Can Water Mutual Funds Aid Sustainable Development?

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Abstract

We conduct the first comparative analysis of the financial performance of global water mutual funds with conventional, ecology and natural resources mutual funds. Based on a unique sample of 88 water, 198 ecology, 370 natural resources, and 7,437 conventional mutual funds covering the 2008 – 2017 period, we contrast the financial performance of these four different fund types. On average, water mutual funds perform comparably to conventional mutual funds and outperform ecology and natural resources funds. The performance dynamics is linked to the state of the economy, such that the outperformance by water mutual funds is not observed when markets are bearish. Overall, fund risk-adjusted performance is predominantly driven by investor activity, especially with regards to their perception of environmental regulatory risk profiles of funds' constituents.

JEL classification: F30, G11, G15, G23, M14

Keywords: Water mutual funds, ecological mutual funds, natural resources mutual funds, conventional mutual funds, financial performance assessment

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Can water mutual funds aid sustainable development?

"The ecosystems on which life itself is based – our food security, energy sustainability, public health, jobs, cities – are all at risk because of how water is managed today…"
World Bank Group President Jim Yong Kim, speaking in New York on 14th March 2018

1. Introduction

The indispensability of water cannot be exaggerated. According to the United Nations, 2.1 billion people lack access to safely managed drinking water services, while 340,000 children under five die every year from water-related diseases. Water is also fundamental in the pursuit of sustainable economic growth. The industrial and energy sectors consumed around 20% of the total global water used in 2015, and this demand is expected to rise to 31% by 2050. However, global water supply is limited because it is such a scarce and irreplaceable resource (WWAP, 2017). These differences between the growth in demand and supply could lead to severe shortages of water resources, undermining sustainable economic development in some of the most vulnerable countries. In recognition of this challenge, stakeholders are pressuring firms to adopt sustainable water policies in order to improve the capacity of water resources and generate social and economic benefits. However, implementing sustainable water management practices requires firms to make significant initial investments with long payback periods. One way of financing these large investments could be through the issuance of securities in financial markets to attract institutional investors with long-term investment horizons. Specialized mutual and pension funds can be persuaded to take water-related risks in the hope of gaining high returns in the long-term (OECD, 2016). Such demand should ensure a sustainable flow of funds into global water management.

Water mutual funds, defined as funds holding portfolios made up of at least 50% of equity assets in the firms involved, focusing on water utilities, infrastructure, equipment and materials, constitute a rapidly growing asset class. Although the first water specialized mutual fund was launched in 2000, by May 2017 there were approximately one hundred water mutual funds with an estimated total of USD 9,917B under management.[1] Therefore, water mutual funds as an asset class could prove an important vehicle for sustainable investment. Based on the implicit assumption that the investment driver for water industry investors is similar to that of conventional investors, i.e. financial utility, in this paper we investigate whether water mutual funds could sustainably support the growth of the global water industry. Water funds, managed on behalf of investors seeking long-term investment opportunities linked with the rapid growth of the global water market, integrate sustainable water principles into portfolio management without sacrificing investor wealth.[2] The effectiveness of water mutual funds as an asset class that matches firms' long-term large financing needs for water management with investors' high investment return requirements in the long-term depends on the ability of water mutual fund managers achieving the high risk-adjusted returns that are attractive to investors. Hence, an examination of the financial performance of water related mutual funds is of utmost importance to an increasing number of investors and policy makers looking to bolster investment in water resourcing. This is the first study to conduct a large sample analysis of the performance of water mutual funds. We also compare their financial performance against that achieved by their ecology, natural resources, and conventional peers, while taking into account economic variables and fund characteristics.

From a modern portfolio theory (see Markowitz, 1952) perspective, the imposition of a sustainable water management criterion on the constitution of a fund could negatively influence the financial performance of that fund. This is due to the sustainable water screen reducing the universe of stocks in which the mutual fund can invest in. Such restrictions erode the benefits of diversification and may lead to the fund performing worse than a conventional

[1] These estimates are based on Morningstar and Thomson Reuters data.
[2] The value of the water resources market has grown from USD 365 billion in 2008 to USD 714 billion in 2016; an increase of 3.8% by 2020 is also forecasted (GWI, 2016).

fund or others with fewer screens. The latter group includes funds with a more diversified portfolio that incorporates a lower investment weight of stocks in water management-related firms, such as ecology or natural resources. Ecology funds, for example, by definition invest at least 50% of equity assets in a mix of firms promoting a cleaner environment, focusing on sustainable energy, pollution control and water treatment issues, with the weight of each sub-class lower than 50% within the whole portfolio. Natural resources funds invest a minimum of 50% of equity assets in a mix of firms related to energy, mining, timber, and water issues, with the weight of each sub-class lower than 50% within the portfolio. However, the diversifiable risk of a portfolio with stocks concentrated on a small number of industries could be substantially reduced by ensuring good geographical diversification (see Solnik, 1995), which may lead water mutual funds – almost all of which invest globally – to perform similarly to global ecology, natural resources and conventional funds.

On the other hand, the preference of global water, ecology and natural resources mutual fund managers for medium (water funds) and large (ecology and natural resource funds) stocks suggests improved financial performance. This is because the projects that water, ecology and natural resources firms engage in require large initial investment outlays and involve high production and innovation costs. Although this reduces financial performance in the short-term (see Friedman, 1970; Silva and Cortez, 2016), the firms, especially those implementing environmental management practices related to water and clean technology, could receive public funds from governments (OECD, 2016), for example in the form of feed-in-tariffs. Such public finance support encourages reductions in the amount of natural resources and energy used, as well as wastewater and other pollutants generated in the benefitting firm's production processes. This inevitably leads to a decrease in their operational costs and an increase in earnings in the long-term. Furthermore, a stakeholder theory perspective (see Freeman, 1984) considers that a more efficient use of natural resources allows firms to offer products that are more attractive to environmentally conscious customers, thereby improving their reputation and revenues. Thus, global water and ecology mutual funds could benefit from improvements in the profitability of water and cleaner environment-related firms in the long-term. The enactment of environmentally-friendly legislations may also benefit the funds and lead to their outperforming global conventional and natural resource mutual funds and market benchmarks. However, the literature on the plausibility of these theories is limited. The only study to explicitly examine the financial performance of water-related mutual funds is that by Alvarez and Rodríguez (2015), who analyse the performance of specialised water funds using Jensen's (1968) model on a sample of five US water mutual funds for the 2007–2012 period. They find that water mutual funds achieve a similar financial performance to both conventional and thematic (water specialized) market benchmarks.

The assessment of water-related investment strategies implemented by mutual funds has mainly received attention in the finance literature as part of the broader stream of green investment literature. The first study to assess the financial performance of green mutual funds was by White (1995), who employed the Jensen's (1968) model using a sample of six US and five German green mutual funds, White (1995) finds that US green funds underperformed compared with both conventional and socially responsible investment (SRI) benchmarks, while German green funds performed similarly to the overall German market during the 1990-1993 period. Extending this line of enquiry, Climent and Soriano (2011) incorporate style factors into Jensen's model, as proposed by Carhart (1997), to evaluate the financial performance of seven green funds and compare it with those of 14 SRI and 28 conventional funds in the US market during the 1987–2009 period. Their findings indicate that green mutual funds underperform compared with both the market benchmark and their conventional peers, but they perform similarly to SRI funds. Likewise, Ibikunle and Steffen (2017) examine a sample of European mutual funds consisting of 175 green, 259 black and 976 conventional mutual funds for the 1991-2014 period. Their results are consistent with those of Climent and Soriano (2011) for green and conventional funds, while they find no significant differences between the financial performance of green and black (fossil energy and natural resource) funds. However, the financial performance of US and European green mutual funds improves in comparison to that of conventional mutual funds when more recent time periods are considered. This could be an indication of different states of the economy influencing the financial performance of funds. It could also reflect a growing consciousness among investors of the policy-related riskiness of less environmentally inclined portfolios.

The above cited works represent only a fraction of the literature on the performance of environmentally themed funds. Silva and Cortez (2016) also evaluate the financial performance of 9 US and 95 European global green mutual funds from 1996 to 2015. They find that green mutual funds tend to perform below the benchmark, especially in non-crisis periods in the European market. Examining the evidence at the aggregate level, Muñoz et al. (2014) use a sample of 18 US and 89 European green funds, 54 US and 267 European conventional funds, and 65 US and 211 European ESG funds from 1994 to 2013. Their findings show that the negative financial performance of ESG funds relative to conventional funds is eliminated in the European green funds with a global focus for the full sample, and for subsamples, when different states of the economy are controlled for. Specifically, they report that green funds' performance is similar to that of their conventional counterparts during non-crisis periods. Conversely, however, US green funds with a global investment focus perform significantly below the market and their conventional peers, even during non-crisis periods (see also Lesser et al., 2016).

