ESG risks and corporate survival

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Abstract
This research is the first attempt to examine the impact of corporate sustainability risks factors on its financial stability. By using S&P500 stocks data from 2019 to 2021 and calculating Altman’s Z-score, we examined the influence of ESG (Environmental, Social, and Corporate Governance) risks score on the company survival chances. We documented diminishing total ESG scores of S&P500 stocks in recent years pointing out that companies pay attention to sustainability issues and invest resources to reduce them. We documented that Altman’s Z-score is negatively influenced by E and S and not by G. These findings are very important since they prove for the first time that high environmental and social risks may reduce corporations’ financial stability and rise their default risks incurring default costs. Moreover, high sensitivity of Altman’s Z-score changes to S changes was found especially for relatively smaller firms. The result of this study emphasizes the importance of sustainability risk and especially social risk to a firm’s survival chances and therefore mitigating those risks can dramatically improve corporates’ financial stability.

Keywords Sustainability · Environmental · Social · Corporate governance · Corporate survival · Altman Z

1 Introduction

Environmental (E), Social (S), and corporate Governance (G) risks are becoming more and more important to corporations around the globe. The corporate concerns of ESG risks reflect the growing importance investors and the general public attribute to sustainability issues. Firms look for ways to mitigate those risks knowing that they will have to commit a lot of resources to ensure a successful process. These investments can weaken the firm’s financial stability because of their scope and nature; however, they can do the opposite through the positive corporate image among investors, customers, and the entire business circles. In this research, we investigate the S&P500 firm’s ESG risk’s impact on the firm’s survival chances measured by Altman’s Z-score. Moreover, we investigate the relative importance of ESG risks to the corporate’s survival chances compared to external economic factors such as GDP growth and U.S. government 10 years bonds yields. Our analysis has established that from the tree ESG risks factors only E and S risks have a negative impact on the firm’s financial stability. S risks have been found to have the strongest influence upon the companies Altman’s Z-score emphasizes that corporate social fairness to its workers, customers, and other business partners is conceived as a major factor in the company’s survival chances, and therefore, corporations must invest resources to ensure they mitigate those risks.

2 Literature Review

Sustainability ingredients have become crucial to corporate long-term success (Eccles et al., 2012; Ortiz-de-Mandojana and Bansal, 2016), and it has been increasingly studied in the academic literature in recent decades. However, there is a gap in the literature about the link between sustainability and a firm’s survival chances and bankruptcy cost that are associated with default risks. The aim of the following research is to bridge that gap of knowledge by examining the direct impact of ESG risks factors on Altman’s Z-score that measures the financial stability of firms. Moreover, we will try to determine whether sustainability issues are more important in recent years to corporation survival than major economic factors. Corporate sustainability generally refers to the integration of financial profitability, environmental protection, and social responsibility into organizations’
mission declarations and every applied to everyday activities (Elkington, 1997; Lo, 2010; Schaltegger et al., 2013). It is also defined as meeting the needs of a firm’s direct and indirect stakeholders such as shareholders, employees, clients, pressure groups, communities, etc., without compromising its ability to meet the needs of future stakeholders as well. Although many researchers have focused on corporate sustainability models and efforts, not many have tried to document the effect of sustainability risks on the financial markets. Cohen (2021) has found that E risks negatively affect excess return over the Nasdaq100 index in some years and that S risks are the most influential factor negatively related to excess returns. Nizam et al. (2019) have studied the impact of sustainability on banks’ performance and concluded that financial performance and social and environmental performance are related, evidence for the banking sector remains limited and inconclusive. Garcia et al. (2019) have found that larger companies have higher levels of performance. They also found that companies in sensitive industries present superior environmental performance even when controlling for size and country. Lee et al. (2013) examined whether portfolios comprising high-ranked Corporate Social Performance (CSP) firms out/underperform portfolios comprised of low-ranked CSP firms for a U.S. sample of firms covering the period from 1998 till 2007. Their results are consistent with the “no-linkage” hypothesis, which argues that no significant difference in the risk-adjusted performance is expected between high- and low-ranked CSP-formed portfolios.

