ESG Controversies: How Do They Affect Market Returns and Individual Asset Choices?*

Rudy De Winne† Aiste Petkeviciute‡

June 22, 2022

Abstract

This paper examines how the financial markets and individual investors react to ESG controversies from 2003 to 2021. First, we use an event study methodology to analyze the market responses to 7,500 controversies affecting 2,826 companies, in returns and volumes. Second, we analyze how individual investors rebalance their portfolios after an ESG controversy. This second analysis relies on the trading records of 20,935 individual investors of a Belgian brokerage house. At the market level, abnormal returns are significantly negative during the week of the event (t) and this effect also continues to be visible the week after the event ($t+1$). However, we notice that the impact of ESG controversies on abnormal returns seems to be stronger regarding the events occurred during the second half of our sample period. We see no such difference between time periods when looking at the abnormal volume of traded shares during the event windows. At the individual level, retail investors significantly decrease their portfolio weights in stocks that experience an ESG controversy during the week of the event, this tendency again being stronger in the second sub-sample period. They also tend to decrease their portfolio weights in the whole industry that the company experiencing an ESG controversy belongs to. This paper is a work in progress.

Keywords: ESG investing, Individual investors, Event study

1 Introduction

Recent years showed that sustainable and ESG-based investments are becoming more attractive as investors are increasingly perceiving their investments not only as a tool to increase their own individual wealth but also as a mean to create a more sustainable future. At least, these are the conclusions from experimental studies recently conducted by Bauer et al. (2021) and Cheng et al. (2015). These findings are also confirmed by Google trends. We observe that the *ESG topic* seems to spark the interest of people, especially during the last 2 years (for more details, see Appendix A). These examples confirm that there is an increasing tendency to invest in a sustainable way and that the topic of ESG is getting more and more important. This topic has been widely covered when it comes to institutional investors (Dhaliwal et al. (2011), Hartzmark & Sussman (2019), Gantchev et al. (2019), Amel-Zadeh & Serafeim (2018)) but it remains widely unexplored in the context of individual investors, especially outside the experimental setting.

Looking at some empirical findings analyzing the investment behavior of individual investors associated to ESG topics, the situation seems to be grimmer. Moss et al. (2020) find that investors

*The authors are grateful to the online brokerage house for providing the data. Any errors are the full responsibility of the authors. Declarations of interest: none.

†Louvain Finance (LIDAM), UCLouvain, Belgium

‡Corresponding author; Louvain Finance (LIDAM), UCLouvain, Mailing address: Chaussée de Binche 151, 7000 Mons, Belgium – Email: aiste.petkeviciute@uclouvain.be

do not rebalance their portfolios following the press releases regarding ESG as they do following non-ESG press releases. However, we believe that this might be due to the asymmetry of responsible investing preferences. As explained by Humphrey et al. (2020), negative externalities have a greater impact on investment choices which means that investors care more about avoiding the negative consequences of their investment rather than pursuing the positive ones. Hence, we decide to test the impact of negative ESG events.

In this study we analyze the impact of ESG controversies using an event study methodology at the market and individual levels. At the *the market level*, we analyze how the returns and trading volumes are affected while, at *the individual level*, we analyse whether individual investors decrease their portfolio weights in stocks that experience ESG controversies. We also test whether individual investors tend to sell assets that resemble those experiencing ESG controversies (i.e., belonging to the same industry group).

This study uses an extensive dataset that covers 20,935 individual investors of a Belgian brokerage house and their trading history over 18 years, as well as the returns and the trading volumes of 2,872 companies that experience at least one ESG controversy during our sample period. Our data also includes individual investors' answers to the MiFID questionnaires and information regarding their demographics.

Our results show that market abnormal returns and trading volumes are significantly lower than 0 during ESG controversy event windows. The impact of ESG controversies is even stronger if we look at more recent years (2013-2021). We also find that individual investors notice ESG controversies and act accordingly. They decrease their portfolio weights in stocks that experience ESG controversies during the week of the event and even more the week after it. We also notice that there is a delay in the reaction regarding stocks that *look alike* and that investors start to decrease the portfolio weights regarding these assets a week later.

In the following steps of the data analysis we plan to use dominance-based rough set approach (see Appendix C) used for multiple-criteria decision analysis as well as logit and probit models in order to understand what type of controversies nudges investors to rebalance their portfolios the most and what kind of characteristics define an investor that cares about ESG controversies. We will also extend this analysis by incorporating newer data (2013-2021) and to compare the individual investors' ESG awareness between the periods.

The rest of the paper is organized as follows. Section 2 reviews the relevant literature findings, Section 3 describes our data, our sample, and the relevant information about the *ESG Controversies score*. Section 4 describes our used methodology. We present our empirical analysis and results in Section 5, Section 6 describes the aspects that will be covered before the conference presentation and Section 7 concludes.

2 Literature review

Recent research shows that sustainability in the financial markets matters. Hartzmark & Sussman (2019) show that institutional investors pay attention to the sustainability rankings, i.e. the fund flows are immediately affected after a change in the ranking. Being classified as a *low sustainability* fund resulted in net outflows of more than $12 billion. On the other hand, being classified as a *high sustainability* fund resulted in more than $24 billion net inflows. When asked, individual investors that are preparing for their retirement also recognize the importance of sustainable investments, as showed by Bauer et al. (2021). 67% of participants express their willingness to invest in a sustainable way. Moreover, 42% of the participants claim to be willing to give up financial returns in order to invest more sustainably. Ceccarelli et al. (2019) confirm this tendency and they find that fund managers tend to adjust their holding towards more climate-friendly stocks in order to retain

their investors. The above-mentioned studies all conclude that investors are indeed supportive and interested in sustainable finance.

However, the preferences of investors do not focus so much on creating the positive externalities as on avoiding the negative ones. As Kahneman & Tversky (2013) have first observed already in 1979, losses loom larger than gains and this seems to apply when looking at socially responsible investment (SRI) too. Krüger (2015) finds that markets react stronger, in absolute terms, to negative corporate social responsibility (CSR) news than to new positive information about CSR. These results are confirmed in an experimental study by Humphrey et al. (2020) where they find that investors especially want to avoid negative responsible investment (RI) externalities but they do not care as much about creating the positive ones. In fact, the study of Moss et al. (2020) only reinforces the pattern that investors react to negative information quicker and to a larger extent than they do so regarding the positive information. Moss et al. (2020) conclude that individual investors do not adjust their portfolios following ESG announcements while they make economically significant changes in response to press releases covering non-ESG announcements.

Regardless of whether the people want to avoid negative externalities via RI (Humphrey et al. (2020)) or want to create positive ones with sustainable investments (Bauer et al. (2021)), women, younger people and people with a higher education level are more likely to invest in a more sustainable and socially responsible way, and men, older people and people with higher income are less likely to do so. Brodback et al. (2019) only confirm these results by establishing a positive link between altruistic values of individuals and the importance of socially responsible investments. They also find that male, older individuals, with higher financial knowledge and belonging to a higher income class are less likely to invest in a sustainable way, while young and female investors are more likely to do so. Riedl & Smeets (2017) find that the biggest driver for investor to invest in a socially responsible manner is their social preferences rather than financial motives.

3 Data

In this study, we analyze the impact of ESG controversies on the returns and the volume of traded shares in the financial markets, as well as on the individual investors' asset choices.

Since we aim to analyze how arising negative information regarding ESG-aspects of a company influence its attractiveness on the financial markets, we concentrate on *ESG Controversies Score*. This score provides an aggregate view of controversies per company captured in the global media regarding environment, workforce, product responsibility, human rights and other (see Figure 1 for the complete list). We obtain the *ESG Controversy Score* from Refinitiv database and we focus our analysis on the changes of this score. The *ESG Controversies Score* varies as the negative news (i.e., controversies) are picked up by the global media and integrated in the score. We believe that it is important to distinguish the *ESG Controversies Score* that is central to our analysis and the *ESG Score*. There is a lot of debate surrounding the accuracy of ESG reporting given the multiplicity of rating providers, as discussed by Berg et al. (2022). Berg et al. (2022) provide three source of ESG scores divergence: *scope*, *measurement* and *weight*. *Scope divergence* means that different categories are used in order to compute the ESG score, depending on the rating provider. The article also states that our chosen ratings provider (Refinitiv) uses the most categories to compute ESG ratings, as compared to other ratings providers. We believe it to be an actual advantage in our study, as we think that a higher number of categories can capture more diverse ESG controversies. The following aspect of divergence (*measurement*) as found by Berg et al. (2022) is related to measuring identical categories in different manners. We believe it does not pose a problem in our study either as we are interested in the negative news (ESG controversies), rather than how the companies are performing in the ESG-domain. For example,

if a tobacco company has an overall high ESG score assigned by the rating provider of our choice, this information is not included into our analysis. We introduce this tobacco company into our analysis only if there's a reported controversy featuring it. But even then, we only look at the relative change in the *ESG Controversies Score*, without considering the values of its previous or current scores. The last dimension of ESG score divergence as Berg et al. (2022) describe it, is related to assigned *weights*. As we pay equal attention to all changes in *ESG Controversy Score*, regardless of the number of points it fell down, we believe that the *weight divergence* among the rating providers does not have a big impact on our core analysis. The market returns, the volume of traded shares and the industry group indices (see Table 2 for some descriptive statistics) are obtained from the same data provider (Refinitiv).

