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Warm-Glow Investing and the Greenwashing Hypothesis

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ABSTRACT

There are many speculations, and some empirical indications in recent literature, that manufacturing firms are particularly prone to greenwashing, a practice by which such firms make misleading claims regarding their environmental performance or that of their products. Simultaneously, very recent evidence suggests that the representative investor has developed a preference for ESG (Environmental, Social, Governance) investments, a so-called "warm-glow" preference. The purpose of this paper is to provide a theoretical explanation why the preference for warm-glow investing may disappear if investors perceive firms in a sector to be greenwashing. We hypothesize that given the ubiquitous contemporary focus on greenwashing, rational investors will factor this greenwashing into their investment decisions. To test this, we investigate patterns of association of ESG scores, and both operating and stock performance for 3,245 listed firms, over a period of two decades, comparing the manufacturing and services sectors in the United States, Europe, and major Asian markets. We find that warm-glow investment is present within the services sector across all regions, but in the manufacturing sector we find noticeable regional differences. In particular, we find ESG-performance patterns for manufacturing firms in the United States that we consider consistent with perceptions of greenwashing. The contribution of this paper is to provide a nuanced perspective on how investors preferences change in relation to industry perceptions. The novelty in our study is two-fold: on the one hand, bringing the problem of greenwashing to the emergent literature on warm-glow investing; on the other, introducing warm-glow investing to the emergent literature on greenwashing.

1. Introduction

With the rise of socially responsible investments and growing general attention to the green transition, firms' non-financial disclosures have gained in importance, not least as they try to secure a high ESG (Environmental, Social and Governance) score to show to investors and other stakeholders. The effect of ESG on firm performance has been extensively researched. Existing empirical studies have investigated multiple industries within single regions (Blasi et al., 2018), as well as across regions (Al Hawaj and Buallay, 2022; Garcia and Orsato, 2020; Lahouel et al., 2022). One approach has been to study the effect of socially and environmentally responsible practices on operating profits, proxied by accounting-based measures such as return on assets (ROA), return on equity (ROE), or return on capital employed (ROCE). Such studies have found mixed results, indicating industry differences (see e.g., Friede et al., 2015; Margolis and Walsh, 2003; McWilliams and Siegel, 2000; Orlitzky et al., 2003). Another approach, in the financial literature, has been to study the effect of ESG or socially responsible investment performance on investor returns (a market-based measure). Again, such studies have found mixed results (see e.g., Bauer et al., 2007; Climent and Soriano, 2011; Dreyer et al., 2023a; Hamilton et al., 1993; Ibikunle and Steffen, 2017; Renneboog, Ter Horst and Zhang, 2008a).

A particular challenge that has been recognized for some years is the quality of ESG reporting in general (Kacanski et al., 2023), and, more specifically, the issue of growing greenwashing (Du, 2015), by which firms deliberately make misleading claims regarding their environmental performance (Yu et al., 2020). The manufacturing and services sectors are the largest contributing sectors within the global economy, and the role of ESG is different from one sector to another. Particularly within the manufacturing sector, ESG is more closely related to

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operating processes and their interaction with the natural environment (Buallay, 2019). Firms within the manufacturing sector therefore tend to focus more on environmental disclosure (Garcia, Mendes-Da-Silva, & Orsato, 2017). On the other hand, in the services sector, social aspects of ESG are more in focus (Buallay, 2019; Goyal et al., 2013). Not surprisingly, costs associated with ESG performance thus differ between sectors, and the associations between ESG score and firm performance differ as well (Tatomir et al., 2022). Interestingly, there appears to be a growing consensus that manufacturers are especially, and perhaps even pervasively, guilty of greenwashing (Baldi and Pandimiglio, 2022; Glavas et al., 2023; Yu et al., 2020).

The purpose of this paper is to provide a theoretical explanation for the absence of warm-glow investing in manufacturing firms, which we attribute to perceived greenwashing. We thus extend the emergent warm-glow theory (Dreyer et al., 2023b) and postulate that given the rise in the preference for responsible (ESG) investments, as well as the apparent pervasiveness of greenwashing in the manufacturing sector, rational investors would be expected to internalize greenwashing in their investment behavior. Therefore, we would expect to observe investors requiring a higher risk-adjusted return for responsible (high ESG) stocks in the manufacturing sector as opposed to the services sector.

To test our theory, we run pooled panel regressions with a large dataset of 3,245 listed manufacturing and services firms over a period of almost two decades (2003–2020), and in three regions of the world (US, Europe, Asia). Our results indicate that in the services sector, ESG costs are lower than their operating benefits in both Europe and the US. Profits are thus higher for high-ESG companies. For Asia, we see this association only in the environmental pillar. In all three regions, investors are willing to accept lower risk-adjusted stock returns for companies that perform better in ESG (both in the aggregate score and in the environmental pillar), in line with a warm-glow hypothesis. On the other hand, for the US manufacturing industry, ESG is associated with higher operating performance as well as higher stock returns. This is compatible with our hypothesis that investors perceive higher greenwashing in the American manufacturing industry, and act rationally with respect to the greenwashing that scholars have started to identify (Baldi and Pandimiglio, 2022; Dreyer and Smith, 2023). It also suggests that firms optimize operating results by investing in ESG reporting. However, investors perceive that the reporting in the sector is misleading, so that the warm-glow effect is not verified.

2. Exploring greenwashing and warm-glow investing

If the ESG score is *the* proxy used to evaluate the socially and environmentally responsible practices of firms based on their respective non-financial disclosures (Widyawati, 2020), conceivably, the metric should minimize information asymmetry (Drempetic et al., 2020). However, as certain practices are hard to verify (Utz, 2019) speculation arises over whether the ESG score truly captures responsible practices (Kacanski et al., 2023). The manufacturing sector is especially difficult to monitor in this regard due to the inherent complexity of the sector, from production to logistics, comprising suppliers, distributors, and retailers at nearly every stage (Buallay, 2019). With the emergence of contemporary ESG literature addressing the issue of greenwashing (Kleffel and Muck, 2022; Li et al., 2023; Testa et al., 2018; Zhang, 2022), whereby firms produce misleading non-financial disclosure reports, there appears to be a consensus that the manufacturing sector is particularly guilty of such practices (Baldi and Pandimiglio, 2022; Yu et al., 2020).

In a global sample, Al Hawaj and Buallay (2022) found there to be a positive association of ESG to operating performance in the manufacturing and services sectors, stating that returns generated by ESG score exceeded the cost of disclosure. Yet, considering that the cost of compliance and investing in responsible activities for the firm may be higher in some industries than in others, certain firms may have an incentive to invest in reporting practices rather than in ESG practices *per se* (Drempetic et al., 2020). At the same time, with growing scrutiny over ESG scores and whether this measurement scheme effectively captures responsible practices, there lies a risk of being accused of greenwashing (Glavas et al., 2023). Recent studies have found that as long as it is not identified and called out, greenwashing has either a positive effect (Li et al., 2023) or no effect (Testa et al., 2018) on operating performance, as the cost of communicating responsible practices is lower than the cost of actually investing in these. Should a firm be accused of greenwashing, however, corporate legitimacy and reputation may be harmed, leading to a negative effect (Seele and Gatti, 2017). Since manufacturing firms have higher costs of investing in responsible activities compared to their peers (Padgett and Galan, 2010), while they at the same time offer bigger challenges for observers to identify non-responsible activities (Andersen and Bams, 2022), we can thus hypothesize that *manufacturing firms are those that would benefit most from greenwashing in terms of operating performance (assuming they are not accused of the practice)*.

