



Carbon-intensive industries in Socially Responsible mutual funds' portfolios

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ABSTRACT

In this research, I study the exposure of Socially Responsible mutual funds (SR) to *black industries* (i.e., carbon-intensive sectors: fossil fuel, metal and utilities) and its effect on the financial performance. To this purpose, I analyze the industry portfolio allocation of a sample of 136 actively-managed US SR mutual funds, investing in domestic and global equity, in the period January 2012–December 2018. I observe that the average weight of black industries in these portfolios is 9.51% falling over time (13.45% in 2012 versus 7.40% in 2018). Another finding is that a greater exposure to fossil fuel and metal industries negatively impacts the portfolios' financial performance. In addition, SR funds managed by firms located in Republican-leaning states and in states with greater CO₂ emissions per capita, are more exposed to carbon-intensive industries, suggesting that SR funds' managers could be influenced by local factors when making their investment decisions. Finally, I observe that SR funds marketed under “low-carbon” labels live up to their name and are less exposed to fossil fuel and metal industries than other types of SR funds.

1. Introduction

According to UNPRI (United Nations Principles for Responsible Investment), the global warming provoked by climate change is the highest priority ESG (environmental, social and governance) concern facing investors. The thirteenth sustainable development goal (SDG) established by the United Nations (UN) spurs to take urgent actions to fight against climate change to mitigate its socioecological effects. In this framework, more and more people are increasingly aware of the negative effects of global warming caused by greenhouse gas (GHG) emissions and the need to make a transition from our current economic model to a low-carbon economy. In this process, the institutional investors (mutual funds, pension funds, etc.) can play an important role. Concretely, the decarbonization of their investment portfolios has emerged in last years as a powerful tool to accelerate this transition (Fabian, 2015). Christophers (2019) explains that institutional investors are the main owners of fossil fuel companies that are responsible for much of these toxic emissions. According to the last report of the IEA (International Energy Agency) (IEA, 2019),¹ the energy industry generates around two-thirds of total GHG emissions and more than 80% of CO₂ emissions, being the share of electricity output from fossil fuels around 65% in 2017. The investment decisions of institutional investors could significantly contribute to curb global warming “by cutting down financial support for and addressing the moral legitimacy of fossil fuel

production and its use” (Trinks, Scholtens, Mulder, & Dam, 2018, p.740).

In recent years, non-state governance initiatives have emerged to encourage institutional investors to perform this decarbonization process, such as, the fossil fuel divestment movement. This initiative appears in response to the apparent failure of states and supranational organisms to promote effective and credible policies to mitigate the negative effects of global warming. Sponsors of these initiatives are NGOs (Non-Governmental Organizations) committed to combatting the climate change and perform “a range of strategies to shame, pressure, facilitate, and encourage investors in general, and large institutional investors in particular, to divest their holdings of fossil fuel stocks in favour of other climate-friendly, or at least climate-neutral, alternatives” (Ayling & Gunningham, 2017, p.2).

Among the different types of institutional investors, socially responsible (SR) mutual funds should lead this decarbonization process considering that their differential aspect is precisely the explicit incorporation of environmental, social and governance (ESG) issues into the investment process (Muñoz, 2019). Benz, Jacob, Paulus, and Wilkens (2020) point out that pension funds and other institutional investors are bound to social norms (Hong & Kacperczyk, 2009 Bolton & Kacperczyk, 2019) and thus should follow the decarbonization trend. Similarly, Boermans and Galema (2019) point out that institutional investors are subject to public surveillance regarding the environmental impact of their investments. This scrutiny is likely to be greater in the case of SR

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¹ CO₂ emissions from fuel combustion highlights 2019, available at: <https://webstore.iea.org/co2-emissions-from-fuel-combustion-2019-highlights>.

mutual funds since this type of funds is targeted to investors especially concerned about the ESG performance of their investments. These investors present a multi-attribute utility function depending not only on financial issues (return and risk) but also on ESG ones (Bollen, 2007).

In this research, I study the exposure of SR mutual funds to environmentally controversial industrial sectors (black industries), its involvement over time and its effect on the risk-adjusted financial performance. In addition, I study the factors that could determine the degree of exposure to these sectors. To do this, I explore the industry portfolio allocation of a broad sample of actively-managed US SR mutual funds (136), investing in domestic equity (88) and global equity (48), in the period January 2012–December 2018. The results achieved indicate that the average weight of black industries in SR mutual fund portfolios is 9.51% although this weight falls over time (13.45% in 2012 versus 7.40% in 2018). Further empirical evidence shows that this fall is driven by existing SR funds changing their allocations and that conventional mutual funds also reduce their exposure to black industries over time. Besides, both SR and conventional mutual funds hold exposure to these industries lower than their relevance in market benchmarks. In addition, I find that SR mutual funds being smaller, younger, less active, cheaper, holding more industry concentrated portfolios and belonging to larger families are more exposed to black industries. Another finding shows that SR funds managed by companies located in Republican-leaning states and in states with greater CO₂ emissions per capita, hold a greater exposure to carbon-intensive industries. These results suggest that SR mutual funds' managers could be influenced by local political and socioeconomic factors when making their investment decisions. Regarding to the SR strategies, I observe that SR funds performing negative screens on thermal coal, investing in renewable energies and making impact investing on low-carbon/fossil-fuel free themes are less exposed to carbon-intensive industries living up to their name. Furthermore, I obtain that overall, the exposure to black industries negatively impacts the financial performance of SR funds, supporting that portfolio decarbonization does not jeopardize investors' interests.

This research contributes to the previous literature by providing empirical evidence of the decarbonization portfolio process in the SR mutual fund industry. As far as I know, this is the first attempt to analyze these issues for this important and growing subset of the collective investment industry (previous literature has focused on pension funds, conventional mutual funds, or synthetic stock portfolios). The empirical evidence obtained reveals the SR mutual fund characteristics that determine their exposure to these activities and the impact of this exposure on their financial performance. Besides, this paper reveals that local political and social factors impact this process. These findings are of interest for investors, advisors, and regulators. Policy-makers who aim to promote the transition to a low-carbon economy also could be interested in these findings.

The rest of the paper is structured as follows; second section makes a literature review and establishes the research hypotheses; third section describes the data and methods; fourth section presents the empirical findings; finally, fifth section ends the paper with the main conclusions.

2. Literature review and research hypotheses

2.1. Literature review

Socially Responsible Investment (SRI) incorporates environmental, social, and governance issues into investment decisions. This strategy has experienced important growth in the last years. Thus, according to the latest report of USSIF (United States Social Investment Forum; USSIF, 2018) the assets managed by sustainable, responsible and impact investing strategies summed \$12 trillion at the beginning of 2018, experiencing a rise of 38% from 2016, and representing the 25% of the total assets under professional management in the United States. Besides, much of this growth is due to institutional asset managers, who integrate ESG issues into the management of assets priced by \$11.6

trillion.

This impressive growth has attracted the attention of financial literature that has analyzed different SRI vehicles. Thus, we can find papers that have analyzed SRI indices. Statman (2006) compares the content of the S&P 500 Index of conventional companies to the contents of four indexes of socially responsible companies, the Domini 400 Social Index (DS 400 Index), the Calvert Social Index, the Citizens Index, and the U.S. portion of the Dow Jones Sustainability Index. Besides, this author compares the financial performance of these SRI indices with that achieved by the S&P 500 and also computes the tracking-error. The empirical findings achieved by Statman (2006) show that SRI indices display an average social score higher than that obtained by the S&P 500 and also superior returns in the period spanned between May 1990 and April 2004 (however this last result varies across sub-periods). Managi, Okimoto, and Matsuda (2012) also compare the financial performance of conventional and SRI indices in the US, UK, and Japan. These authors do not find a statistical difference in means and volatilities generated from the SRI indexes and conventional indexes in either region. Ortas et al. (2012) analyze the case of SRI indices in emerging markets (more specifically, in Brazil) obtaining that SR investors do not sacrifice financial performance in bullish market periods. More recently, Cunha et al. (2020) analyze the financial performance of the Dow Jones Sustainability Indices (DJSIs) for different regions, comparing their performance with that obtained by their conventional peers. Besides, these authors perform different financial performance indicators (return, standard deviation, Jensen-alpha, Sharpe ratio, modified Sharpe ratio, Treynor ratio, Sortino ratio and Omega measure). The empirical evidence obtained by these authors show that the risk-adjusted financial performance of SRI indices vary across regions, showing a superior financial performance in some of them.

Other articles have analyzed synthetic stock portfolios formed by considering specific environmental, social, and governance (ESG) concerns. Thus, Kempf and Osthoff (2007) study the financial performance of an investment strategy consisting of buying stocks with high ESG scores and selling those with low ESG ratings in Europe. These authors find that this trading strategy overcomes a conventional benchmark and achieves a high abnormal return of up to 8.7% per year. Oikonomou, Platanakis, and Sutcliffe (2018) analyze different optimization techniques to build SR stocks portfolios and find that more "formal" optimization approaches (Black-Litterman, Markowitz and robust estimation) allow building SRI portfolios that are both less risky and show superior risk-adjusted returns than do more simplistic approaches. However, these portfolios suffer from a lower diversification. Pereira, Cortez, and Silva (2019) study the financial performance of SR bond portfolios obtaining that the financial results of highly socially rated bonds are not significantly different from that of low-rated bonds. They also observe that in an earlier stage, portfolios of high-rated bonds outperformed portfolios of low-rated bonds, but over time, this out-performance disappears. More recently, Badía, Cortez, and Ferruz (2020) analyze the financial performance of SR stock portfolios based on Environmental, Social, and Governance (ESG) ratings in four regions: North America, Europe, Japan, and the Asia Pacific. These authors obtain that the financial impact of socially responsible investing is different according to the region considered, varies over time, and relies on the screening dimension considered.

Another body of research focuses on SR mutual funds. This type of fund has attracted the interest of mutual fund literature, and consequently, we can find a plethora of researches studying different topics. Most of these studies have been focused on the financial performance of SR funds (Bauer, Koedijk, & Otten, 2005 Renneboog, Ter Horst, & Zhang, 2008 Cortez, Silva, & Areal, 2009 Gil-Bazo, Ruiz-Verdú, & Santos, 2010 Pereira et al., 2019 or Muñoz, 2020, among many others) or the investors' behavior (Bollen, 2007 Benson & Humphrey, 2008 Renneboog, Ter Horst, & Zhang, 2011 Muñoz, 2016 or Riedl & Smeets, 2017, among others). Recently, Miralles-Quiros, Miralles-Quirós, and Nogueira (2020) have made an exhaustive literature review of SRI

showing the evolution of the research in this topic distinguishing among studies focused on indices, synthetic portfolios, and mutual funds.

Despite the important number of articles analyzing SRI in academic literature, some relevant issues remain underexplored. This is the case of the exposure of SR funds' portfolios to environmentally controversial sectors (black industries) and the impact of this exposure on their financial results.

Ibikunle and Steffen (2017) explain that black industries cover a broad range of activities being carbon-intensive in the exploitation and depletion of natural resources and natural capital. According to these authors, they include the extraction, facilitation, transportation, storage, processing, sale and use of natural resources encompassing from upstream drilling companies to downstream utilities. They also enclose the fossil fuel industry (oil, gas and coal), the mining of minerals, ferrous, non-ferrous and precious metals.

