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COVID-19 impact, sustainability performance and firm value: international evidence

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Abstract

We examine the impact of COVID-19 on changes in firm value, and the moderating role of firm-level sustainability performance on this relationship. We find that firms domiciled in countries where the COVID-19 impact is more devastating experienced greater decline in firm value. The negative impact of COVID-19 on firm value is less pronounced for firms with better sustainability performance. Firms domiciled in countries with higher levels of environmental- and stakeholder-value-oriented culture experienced less decline in firm value from the impact of COVID-19. Findings suggest a firm's stakeholder-value orientation contributes to preserving a firm's value when general stakeholder value declines.

Key words: COVID-19; Cross-country; Environmental-value culture; Firm value; Stakeholder value; Sustainability performance

JEL classification: G32, I10, M14, M40, M41, M49

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The purpose of a company is to engage all its stakeholders in shared and sustained value creation. In creating such value, a company serves not only its shareholders, but all its stakeholders – employees, customers, suppliers, local communities and society at large. The best way to understand and harmonize the divergent interests of all stakeholders is through a shared commitment to policies and decisions that

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strengthen the long-term prosperity of a company. (Klaus Schwab, Founder and Executive Chairman, World Economic Forum, Davos Manifesto 2020)

1. Introduction

The world has witnessed the damaging effects of a novel coronavirus (also referred to as COVID-19) since early 2020, leading to the shutting down of many aspects of economic and social life worldwide (Bapuji *et al*., 2020; Brammer *et al*., 2020). Although the world has experienced several pandemics from the late twentieth century through to the early twenty-first century, caused by infectious diseases such as Zika fever, Ebola, severe acute respiratory syndrome (SARS), avian flu, swine flu and Middle East respiratory syndrome (MERS), the COVID-19 pandemic is more lethal with an extensive global spread aided by today's service-oriented economy, in comparison to previous pandemics (Baker et al., 2020a, 2020b; World Bank, 2020; World Economic Forum (WEF), 2020). For example, the World Bank (2020) predicts that the global economy will shrink by 5.2 percent in 2020 due to the COVID-19 pandemic and that it will also experience the deepest recession since the Second World War. In this continuing economic turmoil, COVID-19 has hugely affected the equity market and most stock indices worldwide have fallen (World Economic Forum (WEF), 2020). For example, Baker *et al*. (2020a) show that while the Spanish flu of 1918–1920 triggered daily stock market movements of not more than 2.5 percent, COVID-19 has triggered these movements 24-fold. Conversely, several financial experts argue that firms with a strong focus on sustainability practices and fair management of stakeholders appear to have outperformed their counterparts that lack this focus (e.g., BlackRock, 2020; Schroders, 2020). Whether corporate sustainability performance is moderating the decline of firm value during the COVID-19 pandemic has not yet been empirically examined. This study fills this gap in the literature by examining the association between the impact of COVID-19 on an economy and changes in firm value, and whether this association is moderated by firm-level sustainability performance.

The motivation for our study originates from two sources. Firstly, while evidence shows that firm value declines when crises occur, we know little about what factors enable firms to minimise firm value reduction during these periods. Prior to COVID-19, some studies investigated the outcomes of several pandemics (including Spanish flu, Zika fever, Ebola, SARS, avian flu, swine flu, MERS, enterovirus 71 (EV71), dengue fever and H1N1) on stock returns, mutual funds and firm performance (e.g., Wang *et al*., 2013; Macciocchi *et al*., 2016; Del Giudice and Paltrinieri, 2017; Chen *et al*., 2018; Baker *et al*., 2020a, 2020b; Liu *et al*., 2020a, 2020b). Although some studies examined market reactions to the influence of COVID-19 on the crude oil and exchange rate return (e.g., Iyke, 2020; Liu *et al*., 2020a, 2020b; Phan and Narayan, 2020), no

study has yet examined the acute impact of COVID-19 on changes in firm value. Compared to prior infectious disease pandemics, the global nature of the COVID-19 pandemic allows us to study large cross-country samples with hypotheses developed on this emerging issue. Secondly, a decline in firm value has been observed following the onset of the COVID-19 pandemic, with this suggested by a 38 percent drop in the Dow Jones Industrial Average Index by March 2020 and Standard & Poor (S&P)'s Global Ratings Index experiencing a 35 percent drop in one month alone, that is, February 2020 (Johnston, 2020). In addition, coupled with financial experts' commentary on the possible role of firms' sustainability performance in protecting their value from declining (e.g., BlackRock, 2020; Schroders, 2020), the recent market volatility due to COVID-19 provides the opportunity to examine the role of sustainability performance in protecting firm value. Indeed, this investigation is a timely research agenda.

We draw on the ongoing debate on the potential merits of the 'stakeholder value' model, versus the widely adopted 'shareholder value' model of business (Smith, 2003; Freeman *et al*., 2004, 2007; Freeman, 2010; Freudenreich *et al*., 2019). Several publicly listed companies in various industries are affected by declining share prices, revenues and profit during the COVID-19 pandemic (Bapuji *et al*., 2020; Fu and Shen, 2020). Despite the general decline in share prices and dramatic stock market volatility worldwide (Baker et al., 2020a, 2020b), commentators observe that companies with a focus on sustainability have tended to outperform others (BlackRock, 2020; Gilchrist, 2020; Schroders, 2020).[1] Based on our stakeholder value maximisation argument (Freeman *et al*., 2007), we predict that the sustainability performance of a firm attenuates the negative impact of COVID-19 on changes in firm value.

Using data from 4,278 firms in 47 countries, we examine the association between COVID-19 impact and changes in firm value, and whether this association is moderated by sustainability performance. We measure COVID-19 impact using three variables at the country level: (i) the total number of infections per million population; (ii) the total number of deaths per million population; and (iii) the societal health risk. Change in firm value is measured as the difference in Tobin's Q between the daily average value of Tobin's Q from 1 January 2020 to 31 July 2020 and the daily average value of Tobin's Q during December 2019 divided by the daily average value of Tobin's Q during December 2019. We estimate the regression models using the ordinary least squares (OLS) regression method. We also examine the moderating role of country-level environmental-value-oriented culture and stakeholder orientation

[1]Following Dal Maso *et al*. (2019) and Rezaee (2016), we use social sustainability and environmental sustainability as measures of sustainability performance. Dal Maso *et al*. (2019) use social sustainability and environmental sustainability as proxies for firm-level stakeholder orientation or stakeholder-value orientation. We employ firm-level social performance and environmental performance as measures of social sustainability and environmental sustainability, respectively.

culture in the association between COVID-19 impact and changes in firm value. We undertake several robustness analyses, including two-stage analysis with instrumental variables and a month-by-month analysis for the period from January 2020 to July 2020, to assess the incremental impact of COVID-19 during the pandemic period.

Our findings show that firms operating in countries where COVID-19 is more devastating have experienced declining firm value, with the negative association between COVID-19 impact and firm value less pronounced for firms with better sustainability performance compared to their counterparts with poor sustainability performance. These findings are interpreted to mean that the market value has declined for firms worldwide due to COVID-19, yet the rate of decline is less pronounced for firms that manage their stakeholders fairly through better sustainability performance. Furthermore, we find that the negative firm value effects wrought by COVID-19 are less pronounced for firms operating in higher environmental-value-oriented cultures and domiciled in stakeholder-oriented countries. Our findings are robust using two-stage analysis with instrumental variables, month-to-month analysis from January 2020 to July 2020 and other robustness tests, while excluding countries that are highly affected by COVID-19.

Our study contributes to the literature in several ways. Firstly, it is one of the first studies to examine the role of the impact of COVID-19 on changes in firm value. While some studies (e.g., Iyke, 2020; Liu *et al.*, 2020a, 2020b; Phan and Narayan, 2020) examined the market reactions to COVID-19 on the crude oil and exchange rate return, we focus on the association between changes in firm value and the impact of COVID-19 using a sample of firms drawn from 47 countries. Secondly, our study offers empirical evidence concerning the role of firm-level sustainability performance on mitigating the propensity for firm value to fall in times of crisis, such as the COVID-19 pandemic. This important contribution is based on a cross-country study given that COVID-19 has an acute and long-lasting global impact compared to other pandemics in the past. Thirdly, we contribute to the ongoing debate on shareholder-value focus versus stakeholder-value focus as a viable alternative underpinning corporate governance (Smith, 2003; Freeman *et al.*, 2007). Finally, the findings of this study have important implications given that COVID-19 has severely damaged health and economic well-being worldwide. As shown in our study, firms have the incentive to follow stakeholder-value-oriented governance, which would benefit the preservation of their value as well as contributing to societal well-being, especially at times of pandemic outbreaks or other crises of a similar scale in the future. In terms of policy, the findings suggest that corporate sustainability performance needs to be considered in rolling out possible stimulus packages to boost economies in the post-pandemic period. Furthermore, the findings could inform governments, regulators, investors, financial analysts and managers about the influence of sustainability performance on firm value.

The remainder of the paper is structured as follows. Section 2 presents the background of COVID-19, while Section 3 discusses the literature review and develops hypotheses for the study. Section 4 describes the research methods while Section 5 reports the results. Section 6 provides additional analyses and robustness checks. Section 7 concludes the paper.

2. Background: impact of COVID-19 on the global economy

The novel coronavirus (referred to as COVID-19) spread from the city of Wuhan in China's Hubei Province to become a global pandemic in late 2019 and early 2020, impacting on 188 countries (Bapuji *et al*., 2020; Jones *et al*., 2020). As of 28 September 2020, COVID-19 had caused about 33 million confirmed cases and over one million deaths in 210 countries and territories around the world (Statista, 2020). The ensuing economic crisis and global recession have gravely damaged the world economy and caused massive job losses (Nicola *et al*., 2020). Several experts argue that the impact of the COVID-19 pandemic is very different from that of the Global Financial Crisis (GFC) of 2008–2009 (PricewaterhouseCoopers (PwC), 2020). The World Bank (2020) has estimated that the world economy is likely to shrink by 5.2 percent in 2020, leading to the most severe global recession since the Second World War. The per capita output will be the lowest since 1870 (World Bank, 2020) and is likely to decrease by 3.6 percent with the result that millions of people will slip into poverty. COVID-19 has significantly impacted on both developed and developing countries. For example, economic activity has dropped by 7 percent in developed countries, while it has reduced by 2.5 percent in developing nations (World Bank, 2020). COVID-19 has greatly curtailed the viability of job markets, and unemployment rates have risen significantly worldwide. Many people have lost their jobs and/or experienced income cuts (Jones *et al*., 2020). Numerous businesses are now closed with little possibility of re-opening, causing a great deal of disruption to commerce in most industries (Bapuji *et al*., 2020). For example, retailers and brands have faced many challenges regarding health and safety, the supply chain, the workforce, cash flow, consumer demand and sales and marketing. The World Trade Organization (WTO) (2020) has estimated that world trade is likely to fall approximately 13–32 percent in 2020, and that the gross domestic product (GDP) of the leading economies will most likely fall by 2.4–3.0 percent. COVID-19 has essentially wrecked the tourism/travel industry due to cuts in flights by airline companies and cancellations of business trips and holidays. The price of crude oil has plunged, and consumer spending has plummeted as a result of people staying at home, and not going to shops (Jones *et al*., 2020).

