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Social responsibility and bank resiliency☆

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ABSTRACT

We find strong evidence that measures of social responsibility contribute to increasing the resilience of banks. This finding holds when social responsibility is measured by aggregated ESG scores provided by Thomson Reuters, both according to their older Asset 4 categorization and to the reformed ESG Refinitiv classification, and resilience is proxied by various measures of systemic and systematic risk. The results hold on the level of subcategories of the ESG pillars, where we find that, particularly, variables related to the long-term perspective enhance resilience. Moreover, in our international study, we find significant transatlantic differences.

1. Introduction

Banking is a trust-based business, as became abundantly clear in the Great Financial Crisis even before the collapse of Lehman Brothers.[1] The rapid erosion of investors' trust in the markets and in banks generated a near-collapse of the financial system and forced central banks to stabilize it and rebuild trust through a massive provision of liquidity. While the ultimate sources of trust are still unsettled in the scientific debate, a number of contributing factors have been identified (see Knell and Stix (2015) and Fungacova et al. (2019)). Notably, the ability to honour contracts and pay promised returns on investments has been identified as a basic pillar of trust, especially in the case of financial intermediaries and banks. In this paper, therefore, we take the view that banks' investments in social responsibility can be interpreted as such trust-building engagements. Consequently, we take the view that these investments should be reflected in the riskiness of banks' business models.

In particular, we analyse to what extent socially responsible activities enhance banks' resiliency, and through which channels. Will socially responsible activities reduce systemic risk exposure and contribution, and if so, through which activity? Or do banks trade off investments in social responsibility against systemic risk exposure? Are these relations globally stable or can we identify regional differences?

These questions have been of key importance since ESG ratings in general moved into the focus of investors for evaluating the impact of socially responsible actions on firm performance and risk. More recently, the increasing awareness of green and climate finance is affecting investment behaviour and social and environmental risks. Moreover, as regulators and banking authorities are becoming increasingly attentive to the implications of ESG risk (EU Banking Package, 2021; EBA, 2021; BCBS, 2020), banks are incentivized to adjust their business models in line with the UNEP Principles for UN Environment Program (2018) or the UN Environment Program (2021).

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[1] See Gehrig (2013), Gehrig (2015) and Knell and Stix (2015).

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To measure *social responsibility*, we then refer to so-called ESG-ratings.[2] We concentrate on the particular ratings offered by Thomson Reuters, which provide scores for firms' Environmental (ENV), Social (SOC), Corporate Governance (GOV) and, in the Asset4 methodology pre-2017, also Economic (EC) activities.[3] While many alternative ESG screens are offered by different providers, we concentrate on the Thomson Reuters data because it allows us to make use of an exogenous change in methodology that happened in 2017 for identification. Moreover, those screenings are widely analysed, and their strengths and weaknesses are therefore widely known.[4] We are not implying that any screen is superior on the grounds of measuring various dimensions of social responsibility, but we are trying to identify those dimensions in the chosen data set that carry significant information with respect to our resilience measure.

To measure *resilience*, we provide two measures of systemic risk and two measures for individual banking risk. Implicitly, a bank is viewed as resilient when the risks of non-performing or of not honouring contracts are low. In terms of exposure to systemic risk, we employ the expected capital shortfall measure SRISK, developed by Brownlees and Engle (2017).[5] As a contribution measure, we employ Delta CoVaR by Adrian and Brunnermeier (2016), which is the market Value-at-Risk conditional on a bank being in distress.[6] Individual banking risk is measured by a dynamic market beta coefficient between the bank's returns and the market returns as a measure of systematic risk (Engle, 2002). A variant of Altman's well-established Z-score in the version of Fiordelisi and Marques-Ibanez (2013) is our measure of banks' insolvency risk.

In terms of results, we find that our measures for social responsibility, as proxied by ESG scores, strongly matter for systemic risk more than for individual risk. Particularly, we find a significant negative relationship between systemic risk measures and average ESG scores across different specifications and methodologies. Looking at the pillars composing the average score, we can determine that both environmental and social channels consistently contribute to reducing systemic risk, in both exposure (SRISK) and contribution (Delta CoVaR). Interestingly, we find some but not many differences in which pillars have more impact in Europe relative to the USA, as some ESG scores do matter differently across the Atlantic. Notably, the impact of average CSR on banks' riskiness in Europe is driven by the social dimension in our panel regressions and in our event study. Instead, the corporate governance pillar score contributes to lowering the systemic risk for US banks more than European banks.

At the level of which subcategory is channelling the relationship between ESG and risk, we find that indicators of long-term orientation, like *investments in social and human rights* and *workforce training* play a significant role in enhancing resiliency, particularly among European banks. Moreover, investments in *product responsibility*, *product innovation*, *resource reduction*, *boards structure and functions*, and *vision and strategy* have a statistically similar enhancing effect on both continents.

Controlling for different regulatory systems and accounting standards in Europe and in the USA, the transatlantic differences we report reflect the characteristics of the two banking systems. Both climate risk and social investments are important drivers in European banks' riskiness, while climate risk and corporate governance seem to be stronger drivers of the relationship between risk and ESG in US banks. In particular, labour markets organization contributes to lower exposure to systemic risk for European banks, as can be seen in the positive differential impact of employment quality and workforce training scores.

Our results are particularly relevant to inform current policy debates about enhancing the stability and resiliency of financial systems. For example, the European Commission explicitly calls for monitoring and regulating "systematic and consistent management of environmental, social and governance (ESG) risks by banks" (EU Banking Package, 2021) in its Sustainable Finance Strategy 2021. Our results suggest that the introduction of specific instruments to manage ESG risks may be preferable to adapting broad capital requirements to reflect ESG risk.[7] Interestingly, concerning environmental sustainability we do find consistent and significant results for the impact of climate risk on the riskiness of banks. However, this is not the only channel, and, furthermore, it is not stable across countries. We find strong evidence that trust-building activities contribute to reducing the systemic riskiness of the banks. Thus, social subcategories, such as workforce training and diversity, enhance resilience.

We provide two methodological innovations to address potential endogeneity, exploiting an exogenous change in methodology in ESG scores. Reverse causality is a fundamental concern in this literature, and there is empirical evidence both on out-performance typically preceding CSR investments (Dorfleitner et al., 2015) and resiliency driving CSR investment/s (Bouslah et al., 2013; Cornett et al., 2016). Literature shows that reverse causality holds particularly for measures of corporate governance; however, we respond to potential endogeneity issues exploiting an exogenous shock in 2017, in the form of an unexpected change in the ESG scoring methodology. The identification strategy benefits from the fact that Thomson Reuters data provider changed its scoring method in 2017, retroactively updating components and ESG scores and dismissing the old Asset4 data in favour of new Refinitiv screening. In our sample, we first focus our analysis on the drivers based on the former classification (Asset4) till 2017, which is the information that was available to market participants and could have affected their decisions and behaviour. Then, we implement two identification strategies, and to our knowledge we are the first exploit this change in methodology for identification.

In a first attempt to reduce endogeneity, we estimate whether a significant exogenous change in scoring has an impact on the market perception of systemic riskiness of the institutions in our sample. For this purpose, we consider institutions that have experienced a shock, either a drastic increase or decrease, in their ESG scoring as treated banks, and compare their SRISK level to the rest of the sample, controlling for bank characteristics. We observe that a drastic decrease in ESG scores significantly and strongly increases SRISK, thus enhancing the perception of systemic risk exposure of the banks. Overall this is consistent with our hypothesis that CSR enhances the riskiness of the banks, and the market updates its beliefs on the riskiness of the banks at the publication of new scores. We can also pin down that a higher impact among European banks is produced by a reduction in Social ratings, while for US banks we see a significant impact only by the environmental scores.

Secondly, we apply a 2SLS Instrumental Variable approach, using a section of indicators from the World Bank Sovereign ESG Data and the country-average new Refinitiv scores as instruments for the old Asset4 ESG scores. To our knowledge we are the first to apply the Sovereign

[2] Our interpretation of ESG accords with the third viewpoint of ESG myths 1 of Larcker et al. (2021).

[3] We explain the differences between the TR Asset4 classification, in place until 2017, and their modern Refinitiv Business Classification, and our take on those, in more detail below.

[4] Overall we take an agnostic view and ask about the informational content of the particular ESG screens used in the underlying data set concerning various measures of (systemic) risk.

[5] SRISK estimates the amount of assets exposed to systemic risk in case the market experiences a period of prolonged stress.

[6] Hence, it measures the danger of contagion from a bank being in distress for the whole banking system.

[7] This is particularly relevant for globally systemically important financial institutions that predominantly apply an internal model-based approach to risk weighting.

ESG data for identification in the banking literature, and we improve on existing papers using country-average Refinitiv ESG data.[8]

Finally, we deal with a potential simultaneity bias by using properties of longitudinal data with a dynamic model that includes both lagged explanatory (ESG) variables and lagged dependent variables (risk measures).

To summarize, we contribute in two major ways to the existing literature, providing both new evidence and a methodological improvement, namely: (i) by applying ESG-relevant factors to the above-mentioned risk measures, comparing European and US financial institutions, in particular to systemic risk, and (ii) by proposing identification strategies that would reduce a reverse causality bias. To the best of our knowledge, we are the first to address endogeneity between CSR and risk using the above-mentioned exogenous change in ESG methodology and the Sovereign ESG data from the World Bank. Very few studies have looked at the impact of social responsibility on risk measures and have used methods able to resolve the issue of endogeneity between risk and social scores (El Ghoul et al., 2011 looking at cost of capital, Albuquerque et al. (2020) looking at systematic risk and increased valuations), while none focused on the banking sector and systemic risk.

The paper is organized as follows. After a short survey of the literature in Section 2, Section 3 provides an overview of the sample and data. Section 4 presents the methodology used in the analysis and sets up the identification strategy for measuring the ESG score impact on our risk measures. The presentation of the results follows. First, we present the results of the panel regressions using Asset4 classification in Section 5, then the IV regressions results are reported in Section 6 and the direct impact of the Refinitiv change in scoring is presented in Section 7. Finally, Section 8 discusses the policy implications of our results, and Section 9 concludes.

2. Literature

While the literature on ESG investing is growing rapidly, the focus of most research lies on returns, return volatility and profitability. This literature has long addressed the impact of environmental, social and governance policies on firms' performance. On the one hand, a strand of literature considers managers' investments in corporate social responsibility as detrimental to shareholders (Benabou and Tirole, 2010; Krueger, 2015). On the other hand, proponents of a "value-enhancing view" suggest that investments in social responsibility pay off by maximizing shareholder wealth (Anginer et al., 2018; Ferrell et al., 2016; Albuquerque et al., 2020). A prominent example is the study by Lins et al. (2017), who identify a high ESG score with "social capital" and, thus, "trust". They estimate extra returns of four to seven percent for high social capital firms.

The issue of resiliency has been highlighted by the current pandemic. Recent studies by Albuquerque et al. (2020) and Pagano et al. (2020) focus on the profitability of ESG firms in the full stock market and find the performance of ESG firms to be superior. These findings are checked by Berg et al. (2020), who report that results could be affected by the use of Refinitiv ESG II data, the Thomson Reuters ESG data available after a retrospective change in methodology in April 2020. They show that some results cannot be replicated on the basis of Refinitiv ESG I data, the data applying the methodology in use before April 2020. Thus, they show that no significant ESG effects can be measured on firm performance with the original scoring method. This finding asks which of either of the scoring methods did affect the behaviour of market participants at all. It is evident that only Refinitiv ESG I was available to market participants prior to April 2020, when Refinitiv ESG II was suddenly (and surprisingly) introduced, retrospectively updating the variables. Also, Pagano et al. (2020) focus on returns. They do not aim at measuring resiliency in terms of risk measures but rather at identifying resiliency with social-distancing measures at the workplace, widely implemented by pandemic reaction policies. In contrast to those studies, our focus lies precisely on the relation of risk measures as proxies of resiliency and their relation to ESG scores, which are defined by Thomson Reuters.

Only a few papers address the issues of resiliency and analyse the relations between ESG scores and specific risk measures in banking. Dorfleitner and Grebler (2020) and Dorfleitner et al. (2020) have identified drivers of insolvency risk in a global sample of firms. Chiaramonte et al. (2020) analyse the impact of ESG in the insurance sector. Bouslah et al. (2013) analyse the relation between ESG components and systematic risk. Moreover, there is evidence of higher performance by firms with higher levels of social capital in periods of crisis (Lins et al., 2017). Also, ESG funds outperform conventional funds during periods of crisis (Becchetti et al., 2015; Nofsinger and Varma, 2014). However, none of these studies addresses the issue of systemic risk.

In the case of the banking industry, recent literature focuses on whether attention to CSR impacts banks' behaviour. Kacperczyk and Peydró (2021) have recently shown that banks committed to carbon neutrality affect carbon emissions via credit reallocation, moving loans from less to more virtuous companies. This behaviour seems to be due to a preference for green assets rather than risk considerations. The question of whether corporate socially responsible behaviour affects the financial performance of banks has been studied by Cornett et al. (2016), who conclude that corporate social responsibility is rewarded by the markets. They also find that bigger banks tend to pursue more CSR measures than small banks. Moreover, they show that larger banks faced an increase in CSR strengths and a steep drop in CSR concerns after 2009.

Closest to our work, Anginer et al. (2018), Scholtens and van't Klosters (2019), and Aevoae et al. (2022) focus on systemic risk in the banking sector.[9] The former focus on the corporate governance dimension only, and, in agreement with our results, Anginer et al. (2018) find that shareholder-friendly policies, typically associated with a higher Corporate Governance score, tend to correlate positively with systemic risk of banks in both dimensions, exposure risk (SRISK) and contribution risk (Delta CoVaR). Scholtens and van't Klosters (2019) concentrate on a sample of the most systemic Eurozone banks and focus on the effect of both TR ESG equal-weighted score and pillars on both Z-score and SRISK. In parallel work, Aevoae et al. (2022) also analyse the correlation between ESG factor pillars and their contribution to systemic risk (mainly Delta CoVaR). While analysing various dimensions of risk and particularly exposure to systemic risk (SRISK), we control for endogeneity and establish causal links from the ESG scores and resiliency. Thus, we verify that also the social dimension plays a strong significant role, even after controlling for endogeneity. While Aevoae et al., 2022 analyse an international sample, we concentrate on transatlantic differences between Europe and the US. Finally, we go beyond the pillars, Environmental, Social and Corporate Governance to their underlying subcategories, which allows us to identify some of the ultimate drivers of resiliency.

3. Sample and data

3.1. Sample

Our main sample set comprises 114 European financial institutions and 96 US financial institutions from 2004 to 2019. The data include all listed banks and diversified institutions so classified in the Compustat North America and Compustat Global databases and simultaneously

[8] This latter would improve our IV given the lack of direct impact on the risk measures, as they were not available to market participants before 2017.

[9] See also Cerqueti et al. (2021) on the effects of ESG on the systemic risk exposure of mutual funds.

covered by the Thomson Reuters Datastream ESG database (Thomson Reuters Datastream ESG Content, 2018).

We use daily Compustat market data and quarterly accounting data to estimate all risk measures. Moreover, Compustat datasets provide information on the bank-level data that we use as control variables.