Unlike those important papers, we do not try to expose the linkage between ESG risk to market performances but rather to the firm’s survival chances and financial stability by linking sustainability risks factors to Altman (1968) who developed a model for bankruptcy prediction using multiple discriminant analysis called Altman’s Z-score model. Altman defined his Z-score model as a statistical measure to predict company financial failure, calculated as a linear combination of four or five common financial ratios, weighted by coefficients. At a later work (Altman, 2000) he established two models: Model A Z-score for manufacturing companies closed, and Model B Z-score for non-manufacturing companies. Many researchers have followed his pioneered work and tested the ability of the Z models to forecast the business failure of companies from different sectors and economic regimes. Since the introduction of Altman’s models’ researchers has tested the model’s ability to detect corporate financial default. Hayes et al. (2010) had analyzed the construction of Z-score model by applying it to a sample of 17 U.S. firms from the retail industry, the study revealed that the model correctly predicts bankruptcy at a level of 94%. Mamo (2011) predicted financial distress on 43 banks and concluded that Altman’s model is correct in 80% of the cases in the financial sector. Other researchers have focused on bankruptcy costs that arise when the firm experiences financial distress and potential default. During a default process, a firm exhibits direct and indirect costs that can assume a considerable value of the firm (Altman, 1984; Opler and Titman, 1994). Andrade and Kaplan (1998) estimate financial distress costs to be 10–23% of the firm’s value while Glover (2016) estimates the figure to be 25%. Those costs come from different sources such as lower than market assets liquidation prices and business difficulties incurred by business partners. Since costs of default are high, a firm must invest efforts to avoid potential financial distress including taking care of its ESG risks.

### 3 Methodologies and results

This research is based on S&P500 stocks data from 2019 until 2021. For each stock, we calculated yearly Altman’s Z-score\(^1\) and collected ESG risks factors.\(^2\) Our data contains the years of Covid-19 world pandemic that have risen awareness to the globalization negative effects and imposed new challenges on many business aspects such as transportation of goods and on sight employment. The pandemic has also risen people’s awareness of the need to preserve the environment for future generations. Table 1 summarizes descriptive statistics of all the data (2019–2021) while Fig. 1 presents year-by-year averages.

Table 1 and Fig. 1 show that the total ESG risks have been diminishing from 2019 until 2021. That phenomenon is consistent with the G and S risks. However, E risks of the S&P500 stocks demonstrate inconsistency in its trend, rising from 5.13 in 2019 to 6.08 in 2020 and dropping to 5.64 in 2021. S risks have been found to be higher than E and G risks for all the examined years. The highest standard deviation of the ESG factors is associated with E (5.38) pointing out that S&P500 stocks are

### Table 1 Descriptive statistics data 2019–2021

|          | E   | S   | G   | ESG | Altman’s Z |
|----------|-----|-----|-----|-----|------------|
| Average  | 5.67| 11.05| 7.34| 24.06| 3.71       |
| St. Dev  | 5.38| 4.04| 2.15| 7.10 | 3.00       |
| Max      | 19.09| 20.87| 13.13| 39.35| 16.7       |
| Min      | 0.02| 1.93| 3.26| 10.78| -1.33      |

\(^1\) Altman’s Z-score is based on five financial ratios.

\(^2\) ESG data provided by Sustainalytics, Inc.

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1. Altman’s Z-score is based on five financial ratios.
2. ESG data provided by Sustainalytics, Inc.
relatively different in their environmental sensitivity and behavior while they act relatively similarly on corporate governance issues. Altman’s Z also varies dramatically in a wide range from highly financially stable firms to firms with real bankruptcy potential in the near future. Figure 1 also demonstrates that the average Altman’s Z-score has dropped from 3.71 in 2019 to 3.47 in 2020 and then risen to 4.18 in 2021.

Lioui and Tarelli (2022) compared two dominant methodologies for the construction of an ESG factor: the time-series and cross-sectional approaches. Differences in ESG rating and exposure to other firm characteristics imply an ex ante expected return spread between the two factors. They documented strong variation of the alpha factor in the time series which is negatively related to media attention to ESG. We followed Lioui and Tarelli model of pure factors creation using ESG rating and Altman’s Z as stock’s returns explanatory variables. First, we measured the standalone survival factor on the stocks returns (Eq. 1), and then we added to the regression the ESG explanatory variables (Eq. 2).

\[ R_i = \alpha_i + \beta_1 Z_i, \]  
(1)

\[ R_i = \alpha_i + \beta_1 Z_i + \beta_2 ESG_i. \]  
(2)

The result of Eq. 1 is as follows:

\[ R_i = 8.77 + 2.71Z_i, \]  
\( t: \text{stat} = (2.69)(3.97), \)

\( R^2 = 0.22, F = 15.8. \)

Equation 1 shows significant positive impact of Altman Z-score on stocks return. The \( \beta_1 \) which measures the impact of Z on the stocks return, is 2.71. Table 2 summarizes the results of Eq. 2.