Zhang *et al*. (2020) argue that COVID-19 has influenced financial markets around the world, resulting in an unprecedented level of risk, and that investors have suffered considerably in a short period of time. The share markets have fallen, and stock market volatility has increased dramatically worldwide (Ali

et al., 2020; Baker *et al*., 2020a). Every company is affected by COVID-19 and faces significant losses in all aspects of conducting its business (Bapuji *et al*., 2020). The market value of shares has dropped significantly in Asia (i.e., the Shanghai Stock Exchange Composite Index, Nikkei Stock Average Index); the United States (Dow Jones Industrial Average Index, S&P 500 Index, Nasdaq Composite Index); Europe (Financial Times Stock Exchange 100 Index); as well as stock exchange indexes in Latin America (Rudden, 2020) and Australia (Chau, 2020). Despite this overall and widespread downturn, the stock market has observed that firms maintaining a focus on sustainability are tending to outperform their counterparts that lack a similar focus (BlackRock, 2020; Gilchrist, 2020; Schroders, 2020). Against this background, we examine whether a firm-level sustainability focus influences a general decline in firm value in the aftermath of the COVID-19 pandemic.

3. Literature review and hypotheses development

Prior studies show that infectious disease outbreaks exert a significant impact on the economy and directly affect stock markets globally. For example, in their study, Chen *et al*. (2007) examine the impact of SARS-2003 on Taiwanese stock price movements, finding that stock prices of hotels were negatively affected by the SARS outbreak. Nippani and Washer (2004) evaluate the influence of SARS on the stock markets of Canada, China, Indonesia, the Philippines, Singapore, Thailand and Vietnam and find no negative association between SARS and stock markets, except for those in China and Vietnam. Furthermore, Wang *et al*. (2013) investigate the impact of major infectious disease epidemics, including enterovirus 71, dengue fever, SARS and H1N1, on the performance of biotechnology firms in Taiwan and find a significant positive abnormal return owing to these epidemics. In line with this, Macciocchi *et al*. (2016) examine the short-term economic impact of the Zika virus outbreak in Brazil, Argentina and Mexico. They find nine companies had aggregate negative returns while 10 companies had positive aggregate returns for the whole period in all three countries. Del Giudice and Paltrinieri (2017) investigate the impact of Ebola and the Arab Spring on equity mutual funds in African countries, finding evidence that fund flows were associated with both Ebola and the Arab Spring. Furthermore, Chen *et al*. (2018) examine the impact of the SARS epidemic on the long-term relationship between China and four Asian stock markets: Hong Kong, Taiwan, Singapore and Japan during the period 1998–2008, covering five years before and after the 2002–2003 SARS outbreak. The authors find that the SARS epidemic weakened the long-run relationship between China and the four markets. Using a study of nine events in four epidemic disease outbreaks for the years from 2004 to 2016, Kim *et al*. (2020) detect macroscopic and infectious epidemic disease outbreaks that exerted a negative effect on the restaurant/hospitality industry. These studies, in

general, find negative market reactions due to infectious epidemics throughout the world.

However, COVID-19 is different from other pandemics in several ways: for instance, it has resulted in 4.5 billion people being confined to their homes in most affected countries globally, despite the recent 'stop–start' attempts to get economies moving again. The COVID-19 pandemic has adversely affected people's health due to shutdowns, quarantine and restrictions on mobility and social contact, whereas previous pandemics were limited to specific countries and regions to which the resulting financial crisis was contained. Moreover, this pandemic is extremely contagious with no vaccine (at the time of writing) and has devastated economies significantly more than previous pandemics. For example, Sadang (2020) states that actual and expected revenues are likely to decrease owing to the massive decline in demand for goods and services. Furthermore, firms' debt and interest and other fixed expenses are not likely to have stopped, with any 'quarantine periods' now coming to an end. Most firms have little money in the form of savings on which they can rely. According to the Organisation for Economic Co-operation and Development (OECD) (2020), the volume of sales has dropped significantly, and companies are facing unsolvable financial difficulties to pay their suppliers, employees, lenders and investors, leading to liquidity problems. Very recently, Iyke (2020) examined the impact of COVID-19 on exchange rate return and volatility predictions. The author uses the total number of infections per million people as a measure of the impact of COVID-19, demonstrating that it provides better predictive power than volatility. The devastating global economic shutdown due to COVID-19 is escalating across financial sectors, including equity markets. Dawson (2020) argues that the deteriorating economic climate caused by COVID-19 has had an intense influence on world equity markets, with their dramatic decline being much worse than during and after the 2008–2009 GFC. The author further posits that the values of firms have fallen due to the decline in equity values.

In another study, Aifuwa *et al.* (2020) explore the impact of the coronavirus pandemic on the performance of private sector businesses in Nigeria. Using survey data, they find that COVID-19 harmed both the financial and non-financial performance of these businesses. Fu and Shen (2020) examine the influence of COVID-19 on corporate performance in the energy industry, documenting the negative relationship between COVID-19 and the performance of energy companies. These authors find that the damage wrought by COVID-19 on corporate performance is more pronounced for companies with goodwill impairment in their financial statements. Liu *et al.* (2020a, 2020b) examine the impact of the COVID-19 pandemic on the crude oil and stock market returns, finding that the pandemic positively influences crude oil and stock market returns. Similarly, Phan and Narayan (2020) investigate whether government responses to COVID-19 have led to any stock price reaction in the top 25 countries: they note a possible overreaction of stock markets and market

correction over time. In line with this, using the event study method, Liu *et al.* (2020a, 2020b) examine how COVID-19 has impacted on stock market returns. These authors show that the COVID-19 pandemic has adversely affected the stability of 21 leading stock markets in Japan, South Korea, Singapore, the US, Germany, UK and Italy. They also report that countries in Asia have suffered more negative abnormal returns in comparison to other countries. Ali *et al.* (2020) also examine the reaction of financial markets globally in terms of their decline and volatility. They provide evidence that global stock markets have declined significantly due to COVID-19.

Another recent study by Shen *et al.* (2020) examines whether COVID-19 has any influence on firm performance in China, with the authors documenting that firm performance has deteriorated due to the COVID-19 pandemic. Compared to the Spanish flu pandemic of 1918–1920 and the influenza pandemics of 1957–1958 and 1968, Baker *et al.* (2020a) find that the stock market reactions to COVID-19 are extraordinary, both in absolute terms and relative to prior pandemics. Baker *et al.* (2020a) argue that the probable explanation for the severe stock market reactions to the COVID-19 pandemic is found in the mandatory business closures, draconian restrictions on commercial activity, and voluntary or involuntary social distancing policies, such as lockdowns and curfews. Based on the above discussion, we argue that firms operating in countries suffering much more serious COVID-19 outbreaks have experienced a higher decline in firm value. We formally state this prediction as our first hypothesis:

H1: There is a negative association between the impact of COVID-19 and changes in firm value.

The shareholder wealth maximisation model has traditionally been widely adopted as a theory explaining a firm's activities and corporate governance (Jensen and Meckling, 1976; Berle and Means, 1991). Recent academic debates criticised the propriety of 'shareholder value' maximisation as the goal of the business and argue for a 'stakeholder value' model as a viable alternative for maintaining sustainable societies. This alternative goal of the firm is presented as attractive to shareholders, as shareholder value maximisation would be sustainable if managed as a component of broader stakeholder value (Smith, 2003; Freeman *et al.*, 2007). The stakeholder value maximisation view suggests that firms making sustainable investments to satisfy stakeholders will consequently receive the latter's support for how those firms are conducting their operations, ultimately increasing their value (Deng *et al.*, 2013; Gao *et al.*, 2016; Bose *et al.*, 2020b). This view is aligned with the theory of the firm developed by Coase (1937) who suggests that a firm is formed by a nexus of contracts among different parties, including shareholders, creditors, employees, customers and suppliers. Firms with high levels of investment in sustainability are believed: firstly, to be able to provide more support to their stakeholders; and secondly, to be more likely to fulfil the implicit commitments between themselves and

their stakeholders (Cheng *et al*., 2013; Gao *et al*., 2016). For this reason, stakeholders will be more willing to provide resources and devote efforts to cooperate with these firms and contribute to their value (Renneboog *et al*., 2008; Gao *et al*., 2016; Bose *et al*., 2020b). The global crisis imposed by the COVID-19 pandemic makes it possible to empirically explore if firm-level stakeholder-value orientation contributes to preserving firm value at times of overall declining stakeholder value. Therefore, the impact of COVID-19 on firm value is a worthwhile topic to explore through the lens of stakeholder-value orientation. We employ sustainability performance to represent 'stakeholder value'.

Prior studies argue that businesses with a higher level of sustainability performance can alleviate certain aspects of regulatory, legislative or fiscal actions (Berman *et al*., 1999; Cheng *et al*., 2013; Hillman and Keim, 2001) and attract socially conscious consumers (Hillman and Keim, 2001; Rashid *et al*., 2020) and socially responsible investors (Kapstein, 2001; Cheng *et al*., 2013). Moreover, firms that are more engaged with their stakeholders through maintaining superior sustainability performance are more visible. The COVID-19 pandemic provides the opportunity to evaluate how firms manage their stakeholders during this crisis as well as how stakeholders behave during this time. For example, Edelman (2020), in a recent survey of 12,000 people in 12 countries, reports that approximately 65 percent of respondents indicated that their future purchasing decisions would be influenced by the firm's response during the COVID-19 pandemic. Edelman (2020) also finds that 82 percent of Chinese respondents stated that they moved to a new company as it proved to be innovative and compassionate in its response during the pandemic. Meanwhile, one-third of respondents managed to convince other people to leave a brand that acted inappropriately during the pandemic. Similarly, Just Capital (2020) has developed a tracking system to monitor how the USA's largest employers are treating stakeholders amid the COVID-19 crisis. These examples demonstrate the importance from the firm's perspective of managing stakeholders during this crisis, with investors closely monitoring these developments (Business for Social Responsibility, 2020).

Firms illustrating superior sustainability performance seek to identify and understand actions that may affect their stakeholders (Harrison *et al*., 2010), with these actions more visible during times of crisis. It could be argued that shareholders are likely to reward firms that have superior sustainability performance and treat their stakeholders fairly. Consistent with this view, prior studies argue that companies with superior sustainability performance tend to have better access to valuable resources (Waddock and Graves, 1997); attract and retain higher quality employees (Greening and Turban, 2000); create unforeseen opportunities (Fombrun and Shanley, 1990); and gain social legitimacy (Hawn *et al*., 2011). Therefore, it is reasonable to argue that firms with superior sustainability performance are likely to be more resilient during the COVID-19 pandemic (BlackRock, 2020; Gilchrist, 2020; Schroders, 2020).

Consequently, they are likely to be in a better position to manage pandemic crises to preserve firm value compared to their counterparts. Along this line of thinking, we hypothesise that the impact of COVID-19 on changes in firm value will be less for firms with a higher focus on sustainability performance. We formally state this prediction in the following hypothesis:

H2: The negative association between the impact of COVID-19 and changes in firm value is less pronounced for firms with higher sustainability performance compared to firms with lower sustainability performance.

