A Breath of Change: Can Personal Exposures Drive Green Preferences?*

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Abstract

Are investors' preferences for responsible investing affected by their idiosyncratic personal experiences? Using a comprehensive dataset for hospital visits and the information on portfolio holdings by retail investors in Denmark, we show that when an investor's child is diagnosed with a respiratory disease, the investor decreases (increases) portfolio weights of "brown" ("green") stocks but does not alter their holdings of ESG funds. Consistent with parents attributing respiratory diseases to air pollution, we find no effects for non-respiratory diseases. The results are stronger for more severe diseases and are entirely driven by parents who live with their children.

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Recent years have seen an unprecedented rise in the importance of Environmental (E), Social (S), and Governance (G) factors for investment decision-making. According to Morningstar, at the beginning of 2023, the assets under management of ESG funds reached $2.5 trillion (Bioy et al. (2023)) showing a more than 150% growth over the past three years. As a survey of investors by BlackRock reports 88% of investors citing the environment as the primary focus in ESG investing (BlackRock (2020)), it is crucial to understand what forms investors' preferences towards the E-factor and what can change them over their lifetime. While a growing body of research documents the importance of non-precuniary ethical considerations for ESG investment (e.g., Riedl and Smeets (2017) and Giglio et al. (2023)), the factors that determine individuals' attitudes towards responsible investing remain unclear.

In this paper, we study whether significant life events alter investors' preference for responsible investing. Using administrative data from Denmark, we show that when investors' children get admitted to hospitals with respiratory diseases, they decrease the weight of "brown" stocks in their portfolios and increase the portfolio weight of "green" stocks. These results are economically significant: After receiving the shock, investors increase their holdings of brown stocks by 9% to 12% of the pre-treatment mean, while the weight on "green" stocks increases by 2% of the pre-treatment mean (relative to the control group). This effect is stronger for more serious medical conditions and is entirely driven by parents who are living with their children at the time of the incident. Our findings suggest that idiosyncratic shocks to investors' experiences that can be attributed the results of air pollution affects the investors' preferences for sustainable investing, and, as a result, the relative fraction of "green" versus "brown" stocks in their portfolios.

Our interpretation of the results is the following. Being long established in the medical literature, the connection between air pollution and respiratory diseases is getting more salient with the global rise in ecological awareness. When a child gets diagnosed with a respiratory disease, the parent experiences a shock that she might plausibly associate with the effect of air pollution. This perceived exposure to air pollution can influence investors' stock picking activity. Since personal affection and loyalty to the company are important factors for individual stockholders (e.g., Fama and French (2007), Cohen (2009), and Keloharju et al. (2012)), an increase in the "green" sentiment coming from the personal experience undermines the investor's loyalty towards "brown" stocks that she holds. While rearranging the investment portfolio may not be the parent's first response, when later rebalancing the holdings, the parent pays more attention to the "greenness" of the stocks, carefully evaluating new picks and being more likely to drop previously held "brown" stocks. In line with this interppretation, we find that the treatment effect is not immediate but is rather spread over time, consistent with retail investors slowly revising their portfolios.

We use children's health (as opposed to health outcomes of grown-up family members) to isolate the effect of individual experiences from household wealth shocks. Since healthcare in Denmark is largely free, when a non-working member of the household falls sick, it does not tighten the budget constraint, but exposes the family members to an emotional experience, which, according to our hypothesis, alters their attitude towards responsible investing. Importantly, our shocks are relatively rare (i.e., relatively few investors are treated simultaneously) and idiosyncratic, which makes them plausibly unrelated to any systematic events that could potentially affect current or future stock prices.

To rule out that the treatment effect is driven by various factors accompanying diseases, such as education or wealth, we conduct our analysis in a (staggered) difference-in-differences setting, following the approach of Sun and Abraham (2021). We match treatment and control groups on a range of personal characteristics such as age, wealth, commune, number of kids, etc. However, this does not rule out the possibility that the difference between the treatment and control groups changes due to some confounding factors, such as the effect of a experiencing a sickness or visiting a hospital, and is therefore affected by any disease including non-respiratory. To address this concerns, we conduct placebo tests on other disease groups. The results of the placebo tests confirm that our findings are specific to respiratory diseases. This further supports our conjecture that the salience of the connection between respiratory diseases and air pollution is important for our results.

We then turn to studying whether the effect of investors' tastes is limited to stocks or whether it is also present for other asset categories. Looking at individuals' investment in mutual funds, we find no effect on the probability of holding an ESG fund or the weight of ESG funds in the portfolio after the treatment. One potential explanation is that the investors view "green" and "brown" stock holdings as assets directly related to addressing air pollution, while ESG is a broader term and may be rather associated with social impact, governance standards, or global warming.

If our interpretation of the results is correct, investors' exposure to children's diseases changes their attitude towards stocks that they keep in their portfolios. Then the strength of the effect should be related to how serious the child's medical condition is, as well as to how much the parent is personally affected by this experience. Consistent with this hypothesis, we find that the effect is stronger for children with multiple respiratory diagnoses, multiple hospital visits, and for those children who had to be hospitalized with a respiratory disease for a longer period. Testing the effect of the personal connection between the parent and the child, we find that the effect is exclusively driven by the parents who are living with the child at the moment when the latter gets diagnosed with a respiratory disease. We find little evidence of the effect of gender, education, or geographical location on the treatment effect.

Our main contribution is to show that idiosyncratic experiences can change investors' environmental preferences. We contribute to the literature on the determinants of ESG preferences. Riedl and Smeets (2017) and Giglio et al. (2023) find that most investors that choose to hold ESG do not expect high financial returns on their investment, reporting ethical concerns to be the main driving motive, which is also consistent with the findings of Barber et al. (2021) and Bauer et al. (2021). Looking at large cities that host major stock exchanges, Choi et al. (2020) show that stocks of carbon-emitting firms underperform during temperature hikes, suggesting that investors' experiences of environmental shocks matter for asset pricing. Fisman et al. (2023) document that installation of air monitoring stations in

India created a correlation between the air quality and investors' holdings of "brown" stocks. While the existing literature studies aggregate shocks to preferences that affect large groups of investors, we look at idiosyncratic events that are uninformative about current or future stock prices. Our instrument allows us to guarantee that investors react to their own shocks and not to other traders' (or the government's) potential response to the aggregate shock. On top of that, we show that the effect of ecological problems on investors' holdings is not bound to countries with low air quality but manifests itself even in regions with relatively high ecological standards.

We also contribute to the literature on the effect of health on financial decisions. Rosen and Wu (2004) document that worse health status increases investor's risk aversion. Using data on investors' cancer status, Døskeland and Kvaerner (2022) are able to trace the effect of health shocks on risk aversion to two distinct channels: the expected wealth and the expected lifespan. Following the same approach, Kvaerner (2023) shows the effect of these two channels on inter vivo transfers and bequest motives. In contrast to this literature, we focus on health shocks to non-working family members in order to switch off the wealth channel. Instead of looking at health effects in general, we use them as a shock to investors' "green" sentiment and demonstrate the unique ability of respiratory diseases to cause strong effects on environmental preferences.

Our paper is also related to the vast and growing literature on the effects of personal experiences on economic behavior. Malmendier and Nagel (2011), Malmendier and Nagel (2016), and Malmendier et al. (2021) show that experiencing of various macroeconomic outcomes (such as economic recessions or high inflation) affects financial risk-taking and inflation expectations (even among finance professionals).[1] Happel et al. (2022) show that negative housing experience causes a persistent effect on home ownership. Moreover, indirect experiences of default (or bankruptcy protection) are known to affect the individuals' decisions

[1]Similarly, Koudijs and Voth (2016) show that experiences of counterparty bankruptcy affect traders' risk taking and leverage even in the absence of financial losses. Carvalho et al. (2023) show that loan officers' local economic experience affect their decisions on credit spreads for corporate loans.

to default (Kalda (2020), Kleiner et al. (2021)). We add to this literature by studying the effect of idiosyncratic experiences on investors' environmental preferences.