At the same time, ESG scores affect investor behavior. Recent studies within financial economics show that investors increasingly value the socially and environmentally responsible practices of firms (Hartzmark and Sussman, 2019), and an increased demand for the shares of these responsible firms subsequently increases their stock prices (Pástor et al., 2021), thus maximizing shareholder value. This seemingly altruistic behavior, termed a "warm-glow" by Andreoni (1990)[1], motivates investors to accept lower risk-adjusted returns (Renneboog et al., 2008a) as they derive a sense of satisfaction (or utility, in economics) from their responsible investment decision-making. Pástor et al. (2021) developed a theoretical model that captures investor preferences favoring "green" assets and Dreyer et al. (2023b) have further developed the warm-glow theory by showing how this preference influences investment decisions, finding that responsible assets should and do underperform. Intuitively, as investors (willingly) accept lower risk-adjusted returns, the firm's cost of capital decreases. Firms are thus incentivized to disclose socially and environmentally responsible practices (Heinkel et al., 2001), and even to greenwash, especially when the firm needs to finance capital investments. Higher levels of reported responsible performance, particularly within environmental and governance practices (Ng and Rezaee, 2015; Chava, 2014), have thus been shown to lead to a lower cost of capital of firm investments (El Ghoul, Guedhami, Kwok and Mishra., 2011). Cost of capital can be broken down into cost of equity and cost of debt. Thus, as stock investors accept lower returns, we can hypothesize that *higher ESG scores lead to lower cost of equity, or synonymously, that stock returns become lower for responsible firms*.

On the one hand, scholars claim that investors simply use ESG scores at face value (Auer and Schuhmacher, 2016; Hartzmark and Sussman, 2019), and are thus susceptible to falling for greenwashed assets. Thus, following the warm-glow theory, investors would be willing to accept lower returns for assets they *perceive* to be responsible (Kleffel and Muck, 2022). On the other hand, should investors become aware of greenwashing in the case of a particular firm or sector, one would expect the investor to lose the warm-glow preference for these. Thus, as the investor is no longer able to derive altruistic satisfaction, as a consequence of their perception of greenwashing, they would exhibit the risk-return expectations of someone who cares only about the firm's financial performance (Renneboog, Ter Horst and Zhang, 2008b). A reasonable posit would be that if investors are aware of greenwashed assets, have a warm-glow preference, and are rational, one would observe higher risk-adjusted returns for greenwashed assets, as these would be perceived as non-ESG investments, despite their high ESG scores. Some investors might even perceive a risk associated with greenwashing behavior and would therefore want to be compensated

[1] Andreoni (1990) first used the term "warm-glow" to describe the utility gained through *impure* altruistic behavior of an individual (for the purpose of feeling good). This term has since been applied within several research areas, including within public economics and behavioral finance research.

Table 1
Regression results for operating performance (ROA).

	Dependent variable: Return on Assets (ROA)							
Model (ESGF)	A (ESG)		B (EPS)		C (SPS)		D (GPS)	
	1	2	1	2	1	2	1	2
ESGF	0.1024***	0.0579***	0.0797***	0.2878***	0.0392***	−0.1069***	0.0689***	0.1558***
	(0.0046)	(0.0163)	(0.0034)	(0.0161)	(0.0037)	(0.0148)	(0.0037)	(0.0175)
$ESGF^2$		0.0004 (0.0002)		−0.0027***		0.0016***		−0.0008***
				(0.0002)		(0.0002)		(0.0002)
Leverage	−0.0001**	−0.0003***	−0.0001*	−0.0001**	−0.0002**	−0.0001**	−0.0001***	−0.0001**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Relative Sales	0.0191	0.0577**	0.0142	0.1147***	0.1912***	0.1350***	0.2405***	0.1604***
	(0.0170)	(0.0247)	(0.0221)	(0.0207)	(0.0200)	(0.0216)	(0.0311)	(0.0218)
Constant	1.7436***	2.1925**	3.6718***	2.0607***	3.5942***	6.2563***	1.0556*	−0.4299
	(0.4573)	(0.6468)	(0.4523)	(0.6423)	(0.4523)	(0.5863)	(0.6312)	(0.6964)
R^2	0.0777	0.0642	0.0823	0.1026	0.0614	0.0661	0.0613	0.0755
Adj. R^2	0.0768	0.0632	0.0814	0.1017	0.0605	0.0651	0.0603	0.0745
N (obs.)	20,983	20,958	20,989	20,992	20,975	20,978	20,927	20,970
n (Firms)	3,197	3,164	3,198	3,198	3,196	3,194	3,162	3,194

*p < 0.1.
**p < 0.05.
***p < 0.01.
[a] Standard error terms appear in parentheses.
[b] All regressions include year fixed effects.

accordingly (Heinkel et al., 2001). Regardless, should investors be conscious that firms tend to greenwash, we can hypothesize that the warm-glow effect would tend to disappear for this sector. As previously discussed, recent evidence suggests that greenwashing behavior is significantly higher among manufacturing, rather than services, firms (Baldi and Pandimiglio, 2022). Thus, in line with the warm-glow theory, we hypothesize that *a perception of wider greenwashing in the manufacturing sector should lead investors to require a higher risk-adjusted return for responsible (high ESG) stocks in this sector*. We thus expect to see a warm-glow effect in the services sector rather than in the manufacturing sector.

3. Methodology

Considering the rapid growth of socially responsible investments globally, we focus on three highly influential regions: the US, Europe, and major markets in Asia. The economies representing these regions are at various levels of economic and institutional development, and it can be reasoned that a firm's approach to socially and environmentally responsible practices will, likewise, be at different levels of advancement (Garcia et al., 2017), and stakeholder interests may vary accordingly (McWilliams et al., 2006). The sample selected for our empirical analysis of ESG and firm performance includes publicly listed companies from the US, Europe, and Asia.

3.1. Data collection and sampling

Our observations for the US were collected from the NYSE and NASDAQ exchanges. To represent the European region, we collected data from exchanges in Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal, Switzerland, Denmark, the United Kingdom, Norway, and Sweden (following Auer and Schumacher, 2016). To represent Asia we selected mainland China, Hong Kong, Taiwan, Singapore, South Korea, and Japan, as these are among the most economically developed economies within the Asian region (Lin and Lin, 2011). Manufacturing and services comprise most firms with ESG rating in these regions.

Our sample spans 18 years, from 2002 to 2020, with a combined 21,390 observations of 3,245 firms, collected from Refinitiv Eikon Datastream. Of these, 1,698 firms and 13,049 observations were for the manufacturing sector. We did not include financial services, as Baldi and Pandimiglio (2022) have presented evidence that firms in this part of the services sector exhibit a different greenwashing behavior than the rest. Following Nollet et al. (2016), we use return on assets (ROA) as the accounting-based indicator of operating performance. ROA is measured as the sum of net income plus interest expense, divided by the average of last and current year's total assets. We use excess stock returns as the financial performance indicator, which we define as the difference of the annualized returns of firm *i* and the risk-free rate, all calculated in USD. The risk-free rate was retrieved from the Kenneth R. French Data Library. We further collected data on the firm-specific variables Leverage and Sales. Year fixed effects were included in all the regressions, as this controlled for macroeconomic effects throughout the period 2003–2020. Finally, we categorized firms into the manufacturing and services sector according to the Standard Industry Classification (SIC) codes.

3.2. Panel regressions

We quasi-replicated the methodology used by Nollet et al. (2016). First, we regressed ROA and Excess Stock Returns of firm *i* at time *t*, on different explanatory variables.

$$y_{i,t} = \alpha_0 + \beta_1 ESGF_{i,t} + \beta_2 FIRM'_{i,t} + \varepsilon_{i,t} \quad for\ i = 1, 2, \ldots, K \tag{1}$$

where, $y_{i,t}$ is the firm performance indicator (ROA or Excess Stock Returns), $ESGF_{i,t}$ is the ESG factor (representing either a composite or pillar score)[2] and, $FIRM'_{i,t}$ is a vector that represents the control variables $Leverage_{i,t}$ (debt to equity) and $Sales_{i,t}$ (comparing firm sales to the average of the data sample to avoid issues related to non-stationarity). Finally, $\varepsilon_{i,t} = u_{i,t} + c_i$, where $u_{i,t}$ and c_i are idiosyncratic error terms that represent unobserved firm and time effects.