4. Methodology

4.1. Sample and data

Our sample consists of all firms covered by the Refinitiv (previously, Thomson Reuters) Environmental, Social and Governance (ESG) database for 2019–2020. We obtained financial accounting data from the Refinitiv Worldscope database, sustainability performance data from the Refinitiv ESG database, and stock market data from the Refinitiv DataStream database. We merged firm-year observations in all three databases for the year 2019–2020. Our sampling period is limited by the coverage of the Refinitiv ESG database. We started our sample with 9,328 firms covered by the Refinitiv ESG database for 2019–2020. Furthermore, we collected data on COVID-19 infections and deaths from ourworldindata.org (Roser *et al.*, 2020) and global country-level societal health risk (*SOC_HEALTH_RISK*) data from Knoema (2020). We also collected country-level environmental-value orientation of culture data from the World Values Survey (WVS) and other country-level data from the World Bank database. After merging these databases and dropping all incomplete observations, we obtained an initial sample of 4,278 firms from 47 countries. Table 1 summarises the industry distribution of firms in our sample. It shows that our sample is dominated by firms operating in the financial industry (14.10 percent), followed by the computer industry (10.31 percent) and the services industry (9.59 percent), while the manufacturing: miscellaneous industry (0.49 percent) has the lowest number of observations.

4.2. Measures of COVID-19 impact

We measure COVID-19 impact by the total number of infections per million population and the total number of deaths per million population as at 31 July 2020 from the ourworldindata.org database (Roser *et al.*, 2020). This database is a collaborative effort between researchers at the University of Oxford and Global Change Data Lab, and undertakes daily updates of the total number of COVID-19-related deaths and infections. We also measure the impact of COVID-19 using the country-level societal health risk (*SOC_HEALTH_RISK*)

Table 1
Industry distribution

Name of industry	Number of firms	Percent of sample
Mining/Construction	312	7.29
Food	142	3.32
Textiles/Print/Publishing	109	2.55
Chemicals	114	2.67
Pharmaceuticals	224	5.24
Extractive	169	3.95
Manufacturing: Rubber/glass/etc.	72	1.68
Manufacturing: Metal	105	2.45
Manufacturing: Machinery	147	3.44
Manufacturing: Electrical Equipment	86	2.01
Manufacturing: Transport Equipment	141	3.30
Manufacturing: Instruments	139	3.25
Manufacturing: Miscellaneous	21	0.49
Computers	441	10.31
Transportation	258	6.03
Utilities	99	2.31
Retail: Wholesale	107	2.50
Retail: Miscellaneous	209	4.89
Retail: Restaurant	42	0.98
Financial	603	14.10
Insurance/Real Estate	287	6.71
Services	410	9.58
Others	41	0.96
Total sample	4,278	100

through utilising the Societal Health Risk Index developed by Knoema (2020).[2] Index scores are computed based on a country's: (i) quality of healthcare systems and the availability of healthcare resources; (ii) economic interconnectedness (external and internal); (iii) digital infrastructure; (iv) demographic susceptibility; and (v) trust in government. A higher score of societal health risk indicates a higher level of vulnerability to the spread of COVID-19.

4.3. Measures of sustainability performance

Sustainability performance (*SUST_PERF*) is measured as the average of the environmental performance and social performance scores reported by the Refinitiv ESG database, following Del Maso *et al.* (2019). We create an indicator variable *HIGH_SUST_PERF* that takes a value of 1 if the firm's

[2]Although Knoema (2020) defines this index as the 'Global Coronavirus Susceptibility Index', we labelled it as the 'Societal Health Risk Index' as the index captures country-level health, development, and governance-level factors.

sustainability performance score is in the top quartile of sustainability performance and 0 otherwise, with the latter labelled as *LOW_SUST_PERF*. Environmental performance is measured as the weighted average relative rating of a company covering three environmental category scores: resource use, environmental emissions reduction and innovation (Refinitiv, 2020). Furthermore, social performance is measured as the weighted average relative rating of a company covering four social category scores: workforce, human rights, community and product responsibility (Refinitiv, 2020).

4.4. Empirical models

We employ ordinary least squares regression (OLS) to estimate the following model for testing our first hypothesis (H1), which predicts a negative association between the impact of COVID-19 and changes in firm value:

$$\begin{aligned}\Delta TOBINQ_{i,t+\tau} = {} & \beta_0 + \beta_1 COVID\_IMPACT_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} \\ & + \beta_4 ROA_{i,t} + \beta_5 CAPIN_{i,t} + \beta_6 DIVIDEND_{i,t} \\ & + \beta_7 LIQUIDITY_{i,t} + \beta_8 GROWTH_{i,t} + \beta_9 CGOV\_PERF_{i,t} \\ & + \beta_{10} LNGDP_{i,t} + \beta_{11} SHAREHOLDER_{i,t} + \beta_{12} ENFORCE_{i,t} \\ & + \beta_{13} CNTRY\_GOV_{i,t} + \beta_{14} SDG_{i,t} + \sum Industry_{i,t} + \varepsilon_{i,t}\end{aligned} \tag{1}$$

To test H2, we include the interaction between COVID-19 impact and sustainability performance (*HIGH_SUST_PERF*) in Equation (1). The model is as follows:

$$\begin{aligned}\Delta TOBINQ_{i,t+\tau} = {} & \beta_0 + \beta_1 COVID\_IMPACT_{i,t} + \beta_2 COVID\_IMPACT_{i,t} \\ & \times HIGH\_SUST\_PERF_{i.t} + \beta_3 HIGH\_SUST\_PERF_{i.t} \\ & + \beta_4 SIZE_{i,t} + \beta_5 LEV_{i,t} + \beta_6 ROA_{i,t} + \beta_7 CAPIN_{i,t} \\ & + \beta_8 DIVIDEND_{i,t} + \beta_9 LIQUIDITY_{i,t} + \beta_{10} GROWTH_{i,t} \\ & + \beta_{11} CGOV\_PE + \beta_{12} LNGDP_{i,t} + \beta_{13} SHAREHOLDER_{i,t} \\ & + \beta_{14} ENFORCE_{i,t} + \beta_{15} CNTRY\_GOV_{i,t} + \beta_{16} SDG_{i,t} \\ & + \sum Industry_{i,t} + \varepsilon_{i,t}.\end{aligned} \tag{2}$$

We use the percentage of changes in Tobin's Q ($\Delta TOBINQ$) as a measure of firm value. *TOBINQ* is computed as the sum of the book value of total assets plus the market value of equity minus the book value of equity divided by total assets. $\Delta TOBINQ$ is estimated as the difference between the daily average value of Tobin's Q from 1 January 2020 to 31 July 2020 and the daily average value of Tobin's Q during December 2019 divided by the daily average value of

Tobin's Q during December 2019. The *COVID_IMPACT* is proxied by three variables at the country level: (a) total number of infections per million population (*COVID_INFECTION*); (b) total number of deaths per million population (*COVID_DEATH*); and (c) societal health risk (*SOC_HEALTH_RISK*). Sustainability performance (*SUST_PERF*) is measured as an indicator variable that takes a value of 1 if the firm's sustainability performance score is in the top quartile of sustainability performance (*HIGH_SUST_PERF*) and 0 otherwise. We expect a negative coefficient for β_1 in Equation (1) and a positive coefficient for β_2 in Equation (2) for supporting our hypotheses. Table 2 provides the explanation of all variables.

We control for several variables in Equation (1) following the prior literature. Larger-sized firms enjoy economies of scale (Roll *et al.*, 2009), and subsequently are better at conducting their business; thus, we control for firm size. We also control for leverage (*LEV*) to capture the likelihood of financial distress (Roll *et al.*, 2009; Bose *et al.*, 2020a) and for profitability (*ROA*) as more profitable firms have more favourable investment opportunities that lead to their higher value (Roll *et al.*, 2009; Bose *et al.*, 2020a). Furthermore, we control for capital expenditures to capture future growth opportunities, that is, capital expenditure intensity (*CAPIN*), as firms with better future growth opportunities will enjoy better firm value (Roll *et al.*, 2009). Given that firms paying dividends are more likely to have a larger amount of free cash flows that may lead to overinvesting in marginal projects (Roll *et al.*, 2009), we also control for a firm's dividend payment (*DIVIDEND*) to capture capital constraints. As a firm's liquidity is positively associated with how well it performs (Roll *et al.*, 2009), we also control for share turnover to control for liquidity effects (*LIQUIDITY*) arising from stock trading activity. We control for sales growth (*GROWTH*) due to its influence on firm performance (Bose *et al.*, 2017a, 2017b). We control for firm-level corporate governance performance (*CGOV_PERF*) to capture the effects of good governance effects on firm value. We also control for several country-level variables including gross domestic product (GDP) per capita (*LNGDP*), country-level shareholder orientation (*SHAREHOLDER*), enforcement level (*ENFORCE*), governance (*CNTRY_GOV*) and sustainable development goals (*SDG*).

4.5. Estimation method

We apply the ordinary least squares (OLS) regression method to estimate our research models. We use robust standard errors clustered at the country level to address heteroskedasticity and serial-correlation issues. Furthermore, we use the variance inflation factor (VIF) values to assess potential multicollinearity issues. We also control for the industry in our regression models by controlling the industry effect. All continuous variables, except country-level variables, are winsorised at the 1st and 99th percentiles.

Table 2
Description of variables

Variable(s)		Explanation
ΔTOBINQ	Changes in firm value	The difference between the daily average value of Tobin's Q from 1 January 2020 to 31 July 2020 and the daily average value of Tobin's Q at December 2019 divided by the daily average value of Tobin's Q at December 2019. Tobin's Q is computed as the sum of the book value of total assets plus the market value of equity minus the book value of equity divided by total assets
COVID_INFECTION	COVID-19 infections	The natural logarithm of the total number of COVID-19 infections per million population
COVID_DEATH	COVID-19 deaths	The natural logarithm of the total number of COVID-19 deaths per million population
SOC_HEALTH_RISK	Societal health risk	Country-level societal health risk score on the Societal Health Risk Index developed by Knoema (2020)
SUST_PERF	Sustainability performance	Firm-level sustainability performance measured by the average of the social and environmental pillar scores developed by the Refinitiv ESG database. We compute *HIGH_SUST_PERF* as an indicator variable that takes a value of 1 if the observation is in the top quartile of sustainability performance and 0 otherwise, with the latter labelled as *LOW_SUST_PERF*
SIZE	Firm size	The natural logarithm of the market value of equity
LEV	Leverage	The ratio of total debt divided by total assets
ROA	Profitability	The ratio of net income divided by total assets
CAPEX	Capital expenditures	The amount of capital expenditures scaled by total revenues.
DIVIDEND	Dividend	An indicator variable that takes a value of 1 if firms pay a dividend, and 0 otherwise
LIQUIDITY	Liquidity	The average monthly share trading volume relative to total number of shares outstanding
GROWTH	Sales growth	The percentage changes in annual revenue
CGOV_PERF	Corporate governance performance	The corporate governance performance score developed by the Refinitiv database
LNGDP	Gross domestic product	The natural logarithm of the gross domestic product (GDP) per capita
SHAREHOLDER	Country-level shareholder orientation	

(continued)

Table 2 (continued)