Consequently, we also contribute to the literature on non-financial determinants of stock holding. Such well-documented facts as home bias (French and Poterba (1991)), overinvestment in own employers' stock (Massa and Simonov (2006), Cohen (2009)), and socially responsible investment (Hong and Kacperczyk (2009), Geczy et al. (2021)) caused Fama and French (2007) to conclude that the assumption that investment assets are not consumption goods is unrealistic. Building upon this logic, Keloharju et al. (2012) demonstrate that consumption and investment behavior are related: Long customer-client relationship predicts stock holdings. In a related study, Hong and Kostovetsky (2012) argue that political preferences affect stock holdings. They show that mutual fund managers who donate to the Democrats have lower holdings of "socially irresponsible" companies (such as "sin stocks"). We add to this literature by showing that idiosyncratic exposures to health problems that investors might associate with air pollution affect their environmental preferences, ultimately changing their portfolio compositions.

The paper proceeds as follows. Section 1 discusses the relationship between the air quality and respiratory diseases; Section 2 describes the data; Section 3 introduces our main results; Section 4 shows the heterogeneity of results across different groups of investors and different health outcomes; Section 5 shows the effects of investors' own respiratory diseases on their stock holdings; Section 6 concludes.

1 Air quality and respiratory diseases

This section describes the connection between air pollution and associated diseases and mortality, for Denmark as well as globally. We start by citing evidence that outlines the effect of air pollution on respiratory diseases. We then demonstrate the evidence suggesting that decreasing levels of air pollution in Denmark were accompanied by an increase in concerns about the air quality by the population, potentially increasing the salience of the link between air pollution and respiratory diseases. We define the types of substances that are considered to have health effects in the Appendix.

1.1 General evidence

By the 1970-1980s, the connection between air pollution and cardiopulmonary diseases (an aggregate category comprised of cardiovascular and respiratory diseases) was generally accepted (Pope III and Dockery (2006)). The early evidence of mortality associated with severe pollution episodes from Meuse Valley (Belgium), Donora (PA), and London were related to both cardiovascular and respiratory diseases. Studying the effects of air pollution in six US cities, Dockery et al. (1993) show that the air pollution increases mortality and morbidity from cardiopulmonary diseases but not from other disease groups.[2]. Later works managed to separate the two causes and to demonstrate that both respiratory and cardiovascular diseases.[3]

Importantly, multiple studies detect significant effects of unexpectedly low concentration levels of particulate matter on daily mortality rates (e.g., Schwartz and Marcus (1990) and Schwartz (1991)). Since 2009, EPA estimates the connection between PM pollution and respiratory mortality and morbidity as *"likely to be causal"*, highlighting the "strong evidence for a relationship between short-term $PM_{2.5}$ exposure and several respiratory-related endpoints" (EPA (2019)).[4] The health effects of PM pollution pointed our by the EPA "range from inflammation and changes in lung function to respiratory-related ED visits and hospital admissions."

General morbidity is positively associated with health conditions for different age cat-

[2]As cross-coding difficulties and diagnoses misspecification often obscured the exact cause of death, the two types groups of disease, cardiovascular and respiratory, were often pulled together in earlier studies (Pope III and Dockery (2006)

[3]See Table 1 in Pope III and Dockery (2006) for a review of different studies. A more recent synthesis is presented in EPA (2019).

[4]The difficulty of proving the causal relationship partially comes from the effect of the gaseous co-pollutants. Interestingly, the EPA estimates the relationship between $PM_{2.5}$ and cardiovascular mortality and morbidity as *"causal"*.

egories, including young adults (Shaughnessy et al. (2015)) and children (MacIntyre et al. (2014), Chen et al. (2015), EPA (2019)). Schüepp and Sly (2012) provide a discussion of the possible reasons making children especially vulnerable to PM pollution.[5]

1.2 Pollution and awareness in Denmark

Denmark is a country with low to moderate levels of air pollution (Kaspersen et al. (2023)). The local aggregated data on the yearly average pollution level shows that the air quality has been improving since 2010 (see Figure 2).

Despite the relatively low level of pollution, studies from Denmark show that long-term exposure even to low levels of air pollutants are associated with elevated levels of mortality in the Danish population (Raaschou-Nielsen et al. (2023)). A recent nationwide study by Kaspersen et al. (2023) documents that exposure to air pollution is associated with a higher probability of getting a respiratory tract infection. Although the number of deaths caused by air pollution in Denmark is declining (Figure 1), the estimated total average annual external health-related costs for Denmark during 2014-2016 amounted to 3.9 bln. EUR (Ellermann et al. (2016)).

These large numbers are reflected in the growing interest towards ecological problems as evidenced by the growing number of Google searches of "air quality" (Figure 3).

2 Institutional details, data, and methodology

We assemble a dataset of individual investors aged 18 and above with detailed information on wealth, income, demographic variables, and their holdings of stocks and mutual funds. The dataset is constructed based on different administrative registries made available by Statistics Denmark, as we describe below.

[5] Williams et al. (2002) document that acute respiratory infections are among the leading causes of childhood mortality. The authors estimate that around 1.9 mln. children died from acute respiratory infections in 2000, 70% of which in Africa and Southeast Asia.

Income, wealth, and portfolio holdings are from the official records of the Danish tax authorities (SKAT). These records include personal identification numbers (CPR), which are equivalent to the US social security numbers, and are recorded at the yearly level. SKAT obtains the data on wealth and income from relevant sources: Employers provide the statements about the wages paid to their employees, while financial institutions similarly provide information on amounts of deposits, interests and dividends received, as well as interests paid.

Similarly, SKAT receives the portfolio holdings directly from from financial institutions (e.g., brokerage houses and banks) at an individual asset level, which allows us to observe the ISINs of individual securities in investors' portfolios. We later use these ISIN codes to identify "green" and "brown" assets as we describe further.

Our SKAT data covers the time period from 2011 to 2021. Unless stated otherwise, all monetary values are expressed in nominal Danish kroner deflated to 2015 prices. The average exchange rate in 2015 was DKK 6.8 per $1.

Educational records are from the Ministry of Education of Denmark. All completed years of education, both formal and informal, are recorder and made available through Statistics Denmark.

Individual and family data are from the Danish Civil Registration System. These records contain CPRs, gender, dates of birth, CPR numbers of nuclear family members (parents, children, and siblings), as well as the marital history (the marital status, the CPR of the spouse) and address ID. In addition to providing useful demographic control variables, this dataset helps us link investors to their children in order to study the effect of pediatric health shocks on parent's portfolio holdings.

Individual health outcomes are from the National Patient Registry at the Danish National Board of Health (Sundhedsstyrelsen). This registry is updated each time anyone having a CPR interacts with the Danish hospital system either for an examination or for a treatment. The part of the registry available to us through Statistics Denmark covers both outpatient and inpatient hospitalizations from 1995 to the first quarter of 2019. We observe the time of the visit, the CPR, as well as the detailed diagnosis made according to the 10th addition of the International Classification of Diseases (ICD-10), which is the medical classification list provided and updated by the World Health Organisation.

Most of the data described above is assembled for the purpose of individual tax collection and is therefore of very high quality.[6] In addition to the registry data from Statistics Denmark, we use Morningstar and Nasdaq Nordic to identify the mutual fund names and characteristics. We obtain industry codes for stocks from MSCI.

2.1 Classification of stocks

Following Andersen et al. (2023), we take a conservative approach to stock classification and define "green" stocks as those related to alternative energy production (i.e., wind and solar). Similarly, we label a stock "brown" if it belongs to an industry directly related to traditional energy production (such as extraction and processing of fossil fuels: coal, oil, and gas). This partitioning is mutually exclusive but not collectively exhaustive, living the vast majority of stocks unlabeled.