Table 2 demonstrates that Altman Z has a significant positive impact on stock’s return. Moreover, the existence of the ESG factors in the regression model has risen the \( \beta_1 \) from 2.71 to 2.85 for the ESG, 2.90 for E and 2.76 for G. Only for the model that included S, the \( \beta_1 \) was reduced to 2.51. The delta of \( \beta_1 \) between the original model (Eq. 1) and \( \beta_1 \) in the second model (Eq. 2) demonstrates the sensitivity of the Z impact on stock’s return due to ESG parameters.

We now construct and implement an econometric model that measures the impact of the various ESG risks factors, firm’s size, and two general economic data including U.S. 10 years bonds yields and U.S. GDP (Gross Domestic Product) growth rate, on S&P500 firms Altman’s Z-score. Our aim is to evaluate the importance of the different ESG scores along with external economic data on the individual firm’s survival chances. The model implementation is presented in Eq. 3.

\[ AltZ = 6.34 - 0.14E - 0.28S + 0.10G \]  
\[ - 0.59 \text{Yield} + 0.08 \text{USg} + 1.02 \text{Size}, \]  

\( T \text{stat:}(7.00 **) \quad (-3.09 **) \quad (-4.21 **) \) 
\( (0.80)(-0.97) \quad (1.17) \quad (2.01 **). \)

\( R^2 = 0.21, F = 6.25. \)
where: \( AltZ \) = Altman’s Z-score, \( E \) = environmental risks, \( S \) = social risks, \( G \) = corporate governance risks, \( Yield \) = yields of U.S. government 10 years bonds, \( USg \) = U.S. economy GDP growth rate, \( Size \) = Dummy variable for the corporate market value: 1 = more than 100 B $, 0 = less than 100 B $. ** = significant at 95%.

The econometric model indicates that Altman’s Z-score is negatively influenced by \( E \) and \( S \) and not by \( G \). These findings are very important since they prove that high environmental and social risks may reduce corporates’ financial stability and rise their default risks incurring default costs (see e.g., Merton 1974; Koziol 2014). These findings support the hypothesis that investing resources in order to reduce its \( E \) and \( S \) risks may be increase the firm’s overall value since by doing so it reduces its default probability associated with default costs that may reduce the company value up to 25% of its pre-default value (Glover 2016). These results also support the idea that firms economically should invest resources to mitigate environmental and social damages they incur on their surroundings especially if it faces survival risks. Results also show that \( G \) risks do not affect Altman’s Z-score as the other two ESG components. From investors perspective, they should avoid investing in high environmental and social risks firms if their survival chances are slim or demand a higher return on investment that will compensate the incremental risks involved.

The model results also show no significant impact of U.S. GDP growth and 10 years government bonds on Altman’s Z-score. These findings indicate that \( E \) and \( S \) individually are more important to the corporate survival chances than data from the surrounding economy. Furthermore, the model also records an expected positive impact of the company size on its survival chances. We now repeat Model 3 splitting the data into two size categories according to the firm’s market values (above and below 100 B$) and report the results in Table 3.

Table 3 shows a similar negative effect of \( E \) on Altman’s \( Z \) for both firms’ size categories. However, \( S \) risks have a stronger negative impact on the financial stability of big firms compared to smaller firms. This finding is probably due to the fact that big corporation employs thousands of workers in a global economic surrounding that enhances challenges of the firms’ social policies. Moreover, big firms should influence the firm’s management to adopt high social standards regarding working conditions and gender equality, in order to improve the survival chances of their firm. The split model also shows that \( G \) risks and the external economic factors do not have a significant impact on Altman’s \( Z \) for both size categories. ESG risks are evaluated periodically by the evaluation agencies and therefore the risk scores are frequently being changed over time. Model 4 tries to capture