Muñoz et al. (2014) also investigate the relevance of management in green funds' performance. They find no evidence of successful stock-picking and market-timing abilities for global green mutual fund managers. However, the state of the economy affects green fund management in the opposite direction, depending on the geographical market. While US green fund managers achieve higher risk-adjusted returns in crisis periods than their European peers, the opposite occurs in non-crisis periods. These differences in the financial performance of global green funds could be due to differences in fund characteristics, such as size, expenditure and SRI certification, among others. However, analysis of the relationship between the financial performance of green funds and their characteristics has received less attention in the academic literature, and most of the empirical evidence is focused on comparisons with conventional mutual funds. This is surprising given that fund characteristics potentially play a significant role in fund performance. For example, large mutual funds could benefit from economies of scale to outperform small mutual funds in the global mutual fund market, as argued by Vidal-García et al. (2016). The existence of scale economies allows funds to reduce operating costs and therefore their total expense ratio. This improves the financial performance of mutual funds, as shown by Otten and Bams (2002), Gil-Bazo and Ruiz-Verdú (2009), and Ferreira et al. (2013).

However, excessively large mutual funds may find it difficult to trade large blocks of stocks concentrated in one geographical market. This could lead to liquidity constraints and diseconomies of scale in the local mutual fund market. Such adverse scale effects could be mitigated by extending funds' investment opportunities to international markets, as pointed out by Ferreira et al. (2013). Given that water mutual funds typically invest in a geographically global market, the effect of fund size on their financial performance should be positive. Nevertheless, management costs could increase due to the diversification costs required to manage mutual funds certified as socially responsible investments on an international scale, thus worsening the financial performance of funds. This view is consistent with the modern portfolio theory (see Markowitz, 1952) perspective. SRI certification implies that water- and ecology-related mutual fund managers have to implement additional social and governance screening measures. Screening reduces portfolio diversification opportunities in comparison to other funds of similar sizes, and therefore increases portfolio risk. However, this effect could be mitigated for mutual funds investing in international stock markets (Solnik, 1995), given that a wider geographical spread offers diversification opportunities. Furthermore, the adoption of ESG screening requires that managers seek environmental, social, and governance information in specialized environmental or sustainability reports, thereby increasing selection and search costs (Revelli and Viviani, 2015). This cost increases when portfolios contain a larger spread of instruments across industries and regions/countries. However, the diversification benefits may also serve to offset this cost by reducing performance risks.

In this paper, we examine the above-enumerated issues. Specifically, we address three issues. Firstly, we analyse the financial performance of water mutual funds using both unconditional and conditional models. Secondly, we estimate the financial performance of water mutual funds relative to ecological, natural resources, and conventional mutual funds. This has welfare implications given that the weight of water-related equities in a portfolio could influence long-term financial performance, and therefore investors' decisions, which would then have implications for the funding of sustainable water projects. Thirdly, we examine the effect of mutual fund characteristics and management on the financial performance of funds. We find that, on a risk-adjusted basis, water mutual funds perform comparably to conventional mutual funds and outperform ecology and natural resources funds. This performance is, however, dependent on the state of the economy. The outperformance of water mutual funds over their peers is only observed when markets are bullish; when markets are bearish, the effect dissipates. These performance dynamics appear to be predominantly driven by investor activity in the market rather than managerial skills. We also find that investors, increasingly aware of the regulatory risk associated with investing in *pollutive* stocks, are demanding higher returns for investing in those stocks and related assets, such as mutual funds. However, for assets such as water mutual funds that are already viewed as cleaner than many others, an increasing demand for higher returns is not observed.

2. Data

2.1 Fund sample description

We first obtain our sample of water, ecological, and natural mutual funds data from the Morningstar database. We manually check that each water fund in the sample invests at least 50% of equity assets in water-related companies, i.e. water utilities and infrastructure, water equipment and materials, and water management. We follow the same threshold for the other two classes of specialized funds. Specifically, we ensure that each ecology and natural fund invests more that 50% of equity assets in ecology-related companies (a mix of alternative energy, pollution control, water treatment, and energy efficiency companies) and natural resource companies (a mix of energy, mining, timber, and water related companies) respectively. For ease of matching funds across various databases, each fund is identified by its ISIN. We also obtain a sample of global equity mutual funds domiciled around the world from the Thomson Reuters EIKON/Datastream database. The data includes ISINs, country of domicile, SRI label certification, fund status (whether active, merged, or liquidated), monthly total expenses ratio, monthly total net assets under management, and daily price data (net asset value) in US dollars. The dataset extends from 1st February 2008 to 31st May 2017. Using the ISINs, we match the data from both databases. We thereafter categorise the mutual funds investing in global equities as follows: water, ecological, natural resources, and conventional mutual funds. All sector-specific conventional funds are eliminated, therefore the conventional mutual funds category refers only to global equity funds investing in an unrestricted universe.

We apply several filters in order to ensure data quality. Firstly, mutual funds in the sample must be allocated an ISIN code in both databases. They must also have data on the country of domicile, SRI certification/labelling, mutual fund status (active, merged, or liquidated), monthly total net assets under management, monthly total expenses ratio, and daily price data (Ferreira et al., 2013). Secondly, in order to ensure that the factor regressions are reliably estimated, we only retain funds with at least 24 months of data (Lean et al., 2015; Silva and Cortez, 2016).[3] Thirdly, consistent with Ferreira et al. (2013), we winsorise the data at the 1% level. Fourthly, in the spirit of Ibikunle and Steffen (2017), we include all active, liquidated and merged funds in order to obtain a survivorship bias-free sample.[4] Finally, for consistency (see for example, Ferreira et al., 2013), only water/ecological/natural funds that are commercialized in countries with a minimum of 11 funds are included in the sample. Our final sample includes 8,093 funds domiciled in 24 countries, of which 5,869 are active funds, 1,005 are merged funds, and 1,219 are liquidated funds as at 31st May 2017.

2.2 Fund returns, benchmark indices and factors

For each fund in our sample, we calculate its daily return as the difference between the Napierian logarithm of daily net asset value (price expressed in US dollars) at moment *t* and at moment *t*-1. We use a conventional global market index (S&P Global 1200 Index) and sector (thematic) indices (S&P Global Water Index, S&P Global Ecology Index, and S&P Global Natural Resources Index), all obtained from the Datastream database, as market benchmarks. We also obtain daily size, value, and momentum global factors from the Kenneth R. French

[3] We acknowledge that this could induce a look-ahead bias (see Vidal-García et al., 2016). However, the impact of such bias is minimal, given that only a small fraction of funds is eliminated based on this exclusion criterion.

[4] Previous researchers argue that employing only surviving funds in analyses of this nature leads to an overestimation of the average conventional mutual fund performance, thus resulting in what is known as survivorship bias (see as an example, Brown et al., 1992). Environmental/green funds' performance studies generally address this by including non-surviving funds (dead funds) in their samples (see as examples, Climent and Soriano, 2011; Ibikunle and Steffen, 2017; Nofsinger and Varma, 2014).

data library. Since the S&P Global Natural Resources Index has only been available since June 2008, and daily global factors are only available until May 2017, our analysis covers the nine-year period from June 2008 to May 2017. The daily excess return is computed using the daily US one-month treasury bill rate as the risk-free rate, as in Ferreira et al. (2013); the treasury bill rate is also obtained from the Kenneth R. French library. Finally, we obtain the daily yield on a constant-maturity 3-month US treasury bill, Moody's BAA-rated corporate bond yield per day, and Moody's AAA-rated corporate bond yield per day from the Federal Reserve Bank of St Louis, as proxies of the state of the global economy.

Table 1 reports the summary statistics for the water, ecology, natural resources, and conventional funds. With 88 funds (including 76 surviving ones), water funds are the smallest of the reported funds. Based on our sample, they are also the least risky in terms excess returns variation (annualized standard deviation of 0.95%), while offering the highest mean excess returns across the funds with an annualized mean excess return of 6.09%. This level of return is almost twice as high as the mean excess return for conventional funds (3.74%) and more than four times the return for ecology funds (1.38%), despite both having larger universes of instruments to select from. The natural resources funds in our sample on average offer only negative excess returns at -6.94% per fund. Ecology funds have the smallest average fund size with a typical ecology fund having $54.70M in net assets under management. One would normally expect that conventional funds would have the least risky profile given that they have the least level of restriction with respect to investment avenues. However the fact that, of the 7,437 conventional funds in our sample, 625 have ethical certifications implies investment restrictions. The comparatively higher risk profile (in comparison with water) could be linked to the fact that the funds do not fully benefit from portfolio diversification.

