source: Morningstar Direct.

ESG Funds			Conventional Funds		
Fund	Fund Name	Inception Date	Fund	Fund Name	Inception Date
(1A)	AAF-Hermes European Equities A €	April 2013	(1B)	DPAM Capital B Equities EMU Index P Cap	March 2013
(2A)	AIS Mandarine Active I	September 2005	(2B)	HSBC GIF Euroland Growth M1D	July 2005
(3A)	ALM Actions Zone Euro ISR IC	May 2002	(3B)	BGF Euro-Markets C2	July 2002
(4A)	ASR Euro Aandelen Fonds	July 2010	(4B)	LAM-EURO-SMALL CAPS-UNIVERSAL	June 2010
(5A)	Aviva Actions Euro ISR A/I	May 1998	(5B)	C+F Euro Equities Acc	June 1998
(6A)	AXAWF Fram Human Capital A Cap EUR	October 2007	(6B)	DPAM Capital B Equities EMU Index F Cap	December 2007
(7A)	Belfius Equities Europe S&M Caps C Cap	September 1998	(7B)	Vendôme Sélection Euro PC	November 1998
(8A)	BL-Equities Europe A EUR	December 2011	(8B)	BGF European Special Situations X2	December 2011
(9A)	BL-European Smaller Companies A EUR	November 2012	(9B)	Quaero Capital Argonaut B-EUR	December 2012
(10A)	BNP Paribas Euro Valeurs Durables C C	April 1998	(10B)	SG Actions Euro Small Cap IC	May 1998
(11A)	BNPP Multigestion ISR Actions Euro C	April 2015	(11B)	Indosuez Euro Expansion G	March 2015
(12A)	Candriam Business Equities EMU C Dis EUR	November 1997	(12B)	Bankia Euro Top Ideas Universal FI	August 1997
(13A)	CB European Quality Fund A	June 2000	(13B)	Invesco Pan European Sm Cp Eq E EUR Acc	August 2000
(14A)	Covéa Actions Croissance C	June 1998	(14B)	UniEuropa Mid&Small Caps	September 1998
(15A)	Echiquier Positive Impact Europe A	March 2010	(15B)	Allianz Best Styles Euroland Eq A EUR	May 2010
(16A)	Epargne Ethique Actions C	January 2000	(16B)	New Millennium Euro Equities A	November 1999
(17A)	Expert Euro ISR I	September 2013	(17B)	BPI GIF BPI Euro Large Caps I	August 2013
(18A)	Federal Optimal Plus ESG I	May 2006	(18B)	IVI Umbrella IVI European EUR	February 2006
(19A)	Fédérés Pro Actions ISR Euro MH A/I	May 2013	(19B)	RAM (Lux) Sys European Equities IP EUR	May 2013
(20A)	Fidelity Sustainable Euroz Eq A-Acc-EUR	December 2005	(20B)	LBPAM Actions Midcap E A/I	March 2006
(21A)	Hermes European Alpha Equity F EUR Acc	November 2012	(21B)	BNP Paribas Best Sélection Euro C A/I	January 2013
(22A)	HGA Actions ISR	January 2014	(22B)	Ostrum Actions Small&Mid Cap Euro ID	December 2013
(23A)	Impact ES Actions Europe I	July 2013	(23B)	BNP Paribas Euro Equity C C	May 2013
(24A)	Kempen (Lux) Sustainable Eurp Sm-Cp A	April 2015	(24B)	JPM Euroland Dynamic A perf (dist) EUR	May 2015
(25A)	Lazard Equity SRI C	June 2001	(25B)	Esperia Fds SICAV Duemme Euro Eqs C Cap	September 2001
(26A)	LFER Euro Développement Durable GP	March 2008	(26B)	Eurizon Equity Euro LTE Z Acc	January 2008
(27A)	LUX IM ESG Generali Invmts Euro Eqs DX	October 2014	(27B)	HSBC Euro PME IC	December 2014
