



# Environmental stocks, CEO health risk and COVID-19

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## ABSTRACT

During the COVID-19 pandemic, we find that Australian firms with environmentally sustainable practices generated higher abnormal returns. Firms with CEOs who were exposed to significant health risks from COVID-19 experienced poorer stock market performance. Firms with low pre-COVID default risk and high pre-COVID liquidity performed better during the COVID-19 stock market crash. This research signifies the importance of environmental sustainability for Australian firms to endure pandemics such as COVID-19.

## 1. Introduction

The massive economic and financial shocks from COVID-19 provide us with an opportunity to evaluate if firms benefit from responsible, sustainable environmental practices. With a worldwide death toll reaching 1 million by the end of September 2020, the COVID-19 poses an unprecedented health risk for the world's population, with extraordinary economic and financial consequences. This externally imposed health risk derived from the COVID-19 constitutes also an fertile setting for testing "the CEO effect" (Liebersohn and O'Connor, 1972; Crossland and Hambrick, 2011).

In the absence of an effective medical treatment during its first wave, the only feasible solutions were hygiene and social distancing measures. Lockdowns and mobility restrictions completely halted business activity across the world. By June 2020, the Organization for Economic Cooperation and Development projected a 7.6 % contraction of the world's economic output and a near doubling of the unemployment rate to reach 10 % by the end of 2020. The COVID-19 has also had devastating effects on all major financial markets. For example, in the period from 19 February to 23 March, the Nikkei 225, the S&P500, the EURO STOXX 50 and the ASX 200 incurred value losses of 32 %, 41 %, 44 % and 45 % respectively.<sup>1</sup> The gradual re-opening of economies from May 2020 was followed by a resurgence of COVID-19 cases, which clearly indicates that the health crisis remains with us and will surely have long-lasting economic effects.

Our analysis of the market assessment of environmental sustainability performance of ASX 200 non-financial firms during the COVID-19 market crash present that firms with high environmental scores perform better by 4.25 % or AU\$ 130 million,<sup>2</sup> i.e., investors value positively corporate environmentally sustainable practices. This result suggests that in a situation when drastic expenditure cuts

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<sup>1</sup> See Fig. 1 for the value loss of ASX 200

<sup>2</sup> Absolute figures relate to the median sized firm in the sample of study.