The advantage of this approach is in its intuitiveness to retail investors, whose behavior we study. While the attribution of broader industries to "green" or "brown" categories depends on the informativeness of a specific investor and may therefore be imprecise, the connection between combustion of fossil fuels and the air pollution is well-known to the general audience.

To identify "brown" stocks, we zoom in on the energy sector and look at such industries as oil and gas extraction, petroleum refining, gas production and distribution, electric and gas and other utility (SIC codes 13, 29, 492, and 493). We check each stock before adding to the sample to make sure that its main business corresponds to the assigned classification.

[6] The data on wealth, income, and portfolio holdings is comparable to that of other Nordic countries: Sweden (Calvet et al. (2007), Calvet et al. (2009a), Calvet et al. (2009b)), Finland (Grinblatt and Keloharju (2001), Grinblatt et al. (2012)), and Norway (Hvide and Östberg (2015), Døskeland and Hvide (2011)).

To find “green” stocks, we start with the engines and turbines industry (SIC 351) and search for such keywords as “green”, “solar”, or “wind” in the company names.

Overall, we identify 105 unique “green” stocks and 75 “brown” stocks.

2.2 Classification of mutual funds

Following the existing literature, we classify ESG mutual funds by names (Gaspar et al. (2006), Lapanan (2018), Hellström et al. (2020), Curtis et al. (2021), Michaely et al. (2021), Li et al. (2021)). To identify ESG funds, we use historical fund names from Morningstar and Nasdaq Nordic. We take the keywords list from Michaely et al. (2021) (such as “sustain,” “social,” “impact,” “ESG,” “green,” etc) and translate these keywords in Danish since local investors tend to hold most of their money in Danish funds. We further augment this list with typical Danish keywords related to responsible investment.

Overall, out of 7689 unique funds, we label 565 funds, that is, 7.3% as ESG at some point in time. This label is time-varying, as funds’ names can change. Indeed, 66 out of 565 funds are labeled as ESG after a renaming.

2.3 Sample formation

We start by finding all hospital visits by all patients under the age of 18 from 1995 to 2019 with a ICD-10 diagnosis codes DJ00-DJ99 (respiratory diseases). For each patient, we find their first case of getting admitted to hospital with a respiratory diagnosis. We merge the patients to both of their parents by using the family links. For each “treated” parent, we identify the first time that any of her kids is admitted to the hospital. We then connect the sample of parents with the demographic data and their financial portfolios at the year before their child gets into the hospital, retaining only those parents who hold financial assets, stocks or funds. If both parents participate in the financial market, we keep them both in the datases as separate observation.

Figure 4 shows the distribution of respiratory cases in the final sample across years. Our sample ends in the beginning of 2019, which is reflected by the low number of observations in the last year. The jump in the number of cases in 2014 is driven by the changing rules of treatment for emergency cases. Before 2014, general care practitioners provided out-of-hours primary medical services for acute cases either as home visits or in centralised clinics, but starting from 2014, patients started to get directed to emergency departments in local hospitals (Fløjstrup et al. (2020)), which explains the increase in the number of patients in our data.

2.4 Summary statistics

The summary statistics for the entire sample of financially active Danish residents together with the sample of investors whose children got respiratory diseases is given in Table 1. Panel A presents the summary statistics of individual characteristics for the entire sample of investors (column 1) and the treated sample (column 2). Treated investors have higher income than the average investor bus smaller financial wealth. One potential explanation is the age: the average age in the treated sample is 37.4 years, while the average Danish investor is 53 years old. The treated sample has a higher proportion of male and a higher proportion of married people and their education is 1.7 years longer. The higher number of children in the household is explained by the algorithm that we use to construct the treated sample: We only considered investors with children. It is important to mention that the number reported in Panel A is the number of children in the current household, not the number of children that the individual investor had over her lifespan.

Panel B shows the summary statistics for the portfolio characteristics. Remarkably, investors in the treated sample have comparable portfolio weights of "brown" stocks and more "green" stocks than the average investor. By contrast, the average investor holds significantly more ESG funds than investors from the treated sample.

2.5 Methodology

We conduct staggered difference-in-differences (diff-in-diff) analysis. For each treatment unit, we choose a matching "control" unit and estimate the change in the differences between the treatment and the control groups.

As is documented in the econometric literature, staggered difference in differences can produce biased estimates under heterogeneous treatment effects (Goodman-Bacon (2021)). Following the recommendation of Baker et al. (2022), we use the dynamic diff-in-diff estimator designed by Sun and Abraham (2021). We estimate coefficients of the model

$$Y_{i,t} = \alpha_i + \lambda_t + \sum_{m=-K}^{-2} \mu_m D_{i,t}^m + \sum_{m=0}^{L} \mu_m D_{i,t}^m + \nu_{i,t}, \tag{1}$$

where α_i is the person fixed effect, λ_t is the time fixed effect, and $D_{j,s}$ is an indicator variable such that $D_{j,s} = 1$ if $i = j$ and $t = s$, otherwise $D_{j,s} = 0$. We choose the estimation window of five years in time relative to the treatment, that is, $K = L = 5$. The Average Treatment effect for the Treated (ATT) is defined as the average of the post-treatment coefficients: $ATT = \left(\sum_{m=1}^{K} \mu_m\right) / K$.

The matching is done at the year preceding the treatment. To obtain the matching sample, for each treatment investor we find a set of controls with the same age, gender, marital status, and number of kids in the household, who live in the same commune, and have the same education level. Similar to the treatment group, potential controls are also required to hold financial assets, either stocks or mutual funds. In this set of potential controls, we select the investor who has the closest level of total wealth to the treatment investor.

3 Respiratory diseases and investors' portfolios

In this section we present our main results. We start by studying the change in investors' holdings of "brown" and "green" stocks after her child gets diagnosed with a respiratory disease. We then introduce our measure of "green minus brown" as a way to summarize our findings, to further use it for comparisons of different conditions. We accompany our findings with results for placebo groups, that is, other diseases that have comparable numbers of treated patients. We conclude this section by presenting the results related to another asset type: mutual fund holdings.

3.1 "Brown" stocks

If our hypothesis is correct, we expect the investors to decrease their holdings of brown stocks (relative to the control group) after their children get diagnosed with a respiratory disease. We begin our analysis by estimating the treatment effect on two variables: (i) the weight of "brown" stocks in the investor's portfolio and (ii) the indicator that the investor holds a "brown" stock. The change in the portfolio weight can signalize that the investor is adjusting her portfolio at the intensive margin, while the indicator captures the changes at the extensive margin.

The results of estimating model 1 for both variables are presented in Table 2. Significant negative ATTs indicate that both variables decrease after the treatment. The effect on the portfolio weight becomes statistically significant in the first year after the treatment, while the indicator reacts with a time lag of one year, consistent with a gradual liquidation of "brown" stocks as opposed to a quick selling. The evolution of the treatment effects over time is shown in Figure 5. Both panels A and B show no pre-trend. The treatment effect is lasting, surviving for over 5 years after the investor gets the first-time experience.

The largest single-year effect on the portfolio weight is -27 bps in year 4, while the average effect is -19 bps. Given the average pre-treatment level of 220 bps, the treatment effect ranges from 9% to 12% of the pre-treatment mean, which is economically significant. Similarly, the effect on the probability of holding a "brown" stock ranges from -44 bps to -59 bps, which — compared to the pre-treatment average of 620 bps — gives an estimate of the effect from 7% to 10% relative to the mean.