Most of previous researches focused on investment portfolios' decarbonization have analyzed the financial impact of this process by building synthetic portfolios of bonds or equities, including and excluding carbon-intensive industries or companies, and comparing the results between them (Derwall, Guenster, Bauer, & Koedijk, 2005; Andersson, Bolton, & Samama, 2016; De Jong & Nguyen, 2016; Henriques & Sadosky, 2018; Trinks et al., 2018 or Hunt & Weber, 2019, among others). The analyses from synthetic portfolios allow to isolate the effect of stocks' attributes and do not suffer bias emerging from fund managers' skills or management fees (Kempf & Osthoff, 2007). However, other authors such as Borgers, Derwall, Koedijk, and ter Horst (2015) highlight the relevance of performing analyses at the mutual fund-level to shed light on the exposure and return associated with carbon stock investment in practice. Although researches based on synthetic portfolios data provide with interesting insights, the returns of these portfolios do not consider the impact of real-time transaction costs and trading restrictions.

Another branch of literature has analyzed the financial performance of specific types of institutional investors marketed under the labels of green, environmental-friendly or specialized in renewable energies (Climent & Soriano, 2011 Muñoz, Vargas, & Marco, 2014 Ibikunle & Steffen, 2017 Reboledo, Quintela, & Otero, 2017 or Martí-Ballester, 2019a, 2019b, among others).

More rarely, other authors focused on the portfolio allocation of specific types of institutional investors, such as, Boermans and Galema (2019) who wonder whether pension funds are actively decarbonizing their portfolios. These authors try to answer this question by studying a sample of Dutch pension funds and conclude that pension funds divesting from industries associated with high carbon emissions reduce their environmental footprint, whereas this does not occur for pension funds divesting from most carbon-intensive firms within each industry. This result is very interesting and suggests that the more effective way to decarbonize the institutional investors' portfolios is by excluding black industries from the investable universe. In addition, these authors find that portfolios' decarbonization does not hurt the financial performance of pension funds.

2.2. Research questions and hypotheses

Previous literature has found mixed results regarding the consequences of divesting from carbon-intensive sectors. Thus, we can find papers obtaining that portfolios' decarbonization does not significantly impact the financial performance (Andersson et al., 2016 De Jong & Nguyen, 2016; Trinks et al., 2018 or Boermans & Galema, 2019). In the same vein, Martí-Ballester (2019a) finds that mutual funds specialized in renewable energies do not perform differently from black funds.²

On the other hand, other authors observe that divesting from carbon-intensive industries positively impact the financial performance of

investment portfolios (Henriques & Sadosky, 2018 or Hunt & Weber, 2019). This positive effect could be explained by the poor financial results of black sectors. Fang, Tan, and Wirjanto (2019), using historical prices, observe that the carbon-intensive industries in the North American stock market obtain inferior risk-adjusted returns. Similarly, Martí-Ballester (2019b) finds that black funds are not able to outperform their benchmarks and points out that this result could be reflecting that governments are phasing out fossil fuel subsidization policies in order to spur the transition to a low-carbon economy which hinders the investment opportunities in carbon-intensive sectors.

Ibikunle and Steffen (2017) compare the financial performance of green funds, conventional funds and black funds in Europe in the period 1991–2014 finding that overall, green funds perform similarly to black funds and worse than conventional funds. However, these authors also find that performance of green funds improve over time and that in the period 2012–2014 they perform similarly to their conventional peers and overcome the outcomes of black funds. More specifically, Ibikunle and Steffen (2017) find that green funds outperform their black peers with a value of about 14.36% in the period 2012–2014, reflecting this result that (p. 351) *“while green funds prosper during the transition to a cleaner economy, black funds thrived during the fossil energy and natural resource age and capitalised on the success of the latter. Black funds performed well in the past, but the fossil energy era is approaching its end and will be most likely supplanted by the renewable energy age in the future”*.

Considering this previous empirical evidence, it seems reasonable to expect that SR funds decarbonizing their portfolios do not prejudice their financial performance. Thus, I pose the next research question (RQ) and establish the following research hypothesis (RH):

RQ1: How does the portfolio decarbonization process impact the financial performance of SR mutual funds?

RH1: Holding a lower exposure to carbon sectors do not jeopardize SR mutual funds' financial performance.

SR mutual funds are not a homogenous group and in fact mutual fund managers can use different strategies to incorporate ESG issues into the investment process. The two traditional approaches are the negative or exclusionary screens and the positive or inclusionary screens. Negative screens consist in excluding certain sectors or companies from the eligible stock universe. It is very common that SR funds avoid the investment in sin sectors because some investors consider these activities morally reprehensible (i.e. alcohol, tobacco, weapons, gambling, etc. ...). In this regard, Blitz and Fabozzi (2017) explain that the companies or sectors considered “sin” can evolve over time as a result of changing in social norms. For example, the rising awareness to global warming has provoked that nowadays carbon-intensive sectors hold the label of “sin” and consequently (p. 2) *“large institutional investors are increasingly setting carbon footprint targets, effectively barring them from investing in stocks with high CO2 emissions”*. On the other hand, positive screens consist in selecting specific companies with good records on ESG issues, with a commitment to responsible business practices or that address environmental or social challenges (Muñoz, 2020).

Impact investing and engagement or shareholder activism are also strategies that SR mutual fund managers can use to integrate ESG principles into their investment decisions. Impact investing seeks to have a positive effect on society in the ESG dimension. More concretely, the Global Impact Investing Network (GIIN) defines impact investing as *“investments made with the intention to generate positive, measurable social and environmental impact alongside a financial return”*.³ Engagement encompasses a wide range of practices seeking to influence investee companies to improve their corporate social responsibility records. It could be defined as a relational process between investors and

³ <https://thegiin.org/impact-investing/need-to-know/#what-is-impact-investing>

² Black funds are those investing mainly in carbon-intensive sectors.

companies (McNulty & Nordberg, 2016), and includes among other tools, the proposing and voting on company specific corporate social responsibility issues at annual shareholder meetings (O'Rourke, 2003). Another relevant label in SR mutual fund industry identifies investments committed to the environment. Although aforementioned SR strategies could deal with environmental issues, there is a subset of SR mutual fund industry specialized in green investments and marketed under the specific labels "green" or "environmental friendly" (Muñoz et al., 2014). All these approaches are not excluding and in fact, nowadays SR mutual funds could implement different strategies at the same time to integrate ESG issues into the investment process, performing multiple screens and covering a broad range of non-financial matters in an attempt to appeal as many investors as possible (In, Kim, Park, Kim, & Kim, 2014).

SR funds, whatever the SR strategy/ies performed, suffer pressures from initiatives such as the fossil fuel divestment movement to decarbonize their portfolios and are scrutinized regarding the environmental impact of their investments, as institutional investors they are (Boermans & Galema, 2019). However, it could expect that the exposure to black industries would be lower for the SR mutual funds marketed under "low-carbon" labels. These funds cater to investors especially aware of global warming and it is likely that these investors make a closer monitoring of the SR funds' carbon exposure. Thus, I pose the following research question and research hypothesis:

RQ2: How do SR strategies impact the exposure of SR mutual funds to carbon industries?

RH2: SR mutual funds that explicitly perform SR strategies dealing with carbon issues are less exposed to black industries.

Local political and socioeconomic factors could be drivers of SR mutual funds' exposure to black industries. In this way, Borgers et al. (2015) explain that mutual fund managers could integrate local values, beliefs and norms into their investment decisions because they could be influenced by people with whom they interact (Shu, Sulaeman, & Yeung, 2012, or Hong, Kubik, & Stein, 2004), or merely in an attempt to cater to local investors. Political factors stand out among the different local idiosyncrasies. Borgers et al. (2015) find that mutual funds located in Democrat-leaning states are less exposed to sin sectors (alcohol, tobacco and gambling). Hong and Kostovetsky (2012) wonder whether political values influence investing and find that mutual fund managers who make campaign donations to Democrats (relative to non-donors or Republican donors) hold less of their portfolios exposed to socially irresponsible industries, such as tobacco or weapons. Focusing on environmental issues, Kennedy and Johnson (2020),⁴ based on a broad survey about how Americans perceive climate change, have recently pointed out that Democrats are much more concerned with this issue than Republicans. Similarly, Cragg, Zhou, Gurney, and Kahn (2013) based on data from the League of Conservation Voters, find that Democrats in congress are much more likely to vote "pro-environment" on key pieces of legislation than are Republicans. Similarly, Light and Hale (2018) describe how the current US administration (Republican) has tried to reverse U.S. advances on domestic and international environmental issues triggered during the last two administrations (Democrat). Thus, I pose the following research question and research hypothesis:

RQ3: How do local political factors impact the exposure of SR mutual funds to carbon industries?

RH3: SR mutual funds managed by firms headquartered in Republican-leaning states are more exposed to black industries.

Another local factor that could have a significant influence on

⁴ <https://www.pewresearch.org/fact-tank/2020/02/28/more-americans-see-climate-change-as-a-priority-but-democrats-are-much-more-concerned-than-republicans/>

managers' decisions is the socioeconomic impact of carbon-intensive industries in the area where they are located. People living in areas where this type of industries represent a significant weight of the employment and income, may be contrary to decarbonize the economy. These areas will face more problems to make the transition to a low-carbon economic system, bearing higher costs for carbon regulation. The areas where carbon-intensive industries are more relevant, present higher levels of CO₂ emissions per capita. In this way, Cragg et al. (2013) finds that representatives in high carbon districts are more likely to vote no to pro-green legislation.

Considering the above reasoning, I pose the following research question and research hypothesis:

RQ4: How do environmental local factors impact the exposure of SR mutual funds to carbon industries?

RH4: SR mutual funds managed by firms headquartered in states with greater CO₂ emissions per capita are more exposed to black industries.

3. Data and methods

I obtain the data used in this research mainly from the Morningstar Database. I select all the actively-managed mutual funds domiciled in the US market, labelled as Socially Conscious, investing in domestic equity and global equity in the period January 2012–December 2018 with information about the industry portfolio allocation and the SR strategies performed. Thus, it is obtained a sample composed by 561 different share classes. For each share class, I download information about the daily price, the monthly total net assets, the inception date, the turnover ratio, the net expense ratio, the management company name, the city where the management company is located,⁵ the type of the share class, the SR strategies implemented and the monthly industry allocation of the portfolio.⁶ I work at fund level since all the share classes of a fund have the same portfolio. Thus, I aggregate the information from different share classes belonging to the same fund (Renneboog et al., 2011). Finally, the research sample consists of 136 different SR funds, 88 investing in domestic equity and 48 investing in global equity.

Morningstar classifies the stocks held by mutual fund portfolios into three major economic spheres or super-sectors: i) cyclical; ii) defensive; and iii) sensitive. These three super-sectors are divided into eleven sectors: basic materials, consumer cyclical, financial services, real estate, consumer defensive, healthcare, utilities, communication services, energy, industrials and technology. In turn, these eleven sectors encompass sixty-nine industry groups most of which include more than one industry. Among these industries, I identify those that could be labelled as black industries considering the definitions provided in previous literature (Ibikunle & Steffen, 2017). More concretely, I define three categories of black industries: fossil fuel, metal and utilities. To compute the exposure to the fossil fuel industries, I aggregate the weights of the following industries: oil & gas drilling, oil & gas exploration and production (E&P), oil & gas integrated, oil & gas midstream, oil & gas refining and marketing, oil & gas equipment and services, and coal. To compute the exposure to the metal industries, I sum the weights of the following industries: aluminum, copper, gold, industrial metals & minerals, silver, steel and metal fabrication. Finally, to compute the exposure to the utilities industries, I aggregate the weights of the following industries: utilities-independent power producers, utilities-

⁵ The management company of eight funds belonging to the same family is located out of America (in United Kingdom). In addition, this information is missed for five funds in the sample. Thus, the sample of funds considered in the analyses of the RH3 and RH4 is lower.

