

Article

Firms' Capital Structure during Crises: Evidence from the United Kingdom

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Abstract: This study was conducted using the dynamic panel two-stage least squares system generalized methods of moments (2SLS-system GMM) to examine how UK companies made capital structure decisions during the COVID-19 pandemic. Contrary to expectations, firms opted to reduce their debt exposure during the pandemic. Tobin's Q was the most significant determinant of capital structure, as it mitigated total debt by 0.25% during the pandemic. This result aligns with the pecking order theory, suggesting that firms prefer internal financing over debt. Simultaneously, combined scores (ESG) and the decomposed environment (E), social (S), and governance (G) scores individually and paired with the COVID-19 dummy negatively affected short-term debt by 0.012%, 0.015%, 0.0068%, and 0.00434%, respectively. This study's results highlight the significance of firms adopting less debt-heavy policies during periods of heightened uncertainty to effectively manage financial risk. This result underscores the importance of prudent financial risk management strategies for navigating the challenges posed by sudden crises. Our findings suggest that a complex interplay of factors influences capital structure decisions during crises, with debt reduction and prudent risk management emerging as critical strategies.

Keywords: capital structure; corporate financial performance; corporate social responsibility; COVID-19



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1. Introduction

The COVID-19 pandemic, declared a worldwide health crisis by the World Health Organization in early 2020, spread at an unprecedented speed, resulting in a global catastrophe of unparalleled magnitude [1]. The impact of COVID-19 was far-reaching and affected almost every aspect of life [2]. During the COVID-19 era, governments were forced to impose severe restrictions and adjust their fiscal and monetary policies, such as deferred personal/corporate taxes and lower interest rates [3]. Most governments used deficit expansion and increased debt to cover these epidemic expenses. The global GDP experienced a significant slowdown, leading to challenges in maintaining financial market liquidity. Ref. [4] found a negative correlation between the number of confirmed COVID-19 cases and stock market liquidity. This pandemic produced different adverse impacts on businesses, including shortage of liquidity and insolvency [5], which caused a decline in credit supply, negatively influencing investment, employment, and total factor productivity growth [6]. The year 2020 experienced debt moratoria, a sharp increase in debt issuance, and the development of the flow of new credit for nonfinancial corporations [7]. Capital raising is exceptionally high among enterprises impacted by the epidemic. Most of the new issuance reflects a desire for capital to replace cash flows lost due to the pandemic's economic disruption [8]. Ref. [9] observed an increase in bond issuance by investment-grade firms in the first quarter of 2020 compared to the same period in 2019. In addition, a study by ref. [10] revealed that the COVID-19 pandemic led to a substantial reduction in liquidity in the corporate bond market. This was attributed to heightened investor risk aversion, decreased trading activity, and increased market volatility.

Meanwhile, ref. [11] presented evidence that the pandemic generated a distributional shock to capital allocation. At the same time, ref. [12] posited that enterprises with superior pre-2020 financial situations and additional money had high unemployed lines of credit, used a smaller amount of debt, and had a smaller amount of short-period debt. These outperformed similar firms in terms of stock market responses to this pandemic. Simultaneously, ref. [13] found that the COVID-19 pandemic had a significant negative effect on global equity markets during the initial phase of the outbreak. Firms more substantially affected by the pandemic experienced worse stock performance and volatility in stock returns [14–18]. This effect was particularly pronounced for developed countries compared to emerging markets [19]. Ref. [20] contended that the health crisis witnessed the most significant liquidity demand. The strict restrictions imposed during the pandemic prompted firms to primarily bridge their debt to address their liquidity shortage [20–22].

The debate over the significance of capital structure in finance has been ongoing. While the foundational work of Modigliani and Miller (M&M) [23] suggested that, in an ideal market, capital structure has no bearing on firm value, subsequent research has revealed that this is not universally applicable in the real business environment. Ref. [24] delved into the influence of taxes on capital structure in a more practical setting. The authors posited that despite taxes providing a favorable tax shield for debt financing, this benefit is offset by other factors, such as the risks associated with financial distress and the expenses related to monitoring managers. They introduced an alternative equilibrating process in which companies adjusted their capital structures to strike a balance between the advantages of the tax shield and the drawbacks of financial distress and agency issues. This process implies that there could be an optimal range of capital structures for a given firm. The determination of capital structure holds significant importance within the context of firms. On the one hand, debt is critical in firm operations, significantly influencing corporations' financial performance [25,26]. This essential function of debt became evident during the 2008 financial crisis [27]. Furthermore, corporate debt can finance sustainable business activities. On the other hand, ref. [28] suggested that profitable companies focus less on debt to be perceived as relatively "low risk". Moreover, refs. [29,30] found an inverse relationship between debt and financial performance. Companies with more debt face higher risk [31]. Specifically, the default risk of riskier companies increases, and some are forced to go bankrupt [5,32]. This prompted us to inquire about the potential impact of COVID-19 on the capital structure, specifically, the leverage, of UK-listed companies.

This inquiry aligns with three well-established theories in the literature that elucidate capital structure. Trade-off theory considers the benefits and costs of debt to achieve an optimal capital structure that enhances a firm's value [33]. The pecking order theory proposes that managers follow a hierarchy when selecting financial sources [28]. Conversely, agency theory suggests that profitable firms rely significantly on debt to limit managers' distorted incentives [26]. However, ref. [29] argued that growth firms are expected to incur less leverage. The corporate finance literature also outlines the most common capital structure determinants: profit, corporate social responsibility (CSR), growth, risk, size, liquidity, and tangibility. Profitable firms are likely to increase their leverage ratios according to the trade-offs and agency theory, whereas the level of debt should decrease according to the pecking order theory. Moreover, CSR helps reduce information asymmetry between firms and creditors. CSR is a business model in which firms integrate environmental, social, and governance concerns into their business operations and interactions with their stakeholders. Being responsible can reduce debt's negative impact [34] and help firms attract socially responsible investor funds [35], achieving better access to valuable capital [36,37]. Furthermore, being responsible decreases the cost of capital for businesses [38]. Higher CSR lessens capital constraints. These constraints comprise the firm cost of equity, company debt, the firm reliance on bank borrowing, company borrowing incapacity, the illiquidity of assets, and the equity issuance disability [39]. Firms that adopt more SCR practices will be less influenced by reputation backlashes [40]. Firms with superior CSR scores pay less than others with CSR concerns by seven to eighteen basis points; therefore, companies with little

CSR activities are exposed to an increased probability of meeting financial distress [41]. In contrast, firms with more CSR activities manifest low financial distress risks, which enhances their ability to better finance access [42]. Refs. [43,44] showed that CSR can help firms generate positive reputations. Ref. [45] confirmed that these firms were less exposed in an emergency and described this as a hedge versus reputational risk in the course of predicaments. According to ref. [46], firms with fewer CSR initiatives were dominant, with a high debt risk, during COVID-19. However, notwithstanding COVID-19's impacts on firms, those with a robust corporate culture surpass their contemporaries and give their support to their community [47]. Firms in this challenging time needed more help to survive and overcome insolvency by mitigating the adverse effects of debt during the COVID-19 period. This support would prevent them from struggling to preserve their economic sustainability and establish them in the post-COVID-19 recovery. Ref. [48] declared that CSR activities significantly and positively affect idiosyncratic volatility. CSR activities can be used as a tool in risk management in times of crisis [49,50], a remedy for high-leverage firms, and a protective tool against severe vital crises [34] of the immune system and remedial crises during an emergency era [12,27,46,51]. Thus, we ask whether firms' CSR contributed to debt during this crisis and, if so, to what extent.

According to agency theory, growth firms incur less leverage. The pecking order theory asserts that growth firms exhibit more debt. According to trade-off theory, firms with more risk should earn more profit. The pecking order theory asserts that profitable firms should use less debt. Trade-off theory suggests that firm size has a positive effect on debt. However, in the pecking order model, firms with more tangible assets are expected to have lower leverage.

As evidenced by Our World in Data records, the UK experienced a surge in confirmed COVID-19 cases at the beginning of the pandemic [52]. The Office for National Statistics declared that the UK's GDP experienced large and volatile movements from 2020 to 2021 [53]. The COVID-19 outbreak forced firms to increase their debt, and the potential for rising debt to affect financial stability was particularly concerning. The Bank of England identified this as a critical issue [54]. A literature review on this subject has shown that most previous studies focused on the US (i.e., [20–22,55]). By contrast, the London Stock Exchange has not been extensively investigated. Ref. [56] reported that uncertainty adversely impacts private equity activities in the UK. To the best of our knowledge, no specific study has investigated the pandemic's effect on UK-listed firms' capital structure. To fill this gap, this study explores how firms' capital structures were affected during the pandemic.