In order to analyze individual investors' behavior, we use an extensive dataset provided by an online Belgian brokerage house combining the trading records of 20,935 individual investors over a period of 18 years (from January, 2003 to August, 2021) and individual characteristics that are both, sociodemographic and survey-based. The latter have been collected within the context of MiFID European regulation that came into effect in November 2007 in the countries of the European Union. Our sample is composed of two sub-periods that from now on we refer to as the first sub-period (2003-2012) and the second sub-period (2013-2021). We focus our analysis to stocks that experience at least one ESG Controversy from 2003 to 2021, which results in a decrease of *ESG Controversies score*. This filter leaves us with 2,872 companies to analyze and 7,500 *events*. At the market level, we examine whether and how the returns and the trading volumes are affected by an ESG related controversy in a given company. At the individual level, we look at investors that hold non-null positions during the event weeks (see the timeline in Figure 2) and we study first, how the weight of a company that just experienced an ESG controversy changes within investors' portfolios and second, how the weight of the whole industry that the company experiencing the ESG controversy belongs to adjusts as a result.

The central element of our analysis is the already mentioned *ESG Controversies Score*, which reports company's transparency and performance. The score is benchmarked on industry group[1] and for its computation, different weights are assigned to address the market-cap bias[2]. Companies that face no controversies are attributed with a score of 100%. For the remaining companies in the same industry group experiencing controversies, a percentile rank score is computed using the following equation:

$$ESG\ controversy\ score = \frac{N^{\circ}\ companies\ with\ a\ worse\ value\ +\ \frac{N^{\circ}\ companies\ with\ the\ same\ value}{2}}{N^{\circ}\ companies\ with\ a\ value} \tag{1}$$

This equation is applied to all companies (that experience controversies and not) and the word *value* stands for the number of controversies multiplied by a severity weight[2], which is determined accordingly to the class of market capitalization the company belongs to. The lower this *value* is, the higher *ESG Controversies Score* is attributed to the company.

Changes of *ESG Controversies Score* can occur due to two reasons. The first reason is when a controversy is covered by the global media and is purely related to the activity of a given company. These changes can only be affecting the *ESG Controversies Score* of a given company negatively. The second reason that leads to observe changes in *ESG Controversy Score* is related to controversies experienced by the industry. For example, if some controversial information related to another company of the same industry arises, it can affect the *ESG Controversies Score* of other

[1]Industry group serves as a benchmark for environmental (E) and social (S) concerns, while governance (G) controversies use country of a company as a benchmark for comparison due to differences in regulations.

[2]Large cap class companies ($\geq$10 billion) are assigned with so-called *severity weight* of 0.33, the *severity weight* of mid-cap class companies ($\geq$2 billion) is equal to 0.67 and small-cap class companies ($<$2 billion) receive a *severity weight* of 1.

companies in the same industry in a positive way. In most cases, the *ESG Controversies Scores* are valid for one fiscal year. Given how the *ESG Controversies Score* is created and updated, we look at *negative changes* of *ESG Controversies Score* only and we consider the two aspects (on both, market and individual levels) - i) how an ESG controversy affects the individual company's attractiveness and ii) how an ESG controversy of a company affects the attractiveness of the whole industry that the affected company belongs to. The *ESG Controversies Score* is updated every Friday and it becomes visible to the general public on Mondays.

In order to identify important changes in *ESG Controversies Score* we use an event methodology and we call any decrease in the *ESG Controversies Score* an *event*. Based on this definition of an *event*, we analyze the effects of 7,538 events. However, we eliminate the weeks of ESG controversies becoming publicly known that coincide with weeks of earnings announcements, which leaves us with 7,500 events in our sample. The size of the changes in value vary - in our sample, the score drops at least by 0.5 points and at most by 99. However, on average it decreases by 33.5 and the median decrease is equal to 28.6. The ESG controversies' distribution between different categories and time periods can be seen in Table 1. As we compare two time periods (2003 - 2012 and 2013 - 2021), we see that the total number of companies experiencing ESG controversies during the second period doubled in comparison with the first one. We especially notice a proportionally large increase in environmental and workforce controversies over time.

Table 1: The share of companies affected by different categories of ESG controversies.

Name of the controversy categories	% of companies 2003 - 2012	% of companies 2013 - 2021	% of companies 2000 - 2021
Environmental	5.3%	17.4%	14.2%
Workforce	58.2%	64.7%	65.1%
Product responsibility	44.3%	46.8%	44.5%
Human rights	13.5%	8.5%	9.3%
Shareholders	32.9%	27.7%	33.9%
Community	75.5%	75.8%	72.9%
Management	13.4%	8.0%	10.7%
Total number of companies	1,064	2,141	2,826

Notes: Table presents the list of *ESG Controversies Score* which serve as a basis to calculate *ESG Controversies Score*. Each category contains different number of scores that make up each of the seven controversies listed in this table. First column presents the names of these categories. Second column shows the percentage of companies in the sample between 2003 and 2012 that experience each of the ESG controversy categories. Third column presents the same information but for a different period - between 2013 and 2021. Last column presents the aggregate view of the previous two columns.

Since we establish the importance of the industry group for *ESG Controversies score* calculation, Table 2 exhibits the industry groups that are present in our analysis and the respective count of stocks that belong to each one of them, given our total sample of 2,826 stocks. This is especially important for the part of our analysis regarding the individual investors' portfolio weight changes, where we look at how an ESG controversy regarding one stock affects the other stock's attractiveness in the financial markets when both stocks belong to the same industry group. Table 2 presents how many stocks are experiencing ESG controversies in our sample and how many stocks belong to the same industry group and are appear in the portfolios of individual investors but do not experience any ESG controversies over our analyzed period.

The majority of stocks, experiencing an ESG controversy come from the *Financial services* industry group that includes commercial banks, insurances, brokerage firms and so on. However, most of the stocks in investors' portfolios belong to the *Electronics* sector, which contains electronic

data processing equipment, electronic parts and components and so on. If we look at the last column of Table 2, we see the percentage of ESG controversies experiencing stocks given all the stocks of that industry held by the individual investors of our sample. We notice that the highest ratio value belongs to the *Tobacco* industry and the lowest one - to the *Textile* industry. However, these industry groups represent a very small part in our sample.

Table 2: The count of stocks belonging to different industry groups.

Name of the industry group	Number of stocks experiencing ESG controversies	Number of stocks belonging to the same industry	Ratio
Aerospace	21	73	28.8%
Apparel	18	107	16.8%
Automotive	50	162	30.9%
Beverages	33	94	35.1%
Chemicals	95	349	27.2%
Construction	99	377	26.3%
Drugs, cosmetics & healthcare	196	1,430	13.7%
Electrical	34	230	14.8%
Electronics	266	1,934	13.8%
Financial services	367	1,768	20.8%
Food	71	293	24.2%
Machinery & equipment	81	440	18.4%
Metal producers & manufacturers	175	1,166	15.0%
Miscellaneous	443	3,193	13.9%
Oil, gas, coal & related services	150	1,134	13.2%
Paper, printing & publishing	60	232	25.9%
Recreation	106	449	23.6%
Retailers	138	453	30.5%
Textile	8	61	13.1%
Tobacco	10	17	58.8%
Transportation	88	267	33.0%
Utilities	217	611	35.5%
Total	2,872	14,838	19.4%

Notes: Table shows industry groups that are present in our sample and the number of stocks belonging to each of them. Columns indicate the industry group name, how many stocks of each industry have experienced ESG controversies, how many stocks belong to each industry group that are held during our analyzed event windows and the percentage that shows how big the part of stocks experiencing an ESG controversy is given the size of that industry group in our sample. The industry groups are the following. *Aerospace* contains all the companies related to airplane manufacturing. *Apparel* consists of apparel manufacturers. *Automotive* encompasses manufacturers of automotive and automotive parts. *Beverages* incorporates breweries and distilleries. *Chemicals* take into account household and industrial chemicals, tire manufacturers and other. *Construction* incorporates brick, clay companies, as well as engineering, home-building services and many other. *Drugs, cosmetics & healthcare* contains drug stores, medical services and so on. *Electrical* includes industrial, commercial and individual electrical equipment and other. *Electronics* take into account electronic data processing equipment, government electronic systems and so on. *Financial services* include commercial banks, insurances, brokerage firms and so on. *Food* contain different dairy, grain, and other food producing companies. *Machinery & equipment* includes machinery and equipment for agriculture, business, construction and other sectors. *Metal producers & manufacturers* take into account aluminium, gold, copper and other metal producers as well as the manufacturers. *Oil, gas, coal & related services* include oil, gas and coal producers as well as the distributors. *Paper, printing & publishing* takes into account paper producers, as well as book, magazine and newspapers publishers. *Recreation* includes companies producing or selling games, toys, musical instruments and so on. *Retailers* is composed of discount, wholesale and other retailers. *Textile* includes apparel fabrics and furnishings. *Tobacco* includes cigar and cigarette manufacturers. *Transportation* includes railway, airline, truck and other transport companies. *Utilities* encompasses electric power, natural gas and water companies as well as the distributors.

In our sample, we examine portfolios of 20,935 investors and their weekly changes due to emerging *ESG controversies* over an 18 year period, ranging from 2003 to 2021. We only take into account portfolio weight changes that are related to investors intentional purchases or sales of a

given asset, disregarding the artificial portfolio weight changes due to price fluctuation.