INSERT TABLE 1 ABOUT HERE

As expected, on average conventional funds are the largest funds, with an average size of $124M under management. However, water natural resources and water funds are not far behind, with average net assets under value estimates of $110M and $102M respectively. Also consistent with our expectations, conventional funds on average charge the lowest total expenses per fund, with an average total expenses ratio of 1.61%. Water, natural resources, and ecology charge 1.80%, 1.81%, and 1.93% respectively.

3. Empirical analysis

In this section, we outline the methods for computing abnormal performance and managerial abilities, and conduct the corresponding analyses. Firstly, we contend with the identification of crisis and non-crisis periods, which incidentally are both represented in our sample period.

3.1 Information on economic conditions

Different states of the market could affect mutual fund performance, as argued by Leite and Cortez (2015), Nofsinger and Varma (2014) and Silva and Cortez (2016). Hence, we investigate the performance of the funds while delineating the crisis and non-crisis periods during the period May 2008 – May 2017. We adopt the approach of Pagan and Sossounov (2003), which is based on distinguishing bull and bear markets and examining the peaks and troughs of a relevant market index. Thus, a peak occurs at time t when $ln(P_{t-8},\ldots, P_{t-1}) < ln(P_t) > ln(P_{t+1},\ldots, P_{t+8})$, while a trough exists when $ln(P_{t-8},\ldots, P_{t-1}) > ln(P_t) < ln(P_{t+1},\ldots, P_{t+8})$, where P_t is the value of the market price index. A downward trend in the prices of the market index instrument of at least 20% from peak to trough shows the existence of a crisis period. Using the S&P Global 1200 Index as the relevant market index, we identify one crisis period from May 2008 to July 2009, which corresponds to the global financial crisis and is congruent with Nofsinger and Varma (2014), Silva and Cortez (2016), and the National Bureau of Economic Research (2012). This approach allows us to distinguish between periods of crisis and non-crisis. However, it does not allow us to control for the phase of the crisis or non-crisis periods. To overcome this, we consider the information on global economic conditions by means of the short-term rate and the default spread rate, which have been commonly adopted in previous studies (see as an example, Silva and Cortez, 2016). We use the 12-month moving average yield on a constant-maturity 3-month US Treasury Bill as a proxy of the global short-term rate. This reduces spurious correlation bias. For the global default spread rate, we employ the 12-month moving average of the difference between Moody's BAA-rated corporate bond yield and Moody's AAA-rated corporate bond yield in the US market over the May 2007 to May 2017 period. Both of these are useful predictors for explaining global stock returns (Leite and Cortez, 2014).

3.2 Performance evaluation models

In order to examine water mutual funds' performance on a risk-adjusted return basis relative to ecology, natural resources, and conventional funds, we apply both unconditional and conditional versions of the multifactor Carhart model (1997) based on the CAPM framework. The unconditional model includes the market benchmark factor proposed by Jensen (1968), and size and book-to-market factors proposed by Fama and French (1993) to capture small-scale risk exposure and bankruptcy risk respectively, as well as the momentum factor incorporated by Carhart (1997) which aims to control for the Jegadeesh and Titman (1993) momentum anomaly. This approach is commonly accepted in the literature for analysing green, socially responsible, and conventional mutual fund performance (Climent and Soriano, 2011; Muñoz et al., 2014; Lean et al., 2015) due to its ability to overcome the shortcomings of the traditional Jensen model (1968) and to explain cross-sectional variation in returns. We extend the Carhart (1997) model by introducing a dummy variable that allows us to control for the mutual fund types (water, ecology, natural resources, and conventional) as follows:

$$r_{\mathrm{p,t}} - r_{i,t} = D_{class}\left[\alpha + \beta_{MKT}\left(r_{\mathrm{m,t}} - r_{i,t}\right) + \beta_{SMB} r_{smb,t} + \beta_{HML} r_{hml,t} + \beta_{WML} r_{wml,t} + \mu_{p,t}\right]$$

[1]

where $r_{p,t}$ is the equally weighted average daily fund return for water, ecology, natural resources, or conventional mutual fund portfolio p at time *t*. $r_{i,t}$ is the daily return of the 30-day T-bill rate, which is a proxy for the risk-free rate at time *t*. D_{class} is a dummy variable taking the value of 1 if the fund belongs to the indicated class (water, ecology, natural resources, or conventional) and 0 otherwise. α represents the average annualized four-factor adjusted return on portfolios whose positive (negative) and statistically significant value indicates that funds outperform (underperform) the factor portfolios, while an insignificant value indicates that mutual funds perform similarly to the factor portfolios. $r_{m,t}$ is the return of the market benchmark which corresponds to a conventional global equity market index (S&P Global 1200 Index) or the corresponding sector index (S&P Global Water Index for water funds, S&P Global Ecology Index for ecology funds, S&P Global Natural Resources Index for natural resources funds, and S&P Global 1200 Index for conventional funds) at time *t*. $r_{smb,t}$ is the differential return between a portfolio of small cap and a portfolio of large cap firms at time *t*; $r_{hml,t}$ is the differential return between a high book-to-market stocks portfolio (value) and a low book-to-market stocks portfolio (growth) at time *t*; $r_{wml,t}$ is the differential return between a portfolio of stocks with high previous year returns (winners) and a portfolio of stocks with low previous year returns (losers) at time *t*. β_{MKT}, β_{SMB}, β_{HML} and β_{WML} represent the coefficients measuring the factor loadings of the four investment style factors. $\mu_{p,t}$ is the error term in fund *f* at time *t*.

For comparability, we also contrast water fund performance against each of the other fund classes, i.e., ecology, natural resources, and conventional fund performance, by generating three "difference" portfolios. The portfolios are constructed by subtracting ecology, natural resources, and conventional fund excess returns respectively from water fund excess returns. These portfolios allow us to detect an eventual average over- or underperformance of water funds relative to each of the other fund classes (ecology, natural resources, and conventional funds) and to attribute differences in the financial performance between water funds and other mentioned funds to sustainable water screens.

INSERT TABLE 2 ABOUT HERE

Table 2 presents the results from the estimation of Equation (1). The estimated coefficients for the equally weighted portfolio of funds are presented along with the R^2 values for each estimation row. Panel A employs the S&P Global 1200 index as the market benchmark, while Panel B uses a series of benchmarks. Specifically, in Panel B, S&P Global Water, S&P Global Ecology, S&P Global Natural Resources, and S&P Global 1200 indices are used as market benchmarks for the water funds sector, ecology funds sector, natural resources funds sector, and conventional funds, respectively.

The first main observation from the estimated values in Panel A is the fact that none of the mutual fund classes outperform the market benchmark. This is similar to the findings in the previous literature (see as an example Ibikunle and Steffen, 2017). While no classes outperform the market, only with respect to natural resources is there reliable evidence of underperformance relative to the benchmark, with an annualized alpha estimate of -0.117, which is statistically significant at 0.01 level. The natural resources fund class also experiences the highest exposure to market risk with a statistically significant coefficient value of 0.911. Water funds exposure to market risk holds up well against the other fund classes (β_{MKT} coefficient = 0.789, p-value<0.01). Therefore, the restriction of the universe of instruments that can be included in water funds with a global investment strategy appears not to have significantly increased the riskiness of the funds. All fund classes experience a significantly enhanced exposure to small cap stocks; however, the exposure is larger for natural resources, ecology, and water, with respective β_{SMB} coefficient estimates of 0.611, 0.576 and 0.454. Hence, it does appear that specialized investment screening processes are more likely to exclude large cap stocks (see also Cortez et al., 2012).

The estimates from the analysis on the comparative performance of water versus other fund types suggests that water mutual funds on average outperform all of the other fund types. While the annualized alpha estimates are statistically significant at 0.01 level for both ecology and natural resources, the outperformance over conventional funds is not statistically significant. The β_{HML} estimate for water funds is not statistically significant; however, the corresponding estimate for the comparative estimation versus ecology, natural resources, and conventional funds are all negative, at -0.054, -0.393 and -0.029 respectively, with the water-ecology and water-natural resources estimates statistically significant at 0.05 and 0.01 levels respectively. These estimates imply that water funds are more likely than the three other classes to invest in fast growing firms. This is consistent with the investment predisposition of responsible and environmental fund-types (see Luther et al., 1992 and Kreander et al., 2005). Consistent with the above estimates, especially in relation to natural resources, Bauer et al. (2005) argue that a large proportion of growth stocks exist to the exclusion of traditional value sectors such as energy and basic industries. Hence, while water funds would normally exclude these stocks, other fund-types, such as those with a natural resources focus, are likely to include them. The 0.329 β_{HML} (p-value<0.01) estimate for natural resources, which is the largest for all of the fund types, is consistent with this narrative. Natural resources funds invest in energy and similar industries. These stocks are typically high book-to-market types.