Then, we hand-match the available data with the Thomson Reuters ESG database from Datastream. We have two sets of TR ESG data, as explained carefully in the next sub-sections: Asset4 data comprises information on Environmental, Social, Corporate Governance and Economic indicators, aggregated in an equal-weighted ESG score, before the set was discontinued in 2017. Refinitiv comprise a similar set of indicators on Environmental, Social and Corporate Governance, and is aggregated to a weighted ESG score. This methodology was first implemented in 2017 and Asset4 was retroactively substituted.

For the European sample, we use the MSCI Europe index (Datastream data) as the equity market return benchmark, while we use the S&P 500 index for the North American sample. Following Gehrig and Iannino (2021), we take the yield of German federal bonds (Bundesbank data) and select the US T-Bill rates (Datastream data) as the risk-free rates for European and US banks, respectively.

Finally, we use the World Bank Sovereign ESG data as control and instrumental variables.[10] The World Bank ESG data portal reports 71 ESG country-level indicators, with 40 additional macroeconomic indicators, over 61 years. Variables are reported annually and differentiated into Environmental, Social and Corporate Governance pillars and their sub-categories.

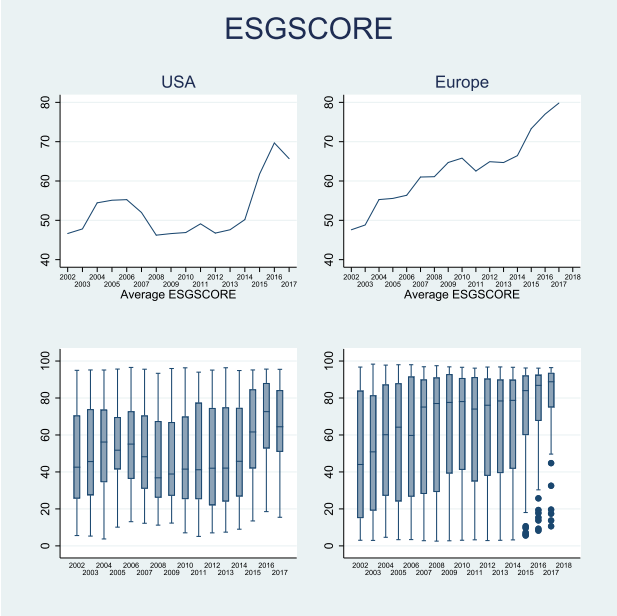

Fig. 1. ESG scores in Europe and the USA. The Figure reports the average evolution (top frames) and box plots by year (bottom frames) of the ESG scores in Europe and the USA separately.
Source: Data: Asset4 2018.

3.2. Data on social responsibility

According to the Financial Times Lexicon (2018), ESG is defined as *"a generic term used in capital markets and used by investors to evaluate corporate behaviour and to determine the future financial performance of companies"*. We use two sets of annual ESG data from Thomson Reuters. We downloaded the old Asset4 ESG scores and indicators in 2018, and the new TR ESG Refinitiv in October 2020. The first set (Asset4) classified CSR into four pillars: **Environmental performance**, **Social performance**, **Governance performance** and **Economic performance** and aggregated them into an equal-weighted ESG score. To evaluate the score for each pillar, we consider different categories individually with different weights. The pillar *Environmental performance* encompasses the categories Resource Reduction, Emissions Reduction, and Product Innovation. The pillar *Social* consists of Employment Quality, Health and Safety, Training and Development, Diversity, Human Rights, Community, and Product Responsibility, whereas the pillar *Corporate Governance* includes Board Structure, Compensation Policy, Board Functions, Shareholder Rights, and Vision and Strategy. Finally, the pillar *Economic* consists of Performance, Shareholder loyalty, and Client loyalty. In our sample 210 financial institutions are covered simultaneously by Compustat and Asset4 ESG data, 114 European firms and 96 US firms.[11]

In 2017, Thomson Reuters dismissed the previous categories and produced a new methodology, now called TR ESG Refinitiv. The main changes concern the removal of the Economic pillar and a weighted aggregate ESG score. The three pillars, Environmental, Social and Governance, are composed respectively of the following categories: Resource use, Emission reduction and Innovation (ENV); Workforce, Human rights, Community and Product responsibility (SOC); and Management, Shareholders and CSR strategy (GOV). The methodology was further updated retrospectively in April 2020; therefore the data we downloaded refer to the new methodology (called Refinitiv ESG II by Berg et al. (2020)), thus, they were not available to the market participants before April 2020.[12]

Tables 1 and 2 report a detailed list of the pillars and the subcategories in each pillar for both the ESG datasets used, Asset4 and Refinitiv. Moreover, Tables 3 and 4 report the summary statistics of the scores and the correlation matrix between each comparable pair in the two sets and in the two geographical areas. The ESG aggregate scores are highly correlated in the two datasets, ranging from .78 in the US and .86 in the European sample. Important changes happened at the pillar level, and the reclassification drastically affected the corporate governance score, with correlations from .59 (USA) to .65 (Europe). On average, all scores have decreased significantly, particularly the Corporate Governance dimension in the USA and the Environmental score in Europe.

We conclude by showing the time evolution of the ESG scores we will use in our analysis (Asset4 data). Figs. 1 to 5 report the evolution of the ESG aggregate score and the four pillar scores in Europe and in the USA. The figures reveal a steady average increase over the years but also significant transatlantic differences, both in the aggregate ESG score and, especially, in the pillars. Europe scores significantly higher in social responsibility, and its attention to CSR seems to have started earlier with a steady increase. It also scores higher in the Environmental and Social dimensions. The US dominates in the Corporate Governance dimension, at least before the Refinitiv methodological change in April 2020, with high averages since early 2000.

4. Methodology

4.1. Measures of resiliency

We conduct our analysis on four measures of risk. We consider two measures of systemic risk, as exposure (SRISK) and contribution (Delta

[10] https://esgdata.worldbank.org/lang=en.

[11] For more information about the methodology Asset4, refer to Refinitiv (2015) "ASSET4 ESG Data Glossary. February 2015.

[12] For more information about the new methodology and a comparison with the old Asset4 methodology, refer to TR (2017) "Thomson Reuters ESG Scores", November 2017, and to Refinitiv (2020) "Environmental, Social and Governance (ESG) scores from Refinitiv", April 2020.

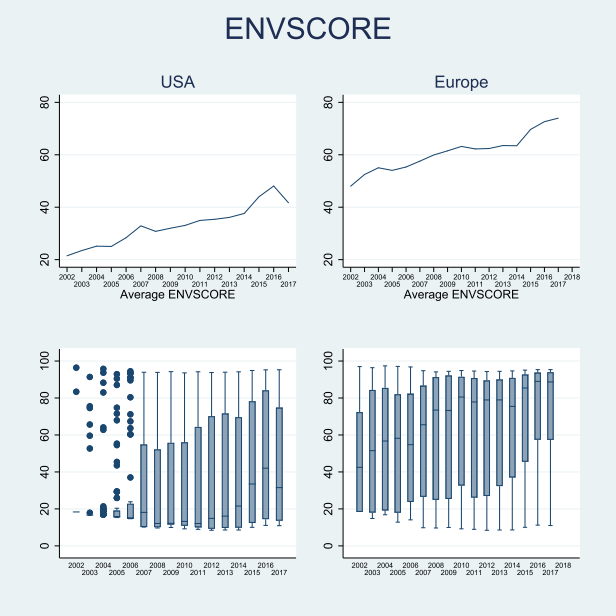

Fig. 2. Environmental scores in Europe and the USA. The Figure reports the average evolution (top frames) and box plots by year (bottom frames) of the Environmental scores in Europe and the USA separately.
Source: Data: Asset4 2018.

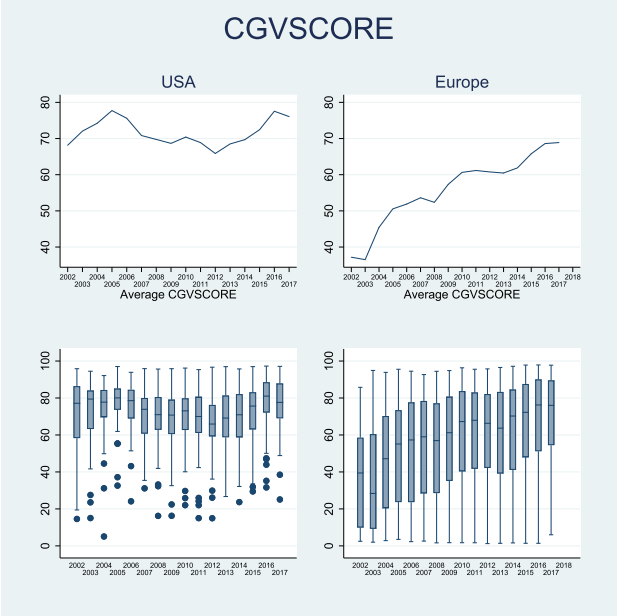

Fig. 4. Corporate governance scores in Europe and the USA. The Figure reports the average evolution (top frames) and box plots by year (bottom frames) of the Corporate Governance score in Europe and the USA separately.
Source: Data: Asset4 2018.

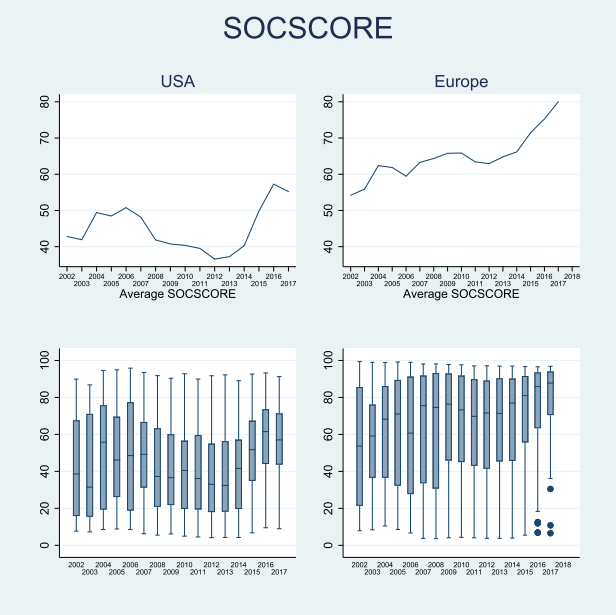

Fig. 3. Social scores in Europe and the USA. The Figure reports the average evolution (top frames) and box plots by year (bottom frames) of the Social score in Europe and the USA separately.
Source: Data: Asset4 2018.

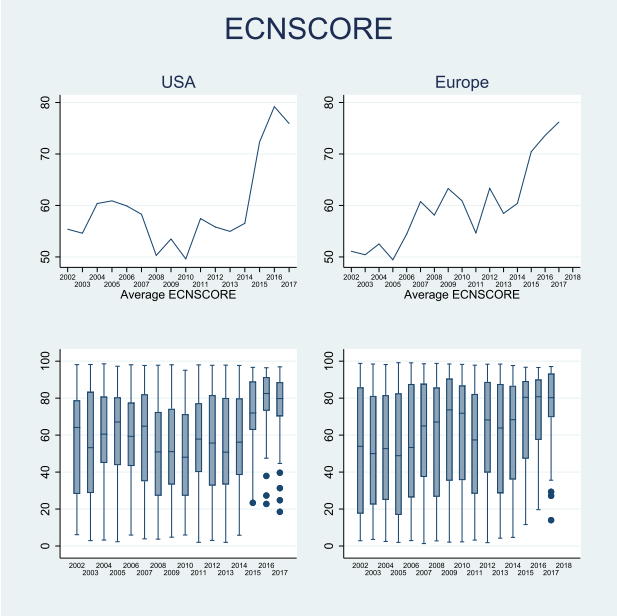

Fig. 5. Economic scores in Europe and the USA. The Figure reports the average evolution (top frames) and box plots by year (bottom frames) of the Economic scores in Europe and the USA separately.
Source: Data: Asset4 2018.

CoVaR), and two measures of systematic risk, as distance to default (Z-score) and sensitivity to market returns (beta).

The SRISK measure, developed by Brownlees and Engle (2017), is an estimate of the capital required to recapitalize an institution at market prices after a prolonged crisis, to render the bank compliant again with capital regulation. As such, it is a hybrid market-based measure of the capital shortfall since it combines market information (the price of seasoned equity) with book values (capital requirements). It considers the combined effect of the sensitivity of the bank returns to aggregate shocks, leverage and market capitalization of individual banks and the banking system at large. A bank is more likely to appear systemically risky if it faces a sizeable capital shortfall in periods of depressed market conditions relative to good times when other banks are doing well (see Gehrig (2013)).

Fig. 6. Risk measures in Europe and the USA. The Figure reports the average evolution of the systemic risk measures used in the analysis: SRISK and $ Delta CoVaR. SRISK is estimated daily as Eq. (1), and Delta CoVaR is estimated daily as Eq. (2), then aggregated annually by Europe and USA.

SRISK for bank i in period t is then estimated as:

$$\begin{aligned} SRISK_{i,t} &= E_{t-1}[Capital\ shortfall_i | Crisis] \\ &= E_{t-1}[k(Debt_{i,t}) - (1-k)(1-LRMES_{i,t})Equity_{i,t}], \end{aligned} \tag{1}$$

$LRMES_{it} = 1 - \exp(ln(1-d)beta)$ is the expected loss in the equity value of bank i if the market were to fall by more than a $d = 40\%$ threshold within the next six months (according to V-lab documentation[13]). The market beta is a dynamic correlation coefficient between the bank and the market returns (Engle, 2002). Finally, we control for differences in accounting rules between European and US banks following Engle et al. (2015). Specifically, we use the prudential capital ratio $k = 8\%$ for US banks and k = 5.5% for European banks. SRISK is estimated daily and then aggregated annually.

We follow Adrian and Brunnermeier (2016) in measuring the contribution to systemic risk by the use of Delta CoVaR. This purely market-based systemic risk measure assesses the spillovers of distress from a given bank to the financial system. Hence, it measures the danger of contagion deriving from a bank being in distress for the whole banking system. Using a quantile regression approach, we identify this distressing event of firm i as an equity loss equal to its $(1-\alpha)\%$ VaR, such as $r_{it} = VaR_{it}(\alpha)$, and CoVaR represents the maximum loss of the market return within the $\alpha\%$-confidence interval, conditionally on some event $C(r_{it})$ observed for bank i: $Pr(r_{mt} \leq CoVaR_t^{m|C(r_{it})}) = \alpha$. Then, the $Delta CoVaR of the bank i we use in our analysis is defined as the difference between the CoVaR of the financial system conditional on firm i being in distress and the CoVaR of the financial system conditional on firm i being in its median state, weighted by the bank's market capitalization:

$$\$\Delta CoVaR_{it}(\alpha) = -(CoVaR_t^{m|r_{it}=(VaR_{it}(\alpha))} - CoVaR_t^{m|r_{it}=Median(r_{it})}) * MV. \tag{2}$$

Delta CoVaR is estimated daily and then aggregated annually. Then, following the original study, we transform it to positive values.