Our rich dataset provides many individual investors' characteristics that can be used in explaining the type of investors that care more or less about a certain ESG controversy occurring. As we show some of these characteristics in Table 3, most of our analyzed investors are men (89.9%) and holding a university degree (73.5%). A typical investor has a sufficient level of financial knowledge (67.1%) and trades on average less than once a month (61.1%).

Table 3: Individual investors' socio-demographic information.

Variables	*N*	%
Gender		
Female	3,210	10.1%
Male	28,708	89.9%
Education		
None	2,377	7.4%
High school diploma	6,102	19.1%
University degree	23,499	73.5%
Financial knowledge		
None	6,822	21.4%
Sufficient	9,845	67.1%
Advanced	1,594	11.5 %
Average number of transactions		
Less than 12	19,491	61.1%
Between 12 & 36	8,324	26.0%
More than 36	4,103	12.9%

Notes: Table presents socio-demographic information regarding individual investors we analyze. First column presents different socio-demographic variables, second column tells how many investors belong to each category and the third column expresses the previous number into a percentage of the overall sample. In the variable list we report statistics regarding gender, education, information about their income, whether investors own real estate, their financial knowledge and experience, the amount they already have invested and the reasons to invest. Individuals belonging to low income class earn less than 40,000 euros per year, between 40,000 and 75,000 euros per year if they belong to the medium income class and more than 75,000 euros per year when they belong to high income class. Regarding the invested amounts in financial markets, the individuals are said to have low invested amount if they have invested less than 50,000 euros, medium if they have invested between 50,000 and 75,000 euros and high invested amount if their investments are bigger than 75,000 euros.

4 Methodology

For this analysis, we study ESG controversies as *events* (see Appendix B for a more detailed overview). We conduct our analysis on two levels: a market level and an individual level. The market level analysis consists of analyzing the extent of abnormality regarding market returns and the volume of shares traded during the weeks that we include into the event window. Regarding the individual level of analysis, we look at how individual investors shift their portfolio weights in the aftermath of an ESG controversy. We first of all examine whether individual investors change the portfolio weights of stocks that experience an ESG controversy. However, we decide to extend our analysis and to investigate whether individual investors' decide to decrease portfolio weights of stocks that *look alike*, meaning stocks that belong to the same industry group as the stock that is experiencing the ESG controversy (see the full list of industry groups in Table 2. Our choice to examine the whole industry has two foundations - first, the industry group plays a role in the calculation of the *ESG Controversies score* (Equation 1). Second, we also are interested in seeing whether investors wish to protect themselves against potential (or overestimated) future risks by getting rid of other stocks belonging to the same sector.

4.1 Event study

In this section, we analyze whether and how does the market react to value changes in *ESG Controversies Scores*, that we call *events*. For this analysis, we use the event study (detailed in Appendix B). We define the event window as a union of three weeks: the week that the ESG

controversy is reported in the Thomson Reuters Eikon database, which we call the week *t*, the week before (*t-1*) and the week after (*t+1*). We decide to include the previous week because the *ESG Controversy Scores* are updated on every Friday but they are visible to the public only on Mondays, therefore we believe that in some cases the general public might be already aware of certain ESG controversies slightly earlier than they are incorporated into the *ESG Controversies Score*. In order to estimate the expected returns, we take 10 weeks before and 10 weeks after the *event* window. For the volume of traded shares we consider 5 weeks before and 5 weeks after[3] the *event* window. The schematic overview of estimation and observation periods can be found in Figure 2.

We compute the abnormal returns during the three weeks of the event window (AR_{t-1}, AR_t and AR_{t+1}) to understand whether the abnormal returns are, in fact, significantly different from 0. Consequently, the measures $AV_{t-1,i}$, $AV_{t=0,i}$ and $AV_{t+1,i}$ assess how abnormal the volumes of traded shares during the event window are compared to the average traded volume of the same stock during more *normal* times.

In our sample, there are 7,812 *events* related to 2,826 companies.

4.2 Multi-criteria decision analysis

To analyse our data more in details, we choose to perform Multi-Criteria Decision Analysis (MCDA) using Dominance-based Rough Set Approach (DRSA). MCDA is often adopted to evaluate various criteria that sometimes can be conflicting, e.g. investors are seeking high returns while trying to reduce their investment risks, in order to deduce a pattern in the data and to provide with a decision rule. MCDA is often used to perform sustainability evaluations due to its flexibility and easy-to-understand results and DRSA appears to be the easiest method to perform the MCDA (Cinelli et al. (2014)). In this study, given that 49% of the companies experience at least 2 ESG controversies simultaneously, the interpretation of their impact might not be that straightforward. Thus, we believe the MCDA framework to be helpful in understanding what type of ESG controversies push investors to rebalance their portfolios and to what extent.

The tool of our choice for this analysis, called Dominance-based Rough Set Approach (DRSA) was proposed by Greco, Matarazzo and Słowiński in 1999. The concept was derived from Słowiński's idea about monotonic relationships that can be observed between ordinal evaluations of the objects in the universe, such as "the colder the weather, the greater the energy consumption". According to the work of Greco et al. (2001), dominance principle consists of the idea that if a new entry x is at least as good as the entry y with respect to all relevant criteria, then x should be classified to be at least as good as y.

For the analysis, our data must be arranged in a form of a *Decision Table* where each column represents an *attribute* (conditional or decision), and each row signifies a different *object*. In this case, the attributes (columns) are the ESG controversies (presented in the 1), demographics and the portfolio weight changes, and the objects (rows) are all the investors portfolio records. DRSA approximates the information reported with the decision attributes by considering the knowledge reported in the condition and decision attributes in the form of *if ..., then ...* decision rules (Greco et al. (2016)). The formalization of this framework can be found in Appendix C.

[3]The duration of 5 weeks for the volumes of shares traded is chosen because the results are identical whether we estimate them using 5, 10 or 20 weeks before and after the event.

5 Results

5.1 Market abnormal returns and volume

We analyze the returns and traded volumes of 2,826 stocks from 22 different industries that have experienced at least one ESG controversy during our observed period ranging from 2003 to 2021. Using 10 (5) weeks prior to the *event window* and 10 (5) weeks after, we estimate market returns (trading volumes) (for the graphical representation, refer to Figure 2). Table 4 presents t-test results regarding abnormal returns (*Panel A*) and abnormal volume of traded shares (*Panel B*). The abnormal returns during the first sub-period (2003-2012) are negative and statistically significant during the week of the event (t) and this effect becomes even stronger the week after the event ($t+1$). This tendency changes during the second sub-period of our sample (2013-2021) where the abnormal returns are significantly negative during the week of the event (t) but the intensity of this tendency decreases during the following week ($t+1$). We also notice that the stocks experiencing ESG controversies are underperforming the market by a larger extent during the second sub-period we analyse than during the first sub-period.

However, we observe a different trend regarding abnormal volumes - the most unusual activity is seen during the week before the event ($t-1$) and the week of the event (t). This could be explained by the fact that some ESG controversies might be already known to the public while they are not yet incorporated into the *ESG Controversies Score* since we know that the score is updated every Friday but becomes visible to the public only on Mondays and a week in our data starts on Thursday and ends on Wednesday (in such a way, the score update happens in the middle of our week). Looking at the abnormal traded volumes during the week after the event, regardless of the time period considered, we see that it is no longer significantly different from 0.