Results in Panel B of Table 2 are generally consistent with the estimates presented for Table 1. This is not surprising given the level of co-movements across global markets and sectors.

The unconditional performance model as expressed in Equation (1) suffers from limitations due to the assumption that the expected returns, betas and factor risk premiums are time invariant. In order to overcome this, we assess the fund risk-adjusted return over different market states by employing a conditional model that incorporates [1] two dummy variables, identifying crisis periods/recessions and non-crisis periods in the regression model, consistent with Nofsinger and Varma (2014):

$$r_{\mathrm{p,t}} - r_{i,t} = D_{class}\left[\alpha_c D_{c,t} + \alpha_{nc} D_{nc,t} + \beta_{MKT}\left(r_{\mathrm{m,t}} - r_{i,t}\right) + \beta_{SMB} r_{smb,t} + \beta_{HML} r_{hml,t} + \beta_{WML} r_{wml,t} + \mu_{p,t}\right] \quad [2]$$

where $D_{c,t}$ represents a dummy variable that takes a value of 1 in crisis periods and a value of 0 in non-crisis periods at time *t*, while $D_{nc,t}$ is a dummy variable that takes a value of 1 in non-crisis periods and a value of 0 otherwise at time *t*. The other variables are as previously defined.

INSERT TABLE 3 ABOUT HERE

The results for the estimation of Equation (2) are presented in Table 3. The alpha estimates obtained for the non-crisis period are highly consistent with the estimates obtained from the estimation of Equation (1), while none of the alpha estimates for the crisis periods are statistically significant. All of the other sets of estimates are in line with the results in Table 2. Hence, it appears that during periods of crisis, when markets are in full retreat, none of the portfolios examined outperform the conventional or sector benchmarks. Furthermore, during these periods, the outperformance of the water funds over the ecology and natural resources funds appears to dissipate. These results show that, as expected, fund performance is dependent on the state of the economy. The additional finding here is that the performance dynamics between various portfolios, such as evidenced in Table 2 between water funds on the one hand and the natural resources and ecology funds on the other, are also dependent on the state of the economy. One implication of this finding is that the development and investment in the water supply and similar industries is driven by a surging level of investment in global financial markets. This is consistent with the argument that an overall global bullish stock market and soaring oil prices are the key drivers for investment in certain sectors such as the renewable energy sector, which in turn leads to improved green portfolio performances (see Ibikunle and Steffen, 2017; Kumar et al. 2012; Bohl et al. 2015; Sadorsky 2012; Inchauspe et al. 2015). Indeed Bohl (2015) points out that the renewable/alternative energy stocks fell in the aftermath of the global financial and economic crisis.

The conditional Equation [2] described above has also been criticized because it fails to capture economic growth (recession) acceleration and slowdown and it assumes that investors do know ex ante the conditioning global economic information on the business cycles (see Kosowski, 2011; Silva and Cortez, 2016). Mutual fund investors rely on the fund manager to make their investment decisions, taking into account his/her recommendation, marketing strategy and/or fund performance information (Gruber, 1996) which only becomes available ex post. Therefore, we propose an alternative conditional model, which extends the Christopherson et al. (1998) and Ferson and Schadt (1996) models on the assumption that the performance and the risk factors measured in Equation [1] change over time according to a set of lagged global economic information variables. The new model is as follows:

$$r_{\mathrm{p,t}} - r_{i,t} = D_{class}\Big[\alpha + \alpha' \mathrm{Z}_{\mathrm{t}-1} + \beta_{MKT}\big(r_{\mathrm{m,t}} - r_{i,t}\big) + \beta_{MKT}{}'\big(r_{\mathrm{m,t}} - r_{i,t}\big)Z_{t-1} + \beta_{SMB}r_{smb,t} + \beta_{SMB}{}' r_{smb,t}Z_{t-1} + \beta_{HML}r_{hml,t} + \beta_{HML}{}' r_{hml,t}Z_{t-1} + \beta_{WML}r_{wml,t} + \beta_{WML}{}' r_{wml,t}Z_{t-1} + \mu_{p,t}\Big] \quad [3]$$

where α represents the average annualized conditional four-factor adjusted return on portfolios, α' represents the relationship between conditional four-factor adjusted return and the information variables, Z_{t-1} represents the vector of lagged information variables (global short-term interest rate and the default spread rate), the coefficients $\beta_{MKT}, \beta_{SMB}, \beta_{HML}, \beta_{WML}$ are the average factor loadings of the four investment style factors which represent the unconditional mean of the conditional betas, and the coefficients $\beta_{MKT}', \beta_{SMB}', \beta_{HML}', \beta_{WML}'$ measure the relationship between conditional factor loadings of the four investment style factors and the information variables. The other variables are as previously defined.

In the regression models [1], [2] and [3], we compute Driskoll and Kraay's (1998) standard errors. This approach uses a panel nonparametric procedure similar to the Newey-West type correction to generate estimators robust to heteroskedasticity, cross-sectional and temporal dependence while eliminating the deficiencies of Beck and Katz's (1995) panel corrected standard errors, the Newey and West method and the Parks-Kmenta method when the cross-sectional dimension N is large (see Hoechle, 2007).

INSERT TABLE 4 ABOUT HERE

Table 4 presents the results for the estimation of Equation (3). Consistent with the observations from Table 3, where the estimates are statistically significant, the findings are largely in line with the estimates presented in Table 2. A notable exception is the negative and statistically significant β_{HML} value for conventional funds, suggesting that conventional funds are more likely to invest in high growth stocks, typically, the smaller stocks, than the low growth/large ones. This is inconsistent with the previous estimates and the positive and statistically significant β_{SMB} estimate for the fund type in Table 4. It is also noteworthy that the R^2 values are larger for the estimations in Table 4 than in Table 2. Overall, the estimates in Tables 3 and 4 underscore the validity of our model specification in Equation (1).

3.3 Selectivity and market timing model

We next focus on a critical aspect of portfolio performance: managerial abilities. This is an important aspect to explore given that the observed positive over-performance of water funds when compared to ecology and natural resources funds observed in Section 3.2 may be a function of managerial competence. The manager's contribution to mutual fund performance could be due to his/her stock selection and/or market timing abilities (Treynor and Mazuy, 1966). In order to assess and compare the stock-picking and market timing abilities of water fund managers on the one hand and those of ecology, natural resources, and conventional fund managers on the other, we extend Equation (3) by incorporating an additional timing risk factor as proposed by Bollen and Busse (2001). This timing risk factor allows us to evaluate the managers' timing abilities in relation to the market, as shown in Equation (4):

$$r_{\mathrm{p,t}} - r_{i,t} = D_{class}\Big[\alpha + \alpha' \mathrm{Z}_{\mathrm{t-1}} + \beta_{MKT}\big(r_{\mathrm{m,t}} - r_{i,t}\big) + \beta_{MKT}{}'\big(r_{\mathrm{m,t}} - r_{i,t}\big)Z_{t-1} + \beta_{SMB} r_{smb,t} + \beta_{SMB}{}' r_{smb,t} Z_{t-1} + \beta_{HML} r_{hml,t} + \beta_{HML}{}' r_{hml,t} Z_{t-1} + \beta_{WML} r_{wml,t} + \beta_{WML}{}' r_{wml,t} Z_{t-1} + \beta_{MKT}^{2}\big(r_{\mathrm{m,t}} - r_{i,t}\big)^{2} + \beta_{MKT}^{2}{}'\big(r_{\mathrm{m,t}} - r_{i,t}\big)^{2} Z_{t-1} + \mu_{p,t}\Big] \quad [4]$$

where α is the annualized conditional portfolio alpha, measuring the fund managers' selectivity skills, i.e. the managers' ability to select stocks that outperform other equities with a similar level of systematic risk, and β_{MKT}^{2} is the average conditional factor loadings of the market timing risk factor which represents the fund managers' market timing ability, i.e. the skill to time when the market rises and falls. If α and β_{MKT}^{2} coefficients are positive and significant, managers have successful selectivity and market timing abilities, respectively, but if they are negative and significant, managers have poor stock-picking and market timing abilities, respectively. The insignificant coefficients indicate the managers' lack of ability to select assets and to time the market, respectively. Driskoll and Kraay's (1998) standard errors are used for statistical inference. The results for the estimation of Equation (4) are presented in Table 5.