(28A)	M&G Pan Eurp Sel Smllr Coms Euro A Acc	November 2001	(28B)	Sextant PEA A	January 2002
(29A)	Macif Croiss Dur et Solid Macif C	April 2002	(29B)	CD Euro Capital C	June 2002
(30A)	MAM Human Values C	July 1998	(30B)	Eurovalor Bolsa Europea FI	June 1998
(31A)	Mandarine Active G	December 2012	(31B)	HANSAsmart Select E I	October 2012
(32A)	Mirova Euro Sustainable Equity I/D EUR	July 2013	(32B)	Allianz Europe Equity Gr Sel A EUR	May 2013
(33A)	NN (L) European Sust Eq I Cap EUR	April 2014	(33B)	HSBC GIF Euroland Eq Smllr Coms XC	March 2014
(34A)	Nordea 1 - European Sm&Mid Cp Eq AP EUR	March 2009	(34B)	Lazard Small Caps Euro R A/I	June 2009
(35A)	Oddo BHF Avenir Euro CI-EUR	December 1998	(35B)	UniDynamicFonds: Europa -net- A	April 1999
(36A)	Ofi RS European Growth Climate Chng I	March 1997	(36B)	AXA Indice Euro C	January 1997
(37A)	Pramerica Azionario Etico	September 2005	(37B)	WSS-Europa T	September 2005
(38A)	Promepar Actions Rendement I A/I	December 2012	(38B)	Moorea Fd Selection Europe RE	January 2013
(39A)	RAM (LUX) - Ethik Quant Strategiefds P	July 2013	(39B)	Calamatta Cuschieri Euro Equity A	October 2013
(40A)	R-co 4Change Human Values C EUR	February 2015	(40B)	Diversification CALM Eurozone Eq €A Inc	May 2015
(41A)	Roche-Brune Europe Actions I	February 2014	(41B)	SG Actions Euro PME C	January 2014
(42A)	Schroder ISF EURO Equity A1 Acc EUR	August 2001	(42B)	Amundi Fds Euroland Equity F EUR C	October 2001
(43A)	Seeyond Equity Factor Investing Euro IC	December 2014	(43B)	CS (Lux) Eurozone Active Opps Eq UB EUR	February 2015



**Table A3.** Matched U.S. ESG focused and conventional mutual funds with fund size on 14 February 2020. Source: Morningstar Direct.

ESG Funds			Conventional Funds		
Fund	Fund Name	Fund Size (\$m)	Fund	Fund Name	Fund Size (\$m)
(1A)	Aberdeen Focused U.S. Equity Instl	21.26	(1B)	ICON Long/Short S	21.81
(2A)	Aberdeen U.S. Multi-Cap Equity C	411.96	(2B)	Nuveen Mid Cap Growth Opps R3	388.18
(3A)	Aberdeen U.S. Small Cap Equity R	866.43	(3B)	Gabelli Growth A	814.79
(4A)	Alger Responsible Investing C	70.73	(4B)	BNY Mellon Large Cap Growth C	79.61
(5A)	AllianzGI Focused Growth P	1118.68	(5B)	Emerald Growth Institutional	1383.77
(6A)	American Century NT Disciplined Gr Inv	407.33	(6B)	Frontier MFG Global Plus Institutional	490.79
(7A)	American Century NT Heritage G	602.30	(7B)	American Century Focused Dynamic Gr Adv	607.69
(8A)	BMO Large-Cap Growth I	508.54	(8B)	Voya SmallCap Opportunities W	474.25
(9A)	Boston Common ESG Impact U.S. Equity	44.82	(9B)	Logan Capital Large Cap Grth Instl	41.38
(10A)	Brown Advisory Growth Equity Inv	2829.72	(10B)	Wells Fargo Premier Large Co Gr Inst	2936.27
(11A)	City National Rochdale U.S. Cor Eq Instl	356.55	(11B)	Columbia Acorn USA Adv	312.84
(12A)	ClearBridge Aggressive Growth R	7440.45	(12B)	Voya Large Cap Growth Port A	6227.79