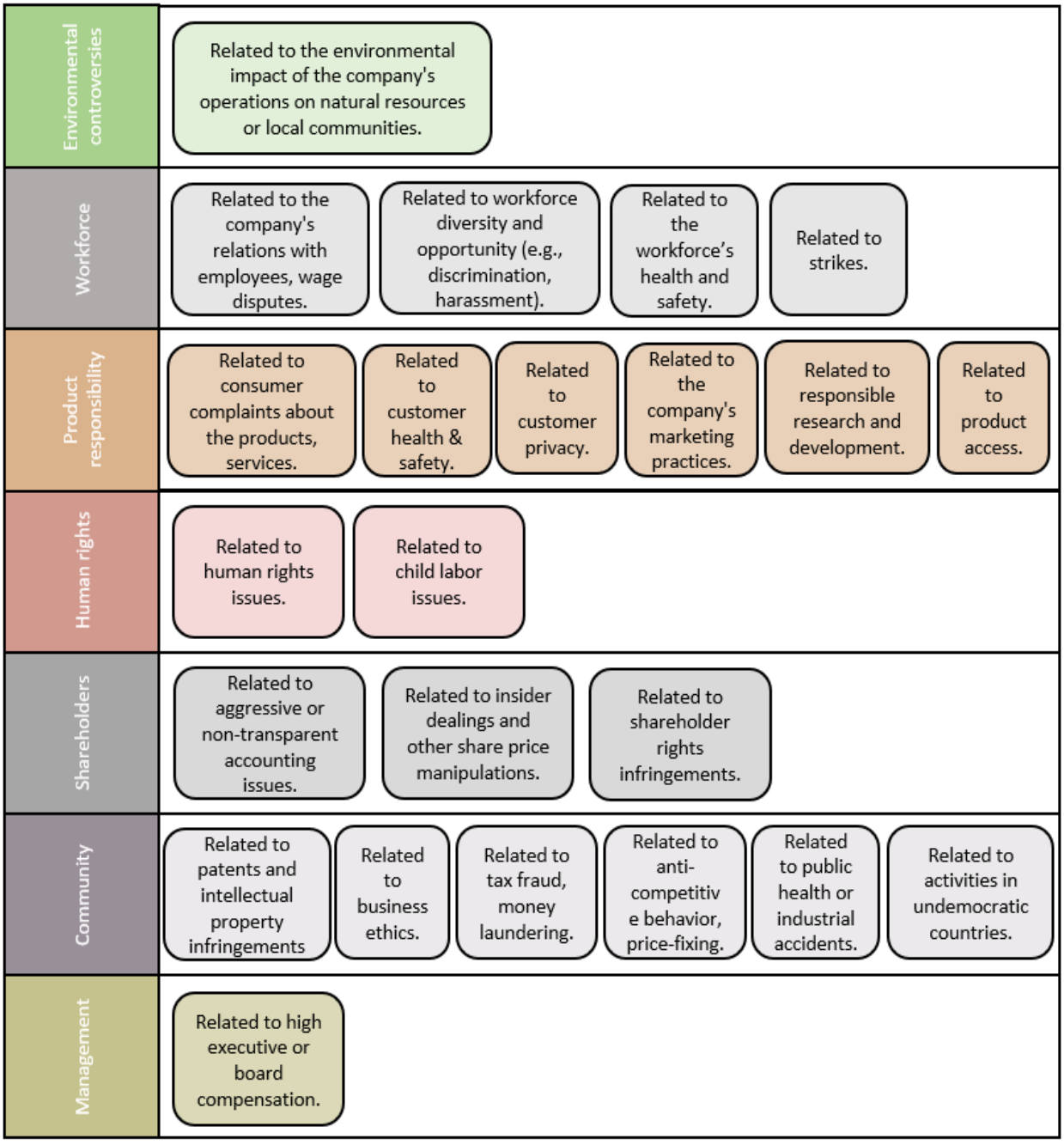
Given that a decrease of *ESG Controversies score* of one company can lead other companies of the same industry see their scores go up, we decide to examine the abnormal returns and abnormal traded volumes per industry. We also think that some ESG controversies are sector-specific and therefore could present a potential risk for all the companies in the same industry (e.g. controversies related to product responsibility). Table 5 shows that companies belonging to the following industry groups of aerospace, automotive, financial services, metal production, oil, gas and coal and utilities are experiencing statistically significant negative abnormal returns the same week as they experience an ESG controversy. We see that most of these industry groups keep experiencing negative abnormal returns also the week after the ESG controversy becomes publicly known ($t+1$), but only a few of them experience the negative abnormal returns a week prior to the *event*. The situation is quite different if we look at the right hand side of the table to analyze the abnormal traded volume. Most of the industries abnormal traded volume is significantly lower than 0 during the week before and the week of the event. This result confirms our line of thinking that stocks featured in ESG Controversies are less atractive for the buyers on the financial markets.

Table 4: Descriptive statistics regarding abnormal returns (AR) and volume measures during different time periods (AV).

Name of the measure	Mean
Panel A	
AR (3-period event windows during 2003-2012):	
Week before the event	0.0503
Week of the event	-0.1078*
Week after the event	-0.0346
AR (3-period event windows during 2013-2021):	
Week before the event	-0.0790
Week of the event	-0.4825***
Week after the event	-0.2054**
AR (3-period event windows during 2003-2021):	
Week before the event	-0.0082
Week of the event	-0.2968***
Week after the event	-0.1208**
Panel B	
Volume (3-period event windows during 2003-2012):	
Week before the event (AV_{t-1})	-0.3965***
Week of the event (AV_t)	-0.2414***
Week after the event (AV_{t+1})	0.0022
Volume (3-period event windows during 2013-2021):	
Week before the event (AV_{t-1})	-0.2639***
Week of the event (AV_t)	-0.2375***
Week after the event (AV_{t+1})	-0.0014
Volume (3-period event windows during 2003-2021):	
Week before the event (AV_{t-1})	-0.3365***
Week of the event (AV_t)	-0.2394***
Week after the event (AV_{t+1})	0.0003

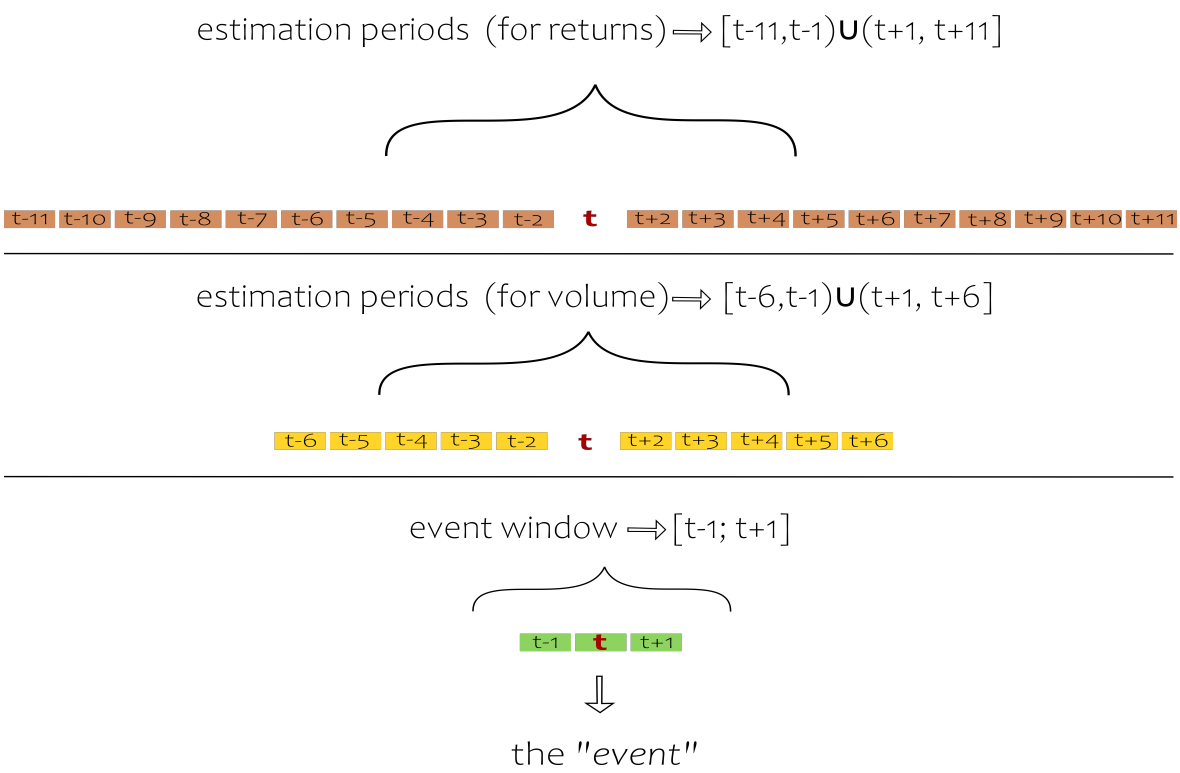
Notes: Table presents mean values of abnormal returns (AR), traded volume measures and their significance levels. Panel A describes information related to AR and the Panel B exhibits findings relating to the market volume measure, called here simply *Volume*. For each of the measures (AR or *Volume*) we report the findings of the event study based on three different time periods: i) 2003-2012, ii) 2013-2021, iii) 2003-2021. Each of these sections are split into three weeks periods: we report the values of the week before the event (*t-1*), the values of the week of the event (t) and the values of the week after the event (*t+1*). The significance levels are determined using t-tests, where the *Hypothesis 0* implies the mean to be equal to 0. Significance levels are *p<0.1, **p<0.05, and ***p<0.01.

Figure 1: Types of controversies that make up each category.



Notes: The figure shows the controversies that make up different category regarding ESG scores. We analyze data regarding seven controversy categories: environment, workforce, product responsibility, human rights, shareholders, community and management. Each category is composed from 1 to 6 controversies. All these scores sum up to 23 controversies that are considered to compute ESG controversy score.

Figure 2: Timelines illustrating estimation, observation and event periods.



Notes: The figure represents the timeline used to compute expected market returns, expected traded volume per stock and the event window. In order to estimate the returns, we use 10 weeks before and after the 3-period event window. This means we take into account the 2 weeks through 11 weeks before and after *actual* event. In order to estimate the abnormal volume, the period we consider is shorter - we look at 5 weeks before and 5 weeks after the event window, which means that we take into account the 2 weeks through 6 weeks before and after the *actual* event. Finally, the event window is defined taking into account the standard 3-period window, which in our case means taking into account the week before the event $(t-1)$, week of the event (t) and the week after the event $(t+1)$. The event week is denoted by t.

Table 5: Descriptive statistics regarding abnormal returns (AR) and abnormal traded volume (AV) per industry group (>30 observations).