We aim to contribute to the literature by showing that companies align with the pecking order theory and adopt less reliant debt policies during periods of high uncertainty. Moreover, we also show that firms with adequate CSR were less debt-prudent during the COVID-19 crisis. Our findings underscore the importance of risk management in corporate financial decision-making, suggesting that firms prioritize financial stability over short-term gains during times of heightened economic uncertainty.

2. Materials and Methods

This study utilized a quarterly dataset of UK-listed companies from 2018 to 2021, focusing on the COVID-19 period from 2020 to 2021. The London Stock Exchange data were obtained from the London Stock Exchange Group (LSEG), known before as Refinitiv Eikon DataStream. Observations were filtered for debt, financial performance, and social responsibility (the study's primary variables). Financial, utility, and real estate companies were excluded from the analysis, along with observations with missing values. The data were winsorized at the 1st and 99th percentiles to mitigate outliers. Control variables were chosen based on the relevant literature as determinants of capital structure. The sample comprised 383 firms with a quarterly unbalanced panel of 6042 observations. For detailed information on the variables, please refer to Appendix A. To investigate the impact of the COVID-19 pandemic on the capital structure proxied by leverage, this study developed the following models based on the theories and literature:

$$CS_{it} = \alpha + \beta_1 CS_{i(t-1)} + \beta_2 CFP_{it} + \beta_3 CSR_{it} + \beta_4 COVID19 + \beta_5 CONTROLS_{it} + \sum \beta_6 Sectors + V. \quad (1)$$

$$CS_{it} = \alpha + \beta_1 CS_{i(t-1)} + \beta_2 CFP_{it} + \beta_3 CSR_{it} + \beta_4 COVID19 + \beta_5 CSR_{it} * COVID19 + \beta_6 CONTROLS_{it} + \sum \beta_7 Sectors + V. \quad (2)$$

The above models examined how leverage determinants affected a firm's capital in 2018–2021. Equation (1) focused on the pandemic period, using a dummy variable that took a value of one for 2020–2021 and zero for otherwise. Additionally, this study examined the interaction between CSR and the COVID-19 dummy in Equation (2). We used the dynamic panel two-stage least squares system general methods of moments (GMM) [57,58]. This approach is favored for several reasons. Firstly, GMM is suitable for short panel datasets with a small time span and large individual, independent variables, that are not strictly exogenous, correlated with previous and potentially current error realizations, fixed effects, and heteroskedasticity and autocorrelation within individuals [59]. The other advantage of using GMM is that this method overcomes endogeneity bias, namely, unobserved heterogeneity, simultaneity, dynamic endogeneity, measurement error, and reverse causality [60]. CS, which represented the dependent variable, was examined individually for capital structure measurements: short-term debt over the asset, long-term debt over the asset, and total debt over the asset in the order of SDA, LDA, and TDA. CSt-1 lagged the dependent variable by one quarter to capture the dynamic nature of CS, but this was more likely to create endogeneity bias, and, hence, we used GMM, so this was not an issue. CFP referred to financial performance proxied by return on asset, return on equity, and the natural logarithm of Tobin's Q, ROA, ROE, and LNQ, respectively, which were tested separately. CSR captured social responsibility proxies: the combined score (ESG), environmental score (E), social score (S), and governance score (G). Each score ranged from zero to 100 and they were examined separately. ESG scores were calculated and available for all companies and historical fiscal periods in the ESG global coverage since the fiscal year 2002 for roughly 1000 companies, mainly from the US and Europe. LSEG captured and calculated over 500 company-level ESG measures, with a subset of 186 of the most comparable and material per industry, driving the overall company assessment and scoring process. These measures were categorized into 10 groups that contributed to the three pillar scores and the final ESG score, which reflected the company's ESG performance, commitment, and effectiveness based on publicly reported information. The ESG pillar score was a relative sum of the category weights, which varied per industry for the environmental and social categories. For governance, the weights remained the same across all industries. More details about CSR decomposition definitions are provided in Appendix B. CONTROLS indicated the firm characteristics that most commonly contributed to explaining the behavior of capital structure based on the previous literature. These variables were growth (MB), size (LNAT), liquidity (CR), tangibility (PPETA), and risk (Beta). Further details about the variable's definitions and calculations are provided in Appendix A. We included a dummy variable for every sector. This dummy took a value of one for specific industries and zero for all others. We had eight sectors: Basic Materials (D1), Consumer Discretionary (D2), Consumer Staples (D3), Energy (D4), Health Care (D5), Industrials (D6), Technology (D7), and Telecommunications (D8). V comprised the unobserved fixed effect and the error term. The post-estimation tests corresponded to the Arellano and Bond for autocorrelation in order one AR (1), Arellano and Bond for autocorrelation in order two AR (2), and Hansen tests for over-identification restriction. As a final test, we used Fisher statistics for the overall model fit. Additionally, we considered the number of instruments to be lower than the number of groups [59].

We used the explanatory variables' lagged values (2/5) as an internal instrument. Ref. [59] suggested that internal instruments are better than external instruments. Hence, we used the collapse option to limit instrument proliferation and the orthogonal option to maintain the unbalanced panel sample size with gaps.

3. Results

The descriptive statistics of the study variables are presented in Table 1. The mean values of the short-term debt over the asset (SDA), long-term debt over the assets (LDA), and total debt over the assets (TDA) measures were far from their median, showing widespread debt measurements. Notably, the minimum values for the financial performance proxies, ROA, ROE, and LNQ, were −198, −365, and −0.0691, respectively, highlighting the heavy impact of COVID-19 on UK-listed firms. However, firms in this sample prioritized governance in their operations as the mean value of governance (G) was the highest (50.4). Additionally, the mean value of the COVID-19 dummy variable was 0.504, suggesting that more than half of the sample suffered from the pandemic.

Table 1. Summary of statistics. The study period was from 2018 to 2021. The variable definitions are in Appendix A.

	Min	Mean	Max	Skewness	Kurtosis	Std. Dev.	p25	Median	p75
SDA	0	0.0618	0.722	3.5	17.3	0.115	0.0024	0.0195	0.0628
LDA	0	0.155	1.06	1.94	8.08	0.191	0.00356	0.0858	0.251
TDA	0	0.228	2.11	3.44	20.6	0.292	0.0251	0.165	0.321
ROA	−198	−6.53	43.8	−3.67	19.8	32.2	−9.17	2.13	6.95
ROE	−365	−11.6	107	−3.38	18.2	61.2	−17.3	2.47	13.2
LNQ	−0.0691	4.45	7.45	−0.796	5.15	1.26	3.83	4.52	5.18
ESG	2.3	44	89.5	−0.0839	2.37	21.7	29.4	44.8	58.8
E	1.19	40.2	91.9	0.26	2.05	25.3	18.7	38.2	58.8
S	3.2	45	93.9	0.0905	2.1	25	27.4	43.9	63.3
G	3.8	50.4	95.6	−0.263	1.97	26.1	29.6	53.8	71.7
MB	−829	15.9	55,943	74	5,516	751	0.82	1.7	3.47
PPETA	0	0.25	0.952	1.1	3.42	0.245	0.046	0.178	0.384
CR	0	2.92	36.3	4.76	28.8	4.98	0.95	1.56	2.76
LNTA	5.73	11.7	17.7	0.124	2.59	2.6	9.76	11.6	13.3
Beta	−1.44	0.616	2.76	0.11	4.23	0.688	0.22	0.6	1
COVID-19	0	0.504	1	−0.0146	1	0.5	0	1	1

Pearson’s pairwise correlation analysis in Table 2 shows that collinearity was not a concern as the correlation coefficient between the variables was less than 80% [61]. Our analysis revealed a significant relationship between most variables, except for growth (MB), which only exhibited a significant relationship with LNQ, environment (E), and social (S) scores. The COVID-19 dummy variable had a negative and significant relationship with S and a positive and significant relationship with LDA, TDA, return on asset (ROA), return on equity (ROE), and controls such as tangibility (PPETA), liquidity (CR), size (LNTA), and risk (Beta). However, COVID-19 showed no significant correlation with short-term debt (SDA), Tobin’s Q (LNQ), CSR combined score (ESG), environment score (E), governance score (G), or growth (MB).