Given recent evidence of non-linearities in ESG-performance associations (Nollet et al., 2016), we extended the analysis to incorporate the (nonlinear) quadratic ESG factor:

$$y_{i,t} = \alpha_0 + \beta_1 ESGF_{i,t} + \beta_2 ESGF^2_{i,t} + \beta_3 FIRM'_{i,t} + \varepsilon_{i,t}\ for\ i = 1, 2, \ldots, K \tag{2}$$

To examine regional ($REGION_i$) differences, and its interaction with

[2] The ESG composite score, as well as the environmental, social and governance pillar scores, cannot be used together as independent variables in the same model due to multicollinearity (see Tatomir et al., 2022).

Table 2
Regression results for stock performance (excess stock returns).

	Dependent variable: Excess Stock Returns							
Model (ESGF)	A (ESG)		B (EPS)		C (SPS)		D (GPS)	
	1	2	1	2	1	2	1	2
ESGF	−0.1578***	−0.0644	−0.1364***	−0.2392***	−0.0936***	0.0280 (0.0582)	−0.0892***	0.0250 (0.0682)
	(0.0179)	(0.0764)	(0.0122)	(0.0440)	(0.0147)		(0.0160)	
$ESGF^2$		−0.0010		0.0013***		−0.0013**		−0.0012*
		(0.0008)		(0.0005)		(0.0006)		(0.0006)
Leverage	−0.0003***	−0.0005**	−0.0004**	−0.0004**	−0.0003***	−0.0003***	−0.0003***	−0.0003***
	(0.0001)	(0.0003)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Relative Sales	−0.1392*	−0.1088	−0.0598	−0.1073	−0.3111***	−0.2696***	−0.4101***	−0.3905***
	(0.0831)	(0.0909)	(0.0804)	(0.0900)	(0.1006)	(0.1061)	(0.0972)	(0.1046)
Constant	−18.2016***	−19.9599***	−21.0989***	−20.2911***	−20.1053***	−22.2864***	−18.6257***	−20.9620***
	(1.9030)	(2.6686)	(1.8798)	(2.1993)	(1.8695)	(2.4389)	(1.9615)	(2.7013)
R^2	0.1287	0.129	0.1327	0.1319	0.1272	0.1271	0.1277	0.1283
Adj. R^2	0.1278	0.1281	0.1318	0.131	0.1263	0.1262	0.1268	0.1274
N (obs.)	21,356	21,355	21,352	21,354	21,356	21,357	21,355	21,354
n (Firms)	3,241	3,241	3,240	3,241	3,241	3,241	3,241	3,241

*p < 0.1.
**p < 0.05.
***p < 0.01.
[a] Standard error terms appear in parentheses.
[b] All regressions include year fixed effects.

the ESG factor term (Barnett and Salomon, 2012), we re-estimated equations (3) and (4), for the individual sectors (Manufacturing and Services, respectively) as follows:

$$y_{i,t} = \alpha_0 + \beta_1 ESGF_{i,t} + \beta_2 FIRM'_{i,t} + \beta_3 REGION_t + \beta_4 \left(ESGF_{i,t} * REGION_t\right) + \varepsilon_{i,t} \; for \; i = 1, 2, \ldots, K \quad (3)$$

Finally, we introduced quadratic interaction effects to equation (3):

$$y_{i,t} = \alpha_0 + \beta_1 ESGF_{i,t} + \beta_2 ESGF^2_{i,t} + \beta_3 FIRM'_{i,t} + \beta_4 REGION_t + \beta_5 \left(ESGF_{i,t} * REGION_t\right) + \beta_6 \left(ESGF^2_{i,t} * REGION_t\right) + \varepsilon_{i,t} for \; i = 1, 2, \ldots, K \quad (4)$$

Due to the large number of observations from our sample, the models run may be sensitive to outliers (Cook, 1977). Thus, we followed (Dreyer et al., 2023a) and applied the Cook's Distance to identify outliers for elimination for each regression. To deal with heteroscedasticity and autocorrelation in the residuals of our regressions, we applied the Heteroscedasticity and Autocorrelation Consistent (HAC) estimator to adjust the standard errors (Newey and West, 1987).

It is worth noting that endogeneity is a common concern in these types of econometric estimations, especially due to the possibility of omitted variables. A common solution is to treat endogeneity by using instrumental variables employing methods such as the GMM (Hansen, 1982). Here one uses the lag of the independent variables to form vectors of instruments. However, we decided not to employ the GMM for different reasons: 1) The classical problem of weak instruments (Stock and Wright, 2000; Dreyer et al., 2013). In this case, although orthogonal to residuals, instrumental variables are not capable of removing endogeneity as they do not explain sufficiently the variation of the independent variables; 2) Our panel has a large amount of data for each sample period with high autocorrelation of the ESG variable in time. This high autocorrelation of our main independent variables necessarily

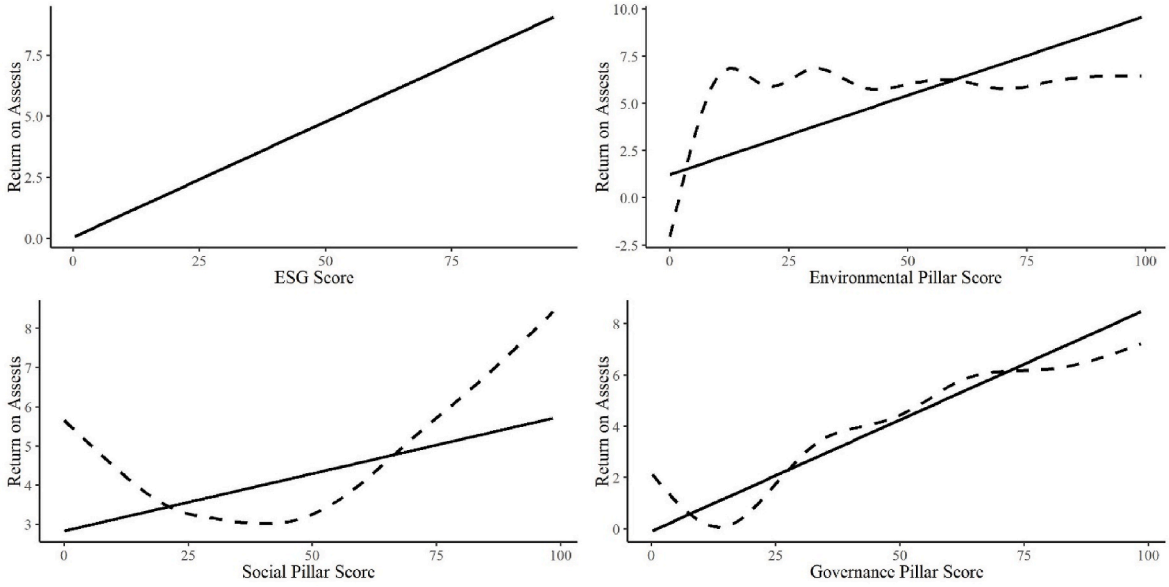


Fig. 1. Linear and quadratic relationship between the ESG factors and operating performance.