(13A)	ClearBridge Mid Cap Growth A2	95.34	(13B)	Segall Bryant & Hamill Small Cap Gr Ret	80.61
(14A)	ClearBridge Select FI	898.85	(14B)	Columbia Small Cap Growth I Adv	972.62
(15A)	ClearBridge Sustainability Leaders A	15.11	(15B)	Dana Small Cap Equity Institutional	15.40
(16A)	Columbia Large Cap Growth Opp A	1641.85	(16B)	Lord Abbett Developing Growth I	1979.71
(17A)	Driehaus Micro Cap Growth	282.41	(17B)	AB Core Opportunities Z	275.71
(18A)	DWS Capital Growth Institutional	1798.65	(18B)	Wells Fargo Opportunity Admin	1840.33
(19A)	DWS Large Cap Focus Growth C	289.46	(19B)	MassMutual Premier Disciplined Gr Svc	273.48
(20A)	Eventide Gilead N	2762.53	(20B)	Invesco Mid Cap Growth R	3230.18
(21A)	Green Century Equity Individual Investor	354.54	(21B)	LKCM Equity Instl	395.23
(22A)	Hartford Growth Opportunities HLS IB	1729.44	(22B)	JHancock U.S. Global Leaders Growth B	1776.42
(23A)	Hartford MidCap HLS IA	2160.72	(23B)	Great-West T. Rowe Price Mid Cp Gr Inv	2044.17
(24A)	Hartford Small Company A	676.93	(24B)	Thrivent Small Cap Stock A	711.91
(25A)	Highland Socially Responsible Equity A	80.30	(25B)	AMG Managers Cadence Mid Cap N	96.75
(26A)	Invesco Summit R5	2791.18	(26B)	Invesco Small Cap Growth Y	2749.78
(27A)	Jensen Quality Growth I	8676.86	(27B)	American Century Growth R	8913.22
(28A)	JPMorgan Intrepid Growth A	1219.69	(28B)	AB Growth I	1292.56
(29A)	JPMorgan Tax Aware Equity A	1288.26	(29B)	PGIM Jennison 20/20 Focus R6	1032.40
(30A)	MainStay Large Cap Growth B	12929.89	(30B)	Invesco American Franchise A	12278.41
(31A)	MFS Blended Research Growth Eq A	222.82	(31B)	Leland Thomson Reuters Vntr Cptl Idx C	186.16
(32A)	MFS New Discovery A	1731.46	(32B)	Hennessy Focus Investor	1761.43
(33A)	Morgan Stanley Inst Advantage IS	498.52	(33B)	Nationwide Geneva Mid Cap Gr R6	610.06
(34A)	Morgan Stanley Inst Discovery A	963.12	(34B)	Wells Fargo Omega Growth Admin	907.48
(35A)	Nuveen Winslow Large-Cap Growth ESG A	762.75	(35B)	Voya Russell Mid Cap Growth Idx Port I	629.19
(36A)	Praxis Growth Index A	350.87	(36B)	Victory RS Growth Y	278.04
(37A)	Quaker Impact Growth I	65.67	(37B)	Victory RS Small Cap Equity C	73.35
(38A)	RBC Small Cap Core A	141.64	(38B)	RMB C	115.58
(39A)	RBC SMID Cap Growth A	105.43	(39B)	Sit Small Cap Growth	106.61
(40A)	Tarkio	110.16	(40B)	JHancock Fundamental All Cap Core A	93.93
(41A)	Timothy Plan Aggressive Growth A	26.81	(41B)	Sparrow Growth No-Load	26.71
(42A)	Timothy Plan Large/Mid Cap Growth C	98.85	(42B)	Rydex S&P 500 Pure Growth C	85.05
(43A)	Trillium ESG Small/Mid Cap Inst	22.08	(43B)	Goldman Sachs Flexible Cap R6	21.68
(44A)	Zevenbergen Genea Institutional	44.26	(44B)	Loomis Sayles Small/Mid Cap Growth Instl	44.63

**Table A4.** Matched European ESG focused and conventional mutual funds with fund size on 17 February 2020. Source: Morningstar Direct.