For a correct interpretation of the results, it is necessary to remember that the estimates of the treatment effect are obtained relative to matched controls. One potential interpretation of the results is that investors actively sell off "brown" stocks in response to the children's diagnoses. Alternatively, some part of the effect can be explained by the treatment group decreasing the probability of buying new brown stocks compared to the control group. Any of the two stories is consistent with our general hypothesis that treated investors change their approach to portfolio formation after receiving shocks to their individual experiences.

3.2 "Green" stocks

Similarly to "brown" stocks, investors' holdings of "green" stocks may be adjusted following the treatment. The results for the proportion of "green" stocks and the probability of holding a "green" stock are displayed in Table 3. The probability of holding a green stock does not change post-treatment, while the proportion of "green" stocks slightly increases after the shock. The ATT for the proportion is significant and amounts to 2% of the pre-treatment mean.

It is important to contrast the results for the "brown" and "green" stocks. First, the effect on the "brown" stock fraction is strong and immediate as compared to the "green" stocks, suggesting that investors are more concerned about contributing to the air pollution than about failing to support the "green" energy industry. The treatment effect on the "green" stock holding is building up over time, potentially driven by diseases that continue to develop over time. Second, comparing the results for the portfolio weight and the indicator of holding "green," we conclude that the effect is present at the intensive margin, that is, possibly driven by those who already hold "green" stocks. Finally, even though the probability of holding "green" stocks does not increase post-treatment, it is perhaps even more important that it does not decrease. The absence of the effect means that our results for "brown" stocks are not driven by investors simply divesting all energy production stocks, switching the investment industry or consolidating their holdings in a smaller number of stocks.

3.3 "Green" minus "brown"

Although the results for the "brown" and "green" stocks are of separate interest, it is more convenient to use the difference between the "green" and "brown" stock holding measures as a representation of the tilt in the investors' portfolios towards ecologically sustainable stock investing. We can then use the difference of (i) portfolio weights and (ii) indicators of holding "green" and "brown" stocks to compare the results across different groups of diseases, health conditions, and investors.

3.4 Placebo tests

An alternative explanation of our findings is that the parents' reaction is not specific to respiratory diseases as the category most saliently connected to air pollution. Several studies find that ESG investment is related to the warm-glow effect (Riedl and Smeets (2017), Andersen et al. (2023)). Consistent with this effect, if a visit to the hospital and a first-hand exposure to any pediatric disease creates the desire to personally contribute to the public good via charitable donations or investment in sustainable assets, one will see an increase in "green" and a decrease in "brown" investment not only for respiratory diseases, but for other diseases as well.

To check to what extent our findings extrapolate to other groups of diseases, we repeat the same procedure for other (well-classified) groups of diseases.[7] Table 4 shows the results. Among all 19 groups of diseases, only the respiratory group demonstrates positive and sta-

[7] We do not study the group "Abnormal findings IKA" as its interpretation and contents are unclear and may involve potential misclassifications.

tistically significant results. This observation suggests that the salience of the connection between the respiratory diseases and air pollution is important for the investors.

In Section 1, we describe the effect of air pollution on the frequency of cardiopulmonary diseases, the group comprised of cardiovascular and respiratory diseases. The connection between air pollution and cardiovascular hospitalizations is well-known in medicine but not as salient to people without a medical degree. The absence of the treatment effect for the diseases of circulatory organs as well as for the diseases of blood suggests that investors are more likely to make intuitive connections between the air quality and the illnesses related to breathing.

3.5 Mutual fund holdings

We now turn to looking at a different class of assets — mutual funds. If investors' environmental concerns extend beyond individual stocks, we expect them to increase their holdings of ESG funds after the treatment. Alternatively, if investors do not consider ESG funds as a means of decreasing air pollution but rather associate them with addressing global warming and the improvement of S- and G-related factors, we will not see a positive effect.

Analysing the results for mutual funds presented in Table 5, we find that investors do not increase their holdings of ESG funds neither at the intensive, nor at the extensive margin. This evidence suggests that investors do not associate ESG funds with decreasing the air pollution. It also speaks against the warm glow explanation of our findings, as research shows that investing in ESG funds is often value-driven (Riedl and Smeets (2017), Giglio et al. (2023)) and identifies the effect of warm glow on ESG fund holdings (Riedl and Smeets (2017), Andersen et al. (2023)). We conclude that the effect is strongest for such assets as "brown" and "green" stocks, which are most directly related to the factor potentially driving the experience (i.e., air pollution).

4 Heterogeneity in the effect

In this section, we start by describing how the severity of the health condition affects the results. Then, we show to what extent our results vary with investors' characteristics.

4.1 Severity of disease

In our study, parents, whose kids get admitted into a hospital with a respiratory disease, get an experience shock that affects their preferences for responsible investing. If this interpretation is correct, the result should be stronger for those patients whose condition at the moment of the hospital visit is more serious or who have respiratory diagnoses with long-lasting health consequences and the potential to return to the acute stage.

As proxies for the seriousness of health condition, we use the number of days the patient has to spend in the hospital, the forward-looking measures of the number of hospital visits for the patient and the number of respiratory diagnoses, and the indicator whether the patient was admitted into the hospital with a chronic initial diagnosis. For each of these measures, we separate the data in two subsamples and estimate the results separately. If our interpretation is correct, we expect to see stronger treatment effects for more serious conditions (chronic diagnosis upon the admittance, higher numbers of hospital visits and respiratory diagnoses, and more days spent in the hospital).

Table 6 shows the results. Interestingly, against our expectations, the effects are strongest for the non-chronic diseases. The caveat here is that we only see the diagnoses with which the patient was admitted to the hospital. Most patients in our sample come to the hospital with acute respiratory tract infections (mostly of the upper respiratory tract). These cases can be early signs of other respiratory diseases or aggravations of pre-existing conditions. Since our data does not track the entire medical history for each patient but only records hospital visits, we do not observe whether a patient has a respiratory diagnosis established by the general practitioner prior to the hospital visits. However, since the response of the sample that is admitted with a non-chronic diagnosis is weaker, it is possible that they are aware of their pre-existing respiratory condition, which means that the actual treatment moment happened before the first hospital visit.

Columns 3 to 8 of Table 6 show that the results are stronger for the patients that make several hospital visits in our data sample and those who get several respiratory diagnoses. Splitting the sample by the number of days spent in the hospital, we see that those who spent more than one day demonstrate a stronger effect than the rest of the sample. Overall, the results are consistent with more severe cases causing stronger reactions.

4.2 Investors' characteristics

We proceed to testing whether investors' characteristics influence our results. With one notable exception, Table 7 shows little evidence that investors' characteristics affect our results. The outcome is similar for less educated and more educated investors, and investors living in and outside of big (that is, top-10) Danish cities. Separating the sample into mothers and fathers, we see a somewhat stronger result at the intensive margins for the fathers. However, the interpretation of this finding is obscured by the possibility that only one partner is investing on behalf of the entire family. Meanwhile, the extensive margin outcomes for both samples are very close.

Interestingly, our results are entirely driven by parents who live with their kids (i.e., have the same living address) at the moment when the sickness happens. This finding supports our conjecture that the first-hand experience has a stronger effect on investors' preferences, and therefore induces a larger effect on responsible investing.

5 Shocks to investors' own health

Up until this point, we focused exclusively on the shocks that are unrelated to the health of the investor herself or any of the working family members. In doing so, our motivation is to explore a strong shock to preferences that is unrelated to the investor's budget constraint and/or liquidity needs. However, even taking into account potential identification issues, it is useful to know whether investors' own health shocks induce a comparable effect on their holdings.

To estimate this effect, we start by forming the sample in the same way as we did for the children. The limitation here is that we do not observe the entire history of hospital visits for grown-ups as our dataset starts in 1995. We proceed assuming that by 2010 the effect of investors' experiences from hospital visits prior to 1995 on their stock holdings gets negligibly small.