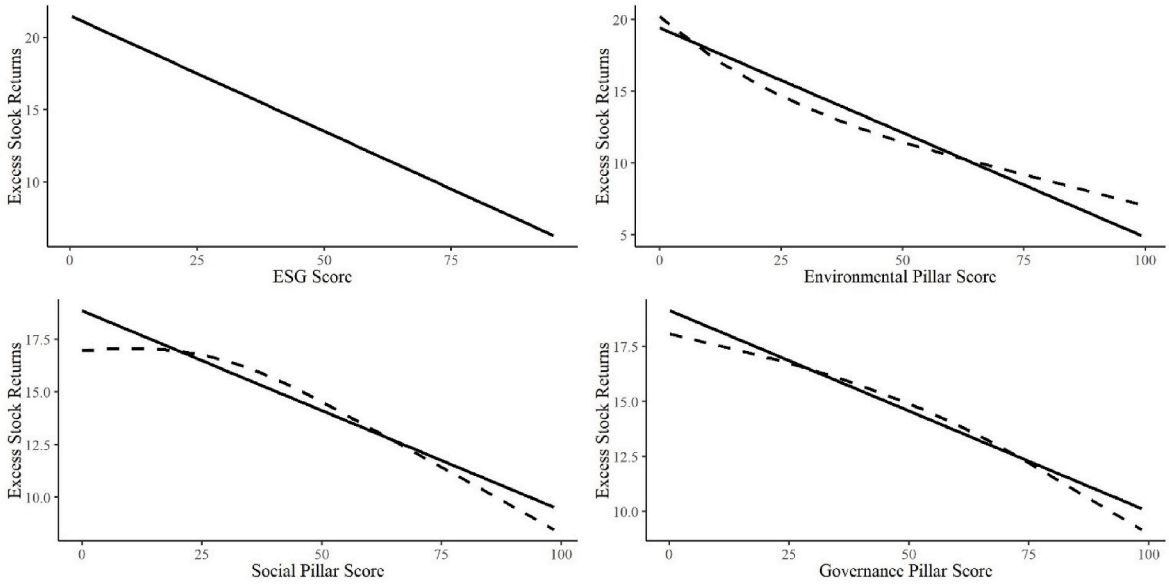


Fig. 2. Linear and quadratic relationship between the ESG factors and stock performance.

Table 3
Regression results for operating performance (ROA) in the services sector including dummies for regions.

	Dependent variable: Return on Assets (ROA)							
Model (ESGF)	A (ESG)		B (EPS)		C (SPS)		D (GPS)	
	1	2	1	2	1	2	1	2
ESGF	−0.0131	0.1023*	−0.0317***	0.0253	−0.0098	0.0308	−0.0203	0.0165
	(0.0136)	(0.0542)	(0.0101)	(0.0377)	(0.0119)	(0.0441)	(0.0130)	(0.0596)
ESGF^2		−0.0015**		−0.0009*		−0.0005		−0.0004
		(0.0007)		(0.0005)		(0.0005)		(0.0006)
ESGF Interactions								
*Europe	0.1057***	0.1261	0.0984***	0.3492***	0.0758***	0.1967**	0.0145	−0.0412
	(0.0209)	(0.0899)	(0.0158)	(0.0600)	(0.0184)	(0.0776)	(0.0185)	(0.0798)
*US	0.4755***	0.7138***	0.3282***	0.7612***	0.2074***	−0.1230	0.3181***	0.4265***
	(0.0214)	(0.0997)	(0.0137)	(0.0571)	(0.0194)	(0.0853)	(0.0204)	(0.0897)
ESGF^2 Interactions								
*Europe		0.0001		−0.0029***		−0.0010		0.0005
		(0.0009)		(0.0007)		(0.0008)		(0.0008)
*US		−0.0027**		−0.0062***		0.0034***		−0.0013
		(0.0010)		(0.0007)		(0.0009)		(0.0009)
Leverage	−0.0002	−0.0001	−0.0001	−0.0001	−0.0002	−0.0002	−0.0002	−0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Relative Sales	−0.0463	0.1005***	0.0213	0.2245***	0.4540***	0.4057***	0.4099***	0.4522***
	(0.0396)	(0.0390)	(0.0357)	(0.0399)	(0.0452)	(0.0512)	(0.0482)	(0.0558)
Constant	17.9659***	16.1808***	18.4959***	18.2323***	17.0733***	16.4203***	15.5050***	14.7167***
	(1.3087)	(2.3458)	(1.2381)	(2.2297)	(1.2782)	(2.1582)	(1.3978)	(2.2812)
R^2	0.2344	0.2369	0.2213	0.2403	0.1841	0.1841	0.2117	0.2121
Adj. R^2	0.2321	0.2343	0.2189	0.2377	0.1816	0.1813	0.2093	0.2094
N (obs.)	8,206	8,201	8,215	8,215	8,205	8,203	8,203	8,204
n (Firms)	1,532	1,532	1,532	1,532	1,533	1,531	1,532	1,529

*p < 0.1.
**p < 0.05.
***p < 0.01.
[a] Standard error terms appear in parentheses.
[b] All regressions include year fixed effects.

leads to high collinearity in the GMM covariance matrix or, in other words, to the impossibility of its inversion (determinant close to zero). Consequently, GMM estimates are often unstable and dependent on the vector of instruments selected (Dreyer et al., 2023a).

4. Findings

Tables 1 and 2 report regression results for the full cross-regional sample of firms within the manufacturing and services sector, of the association of the ESG composite and pillar scores (ESGF) on firm performance. In Table 1, all linear ESG Factor (ESGF) coefficients have a positive association to operating performance. The firm specific control variables, leverage and relative sales have a consistently negative and significant, and positive and significant relationship, with operating performance; respectively, in line with the findings of Nollet et al. (2016). The linear effects for all the models (estimations A1 – D1) are positively related to ROA ($p < 0.01$). In the quadratic models, the environmental pillar score (EPS, estimation B2) and the governance

Table 4
Regression results for stock performance (excess stock returns) in the services sector including dummies for regions.

	Dependent variable: Excess Stock Returns							
Model (ESGF)	A (ESG)		B (EPS)		C (SPS)		D (GPS)	
	1	2	1	2	1	2	1	2
ESGF	−0.1487**	0.3642	−0.1320***	0.2304	−0.0836	0.2013	−0.0810	0.3422
	(0.0719)	(0.2536)	(0.0486)	(0.1963)	(0.0531)	(0.2063)	(0.0630)	(0.3108)
ESGF^2		−0.0058**		−0.0052**		−0.0036		−0.0041
		(0.0027)		(0.0024)		(0.0023)		(0.0029)
ESGF Interactions								
*Europe	−0.0404	−0.3080	−0.0138	−0.2328	−0.0462	−0.1754	−0.0671	−0.5473
	(0.0876)	(0.3656)	(0.0602)	(0.2456)	(0.0666)	(0.2824)	(0.0785)	(0.3848)
*US	−0.0701	−0.4099	−0.0702	−0.5974***	−0.0523	0.0209	−0.0681	−0.5325
	(0.0892)	(0.3557)	(0.0564)	(0.2262)	(0.0702)	(0.2942)	(0.0810)	(0.3741)
ESGF^2 Interactions								
*Europe		0.0033		0.0034		0.0021		0.0047
		(0.0036)		(0.0029)		(0.0029)		(0.0035)
*US		0.0040		0.0076***		0.00004		0.0045
		(0.0036)		(0.0028)		(0.0030)		(0.0035)
Leverage	−0.0004	−0.0004	−0.0004	−0.0004	−0.0004	−0.0004	−0.0004	−0.0004
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Relative Sales	−0.2072	−0.1460	−0.0786	−0.1127	−0.4112**	−0.3155*	−0.4393***	−0.4513***
	(0.1662)	(0.1723)	(0.1536)	(0.1658)	(0.1669)	(0.1693)	(0.1597)	(0.1690)
Constant	−22.1965***	−31.7108***	−24.7483***	−27.0165***	−25.3259***	−28.6890***	−21.9251***	−31.1746***
	(4.4831)	(6.1540)	(3.7772)	(4.1652)	(3.8210)	(4.6214)	(4.6147)	(8.0523)
R^2	0.0805	0.0812	0.0799	0.0805	0.0785	0.0793	0.0800	0.0802
Adj. R^2	0.0777	0.0781	0.0771	0.0774	0.0758	0.0761	0.0773	0.0771
N (obs.)	8,328	8,326	8,330	8,330	8,329	8,328	8,327	8,326
n (Firms)	1,545	1,545	1,545	1,545	1,545	1,545	1,545	1,545

*p < 0.1.
**p < 0.05.
***p < 0.01.
[a] Standard error terms appear in parentheses.
[b] All regressions include year fixed effects.

pillar score (GPS, estimation D2) exhibit n-shaped relationships, while the social pillar score (SPS, estimation C2) reveals a u-shaped relationship (p < 0.01).