ESG Funds			Conventional Funds		
Fund	Fund Name	Fund Size (€m)	Fund	Fund Name	Fund Size (€m)
(1A)	AAF-Hermes European Equities A €	250.58	(1B)	DPAM Capital B Equities EMU Index P Cap	217.06
(2A)	AIS Mandarine Active I	234.91	(2B)	HSBC GIF Euroland Growth M1D	235.96
(3A)	ALM Actions Zone Euro ISR IC	2095.22	(3B)	BGF Euro-Markets C2	1904.47
(4A)	ASR Euro Aandelen Fonds	20.98	(4B)	LAM-EURO-SMALL CAPS-UNIVERSAL	18.71
(5A)	Aviva Actions Euro ISR A/I	249.50	(5B)	C+F Euro Equities Acc	281.73
(6A)	AXAWF Fram Human Capital A Cap EUR	235.51	(6B)	DPAM Capital B Equities EMU Index F Cap	217.06
(7A)	Belfius Equities Europe S&M Caps C Cap	214.53	(7B)	Vendôme Sélection Euro PC	210.52
(8A)	BL-Equities Europe A EUR	1389.90	(8B)	BGF European Special Situations X2	1328.85
(9A)	BL-European Smaller Companies A EUR	213.11	(9B)	Quaero Capital Argonaut B-EUR	232.79
(10A)	BNP Paribas Euro Valeurs Durables C C	73.58	(10B)	SG Actions Euro Small Cap IC	87.27
(11A)	BNPP Multigestion ISR Actions Euro C	116.01	(11B)	Indosuez Euro Expansion G	130.22
(12A)	Candriam Business Equities EMU C Dis EUR	102.50	(12B)	Bankia Euro Top Ideas Universal FI	92.63
(13A)	CB European Quality Fund A	82.81	(13B)	Invesco Pan European Sm Cp Eq E EUR Acc	77.64
(14A)	Covéa Actions Croissance C	249.10	(14B)	UniEuropa Mid&Small Caps	259.80
(15A)	Echiquier Positive Impact Europe A	177.28	(15B)	Allianz Best Styles Euroland Eq A EUR	190.87
(16A)	Epargne Ethique Actions C	36.11	(16B)	New Millennium Euro Equities A	33.02
(17A)	Expert Euro ISR I	11.96	(17B)	BPI GIF BPI Euro Large Caps I	12.94
(18A)	Federal Optimal Plus ESG I	487.30	(18B)	IVI Umbrella IVI European EUR	496.25
(19A)	Fédérés Pro Actions ISR Euro MH A/I	351.81	(19B)	RAM (Lux) Sys European Equities IP EUR	357.70
(20A)	Fidelity Sustainable Euroz Eq A-Acc-EUR	285.33	(20B)	LBPAM Actions Midcap E A/I	245.34
(21A)	Hermes European Alpha Equity F EUR Acc	155.91	(21B)	BNP Paribas Best Sélection Euro C A/I	131.54
(22A)	HGA Actions ISR	301.36	(22B)	Ostrum Actions Small&Mid Cap Euro ID	317.49
(23A)	Impact ES Actions Europe I	1735.73	(23B)	BNP Paribas Euro Equity C C	1596.13
(24A)	Kempen (Lux) Sustainable Eurp Sm-Cp A	250.98	(24B)	JPM Euroland Dynamic A perf (dist) EUR	249.58
(25A)	Lazard Equity SRI C	208.10	(25B)	Esperia Fds SICAV Duemme Euro Eqs C Cap	200.60
(26A)	LFR Euro Développement Durable GP	105.07	(26B)	Eurizon Equity Euro LTE Z Acc	122.63
(27A)	LUX IM ESG Generali Invmts Euro Eqs DX	118.11	(27B)	HSBC Euro PME IC	124.72
(28A)	M&G Pan Eurp Sel Smllr Coms Euro A Acc	209.47	(28B)	Sextant PEA A	224.25
(29A)	Macif Croiss Dur et Solid Macif C	30.29	(29B)	CD Euro Capital C	26.01