Individual banking risk is measured both via systematic risk, as proxied by market beta, and a measure of bank default. The latter distance to default is widely proxied in the banking literature by the Z-score (Boyd and Runkle, 1993; Fiordelisi and Marques-Ibanez, 2013). It measures the distance of a bank's return on assets to the insolvency threshold in multiples of standard deviations. This measure combines information on the bank's performance (ROA), leverage (equity-to-assets ratio), and risk (standard deviation of ROA). Higher Z-score values represent a larger distance to default. We estimate the following version of Z-scores for each institution:

$$Z - score_{it} = \frac{ROA_{it} + E_{it}/TA_{it}}{\sigma_{ROA_i}}. \tag{3}$$

Z-score is estimated quarterly and then aggregated annually.

Finally, we estimate a dynamic market beta coefficient between the bank's returns and the market returns. The return volatilities of each institution i, $\sigma_{i,t}$, and of the market, $\sigma_{m,t}$, are estimated by an asymmetric GJR GARCH model (Glosten et al., 1993). The correlation between each institution's return and the European market index, $\rho_{i,t}$, is estimated by a dynamic conditional correlation (DCC) model (Engle, 2002). The beta measure is estimated daily and then aggregated annually:

$$Beta_{it} = \rho_{i,t}\frac{\sigma_{i,t}}{\sigma_{m,t}}. \tag{4}$$

[13] https://vlab.stern.nyu.edu/docs/srisk/MES.

Table 5 lists all the risk measures and control variables used in the analysis. Fig. 6 reports the evolution of the systemic risk measures over time, for Europe and the US separately. In terms of exposure to systemic risk, the capital shortfall (SRISK) for European banks in our sample considerably exceeds that of US banks. In terms of the contribution measure Delta CoVaR, no significant transatlantic differences can be detected.

4.2. ESG contributions to resiliency

To analyse the explanatory power of ESG scores on any of the resiliency measures $RES \in$ {SRISK, ΔDelta CoVaR, Beta, Z-score}, we separately regress the annual RES measure on each lagged categorical ESG rating, distinguishing the aggregate ESG score, the pillars and the sub-groups of each pillar. This allows us to extract the drivers of the RES levels.

Thus, we set up three models. First, we use the ESG aggregate score as a proxy for social responsibility and regress $RES_{i,t}$ for company i at time t on the lagged score $ESG_{i,t-1}$ and the set of control variables $X_{q,i,t-1}$:

$$\begin{aligned} RES_{i,t} &= \alpha + \gamma_1 ESG_{i,t-1} + \gamma_2 ESG_{i,t-1} * ln(TA_{i,t-1}) + \gamma_3 ESG_{i,t-1} \\ &\quad * \ Europe \\ &\quad + \lambda_0 RES_{i,t-1} + \sum_q \lambda_q X_{q,i,t-1} + \mu_i + \tau_t + \epsilon_{i,t}. \end{aligned} \tag{5}$$

We recall that i is the counter for each financial institution and t represents the year from 2004 to 2017. The dependent variable RES is the risk measure, alternatively as SRISK, Delta CoVaR, market beta or Z-score. ESG is the weighted-average aggregate score for each firm and year, and we include interacted terms with size ($ln(TA)$) to address the evidence that larger firms tend to be more involved in CSR practices (Cornett et al., 2016).[14] Moreover, we interact ESG with a dummy for the geographical location ($Eur = 1$ if bank headquarters are located in Europe) to address any differences between the two continents. Given the persistence we find in banks' riskiness, we control for the lagged value of the risk measure. Moreover, we include a set of known lagged bank-specific variables as determinants of bank risk (Gehrig and Iannino, 2018, 2021; Scholtens and van't Klosters, 2019), $X_{q,i,t-1}$, such as the logarithm of total assets, leverage, market-to-book, change in shareholders' equity, past year stock performance, and stock volatility.[15] In the case of SRISK, we also include market beta and Z-score as known drivers of the expected capital shortfall. Thus, we intend to study the effect on systemic risk, ceteris paribus, the impact on systematic solvency and cost of capital. Similarly, for the systematic risk regressions, we include lagged SRISK to control for the systemic exposure of the banks. Moreover, we include macro variables to capture the official supervisory power across countries (Barth et al., 2013) and the annual GDP growth rates. We include fixed effects, either country- or firm-fixed effects, μ_i. Firm-fixed effects capture idiosyncratic differences in riskiness among the banks in the sample, while country-fixed effects capture macro and other supervisory differences. Finally, year-fixed effects, τ_t, address changing macro-economic conditions.

Given that the role of governance is well-documented in the literature (Beltratti and Stulz, 2012; Fahlenbrach and Stulz, 2011) and whether it belongs to the Social and Environmental dimensions is debated (e.g. Larcker et al. (2021)), we also perform our analysis excluding it from the regressions. Thus, we perform regressions on an equal-weight score combining only social and environmental sub-scores.[16]

Secondly, we disentangle the effects of each pillar of the ESG score and regress RES on ($Pillar$): ENV-score, SOC-score, CG-score and EC-score, to identify which ESG category explains most of the systemic financial stability:

$$\begin{aligned} RES_{i,t} &= \alpha + \sum \gamma_1 Pillar_{i,t-1} + \sum \gamma_2 Pillar_{i,t-1} * ln(TA_{i,t-1}) \\ &\quad + \sum \gamma_3 Pillar_{i,t-1} * Eur + \lambda_0 RES_{i,t-1} + \sum_q \lambda_q X_{q,i,t-1} \\ &\quad + \mu_i + \epsilon_{i,t}. \end{aligned} \tag{6}$$

We consider that the categorical scores might be highly correlated. Thus we first test Variance Inflation Factors, which do not show any critical level of multicollinearity.[17]

Finally, to have a more detailed insight into which categories of each pillar are sufficient to work as an effective policy measure to improve financial stability, we regress RES on each sub-category of each pillar separately ($Subcat$):

$$\begin{aligned} RES_{i,t} &= \alpha + \sum \gamma_1 Subcat_{i,t-1} + \sum \gamma_2 Subcat_{i,t-1} * ln(TA_{i,t-1}) \\ &\quad + \sum \gamma_3 Subcat_{i,t-1} * Eur + \lambda_0 RES_{i,t-1} + \sum_q \lambda_q X_{q,i,t-1} \\ &\quad + \mu_i + \epsilon_{i,t}. \end{aligned} \tag{7}$$

4.3. Identification strategy

Identifying the causal relation in this setting is difficult because resilient banks might also be more inclined to introduce socially responsible policy measures. The literature supports the presence of reserve causality, especially in the case of corporate governance regarding the impact on performance (Dorfleitner et al., 2015; Friede et al., 2015). Less risky banks would invest more in corporate governance. There is less evidence that safer banks would invest more in social and environmental measures, but nevertheless, we explicitly control for endogeneity. We offer two approaches, first the use of longitudinal data and fixed effects, and second an instrumental variable approach that explicitly exploits the Thomson Reuters change in methodology in 2017 to study the effect of such an exogenous shock in ESG ratings on SRISK.

Let us start by analysing longitudinal data and fixed effects. Measures of risk are regressed on the first lag of ESG scores, thus allowing us to draw conclusions on how ESG affects the risk in the following year, and avoiding simultaneity bias. Moreover, we could still have issues of reverse causality if the risk measure affects ESG through its lags because of its persistence. Thus, we introduce lagged dependent variables as control variables. We include firm-fixed effects to address any omitted firm-specific variables, on the assumption that endogeneity is driven by such non-varying effects. The literature supports that in small samples, country effects work well to control for unobserved heterogeneity (Gormley and Matsa, 2014). Thus we also apply country-fixed effects as a robustness check.

Next, we investigate systemic risk exposure at the time of the change in Refinitiv methodology in 2017. With the implementation and publication of a new measurement method in 2017, the pillars of ESG scores have been retroactively calculated and aggregated differently in new scores under the name of Refinitiv. The new methodology was not available prior to 2017. Thus banks and financial institutions were not able to take the effects of ESG policy implementations into account (Berg et al., 2020).

Thus, we safely assume that banks could not affect the change in ESG methodology and that the market was not aware of the change in methodology beforehand. We set a time dummy of the exogenous shock to 2017 and include the period from 2014–2020. We consider treated

[14] As robustness checks, we consider an equal-weighted average of only Environmental and Social scores, excluding Corporate Governance and Economic Pillars.

[15] See Table 5 for details on such control variables.

[16] We report the results only in the Appendix for the Referees.

[17] Nonetheless, we regress the four pillars in a single specification and run separate regressions for each pillar in an unreported robustness check.

banks as all the institutions that exhibit a drastic increase or decrease in ESG, with all other banks as controls. We calculate the difference between the old Asset4 data and the new Refinitiv data in 2017. We consider an increase in scores drastic if the difference lies above its 90th percentile, and a decrease in scores drastic if the difference lies below its 10th percentile. We then apply all the control variables previously used, and year- and country-fixed effects. Particularly, we include the lagged risk measures to control for the firm-specific riskiness of the banks and lagged ESG scores as control variables for firm-specific preference for social responsibility. Lastly, we also try placebo tests to check whether changing the time and/or the calculation of the difference has an effect.[18]

Finally, we use a 2SLS Instrumental Variable approach with robust standard errors using two sets of instruments: a section of the Sovereign ESG data from the World Bank data portal and the country-average new scores after the change in methodology in 2017. We use the World Bank indicators as instruments for the social responsibility of the banks in our sample, after running several checks to select the most appropriate instruments among 71 ESG indicators in the data portal. First, we exclude all indicators that might be directly or indirectly correlated with our risk measures. For example, we exclude indicators of pollution, because through the bank's loan portfolio and through creditors' investments we might find a correlation between banks' riskiness and pollution measures. The chosen set of instruments includes variables such as food security, climate risk, education and skill, poverty and education, gender, human rights, internet usage, government effectiveness, and stability and rule of law, as listed in more detail in Table 5. We assume that the banks in our sample cannot have a direct or indirect effect on these country variables, and those indicators cannot affect banks' riskiness other than through their impact on the ESG scores. For example, country indicators of human rights (voice and accountability), gender balance (proportions of seats held by women in national parliament) or climate risk (level of water stress) will impact the demand for CSR. However, they do not seem directly to affect the riskiness in the cross-section of our institutions. With this large number of indicators, we perform an unweighted principal component analysis on the selection of indicators to reduce dimensionality in a data-rich environment (Bai and Ng, 2009). The first two components are used as instruments. The literature proves that a linear transformation of valid instruments is still a valid instrument, and it improves efficiency by reducing dimensionality (Smith and Winkelried, 2011).

Finally, we add new Refinitiv sub-category scores averaged by country and by year as instruments for the old Asset4 data in the sample 2004–2017. This instrument is in line with El Ghoul et al. (2011), who use average ESG scores as instruments, but it improves the reverse causality bias because Refinitiv data were not available to market participants at the time of their decisions. Similarly, as above, we take the first two principal components of the ESG subcategories to address collinearity among ESG indicators.

Given the above discussion, our instruments could not affect risk measures directly, while we assume that they can affect SRISK only through their correlation with the old Asset4 data. Tests of instrument validity and under- and over-identification are performed and reported in the results section, suggesting we have strong and valid instruments that tend to be uncorrelated with the error term.

In the following Section, we first report results from the panel regressions using old Asset4 data, including lag regressors and firm-fixed effects to control for unobserved heterogeneity that could affect both ESG scores and systemic risk at the bank level.[19],[20]

Then, we report the results from the instrumental variable approach using ESG Sovereign data and average Refinitiv data as instruments for the Asset4 data.

Finally, we report the results of the direct impact of the exogenous change in scoring, where treated banks are considered institutions with a drastic increase or decrease in ESG from the old Asset4 to the new Refinitiv data.

5. Impact of ESG on riskiness based on panel regressions

We start this analysis by looking at the panel regression results based solely on the Asset4 classification of Thomson Reuters, which was discontinued in 2017.

It is useful to start with the aggregate scores and then continuously dig deeper into the various components to distil the economic structure.

5.1. Aggregate scores

Let us start with the equally weighted aggregate ESG score. Table 6 reports the results of the panel data regressions on the two systemic risk measures, SRISK (exposure measure, column 1 in tables) and Delta CoVaR (contribution measure, column 2), and on two measures of firm individual risk, Z-score (insolvency risk, column 3) and market beta (systematic risk, column 4). Across the board, we find a strongly significant and resiliency-enhancing effect of the aggregate ESG score (L.Equal-Weighted Rating) on both systemic risk measures. High ESG levels are related to a reduction in exposure and contribution risk.

These results suggest that, on average, banks that score high in the ESG dimensions present lower riskiness (Bouslah et al., 2013; Scholtens and van't Klosters, 2019). More interestingly, the markets seem to appreciate the socially responsible involvement of the banks in our sample. We observe that firms with better ESG rankings tend to be perceived as less systemically risky in terms of their contribution and their exposure.

Moreover, we do not identify significant transatlantic differences, by introducing a region dummy (Europe = 1) and interacting it with the ESG score (L.Equal-Weighted Rating * Europe). The following analysis of pillars and sub-categories will shed more light on any transatlantic differences.

Importantly, we also find that firm size, measured by the logarithm of total assets, significantly reduces the positive resiliency-enhancing impact of ESG on systemic risk (L.Equal-Weighted Rating * c.ln(L.TA)). In other words, the effects d CSR on small and large firms are significantly different. ESG measures tend to be more effective in enhancing resiliency for smaller firms.

5.2. Pillars

By disentangling the components of the equal-weighted ESG score into its major pillars, ENV score (L.Environmental), SOC score (L.Social), CG score (L.Corporate Governance) and EC score (L.Economic), Table 7 provides more information about the drivers of the aggregate findings and the channels of the relationship between CSR and risk. We find that both the *social* and the *environmental* pillars greatly contribute to reducing our measures of systemic risk. In particular, one standard deviation increase in Social score in an average-size US bank will decrease DeltaCoVaR by 0.17 standard deviations, ceteris paribus. This result is consistent with the particular nature of the banking services, highly focused on human and social capital (Scholtens and van't Klosters, 2019). The environmental- pillar seems to be stronger in both systemic risk measures, reporting one standard deviation increase in Environmental score will increase DeltaCoVaR in an average-size

[18] For sake of space, we do not report these placebo results, which confirm that the change in methodology was not anticipated and there is no effect other than in 2017.

[19] The Appendix reports OLS regressions with country-fixed effects (Gormley and Matsa, 2014).

[20] Given the medium time dimension of the sample, we also estimated our dynamic panel regressions by instrumental variables approach in which we instrument the first lag of the risk measures with their second lag. Results are robust; therefore we omit their presentation in the paper.

US bank by 0.41 standard deviations, ceteris paribus, consistent with parallel literature (Aevoae et al., 2022).

Consistent with the aggregate results, the two pillars play different roles for smaller vs. larger firms, being more beneficial in reducing risk for smaller firms that are more dependent on human capital and have a higher preference for green assets. Size significantly reduces the positive resiliency-enhancing impact in the interaction terms, e.g., L.Social * c.ln(L.TA), as also seen in the overall ESG score.