Table 2. Pearson's pairwise correlation matrix. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The variable definitions are in Appendix A.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) SDA	1.000															
(2) LDA	0.133 ***	1.000														
(3) TDA	0.602 ***	0.797 ***	1.000													
(4) ROA	−0.067 ***	−0.024 *	−0.115 ***	1.000												
(5) ROE	−0.146 ***	0.015	−0.038 ***	0.766 ***	1.000											
(6) LNQ	−0.149 ***	−0.100 ***	−0.059 ***	−0.205 ***	−0.039 ***	1.000										
(7) ESG	−0.048 **	0.109 ***	0.077 ***	0.079 ***	0.143 ***	−0.027	1.000									
(8) E	−0.044 **	0.155 ***	0.120 ***	0.089 ***	0.158 ***	−0.030	0.559 ***	1.000								
(9) S	−0.037 *	0.146 ***	0.111 ***	0.029	0.058 ***	−0.086 ***	0.566 ***	0.519 ***	1.000							
(10) G	−0.015	0.041 **	0.028	0.041 **	0.100 ***	−0.059 ***	0.387 ***	0.324 ***	0.334 ***	1.000						
(11) MB	−0.006	−0.012	−0.011	−0.009	−0.007	0.035 **	0.014	−0.051 **	−0.081 ***	0.029	1.000					
(12) PPETA	0.125 ***	0.199 ***	0.164 ***	0.121 ***	0.058 ***	−0.226 ***	−0.071 ***	−0.051 **	0.013	0.015	−0.017	1.000				
(13) CR	−0.201 ***	−0.162 ***	−0.203 ***	−0.017	0.006	0.070 ***	−0.115 ***	−0.113 ***	−0.080 ***	−0.080 ***	0.001	−0.160 ***	1.000			
(14) LNTA	−0.143 ***	0.216 ***	0.024 *	0.483 ***	0.394 ***	−0.288 ***	0.473 ***	0.608 ***	0.529 ***	0.374 ***	−0.023 *	0.168 ***	−0.186 ***	1.000		
(15) Beta	−0.078 ***	0.098 ***	0.005	0.026 *	−0.043 ***	−0.010	0.160 ***	0.191 ***	0.221 ***	0.173 ***	0.021	−0.011	0.032 **	0.231 ***	1.000	
(16) COVID-19	−0.007	0.029 **	0.022 *	0.032 **	0.022 *	−0.012	−0.030	−0.028	−0.063 ***	0.017	0.013	0.035 ***	0.063 ***	0.031 **	0.169 ***	1.000

First, we tested the effects of COVID-19 and the capital structure determinants on capital structure. We also estimated the impact of CSR on leverage to investigate whether firms' CSR contributes to debt during crises and, if so, to what extent. Table 3 presents the combined ESG scores for the CSR variables. All lagged values of the debt measurements, L.SDA, L.LDA, and L.TDA, were statistically significant, proving the dynamic nature of the capital structure. This result implies that the previous year's capital structure affects that of the current year. The dummy variable for COVID-19 had a statistically significant adverse effect on capital structure. COVID-19 negatively impacted all CS terms in the presence of any financial performance measure. These results confirmed the fact that a period of uncertainty increases risk due to information asymmetry, which reduces firm debt [62–64]. This finding contradicts the results of refs. [20–22], who found that debt increased during the COVID-19 pandemic. One potential explanation for the contradictory findings is differences in the data sources and methodological approaches used in the studies. Government policies and support measures implemented during the pandemic could have contributed to the observed differences in debt dynamics. For example, the UK government introduced several financial support programs, such as the Coronavirus Job Retention Scheme and the Self-Employment Income Support Scheme, aimed at helping businesses and individuals affected by the pandemic. These measures might have helped reduce the debt burden. The pandemic has also resulted in notable shifts in consumer behavior and spending patterns. Lockdowns, social distancing measures, and reduced economic activity led to changes in consumption habits, such as reduced discretionary spending and increased savings. Studies reporting an increase in debt captured the initial phase of the pandemic when economic uncertainty and disruption were at their peak. However, this study analyzed a full pandemic period.

Table 3. Dynamic panel 2SLS system–GMM results for CS measures (SDA, LDA, and TDA) with financial performance proxies (ROA, ROE, and LNQ), the combined ESG scores, and the COVID-19 dummy for 2018–2021. Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The variable definitions are in Appendix A.

VARIABLES	(1) SDA	(2) SDA	(3) SDA	(4) LDA	(5) LDA	(6) LDA	(7) TDA	(8) TDA	(9) TDA
L.SDA	0.710 *** (0.00306)	0.729 *** (0.00296)	0.727 *** (0.00299)						
L.LDA				0.850 *** (0.00349)	0.683 *** (0.00617)	0.839 *** (0.00382)			
L.TDA							0.800 *** (0.00563)	0.663 *** (0.00771)	0.833 *** (0.00501)
ROA	-2.49×10^{-4} *** (2.64×10^{-5})			-2.72×10^{-4} *** (3.33×10^{-5})			-5.34×10^{-4} *** (5.45×10^{-5})		
ROE		-1.58×10^{-4} *** (4.73×10^{-6})			-1.89×10^{-4} *** (1.25×10^{-5})			-3.39×10^{-4} *** (1.27×10^{-5})	
LNQ			-4.32×10^{-3} *** (3.06×10^{-4})			-9.51×10^{-4} * (4.98×10^{-4})			-0.00260 *** (7.83×10^{-5})
ESG	-9.04×10^{-5} *** (9.62×10^{-6})	-6.29×10^{-5} *** (9.19×10^{-6})	-7.40×10^{-5} *** (8.04×10^{-6})	-5.76×10^{-6} (1.65×10^{-5})	-1.18×10^{-4} *** (2.36×10^{-5})	-1.29×10^{-5} (1.57×10^{-5})	-9.25×10^{-5} *** (2.04×10^{-5})	-1.84×10^{-4} *** (2.94×10^{-5})	-6.89×10^{-5} *** (1.83×10^{-5})
COVID-19	-0.00197 *** (2.81×10^{-4})	-0.00214 *** (2.13×10^{-4})	-0.00186 *** (2.48×10^{-4})	-0.00935 *** (49.3×10^{-4})	-0.00451 ** (6.71×10^{-4})	-0.00939 *** (4.90×10^{-4})	-0.0104 *** (6.72×10^{-4})	-0.00539 *** (8.21×10^{-4})	-0.0110 *** (6.69×10^{-4})
MB	1.80×10^{-5} *** (8.85×10^{-7})	4.06×10^{-5} *** (5.11×10^{-7})	6.46×10^{-6} *** (7.72×10^{-7})	3.46×10^{-6} ** (1.58×10^{-6})	6.31×10^{-5} *** (2.74×10^{-6})	-8.47×10^{-7} (1.36×10^{-6})	1.58×10^{-5} *** (2.37×10^{-6})	0.000105 *** (6.83×10^{-6})	-4.04×10^{-5} *** (1.24×10^{-6})
PPETA	0.0670 *** (0.00351)	0.0549 *** (0.00323)	0.0503 *** (0.00324)	0.0706 *** (0.00604)	0.210 *** (0.00979)	0.0809 *** (0.00580)	0.164 *** (0.00976)	0.288 *** (0.0133)	0.132 *** (0.00776)
CR	-0.000386 *** (0.000147)	-0.000386 ** (0.000154)	-0.000398 ** (0.000166)	0.00192 *** (0.000281)	0.00366 *** (0.000422)	0.000922 *** (0.000318)	0.00325 *** (0.000365)	0.00329 *** (0.000405)	0.00143 *** (0.000300)
LNTA	0.000437 (0.000462)	0.000797* (0.000425)	-0.00319 *** (0.000414)	0.00553 *** (0.000693)	0.00946 *** (0.00138)	0.00579 *** (0.00123)	0.00864 *** (0.00123)	0.0120 *** (0.00153)	0.00281 *** (0.00103)
Beta	-0.000611 (0.000425)	-0.000201 (0.000363)	-0.000854 ** (0.000339)	-0.00209 ** (0.000992)	-0.00918 *** (0.00119)	-0.00400 *** (0.000896)	-0.00805 *** (0.00108)	-0.00969 *** (0.00137)	-0.00775 *** (0.00104)
D1 Basic Materials	-0.0194 *** (0.00161)	-0.0159 *** (0.00152)	-0.0186 *** (0.00202)	-0.0384 *** (0.00284)	-0.0910 *** (0.00583)	-0.0470 *** (0.00348)	-0.0733 *** (0.00484)	-0.114 *** (0.00748)	-0.0643 *** (0.00458)
D2 Consumer Discr.									
D3 Consumer Staples	-0.0124 *** (0.00166)	-0.00987 *** (0.00150)	-0.00810 *** (0.00168)	-0.0158 *** (0.00291)	-0.0317 *** (0.00578)	-0.0196 *** (0.00297)	-0.0330 *** (0.00417)	-0.0513 *** (0.00685)	-0.0267 *** (0.00366)
D4 Energy	-0.00867 *** (0.00209)	-0.00625 *** (0.00183)	-0.00631 *** (0.00148)	-0.0218 *** (0.00483)	-0.0196 ** (0.00866)	-0.0147 ** (0.00690)	-0.0439 *** (0.00812)	-0.0467 *** (0.0133)	-0.0259 *** (0.00901)
D5 Health Care	-0.00852 * (0.00464)	-0.00931 ** (0.00407)	-0.00922 ** (0.00408)	-0.0101 ** (0.00422)	-0.00461 (0.00846)	-0.0114 *** (0.00395)	-0.0213 *** (0.00668)	-0.0254 ** (0.0108)	-0.0177 ** (0.00729)
D6 Industrials	-0.00473 *** (0.000752)	-0.00496 *** (0.000696)	-0.00303 *** (0.000781)	-0.0169 *** (0.00126)	-0.0279 *** (0.00200)	-0.0179 *** (0.00114)	-0.0258 *** (0.00321)	-0.0386 *** (0.00385)	-0.0208 *** (0.00255)
D7 Technology	-0.0114 *** (0.00272)	-0.00916 *** (0.00236)	-0.0146 *** (0.00260)	-0.0144 *** (0.00371)	-0.0210 ** (0.0103)	-0.0136 *** (0.00418)	-0.0278 *** (0.00691)	-0.0430 *** (0.0127)	-0.0288 *** (0.00663)
D8 Telecom	0.00982 ** (0.00381)	0.00716 *** (0.00264)	0.0103 *** (0.00378)	-0.00948 ** (0.00444)	-0.00230 (0.00756)	-0.0121 ** (0.00515)	-0.00701 (0.00545)	-0.00715 (0.00764)	0.00241 (0.00532)
Constant	0.00152 (0.00600)	-0.00270 (0.00580)	0.0716 *** (0.00540)	-0.0473 *** (0.00851)	-0.0952 *** (0.0186)	-0.0429 *** (0.00848)	-0.0781 *** (0.0168)	-0.115 *** (0.0210)	0.00994 (0.0133)

