THE VARIOUS RISK EXPOSURES OF INSTITUTIONAL INVESTORS

Kumulative Dissertation

der Wirtschaftswissenschaftlichen Fakultät

der Universität Augsburg

zur Erlangung des akademischen Grades eines Doktors

der Wirtschaftswissenschaften

(Dr. rer. pol.)

vorgelegt von

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Tag der mündlichen Prüfung: 26.02.2021

In der Dissertation enthaltene Arbeiten

Die vorliegende Dissertation enthält die folgenden fünf Forschungsarbeiten. Hiervon sind drei bereits publiziert.

Forschungsarbeit 1:

Benz, Lukas; Rohleder, Martin; Syryca, Janik; Wilkens, Marco (2019): "Shedding light on the exposure of mutual funds: Which investments drive mutual fund characteristics?" *Journal of Asset Management*, Vol. 20 No. 7, pp. 534–551. doi: 10.1057/s41260-019-00144-2.

Forschungsarbeit 2:

Benz, Lukas (2021): "Trading in the Dark – What are Fund Managers doing when no one is watching?" Working Paper, University of Augsburg.

Forschungsarbeit 3:

Benz, Lukas; Paulus, Stefan; Scherer, Julia; Syryca, Janik; Trück, Stefan (2021): "Investors' Carbon Risk Exposure and their Potential for Shareholder Engagement." *Business Strategy and the Environment*, Vol. 30 No. 1, pp. 282–301, 2021. doi: 10.1002/bse.2621.

Forschungsarbeit 4:

Benz, Lukas; Paulus, Stefan; Rohleder, Martin; Wilkens, Marco (2021): "Ownership comes with responsibility – The impact of ownership characteristics on CSR" Working Paper, University of Augsburg.

Forschungsarbeit 5:

Benz, Lukas; Jacob, Andrea; Paulus, Stefan; Wilkens, Marco (2020): "Herds on green meadows: the decarbonization of institutional portfolios." *Journal of Asset Management*, Vol. 21 No. 1, pp. 13–31. doi: 10.1057/s41260-019-00147-z.

Contents

1 Introduction

1.1 Motivation

An institutional investor is an organization that invests money on behalf of others or for itself in a variety of financial instruments and asset classes, controlling a significant proportion of all financial assets worldwide and having significant influence in all markets. Due to the large number of investments, the portfolios of these investors are exposed to a variety of different types of risk which must be assessed and considered by the portfolio managers. Krueger *et al.* (2020) highlight the fact that institutional investors have to consider at least six different sources of risk, namely financial, operational, governance, social, climate and other environmental risks. Their study shows that institutional investors consider financial risks, i.e. risks related to earnings or leverage of their investments, as most threatening, followed by operational and governance risks. These financial risks are determined, inter alia, by the composition of the portfolio and the characteristics of the assets under management. As shown by Benz *et al.* (2019) for mutual funds and Aragon and Martin (2012) for hedge funds, institutional investors not only invest in trivial assets such as equities and bonds, which expose the investor mainly to linear risks, but also in more complex securities such as options, swaps, and futures, exposing a portfolio to more complex sources of non-linear risk.

After all, about 10% of all investors consider climate risk to be the most threatening one, which underlines the importance of this risk factor. The general climate risk includes, among others, the so-called carbon risk, which arises from the growing awareness of the impact of climate change on companies and includes all uncertainties arising from the transition process from a brown to a green economy (Görgen *et al.*, 2020). In recent years, there have been a vast number of articles, both theoretical (e.g., Busch and Hoffmann (2011)) and empirical (e.g., Cunha *et al.* (2019)), which have shown that investors should consider this risk factor in their investment process.

In summary, the portfolios of institutional investors are constantly exposed to a variety of different types of risk. Therefore, one of the key tasks of portfolio managers is to be able to correctly assess and measure the risks taken and to act and react accordingly to portfolio changes or to external influences. This dissertation discusses several types of risk arising in the investment and portfolio allocation processes of institutional.

In order to show that a specific type of institutional investor, namely US domestic equity funds, is exposed to a variety of risks through a wide range of financial securities, Article I provides a detailed identification and classification of all positions held by these funds. First, it is shown that the portfolios are exposed to financial risks through trivial linear positions such as equities, bonds, and cash positions. Furthermore, the exposure of the portfolios to non-linear risks through various complex instruments such as options and futures is highlighted. This precise breakdown of the funds' exposure to the financial securities held, makes it possible to break down all sources of risk accurately. This enables to determine the impact of a change in exposure to a particular financial asset and thereby control for the exact allocation of the portfolio. This procedure allows a precise analysis of the influence of different sources of risk, on different fund characteristic, in this case in the form of exposure to linear and non-linear financial securities. To identify the various financial instruments, monthly and quarterly holding reports are used in this study to examine the influence of linear or non-linear exposures on fund characteristics.

However, these low frequency reports do not reflect the exact trading activity of a fund manager between reporting dates, which may lead to distorted conclusions about the fund’s portfolio held in between two consecutive reportings. Investors and research studies (e.g., Daniel *et al.* (1997)) determining the performance of their investments based on the reported holdings or selecting the respective investment based on certain holdings or the investments’ risk profile, are exposed to agency risk as they are unable to observe the exact intermediate

portfolio composition (Kacperczyk *et al.*, 2008). The trading behavior of a fund manager in between two reportings, so-called interim trading, may change the risk structure of the fund compared to the risk structure that may be implied by the published holdings. In addition to an unobservable impact on a fund's risk structure, these trading activities could have an impact on a fund's performance. Article II therefore proposes an extension of the methodology used by Kacperczyk *et al.* (2008) to study the interim trading behavior of funds and shows its influence on the risk structure of the fund and various performance measures.

In addition to financial risks resulting from the financial securities held, companies and their investors must also deal with other risks that are not of a financial nature, but which nevertheless jeopardize the portfolio in the long term. One of these risks results from the influence of climate change, whereby the industry will not be able to consume all remaining coal, oil and gas reserves to achieve the 2°C target set in Paris (Le Quéré *et al.*, 2015). Therefore, assets lose their economic value long before their expected useful life, and the resulting carbon bubble might have a lasting impact on the valuation of carbon-intensive companies. As the negative impact of carbon emissions is becoming increasingly evident to society, these firms must be able to deal with possible changes in customer demand and the increased reputational risk associated with being classified as unsustainable or highly polluting (Cubas-Díaz and Sedano, 2018). It is therefore also of great importance for the financiers of these companies. As shown by Cunha *et al.* (2019), institutional investors are becoming increasingly aware of the risks associated with climate change and are integrating social, government or environmental criteria into their investment decisions. Article III takes an in-depth look on this topic and shows which of the various groups of institutional investors is affected by carbon risk and to what extent. In addition to being portfolio managers, however, investors should also be seen as stakeholders with voting rights in the companies. Therefore, the ownership structure of carbon

intensive companies is examined to understand which investor group could have the greatest potential to engage in sustainable carbon management of the companies.

In order to examine the engagement of shareholders more closely, i.e. the behavior of investors to use their position as shareholders to influence corporate decisions on environmental, social and governance issues, a new methodological approach is implemented in Article IV. To this end, the link between a firm's corporate social responsibility (CSR) performance and the eco-social preference of its investors, measured by the ESG values of the firms held by the investor, is examined in more detail. The objective is to show that companies financed by investors having portfolios with a high eco-social preference show an improved CSR performance, i.e. the investors exert influence to improve the company with regard to their own preference. When investigating the influence of investors on corporate decisions and processes, not only the preference of individual shareholders is important, but also the heterogeneity of investors with regard to this topic (Hoskisson *et al.*, 2002). It can be assumed that investors with completely different preferences hinder a successful engagement process. To shed light on this matter, it is examined whether the heterogeneity of the investors regarding their eco-social preference has an influence on the CSR performance of the firm.

Investors' shareholder engagement, as examined above, aims to engender new standards of corporate ESG practices in order to reduce firms' carbon risk in the long term (Hoepner *et al.*, 2018). Article V considers another sustainable trend in asset management, the decarbonization of institutional portfolios. In its traditional form, decarbonization describes the action to divest from carbon-intensive assets while investing in low-carbon assets instead and is mainly promoted by the Portfolio Decarbonization Coalition (PDC, 2015). The goal of the PDC is to "drive greenhouse gas emissions reductions by mobilizing a critical mass of institutional investors committed to gradually decarbonizing their portfolios" (PDC, 2015, p. 1). In Article V, the mobilization of a critical mass is associated with the herding behavior of

institutional investors (following the method of Sias (2004)), i.e. the phenomenon of investors following the trading activities of other investors while ignoring their own information. This herding behavior of institutional investors is then associated with the idea of decarbonization. Therefore, it is important to examine whether institutional investors are more likely to follow the trades of other investors in the sense of decarbonization rather than trades in the sense of carbonization. This decarbonization herding is defined as investors following their own or other investors' purchases of green stocks or sales of brown stocks. In contrast, carbon herding is defined as investors behaving in exactly the opposite way, i.e. purchases of brown stocks and sales of green stocks are more followed. It also shows what type of investors are executing the trades that other investors are following, potentially triggering a critical mass of investors to decarbonize their portfolio.

In the following, brief summaries of the individual articles are given. Chapters 2 to 6 contain the individual articles and in chapter 7 the results and contributions of each article are summarized.

1.2 Overview over papers included

Paper title	Co-authors	Published?	Journal	Date
Shedding light on the exposure of mutual funds – Which investments drive mutual fund characteristics?	Rohleder, Martin Syryca, Janik Wilkens, Marco	Yes	*Journal of Asset Management*, 20 (7), pp. 534–551[1]	2019
Trading in the Dark – What are Fund Managers doing when no one is watching?	–	No	Working Paper, University of Augsburg	2021
Investors' Carbon Risk Exposure and their Potential for Shareholder Engagement	Paulus, Stefan Scherer, Julia Syryca, Janik Trück, Stefan	Yes	*Business Strategy and the Environment*, 30(1), pp. 282-301[2]	2021
Ownership comes with responsibility – The impact of ownership characteristics on CSR	Paulus, Stefan Rohleder, Martin Wilkens, Marco	No	Working Paper, University of Augsburg	2021
Herds on green meadows: the decarbonization of institutional portfolios	Jacob, Andrea Paulus, Stefan Wilkens, Marco	Yes	*Journal of Asset Management*, 21 (1), pp. 13-31[3]	2020

1.2.1 Article I: Shedding light on the exposure of mutual funds – Which investments drive mutual fund characteristics?

Using an extensive holdings dataset for 2,707 US domestic equity funds, the first article examines the impact of different types of risk to which a fund is exposed via its investments. A detailed identification algorithm is used to identify 99.5% of all holding positions and classify them into 34 different types of investment instruments used by these funds. These include but are not limited to long and short equities, bonds, cash positions, and a wide range of complex investments exposing the fund to non-linear risk. This information enables the entire portfolio to be considered with its exact allocation. Thus, it is possible to examine the influence of a

[1] VHB-Jourqual 3: B, doi: 10.1057/s41260-019-00144-2.
[2] VHB-Jourqual 3: B, doi: 10.1002/bse.2621. This paper, previously known as "Investor Ownership and Carbon-Intensive Stocks: Who Holds the Carbon Risk Bomb?", was already included as a working paper in the dissertation of Janik Syryca. The working paper was subsequently completely revised, further developed and successfully published.
[3] VHB-Jourqual 3: B, doi: 10.1057/s41260-019-00147-z.

change in a particular type of investment on various fund characteristics and at the same time controlling for the remaining portfolio allocation.

The article has focused on the influence of complex derivatives and, as it is shown, the use of these instruments is widespread among investment funds, with an average of over 40% of all funds using some form of derivatives. Nevertheless, the average aggregated exposure as a percentage of the funds' TNA obtained through all complex instruments is very low, at less than 2%, and relatively stable over time. For the individual non-linear financial securities, an average exposure ratio of less than 0.5% is shown, indicating that the funds are far less exposed to non-linear risks and their influence on various fund characteristics are less pronounced than previous studies suggest.

1.2.2 Article II: Trading in the Dark – What are Fund Managers doing when no one is watching?

The second article examines in more detail the unobservable trading behavior of fund managers between the low-frequency reporting dates. These reporting gaps make it difficult for investors and researchers to assess the precise intermediary activities of fund managers and to measure the performance of funds on the basis of their holdings. This imbalance of information creates risks such as agency costs between fund managers and their investors. However, by using the monthly or quarterly changes in reported holdings, it is possible to approximate the implicit trades executed by the fund manager. Based on this, it can then be determined what the interim trading behavior between two reports is like, whether it deviates from the expectations resulting from the reporting and whether there is a correlation between the intermediate trading behavior of the fund managers and the fund performance. For this purpose, a daily holding structure is estimated for each fund under the assumption that the fund manager would not have traded between two reports, with exceptions for trading activities that could have been implied from

two consecutive reported portfolio holdings. With these approximated daily values for each of the held positions, an approximated fund return is calculated, representing the fund return an investor would expect if the fund manager had traded as the portfolio changes imply. For the approximated return, monthly risk measures are then calculated and compared with risk measures for the actual daily fund return. Remaining differences between the two time series should be driven by interim trading activities which could not be expected from the published reports.

Using a dataset of 835 US domestic equity funds, it is first shown that the fund managers execute trades that cannot be implied by the changes in their reportings, and that this behavior results on average in the actual risk exceeding the implied risk. It is also shown that the intermediate deviation from the expected risk structure has an impact on the risk-adjusted gross performance and gross return of the funds. In months in which the interim trading activity results in the actual fund risk deviating significantly from the anticipated risk, both positively and negatively, the funds show a higher risk-adjusted performance, but their interim trading activities harm their gross return.

1.2.3 Article III: Investors’ Carbon Risk Exposure and their Potential for Shareholder Engagement

Uncertainties about future regulations such as emission certificates or carbon taxes and a changing environmental awareness among consumers force companies and their investors to become aware of their exposure to so-called carbon risks. The goal of this article is to analyze the behavior of six different types of investors regarding their investments in carbon-intensive firms. Therefore, the share of carbon-intensive companies in their portfolios is examined in detail and it is shown that government agencies' portfolios in particular are heavily dominated by them, accounting on average for almost 49% of their portfolio value In their role as

shareholders, investors could use their voting rights to exert pressure on companies and, in relation to this study, to influence the firms' carbon risk management. It is shown that governmental agencies with 27%, investment advisors with 18%, and hedge funds with 13 % hold the largest proportion of shares in carbon-intensive companies in their portfolios and could therefore have the greatest influence on these companies. A different picture emerges when the entire universe of carbon-intensive companies is considered, and not just the stocks included in investors' portfolios. It becomes clear that the most capital-intensive groups of investors, investment advisors and hedge funds finance the largest share of carbon-intensive companies. In terms of the market capitalization of all existing carbon-intensive companies, government agencies only hold a small share. This suggests that their high exposure to carbon risk is generated by individual selective high investments rather than by broadly distributed investments.

1.2.4 Article IV: Ownership comes with responsibility – The impact of ownership characteristics on CSR

In order to answer the question of whether and how the interests of owners have an influence on entrepreneurial decisions, previous studies have usually assumed that individual investor groups have a certain preference for key characteristics of companies. However, this approach presumes that the individual investors within this group are homogeneous and is therefore a flawed approach. This article proposes a new methodology which does not presume the preferences of the company owners but allows for a precise determination of this preference. Based on the equities held, the investor characteristics of each individual investor are first determined. These investor characteristics state, for example, that this investor holds shares with an average market capitalization of X$. Next, the investor characteristics of all company owners are used to determine a share-weighted ownership characteristic. This measure indicates that the owners have companies with certain characteristics in their portfolio, such as an average

market capitalization of X$, which is here interpreted as a preference for companies of this size. Therefore, the proposed methodology does not presume the preference of the owners but allows to determine it precisely.

This research combines an extensive ownership database from the Refinitiv Ownership and Profiles database with ESG information on the owners' shares held from Thomson Reuters' ASSET4 ESG database to examine the impact of shareholder engagement on corporate CSR performance. In this context, it is examined whether the preference of the owners for the ESG score of the shares they hold, as an indicator of their eco-social preferences, has an influence on the CSR performance of the company. The empirical study shows that companies are more likely to improve their CSR performance if their owners have a high portfolio-based ESG preference and the ownership structure is more homogeneous in terms of the owners' ESG preference, i.e. the owners' preferences are more similar.

1.2.5 Article V: Herds on green meadows: the decarbonization of institutional portfolios

In this article, one of the emerging trends in sustainable asset management, the decarbonization of investors' portfolios, is analyzed and combined with the theory of investor herding. The idea of organizations such as the PDC is to mobilize a critical mass of investors to follow the decarbonization movement.

In order to investigate whether this behavior can be observed on the financial market, this study uses a method similar to Sias (2004) to measure the herding behavior of institutional investors. It is first shown that these investors in general demonstrate herding behavior and to be more specific, follow the trades of other investors rather their own. Next, the herding measure is combined with a classification of stocks into green and brown and it is shown that there are more follow up trades on the purchase of green and sale of brown stocks compared to the sale of green and purchase of brown stocks. It is therefore shown, that decarbonization

herding exists and is of higher importance than carbonization herding. Furthermore, it is shown that hedge funds and investment advisors make up the largest part of herding and engage highly in decarbonization herding. Therefore, to mobilize a critical mass of investors to follow the decarbonization movement as proposed by the PDC, these types of investors are the ones who could have the greatest impact.