		Returns				*Volume*			
Industry group	N	AR_{t-1}	AR_t	AR_{t+1}	CAR	AV_{t-1}	AV_t	AV_{t+1}	CAV
Aerospace	71	-0.8497***	-1.4644***	-1.1774***	-3.4915***	-0.4538***	-0.3457***	-0.0050	-0.8027***
Automotive	222	0.2798	-0.6435*	-0.7713***	-1.1349**	-0.2917***	-0.1530***	0.0501	-0.4061***
Beverages	100	-0.3436	-0.0704	-0.4086	-0.8225	-0.2900***	-0.2932***	-0.0790**	-0.6693***
Chemicals	251	0.2530	-0.1132	0.6743**	0.8140**	-0.3851***	-0.2703***	-0.0194	-0.6828***
Construction	207	-0.1641	-0.4276	-0.6954**	-1.2870**	-0.4593***	-0.3036***	-0.00627	-0.8255***
Drugs, cosmetics & health care	532	-0.0342	-0.0297	-0.3068	-0.3708	-0.3422***	-0.2636***	0.0323	-0.5804***
Electrical	65	0.3794	0.0118	-0.3527	0.0385	-0.3914***	-0.3130***	-0.1284**	-0.8510***
Electronics	666	-0.0924	0.1738	-0.1285	-0.0470	-0.2067***	-0.1459***	-0.0155	-0.3640***
Financial services	1063	0.0812	-0.5399***	-0.2973**	-0.7560***	-0.4151***	-0.2986***	-0.0325***	-0.7602***
Food	205	0.0826	0.1569	0.1355	0.3751	-0.2865***	-0.2460***	-0.0317	-0.5665***
Machinery & equipment	171	-0.6391*	-0.0428	-0.4192	-1.2219***	-0.3984***	-0.3017***	-0.00549	-0.6924***
Metal production	469	-0.3437*	-0.8194***	0.3544	-0.8087**	-0.3772***	-0.2681***	0.00882	-0.6440***
Oil, gas and coal	463	0.0144	-0.8821***	0.3973*	-0.4703	-0.4954***	-0.3524***	-0.0144	-0.8048***
Paper, printing & publishing	124	0.0497	0.5198*	-0.7057	-0.1361	-0.4846***	-0.3987***	-0.00319	-0.9223***
Recreation	244	0.3797	-0.4301*	-0.2247	-0.2751	-0.1890***	-0.1967***	0.0232	-0.3563***
Retailers	399	0.0524	-0.0389	-0.2080	-0.1945	-0.1584***	-0.00927	0.0133	-0.0906
Tobacco	43	0.2747	0.4790	1.1616**	1.9153**	-0.1369	-0.0482	0.0587	
Transportation	285	-0.0220	-0.0256	-0.5058*	-0.5534	-0.3259***	-0.2590***	0.0589	-0.4592***
Utilities	630	0.0582	-0.4423***	0.0410	-0.3431	-0.3488***	-0.2552***	0.0362	-0.3488***
Miscellaneous	876	0.0515	-0.1778	-0.1586	-0.2848	-0.3247***	-0.2488***	0.0243	-0.5659***

Notes: Table presents average abnormal returns (AR), abnormal traded volume (AV), cumulated abnormal returns (CAR), cumulated abnormal volumes traded (CAV) as well as their significance levels, according to the industry-group. The columns from 3 to 6 concern the study of returns and the columns from 7 to 10 - the analysis of abnormal traded volume. Regarding the events, we have the same information type of information - the number of observations, the mean value the week before the event, the mean value during the week of the event, the mean value during the week after the event and the compilation of previously mention values. Given the full list of industry groups we analyze 2, here we show only industries that have >30 observations. Significance levels are *p<0.1, **p<0.05, and ***p<0.01.

5.2 Individual investors abnormal volume, the number of trades, weekly positions and Diversification Index scores

To analyze the individual investor trading behavior surrounding the *events*, we use the trading records of a Belgian brokerage house. Given its smaller size (compared to the market records), not all the events are covered by the data. Overall, we have data to study investors' portfolio composition (Panels A and B in Table 6) surrounding 7,241 events (which makes up 96% of the events we identify on the market level) which involve 2,664 companies. All these events mean that a given company experiences an ESG-related controversy.

In order to examine individual investor portfolio changes, we use t-tests to compare the portfolio weights during the three weeks of our identified *event window*. The event window consists of the event week which is denoted by *t*, the week before the event denoted as *t-1* and the week after the event denoted as *t+1*.

Last three columns of Table 6 describe individual investors' behavior regarding asset and industry weight changes in their portfolios (*Panel A*) as well as position changes in euros (*Panel B*) during both sub-sample periods respectively. While the asset-weights and industry-weights remain unchanged during the 3-week event windows in the first sub-sample period, we see that the behavior of individual investors' shifts in the second sub-sample period. Investors adjust their portfolios as a result of ESG controversies by decreasing the weights of both, the company that is featured in the global news regarding this controversy as well as the weight of the whole industry this company belongs to. Table 6 shows that investors react rather now than later and modify their positions the week of the event.

Looking at the same columns in the *Panel B* we see that individual investors decrease their positions in monetary terms of the ESG controversies experiencing stocks the week of the event in the second sub-sample period, while the decrease in the first sub-sample period is visible only the week after the event. While the changes in value are significant for individual assets, the impact on the whole sector is apparent only in the first sub-sample period.

Table 6 covers 20,935 individual investors and their positions in 14,838 stocks, among which 2,664 stocks experience at least one ESG controversy during our sample period. In our sample, we kept only the investors that had non-null positions during the 3-week event window in the assets featured in the global media's coverage of ESG controversies. The advantage of this filter is that we believe it to be accurately representing the real situation, meaning that it includes investors that trade often but also investors that did not connect to the trading platform in months. However, including investors that manage their portfolios passively and that may not be paying attention to the news relating to their investments might dampen our results. In order to remedy this problem, we create a subsample within our data and include only investors that execute trades (of any stocks) during the 3 weeks of the event window. In this way, we are sure to only take into account investors who actively manage their portfolios. We present the results based on this reduced sample in the Appendix A in Table 9. Results are mostly similar and tending towards similar conclusions as described here-above. Main differences regarding the first sub-sample period are that investors seem to be even increasing the weights of ESG controversies experiencing assets the week of the event, but they are significantly decreasing the weights of the industry that contains the company during the week after the event. Regarding the second sub-sample, investors that are actively managing their portfolios differ from the overall sample by attempting to decrease their exposure to the industry that contains the ESG controversies experiencing asset even the week after the event. Their position adjustments in terms of value, however, are no longer significant.

Table 7 presents the same analysis as Panel A of Table 6, only computed per industry. We see that the portfolio changes of automotive, drugs, cosmetics & health care, and oil, gas and coal industries are the most pronounced during the week of the event. Delayed reactions concern

aerospace and food industry groups, as investors decrease the weights of these industries in their portfolios the week following the event. ESG controversies featuring companies from the industry of oil, gas and coal have the greatest impact on the sector: investors keep decreasing the weight of this industry in their portfolios during the week of the event as well as the following week and even at a greater extent.

In order to model the probability of investors selling the stocks experiencing ESG controversies, we estimate a logistic regression model and present the results in Table 8. The dependent variable is binary and takes the value of 1 when an investor sells her position (partially or fully) over the 3-week event window. The independent variables are the following: variables E and S are binary and equal to 1 when the experienced ESG controversy is of environmental (E) or social nature (S), *Portfolio value* expresses investors' weekly portfolio value expressed in millions, *Age* is a continuous variable describing the age of investor at every trade she makes, *Female* takes a value of 1 when an investor identifies as a female and *Education* equals to 1 if the investor has a university degree.

Table 8 presents three models that differ only by the sample period we consider. In each model, marginal effects are computed for each of the variables and presented in the column on their right. These models are computed using the whole sample of 20,935 individual investors who hold non-empty positions of assets experiencing ESG controversies during the 3-week event windows, meaning it includes the investors that actively manage their portfolios but also those who did not check their online investment accounts for months.

In the first sub-sample period, we see that a stock featured in the environmental controversy (E) is more likely to be sold (as compared to the omitted category of *Governance* controversies), that a stock is less likely to be sold if the controversies are of social nature (S) and both of these results are statistically significant. Looking at the results regarding the second sub-sample, we are surprised to see that the result is no longer significant. Investors are still less likely to sell their positions if a social controversy occurs, more likely to sell if they hold a large portfolio and the likelihood of selling decreases with age. We additionally regress the same model using another time-period (2019-2021), which we identified using Google Trends (Figure 3 in Appendix A) as a period where ESG popularity is increasing. We see that the coefficient is stronger and again significant regarding the environmental controversies (E), that stocks featured in social controversies are less likely to be sold and that older investors are less likely to sell a stock when an ESG controversy occurs.

Table 10 from Appendix A presents the same models as in Table 8 except for being computed using a smaller sample. We keep only the investors that actively manage their portfolios (i.e., they have made at least one trade during the 3-week event window). Results in Table 10 differ from those of Table 8 by investors being significantly more likely to sell their positions as an environmental controversy occurs during the second sub-sample period. Investors with larger portfolios are less likely to sell the position and this result is consistent and significant in all three models. Older investors also are significantly less likely to sell their positions if we consider active investors portfolios only.

Table 6: Individual investors portfolio and position changes during the *events* between 2003 and 2021.