⁶ For 74 out 136 funds monthly portfolios are available; and, for 62 out 136 funds quarterly portfolios are available. When monthly portfolios are not available, I consider only the months with portfolio data.

Table 1
Percentage of the SR funds' portfolio invested in black industries.

	Obs.	Mean	SD	Median	10th percentile	90th percentile
Black industries	6215	9.51	8.44	8.35	1.31	16.88
Fossil fuel industries	6215	5.32	4.29	4.88	0.00	10.86
Metal industries	6215	1.23	1.86	0.46	0.00	3.36
Utilities industries	6215	2.97	7.44	1.65	0.00	4.69

Table 1 shows the average weight of the black industries in the SR funds' portfolios. Black industries label is the sum of the fossil fuel, metal and utilities industries exposures. It is provided the number of portfolios analyzed and the following statistics: mean, standard deviation, median, 10th percentile and 90th percentile.

diversified, utilities regulated-electric, utilities regulated-gas and utilities regulated-water.⁷ (Table A1) I build an additional variable representing the sum of the weights of the fossil fuel, metal and utilities industries (*black industries*). In Table 1, it is provided the summary statistics for all these variables.

As can be seen in Table 1, the average weight of black industries in the SR funds' portfolios is 9.51%, being the average weight of the fossil fuel/metal/utilities industries 5.32%/1.23%/2.97%, respectively. Fig. 1a plots the evolvement of these weights over the sample period.

As can be noted from the Fig. 1, the relevance of black industries in SR funds' portfolios falls over time. Thus, in 2012 the average percentage of the portfolio invested in these industries is 13.45% whereas in 2018 this figure is 7.40%. This fall is mainly spurred by the divestment from the fossil fuel industries (8.32% in 2012 versus 3.70% in 2018). These summary statistics reveal that SR mutual funds have decarbonized their portfolios over the past few years. To check whether this decarbonization process is driven by existing SR funds changing their allocations or by new entrants to the market having a lower exposure to these sectors, I plot separately the evolvement of these exposures for incumbent and new entrants SR funds (37 out of 136 are new entrants). Fig. 1b, c shows the results for the SR incumbent (new-entrants) funds.

As can be seen in Fig. 1b and c, the exposure to black industries is greater for incumbent funds than for the new entrant ones, from 2012 to 2016. However, in the years 2017 and 2018 it occurs the contrary. Besides, if we focus on the Fig. 1b and compare it with Fig. 1a (all the SR funds together), we can observe that the results are very similar. Thus, it seems that the fall in the exposure to black industries in the SR mutual fund industry over the period analyzed is due to the existing SR funds changing their portfolio holdings. The decarbonization process is not exclusive of the SR funds but also occurs for other institutional investors. In Fig. 1d, it is plotted the exposure to black industries of a sample of US equity conventional mutual funds (7399 in total).

If we focus on the results shown in Fig. 1d, we can check that the falling trend of the exposure to black sectors also occurs in the conventional mutual fund industry. Besides, if we compare the results shown in Fig. 1d with those shown in Fig. 1a, we can observe mixed results according to the period analyzed. Thus, in the period 2012–2016, surprisingly conventional mutual funds are less exposed to these sectors than the SR mutual funds in the sample analyzed. However, in the period 2017–2018, the contrary occurs and SR mutual funds seem to be less exposed to black industries. These results suggest that the portfolio decarbonization trend has gained prominence in the SR mutual fund industry in the last years. Additionally, Fig. 1e plots the exposure to

⁷ In Appendix 1, it is shown the definition provided by Morningstar for each one of these industries and some summary statistics for the average weight of the different super-sectors and sectors in the portfolios analyzed.

black industries of an index fund aiming to replicate the S&P500.

As can be seen in Fig. 1e, the exposure of this fund to black sectors falls over time. This finding reflects that the share of black industries in the total market capitalization has been decreasing during the period. However, if we compare the information provided in Fig. 1e with that provided in Fig. 1a and d, we can check that the exposure of both conventional and SR mutual funds to black sectors (and more concretely, to fossil fuel sectors) is lower than the exposure of the index fund. This result could be reflecting that institutional investors hold a lower exposure to black sectors due to the social pressure from initiatives such as the fossil fuel divestment movement.

To test the RH1, I regress the risk-adjusted financial performance of SR funds on the weight of black industries and other funds' characteristics. To approach the risk-adjusted financial performance of each fund in each month, I compute the monthly five-factor alphas (Fama & French, 2015). Expression 1 shows the equation for this model.

$$r_{i,t} = \alpha_i + \beta_{RMRF,i}RMRF_t + \beta_{SMB,i}SMB_t + \beta_{HML,i}HML_t + \beta_{RMW,i}RMW_t + \beta_{CMA,i}CMA_t + \varepsilon_{i,t} \tag{1}$$

where $r_{i,t}$ is the excess return on fund i on the risk-free asset in period t ; $RMRF_t$ is the market factor (the excess return on the risk-free asset of the market benchmark portfolio at moment t); SMB_t is the size factor (the excess return of small caps over large capitalisation stocks); HML_t is the book-to-market factor (the excess return of value stocks over growth stocks); RMW_t is the profitability factor (the excess return of stocks with robust profitability over stocks with weak profitability); CMA_t is the investment factor (the excess return of conservative stocks over aggressive stocks⁸); and $\varepsilon_{i,t}$ is the error term in fund i over period t . The factors data are obtained from Kenneth French's website.⁹ The alpha coefficient is computed at the end of each month for each fund using the daily returns in the previous year (the daily returns are computed from the daily fund prices obtained from Morningstar database). Then, I annualize these alphas.

The funds' characteristics include the size of the fund approached by the log of the total net assets; the age of the fund expressed in years and computed as the difference between the month t and the inception date of fund's oldest share class; the family size approached as the log of the total net assets managed by all the SR funds belonging to the same family; the turnover ratio; the net expense ratio¹⁰; a dummy variable that adopts the value of 1 when the fund holds institutional share class and 0 otherwise; the industry concentration of the portfolio approached by the Herfindahl index (HI)¹¹; and a set of dummy variables to control for the SR strategy/ies performed by the fund. More concretely, Morningstar considers the following five generic SR strategies labels: incorporation that adopts the value of 1 when the SR fund performs positive screens and 0 otherwise; engagement that adopts the value of 1 when the SR fund performs shareholder activism and 0 otherwise; impact_investing that adopts the value of 1 when the SR fund makes impact investing and 0 otherwise; negative_screens that adopts the value of 1 when the SR fund performs negative screens and 0 otherwise; and environmental_sector that adopts the value of 1 when the SR fund

⁸ Fama and French (2015) call conservative and aggressive stocks those of low and high investment firms.

⁹ I use US factors for the SR funds investing in domestic equity and global factors for the SR funds investing in global equity. I thank Kenneth French for making this information available on his website: <http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/>

¹⁰ The turnover ratio and the net expense ratio are only available on an annual basis. Following previous literature, I make the assumption that for all the months in the year t , the value of these magnitudes is the same.

¹¹ The Herfindahl index (HI) can be used to approach the concentration degree of an investment portfolio (see Kacperczyk et al., 2005). The expression that allows to compute the HI is as follows: $HI_t = \sum_{i=1}^n w_{i,t}^2$; where $w_{i,t}$ is the weight of the mutual fund holdings in industry i in month t .

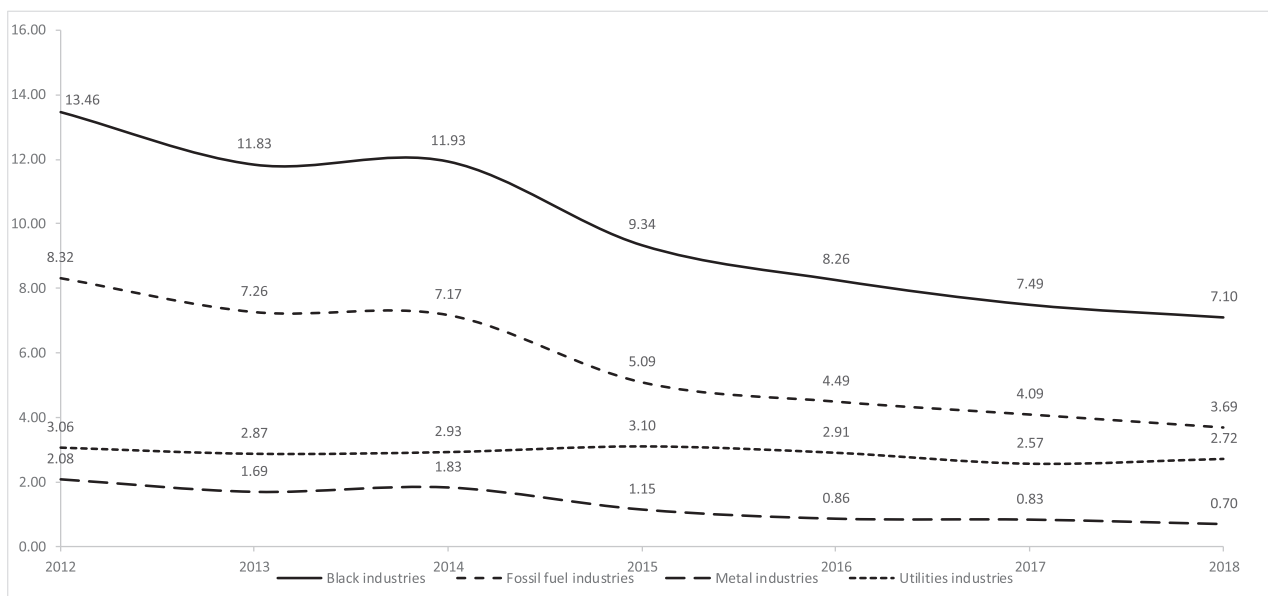
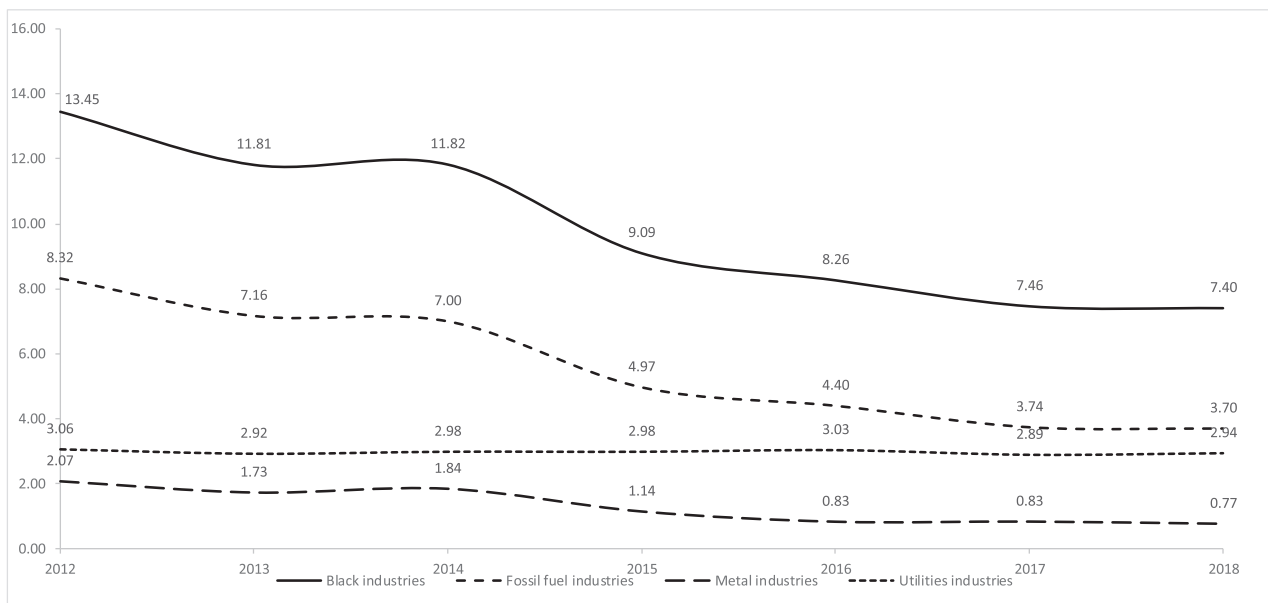