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2 Article I: Shedding light on the exposure of mutual funds – Which investments drive mutual fund characteristics?

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Journal of Asset Management, Vol. 20 No. 7, pp. 534–551

https://doi.org/10.1057/s41260-019-00144-2

Abstract. This paper is the first to identify and classify nearly all investment instruments held by equity funds by investigating their portfolio holdings. This enables us to analyze the effects of long and short exposures from different complex instruments including short sales, options and futures but also previously neglected derivatives like warrants and units on funds' risk, performance and other characteristics. These analyses are of general interest, especially in the light of ongoing discussions regarding further regulation of complex instrument use by mutual funds. Our empirical analyses document that on average more than 40% of funds use complex instruments. However, relative to their total assets, funds' average exposure from such positions is very small with values below 2%. Consequentially, the effects of instruments are often weaker than suggested by previous research or even show opposite directions.

JEL Classification: G11, G20, G23

Keywords: Equity mutual funds, risk, performance, derivatives, complex investments, holdings

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We thank the editor, Dan di Bartolomeo, and an anonymous referee as well as the participants of research seminars at the Universities of Augsburg and Passau for helpful comments and suggestions. All remaining errors are our responsibility.

3 Article II: Trading in the Dark – What are Fund Managers doing when no one is watching?

Benz, Lukas[a]

Working Paper (2021); University of Augsburg

Abstract. When assessing the performance of equity mutual funds, performance measures are often calculated on the basis of holding information which are reported on a low-frequency basis. Thus, they do not reflect the exact trading activity of the fund managers in between the reporting dates, which can lead to biased conclusions on the managers' skill. In this study a new model is proposed to measure the influence of the fund managers' interim trading activity by comparing the actual realized risk with an approximated risk measure calculated from consecutive reported holding information. It is shown that the actions of the fund managers between two reports lead on average to a higher level of risk than the holdings suggest. Looking at the trading behavior of the fund managers in the individual months, it can be shown that the risk-adjusted performance increases if the fund managers increase or decrease their overall risk through their interim actions. In contrast, fund managers harm the gross return if they excessively alter the overall risk between two reportings compared to the risk implied by the holdings.

JEL Classification: G11, G12, G29

Keywords: Interim trading, mutual funds, interim risk, performance, holdings

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3.1 Introduction

Managers of active mutual funds are usually considered to be informed and qualified, yet studies on their performance have shown mixed results. While some studies, such as Carhart (1997) and Wermers (2000), show that mutual fund managers underperform passive benchmarks after expenses, other studies (e.g., Kacperczyk *et al.* (2005) or Cremers and Petajisto (2009)) show that certain funds are indeed able to outperform benchmarks and thus demonstrate skill. In examining the capabilities of investment fund managers, some studies use trade-based performance measures to determine whether individual fund trades have been profitable (e.g., Chen *et al.* (2000), Alexander *et al.* (2007) or Rohleder *et al.* (2018)) or whether institutional trading activities predict future stock returns (e.g., Frazzini and Lamont (2008) or Wermers *et al.* (2012)).

All of these studies have in common that they do not use actual trading data, but changes from consecutive quarterly or semi-annually disclosed holding reports to proxy for trades executed between these reports. Due to the low frequency of available information it is not possible to examine the exact trading activities of the managers between the reports, but one can solely evaluate the final outcome, the reported holdings. Consequently, despite the more and more extensive disclosure requirements (Agarwal *et al.*, 2015), the results of these studies may be biased. By examining only quarterly or semi-annually changes in portfolio composition, several problems arise. Some funds may alter or distort their portfolios to mislead both researchers and investors as to their true skill by disclosing stock holdings at the wrong levels and therefore disproportionately disclosing higher (lower) percentages of winner (loser) stocks over the quarter. This practice known as window dressing is associated with less skilled managers who perform poorly compared to non-window dressing managers as shown by Agarwal *et al.* (2014). As these studies consider actively managed funds, it is in the nature of things for managers to trade between two reporting dates. An important part of their job is to

identify undervalued stocks and invest their clients' money profitably. During periods of positive inflows, fund managers need to increase or open new positions, and during periods of withdrawal, they need to liquidate positions to pay off investors. These trading activities between two reportings, the so-called interim trading, can be divided into two parts. The initial part can be anticipated by the holding changes of two successive reportings. The second part of interim trading occurs without investors or other outsiders being aware of it and cannot be anticipated by holding changes. Both of these trading activities can be beneficial to the investor if the fund manager uses information advantages to trade profitably within two reporting periods. However, increased trading activity can also be disadvantageous for investors due to the costs involved. Increased transaction and agency costs as well as negative effects on the risk strategy preferred by the investor can be caused by the intermediate trading activity of the fund manager. When measuring the performance of investment funds, it is therefore important to take appropriate account of the interim trading activities of fund managers.

Existing studies have examined the actions of funds between their reports in different ways. Puckett and Yan (2011) examine the interim trading skill of institutional investors using actual intra-quarter trade data provided by ANcerno Ltd and calculate the interim trading performance of each fund as the difference between the performance of all shares that the fund buys and those it sells from the execution date up to the end of the respective quarter. Furthermore, they show that the trading performance of institutional investors is significantly positive, and they further argue that this relation is not evident if the performance of these investors is calculated on the basis of quarterly holding reports. Therefore, this illustrates the importance of an adequate consideration of the interim trading activity of managers.

A different approach to measure interim trading was proposed by Farrell (2018). Having only quarterly equity holdings of mutual funds, the author uses a genetic algorithm to model a daily holding structure, resulting in a daily return series for each fund that most closely matches

the actual daily fund return. The modelled daily holdings and trades calculated from these holdings are used to measure whether the funds tend to demand or supply liquidity. It is shown that the funds tend to provide liquidity and that this liquidity provision is consistent over time and can therefore be used to predict future returns.

The approach most similar to mine was developed by Kacperczyk *et al.* (2008). They estimate the impact of unobserved trading in between two reportings as the return gap resulting from the difference of the actual daily fund return and the return of a portfolio investing in the previously disclosed fund holdings. Interim trading actions of some funds are profitable, while these hidden trades destroy value for other funds according to their study. They conclude that the interim trading of funds is a sign of skill and can be an indicator of future performance.

To measure interim trading, I follow the idea of Kacperczyk *et al.* (2008) and extend their model to measure interim trading in a more precise way. As already mentioned, some of the fund manager's trading actions between two reports can be anticipated when considering the disclosed holdings in two consecutive months. An increase (decrease) in the value held in a particular position from one month to the next can be achieved either by the daily return on the position in question or by an additional purchase (sale) by the fund manager in between reports. Given this, an approximation model is proposed that estimates the daily holding structure of each position reflecting the trading behavior that would have been anticipated by the reported holdings. In order to further extend the method, I do not compare return time series with each other (as in Kacperczyk *et al.* (2008)), but rather the difference in certain risk measures based on the actual and the approximated return time series respectively. One advantage of this approach is that not only the extent of interim trading of funds can be examined, but also whether this trading behavior leads to an increase or decrease of the portfolio risk above (below) the risk anticipated from the reported holdings. Therefore, the approximated measures reflect the risk resulting from the trading behavior of the funds, which can be derived

from the reported holdings and the actual measure reflects the risk resulting from the actual daily trading activity of the respective fund. The remaining differences between these measures are due to unexpected trading between the reportings. Therefore, in this study interim trading is defined as deviation from the anticipated holding structure rather than the last known holding structure, which is a more accurate way to measure unobserved trading.

My results show that the actual risk taken by the funds differs from the risk that can be anticipated from the holdings and I conclude that funds actively trade between reports, i.e. they engage in interim trading. Using three different risk measures, the funds' overall, systematic, and idiosyncratic risk, it is shown that the funds increase their risk through these trading activities on average by 2.6%, 0.65% and 4.91% respectively compared to the risk anticipated from their holdings.

However, in order to examine the influence of these trading activities on the performance of the funds more closely, a distinction is made between months in which the fund intermediately increases its risk and months in which it reduces its risk compared to the risk of the approximated fund portfolio. As shown, the relationship varies depending on the risk and performance measures used. Funds exhibit a higher significant risk-adjusted gross performance in months in which their overall risk differs substantially from their approximate overall risk, compared with months in which the fund manager tends to act more in line with the anticipated change in reported holdings, i.e. actual risk is closer to implicit risk. If the overall risk is decomposed into systematic and idiosyncratic risk, a contrary pattern emerges. In months in which the funds take a higher (lower) systematic risk than expected, they show a significant lower (higher) performance, whereas an intermediate increase in idiosyncratic risk above (below) the expected level results in a significantly higher (lower) performance.

A different relation arises between the interim trading and the funds' gross return. An excessive deviation of the overall risk compared to the risk of the approximated portfolio is accompanied by a decrease in the gross return compared to months in which the managers trade as expected by the holding changes. This relation is almost entirely driven by the intermediate deviation of the idiosyncratic risk compared to the risk expected by the holding changes. However, a deviation from the expected systematic risk does not lead to differences in gross returns.

The remainder of the paper proceeds as follows. Section 3.2 describes the data sources and provides first summary statistics. Section 3.3 motivates the proposed method of approximation of the daily fund holding structure, provides tests of goodness of the approximation and introduces the used performance and risk measures. Section 3.4 introduces the interim trading measure and investigates the general impact of interim trading as well as its impact on the funds' performance and return. Section 3.5 concludes the study.

3.2 Data and summary statistic

To answer my research question, I obtain data on mutual funds from different sources. From the Center for Research in Security Prices Mutual Fund Database I gather monthly share class level information such as returns, total net assets (TNA) as well as further characteristics like turnover and fees. Furthermore, I use the Morningstar Mutual Fund Database and obtain share class level daily return indices as well as information about the daily TNA. Both databases are free of survivorship bias and I follow Pastor *et al.* (2015) and Berk and van Binsbergen (2015), match these databases on share class level using CUSIPs and aggregate all share class level data on portfolio level using TNA-weights and the Morningstar share class portfolio map.

In this study I focus on US domestic equity funds and conduct several screening mechanisms to ensure high data quality. Funds with less than 80% of exposure in equity over

time as well as all funds with less than 24 monthly returns during the sample period are not considered in this study. Furthermore, I follow Fama and French (2010) and exclude all funds before they first surpass a threshold of $5 million TNA to ease incubation bias (Evans, 2010). The preliminary dataset contains 2,802 US domestic equity funds, which are presented in Table 1 Panel A, for which I was able to obtain all the data mentioned above from 1997 to 2015. Since I later exclude all funds that invest in any way in any kind of derivatives or derivative-like instruments, that leaves remain 835 US domestic equity funds reported in Panel B. These non-derivative using funds are slightly smaller than the average of the overall sample, which was also shown by Natter *et al.* (2016), but the remaining fund characteristics are about the same compared to the overall sample.

[Insert Table 1 here.]

In order to investigate the trading behavior of the managers later on, information about the holding structure of the individual funds is obtained from the Morningstar Holding database. This database reports - usually monthly or quarterly - a variety of information on each position in the funds' portfolios, e.g., the name, number of shares, type of holding, various identifiers (such as ISIN) and, most importantly, market value. This distinguishes the used MSTAR holdings from most other databases that only report common stock holdings.

In addition, daily stock returns for all the stocks held in the portfolios of the funds as well as daily returns for different indices such as the S&P500, the MSCI World ex US and different bond indices[1] are obtained from Thomson Reuters.

3.3 Methodology, Performance and Risk measures

The objective of the proposed method is to approximate a daily holding pattern for each fund representing the trading behavior, which can be implied from two consecutive reports of the

[1] Corporate, government and municipal bond indices from Barclays are used in this study.

funds. Based on these approximated daily holdings, a value-weighted fund return series is calculated, and by later comparing this approximated daily fund return with the actual fund return, the influences of interim trading can be examined.

3.3.1 Approximation of daily fund return series

As mentioned before, the monthly/quarterly reports of a fund do not fully shed light on the exact transactions a fund executes between these dates. For each fund, a daily holding structure is estimated under the assumption that the fund manager would not have traded between two reports, with exceptions for trading activities that could have been expected from the respective reported portfolio holdings.

The daily holding structure of each security held is approximated by comparing the reported held values in two consecutive reportings to determine which securities have been increased or decreased during the reporting period. Imagine the following example in which a fund holds a $100 stock position in December which shows a value of $150 end of January. The $50 increase in the stock position can be achieved either by the daily return of the stock or by an additional stock purchase by the fund manager between reportings.

The relationship between the held values of a position from one reporting to the following can be expressed by the following equation.

$$HV_{i,s,m} = HV_{i,s,m-1} \; e^{\sum_{d=1}^{D} r_{s,d} + g_{i,s,m}} \tag{1}$$

Here, $HV_{i,s,m}$ is the fund's *i* held value of security *s* reported in month *m* and $HV_{i,s,m-1}$ is the held value of the same security *s* reported in the previous month.[2] *D* is the number of trading days lying in between these reportings, e.g., around 21 for monthly reportings or 60 for quarterly reportings, and $r_{s,d}$ is the daily return of the position *s* at day *d*. It is therefore assumed

[2] The equation presented here reflects the monthly case but is the same when the fund reports quarterly.

that the value held at a given time is based on the value at the time of the previous reporting, increased by the daily return of the position and a constant daily flow $g_{i,s,m}$. For each fund in each month/quarter, this flow can be calculated as:

$$g_{i,s,m} = \frac{ln(HV_{i,s,m}) - ln(HV_{i,s,m-1}) - \sum_{d=1}^{D} r_{s,d}}{D} \quad (2)$$

This variable has a value of zero if the change in the values held between two reportings can be fully explained by the daily return. However, it is not zero if the fund manager has actively changed his portfolio holdings and increased/decreased his position. Given that, the held value of each position on each day using a daily version of equation (1) can be recursively calculated, e.g.,

$$HV_{i,s,1} = HV_{i,s,0}\, e^{r_{s,1}+g_{i,s,m}} \quad (3)$$

$$HV_{i,s,2} = HV_{i,s,0}\, e^{r_{s,1}+g_{i,s,m}+r_{s,2}+g_{i,s,m}} = HV_{i,s,1}\, e^{r_{s,2}+g_{i,s,m}} \quad (4)$$

$$HV_{i,s,3} = HV_{i,s,0}\, e^{r_{s,1}+g_{i,s,m}+r_{s,2}+g_{i,s,m}+r_{s,3}+g_{i,s,m}} = HV_{i,s,2}\, e^{r_{s,3}+g_{i,s,m}} \quad (5)$$

....

where $HV_{i,s,1}$ is the held value of fund *i* in stock *s* on day 1, $HV_{i,s,2}$ the held value on day 2 and so forth.

For each security held, the proposed model is therefore able to estimate a daily value that an investor would expect the fund to hold based on the disclosed holding positions and their daily return. With these approximated daily values for each of the held positions, the approximated fund return $R_{i,d}^{approx}$ on each day can be calculated using the following equation

$$R_{i,d}^{approx} = \sum_{s=1}^{N} \frac{HV_{i,s,d}}{HV_{i,d}}\, r_{s,d} = \sum_{s=1}^{N} w_{s,d}\, r_{s,d} \quad (6)$$

where $HV_{i,s,d}$ is the fund's i (approximated) held value of security s at day d, $HV_{i,d}$ is the aggregated (approximated) held value of all securities of the fund i, N is the number of securities in the portfolio of fund i at day d and $r_{s,d}$ is the return on day d of security s. Therefore, this return time series represents the daily return of the fund that an investor would expect if the fund manager had traded as the reported positions implied between two reports.

To ensure the most accurate approximation possible, it is important for the proposed methodology to ensure a precise and clear classification of all holding positions. As reported in Table 2, it was possible to classify over 99.5% of the holding positions of all the funds (2,802) in my sample, using the holding type reported by MSTAR as well as several string search algorithms and manual checks to ensure correct identification.[3] In some rare cases (0.46%) it was not possible to correctly identify the position held due to missing or inaccurate data.

Furthermore, it is not enough to achieve the most accurate classification possible; it is also necessary to ensure that the majority of positions are accurately identified and that the exact daily return can be assigned to the position. For securities where an exact identification was not possible, the returns are approximated with the return of an index, depending on the classified type of security.

[Insert Table 2 here.]

As expected for equity funds, over 96% of all held positions are common equities and nearly 91.8% of those stocks can be matched with their correct return. The remaining 8.2% are approximated with the return of the S&P500 or the MSCI World ex US depending on whether the stock is from the US or identified as an international stock. Around 0.9% of all the funds positions are identified as either corporate, governmental or municipal bonds and are fully approximated by the respective bond index. In some rare cases (0.33%) the observed funds are

[3] The other securities, which cannot be classified, are not considered below.

invested in other funds, of which over 40% can be correctly identified. The return series of the remaining held funds are approximated either with the S&P500, MSCI World ex US or the risk free rate depending on whether the fund held is a US equity fund, an international equity fund, or if the fund is identified as a cash-like money market fund. The identified positions in cash and repurchase agreements are also matched with the risk-free interest rate to act as the return the fund derives from these positions. As shown in Table 2 the funds also engage in derivatives such as swaps, options, futures, etc. As there is no way to accurately approximate the daily return on these positions and as shown by Natter *et al.* (2016) and Benz *et al.* (2019) the funds' return is influenced by these instruments, all funds invested in any kind of derivatives, as already mentioned, are excluded from this study.