Name of the measure	Mean, 2003-2012	Mean, 2013-2021	Mean, 2003-2021
Panel A → Δ weights within portfolios (in %)			
Individual assets (ω_i):			
i) $\omega_{i,t}$ - $\omega_{i,t-1}$	0.0012	-0.0512***	-0.0060***
ii) $\omega_{i,t+1}$ - $\omega_{i,t}$	-0.0233	-0.0009	-0.0020
Sector assets (ω_j):			
i) $\omega_{j,t}$ - $\omega_{j,t-1}$	0.0021	-0.0121***	-0.0141***
ii) $\omega_{j,t+1}$ - $\omega_{j,t}$	-0.0042	-0.0002	-0.0078**
Panel B → Δ values of positions (in euros)			
Individual positions (pos_i):			
i) $pos_{i,t}$ - $pos_{i,t-1}$	51.28***	-16.89*	12.89
ii) $pos_{i,t+1}$ - $pos_{i,t}$	-45.24***	35.08**	-0.01
Sector positions (pos_j):			
i) $pos_{j,t}$ - $pos_{j,t-1}$	509.6**	-79.66	177.80
ii) $pos_{j,t+1}$ - $pos_{j,t}$	-278.5**	191.2	-14.05

Notes: Table presents the results from t-tests who compare the investors' portfolio changes in ESG controversies experiencing stocks. The same *event window* is considered in both panels, A and B. It consists of a three week period - the week of the event *t*, the week before the event *t-1* and the week after the event *t+1*. In Panel A we compare investors' portfolio weights (ω) of i) individual asset i experiencing an ESG controversy and ii) the whole industry j that the asset experiencing an ESG controversy belongs to. In Panel B, we examine investors' portfolio changes in euros (pos) in the aftermath of an ESG controversy. Once again, we compare i) changes in positions in individual assets (pos_i) experiencing ESG controversies and ii) changes in positions of the assets belonging to the same industry as the asset experiencing an ESG controversy (pos_j). Significance levels are *p<0.1, **p<0.05, and ***p<0.01.

Table 7: Changes in portfolio weights ω_j induced by the rise of ESG Controversies in the same industry group between 2003 and 2012.

Industry group	N	$\omega_{j,t} - \omega_{j,t-1}$	$\omega_{j,t+1} - \omega_{j,t}$
Aerospace	15,804	-0.0153	-0.0259**
Automotive	74,849	-0.0231***	0.0085
Beverages	37,135	0.0005	0.0002
Chemicals	50,317	-0.0014	0.0280***
Construction	28,101	0.0112	-0.0239
Drugs, cosmetics & health care	138,716	-0.0111***	0.00754*
Electrical	13,724	0.0010	0.0043
Electronics	188,247	-0.0045	-0.0083*
Financial services	196,777	0.0079	0.0028
Food	24,875	-0.0084	-0.0180**
Machinery & equipment	9,192	-0.0209*	0.0405**
Metal production	75,097	-0.0011	0.0136
Paper, printing & publishing	2,899	-0.0159	-0.0070
Oil, gas and coal	106,202	-0.0216***	-0.0692***
Recreation	25,046	0.0534***	0.0212
Retailers	56,643	-0.0054	0.0236***
Textile	500	-0.0088	-0.0230
Tobacco	3,871	-0.0184	0.0150
Transportation	32,018	-0.0033	-0.0005
Utilities	121,167	-0.0074	0.0125**
Miscellaneous	130,199	-0.0014	0.0004

Notes: Table presents investors' portfolio changes of a given sector per industry group. First column names the industry group, second column describes how many observations we have for each industry group, third table describes investor portfolio weight changes in a given industry between the week of the event ($\omega_{j,t}$) and the week before the event ($\omega_{j,t-1}$) and the fourth column describes investor portfolio weight changes between the week after the event ($\omega_{j,t+1}$) and the week of the event ($\omega_{j,t}$). Significance levels are *p<0.1, **p<0.05, and ***p<0.01.

Table 8: Logistic regressions explaining the selling behavior of ESG controversies experiencing assets.

	Sold $(t-1 \rightarrow t+1)$:					
	2003-2012	ME	2013-2021	ME	2019-2021	ME
Intercept	-5.091^{***} (0.124)		-5.147^{***} (0.139)		-5.075^{***} (0.285)	
E	0.270^{***} (0.099)	0.001	0.050 (0.057)	0.0002	0.399^{***} (0.098)	0.001
S	-0.200^{***} (0.076)	-0.001	-0.458^{***} (0.060)	-0.0014	-0.717^{***} (0.114)	-0.0018
Ln(Portfolio value)	0.125^{***} (0.011)	0.001	0.146^{***} (0.011)	0.0005	0.158^{***} (0.022)	0.0004
Financial literacy	0.012 (0.045)	0.0001	-0.002 (0.056)	-0.00001	0.023 (0.112)	0.0001
Age	0.001 (0.002)	0.000003	-0.004^{**} (0.002)	-0.000001	-0.007^{*} (0.004)	-0.00002
Female	0.067 (0.076)	0.0003	0.100 (0.097)	0.0003	0.018 (0.194)	0.0001
Education	-0.065 (0.049)	-0.0003	0.021 (0.063)	0.0001	0.050 (0.135)	0.0001
Observations	599,573		776,338		228,469	
Adjusted R^2	0.028		0.029		0.016	

Notes: Table shows the results from logistic regressions based on three different time-periods: 2003-2012, 2013-2021 and 2019-2021 and their respective marginal effects (ME). The dependent variable in all three cases is binary and equals to 1 when an investor sold (fully or partially) her position in the asset featured in ESG controversies during the 3-week event window and 0 otherwise. The independent variables are the following: *E* is a binary variable and takes value 1 when the identified controversy is of the environmental nature, *S* is a binary variable that is equal to 1 when the controversy concerns social aspects, *Ln(Portfolio value)* describes the investors weekly portfolio value expressed in a logarithmic form, *Financial literacy* is binary and equal to 1 when an investor claims to understand the functioning of financial markets, *Age* is a continuous variable defining investor's age every week, *Female* takes value 1 if the investor identifies as a female and 0 otherwise, *Education* takes value 1 if the investor has a university degree. The data used for these models is the same as in Table 6, meaning that all the investors are considered (those that actively manage their portfolios and those who do not). Significance levels are *p<0.1; **p<0.05; ***p<0.01

6 Conclusion

As the interest in sustainable finance and ESG-investing keeps rising, we deem it important to examine the impact that ESG controversies have on market returns, volumes and individual investors' asset choices of the assets experiencing these controversies. For our analysis, we use the *ESG Controversy Score* from Thomson Reuters Eikon to identify when an ESG controversy occurs and the so-called *event* happens. First aspect of our analysis consists of looking whether the returns and the volumes traded during the event windows are abnormal. Second aspect of our study focuses on whether and how individual investors shift their portfolio weights of stocks experiencing ESG controversies during the same event windows. We also examine whether individual investors try to actively protect themselves from other potential controversies arising in companies that *look alike*, i.e., belong to the same industry group.

Our paper differs from other studies on the topic by several aspects. First, we analyse how negative information regarding ESG criteria affects market returns and volumes of 2,826 companies over an extensive time period of 18 years. Second, we use a large dataset covering 20,935 individual investors and their trading history over 18 years to understand whether individual investors react to arising ESG controversies. We empirically observe whether they change the portfolio weights of stocks that experience such controversies.

We find that the market abnormal returns are significantly lower than 0 the week that an ESG controversy becomes publicly known and this effect continues during the following week. We see that this tendency is a lot stronger during the second sub-sample period rather than the earlier years of our analysis. Regarding the volumes, we see already statistically significant abnormal activity during the week before the information regarding ESG controversies becomes integrated into the *ESG Controversies Score* as well as the week of the event. These results are similar in both sub-sample periods and we think they can be arise because the markets can learn the negative news earlier than the *ESG Controversies Score* changes. If an event occurs on Monday, it might already be reported in the global media, but the score would change only on Friday, thus the earlier reaction.

At the individual level, we notice that investors decrease the weights of assets that experience ESG controversies as well as of the industries that these assets belong to within their portfolios during the week of the event's occurrence. These tendencies are statistically significant only during the second sub-sample period or if we consider the 18 year sample period as a whole.

We contribute to the literature by actually observing whether individual investors care about sustainable aspects of the companies they invest in as much as they appear to do so in the experimental studies. Using a large dataset we have the opportunity to observe whether companies experiencing ESG controversies lead individual investors to in fact decrease the portfolio weights of these companies in their own portfolios. In other words, we are able to examine whether the attitude-behavior gap surrounding ESG-investing, indeed, exists. Our study shows that not only financial markets react negatively to ESG controversies, but that individual investors do so too. They decrease portfolio weights of companies that experience ESG controversies and they also reduce the weights of companies that belong to the same industry group in order to protect themselves against potential similar situations.

References

Amel-Zadeh, A. & Serafeim, G. (2018), 'Why and how investors use esg information: Evidence from a global survey', *Financial Analysts Journal* **74**(3), 87–103.

Bauer, R., Ruof, T. & Smeets, P. (2021), 'Get real! individuals prefer more sustainable investments', *The Review of Financial Studies* **34**(8), 3976–4043.

Berg, F., Koelbel, J. F. & Rigobon, R. (2022), 'Aggregate confusion: The divergence of esg ratings', *Review of Finance* .

Błaszczyński, J., Greco, S., Słowiński, R. & Szelg, M. (2009), 'Monotonic variable consistency rough set approaches', *International Journal of Approximate Reasoning* **50**(7), 979–999.

Brodback, D., Guenster, N. & Mezger, D. (2019), 'Altruism and egoism in investment decisions', *Review of Financial Economics* **37**(1), 118–148.