Looking at the differential effect on SRISK in the two regions of our analysis, we observe a clear distinction between European and US institutions. Interestingly, the Social score interaction with the region dummy (L.Social * Europe) shows that social investments weakly but significantly enhance systemic exposure (SRISK) for European banks, while they are not even significant for American firms. European banks that score high on the social pillar tend to be significantly less exposed to systemic risk. On the other hand, the Governance score interaction with the region dummy (L.Corporate Governance * Europe) suggests that European banks that score high on the governance dimension also tolerate higher capital shortfalls, and vice versa for US banks. Consistent with our results, Anginer et al. (2018) also find a positive relationship between high corporate governance score and risk in countries where shareholder-friendly corporate governance is accompanied by higher financial safety nets provided by the state.

5.3. Subcategories

Finally, by looking at the individual score components, we can identify more nuanced micro-interactions between rating scores and risk measures.

5.3.1. Common drivers

Tables 8 to 11 present an even more detailed picture of the relationship between CSR and risk. We find the strongest enhancing effects on both systemic risk measures, especially for smaller firms, in the following components: product innovation (Environmental pillar), human rights and training and development policies (Social pillar), vision and strategy (Governance pillar) and client loyalty (Economic pillar). Delta CoVaR seems to be affected by a few more indicators, such as product responsibility and employment quality (Social pillar), board structure and functions and shareholders' rights (Governance pillar). Very little impact is observed for systematic measures of risk, we only observe that investments in emission reduction and diversity and opportunity are related to a reduction in Z-score, particularly for smaller US banks. Beta, on the other hand, seems to be strongly affected by resource reduction investments.

Interpreting the findings, proxies for longer management horizon tend to be associated with lower systemic relevance, such as *customer/product responsibility*, *society/human rights* and *training and development*. These variables positively contribute to charter value, which tends to be preserved by higher capital buffers. However, the positive contributions to resiliency are lower for larger banks. Our results in part confirm previous findings of a negative (enhancing) effect on individual firm risk of two dimensions in particular, Employee Relations and Human Rights (Bouslah et al., 2013).

Further investigating transatlantic differences, only three indicators generate significantly different responses with respect to resiliency. Investments in the workforce, such as training and development and employment quality, are related to lower levels of systemic risk for European banks. Then, looking at systematic risk, investments in emission reduction seem to be detrimental in terms of distance to default particularly for European banks, while production innovation might negatively affect Z-score levels for the old continent.

6. Impact of ESG on riskiness based on instrumental variable approach

The results in the previous section establish that ESG scores and riskiness are highly correlated. We resolved any simultaneity bias by making use of the longitudinal dimension of our data. However, statements on causality require additional care. Thus, we propose an instrumental variable approach to reduce potential reverse causality and thus determine the impact of ESG scores on the riskiness of the banks.

Since the implementation of a new measurement method for ESG scores in 2017, the pillars of ESG scores have been calculated and aggregated differently and retroactively updated. Therefore, in this subsection, we present the impact of ESG measures on SRISK on European and US financial institutions using the World Bank ESG Sovereign indicators and the average new ESG calculation regime as instruments for the Asset4 data.

Before looking at the results, we discuss the instruments used. We performed several tests for validity and identification, and conclude that we have supporting evidence for strong and valid instruments for the Asset4 ESG scores, especially for the regressions involving SRISK and Z-score. Tests on each regression are reported at the end of each table of results (Tables 12 and 13).[21]

First of all, we test for endogeneity of the Asset4 ESG scores, as the difference between two Sargan–Hansen statistics where the regressors are treated as endogenous or exogenous. Rejecting the null hypothesis that the specified endogenous regressors can actually be treated as exogenous, we have evidence that ESG scores are in fact endogenous to the risk specifications, with the exception of Delta CoVaR regressions.

Then, we can safely assume that our instruments are relevant and strong, i.e., highly correlated with the ESG Asset4 scores. The small-sample first-stage F-tests show that all instruments chosen are strongly correlated with the endogenous ESG variables. The nulls of under-identification (SW first-stage chi-squared) and of weak identification (SW first-stage F statistics) are both rejected for all regressors, in all specifications and for all measures of risk. Furthermore, we reject the null of the overall equations being under-identified (rank LM test) or weakly identified (Kleibergen and Paap (2006) Wald rank F statistic).

Using the Anderson and Rubin (1949) test and the Stock and Wright (2000) S statistic for weak-instrument robust-inference, i.e., testing jointly the significance of the endogenous regressors, we reject the null hypothesis that the coefficients of the endogenous regressors are jointly equal to zero and overidentifying restrictions are valid for all regressions.

The Sargan (1958) J tests for over-identification show that we cannot reject the null of overidentification in SRISK and Z-score regressions, supporting the validity of our IV approach, especially for these two risk measure specifications.

Thus, we conclude that our instruments are relevant in most specifications and valid for all risk measures.

Inspecting the results, the 2SLS IV regressions confirm most of our previous findings on systemic risk. According to Table 12, aggregate social responsibility has an enhancing impact on reducing systemic risk, regarding exposure risk in both continents (SRISK, column 1), and contribution risk for European banks (Delta CoVaR, column 2), and systematic risk (Beta, column 4). This effect is markedly stronger for smaller firms. Given the validity of our instruments, this finding suggests that ESG investments indeed contribute to lowering systemic risk, especially on the exposure dimension.

[21] First-stage test statistics, and under-identification, weak-identification and weak-identification-robust test statistics, are heteroskedasticity-robust. Moreover, more first-stage tests on the single endogenous variables are reported in Appendix.

Interestingly, the differential effect between Europe and the US shows that European banks benefit less from this positive effect by about 8% of the average US effect.

Also, looking at Table 13, we perform three separate regressions and confirm the strong positive impact of all three pillars, Environmental, Social and Corporate Governance on most risk measures. As reported repeatedly, smaller banks seem to be able to exploit the beneficial effect of ESG investments and policies more than larger firms, on all dimensions and risk measures.

7. Impact of exogenous ESG shock on riskiness

Finally, we investigate whether ESG scores affect systemic risk by exploiting the unexpected change in the scoring technology. In 2017 the event per se was unexpected and, therefore, qualifies as an exogenous shock to ESG scores at the level of the individual banks. Therefore, this change could not affect their behaviour. Accordingly, we introduce in our regressions a time dummy equal to 1 on and after 2017. We identify treated institutions as the banks that have seen a drastic increase or decrease in their ESG and pillar scores, such as a change between old Asset4 and new Refinitiv higher than its 90th percentile (we refer to these institutions as Treated Plus) or lower than its 10th percentile (Treated Minus).

Tables 14 and 15 report the estimation results of the regressions of SRISK on the exogenous shock in 2017, on two treated firms' dummies (Treated Plus and Treated Minus) and on the two interactions between the shock dummy and the treated dummies. We are interested in the interaction terms Time*Treated Plus and Time*Treated minus.

We observe in Table 14 that the banks that have experienced a negative shock in their ESG scores experience a significant decrease in resiliency in the next period. We do not observe a similar significance for treated banks that experienced an increase in ESG scores. The same results appear for the Social and Environmental pillars, except for Corporate Governance. Thus, we can interpret this as strong evidence that the market updates its beliefs on systemic exposure and considers ESG, especially in its Environmental and Social dimensions, as an important driver of riskiness: banks that have experienced an expected negative shock in ESG are, after 2017, perceived to be riskier in terms of systemic exposure. Assuming that negative news tends to be more salient than positive news, we do not see any effect of a positive shock on ESG scores on the perception of risk of the treated institutions in our sample period.

Comparing European and US banks (Table 15), we observe that the above results are mostly driven by European banks. Social and Environmental pillars have similar negative effects on riskiness once the European banks experience a downgrade, again confirming that ESG scores affect the riskiness of banks, as proxied by the market perception. However, such effects do occur only weakly on the Environmental pillar for US banks.

We tried several placebo tests, by changing the time dummy of the event to investigate whether the market was aware of the change in methodology before 2017 or its reaction was anticipated or delayed. Results are not significant if we define the time dummy as 2016 or 2018, nor if we calculate the difference between scores in 2016. This insignificance supports our assumption that the market was not aware of the change in methodology before 2017.[22]

In summary, the latter results show that both climate risk and social investments are important drivers in the European banks' riskiness, while climate risk seems to be the sole driver of the relationship between risk and ESG in American banks.

8. Policy implications

Our analysis suggests that various, but by no means all, of the constituent ESG factors are informative about the inherent risks of banks' business models. To the extent that these subscores contain information on planning horizon and long-term orientation, they also affect banks' systemic risk. Most of the significant factors that we identify contribute positively to bank resiliency as measured by market-based statistics.

To the extent that ESG scores are informative about bank riskiness, they also constitute useful inputs for regulatory purposes. In this sense, our analysis provides recommendations on specific subcategories or pillars that might be particularly relevant. For example, according to the recommendations of the European Commission about reforming Basel III, our analysis provides information about subcategories that might require extra risk weights or reductions in risk weights. In their preferred option, by providing proper incentives for bank management, our analysis could even direct policymakers' attention to the most effective subcategories.

All these recommendations, however, are based on the specific ESG definitions applied in the screening process. Our analysis has concentrated on the Thomson Reuters screens and has found that some of their subscreens provide useful information for regulatory purposes. This does not mean that regulating ESG reporting becomes superfluous. In particular, mandated scores should be manipulation-proof to prevent misrepresentation.[23] Having said this, our analysis suggests that the correlation of responses to the specific private scoring mechanism and market-based resiliency measures are significant and economically plausible and, thus, alleviate such potential whitewashing concerns to some extent.

9. Conclusions

ESG matters. This is the strong evidence of our study on bank resiliency. We find that ESG has a stabilizing effect on systemic risk measures, both the exposure and the contribution measures. In this sense, adherence to the UNEP Principles for Responsible Banking clearly enhances bank resiliency.

As predicted by theory, it is particularly measures related to long-term objectives, like customer and product responsibility, investments in social institutions and workforce training, that are resiliency-enhancing.

In the transatlantic comparison, the relative effectiveness of ESG measures differs between Europe and the US. European banks benefit more from labour market institutions in terms of systemic risk exposure, and investments in workforce, human rights and training will improve the systemic riskiness of European institutions.

Based on our results, we predict that banks with higher ESG ratings will perform better and impose fewer prudential concerns on supervisory authorities during the current pandemic crisis, and the repercussions from the war in Ukraine, which are not covered in our data set. This provides an immediate test of our model and predictions for future research, once the multi-crises have passed.

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.

Appendix

See Tables 1–15.

[22] Given their insignificance, we do not report these results, here, but they are available on request.

[23] The manipulation argument is particularly relevant for ESG labels of financial products, but may also affect less marketing-sensitive ESG reporting.

Table 1
Asset4 ESG variables, 2018.
Source: ASSET4 ESG Data Glossary, February 2015.

Pillars	Name	Description
ESG score	Equal-Weighted ESG rating	The Equal Weighted Rating reflects a balanced view of a company's performance in all four areas, economic, environmental, social and corporate governance.
Corporate governance	Corporate governance	The corporate governance pillar measures a company's systems and processes, which ensure that its board members and executives act in the best interests of its long term shareholders. It reflects a company's capacity, through its use of best management practices, to direct and control its rights and responsibilities through the creation of incentives, and checks and balances to generate long term shareholder value.
	Board of directors/Board functions	The board of directors/board functions category measures a company's management commitment and effectiveness towards following best practice corporate governance principles related to board activities and functions. It reflects a company's capacity to have an effective board by setting up the essential board committees with allocated tasks and responsibilities.
	Board of directors/Board structure	The board of directors/board structure category measures a company's management commitment and effectiveness towards following best practice corporate governance principles related to a well balanced membership of the board. It reflects a company's capacity to ensure a critical exchange of ideas and an independent decision-making process through an experienced, diverse and independent board.
	Board of directors/Compensation policy	The board of directors/compensation policy category measures a company's management commitment and effectiveness towards following best practice corporate governance principles related to competitive and proportionate management compensation. It reflects a company's capacity to attract and retain executives and board members with the necessary skills by linking their compensation to individual or company-wide financial or extra-financial targets.
	Integration/Vision and strategy	The integration/vision and strategy category measures a company's management commitment and effectiveness towards the creation of an overarching vision and strategy integrating financial and extra-financial aspects. It reflects a company's capacity to convincingly show and communicate that it integrates the economic (financial), social and environmental dimensions into its day-to-day decision-making processes.
	Shareholders/ Shareholder rights	The shareholders/shareholder rights category measures a company's management commitment and effectiveness towards following best practice corporate governance principles related to a shareholder policy and equal treatment of shareholders. It reflects a company's capacity to be attractive to minority shareholders by ensuring them equal rights and privileges and by limiting the use of anti-takeover devices.
Economic	Economic	The economic pillar measures a company's capacity to generate sustainable growth and a high return on investment through the efficient use of all its resources. It is reflection of a company's overall financial health and its ability to generate long term shareholder value through its use of best management practices.
	Margins/Performance	The margins/performance category measures a company's management commitment and effectiveness towards maintaining a stable cost base. It reflects a company's capacity to improve its margins by increasing its performance (production process innovations) or by maintaining a loyal and productive employee and supplier base.
	Profitability /Shareholder loyalty	The profitability/shareholders loyalty category measures a company's management commitment and effectiveness towards generating a high return on investments. It reflects a company's capacity to maintain a loyal shareholder base by generating sustainable returns through a focused and transparent long-term communications strategy with its shareholders.
	Revenue/Client loyalty	The revenue/client loyalty category measures a company's management commitment and effectiveness towards generating sustainable and long-term revenue growth. It reflects a company's capacity to grow, while maintaining a loyal client base through satisfaction programmes and avoiding anti-competitive behaviours and price fixing.
Environmental	Environmental	The environmental pillar measures a company's impact on living and non-living natural systems, including the air, land and water, and complete ecosystems. It reflects how well a company uses best management practices to avoid environmental risks and capitalize on environmental opportunities to generate long term shareholder value.
	Emission reduction	The emission reduction category measures a company's management commitment and effectiveness towards reducing environmental emission in the production and operational processes. It reflects a company's capacity to reduce air emissions (greenhouse gases, F-gases, ozone-depleting substances, NOx and SOx, etc.), waste, hazardous waste, water discharges, spills or its impacts on biodiversity and to partner with environmental organizations to reduce the environmental impact of the company in the local or broader community.
	Product innovation	The product innovation category measures a company's management commitment and effectiveness towards supporting the research and development of eco-efficient products or services. It reflects a company's capacity to reduce the environmental costs and burdens for its customers, and thereby creating new market opportunities through new environmental technologies and processes or eco-designed, dematerialized products with extended durability.
	Resource reduction	The resource reduction category measures a company's management commitment and effectiveness towards achieving an efficient use of natural resources in the production process. It reflects a company's capacity to reduce the use of materials, energy or water, and to find more eco-efficient solutions by improving supply chain management.
Social	Social	The social pillar measures a company's capacity to generate trust and loyalty with its workforce, customers and society, through its use of best management practices. It is a reflection of the company's reputation and the health of its license to operate, which are key factors in determining its ability to generate long term shareholder value.
	Customer/Product responsibility	The customer/product responsibility category measures a company's management commitment and effectiveness towards creating value-added products and services upholding the customer's security. It reflects a company's capacity to maintain its license to operate by producing quality goods and services integrating the customer's health and safety, and preserving its integrity and privacy also through accurate product information and labelling.

(*continued on next page*)

Table 1 (*continued*).