INSERT TABLE 5 ABOUT HERE

In Panel A, both the stock picking and timing abilities coefficient estimates are statistically significant for natural resources funds. While the former is negative (-0.35, p-value = <0.01), the latter is positive (5.53, p-value = <0.05). This implies that, on average, while natural resources fund managers are not quite adept at stock picking, on average they appear to time their entry and exit from stock positions very well. The contradictory effects of the two abilities suggests that the average effect of managerial abilities on the funds is nil. For water, ecology, and conventional funds, the stock picking coefficient estimates are not statistically significant, suggesting that the effect of stock picking ability is non-existent for those funds. For water and ecology funds, there is some evidence of stock timing abilities with estimates of 3.04 and 3.43 respectively; however, the estimates are only statistically significant at 0.1 level of statistical significance. The estimates in Panel B are largely consistent with the estimates in Panel A. The most important takeaway from this analysis is that the performance of the funds are predominantly driven by investor activity/the market rather than managerial skills, thus lending support to the finding that, on average, water funds offer higher returns than ecology and natural resources funds on a risk-adjusted basis. This is driven by the choice of firms that water funds typically invest in, which are small and fast growing.

3.4 The effects of mutual fund characteristics on fund performance.

Previous researchers have found that the characteristics of mutual funds, such as size or expenses, influence their performance. This effect could be present in our sample. For this reason, we analyze whether size, expenses and SRI labelling of funds affect mutual fund performance using the following models for the full sample of funds (Equation 5) and for each specific fund category (Equation 6), respectively:

$$\left(r_{p,t} - r_{i,t}\right) = \alpha_0 \sum_{class=1}^{4} D_{class} + \alpha_4 \sum_{class=1}^{4} D_{class} * Crisis_t + \alpha_8 \sum_{class=1}^{4} D_{class} * Ethical_p + \beta_{MKT}\left(r_{m,t} - r_{i,t}\right) + \gamma_0 LTNA_{p,t} + \gamma_1 TER_{p,t} + \mu_{p,t} \quad [5]$$

$$\left(r_{p,t} - r_{i,t}\right) = \sum_{class=1}^{4} D_{class}\left[\alpha_0 + \alpha_4 Crisis_t + \alpha_8 Ethical_p + \beta_{MKT}\left(r_{m,t} - r_{i,t}\right) + \gamma_0 LTNA_{p,t} + \gamma_1 TER_{p,t} + \mu_{p,t}\right] \quad [6]$$

where $r_{p,t}$ is the equally weighted average daily fund return at time t and $r_{i,t}$ is the daily return of the 30 day T-bill rate at time t. α_{0p} represents the average return earned by water mutual funds, while α_1, α_2 and α_3 correspond to the additional annualized average return earned by ecology, natural resources, and/or conventional mutual funds respectively. α_4, α_5, α_6 and α_7 are the additional annualized average return earned by water, ecology, natural resources, and/or conventional funds in times of economic crisis. D_{class} is a dummy variable taking a value of 1 if the fund belongs to an indicated class (water, ecology, natural resources, or conventional) and 0 otherwise, and *Crisis* is a dummy variable that takes the value of 1 if time t is defined as a period of economic crisis and 0 otherwise. Ethical is a dummy variable that takes the value of 1 if a fund is SRI-certified and 0 otherwise, while $r_{m,t}$ is the return of the market benchmark, which is a sector index at time t. *LTNA* is the three-month retarded Napierian logarithm of monthly total net assets for fund p at time t, and *TER* is the three-month retarded monthly total expense ratio for fund p at time t. The three-month retardation is applied in order to avoid spurious correlation problems (Vidal-García et al., 2016). β_{0p}, is the coefficient measuring the systematic risk, and $\mu_{p,t}$ is the error term in fund f at time t. We estimate both models by implementing Petersen's (2009) approach that introduces a double cluster by time and mutual funds in order to generate robust standard errors.

INSERT TABLE 6 ABOUT HERE

There are several observations in Table 6 that demand attention. We first consider the impact of SRI certification on fund performance. All fund types, with the exception of water, are impacted by SRI certification. Generally, the effect is positive for ecology and natural resources funds, with coefficient estimates of 0.06 (p-value = <0.01) and 0.05 (p-value = <0.05) respectively. This is consistent with the view that investors are becoming increasingly aware of the regulatory risk associated with investing in *pollutive* stocks and are therefore likely to demand a higher return for their investments in such stocks, while demanding less for stocks in similar industries but with cleaner and more socially responsible activities. This is more likely to be the case for fund types where the investment universe is already restrictive, such as the ecology and natural resources funds. As investors become more conscious of the risk of investing in emissions-intensive and non-socially responsible funds, the risk associated with reduced investment universe shrinks for the funds that are perceived as being socially responsible and/or 'green'. This is in line with the findings of Ibikunle and Steffen (2017), when they compare the risk-adjusted performances of green and natural resource-intensive or 'black' funds over a 24-year period. They find a shift in the performance profiles of both fund types as green funds gradually outperform the black ones, after previously under-performing during the height of the fossil fuel age. Their results and the coefficient estimates in Table 6 constitute evidence of a gradual transmission to an emissions-constrained era in the global economy.

In contrast to the effect of SRI certification on fund types with already restricted investment universes, the impact of SRI certification on conventional funds is negative (-0.01, p-value = <0.1). Firstly, this could be explained by the so-called *sin stock theory* (see Galema et al. 2008; Hong and Kacperczyk 2009). Specifically, a stream of the literature contends that sin stocks enjoy higher book-to-market ratios and higher excess returns, when compared to the socially responsible stocks. Furthermore, consistent with the classical portfolio theory, SRI certification for a typical conventional fund should lead to a restricted investment universe. Therefore, SRI certification for conventional funds will also lead to reduced diversification opportunities. The negative implications of reduced diversification benefits on financial performance therefore explain the significant performance differences between the SRI-certified conventional funds and their non SRI-certified counterparts.

Broadly consistent with our expectations, excess returns for each fund type are negatively related to expense levels and fund sizes. Higher expense rates reduce profits, while growth rates for large funds are lower.

4. Conclusion

Financial markets are vehicles through which resources are channeled from where they are in surplus to where they are scarce. Now, no issue demands resources on a global scale more than the sustainable provision of water services to the over 2.1 billion people who currently lack access to them. In this paper, we investigate whether market mechanisms offer solutions for resourcing sustainable water projects. We focus on water mutual funds. An implicit assumption underlying our analysis is that the investment driver for water mutual fund investors is similar to that of other (mean-variance optimizing) investors – financial utility. This assumption is consistent with the SRI financial performance analysis literature (see as examples, Climent and Soriano, 2011; Ibikunle and Steffen, 2017). Thus, if water mutual funds are to represent a viable funding path for water projects, they must offer superior or comparable risk-adjusted returns when compared to their peers, such as conventional, ecology and natural resources mutual funds. Our analysis yields evidence supporting the view that mutual funds could play a role in resourcing critical sustainable water projects.

Firstly, we find that, on a risk-adjusted basis, water mutual funds perform comparably to conventional mutual funds, with no distinctions identified in their performances over the decade 2008–2017. Water mutual funds also outperform their close peers, ecology, and natural resources funds. This performance is however linked to the state of the economy. Water mutual funds only offer superior risk-adjusted returns over their peers when the economy is doing well; when markets are bearish, the outperformance effect dissipates. Secondly, evidence suggests that the performance dynamics we observe are not driven by the fund management skills/abilities of fund managers; rather, they are predominantly driven by investor activity in the market. This further lends credence to the view that water mutual funds inherently outperform their peers (ecology and natural resources funds) and perform comparably to conventional mutual funds, with far reduced restrictions, on a risk-adjusted basis. Finally, we also find that investors, increasingly cognizant of the regulatory risk they assume when investing in certain sectors that are perceived as *pollutive*, are demanding higher returns for investing in those sectors and related assets. However, for assets such as water mutual funds that are already viewed as cleaner than many other asset types, the demand for higher returns is tempered by the acknowledgment of reduced environmental regulatory risk. This finding is consistent with the arguments and findings of Ibikunle and Steffen (2017: 353), who argue that their results are driven by a *'looming end of the fossil fuel and natural resource age and (an) impending renewable energy era'*.

The effects of incorporating sustainable water screening in investment decisions is of upmost importance to an increasing number of investors with long-term horizons, and to governments of countries with high water stress who need effective instruments to maximize the mobilization of private resources in support of sustainable water practices implemented by firms. Therefore, our findings hold significant implications for policy and investment decision making against the backdrop of the drive to resource the global water resources industry.