### Table 2

| Model | \( \alpha \) | \( \beta_1(Z) \) | \( \beta_2(ESG) \) | \( R^2 \) | \( F \) |
|-------|--------------|----------------|-----------------|--------|------|
| 1     | 4.41 (0.48)  | 2.85 (3.87)    | 0.16 0.51       | 0.18   | 12.1 |
| 2     | 5.79 (1.32)  | 2.90 (4.10)    | 0.40 (1.12)     | 0.17   | 13.5 |
| 3     | 15.79 (2.16) | 2.51 (3.54)    | -0.56 (1.07)    | 0.19   | 14.1 |
| 4     | 1.32 (0.17)  | 2.76 (4.03)    | 0.99 (1.05)     | 0.17   | 13.7 |

The explanatory variable is the stock’s return, the number in the brackets are the \( t \) statistics

### Table 3

| Big firms | \( \beta_0 \) | \( \beta_1(E) \) | \( \beta_2(S) \) | \( \beta_3(G) \) | \( Yield \) | \( USg \) | \( R^2 \) | \( F \) |
|-----------|--------------|----------------|----------------|---------------|-------------|---------|--------|------|
| \( 7.76^{**} (5.77) \) | -0.14* (1.84) | -0.31** (3.43) | 0.10 (0.65) | -0.50 (0.63) | 0.08 (0.79) | 0.21 | 6.22 |
| \( 6.09^{**} (4.60) \) | -0.13** (2.45) | -0.22** (2.27) | 0.10 (0.50) | -0.84 (0.84) | 0.11 (0.97) | 0.15 | 3.41 |

\( ** \) = Significant level of 95%

\( * \) = Significant level at 90%

The numbers in the brackets are \( t \) statistics
the changes of ESG components on the changes of Altman’s $z$.

$$\Delta AltZ = 0.01 \Delta E - 0.33 \Delta S + 0.31 \Delta G,$$

(4)

$t$ stat: (0.08) (−2.32 **) (1.07),

$R^2 = 0.16, F = 3.73.$

where: $\Delta AltZ =$ changes in Altman’s $z$-score,$\Delta E =$ changes in the environmental risks,$\Delta S =$ changes in the social risks,$\Delta G =$ changes in the corporate governance risks, ** = significant at 95%.

Model 4 indicates that changes in the S score have a negative significant effect on the changes on Altman’s Z-score. This model adds information to the results of Model 3 since it emphasizes the high sensitivity of the company’s survival chances to changes in its social risks.

No such sensitivities were recorded with E and G changes.

The split model into two size categories is presented in Table 4.

Table 4 shows that Altman’s Z-score changes are more sensitive to S changes for relatively smaller firms than for bigger firms. Table 3 also indicates that there is no size-based difference of Altman’s Z-score changes to E and G changes.

### 4 Summary and conclusions

This research is the first attempt to examine the impact of corporate sustainability risks factors on its financial stability. By using S&P500 stocks data from 2019 to 2021 and calculating Altman’s Z-score, we examined the influence of the ESG risks score on the company’s survival chances. In addition to the ESG scores, we incorporate to our model external economic data od U.S. government bonds yields and U.S. economic GDP growth rate. We documented diminishing total ESG scores of S&P500 stocks in recent years pointing out that companies pay attention to sustainability issues and invest resources to reduce them. A decline in S and G has been documented while E score raised from 2019 to 2020 and then declined towards 2021. We found that the average Altman’s Z-score for S&P500 stocks was 3.71 during the examined years improving to 4.18 in 2021. We also found that Altman’s Z-score is negatively influenced by E and S and not by G. These findings are very important since they prove for the first time that high environmental and social risks may reduce corporates’ financial stability and rise their default risks incurring default costs. Moreover, we documented a high sensitivity of Altman’s Z-score changes to S changes, especially for relatively smaller firms. No such sensitivities were detected of Altman’s z changes for E and G changes. The result of this study emphasizes the importance of sustainability risk and especially social risk to a firm’s survival chances and, therefore, mitigating those risks can dramatically improve corporates’ financial stability. The current study was based on data from the years in which the Covid-19 pandemic has changed the global business circumstances and the view of investors on issues such as climate change and social sustainability. It would be interesting to reexamine the discussed issues in the future in the absence of the pandemic.

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**Declarations**

**Conflict of interest** There is no financial or non-financial interests that are directly or indirectly related to the work submitted for publication.

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