Pillars	Name	Description
	Society/Community	The society/community category measures a company's management commitment and effectiveness towards maintaining the company's reputation within the general community (local, national and global). It reflects a company's capacity to maintain its license to operate by being a good citizen (donations of cash, goods or staff time, etc.), protecting public health (avoidance of industrial accidents, etc.) and respecting business ethics (avoiding bribery and corruption, etc.).
	Society/Human rights	The society/human rights category measures a company's management commitment and effectiveness towards respecting the fundamental human rights conventions. It reflects a company's capacity to maintain its license to operate by guaranteeing the freedom of association and excluding child, forced or compulsory labour.
	Score - Diversity and opportunity/Policy	Does the company have a work-life balance policy? AND Does the company have a diversity and equal opportunity policy?
	Score - Employment quality/Policy	Does the company have a competitive employee benefits policy or ensuring good employee relations within its supply chain? AND Does the company have a policy for maintaining long term employment growth and stability?
	Score - Health & Safety/Policy	Does the company have a policy to improve employee health & safety within the company and its supply chain?
	Score - Training and development/Policy	Does the company have a policy to support the skills training or career development of its employees?

Table 1: The table reports the ESG variables used in the analysis, as classified by ASSET4 Equal Weighted Ratings (EWR). Data were downloaded in 2018, and are currently inactive variables, being substituted by a new TR categorization reported in Table 2. Data consists of 4 pillars: Environmental, Social, Governance and Economic performance. Each pillars reports the main categories of aggregation.

Table 2
TR Refinitiv ESG variables, 2020.
Source: Environmental, Social and Governance (ESG) scores from Refinitiv, April 2020.

Pillars	Name	Description
Environmental	Resource use	The resource use score reflects a company's performance and capacity to reduce the use of materials, energy or water, and to find more eco-efficient solutions by improving supply chain management.
	Emissions reduction	The emission reduction score measures a company's commitment and effectiveness towards reducing environmental emissions in its production and operational processes.
	Innovation	The innovation score reflects a company's capacity to reduce the environmental costs and burdens for its customers, thereby creating new market opportunities through new environmental technologies and processes or eco-designed products.
Social	Workforce	The workforce score measures a company's effectiveness in terms of providing job satisfaction, a healthy and safe workplace, maintaining diversity and equal opportunities and development opportunities for its workforce.
	Human rights	The human rights score measures a company's effectiveness in terms of respecting fundamental human rights conventions.
	Community	The community score measures the company's commitment to being a good citizen, protecting public health and respecting business ethics.
	Product responsibility	The product responsibility score reflects a company's capacity to produce quality goods and services, integrating the customer's health and safety, integrity and data privacy.
Governance	Management	The management score measures a company's commitment and effectiveness towards following best practice corporate governance principles.
	Shareholders	The shareholders score measures a company's effectiveness towards equal treatment of shareholders and the use of anti-takeover devices.
	CSR strategy	The CSR strategy score reflects a company's practices to communicate that it integrates economic (financial), social and environmental dimensions into its day-to-day decision-making processes.

Table 2: The table reports the new categorization of ESG Pillars, as classified by TR Refinitiv after the change in methodology from ASSET4® Equal Weighted Ratings (EWR) to Thomson Reuters Refinitiv ESG Scores. Data were downloaded in 2020. Data consists of 3 pillars: Environmental, Social, and Governance performance. Each pillars reports the main categories of aggregation.

Table 3
Summary statistics and correlation matrix between Asset4 ESG 2018 and TR Refinitiv 2020. Europe.

	ESG 2018	ESG 2020	ENV 2018	ENV 2020	SOC 2018	SOC 2020	CG 2018	CG 2020
ESG 2018	1							
ESG 2020	0.8554	1						
ENV 2018	0.9008	0.8088	1					
ENV 2020	0.7793	0.8099	0.8552	1				
SOC 2018	0.9027	0.8226	0.8199	0.722	1			
SOC 2020	0.8329	0.9115	0.793	0.7708	0.8745	1		
CG 2018	0.7394	0.6821	0.5687	0.5337	0.5542	0.5541	1	
CG 2020	0.6007	0.8127	0.5061	0.4598	0.5063	0.5334	0.6521	1

	Asset4 2018				TR Refinitiv 2020				Diff
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	
ESG-SCORE	64.43356	31.40516	2.57	98.32	50.39411	21.357	1.55	95.01	−14.04
ENV-SCORE	62.47882	31.37633	8.44	97.38	40.76698	32.1277	0	98.15	−21.71
SOC-SCORE	66.57168	29.05628	3.58	99.45	49.95678	23.7116	0.61	97.32	−16.61
CG-SCORE	56.63782	27.91034	1.24	97.88	53.94699	23.9218	1.67	97.17	−2.691

The table reports the summary statistics and the correlation matrix between the scores in the two datasets for European banks: Asset4 ESG scores data downloaded in 2018 and TR Refinitiv data downloaded in 2020. We report each pair of variables: aggregate ESG scores (ESG), Environmental scores (ENV), Social (SOC), Corporate Governance scores (CG). Number of observations = 1225.

Table 4
Summary statistics and correlation matrix between Asset4 ESG 2018 and TR Refinitiv 2020. USA.

	ESG 2018	ESG 2020	ENV 2018	ENV 2020	SOC 2018	SOC 2020	CG 2018	CG 2020
ESG 2018	1							
ESG 2020	0.7828	1						
ENV 2018	0.8121	0.7442	1					
ENV 2020	0.6952	0.75	0.891	1				
SOC 2018	0.8731	0.7062	0.6596	0.5717	1			
SOC 2020	0.7427	0.8157	0.6744	0.672	0.7836	1		
CG 2018	0.567	0.544	0.3826	0.3296	0.3772	0.2913	1	
CG 2020	0.4429	0.7577	0.359	0.3337	0.3046	0.2888	0.587	1

	Asset4 2018				TR Refinitiv 2020				Diff
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	
ESG-SCORE	52.85121	25.52688	3.74	96.54	42.31527	15.8615	1.89	87.62	−10.54
ENV-SCORE	34.8479	30.33044	8.44	96.4	16.33992	25.5122	0	95.3	−18.51
SOC-SCORE	45.03046	25.0693	4.12	95.85	45.53673	17.9471	2.11	90.16	+0.51
CG-SCORE	71.24088	15.54694	5.06	97.25	48.97498	21.0569	1.46	93.02	−22.27

The table reports the summary statistics and the correlation matrix between the scores in the two datasets for USA banks: Asset4 ESG scores data downloaded in 2018 and TR Refinitiv data downloaded in 2020. We report each pair of variables: aggregate ESG scores (ESG), Environmental scores (ENV), Social (SOC), Corporate Governance scores (CG). Number of observations = 1153.

Table 5
Other variables.

Variable	Description and reference	Database
SRISK	Equation 13 (Brownlees and Engle, 2017), where k = 0.08 for USA banks and k = 5.5% for European banks.	Compustat Global, Datastream and Bundesbank, own calc.
Delta CoVaR	Equation 8, estimated by quantile regression and empirical quantile at alpha = 0.05 (Adrian and Brunnermeier, 2016).	Compustat Global, Datastream and Bundesbank, own calc.
$ Delta CoVaR	Delta CoVaR ∗ market capitalization	Compustat Global, own calc.
Z-score	Equation 15 (Lepetit and Strobel, 2013)	Compustat Global, own calc.
Beta	Conditional dynamic market beta: $\rho_{im} \cdot * \sigma_i \cdot / \sigma_m$, where ρ_{im}, correlation coefficient between the bank's and the market returns, is estimated by Dynamic Conditional Correlation model (Engle, 2002), and the volatilities σ are estimated by asymmetric GJR GARCH model (Glosten et al., 1993)	Compustat Global and Datastream, own calc.
Market return	MSCI Europe index	Datastream
Stock return	Bank's log stock return	Compustat Global own calc.
Market value	(stock price ∗ shares outstanding) standardized	Compustat Global, own calc.
Market-to-book ratio	Market capitalization/Book equity Daniel and Titman (2006)	Compustat Global, own calc.
Total liabilities	Reported total liabilities	Compustat Global
Total Assets (TA)	Reported total assets	Compustat Global
Leverage (LVG)	(Total liabilities + Market capitalization)/Market capitalization	Compustat Global, own calc.
Change in shareholders equity	First difference in Shareholder Equity	Compustat Global, own calc.
Past performance	Stock price momentum over past 4 quarters	Compustat Global, own calc.
Stock volatility	Squared daily stock returns	Compustat Global, own calc.
Official supervisory power	Index of the extent to which supervisory authorities have the authority to discipline banks by taking specific actions to prevent and correct problems.	Barth et al. (2013, 2006).
GDP	Annual GDP growth (%)	Sovereign ESG World Bank
Food security	Agriculture, forestry, and fishing value added (% of GDP), standardized	Sovereign ESG World Bank
Food security	Food production index (2014–2016 = 100), standardized	Sovereign ESG World Bank
Climate risk	Level of water stress: freshwater withdrawal, standardized	Sovereign ESG World Bank
Climate risk	Heat Index 35 (projected change in days), standardized	Sovereign ESG World Bank
Education & Skill	School enrolment, primary (% gross), standardized	Sovereign ESG World Bank
Poverty & Education	Income share held by lowest 20%, standardized	Sovereign ESG World Bank
Gender	Proportion of seats held by women in national parliaments (%), standardized	Sovereign ESG World Bank
Gender	Ratio of female to male labor force participation rate (%), standardized	Sovereign ESG World Bank
Human rights	Economic and Social Rights Performance Score, standardized	Sovereign ESG World Bank
Economic environment	Individuals using the Internet (% of population), standardized	Sovereign ESG World Bank
Government effectiveness	Estimate, standardized	Sovereign ESG World Bank
Human rights	Voice and accountability, standardized	Sovereign ESG World Bank
Stability & Rule of law	Political stability and absence of violence/Terrorism, standardized	Sovereign ESG World Bank

This table reports detailed information on the data and variables used in the empirical analysis. It refers to the sources of the data and the data providers descriptions, when available.

Table 6
Panel data regressions on Equal-Weighted ESG score.

	(1) SRISK	(2) $ Delta CoVaR	(3) Z-score	(4) Beta
L.ESG Equal-Weighted Rating	−248.8***	−3.545***	−0.0361	−0.00249
	(89.66)	(1.225)	(0.0281)	(0.00182)
	−0.350	−0.299	−0.0777	−0.184
L.ESG Equal-Weighted Rating ∗ Europe	−28.43	−0.615	−0.00370	0.000135
	(24.60)	(0.454)	(0.00964)	(0.000529)
	−0.0533	−0.0692	−0.0106	0.0133
L.ESG Equal-Weighted Rating ∗ L.ln(TA)	27.35***	0.380***	0.00364	0.000233
	(9.260)	(0.142)	(0.00257)	(0.000164)
	0.525	0.437	0.107	0.235
L.SRISK	0.725***	−0.00213***	1.38e−05***	7.26e−07*
	(0.0267)	(0.000374)	(4.52e−06)	(4.16e−07)
	0.722	−0.127	0.0211	0.0381
L.Z-score	−32.02	−0.335	0.616***	−0.00208**
	(42.70)	(0.630)	(0.0311)	(0.00105)
	−0.0208	−0.0131	0.613	−0.0712
L.Beta	−1869**		0.180	0.355***
	(720.3)		(0.325)	(0.0187)
	−0.0359		0.00530	0.359
L.$Delta CoVaR		0.597***		
		(0.0408)		
		0.598		
L.ln(TA)	−998.1	−0.814	−0.819***	−0.00750
	(650.0)	(9.231)	(0.224)	(0.0169)
	−0.0976	−0.00477	−0.123	−0.0386
Leverage	51.61	−0.00923	−0.0130**	−0.00160***
	(32.14)	(0.175)	(0.00629)	(0.000602)
	0.0745	−0.000799	−0.0288	−0.122
Market-to-Book	−30.89	5.505***	−0.166**	−0.00280
	(129.6)	(1.220)	(0.0772)	(0.00549)
	−0.00337	0.0360	−0.0278	−0.0161
Past performance	−132,746	5193***	120.4**	−1.642
	(102,953)	(1518)	(55.82)	(3.857)
	−0.0123	0.0288	0.0170	−0.00798
Change in shareholders equity	0.142	0.00315**	0.000113***	−8.01e−08
	(0.107)	(0.00141)	(2.36e−05)	(9.32e−07)
	0.0341	0.0455	0.0416	−0.00102
Volatility	790,193**	2588	−168.2**	144.6***
	(398,342)	(2801)	(75.91)	(14.40)
	.	0.00962	−0.0160	0.472
Official supervisory power	−120.5	2.433	0.0461	0.0164***
	(149.4)	(2.326)	(0.0617)	(0.00364)
	−0.0133	0.0162	0.00782	0.0956
GDP growth (annual %)	−80.58	−1.714	0.104**	−0.00579*
	(128.8)	(1.949)	(0.0478)	(0.00318)
	−0.00796	−0.0101	0.0157	−0.0301
Constant	12,171*	−35.93	14.28***	0.598***
	(7019)	(94.51)	(2.755)	(0.185)
Observations	2287	2287	2287	2287
Number of IDs	191	191	191	191
Adjusted R^2	0.692	0.551	0.514	0.644
RMSE	6825	100.5	2.527	0.168
Year Effects F-stat	4.399***	7.883***	3.525***	22.21***

The table reports the results of firm-year fixed effects regressions of (1) SRISK, (2) $ Delta CoVaR, (3) Z-score, and (4) Beta, on the ESG aggregated scores, 2004 to 2017. We include the ESG score interacted with size (ln(TA)) and with a Europe = 1 dummy. As control variables we include lagged bank-level information: lagged risk measure, market beta, Z-score, log of total assets (ln(TA)), leverage ratio, market-to-book, change in shareholders' equity, past year performance, and stock returns volatility. Moreover, we include country macroeconomic variables: official supervisory power (Barth et al., 2013), and GDP growth. For each variable, we report estimated coefficients, robust standard errors in parenthesis, and standardized coefficients. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 7
Panel data regressions on the 3 ESG pillars.

