



Integrating sustainability risks in asset management: the role of ESG exposures and ESG ratings

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Abstract

The rising sustainability awareness among regulators, consumers and investors results in major sustainability risks of firms. We construct three ESG risk factors (Environmental, Social and Governance) to quantify the ESG risk exposures of firms. Taking these factors into account significantly enhances the explanatory power of standard asset pricing models. We find that portfolios with pronounced ESG risk exposures exhibit substantially higher risks, but investors can compose portfolios with lower ESG risks while keeping risk-adjusted performance virtually unchanged. Moreover, investors can measure the ESG risk exposures of all firms in their portfolios using only stock returns, so that even stocks without qualitative ESG information can be easily considered in the management of ESG risks. Indeed, strategically managing ESG risks may result in potential benefits for investors.

Keywords ESG ratings · ESG exposures · Risk management · Stock returns · CSR

JEL Classification G11 · G12 · G14 · G23

Introduction

In 2017, insurers paid a record of \$134bn in compensation for natural disasters (Aon Benfield 2017). Highlighting the importance of effective governance, Volkswagen's emissions scandal in 2015 resulted in equity market value losses of more than \$20bn for Volkswagen within five trading days and substantial losses for Volkswagen's competitors due to spillover effects (Barth et al. 2019a). Also, population growth, globalization and inequality impose severe sustainability challenges. Recognizing the importance of such environmental, social and governance (ESG) considerations, the United Nations formalized the Sustainable Development Goals (SDGs, United Nations 2015) which were adopted by governments around the world.

Promoting sustainability by achieving these SDGs requires profound changes in the economic environment. Consumers, investors and other stakeholders expect firms to adopt sustainable business models. Also, regulatory authorities are driving the integration of ESG considerations by directing private capital flows toward sustainable investments.¹ For instance, in 2019, the European Parliament is expected to adopt a fundamental directive intended to put “*ESG considerations at the heart of the financial system*” (Directive 2016/2341). Risks arising from these effects are hardly diversifiable, as they affect the whole economic environment, not just single firms or industries (Scholtens 2017).

To be effective, risk management systems need to consider ESG risks when assessing portfolios. For investors, risk management is a main motivation to consider ESG in their investment decisions. However, a lack of quantitative ESG data which is comparable, easily accessible and of high quality slows the integration of ESG (CFA Institute 2017).

We therefore propose to apply return-based ESG exposures to measure ESG risks and integrate these into asset management. In doing so, we contribute to the existing

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¹ Private investments are needed to close the €180-billion gap in additional yearly investments needed to meet the SDGs (European Commission 2018).



literature in three ways. First, we explore three ESG-related risk factors in order to capture ESG risk exposures of firms. Second, we derive conclusions regarding the link between ESG and performance by composing portfolios based on ESG ratings and ESG exposures.² Third, we investigate whether the performance of stocks without ESG ratings affects these conclusions.

Our empirical study applies an augmented Fama and French (2015) five-factor model to estimate ESG risk exposures of firms. For each ESG pillar, we develop one ESG-related zero-investment factor that covers the return differences between firms with high ESG ratings (long) and firms with low ESG ratings (short). In the same spirit, Statman and Glushkov (2016) develop two ESG-related factors to classify mutual funds. In contrast to our study, their factors are related to ESG-motivated exclusions of sin industries and do not investigate the three ESG pillars separately.³ Especially, Gorgen et al. (2018) develop a carbon factor to measure the sensitivities of firms to stock market's time-varying perception of risks arising from the transition toward a carbon-free economy. This carbon factor covers risks of firms regarding carbon emissions along the value chain, public perception of carbon policy and adaptability of low-carbon business models. In contrast, our environmental factor is more generally defined, relying on the overall environmental performance. In addition to carbon emissions, this includes resource use (for example, energy consumption and waste treatment), water emissions as well as firms' capabilities to foster innovations reducing overall environmental costs. Henriksson et al. (2019) construct an ESG-related factor to overcome the sparse voluntary ESG data reported by firms in the S&P 500. Unlike our factors, they do not distinguish between the three ESG pillars and they do not rely on ESG ratings but on material ESG information published by the firms themselves.

In general, ESG ratings are usually available for a limited number of stocks only. In the empirical literature on equity funds, usually 20–40 percent of equity portfolios remain unrated (Kempf and Osthoff 2008; Auer 2016; Henke

2016; El Ghoual and Karoui 2017). Sidestepping the issue, authors often assume that rated stocks appropriately represent unrated stocks (Wimmer 2013; Borgeers et al. 2015; Ameer 2016; Auer 2016). Neglecting unrated stocks reduces the investment universe which could impact performance through a lack of diversification. Also, ESG rating agencies predominantly cover large firms resulting in a systematic lack of small firms in ESG portfolios. Unlike ESG ratings, stock returns are broadly available enabling us to calculate ESG risk exposures for all firms. Therefore, composing ESG portfolios based on ESG exposures enables us to consider both rated and unrated stocks.

Studying a comprehensive sample of European stocks from 2003 to 2016, we derive four main results. First, ESG ratings and ESG exposures of firms correlate positively but not perfectly. Differences between ratings and exposures may be caused by the industry benchmarking of ESG ratings and by ESG risks which are not assigned to firms by ESG rating agencies. Second, the environmental risk factor yields a significant positive annual mean return of three percent, indicating that “brown” firms outperform “green” firms. Third, the social risk factor shows significant and negative returns during recessions. This suggests that the least social firms underperform the most social firms, which is in line with a “flight to quality” effect during crisis periods. Fourth, ESG factors significantly enhance the explanatory power of standard asset pricing models. However, our results do not point to a systematic ESG-related risk premium or discount. While very pronounced ESG exposures are associated with higher portfolio risks, we show that investors can still reduce ESG risk exposures of their portfolios without harming performance.

The remainder of the paper is organized as follows: “[ESG exposures versus ESG ratings](#)” section describes and compares the concepts of ESG ratings and ESG exposures. “[ESG factors and stock returns](#)” section presents the data and introduces our three ESG risk factors. Following a descriptive analysis of the factors, we carry out asset pricing tests for ESG decile portfolios. “[Portfolio performance under consideration of ESG](#)” section delivers risk and return properties of ESG portfolios based on ESG ratings and ESG exposures. In addition, we examine if unrated stocks affect our results. Subsequently, we investigate ESG risks from an investor's perspective. “[Conclusion](#)” section concludes.

ESG exposures versus ESG ratings

ESG concerns such as natural resources, supply chain flow and labor reliability, as well as evolving governance regulations, play an important role when assessing investment risks. Hence, it is of crucial importance for investors to consider ESG risks in their risk management systems.

² There is an ongoing debate regarding the impact of ESG integration on financial performance. Though there is evidence for CSR affecting corporate performance [for example, Hong and Kacperczyk (2009); El Ghoual et al. (2011); Chava (2014) and Eccles et al. (2014)], literature investigating the performance of ESG portfolios shows mixed results. Papers covering the US market [for example, Derwall et al. (2005); Galema et al. (2008); Dorfleitner et al. (2018); Gloßner (2018) and Amiraslani et al. (2019)] and the European market (Brammer et al. 2006; Mollet and Ziegler 2014; Auer 2016; Auer and Schuhmacher 2016 and Barth et al. 2019b) indicate a partly positive relation between CSR and performance for the US, whereas the evidence for Europe does not show a significant performance impact.

³ Similarly, Jin (2018) applies one aggregated ESG-related factor to evaluate U.S. equity funds and finds that fund managers tend to hedge ESG-related systematic risks.



Accordingly, access to consistent, comparable and reliable ESG information has become a precondition to making investment decisions.

To assess a firm's level of sustainability, researchers and practitioners usually rely on ESG ratings. Based on publicly available information, private rating agencies aggregate a large number of ESG-related indicators to derive numeric ESG labels for each firm. More specifically, rating agencies usually derive ratings for each of the three ESG pillars separately, as well as collating one aggregated ESG rating. In this paper, we use each of the three ESG ratings separately to determine the ESG risk exposures of firms based on correlations between stock returns and the respective ESG risk factors. Importantly, these ESG exposures are not designed to replace ESG ratings. Rather, they reflect firms' sensitivities to ESG risks triggered by the rising sustainability consideration on capital markets.