3.3.2 Goodness of the approximation

Since the approximated fund return is later compared with the actual fund return, the accuracy of the approximation must be ensured. As a first step, for each fund month and for each fund, the percentage of securities that can be correctly identified and matched to their actual return in relation to the total number of securities in the portfolio of the funds are examined. The higher the percentage of correctly identified positions, the higher the quality of the approximation should be. Table 3 Panel A shows descriptive statistics for these percentages. The identification rate seems to be rather high across all funds. There are just a few fund months with less than 80% of correctly identified holdings while on average over 90% of all holdings are correctly identified. There are some fund months and even entire funds where the portfolio positions can be fully associated with their return time series.

[Insert Table 3 here.]

In a next step, the correlation between the daily approximated and actual return of the fund is investigated more closely. As shown above, the identification of the holding positions

was fairly accurate. If the approximated daily values of the held positions are close to the true daily values, the two resulting return time series should be similar and show a high correlation. The correlation for each fund month as well as for the whole fund are calculated and descriptive statistics for the correlation coefficients are reported in Panel B. As it can be seen the correlations are quite high with an average of over 98% for the fund months, while even the smallest 1% correlation is still over 85%. A similar pattern is shown when looking at the correlation calculated for the funds as a whole.

In a final test of the quality of the approximation, the two checks above are combined, and the funds are sorted according to the percentage of correctly identified positions into deciles. For each decile, the average correlation between the approximated and actual return of the funds as well as the average standard deviation of the monthly correlation of the approximated and actual return per fund are calculated and reported in Panel C. A pattern that one would have suspected when looking at the previous tests is shown. The higher the percentage of correctly identified holding positions, the higher the correlation between the approximated and actual return. Furthermore, these funds also have the lowest standard deviation, which means that the approximation for these funds is also the most consistent over time. All the above-mentioned tests indicate a successful approximation of the daily holding structure of the funds, which is crucial for further analyses in this study.

3.3.3 Performance and risk measures

To determine the impact of interim trading on them afterwards, various performance and risk measures for both the approximate and the actual daily fund return are calculated.[4] I use the monthly standard deviation of the daily return series, $\sigma_{i,t}^{approx}$ and $\sigma_{i,t}^{actual}$, as measures of the

[4] Since the approximated fund return is calculated without taking any costs into account, the gross version of the actual return instead of a net return is used.

overall risk of the fund *i* in month *t*. For each fund month, I estimate further measures of performance and risk based on the two daily returns series using the CAPM following Jensen (1968).

$$R_{i,d,t}^{approx} - r_{f,d} = \alpha_{i,t}^{approx} + \beta_{Mkt,i,t}^{approx}(R_{Mkt,d,t} - r_{f,d}) + \varepsilon_{i,d,t}^{approx} \quad (7)$$

$$R_{i,d,t}^{actual} - r_{f,d} = \alpha_{i,t}^{actual} + \beta_{Mkt,i,t}^{actual}(R_{Mkt,d,t} - r_{f,d}) + \varepsilon_{i,d,t}^{actual} \quad (8)$$

In these models, $R_{i,d,t}^{approx}$ is the approximated fund return of fund *i* introduced in section 3.3.1 while $R_{i,d,t}^{actual}$ is the actual fund return of fund *i* on day *d* in month *t*. $R_{Mkt,d,t}$ is the daily market return and $r_{f,d}$ equals the risk-free rate.[5]

The main parameters of interest are the risk-adjusted performance measures $\alpha_{i,t}^{approx}$ and $\alpha_{i,t}^{actual}$ and the systematic risk measures $\beta_{Mkt,i,t}^{approx}$ and $\beta_{Mkt,i,t}^{actual}$ of the fund *i* in the month *t*, both of which are estimated for either the approximated or the actual return series. I further use the monthly standard deviation of the residuals $\sigma(\varepsilon_{i,d,t}^{approx})$ and $\sigma(\varepsilon_{i,d,t}^{actual})$ as measures for the idiosyncratic risk found in the funds' portfolio in month *t*.

$$idiosyncratic\ risk_{i,t}^{approx} = \sigma(\varepsilon_{i,d,t}^{approx}) \quad (9)$$

$$idiosyncratic\ risk_{i,t}^{true} = \sigma(\varepsilon_{i,d,t}^{actual}) \quad (10)$$

3.4 Interim trading measure and its relation to the fund's performance

3.4.1 Interim trading

Due to the low frequency of the reports, investors in mutual funds cannot observe all actions of the fund managers. They might trade between reportings without the investor knowing or

[5] Market return as well as the risk-free rate are obtained from the website of Kenneth French (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/).

expecting it. These interim trades could be beneficial to the investor if an informed fund manager uses his information advantage to time his trades and thereby enhance fund performance. However, these trades could also impair the performance of the fund due to costs, such as agency as well as trading costs, or could change the risk structure of the fund unfavorably for some investors.

To measure the interim trading activity and its impact on different risk and performance measures of mutual funds an extension of a model similar to Kacperczyk *et al.* (2008) is used. They calculate the funds' interim trading as the return gap resulting from the difference of the actual fund return and the return of a portfolio investing in the previously disclosed fund holdings. The effects of interim trading are included in the actual return, but not in the return on the most recently reported holdings. They therefore define interim trading as any deviation in the holding structure from the last reported holdings.

In this study, their model is extended by comparing the actual risk of a fund to the risk measure calculated for the approximated daily return. As mentioned above, the approximated return series and therefore the risk measures calculated for this return, reflects the trading behavior of the funds, which can be derived from the reported holdings. In contrast, the time series of the actual return and the risk measures calculated from it reflects the actual daily trading activity of the respective fund. The remaining differences arising between the risk measures calculated for the two return time series are assumed to be driven by the interim trading that is not anticipated by the holding changes. Therefore, interim trading within two reports is defined as a deviation from the expected holding structure, rather than the last known holding structure, which is a more accurate way to measure unobserved trading.

By comparing two measures of risk, it is possible to determine not only whether the fund trades between two reportings, but also whether this trading activity results in a higher or

lower risk than the reported holdings imply. I calculate the interim risk measure for each fund *i* in month *t* as

$$interim\ risk_{i,t} = risk_{i,t}^{actual} - risk_{i,t}^{approx} \quad (11)$$

where $risk_{i,t}^{actual}$ ($risk_{i,t}^{approx}$) is one of the three monthly risk measures (described in section 3.3.3) calculated for the actual and the approximated return series introduced in section 3.3.1. A positive interim risk measure indicates that the actual risk exceeds that of the approximated portfolio, i.e. the fund manager has increased the risk between two reports beyond the level that can be anticipated by the holdings. A negative interim risk measure indicates that the fund manager actually shows a lower risk than the change in reportings imply. If the risk measure is close to zero, the fund manager did not actively change its risk in between but rather shows a similar risk as expected by the reported holding change, i.e. the fund manager does not show interim trading behavior.

Table 4 reports the mean values of the risk measures of the two return time series as well as the respective interim risk measure.

[Insert Table 4 here.]

As shown in Panel A, the differences in all risk measures are significant and positive, indicating that the actual risk differs from the risk that one would expect from the reported two consecutive portfolios. Fund managers therefore tend to increase their risk between two reports, which I attribute to the executed intermediate trades that cannot be implied from the holdings.

Certainly, the pooled average does not paint an accurate picture and the fund managers' trading behavior might differ from month to month. Therefore, Panel B reports a quintile division of the interim risk measure. Within each fund, individual months are categorized into quintiles based on their interim risk measure. Here, quintile 1 contains the months in which the

risk difference is most negative, i.e. the actual fund risk within the month is lower than implied by the holdings, and quintile 5 contains the months with the most positive risk difference. The middle quintiles contain the months in which the actual trading behavior of the managers is similar to that of the implied, approximated one, and the risk measures therefore do not show large differences. For each of the quintiles the average of the respective interim risk measure is reported based on the overall, the systematic or the idiosyncratic risk. As shown by the significant the significant differences between the first and fifth quintiles, there are distinct differences in the interim actions of the fund managers from month to month.

3.4.2 Relation of interim trading and performance

As shown above, fund managers on average tend to increase their risk compared to the risk anticipated from the reports. Nonetheless, the pooled average does not show exactly what fund managers do when no one is watching, and as shown by the quintile division the fund managers act differently across months. They increase their risk compared to the approximated risk in one month and show a different behavior in another. In a next step, the influence of this changing trading behavior on different performance measures of the funds is examined more closely. Therefore, the funds are again divided into quintiles according to one of their interim trading measures, using the same scheme as before in Table 4 Panel B. For each of the quintiles the average annualized risk-adjusted gross performance as well as the monthly gross return are reported. This provides a first impression of whether different fund strategies, with regard to interim trading, lead to differences in gross performance and return for the respective fund month.

[Insert Table 5 here.]

Looking at the risk-adjusted performance as a measure of the fund managers skill, it is noticeable that an excessive deviation (both positive and negative, i.e. the 1st and 5th quintile)

of the actual overall risk from the approximated overall risk comes with an higher risk-adjusted performance compared to months with less pronounced interim trading, i.e. the middle quintiles. However, when comparing the most positive and negative risk differences (i.e. the 5th and 1st quintile), no significant difference in the risk-adjusted performance is found. When the overall risk is decomposed into systematic and idiosyncratic risk, a different pattern arises. In months in which the interim trading decreases the funds' actual systematic risk compared to the systematic risk of the approximated portfolio, the funds show a significant outperformance of 0.34%. On the contrary, a higher systematic risk than that implied by the holdings is not rewarded with a higher performance, the funds have significantly underperformed in these months by -0.06%. When interim trading is measured based on the idiosyncratic risk, the pattern is reversed, which is not surprising given the opposite direction of systematic and idiosyncratic risk. If the actions of the fund managers in between reportings increase idiosyncratic risk above the level implied by the reportings, funds show a significantly higher performance compared to the first quintile (0.28%). A possible explanation for this relation could be, that in order to achieve a risk-adjusted outperformance, the fund manager has to deviate from its benchmark, i.e. increasing its idiosyncratic risk, for which securities with high idiosyncratic risk could potentially be used to outperform the benchmark (Falkenstein, 1996).

However, if the gross return is taken into account, a different picture is given. Excessive interim trading, as deviation of the approximated risk, is associated with lower gross returns compared to months in which the funds' managers tend to trade as implied by the holding changes. When comparing these extreme scenarios, it becomes clear that taking a higher than implied risk is significantly more disadvantageous for the gross return of the funds, which even leads to a slightly negative gross return (-0.03%). This pattern is driven by the idiosyncratic risk which shows the same pattern. Consequently, an excessive deviation of the systematic risk,

neither positive nor negative, from the expected systematic risk does not mean that the fund generates a higher return in these months.

The descriptive quintile division above gives a first impression of the relation of interim trading and the fund's performance. However, the identified relation could also be driven by different fund characteristics. Therefore, taking into account various fund characteristics, regression analyses are used to determine the influence of interim trading on fund performance. Monthly panel regressions following equation (8) are carried out where $fund\ performance_{i,t}$ is either the actual risk-adjusted gross performance or the gross return. The fund's size, expenses, turnover, a load dummy, age and the fund flow are included as $controls_{i,t,j}$.

$$\begin{aligned} fund\ performance_{i,t} &= \varphi_0 + \varphi_1\ positive\ interim\ trading_{i,t} \\ &+ \varphi_2\ negative\ interim\ trading_{i,t} + \sum_{j=3}^{J} \varphi_j controls_{i,t,j} + \eta_{i,t} \end{aligned} \tag{12}$$

The two main variables of interest, $positive\ interim\ trading_{i,t}$ and $negative\ interim\ trading_{i,t}$, are dummy variables indicating whether the fund i engages in interim trading in this month, showing higher or lower actual risk than anticipated from the reported holdings. With before used the $interim\ risk_{i,t}$ measure, any risk difference between the actual and approximated risk was treated as if it resulted from a fund's interim trading actions. This seems slightly too strict due to the approximation aspect of the method used. I therefore define each fund month as an interim trading month if the interim risk measure is greater (smaller) than the fund's average interim risk measure plus (minus) the volatility of the risk difference.[6] In this way I control for differences in the quality of approximation across

[6] As a robustness check, the quintile division introduced above is used to redefine interim trading. Here, positive interim trading is defined as all the fund months in the 5th quintile and negative interim trading as fund months from the 1st quintile. The results remain the same.

funds and identify only those months as interim trading months in which the interim trading action for a particular fund is excessive, resulting in a higher or lower risk than expected by the holdings.

$$positive\ interim\ trading_{i,t} = \begin{cases} 1, & if\ interim\ risk_{i,t} > \left(\overline{interim\ risk_i} + \sigma(interim\ risk_i)\right) \\ 0 & \end{cases} \quad (13)$$

$$negative\ interim\ trading_{i,t} = \begin{cases} 1, & if\ interim\ risk_{i,t} < \left(\overline{interim\ risk_i} - \sigma(interim\ risk_i)\right) \\ 0 & \end{cases} \quad (14)$$

Hereby, $interim\ risk_{i,t}$ is the measure introduced in section 3.4.1, based on the overall, systematic or idiosyncratic risk of the fund. Table 6 reports the results of time-fixed effects panel regressions with clustered standard errors to examine the influence of the interim trading on the funds' gross performance and return.

[Insert Table 6 here.]

The results from the quintile division hold even after controlling for different fund characteristics and time fixed effects. Funds engaging in interim trading measured by the overall risk show an increased risk-adjusted performance. Again, if the overall risk is decomposed into the systematic and idiosyncratic part, the two interim trading directions have different influences on the risk-adjusted performance. Fund managers significantly increase their performance by decreasing their systematic risk or by increasing their idiosyncratic risk compared to the risk level implied by the reported holdings.

The regression analyses also support the finding that excessive interim trading has a negative impact on the funds' gross return, probably due to increased trading costs coming with an increased trading behavior. Similarly, as already shown in the descriptive statistics, this

relationship is determined by the intermediate increase or decrease in idiosyncratic risk rather than by a deviation of the systematic risk compared to the approximated one.

3.5 Conclusion

In this study, a new model to measure the interim trading behavior of mutual funds is proposed. The tendency of the funds to engage in interim trading is measured, whereby interim trading is defined as the difference between the actual fund risk and the risk calculated for an approximate return series, implied by the reported holdings of the funds. It is demonstrated that fund managers tend to show, on average, a higher risk than the reported holdings imply, which is attributed to their interim trading behavior. However, fund managers do not exhibit the same trading behavior every month, but rather change their behavior from month to month. There are months in which managers deviate excessively from their implied risk, either positively or negatively, and months in which the actual risk of the funds is similar to the approximated risk.

In months of high deviation, i.e. higher level of interim trading, funds show an increased risk-adjusted gross performance. Managers achieve this either by strongly reducing the systematic risk or by strongly increasing the idiosyncratic risk compared to the respective risk implied by the holdings. In contrast, an excessive deviation, either positive or negative, from the approximated overall risk leads to a reduced gross return. Managers who strongly increase their overall risk above the level implied by the reportings even show a slightly negative return before costs. This relation is mainly driven by the increased idiosyncratic risk taken by the fund manager, whereas a deviation from the expected systematic risk does not result in any differences in their gross return.

These relations are still evident and significant even after controlling for different fund characteristics and time-fixed effects. The results shown indicate that funds engaging in excessive trading in between two reportings, measured by intermediate increase or decrease of

their overall risk, show a higher risk-adjusted performance but lower gross return. It seems that the excessive interim trading by fund managers is aimed at making their performance look better. This phenomenon could be driven by the fact that some fund managers are compensated by their performance relative to a benchmark (Ma *et al.*, 2019). At the same time, however, the fund managers are not able to take advantage of this increased trading activity, measured against overall risk, to generate higher gross returns. The acquired results highlight the importance of an adequate consideration of the interim trading activities of investment fund managers and how these can bias performance measures based on reported holding information.

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Tables

Table 1 – Pooled descriptive statistics of fund variables

	Panel A: All Funds		Panel B: Non-derivative using Funds	
	Mean	Median	Mean	Median
Net return (% p.m.)	0.0065	0.0111	0.0060	0.0103
Gross return (% p.m.)	0.0075	0.0121	0.0071	0.0113
Expense ratio (% TNA, p.a.)	0.0123	0.0119	0.0125	0.0119
Turnover ratio (% TNA, p.a.)	0.8168	0.6400	0.7406	0.5400
Load fund	0.7223	1.0000	0.6527	1.0000
Age (in months)	152.65	124.00	114.59	86.00
TNA ($ mil.)	1,189.15	239.20	864.92	201.20
Net Flow (% TNA)	0.0086	-0.0027	0.0133	-0.0005

This table reports pooled descriptive statistics of the various fund variables used in later research from 1997 to 2015. Panel A shows the descriptive statistics for all 2,802 funds. Panel B shows the descriptive statistics for 835 non-derivative using funds.