	(1) SRISK	(2) $ Delta CoVaR	(3) Z-score	(4) Beta
L.Environmental pillar	−256.4***	−4.301***	−0.0452	−0.00247
	(93.85)	(1.243)	(0.0300)	(0.00155)
	−0.413	−0.415	−0.111	−0.209
L.Social pillar	−171.9	−2.061*	−0.00308	−0.00137
	(108.3)	(1.138)	(0.0354)	(0.00250)
	−0.241	−0.173	−0.00662	−0.101
L.Corporate governance pillar	−61.01	−0.572	−0.0470	0.00164
	(71.95)	(1.064)	(0.0296)	(0.00186)
	−0.0705	−0.0396	−0.0831	0.0999
L.Economic pillar	83.23	1.118	0.0174	−0.000419
	(62.22)	(0.684)	(0.0269)	(0.00127)
	0.110	0.0889	0.0353	−0.0293
L.Environmental pillar ∗ Europe	22.30	−0.177	0.00757	0.000278
	(19.27)	(0.358)	(0.00792)	(0.000433)
	0.0408	−0.0194	0.0212	0.0268
L.Social pillar ∗ Europe	−54.60*	−0.400	0.00314	−0.000699
	(28.20)	(0.531)	(0.0130)	(0.000781)
	−0.102	−0.0450	0.00900	−0.0690
L.Corporate governance pillar ∗ Europe	38.87*	0.0489	−0.0141	0.000724
	(23.23)	(0.368)	(0.0120)	(0.000589)
	0.0640	0.00483	−0.0355	0.0628
L.Economic pillar ∗ Europe	−38.58*	−0.350	0.00129	−0.000418
	(20.28)	(0.255)	(0.00802)	(0.000500)
	−0.0687	−0.0373	0.00351	−0.0392
L.Environmental pillar ∗ L.ln(TA)	23.75***	0.422***	0.00370	0.000213
	(8.800)	(0.123)	(0.00277)	(0.000139)
	0.508	0.540	0.121	0.240
L.Social pillar ∗ L.ln(TA)	21.16**	0.269**	−0.000372	0.000229
	(10.68)	(0.123)	(0.00312)	(0.000221)
	0.402	0.307	−0.0108	0.229
L.Corporate governance pillar ∗ L.ln(TA)	4.145	0.0303	0.00400	−0.000166
	(7.287)	(0.108)	(0.00274)	(0.000167)
	0.0632	0.0277	0.0934	−0.134
L.Economic pillar ∗ L.ln(TA)	−6.319	−0.113	−0.000551	−6.64e−07
	(6.511)	(0.0736)	(0.00252)	(0.000109)
	−0.110	−0.118	−0.0147	−0.000610
L.SRISK	0.711***	−0.00234***	1.14e−05**	6.48e−07
	(0.0292)	(0.000403)	(4.51e−06)	(4.48e−07)
	0.708	−0.140	0.0175	0.0340
L.Z-score	−40.72	−0.430	0.609***	−0.00195*
	(44.02)	(0.651)	(0.0304)	(0.00107)
	−0.0265	−0.0168	0.606	−0.0667
L.Beta	−1967***		0.274	0.350***
	(682.2)		(0.330)	(0.0186)
	−0.0378		0.00805	0.354
L.$Delta CoVaR		0.584***		
		(0.0410)		
		0.585		
L.ln(TA)	−1761**	−9.103	−1.006***	−0.00664
	(856.9)	(11.23)	(0.273)	(0.0177)
	−0.172	−0.0534	−0.151	−0.0342
Leverage	47.28	−0.0718	−0.0122*	−0.00170***
	(31.75)	(0.204)	(0.00621)	(0.000612)
	0.0683	−0.00621	−0.0269	−0.129
Market-to-Book	−65.43	5.027***	−0.150*	−0.00396
	(134.5)	(1.372)	(0.0781)	(0.00515)
	−0.00714	0.0329	−0.0251	−0.0228
Past performance	−123,724	5189***	115.4**	−1.435
	(101,282)	(1547)	(55.98)	(3.838)
	−0.0114	0.0287	0.0163	−0.00698
Change in shareholders equity	0.156	0.00341**	0.000110***	1.80e−07
	(0.107)	(0.00136)	(2.43e−05)	(9.27e−07)
	0.0375	0.0493	0.0404	0.00228
Volatility	791,652**	2427	−146.6*	143.7***
	(382,387)	(2747)	(74.66)	(14.18)
	0.0491	0.00902	−0.0139	0.469
Supervisory power	−168.3	1.636	0.0496	0.0157***
	(153.4)	(2.359)	(0.0612)	(0.00359)
	−0.0186	0.0109	0.00841	0.0914
GDP growth (annual %)	−49.11	−1.534	0.104**	−0.00528
	(125.4)	(1.907)	(0.0478)	(0.00331)
	−0.00485	−0.00908	0.0157	−0.0275

(*continued on next page*)

Table 7 (*continued*).

Constant	21,307**	75.65	16.33***	0.603***
	(9096)	(115.9)	(3.172)	(0.192)
Observations	2287	2287	2287	2287
Number of IDs	191	191	191	191
Adjusted R^2	0.697	0.560	0.518	0.645
RMSE	6771	99.47	2.518	0.168
Year effects F-stat	4.476***	7.552***	3.869***	23.45***

The table reports the results of firm-year fixed effects regressions of (1) SRISK, (2) $ Delta CoVaR, (3) Z-score, and (4) Beta, on the Asset4 ESG pillars scores: Environmental, Social, Corporate Governance and Economic, 2004 to 2017. As control variables we include lagged bank-level information: lagged risk measure, market beta, Z-score, log of total assets (ln(TA)), leverage ratio, market-to-book, change in shareholders' equity, past year performance, and stock returns volatility. Moreover, we include country macroeconomic variables: official supervisory power (Barth et al., 2013), and GDP growth. For each variable, we report estimated coefficients, robust standard errors in parenthesis, and standardized coefficients. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 8
Panel data regressions on ESG subcategories: Environmental.

	(1) SRISK	(2) $Delta CoVaR	(3) Z-score	(4) Beta
L.Emission reduction	109.7	−1.340	−0.0704**	−0.000206
	(120.5)	(1.121)	(0.0297)	(0.00216)
L.Product innovation	−289.8***	−3.391***	0.0209	0.00247
	(77.89)	(1.039)	(0.0239)	(0.00154)
L.Resource reduction	−229.3***	−1.409	0.00515	−0.00446**
	(78.22)	(1.098)	(0.0264)	(0.00174)
L.Emission reduction ∗ Europe	10.84	−0.577	0.0191**	8.09e−05
	(27.34)	(0.394)	(0.00851)	(0.000608)
L.Product innovation ∗ Europe	−14.10	−0.219	−0.0132**	−0.000186
	(23.14)	(0.371)	(0.00663)	(0.000452)
L.Resource reduction ∗ Europe	11.17	0.288	−0.00456	0.000253
	(17.84)	(0.298)	(0.00804)	(0.000502)
L.Emission reduction ∗ L.ln(TA)	−10.18	0.168	0.00576**	−4.77e−07
	(12.45)	(0.118)	(0.00256)	(0.000185)
L.Product innovation ∗ L.ln(TA)	28.00***	0.329***	−0.00103	−0.000183
	(7.597)	(0.103)	(0.00204)	(0.000133)
L.Resource reduction ∗ L.ln(TA)	21.45***	0.117	−0.000746	0.000393***
	(7.216)	(0.100)	(0.00237)	(0.000150)
L.SRISK	0.698***	−0.00246***	1.28e−05***	6.67e−07
	(0.0263)	(0.000401)	(4.57e−06)	(4.46e−07)
L.Z-score	−50.95	−0.545	0.610***	−0.00231**
	(43.66)	(0.653)	(0.0311)	(0.00102)
L.Beta	−1854***		0.163	0.354***
	(703.8)		(0.327)	(0.0187)
L.$Delta CoVaR		0.581***		
		(0.0404)		
L.ln(TA)	−1204**	−3.344	−0.846***	−0.0112
	(588.6)	(8.293)	(0.218)	(0.0157)
Leverage	49.49	−0.00927	−0.0127*	−0.00166***
	(32.00)	(0.183)	(0.00654)	(0.000617)
Market-to-Book	−11.47	5.570***	−0.173**	−0.00415
	(122.7)	(1.328)	(0.0758)	(0.00479)
Past performance	−123,925	5082***	117.0**	−1.650
	(102,403)	(1499)	(56.08)	(3.854)
Change in shareholders' equity	0.135	0.00319**	0.000112***	−1.38e−07
	(0.108)	(0.00140)	(2.32e−05)	(9.29e−07)
Volatility	784,295**	2838	−172.2**	144.5***
	(389,260)	(2869)	(76.48)	(14.38)
Supervisory power	−144.6	2.061	0.0332	0.0163***
	(155.5)	(2.277)	(0.0592)	(0.00368)
GDP growth (annual %)	−105.5	−1.531	0.109**	−0.00593*
	(130.0)	(1.911)	(0.0476)	(0.00322)
Constant	16,016**	14.05	14.86***	0.648***
	(7082)	(90.19)	(2.737)	(0.177)
Observations	2287	2287	2287	2287
Number of IDs	191	191	191	191
Adjusted R^2	0.697	0.559	0.515	0.644
RMSE	6770	99.62	2.524	0.168

The table reports the results of firm-year fixed effects regressions of (1) SRISK, (2) $ Delta CoVaR, (3) Z-score, and (4) Beta, on the ESG Subcategories in the Environmental pillar (as listed in Table 1), 2004 to 2017. We include the ESG subcategories scores interacted with size (ln(TA)) and with a Europe = 1 dummy. As control variables we include lagged bank-level information: lagged risk measure, market beta, Z-score, log of total assets (ln(TA)), leverage ratio, market-to-book, change in shareholders' equity, past year performance, and stock returns volatility. Moreover, we include country macroeconomic variables: official supervisory power (Barth et al., 2013), and GDP growth. We report estimated coefficients and robust standard errors in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 9
Panel data regressions on ESG subcategories: Social.

	(1) SRISK	(2) $Delta CoVaR	(3) Z-score	(4) Beta
L.Customer/Product responsibility	−57.82	−1.554**	0.0136	−0.00100
	(57.67)	(0.731)	(0.0187)	(0.00120)
L.Society/Community	58.62	1.023	0.0105	0.000116
	(71.23)	(0.964)	(0.0221)	(0.00130)
L.Society/Human rights	−403.7***	−3.135**	0.0451	−0.00178
	(109.5)	(1.332)	(0.0294)	(0.00161)
L.Diversity and opportunity	−66.64	−1.292	−0.0454**	0.000249
	(62.52)	(0.904)	(0.0207)	(0.00128)
L.Employment quality	71.62	−2.145**	−0.0490*	−0.00173
	(90.20)	(1.027)	(0.0276)	(0.00154)
L.Health & Safety	9.909	0.847	−0.00199	0.000163
	(44.54)	(0.679)	(0.0152)	(0.000978)
L.Training and development	−108.0*	−1.695*	0.00314	−0.000999
	(64.55)	(0.917)	(0.0186)	(0.00126)
L.Customer/Product responsibility ∗ Europe	−18.66	0.0780	−0.00381	0.000315
	(22.13)	(0.302)	(0.00668)	(0.000444)
L.Society/Community ∗ Europe	7.788	0.293	0.00220	6.63e−05
	(14.95)	(0.254)	(0.00730)	(0.000439)
L.Society/Human rights ∗ Europe	−1.485	−0.186	−0.0178	−7.77e−05
	(49.06)	(0.594)	(0.0126)	(0.000537)
L.Diversity and opportunity ∗ Europe	−1.058	−0.142	0.00743	−0.000759
	(20.27)	(0.352)	(0.00835)	(0.000486)
L.Employment quality ∗ Europe	−1.626	−0.823*	0.00210	−0.000291
	(27.14)	(0.422)	(0.00894)	(0.000519)
L.Health & Safety ∗ Europe	−16.28	−0.282	−0.000837	0.000484
	(15.61)	(0.234)	(0.00704)	(0.000384)
L.Training and development ∗ Europe	−40.28**	−0.186	0.000610	−0.000536
	(17.53)	(0.253)	(0.00598)	(0.000384)
L.Customer/Product responsibility ∗ L.ln(TA)	7.867	0.143*	−0.000958	6.30e−05
	(5.689)	(0.0728)	(0.00157)	(0.000100)
L.Society/Community ∗ L.ln(TA)	−6.075	−0.109	−0.000949	3.67e−06
	(6.950)	(0.0978)	(0.00196)	(0.000114)
L.Society/Human rights ∗ L.ln(TA)	37.60***	0.312**	−0.00231	0.000168
	(9.594)	(0.125)	(0.00226)	(0.000121)
L.Diversity and opportunity ∗ L.ln(TA)	6.855	0.132	0.00397**	3.70e−06
	(6.884)	(0.0988)	(0.00185)	(0.000122)
L.Employment quality ∗ L.ln(TA)	−9.027	0.230**	0.00427*	0.000172
	(8.771)	(0.116)	(0.00237)	(0.000129)
L.Health & Safety ∗ L.ln(TA)	−0.0345	−0.0590	0.000320	−3.96e−05
	(4.526)	(0.0632)	(0.00138)	(8.16e−05)
L.Training and development ∗ L.ln(TA)	13.65*	0.201**	−0.000753	0.000127
	(7.143)	(0.0999)	(0.00171)	(0.000114)
L.SRISK	0.704***	−0.00252***	9.01e−06	5.27e−07
	(0.0293)	(0.000471)	(5.64e−06)	(4.64e−07)
L.Z-score	−37.48	−0.610	0.605***	−0.00237**
	(46.60)	(0.602)	(0.0316)	(0.00114)
L.Beta	−1502**		0.216	0.354***
	(667.7)		(0.338)	(0.0195)
L.$Delta CoVaR		0.590***		
		(0.0394)		
L.ln(TA)	−1702**	−22.37**	−0.913***	−0.0195
	(722.4)	(10.89)	(0.252)	(0.0212)
Leverage	50.02*	0.00266	−0.0143**	−0.00163**
	(30.14)	(0.201)	(0.00613)	(0.000640)
Market-to-book	−72.91	4.769***	−0.188**	−0.00348
	(119.7)	(1.470)	(0.0742)	(0.00566)
Past performance	−84,321	5442***	123.9**	−2.017
	(107,019)	(1589)	(55.89)	(3.877)
Change in shareholders' equity	0.147	0.00321**	0.000113***	−1.01e−07
	(0.108)	(0.00144)	(2.30e−05)	(9.29e−07)
Volatility	819,347**	2363	−159.8**	144.0***
	(404,280)	(2777)	(77.15)	(14.39)
Supervisory power	−169.2	1.871	0.0265	0.0172***
	(156.8)	(2.438)	(0.0567)	(0.00365)
GDP growth (annual %)	−105.4	−1.789	0.114**	−0.00584*
	(125.1)	(1.768)	(0.0481)	(0.00331)
Constant	21,931***	203.8*	15.35***	0.734***
	(7947)	(111.3)	(3.141)	(0.230)
Observations	2287	2287	2287	2287
Number of IDs	191	191	191	191

(*continued on next page*)

Table 9 (*continued*).

Adjusted R^2	0.701	0.564	0.516	0.643
RMSE	6723	99.09	2.522	0.168

The table reports the results of firm-year fixed effects regressions of (1) SRISK, (2) $ Delta CoVaR, (3) Z-score, and (4) Beta, on the ESG Subcategories in the Social pillar as listed in Table 1, 2004 to 2017. We include the ESG subcategories scores interacted with size (ln(TA)) and with a Europe = 1 dummy. As control variables we include lagged bank-level information: lagged risk measure, market beta, Z-score, log of total assets (ln(TA)), leverage ratio, market-to-book, change in shareholders' equity, past year performance, and stock returns volatility. Moreover, we include country macroeconomic variables: official supervisory power (Barth et al., 2013), and GDP growth. We report estimated coefficients and robust standard errors in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 10
Panel data regressions on ESG subcategories: Corporate governance.