Table 3. Cont.

VARIABLES	(1) SDA	(2) SDA	(3) SDA	(4) LDA	(5) LDA	(6) LDA	(7) TDA	(8) TDA	(9) TDA
F-Stat	18,095	21,854	33,139	62,461	21,926	41,513	21,566	23,826	26,951
Prob > F	0	0	0	0	0	0	0	0	0
AR (1)	4.60×10^{-7}	2.72×10^{-8}	4.99×10^{-7}	1.97×10^{-8}	1.19×10^{-7}	1.94×10^{-8}	1.71×10^{-9}	2.07×10^{-8}	1.73×10^{-9}
AR (2)	0.463	0.493	0.365	0.0223	0.271	0.0210	0.0380	0.193	0.0194
Hansen	0.438	0.377	0.0852	0.416	0.110	0.153	0.105	0.249	0.0839

We found that all the proxies for financial performance had a negative relationship with debt. This aligns with ref. [22], while it opposes ref. [65] as they did not report solid evidence for a leverage decline in listed firms. They remarked that these firms have a “spare tire”, allowing more financial market access. However, our results align with previous studies stating that profit has an inverse relationship with debt [29,30]. This view is consistent with the pecking order theory, which posits that firms first rely on their own financial resources, such as retained earnings, and then on debt [28,66].

The ESG scores had a negative and significant effect on debt, except for LDA, in the presence of ROA or LNQ. The effect was negative but insignificant. These results show that when firms engage in socially responsible activities, they decrease their debt, as observed during the COVID-19 pandemic. The rational interpretation of this finding is that CSR positively affects firms’ financial performance [12,17,51,67,68]. As we proved, financial performance impacted debt negatively during the pandemic, which led firms who integrated CSR into their operations to be less debt-prudent during the crisis. In brief, CSR had a negative impact on debt by enhancing the financial performance of corporations. The literature emphasizes the significance of CSR. For instance, ref. [69] showed that companies that disclose more social responsibility tend to have better market value. Additionally, ref. [34] noted that CSR can mitigate the adverse effects of high debt. More recently, ref. [70] demonstrated that superior CSR can assist firms in reducing information asymmetry, fostering stakeholder involvement, boosting stock prices in the stock market, and improving competitive advantage in the product market. During the COVID-19 pandemic, CSR proved to be crucial. Ref. [46] showed that firms with fewer CSR initiatives are dominant and have higher debt risk. The pandemic significantly impacted less resilient firms, leaving them more vulnerable than more resilient firms [71]. However, firms with strong corporate cultures were able to mitigate the effects of the pandemic on stock returns, outperforming their peers [47]. Additionally, low-resilience firms significantly underperformed compared to more resilient ones during the pandemic [71]. The COVID-19 pandemic also shifted resource allocation toward more resilient US and European industries [72]. These findings highlight the importance of CSR and corporate culture in navigating crises such as the COVID-19 pandemic. After showing the importance of CSR for corporations, we aimed to determine which component of CSR proxied by the ESG pillar was dominant in this effect. For this purpose, we analyzed the effect of ESG components (E, S, and G) separately, shown in Appendix A, respectively. We found similar results for the combined ESG score; any component of ESG contributed to decreasing debt during the pandemic. This decrease was more apparent from E on TDA in the presence of ROA, from S on TDA in the presence of LNQ, and from G on SDA in the presence of LNQ. We compared this to the decrease from ESG, which was greater on TDA in the presence of ROE. Furthermore, the COVID-19 dummy negatively impacted all debt measures in all specifications. In summary, COVID-19, financial performance, and social responsibility all had significant and adverse effects on debt, decreasing it. The combined score in Table 3 indicates that a firm’s growth contributed to increasing debt, as it had a positive and significant effect on all specifications except LNQ, which had a negative impact on long-term debt and a significant adverse effect on total debt. The fact that tangibility positively and significantly impacted all specifications contradicts [22] findings that tangibility had no explanatory power during the COVID-19 pandemic. CR positively and significantly affected all long-term debt specifications and total debt. By contrast, it negatively and significantly affected short-term debt in all specifications. LNTA contributed to the increase in long-term and total debt. The coefficient consistently showed a strong positive relationship in all specifications, as reported by ref. [22], where size was found to affect debt positively. Simultaneously, its effect on short-term debt was significantly positive in the presence of ROE, whereas it was negative and significant in the presence of LNQ. Beta had a significantly negative effect on all specifications except short-term debt; however, its effect was insignificant in the presence of ROA or ROE. All sectors had statistically significant negative impacts on all forms of debt in all specifications except

for the health care effect on long-term debt in the presence of ROE; in this case, the effect was negative but insignificant. The telecommunications sector effect was significant and positive for all short-term debt specifications. It negatively and significantly impacted LDA in the presence of ROA and LNQ. Additionally, it had an insignificant effect on total debt for all specifications and long-term debt in the presence of ROE. The COVID-19 dummy and most capital structure determinants and industries contributed to decreasing debt during the pandemic. GMM restrictions were achieved for all specifications, namely, autocorrelation in order one AR (1), the non-existence of autocorrelation in order two AR (2), and the validity of the exogenous instruments by running the Hansen test. Further, all instruments were lower in number than the number of groups [59], and Fisher's statistics proved the overall model fitting.

In Table 4 and Appendix A, we show an investigation using Equation (2). The results show the effect of the four CSR pillars in the order of ESG, E, S, and G, paired with COVID-19 in the presence of alternative CFP proxies (ROA, ROE, and LNQ).

Table 4. Dynamic panel 2SLS system–GMM results for CS measures (SDA, LDA, and TDA) with financial performance proxies (ROA, ROE, and LNQ) and the combined ESG scores paired with the COVID-19 dummy for 2018–2021. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The variable definitions are in Appendix A.