To get a sense of the relationship between ESG ratings and the ESG exposures of firms, we calculate Spearman rank correlations of the two over time and for each pillar. These correlations range around 0.25. Although the correlations are significantly positive, there are still notable differences between rankings based on ESG ratings and ESG exposures.⁴ These differences might arise when publicly available information (ESG reports, media coverage, etc.) implies a high level of ESG, whereas information reflected in stock returns shows a positive risk exposure to ESG factors or vice versa. We identify two main causes of such discrepancies: (1) unassigned ESG risks and/or (2) industry adjustments of ESG ratings.

Unassigned ESG risks occur if ESG ratings do not reflect firm-specific characteristics causing a (positive or negative) correlation of the firm's returns and the ESG factors' returns. For instance, consider a grocery retailer that is highly responsible based on common ESG measures such as eco-efficient supply chain management, safe and satisfied workforce and commitment to best practice governance principles. Based on comprehensive ESG reports, the firm might receive very high ESG ratings. However, if the grocery branches are located on the Las Vegas Strip, the firm's returns correlate with the neighboring gambling casinos. Consequently, the firm's ESG exposure would indicate high ESG risks (Statman 2016). Irrespective of the question of whether rating agencies should punish the firm for selling products in Las Vegas, ESG exposures can help investors to be aware of the ESG risks associated with the firm. Such unassigned ESG risks can also be triggered or strengthened by ESG information being published by the target firm itself. This makes ESG ratings subject to

potential greenwashing and incomplete data (Parguel et al. 2011).⁵

In addition, commonly used ESG rating agencies, such as MSCI, Sustainalytics or Thomson Reuters, provide relative ESG ratings using industry adjustments. ESG ratings provide insights regarding the ESG performance of a firm relative to its industry peers, whereas ESG exposures deliver absolute exposures to ESG risks. For instance, consider the oil and gas firm Royal Dutch Shell. Numerous sustainability activities make Shell a leader within its industry resulting in high environmental ratings. According to its environmental ratings, Shell is among the best stocks in our sample. Nevertheless, Shell's value chain is associated with extensive greenhouse gas emissions and considerable use of materials, energy and water. Shell's stock returns are therefore associated with high environmental risk exposures. Accordingly, Shell is ranked low in our sample, with regard to its (absolute) environmental exposure.

In summary, investors usually apply ESG ratings to assess ESG risks of firms. These ESG ratings provide numeric, industry-benchmarked ESG labels. We propose to enhance investors' ESG risk assessment using ESG exposures based on standard asset pricing techniques that reflect the valuable informational content of stock returns.

ESG factors and stock returns

Data

As a measure of corporate sustainability, we use ESG ratings from the Thomson Reuters ESG database which is a replacement and enhancement of the ESG database ASSET4 (Utz and Wimmer 2014; Chatterji et al. 2015; Dorfleitner et al. 2015). Thomson Reuters provides transparent, accurate and comparable ESG ratings for a global universe of more than 4500 firms (Stellner et al. 2015). Based on quantitative and qualitative ESG data (ESG reports, NGO announcements, etc.), Thomson Reuters derives more than 400 firm-level ESG measures. These measures are aggregated to three firm-level ESG pillar ratings. A percentile rank methodology leads to relative ESG ratings ranging from the lowest percentile (lowest level of ESG) to the highest percentile (highest level of ESG).⁶

⁴ Kendall's rank correlations are slightly lower in magnitude, but p values remain below 1%.

⁵ Although we use ESG ratings in the construction of the ESG factors, ESG exposures should be largely independent of greenwashing and incomplete data due to diversification effects.

⁶ E- and S-ratings for each firm are benchmarked against the firm's industry peers. Governance scores are calculated against the firm's country of headquarter.



Table 1 Data and descriptive statistics

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
<i>Panel A: # of stocks</i>														
All stocks	1019	980	981	1018	1023	1057	1034	918	946	1113	1058	1061	1070	1066
Rated	415	432	600	755	778	815	825	789	806	839	824	829	838	837
Unrated	604	548	381	263	245	242	209	129	140	274	234	232	232	229
	Min		5th P		1st Q		Median		Mean		3rd Q		95th P	Max
<i>Panel B: descriptive statistics of ESG ratings</i>														
ENV	13.39		28.60		46.73		59.62		58.70		71.94		84.39	96.32
SOC	7.36		26.72		44.62		57.57		56.42		68.76		82.83	93.09
CGV	3.92		21.14		36.62		49.30		48.96		60.47		75.57	97.16

This table shows descriptive statistics of the sample stocks and their Thomson Reuters ESG ratings. Panel A reports the numbers of all index constituents in the STOXX Europe Total Market index, as well as the number of rated and unrated stocks at the end of each year from 2003 to 2016. Panel B shows descriptive statistics on the time series means of environmental, social and governance ratings for all rated stocks between 2003 and 2016

Our empirical analysis focuses on the European stock market, as Europe accounts for over half of the assets managed sustainably worldwide (GSIA 2017). We use yearly constituents of the STOXX Europe Total Market Index which covers approx. 95 percent of free float market capitalization across 17 European countries from EIKON.

Panel A of Table 1 shows the total number of stocks, divided into stocks with and without ESG ratings at each year end from 2003 to 2016. The total number of stocks ranges between 918 and 1113. The number of rated stocks increases from 415 in 2003 to 837 in 2016. The beginning of the sample period is determined by the availability of the Thomson Reuters ESG ratings. Importantly, Thomson Reuters did not change the rating methodology during the sample period. Panel B of Table 1 shows descriptive statistics regarding the ESG ratings.

For all stocks, we downloaded daily and monthly total returns, closing prices, market values (all in Euro), dividend yields and Industry Classification Benchmark codes from EIKON. Concerning stock returns, we apply usual corrections following Ince and Porter (2006). The returns of the five Fama and French factors, as well as the momentum factor, are downloaded from Kenneth R. French data library.⁷ As risk-free rates, we use the 1-month EURIBOR and the daily EONIA from EIKON.

Factor construction and estimation of ESG exposures

We examine each ESG pillar (ENV, SOC and CGV) separately instead of considering them together as one aggregated ESG factor, as mixing the three pillars might have confounding effects (Galema et al. 2008). For instance, a firm with well-developed governance structures and weak employee relations may show an average ESG rating although neither its G- nor its S-rating is close to average. In addition, the firm's stock returns may face offsetting impacts making it very difficult to assess the firm's ESG risk exposure based on its returns—even though it is clear that the firm is exposed to social risks. For these reasons, ESG pillars may partly overlap under certain circumstances leading to a trade-off between specificity and cleanness.

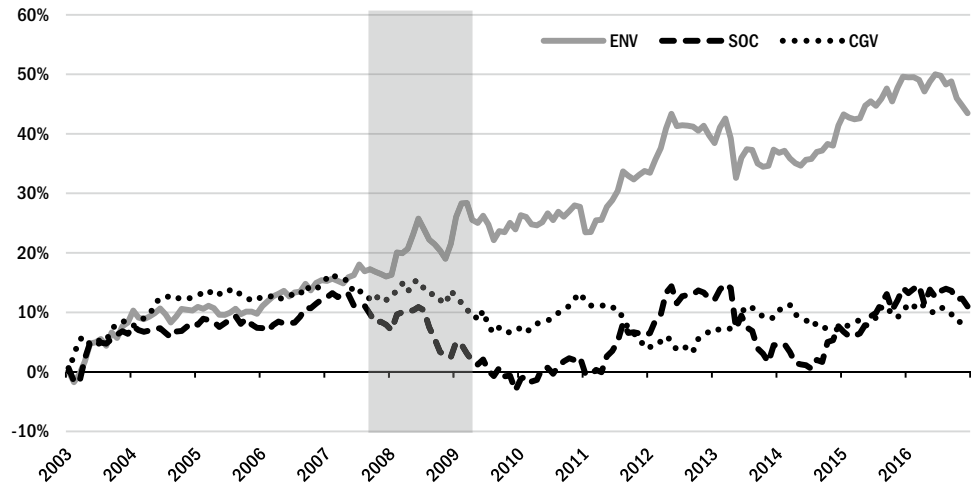
The ENV factor represents the returns of a zero-investment portfolio with long positions in firms with low environmental ratings and short positions in firms with high environmental ratings. More precisely, like Gørgen et al. (2018) introducing a carbon factor, we follow the Fama and French (1993) methodology when constructing our ESG factors. To determine the ENV factor, we unconditionally sort stocks into six portfolios based on their market capitalization and their environmental rating. As breakpoints, we apply the median size and terciles of the respective environmental ratings. We calculate monthly value-weighted returns for four of the six portfolios: small size and low environmental rating (SL), big size and low environmental rating (BL), small size and high environmental rating (SH) and big size and high environmental rating (BH).⁸ As all ESG ratings are

⁷ We thank Kenneth R. French for supplying this data for Europe at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. Since these European factor returns are calculated in US dollars, we converted them into Euro following Glück et al. (2019).