Table 2 – Number of observations and quality of identification for different instrument types

	Number of Observations	in %	True Return	Approximated by	in %
Stocks	44,902,140	96.88%	91.80%	SP500	6.04%
				MSCI World (ex US)	2.16%
Corporate Bonds	345,563	0.75%		Corporate Bond Index	100%
Government Bonds	74,928	0.16%		Government Bond Index	100%
Municipal Bonds	3,489	0.01%		Municipal Bond Index	100%
Funds	28,785	0.06%	40.28%	SP500	5.01%
Moneymarket Funds	125,024	0.27%		MSCI World (ex US)	10.41%
				Risk free rate	43.89%
Cash	244,040	0.53%		Risk free rate	100%
Repo	69,491	0.15%		Risk free rate	100%
MBS	75,385	0.16%			
Swaps	4,449	0.01%			
Options	127,318	0.27%			
Futures	47,877	0.10%		Complex Instruments	1.35%
Warrants	57,589	0.12%			
Units	29,891	0.06%			
Not Identified	212,220	0.46%			
Total	46,348,189	100.00%			

This table reports the overall number of observations identified as the respective holding type as well as the percentage of correctly identified holding positions and percentages of approximated positions for all 2,802 funds from 1997 to 2015.

Table 3 – Goodness of the approximation

Panel A. Correlation of approximated and actual return

	Min	1%	10%	25%	50%	Mean	75%	90%	99%	Max
Correlation fund month	0.98%	85.43%	97.39%	98.90%	99.57%	98.70%	99.84%	99.93%	99.99%	100.00%
Correlation fund	23.96%	84.05%	96.84%	98.30%	99.14%	98.28%	99.55%	99.75%	99.90%	99.95%
Standard Deviation monthly correlation	0.08%	0.15%	0.42%	0.75%	1.48%	2.46%	2.80%	5.57%	12.71%	38.25%

Panel B. Proportion of the correctly identified and matched positions

	Min	1%	10%	25%	50%	Mean	75%	90%	99%	Max
% of fund month	0.00%	72.68%	84.00%	88.14%	92.54%	91.58%	96.27%	98.41%	100.00%	100.00%
% of fund	19.32%	75.08%	84.89%	88.78%	92.06%	91.37%	94.94%	97.52%	99.75%	100.00%

Panel C. Decile division

Decile	Mean Standard Deviation of Fund Correlation	Mean Fund Correlation
1 (77.60%)	5.53%	92.83%
2 (85.32%)	3.29%	97.59%
3 (88.00%)	2.92%	98.16%
4 (89.41%)	3.05%	98.33%
5 (90.55%)	2.91%	97.92%
6 (91.55%)	2.16%	98.83%
7 (92.42%)	2.12%	98.71%
8 (93.66%)	2.65%	98.89%
9 (95.06%)	1.42%	99.24%
10 (97.83%)	1.13%	99.35%

This table reports tests for the goodness of the approximation. Panel A reports descriptive statistics for the correlation of approximated and actual return calculated on fund month and fund level as well as the standard deviation of the correlation on fund month level. Panel B reports the proportion of the positions that can be identified and matched to the actual return. In Panel C, I sort the funds according to the percentage of correctly identified positions into deciles (presented in parentheses). For the funds in each decile, I then report the average standard deviation of the correlation between the approximate and actual return and the average correlation itself.

Table 4 – Interim Risk Measure

Panel A. Descriptive statistic

	Actual	Approximated	Difference (Interim Risk)
Overall Risk	0.0117	0.0114	0.0004***
Systematic Risk	1.0364	1.0297	0.0067***
Idiosyncratic Risk	0.0064	0.0061	0.0003***

Panel B. Quintile division

	Overall Risk	Systematic Risk	Idiosyncratic Risk
1	-0.0007	-0.1083	-0.0005
2	-0.0001	-0.0215	-0.0002
3	0.0002	0.0028	0.0001
4	0.0005	0.0290	0.0004
5	0.0018	0.1314	0.0015
5 - 1	0.0025***	0.2396***	0.0020***

For the actual and the approximated return time series, Panel A reports the pooled averages of the overall, systematic, and idiosyncratic risk, as well as their difference, the interim risk measure. Panel B reports a quintile division for each of the interim risk measures. Within each fund, the individual months are categorized into quintiles based on their interim risk measure and the average interim risk measure is reported for each quintile. Statistical significance is measured by two-sided t-tests and *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Table 5 – Relation of interim trading and performance - Quintile classification

	Panel A. Risk-adjusted Gross Performance			Panel B. Gross Return		
Interim Trading	Overall Risk	Systematic	Idiosyncratic	Overall Risk	Systematic	Idiosyncratic
1	0.0025***	0.0034***	0.0012***	0.0061***	0.0069***	0.0050***
2	0.0023***	0.0026***	0.0015***	0.0128***	0.0069***	0.0105***
3	0.0019***	0.0028***	0.0021***	0.0127***	0.0069***	0.0111***
4	0.0014***	0.0024***	0.0020***	0.0093***	0.0079***	0.0090***
5	0.0027***	-0.0006**	0.0040***	-0.0003	0.0069***	-0.0003
5 - 1	0.0002	-0.0039***	0.0028***	-0.0064***	0.0000	-0.0053***

This table reports the quintile division of the fund months based on the magnitude of the respective interim risk measure. For each of the quintiles I report in Panel A the average annualized risk-adjusted gross performance and in Panel B the monthly gross return. Statistical significance is measured by one-sided t-tests against zero and *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Table 6 – Relation of interim trading and performance – Panel Regressions

	Panel A. Risk-adjusted Gross Performance			Panel B.Gross Return		
Negative Interim Trading (Overall Risk)	0.0006**			-0.0057***		
	(0.02)			(0.00)		
Positive Interim Trading (Overall Risk)	0.0009***			-0.0167***		
	(0.00)			(0.00)		
Negative Interim Trading (Systematic Risk)		0.0007**			-0.0006	
		(0.02)			(0.17)	
Positive Interim Trading (Systematic Risk)		-0.0032***			-0.0002	
		(0.00)			(0.64)	
Negative Interim Trading (Idiosyncratic Risk)			-0.0008**			-0.0054***
			(0.03)			(0.00)
Positive Interim Trading (Idiosyncratic Risk)			0.0022***			-0.0103***
			(0.00)			(0.00)
Log TNA	0.0004***	0.0004***	0.0004***	0.0004***	0.0004***	0.0004***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Expense Ratio	0.4774***	0.4778***	0.4773***	0.6338***	0.6336***	0.6338***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Turnover Ratio	-0.0005***	-0.0005***	-0.0005***	-0.0006***	-0.0006***	-0.0006***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Load Dummy	-0.0012***	-0.0012***	-0.0012***	-0.0012***	-0.0013***	-0.0012***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age	0.0000**	0.0000**	0.0000***	0.0000**	0.0000**	0.0000**
	(0.01)	(0.02)	(0.01)	(0.02)	(0.03)	(0.02)
Flow	0.0134***	0.0133***	0.0133***	0.0152***	0.0152***	0.0153***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.0047***	-0.0045***	-0.0048***	-0.0017**	-0.0016*	-0.0018**
	(0.00)	(0.00)	(0.00)	(0.05)	(0.06)	(0.04)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.010	0.012	0.010	0.013	0.013	0.012
Number of Observations	73.607	73.607	73.607	73.607	73.607	73607

This table reports the results of monthly panel regressions with time-fixed effects and clustered standard errors to examine the influence of the interim trading on the funds' gross performance and return for 835 US domestic equity mutual funds from 1997 to 2015. The funds' size, expenses, turnover, a load dummy, age, and the fund flow are included as control variables. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively.

4 Article III: Investors' Carbon Risk Exposure and their Potential for Shareholder Engagement

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Business Strategy and the Environment, Vol. 30 No. 1, pp. 282–301, 2021

https://doi.org/10.1002/bse.2621

Abstract. This article examines the exposure to and management of carbon risks of different investor types. Considering the dual role as portfolio manager and partial owner, we analyze carbon risk for investors both in terms of exposure to portfolio values and in terms of responsibility as shareholder of carbon-intensive firms. We show that among various investor types the preference for holding carbon-intensive stocks differs substantially, even when considering traditional investment decision parameters. In particular, it is governments whose portfolio values are most threatened by a carbon risk exposure of 49%, but at the same time they prefer larger ownership shares in polluting firms. In contrast, individual investors, investment advisors and mutual funds avoid holding stakes in these firms, while revealing only a moderate exposure of their assets to carbon risk. In view of the Paris Agreement, which includes the consistent steering of financial flows towards a low carbon transformation of the economy, our study provides policymakers with important implications regarding the coverage and effects of respective regulations. By identifying the ownership structures of carbon-intensive firms and respective owners' portfolio compositions, we also offer implications for further research on portfolio decarbonization and shareholders' influence of corporate carbon management.

JEL Classification: G11, G32, Q56

Keywords: Equity mutual funds, risk, performance, derivatives, complex investments, holdings

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5 Article IV: Ownership comes with responsibility – The impact of ownership characteristics on CSR

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Working Paper (2021); University of Augsburg

Abstract. This article provides a novel methodology to investigate the influence of share ownership on corporate decision making. Quantifying the characteristics of firms' owners based on their measurable investment habits enables us to assess their predominant preferences. We demonstrate that a preference by owners for eco-social investments is a positive force in their firms' CSR performance. In contrast, firms exhibit a lower CSR performance when owners show a higher degree of heterogeneity in terms of eco-social preferences. Furthermore, we find that universal as well as long-term ownerships significantly encourage CSR, hence confirming prominent theoretical concepts.

JEL Classification: G11, G15, G23, G30, M14

Keywords: Ownership, Institutional Investor, Shareholder Engagement, ESG, Corporate Social Responsibility

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5.1 Introduction

The question of whether and how the interests of a firm's owners influence corporate decision making has been a focus of the literature on financial economics and management for quite some time. Studies on the subject usually approximate owner preferences by simply imputing pre-defined characteristics to specific investor types[1] whose aggregate ownership share in the firm is known (e.g., Oswald and Jahera, 1991, David *et al.*, 1998, Piotroski and Roulstone, 2004, among others). However, this approach omits heterogeneous preferences within owner types and neglects the preferences of owners assigned to other types.

In this article, we propose an innovative two-step approach to measuring the preferences of corporate ownership that renders any previous attribution or categorization of owners obsolete. In the first step, each owner's characteristics are measured based on their equity portfolio holdings. In the second step, by constructing a "portfolio of owners" for each firm, we are able to measure the corporate ownership's dominating preferences as the share-weighted average of the owners' characteristics.[2] While this methodological refinement is generally applicable to ownership preferences regarding any quantifiable firm characteristic, this article concentrates on a question that is the current focus of public and scientific interest and at the same time of high societal relevance – namely, do owners have an influence on corporate social responsibility (CSR)?

In their role as transformers of lot size, maturity, and risk, participants in the financial market have an influence on economic growth and thus, to a considerable extent, on our society. Their expectations and attitudes have societal effects ranging from the way investee firms operate at the micro-level to macroeconomic trends (Levine, 2008). As a consequence, society

[1] Like, e.g., hedge funds as aggressive and short-term or pension funds as conservative and long-term.
[2] In this article, the terms "investor" and "owner" are used as synonyms and denote a single equity investor of a firm. The term "ownership" describes the aggregate of all corporate owners, i.e. the firm's "portfolio of owners".

expects appropriate business behavior (Wood, 1991). Financial markets therefore have a social responsibility, underlined not least by the Paris Agreement, which considers the allocation of financial flows in line with low-carbon and climate-resistant development as one of its central aims (UNFCCC, 2015)

Given the sharp increase in socially responsible investments worldwide[3], it appears that a growing number of generally institutional but also individual investors are willing to shoulder this responsibility by integrating sustainability criteria into their investment decision-making. In addition to traditionally norm-constrained investors such as pension funds and religious organizations (Hong and Kacperczyk, 2009), examples include voluntary initiatives such as the Portfolio Decarbonization Coalition (PDC) or Principles of Responsible Investment (PRI), as well as investors with appropriate investment objectives (e.g., SRI funds). The integrated sustainability criteria go far beyond climate change and cover a broad spectrum of environmental, social and governance (ESG) aspects (van Duuren *et al.*, 2016). In parallel to their functions as capital allocators, investors are also partial owners of the actual primary source of economic and eco-social prosperity, i.e. the corporations. Not a new insight, but one that became apparent recently in Larry Fink's highly regarded letter to CEOs, in which the world's largest asset manager undertakes to fulfill his (fiduciary) social responsibility as an investor and as active owner (BlackRock, 2020).

With our central research question, we establish a link between these two roles and investigate whether the eco-social preferences of a firm's investors, reflected in the ESG scores of their portfolios, also influence that firm's CSR performance. Our methodological refinement allows us to test the corresponding hypotheses empirically, explicitly taking into account the heterogeneity of owners' preferences, which is suspected of hampering management's

[3] According to the Global Sustainable Investment Alliance (GSIA), sustainable investments increased by 66% between 2014 and 2018, see GSIA (2018).

decision-making in the need to heed the owners' possibly opposing interests (Goranova and Ryan, 2014). Moreover, based on theoretical deductions including the concepts of universal (Hawley and Williams, 2007) and long-term investors (Bãnabou and Tirole, 2010), we identify and test additional owner characteristics that might suggest a preference for or a link to CSR.

To be able to identify the owners' characteristics in the first step and then aggregate owners' preferences at corporate level in the second step, we compile an extensive global ownership and stock dataset that includes 28,201 firms, which on average cover 93% of the annual worldwide market capitalization during the period from 2002 to 2017. For these firms, we achieve an ownership coverage of 65% on an annual average. To the best of our knowledge, this sample is unsurpassed in global coverage of ownership information, aggregated market capitalization, number of observed firms and length of observation period.

Our methodological development builds on a broad base of quantified owner characteristics and demonstrates that there is considerable heterogeneity within the investor types previously treated as homogeneous. The empirical results show that firms whose investors show predominantly stronger portfolio-based ESG preferences are significantly increasing their efforts to improve CSR. This is especially the case with regard to environmental and corporate governance issues, and less for social concerns. These findings indicate that investors' commitment to sustainability is not limited to the portfolio level, but also includes an engagement as corporate owners. In contrast, firms exhibit a lower CSR performance with owners who show a higher degree of heterogeneity in terms of eco-social preferences. This suggests that conflicting voices reduce management's decision-making ability through the need to reconcile disparate corporate owners' desires as well as reduce the possibility of collaboration among active shareholders. Further, consistent with the theoretical assumption that so-called universal owners promote CSR activities in their own interest, we find a positive relationship between CSR performance and the average number of firms held by corporate

owners. Likewise, we find that the CSR efforts of a firm critically depend on its owners' investment horizon and thus support the hypothesis that long-term ownership encourages CSR activities.

We avoid endogeneity concerns by adjusting the ownership characteristics used in our main analysis as explanatory variables for the variation in firm characteristics (CSR). Since owner characteristics themselves were determined based on firm characteristics, we thus eliminate the individual contribution of the respective firm to the calculated owner characteristics. The firm-level aggregate of corporate owners' characteristics, referred to as "ownership characteristics", does not therefore depend on the respective firm itself. Furthermore, we address concerns regarding the reverse causality of our results. By conducting (Granger) causality tests, we provide evidence that our coefficient estimates are not driven by positive or negative screening based on ESG criteria in the owners' investment decision processes. Several other tests, including the use of ESG data from an alternative data provider, the different consideration of time-invariant effects, as well as other control variables, confirm the robustness of our analyses.

This article contributes generally to the ongoing debate on the separation of ownership and control in publicly listed corporations (e.g., Vernon, 1970, Claessens *et al.*, 2000, among others). In doing so, we empirically show that shareholders influence corporate decisions, which is evidence against their having a purely passive role as characterized by Berle and Means (1932). Second, our innovative methodological approach precludes the criticism regarding the blanket attribution of investors based on a predefined typology and the associated neglect of conflicting preferences in their functions as active owners (e.g., Bagwell, 1991, Hoskisson *et al.*, 2002). While this article focuses exclusively on CSR, the methodology developed here can be universally adapted to any quantifiable firm characteristic, opening a wide field for further research. Third, our tests regarding investors' CSR engagement address

the issue of whether shareholders have an influence on the environmental, social and governance policies of their firms. We also confirm the literature that has already answered this question in the affirmative. Our study is neither a substitute for, nor a contradiction of, these studies, but rather a completion that does not restrict itself to a specific group of owners (like, e.g., Dyck *et al.*, 2019 and Chen *et al.*, 2020) or a single channel through which owners can exercise influence (like, e.g., Dimson *et al.*, 2015). And fourth, for the first time to the best of our knowledge, we empirically test and confirm prominent theoretical concepts concerning the positive influence of long-term (Bãnabou and Tirole, 2010) and universal ownership (Hawley and Williams, 2007) on CSR.