Table 8 shows the results. The ATT is insignificant for all four variables, as well as for the differences between "green" and "brown" holdings (unreported). We conclude that investors do not significantly react to their own health shocks.

This has several potential explanations. First, our assumptions about the irrelevance of the medical history prior to 1995 may be wrong. Second, grown-up investors know much more about their own health, which makes a "surprise" hospital visit less likely. Third, grown-up individuals are potentially more likely to attribute their conditions to their own actions (such as smoking, which we do not observe). Finally, if investors perceive their own health shock as affecting their budget constraint, they will perceive themselves less rich. If "green" investing is a luxury good as suggested by Andersen et al. (2023), this may give rise to an effect of the opposite sign, which can cancel out the influence of own health shock.

6 Conclusion

In this paper, we establish that individual experiences affect the investors' preferences for responsible investing. When a child gets admitted to a hospital with a respiratory disease, her parents decrease (increase) the portfolio weights of "brown" ("green") stocks, and are more likely to completely stop investing in "brown" stocks. Consistent with the conjecture that parents associate pediatric respiratory diseases with air pollution we find no such effects for non-respiratory diseases.

The first-hand experience is important for the results. We show that our findings are entirely driven by parents who are living with their children at the moment of the hospital visit. Moreover, we find stronger effects for more severe health conditions. Looking at investors' own health outcomes, we find no significant effect on stock holdings.

Regarding the effects for other asset types, we find no effect of the shocks on the investors' holdings of ESG funds, which can mean that individuals do not perceive investment in ESG funds as a way to address air pollution.

Documenting the effect of health shocks on "green" investing in Denmark, which has relatively moderate level of air pollution, we demonstrate that the absolute level of pollution means less than its salience. Preferences for responsible investing are likely to continue playing a key role in shaping investors' portfolio, irrespective of the absolute level of pollution.

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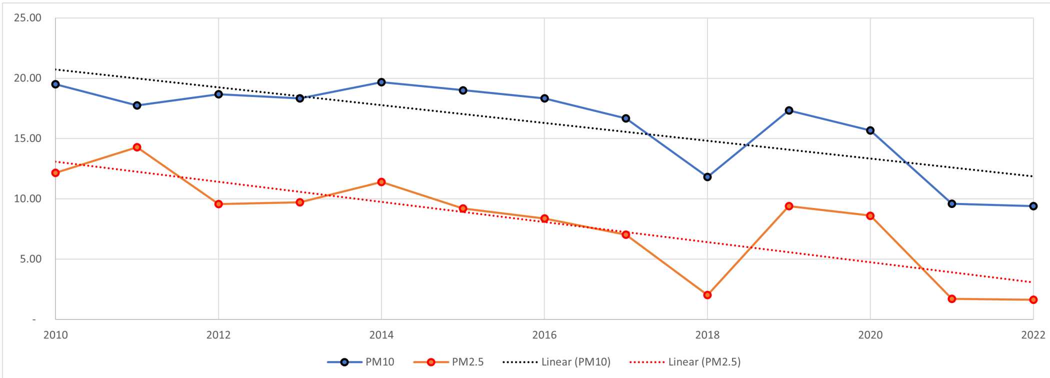


Figure 1: Yearly average PM pollution levels in Denmark (in $\mu g/m^3$) across all measurement stations. Source: Aarhus University Air Quality Measurement Database.

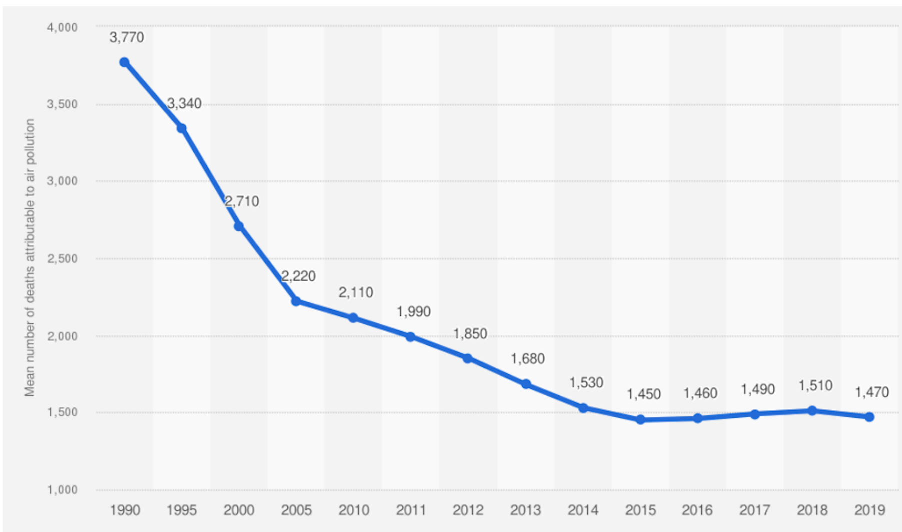


Figure 2: Number of deaths attributable to air pollution in Denmark from 1990 to 2019. Source: Health Effects Institute; Statista.

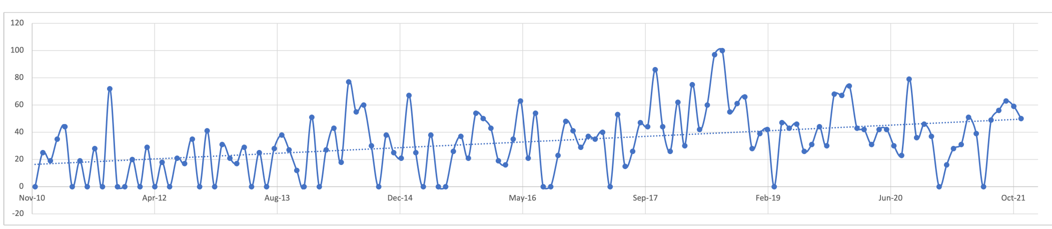


Figure 3: Google search *Interest over time* index for "air quality" with a fitted linear trend.