Fig. 1. a Average percentage of the SR funds' portfolios invested in black industries by year (2012–2018). Fig. 1a shows the evolution of black industries' weights indicators over the period analyzed. The weights provided (expressed in %) have been computed as the mean of the weights of black industries in the portfolios of each year in the sample analyzed (2012–2018). The number of the portfolios considered in each year is: 2012-681 portfolios, 2013-742 portfolios, 2014-769 portfolios, 2015-819 portfolios, 2016-1031 portfolios, 2017-1072 portfolios and 2018-1101 portfolios. b. Average percentage of the incumbent SR funds' portfolios invested in black industries by year (2012–2018). Fig. 1b shows the evolution of black industries' weights indicators over the period analyzed. The weights provided (expressed in %) have been computed as the mean of the weights of black industries in the portfolios of incumbent SR funds in each year in the sample analyzed (2012–2018). 99 out of 136 are incumbent SR funds. The number of the portfolios considered in each year is: 2012-678 portfolios, 2013-707 portfolios, 2014-721 portfolios, 2015-703 portfolios, 2016-715 portfolios, 2017-724 portfolios and 2018-746 portfolios. Fig. 1c shows the evolution of black industries' weights indicators over the period analyzed. The weights provided (expressed in %) have been computed as the mean of the weights of black industries in the portfolios of new entrant SR funds in each year in the sample analyzed (2012–2018). 37 out of 136 are new-entrant SR funds. The number of the portfolios considered in each year is: 2012-3 portfolios, 2013-35 portfolios, 2014-48 portfolios, 2015-116 portfolios, 2016-316 portfolios, 2017-348 portfolios and 2018-355 portfolios. Fig. 1d shows the evolution of black industries' weights indicators over the period analyzed. The weights provided (expressed in %) have been computed as the mean of the weights of black industries in the portfolios of a sample of 7339 conventional US equity mutual funds each year in the sample analyzed (2012–2018). The number of the portfolios considered in each year is: 2012-22,960 portfolios, 2013-23,153 portfolios, 2014-23,886 portfolios, 2015-24,128 portfolios, 2016-24,596 portfolios, 2017-25,046 portfolios and 2018-25,053 portfolios. e. Average weight of black industries in a market benchmark by year (2012–2018). Fig. 1e shows the evolution of black industries weights indicators over the period analyzed. The weights provided (expressed in %) have been computed as the mean of the weights of black industries in the portfolios of an index fund that aims to replicate the S&P500.

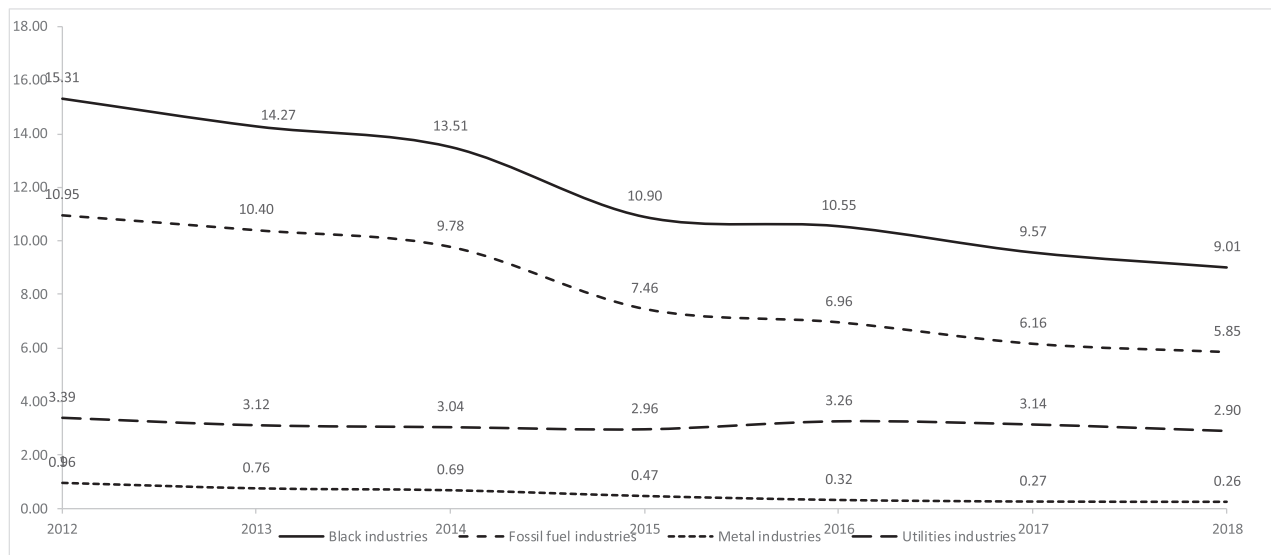
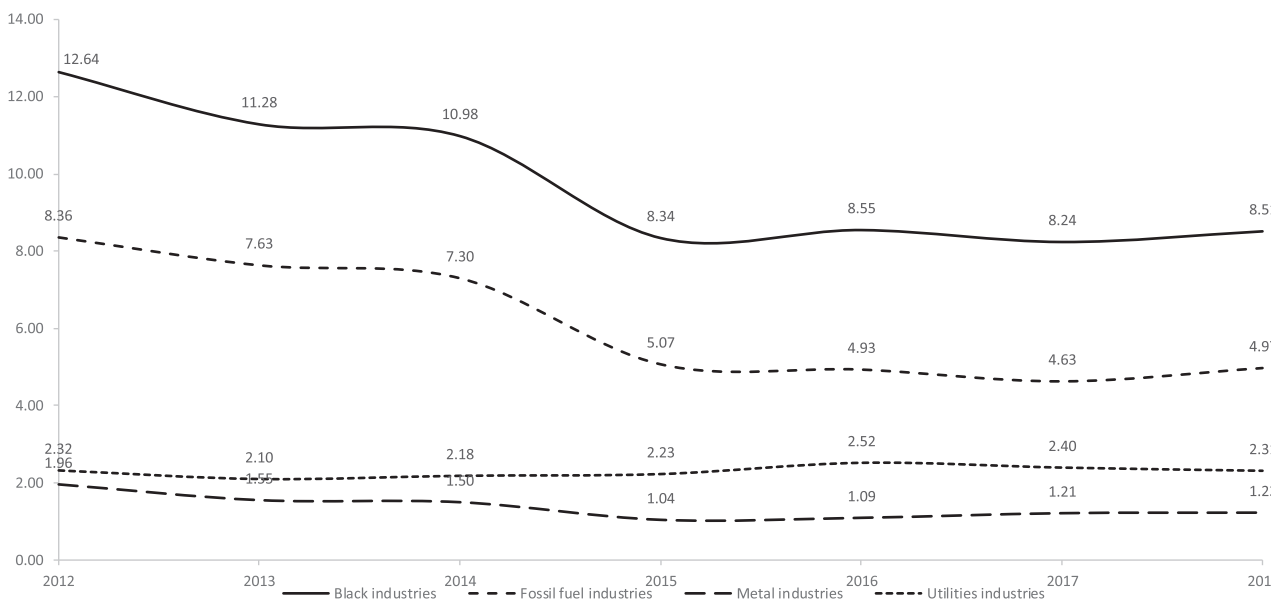
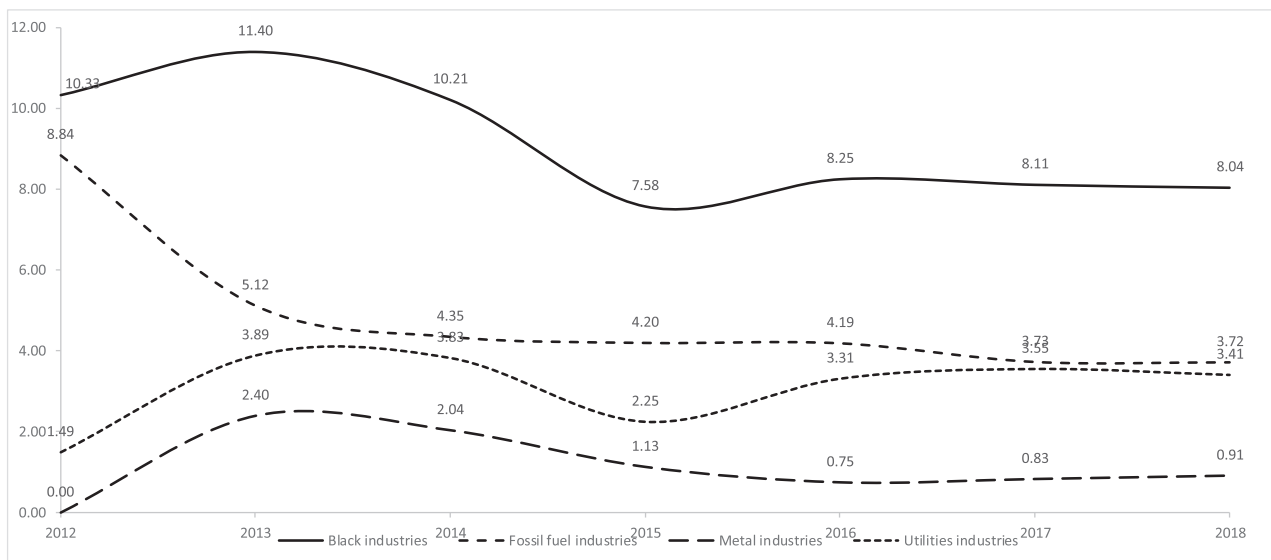


Fig. 1. (continued).