VARIABLES	(1) SDA	(2) SDA	(3) SDA	(4) LDA	(5) LDA	(6) LDA	(7) TDA	(8) TDA	(9) TDA
L.SDA	0.701 *** (0.00270)	0.719 *** (0.00277)	0.747 *** (0.00284)						
L.LDA				0.848 *** (0.00409)	0.703 *** (0.00565)	0.838 *** (0.00399)			
L.TDA							0.804 *** (0.00507)	0.696 *** (0.00669)	0.837 *** (0.00439)
ROA	-2.93×10^{-4} *** (2.35×10^{-5})			-2.93×10^{-4} *** (2.99×10^{-5})			-5.16×10^{-4} *** (4.94×10^{-5})		
ROE		1.68×10^{-4} *** (4.30×10^{-6})			-1.34×10^{-4} *** (1.14×10^{-5})			-2.68×10^{-4} *** (1.01×10^{-5})	
LNQ			-2.93×10^{-3} *** (2.47×10^{-4})			-1.20×10^{-3} ** (5.28×10^{-4})			-2.50×10^{-3} *** (6.37×10^{-4})
ESG	-3.84×10^{-5} *** (1.23×10^{-5})	1.82×10^{-6} (1.10×10^{-5})	3.83×10^{-5} *** (8.33×10^{-6})	-7.01×10^{-5} *** (2.58×10^{-5})	-1.65×10^{-5} (2.68×10^{-5})	-0.000113 *** (2.45×10^{-5})	-9.43×10^{-5} *** (2.69×10^{-5})	1.09×10^{-5} (2.81×10^{-5})	-8.54×10^{-5} *** (2.56×10^{-5})
COVID-19	0.00243 *** (0.000676)	0.00348 *** (0.000575)	0.00275 *** (0.000541)	−0.0158 (0.00163)	−0.00822 *** (0.00126)	−0.0203 *** (0.00156)	−0.0139 *** (0.00186)	−0.000469 (0.00166)	−0.0199 *** (0.00164)
ESGCOVID-19	-9.79×10^{-5} *** (1.33×10^{-5})	-1.17×10^{-4} *** (1.22×10^{-5})	-9.25×10^{-5} *** (1.12×10^{-5})	1.29×10^{-4} *** (2.91×10^{-5})	6.46×10^{-5} ** (2.55×10^{-5})	2.19×10^{-4} *** (2.73×10^{-5})	7.17×10^{-5} ** (3.40×10^{-5})	1.27×10^{-4} *** (2.98×10^{-5})	1.72×10^{-4} *** (3.17×10^{-5})
MB	2.11×10^{-5} *** (7.88×10^{-7})	4.60×10^{-5} (4.52×10^{-7})	6.55×10^{-6} *** (6.56×10^{-7})	-5.77×10^{-6} *** (1.46×10^{-6})	5.24×10^{-5} *** (2.62×10^{-6})	-8.56×10^{-6} *** (1.16×10^{-6})	6.73×10^{-6} *** (1.42×10^{-6})	9.36×10^{-5} *** (5.29×10^{-6})	-1.24×10^{-5} *** (1.01×10^{-6})
PPETA	0.0617 *** (0.00269)	0.0547 *** (0.00255)	0.0439 *** (0.00202)	0.0794 *** (0.00597)	0.182 *** (0.00827)	0.0906 *** (0.00565)	0.161 *** (0.00774)	0.242 *** (0.0109)	0.128 *** (0.00624)
CR	−0.000663 *** (0.000129)	−0.000608 *** (0.000147)	−0.000614 *** (0.000163)	0.00239 *** (0.000273)	0.00308 *** (0.000315)	0.00133 *** (0.000299)	0.00326 *** (0.000306)	0.00273 *** (0.000321)	0.00141 *** (0.000268)
LNTA	0.00130 *** (0.000352)	0.00114 *** (0.000333)	−0.000789 *** (0.000294)	0.00394 *** (0.000661)	0.0109 *** (0.00104)	0.00370 *** (0.000639)	0.00768 *** (0.00101)	0.0130 *** (0.00110)	0.00301 *** (0.000798)
Beta	−0.000550 (0.000457)	−0.000576 (0.000393)	−0.000614 * (0.000348)	−0.00214 ** (0.000947)	−0.00755 *** (0.00108)	−0.00298 *** (0.000897)	−0.00825 *** (0.000963)	−0.00867 *** (0.00110)	−0.00751 *** (0.000895)
D1 Basic Materials	−0.0180 *** (0.00143)	−0.0155 *** (0.00135)	−0.0156 *** (0.00133)	−0.0423 *** (0.00271)	−0.0828 *** (0.00456)	−0.0500 *** (0.00309)	−0.0746 *** (0.00423)	−0.103 *** (0.00571)	−0.0625 *** (0.00415)
D2 Consumer Discr.									
D3 Consumer Staples	−0.0119 *** (0.00139)	−0.0106 *** (0.00122)	−0.0101 *** (0.00132)	−0.0148 *** (0.00327)	−0.0308 *** (0.00475)	−0.0192 *** (0.00310)	−0.0325 *** (0.00391)	−0.0468 *** (0.00564)	−0.0259 *** (0.00332)
D4 Energy	−0.00749 *** (0.00191)	−0.00684 *** (0.00170)	−0.00234 (0.00162)	−0.0239 *** (0.00485)	−0.0245 *** (0.00697)	−0.0151 ** (0.00621)	−0.0468 *** (0.00719)	−0.0433 *** (0.0112)	−0.0259 *** (0.00695)
D5 Health Care	−0.00842 ** (0.00393)	−0.00933 ** (0.00372)	−0.00641 ** (0.00276)	−0.00896 ** (0.00431)	−0.00756 (0.00575)	−0.0115 *** (0.00397)	−0.0224 *** (0.00640)	−0.0236 *** (0.00796)	−0.0201 *** (0.00596)
D6 Industrials	−0.00495 *** (0.000654)	−0.00519 *** (0.000657)	−0.00314 *** (0.000593)	−0.0152 *** (0.00114)	−0.0267 *** (0.00173)	−0.0178 *** (0.00125)	−0.0252 *** (0.00302)	−0.0349 *** (0.00302)	−0.0215 *** (0.00204)
D7 Technology	−0.00996 *** (0.00243)	−0.00802 *** (0.00215)	−0.00802 *** (0.00177)	−0.0149 *** (0.00373)	−0.0198 ** (0.00801)	−0.0172 *** (0.00373)	−0.0313 *** (0.00637)	−0.0311 *** (0.00998)	−0.0250 *** (0.00560)
D8 Telecom	0.00782 ** (0.00319)	0.00579 ** (0.00225)	0.000564 (0.00321)	−0.00997 ** (0.00446)	−0.0100 (0.00697)	−0.00892 * (0.00512)	−0.00679 (0.00504)	−0.0126* (0.00653)	0.00239 (0.00537)
Constant	−0.0100 ** (0.00450)	−0.00915 ** (0.00429)	0.0280 *** (0.00386)	−0.0259 *** (0.00864)	−0.115 *** (0.0139)	−0.0116 (0.00891)	−0.0646 *** (0.0137)	−0.135 *** (0.0152)	0.00841 (0.0104)

Table 4. Cont.

VARIABLES	(1) SDA	(2) SDA	(3) SDA	(4) LDA	(5) LDA	(6) LDA	(7) TDA	(8) TDA	(9) TDA
F-Stat	25,640	22,360	43,476	79,857	52,245	59,174	19,213	53,581	29,484
Prob > F	0	0	0	0	0	0	0	0	0
AR (1)	5.22×10^{-7}	3.00×10^{-8}	5.16×10^{-7}	1.85×10^{-8}	1.02×10^{-7}	1.79×10^{-8}	1.64×10^{-9}	1.51×10^{-8}	1.67×10^{-9}
AR (2)	0.224	0.148	0.380	0.0564	0.234	0.0657	0.0493	0.0757	0.0281
Hansen	0.388	0.432	0.319	0.427	0.138	0.229	0.181	0.320	0.164

All models revealed the adverse impact of financial performance in all specifications on all debt terms, except when G was included; LNQ did not affect LDA and TDA. CSR paired with COVID-19 negatively impacted short-term debt in the presence of ROA, ROE, and LNQ. Additionally, ESG negatively impacted TDA in the presence of ROE. However, G negatively affected SDA only in the presence of ROE and negatively influenced all specifications of LND and TDA.