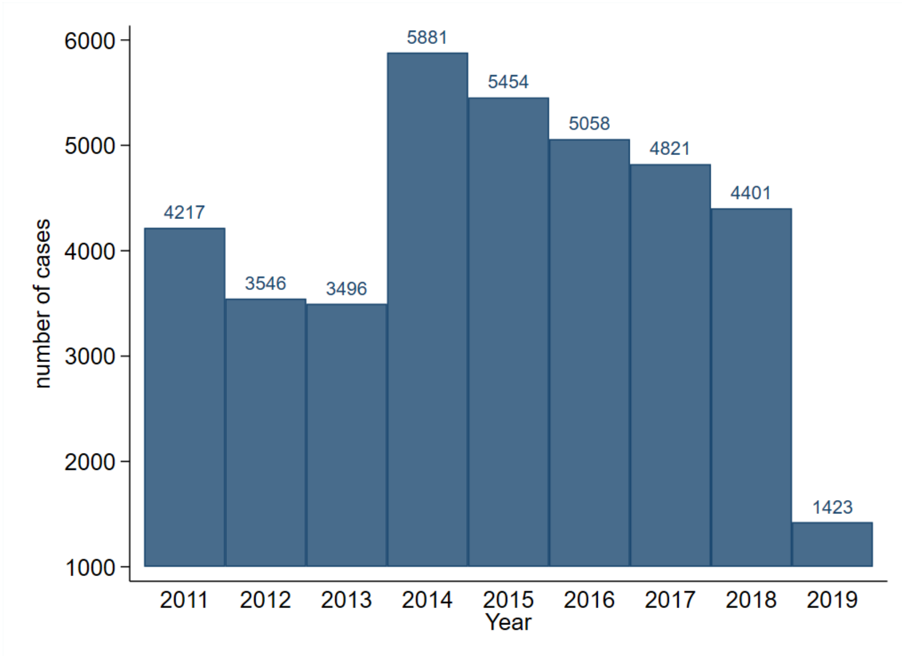
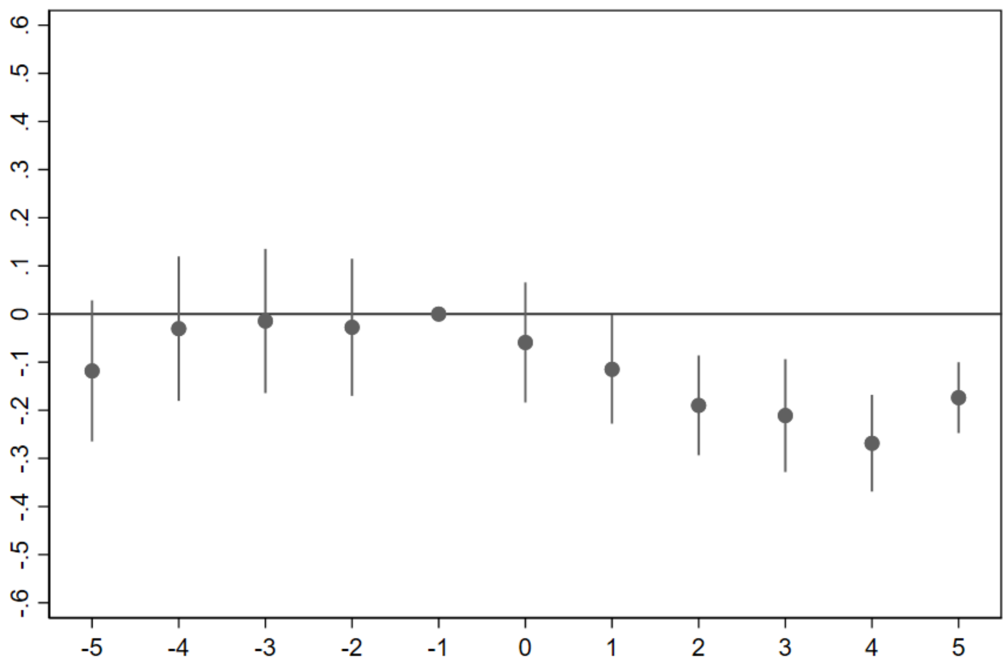


Figure 4: The distribution of the number of children admitted to hospitals in Denmark with respiratory diseases from 2011 to 2019 (in the treated sample).

Figure 5: Diff-in-diff results for the portfolio weight and the probability of holding "brown" stocks for traders, whose children get diagnosed with a respiratory disease. 95% two-sided confidence intervals are plotted using standard errors clustered at the commune level.

Panel A: Portfolio weight of "brown" stock.



Panel B: Indicator of holding a "brown" stock.

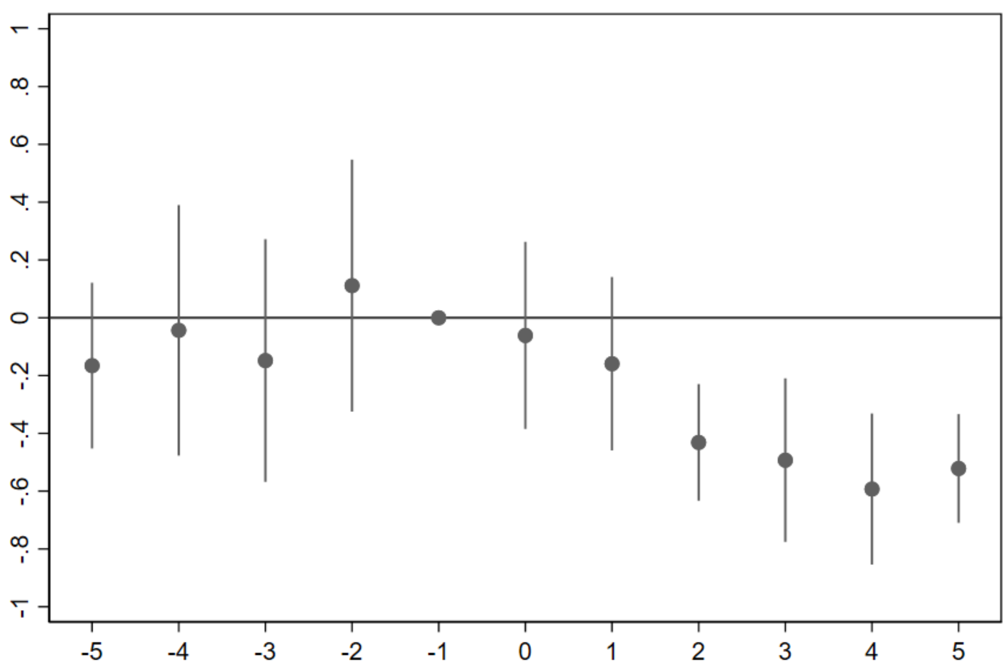
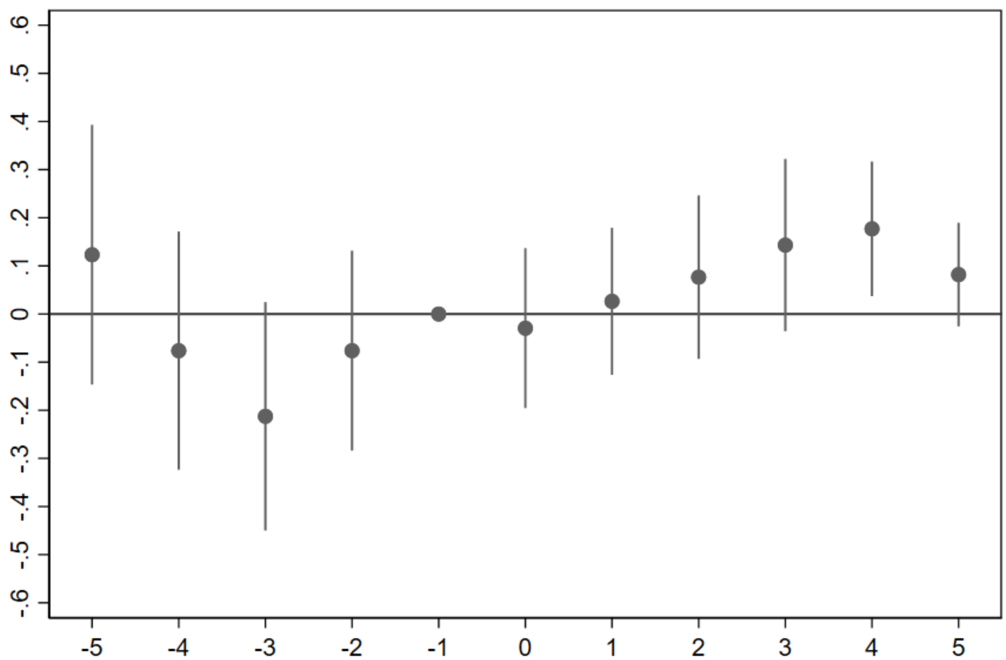


Figure 6: Diff-in-diff results for the portfolio weight and the probability of holding "green" stocks for traders, whose children get diagnosed with a respiratory disease. 95% two-sided confidence intervals are plotted using standard errors clustered at the commune level.

Panel A: Portfolio weight of "green" stock.



Panel B: Indicator of holding a "green" stock.