⁸ The number of stocks in the portfolios SL, BL, SH and BH ranges between 69 in 2003 to 139 in 2016.



Fig. 1 Cumulative returns of the ESG factors. This figure shows the cumulative monthly returns of the ESG factors based on monthly returns for the period 2003–2016. The gray-shaded area denotes the financial crisis from May 2007 to February 2009



updated on a yearly basis, we also update the sorting of the portfolios on a yearly basis. Finally, we obtain the return of the ENV factor in month t :

$$ENV_t = 0.5(SL_t + BL_t) - 0.5(SH_t + BH_t) \quad (1)$$

The ENV factor can be interpreted as time-varying market valuation of ENV risks measured as the return difference between “brown” firms and “green” firms. The SOC factor and the CGV factor are constructed analogously, however, based on social and governance ratings, respectively.

As basis for estimating the ESG exposures of firms, we apply the Fama and French (2015) five-factor model augmented by the momentum factor (Carhart 1997), hereafter 6F-FFC model:

$$er_{i,t} = \alpha_i + \beta_i^{MKT}MKT_t + \beta_i^{SMB}SMB_t + \beta_i^{HML}HML_t + \beta_i^{RMW}RMW_t + \beta_i^{CMA}CMA_t + \beta_i^{MOM}MOM_t + \varepsilon_{i,t} \quad (2)$$

where $er_{i,t}$ is the excess return of stock i in month t , α_i can be interpreted as abnormal performance of stock i and MKT_t is the excess return of the market. SMB_t , HML_t , RMW_t , CMA_t and MOM_t are the returns of the five Fama and French factors and the momentum factor. $\varepsilon_{i,t}$ is an error term with zero mean.

To determine the ESG exposures for stock i , we add three ESG-related factors to the 6F-FFC model, resulting in a 9F-ESG model:

$$er_{i,t} = \alpha_i + \beta_i^{MKT}MKT_t + \beta_i^{SMB}SMB_t + \beta_i^{HML}HML_t + \beta_i^{RMW}RMW_t + \beta_i^{CMA}CMA_t + \beta_i^{MOM}MOM_t + \beta_i^{ENV}ENV_t + \beta_i^{SOC}SOC_t + \beta_i^{CGV}CGV_t + \varepsilon_{i,t} \quad (3)$$

To determine a firm’s return-based ESG exposures for a given year T , we perform the 9F-ESG model (Eq. 3) using daily returns covering the previous year $T-1$. We use the coefficients β_i^{ENV} , β_i^{SOC} , β_i^{CGV} as ESG exposures for each firm.

ESG factor returns

To gain first insights regarding the ESG factors, Fig. 1 shows cumulative returns of these factors from 2003 to 2016. The cumulative returns for all three factors are positive and comparable in their magnitude from 2003 until the beginning of the financial crisis in 2007.

Hence, low ESG firms outperformed high ESG firms, regardless of the ESG pillar. During the financial crisis (Fig. 1, gray area, 05/2007–02/2009), the ENV factor experienced considerable positive returns, whereas the SOC factor lost its previous positive returns. Similarly, the CGV factor shows slightly negative returns during the crisis. During the post-crisis period from 2010 to 2016, the ENV factor continued to rise, whereas the SOC and CGV factors failed to show a clear trend.

Table 2 presents descriptive statistics and Pearson correlations of the ESG factors, the five Fama and French factors and the Carhart factor based on monthly returns. On average, the ESG factors delivered positive monthly returns, indicating that low ESG firms performed better than high ESG firms during our total sample period (Panel A). The ENV factor yielded a mean return of 26 basis points (approx. 3.12 percent per year) which is significant at the 5% level. The SOC and CGV factors show mean returns of seven and five basis points which are not statistically different from zero. The ESG factors exhibit positive correlations, while the variance inflation factors based on the 9F-ESG model show a maximum of 3.99, indicating that multicollinearity does not largely affect our results when applying the 9F-ESG model (Eq. 3).



Table 2 Descriptive statistics and correlations of the Fama and French factors and the ESG factors

	Mean	<i>t</i> -stat	SD	Min	Max	VIF	SMB	HML	RMW	CMA	MOM	ENV	SOC	CGV
Panel A: total sample period (<i>N</i> = 168)														
MKT	0.62	(1.965)	4.09	-13.89	13.84	1.99	-0.05	0.44	-0.35	-0.28	-0.46	-0.27	-0.11	-0.08
SMB	0.28	(1.965)	1.84	-5.16	5.10	1.29		0.04	-0.12	-0.18	-0.08	0.29	0.34	0.27
HML	0.10	(0.608)	2.19	-4.43	7.33	3.99			-0.77	0.27	-0.46	-0.57	-0.39	0.02
RMW	0.32	(2.840)	1.48	-3.90	4.31	2.89				-0.25	0.44	0.38	0.13	-0.04
CMA	0.15	(1.445)	1.38	-3.01	5.78	1.59					0.16	-0.23	-0.25	-0.05
MOM	0.87	(2.877)	3.91	-26.91	12.97	1.75						0.29	0.09	0.15
ENV	0.26	(2.178)	1.54	-6.64	4.51	3.07							0.75	0.20
SOC	0.07	(0.597)	1.42	-6.78	3.95	2.68								0.22
CGV	0.05	(0.649)	0.95	-2.57	2.76	1.18								
Panel B: recession periods (<i>N</i> = 25)														
MKT	-3.56	(-7.888)	2.26	-13.89	6.11	5.73	0.01	0.30	-0.06	-0.58	-0.53	0.08	0.12	0.02
SMB	-0.32	(-1.647)	0.98	-5.16	5.10	2.67		-0.13	0.01	-0.56	-0.10	0.62	0.49	0.25
HML	-0.45	(-3.146)	0.71	-4.28	2.46	2.48			-0.65	0.05	-0.39	-0.29	-0.14	0.36
RMW	0.71	(6.631)	0.54	-1.36	4.31	2.55				0.00	0.39	0.10	-0.13	-0.31
CMA	0.78	(4.819)	0.81	-2.58	5.78	4.11					0.16	-0.46	-0.48	-0.09
MOM	0.71	(6.631)	0.54	-1.36	4.31	4.32						0.09	-0.07	0.16
ENV	0.52	(3.772)	0.69	-1.81	4.51	3.36							0.74	0.21
SOC	-0.42	(-4.052)	0.52	-2.85	2.66	2.72								0.15
CGV	0.06	(0.601)	0.51	-2.14	2.76	2.06								
Panel C: expansion periods (<i>N</i> = 143)														
MKT	1.35	(4.674)	3.46	-10.36	13.84	1.79	-0.17	0.47	-0.40	-0.09	-0.42	-0.36	-0.27	-0.12
SMB	0.38	(2.740)	1.68	-4.25	4.82	1.23		0.06	-0.14	0.01	-0.05	0.21	0.30	0.29
HML	0.20	(1.063)	2.24	-4.43	7.33	4.39			-0.78	0.37	-0.46	-0.62	-0.45	-0.05
RMW	0.26	(2.029)	1.51	-3.90	3.40	3.06				-0.35	0.44	0.42	0.18	0.02
CMA	0.05	(0.441)	1.23	-3.01	3.90	1.53					0.13	-0.18	-0.17	-0.04
MOM	0.57	(1.749)	3.93	-26.91	7.16	1.72						0.32	0.15	0.15
ENV	0.21	(1.696)	1.50	-6.64	3.37	3.40							0.77	0.20
SOC	0.15	(1.261)	1.43	-6.78	3.95	2.97								0.24
CGV	0.05	(0.621)	0.87	-2.57	2.11	1.17								

This table presents descriptive statistics and Pearson correlations of the Fama and French factors, the Carhart factor and the ESG factors in Panel A. The results are calculated based on monthly returns for the period from 2003 to 2016. Mean, standard deviation, min and max are reported in percent. Bold values indicate *t*-values significant at the 10% level and significant correlations larger than 0.5 in absolute values. Following Newey and West (1987, 1994), we adjust standard errors for autocorrelation and heteroscedasticity. Panel B and C show the results from recession and expansion subsamples. We divide the total period in recessions and expansion periods. Using a peak-and-through approach, we identify March 2002 to March 2003 and May 2007 to February 2009 as recessions months. The remaining months are considered to be expansion months

The previous literature also indicates that ESG-related returns may depend on market states. High ESG firms may yield relative low returns in upward moving markets but receive relative high returns in downward markets (Nofsinger and Varma 2014; Lins et al. 2017). Following Nofsinger and Varma (2014), we define recessions by the peaks and troughs of the STOXX Europe total return index, according to which two recession periods can be identified in our sample timespan: the bursting of the dotcom bubble from March 2002 to March 2003 and the global financial crisis from May 2007 to February 2009. The remaining months are considered periods of expansion. Panels B and

C of Table 2 show descriptive statistics of the ESG factors for recession and expansion sub-periods, respectively.