	(1) SRISK	(2) $Delta CoVaR	(3) Z-score	(4) Beta
L.Board of directors/Board functions	−148.2	−1.865*	−0.0308	−0.000785
	(105.2)	(1.101)	(0.0256)	(0.00142)
L.Board of directors/Board structure	−10.49	−1.947**	0.000274	−4.71e−05
	(93.15)	(0.894)	(0.0227)	(0.00141)
L.Board of directors/Compensation policy	−26.21	−0.547	0.0172	0.00103
	(52.81)	(0.750)	(0.0193)	(0.00117)
L.Integration/Vision and strategy	−191.6***	−2.486**	−0.0460	−0.00122
	(72.52)	(0.980)	(0.0284)	(0.00167)
L.Shareholders/Shareholder rights	3.964	1.173*	−0.0263	0.000791
	(67.58)	(0.703)	(0.0167)	(0.000986)
L.Board of directors/Board functions ∗ Europe	26.06	0.329	−0.00342	−0.000479
	(20.42)	(0.443)	(0.00959)	(0.000566)
L.Board of directors/Board structure ∗ Europe	−30.01	−0.274	0.0101	0.000211
	(26.58)	(0.322)	(0.00950)	(0.000535)
L.Board of directors/Compensation policy ∗ Europe	2.911	0.0279	−0.00314	−0.000444
	(19.19)	(0.259)	(0.00773)	(0.000482)
L.Integration/Vision and strategy ∗ Europe	15.14	−0.225	−0.00456	0.000282
	(22.87)	(0.314)	(0.00932)	(0.000472)
L.Shareholders/Shareholder rights ∗ Europe	4.547	−0.0631	−0.00551	0.000638
	(18.68)	(0.209)	(0.00558)	(0.000422)
L.Board of directors/Board functions ∗ L.ln(TA)	11.62	0.142	0.00242	0.000109
	(10.22)	(0.116)	(0.00227)	(0.000137)
L.Board of directors/Board structure ∗ L.ln(TA)	3.641	0.205**	−0.000845	−4.67e−05
	(8.986)	(0.0900)	(0.00198)	(0.000126)
L.Board of directors/Compensation policy ∗ L.ln(TA)	1.755	0.0318	−0.000919	−3.56e−05
	(5.530)	(0.0760)	(0.00179)	(9.96e−05)
L.Integration/Vision and strategy ∗ L.ln(TA)	18.43**	0.255**	0.00487*	0.000122
	(7.287)	(0.103)	(0.00263)	(0.000142)
L.Shareholders/Shareholder rights ∗ L.ln(TA)	0.457	−0.0989	0.00181	−9.73e−05
	(6.692)	(0.0698)	(0.00149)	(9.00e−05)
L.SRISK	0.716***	−0.00233***	9.97e−06**	6.82e−07
	(0.0243)	(0.000431)	(4.87e−06)	(4.31e−07)
L.Z-score	−41.01	−0.510	0.606***	−0.00250**
	(43.12)	(0.671)	(0.0308)	(0.00108)
L.Beta	−1660**		0.144	0.354***
	(641.4)		(0.326)	(0.0193)
L.$Delta CoVaR		0.599***		
		(0.0406)		
L.ln(TA)	−1478	−8.616	−0.994***	−1.55e−05
	(917.5)	(11.92)	(0.293)	(0.0169)
Leverage	50.28	−0.0137	−0.0121**	−0.00162***
	(33.49)	(0.170)	(0.00605)	(0.000601)
Market-to-book	−8.634	6.288***	−0.159**	−0.00297
	(118.7)	(1.477)	(0.0792)	(0.00497)
Past performance	−108,786	5178***	115.2**	−1.356
	(108,671)	(1570)	(55.57)	(3.853)
Change in shareholders' equity	0.152	0.00331**	0.000111***	−3.62e−07
	(0.106)	(0.00136)	(2.35e−05)	(9.34e−07)
Volatility	800,319*	2775	−164.7**	145.1***
	(409,576)	(2870)	(75.26)	(14.50)
Supervisory power	−155.4	2.456	0.0678	0.0161***
	(151.8)	(2.360)	(0.0587)	(0.00374)
GDP growth (annual %)	−98.37	−1.996	0.109**	−0.00583*
	(125.2)	(2.036)	(0.0473)	(0.00330)

(*continued on next page*)

Table 10 (*continued*).

	(1) SRISK	(2) $Delta CoVaR	(3) Z-score	(4) Beta
Constant	18,122*	66.74	16.65***	0.511***
	(9694)	(124.6)	(3.407)	(0.188)
Observations	2287	2287	2287	2287
Adjusted R^2	0.690	0.551	0.520	0.643
RMSE	6850	100.5	2.513	0.168
Number of IDs	191	191	191	191

The table reports the results of firm-year fixed effects regressions of (1) SRISK, (2) $ Delta CoVaR, (3) Z-score, and (4) Beta, on the ESG Subcategories in the Corporate Governance pillar as listed in Table 1, 2004 to 2017. We include the ESG subcategories scores interacted with size (ln(TA)) and with a Europe = 1 dummy. As control variables we include lagged bank-level information: lagged risk measure, market beta, Z-score, log of total assets (ln(TA)), leverage ratio, market-to-book, change in shareholders' equity, past year performance, and stock returns volatility. Moreover, we include country macroeconomic variables: official supervisory power (Barth et al., 2013), and GDP growth. We report estimated coefficients and robust standard errors in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 11
Panel data regressions on ESG subcategories: Economic.

	(1) SRISK	(2) $ Delta CoVaR	(3) Z-score	(4) Beta
L.Margins/Performance	−41.90	−1.225	−0.000935	−0.00141
	(47.24)	(1.066)	(0.0157)	(0.00115)
L.Profitability/Shareholder loyalty	119.3	1.160	−0.0118	0.000534
	(76.78)	(0.734)	(0.0174)	(0.00109)
L.Revenue/Client loyalty	−117.2**	−1.076*	0.00582	−0.000923
	(56.62)	(0.582)	(0.0210)	(0.00129)
L.Margins/Performance ∗ Europe	−16.12	−0.442	−0.00306	−0.000924**
	(11.66)	(0.360)	(0.00678)	(0.000377)
L.Profitability/Shareholder loyalty ∗ Europe	−7.230	0.0665	0.0102	0.000443
	(20.12)	(0.307)	(0.00725)	(0.000446)
L.Revenue/Client loyalty ∗ Europe	−17.50	−0.175	−0.00165	0.000113
	(17.38)	(0.207)	(0.00735)	(0.000380)
L.Margins/Performance ∗ L.ln(TA)	4.867	0.134	0.000929	0.000168*
	(4.731)	(0.123)	(0.00132)	(0.000102)
L.Profitability/Shareholder loyalty ∗ L.ln(TA)	−11.70	−0.132	0.00221	−0.000119
	(7.408)	(0.0806)	(0.00150)	(9.24e−05)
L.Revenue/Client loyalty ∗ L.ln(TA)	12.55**	0.110*	−0.000949	9.25e−05
	(5.958)	(0.0570)	(0.00191)	(0.000110)
L.SRISK	0.733***	−0.00207***	1.57e−05***	7.62e−07*
	(0.0267)	(0.000364)	(4.48e−06)	(4.28e−07)
L.Z-score	−10.42	−0.0637	0.601***	−0.00170
	(36.77)	(0.660)	(0.0314)	(0.00110)
L.Beta	−1973***		0.248	0.350***
	(733.6)		(0.324)	(0.0187)
L.$Delta CoVaR		0.609***		
		(0.0398)		
L.ln(TA)	284.7	13.51	−0.784***	−0.000973
	(610.4)	(8.322)	(0.229)	(0.0155)
Leverage	41.64	−0.119	−0.0108*	−0.00173***
	(34.65)	(0.161)	(0.00602)	(0.000642)
Market-to-book	12.18	5.607***	−0.161**	−0.00337
	(110.9)	(1.432)	(0.0749)	(0.00535)
Past performance	−115,056	5448***	104.5*	−1.678
	(98,964)	(1651)	(53.11)	(3.773)
Change in shareholders equity	0.151	0.00320**	0.000105***	3.62e−08
	(0.109)	(0.00143)	(2.37e−05)	(9.42e−07)
Volatility	830,919**	2788	−151.4**	145.1***
	(410,214)	(2825)	(75.16)	(14.13)
Supervisory power	−70.53	2.867	0.0379	0.0177***
	(148.0)	(2.239)	(0.0596)	(0.00354)
GDP growth (annual %)	−106.4	−2.020	0.109**	−0.00598*
	(134.4)	(2.002)	(0.0496)	(0.00322)
Constant	−966.1	−175.9**	13.27***	0.549***
	(6028)	(88.79)	(2.755)	(0.165)
Observations	2287	2287	2287	2287
Adjusted R^2	0.690	0.548	0.524	0.646
RMSE	6850	100.8	2.503	0.168
Number of IDs	191	191	191	191

The table reports the results of firm-year fixed effects regressions of (1) SRISK, (2) $ Delta CoVaR, (3) Z-score, and (4) Beta, on the ESG Subcategories in the Economic pillar as listed in Table 1, 2004 to 2017. We include the ESG subcategories scores interacted with size (ln(TA)) and with a Europe = 1 dummy. As control variables we include lagged bank-level information: lagged risk measure, market beta, Z-score, log of total assets (ln(TA)), leverage ratio, market-to-book, change in shareholders' equity, past year performance, and stock returns volatility. Moreover, we include country macroeconomic variables: official supervisory power (Barth et al., 2013), and GDP growth. We report estimated coefficients and robust standard errors in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 12
IV regressions on the ESG score.

	(1) SRISK	(2) $ Delta CoVaR	(3) Z-score	(4) Beta
L.ESG score	−517.3***	−2.213	0.0318	−0.00328*
	(122.8)	(1.437)	(0.0237)	(0.00184)
L.ESG score ∗ Europe	81.03***	−1.054***	−0.00707	2.97e−05
	(29.51)	(0.320)	(0.00763)	(0.000558)
L.ESG score ∗ L.ln(TA)	45.88***	0.280**	−0.00236	0.000363**
	(10.79)	(0.131)	(0.00224)	(0.000165)
L.SRISK	0.780***	−0.00102**	9.07e−06**	1.36e−07
	(0.0388)	(0.000422)	(4.59e−06)	(4.97e−07)
L.Z-score	13.86	0.0240	0.969***	0.000666
	(14.15)	(0.162)	(0.00898)	(0.000442)
L.Beta	103.3		0.449	0.689***
	(856.7)		(0.283)	(0.0414)
L.$Delta CoVaR		0.891***		
		(0.0335)		
L.ln(TA)	−2388***	−3.463	0.149	−0.0162
	(543.5)	(5.924)	(0.174)	(0.0114)
Leverage	57.38***	0.0241	−0.00325	−0.000464
	(14.50)	(0.0766)	(0.00313)	(0.000385)
Market-to-book	41.64	2.748***	−0.0366	0.00205
	(59.07)	(0.868)	(0.0281)	(0.00195)
Past performance	−8632	4480***	131.7**	23.47***
	(153,117)	(1486)	(52.18)	(5.397)
Change in shareholders equity	0.265	0.00565***	0.000143***	−1.06e−06
	(0.179)	(0.00161)	(2.30e−05)	(1.33e−06)
Volatility	1.355e+06***	4636*	−157.7	142.3***
	(511,855)	(2596)	(105.3)	(14.99)
Supervisory power	−370.4*	4.558	0.143*	−0.00462
	(220.9)	(3.160)	(0.0756)	(0.00444)
GDP growth (annual %)	−270.9	−1.156	0.211***	0.00443
	(207.9)	(2.488)	(0.0698)	(0.00529)
Observations	1095	1095	1089	1095
R2 adjusted	0.862	0.928	0.949	0.664
RMSE	7758	84.54	2.411	0.176
Stock-Wright LM S statistic	253.7***	266.0***	277.4***	190.6***
Anderson-Rubin Wald Chi2 statistic	1082***	792.5***	4960***	217.7***
Anderson-Rubin Wald F statistic	63.04***	46.19***	288.9***	12.69***
LM redundancy test statistic	576.4***	571.3***	611.1***	580.2***
Kleibergen–Paap rk LM statistic	141.9***	199.8***	246.9***	197.4***
Endogeneity test	10.77**	6.174	7.689*	8.164*
Hansen J statistic	12.66	23.89**	13.67	38.98**

The table reports the results of 2SLS-IV regressions of (1) SRISK, (2) $ Delta CoVaR, (3) Z-score, and (4) Beta, on the Asset4 ESG aggregate scores, 2004 to 2017, instrumented by the principal components of a selection of World Bank Sovereign ESG data (listed in Table 5) and country-average Refinitiv ESG scores. We include the ESG scores and instruments interacted with size (ln(TA)) and with a Europe = 1 dummy. As control variables we include lagged bank-level information: lagged risk measure, market beta, Z-score, log of total assets (ln(TA)), leverage ratio, market-to-book, change in shareholders' equity, past year performance, and stock returns volatility. Moreover, we include country macroeconomic variables: official supervisory power (Barth et al., 2013), and GDP growth. We report estimated coefficients and robust standard errors in parenthesis, and tests of weak-instrument robust-inference, under-identification, endogeneity and over-identification, with their corresponding p-values. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 13
IV regressions on the ESG pillars.

	(1) SRISK	(2) $ Delta CoVaR	(3) Z-score	(4) Beta	(1) SRISK	(2) $ Delta CoVaR	(3) Z-score	(4) Beta	(1) SRISK	(2) $ Delta CoVaR	(3) Z-score	(4) Beta
L.Environment pillar score	−477.0***	−6.777***	0.0390	−0.00329*								
	(123.7)	(1.782)	(0.0239)	(0.00172)								
L.Environment score ∗ Europe	30.33	−0.0874	−0.00193	0.000452								
	(23.30)	(0.346)	(0.00530)	(0.000357)								
L.Environment score ∗ L.ln(TA)	52.84***	0.727***	−0.00402	0.000395**								
	(13.12)	(0.186)	(0.00245)	(0.000173)								
L.Social pillar score					−421.2***	−2.301	0.0598*	−0.00417**				
					(147.2)	(1.630)	(0.0312)	(0.00206)				
L.Social score ∗ Europe					57.58*	−1.099***	−0.00590	−5.74e−05				
					(30.58)	(0.310)	(0.00765)	(0.000556)				
L.Social score ∗ L.ln(TA)					42.66***	0.333*	−0.00607*	0.000523**				
					(15.93)	(0.172)	(0.00359)	(0.000230)				
L.Governance pillar score									−582.4***	−9.226***	0.0535*	−0.00514**
									(153.6)	(2.787)	(0.0287)	(0.00203)
L.Governance pillar score ∗ Europe									−37.40	−1.115	−0.00250	0.000375
									(61.97)	(0.970)	(0.0124)	(0.000875)
L.Governance pillar score ∗ L.ln(TA)									86.20***	1.285***	−0.00562*	0.000670***
									(20.51)	(0.378)	(0.00328)	(0.000239)
L.SRISK	0.804***	−0.00150***	1.01e−05**	5.95e−07	0.804***	−0.00112**	1.22e−05**	−1.11e−09	0.772***	−0.00173***	1.08e−05**	3.67e−07
	(0.0323)	(0.000404)	(4.00e−06)	(3.84e−07)	(0.0392)	(0.000458)	(5.25e−06)	(5.52e−07)	(0.0378)	(0.000491)	(4.42e−06)	(4.26e−07)
L.Z-score	−2.232	0.0875	0.975***	0.000119	−4.633	−0.0474	0.972***	0.000556	−15.40	−0.0231	0.976***	5.81e−05
	(18.40)	(0.285)	(0.00740)	(0.000378)	(18.50)	(0.180)	(0.00971)	(0.000463)	(24.26)	(0.366)	(0.00760)	(0.000405)
L.Beta	−991.8		0.748**	0.623***	−891.4		0.583*	0.696***	−1197		0.765**	0.622***
	(796.0)		(0.302)	(0.0283)	(1088)		(0.304)	(0.0424)	(945.7)		(0.306)	(0.0297)

(*continued on next page*)

Table 13 (*continued*).