Variable(s)		Explanation
		An indicator variable that takes a value of 1 if the firm is domiciled in a shareholder-oriented country, and 0 otherwise. Firms domiciled in common law countries are classified as shareholder-oriented countries
ENFORCE	Enforcement	Principal component of 'Rule of Law', 'Regulatory Quality' and 'Control of Corruption' from the Worldwide Governance Indicators (World Bank)
CNTRY_GOV	Country-level governance	Country-level anti-directors' rights developed by Djankov *et al.* (2008)
SDG	Sustainable development goals	Country-level sustainable development goals score collected from World Bank database
POP_DENSITY	Population density	The natural logarithm of the number of people per square kilometre
AGE_65_YR	Population over 65 years of age	The percentage of population over 65 years of age
HOSPITAL_BEDS	Hospital beds	The natural logarithm of the number of hospital beds per thousand of population. We multiply it by minus one (−1) to interpret the lower number of hospital beds that may affect the number of COVID-19 infections and deaths due to lack of public health support
ENV_VALUE	Environmental-value orientation	Country-level environmental value collected from the World Values Survey (WVS). We compute *HIGH_ENV_VALUE* as an indicator variable that takes a value of 1 if the observation is in the top quartile of environmental values and 0 otherwise, with the latter labelled as *LOW_ENV_VALUE*
STAKE	Stakeholder orientation	An indicator variable that takes a value of 1 if the firm is domiciled in a stakeholder-oriented country, and 0 otherwise

5. Empirical results

5.1. Descriptive statistics and correlation matrix

The descriptive statistics for the dependent variable and the independent variables are reported in Table 3, Panel A. The mean (median) of changes in firm value measured by Tobin's Q ($\Delta TOBINQ$) is −0.067 (−0.065) which suggests that, on average, firm value declines in our sample. This is not surprising given that firm values across the world are greatly affected by COVID-19. The mean (median) total number of infections (*COVID_INFECTION*) and deaths (*COVID_DEATH*) per million population is 7,429.803 (6,170.962) and 316.234 (459.422), respectively, suggesting that, on average, the number of infections and deaths is 7,429.803 and 316.234 per million population across the world. The mean (median) of societal health risk (*SOC_HEALTH_RISK*) is 46.723 (48.400). The mean (median) sustainability performance (*SUST_PERF*) score is 39.160 (41.898). The mean (median) size of firms in our sample, as measured by the natural logarithm of market capitalisation, is 7.777 (7.806), suggesting an average total market capitalisation of $US95.99 billion. The mean leverage ratio (*LEV*) is 25.70 percent, while the average profitability (*ROA*) is 1.70 percent, average liquidity (*LIQUIDITY*) is 1.495, and the average sales growth (*GROWTH*) is 9.10 percent. About 71.20 percent of firms in our sample paid dividends. The mean (median) corporate governance performance for firms in our sample is 0.456 (0.461). The average GDP per capita is $US48,778.06, while average country-level enforcement (*ENFORCE*) and shareholder protection score (*CNTRY_GOV*) is 2.126 and 3.192, respectively. The mean score of country-level sustainable development goals (*SDG*) is 75.321. About 64.70 percent of our firms in our sample are domiciled in shareholder-oriented (*SHAREHOLDER*) countries.

Table 3, Panel B provides the mean and median tests of the dependent variable based on COVID-19 infections and deaths per million people. We created an indicator variable of *HIGH_INFECTION* (*HIGH_DEATH*) that takes a value of 1 if a country's COVID-19 infections (deaths) are greater than the median of country-adjusted COVID-19 infections (deaths). The results suggest that firms operating in countries with a higher level of COVID-19 infections (deaths) have a lower firm value ($\Delta TOBINQ$) compared to firms operating in countries with a lower level of COVID-19 infections (deaths). Furthermore, sustainability performance (*SUST_PERF*) is also lower in countries with a higher level of COVID-19 infections (deaths).

Table 3, Panel C provides country-level descriptive statistics. Our sample is dominated by firms operating in the US followed by those in the UK, while Egypt, Greece and Uruguay have the lowest number of observations. Regarding COVID-19 infections per million people, Chile (18,494.04) has the highest number of infections, followed by Panama (14,877.08) and the US (13,579.99), while Thailand (47.42) has the lowest number. Furthermore,

Table 3
Descriptive statistics

Panel A: Descriptive statistics

	N	Mean	Std. dev.	Median	1st Quartile	3rd Quartile
ΔTOBINQ	4,278	−0.067	0.126	−0.065	−0.144	−0.014
COVID_INFECTION	4,278	7429.803	5742.695	6170.962	1691.863	13579.990
COVID_DEATH	4,278	316.234	227.831	459.422	45.156	459.422
SOC_HEALTH_RISK	4,278	46.723	11.900	48.400	38.300	48.400
SUST_PERF	4,278	39.160	22.163	41.898	19.235	50.420
SIZE	4,278	7.777	1.595	7.806	6.667	8.804
LEV	4,278	0.257	0.206	0.232	0.080	0.384
ROA	4,278	0.017	0.129	0.031	0.006	0.069
CAPEX	4,278	0.125	0.285	0.038	0.017	0.093
DIVIDEND	4,278	0.712	0.453	1.000	0.000	1.000
LIQUIDITY	4,278	1.495	1.631	1.001	0.453	1.948
GROWTH	4,278	0.091	0.347	0.034	−0.040	0.130
CGOV_PERF	4,278	0.456	0.238	0.461	0.269	0.647
LNGDP	4,278	10.592	0.759	10.913	10.609	11.086
SHAREHOLDER	4,278	0.647	0.478	1.000	0.000	1.000
ENFORCE	4,278	2.126	1.261	2.521	2.279	3.026
CNTRY_GOV	4,278	3.192	1.072	3.000	3.000	4.000
SDG	4,278	75.321	3.919	74.520	73.887	77.887

Table 3 (continued)

Panel B: Mean and median tests

	HIGH_INFECTION (2,121 firms)		*LOW_INFECTION* (2,157 firms)		Mean test (*t*-statistic)	Median test (*z*-statistic)
	Mean	Median	Mean	Median		
ΔTOBINQ	−0.072	−0.067	−0.062	−0.064	−2.428***	3.064***
SUST_PERF	34.943	34.130	43.448	47.420	−12.786***	−12.609***
	HIGH_DEATH (2,398 firms)		*LOW_DEATH* (1,880 firms)		Mean test (*t*-statistic)	Median test (*z*-statistic)
	Mean	Median	Mean	Median		
ΔTOBINQ	−0.072	−0.071	−0.060	−0.059	−3.272***	−4.236***
SUST_PERF	37.411	38.240	41.391	45.908	−5.852***	−6.514***

Panel C: Country-level descriptive statistics

Country	*N*	Percent	*ΔTOBINQ*	Total infections per million people	Total deaths per million people	Societal health risk	Sustainability performance
Argentina	17	0.40	−0.069	3,960.17	73.26	41.10	26.49
Australia	319	7.46	−0.114	639.34	7.41	28.00	39.25
Austria	17	0.40	−0.095	2,332.68	79.72	30.70	64.78
Belgium	34	0.79	−0.092	5,969.14	849.21	37.10	50.69
Brazil	50	1.17	−0.217	12,279.40	429.35	49.40	48.51
Canada	138	3.23	−0.094	3,067.79	236.58	34.40	39.09
Chile	6	0.14	−0.038	18,494.04	490.53	42.40	41.24

(continued)

Table 3 (continued)

Panel C: Country-level descriptive statistics

Country	*N*	Percent	*ΔTOBINQ*	Total infections per million people	Total deaths per million people	Societal health risk	Sustainability performance
China	493	11.52	0.025	60.79	3.24	72.90	27.38
Colombia	6	0.14	−0.109	5,621.14	192.80	49.70	49.53
Czech Republic	2	0.05	−0.047	1,526.01	35.39	37.80	50.41
Denmark	38	0.89	−0.001	2,369.57	106.18	39.10	53.85
Egypt	1	0.02	−0.113	916.18	46.65	55.50	3.09
Finland	34	0.79	−0.075	1,339.72	59.38	30.10	64.62
France	100	2.34	−0.081	2,858.33	463.50	34.30	67.10
Germany	123	2.88	−0.061	2,490.91	109.10	38.30	55.43
Greece	1	0.02	−0.136	422.24	19.48	41.40	26.22
Hungary	2	0.05	−0.093	466.34	61.70	39.40	77.70
Indonesia	26	0.61	−0.139	388.76	18.49	59.30	50.73
India	2	0.05	−0.067	1,187.58	25.90	68.90	69.62
Ireland	24	0.56	−0.088	5,270.98	357.04	38.10	46.80
Israel	15	0.35	−0.002	8,131.09	58.11	43.20	27.22
Italy	64	1.50	−0.067	4,087.84	581.06	49.50	61.90
Japan	24	0.56	0.014	267.04	7.95	37.80	33.66
Luxembourg	18	0.42	−0.084	10,569.09	182.12	33.30	48.06
Mexico	22	0.51	−0.113	3,227.88	356.78	55.20	60.11
Malaysia	47	1.10	−0.057	276.96	3.83	50.20	54.19
New Zealand	33	0.77	−0.085	250.92	4.56	33.70	33.12
Netherlands	55	1.29	−0.061	3,149.31	358.74	38.30	58.08
Norway	42	0.98	−0.064	1,691.86	47.04	25.10	53.35
Pakistan	4	0.09	−0.051	1,259.91	26.94	63.80	19.32
Panama	2	0.05	−0.121	14,877.05	323.77	48.80	61.02
Peru	4	0.09	−0.035	12,358.79	576.89	52.10	22.80

(continued)

Table 3 (continued)

Panel C: Country-level descriptive statistics

Country	*N*	Percent	*ΔTOBINQ*	Total infections per million people	Total deaths per million people	Societal health risk	Sustainability performance
Philippines	14	0.33	−0.082	815.60	18.10	61.10	51.94
Poland	16	0.37	−0.041	1,189.83	45.16	41.90	39.55
Portugal	5	0.12	−0.061	4,988.67	169.37	42.40	75.93
Russia	20	0.47	−0.033	5,718.31	94.58	38.80	43.37
Singapore	40	0.94	−0.078	8,855.72	4.62	45.50	50.59
South Africa	77	1.80	−0.162	8,129.82	131.72	49.10	49.46
South Korea	27	0.63	−0.089	279.02	5.87	32.30	33.28
Spain	42	0.98	−0.073	6,170.96	608.39	42.90	67.05
Sweden	100	2.34	−0.040	7,931.27	568.26	33.70	52.33
Switzerland	90	2.10	−0.064	4,036.34	196.77	36.90	49.61
Thailand	22	0.51	−0.103	47.42	0.83	53.90	59.70
Turkey	13	0.30	0.001	2,725.80	67.28	52.60	26.98
Uruguay	1	0.02	−0.165	357.83	10.08	39.10	53.73
United Kingdom	245	5.73	−0.131	4,453.07	677.59	44.40	47.34
United States	1,803	42.15	−0.066	13,579.99	459.42	48.40	31.80
Total/Average	4,278	100	−0.067	7,429.80	316.23	46.72	39.16

***, ** and * represent statistical significance at the 1, 5 and 10 percent levels, respectively. Variable definitions are provided in Table 2.