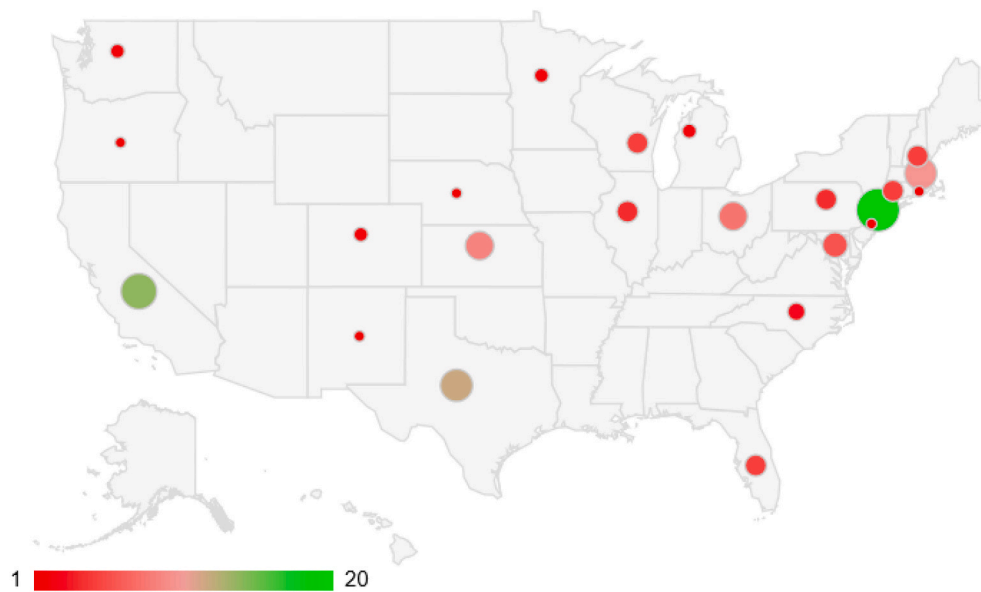


Fig. 2. Number of SR funds by State. Source: Elaborated with information from Morningstar Database. To determine the location of mutual fund companies, I have used the information provided by Morningstar under the label “City firm”. The SR funds for which firm city information is available are managed by mutual fund companies located in 23 different states: California, Colorado, Connecticut, Florida, Illinois, Kansas, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, Texas, Washington and Wisconsin.

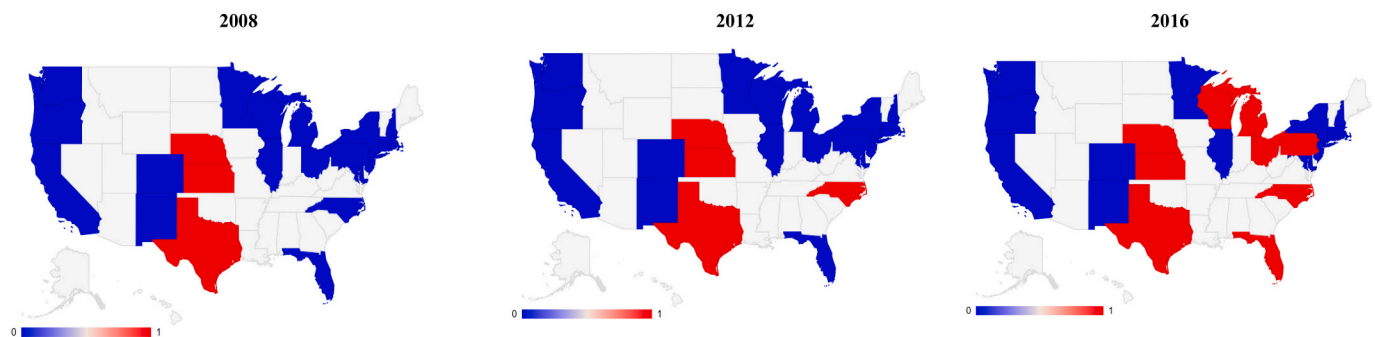


Fig. 3. Republican-leaning (red) and Democrat-leaning (blue) states according to 2008–2016 U.S. Presidential elections. Source: Elaborated with data from U.S. Electoral College. <https://www.archives.gov/electoral-college> (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

invests in green industries and 0 otherwise.¹²

In order to test the RH2, I regress the weight of black industries on funds’ characteristics and additional dummy variables reflecting SR strategies explicitly related to carbon issues. More concretely, Morningstar provides with more detailed information for three out of the five generic SR strategies, some of which are explicitly related to carbon issues. These labels are the following: *fossil_fuel_carbon_free* that adopts the value of 1 when the SR fund makes impact investing regarding this theme and 0 otherwise; *renewable_energies* that adopts the value of 1 when the SR fund invests in this sector and 0 otherwise; and *negative_thermal_coal* that adopts the value of 1 when the SR fund excludes companies from this sector and 0 otherwise (see Appendix 2).

In order to test RH3 and RH4, I build two additional variables. First, I build a dummy variable that adopts the value of 1 when the

management company is located in a Republican-leaning state and 0 otherwise. In order to determine the location of a mutual fund company, I use the information provided by Morningstar under the label “city firm”. Fig. 2 plots the number of SR funds distributed among different states according to the location of their management companies. To determine what states are Republican-leaning, I use the information of the 2008–2016 U.S. presidential election data available at U.S. Electoral College.¹³ Fig. 3 plots the republican-leaning (red) and democrat-leaning (blue) states according to the U.S. presidential election results. The second variable is the yearly CO2 emissions per capita of the states where the SR fund companies are located. This information

¹³ <https://www.archives.gov/electoral-college>

¹² Appendix 2 shows the definition provided by Morningstar for each one of these SR strategies.

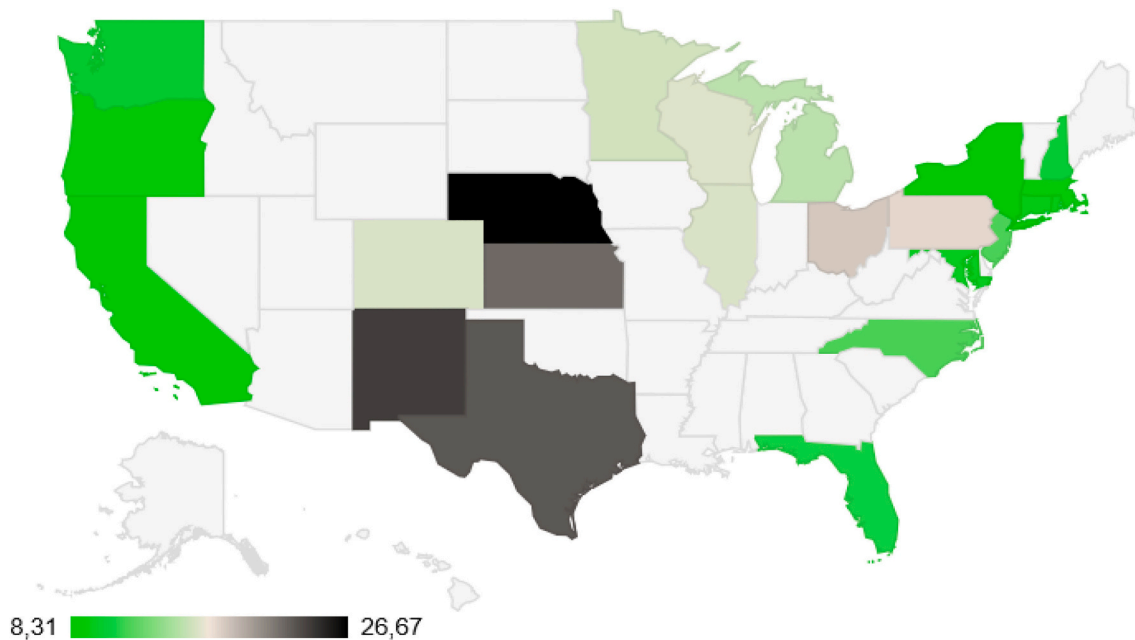


Fig. 4. Annual Average CO2 emissions per-capita by State (metric tons’ carbon dioxide per person). Source: Elaborated with data from the U.S. energy information administration (EIA): <https://www.eia.gov/environment/emissions/state/analy>

Table 2
Summary statistics.

	Mean	SD	Median	10th percentile	90th percentile
Five factor alpha (%)	-5.28	5.68	-4.86	-12.23	0.87
Fund size (\$ millions)	1085.55	5563.34	201.72	21.51	2039.14
Family size (\$ millions)	8439.74	16,397.10	2665.71	117.11	20,035.82
Fund age	15.03	15.18	12.17	1.93	28.04
Turnover ratio (%)	41.56	33.53	32.00	11.00	85.00
Expense ratio (%)	1.04	0.40	1.02	0.49	1.50
HI (%)	4.08	2.97	3.51	1.99	5.99
CO2 emissions (tons per person)	13.50	5.19	10.30	8.25	21.34

Table 2 reports the summary statistics for different mutual fund characteristics. More concretely it is provided information for the annualized monthly estimated 5-factor alpha coefficients, the fund size expressed in \$ million, the family size expressed in \$ million, the fund age expressed in years, the turnover and net expense ratios expressed in %, the Herfindahl index approaching the concentration of SR funds’ portfolios expressed in % and the CO2 emission per capita of the states where the SR funds are located expressed in metric tons’ carbon dioxide per person. For each feature, it is provided the mean, the standard deviation, the median, the 10th percentile and the 90th percentile.

it is obtained from the EIA (US Energy Information Administration)¹⁴ and it is plotted in Fig. 4.

Tables 2 and 3 show the summary statistics for above variables.

Table 2 reports the summary statistics for the 5-factor alpha coefficient, the total net assets, the family size, the age of funds, the turnover

¹⁴ The last year with available information is 2016. I make the assumption that CO2 emissions per capita in 2017 and 2018 are the same as those occurred in 2016. This information is only available in a yearly basis, thus I make the assumption that for all the months in the year t, the value of these magnitudes is the same. <https://www.eia.gov/environment/emissions/state/analysis/>

Table 3
Summary statistics (dummy variables).

	Mean	SD	D = 1	D = 0
Republican leaning state	0.237	0.426	57	109
Institutional share classes	0.763	0.425	109	27
Positive Screens	0.795	0.404	100	36
Negative Screens	0.677	0.468	93	43
Engagement	0.195	0.396	27	109
Impact investing	0.242	0.428	31	105
Environmental sector	0.028	0.166	4	132
Low-carbon/fossil-fuel free	0.137	0.344	14	122
Renewable energies	0.018	0.134	2	134
Negative Screens on Thermal Coal	0.204	0.403	25	111

Table 3 reports the summary statistics of mutual funds’ characteristics approached by dummy variables. It is provided information for the Republican-leaning state dummy, the institutional share class dummy and the SR strategy indicators (positive screens, negative screens, engagement, impact investing, environmental sector, impact investing on low carbon fossil fuel free themes, negative screens on thermal coal and renewable energies). For each dummy variable it is provided the mean, the standard deviation and the number of funds adopting the value of 1/0.

ratio, the net expense ratio, the Herfindahl index and the CO2 emissions per capita. For each one of these variables, it is reported the mean, the median, the standard deviation, the 10th percentile and the 90th percentile. As can be seen in Table 2, the average five-factor alpha is -5.28%, the mean total net assets managed by SR funds are \$1085.55 and the average family size reaches \$8439.74 million. The mean fund age is 15.03 years and the average turnover ratio/net expense ratio is 41.56%/1.04%, respectively. The mean Herfindahl index is 4.08% and the average yearly CO2 emissions per capita in the states where SR funds’ companies are located reaches 13.50 tons.

Table 3 reports the summary statistics for the indicator variables considered in the research. It is provided the mean, the standard deviation and the number of funds for which the indicator adopts the value of 1/0.¹⁵ As can be observed in Tables 3, 57 funds are managed by

¹⁵ The mean and standard deviation are affected by both the number of funds and the number of observations for each fund.

Table 4
Impact of SR funds' portfolios exposure to black industries on the risk-adjusted financial performance.