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Table 1. Summarized statistics of mutual fund classes

This table summarizes descriptive statistics for our sample of mutual funds from June 2008 to May 2017. The first column titled mutual fund class refers to the classification of funds as water, ecology, natural resources, and conventional mutual funds. Mean excess return and corresponding standard deviation present the average daily fund excess return with respect to the free-risk rate and its standard deviations, respectively, on an annualized basis expressed in percentages over the full period. TNA is the average total net assets under management in millions of dollars. TER is the average total expenses ratio charged by each class of mutual funds in percentages. Number of funds presents the number of global equity mutual funds for each class. Number of surviving funds presents the number of surviving funds for each class. Number of ethical funds presents the number of SRI certified mutual funds for each class.

Mutual Fund Class	Mean Excess Return (%)	Standard deviation (%)	TNA ($ Millions)	TER (%)	Number of funds	Number of surviving funds	Number of Ethical funds
Water	6.09	0.95	102.00	1.80	88	76	74
Ecology	1.38	1.11	54.70	1.93	198	129	161
Natural Resources	-6.94	1.34	110.00	1.81	370	218	3
Conventional	3.74	0.99	124.00	1.61	7437	5446	625

Table 2. Carhart four-factor model performance estimates

The table reports the estimated coefficients for the equally weighted portfolio of funds (water or ecology or natural resources or traditional or water-ecology or water-natural resources or water-traditional) for the 2008-2017 period. Panel A reports the results using the S&P Global 1200 index as a market benchmark and Panel B reports the results adopting the S&P Global Water, S&P Global Ecology, S&P Global Natural Resources, and S&P Global 1200 indexes as a market benchmark for the water funds sector, ecology funds sector, natural resources funds sector, and conventional funds, respectively. Water funds refer to global equity funds that invest their assets principally in equities of water related companies including water utilities and infrastructure, water equipment and materials, and water management. Ecology funds refer to global equity funds that invest their assets principally in equities of clean environment companies including water treatment, pollution control, alternative energy and energy efficiency companies (pure alternative energy funds are excluded from this category). Natural resources funds refer to global equity funds that invest principally in equities of natural resources companies including a mix of energy, mining, timber, and water issues (pure water funds and pure energy funds are excluded from this category). Conventional funds refer to global equity funds whose portfolio is fully diversified by industries and geographical markets. The "difference" portfolios are built by subtracting either ecology or natural resources or conventional mutual fund returns from the water portfolio return The alpha estimates (α) are annualized for presentation. The coefficients β_{MKT}, β_{SMB}, β_{HML} and β_{WML} represent loadings on the excess market return (Market), size factor (SMB), value factor (HML) and momentum factor (WML), respectively. Standard errors are corrected for autocorrelation and heteroskedasticity using the Driscoll-Kraay (1998) procedure and presented in parentheses. The p-values for significance at the 1%, 5%, and 10% levels are indicated using ***, ** and * respectively.

Portfolio	Alpha α	Market β_{MKT}	SMB β_{SMB}	HML β_{HML}	WML β_{WML}	R^2
Panel A: S&P Global 1200 Index						
Water	0.0165	0.7887 ***	0.4539 ***	0.0193	-0.0066	0.5018
	(0.0001)	(0.0155)	(0.0422)	(0.0354)	(0.017)	
Ecology	-0.0306	0.7868 ***	0.5761 ***	0.0918 *	0.0053	0.3980
	(0.0001)	(0.0226)	(0.0527)	(0.0491)	(0.0262)	
Natural resources	-0.1174 ***	0.9107 ***	0.6111 ***	0.3293 ***	-0.0316	0.3526
	(0.0001)	(0.0295)	(0.0502)	(0.0707)	(0.0494)	
Conventional	0.0014	0.7085 ***	0.392 ***	0.0611 *	-0.005	0.4059
	(0.0001)	(0.0189)	(0.0372)	(0.0353)	(0.0178)	
Water-Ecology	0.0377 ***	-0.0117	-0.1207 ***	-0.0544 **	-0.0107	0.0204
	(0.0001)	(0.0097)	(0.028)	(0.0269)	(0.0157)	
Water-Natural resources	0.1258 ***	-0.1001 ***	-0.1741 ***	-0.3934 ***	0.0332	0.0945
	(0.0001)	(0.0224)	(0.0495)	(0.0599)	(0.0439)	
Water-Conventional	0.014	0.0671 ***	0.0784 ***	-0.0285	0.0009	0.0428
	(0.0001)	(0.0083)	(0.023)	(0.0225)	(0.0122)	
Panel B: Sector Benchmarks Indexes						

Water	0.0134 (0.0001)	0.7551 *** (0.0146)	0.1916 *** (0.027)	0.0457 (0.0299)	-0.0194 (0.0153)	0.5561
Ecology	0.0139 (0.0001)	0.5837 *** (0.0527)	0.2578 *** (0.0697)	0.2885 *** (0.0658)	-0.0357 (0.0326)	0.3503
Natural resources	-0.0367 * (0.0001)	0.7997 *** (0.0246)	0.3991 *** (0.0447)	0.2149 *** (0.0561)	0.0611 ** (0.0257)	0.4579
Conventional	0.0014 (0.0001)	0.7085 *** (0.0189)	0.392 *** (0.0372)	0.0611 * (0.0353)	-0.005 (0.0178)	0.4059
Water-Ecology	0.0357 *** (0.0001)	0.0152 * (0.0083)	-0.0934 *** (0.0258)	-0.0648 ** (0.0279)	-0.003 (0.0164)	0.0215
Water-Natural resources	0.1191 *** (0.0001)	-0.0048 (0.017)	-0.06 (0.0446)	-0.4312 *** (0.0618)	0.0608 (0.0441)	0.0771
Water-Conventional	0.0093 (0.0000)	0.1209 *** (0.007)	0.1065 *** (0.0201)	-0.0478 ** (0.0234)	0.016 (0.0127)	0.167

Table 3. Conditional Carhart four-factor model performance estimates by different market states

The table reports the estimated coefficients for the equally weighted portfolio of funds (water or ecology or natural resources or traditional or water-ecology or water-natural resources or water-traditional) resulting from the conditional Carhart four-factor model incorporating a dummy variable to distinguish crisis from non-crisis periods within the 2008-2017 period. Panel A reports the results using the S&P Global 1200 index as a market benchmark and Panel B reports the results adopting the S&P Global Water, S&P Global Ecology, S&P Global Natural Resources, and S&P Global 1200 indexes as a market benchmark for the water funds sector, ecology funds sector, natural resources funds sector, and conventional funds, respectively. Water funds refer to global equity funds that invest their assets principally in equities of water related companies including water utilities and infrastructure, water equipment and materials, and water management. Ecology funds refer to global equity funds that invest their assets principally in equities of clean environment companies including water treatment, pollution control, alternative energy, and energy efficiency companies (pure alternative energy funds are excluded from this category). Natural resources funds refer to global equity funds that invest principally in equities of natural resources companies including a mix of energy, mining, timber, and water issues (pure water funds and pure energy funds are excluded from this category). Conventional funds refer to global equity funds whose portfolio is fully diversified by industries and geographical markets. The "difference" portfolios are built by subtracting either ecology or natural resources or conventional mutual fund returns from the water portfolio return. The alpha estimates in crisis (α_c) and non-crisis (α_{nc}) markets are annualized for presentation. The coefficients β_{MKT}, β_{SMB}, β_{HML} and β_{WML} represent loadings on the excess market return (Market), size factor (SMB), value factor (HML). and momentum factor (WML), respectively. Standard errors are corrected for autocorrelation and heteroskedasticity using the Driscoll-Kraay (1998) procedure and presented in parentheses. The p-values for significance at the 1%, 5%, and 10% levels are indicated using ***, ** and *, respectively.