The ENV factor exhibits significantly positive returns in both market states, indicating that “brown” firms significantly outperformed “green” firms. Notably, this outperformance during recessions is about twice as high as during expansions. In line with the previous literature (for example, Edmans 2011; Lins et al. 2017), we find that the SOC factor shows highly significant and negative returns during recessions (-0.42 percent per month or -5 percent p.a.), i.e., firms with high SOC ratings significantly outperform firms with low SOC ratings. These results are consistent



with a “flight to quality” effect as reported by Dong et al. (2019) for the US market. During crisis periods, investors shift portfolio weights from risky (low ESG) stocks to less risky (high ESG) stocks. During expansions, however, we observe the opposite effect, when the SOC factor shows a positive average return of 0.15 percent per month. For the CGV factor, average returns do not show large differences between recessions and expansions.

Overall, the results from Table 2 suggest that ESG risks are associated with time-varying returns which, partly, relate to market states. In line with our results, Dong et al. (2019) report an outperformance of US equity funds overweighting low ESG stocks compared to funds underweighting them by about 2 percent annually (which reverses during the financial crisis). Brammer et al. (2006) and Mollet and Ziegler (2014) find the comparable results on the performance of portfolios formed using ESG ratings in Europe.

Explanatory power of ESG factors

If there is ESG-related stock return variation, adding ESG factors should improve the explanatory power of standard asset pricing models. We first sort all stocks into equally weighted decile portfolios based on their ESG exposures. The portfolios are updated yearly and rebalanced on a monthly basis. We then run time series regressions explaining the variation in the portfolios’ monthly excess returns using the 6F-FFC and the 9F-ESG model. We evaluate the added explanatory power of the ESG factors by examining the change in adj. R^2 when expanding the 6F-FFC to the 9F-ESG model.⁹

Table 3 shows coefficient estimates and changes in adj. R^2 .¹⁰ In Panel A, decile portfolios based on ENV exposures show market beta coefficients about one. Adding ESG factors increases adj. R^2 for all deciles on conventional significance levels, indicating significant increases in explanatory power. Large increases of more than 3 percent exhibit the top decile (“green”, lowest ENV exposure of -1.206) and the bottom decile (“brown”, highest ENV exposure of 1.232). Thus, both extreme deciles appear to be associated with higher risks. Görden et al. (2018) find the comparable results for their carbon factor, which are somewhat more pronounced in the highest carbon exposure decile.

The deciles based on SOC and CGV exposures in Panels B and C show the expected patterns. Similarly to the ENV exposures, we find that the ESG factors significantly increase the adj. R^2 for virtually all of the SOC and CGV

deciles. F -tests show statistical significance at the 1% level for more than half of the decile portfolios. Therefore, ESG factors significantly enhance the explanatory power of standard asset pricing models, indicating that a substantial part of the return variation can be traced to the ESG factors.

This result is confirmed by a R^2 decomposition using Shapley values (for example, Kruskal 1987).¹¹ In unreported results, we decompose the R^2 values of the decile portfolios and find that a substantial part of these can be allocated to the ESG factors, highlighting their relative importance. For some of the decile portfolios, ESG factors show an even higher relative importance than common factors such as SMB, RMW or CMA.

Portfolio performance under consideration of ESG

For investors, evidence for ESG-related stock return variation may raise the question of whether ESG risks are systematically related to portfolio performance. Therefore, we investigate the relationship between ESG risks and risk–return profiles of equity portfolios.

Performance of ESG quintile portfolios

We compose equally weighted quintile portfolios based on ESG ratings and ESG exposures and calculate risk and return measures based on monthly returns (for example, Auer and Schuhmacher 2016 and Galema et al. 2008). The portfolios are updated at the beginning of each year for our sample between 2003 and 2016.

Panel A of Table 4 presents mean excess returns of the quintile portfolios. Concerning ENV ratings, we find that stocks in the top quintile (highest ratings) show an average annual return of 8.77 percent which is 2.51 percent lower than the average return of the bottom quintile. However, testing for equality, we do not find evidence for significant differences between the five mean returns. This is also true for the mean returns of the quintile portfolios based on SOC and CGV ratings. Compiling quintiles based on ESG exposures instead of ratings (lines four to six of Panel A) shows below-average returns for the majority of top and bottom quintile portfolios across all three pillars. Again, we find that the mean returns of the quintile portfolios do not significantly differ from each other.¹² Thus, there is no evidence

⁹ We apply an F -test for nested models, as the 6F-FFC model is a subset of the 9F-ESG model.

¹⁰ Detailed results, including all coefficient estimates, are available upon request.

¹¹ Shapley values account for the interplay between the individual factors. For a deeper discussion of methods to decompose R^2 , see Klein and Chow (2013).

¹² Considering that quintile returns might be heteroskedastic or non-normal, we also apply the Welch (1938) test and the nonparametric test by Kruskal and Wallis (1952). The results remain robust.



Table 3 Explanatory power of ESG factors based on ESG decile portfolios

	9F-ESG model				Explanatory power of ESG factors (%)		
	β^{MKT}	β^{ENV}	β^{SOC}	β^{CGV}	Adj. R^2 6F-FFC	Adj. R^2 9F-ESG	Δ adj. R^2
<i>Panel A: ENV deciles</i>							
Top (low exposure)	1.093***	-1.206***	0.481***	0.078	86.03	89.06	3.02***
2	0.991***	-0.711***	0.421***	0.045	92.74	94.24	1.50***
3	0.986***	-0.221**	0.123	-0.056	95.80	95.91	0.11*
4	0.913***	-0.202***	0.006	-0.043	96.40	96.65	0.25***
5	0.993***	-0.128**	0.193**	0.105	97.07	97.20	0.13**
6	0.932***	0.182**	0.001	0.077	96.37	96.59	0.21***
7	1.001***	0.125**	-0.010	0.043	97.15	97.20	0.14*
8	0.980***	0.364***	-0.122	0.109	96.32	96.90	0.58***
9	1.009***	0.577***	-0.348***	-0.061	94.89	95.78	0.89***
Bottom (high exposure)	1.127***	1.232***	-0.759***	-0.405***	90.02	93.16	3.14***
<i>Panel B: SOC deciles</i>							
Top (low exposure)	1.060***	0.499***	-1.106***	-0.074	90.23	92.88	2.65***
2	1.004***	0.262**	-0.557***	-0.039	94.32	95.15	0.83***
3	0.962***	0.039	-0.294***	0.057	96.43	96.80	0.37***
4	0.945***	0.160**	-0.130*	0.171***	96.80	96.97	0.17**
5	0.917***	0.129*	-0.164**	0.079	96.69	96.77	0.08*
6	0.926***	-0.050	0.031	-0.089	97.15	97.14	-0.01
7	0.958***	-0.054	0.158**	0.144	96.70	96.85	0.15**
8	0.977***	-0.198*	0.402***	-0.091	95.60	96.12	0.51***
9	1.078***	-0.347***	0.649***	-0.003	95.71	96.84	1.12***
Bottom (high exposure)	1.204***	-0.382**	0.971***	-0.226	88.22	89.89	1.67***
<i>Panel C: CGV deciles</i>							
Top (low exposure)	1.064***	0.030	0.149	-1.539***	83.28	87.78	4.51***
2	0.985***	0.000	0.072	-0.690***	93.31	94.76	1.45***
3	0.948***	-0.025	-0.010	-0.242**	95.69	95.86	0.17**
4	0.945***	0.107	-0.027	-0.184**	96.20	96.30	0.10*
5	0.953***	0.039	0.150**	-0.118	96.28	96.43	0.16**
6	0.962***	0.061	-0.036	0.164***	97.04	97.11	0.07*
7	0.932***	0.007	-0.074	0.303***	96.18	96.47	0.29***
8	1.032***	-0.059	-0.011	0.409***	96.74	97.18	0.44***
9	1.056***	0.045	-0.196**	0.674***	95.04	96.31	1.27***
Bottom (high exposure)	1.144***	-0.106	-0.075	1.072***	91.06	93.10	2.04***

This table shows factor exposures and adj. R^2 of ESG exposure decile portfolios. The results are calculated based on monthly returns for the period from 2003 to 2016. Panels A, B and C report the results for the ENV, SOC and CGV exposure deciles. Decile portfolios are updated at the beginning of each year according to their current ESG ratings and ESG exposures. The last column investigates changes in adj. R^2 when the ESG factors are added to the 6F-FFC model (resulting in the 9F-ESG model). Significance levels are calculated based on two-sided t -tests for exposures and one-sided F -tests for changes in adj. R^2 . Following Newey and West (1987, 1994), we adjust standard errors for autocorrelation and heteroscedasticity. ***, ** and * indicate significance at the 1%, 5% and 10% level

for a persistent link between ESG risk exposures and average stock returns.¹³

¹³ Taking into account that returns on quintile portfolios could also be driven by factor exposures, we calculate alphas from the 6F-FFC model and again find no significant relationship between ESG exposures and alphas. These results are available upon request.