The remainder of the paper is structured as follows. Section 5.2 places our contribution in the context of existing approaches to investigating shareholders' influence on corporate decision-making and concludes by developing hypotheses on how ownership characteristics influence CSR. In section 5.3, we introduce the data and present summary statistics of our sample. Section 5.4 contains a detailed explanation of the methodological approach. Section 5.5 presents the results on whether ownership preferences are linked to CSR performance, verifies them for (Granger) causality, and gives an overview of conducted robustness tests. Section 5.6 concludes.

5.2 Theoretical Background and Hypothesis Development

5.2.1 Integration into existing research and contributions

In their renowned book “The Modern Corporation and Private Property” published in 1932, Adolf Berle and Gardiner Means postulated that the separation of ownership and control has become a common characteristic of large US public companies. In their appraisal, shareholders have a more or less inactive role within the company and have only a very limited effect on corporate decision-making. As a result of this assessment, the question of how (and whether)

the interests of corporate owners can be represented and fulfilled by the management has been increasingly discussed and empirically examined.

Beginning with and based on agency theory (Jensen and Meckling, 1976), corporate governance mechanisms, such as performance-oriented compensation or controlling by outside directors, were established to subtly balance the interests of shareholders and corporate management. The relevance of these mechanisms for shareholder value is confirmed by several studies (e.g., Cremers and Nair, 2005, Bebchuk *et al.*, 2009, among others).

In addition to the need of management to take owners' interest into account contingent on contractual or organizational arrangements, Hirschman (2004) formulated fundamental and direct response options that owners may exercise in the absence of satisfactory corporate (management) performance, namely "exit" and "voice".[4] "Exit" simply describes the shareholders' option to express their dissatisfaction by selling shares. To verify the effectiveness of this strategy, Parrino *et al.* (2003) find empirical support for the hypothesis that changes in shareholder composition influence the board's decisions. Of course, the exited owners do not benefit from this response, but Admati and Pfleiderer (2009) see the mere threat of an exit as a disciplinary tool to impact managerial behavior − the hazard of divestment thus represents a hybrid between "exit" and the second response option "voice". Apart from this rather indirect and informal approach, exercising their rights as partial owners is a traditional way for shareholders to "voice" displeasure with management. In this context, several empirical studies examine the response to and success of shareholder proposals (Gordon and Pound, 1993, Karpoff *et al.*, 1996, and Gillan and Starks, 2000, among others).

McCahery *et al.* (2016) argue that many interventions by shareholders also take place behind the scenes. These personal interactions with corporate representatives are therefore

[4] Hirschman (2004) also mentioned a third option "loyalty", which will not be discussed in this article.

generally not applicable to empirical research. An exception is a work by Carleton *et al.* (1998), which relies on a private database of the correspondence between TIAA-CREF[5] and investee firms. It shows that a high proportion of agreements on corporate governance issues are reached without shareholders voting and that the targeted firms also initiate actions to fulfill these agreements.

Without limiting themselves to concrete channels and to overcome the problem of hidden shareholder activism, many scholars focus on specifically characterized owner groups and use their aggregated ownership share in the respective firm as a "potential for influence". The underlying idea is obvious: the higher the share of a certain group of owners, the more likely it is that corporate decisions will be guided by their interests or characteristics. For example, Cornett *et al.* (2007) argue that institutional investors, as owners with stronger monitoring capabilities, pressure firms to act in the best interest of shareholders and confirm a positive relationship between institutional ownership and firms' operating cash flow returns. A disadvantage of this approach is the assumption that the owners of a group have the same interests and act with a unified voice. Hoskisson *et al.* (2002) show that there are heterogeneous preferences within the group of institutional investors depending on the type of investor, and argue that these potentially conflicting voices should be taken into account.

One attempt to reduce this intra-group heterogeneity is to define more granular owner groups. For example, Borisova *et al.* (2015) find support for the hypothesis that high government ownership is generally associated with a higher cost of debt, consistent with state-induced investment distortions. Boubakri *et al.* (2013) interpret foreign investors as owners who are more likely to undertake capital budgeting decisions and find a positive relationship between foreign ownership share and earnings volatility of newly privatized firms. Dyck *et al.*

[5] Teachers Insurance and Annuity Association – College Retirement Equities Fund

(2019) characterize pension funds as long-term investors and hedge funds as short-term investors and show that pension funds, in contrast to hedge funds, promote the environmental performance of firms. However, this approach can also be criticized with the same argument, namely that it cannot be assumed that owners even within a more granular group are homogeneous and have identical preferences, (e.g., Çelik and Isaksson (2014)) or that other owners of the same firm who do not belong to the group under consideration can be neglected. The interests of these omitted owners could indeed conflict with those of the examined owner group. Since the corporate executives are obliged to consider the preferences of all owners according to their voting rights, this requires a methodical approach that respects the individual preferences of all owners, taking into account their respective ownership shares.

Our contribution addresses these points of criticism and represents a methodological improvement for investigating the relationship between ownership and corporate policy. First, unlike previous approaches, we do not distinguish between pre-aggregated owner groups but refer to the level of single investors or investment companies. Second, we include all identifiable owners of a company and thus also take into account their potentially competing preferences. Third, we use only measurable owner characteristics that reflect their preferences and are therefore independent of assumptions about the preferences of different owners, owner groups, or types. This represents a significant improvement over previous approaches and is generally applicable to ownership preferences regarding any quantifiable firm characteristic.

Besides this methodological refinement, we also contribute to an emerging research focus examining the impact of shareholders on CSR. Following the Friedman doctrine, companies fulfill the exclusive purpose of maximizing shareholder value (Friedman, 1970). On that note, shareholders' values are described as purely monetary and their role as rational utility maximizers. Accordingly, Gillan and Starks (1998) see the inherent motivation of active shareholders as the reduction of agency conflicts and the associated costs that counteract the

growth of their values. Non-financial motives for owners to become engaged, especially with regard to the company's social and environmental impact, do not at a first glance fit into this framework.

To still be compatible with the classic shareholder primacy view, many scholars seek to establish a link between CSR and firms' financial performance. In a survey of more than 2,200 individual studies from 1978 to 2015, Friede *et al.* (2015) conclude that the large majority report a positive relation between ESG criteria and corporate financial performance. This argues in favor of theories summarized by Bãnabou and Tirole (2010) under the banner of "doing well by doing good".

A second approach to explaining CSR engagements is to rethink the definition of "shareholder value". Among others, Hart and Zingales (2017) argue that owners consider social and ethical factors as well as externalities generated by the corporation's profit-making activities. Thus, rather than maximizing shareholder wealth in the sense of market value, the appropriate objective should be shareholder welfare, which is defined as the combination of shareholder wealth and negative externalities. Even if CSR investments are expected to lower financial returns, investors may value a firm's social expenditures (Baron, 2008) – a prosocial investor attitude that Bãnabou and Tirole (2010) subsume as "delegated philanthropy".

5.2.2 Testable hypotheses

Regardless of whether their original motives are financial or philanthropic (or both), a growing number of investors advocate including CSR criteria in their investment decisions and engagement priorities. For example, the Portfolio Decarbonization Coalition (PDC), whose signatories manage assets of over US$ 3,200 billion, is pushing for a reduction in greenhouse gases. In addition to shifting their portfolios towards more climate-friendly investments, they are also seeking to achieve this goal through targeted engagements (PDC, 2015). Another

organizational platform provided by the United Nations, the Principles of Responsible Investment (PRI) initiative, supports institutional investors in making their investment decisions in line with CSR criteria and in functioning as active owners (PRI, 2019).

In addition to these voluntary associations of institutional investors, norm-constrained owner groups such as pension funds, university endowments, and religious organizations are also associated with higher eco-social or ethical investment behavior (Hong and Kacperczyk, 2009). The decisive question here is whether this seemingly eco-social awareness of investors is actually leading to changes at the source of externalities − in the corporations.

Our first hypothesis is related to the investigation of Dyck *et al.* (2019), which first addresses this question and shows that institutional ownership share is positively related to future CSR performance. It further demonstrates that this effect intensifies when using exclusively the ownership shares of PRI signatories – a labeled owner group for which a higher eco-social awareness sounds plausible. Taking into account the above-mentioned points of criticism regarding the assumption of homogeneous institutional preferences, we refer to the individual eco-social preferences of the entire range of corporate owners and hypothesize:

H1a: The higher the level of the ownership's ESG preference is, the higher the CSR performance.

H1b: An increase in the ownership's ESG preference causes positive changes in future CSR performance.

On the surface, these predictions sound trivial, but their empirical confirmations would represent the first evidence of corporate management response to the eco-social demands of their principals.

The second hypothesis addresses the influence of owners' heterogeneity directly. Dimson *et al.* (2015) show that collaborations among shareholders contribute positively to the success of CSR engagements. A basic prerequisite for entering into such alliances is that the shareholders' preferences regarding the purpose of engagement are similar. On the other hand, heterogeneous or even conflicting shareholder interests lead to challenges for management and shareholder agreement on the appropriateness of an action (Goranova and Ryan, 2014). Therefore, we expect that:

H2a: The higher the level of ownership's heterogeneity regarding ESG preferences is, the lower the CSR performance.

H2b: An increase in the ownership's heterogeneity regarding ESG preferences causes negative changes in future CSR performance.

Following the "doing well by doing good" hypothesis, the literature mentions specific owner characteristics that are linked to the promotion of CSR activities. In this context, Monks and Minow (1995) coined the term "universal ownership" to describe (institutional) investors with a wide range of equity holdings. Due to their slice of the broad economy, they are particularly affected by corporate externalities. The logical deduction is that it is in the universal owners' self-interest to reduce negative and encourage positive externalities by influencing holding firms' businesses. However, this derivation has never been empirically verified. With our third hypothesis we refer to the fundamental characteristic that defines the "universality" of an owner, i.e. the number of portfolio firms held. In this way, we avoid an exclusive consideration of specific investors or types of investors (for example, pension funds are often referred to as universal owners), but also include the entire ownership of a company. Based on these theoretical assumptions, we argue that:

H3a: The higher the ownership's universality is, the higher the CSR performance.

H3b: An increase in the ownership's universality causes positive changes in future CSR performance.

A second characteristic that Hawley and Williams (2001) attribute to universal owners is the long-term nature of their relationships with holding firms. Bãnabou and Tirole (2010) argue that investments in CSR activities are not immediately reflected in an increase in shareholder value, but are first and foremost costs. Accordingly, it can be expected that short-sighted investors will be less interested in promoting CSR activities and more interested in reducing them in order to maximize short-term profits. In contrast, it can be concluded that long-term owners aim to promote CSR activities that contribute to a sustainable and intertemporal maximization of profits. In contrast to Nguyen *et al.* (2020), who find that long-term investors increase the shareholder value of CSR activities, we investigate the direct connection between ownership investment horizon and CSR activities and assume that:

H4a: The longer the ownership's investment horizon is, the higher the CSR performance.

H4b: An increase in the ownership's investment horizon causes positive changes in future CSR performance.

5.3 Data and summary statistics

5.3.1 Data sources and sample construction

Our global dataset consists of three major databases: ownership information, firms' financial characteristics, and firms' ESG information. We obtain data regarding ownership information from the Refinitiv Ownership and Profiles (ROP) database[6]. Refinitiv's ownership data covers the majority of publicly listed firms worldwide. Primary sources of this database include SEC

[6] Formerly known as Thomson Reuters Global Equity Ownership database.

filings, international declarable stakes notifications, mutual fund and ETF portfolios, share registers, and directors' and insiders' disclosures. The database provides information about the number of shares held and the respective market value of the owners' positions in the individual firms. The data also enables us to identify the investor type of the individual owners (e.g., hedge funds). We calculate each investor's ownership share based on their number of shares held in relation to the respective firm's common shares outstanding for each year-end. In addition to the ownership information, we use the reported value of the positions held by each investor to calculate holding weights and thereby create a panel of the owners' global stock portfolios. It should be noted that the portfolios considered here do not reflect the single fund levels (e.g., iShares Core MSCI World) but the investment company levels (BlackRock Inc.).[7]

Stock returns, common shares outstanding and market capitalizations are obtained from Refinitiv Datastream[8] (RDS). To ensure that observed stocks are not exclusively owned by individual major investors, firms have to pass a minimum free-float requirement of at least 10% of the total market capitalization. We include firms that have been delisted or newly listed during the observation period to avoid survivorship bias. As already shown by Ince and Porter (2006) integrity of the RDS returns is not beyond doubt, which is why we adapt their proposed screens to daily returns.[9]

To determine the firms' CSR performance, we employ information from the ASSET4 ESG database provided by Thomson Reuters. ASSET4 analysts collect firm-specific data on ESG dimensions from a variety of public sources to quantify the quality of a firm's ESG policies. The data contains 70 environmental, 78 social, and 71 governance indicators. These

[7] Most (proxy) voting-rights policies incl. CSR strategy apply at company level and do not differ from fund to fund within an investment company. In the context of this investigation, the investment company level is therefore chosen as plausible owner level.
[8] Formerly known as Thomson Reuters Datastream.
[9] Ince and Porter (2006) originally developed screens for monthly returns. The adaptation to daily returns has the advantage that remaining outliers or approximations caused by these screens are less significant when converting to annual returns.

indicators are answers to YES/NO questions, double YES/NO questions and numerical questions with a positive or negative direction that reflect a firm's commitment to CSR-relevant issues (e.g., "Does the company monitor the diversity and equal opportunities in its workforce?" as a YES/NO question with a positive direction within the "social" subcategory). When assessing the answers, we follow Dyck *et al.* (2019) and evaluate, for example, a "YES" to a question with a positive direction with a value of "1" and with "0" for "NO".[10] The sum of the evaluated indicator values (*I*) divided by the total number of indicators gives the "raw" ESG score or, by referring to the indicators of the respective subcategory, the raw E, S and G scores:

$$Firm\ score_{it} = \frac{1}{N}\sum_{n=1}^{N} I_{nit} \times 100 \qquad (1)$$

In Equation (1), $Firm\ score_{it}$ represents the corresponding raw E, S, G or ESG score of a firm i in year t, N is the number of indicators and I_{nit} denotes the value of indicator n. The scores are calculated on an annual basis, which allows us to track changes in firms' ESG activities over time. In contrast to the "ranked-based" scores directly provided by ASSET4 ESG, these scores are not relative to other firms' scores evaluated in the year under review. Firm-specific changes in CSR performance can thus be observed independently of changes in other firms' scores.[11] Since this data is available from 2002, it also defines the beginning of our investigation period.

[10] Details on the ESG-specific indicators and their translation into indicator values are available upon request.
[11] This avoids, for example, accusing a firm of slackening its CSR efforts when in fact these have remained constant and only the scores of other firms have improved.

5.3.2 Summary statistics

Table 1 gives an impression of the extensive coverage of our sample in terms of market capitalization and ownership information. The aggregated market capitalization of the sample firms (RDS database) covers an annual average of 93.49% of the aggregated global common equity of all listed firms (according to The World Bank, 2018). On average, we observe 150,554 owners holding around 64% of the sample market capitalization each year-end (ROP database).

Accordingly, the remaining ownership shares are not covered by Refinitiv's primary sources and can therefore predominantly be described as small or micro investors, which are neglected in this investigation[12]. We observe an increase in the coverage of ownership information over time, which can be explained by the growing market share of institutional investors (see OECD, 2017). To the best of our knowledge, we use a sample that is unsurpassed in terms of both aggregated market capitalization and the amount of ownership information covered.

[Insert Table 1 here.]

The geographical distribution of the sample firms includes 50 countries with economies at all stages of development, and without exclusion of any industry. Table 2 provides basic summary statistics for the full sample consisting of 28,201 firms on an annual basis between 2002 and 2017. This large number of firms is needed to ensure the most complete possible replication of the owners' global stock portfolios. Market value and return statistics refer to the full sample of 338,897 firm-years, respectively, whereas the ESG score and its subscores refer to 51,966 firm-years or 7,089 firms for which ASSET4 ESG information is available.

[12] Refinitiv's ownership database sources most of its information from reports of declarable shareholdings (e.g., 13d and 13f filings). Since the reporting obligation is in most cases only triggered at volume-related thresholds, the database mainly reflects large investors or investors with large ownership shares.

Panel A shows a mean (median) market capitalization of $2.352 ($352) million and a mean (median) stock return of 9.58% (3.40%) p.a. for the full sample. For the subsample of firm-years for which ESG information is available, the mean ESG score is 37.33. The means of the subscores are 20.28 for environmental, 41.34 for social and 49.75 for governance, respectively, with a perfect score being 100.

[Insert Table 2 here.]

We provide more detail on the covered ownership level and ESG scores across countries in Panel B and industries in Panel C. With about 25%, the majority of our sample firms are located in the US, and with an average of 73.93%, US firms also achieve one of the highest levels of coverage with regard to ownership data. The least amount of ownership information shown is for Pakistan with an average of 13.90%. Panel C shows the average ownership coverage per industry, ranging from 55.30% to 61.22% for the full sample and from 63.08% to 73.62% for ASSET4 ESG firms. In total, the average ownership coverage of all firm-years is lower than for ASSET4 ESG firm-years (58.78% compared to 68.34%).