Table 2 presents the regressions results for the association of ESGF for stock performance. We find evidence for a negative effect of the ESG score (estimation A1) and EPS (estimation B1) on returns. In the quadratic models we find an n-shaped relationship for ESG, SPS and GPS (estimations A2, C2, D2; p < 0.01, p < 0.1, p < 0.01).

Figs. 1 and 2 illustrate the statistically significant relationships between the ESG factors and operating and stock performances, respectively. One can clearly identify the so-called "warm-glow" effect, as we find lower risk-adjusted returns for investments with a higher ESG and environmental score. This "warm-glow" effect is further reinforced by a positive effect of the ESG on operating performance. Considering that the two sectors within this analysis have differing ESG priorities and thus may exhibit different associations to performance, we repeated the same exercises by splitting our sample for an analysis on the services and manufacturing sector, respectively.

4.1. Services sector analysis

Tables 3 and 4 show the regression results for the association of the ESG composite and pillar scores (ESGF) on firm performance, reporting region effects. Here, Asia serves as a base level for the region dummy coefficients, and the estimate for the remaining regions is the difference in respective coefficients. The results show the relationship of the ESG factor and performance within the services sector to be more consistent across regions. The regression includes that same firm-specific control variables and shows that relative sales have a positive relationship to operating performance but a negative relationship to stock performance when significant. Additionally, the models include year fixed effects that control for macro-economic effects.

The results show the association of the ESG composite score on ROA to be neutral in Asia, and positive and significant in Europe and the US

Table 5
Summary of the industry analysis for the services sector.

	Asia		Europe		US	
	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic
	ROA		ROA		ROA	
ESG Composite Score		n	+	n	+	
Environmental Pillar Score	–	n	+	n	+	n
Social Pillar Score			+		+	u
Governance Pillar Score					+	
	Excess Stock Returns		Excess Stock Returns		Excess Stock Returns	
ESG Composite Score	–	n	–	n	–	n
Environmental Pillar Score	–	n	–	n	–	
Social Pillar Score						
Governance Pillar Score						

[a] A positive (negative) sign indicates a positive (negative) linear relationship between the ESG factor and the specified firm performance (operating or stock).

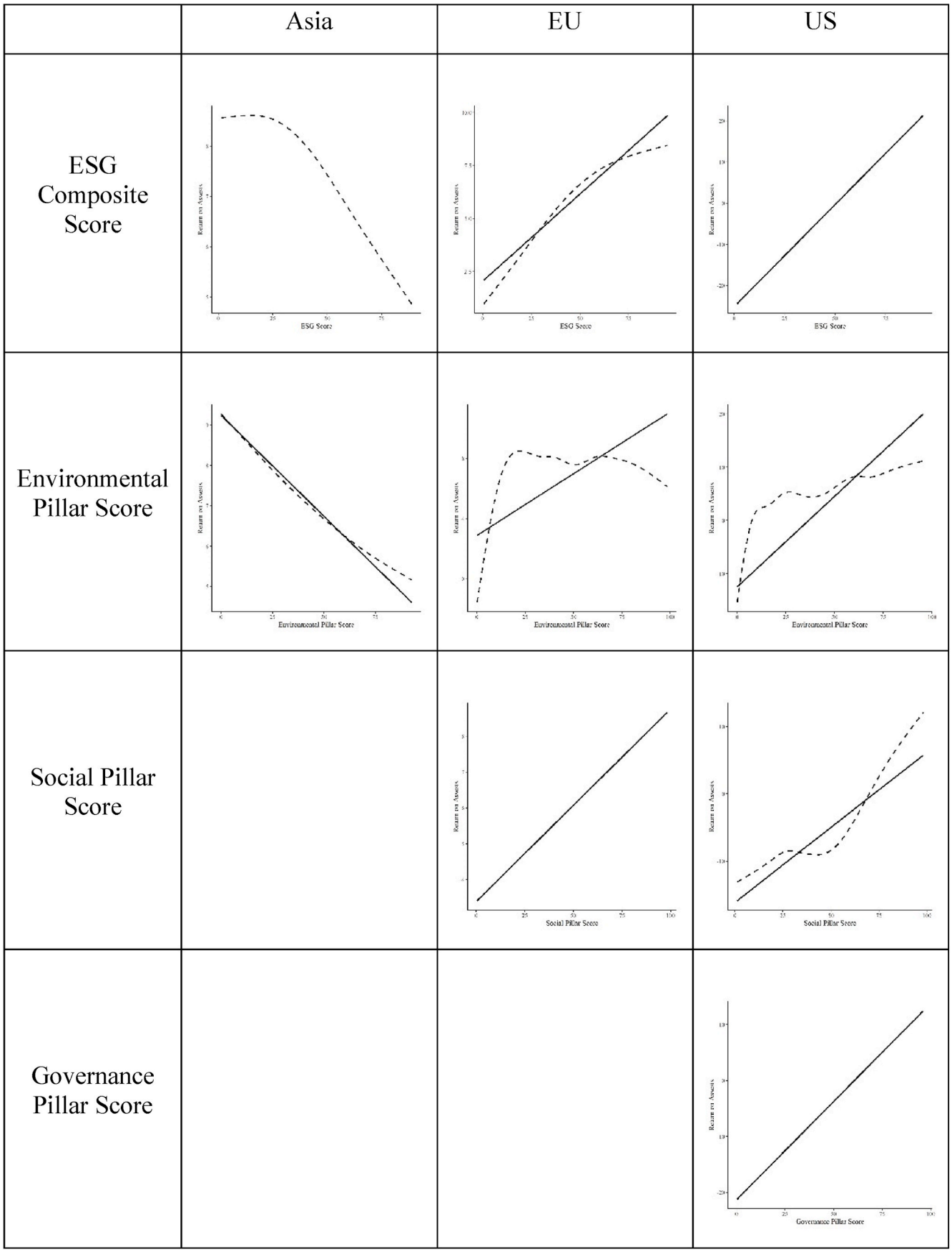


Fig. 3. Linear and quadratic relationship between the ESG factors and operating performance by region in the services sector.