	Model 1	Model 2	Model 3	Model 4
Black industries	-0.095*** (-6.23)			
Fossil fuel industries		-0.150*** (-7.2)		
Metal industries			-0.425*** (-8.81)	
Utilities industries				0.041 (1.23)
Fund Size	-0.084 (-0.57)	-0.146 (-1.00)	-0.070 (-0.48)	-0.122 (-0.83)
Family Size	-0.653*** (-6.28)	-0.581*** (-5.56)	-0.577*** (-5.57)	-0.612*** (-5.93)
Fund Age	-0.076*** (-13.09)	-0.075*** (-12.86)	-0.080*** (-13.61)	-0.076*** (-13.01)
Turnover ratio	-0.004 (-1.31)	-0.004 (-1.39)	-0.003 (-1.23)	-0.002 (-0.85)
Net Expense ratio	-0.731*** (-2.67)	-0.581** (-2.15)	-0.654** (-2.39)	-0.477* (-1.76)
HI	0.251*** (6.6)	0.213*** (5.83)	0.244*** (6.53)	0.182*** (4.7)
Institutional Share classes	0.680*** (3.59)	0.705*** (3.7)	0.753*** (3.97)	0.757*** (4.01)
Positive screens	0.476** (2.23)	0.210 (0.97)	0.650*** (3.02)	0.423** (1.98)
Negative screens	-1.611*** (-7.49)	-1.600*** (-7.41)	-1.355*** (-6.35)	-1.501*** (-6.98)
Engagement	-0.040 (-0.19)	0.059 (0.27)	-0.264 (-1.22)	0.073 (0.34)
Impact Investing	0.695*** (4.00)	0.692*** (3.96)	0.828*** (4.88)	0.974*** (5.73)
Environmental sector	-1.436 (-1.44)	-2.386** (-2.41)	-2.635*** (-2.65)	-2.059** (-1.96)
Intercept	1.324** (2.14)	1.598** (2.57)	0.023 (0.04)	-0.221 (-0.38)
Time Controls	YES	YES	YES	YES
Style Controls	YES	YES	YES	YES
Number of Obs.	5971	5971	5971	5971
R2	0.192	0.193	0.1972	0.1864
VIF	2.09	2.02	2.02	2.3

This table reports the OLS regression for eq. (2), the dependent variable being the annualized monthly five-factor alpha expressed in %. It contains the estimated coefficient for each independent variable and the associated t-ratio between brackets (computed with robust standard errors). Model 1/2/3/4 analyze the impact of SR funds' exposure to black industries/fossil-fuel industries/metal industries/utilities industries (weights expressed in %). The turnover ratio, the net expense ratio and the Herfindahl index are expressed in %. All the models include time and Morningstar financial style controls. The table also reports the R-squared and the VIF (variance inflation factor) testing potential multicollinearity problems.

*** Significant at 1%;
** significant at 5%;
* significant at 10%.

companies located in Republican-leaning states¹⁶ and 109 funds have institutional share classes. 100/93/27/31/4 funds perform positive screens/negative screens/engagement/impact investing/environmental sector SR strategies. Regarding the SR strategies explicitly related to carbon issues, it is observed that 14 funds perform impact investing regarding low-carbon/fossil-fuel free themes, 25 funds exclude thermal coal companies and 2 funds invest in renewable energies. Besides, Appendix 3 reports the correlation matrix for the variables considered across models (Table A2 and A3).

4. Empirical findings

4.1. Effect of black industries' exposure on risk-adjusted financial performance

To test the RH1, I regress the estimated 5-factor alpha coefficients on the weight of black industries and other mutual fund characteristics that could affect the financial performance. In addition, I include time and

financial-style controls.¹⁷

$$\begin{aligned}
 \text{Five_factor_alpha}_{p,t} = & \alpha_0 + \beta_1 \text{Black_industry_weight}_{p,t} \\
 & + \sum_{k=2}^8 \beta_k (\text{Fund Characteristics Controls}_{p,t}) \\
 & + \sum_{k=9}^{13} \beta_k (\text{SR_strategy}_{p,t}) + \sum_{k=14}^{19} (\text{Time}_t) \\
 & + \sum_{k=20}^{34} \beta_k (\text{Style}_p) + \varepsilon_{p,t}
 \end{aligned} \tag{2}$$

I regress several models from expression (2) differing in the proxies used for the exposure to the black industries. Table 4 reports the results from these models.

Model 1 considers the exposure of SR funds' portfolios to all industries labelled as black (fossil fuel, metal and utilities industries). The results achieved indicate that a greater exposure to these industries negatively impacts the risk-adjusted financial performance of SR funds, since the estimated coefficient on this variable is negative and significant. This result is conducted by the exposure to fossil fuel and metal

¹⁶ The sum of funds with 1 and 0 overcomes the total number of funds in the sample since for funds managed by firms located in Florida, Michigan, North-Carolina, Ohio, Pennsylvania and Wisconsin, the Republican-leaning state dummy changes over time (see Fig. 3).

¹⁷ I include six dummy variables that take the value of 1 whether the year is 2013/2014/2015/2016/2017/2018, respectively, and 0 otherwise (I take 2012 as the base year). The funds included in the sample belongs to 16 different Morningstar style categories: US Fund Large Blend, US Fund Large Growth, US Fund Large Value, US Fund Mid-Cap Blend, US Fund Mid-Cap Growth, US Fund Mid-Cap Value, US Fund Small Blend, US Fund Small Growth, US Fund Small Value, US Fund Foreign Large Blend, US Fund Foreign Large Growth, US Fund Foreign Large Value, US Fund Foreign Small/Mid Growth, US Fund Foreign Small/Mid Value, US Fund World Large Stock and US Fund World Small/Mid Stock. I take as base category the first one and include dummy variables for the remaining financial styles.

industries. In this way, this evidence also occurs when considering only the weight of fossil fuel industries (model 2) and only the weight of metal industries (model 3). However, results from model 4 show that the estimated coefficient on utilities industries weight is positive but non-significant. Considering the statistics shown in Fig. 1 informing that the fall of the SR funds' exposure to carbon-intensive sectors has been mainly driven by the fossil fuel industries (8.32% in 2012 versus 3.70% in 2018), the results from Table 4 are consistent with the RH1 and I can conclude that the decarbonization of SR funds' portfolios does not jeopardize their financial performance and it could even have a positive impact.

Regarding the estimated coefficients on the remaining independent variables, the results achieved point out that the financial performance of SR funds is positively (negatively) related to the degree of industry portfolio concentration and the existence of institutional share classes (the family size, the fund age and the net expense ratio). These results are consistent with those previously observed in mutual fund literature. The positive estimated coefficient on the portfolio Herfindahl index could be explained by the findings of Kacperczyk, Sialm, and Zheng (2005) who observe that actively-managed mutual funds with more industry concentrated portfolios obtain a better financial performance. Thus, these authors point out that mutual fund managers could decide to concentrate their holdings in industries where they have informational advantages to exploit them and achieve a superior financial performance. Institutional investors are more sophisticated than individual ones since they have better information and more resources to make their investment decisions (Keswani & Stolin, 2008). In this way, they show superior selection skills (Feng, Zhou, & Chan, 2014) and make a more exhausting monitoring of mutual fund managers (James & Karceski, 2006). Thanks to the moderation of agency problems from greater monitoring, funds with institutional share class outperform other funds without this type of share class (Evans & Fahlenbrach, 2012). The results for fund age are consistent with those previously found by Evans (2010) and Adams, Nishikawa, and Rao (2018). Bhojraj, Jun Cho, and Yehuda (2012) observe that the positive link between family size and fund performance falls over time and the results for the net expense ratio could be reflecting the negative effect of charging greater fees (Ferreira, Keswani, Miguel, & Ramos, 2013).

Among SR strategies dummies, the results achieved point out that performing positive screens and impact investing (negative screens and environmental sector strategies) positive (negative) impact the financial performance. Positive screens consist in investing in stocks with good records on corporate social responsibility (CSR) issues. Previous literature has shown that could exist a positive relationship between good records on CSR dimension and the financial performance (Torugsa, O'Donohue, & Hecker, 2012 or Saeidi, Sofian, Saeidi, Saeidi, & Saeidi, 2015). Impact investing seeks both social and financial objective and it could be justified only whether those companies can offer a higher performance than with a simple portfolio diversification (Viviani & Maurel, 2019). Negative screens consist in excluding sin sectors that could yield greater risk-adjusted financial performance due to be shunned by large institutional investors pressured by societal norms (Hong & Kacperczyk, 2009). Capelle-Blancard and Monjon (2014) show that only exclusionary screens – such as avoiding 'sin' stocks – decrease financial performance. Barnett and Salomon (2006) explain that whereas negative screens impose more diversification costs upon a fund,

positive screens disproportionately increase a fund's selectivity, consequently being plausibly to expect a negative performance effect for 'negative' screens and a positive performance effect for 'positive' screens. Finally, environmental sector label includes the SR funds investing in renewable energies and other industries related to environmental issues (see Appendix 2). The poor financial performance of funds focused on these industries has been previously documented by Reboredo et al. (2017), among others. Whereas decarbonizing investment portfolios does not jeopardize financial performance of SR funds, the investment in SR funds focused in green technologies seems to be unattractive from a financial point of view. Notwithstanding, it is necessary to clarify that only 4 out 136 funds in the sample analyzed hold this label and that the other SR strategies also could deal with environmental issues.

4.2. Determinant of SR funds' exposure to black industries

SR mutual funds can perform different strategies to integrate ESG issues into the investment process. In order to test the RH2, I regress the weight of black industries in the SR funds' portfolios on different mutual fund characteristics and on a set of dummy variables identifying the SR funds that explicitly perform strategies dealing with carbon issues. Concretely, I substitute the more generic labels referred to negative screens, impact investing and environmental sector for others more specific being negative screens on thermal coal, impact investing regarding low-carbon/fossil-fuel free themes and renewable energies, respectively (see Appendix 2).

$$\begin{aligned}
 \text{Black_industry_weight}_{p,t} = & \alpha_0 + \sum_{k=1}^3 \beta_k (\text{Carbon_SR_strategy}_{p,t}) \\
 & + \sum_{k=4}^{10} \beta_k (\text{Fund Characteristics Controls}_{p,t}) \\
 & + \sum_{k=11}^{12} \beta_k (\text{SR_strategy}_{p,t}) + \sum_{k=13}^{18} (\text{Time}_t) \\
 & + \sum_{k=19}^{33} \beta_k (\text{Style}_p) + \varepsilon_{p,t}
 \end{aligned} \tag{3}$$

I regress several models from eq. (3) differing in the proxy for the dependent variable. Table 5 shows the results for these models.

Model 1 considers as dependent variable the exposure to all industries labelled as black (fossil fuel, metal and utilities). The results obtained indicate that SR funds that perform impact investing regarding low-carbon/fossil-fuel free themes and excluding thermal coal companies are less exposed to black industries, since the estimated coefficients on these dummy variables are negative and significant. However, the estimated coefficient on the renewable energy dummy is positive and significant. This result seems to indicate that the two SR funds in the sample analyzed with this label are especially exposed to black industries. However, when analyzing the exposure to different black industries separately, I can observe that this striking result is conducted by the exposure to utilities industries (model 4). In fact, in model 2 (exposure only to fossil fuel industries) and model 3 (exposure only to metal industries) the estimated coefficient on the renewable energy dummy turns into negative and significant. The explanation for

Table 5
Drivers of SR funds' portfolios exposure to black industries: Carbon SR labels.