Belgium (849.21) has the highest number of COVID-19 deaths per million population, followed by the UK (677.59) and Spain (608.39), while Thailand (0.83) has the lowest number. With reference to societal health risk, China (72.90) has the highest level, followed by India (68.90) and Pakistan (63.80), while Norway (25.10) has the lowest level. Furthermore, Hungary (77.70) has the highest level of sustainability performance, followed by Portugal (75.93), while Egypt (3.09) has the lowest level.

Table 4 reports the results from Pearson's correlation matrix. The results show that the correlation between $\Delta TOBINQ$ and COVID-19 impact proxies is negative and statistically significant except for societal health risk. Moreover, no multicollinearity issues are apparent in our research models as all correlation coefficients are below 0.80, the threshold below which Gujarati and Porter (2009) suggest that no multicollinearity problems are created. The mean VIF value of the variables used in the model is 2.92 and ranges from 1.18 to 6.30. A VIF value higher than 10 is considered to potentially lead to multicollinearity concerns (Gujarati and Porter, 2009). Thus, our results are unlikely to suffer from multicollinearity problems.

5.2. Regression analysis

5.2.1. Impact of COVID-19 on changes in firm value

Our first hypothesis (H1) predicts that firms in countries where the impact of COVID-19 is higher are experiencing lower firm value. We use three proxies for the COVID-19 impact. Table 5, Models (1) and (2) show the regression results using the total number of COVID-19 infections and deaths per million population, respectively, while Model (3) highlights the global country-level societal health risk. Table 5 shows that the coefficients of $COVID\_IMPACT$ are negative and statistically significant across all models from Models (1) to (3) ($\beta = -0.007$, $p < 0.10$; $\beta = -0.007$, $p < 0.05$; $\beta = -0.084$, $p < 0.05$), suggesting that the impact of COVID-19 is negatively associated with changes in firm value. These findings suggest that firms in countries with more COVID-19 impact have lower firm value. This finding is not surprising given that COVID-19 is a worldwide pandemic that is adversely affecting business activity. In terms of economic significance, the coefficient estimates from Table 5, Models (1) to (2) indicate that a one standard deviation increase in COVID-19 infections and deaths per million population leads to a 10.11 percent and 10.85 percent reduction, respectively, in changes in firm value, while this reduction is 15.80 percent if the Societal Health Risk Index score rises by one

Table 4
Correlation matrix

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]
ΔTOBINQ	[1]	1.000																
COVID_INFECTION	[2]	−0.172***	1.000															
COVID_DEATH	[3]	−0.149***	0.917***	1.000														
SOC_HEALTH_RISK	[4]	0.145***	−0.295***	−0.214***	1.000													
SIZE	[5]	0.139***	−0.150***	−0.068***	0.167***	1.000												
LEV	[6]	−0.034**	0.057***	0.073***	−0.014	0.048***	1.000											
ROA	[7]	−0.047***	−0.137***	−0.103***	0.037**	0.344***	−0.089***	1.000										
CAPEX	[8]	−0.043***	−0.014	−0.045***	−0.062***	−0.085***	0.083***	−0.141***	1.000									
DIVIDEND	[9]	−0.088***	−0.262***	−0.204***	0.037**	0.304***	0.024	0.398***	−0.052***	1.000								
LIQUIDITY	[10]	0.156***	0.107***	0.091***	0.276***	−0.019	0.081***	−0.159***	−0.003	−0.266***	1.000							
GROWTH	[11]	0.131***	0.025*	0.016	0.060***	−0.003	−0.039**	−0.119***	0.057***	−0.165***	0.075***	1.000						
CGOV_PERF	[12]	0.062***	−0.106***	−0.075***	−0.064***	0.240***	0.051***	0.123***	−0.063***	0.167***	−0.067***	−0.097***	1.000					
LNGDP	[13]	−0.087***	0.683***	0.594***	−0.535***	−0.173***	0.021	−0.152***	0.043***	−0.259***	0.090***	0.038**	−0.049***	1.000				
STAKE	[14]	−0.159***	0.538***	0.366***	−0.137***	−0.260***	−0.025	−0.149***	0.062***	−0.268***	0.172***	0.074***	−0.079***	0.525***	1.000			
ENFORCE	[15]	−0.144***	0.563***	0.482***	−0.725***	−0.189***	−0.001	−0.114***	0.057***	−0.180***	−0.071***	−0.007	0.003	0.906***	0.471***	1.000		
CGOV	[16]	−0.291***	0.398***	0.315***	−0.622***	−0.149***	−0.009	−0.005	0.037**	−0.018	−0.258***	−0.067***	0.018	0.253***	0.396***	0.490***	1.000	
SDG	[17]	0.024	0.090***	0.281***	−0.471***	0.065***	0.032**	0.013	−0.014	0.027*	−0.134***	−0.049***	0.074***	0.487***	−0.263***	0.582***	0.110***	1.000

***, ** and * represent statistical significance at the 1, 5 and 10 percent levels, respectively. Variable definitions are provided in Table 2.

Table 5
Regression results between COVID-19 impact and changes in firm value

	Dependent variable = $\Delta TOBINQ$			
	COVID_INFECTION Model (1)	*COVID_DEATH* Model (2)	*SOC_HEALTH_RISK* Model (3)	Only control variables Model (4)
COVID_IMPACT	−0.007*	−0.007**	−0.084**	
	(−1.817)	(−2.395)	(−2.096)	
SIZE	0.007***	0.007***	0.007***	0.006***
	(4.210)	(4.203)	(4.289)	(4.462)
LEV	−0.002	−0.002	−0.005	−0.004
	(−0.158)	(−0.119)	(−0.365)	(−0.272)
ROA	−0.025	−0.026	−0.024	−0.024
	(−1.367)	(−1.458)	(−1.381)	(−1.298)
CAPIN	0.007	0.006	0.009	0.010
	(1.099)	(0.890)	(1.302)	(1.540)
DIVIDEND	−0.025***	−0.025***	−0.023***	−0.023***
	(−3.873)	(−3.891)	(−3.217)	(−3.443)
LIQUIDITY	0.007***	0.007***	0.007***	0.006***
	(6.159)	(6.205)	(5.860)	(5.659)
GROWTH	0.025*	0.025*	0.025*	0.026*
	(1.925)	(1.916)	(1.923)	(1.946)
CGOV_PERF	0.035***	0.035***	0.033**	0.037***
	(2.875)	(2.816)	(2.616)	(2.895)
LNGDP	−0.004	−0.001	−0.027*	−0.026
	(−0.212)	(−0.080)	(−1.723)	(−1.668)
SHAREHOLDER	−0.010	−0.005	0.014	−0.007
	(−0.686)	(−0.370)	(0.654)	(−0.473)
ENFORCE	0.001	−0.004	−0.004	0.009
	(0.113)	(−0.394)	(−0.244)	(0.736)

(continued)

Table 5 (continued)

	Dependent variable = $\Delta TOBINQ$			
	COVID_INFECTION Model (1)	*COVID_DEATH* Model (2)	*SOC_HEALTH_RISK* Model (3)	Only control variables Model (4)
CNTRY_GOV	−0.022***	−0.021***	−0.035***	−0.028***
	(−2.905)	(−2.719)	(−3.974)	(−3.531)
SDG	0.002	0.004***	0.004	0.003
	(1.157)	(3.014)	(1.643)	(1.634)
Intercept	−0.080	−0.247	0.338*	0.053
	(−0.478)	(−1.527)	(1.870)	(0.278)
Industry fixed effects	Yes	Yes	Yes	Yes
N	4,278	4,278	4,278	4,278
R^2	0.231	0.234	0.234	0.228
Gujarati (2003) ΔR^2-*F*-statistic	15.88***	32.46***	36.08***	

***, ** and * represent statistical significance at the 1, 5 and 10 percent levels, respectively. Coefficient values (robust *t*-statistics) are shown with standard errors clustered at the country level. Variable definitions are provided in Table 2.

standard deviation, as shown in Model (3).[3] The results are economically significant.

Regarding control variables, we find that the coefficients of *SIZE*, *LIQUIDITY*, *GROWTH* and *CGOV_PERF* are positive and statistically significant, suggesting that larger firms, with higher liquidity, higher growth and higher corporate governance performance enjoy a higher level of firm value. On the other hand, the coefficients for *DIVIDEND* are negative and statistically significant, indicating that firms that paid dividends have lower firm value. Regarding country-level control variables, we find that firms in countries with good investor rights have lower firm value. The probable reason is that COVID-19 deaths and infections are higher in developed market economies.

The R^2 values of our research models in Table 5 vary from 0.231 to 0.234, suggesting that the independent variables collectively capture between 23.10 percent and 23.40 percent of the variation of changes in firm value. To assess the incremental contribution of the impact of COVID-19 on the explanatory power of our regression models, we follow Gujarati (2003) by repeating our regression analyses in Table 5, after excluding the main test variable *COVID_IMPACT*, proxied by *COVID_INFECTION*, *COVID_DEATH* and *SOC_HEALTH_RISK*. Table 5, Model (4) reports the regression results. We then compare the explanatory power (R^2) of all three regressions from Models (1) to (3) with Model (4) and compute the *F*-statistic, as demonstrated by Gujarati (2003), using the R^2 statistics reported for the regressions with and without *COVID_IMPACT*. This tests the null hypothesis that the inclusion of *COVID_IMPACT* as an explanatory variable does not affect the explanatory power (R^2) of our regression models. The Gujarati (2003) *F*-statistics reported in Table 5 for Models (1)–(3) range between 15.88 and 36.08 and are significant at the 1 percent level, suggesting that *COVID_IMPACT* significantly increases the explanatory power of the regression models. It is suggested here that COVID-19 impact is incrementally informative information for explaining the changes in firm value. Overall, we find that the impact of COVID-19 is associated with a decline in firm value.

5.2.2. Impact of COVID-19 on changes in firm value: role of sustainability performance

In Table 6, we report the results of the role of sustainability performance in the association between country-level COVID-19 impact and changes in firm value. The key variable of interest in Table 6 is the interaction between COVID-19 impact and sustainability performance (*COVID_IMPACT* ×

[3]The standard deviations of the natural logarithm of COVID-19 infections, deaths, and societal health risk are 1.819, 1.952 and 0.237, respectively. The value 10.11% is computed as: (−0.007 × 1.819)/0.126); 10.85% as (−0.007 × 1.953)/0.126); and 15.80% as (−0.084 × 0.237)/0.126).