Portfolio	Alpha crisis α_c	Alpha non-crisis α_{nc}	Market β_{MKT}	SMB β_{SMB}	HML β_{HML}	WML β_{WML}	R^2
Panel A: S&P Global 1200 Index							
Water	-0.0647	0.0212	0.7883 ***	0.4538 ***	0.0188	-0.0075	0.5019
	(0.0003)	(0.0001)	(0.0156)	(0.0421)	(0.0353)	(0.0170)	
Ecology	-0.086	-0.0233	0.7863 ***	0.576 ***	0.0913 *	0.0042	0.3981
	(0.0004)	(0.0001)	(0.0227)	(0.0525)	(0.0492)	(0.0262)	
Natural resources	-0.0072	-0.1168 ***	0.9106 ***	0.6111 ***	0.3293 ***	-0.0317	0.3526
	(0.0007)	(0.0001)	(0.0294)	(0.0501)	(0.0708)	(0.049)	
Conventional	-0.0985	0.0096	0.7079 ***	0.3917 ***	0.0606 *	-0.0063	0.4060
	(0.0003)	(0.0001)	(0.019)	(0.0369)	(0.0354)	(0.0178)	
Water-Ecology	0.0166	0.0365 ***	-0.0116	-0.1207 ***	-0.0543 **	-0.0104	0.0205
	(0.0003)	(0.0001)	(0.0097)	(0.028)	(0.0269)	(0.0158)	
Water-Natural resources	-0.1127	0.1341 ***	-0.1007 ***	-0.1742 ***	-0.3942 ***	0.0316	0.0949
	(0.0007)	(0.0001)	(0.0221)	(0.0493)	(0.0598)	(0.0436)	
Water-Conventional	0.0328	0.0116	0.0672 ***	0.0784 ***	-0.0283	0.0014	0.043
	(0.0003)	(0.0001)	(0.0083)	(0.023)	(0.0224)	(0.0122)	

Panel B: Sector Benchmarks Indexes							
Water	-0.0495	0.017	0.7549 ***	0.1916 ***	0.0453	-0.0201	0.5562
	(0.0003)	(0.0001)	(0.0146)	(0.0269)	(0.03)	(0.0154)	
Ecology	-0.0665	0.0195	0.5834 ***	0.2578 ***	0.288 ***	-0.0366	0.3503
	(0.0004)	(0.0001)	(0.0528)	(0.0694)	(0.0657)	(0.0329)	
Natural resources	-0.022	-0.035 *	0.7997 ***	0.3991 ***	0.2148 ***	0.0608 **	0.4579
	(0.0004)	(0.0001)	(0.0246)	(0.0447)	(0.0561)	(0.0256)	
Conventional	-0.0985	0.0096	0.7079 ***	0.3917 ***	0.0606 *	-0.0063	0.4060
	(0.0003)	(0.0001)	(0.019)	(0.0369)	(0.0354)	(0.0178)	
Water-Ecology	0.0255	0.0338 **	0.0154 *	-0.0934 ***	-0.0646 **	-0.0026	0.0216
	(0.0003)	(0.0001)	(0.0083)	(0.0258)	(0.0279)	(0.0164)	
Water-Natural resources	-0.0832	0.1252 ***	-0.0052	-0.0599	-0.4318 ***	0.0596	0.0773
	(0.0007)	(0.0001)	(0.0169)	(0.0445)	(0.0618)	(0.0437)	
Water-Conventional	0.0537	0.0054	0.1212 ***	0.1064 ***	-0.0474 **	0.0168	0.1674
	(0.0002)	(0.0000)	(0.0071)	(0.0201)	(0.0234)	(0.0127)	

Table 4. Conditional Carhart four-factor model performance estimates using economic information

The table reports the estimated coefficients for the equally weighted portfolio of funds (water or ecology or natural resources or traditional or water-ecology or water-natural resources or water-traditional) resulting from the conditional Carhart four-factor model incorporating continuous information variables (global short-term interest rate and default spread) for the 2008-2017 period. Panel A reports the results using the S&P Global 1200 index as a market benchmark and Panel B reports the results adopting the S&P Global Water, S&P Global Ecology, S&P Global Natural Resources, and S&P Global 1200 indexes as a market benchmark for the water funds sector, ecology funds sector, natural resources funds sector, and conventional funds, respectively. Water funds refer to global equity funds that invest their assets principally in equities of water related companies including water utilities and infrastructure, water equipment and materials, and water management. Ecology funds refer to global equity funds that invest their assets principally in equities of clean environment companies including water treatment, pollution control, alternative energy, and energy efficiency companies (pure alternative energy funds are excluded from this category). Natural resources funds refer to global equity funds that invest principally in equities of natural resources companies including a mix of energy, mining, timber, and water issues (pure water funds and pure energy funds are excluded from this category). Conventional funds refer to global equity funds whose portfolio is fully diversified by industries and geographical markets. The "difference" portfolios are built by subtracting either ecology or natural resources or conventional mutual fund returns from the water portfolio return. The average conditional alpha estimates (α) are annualized for presentation. The coefficients β_{MKT}, β_{SMB}, β_{HML} and β_{WML} represent the average conditional loadings on the excess market return (Market), size factor (SMB), value factor (HML) and momentum factor (WML), respectively. Standard errors are corrected for autocorrelation and heteroskedasticity using the Driscoll-Kraay (1998) procedure and presented in parentheses. The p-values for significance at the 1%, 5%, and 10% levels are indicated using ***, ** and * respectively.

Portfolio	Alpha α	Market β_{MKT}	SMB β_{SMB}	HML β_{HML}	WML β_{WML}	R^2
Panel A: S&P Global 1200 Index						
Water	-0.0007	0.9034 ***	0.2174 **	0.0022	0.0237	0.5174
	(0.0002)	(0.0361)	(0.0882)	(0.0818)	(0.0404)	
Ecology	0.0098	0.8857 ***	0.4841 ***	-0.1133	0.0482	0.4162
	(0.0002)	(0.0479)	(0.1222)	(0.116)	(0.0602)	
Natural resources	-0.2247 **	0.828 ***	0.6227 ***	0.3186 **	-0.3721 ***	0.3903
	(0.0004)	(0.0582)	(0.1269)	(0.1564)	(0.0889)	
Conventional	-0.0268	0.7921 ***	0.2904 ***	-0.1626 **	-0.0443	0.4235
	(0.0002)	(0.0312)	(0.0774)	(0.0724)	(0.0408)	
Water-Ecology	-0.0263	0.0297	-0.3115 ***	0.0735	-0.0464	0.0615
	(0.0002)	(0.026)	(0.0684)	(0.0634)	(0.0365)	
Water-Natural resources	0.2524 ***	0.056	-0.4367 ***	-0.4414 ***	0.3877 ***	0.2439
	(0.0004)	(0.0496)	(0.105)	(0.1319)	(0.0798)	
Water-Conventional	0.0239	0.1082 ***	-0.0852	0.1534 ***	0.0551 *	0.0758
	(0.0002)	(0.0241)	(0.0528)	(0.0534)	(0.0308)	

Panel B: Sector Benchmarks Indexes											
Water	-0.0447 (0.0002)		0.9059 (0.0262)	***	0.0325 (0.0574)		-0.1877 (0.0551)	***	-0.0453 (0.0335)		0.5696
Ecology	-0.0652 (0.0003)		1.0034 (0.1137)	***	0.3568 (0.1596)	**	-0.4307 (0.1452)	***	0.0184 (0.0797)		0.3919
Natural resources	-0.16 (0.0002)	***	0.8466 (0.0362)	***	0.1205 (0.0756)		-0.2677 (0.1033)	**	0.1267 (0.0651)	*	0.4798
Conventional	-0.0323 (0.0002)		0.842 (0.0381)	***	0.3216 (0.0752)	***	-0.1795 (0.073)	**	-0.0374 (0.0424)		0.4233
Water-Ecology	-0.0211 (0.0002)		0.0185 (0.0243)		-0.3178 (0.0643)	***	0.1035 (0.0677)		-0.0454 (0.0383)		0.0589
Water-Natural resources	0.2802 (0.0004)	***	0.0444 (0.0423)		-0.4418 (0.105)	***	-0.3257 (0.1371)	**	0.3996 (0.0838)	***	0.2157
Water-Conventional	0.0216 (0.0001)		0.148 (0.0203)	***	-0.0643 (0.0448)		0.1577 (0.052)	***	0.0512 (0.0297)	*	0.1984

Table 5. Conditional Bollen and Busse model managerial abilities using economic information

This table reports the estimated coefficients for the equally weighted portfolio of funds (water or ecology or natural resources or traditional or water-ecology or water-natural resources or water-traditional) resulting from the conditional Bollen and Busse model incorporating continuous information variables (global short-term interest rate and default spread) for the 2008-2017 period. Panel A reports the results using the S&P Global 1200 index as a market benchmark and Panel B reports the results adopting the S&P Global Water, S&P Global Ecology, S&P Global Natural Resources, and S&P Global 1200 indexes as a market benchmark for the water funds sector, ecology funds sector, natural resources funds sector, and conventional funds, respectively. Water funds refer to global equity funds that invest their assets principally in equities of water related companies including water utilities and infrastructure, water equipment and materials, and water management. Ecology funds refer to global equity funds that invest their assets principally in equities of clean environment companies including water treatment, pollution control, alternative energy, and energy efficiency companies (pure alternative energy funds are excluded from this category). Natural resources funds refer to global equity funds that invest principally in equities of natural resources companies including a mix of energy, mining, timber, and water issues (pure water funds and pure energy funds are excluded from this category). Conventional funds refer to global equity funds whose portfolio is fully diversified by industries and geographical markets. The "difference" portfolios are built by subtracting either ecology or natural resource or conventional mutual fund returns from the water portfolio return. The average conditional alpha estimates (α) represent stock-picking ability and they are annualized for presentation. The coefficients β_{MKT}, β_{SMB}, β_{HML} and β_{WML} represent the average conditional loadings on the excess market return (Market), size factor (SMB), value factor (HML), and momentum factor (WML), respectively. The coefficient $\beta_{MKT}{}^2$ represents timing ability with regard to the market return. Standard errors are corrected for autocorrelation and heteroskedasticity using the Driscoll-Kraay (1998) procedure and presented in parentheses. The p-values for significance at the 1%, 5%, and 10% levels are indicated using ***, ** and * respectively.