4. Conclusions and Discussion

The COVID-19 pandemic led to decreased leverage for UK-listed firms, with LNQ being the main contributor to reducing debt. A one-unit increase in LNQ results in a 0.25% decrease in total debt. Social responsibility and its components also play a role in decreasing debt, suggesting that firms can reduce their debt burden by considering resource utilization, emissions reduction, innovation, workforce management, human rights, community engagement, product responsibility, management, shareholders, and CSR strategy. This highlights the importance of a holistic approach to business operations that incorporates various aspects of CSR for long-term financial sustainability. Firms should prioritize CSR as a critical component of their business strategy, which can lead to financial success and a positive social impact. The significance of environmental, social, and governance (ESG) practices in reducing debt is highlighted. These practices improve risk management and transparency by addressing climate change, resource scarcity, and regulatory fines. Strong ESG practices also enhance investor confidence and access to capital, attract ESG-focused investors, lower the cost of capital, improve operational efficiency and cost savings, and have a positive impact on long-term sustainability. The importance of ESG practices lies in financial stability, competitive advantage, and sustainable development. Lower debt levels contribute to a company's financial stability, while strong ESG practices attract investors, talent, and customers who value sustainability and social responsibility. By promoting ESG principles, companies can contribute to a more sustainable and equitable future, addressing global challenges such as climate change and social inequality.

Overall, embracing ESG principles improves financial performance, enhances reputation, and contributes to a more sustainable future for companies and society as a whole. This study's findings also indicate that during times of uncertainty and increased risk, firms should opt for a decreased debt policy.

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Appendix A

Table A1. Variable descriptions. All variables were retrieved from the LSEG (Refinitiv Eikon) data stream).

Variables	Definition	Source
Dependent variables		
Accounting measurements		
ROA	Return on asset: measures how a firm efficiently uses its assets and generates gains. $= (\text{Net Income} - \text{Bottom Line} + ((\text{Interest Expense on Debt} - \text{Interest Capitalized}) \times (1 - \text{Tax Rate}))) / \text{Average of Last Year's and Current Year's Total Assets} \times 100$.	LSEG
ROE	Return on equity: measures how well a firm makes returns from its equity. $= ((\text{Net Income} - \text{Bottom Line} - \text{Preferred Dividend Requirement}) / \text{Average of Last Year's and Current Year's Common Equity} \times 100)$.	LSEG
Market measurement		
LNQ	The natural logarithm of Tobin's Q. Tobin's Q is long-term financial performance expectations that stem from shareholder-related financial performance. $= \text{LN} ((\text{The market value of equity} + \text{book value of assets} - \text{book value of equity} - \text{deferred taxes}) / \text{book value of assets})$.	Authors' calculation
Explanatory variables		
CSR measurements		
ESG	A relative sum of the environmental, social, and governance pillars.	LSEG
E	The weighted average relative rating of resource use, emission, and innovation related to company reports on their environmental activities.	LSEG
S	The weighted average relative rating of the workforce, human rights, community, and product responsibility is interrelated to companies' social commentary.	LSEG
G	Based on company governance details, the weighted average relative rating of management, shareholders, and CSR strategy is formed. Appendix B provides more information on each pillar.	LSEG
Capital structure measurements		
SDA	The short-term debt ratio. $= (\text{The portion of debt payable within one fiscal year consisting of the current portion of long-term debt and sinking fund obligations of preferred stock or Debentures}) / \text{the book value of total assets}$.	Authors' calculation
LDA	The long-term debt ratio is $= (\text{all interest-bearing financial obligations, not including amounts demanded within one fiscal year. It is shown net of premium or discount}) / \text{the book value of total assets}$.	Authors' calculation
TDA	The total debt ratio represents all interest-bearing and capitalized lease obligations. $= (\text{Sum of long and short-term debt}) / \text{the book value of total assets}$.	Authors' calculation
Control variables		
MB	Growth = market value of the company / total shareholder's equity	Authors' calculation
PPETA	Tangibility represented by fixed assets (Property + plant + and equipment) / the book value of total asset	LSEG
CR	The current ratio measures firm liquidity. $= \text{current assets (Denotes cash and other assets, sold, or estimated to turn to cash, sold or consumed within one fiscal year or one operating cycle)} / \text{current liabilities (represents a debt or other requirements that the firm assumes to fulfill within one fiscal year)}$.	LSEG
LNTA	The natural logarithm of the firm's total assets and measures the size.	Authors' calculation
Beta	Systematic risk (beta) measures a stock's volatility concerning the overall market volatility. $= \text{percent changes of end price between 23 and 35 consecutive months related to the local market index}$.	LSEG
COVID-19	The dummy variable takes the value of one for the period 2020–2021 and zero otherwise.	Authors' calculation
Industry dummies	Basic Materials (D1), Consumer Discretionary (D2), Consumer Staples (D3), Energy (D4), Health Care (D5), Industrials (D6), Technology (D7), and Telecommunications (D8). These are based on the London Stock Exchange ICB Industry classifications. Each dummy takes the value of one if it is related to a specific industry and zero otherwise.	Authors' calculation

Appendix B

Table A2. Definition of ESG pillar subcategories.

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

Note: these descriptions were taken from LSEG, 2023. <https://www.lseg.com/en>. Accessed on 7 January 2024.

Appendix C

Table A3. Dynamic panel 2SLS system–GMM results for CS measures (SDA, LDA, and TDA) with financial performance proxies (ROA, ROE, and LNQ), E scores, and the COVID-19 dummy for 2018–2021. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The variable definitions are in Appendix A.

VARIABLE	(1) SDA	(2) SDA	(3) SDA	(4) LDA	(5) LDA	(6) LDA	(7) TDA	(8) TDA	(9) TDA
L.SDA	0.645 *** (0.00248)	0.642 *** (0.00292)	0.656 *** (0.00213)						
L.LDA				0.798 *** (0.00446)	0.595 *** (0.00544)	0.790 *** (0.00390)			
L.TDA							0.719 *** (0.00440)	0.552 *** (0.00552)	0.760 *** (0.00472)
ROA	-3.60×10^{-4} *** (2.20×10^{-5})			-9.50×10^{-5} *** (2.74×10^{-5})			-4.10×10^{-4} *** (3.38×10^{-5})		
ROE		-2.33×10^{-4} ***			-7.37×10^{-5} *** (1.64×10^{-5})			-2.21×10^{-4} *** (1.59×10^{-5})	
LNQ			-3.42×10^{-3} *** (2.51×10^{-4})			-42.1×10^{-4} (6.37×10^{-4})			-2.14×10^{-3} *** (6.86×10^{-4})
E	-6.89×10^{-5} *** (9.61×10^{-6})	-4.65×10^{-5} *** (9.90×10^{-6})	-2.36×10^{-5} ** (1.05×10^{-5})	-1.48×10^{-4} *** (2.69×10^{-5})	-1.50×10^{-4} *** (3.06×10^{-5})	-1.41×10^{-4} *** (2.09×10^{-5})	-2.35×10^{-4} *** (3.25×10^{-5})	-7.87×10^{-5} ** (3.76×10^{-5})	-1.31×10^{-4} *** (3.01×10^{-5})
COVID-19	-7.09×10^{-4} *** (2.24×10^{-4})	-5.63×10^{-4} ** (2.47×10^{-4})	-1.92×10^{-4} (2.42×10^{-4})	-7.24×10^{-3} *** (6.20×10^{-4})	1.37×10^{-3} (9.23×10^{-4})	-7.13×10^{-3} *** (5.51×10^{-4})	-4.74×10^{-3} *** (6.58×10^{-4})	1.86×10^{-3} * (9.55×10^{-4})	-6.15×10^{-3} *** (5.99×10^{-4})
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sectors	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES	YES	YES	YES
F-Stat	16,448	20,267	38,345	62,081	11,637	81,732	43,538	35,426	45,351
Prob > F	0	0	0	0	0	0	0	0	0
AR (1)	0.0212	0.0322	0.0219	1.98×10^{-7}	6.73×10^{-7}	1.82×10^{-7}	1.34×10^{-9}	1.18×10^{-8}	1.47×10^{-9}
AR (2)	0.791	0.946	0.849	0.0127	0.407	0.0121	0.107	0.303	0.0225
Hansen	0.116	0.191	0.150	0.309	0.266	0.221	0.0494	0.125	0.102

Appendix D

Table A4. Dynamic panel 2SLS system–GMM results for CS measures (SDA, LDA, and TDA) with financial performance proxies (ROA, ROE, and LNQ), S scores, and the COVID-19 dummy for 2018–2021. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$. The variable definitions are in Appendix A.