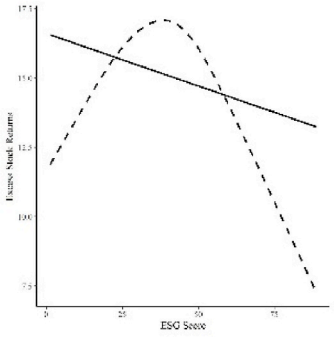
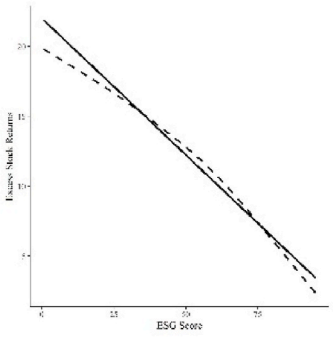
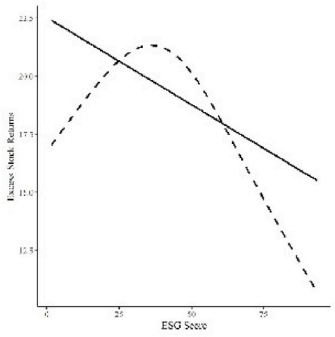
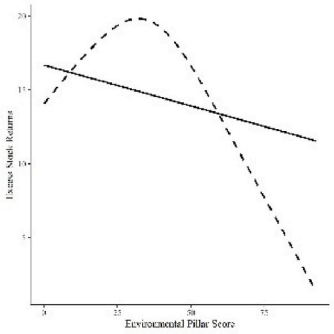
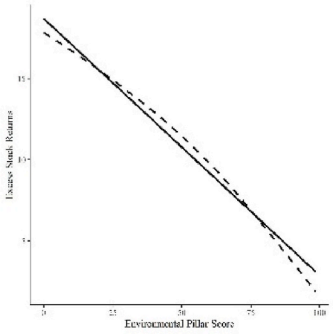
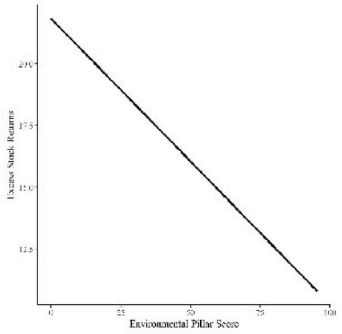
	Asia	EU	US
ESG Composite Score			
Environmental Pillar Score			
Social Pillar Score			
Governance Pillar Score			

Fig. 4. Linear and quadratic relationship between the ESG factors and stock performance by region in the services sector.

Table 6
Regression results for operating performance (ROA) in the manufacturing sector including dummies for regions.

	Dependent variable: Return on Assets (ROA)							
Model (ESGF)	A (ESG)		B (EPS)		C (SPS)		D (GPS)	
	1	2	1	2	1	2	1	2
ESGF	−0.0207***	−0.0545***	−0.0291***	−0.0362***	−0.0097***	−0.0681***	0.0053	0.0081
	(0.0038)	(0.0151)	(0.0027)	(0.0094)	(0.0034)	(0.0115)	(0.0033)	(0.0132)
ESGF^2		0.0004**		0.0001		0.0007***		−0.00004
		(0.0002)		(0.0001)		(0.0001)		(0.0001)
ESGF Interactions								
*Europe	−0.0018	0.0070	0.0034	−0.0005	−0.0031	0.0086	−0.0110**	0.0284
	(0.0060)	(0.0261)	(0.0044)	(0.0156)	(0.0053)	(0.0213)	(0.0052)	(0.0224)
*US	0.0708***	0.1171***	0.0620***	0.0664***	0.0501***	0.1254***	0.0247***	0.0563**
	(0.0063)	(0.0273)	(0.0044)	(0.0143)	(0.0056)	(0.0212)	(0.0055)	(0.0233)
ESGF^2 Interactions								
*Europe		−0.0001		0.00004		−0.0003		−0.0004
		(0.0003)		(0.0002)		(0.0002)		(0.0002)
0.5								
*US		−0.0005*		−0.0001		−0.0009***		−0.0003
		(0.0003)		(0.0002)		(0.0002)		(0.0002)
Leverage	−0.0002***	−0.0003***	−0.0002***	−0.0002***	−0.0002***	−0.0002***	−0.0002***	−0.0002***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Relative Sales	−0.1537***	−0.1629***	−0.1223***	−0.1253***	−0.1525***	−0.1568***	−0.1336***	−0.1315***
	(0.0207)	(0.0209)	(0.0202)	(0.0212)	(0.0200)	(0.0205)	(0.0199)	(0.0224)
Constant	3.7537***	4.3954***	3.8187***	3.7942***	3.4041***	4.1809***	2.6450***	2.5123***
	(0.3948)	(0.4627)	(0.3842)	(0.3910)	(0.3801)	(0.4027)	(0.3847)	(0.4212)
R^2	0.0646	0.0661	0.0685	0.0690	0.0611	0.0632	0.0561	0.0568
Adj. R^2	0.0627	0.0640	0.0667	0.067	0.0593	0.0612	0.0543	0.0547
N (obs.)	12,733	12,708	12,742	12,738	12,729	12,721	12,744	12,732
n (Firms)	1,674	1,671	1,673	1,671	1,673	1,670	1,673	1,671

*p < 0.1.
**p < 0.05.
***p < 0.01.
[a] Standard error terms appear in parentheses.
[b] All regressions include year fixed effects.

Table 7
Regression results for stock performance (excess stock returns) in the manufacturing sector including dummies for regions.

	Dependent variable: Excess Stock Returns							
Model (ESGF)	A (ESG)		B (EPS)		C (SPS)		D (GPS)	
	1	2	1	2	1	2	1	2
ESGF	−0.0016	−0.0443	−0.0190	−0.0248	0.0003	−0.0743	0.0402*	0.1018
	(0.0232)	(0.0949)	(0.0169)	(0.0616)	(0.0207)	(0.0746)	(0.0205)	(0.0874)
ESGF^2		0.0005		0.00004		0.0009		−0.0007
		(0.0011)		(0.0007)		(0.0009)		(0.0009)
ESGF Interaction								
*Europe	−0.0673**	−0.1413	−0.0169	−0.2361***	−0.0612**	−0.0870	−0.0711**	−0.0172
	(0.0321)	(0.1387)	(0.0242)	(0.0867)	(0.0275)	(0.1131)	(0.0288)	(0.1281)
*US	0.0669**	0.1142	0.0820***	0.1323	0.0577**	0.1856*	−0.0159	0.1593
	(0.0323)	(0.1375)	(0.0231)	(0.0804)	(0.0291)	(0.1124)	(0.0293)	(0.1284)
ESGF^2 Interaction								
*Europe		0.0006		0.0025***		0.0001		−0.0005
		(0.0015)		(0.0010)		(0.0012)		(0.0013)
*US		−0.0005		−0.0006		−0.0015		−0.0017
		(0.0015)		(0.0009)		(0.0012)		(0.0013)
Leverage	−0.0005*	−0.0005*	−0.0004*	−0.0005*	−0.0005*	−0.0005*	−0.0005*	−0.0005*
	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0003)
Relative Sales	−0.4127***	−0.4327***	−0.4808***	−0.5249***	−0.4234***	−0.4076***	−0.3887***	−0.3687***
	(0.1099)	(0.1201)	(0.1108)	(0.1201)	(0.1094)	(0.1200)	(0.1042)	(0.1138)
Constant	−24.0670***	−23.1770***	−22.0362***	−22.7754***	−24.1694***	−23.1478***	−25.8809***	−26.4435***
	(2.2716)	(2.8524)	(2.1563)	(2.4494)	(2.1817)	(2.5386)	(2.2641)	(2.7871)
R^2	0.281	0.2803	0.2786	0.2797	0.28	0.2812	0.2797	0.2819
Adj. R^2	0.28	0.2787	0.2772	0.2781	0.2785	0.2796	0.2783	0.2803
N (obs.)	12,701	12,705	12,704	12,709	12,702	12,699	12,699	12,693
n (Firms)	1,676	1,675	1,675	1,674	1,678	1,674	1,673	1,673

*p < 0.1.
**p < 0.05.
***p < 0.01.
[a] Standard error terms appear in parentheses.
[b] All regressions include year fixed effects.

Table 8
Summary of the industry analysis for the manufacturing sector.