	Model 1 (Black industries)	Model 2 (Fossil fuel industries)	Model 3 (Metal industries)	Model 4 (Utilities industries)
Low-carbon/Fossil-fuel free	-4.098*** (-16.08)	-2.672*** (-13.34)	-0.604*** (-7.28)	-0.822*** (-6.68)
Renewable energies	22.717*** (14.34)	-3.560*** (-3.08)	-1.644*** (-3.67)	27.921*** (28.07)
Negative screens on Thermal Coal	-2.192*** (-14.01)	-2.085*** (-18.44)	-0.153*** (-2.9)	0.046 (0.58)
Fund Size	-0.240*** (-2.2)	-0.357*** (-4.44)	0.153*** (4.67)	-0.035 (-0.69)
Family Size	0.701*** (8.2)	0.560*** (9.18)	0.143*** (5.43)	-0.002 (-0.05)
Fund Age	-0.011*** (-2.84)	0.013*** (5.18)	-0.011*** (-9.27)	-0.013*** (-6.53)
Turnover ratio	-0.021*** (-10.59)	-0.015*** (-10.6)	-0.003*** (-3.84)	-0.004*** (-4.53)
Net Expense ratio	-2.485*** (-13.55)	-0.907*** (-7.2)	-0.493*** (-8.14)	-1.085*** (-15.62)
HI	0.445*** (3.5)	0.116 (1.04)	0.111** (2.57)	0.218*** (5.46)
Institutional Share classes	0.016 (0.09)	-0.308** (-2.43)	-0.023 (-0.47)	0.347*** (4.22)
Positive screens	-0.157 (-0.91)	-1.201*** (-9.71)	0.265*** (5.06)	0.779*** (9.31)
Engagement	0.057 (0.31)	0.666*** (4.97)	-0.495*** (-9.06)	-0.114 (-1.34)
Intercept	14.632*** (23.66)	11.738*** (24.71)	0.987*** (4.8)	1.907*** (8.85)
Time Controls	YES	YES	YES	YES
Style Controls	YES	YES	YES	YES
Number of Obs.	6215	6215	6215	6215
R2	0.7443	0.5126	0.4377	0.9136
VIF	1.89	1.89	1.89	1.89

This table reports the OLS regression for eq. (3), the dependent variable being the SR funds' exposure to black industries (model 1), fossil fuel industries (model 2), metal industries (model 3) and utilities industries (model 4), expressed in %. It contains the estimated coefficient for each independent variable and the associated t-ratio between brackets (computed with robust standard errors). Impact investing on Low-carbon/fossil fuel free themes, renewable energies and negative screens on thermal coal are dummy variables adopting the value of 1 when the fund holds these labels and 0 otherwise. The turnover ratio, the net expense ratio and the Herfindahl index are expressed in %. All the models include time and Morningstar financial style controls. The table also reports the R-squared and the VIF (variance inflation factor) testing potential multicollinearity problems.

*** Significant at 1%;
** significant at 5%;
* significant at 10%.

this result could lay in the fact that utilities industries include not only those utilities that operate with fossil fuel energies but also those based on alternative energies. Thus, I can conclude that SR funds marketed under SR labels reflecting a low-carbon commitment live up to their name and their portfolios are less exposed to black industries, at least, to fossil fuel and metal industries. This result is consistent with the RH2.

The mutual fund characteristics controls allow me to explore how SR funds features affect the exposure to black industries. The estimated coefficients for some mutual funds' characteristics vary across models, reflecting different patterns according to the specific industry analyzed. Results from model 1 that considers as dependent variable the exposure to all industries labelled as black (fossil fuel, metal and utilities) suggest that SR funds being smaller, younger, less active, cheaper, with a more industry concentrated portfolio and belonging to greater families are more exposed to these industries. An interesting finding can be observed in model 2 regarding the negative and significant estimated coefficient on the institutional share class dummy. This means that those funds with institutional share classes (targeted to institutional investors) are less exposed to fossil fuel industries. This result is consistent with the empirical evidence found by [Borgers et al. \(2015\)](#) who find that mutual funds managing institutional share classes are less exposed to sin stocks (alcohol, tobacco and gambling). Mutual funds with institutional

investors could be suffered a closer monitoring resulting in a less carbonized portfolio.

Previously, I have obtained that the exposure to black industries negatively impact the financial performance of SR funds. Thus, one could wonder why this type of funds invest in these sectors. I have hypothesized that local factors could influence managers' decisions, impacting the composition of SR funds' portfolios. More concretely, in the case of the exposure to black industries, local political and socio-economic factors could be especially relevant. In order to test the RH3 and RH4, I regress the weight of black industries in SR funds' portfolios on proxies for these local factors and the rest of controls.

$$\begin{aligned}
 \text{Black_industry_weight}_{p,t} = & \alpha_0 + \beta_1 \text{Local_proxy}_{p,t} \\
 & + \sum_{k=2}^8 \beta_k (\text{Fund Characteristics Controls}_{p,t}) \\
 & + \sum_{k=9}^{13} \beta_k (\text{SR_strategy}_{p,t}) + \sum_{k=14}^{19} (\text{Time}_t) \\
 & + \sum_{k=20}^{34} \beta_k (\text{Style}_p) + \varepsilon_{p,t}
 \end{aligned}
 \tag{4}$$

Table 6
Drivers of SR funds' portfolios exposure to black industries: Local factors.

	Black industries		Fossil fuel industries		Metal industries		Utilities industries	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Republican-leaning State	1.454*** (9.25)		0.746*** (6.28)		-0.119*** (-3.12)		0.826*** (9.31)	
CO2 emissions per capita		0.107*** (6.54)		0.062*** (5.22)		0.003 (0.8)		0.042*** (5.28)
Fund Size	-0.376*** (-3.77)	-0.441*** (-4.42)	-0.376*** (-4.97)	-0.415*** (-5.51)	0.164*** (5.97)	0.158*** (5.68)	-0.164*** (-3.03)	-0.184*** (-3.41)
Family Size	0.174* (1.89)	0.312*** (3.34)	0.085 (1.34)	0.164** (2.57)	-0.029 (-1.19)	-0.026 (-1.08)	0.119** (2.31)	0.174*** (3.33)
Fund Age	0.008** (2.19)	0.004 (1.1)	0.022*** (8.42)	0.020*** (7.68)	-0.010*** (-8.39)	-0.009*** (-8.34)	-0.005*** (-2.61)	-0.007*** (-3.55)
Turnover ratio	-0.019*** (-8.83)	-0.020*** (-9.13)	-0.014*** (-9.2)	-0.014*** (-9.42)	-0.001** (-1.97)	-0.001** (-2.13)	-0.004*** (-4.04)	-0.004*** (-4.24)
Net Expense ratio	-3.795*** (-18.06)	-3.913*** (-18.48)	-1.739*** (-11.9)	-1.792*** (-12.3)	-0.853*** (-11.37)	-0.831*** (-11.09)	-1.203*** (-12.09)	-1.290*** (-12.86)
HI	0.070 (1.21)	0.055 (0.97)	-0.222*** (-8.38)	-0.227*** (-8.69)	-0.057*** (-6.22)	-0.052*** (-5.85)	0.348*** (8.96)	0.335*** (8.64)
Institutional Share classes	-0.917*** (-5.13)	-0.625*** (-3.66)	-0.791*** (-6.1)	-0.640*** (-5.18)	-0.121*** (-2.67)	-0.144*** (-3.19)	-0.005 (-0.06)	0.159* (1.89)
Intercept	18.572*** (35.42)	17.198*** (27.52)	15.076*** (41.66)	14.230*** (32.69)	2.395*** (18.15)	2.263*** (16.39)	1.101*** (4.32)	0.705** (2.27)
SR strategy controls	YES	YES	YES	YES	YES	YES	YES	YES
Time Controls	YES	YES	YES	YES	YES	YES	YES	YES
Style Controls	YES	YES	YES	YES	YES	YES	YES	YES
Number of Obs.	5391	5391	5391	5391	5391	5391	5391	5391
R2	0.792	0.791	0.587	0.587	0.462	0.462	0.919	0.918
VIF	1.77	1.78	1.77	1.78	1.77	1.78	1.77	1.78

This table reports the OLS regression for eq. (4), the dependent variable being the SR funds' exposure to black industries (models 1 and 2), fossil fuel industries (models 3 and 4), metal industries (models 5 and 6) and utilities industries (models 7 and 8), expressed in %. It contains the estimated coefficient for each independent variable and the associated t-ratio between brackets (computed with robust standard errors). Republican-leaning state is considered in models 1, 3, 5 and 7 to test the RH3 and CO2 emissions per capita is considered in models 2, 4, 6 and 8 to test the RH4. The turnover ratio, the net expense ratio and the Herfindahl index are expressed in %. All the models include SR strategy, time and Morningstar financial style controls. The table also reports the R-squared and the VIF (variance inflation factor) testing potential multicollinearity problems.

*** Significant at 1%;

** significant at 5%;

* significant at 10%.

I regress different models from expression (4) differing in the black industry proxy and in the local factor proxy. The results for these models are reported in Table 6.

Models 1, 3, 5 and 7 analyze the effect of local political factors on SR funds' exposure to black industries. The proxy for this factor is a dummy variable identifying Republican-leaning states (1) or Democrat-leaning states (0). Model 1 considers the exposure to all industries labelled as black (fossil fuel, metal and utilities). The results achieved indicate that SR funds managed by firms located in Republican-leaning states are more exposed to black industries since the estimated coefficient on this variable is positive and significant. This empirical evidence is conducted by the exposure to fossil fuel and utilities industries since the estimated coefficient in model 5 (exposure to metal industries) is negative and significant. Models 2, 4, 6 and 8 analyze the effect of socioeconomic local factors. The proxy for this factor is the CO2 emissions per capita of the state where the SR fund management company is located. In those states where CO2 emissions per capita are greater, carbon-intensive industries could have a greater socioeconomic impact. The results obtained indicate that SR funds managed by firms located in states with higher records of CO2 emissions per-capita are more exposed to black industries. These results are again driven by the exposure to fossil fuel and utilities industries (models 4 and 8). All these results together are consistent with RH3 and RH4 and seem to indicate that SR fund managers could be influenced by local factors when making their investment decisions.

5. Conclusions

The negative consequences of global warming are increasingly evident and more and more people are aware of the necessity to make a transition from our current economic model to a low carbon economy. In this framework, decarbonization of institutional investors' portfolios has emerged in recent years as a powerful tool to spur this process. This research is focused on one type of institutional investor especially concerned with this issue, the SR mutual funds. These institutional investors should lead this transition considering that their differential feature is precisely the explicit inclusion of ESG issues into the investment decisions. Thus, I have analyzed the exposure of the SR funds' portfolios to black industries, its evolution over time and its impact on the risk-adjusted financial performance. Additionally, I have analyzed some factors that could determine a higher or lower exposure to these sectors.

The findings achieved reveal that SR funds in the sample analyzed have followed the decarbonization trend since their exposure to black industries has fallen over time, especially driven by divestment from fossil fuel industries (those related with oil, gas and coal), probably triggered by non-state governance initiatives such as the fossil fuel divestment movement. In addition, it is observed that a greater exposure to fossil fuel and metal industries negatively impacts the risk-adjusted financial performance of SR funds. Thus, this research provides with empirical evidence of interest for both managers and investors, supporting that the decarbonization of institutional investors' portfolios does not jeopardize investors' outcomes and that it could even be financially beneficial.