VARIABLES	(1) SDA	(2) SDA	(3) SDA	(4) LDA	(5) LDA	(6) LDA	(7) TDA	(8) TDA	(9) TDA
L.SDA	0.645 *** (0.00251)	0.636 *** (0.00267)	0.657 *** (0.00230)						
L.LDA				0.794 *** (0.00446)	0.597 *** (0.00601)	0.789 *** (0.00462)			
L.TDA							0.732 *** (0.00483)	0.561 *** (0.00540)	0.763 *** (0.00481)
ROA	-4.30×10^{-4} *** (2.48×10^{-5})			-7.32×10^{-5} ** (3.38×10^{-5})			-5.58×10^{-4} *** (4.52×10^{-5})		
ROE		-2.26×10^{-4} *** (6.11×10^{-6})			-1.34×10^{-4} *** (1.84×10^{-5})			-3.48×10^{-4} *** (1.72×10^{-5})	
LNQ			-3.43×10^{-3} *** (2.47×10^{-4})			-1.48×10^{-3} *** (5.29×10^{-4})			-33.8×10^{-3} *** (6.39×10^{-4})
S	-3.61×10^{-5} *** (9.94×10^{-6})	-3.46×10^{-5} *** (1.00×10^{-5})	-1.19×10^{-5} (9.41×10^{-6})	-8.96×10^{-5} *** (2.57×10^{-5})	-1.20×10^{-4} *** (3.86×10^{-5})	-1.18×10^{-4} *** (2.74×10^{-5})	-1.28×10^{-4} *** (4.12×10^{-5})	-1.08×10^{-4} ** (4.63×10^{-5})	-1.47×10^{-4} *** (3.61×10^{-5})
COVID-19	-1.09×10^{-3} *** (2.26×10^{-4})	-8.67×10^{-4} *** (2.53×10^{-4})	-7.29×10^{-4} *** (2.52×10^{-4})	-6.77×10^{-3} *** (6.38×10^{-4})	8.32×10^{-4} (1.01×10^{-3})	-7.52×10^{-3} *** (5.91×10^{-4})	-5.85×10^{-3} *** (72.0×10^{-4})	1.47×10^{-3} (1.08×10^{-3})	-6.29×10^{-3} *** (6.82×10^{-4})
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sectors	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES	YES	YES	YES
F-Stat	19,646	15,370	35,077	37,527	14,064	54,491	38,850	21,925	45,269
Prob > F	0	0	0	0	0	0	0	0	0
AR (1)	0.0208	0.0321	0.0223	1.90×10^{-7}	7.50×10^{-7}	1.73×10^{-7}	1.25×10^{-9}	1.10×10^{-8}	1.34×10^{-9}
AR (2)	0.894	0.949	0.718	0.0160	0.387	0.00984	0.0879	0.280	0.0225
Hansen	0.116	0.137	0.191	0.272	0.188	0.234	0.0685	0.117	0.0970

Appendix E

Table A5. Dynamic panel 2SLS system–GMM results for CS measures (SDA, LDA, and TDA) with financial performance proxies (ROA, ROE, and LNQ), G scores, and the COVID-19 dummy for 2018–2021. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$. The variable definitions are in Appendix A.

VARIABLES	(1) SDA	(2) SDA	(3) SDA	(4) LDA	(5) LDA	(6) LDA	(7) TDA	(8) TDA	(9) TDA
L.SDA	0.695 *** (0.00278)	0.736 *** (0.00240)	0.782 *** (0.00348)						
L.LDA				0.874 *** (0.00286)	0.725 *** (0.00451)	0.903 *** (0.00330)			
L.TDA							0.872 *** (0.00444)	0.802 *** (0.00468)	0.895 *** (0.00305)
ROA	-2.79×10^{-4} *** (2.09×10^{-5})			-1.40×10^{-4} *** (3.15×10^{-5})			-3.23×10^{-4} *** (3.85×10^{-5})		
ROE		-1.22×10^{-4} *** (3.85×10^{-6})			-6.95×10^{-5} *** (1.20×10^{-5})			-1.14×10^{-4} *** (9.80×10^{-6})	
LNQ			-6.92×10^{-4} ** (2.85×10^{-4})			-3.96×10^{-4} (5.86×10^{-4})			-5.66×10^{-4} (7.05×10^{-4})
G	-4.37×10^{-6} (5.76×10^{-6})	-3.36×10^{-6} (4.11×10^{-6})	-6.10×10^{-5} *** (6.32×10^{-6})	-6.55×10^{-6} (9.00×10^{-6})	-2.99×10^{-5} ** (1.36×10^{-5})	2.30×10^{-5} *** (8.65×10^{-6})	-2.74×10^{-5} ** (1.16×10^{-5})	-3.86×10^{-5} *** (1.37×10^{-5})	-5.24×10^{-5} *** (1.15×10^{-5})
COVID-19	-2.44×10^{-3} *** (2.39×10^{-4})	-1.86×10^{-3} *** (1.98×10^{-4})	-1.30×10^{-3} *** (2.28×10^{-4})	-6.08×10^{-3} *** (4.90×10^{-4})	-8.69×10^{-4} (6.87×10^{-4})	-7.58×10^{-3} *** (4.30×10^{-4})	-8.06×10^{-3} *** (5.56×10^{-4})	-5.25×10^{-3} *** (6.10×10^{-4})	-9.06×10^{-3} *** (4.82×10^{-4})
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sectors	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES	YES	YES	YES
F-Stat	27,161	23,819	120,683	279,318	164,378	388,153	121,309	114,797	215,227
Prob > F	0	0	0	0	0	0	0	0	0
AR (1)	7.46×10^{-7}	3.84×10^{-8}	4.78×10^{-7}	1.82×10^{-8}	1.10×10^{-7}	1.86×10^{-8}	1.26×10^{-9}	5.38×10^{-9}	1.97×10^{-9}
AR (2)	0.357	0.405	0.265	0.113	0.691	0.0792	0.150	0.311	0.0719
Hansen	0.299	0.354	0.271	0.378	0.128	0.288	0.228	0.211	0.280

Appendix F

Table A6. Dynamic panel 2SLS system–GMM results for CS measures (SDA, LDA, and TDA) with financial performance proxies (ROA, ROE, and LNQ) and E scores paired with the COVID-19 dummy for 2018–2021. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$. The variable definitions are in Appendix A.

VARIABLES	(1) SDA	(2) SDA	(3) SDA	(4) LDA	(5) LDA	(6) LDA	(7) TDA	(8) TDA	(9) TDA
L.SDA	0.637 *** (0.00217)	0.629 *** (0.00258)	0.669 *** (0.00198)						
L.LDA				0.794 *** (0.00367)	0.618 *** (0.00508)	0.789 *** (0.00350)			
L.TDA							0.719 *** (0.00395)	0.586 *** (0.00423)	0.764 *** (0.00396)
ROA	-3.82×10^{-4} *** (2.09×10^{-5})			-1.13×10^{-4} *** (2.24×10^{-5})			-4.43×10^{-4} *** (3.01×10^{-5})		
ROE		-2.59×10^{-4} *** (7.09×10^{-6})			-4.70×10^{-5} *** (1.38×10^{-5})			-1.96×10^{-4} *** (1.41×10^{-5})	
LNQ			-3.15×10^{-3} *** (2.24×10^{-4})			-1.13×10^{-3} ** (5.64×10^{-4})			-3.07×10^{-3} *** (5.47×10^{-4})
E	-4.08×10^{-5} *** (9.60×10^{-6})	-1.65×10^{-6} (1.10×10^{-5})	9.86×10^{-5} *** (9.60×10^{-6})	-1.97×10^{-4} *** (2.45×10^{-5})	2.13×10^{-5} (2.99×10^{-5})	-2.11×10^{-4} *** (2.16×10^{-5})	-2.14×10^{-4} *** (3.10×10^{-5})	1.40×10^{-4} *** (4.52×10^{-5})	-1.12×10^{-4} *** (2.50×10^{-5})
COVID-19	0.00410 *** (0.000560)	0.00663 *** (0.000587)	0.00342 *** (0.000369)	−0.0124 *** (0.000993)	−0.00506 *** (0.00140)	−0.0142 *** (0.00129)	−0.00657 *** (0.00150)	0.00161 (0.00145)	−0.00930 ** (0.00131)
ECOVID-19	-1.05×10^{-4} *** (1.07×10^{-5})	-1.53×10^{-4} *** (1.16×10^{-5})	-8.10×10^{-5} *** (8.67×10^{-6})	1.018×10^{-4} *** (1.80×10^{-5})	1.01×10^{-4} *** (2.79×10^{-5})	1.50×10^{-4} *** (1.97×10^{-5})	3.49×10^{-5} (2.71×10^{-5})	-3.45×10^{-5} (3.00×10^{-5})	5.59×10^{-5} ** (2.24×10^{-5})
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sectors	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES	YES	YES	YES
F-Stat	20,443	27,024	42,846	75,999	25,525	92,942	56,055	56,459	62,621
Prob > F	0	0	0	0	0	0	0	0	0
AR (1)	0.0214	0.0326	0.0220	1.76×10^{-7}	5.11×10^{-7}	1.54×10^{-7}	1.42×10^{-9}	8.98×10^{-9}	1.35×10^{-9}
AR (2)	0.859	0.826	0.966	0.0495	0.299	0.0354	0.0952	0.199	0.0168
Hansen	0.218	0.331	0.294	0.380	0.351	0.283	0.0687	0.248	0.109