Table 6
Regression results between COVID-19 impact and changes in firm value: role of sustainability performance

	Dependent variable = $\Delta TOBINQ$		
	COVID_INFECTION Model (1)	*COVID_DEATH* Model (2)	*SOC_HEALTH_RISK* Model (3)
COVID_IMPACT	−0.012***	−0.014***	−0.130***
	(−3.488)	(−5.512)	(−3.149)
COVID_IMPACT×HIGH_SUST_PERF	0.020***	0.020***	0.135***
	(2.816)	(3.528)	(10.498)
HIGH_SUST_PERF	−0.146**	−0.085**	−0.501***
	(−2.184)	(−2.212)	(−10.894)
SIZE	0.006*	0.006*	0.007**
	(1.968)	(1.967)	(2.098)
LEV	−0.004	−0.004	0.013
	(−0.255)	(−0.258)	(1.125)
ROA	−0.026	−0.025	0.008
	(−1.498)	(−1.500)	(0.533)
CAPIN	0.005	0.004	0.006
	(0.835)	(0.596)	(0.950)
DIVIDEND	−0.027***	−0.027***	−0.022***
	(−4.481)	(−4.652)	(−4.070)
LIQUIDITY	0.006***	0.006***	0.006***
	(6.080)	(6.599)	(5.647)
GROWTH	0.026*	0.026*	0.016
	(2.004)	(1.981)	(1.541)
CGOV_PERF	0.029**	0.027**	0.035***
	(2.404)	(2.388)	(3.331)
LNGDP	−0.000	0.002	−0.021
	(−0.030)	(0.136)	(−1.321)

(continued)

Table 6 (continued)

	Dependent variable = $\Delta TOBINQ$		
	COVID_INFECTION Model (1)	*COVID_DEATH* Model (2)	*SOC_HEALTH_RISK* Model (3)
SHAREHOLDER	−0.005	0.001	0.016
	(−0.352)	(0.095)	(0.817)
ENFORCE	−0.000	−0.005	−0.007
	(−0.044)	(−0.420)	(−0.405)
CNTRY_GOV	−0.021***	−0.019***	−0.035***
	(−2.846)	(−2.705)	(−4.369)
SDG	0.002	0.003***	0.004*
	(1.165)	(2.699)	(1.721)
Intercept	−0.081	−0.229	0.428**
	(−0.518)	(−1.499)	(2.552)
Industry fixed effects	Yes	Yes	Yes
N	4,278	4,278	4,278
R^2	0.242	0.249	0.347

***, ** and * represent statistical significance at the 1, 5 and 10 percent levels, respectively. Coefficient values (robust *t*-statistics) are shown with standard errors clustered at the country level. Variable definitions are provided in Table 2.

HIGH_SUST_PERF). The interaction term captures the differences in the effects of country-level COVID-19 impact on changes in firm value between firms with higher sustainability performance and those with lower sustainability performance. Moreover, the coefficient of *COVID_IMPACT* captures the effects of country-level COVID-19 impact on changes in firm value for firms with lower sustainability performance. In Table 6, the coefficients of *COVID_IMPACT* are negative and statistically significant ($\beta = -0.012$, $p < 0.01$ in Model (1); $\beta = -0.014$, $p < 0.01$ in Model (2); and $\beta = -0.130$, $p < 0.01$ in Model (3)) across all models from Models (1) to (3), suggesting that, after controlling for other factors, the average reduction in firm value led by country-level COVID-19 impact is higher for firms with lower sustainability performance. On the other hand, the coefficients of the interaction term *COVID_IMPACT* × *HIGH_SUST_PERF* are positive and statistically significant ($\beta = 0.020$, $p < 0.01$ in Model (1); $\beta = 0.020$, $p < 0.01$ in Model (2); and $\beta = 0.135$, $p < 0.01$ in Model (3)) across all models from Models (1) to (3), suggesting that, after controlling for other factors, the average reduction in firm value led by country-level COVID-19 impact is lower for firms with higher sustainability performance. Furthermore, the sum of the coefficients of *COVID_IMPACT* and the interaction term *COVID_IMPACT* × *HIGH_SUST_PERF* across all models is positive, while a test of the linear combination of the coefficients of *COVID_IMPACT* and *COVID_IMPACT* × *HIGH_SUST_PERF* shows significant results for firms with higher sustainability performance ($F = 8.42$, $p < 0.01$ in Model (1); $F = 21.33$, $p < 0.01$ in Model (2); $F = 56.67$, $p < 0.01$ in Model (3)). Hence, the negative association of the impact of COVID-19 and changes in firm value is attenuated by sustainability performance. Overall, we find that sustainability performance has an important role in mitigating the negative impact of COVID-19 on changes in firm value.

6. Additional analysis and robustness checks

6.1. Instrumental variable analysis

We employ an instrumental variable method to re-estimate our models as some of the firm-level and country-level variables are difficult to quantify and control, with this possibly creating omitted variable bias (Huang *et al.*, 2018) in our findings. We choose three instrumental variables: population density (*POP_DENSITY*), population over 65 years of age (*AGE_65_YR*) and number of hospital beds per thousand of population (*HOSPITAL_BEDS*). The rationale behind population density (*POP_DENSITY*) is that COVID-19 infections and deaths spread more quickly in countries with higher population density. We select the percentage of population over 65 years of age (*AGE_65_YR*) as people in this age group are highly vulnerable to COVID-19 infections and death. Finally, the lower number of hospital beds per

thousand of population may affect COVID-19 infections and deaths due to the lack of public health support. We select these three instrumental variables as it is highly likely that they influence the extent of country-level COVID-19 infections and deaths, but they are unlikely to affect the market value of a firm. Therefore, we believe that these variables can be used as instrumental variables. We measure population density (*POP_DENSITY*) as the natural logarithm of the population per square kilometre. Furthermore, *AGE_65_YR* is the percentage of a country's population over 65 years of age. We measure *HOSPITAL_BEDS* as the natural logarithm of the number of hospital beds per thousand of population in a country: this figure is multiplied by minus one (−1) to interpret how the lower number of hospital beds may affect COVID-19 infections and death due to the lack of public health support.

Table 7 reports the two-stage least squares (2SLS) results. Models (1) and (3) report the first-stage results where COVID-19 infections and deaths are the dependent variables. The coefficients of *POP_DENSITY*, *AGE_65_YR* and *HOSPITAL_BEDS* are positive and highly significant, as expected. Furthermore, Shea's partial R^2 values are 23.80 percent in Model (1) and 30.01 percent in Model (3), while the partial *F*-statistics of the first-stage model are 442.205 in Model (1) and 606.897 in Model (2). Based on the analysis by Stock *et al.* (2002), these high *F*-statistics suggest that our instruments are not weak. Table 7, Models (2) and (4) report the second-stage regression results with *COVID_INFECTION* and *COVID_DEATH* instrumented from the first stage. The coefficients of *COVID_INFECTION* and *COVID_DEATH* are negative and statistically significant ($\beta = -0.007$, $p < 0.05$; $\beta = -0.005$, $p < 0.05$) in Models (2) and (4), corroborating our main findings. Finally, the over-identification test (Sargan test statistic) is statistically insignificant for both Model (1) ($\chi^2 = 4.495$, $p > 0.10$) and Model (2) ($\chi^2 = 3.667$, $p > 0.10$), suggesting that our instruments fulfil the conditions of exogeneity and relevance. Therefore, these three instrumental variables can be considered valid. Overall, our conclusion seems to be robust to endogeneity.

6.2. Impact of COVID-19 on changes in firm value: roles of country-level environmental-value orientation culture and stakeholder orientation culture

In this study, we examine the roles of two country-level factors that may affect the association between the impact of COVID-19 and firm value: environmental-value-oriented culture and stakeholder-oriented culture. Schwartz (1994, 2003) reports differences between countries on the extent to which they attach importance to the natural environment. That is, countries with universalistic-value orientation tend to underscore protecting the natural environment in their institutions and practices. The author states that countries with this value orientation give due regard to '[u]nderstanding, appreciation, tolerance, and protection for the welfare of all people and for nature', which are manifested in 'social justice', 'protecting the environment' and 'unity with

Table 7
Two-stage least squares (2SLS) regression results between COVID-19 impact and changes in firm value

	Dependent variable = $\Delta TOBINQ$			
	First-stage DV = *COVID_INFECTION* Model (1)	Second-stage DV = $\Delta TOBINQ$ Model (2)	First-stage DV = *COVID_DEATH* Model (3)	Second-stage DV = $\Delta TOBINQ$ Model (4)
COVID_IMPACT		−0.007**		−0.005**
		(−2.088)		(−2.284)
SIZE	0.020*	0.007***	0.033***	0.007***
	(1.930)	(5.399)	(2.600)	(5.430)
LEV	0.133*	−0.002	0.168*	−0.002
	(1.870)	(−0.259)	(1.890)	(−0.275)
ROA	−0.178	−0.025	−0.296*	−0.025
	(−1.420)	(−1.609)	(−1.890)	(−1.639)
CAPIN	−0.327***	0.007	−0.415***	0.007
	(−6.020)	(1.006)	(−6.120)	(1.021)
DIVIDEND	−0.238***	−0.025***	−0.263***	−0.025***
	(−6.290)	(−5.280)	(−5.550)	(−5.257)
LIQUIDITY	0.019*	0.007***	0.021*	0.007***
	(1.950)	(5.419)	(1.670)	(5.395)
GROWTH	−0.050	0.025***	−0.047	0.025***
	(−1.210)	(4.956)	(−0.900)	(4.992)
CGOV_PERF	−0.265***	0.035***	−0.283***	0.035***
	(−4.340)	(4.591)	(−3.710)	(4.686)
LNGDP	3.230***	−0.002	2.954***	−0.008
	(51.670)	(−0.152)	(37.850)	(−0.751)
SHAREHOLDER	−1.097***	−0.010	−0.585***	−0.005
	(−18.240)	(−1.465)	(−7.800)	(−0.791)
ENFORCE	−1.053***	0.001	−1.653***	−0.001
	(−25.800)	(0.115)	(−32.430)	(−0.114)

(continued)

Table 7 (continued)

	Dependent variable = $\Delta TOBINQ$			
	First-stage DV = *COVID_INFECTION* Model (1)	Second-stage DV = $\Delta TOBINQ$ Model (2)	First-stage DV = *COVID_DEATH* Model (3)	Second-stage DV = $\Delta TOBINQ$ Model (4)
CNTRY_GOV	0.700***	−0.021***	0.631***	−0.023***
	(33.880)	(−5.629)	(24.490)	(−7.043)
SDG	−0.191***	0.002**	−0.041***	0.004***
	(−21.080)	(2.511)	(−3.660)	(4.177)
POP_DENSITY	0.055***		0.063***	
	(4.410)		(4.040)	
AGE_65_YR	0.142***		0.297***	
	(14.070)		(23.570)	
HOSPITAL_BEDS	2.254***		3.191***	
	(35.560)		(40.20)	
Intercept	−9.662***	−0.089	−21.177***	−0.166
	(−7.390)	(−0.563)	(−12.980)	(−0.962)
Industry fixed effects	Yes	Yes	Yes	Yes
N	4,278	4,278	4,278	4,278
R^2	0.759	0.231	0.674	0.233
Shea's partial R^2	0.238		0.301	
Partial *F*-statistic	442.205***		606.897***	
Sargan test statistic (Over-identification test)		4.495 (*p*-value > 0.10)		3.667 (*p*-value > 0.10)

***, ** and * represent statistical significance at the 1, 5 and 10 percent levels, respectively. Coefficient values (robust *t*/*z*-statistics) are shown with standard errors clustered at the country level. Variable definitions are provided in Table 2.

nature' (p. 31). Following this line of thinking, we hypothesise that firms domiciled in countries with higher environmental-value orientation and stakeholder focus are likely to adopt firm-level stakeholder orientation. This would, in turn, mean that the adverse impact of COVID-19 on firm value would be less pronounced in these countries.