Investors usually optimize their risk–return profiles. As investors broadly consider ESG to improve risk management, we explore whether ESG exposures are related to portfolio risks. For each quintile portfolio, we calculate the volatilities of excess returns in Panel B. The rating quintiles show very similar monthly return volatilities



Table 4 Risk and return measures of ESG quintile portfolios

	Top	2	3	4	Bottom	<i>p</i> value (%) (H_0 : all quintiles equal)
<i>Panel A: mean excess returns (% p.a.)</i>						
Ratings						
ENV	8.77	10.58	10.97	13.47	11.28	58.79
SOC	9.99	10.09	10.83	11.70	12.22	67.75
CGV	9.68	11.51	10.33	11.19	11.85	78.27
Exposures						
ENV	9.69	11.62	10.93	12.15	10.71	86.27
SOC	10.54	11.69	11.67	11.47	9.76	90.42
CGV	12.19	10.86	11.41	11.22	9.34	71.93
<i>Panel B: volatility of excess returns (%)</i>						
Ratings						
ENV	5.14	4.92	4.82	5.05	4.99	93.69
SOC	4.78	5.00	4.93	5.21	5.02	86.31
CGV	4.86	4.99	5.03	4.90	5.11	96.87
Exposures						
ENV	5.57	4.56	4.59	4.81	5.73	0.29
SOC	5.66	4.61	4.33	4.70	5.90	0.00
CGV	5.53	4.53	4.55	4.87	5.81	0.14
<i>Panel C: 6F-FFC idiosyncratic volatility (%)</i>						
Ratings						
ENV	1.70	1.72	2.18	2.59	1.76	6.69
SOC	2.14	2.07	2.77	2.47	2.03	32.21
CGV	2.07	2.59	1.67	2.29	2.06	37.66
Exposures						
ENV	8.53	2.06	1.85	1.90	6.07	0.00
SOC	5.06	1.86	1.77	2.18	5.83	0.00
CGV	9.52	2.52	2.21	2.16	5.26	0.00
<i>Panel D: 99% value-at-risk (%)</i>						
Ratings						
ENV	14.62	15.34	14.31	16.30	16.27	
SOC	14.34	14.90	14.39	17.05	15.55	
CGV	15.60	14.84	15.14	14.80	15.37	
Exposures						
ENV	14.63	13.58	16.49	16.48	20.62	
SOC	16.96	14.66	13.08	15.64	18.34	
CGV	18.44	14.29	14.16	15.62	16.65	

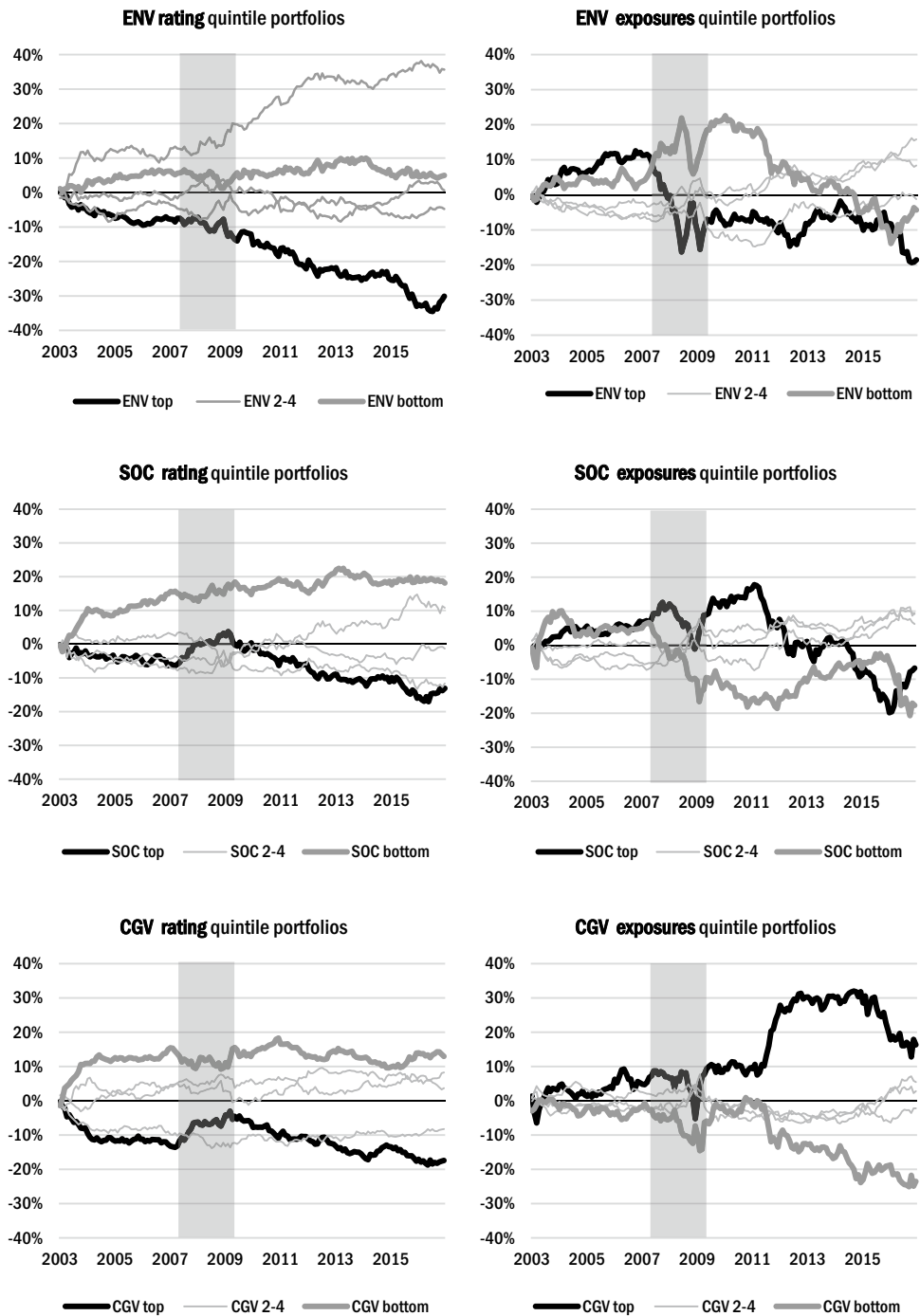
This table shows performance and risk measures of ESG quintile portfolios. Portfolios are updated and rebalanced at the beginning of every year based on their current ESG rating and ESG exposures, respectively. All values are calculated based on monthly returns for the period from 2003 to 2016. The excess returns in Panel A are calculated as the difference between mean quintile portfolio return and the mean risk-free rate. The volatilities in Panel B are calculated based on the monthly returns of each quintile portfolio. The idiosyncratic volatilities in Panel C are calculated using the 6F-FFC model. Panel D shows the historical monthly value-at-risk. The last column reports *p* values from significance tests on equality of the quintiles. Mean excess returns in Panel A are tested based on a two-sided analysis of variance tests. Volatilities in Panels B and C are evaluated using the test by Levene (1960)

of about 5 percent. Testing for equal variances based on Levene (1960), we do not find any significant differences. ESG ratings therefore seem to be unrelated to portfolio risks. In contrast, the top and bottom ESG exposure portfolios are associated with higher volatilities compared to

the quintiles two, three and four. Testing for equality of all variances, we find *p* values below 1 percent indicating significant differences between the variances of the quintile portfolio returns. However, this effect could be driven by differing factor exposures across the quintiles.