Ceccarelli, M., Ramelli, S. & Wagner, A. F. (2019), 'When investors call for climate responsibility, how do mutual funds respond?'.

Cheng, M. M., Green, W. J. & Ko, J. C. W. (2015), 'The impact of strategic relevance and assurance of sustainability indicators on investors' decisions', *Auditing: A Journal of Practice & Theory* **34**(1), 131–162.

Cinelli, M., Coles, S. R. & Kirwan, K. (2014), 'Analysis of the potentials of multi criteria decision analysis methods to conduct sustainability assessment', *Ecological indicators* **46**, 138–148.

Dhaliwal, D. S., Li, O. Z., Tsang, A. & Yang, Y. G. (2011), 'Voluntary nonfinancial disclosure and the cost of equity capital: The initiation of corporate social responsibility reporting', *The Accounting Review* **86**(1), 59–100.

Gantchev, N., Giannetti, M. & Li, R. (2019), 'Does money talk? market discipline through selloffs and boycotts', *European Corporate Governance Institute, Finance Working Paper* (634), 19–9.

Greco, S., Matarazzo, B. & Slowinski, R. (2001), 'Rough sets theory for multicriteria decision analysis', *European Journal of Operational Research* **129**(1), 1–47.

Greco, S., Matarazzo, B. & Słowiński, R. (2016), Decision rule approach, *in* 'Multiple criteria decision analysis', Springer, pp. 497–552.

Hartzmark, S. M. & Sussman, A. B. (2019), 'Do investors value sustainability? a natural experiment examining ranking and fund flows', *The Journal of Finance* **74**(6), 2789–2837.

Humphrey, J., Kogan, S., Sagi, J. S. & Starks, L. T. (2020), 'The asymmetry in responsible investing preferences', *Available at SSRN 3583862* .

Kahneman, D. & Tversky, A. (2013), 'Prospect theory: An analysis of decision under risk', pp. 99–127.

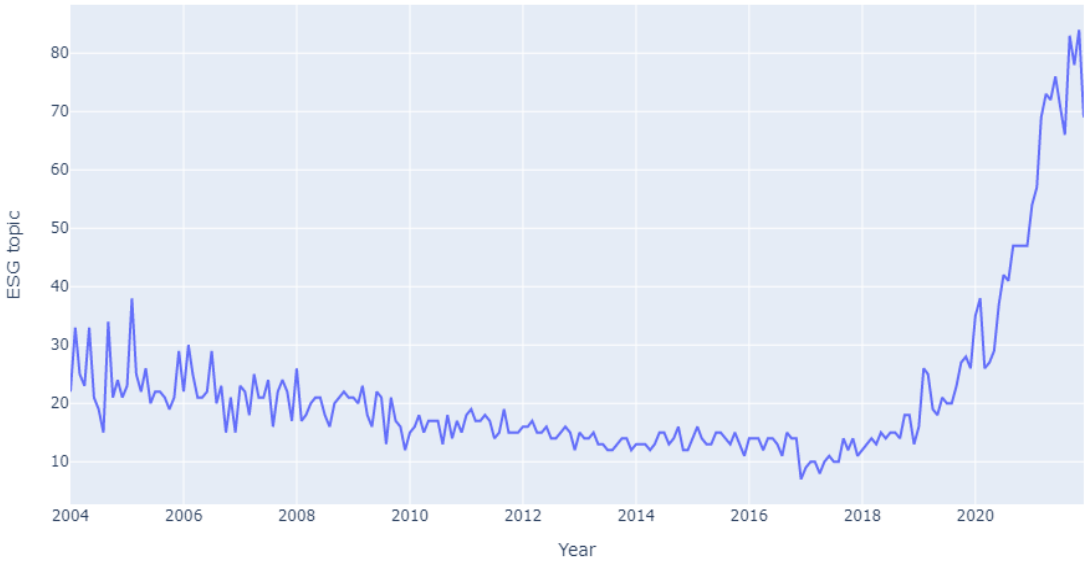
Krüger, P. (2015), 'Corporate goodness and shareholder wealth', *Journal of Financial Economics* **115**(2), 304–329.

Moss, A., Naughton, J. P. & Wang, C. (2020), 'The irrelevance of esg disclosure to retail investors: Evidence from robinhood', *Available at SSRN 3604847* .

Riedl, A. & Smeets, P. (2017), 'Why do investors hold socially responsible mutual funds?', *The Journal of Finance* **72**(6), 2505–2550.

A Appendix

Figure 3: Google trends regarding the search intensity of ESG topic over time.



Notes: The figure visually represents the increase of Google search regarding *ESG topic* over time. The timeline includes Google searches from the beginning of 2004 till the end of 2021. Y-axis shows how many time any term related to the topic of ESG was searched for in any given month and the x-axis represents the month and the year.

Table 9: Individual investors portfolio and position changes during the *3-week event windows*.

Name of the measure	Mean, 2003-2012	Mean, 2013-2021	Mean, 2003-2021
Panel A			
Changes in *individual* asset weights ω_i of a portfolio (%):			
i) $\omega_{i,t}$ - $\omega_{i,t-1}$	0.0135*	-0.0232***	-0.0035
ii) $\omega_{i,t+1}$ - $\omega_{i,t}$	-0.0035	-0.0059	-0.0046
Changes in *sector* asset weights ω_j of a portfolio (%):			
i) $\omega_{j,t}$ - $\omega_{j,t-1}$	-0.0116	-0.0496***	-0.0292***
ii) $\omega_{j,t+1}$ - $\omega_{j,t}$	-0.0385**	-0.0344**	-0.0366***
Panel B			
Changes in *individual* asset positions pos_i expressed in euros:			
i) $pos_{i,t}$ - $pos_{i,t-1}$	53.06	-27.95	15.88
ii) $pos_{i,t+1}$ - $pos_{i,t}$	-155.90***	30.34	-70.43**
Changes in positions ω_j following *sector* controversies expressed in euros:			
i) $pos_{j,t}$ - $pos_{j,t-1}$	982.0***	-902.2	117.2
ii) $pos_{j,t+1}$ - $pos_{j,t}$	-1033.7***	-193.6	-648.1

Notes: Table describes only the investors that traded stocks in their portfolios during the 3 weeks of the event. In this case, our data covers 6,522 events concerning 2,437 companies and includes stock-positions of 15,629 investors. Significance levels are *p<0.1, **p<0.05, and ***p<0.01.

Table 10: Logistic regressions explaining the selling behavior of ESG controversies experiencing stocks.

	Sold $(t-1 \rightarrow t+1)$:					
	2003-2012	ME	2013-2021	ME	2019-2021	ME
Intercept	-3.695^{***}		-2.913^{***}		-3.038^{***}	
	(0.123)		(0.146)		(0.296)	
E	0.222^{**}	0.003	0.099^{*}	0.001	0.372^{***}	0.005
	(0.099)		(0.057)		(0.098)	
S	-0.010	-0.0001	-0.484^{***}	-0.01	-0.483^{***}	-0.01
	(0.076)		(0.061)		(0.114)	
Ln(Portfolio value)	-0.006	-0.0001	-0.075^{***}	-0.001	-0.073^{***}	-0.001
	(0.009)		(0.011)		(0.027)	
Age	-0.010^{***}	-0.0001	-0.016^{***}	-0.0002	-0.013^{***}	-0.0002
	(0.002)		(0.002)		(0.005)	
Female	0.044	0.001	0.101	0.001	-0.015	-0.0002
	(0.077)		(0.092)		(0.190)	
Education	-0.079	-0.001	-0.050	-0.001	-0.028	-0.0004
	(0.049)		(0.060)		(0.133)	
Observations	218,542		186,459		46,003	
Adjusted McFadden	0.026		0.028		0.011	

Notes: Table shows the results from logistic regressions based on three different time-periods: 2003-2012, 2013-2021 and 2019-2021 and their respective marginal effects (ME). The dependent variable in all three cases is binary and equals to 1 when an investor sold (fully or partially) her position in the asset featured in ESG controversies during the 3-week event window and 0 otherwise. The independent variables are the following: *E* is a binary variable and takes value 1 when the identified controversy is of the environmental nature, *S* is a binary variable that is equal to 1 when the controversy concerns social aspects, *Portfolio value* describes the investors weekly portfolio value expressed in millions of euros, *Age* is a continuous variable defining investor's age every week, *Female* takes value 1 if the investor identifies as a female and 0 otherwise, *Education* takes value 1 if the investor has a university degree. The data used for these models is the same as in Table 9, meaning that only investors actively managing their portfolios are considered. Significance levels are *p<0.1; **p<0.05; ***p<0.01.

B Appendix

The event study allows us to test the semi-strong form of the Efficient Market Hypothesis (EMH) around ESG events and to see whether the prices adapt quickly. Occurrence of such *events* leads to abnormal stock returns (AR_t), that we compute using Equation 2. First, we run a regression of a stock return (R_t) against the market return ($R_{M,t}$), in order to find the intercept ($\hat{\alpha}$) and the slope ($\hat{\beta}$). To obtain these coefficients, we use the estimation period of 10 weeks before and 10 weeks after our 3-period event window. In other words, this means that we estimate $\hat{\alpha}$ and $\hat{\beta}$ using 11 to 1 weeks before the event and 1 to 12 weeks after the event, as shown in Figure 2 (that can be found in the main text of Chapter 3).