	(1) SRISK	(2) $ Delta CoVaR	(3) Z-score	(4) Beta	(1) SRISK	(2) $ Delta CoVaR	(3) Z-score	(4) Beta	(1) SRISK	(2) $ Delta CoVaR	(3) Z-score	(4) Beta
L.$Delta CoVaR		0.810***				0.897***				0.766***		
		(0.0368)				(0.0309)				(0.0439)		
L.ln(TA)	−3596***	−25.34**	0.222	−0.0263*	−2472**	−9.841	0.426	−0.0317*	−6454***	−69.88***	0.338	−0.0446**
	(925.0)	(12.21)	(0.210)	(0.0136)	(1084)	(10.44)	(0.293)	(0.0181)	(1594)	(27.00)	(0.275)	(0.0198)
Leverage	80.39***	0.159	−0.00291	−0.000664	62.62***	0.129	−0.00690	−0.000318	128.2***	0.787**	−0.00476	−0.000362
	(20.64)	(0.194)	(0.00373)	(0.000407)	(20.42)	(0.148)	(0.00449)	(0.000499)	(31.47)	(0.387)	(0.00479)	(0.000490)
Market-to-book	−272.1**	2.723**	−0.0479	−0.00123	−14.33	1.881**	−0.0357	0.00115	−57.49	7.283***	−0.0740**	0.000925
	(115.0)	(1.264)	(0.0329)	(0.00246)	(67.47)	(0.753)	(0.0299)	(0.00205)	(108.6)	(1.822)	(0.0304)	(0.00248)
Past performance	−50,063	6025***	179.2***	13.95***	23,628	5156***	123.2**	26.41***	−509,297**	−881.8	214.0***	10.21*
	(171,448)	(2253)	(52.87)	(5.244)	(187,812)	(1706)	(54.64)	(5.530)	(246,744)	(3533)	(55.78)	(5.766)
Change in shareholders equity	0.134	0.00377**	0.000130***	−1.27e−06	0.330*	0.00585***	0.000141***	−9.80e−07	0.201	0.00526***	0.000126***	−7.44e−07
	(0.118)	(0.00158)	(2.15e−05)	(1.10e−06)	(0.195)	(0.00168)	(2.56e−05)	(1.44e−06)	(0.131)	(0.00165)	(2.22e−05)	(1.19e−06)
Volatility	882,904**	5.926	−227.0***	142.7***	1.332e+06**	4494	−146.1	150.6***	384,286	−7056	−198.0**	139.3***
	(416,889)	(3595)	(80.04)	(13.27)	(550,618)	(3023)	(119.5)	(12.23)	(474,425)	(5103)	(86.52)	(14.67)
Supervisory power	−433.9**	0.243	0.102*	0.00357	−176.4	5.939*	0.126	−0.00327	−360.9	1.315	0.0867	0.00456
	(221.0)	(3.070)	(0.0531)	(0.00365)	(245.5)	(3.269)	(0.0775)	(0.00449)	(282.9)	(4.064)	(0.0536)	(0.00394)
GDP growth (annual %)	108.3	−1.077	0.0857	−0.000862	−194.8	−0.0791	0.200***	0.00395	132.1	−1.136	0.0952*	−0.00114
	(208.8)	(3.027)	(0.0576)	(0.00497)	(225.9)	(2.574)	(0.0733)	(0.00538)	(273.8)	(4.051)	(0.0564)	(0.00524)
Observations	1950	1950	1943	1950	1044	1044	1038	1044	1950	1950	1943	1950
R2 adjusted	0.726	0.785	0.932	0.681	0.836	0.922	0.947	0.669	0.588	0.654	0.929	0.633
RMSE	10 300	149.4	2.811	0.193	8583	89.15	2.440	0.174	12 631	189.6	2.871	0.207
Stock-Wright LM S statistic	369.4***	347.0***	430.4***	270.5***	242.5***	256.7***	268.1***	178.7***	370.1***	346.2***	432.3***	276.2***
Anderson-Rubin Wald Chi2 statistic	1241***	771.7***	6691***	398.5***	1052***	762.8***	5354***	220.5***	1212***	740.1***	6358***	355.7***
Anderson-Rubin Wald F statistic	91.77***	57.08***	494.8***	29.47***	75.39***	54.69***	383.7***	15.81***	89.64***	54.74***	470.2***	26.31***
LM redundancy test statistic	979.7***	967.6***	1036***	1022***	488.2***	480.6***	517.1***	485.3***	671.9***	665.2***	771.5***	767.4***
Kleibergen–Paap rk LM statistic	66.42***	50.80***	69.49***	70.68***	79.38***	77.72***	82.84***	82.13***	40.44***	21.14**	42.67***	42.87***
Endogeneity test	22.07***	11.63**	8.672*	39.82***	5.082	10.75**	6.090	20.31***	12.44**	4.134	10.60**	34.47***
Hansen J statistic	11.14	16.63*	7.669	21.27**	16.86*	13.86	14.00	19.35**	4.322	13.40	3.891	19.47*

The table reports the results of 2SLS-IV regressions of (1) SRISK, (2) $ Delta CoVaR, (3) Z-score, and (4) Beta, on the Asset4 ESG Pillars scores, 2004 to 2017, instrumented by the principal components of a selection of World Bank Sovereign ESG data (listed in Table 5) and country-average Refinitiv ESG scores corresponding to the pillars. We include the ESG scores and instruments interacted with size (ln(TA)) and with a Europe = 1 dummy. As control variables we include lagged bank-level information: lagged risk measure, market beta, Z-score, log of total assets (ln(TA)), leverage ratio, market-to-book, change in shareholders' equity, past year performance, and stock returns volatility. Moreover, we include country macroeconomic variables: official supervisory power (Barth et al., 2013), and GDP growth. We report estimated coefficients and robust standard errors in parenthesis, and tests of weak-instrument robust-inference, under-identification, endogeneity and over-identification, with their corresponding p-values. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 14
Impact of Refinitiv scoring change on SRISK.

	(1) SRISK ESG	(2) SRISK EN	(3) SRISK SO	(4) SRISK CG
Time = 2017	−3099***	−2812***	−3452***	−2790***
	(0.000119)	(0.000836)	(0.000178)	(3.12e−05)
Treated minus = 1	−242.1	−204.6	−2407***	236.5
	(0.811)	(0.708)	(0.000712)	(0.843)
1.time ∗ 1.Treated minus	2628**	2655***	4008***	1296
	(0.0249)	(0.00274)	(9.47e−06)	(0.311)
Treated plus = 1	−393.7	208.0	−1075*	−686.1
	(0.504)	(0.755)	(0.0821)	(0.269)
1.time ∗ 1.Treated plus	1033	−162.0	1485	252.4
	(0.302)	(0.878)	(0.144)	(0.807)
L.ESG score	−3.843			
	(0.785)			
L.Environment pillar score		56.05		
		(0.629)		
L.Social pillar score			11.91	
			(0.919)	
L.Governance pillar score				16.39
				(0.710)
L.SRISK	0.854***	0.854***	0.850***	0.852***
	(0)	(0)	(0)	(0)
L.Z-score	10.36	8.301	10.46	11.18
	(0.582)	(0.660)	(0.556)	(0.563)
L.Beta	−73.38	−54.78	1.776	−214.8
	(0.948)	(0.961)	(0.999)	(0.840)
L.ln(TA)	299.9	265.1	232.6	272.5
	(0.272)	(0.313)	(0.364)	(0.303)
Leverage	6.061	6.200	7.024	6.761
	(0.317)	(0.308)	(0.237)	(0.269)
Market-to-book	−88.48	−119.4*	−112.7	−96.46
	(0.265)	(0.0748)	(0.164)	(0.188)
Past performance	−145,827	−160,080	−150,044	−164,113
	(0.218)	(0.190)	(0.216)	(0.168)
Change in shareholders equity	0.217	0.222	0.216	0.221
	(0.241)	(0.224)	(0.241)	(0.229)
Volatility	387,891***	383,713***	374,023***	390,648***
	(0.00135)	(0.00213)	(0.00304)	(0.00157)
Supervisory power	−194.8	419.5	−167.4	−168.6
	(0.359)	(0.707)	(0.732)	(0.590)
GDP growth (annual %)	−388.6	−431.1	−298.6	−364.1
	(0.355)	(0.281)	(0.480)	(0.376)

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Table 14 (*continued*).

	(1) SRISK ESG	(2) SRISK EN	(3) SRISK SO	(4) SRISK CG
Constant	571.2	−6777	441.8	−345.2
	(0.844)	(0.658)	(0.969)	(0.952)
Observations	506	510	510	510
Adjusted R^2	0.922	0.922	0.922	0.921
RMSE	4778	4762	4737	4765

The table reports the results of country-year fixed effects regressions of SRISK on the change in ESG scores, given the methodological shock in 2017. We include all banks headquartered in Europe or USA. The specification includes a dummy variable for the event (Time = 1: on and after 2017), a dummy variable identifying the treated banks (Treated Plus or Treated Minus), and an interaction dummy identifying treated banks after 2017. Treated banks are considered banks who had a change in ESG scores higher than the 90th percentile (Treated Plus) or lower than the 10th percentile (Treated Minus) of the difference in old and new scores in 2017. As control variables we include lagged bank-level information: lagged risk measure, market beta, Z-score, log of total assets (ln(TA)), leverage ratio, market-to-book, change in shareholders' equity, past year performance, and stock returns volatility. Moreover, we include country macroeconomic variables: official supervisory power (Barth et al., 2013), and GDP growth. We report robust standard errors in parenthesis. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 15
Impact of Refinitiv change in ESG scoring on SRISK: Europe vs. USA.

	Europe ESG DD-	Europe CoGOV DD-	Europe ENV DD-	Europe SOC DD-	USA ESG DD-	USA CoGOV DD-	USA ENV DD-	USA SOC DD-
Time = 2017	−2494***	−2412***	−2550***	−2649***	−4190***	−4173***	−4406***	−0.249
	(0.00157)	(0.00154)	(0.00135)	(0.00125)	(2.35e−05)	(1.50e−05)	(9.22e−06)	(0.412)
Treated minus = 1	−1681	−4736**	−700.6	−1243**	649.7	740.9	−194.7	−0.489
	(0.129)	(0.0126)	(0.374)	(0.0222)	(0.715)	(0.709)	(0.831)	(0.628)
1.time ∗ 1.Treated minus	2368	2010	2627***	3244***	206.9	58.84	1714*	0.628
	(0.109)	(0.440)	(0.00507)	(0.000157)	(0.910)	(0.974)	(0.0712)	(0.513)
L.ESG score	1.705				−3.075			
	(0.917)				(0.899)			
L.Governance pillar score		−8.114				−2.347		
		(0.436)				(0.885)		
L.Environment pillar score			−7.033				29.76	
			(0.523)				(0.177)	
L.Social pillar score				10.52				0.00795
				(0.541)				(0.565)
L.SRISK	0.897***	0.900***	0.895***	0.896***	0.776***	0.776***	0.767***	−3.67e−07
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0.975)
L.Z-score	18.54	14.62	19.88	15.70	−12.40	−14.25	−15.93	0.974***
	(0.298)	(0.383)	(0.260)	(0.406)	(0.734)	(0.688)	(0.653)	(0)
L.Beta	−1375	−1495	−1202	−1496	1473	1462	1410	0.336
	(0.467)	(0.436)	(0.550)	(0.403)	(0.234)	(0.225)	(0.244)	(0.589)
L.$ Delta CoVaR								
L.ln(TA)	280.6	400.6	337.3	208.7	−22.83	−16.99	−425.4	0.0752
	(0.457)	(0.243)	(0.278)	(0.574)	(0.959)	(0.969)	(0.435)	(0.662)
Leverage	0.483	−2.518	0.112	1.081	203.6	202.3*	232.2*	−0.0223
	(0.949)	(0.721)	(0.986)	(0.879)	(0.107)	(0.0943)	(0.0847)	(0.575)
Market-to-book	−7.089	16.45	−23.18	−15.84	−498.4*	−517.7*	−568.4*	0.123
	(0.898)	(0.756)	(0.652)	(0.785)	(0.0818)	(0.0918)	(0.0522)	(0.564)
Past performance	−144,495	−135,972	−148,379	−158,520	−99,384	−101,332	16,139	68.22
	(0.286)	(0.306)	(0.290)	(0.252)	(0.811)	(0.807)	(0.969)	(0.775)
Change in shareholders equity	0.329	0.344	0.326	0.325	0.380	0.382	0.389	0.000161***
	(0.182)	(0.165)	(0.188)	(0.186)	(0.214)	(0.211)	(0.207)	(0.00196)
Volatility	335,708***	316,037***	358,274***	319,719***	−825,499	−809,027	−1.052e+06	206.3
	(0.00473)	(0.00947)	(0.00358)	(0.00665)	(0.713)	(0.717)	(0.653)	(0.815)
Supervisory power	−159.6	−216.9	−185.5	−86.66				
	(0.755)	(0.652)	(0.697)	(0.867)				
GDP growth (annual %)	444.0	425.5	469.0	585.1	−2466***	−2464***	−2445***	0.0887
	(0.423)	(0.430)	(0.389)	(0.304)	(6.02e−05)	(9.27e−05)	(0.000134)	(0.744)
Constant	−891.6	−793.3	−1077	−1306	4930	4915	8799	−1.327
	(0.853)	(0.867)	(0.828)	(0.793)	(0.298)	(0.323)	(0.136)	(0.363)
Observations	252	252	252	252	254	254	254	254

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Table 15 (*continued*).

	Europe ESG DD-	Europe CoGOV DD-	Europe ENV DD-	Europe SOC DD-	USA ESG DD-	USA CoGOV DD-	USA ENV DD-	USA SOC DD-
Adjusted R^2	0.946	0.947	0.946	0.946	0.877	0.877	0.878	0.978

The table reports the results of firm-year fixed effects regressions of SRISK on Refinitiv ESG scores, including the methodological shock in 2017. We only include banks headquartered in the USA. The specifications include a dummy variable for the event (Time = 1: on and after 2017), a dummy variable identifying the treated banks (Treated Minus), and an interaction dummy identifying treated banks after 2017. Treated banks are considered banks who had a change in ESG scores lower than the 10th percentile (Treated Minus) of the difference in old and new scores in 2017. As control variables we include lagged bank-level information: lagged risk measure, market beta, Z-score, log of total assets (ln(TA)), leverage ratio, market-to-book, change in shareholders' equity, past year performance, and stock returns volatility. Moreover, we include country macroeconomic variables: official supervisory power (Barth et al., 2013), and GDP growth. We report estimated coefficients and robust standard errors in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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