5.4 Measuring the Characteristics of Corporate Ownership

5.4.1 Owner characteristics

The first step in determining the ownership characteristics of a firm is to evaluate the characteristics of every single owner. To obtain a measurable assessment of the objectives pursued by the individual owners, we refer to their portfolio compositions and the resulting portfolio characteristics. In doing so, we assume that the characteristics of an investor are expressed by the characteristics and weighting of their individual holdings within the portfolio, and that these at the same time reflect the characteristics or preferences of their role as owner. This has the advantage that we do not depend on labels or generalized assumptions regarding

the characteristics of various investor or owner groups but can make an objective measurement at investor level.

To quantify owner attitudes towards aspects of ESG, we calculate the sustainability scores of a portfolio following Gibson and Krueger (2018). For each year, the total ESG score and its subscores are aggregated at portfolio level by computing the value-weighted average of the ESG scores of the holdings as:

$$Investor\ score_{jt} = \sum_{i=1}^{N^{jt}} weight_{jit} \times Firm\ score_{it} \quad (2)$$

where $weight_{jit}$ is the holding weight of firm i in owner portfolio j at each year-end t and $Investor\ score_{jt}$ describes either the raw E, S, G or ESG score of the corresponding investor.

To determine each investor's investment horizon, we follow Gaspar *et al.* (2005) and use the turnover ratio derived from portfolio holdings to build an approximation of the commitment period of an owner:

$$Investor\ turnover_{jt} = \frac{\min\left(\left|buy\ val_{jt}\right|, \left|sell\ val_{jt}\right|\right)}{0.5(TNA_{jt} + TNA_{jt-1})} \quad (3)$$

In Equation (3), $buy\ val_{jt}$ is the value of buy trades and $sell\ val_{jt}$ is the value of sell trades since the end of the previous year, and TNA_{jt} is the held value of all equity holdings of the owner portfolio in the corresponding year. The higher the turnover ratio, the more frequently the owner trades portfolio positions, and the shorter the investment horizon and vice versa. As this definition reflects the turnover of a portfolio on a year-end basis, we necessarily neglect interim trading, which renders this figure a lower bound of the actual turnover.

Universal owners are characterized by the fact that they represent a high share of the entire market in their portfolios (e.g., Hawley and Williams, 2007). To measure an owner's "universality", we count the number of firms in which an owner has invested at each year-end and thus follow the logic that the higher the number, the more universal the owner.

Analogous to the calculation of the owners' ESG scores in equation (2), we also use the value-weighted average of holding returns as a measure of owner portfolio returns.

$$Investor\ return_{jt} = \sum_{i=1}^{N^{jt}} weight_{jit-1} \times ret_{it} \quad (4)$$

Unlike Equation (2), we use the holding weight at the beginning of each year ($weight_{jit-1}$) to avoid falsifications due to return-induced weight changes. These portfolio returns are calculated on a buy-and-hold assumption and trades during the year are therefore neglected. Only long equity positions are considered, as short, fixed-income, derivatives or cash positions are not available in the data. Also, expenses such as transaction costs or fees are not taken into account, which is why these returns are interpreted as hypothetical buy-and-hold portfolio raw returns.

Table 3 shows the means and standard deviations of portfolio characteristics for each investor type. By comparing the means of portfolio ESG scores across investor types, it comes as no surprise that pension funds are the leaders among all owner types, with an average ESG score of 44.55. This is in line with expectations since pension funds are often bound to social norms, which include awareness for ESG aspects (Hong and Kacperczyk, 2009). Hedge funds have the highest turnover (15.25%), which confirms the short-term orientation of this type of investor (Cella *et al.*, 2013). In contrast, individual investors have the lowest turnover ratio of 0.69% and can, therefore, be described as buy-and-hold investors. Since individual investors make up the majority of observations, they also have a significant influence on the equal-

weighted overall means. For example, all investors combined show an average turnover ratio of only 3.03%. As noted above, the portfolios considered here reflect the investment company level at year-end. Both the high level of aggregation and the neglected intra-year trades have a negative effect on turnover ratios, as opposing trades of the individual funds of an investment company are netted out.

[Insert Table 3 here.]

A general attribution of certain characteristics based on investor types seems to be justified when only the means are considered, but for the standard deviations it becomes clear that there is considerable heterogeneity within the different types of investors. This heterogeneity among investors, regardless of the investor type, requires methodological development that can establish a relationship between the increasingly diverse and dynamic ownership structures and the CSR activities they encourage.

5.4.2 Endogeneity adjustments

The owner characteristics of a firm described in the previous section are used in our main analysis as explanatory variables for firm characteristics (ESG scores). Since the owner characteristics themselves were determined based on firm characteristics, we might be confronted with endogeneity. To ensure that only the effects of the owners on firm characteristics are considered, we eliminate the individual contribution of the respective firm to the calculated owner characteristics as:

$$Investor\ score\ adj_{jst} = Investor\ score_{jt} - \frac{weight_{jst}\ ((\sum_{i=1}^{N^j} weight_{jit} \times Firm\ score_{it}) - Firm\ score_{st})}{weight_{jst} - 1} \qquad (5)$$

where $Investor\ score\ adj_{jst}$ is the raw E, S, G or ESG score of owner portfolio j for each specific firm s based on all other firms i in the respective owner portfolio in year t. Consistently, the same adjustment for the owner portfolio return is executed using the weights of the previous

year $weight_{jst-1}$. Following the same principle, we adjust investor turnover by neglecting the buy and sell values as well as the value held ($value_{jst}$) by the respective firm s:

$$Investor\ turnover\ adj_{jst} = \frac{\min\left(\left|\left(buy\ value_{jt} - buy\ value_{jst}\right)\right|, \left|\left(sell\ value_{jt} - sell\ value_{jst}\right)\right|\right)}{0.5((TNA_{jt} - value_{jst}) + (TNA_{jt-1} - value_{jst-1}))} \quad (6)$$

Lastly, the number of portfolio holdings, as a measure of an owner's universality, is simply adjusted by subtracting 1. The owners' characteristics adjusted in this way are individual for each firm-year. Therefore, the firm-level aggregate of corporate owners' characteristics − referred to as ownership characteristics and described in the following section − is not influenced by the respective firm itself.[13]

5.4.3 Ownership characteristics

So far, the evaluation of the owners' portfolio characteristics based on portfolio holdings has been the focus of attention. The second methodical step takes the perspective of an individual firm or its executives and provides a quantifiable answer to the overriding question in the context of corporate management: What is the owners' preference regarding certain aspects of corporate policy? To aggregate the heterogeneous or even opposed preferences of a large number of different partial owners to one figure, we consider the individual firm technically as a "portfolio of owners", which enables us to compute the ownership characteristic of a firm as follows:

$$Ownership\ characteristic_{st} = \sum_{j=1}^{N^S} perc\ held_{jst} \times Investor\ characteristic\ adj_{jst} \quad (7)$$

The particular adjusted characteristics (ESG scores, number of holdings, turnover, and return) of the owner portfolios j are parameterized by $Investor\ characteristic\ adj_{jst}$. By

[13] Since the firm-level aggregate of corporate owners' characteristics is carried out under consideration of owner preferences (portfolio weights) and ownership structure (ownership shares), the respective firm characteristic is not endogenously affected by other firms' average characteristics (e.g., peer pressure) which avoids a reflection problem according to Manski (1993).

using the ownership share of the respective owner ($perc\ held_{jst}$) as a weighting factor, we implicitly integrate the balance of power between the owners. At the same time, the amount of the ownership share determines the prospects of success of a forced change in future corporate policy orientation, for example within the context of a vote on a specially submitted shareholder proposal. Accordingly, the preferences of an owner with a high ownership share are given a correspondingly higher weighting and vice versa.

As seen in Panel C of Table 2, we achieve an average ownership coverage of 68.35% for ASSET4 ESG firms and therefore neglect the remaining free float held by investors who are not subject to regulatory reporting requirements (e.g., SEC filings). As the associated reporting thresholds are triggered when the portfolio value or the ownership share is sufficiently high, these investors are essentially small. Due to their minor ownership shares, these small investors would in any case have only petty effects on our measure. The definition of $perc\_held_{jst}$ therefore simplifies by assuming full ownership coverage and corresponds to the ratio between the shares held by an owner j and the total shares held by all owners that can be represented by our sample per firm and year.

Within the ownership structure of a firm, different shareholders might have different preferences for CSR policies. This heterogeneity harbors potential conflicts among shareholders and leads to challenges for corporate management to align CSR activities in the common interest of the entire ownership. Nevertheless, a homogeneous set of interests among shareholders promises not only to improve management's decision-making ability from the owners' standpoint, but also to improve the possibility of collaboration among active shareholders. To quantify the heterogeneity of owners' eco-social preferences, we use the standard deviation of the owners' ESG scores within a firm:

$$Ownership\ heterogeneity_{st} = \sqrt{\frac{1}{N^s}\sum_{j=1}^{N^s}(Investor\ score\ adj_{jst} - \overline{Investor\ score\ adj_{jst}})^2} \quad (8)$$

Table 4 shows the summary statistics of the calculated ownership characteristics for firm-years with available ASSET4 ESG information. The average firm's ownership possesses an ESG score of 34.78. Compared to the owners' portfolio ESG scores with a mean of 39.34 (Table 3), this indicates that owners holding larger ownership shares tend to have a less strong preference for ESG. The standard deviation of the owners' ESG preferences within firm-years, referred to as Ownership ESG score Heterogeneity, is on average 7.45, while the overall standard deviation of ESG preferences at the portfolio level shows a standard deviation of 9.96 (Table 3). This implies that owners have more similar ESG preferences within firms than across all owners. These relationships also apply to the respective subscores.

Compared to the average number of holdings at the portfolio level of around 35 (Table 3), the average number of holdings of the ownerships is relatively high at over 1,800. This is mainly due to the statistical effect of averaging on firm-year level, since owners with a high number of holdings also appear in a high number of firm-years. At 11.12%, the Ownership turnover is also higher than at the individual owner level (3.03%). In contrast, the return at the ownership level is lower than at the portfolio level (7.17% to 12.27%). This suggests that on average the dominate portion of a firm's owners have shorter investment horizons and generate lower returns than the average figures at the individual owner level.

[Insert Table 4 here.]

5.5 Corporate Ownership Characteristics and Social Responsibility

5.5.1 Is CSR related to the characteristics of ownership?

With our first analysis we investigate the contemporary relation between ownership characteristics and firms' CSR performance by conducting a panel regression at the firm-year level:

$$\begin{aligned} Firm\ score_{st} = \alpha &+ \beta_1 Ownership\ score_{st} + \beta_2 Ownership\ heterogeneity_{st} \\ &+ \beta_3 Ownership\ holdings_{st} + \beta_4 Ownership\ turnover_{st} \\ &+ \beta_5 Ownership\ return_{st} + \eta Controls_{st} + \lambda + \tau + \varepsilon_{st} \end{aligned} \quad (9)$$

The dependent variable, denoted by $Firm\ score_{st}$, is one of the environmental, social, governance, or the total ESG score of firm s in year t. The ownership's eco-social preference and its heterogeneity are denoted by $Ownership\ score_{st}$ and $Ownership\ heterogeneity_{st}$ according to the respective score of the dependent variable. $Ownership\ holdings_{st}$ is the ownership's universality defined as the natural logarithm of the owners' share-weighted number of holdings, and $Ownership\ turnover_{st}$ proxies the ownership investment horizon. As a control variable at ownership level, we include $Ownership\ return_{st}$ computed as the corporate owners' share-weighted equity portfolio return. Following Dyck *et al.* (2019) we use firm size as the natural logarithm of market capitalization, assets tangibility, yearly stock return, leverage, and Tobin's Q as firm-level control variables ($Controls_{st}$). As seen in Table 2, variation exists in firms' ESG scores across industries and countries. We conservatively control for these variations with firm (λ) and time-fixed effects (τ), and cluster standard errors at firm level.

Table 5 shows the corresponding regression estimates. The first three columns show coefficient estimates for the subcategories of ESG, column 4 for the total ESG score. The coefficients on Ownership E, S, G or ESG score indicate a positive relationship between

ownership's eco-social preferences and the level of the owned firm's CSR, each significant at the 1% level. This confirms the hypothesis *H1a* that the owners' eco-social awareness is positively related to CSR performance. As a consequence of the adjustments described in section 5.3.2, these coefficients are not endogenously driven by the firm itself.[14] Rather, they are an indication that ownership with high eco-social awareness is not coincidentally linked to a firm with higher CSR performance but can be consistently attributed to the owners' general investment preference. Accordingly, the CSR efforts of a company are not detached from the preferences of its owners. Also, the coefficients of the owners' heterogeneity show consistent results. The negative signs meet expectations (*H2a*) that a firm that has a more disparate ownership structure in terms of eco-social preferences, on average shows significantly lower CSR performance.

Further, the results confirm the positive influence attributed in particular to universal and long-term owners (*H3a* and *H4a*). Except for the environmental subcategory, the coefficients for the share-weighted number of firms held by the owners (*Ownership holdings*) show a positive and significant relationship with CSR. Also, the ownership investment horizon, which we approximate by the owners' share-weighted portfolio turnover ratio (*Ownership turnover*), shows a significant relationship with CSR performance; the higher the owners' turnover is − or the shorter their investment horizon is − the lower the firms' CSR performance. The ownership return also shows a negative relationship with each of the firm's ESG categories, indicating that financially more successful ownership is associated with lower CSR performance. Due to the lack of a theoretical foundation regarding this relationship so far,

[14] Without the adjustment described in section 5.3.2, an extreme constellation would be possible, in which a single owner owns a single firm in full. In this case, the explanatory and dependent variable (e.g., Ownership ESG score and firm's ESG score) would be completely identical. This constellation and also milder variants of endogeneity are excluded by the adjustment.

we can only assume that financially more successful ownerships avoid the promotion of CSR and the associated costs.

[Insert Table 5 here.]

5.5.2 Do ownership characteristics drive firms' CSR performance?

So far, the results have shown a strong and significant relationship between ownership characteristics and the level of CSR. These findings, we argue, suggest that the CSR efforts of a firm are influenced by the corresponding preferences of its ownership. In this section, we further examine whether these ownership characteristics are drivers of CSR activities in line with the theoretical assumptions in Section 5.2.2. To test the derived hypotheses, we use a dynamic specification of the empirical model described in Equation (9) by adding the firm's current CSR level as a predictor for the CSR level in the following year:

$$\begin{aligned}\Delta Firm_{score_{st+1}} = \alpha &+ \beta_1 \Delta Ownership\ score_{st} + \beta_2 \Delta Ownership\ heterogeneity_{st} \\ &+ \beta_3 \Delta Ownership\ holdings_{st} + \beta_4 \Delta Ownership\ turnover_{st} \\ &+ \beta_5 \Delta Ownership\ return_{st} + \delta \Delta Firm\ score\ (IV)_{st} + \eta \Delta Controls_{st} + \tau + \varepsilon_{st}\end{aligned} \tag{10}$$

To deal with concerns about autocorrelation resulting from dynamic panel estimation, we follow Anderson and Hsiao (1982) and specify Equation (10) in terms of first differences (Δ) and use $\Delta Firm\ score_{st-1}$ as an instrument variable (*IV*) for $\Delta Firm\ score_{st}$. We control for firm-level characteristics ($\Delta Controls_{st}$) as described in Section 5.5.1, and year fixed effects denoted by τ, to control for firm-invariant changes in CSR scoring (e.g., changes in the ASSET4 valuation methods).

[Insert Table 6 here.]

Table 6 reports the results on the influence of ownership characteristics on the firm ESG score as well as for the subscores in the subsequent year. Column 4 shows a positive coefficient on ownership ESG score, significant at the 1% level. Columns 1 to 3 confirm this positive

relation regarding each subcategory, significant at least at the 10% level. These results show the first empirical evidence that corporate executives are responding to their owners' eco-social preferences or demands (*H1b*). Except for the social dimension, coefficients on ownership heterogeneity are significantly negative. This indicates that if firms are confronted by owners who are more disunited in their eco-social preferences, CSR performance will be lower (*H2b*). This accords with the expectation that conflicting shareholder interests lead to challenges for management and shareholder agreement on the appropriateness of an action (Goranova and Ryan, 2014) and confirms the corollary hypothesis that a unified voice among corporate owners in terms of eco-social preferences positively affects CSR efforts (Dimson *et al.*, 2015).

Also, hypothesis *H3b* regarding the inherent interest of universal ownership to reduce negative and encourage positive externalities by promoting CSR can be confirmed by the positive and significant relationship between the number of ownership holdings and future CSR performance in all specifications. Furthermore, hypothesis *H4b* is confirmed in that a positive change in long-term ownership is associated with increased future CSR performance, indicated by the negative coefficients on ownership turnover. Since coefficients on changes in ownership return are consistently negative, more financially successful owners seem to be a driving cause of reduced CSR activity.

5.5.3 Reverse causality: Does CSR performance attract characteristic ownerships?

A potential concern is that our findings on the relationship between ownership characteristics and future CSR performance are not driven by the influence of owners as set out in the hypotheses, but are merely a consequence of positive or negative screening based on CSR criteria in the owners' investment decision process. Accordingly, the ESG score of the selected firms would predict the level of the ownerships' eco-social awareness or other ownership characteristics and thus call the causation of our coefficient estimates into question.