	Asia		Europe		US	
	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic
	ROA		ROA		ROA	
ESG Composite Score	–	u	–	u	+	
Environmental Pillar Score	–		–		+	
Social Pillar Score	–	u	–	u	+	
Governance Pillar Score			–		+	
	Excess Stock Returns		Excess Stock Returns		Excess Stock Returns	
ESG Composite Score			–		+	
Environmental Pillar Score				u	+	
Social Pillar Score			–		+	
Governance Pillar Score	+					

[a] A positive (negative) sign indicates a positive (negative) linear relationship between the ESG factor and the specified firm performance (operating or stock).

($p < 0.01$). All individual pillar scores have a positive and significant effect on operating performance in the US ($p < 0.01$), while EPS and SPS are positive and significant in Europe ($p < 0.01$). However, the results show a negative and significant effect on operating performance in Asia ($p < 0.01$) for EPS.

Table 4 presents the results of the estimations of excess stock returns in the services sector, reporting region effects. The results suggest that the relationship between the ESG factors and performance is consistent at the regional level in line with the warm-glow theory (Dreyer et al., 2023b). We find a negative and significant relationship of the ESG score ($p < 0.05$) and EPS ($p < 0.01$) on stock performance across all three regions. These results show that for the services sector, investors exhibit altruistic behavior by accepting lower risk-adjusted returns for firms that perform well within ESG and particularly environmental practices.

A summary of the results of the regional analysis of the services sector is provided in Table 5. The results of the regional analysis suggest that the association of ESG to performance is region-specific for ROA and excess stock returns. Figs. 3 and 4 illustrate the relationship between the ESG factors and firm performance presented in preceding tables. The services sector appears to confirm the theory. Across all three regions, we find a warm-glow effect. Firms in the service sector benefit from a low cost of capital as investors are willing to pay a premium for stocks of firms that invest in higher ESG and environmental performance.

4.2. Manufacturing sector analysis

Tables 6 and 7 show the regression results for the association of the ESG composite and pillar scores (ESGF) on firm performance, reporting region effects. Here again, Asia serves as a base level for country dummies. The results show the relationship of the ESG factor and performance within the manufacturing sector to be regionally dependent. The regression includes the same firm-specific control variable and shows that both leverage and relative sales have a negative relationship to performance when significant. Additionally, the models include year fixed effects that control for macroeconomic effects.

The association of ESG, EPS and SPS are significant and negative on ROA ($p < 0.01$) across Asia and Europe. Additionally, we find GPS to have a significant and negative effect in Europe ($p < 0.05$). However, we find the opposite to be true in the US with consistently positive and significant relationships on ROA ($p < 0.001$) across the ESG composite and pillars scores. Including a quadratic term, results in an asymmetrical u-shape for ESG (estimation A2) and SPS (estimation C2) in Asia ($p < 0.05$ and $p < 0.01$).

Table 7 presents the results of the estimations of excess stock returns in the manufacturing sector, reporting region effects. The results suggest that the relationship between the ESG factor and performance is more complex at the regional level. We see that the ESG composite score (estimation A1) has a negative and significant relationship to stock performance in Europe ($p < 0.05$) and a significant and positive relationship in the US ($p < 0.05$). Similarly, on the individual pillar levels, we find a negative and significant relationship of SPS (estimation C1) on excess stock returns in Europe ($p < 0.05$) and positive and significant relationship across EPS and SPS (estimation B1 and C1) for the US ($p < 0.05$). Curiously, we find a positive and significant effect of GPS on stock performance in Asia ($p < 0.1$). One could argue, given the findings of Baldi and Pandimiglio (2022) and Yu et al. (2020) that the manufacturing sector is likely to engage in greenwashing, that we should observe no effect, or possibly a positive effect, of ESG on stock performance. Taking this into consideration, there still appear to be regional differences as warm-glow investment is present in Europe but not in Asia and the US.

A summary of the results of the regional analysis of the manufacturing sector is provided in Table 8. The results of the regional analysis suggest that the association of ESG to performance is region-specific for both ROA and excess stock returns. Figs. 5 and 6 illustrate the relationship between the ESG factors and firm performance presented in Table 8. In summary, we find that the association of the ESG factor to firm performance in the manufacturing sector deviates from the general analysis and differs significantly in comparison to the services sector. Most notably, within the US we observe that the association of the ESG factor to both operating and stock performance is positive. US firms within the manufacturing sector may be engaging in greenwashing to a higher degree (Baldi and Pandimiglio, 2022), possibly due to low levels of disclosure credibility (Fernandez-Feijoo2014) as a result of limited regulation (Delmas and Burbano, 2011), and subsequently the ESG has a positive effect on ROA (Li et al., 2023). Should investors be aware of greenwashing, they would exhibit conventional risk-reward expectations in this region and therefore expect to earn higher returns to be compensated for the risk of investing in such firms.

5. Concluding discussion

What are the implications of our results? We empirically investigated the association of ESG on firm performance in a global sample of services and manufacturing sector firms. The purpose of this study was to find a salient pattern of ESG relationships with firm performance, that could be explained by the warm-glow theory of investor preferences under conditions of perceived greenwashing.

5.1. Implications for theory

The novelty in our study is two-fold: on the one hand, we bring the problem of greenwashing to the emergent literature on warm-glow investing; on the other, we introduce warm-glow investing to the literature on greenwashing. In line with the theory, we find evidence for altruistic investor behavior in general. We find that warm-glow holds true across all three regions for the services sector, where investors accept lower risk-adjusted returns for the ESG and environmental pillar