To test the role of environmental-value orientation culture, we created an indicator variable *HIGH_ENV_VALUE* with a value of 1 if the observation is in the top quartile of country-level environmental-value orientation culture, and 0 otherwise, with the latter labelled *LOW_ENV_VALUE*. We measure the country-level environmental-value orientation culture using data from the World Values Survey (WVS), with our study's regression results reported in Table 8. The coefficient of *COVID_IMPACT* is negative and statistically significant across all models ($\beta = -0.016$, $p < 0.01$ in Model (1); $\beta = -0.013$, $p < 0.05$ in Model (2)) except Model (3), suggesting that, after controlling for other factors, the average reduction in firm value led by country-level COVID-19 impact is higher for firms domiciled in countries with lower country-level environmental values. On the other hand, the coefficients of the interaction term *COVID_IMPACT* × *HIGH_ENV_VALUE* are positive and statistically significant ($\beta = 0.070$, $p < 0.05$ in Model (1); $\beta = 0.033$, $p < 0.10$ in Model (2); $\beta = 0.399$, $p < 0.10$ in Model (3)) across all models from Models (1) to (3), suggesting that, after controlling for other factors, the average reduction in firm value led by country-level COVID-19 impact is lower for firms with higher country-level environmental values. Furthermore, the sum of the coefficients of *COVID_IMPACT* and the interaction term *COVID_IMPACT* × *HIGH_ENV_VALUE* across all models is positive, while a test of the linear combination of the coefficients of *COVID_IMPACT* and *COVID_IMPACT* × *HIGH_ENV_VALUE* shows significant results for firms with higher country-level environmental values ($F = 5.78$, $p < 0.01$ in Model (1); $F = 3.57$, $p < 0.05$ in Model (2); $F = 2.57$, $p < 0.10$ in Model (3)). Hence, the negative impact of the COVID-19 pandemic on changes in firm value is attenuated by a country-level environmental-value culture. Overall, we find that a country-level environmental-value orientation culture has an important role in mitigating the negative impact of the COVID-19 pandemic on changes in firm value.

To test the role of country-level stakeholder-orientation culture, we create an indicator variable that takes a value of 1 if the firm is domiciled in a stakeholder-oriented country *(STAKE)*, and 0 otherwise. Following the prior literature (Simnett *et al.*, 2009), we define firms domiciled in code law countries as having a more stakeholder-oriented culture, while firms domiciled in common law countries are defined as having a more shareholder-oriented culture. In our sample of firms, some countries classified as neither shareholder oriented nor stakeholder oriented are excluded from this analysis. Table 9 reports the regression results. The coefficients of *COVID_IMPACT* are negative and statistically significant across all models ($\beta = -0.037$, $p < 0.01$ in Model (1); $\beta = -0.025$, $p < 0.01$ in Model (2); $\beta = -0.215$, $p < 0.01$ in

Table 8
Regression results between COVID-19 impact and changes in firm value: role of environmental-value orientation culture

	Dependent variable = *ΔTOBINQ*		
	COVID_INFECTION Model (1)	*COVID_DEATH* Model (2)	*SOC_HEALTH_RISK* Model (3)
COVID_IMPACT	−0.016***	−0.013**	−0.083
	(−2.907)	(−2.619)	(−1.642)
COVID_IMPACT × HIGH_ENV_VALUE	0.070**	0.033*	0.399*
	(2.636)	(1.769)	(1.737)
HIGH_ENV_VALUE	−0.483**	−0.062	−1.392
	(−2.255)	(−0.859)	(−1.663)
SIZE	0.004*	0.005**	0.005*
	(1.791)	(2.160)	(1.818)
LEV	0.006	0.006	0.006
	(0.384)	(0.353)	(0.335)
ROA	0.003	−0.005	0.003
	(0.165)	(−0.314)	(0.205)
CAPIN	0.005	0.004	0.008
	(0.848)	(0.746)	(1.140)
DIVIDEND	−0.012	−0.015	−0.011
	(−1.191)	(−1.473)	(−1.043)
LIQUIDITY	0.006**	0.006***	0.006**
	(2.349)	(2.695)	(2.184)
GROWTH	0.020	0.021	0.022
	(1.241)	(1.326)	(1.329)
CGOV_PERF	0.030**	0.030**	0.031**
	(2.660)	(2.482)	(2.570)
LNGDP	−0.001	−0.018	−0.074**
	(−0.029)	(−0.493)	(−2.445)

(continued)

Table 8 (continued)

	Dependent variable = $\Delta TOBINQ$		
	COVID_INFECTION Model (1)	*COVID_DEATH* Model (2)	*SOC_HEALTH_RISK* Model (3)
SHAREHOLDER	0.001	0.026	0.033
	(0.043)	(0.940)	(1.201)
ENFORCE	−0.003	−0.004	0.018
	(−0.161)	(−0.146)	(0.679)
CNTRY_GOV	−0.013	−0.018	−0.041***
	(−1.237)	(−1.558)	(−4.094)
SDG	0.003	0.006**	0.004
	(1.067)	(2.433)	(1.534)
Intercept	−0.084	−0.184	0.765**
	(−0.265)	(−0.437)	(2.596)
Industry fixed effects	Yes	Yes	Yes
N	4,278	4,278	4,278
R^2	0.369	0.345	0.355

***, ** and * represent statistical significance at the 1, 5 and 10 percent levels, respectively. Coefficient values (robust *t*-statistics) are shown with standard errors clustered at the country level. Variable definitions are provided in Table 2.

Table 9
Regression results between COVID-19 impact and changes in firm value: role of stakeholder orientation

	Dependent variable = *ΔTOBINQ*		
	COVID_INFECTION Model (1)	*COVID_DEATH* Model (2)	*SOC_HEALTH_RISK* Model (3)
COVID_IMPACT	−0.037***	−0.025***	−0.215***
	(−3.716)	(−4.820)	(−5.188)
COVID_IMPACT × STAKE	0.067**	0.032**	0.278***
	(2.337)	(2.163)	(6.380)
STAKE	−0.523**	−0.168**	−1.042***
	(−2.341)	(−2.336)	(−6.480)
SIZE	0.006***	0.006***	0.005***
	(7.206)	(5.687)	(5.884)
LEV	0.003	−0.000	0.016**
	(0.459)	(−0.025)	(2.438)
ROA	−0.014	−0.026**	0.004
	(−1.171)	(−2.165)	(0.285)
CAPIN	0.007	0.008	0.006
	(1.281)	(1.396)	(1.006)
DIVIDEND	−0.028***	−0.030***	−0.024***
	(−5.993)	(−8.287)	(−6.419)
LIQUIDITY	0.006***	0.006***	0.004***
	(4.434)	(5.054)	(3.269)
GROWTH	0.015*	0.018*	0.012
	(1.694)	(2.003)	(1.551)
CGOV_PERF	0.037***	0.036**	0.044***
	(2.758)	(2.531)	(3.724)
LNGDP	0.030	0.004	−0.002
	(1.123)	(0.219)	(−0.091)
ENFORCE	0.011	0.005	0.010
	(0.731)	(0.359)	(0.645)
CNTRY_GOV	−0.021*	−0.021**	−0.023**
	(−1.848)	(−2.353)	(−2.186)
SDG	−0.004	0.003	0.001
	(−1.361)	(1.131)	(0.304)
Intercept	0.265	−0.104	0.782***
	(1.005)	(−0.500)	(2.825)
Industry fixed effects	Yes	Yes	Yes
N	3,602	3,602	3,602
R^2	0.259	0.225	0.309

***, ** and * represent statistical significance at the 1, 5 and 10 percent levels, respectively. Coefficient values (robust *t*-statistics) are shown with standard errors clustered at the country level. Variable definitions are provided in Table 2.

Model (3)), suggesting that, after controlling for other factors, the average reduction in firm value led by country-level COVID-19 impact is higher for firms domiciled in countries with a shareholder-oriented culture. On the other

hand, the coefficients of the interaction term *COVID_IMPACT* × *STAKE* are positive and statistically significant ($\beta = 0.067$, $p < 0.05$ in Model (1); $\beta = 0.032$, $p < 0.05$ in Model (2); $\beta = 0.278$, $p < 0.01$ in Model (3)) across all models, suggesting that, after controlling for other factors, the average reduction in firm value led by country-level COVID-19 impact is lower for firms domiciled in a stakeholder-oriented culture. Furthermore, the sum of the coefficients of *COVID_IMPACT* and the interaction term *COVID_IMPACT* × *STAKE* across all models is positive, while a test of the linear combination of the coefficients of *COVID_IMPACT* and *COVID_IMPACT* × *STAKE* shows significant results for firms with higher country-level environmental values ($F = 7.06$, $p < 0.01$ in Model (1); $F = 13$, $p < 0.01$ in Model (2); $F = 26.86$, $p < 0.01$ in Model (3)). Hence, the negative impact of COVID-19 on changes in firm value is attenuated by a country-level stakeholder-oriented culture. Overall, we find that a country-level stakeholder-oriented culture has an important role in mitigating the negative impact of the COVID-19 pandemic on changes in firm value.

Overall, we find that firms in countries experiencing a higher level of COVID-19 impact have lower firm value. The negative impact is less pronounced for firms with higher sustainability performance, and for firms domiciled in countries with a higher environmental-value-oriented culture and a stakeholder-oriented culture.

6.3. Month-to-month analysis

We also examine the association month-by-month between COVID-19 impact and firm value to establish the robustness of our findings. Table 10, Panel A reports the regression results for the COVID-19 impact. The coefficient of *COVID_IMPACT* is negative and statistically significant across all models from March 2020 to July 2020; however, it is statistically insignificant for January 2020 and February 2020. This finding is not surprising given that COVID-19 became much more visible in March 2020. Furthermore, Table 10, Panel B shows the regression results for COVID-19 deaths. The coefficient of *COVID_IMPACT* is negative and statistically significant across all models from April 2020 to July 2020; however, it is statistically insignificant from January 2020 to March 2020.