To determine whether ownership characteristics govern a firm's CSR performance, we follow Holtz-Eakin *et al.* (1988) and test Granger causality within a panel vector autoregressive (VAR) framework.[15] Contrary to a related approach used by Dyck *et al.* (2019), we use first differences instead of firm fixed effects to control for endogeneity caused by the dynamic panel setup. However, our results remain unchanged when using firm fixed effects instead.

Panel A of Table 7 reports the causal relationship between ownership ESG scores and the corresponding firm scores. The coefficient estimates of the first four columns correspond to the results in Table 6 and show a positive and significant impact of ownership on future CSR performance, whereas Columns 5 to 8 report that future ownership ESG scores do not depend on firms' CSR performance. We therefore do not find evidence for the screening hypothesis or reverse causality regarding the relation between ownership ESG score and CSR performance.

Panel B of Table 7 shows the causality checks for the remaining ownership characteristics. A significant influence of CSR performance on the future characteristics of owners (second column in each case) would mean that the CSR performance of a firm would "attract" a characteristic ownership. It would, therefore, be conceivable that firms that operate in a more sustainable manner would be particularly appealing to long-term oriented, universal or homogeneous owners. We also find no empirical support for this supposition. Instead, we find confirmation for our baseline results of ownership characteristics driving CSR performance. However, the low negative correlation between CSR performance and future ownership return suggests that firms with higher CSR commitment tend to "scare off" investors

[15] In particular, we estimate a symmetric pair of panel VAR models. The first is identical to the model defined in Equation (10), in which firms' future CSR performance is considered to depend on ownership score. In the second regression the respective future ownership ESG score depends on CSR performance, the lagged ownership score as an instrument for ownership score and controls. These pairwise regressions are also performed for the remaining ownership characteristics.

with a stronger focus on returns. This would also be in line with the conjecture that CSR-oriented investors may be prepared to forfeit financial performance for better ESG performance.

[Insert Table 7 here.]

5.5.4 Further robustness tests

We perform several additional analyses to test the robustness of our results. In our main analysis, we capture unobserved and time-invariant firm characteristics that influence the variation in CSR activities by controlling for firm fixed effects. Several related investigations instead use fixed effects to capture unobserved heterogeneity in country or industry attributes (e.g., Dimson *et al.*, 2015; Dyck *et al.*, 2019; Chen *et al.*, 2020). To establish comparability with these empirical settings, we introduce a country and industry fixed effects specification.[16] Compared to our main findings in Table 5, the coefficient estimates in these additional specifications are higher. This is in accordance with expectations, as the estimates are less dependent on the cross-sectional variation and more on the likely lower time-series variation within firms. However, this procedure might lead to omitted (firm-level) variable bias, since it cannot be assumed that firms are fully homogeneous either within industries or countries.

Second, we review our findings using the ranked-based ESG scores provided by ASSET4 ESG. As described in Section 5.2.1, to avoid distorting the development of individual firm scores over time, for our investigation we use specially calculated raw ESG scores that are not related to all firm scores evaluated in the respective year. Since our analysis in Table 5 is a contemporary view, it should make no difference whether ranked or raw scores are used. Unreported results confirm this expectation for the main results. To address further concerns about the ESG data used, we repeat our analysis using ESG ratings from the alternative data

[16] For the sake of clarity, the result tables from this and the following robustness tests are available on request.

provider “Sustainalytics” and our main findings remain unchanged economically and statistically.

Third, we argue that using the overall institutional ownership share as an explanatory variable for the estimation of CSR performance by previous studies is a rather superficial methodological approach since it is based on the blanket assumption of homogeneous owner interests or characteristics. By using the ownership characteristics presented here as explanatory variables, we offer a methodological improvement for the investigation of ownership influence on firm characteristics in general, and on CSR in specific. To demonstrate this, we include the overall institutional ownership share in our baseline model as a control. As expected, the influence of the institutional ownership share on CSR is insignificant and our outcomes for ownership characteristics remain unaffected in all specifications.

5.6 Conclusion

Do investors have any influence on the activities of the firms they own? In times of growing social and ecological awareness, this question is at the heart of a debate on whether investors can stimulate CSR activities, for example by (threatening) the divestment of shares or by shareholder engagement. We contribute to this debate by providing a novel methodology to directly measure explicit ownership preferences with respect to ESG criteria and relating these to the CSR performance of the firms they own. This novel approach addresses several points of criticism of previous approaches, provides a new category of firm-level variables and thus opens up a multitude of possible investigations on the influence of ownership on corporations − not only with regard to ESG and CSR.

Our analysis of a comprehensive sample of publicly traded firms from 2002 to 2017 provides global evidence that ownership characteristics drive CSR performance. In particular, we find that stronger eco-social preferences, as shown by the owners’ investment habits, are

positively related to a firm's efforts to improve its CSR performance. Irrespective of whether this results from an active influence of shareholders or from a proactive adjustment of the firm, it implies that corporate management is responding to the eco-social demands of its principals. However, if corporate management is confronted with owners who show a higher degree of heterogeneity regarding their eco-social preferences, this results in lower CSR performance. Further, we find first empirical evidence for the positive influence of universal as well as long-term ownership on CSR performance in line with theoretical assumptions articulated in the relevant literature.

We hope that this study inspires future work on better understanding the shareholders' potential to drive corporate businesses, especially with regard to meeting their eco-social preferences. On the other hand, this study is also intended to make (prospective) shareholders aware of their participation rights and thus of their own social responsibility. Furthermore, an outstanding empirical task is to determine whether this kind of shareholder primacy has the potential to enhance financial benefits. Finally, we hope that the methodological contribution of this article shifts the direction of ownership research towards the integration of quantifiable owner preferences.

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Tables

Table 1 – Global market capitalization and ownership coverage

	Global market capitalization	Aggregated market capitalization		Ownership Information			
Year	Trillion $	Trillion $	As % of global market capitalization	Number of owners	Number of firms held	Held value in trillion $	Covered ownership share
2002	22.77	20.31	89.19%	67,747	14,114	11.38	56.06%
2003	31.25	28.15	90.07%	74,230	14,911	16.13	57.30%
2004	36.68	33.00	89.97%	98,323	15,416	19.13	57.98%
2005	40.44	37.43	92.56%	121,917	16,890	22.43	59.93%
2006	49.99	45.88	91.78%	138,722	17,525	27.97	60.96%
2007	60.31	54.56	90.48%	156,399	18,493	35.65	65.34%
2008	32.27	29.68	91.99%	161,801	18,520	19.13	64.45%
2009	44.61	41.95	94.03%	166,615	18,737	27.52	65.61%
2010	51.47	48.19	93.63%	168,601	19,123	31.63	65.63%
2011	44.38	42.55	95.87%	173,552	19,269	28.11	66.06%
2012	51.13	48.49	94.83%	168,348	19,351	32.11	66.22%
2013	60.24	58.02	96.32%	168,506	19,516	39.27	67.67%
2014	63.43	60.58	95.50%	173,049	19,946	41.80	69.00%
2015	61.90	60.64	97.97%	182,984	20,334	41.73	68.82%
2016	65.00	62.53	96.21%	192,561	20,529	43.30	69.23%
2017	79.23	75.61	95.43%	195,506	20,497	52.82	69.86%
Average	49.69	46.72	93.49%	150,554	18,323	30.63	64.38%

This table shows summary statistics on the yearly coverage of global market capitalization and ownership information of our sample from 2002 to 2017. Global market capitalization is the worldwide market value of common equity according to Worldbank (2018). Aggregated market capitalization is the aggregated market value at each year-end out of our sample of 28,201 firms. We report ownership information regarding the number of owners observed, the number of firms held, the value held in $US (held value in trillion $), and as a proportion of aggregated market capitalization (covered ownership share). The data are from the RDS database, ROP database, and Worldbank (2018).

Table 2 – Summary Statistics

Panel A. Summary statistics (pooled)

	Observations	Mean	Standard deviation	p1	Median	p99
Market capitalization	338,897	2,352,406	10,940,484	640	351,980	37,168,513
Return	333,863	9.58%	52.41%	-95.47%	3.40%	192.84%
ESG-score	51,966	37.33	10.79	15.98	36.07	61.87
E-score	51,966	20.28	12.88	5.71	16.43	53.57
S-score	51,966	41.34	12.97	17.95	39.74	71.15
G-score	51,966	49.75	14.31	14.08	52.11	74.65

Table 2 continued – Summary Statistics

Panel B. Summary statistics by country

	All firms		Asset4 ESG firms					
	Firms	Ownership	Firms	Ownership	E score	S score	G score	ESG score
Argentina	33	34.80%	16	33.81%	13.53	32.17	22.58	23.10
Australia	837	50.17%	478	47.27%	15.64	39.01	52.70	35.98
Austria	74	64.51%	21	58.57%	21.45	41.63	42.16	35.35
Bahrain	25	48.06%	7	56.39%	6.79	25.32	37.25	23.26
Belgium	130	54.87%	35	54.45%	20.92	42.28	47.64	37.19
Brazil	307	63.67%	102	67.59%	24.10	50.49	41.11	39.01
Canada	1,423	45.60%	405	55.34%	17.44	38.92	60.84	39.16
Chile	133	81.56%	41	81.50%	20.28	43.39	30.14	31.71
China	3,383	53.72%	279	64.99%	15.78	36.18	41.05	31.24
Czech Republic	15	73.00%	5	80.92%	21.19	45.63	45.51	37.78
Denmark	127	46.64%	33	47.19%	22.56	43.82	45.30	37.51
Egypt	77	53.08%	11	63.66%	10.84	36.10	28.17	25.45
Finland	122	60.38%	29	53.27%	30.95	47.21	53.06	43.91
France	520	64.28%	122	62.26%	30.76	52.19	52.49	45.44
Germany	587	56.22%	127	59.37%	27.61	49.75	44.19	40.87
Greece	155	41.46%	25	48.11%	18.71	41.13	33.61	31.52
Hong Kong	1,224	62.66%	205	70.26%	15.59	38.92	46.68	33.98
Hungary	19	55.62%	4	68.26%	30.62	58.26	56.07	48.72
India	1,005	62.02%	103	77.27%	24.95	46.81	47.52	40.05
Indonesia	254	59.83%	37	73.04%	20.61	47.23	41.19	36.76
Ireland	61	63.50%	18	61.70%	18.18	40.41	54.19	37.77
Israel	194	65.70%	18	49.60%	17.56	42.85	44.76	35.39
Italy	298	64.78%	73	55.93%	23.91	48.23	45.89	39.70
Japan	2,897	49.02%	461	46.28%	26.39	39.19	27.72	31.38
Kuwait	131	49.76%	10	36.17%	11.17	33.48	33.76	26.44
Malaysia	423	51.15%	55	80.40%	19.03	45.97	51.86	39.27
Mexico	147	40.90%	47	48.44%	20.80	43.74	36.84	34.17
Morocco	41	66.94%	3	80.54%	12.32	46.84	26.01	29.05
Netherlands	152	50.24%	51	50.75%	25.68	48.93	55.66	43.68
New Zealand	101	40.67%	59	44.04%	15.58	35.71	47.16	32.99
Norway	244	62.43%	32	62.58%	21.73	44.53	48.40	38.50
Oman	33	47.54%	10	61.84%	10.14	36.48	39.96	29.19
Pakistan	86	13.19%	5	65.71%	10.57	32.95	28.73	24.43
Papua New Guinea	3	71.77%	-	-	-	-	-	-
Philippines	127	52.29%	24	65.18%	18.90	44.38	48.25	37.49
Portugal	43	77.74%	13	76.31%	26.22	50.03	47.33	41.54
Qatar	43	31.57%	14	45.96%	7.68	31.14	29.66	23.16
Russian Federation	205	61.03%	38	61.53%	20.96	43.90	43.77	36.53
Singapore	435	61.93%	55	62.45%	16.10	38.56	47.19	34.18
South Africa	314	56.72%	142	66.65%	22.11	52.33	58.63	44.71
South Korea	1,065	50.38%	136	60.93%	27.16	47.13	30.75	35.43
Spain	189	60.92%	66	59.42%	27.62	53.04	48.55	43.46
Sweden	342	58.95%	74	59.35%	25.57	45.25	50.27	40.58
Switzerland	269	49.39%	82	48.92%	23.00	44.25	49.49	39.16
Taiwan	979	43.84%	146	50.49%	22.89	39.95	33.14	32.29
Thailand	249	48.74%	30	54.84%	22.13	46.69	52.46	40.71
Turkey	183	32.55%	30	71.58%	23.63	40.61	38.29	34.43
United Kingdom	1,450	74.63%	469	79.64%	22.07	45.71	56.92	41.79
United States	6,950	72.93%	2,843	87.20%	16.54	37.49	57.30	37.22
Vietnam	97	55.97%	-	-	-	-	-	-

Table 2 continued – Summary Statistics

Panel C. Summary statistics by industry

	All firms		Asset4 ESG firms					
	Firms	Ownership	Firms	Ownership	E score	S score	G score	ESG score
Basic Materials	2,695	55.30%	674	63.08%	25.53	43.11	51.31	40.15
Cyclical Consumer G&S	3,883	63.48%	971	73.62%	20.06	40.27	48.57	36.50
Energy	1,580	58.66%	501	67.73%	20.76	41.32	54.23	38.93
Financials	4,749	56.37%	1540	65.63%	13.94	39.35	49.32	34.46
Healthcare	2,061	60.59%	637	73.54%	15.98	39.45	50.89	35.66
Industrials	4,236	59.32%	1,059	67.83%	23.90	42.37	48.08	38.32
n.a.	3,234	55.19%	141	68.63%	11.23	32.09	44.57	29.47
Non-Cyclical Consumer G&S	1,653	61.22%	447	68.40%	21.20	43.67	49.41	38.35
Technology	3,062	57.41%	669	72.53%	22.04	40.62	49.09	37.43
Telecommunications Services	388	60.58%	174	67.27%	18.08	46.12	50.27	38.50
Utilities	660	58.92%	276	63.43%	29.60	46.40	51.66	42.74
Total	28,201	58.78%	7,089	68.34%	20.28	41.34	49.75	37.33

Panel A of this table shows summary statistics of market capitalization, returns as well as environmental, social, governance, and ESG scores. Return is the yearly stock return winsorized at the 1%-level, ESG scores are calculated as described in the text. Panel B shows the average percentage of covered ownership information (Ownership) by country for the full sample and the subsample of Asset4 ESG firms, ESG Scores, and its subscores are shown as averages. Panel C shows the same variables as in Panel B by industry. The data is obtained from the ASSET4 ESG, RDS, and ROP database.

Table 3 – Portfolio characteristics by investor type

	N	E score	S score	G score	ESG score	Portfolio Value $Tsd.	# Holdings	Turnover	Return
		mean (standard deviation)							
Bank and Trust	6,962	27.78 (9.82)	47.43 (9.89)	54.62 (14.11)	43.48 (9.88)	1,446,999 (6,622,538.75)	164.83 (343.39)	10.15% (11.20%)	9.13% (25.72%)
Corporation	78,495	21.64 (12.79)	40.81 (11.86)	40.73 (15.02)	34.66 (10.65)	830,038 (4,481,494.02)	5.12 (33.34)	1.40% (4.68%)	9.69% (39.22%)
Endowment Fund	192	22.66 (11.70)	41.61 (10.23)	57.74 (9.10)	40.78 (9.46)	473,500 (1,188,864.13)	59.13 (165.32)	11.12% (14.94%)	9.10% (29.14%)
Foundation	307	25.62 (14.83)	44.98 (12.63)	54.92 (13.36)	42.02 (12.61)	595,404 (1,482,838.66)	33.31 (109.95)	4.30% (8.25%)	11.06% (33.88%)
Government/SWF	1,535	28.48 (12.51)	50.91 (13.19)	50.96 (12.96)	43.76 (11.10)	15,563,791 (45,283,209.22)	105.09 (684.15)	3.94% (6.97%)	10.07% (36.21%)
Hedge Fund	29,558	22.35 (8.88)	43.38 (9.15)	57.11 (8.80)	41.11 (7.67)	4,414,011 (35,601,596.42)	250.15 (684.36)	15.25% (13.87%)	10.00% (30.15%)
Holding Company	2,567	23.18 (12.29)	45.64 (13.24)	45.40 (13.79)	38.38 (11.16)	3,085,615 (6,213,982.21)	8.12 (46.42)	1.93% (5.40%)	12.18% (41.37%)
Individual Investor	479,858	19.65 (12.07)	41.95 (12.05)	56.19 (10.66)	39.44 (9.81)	35,686 (608,878.72)	1.28 (0.80)	0.69% (3.88%)	13.06% (41.20%)
Insurance Company	2,088	25.31 (11.24)	45.49 (10.69)	49.33 (14.09)	40.29 (10.08)	3,223,739 (11,040,276.48)	109.65 (365.51)	7.51% (8.77%)	10.08% (28.07%)
Investment Advisor (incl. Mutual Funds)	60,914	25.58 (9.49)	46.32 (9.38)	56.72 (10.64)	43.06 (8.67)	2,283,112 (23,523,133.44)	188.60 (462.45)	13.12% (11.81%)	10.15% (26.50%)
Others	5,338	21.67 (11.12)	42.88 (11.73)	51.07 (12.77)	38.76 (10.03)	2,571,006 (9,527,110.66)	155.97 (522.59)	5.54% (11.86%)	13.00% (39.77%)
Pension Fund	2,696	26.74 (9.19)	48.96 (9.39)	57.26 (10.25)	44.55 (8.42)	6,222,584 (19,681,654.78)	396.16 (913.82)	9.06% (9.61%)	10.11% (29.22%)
Private Equity	1,504	16.28 (10.91)	37.64 (11.31)	51.95 (9.85)	35.45 (8.95)	776,684 (1,578,389.12)	9.73 (18.36)	7.34% (11.79%)	11.48% (42.95%)
Venture Capital	727	14.68 (9.94)	35.23 (12.01)	50.88 (9.18)	33.74 (8.75)	431,783 (827,773.82)	14.57 (43.46)	8.51% (12.09%)	9.59% (43.96%)
All	672,741	20.71 (11.95)	42.40 (11.78)	54.33 (12.35)	39.34 (9.96)	643,179 (10,871,010.30)	34.79 (232.90)	3.03% (8.01%)	12.27% (10.63%)

This table shows summary statistics of owner characteristics categorized by the Refinitiv's predefined typology. Owner characteristics are calculated as described in the text and shown as means and standard deviations (in brackets) within each owner type between 2002 and 2017.