Portfolio	Alpha α	Market β_{MKT}	SMB β_{SMB}	HML β_{HML}	WML β_{WML}	Market^2 $\beta_{MKT}{}^2$	R^2
Panel A: S&P Global 1200 Index							
Water	-0.0787 (0.0003)	0.9331 *** (0.0352)	0.2244 ** (0.0874)	-0.0104 (0.0813)	0.0358 (0.0399)	3.0403 * (1.6944)	0.5180
Ecology	-0.1093 (0.0003)	1.0139 *** (0.0511)	0.5875 *** (0.1174)	-0.196 * (0.1162)	0.0774 (0.0617)	3.4274 * (1.8058)	0.4173
Natural resources	-0.3505 *** (0.0004)	0.9334 *** (0.0634)	0.6681 *** (0.1207)	0.3085 ** (0.1555)	-0.3659 *** (0.0906)	5.5344 ** (2.4537)	0.3902
Conventional	-0.0817 (0.0002)	0.8475 *** (0.0374)	0.3206 *** (0.074)	-0.1873 ** (0.0731)	-0.0339 (0.0411)	1.5354 (1.4048)	0.4237
Water-Ecology	-0.0064 (0.0002)	-0.0698 ** (0.0293)	-0.4106 *** (0.0695)	0.1432 ** (0.0651)	-0.0626 (0.0393)	0.1095 (0.9335)	0.0609
Water-Natural resources	0.2889 *** (0.0004)	-0.006 (0.0541)	-0.4618 *** (0.1084)	-0.4422 *** (0.1331)	0.3925 *** (0.0822)	-2.0102 (1.9081)	0.2424
Water-Conventional	-0.0101 (0.0002)	0.0847 *** (0.0269)	-0.1072 * (0.0542)	0.1621 *** (0.0559)	0.057 * (0.0314)	1.8106 * (1.032)	0.0763

Panel B: Sector Benchmarks Indexes							
Water	-0.0330 (0.0002)	0.9045 *** (0.0252)	0.0324 (0.0586)	-0.1871 *** (0.0551)	-0.0457 (0.0338)	-0.8122 (1.8952)	0.5700
Ecology	-0.1344 (0.0003)	1.0164 *** (0.1089)	0.357 ** (0.157)	-0.4291 *** (0.1449)	0.0273 (0.0802)	3.0264 (2.6348)	0.3928
Natural resources	-0.2101 *** (0.0003)	0.8497 *** (0.0347)	0.1156 (0.0746)	-0.2700 *** (0.103)	0.1280 ** (0.0641)	1.3325 (1.4474)	0.4799
Conventional	-0.0817 (0.0002)	0.8475 *** (0.0374)	0.3206 *** (0.074)	-0.1873 ** (0.0731)	-0.0339 (0.0411)	1.5354 (1.4048)	0.4237
Water-Ecology	-0.0393 (0.0002)	0.0207 (0.0245)	-0.3185 *** (0.0645)	0.1037 (0.0675)	-0.0428 (0.0385)	1.0254 (0.9993)	0.0606
Water-Natural resources	0.2762 ** (0.0004)	0.044 (0.0421)	-0.4435 *** (0.1055)	-0.3262 ** (0.137)	0.3997 *** (0.0846)	-0.1547 (1.8954)	0.2160
Water-Conventional	-0.0148 (0.0002)	0.1519 *** (0.0208)	-0.066 (0.0452)	0.1574 *** (0.0521)	0.0552 * (0.03)	1.9794 (1.1919)	0.2022

Table 6. The effect of fund characteristics on financial performance

This table reports the estimated coefficients from the following panel regressions using daily mutual fund observations, $r_{p,t}$:

$$(r_{p,t} - r_{i,t}) = \alpha_0 \sum_{class=1}^{4} D_{class} + \alpha_4 \sum_{class=1}^{4} D_{class} * Crisis_t + \alpha_8 \sum_{class=1}^{4} D_{class} * Ethical_p + \beta_{MKT}(r_{m,t} - r_{i,t}) + \gamma_0 LTNA_{p,t} + \gamma_1 TER_{p,t} + \mu_{p,t}$$

$$(r_{p,t} - r_{i,t}) = \sum_{class=1}^{4} D_{class}\left[\alpha_0 + \alpha_4 Crisis_t + \alpha_8 Ethical_p + \beta_{MKT}(r_{m,t} - r_{i,t}) + \gamma_0 LTNA_{p,t} + \gamma_1 TER_{p,t} + \mu_{p,t}\right]$$

The mutual funds include water or ecology or natural resources or traditional or water-ecology or water-natural resources or water-traditional for the 2008-2017 period. The dependent variable is the excess daily return for each mutual fund. D_{class} represents a dummy variable that takes a value of 1 if the fund belongs to an indicated category (water, ecology, natural resources, and conventional) and 0 otherwise. Water funds refer to global equity funds that invest their assets principally in equities of water related companies including water utilities and infrastructure, water equipment and materials, and water management. Ecology funds refer to global equity funds that invest their assets principally in equities of clean environment companies including water treatment, pollution control, alternative energy, and energy efficiency companies (pure alternative energy funds are excluded from this category). Natural resources funds refer to global equity funds that invest principally in equities of natural resources companies including a mix of energy, mining, timber, and water issues (pure water funds and pure energy funds are excluded from this category). Conventional funds refer to global equity funds whose portfolio is fully diversified by industries and geographical markets. Crisis is a dummy variable that takes the value of 1 for a crisis period and 0 otherwise. Ethical is a dummy variable that takes the value of 1 if the fund has SRI certification and 0 otherwise. Sector benchmark refers to the excess market returns using the S&P Global Water, S&P Global Ecology, S&P Global Natural Resources, and S&P Global 1200 indexes as a market benchmark for the water funds sector, ecology funds sector, natural resources funds sector, and conventional funds, respectively. LTNA is the natural logarithm of total net assets under management in US dollars of each fund at time *t*. TER represents the total annual expenses as a fraction of TNA. Standard errors are corrected for autocorrelation and heteroskedasticity using the Petersen (2009) procedure and presented in parentheses. The p-values for significance at the 1%, 5%, and 10% levels are indicated using ***, ** and * respectively.

Variables	Full sample	Water MF	Ecology MF	Natural Resources MF	Conventional MF
	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
Water	0.0742 **	0.0559	-		-
	(0.0001)	(0.0002)	-		-
Ecology	-0.0574 *		0.0933 *		-
	(0.0001)		(0.0002)		-
Natural Resources	-0.0624 ***		-	0.0693	-
	(0.0001)		-	(0.0002)	-
Conventional	-0.0110		-		0.0591 ***
	(0.0001)		-		(0.0001)
Crisis	-	-0.0399	-0.0611	-0.0291	-0.1093
	-	(0.0003)	(0.0006)	(0.0005)	(0.0004)
Water*Crisis	-0.0660		-		-

	(0.0003)		-		-
Ecology*Crisis	-0.0349		-		-
	(0.0007)		-		-
NaturalResources*Crisis	-0.0497		-		-
	(0.0004)		-		-
Conventional*Crisis	-0.1070		-		-
	(0.0004)		-		-
Ethical		0.0013	0.0594 ***	0.0496 **	-0.0118 *
		(0.0001)	(0.0001)	(0.0001)	(0.0000)
Water*Ethical	0.0014		-		-
	(0.0001)		-		-
Ecology*Ethical	0.0591 ***		-		-
	(0.0001)		-		-
NaturalResources*Ethical	0.0462 **		-		-
	(0.0001)		-		-
Conventional*Ethical	-0.0118 *		-		-
	(0.0000)		-		-
Sector Benchmark	0.6435 ***	0.7342 ***	0.5746 ***	0.7619 ***	0.6360 ***
	(0.0150)	(0.0332)	(0.0364)	(0.0229)	(0.0152)
LTNA	-0.0015 *	-0.0004	-0.0057 **	-0.0046 *	-0.0012
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
TER	-0.0143 ***	-0.0177 ***	-0.0173 **	-0.0154 **	-0.0141 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2	0.3941	0.5516	0.3380	0.4466	0.3905
Observations	11888096	142723	312323	559675	10873375
MF	8093	88	198	370	7437