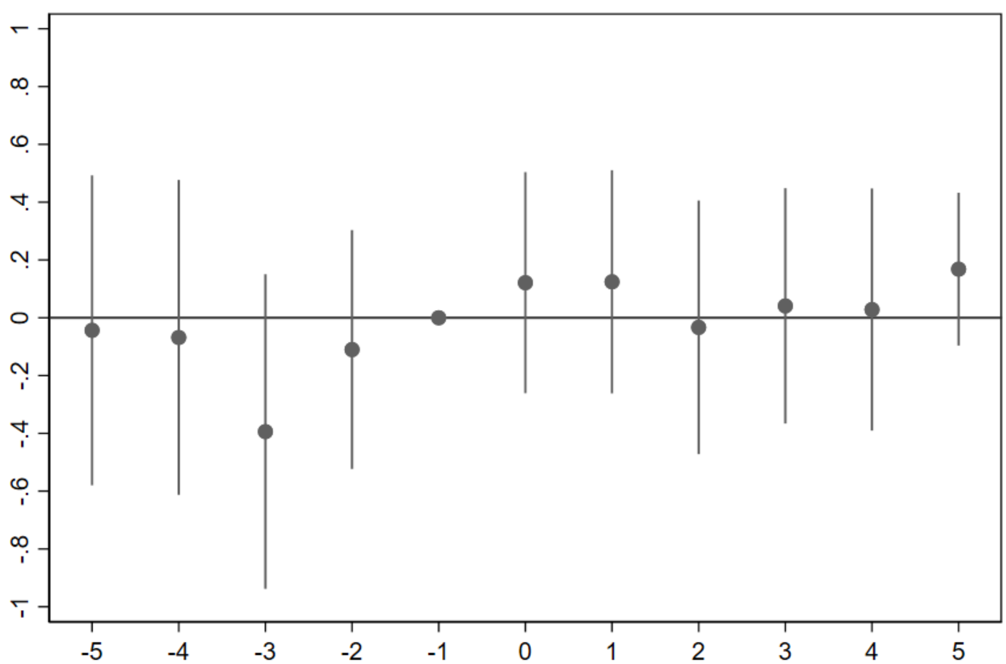


Table 1: Summary statistics for (column 1) all traders who hold risky assets (stocks or mutual funds) and (column 2) for the treated sample. Standard deviations are in the parenthesis.

Panel A: individual characteristics.

	All	Sample
Income (1,000 DKK)	362.2	513.9
	(632.8)	(637.6)
Financial wealth (1,000 DKK)	635	370.8
	(1583.4)	(1146.3)
Age (years)	53	37.4
	(19.9)	(7.8)
Gender (% male)	53.3	58.7
	(49.9)	(49.2)
Married (%)	52.1	59.4
	(50.0)	(49.1)
Education (years)	13.8	15.5
	(3.0)	(2.2)
Number of children	0.5	1.3
	(0.9)	(0.9)
N	14,668,121	49,362

Panel B: portfolio characteristics.

	All	Sample
Market value of risky assets (1,000 DKK)	204.9	170
	(19732.6)	(7341.1)
Risky asset share (%)	36.9	32.6
	(80.9)	(45.2)
Invest in ESG fund (%)	7.1	2.9
	(25.6)	(16.8)
Portfolio weight in ESG funds (%)	2.2	0.9
	(11.6)	(7.8)
Invest in brown stocks (%)	6.4	6.2
	(24.5)	(24.1)
Portfolio weight on brown stocks (%)	2.1	2.2
	(11.3)	(11.9)
Invest in green stocks (%)	11	13.1
	(31.3)	(33.8)
Portfolio weight on green stocks (%)	4	5.1
	(15.9)	(18.5)
N	14,668,121	49,362

Table 2: Results for the diff-in-diff estimation of the portfolio weight and the probability of holding "brown" stocks for the investors, whose children got diagnosed with a respiratory disease. The table provides treatment estimates for separately for time periods relative to the treatment as well as the overall ATT. The category indicator $\mathbb{1}\{x\} = 1$ if the investor holds at least one stock of category x in her portfolio, otherwise $\mathbb{1}\{x\} = 0$. Standard errors clustered at commune level are given in parentheses.

Rel. time	Portf. weight	$\mathbb{1}$\{holds "brown"\}
t+5	-0.174***	-0.522***
	(0.038)	(0.096)
t+4	-0.269***	-0.593***
	(0.051)	(0.133)
t+3	-0.211***	-0.493***
	(0.060)	(0.144)
t+2	-0.190***	-0.431***
	(0.053)	(0.103)
t+1	-0.115**	-0.159
	(0.058)	(0.153)
t	-0.059	-0.061
	(0.064)	(0.165)
t−2	-0.028	0.111
	(0.073)	(0.222)
ATT, p.p.	-0.192***	-0.439***
	(0.042)	(0.1)
Num. obs.	758,702	758,702
Num. treated	49,884	49,884

Table 3: Results for the diff-in-diff estimation of the portfolio weight and the probability of holding "green" stocks for the investors, whose children got diagnosed with a respiratory disease. The table provides treatment estimates for separately for time periods relative to the treatment as well as the overall ATT. The category indicator $\mathbb{1}\{x\} = 1$ if the investor holds at least one stock of category x in her portfolio, otherwise $\mathbb{1}\{x\} = 0$. Standard errors clustered at commune level are given in parentheses.

Rel. time	Portf. weight	$\mathbb{1}\{$holds "green"$\}$
t+5	0.82	0.168
	(0.055)	(0.135)
t+4	0.177**	0.028
	(0.071)	(0.214)
t+3	0.143	0.041
	(0.091)	(0.208)
t+2	0.077	-0.033
	(0.087)	(0.224)
t+1	0.026	0.124
	(0.078)	(0.197)
t	-0.029	0.121
	(0.085)	(0.195)
t−2	-0.076	-0.110
	(0.106)	(0.211)
ATT, p.p.	0.101*	0.066
	(0.061)	(0.167)
Num. obs.	758,702	758,702
Num. treated	49,884	49,884

Table 4: Comparison of treatment results for different groups of diseases. *Difference in weight* is computed as the difference in portfolio weights of "green" and "brown" stocks in the investor's portfolio, and *difference in indicators* is defined as $\mathbb{1}\{\text{"green"}\}$-$\mathbb{1}\{\text{"brown"}\}$. Standard errors clustered at commune level are given in parentheses.

Disease gr.	Diff. weight	Diff. indic.	num. obs.	num. treated
Lesions, poisonings, etc.	-0.010	0.127	1,193,859	78,881
	(0.081)	(0.144)		
Respiratory	0.293***	0.505***	758,702	49,884
	(0.073)	(0.172)		
Bones, muscles, and connective tissue	-0.048	0.282	658,803	41,867
	(0.091)	(0.176)		
Digestive organs	0.021	0.210	546,507	34,850
	(0.119)	(0.218)		
Infectious and parasitic	0.036	-0.279	476,204	31,372
	(0.097)	(0.197)		
Urinary and geniral organs	-0.110	-0.105	373,091	24,009
	(0.143)	(0.319)		
Congenital and chromosomal	-0.045	0.177	357,477	23,285
	(0.114)	(0.25)		
Skin and subcutaneous tissue	0.123	-0.012	331,860	21,346
	(0.116)	(0.33)		
Ear and mastoid process	0.178	0.089	263,388	17,197
	(0.186)	(0.34)		
Endocrine, nutritional, and metabolic	-0.037	-0.219	261,290	16,872
	(0.179)	(0.405)		
Eye	0.278	-0.332	225,288	14,503
	(0.179)	(0.351)		
Nervous system	0.171	-0.053	171,817	11,020
	(0.214)	(0.37)		
Mental and behavioral disorders	-0.263	-0.000	149,962	9,763
	(0.197)	(0.415)		
Neoplasms	-0.068	0.473	127,972	8,173
	(0.219)	(0.378)		
Circulatory organs	-0.157	0.102	78,586	5,071
	(0.241)	(0.586)		
Diseases in the perinatal period	0.035	-0.426	60,416	4,137
	(0.369)	(0.708)		
Blood and blood-forming organs	0.097	-0.172	52,699	3,363
	(0.361)	(0.789)		
Pregnancy, childbirth, and maternity	-0.590	-1.030	40,435	2,756
	(0.361)	(0.67)		
External causes of injury	0.083	0.668	1,550	107
	(2.011)	(3.428)		

Table 5: Results for the diff-in-diff estimation of the portfolio weight and the probability of holding ESG funds for the investors, whose children got diagnosed with a respiratory disease. The table provides treatment estimates for separately for time periods relative to the treatment as well as the overall ATT. The category indicator $\mathbb{1}\{x\} = 1$ if the investor holds at least one stock of category x in her portfolio, otherwise $\mathbb{1}\{x\} = 0$. Standard errors clustered at commune level are given in parentheses.