The estimation period allows us to complete the *expected return*. Afterwards, we use these coefficients to compute the expected return, we follow the Equation 2 and compute the difference between the observed return for stock i and the expected return and get the abnormal return. In order to study how much out-of-ordinary these abnormal returns are, we use Equation 3 and

compute cumulative abnormal return (CAR) during the observation period of our choice. We decide to compute them using the usual 3-period window therefore we take into account the week before the event, the week of event and the week after the event. For market returns, we use the MSCI World Index returns.

$$AR_{t,i} = \underbrace{R_{t,i}}_{\text{observed return}} - \underbrace{(\hat{\alpha} + \hat{\beta} R_{M,t})}_{\text{expected return}} \tag{2}$$

$$CAR_i = \sum_{t=t-1}^{t=t+1} AR_{t,i} \tag{3}$$

We analyze the returns[4] as well as the volume[5] prior and following the *events*. For the volume analysis, we compute 3 measures:

$$AV_{t-1,i} = \frac{Volume_{t-1,i} - \overline{Volume_i}}{\overline{Volume_i}} \tag{4}$$

$$AV_{t,i} = \frac{Volume_{t=0,i} - \overline{Volume_i}}{\overline{Volume_i}} \tag{5}$$

$$AV_{t+1,i} = \frac{Volume_{t+1,i} - \overline{Volume_i}}{\overline{Volume_i}} \tag{6}$$

$$CAV_i = \sum_{t=t-1}^{t=t+1} Vol_{t,i} \tag{7}$$

We compute $AV_{t-1,i}$, $AV_{t=0,i}$ and $AV_{t+1,i}$ measures using the 10 year trading history of 13,719 individual investors. We use the equations 4, 5 and 6 to compare traded volume of a stock i during the week before the event (t-1), the week of event (t=0), the week after the event (t+1) and the average traded volume of the same stock during more "normal" times ($\overline{Volume_i}$). $\overline{Volume_i}$ refers to the average value computed taking into account the traded volume 5 weeks before and 5 weeks after our analyzed 3-period event window (i.e., $-11 \leq t < -1 \cup 1 < t \leq 11$).

C Appendix

The methodology in order to compute a preference model using DRSA methodology and jMAF software:

1. The intuition

To begin with, data must be arranged in a form of *Decision Table*, where each column represents an *attribute* (conditional or decision), and each row signifies a different *object*. In this case, the attributes (columns) are the ESG controversies (presented in Figure 1) and the objects (rows) are the investors' portfolio weight changes surrounding each event.

For each model which is being computed, there can be only one decision attribute per time, which must be defined as a *cost* (standing for the idea of *the less, the better*) or a *gain* (meaning *the more, the better*). All the other (conditional) attributes can be described as a *cost*, *gain* or *none*. This helps us to partition all the *objects* in decision classes using decision and conditional attributes.

2. The formalization of the theory

[4]They represent a theoretical growth in value of a share holding over a specified period, assuming that dividends are re-invested to purchase additional units of an equity at the closing price applicable on the ex-dividend date.

[5]The number of shares traded for a stock on a particular day, expressed in thousands.

We define the information system $IS = (U, G)$ where U represents the records of investors' portfolio changes and G - all the ESG controversies we cover (see Figure 1 for more details), socio-demographic variables of investors as well as the extent to which the portfolio weight changes. The set of ESG controversies, socio-demographic variables and so on, which we define as $G = \{g_1, g_2, ..., g_n\}$, can be seen as an union between conditional attributes (C) and decision attribute (d), such as $G = C \cap d$. In our case, the decision variable d is the extent to which the portfolio weight changes from one week to another and the conditional attributes C are all the rest. The decision attribute d makes a partition of the universe U by dividing it into a finite number of decision classes. They are denoted as $Cl = \{Cl_1, Cl_2, ..., Cl_m\}$ and each object ($x \in U$) belongs to only one decision class. The decision classes are preference ordered which means that if the decision attribute is defined as a *gain*, then $Cl_1 < Cl_2$ and inversely if d is defined as a *cost*. The sets deduced using DRSA are called upward union, which is denoted $Cl_t^{\geq} = U_{s \geq t} Cl_s$ and downward union which is denoted $Cl_t^{\leq} = U_{s \leq t} Cl_s$ of decision classes where $t = 1, ..., m$. Looking at the upward union, if $x \in Cl_t^{\geq}$, the statement is read as "x belongs to at least class Cl_t", and if x belongs to the downward union, the statement is read as "x belongs to at most class Cl_t".

These decision classes are approximated by the granules of knowledge, P-dominating or P-dominated sets, which are derived from the evaluation of attributes, where $P \subseteq G$. If a set of objects is dominating x with respect to P criteria, the set is called P-dominating set or positive dominance cone and can be denoted by $D_P^+(x) = \{y \in U : yD_px\}$. If the situation is the opposite and a set of objects is dominated by x with respect to P criteria, it is called P-dominated set or negative dominance cone and can be denoted by $D_P^-(x) = \{y \in U : yD_px\}$.

P-lower approximation of union of classes $Cl_t^{\geq}$, which is denoted by $\underline{P}(Cl_t^{\geq}) = \{x \in U : D_P^+(x) \subseteq Cl_t^{\geq}\}$ is at the basis of generating certain rules. Intuitively, the lower approximation contains all objects x so that the positive dominance cone in the condition attribute space is included in this union. However, in practical terms this definition happens to be too restraining which often results in lower approximation being empty. The P-upper approximation of union of classes $Cl_t^{\geq}$ contributes towards deduction of *possible rules* and is denoted by $\overline{P}(Cl_t^{\geq}) = \{x \subseteq U : D_P^-(x) \cap Cl_t^{\geq} \neq \emptyset\}$ and is equal to all the objects x that have a non-empty intersection between the negative dominance cone in the condition attribute space and this union. Same concepts can also be defined for the class approximated as *at most* $Cl_t^{\leq}$. Its P-lower approximation is equal to $\underline{P}(Cl_t^{\leq}) = \{x \in U : D_P^-(x) \subseteq Cl_t^{\leq}\}$ and its P-upper approximation is equal to $\overline{P}(CL_t^{\geq}) = \{x \in U : D_P^+(x) \cap Cl_t^{\leq} \neq \emptyset$. In both, *at most* or *at least* cases, by subtracting a P-lower approximation from a P-upper approximation we obtain a concept which is called P-boundary, and which is responsible for generating approximate rules. For the *at least* type it is denoted by $Bn_P(Cl_t^{\geq}) = \overline{P}(Cl_t^{\geq}) - \underline{P}(Cl_t^{\geq})$ for all $t = 2, \ldots, m$ and for *at most* type it is denoted by $Bn_P(Cl_t^{\leq}) = \overline{P}(Cl_t^{\leq}) - \underline{P}(Cl_t^{\leq})$, for all $t = 1, \ldots, m \breve{} 1$. Certain decision rules can provide either lower either upper profile descriptions belonging to $\underline{P}(Cl_t^{\geq})$ or $\overline{P}(Cl_t^{\leq})$ respectively. In the first case of $\underline{P}(Cl_t^{\geq})$, the decision rule would be defined such as if $g_{i_1}(x) \geq r_{i_1}$, and ... and $g_{i_p}(x) \geq r_{i_p}$, then $x \in Cl_t^{\geq}$ where i indicates an attribute, $r_{i_1}, ..., r_{i_1} \in \mathbb{R}$ and $t = 2, ..., m$. In the case of $\overline{P}(Cl_t^{\leq})$, the decision rule's definition is such as $g_{i_1}(x) \leq r_{i_1}$, and ... and $g_{i_p}(x) \leq r_{i_p}$, then $x \in Cl_t^{\leq}$ where i indicates an attribute, $r_{i_1}, ..., r_{i_1} \in \mathbb{R}$ and $t = 1, ..., m-1$. All decision rules, proposed here, are calculated using VC-DomLEM algorithm whose overall goal is to find the smallest possible set of rules with high predictive accuracy (Błaszczyński et al. (2009)). Each decision rule proposes to which class an object should be assigned, once the initial condition of the rule is satisfied, and each rule can be measured in four ways:

- support of the rule r_X: $supp(r_x) = | \|\Phi\|_{r_X} \cap \|\Psi\|_{r_X} |$,

  intuition: objects that are covered by this rule supports condition and decision parts of this rule,

- strength of $r_X : \sigma(r_X) = \frac{supp(r_X)}{|U|}$,

  intuition: the strength of each rule is equal to the number of examples supporting that rule divided by all the objects belonging to this data set,

- certainty of $r_X : cer(r_X) = \frac{supp(r_X)}{\Phi_{r_X}}$,

  intuition: certainty of each rule is equal to the number of objects that support the rule divided by the number of objects which fulfil the condition part of the rule,

- coverage of $r_X : cov(r_X) = \frac{supp(r_X)}{\Psi_{r_X}}$,

  intuition: coverage of each rule is equal to the number of objects that are covered by this rule divided by the number of objects that fulfil the decision part of the rule,

  where $|.|$ represents the cardinality of a set, Φ denotes the condition part of the rule and Ψ signifies the decision part of the rule, e.g. if Φ, then Ψ. In this analysis the decision rules' accuracy is measured with support, strength and coverage.