Fig. 2 Cumulative market-adjusted returns of ESG quintile portfolios. This figure shows the cumulative market-adjusted monthly returns of the ESG quintile portfolios based on ESG ratings and ESG exposures for the period from 2003 to 2016. The gray-shaded area denotes the financial crisis from May 2007 to February 2009



To control for common risk factors, we calculate the idiosyncratic volatility based on the 6F-FFC model (Panel C). The results remain largely unchanged. Again, the top and bottom exposure quintiles show significantly higher idiosyncratic risks than the remaining quintiles. These idiosyncratic risks can be largely explained by the three ESG factors (see asset pricing tests in “[Explanatory power of ESG factors](#)” section). In addition, the top and bottom ESG exposure quintiles show relatively large downside

risks (Panel D) as indicated by high historical value-at-risk values of up to 20.62 percent per month.

To sum up, we do not find evidence for a significant link between ESG risks and average stock returns. Still, it is important to consider ESG in portfolio management from a risk perspective. We find that very pronounced ESG exposures are associated with high idiosyncratic risk. These risks can be explained by the ESG risk factors.



To illustrate the risks associated with very pronounced ESG exposures, Fig. 2 shows the cumulative market-adjusted returns of the ESG quintile portfolios. On the left-hand side, the market-adjusted returns of the top and bottom ESG rating quintiles (thick lines) show similar volatilities compared to the remaining quintiles (thin lines). In contrast, the top and the bottom portfolios based on ESG exposures (right-hand side) show more volatile deviations from the market return than the remaining quintiles. This effect is especially pronounced for the ENV exposure portfolios during the financial crisis (gray-shaded area).

Quintile portfolios based on ESG ratings are per se industry-adjusted due to the industry adjustment in the ESG rating methodology. ESG exposure quintile portfolios, however, may involve deviations from market industry weights that affect risk and returns of the portfolios. Table 5 shows the average industry weights of the ESG exposure quintile portfolios.

Indeed, the industry weights differ substantially across the quintiles. For instance, the bottom ENV exposure quintile (high ENV risks) shows significantly lower weights on Financials and higher weights on Oil and Gas compared to the top ENV exposure quintile. This appears to be reasonable, as operating in the Oil and Gas industry is usually associated with extensive resource use and greenhouse gas emissions.¹⁴

Rated versus unrated stocks

As stock returns are broadly available, portfolios based on ESG exposures include unrated stocks which cannot be considered for portfolios based on ESG ratings. Therefore, we investigate whether the inclusion of unrated stocks affects our results. First, we compare stock characteristics as well as industry and country exposures of rated and unrated stocks. To do so, we divide the sample into two portfolios containing the rated stocks and the unrated stocks and update the equal-weighted portfolios on a yearly basis.

Panel A of Table 6 compares stock fundamentals of the rated and the unrated portfolio. Unrated stocks are on average more than four times smaller than rated stocks. Also, unrated stocks have lower book-to-market ratios. Our results are in line with the findings of Galema et al. (2008), for the US market. Therefore, disregarding unrated stocks could lead to a systematic disregard of small growth stocks.

In Panel B, we compare the industry compositions of both portfolios. Although we find some statistically significant differences, the overall industry composition appears similar from an economic standpoint. However, we find

considerable differences in the country composition of the portfolios in Panel C.¹⁵ The rated portfolio is comprised, on average, of 30.99 percent of stocks invested from the UK. This is 15.75 percentage points more than the unrated portfolio.

Besides differences due to *average* characteristics, differences in the *tails* of the ESG exposure distributions of rated and unrated stocks might also affect portfolio composition when including unrated stocks. To investigate this, we estimate kernel densities based on the ESG exposures for rated stocks and unrated stocks. We then test both densities for equality using the nonparametric Kolmogorov–Smirnov test (Frank and Massey 1951). In the unreported results, we find that the ESG exposures of rated and unrated stocks differ significantly from each other.¹⁶ Although economically small, this difference could affect risk and returns of ESG portfolios. We therefore split each quintile portfolio (see Table 4) into two sub-portfolios containing rated and unrated stocks, respectively.

Risk and return measures for the sub-portfolios are shown in Table 7. As shown in Panel A, there seem to be differences between the mean excess returns within the top and bottom quintiles based on ENV and SOC exposures, but not based on CGV exposures. Regarding volatilities in Panel B, there is no evidence for any systematic difference between rated and unrated sub-portfolios. Panel C shows that the correlations between the returns of the rated and unrated sub-portfolios range between 0.89 and 0.95. All correlations are significantly positive on the 1% level. This suggests that the returns do not only share similar volatilities, but also highly positive correlations.

To sum up, we find differences in characteristics and risk exposures between rated and unrated stocks. These result in slight differences in average returns but not in volatilities. As our study focuses on portfolio risks, we conclude that there is no clear evidence for unrated stocks systematically affecting our previous results. However, a deeper discussion of the differences between the mean returns of rated and unrated stocks could be considered for future research.

ESG screenings from an investor's perspective

From an investor's point of view, avoiding stocks with pronounced ESG risks reduces portfolio risks. However, avoiding stocks with high ESG risks also means a smaller investment universe. To explore whether reducing the investment universe has an impact on performance, we compare the performance of widely used ESG screenings with a passive

¹⁴ Compare the discussion of the differences between ESG ratings and ESG exposures in “ESG exposures versus ESG ratings” section.

¹⁵ For brevity, we report significant results only. Detailed results are available upon request.

¹⁶ Results are available upon request.



Table 5 Industry weights of ESG exposure quintile portfolios (%)

	Top	2	3	4	Bottom	<i>p</i> value (%) (H_0 : all quintiles equal)
<i>ENV exposure</i>						
Basic materials	5.2	4.8	6.3	7.2	10.0	0.00
Consumer goods	9.2	10.6	11.2	11.1	12.2	0.00
Consumer services	16.3	14.9	14.3	14.0	11.8	0.00
Financials	29.3	23.7	22.6	22.7	15.3	0.00
Health care	5.1	6.7	6.6	6.4	6.0	0.31
Industrials	21.2	22.9	22.9	23.3	23.3	0.01
Oil and gas	3.5	3.3	3.7	3.9	8.7	0.00
Technology	5.1	5.1	5.3	5.1	5.8	0.29
Telecommunications	2.9	3.2	2.6	2.2	2.5	0.00
Utilities	2.9	4.8	4.4	4.4	4.3	0.02
<i>SOC exposure</i>						
Basic materials	10.3	6.4	6.1	5.5	5.2	0.00
Consumer goods	11.4	12.6	11.7	10.8	7.9	0.00
Consumer services	14.8	15.2	13.8	12.8	14.6	0.37
Financials	14.1	18.7	22.7	27.5	30.6	0.00
Health care	5.5	6.2	6.5	6.2	6.3	0.25
Industrials	22.3	23.9	23.8	22.5	21.1	0.03
Oil and gas	7.1	4.6	3.6	3.6	3.9	0.00
Technology	7.0	5.2	4.3	4.7	5.2	0.00
Telecommunications	2.1	1.9	3.1	3.1	3.3	0.00
Utilities	5.4	5.2	4.3	3.4	2.0	0.00
<i>CGV exposure</i>						
Basic materials	8.1	6.8	6.6	6.1	6.1	0.00
Consumer goods	7.0	8.7	10.2	12.1	16.4	0.00
Consumer services	14.1	15.7	14.5	13.5	13.5	0.00
Financials	22.7	25.4	24.0	22.4	19.0	0.00
Health care	5.6	6.8	7.0	6.3	5.2	0.38
Industrials	20.0	21.0	21.6	24.9	26.1	0.00
Oil and gas	10.2	4.4	3.7	2.7	3.0	0.00
Technology	6.9	4.7	4.7	4.8	5.3	0.00
Telecommunications	2.5	2.7	3.2	2.9	2.5	56.91
Utilities	3.2	3.8	4.7	4.9	3.8	0.00

This table shows average industry weights of quintile portfolios based on ESG exposures. The time series averages of the mean industry weights are calculated using the Industry Classification Benchmark codes from EIKON. Portfolios are updated and rebalanced at the beginning of every year based on their current ESG exposures. The last column reports *p* values from significance tests on equality of the quintiles based on a two-sided analysis of variance tests

investment in the market (Renneboog et al. 2008). To do so, we look at the performance of several equity portfolios screened by ESG ratings and exposures, applying common positive and negative screening procedures with different cutoffs. More precisely, we rank all stocks based on their ESG ratings or ESG exposures at the end of every year end. Then, we form equal-weighted portfolios excluding the stocks with the lowest ranks (negative screening) or only including stocks with the highest ranks (positive screening). The cutoff rate specifies the proportion of stocks selected

from the stock universe. We apply cutoff rates between 10 percent and 90 percent. To assess risk-adjusted performance, we calculate mean excess returns and alphas based on the 6F-FFC for each of the nine portfolios per ESG pillar.