Other findings indicate that those SR funds marketed under labels

signaling a commitment to the fight against global warming are less exposed to carbon-intensive sectors. This result points out that low-carbon labels in mutual fund industry are not only a marketing strategy and that those funds holding them really invest differently. In addition, it is observed that SR mutual fund managers could invest in black industries influenced by local factors. Thus, SR funds managed by companies located in Republican-leaning states and in states with a greater level of CO2 emissions per capita are more exposed to black industries, especially, to fossil fuel industries. This last result could be of especial interest to NGOs seeking the transition to a low-carbon economy, since it reveals those geographical areas where it is necessary to make a greater effort to achieve that people engage to decarbonization global trend.

Further research can be performed in the fields studied in this paper. First, it could be interesting to analyze whether the ESG scores provided by sell-side research companies, who are specialized in reporting this type of information, are influenced by the carbon exposure of mutual funds' portfolios. Second, another interesting issue could be to analyze the effect of mutual fund managers' characteristics on the carbon exposure of their investment portfolios. Thirdly, event-driven analyses focused on the impact of the approval of environmental laws on the

portfolio decarbonization process could be of interest, especially, for regulators and policy-makers. Finally, this article is focused on the US market, however, the analyses of other markets could provide interesting additional insights, given the impact of institutional frameworks on mutual fund managers' decisions.

Declaration of Competing Interest

None.

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Appendix A. Appendix 1

Table A1

Percentage of the SR funds' portfolios invested in super sectors and sectors of Morningstar.

	Panel A: Super sectors					
	Obs.	Mean	SD	Median	10th percentile	90th percentile
Cyclical	6215	34.27	9.77	34.46	21.78	45.66
Defensive	6215	23.24	8.71	23.10	12.93	31.82
Sensitive	6215	38.43	8.97	37.98	27.73	49.05
	Panel B: Sectors					
Basic Materials	6215	5.10	3.62	4.27	1.25	10.33
Communication services	6215	2.52	2.42	2.17	0.00	5.36
Consumer cyclical	6215	12.32	5.46	12.33	5.14	19.08
Consumer defensive	6215	9.03	6.35	8.08	2.94	15.79
Energy	6215	5.27	4.21	4.85	0.00	10.78
Financial services	6215	14.75	6.88	16.03	4.02	22.34
Healthcare	6215	11.27	5.35	11.98	3.05	17.32
Industrials	6215	14.32	6.16	13.26	7.73	21.86
Real Estate	6215	2.11	2.38	1.44	0.00	5.61
Technology	6215	16.31	8.85	15.07	6.56	27.28
Utilities	6215	2.96	7.44	1.64	0.00	4.69

Fossil fuel industries include the following Morningstar industries: oil & gas drilling, oil & gas E&P, oil & gas integrated, oil & gas midstream, oil & gas refining and marketing, oil & gas equipment and services and coal. Morningstar provides the next description for these industries:

Oil & Gas Drilling: "Companies primarily engaged in contract drilling and exploration for petroleum and natural gas, including offshore and onshore drilling as well as related oil well and contracting services".

Oil & Gas E&P: "Energy companies which are primarily engaged in gas exploration and production".

Oil & Gas Integrated: "Major energy companies engaged in the diverse aspects of oil and gas operations including crude oil & gas exploration, production, manufacturing, refining, marketing and transportation".

Oil & Gas Midstream: "Companies primarily engaged in owning and operating oilfield pipelines involving the gathering, processing and transportation of natural crude petroleum".

Oil & Gas Refining and Marketing: "Companies primarily engaged in the refining, gathering, marketing and selling of petroleum and petroleum products".

Oil & Gas Equipment and Services: "Companies primarily engaged in providing oilfield services and equipment such as contract drilling, seismic surveys, equipment and tool rental, pumping and processing services, inspection and contracting services".

Coal: "Companies engaged in mining coal".

Metal industries include the next Morningstar industries: aluminum, copper, gold, industrial metals & minerals, silver, steel and metal fabrication. Morningstar provides the following description for these industries:

Aluminum: "Companies engaged in the production, refining, marketing, and distribution of aluminum and related aluminum based products".

Copper: "Companies engaged in the exploration, mining, smelting and refining of copper ores and related copper products".

Gold: "Companies engaged in Gold ore related activities including exploration, mining, processing, extraction and smelting".

Industrial metals & minerals: “Companies engaged in the mining, refining, producing, smelting and milling of miscellaneous ores including Lead, Zinc, Uranium, Radium, Vanadium, Nickel, Tin, Coal, Titanium, Platinum and other related materials”.

Silver: “Companies engaged in Silver ore related activities including exploration, mining, and extraction”.

Steel: “Companies engaged in the production and processing of steel and steel- and iron- based products”.

Metal fabrication: “Companies that fabricate, stamp or form iron, steel or other metals into products such as structured components, auto and aircraft assemblies, tanks and vessels and other industrial products”.

Utilities industries include the following Morningstar industries: utilities-independent power producers, utilities-diversified, utilities regulated-electric, utilities regulated-gas and utilities regulated-water. Morningstar provides the description for these industries:

Utilities-independent power producers: “Companies that own and operate merchant power generation facilities and sell electricity into retail and wholesale markets”.

Utilities-diversified: “Companies engaged in the regulated generation, transmission and/or distribution of electricity and natural gas, and own and operate merchant power generation facilities and energy marketing operations”.

Utilities regulated-electric: “Companies engaged in the generation, transmission and/or distribution of electric energy for sale”.

Utilities regulated-gas: “Companies engaged in the transmission, storage and/or distribution of natural gas”.

Utilities regulated-water: “Companies engaged in distributing water for sale”.

These definitions have been extracted from Morningstar Global Equity Classification Structure brochure; more information available at: <https://www.morningstar.com/content/dam/marketing/apac/au/pdfs/Legal/GlobalEquityClassStructure.pdf>

Appendix B. Appendix 2

Morningstar provides the definition for the labels that represent different SR strategies:

1° ESG Incorporation: “These funds indicate the use of any sort of environmental, social, or governance factors in their investment process. These strategies often use positive screens to make their investment choices, tacitly removing companies that do not meet their standards in relevant environmental, social, and/or governance areas. ESG incorporation typically includes best-in-class strategies where managers select investments based on stronger ESG performance relative to peers.” This category would represent SR funds performing positive screens.

2° Engagement: “These funds use shareholder engagement, including raising resolutions, active proxy voting, and direct company engagement to pursue ESG goals with invested companies”.

3° Impact Investment: “These funds seek to make a measurable impact in investments on specific issue areas alongside financial return”.

4° Environmental sector overall: “These non-diversified funds invest in environmentally-oriented industries, such as Renewable Energy and Water”.

5° Negative screens: “These funds intend to avoid a certain industries or groups of industries not aligning with the fund’s values”.

Above labels represent the 5 generic SR strategies. In turn, for impact investing, environmental sector overall and negative screens Morningstar provides with more specific labels related with different ESG themes, some of them explicitly related to carbon issues. These labels are defined as follows:

1° Low-carbon/fossil fuel free: “These funds seek to make a measurable impact alongside financial return by investing in companies with small carbon footprints either in general or relative to their sectors/industries/investment style, or in companies with low-carbon risk”.

2° Renewable energies: “These funds specifically pursue companies in the renewable energy industry. They are frequently non-diversified funds and may or may not include other ESG and impact themes”.

3° Negative screens on thermal coal: “These funds intend to avoid investing in companies deriving a significant percentage of their revenue from the extraction, distribution, sale, or use of thermal coal”.

These definitions have been extracted from the Sustainability Leveraging Brochure of Morningstar; more information is available at: <https://adviso.r.morningstar.com/AWSOE/Training/MRCloud/LeveragingSustainability.pdf>

Appendix C. Appendix 3

Table A2

Correlation matrix (Part I).

	5-factor alpha	Black industries	Fossil fuel industries	Metal industries	Utilities industries	Fund Size	Family Size	Fund Age	Turnover ratio	Net Expense ratio	Institutional Share classes
Black industries	-0.03										
Fossil fuel industries	-0.08	0.44									
Metal industries	-0.02	0.32	0.27								
Utilities industries	0.01	0.80	-0.13	-0.04							
Fund Size	-0.11	-0.03	0.07	0.03	-0.09						
Family Size	-0.06	-0.15	0.05	0.17	-0.24	0.46					
Fund Age	0.02	-0.02	-0.09	0.03	0.03	-0.30	-0.07				
Turnover ratio	-0.04	-0.14	-0.11	-0.11	-0.07	-0.05	-0.08	0.19			
Net Expense ratio	0.05	0.55	-0.09	-0.01	0.67	-0.03	-0.14	0.19	-0.07		

(continued on next page)

Table A2 (continued)

	5-factor alpha	Black industries	Fossil fuel industries	Metal industries	Utilities industries	Fund Size	Family Size	Fund Age	Turnover ratio	Net Expense ratio	Institutional Share classes
Institutional Share classes	0.03	-0.26	-0.08	0.09	-0.27	0.20	0.35	-0.04	0.19	-0.20	
Positive screens	0.13	-0.07	-0.20	0.05	0.03	-0.09	0.03	-0.01	-0.13	0.02	0.20
Negative screens	-0.02	-0.14	-0.12	-0.11	-0.07	-0.20	-0.16	0.11	0.09	-0.07	-0.16
Engagement	0.07	-0.21	-0.26	-0.07	-0.07	0.07	0.00	-0.04	0.07	0.00	0.21
Impact Investing	-0.09	-0.08	0.16	-0.03	-0.17	0.17	0.00	-0.35	-0.01	-0.20	-0.14
Low-carbon/Fossil-fuel free	0.03	-0.20	-0.24	-0.05	-0.07	0.18	0.26	-0.13	0.00	0.01	0.22
Renewable energies	-0.01	0.72	-0.15	-0.06	0.93	-0.08	-0.25	0.10	-0.04	0.67	-0.27
Negative screens on Thermal Coal	-0.02	-0.12	-0.13	-0.07	-0.04	0.09	-0.05	-0.29	-0.17	-0.07	-0.07
Environmental sector	0.01	0.67	-0.18	-0.07	0.88	-0.07	-0.21	0.11	-0.05	0.69	-0.23
Republican	-0.09	-0.06	0.03	-0.09	-0.07	0.10	0.05	-0.11	0.11	-0.15	0.05
co2	-0.08	-0.01	0.22	0.11	-0.16	0.05	0.04	0.15	0.12	-0.13	0.02

In bold, it is highlighted the correlations significant at 5%.

Table A3

Correlation matrix (Part II).

	Positive screens	Negative screens	Engagement	Impact Investing	Low-carbon/ Fossil-fuel free	Renewable energies	Negative screens on Thermal Coal	Environmental sector	republican
Negative screens	0.25								
Engagement	0.19	0.23							
Impact Investing	-0.31	0.24	0.16						
Low-carbon/Fossil-fuel free	0.21	0.23	0.72	0.29					
Renewable energies	-0.03	-0.07	-0.08	-0.21	-0.06				
Negative screens on Thermal Coal	0.25	0.25	0.19	0.35	0.38	-0.07			
Environmental sector	-0.01	-0.08	-0.02	-0.16	0.02	0.89	-0.08		
republican	-0.49	-0.17	-0.22	0.11	-0.16	-0.07	-0.13	-0.09	
co2	-0.48	-0.22	-0.29	-0.20	-0.31	-0.14	-0.35	-0.14	0.57

In bold, it is highlighted the correlations significant at 5%.

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