Rel. time	Portf. weight	$\mathbb{1}\{$holds ESG fund$\}$
t+5	0.132	-0.350
	(0.160)	(0.381)
t+4	-0.023	-0.625
	(0.214)	(0.484)
t+3	-0.009	-0.980*
	(0.262)	(0.529)
t+2	0.043	-0.542
	(0.252)	(0.490)
t+1	-0.017	-0.227
	(0.232)	(0.426)
t	0.028	0.165
	(0.252)	(0.464)
t−2	-0.116	-0.097
	(0.290)	(0.582)
ATT, p.p.	0.025	-0.545
	(0.187)	(0.376)
Num. obs.	236,539	236,539
Num. treated	49,884	49,884

Table 6: Results for the diff-in-diff estimations (by medical condition) of the differences in portfolio weights and the probabilities of holding "green" and "brown" stocks for the investors, whose children got diagnosed with a respiratory disease. The category indicator $\mathbb{1}\{x\} = 1$ if the investor holds at least one stock of category x in her portfolio, otherwise $\mathbb{1}\{x\} = 0$. Standard errors clustered at commune level are given in parentheses.

	Chronic		Num. hosp. visits		Num. diag		Bed days	
ATT	no	yes	1	> 1	1	> 1	1	> 1
$\mathbb{1}\{$"green"$\}$-$\mathbb{1}\{$"brown"$\}$	0.504***	0.285	0.385*	0.786***	0.455**	0.891*	0.331	0.684***
	(0.194)	(0.372)	(0.231)	(0.303)	(0.204)	(0.517)	(0.245)	(0.25)
Portf. weight	0.324***	0.104	0.271***	0.343*	0.276***	0.411*	0.201**	0.398***
	(0.081)	(0.18)	(0.1)	(0.18)	(0.085)	(0.243)	(0.102)	(0.14)
Num. obs.	563,122	195,580	544,001	214,701	662,283	96,419	443,555	315,147
Num. treated	37,137	12,747	35,644	14,240	43,456	6,428	29,125	20,759

Table 7: Results for the diff-in-diff estimations (by investor's category) of the differences in portfolio weights and the probabilities of holding "green" and "brown" stocks for the investors, whose children got diagnosed with a respiratory disease. The category indicator $\mathbb{1}\{x\} = 1$ if the investor holds at least one stock of category x in her portfolio, otherwise $\mathbb{1}\{x\} = 0$. Standard errors clustered at commune level are given in parentheses.

	Educ. length		Parent		Big city		Live together	
ATT	< 15.5 years	> 15.5 years	father	mother	no	yes	no	yes
$\mathbb{1}\{$"green"$\}$-$\mathbb{1}\{$"brown"$\}$	0.229	0.576**	0.473**	0.575**	0.364*	0.471	-0.499	0.607***
	0.278	0.267	0.215	0.236	0.206	0.379	0.785	0.195
Portf. weight	0.252**	0.235*	0.370***	0.190*	0.281***	0.297**	-0.632*	0.381***
	0.128	0.129	0.091	0.106	0.098	0.144	0.371	0.091
Num. obs.	380,522	376,341	452,222	306,480	458,022	259,159	73,054	685,648
Num. treated	27,535	25,957	29,333	20,551	36,122	22,439	6,566	43,318

Table 8: Results for the diff-in-diff estimation of the portfolio weight and the probability of holding "brown" and "green" stocks for the investors, who get diagnosed with a respiratory disease. The table provides treatment estimates for separately for time periods relative to the treatment as well as the overall ATT. The category indicator $\mathbb{1}\{x\} = 1$ if the investor holds at least one stock of category x in her portfolio, otherwise $\mathbb{1}\{x\} = 0$. Standard errors clustered at commune level are given in parentheses.

	"Brown" stocks		"Green" stocks	
Rel. time	Portf. weight	$\mathbb{1}$\{holds category\}	Portf. weight	$\mathbb{1}$\{holds category\}
t+5	-0.027	-0.085	0.087	0.013
	(0.033)	(0.074)	(0.054)	(0.102)
t+4	0.007	-0.061	0.105*	0.063
	(0.037)	(0.106)	(0.059)	(0.113)
t+3	0.014	-0.002	0.113*	-0.001
	(0.034)	(0.110)	(0.064)	(0.096)
t+2	-0.033	-0.076	0.089	0.054
	(0.039)	(0.109)	(0.055)	(0.116)
t+1	-0.015	-0.115	0.003	-0.69
	(0.045)	(0.097)	(0.058)	(0.131)
t	0.009	-0.101	-0.002	-0.046
	(0.052)	(0.106)	(0.063)	(0.127)
t−2	0.036	-0.002	0.012	0.035
	(0.051)	(0.107)	(0.072)	(0.168)
ATT, p.p.	-0.011	-0.068	0.079	0.012
	(0.031)	(0.082)	(0.049)	(0.088)
Num. obs.	1,286,277	1,286,277	1,286,277	1,286,277
Num. treated	108,678	108,678	108,678	108,678

Appendix

A-1.1 Criteria air pollutants

Since air pollution is subject to monitoring and regulation by the government in most countries, we turn to regulatory documents for the classification of relevant pollutants. The US Clean Air Act describes the so-called "criteria pollutants" that are known or suspected to influence human mortality and/or morbidity or negatively affect the environment (Clean Air Act (1971)). This group includes five elements: particulalte matter (PM), ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, and lead. The concentration of each of each of these pollutants in the air is monitored and compared to the safe amounts stated in the National Ambient Air Quality Standards (NAAQS).[8]

Regulatory standards and guidelines often focus on particulate matter due to its well-documented health effects and its association with visible pollution. Moreover, monitoring and measuring gaseous pollutants can be more complex and expensive compared to measuring particulate matter. However, gaseous pollutants such as nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), and volatile organic compounds (VOCs) also pose significant health and environmental risks (EPA (2019)).

Particulate Matter (PM) refers to air-suspended mixture of solid and liquid particles that appear due to the emission of combustion proceeds, condensation of liquid pollutants, or from the suspension of dust, seas salt, soil, and other firm substances in the air. These particles vary by origin, air concentration, size, shape, and composition. The common classification distinguishes coarse particles (with an aerodynamic diameter greater than 2.5 μm), fine particles (diameter between 0.1 μm and 2.5 μm), and ultrafine particles (diameter less than 0.1 μm)[9] The usual sampling convention relies on nested groups; for example, the category PM_{10} includes all particles with a diameter below 10 μm (even the ultrafine ones).

The efforts of regulators such as the EPA aim to reduce the pollution levels to protect

[8]See Suh et al. (2000) for a detailed comparison between criteria air pollutants with other toxic substances.
[9]See, for example, Pope III and Dockery (2006) and Donaldson et al. (2001) for the classification.

public health and the environment by limiting exposure to harmful air pollutants. In the Integrated Science Assessment for Particulate Matter 2019, the EPA conducts a review of research articles by the pollutants that were found to be related to respiratory diseases (EPA (2019)). The majority of these studies focused on the role of nitrate, sulfate, organic carbon, elemental carbon, and black carbon. Although most of them come to the form of PM pollution from combustion-related processes, some can appear as products of chemical reactions in the atmosphere or due to biogenic emission.