The first column of Table 8 shows that positive screenings based on ENV ratings are associated with lower mean excess returns than the equally weighted benchmark portfolio consisting of all stocks (100 percent cutoff). The underperformance is highly significant and ranges between 2.98 percent p.a. (10 percent cutoff) and 1.11 percent p.a.



Table 6 Characteristics of the rated portfolio and unrated portfolio

	All stocks	Rated portfolio	Unrated portfolio	Rated–unrated
<i>Panel A: stock fundamentals</i>				
# of stocks	1024	756	269	487***
Market capitalization (m€)	7725	9507	2162	7344***
Dividend yield (%)	0.69	0.66	0.81	0.21
Book-to-market	3.39	3.44	3.23	−0.15***
Mean excess return (%)	0.91	0.91	0.91	0.00
SD of excess returns (%)	4.92	4.94	5.00	0.06
<i>Panel B: industry weights (%)</i>				
Basic materials	6.55	7.18	4.52	2.67***
Consumer goods	10.84	11.06	10.64	0.42
Consumer services	14.48	14.95	12.87	2.08***
Financials	22.63	21.69	25.63	−3.94***
Health care	6.04	6.09	6.05	0.03
Industrials	22.53	22.03	24.56	−2.53
Oil and gas	4.55	4.84	3.7	1.14*
Technology	5.52	4.79	6.85	−2.06
Telecommunications	2.87	3.09	2.1	0.99
Utilities	3.98	4.28	3.23	1.05
<i>Panel C: country weights (%)</i>				
Denmark	2.70	3.06	1.69	1.37*
Italy	7.88	6.36	12.64	−6.28***
Luxembourg	0.50	0.38	1.08	−0.71***
United Kingdom	27.67	30.99	15.24	15.75***

This table reports characteristics of the portfolios containing rated and unrated stocks. Panel A shows time series averages of various stock fundamentals. To calculate excess returns, we use the 1-month EURIBOR. Panel B reports the time series averages of the mean industry weights using the Industry Classification Benchmark codes from EIKON. Panel C shows the average country weights using the geographical classification codes from EIKON. For brevity in Panel C, we report the significant results only. The detailed results are available upon request. ***, ** and * indicate significance at the 1%, 5% and 10% level

(50 percent cutoff). This finding is in line with Trinks and Scholtens (2017) who investigate negative ESG screenings based on a global sample. The underperformance weakens but remains significant when we look at the alphas in Panel B. Ranking stocks based on ESG exposures, we find a similarly deteriorating performance when positive screenings are applied. Notably, none of the t -values indicates a significant difference between benchmark return and ENV-exposure-screened portfolio returns. In line with our previous results, this points to an insignificant relationship between ENV exposures and financial performance. We thus do not find any significant performance impact due to screenings based on ENV exposures.

The results for screenings based on SOC ratings and exposures show analogous results. Similar to ENV ratings, we find significantly lower mean excess returns than the market (approx. 1 percent p.a.) for positive screenings based on SOC ratings. The underperformance is, however, not robust to controlling for common risk factors, as 6F-FFC alphas are insignificant. Applying screenings based on SOC exposures does not indicate a significant impact on performance.

The results for the CGV pillar show that negative and positive screenings based on CGV ratings slightly decrease excess returns, while for the 6F-FFC alpha, there seems to be no link between CGV ratings and risk-adjusted performance. As to positive screenings based on CGV exposures, we find that returns mostly increase. However, neither returns nor alphas based on the 6F-FFC model show significant results. We therefore find that CGV screenings do not have an impact on performance.

In summary, we derive three main results regarding the performance impact of ESG screenings. First, positive ENV screenings are associated with a systematic sacrifice of financial performance when applied on ENV ratings, but do not show an impact on performance when applied based on ENV exposures. Second, portfolio returns decrease when investors select firms with the highest SOC ratings. SOC exposures, however, are virtually unrelated to financial performance. Third, we do not find any significant relationship between CGV ratings or exposures and financial performance. Our results thus indicate that investors can reduce



Table 7 Risk and return of rated and unrated stocks within ESG exposure quintile portfolios

	Top	2	3	4	Bottom
<i>Panel A: mean annualized excess returns of quintile portfolios (%)</i>					
ENV					
All stocks	9.69	11.62	10.93	12.15	10.71
Rated	8.49	11.62	11.18	11.74	11.52
Unrated	12.52	12.56	12.44	14.00	10.03
Rated–unrated	−4.02	−0.94	−1.26	−2.26	1.49
<i>t</i> -stat	(−1.685)	(0.413)	(0.105)	(−0.678)	(1.666)
SOC					
All stocks	10.54	11.69	11.67	11.47	9.76
Rated	11.03	11.45	11.74	11.40	9.31
Unrated	9.22	12.11	11.84	13.46	11.59
Rated–unrated	1.81	−0.66	−0.10	−2.07	−2.69
<i>t</i> -stat	(1.808)	(0.441)	(0.889)	(−0.570)	(−1.939)
CGV					
All stocks	12.19	10.86	11.41	11.22	9.34
Rated	11.58	10.83	11.24	10.96	9.86
Unrated	12.76	11.82	12.67	12.59	10.94
Rated–unrated	−1.17	−0.99	−1.43	−1.62	−1.08
<i>t</i> -stat	(0.040)	(0.191)	(−0.153)	(−0.292)	(0.124)
<i>Panel B: volatilities of excess returns of quintile portfolios (%)</i>					
ENV					
All stocks	5.57	4.56	4.59	4.81	5.73
Rated	5.56	4.58	4.56	4.93	5.74
Unrated	5.69	4.79	4.77	4.62	6.17
Rated–unrated	−0.13	−0.21	−0.20	0.31	−0.43
<i>p</i> value (%)	76.43	57.03	57.11	40.65	35.37
SOC					
All stocks	5.66	4.61	4.33	4.70	5.90
Rated	5.73	4.58	4.35	4.73	5.99
Unrated	6.12	5.22	4.56	4.86	5.96
Rated–unrated	−0.39	−0.64	−0.21	−0.12	0.02
<i>p</i> value (%)	39.59	9.44	53.55	74.32	95.85
CGV					
All stocks	5.53	4.53	4.55	4.87	5.81
Rated	5.57	4.58	4.51	4.88	5.88
Unrated	6.10	4.95	4.65	5.09	5.91
Rated–unrated	−0.53	−0.37	−0.14	−0.22	−0.04
<i>p</i> value (%)	23.94	31.33	70.07	57.30	93.70
<i>Panel C: correlations of excess returns of rated and unrated quintile portfolios (%)</i>					
ENV					
Correlation	0.92	0.92	0.95	0.94	0.91
<i>p</i> value (%)	0.00	0.00	0.00	0.00	0.00
SOC					
Correlation	0.91	0.91	0.92	0.94	0.93
<i>p</i> value (%)	0.00	0.00	0.00	0.00	0.00
CGV					
Correlation	0.89	0.90	0.94	0.94	0.93
<i>p</i> value (%)	0.00	0.00	0.00	0.00	0.00

This table shows risk and return measures for ESG exposure quintile portfolios. Each portfolio is decomposed in sub-portfolios based on rated and unrated stocks. All values are calculated based on monthly returns of quintile portfolios for the period from 2003 to 2016. Panel A shows mean annualized excess returns, Panel B volatilities of excess returns and Panel C correlations of excess returns of rated and unrated sub-portfolios based on ESG exposures. *t*-statistics are reported in parentheses. Bold values indicate *t*-values significant at the 10% level. Following Newey and West (1987, 1994), we adjust standard errors for autocorrelation and heteroskedasticity. *p* values in Panel B are calculated from significance tests on equality of the volatilities of the rated and unrated sub-portfolio using the test by Levene (1960). *p* values in Panel C stem from testing correlations being significantly different from zero