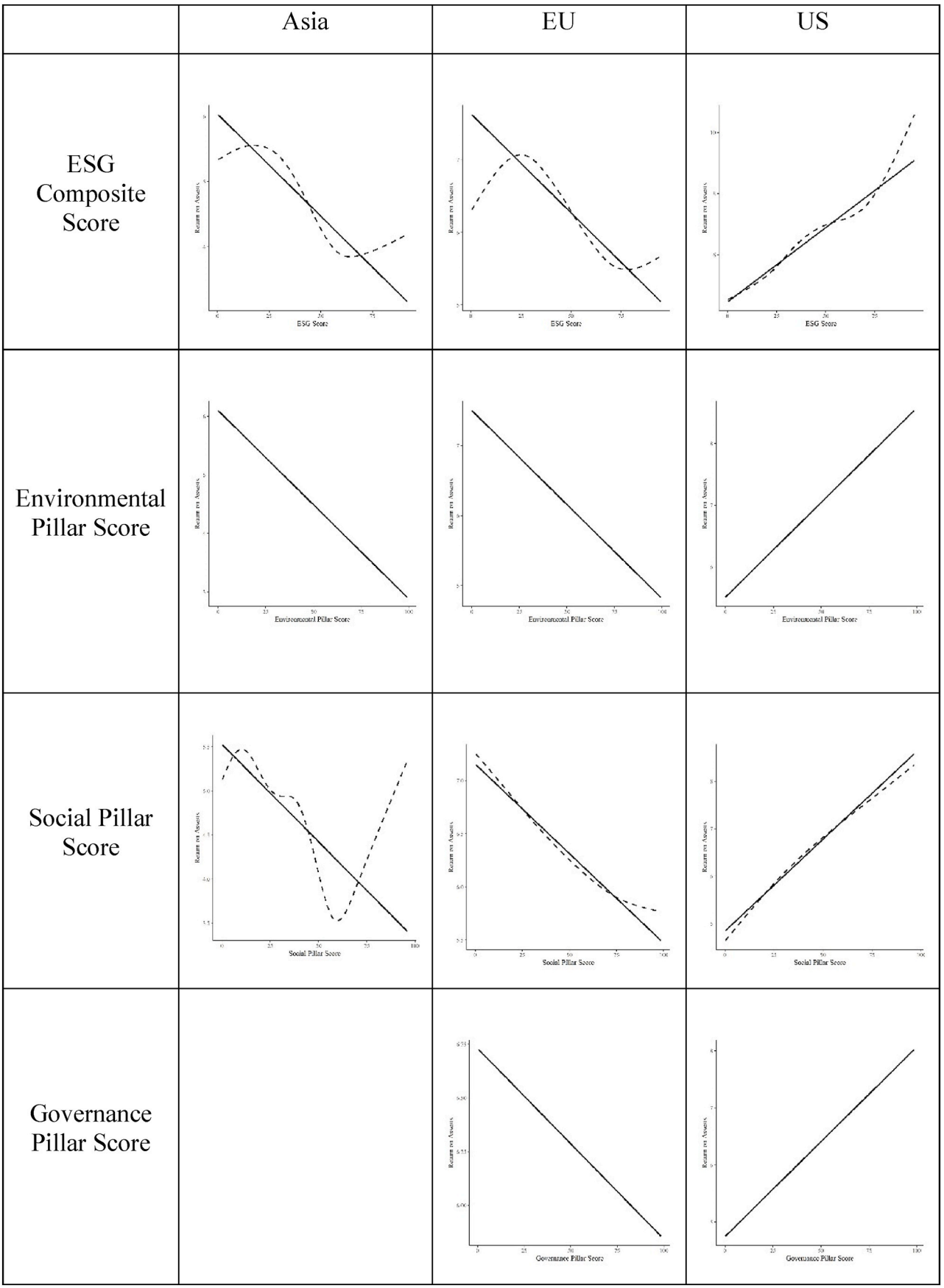


Fig. 5. Linear and quadratic relationship between the ESG factors and operating performance by region in the manufacturing sector.

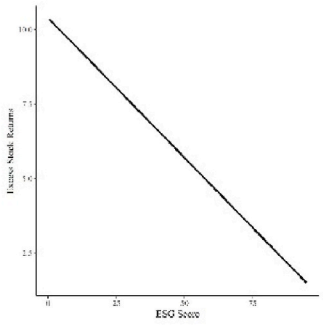
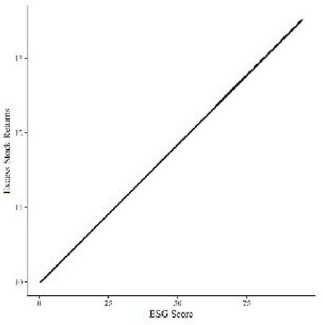
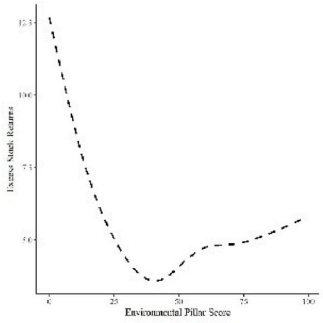
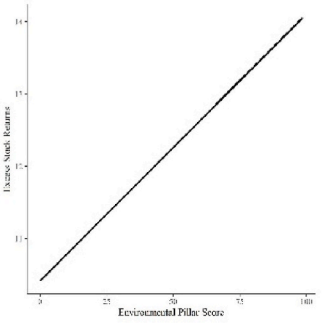
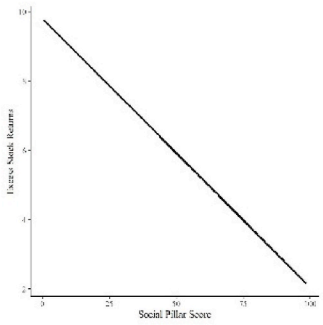
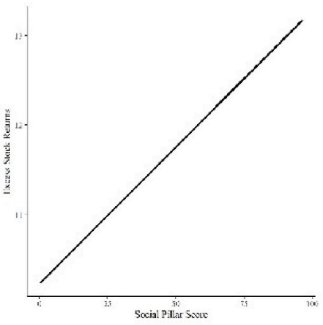
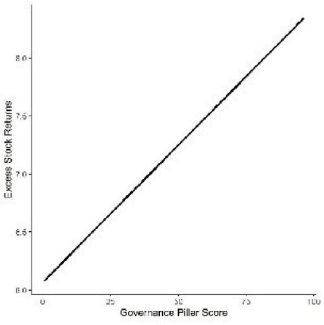
	Asia	EU	US
ESG Composite Score			
Environmental Pillar Score			
Social Pillar Score			
Governance Pillar Score			

Fig. 6. Linear and quadratic relationship between the ESG factors and stock performance by region in the manufacturing sector.

score. Consequently, firms benefit from a lower cost of capital (Chava, 2014; Cornell, 2021; El Ghoul et al., 2011; Ferrat et al., 2022; Ng and Rezaee, 2015). In Europe and the US, we find that the ESG factor has a positive association to operating performance, corroborating earlier findings of for example Friede, Busch, and Bassen (2015) and Xie et al. (2019). The environmental pillar score has a negative effect in Asia. A possible explanation could be that the Asian region is still at the earlier stages of investing in and implementing responsible practices, leading to weaker short-term performance (Andersen and Bams, 2022; Renneboog et al., 2008b).

We find that the association of ESG to performance in the manufacturing sector deviates from the logical relationship we find for the services sector. Since some scholars have pointed out that firms are less likely to engage in responsible practices if the cost of compliance is high (Andersen and Bams, 2022), the manufacturing sector may be more likely to engage in greenwashing compared to services (Baldi and Pandimiglio, 2022). Thus, one would expect the association to operating performance to be consistently positive in manufacturing (Al Hawaj and Buallay, 2022). However, we find there to be regional differences, as this result is verified for the US only. In Europe, we speculate that tighter regulation may reduce the effect. This falls in line with the findings of Chen et al. (2022) who argue that overinvestment in environmental practices would diminish operating performance for the manufacturing sector. Considering the warm-glow theory, that the investor would accept lower returns for a stock they perceive to be responsible (Dreyer et al., 2023b), if the investor is aware of greenwashing, they would in turn demand higher returns, despite high ESG scores, as they take the risk of investing in a firm, they know *de facto* to be irresponsible. Therefore, despite the prevalence of warm-glow investment generally, evidence remains of more conventional investor preferences, particularly within the manufacturing sector in the US. As a suggestion for future research, it is recommendable to investigate the underlying institutional dimensions that differentiate the association of ESG to firm performance within a dynamic industry (such as manufacturing) across the globe.

5.2. Implications for policy and practice

The consequence of our findings in practice is thus twofold. Firstly, in light of the warm-glow theory, if ESG scores are not trustworthy in some sectors, firms with poor socially and environmentally responsible practices (but a high ESG score) will continue to be incentivized by the market, impeding the green transition (Dreyer, 2023; Dreyer and Smith, 2023). The warm-glow investor preference can benefit the green transition. This is especially the case for the manufacturing industry. However, greenwashing is likely to be recognized by investors, and if investors believe that greenwashing is ubiquitous in a sector, those investors will no longer pay a premium for the stocks of responsible firms, driving up the cost of capital and eliminating the incentive for those firms to become greener.

Secondly, the altruism of investors may diminish, as more profit-minded investors are likely to be rewarded with higher actual returns (Heinkel et al., 2001), meaning that the convergence that has been observed recently of investor and stakeholder interests (Tatomir et al., 2022), may only be a temporary phenomenon. This leads to further implications. As the ESG score is still not a standardized metric (Kacanski et al., 2023), regulatory intervention may be required to prompt capital intensive sectors (such as manufacturing) to invest in responsible activities, not just in reporting (Andersen and Bams, 2022).

CRediT authorship contribution statement

Mirel Tatomir: Conceptualization, Methodology, Visualization, Formal analysis, Writing – original draft, Writing – review & editing. **Johannes K. Dreyer:** Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Kristian J. Sund:** Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. **Jiang Yu:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

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