(30A)	MAM Human Values C	40.32	(30B)	Eurovalor Bolsa Europea FI	40.71
(31A)	Mandarine Active G	244.93	(31B)	HANSAsmart Select E I	258.79
(32A)	Mirova Euro Sustainable Equity I/D EUR	789.57	(32B)	Allianz Europe Equity Gr Sel A EUR	762.72
(33A)	NN (L) European Sust Eq I Cap EUR	430.81	(33B)	HSBC GIF Euroland Eq Smllr Coms XC	427.88
(34A)	Nordea 1 - European Sm&Mid Cp Eq AP EUR	601.52	(34B)	Lazard Small Caps Euro R A/I	600.95
(35A)	Oddo BHF Avenir Euro CI-EUR	556.01	(35B)	UniDynamicFonds: Europa -net- A	497.52
(36A)	Ofi RS European Growth Climate Chng I	195.80	(36B)	AXA Indice Euro C	206.53
(37A)	Pramerica Azionario Etico	25.97	(37B)	WSS-Europa T	25.25
(38A)	Promepar Actions Rendement I A/I	67.15	(38B)	Moorea Fd Selection Europe RE	58.62
(39A)	RAM (LUX) - Ethik Quant Strategiefds P	7.98	(39B)	Calamatta Cuschieri Euro Equity A	6.62
(40A)	R-co 4Change Human Values C EUR	7.15	(40B)	Diversification CALM Eurozone Eq €A Inc	9.16
(41A)	Roche-Brune Europe Actions I	58.86	(41B)	SG Actions Euro PME C	56.61
(42A)	Schroder ISF EURO Equity A1 Acc EUR	3385.38	(42B)	Amundi Fds Euroland Equity F EUR C	3065.46
(43A)	Seeyond Equity Factor Investing Euro IC	24.56	(43B)	CS (Lux) Eurozone Active Opps Eq UB EUR	25.29

**Table A5.** Results (*p*-values) of the two-sample Kolmogorov-Smirnov (KS) and Wilcoxon signed-rank test. (*n* is the number of paired monthly return data points).

US funds				European Funds			
Pair Id	<i>n</i>	KS	Wilcoxon	Pair Id	<i>n</i>	KS	Wilcoxon
1	187	0.0001	0.1636	1	81	0.2478	0.9212
2	226	0.6228	0.9271	2	172	0.9726	0.2773
3	193	0.6902	0.7771	3	210	0.9980	0.8153
4	136	0.9271	0.1483	4	115	0.9436	0.5200
5	135	0.6604	0.3996	5	253	0.4735	0.0165
6	58	0.9155	0.7864	6	145	0.6047	0.6371
7	164	0.7723	0.2241	7	253	0.4079	0.0929
8	144	0.7948	0.9245	8	97	0.3484	0.8011
9	91	0.2325	0.0062	9	85	0.4773	0.2620
10	247	0.8836	0.2292	10	253	0.4079	0.0074
11	85	0.1991	0.0161	11	57	0.9824	0.2870
12	157	0.4707	0.4012	12	253	0.7655	0.9849
13	73	0.3807	0.5825	13	233	0.3003	0.9938
14	86	0.8537	0.0352	14	253	0.1382	0.5451
15	50	0.3959	0.0239	15	116	0.2198	0.1439
16	265	0.2272	0.6241	16	239	0.8713	0.0582
17	74	0.0247	0.4540	17	76	0.7973	0.2150
18	209	0.8136	0.7831	18	164	0.5886	0.0598
19	229	0.9944	0.4640	19	80	0.6953	0.0566
20	138	0.4765	0.0393	20	166	0.2832	0.4409
21	287	0.6250	0.9765	21	84	0.8438	0.8322
22	212	0.0824	0.0632	22	70	0.8787	0.0411
23	270	0.8610	0.0602	23	78	0.9766	0.1214
24	282	0.3054	0.3962	24	56	0.9807	0.8162
25	276	0.4634	0.6029	25	217	0.7572	0.0538
26	135	0.4623	0.5437	26	142	0.2040	0.2533
27	197	0.2620	0.4413	27	61	0.2760	0.1571
28	178	0.9415	0.4694	28	216	0.5153	0.1402
29	106	0.8394	0.1445	29	204	0.2299	0.2056
30	175	0.4574	0.8110	30	253	0.9384	0.8268