Table 8 Performance of ESG-screened portfolios

cut off	ENV screenings				SOC screenings				CGV screenings			
	ENV ratings		ENV exposures		SOC ratings		SOC exposures		CGV ratings		CGV exposures	
	Δ to 100% cut off		Δ to 100% cut off		Δ to 100% cut off		Δ to 100% cut off		Δ to 100% cut off		Δ to 100% cut off	
Panel A: Mean excess returns (p. a., %)												
10%	7.94	(-2.686)	8.07	(-1.048)	10.16	(-.724)	9.04	(-.828)	9.97	(-1.052)	11.10	(.029)
20%	8.77	(-2.749)	9.65	(-.792)	9.99	(-1.251)	10.55	(-.291)	9.68	(-1.818)	11.81	(.490)
30%	9.20	(-2.489)	10.13	(-.704)	9.82	(-1.767)	10.95	(-.064)	10.26	(-1.177)	11.59	(.512)
40%	9.66	(-2.237)	10.65	(-.375)	10.06	(-1.655)	11.05	(.041)	10.60	(-.778)	11.65	(.729)
50%	9.81	(-2.437)	10.71	(-.402)	9.88	(-2.389)	11.15	(.202)	10.44	(-1.350)	11.48	(.674)
60%	10.09	(-2.435)	10.78	(-.396)	10.30	(-1.626)	11.32	(.550)	10.51	(-1.327)	11.49	(.838)
70%	10.60	(-1.153)	11.03	(.014)	10.48	(-1.469)	11.29	(.574)	10.57	(-1.270)	11.33	(.660)
80%	10.82	(-.533)	11.06	(.090)	10.64	(-1.407)	11.31	(.784)	10.68	(-1.005)	11.39	(1.056)
90%	11.05	(.837)	11.10	(.305)	10.85	(-.539)	11.32	(1.157)	10.73	(-1.272)	11.29	(1.035)
100%	10.92		11.02		10.92		11.02		10.92		11.02	
Panel B: Alphas from 6F-FFC (p. a., %)												
10%	-1.48	(-1.778)	-3.23	(-1.327)	-0.41	(-.431)	-3.39	(-1.731)	0.31	(.286)	0.96	(.338)
20%	-0.66	(-.952)	-1.07	(-.705)	-0.82	(-1.159)	-1.02	(-.723)	-0.22	(-.276)	1.73	(.956)
30%	-0.83	(-1.302)	-0.45	(-.387)	-0.84	(-1.368)	-0.57	(-.518)	-0.02	(-.033)	1.54	(1.229)
40%	-0.85	(-1.677)	-0.08	(-.087)	-0.43	(-.860)	-0.31	(-.358)	0.30	(.659)	1.49	(1.492)
50%	-0.86	(-2.101)	-0.02	(-.022)	-0.90	(-1.951)	-0.18	(-.227)	0.01	(.032)	1.09	(1.396)
60%	-0.65	(-1.820)	0.10	(.166)	-0.44	(-1.019)	0.04	(.059)	0.00	(.006)	0.87	(1.417)
70%	-0.07	(-.287)	0.29	(.539)	-0.22	(-.596)	0.03	(.049)	-0.17	(-.568)	0.66	(1.387)
80%	-0.01	(-.063)	0.25	(.587)	-0.08	(-.294)	0.02	(.050)	-0.09	(-.375)	0.57	(1.611)
90%	0.26	(1.454)	0.28	(1.018)	0.06	(.335)	0.14	(.501)	-0.05	(-.275)	0.25	(.950)

This table reports performance measures for ESG-screened portfolios. We sort stocks at the beginning of each year based on their current ESG rating and ESG exposures, respectively. Then, different cutoff rates are applied to compose portfolios. The cutoff rate specifies the proportion of stocks selected for each portfolio. We update and rebalance the equally weighted portfolios at the beginning of every year. All values are calculated based on monthly returns for the period from 2003 to 2016. The excess returns in Panel A are calculated in excess of the 1-month EURIBOR. The alphas in Panel B are calculated based on the 6F-FFC model applying the equally weighted benchmark portfolio consisting of all stocks (100 percent cutoff) as market factor. Data bars indicate the deviation from the equally weighted benchmark portfolio consisting of all stocks (100 percent cutoff). All portfolio measures are annualized. *t*-statistics are reported in parentheses. Bold *t*-values indicate significance at the 10% level. Following Newey and West (1987, 1994), we adjust standard errors for autocorrelation and heteroscedasticity

ESG risk exposures without sacrificing financial performance, regardless of the ESG pillar.

Conclusion

The increasing sustainability awareness of governments, regulatory authorities and customers encourages firms to adopt sustainable business practices. This rise in awareness regarding sustainability is changing the economic environment and involves profound changes on capital markets. Because ESG risks are hardly diversifiable, it has become critically important for investors to understand the ESG profile of the firms and portfolios they are investing in. Thus, comparable and reliable ESG data are of crucial importance in investment decision-making and sophisticated risk management. In this paper, we propose applying return-based ESG exposures to measure and integrate ESG risks into asset management.

We contribute to the existing ESG literature in three ways. First, we explore three ESG risk factors in order to capture ESG risk exposures of firms. Second, we draw conclusions regarding the relationship between ESG factors and performance by composing portfolios based on ESG ratings and ESG exposures. Third, we investigate whether the

performance of stocks without ESG ratings has an impact on these conclusions.

As the rising sustainability awareness affects firm values (due to changes in stakeholder behavior, ESG regulation, etc.), market pricing of stocks can be expected to reflect firms' ESG risks. Against this background, we develop a multifactor model to measure ESG exposures of firms or portfolios. In particular, we introduce three environmental, social and governance factors with which to measure the stock market's time-varying perception and valuation of ESG risks.

Based on a comprehensive sample of European stocks between 2003 and 2016, we derive the four main empirical results. First, comparing ESG ratings and ESG exposures of firms shows a positive but not perfect relationship. These differences between ratings and exposures may be due to the industry benchmarking of ESG ratings and to ESG risks which are not assigned to firms by ESG rating agencies. Second, firms with low environmental ratings outperformed firms with high environmental ratings, as indicated by the ENV factor showing a significant and positive mean annual return of about 3 percent. Third, in line with a "flight to quality" effect during crisis periods, highly social firms outperform less social firms during crises, as indicated by significant negative returns of the SOC factor during recessions.



Fourth, adding ESG factors significantly enhances the explanatory power of standard asset pricing models with regard to ESG decile portfolios. However, there is no evidence for a systematic ESG-related return premium or discount. Whereas we find that very pronounced ESG exposures are related to higher portfolio risks, investors can still compose portfolios with lower ESG risk exposures while keeping risk-adjusted performance virtually unchanged.

Investigating risk and return properties of portfolios based on ESG ratings and ESG exposures enables us to derive implications from an investor's perspective. Whereas stocks with the best ENV ratings underperform the market return by about 2 percent annually, SOC and CGV ratings appear to be unrelated to portfolio returns. This could be attributed to an overvaluation of stocks with high ENV ratings due to a rising awareness of environmental risks among investors. Composing portfolios based on ESG exposures, we do not find that ESG exposures have a substantial impact on portfolio returns. However, portfolios with pronounced ESG exposures show higher risks as the remaining stocks in the market. A large proportion of these risks can be explained by the ESG factors. Also, we find that investors can compose portfolios with lower ESG risk exposures while keeping risk-adjusted performance virtually unchanged. Calculating ESG exposures thus enables investors to avoid ESG risks without sacrificing financial performance.

Our study relies on ESG ratings provided by Thomson Reuters EIKON. While Thomson Reuters is a major data provider widely used by investors and academics, future research would likely benefit from calculating ESG factors based on data by other ESG rating agencies to evaluate the impact of different methodologies across ESG rating agencies. Since we construct the three ESG factors as zero-investment portfolios based on diversified top and bottom tercile portfolios, we expect that manageable differences in ESG ratings should not result in substantial differences in the composition of the tercile portfolios. In this context, we note that the correlations between the ESG firm ratings of different rating agencies are (not perfectly) but usually significantly positive (see, for example, Chatterji et al. 2015; Dorfleitner et al. 2015).

In summary, taking ESG risk into account when managing equity portfolios enables investors to better assess the ESG risk exposures of their portfolios solely based on the high informational content of stock returns. In addition, investors can easily add ESG exposures into their risk management systems. Strategically managing these ESG risks may result in potential benefits for investors.

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