Table 4 – Ownership Characteristics

	Mean	Median	Standard deviation	p1	p99
Ownership E score	21.69	23.86	9.51	1.11	40.39
Ownership S score	37.81	42.66	14.46	2.14	60.17
Ownership G score	44.37	49.48	18.00	2.42	65.98
Ownership ESG score	34.78	39.04	13.53	1.91	52.32
Ownership E score Heterogeneity	6.20	5.52	3.04	1.41	13.54
Ownership S score Heterogeneity	8.27	5.86	5.75	1.51	21.05
Ownership G score Heterogeneity	9.47	7.36	6.80	1.64	23.89
Ownership ESG score Heterogeneity	7.45	5.35	5.23	1.18	18.97
Ownership # of Holdings	1,805.22	1,523.62	1,328.48	35.66	5,291.27
Ownership Turnover	11.12%	11.84%	5.76%	0.46%	24.10%
Ownership Return	7.17%	7.17%	17.60%	-43.29%	55.74%

This table shows summary statistics on ownership characteristics and heterogeneity of 42,237 firm-years. Variables are defined as described in the text.

Table 5 – Ownership Characteristics and their relation to CSR

	(1) Firm E score	(2) Firm S score	(3) Firm G score	(4) ESG score
Ownership E score	0.106***			
	(0.014)			
Ownership S score		0.028***		
		(0.008)		
Ownership G score			0.062***	
			(0.008)	
Ownership ESG score				0.044***
				(0.008)
Ownership E score Heterogeneity	-0.388***			
	(0.059)			
Ownership S score Heterogeneity		-0.076		
		(0.055)		
Ownership G score Heterogeneity			-0.466***	
			(0.045)	
Ownership ESG score Heterogeneity				-0.554***
				(0.051)
Ownership Holdings	-0.118	0.290***	0.697***	0.250***
	(0.096)	(0.096)	(0.110)	(0.081)
Ownership Turnover	-5.969***	-1.802	-8.734***	-4.197***
	(1.416)	(1.363)	(1.405)	(1.111)
Ownership Return	-0.488**	-0.980***	-1.291***	-0.888***
	(0.208)	(0.197)	(0.220)	(0.165)
Tobin's Q	0.135*	0.035	-0.040	0.051
	(0.069)	(0.059)	(0.063)	(0.050)
Return	-0.426***	-0.606***	-0.630***	-0.533***
	(0.082)	(0.076)	(0.083)	(0.063)
Size	0.540***	0.783***	0.489***	0.613***
	(0.117)	(0.106)	(0.116)	(0.091)
Assets Tangibility	-0.541	0.095	0.025	-0.234
	(0.427)	(0.416)	(0.406)	(0.334)
Leverage	0.003	0.036	-0.013	0.010
	(0.046)	(0.043)	(0.041)	(0.036)
Constant	10.440***	22.250***	35.193***	23.970***
	(2.546)	(2.336)	(2.519)	(1.966)
Observations	42,237	42,237	42,237	42,237
Within R-squared	0.015	0.013	0.029	0.029
Adjusted R-squared	0.893	0.901	0.911	0.910

This table reports regression estimates of ESG scores on ownership characteristics and control variables with time and firm fixed effects. The sample consists of 42,237 firm-years (excluding incomplete and singleton observations). Standard errors are clustered at the firm level and are reported in parentheses. Significance levels are denoted by asterisk (*** p<0.01, ** p<0.05, * p<0.1).

Table 6 – Ownership Characteristics as a driver of CSR performance

	(1) Lead Firm E Score	(2) Lead Firm S score	(3) Lead Firm G score	(4) Lead Firm ESG Score
Ownership E score	0.019**			
	(0.009)			
Ownership S score		0.009*		
		(0.005)		
Ownership G score			0.012**	
			(0.005)	
Ownership ESG score				0.016***
				(0.004)
Ownership E score	-0.174***			
Heterogeneity	(0.034)			
Ownership S score		0.011		
Heterogeneity		(0.034)		
Ownership G score			-0.099***	
Heterogeneity			(0.031)	
Ownership ESG score				-0.212***
Heterogeneity				(0.033)
Ownership Holdings	0.136**	0.274***	0.208**	0.245***
	(0.061)	(0.065)	(0.093)	(0.052)
Ownership Turnover	-1.364*	-0.899	-1.882**	-1.506***
	(0.724)	(0.826)	(0.915)	(0.556)
Ownership Return	-0.212	-0.301*	0.013	-0.248**
	(0.142)	(0.154)	(0.173)	(0.107)
Firm E score	-0.144*			
	(0.075)			
Firm S score		-0.036		
		(0.041)		
Firm G score			0.027	
			(0.035)	
Firm ESG score				-0.383***
				(0.061)
Tobin's Q	-0.003	0.087**	0.007	0.035
	(0.039)	(0.044)	(0.044)	(0.034)
Return	-0.113**	-0.047	-0.219***	-0.211***
	(0.057)	(0.061)	(0.063)	(0.047)
Size	0.273***	0.260***	0.359***	0.408***
	(0.070)	(0.076)	(0.078)	(0.064)
Assets Tangibility	-0.163	0.646***	0.242	0.109
	(0.215)	(0.239)	(0.265)	(0.176)
Leverage	-0.001	0.019	-0.024	-0.006
	(0.021)	(0.028)	(0.031)	(0.020)
Constant	1.307***	1.172***	0.906***	1.642***
	(0.107)	(0.070)	(0.059)	(0.096)
Observations	30,451	30,451	30,451	30,451
R-squared	0.108	0.013	0.132	0.296

This table reports regression estimates of first differenced ESG scores on first differenced ownership characteristics, control variables and time fixed effects following Anderson and Hsiao (1981). The sample consists of 30,451 firm-years (excluding incomplete and singleton observations). Standard errors are clustered at the firm level and are reported in parentheses. Significance levels are denoted by asterisk (*** p<0.01, ** p<0.05, * p<0.1).

Table 7 – Granger causality Tests

Panel A. Ownership ESG-scores and firm ESG-scores

	(1) Lead Firm E score	(2) Lead Firm S score	(3) Lead Firm G score	(4) Lead Firm ESG score	(5) Lead Ownership E score	(6) Lead Ownership S score	(7) Lead Ownership G score	(8) Lead Ownership ESG score
Ownership E score	0.019**				0.511***			
	(0.009)				(0.131)			
Ownership S score		0.009*				0.509***		
		(0.005)				(0.131)		
Ownership G score			0.012**				0.493***	
			(0.005)				(0.137)	
Ownership ESG score				0.016***				0.505***
				(0.004)				(0.136)
Firm E score	-0.144*				-0.010			
	(0.075)				(0.007)			
Firm S score		-0.036				-0.003		
		(0.041)				(0.011)		
Firm G score			0.027				-0.007	
			(0.035)				(0.011)	
Firm ESG score				-0.383***				-0.008
				(0.061)				(0.014)
Ownership Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	30,451	30,451	30,451	30,451	30,451	30,451	30,451	30,451
R-squared	0.108	0.013	0.132	0.296	0.750	0.721	0.749	0.728

Table 7 continued – Granger causality Tests

Panel B. Ownership characteristics and firm ESG score

	(1)		(2)		(3)		(4)	
	Lead Firm ESG score	Lead Ownership Heterogeneity	Lead Firm ESG score	Lead Ownership Holdings	Lead Firm ESG score	Lead Ownership Turnover	Lead Firm ESG score	Lead Ownership Return
Ownership ESG score	0.015***	-0.005***	0.015***	0.002	0.016***	-0.000***	0.016***	-0.000
	(0.004)	(0.002)	(0.004)	(0.008)	(0.004)	(0.000)	(0.005)	(0.000)
Ownership Heterogeneity	-0.210***	0.424***	-0.207***	-0.020	-0.210***	-0.000	-0.213***	0.004
	(0.032)	(0.119)	(0.032)	(0.020)	(0.032)	(0.000)	(0.033)	(0.003)
Ownership Holdings	0.267***	0.050	0.243***	-0.120	0.239***	-0.004***	0.247***	-0.015***
	(0.057)	(0.033)	(0.055)	(0.367)	(0.054)	(0.001)	(0.056)	(0.005)
Ownership Turnover	-1.527**	0.453**	-1.511**	0.280	-1.504**	0.153***	-1.582***	0.248***
	(0.594)	(0.186)	(0.593)	(0.673)	(0.593)	(0.034)	(0.598)	(0.058)
Ownership Return	-0.249**	-0.087***	-0.247**	-0.038	-0.246**	-0.000	-0.244**	0.081***
	(0.109)	(0.031)	(0.109)	(0.027)	(0.109)	(0.002)	(0.109)	(0.023)
Firm ESG score	-0.381***	0.003	-0.382***	0.000	-0.382***	0.000	-0.369***	-0.001**
	(0.061)	(0.002)	(0.061)	(0.001)	(0.061)	(0.000)	(0.061)	(0.000)
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	30,442	30,442	30,468	30,468	30,468	30,468	29,951	29,951
R-squared	0.317	0.119	0.317	0.081	0.317	0.143	0.324	0.630

This table reports the results of Granger causality tests on the influence of ownership characteristics on CSR. In Columns (1) through (4) of Panel A, the dependent variables are the firms' future environmental, social, governance and ESG performance. In Columns (5) through (8), the dependent variables are the respective future ownership scores. Panel B reports the results of the same test pairwise for each of the remaining ownership characteristics. All tests are carried out as panel VAR including all ownership and firm controls as well as year fixed effects. Robust standard errors are reported in parentheses. Significance levels are denoted by asterisk (*** p<0.01, ** p<0.05, * p<0.1).

6 Article V: Herds on green meadows: the decarbonization of institutional portfolios

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Journal of Asset Management, Vol. 21 No. 1, pp. 13–31.

https://doi.org/10.1057/s41260-019-00147-z

Abstract.

We analyze an emerging sustainable trend in asset management: the decarbonization of institutional portfolios. By using broad institutional ownership data we show that investors exhibit herding behavior in the sense of decarbonization. They are inclined to follow their own or other investors' buys in green stocks and sales in brown stocks over adjacent quarters. Beyond that, we find that Hedge Funds as well as Investment Advisors lead the herd by executing trades in the sense of decarbonization. This is in line with expectations that sophisticated investors, who integrate environmental aspects into their investment decision process, are able to attract imitators. For the aspired achievement of market-wide decarbonization, investors leading the herd should be encouraged to further decarbonize their portfolios in order to trigger follow-up trades.

JEL Classification: G11, G15, G23, M14

Keywords: Decarbonization, institutional investors, herding

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7 Conclusion

This dissertation aims to improve the general understanding of the various types of risk found in the portfolio of institutional investors.

The first article sheds light on the risk to which extend US domestic equity funds are exposed to various financial securities and shows the effects of the combined use of linear and non-linear instruments on the risk, performance, and other characteristics of funds. It is shown that the average exposure in relation to the TNA of the funds resulting from the individual complex derivatives is almost negligible even in the extremes and does not exceed 2% of the net assets even when aggregated. Consequentially, the effects of these investments on funds' risks, performance and other characteristics are minor. The results presented in this article contribute, inter alia, to the literature on the influence of complex risk caused by using derivatives. The methodical approach of a simultaneous consideration of the exact non-linear and linear exposure of the funds is the great advantage of this study. Previous analyses regarding the use of derivatives by funds have usually used only crude indicator variables, resulting in the loss of crucial information and potentially distorting results. By taking the exact composition of the portfolio into account, a more precise determination of the influences on the fund characteristics is possible. The findings of this study sustainably increase the understanding concerning the influence of non-linear risk exposure driven by complex derivatives on mutual funds and demonstrate the importance of the exact consideration of the funds' portfolio composition rather than the sole use of a particular financial instrument.

Article II deals with the issue of interim trading risk arising from unobservable trading activities by fund managers between two consecutive holdings reports. Using an extension of the method of Kacperczyk *et al.* (2008), the impact of these unobservable trading activities is measured by comparing the actual risk the funds are exposed to with the approximated risk that

reflects the risk expected from the reported holding positions. The results of this study illustrate the relevance of the correct consideration of the interim trading behavior of fund managers when examining the funds' performance and risk based on published holdings. It is shown that an excessive interim trading, measured by the intermediate deviation of the actual risk compared to the risk expected from the reported holdings, comes with an increase in the risk-adjusted performance. However, this trading behavior of the fund managers has a negative impact on the gross return of the funds, which is not favorable from the investors' point of view. Therefore, future research should take the trades executed in between two reportings into account to a greater extent as they have a significant influence on funds' performance and risk measures.

The third article deals with another type of risk faced by institutional investors, which is one of the risks resulting from the worldwide transition process of the economy, the so-called carbon risk. To this end, the exposure to and management of these carbon risks of different groups of institutional investors are examined from 2000 to 2015. Thereby, it is shown that governmental agencies hold the highest proportion of carbon-intensive stocks in their portfolio, with 49% of their assets under management being identified as heavy polluting. In addition, the governmental agencies hold the highest percentage of the outstanding shares of the carbon-intensive companies held. If the entire universe of all carbon-intensive stocks is considered, and not just those held by investors, a different picture emerges. The results reveal that hedge funds and investment advisors have the largest share of ownership in all of these companies and are therefore identified as the main financiers and at the same time the beneficiaries of the polluting companies. The results of this study provide, inter alia, policy makers with information on potential addressees of regulation, namely hedge funds and investment advisors. These groups will have an important role to play in ensuring that financial flows are consistent with the transition to a low-carbon economy as defined by the Paris Convention (UNFCCC, 2015). In

addition, this study is intended to stimulate future research to further investigate the influence of the ownership structure of carbon-intensive companies on the level of the companies' emissions and their carbon risk management.

The influence of shareholder engagement, already briefly mentioned in Article III, is further examined in Article IV. The study examines whether the preference of the owners regarding specific firm characteristics has an influence the respective company. This study shows that there is a positive correlation between the eco-social preference of the owners and the CSR performance of the company. This implies that the management reacts to the eco-social demands of the owners, whereby no distinction is made between an active influence or a proactive adjustment by the company. According to the study, CSR performance is negatively affected if the company is associated with a higher heterogeneity of investors' eco-social preferences. This suggests that differences in investor preferences could therefore complicate the engagement process or even have negative effects. The results of this study reinforce the idea of shareholder engagement as a driver of change towards a greener economy. The study is intended to inspire new research to better understand the process of shareholder engagement and its importance and impact in relation to the transition process caused by climate change. Furthermore, the methodology to measure owner preferences and their impact on the key business indicators proposed in this study can be universally applied in future work and is not limited to the analysis of CSR performance, which should be exploited by future research.

The PDC's goal of mobilizing a critical mass that reallocates its portfolio in the sense of decarbonization (PDC, 2015) is examined more closely in the final article of this dissertation. First, using traditional herding measures (following Sias (2004)), it is shown that there are groups of investors who, through their trades, trigger a large number of follow-up trades in the next quarter. Subsequently, this finding is combined with a classification of the firms with respect to their ESG score. By doing this, it is shown that investors are more likely to follow

the trades of other investors in the next quarter if these are carried out in the sense of decarbonization, i.e. the purchase of green companies as well as the sale of brown companies trigger more follow-up actions than trades in the sense of carbonization. The main objective of the PDC is supported by this study and it is even shown which group of institutional investors is the one leading the herd. In specific, the trades of investment advisors and hedge funds are followed most often, and these types of investors are best suited to mobilize the desired critical mass to achieve the long-term goal of decarbonization. This study focused mainly on an as-is description of the phenomenon of herding regarding the trend of decarbonization. Further investigations on the underlying causes of the decarbonization herding and its influence on the stock prices of green and brown companies are left to future research.

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