Appendix G

Table A7. Dynamic panel 2SLS system–GMM results for CS measures (SDA, LDA, and TDA) with financial performance proxies (ROA, ROE, and LNQ) and S scores paired with the COVID-19 dummy for 2018–2021. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$. The variable definitions are in Appendix A.

VARIABLES	(1) SDA	(2) SDA	(3) SDA	(4) LDA	(5) LDA	(6) LDA	(7) TDA	(8) TDA	(9) TDA
L.SDA	0.641 *** (0.00228)	0.633 *** (0.00270)	0.663 *** (0.00202)						
L.LDA				0.795 *** (0.00399)	0.620 *** (0.00535)	0.788 *** (0.00431)			
L.TDA							0.724 *** (0.00376)	0.589 *** (0.00469)	0.761 *** (0.00413)
ROA	-4.61×10^{-4} *** (2.19×10^{-5})			-6.02×10^{-5} ** (2.95×10^{-5})			-5.59×10^{-4} *** (3.09×10^{-5})		
ROE		-2.38×10^{-4} *** (5.93×10^{-6})			-8.35×10^{-5} *** (1.45×10^{-5})			-2.93×10^{-4} *** (1.26×10^{-5})	
LNQ			-3.48×10^{-3} *** (2.15×10^{-4})			-1.59×10^{-3} *** (4.87×10^{-4})			-3.87×10^{-3} *** (5.16×10^{-4})
S	-4.90×10^{-5} *** (1.06×10^{-5})	-1.60×10^{-5} (9.94×10^{-6})	3.32×10^{-5} *** (9.40×10^{-6})	-1.45×10^{-4} *** (2.44×10^{-5})	1.38×10^{-5} (3.05×10^{-5})	-1.80×10^{-4} *** (3.26×10^{-5})	-2.32×10^{-4} *** (3.47×10^{-5})	-2.17×10^{-5} (3.59×10^{-5})	-1.61×10^{-4} *** (3.14×10^{-5})
COVID-19	0.000425 (0.000655)	0.00279 *** (0.000623)	−0.000385 (0.000571)	−0.0111 *** (0.00135)	−0.00543 *** (0.00140)	−0.0132 *** (0.00171)	−0.0119 *** (0.00172)	−0.00269 (0.00170)	−0.0141 *** (0.00180)
SCOVID-19	-2.98×10^{-5} ** (1.22×10^{-5})	-6.75×10^{-5} *** (1.22×10^{-5})	-2.37×10^{-6} (1.10×10^{-5})	8.53×10^{-5} *** (2.21×10^{-5})	9.04×10^{-5} *** (2.66×10^{-5})	1.11×10^{-4} *** (2.72×10^{-5})	1.26×10^{-4} *** (2.75×10^{-5})	3.22×10^{-5} (3.08×10^{-5})	1.39×10^{-4} *** (2.98×10^{-5})
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sectors	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES	YES	YES	YES
F-Stat	23,589	19,307	58,258	64,238	26,548	84,378	67,067	74,876	69,728
Prob > F	0	0	0	0	0	0	0	0	0
AR (1)	0.0210	0.0323	0.0222	1.77×10^{-7}	5.15×10^{-7}	1.64×10^{-7}	1.66×10^{-9}	6.89×10^{-9}	1.36×10^{-9}
AR (2)	0.240	0.268	0.757	0.0272	0.202	0.0212	0.110	0.172	0.0205
Hansen	0.128	0.216	0.119	0.393	0.270	0.300	0.0463	0.112	0.0815

Appendix H

Table A8. Dynamic panel 2SLS system–GMM results for CS measures (SDA, LDA, and TDA) with financial performance proxies (ROA, ROE, and LNQ) and G scores paired with the COVID-19 dummy for 2018–2021. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The variable definitions are in Appendix A.

VARIABLES	(1) SDA	(2) SDA	(3) SDA	(4) LDA	(5) LDA	(6) LDA	(7) TDA	(8) TDA	(9) TDA
L.SDA	0.696 *** (0.00256)	0.734 *** (0.00211)	0.778 *** (0.00265)						
L.LDA				0.876 *** (0.00272)	0.740 *** (0.00380)	0.904 *** (0.00294)			
L.TDA							0.869 *** (0.00357)	0.808 *** (0.00330)	0.894 *** (0.00232)
ROA	-2.63×10^{-4} *** (1.96×10^{-5})			-1.17×10^{-4} *** (3.09×10^{-5})			-2.93×10^{-4} *** (3.52×10^{-5})		
ROE		-1.24×10^{-4} *** (3.23×10^{-6})			-5.18×10^{-5} *** (1.11×10^{-5})			-9.66×10^{-5} *** (8.00×10^{-6})	
LNQ			-1.13×10^{-3} *** (2.55×10^{-4})			-4.71×10^{-4} (5.47×10^{-4})			-5.58×10^{-4} (5.78×10^{-4})
G	-1.56×10^{-5} ** (7.21×10^{-5})	1.24×10^{-5} * (6.36×10^{-5})	-4.44×10^{-5} *** (7.54×10^{-5})	5.65×10^{-5} *** (1.18×10^{-5})	1.25×10^{-4} *** (1.47×10^{-5})	1.24×10^{-4} *** (1.65×10^{-5})	1.41×10^{-5} (1.47×10^{-5})	9.83×10^{-5} *** (1.59×10^{-5})	4.33×10^{-5} *** (1.54×10^{-5})
COVID-19	-0.00261 *** (0.000589)	0.000318 (0.000492)	-0.000765 (0.000569)	-0.00388 *** (0.000868)	0.00425 *** (0.000910)	-0.00519 *** (0.00116)	-0.00626 *** (0.00139)	0.00102 (0.00142)	-0.00695 *** (0.00136)
GCOVID-19	3.21×10^{-6} (9.72×10^{-5})	-4.34×10^{-5} *** (8.87×10^{-5})	-1.50×10^{-5} (1.02×10^{-5})	-5.35×10^{-5} *** (1.47×10^{-5})	-1.17×10^{-4} *** (1.78×10^{-5})	-4.91×10^{-5} ** (2.14×10^{-5})	-4.40×10^{-5} * (2.30×10^{-5})	-1.34×10^{-4} *** (2.41×10^{-5})	-4.91×10^{-5} ** (2.39×10^{-5})
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sectors	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES	YES	YES	YES
F-Stat	41,462	32,389	132,931	404,937	250,876	535,344	174,330	194,306	516,418
Prob > F	0	0	0	0	0	0	0	0	0
AR (1)	7.10×10^{-7}	3.65×10^{-8}	5.57×10^{-7}	1.77×10^{-8}	8.83×10^{-8}	1.74×10^{-8}	1.35×10^{-9}	5.33×10^{-9}	1.96×10^{-9}
AR (2)	0.377	0.142	0.209	0.0619	0.374	0.0443	0.102	0.127	0.0471
Hansen	0.249	0.360	0.246	0.455	0.221	0.547	0.236	0.269	0.195

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