31	52	0.0264	0.1649	31	84	0.8438	0.4260
32	276	0.0489	0.2328	32	67	0.8617	0.8734
33	76	0.9039	0.0099	33	69	0.8733	0.8670
34	276	0.2477	0.7162	34	127	0.4232	0.9568
35	128	0.8296	0.4403	35	169	0.6994	0.0256
36	152	0.7307	0.0687	36	253	0.3481	0.7102
37	233	0.0187	0.9876	37	172	0.0107	0.3814
38	189	0.1938	0.8245	38	84	0.7238	0.4106
39	306	0.3530	0.4677	39	75	0.0162	0.2464
40	103	0.7167	0.8397	40	56	0.3361	0.0721
41	230	0.7877	0.6653	41	71	0.7621	0.0284
42	191	0.7682	0.0302	42	219	0.8974	0.5880
43	53	0.9724	0.4955	43	59	0.9854	0.2200
44	53	0.2048	0.0582				

**Table A6.** Actively managed sustainable funds which invest primarily in equities, are domiciled in the UK, and are in existence in the year 2000. The absence of a closure date means that the fund is ongoing as of October 2020. OCF = overall charge figure (October 2020).

Fund Name	Inception Date	Closure Date	OCF
Scottish Widows Ethical A	29 June 1987		2.50%
BMO Responsible UK Income 1 Acc	13 October 1987		1.50%
Jupiter Ecology	31 March 1988		1.50%
Kames Ethical Equity GBP A Acc	17 April 1989		1.50%
Sovereign Ethical	27 November 1989	30 October 2015	
OMR Quilter Investors Ethical	28 February 1992		0.76%
Friends Provident Pkg Ethical	26 November 1993	24 January 2001	
Friends Provident Ord Ethical	26 November 1993	24 January 2001	
Capita Finl Berkeley Scly Resp	03 January 1994	23 March 2004	
Elas Ethical DP Life	23 February 1994	26 July 2016	
Elas Ethical DP Pension	23 February 1994	26 July 2016	
Halifax Ethical Fund A	23 February 1994	11 April 2011	
Janus Henderson UK Responsible A Inc	15 May 1995		1.50%
CIM UT. Mgrs Co-op	19 May 1995	20 July 2001	
AP/Premier Ethical EP Pen	30 April 1996		1.10%
F& C UK Ethical SC2	11 October 1996	13 July 2009	
Merchant Inv Asr Ethical	12 December 1997	27 May 2005	
Old Mutual Ethical A	16 April 1998	30 April 2010	
Stan Life Ethical 1 Pen	30 June 1998		0.63%
SE Socially Responsible Eq Pen	01 September 1998		1.50%
Aegon UK Scly Resp A	08 September 1998	31 January 2003	
Aegon UK Scly Resp B	08 September 1998	22 January 2003	
Family Charities Ethical Tr Acc	31 March 1999		1.50%
Prudential Ethical A	06 April 1999	07 June 2012	
Aviva LT UK Ethical NU Pen	10 May 1999		0.45%
ASI Global Ethical Equity A Acc	21 May 1999		1.45%
L&G Ethical R	05 July 1999		0.45%
RLP Sustainable Leaders	29 October 1999		1.00%
Old Mutual Ethical	03 December 1999	30 April 2010	
Elas Ethical SP Pension	08 March 2000	26 July 2016	
Ethical AIM VCT	29 March 2000	17 January 2008	
CAF Scly Resp	24 October 2000	31 October 2006	
Standard 2 Ethical Pens.	30 October 2000	27 June 2014	

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