Furthermore, Table 11, Panels A and B show the regression results of the moderating role of sustainability performance on the association between COVID-19 impact and firm value. Table 11, Panel A confirms that the coefficient of *COVID_IMPACT* is negative and statistically significant for firms with poorer sustainability performance, which is consistent with the main findings reported in Table 6. Furthermore, the coefficient of the interaction term *COVID_IMPACT* × *HIGH_SUST_PERF* is positive and statistically significant across all models from April 2020 to July 2020. This suggests that the average reduction in monthly firm value led by country-level COVID-19

Table 10
Regression results between COVID-19 impact and firm value: monthly analysis

Panel A: Regression results between COVID-19 infections and firm value (from January 2020 to July 2020)

	Dependent variable = *TOBINQ*						
	July 2020 *COVID INFECTION* Model (1)	June 2020 *COVID INFECTION* Model (2)	May 2020 *COVID INFECTION* Model (3)	April 2020 *COVID INFECTION* Model (4)	March 2020 *COVID INFECTION* Model (5)	February 2020 *COVID INFECTION* Model (6)	January 2020 *COVID INFECTION* Model (7)
COVID_IMPACT	-0.158**	-0.235***	-0.250***	-0.249***	-0.181*	0.114	0.198
	(−2.430)	(−3.497)	(−3.979)	(−3.958)	(−1.678)	(0.947)	(0.673)
Intercept	2.639	2.343	0.396	-1.399	2.059	8.475*	7.969*
	(1.026)	(0.818)	(0.139)	(−0.503)	(0.727)	(1.845)	(1.768)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4,278	4,278	4,278	4,278	4,278	4,278	4,278
R^2	0.211	0.207	0.212	0.214	0.212	0.200	0.204

Panel B: Regression results between COVID-19 deaths and firm value (from January 2020 to July 2020)

	Dependent variable = *TOBINQ*						
	July 2020 *COVID DEATH* Model (1)	June 2020 *COVID DEATH* Model (2)	May 2020 *COVID DEATH* Model (3)	April 2020 *COVID DEATH* Model (4)	March 2020 *COVID DEATH* Model (5)	February 2020 *COVID DEATH* Model (6)	January 2020 *COVID DEATH* Model (7)
COVID_IMPACT	-0.109**	-0.159***	-0.151***	-0.136***	-0.076	0.820	5.155
	(−2.050)	(−3.091)	(−3.156)	(−3.077)	(−1.112)	(1.474)	(1.232)

(continued)

Table 10 (continued)

Panel B: Regression results between COVID-19 deaths and firm value (from January 2020 to July 2020)

	Dependent variable = *TOBINQ*						
	July 2020 *COVID DEATH* Model (1)	June 2020 *COVID DEATH* Model (2)	May 2020 *COVID DEATH* Model (3)	April 2020 *COVID DEATH* Model (4)	March 2020 *COVID DEATH* Model (5)	February 2020 *COVID DEATH* Model (6)	January 2020 *COVID DEATH* Model (7)
Intercept	1.304	0.595	-0.395	-1.350	3.053	7.466*	7.607
	(0.516)	(0.205)	(−0.138)	(−0.495)	(1.129)	(1.727)	(1.687)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4,278	4,278	4,278	4,278	4,278	4,278	4,278
R^2	0.211	0.206	0.211	0.214	0.211	0.200	0.204

***, ** and * represent statistical significance at the 1, 5 and 10 percent levels, respectively. Coefficient values (robust *t*-statistics) are shown with standard errors clustered at the country level. Variable definitions are provided in Table 2.

impact is lower for firms with higher sustainability performance which is consistent with our findings shown in Table 6. We find qualitatively similar results for COVID-19 deaths used as a proxy for COVID-19 impact, as shown in Table 11, Panel B.

6.4. Additional control variables

In our regression models, we control for various country-level factors including country-level financial development (*LNGDP*), shareholder orientation (*SHAREHOLDER*), legal environment (*ENFORCE*), governance (*CNTRY_GOV*) and sustainable development goals (*SDG*). We also include country-level financial opaqueness, public awareness (Dhaliwal *et al*., 2012), country-level market capitalisation, and the number of listed companies as a control variable in Equation (1) as our variable of interest, COVID-19 impact, as measured by country-level total infections and total deaths, can be affected by these factors. We do not report the regression results in this paper for reasons of brevity. However, the unreported results show that our findings remain qualitatively similar after controlling for the above-mentioned variables.

6.5. Alternative measures of firm value

In this study, we use Tobin's Q as a measure of firm value. Prior studies argue that Tobin's Q may be biased due to potential measurement errors associated with this measure (Ferreira and Matos, 2008; Bose *et al*., 2017a, 2017b). We replaced *TOBINQ* with the natural logarithm of *TOBINQ* and $-1/TOBINQ$ to address this measurement issue. We again do not report these results in this paper for reasons of brevity. However, the unreported results show our findings remain qualitatively similar, and this corroborates the robustness of our findings.

6.6. Country-fixed effects and sensitivity analyses

In our main analysis, we used country-specific control variables. To assess the robustness of our findings, we re-run our baseline regression models using country-fixed effects. We do not report the regression results in this paper for reasons of brevity. However, the unreported results show that the tenor of our findings remains qualitatively similar using country-fixed effects. Furthermore, for country sensitivity tests, we re-run our regression models after excluding each of the following groups, one at a time: (1) US firms, (2) Japanese firms, (3) UK firms, (4) Chinese firms, (5) Italian firms and (6) firms from countries with less than 10, 20 and 30 observations. We find that the unreported results of each analysis remain qualitatively similar to our main findings.

Table 11
Regression results between COVID-19 impact and firm value: role of sustainability performance

Panel A: Regression results between COVID-19 infections and firm value (from January 2020 to July 2020)

	Dependent variable = *TOBINQ*						
	July 2020 *COVID INFECTION* Model (1)	June 2020 *COVID INFECTION* Model (2)	May 2020 *COVID INFECTION* Model (3)	April 2020 *COVID INFECTION* Model (4)	March 2020 *COVID INFECTION* Model (5)	February 2020 *COVID INFECTION* Model (6)	January 2020 *COVID INFECTION* Model (7)
COVID_IMPACT	-0.257***	-0.288***	-0.300***	-0.284***	-0.179*	0.104**	0.188
	(−5.253)	(−4.032)	(−3.855)	(−3.511)	(−1.753)	(1.996)	(1.639)
COVID_IMPACT×HIGH_SUST_PERF	0.196***	0.125*	0.110*	0.123**	0.055	-0.000	-0.137
	(3.469)	(1.844)	(1.701)	(2.045)	(0.777)	(−0.004)	(−0.990)
HIGH_SUST_PERF	-1.979***	-1.425***	-1.235**	-1.090**	-0.629	-0.430***	-0.358***
	(−4.391)	(−2.626)	(−2.461)	(−2.468)	(−1.474)	(−3.463)	(−3.115)
Intercept	3.697**	2.504	1.358	0.914	4.480**	6.783***	6.246***
	(2.152)	(1.213)	(0.649)	(0.451)	(2.561)	(4.070)	(3.471)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4,278	4,278	4,278	4,278	4,278	4,278	4,278
R-squared	0.280	0.211	0.215	0.216	0.214	0.203	0.206

Panel B: Regression results between COVID-19 deaths and firm value (from January 2020 to July 2020)

	Dependent Variable = *TOBINQ*						
	July 2020 *COVID DEATH* Model (1)	June 2020 *COVID DEATH* Model (2)	May 2020 *COVID DEATH* Model (3)	April 2020 *COVID DEATH* Model (4)	March 2020 *COVID DEATH* Model (5)	February 2020 *COVID DEATH* Model (6)	January 2020 *COVID DEATH* Model (7)

(continued)

Table 11 (continued)

Panel B: Regression results between COVID-19 deaths and firm value (from January 2020 to July 2020)

	Dependent Variable = *TOBINQ*						
	July 2020 *COVID DEATH* Model (1)	June 2020 *COVID DEATH* Model (2)	May 2020 *COVID DEATH* Model (3)	April 2020 *COVID DEATH* Model (4)	March 2020 *COVID DEATH* Model (5)	February 2020 *COVID DEATH* Model (6)	January 2020 *COVID DEATH* Model (7)
COVID_IMPACT	-0.206***	-0.194***	-0.170***	-0.137***	-0.087	0.541**	3.140*
(−4.776)	(−3.453)	(−3.178)	(−2.833)	(−1.323)	(2.094)	(1.657)	
COVID_IMPACT×HIGH_SUST_PERF	0.155***	0.106*	0.086*	0.090*	0.079	-0.134	-2.145
	(3.075)	(1.856)	(1.640)	(1.960)	(1.384)	(−0.481)	(−1.016)
HIGH_SUST_PERF	-1.182***	-0.966***	-0.803***	-0.593***	-0.492***	-0.397***	-0.360***
	(−4.577)	(−3.265)	(−3.053)	(−2.783)	(−3.230)	(−3.610)	(−3.262)
Intercept	4.116**	3.746*	3.386*	3.267*	5.741***	5.756***	6.113***
	(2.365)	(1.893)	(1.814)	(1.931)	(3.777)	(3.145)	(3.298)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4,278	4,278	4,278	4,278	4,278	4,278	4,278
R-squared	0.279	0.209	0.213	0.214	0.214	0.203	0.206

***, ** and * represent statistical significance at the 1, 5 and 10 percent levels, respectively. Coefficient values (robust *t*-statistics) are shown with standard errors clustered at the country level. Variable definitions are provided in Table 2.

6.7. Other analyses

In our sample, 3,402 firms have a December fiscal year-end. Our dependent variable, $\Delta TOBINQ$, is estimated as the difference between the daily average value of Tobin's Q from 1 January 2020 to 31 July 2020 and the daily average value of Tobin's Q during December 2019 divided by the daily average value of Tobin's Q during December 2019. To evaluate the robustness of our findings, we re-run our regression models using only those firms that closed their financial year on 31 December 2019. For reasons of brevity, we do not report these results in this paper. However, the unreported results show that the tenor of our findings remains the same.

7. Conclusion

In this study, we examine the association between the impact of COVID-19 and changes in firm value and the moderating role of firm-level sustainability performance on this association. We also examine the moderating role of country-level environmental-value-oriented culture and stakeholder-oriented culture on the association between COVID-19 impact and changes in firm value. Using data from 4,278 firms from 47 countries, we find that firms worldwide have experienced a serious decline in firm value due to the COVID-19 pandemic. However, the negative impact of COVID-19 on changes in firm value is less pronounced for firms with higher sustainability performance, firms domiciled in countries with a lower environmental-value-oriented culture, and firms in a country with a stakeholder-oriented culture.

The findings of this study offer both empirical and theoretical contributions. First, our study's empirical evidence of the role of firm-level sustainability performance in mitigating firm value decline in the aftermath of the COVID-19 pandemic extends the literature on the impact of crises on firm value. Methodologically, the COVID-19 pandemic has created an appropriate setting in which to conduct a cross-country study, as the scale of this pandemic is far more global, and damagingly so, compared to previous pandemics. Second, the study adds to the ongoing debate on firms' shareholder value focus versus stakeholder value focus by proposing a viable alternative for underpinning corporate governance in our contemporary society (see Smith, 2003; Freeman, 2010). Third, our findings have implications for policymakers. That is, the findings suggest the need to consider corporate sustainability performance when making decisions on corporate regulatory policies or on any possible stimulus package to boost economies in the post-pandemic period.

Some limitations of this study need to be highlighted. First, the impact of the pandemic was not fully documented at the time we collected our data and conducted the analysis. As the COVID-19 impact is still unfolding, a more complete picture could emerge with data over a more extended period, with this possible in the future. Nonetheless, our study offers theoretical insights and

initial empirical evidence to facilitate further research. Second, we rely on the Refinitiv ESG database coverage for selection of firms in our sample which covers firms from only 47 countries. Future studies could validate our findings by covering firms from more countries. Third, we document our findings based on only one year of data. Future studies could analyse multiperiod data to examine the impact of COVID-19 by considering pre- and post-pandemic periods. Although we control for several variables at firm level, country level and industry level, our study may suffer from omitted variable bias. Despite the limitations, the findings of our study add to the growing body of literature on the impact of the COVID-19 pandemic on the capital market, and the role of sustainability performance in mitigating the decline in firm value during such times of crisis.

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