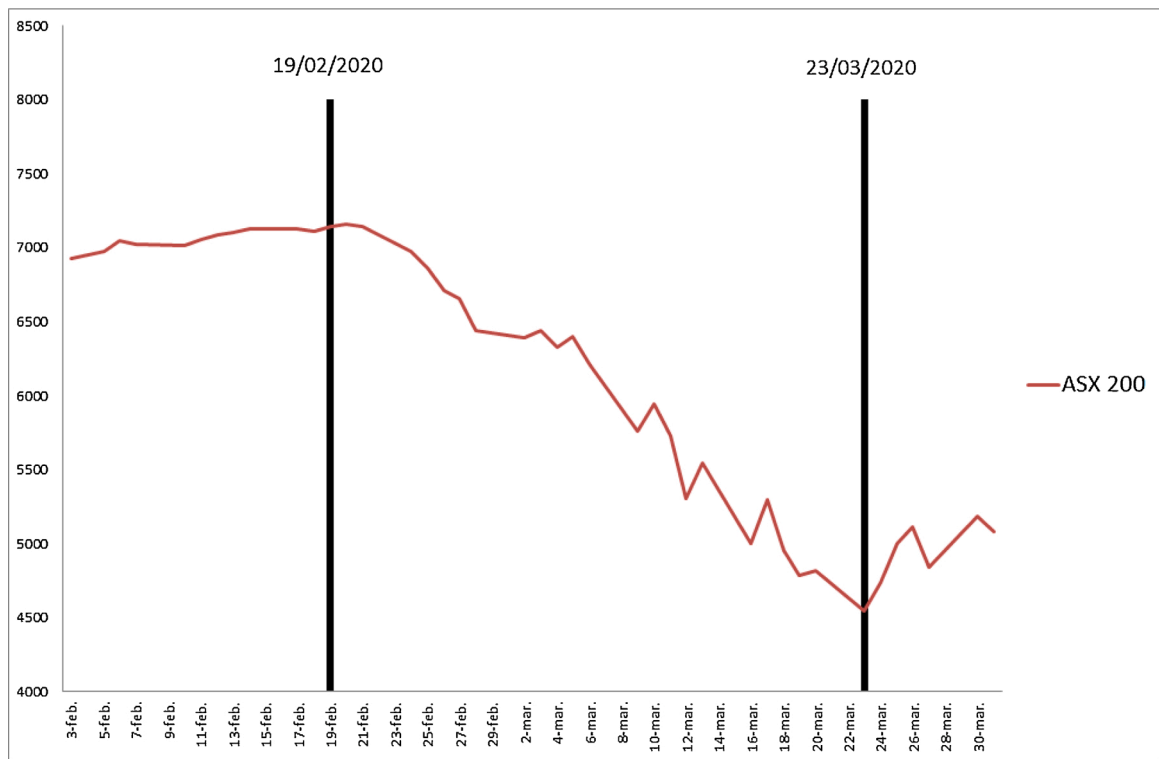


Fig. 1. Evolution of the ASX 200 index during the COVID-19 crisis.

might be necessary for the survival of Australian firms, still our investors favour environmental sustainability. Our results for CEOs' health risk illustrate that firms with aged-CEOs perform worse by 7% or AU\$ 209 million during the COVID-19, which conveys that investors perceive a "CEO effect" derived from the harmful impact of the health risk from the COVID-19. Finally, we find that the firms with low pre-COVID default risk and high pre-COVID liquidity perform better during the COVID-19 and these are crucial factors for firms to navigate through the pandemic.

Although the source of the COVID-19 remains elusive, it is alleged to be animal-origin (Andersen et al., 2020) and like previous zoonotic pandemics such as SARS and MERS, its expansion relates to poor environmental practices (Contini et al., 2020; Decaro and Lorusso, 2020).<sup>3</sup> There is evidence that relates COVID-19 to poor environmental conditions (Espejo et al., 2020). Multiple studies show a positive relationship between air pollution and death risk from COVID-19 (Andree, 2020; Fattorini and Regoli, 2020; Magazzino and Schneider, 2020; Ogen, 2020; Pansini and Fornacca, 2020; Wu et al., 2020 and Travaglio et al., 2021). There is also evidence of the positive influence of good air quality on COVID-19 recoveries (Saha et al., 2020).

Prior studies show mixed evidence on the nature of the association between environmental activities and firm performance (e.g., Chen and Metcalf, 1980; Hart and Ahuja, 1996; Orlitzky et al., 2003; Filbeck and Gorman, 2004; Moneva and Ortas, 2010; Gonenc and Scholtens, 2017; Limkriangkrai et al., 2017). However, with a meta-analysis of the literature on environmental and financial performance, Golcic and Smith (2013) weigh more on the positive association. There are also signs of the growing importance for businesses of practising environmental sustainability. For instance, there is a steady growth in firms' non-financial reporting requirements,<sup>4</sup> and the green bond market has grown over the past few years.<sup>5</sup> If the investors perceive that the origin of the on-going pandemic is linked to poor environmental policies, the markets might punish companies with a weak record on environmental practices.

<sup>3</sup> Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS)

<sup>4</sup> There are mandatory sustainability reporting requirements affecting all public-interest entities operating in European Union, US listed companies subject to the Securities and Exchange Commission regulations, UK listed companies under the Companies Act 2006 or Chinese large corporations under the 2008 Environmental Information Disclosure Act. According to the 2016 "Carrots and sticks" report published by the Global Reporting Initiative (GRI) the amount of reporting instruments grew from 60 affecting 19 countries in 2006 to 383 affecting 71 countries in 2016.

<sup>5</sup> Since the publication of the UN sustainable development goals (SDGs) in 2015, the size of the green bond market has multiplied by 6 from a USD 41.8 billion to USD 255 billion in 2019 and 30% of the European Union's €750 billion recovery fund will be raised through green bonds. In parallel with this growth in green financial instruments, there is a proliferation of green stock exchange indexes and even the creation of the Luxembourg Green Exchange (LGX) exclusively dedicated to green finance.

However, the evolution to a green economy requires massive investments that investors might consider mistimed during this severe recession.<sup>6</sup> There are signs indicating a growing resistance to the implementation of sustainable corporate practices. On March 26, 2020, the US Environmental Protection Agency (EPA) announced a freeze in the enforcement of environmental regulations due to the COVID-19 crisis. The adoption of less restrictive environmental business regulations might dampen the comparative return for companies that follow environmentally sustainable policies. Therefore, if investors anticipated a post COVID-19 scenario characterised by deregulation and a less green economic recovery, the investment in good environmental business practices might be seen as impractical. Moreover, if environmental sustainability programmes require the use of resources that are necessary to sustain corporations during the economic slowdown, environmentally friendly companies might experience negative market returns. In sum, given there are positive and negative views on environmental initiatives, how investors view pro-environment stocks remains an empirical question. Therefore, this study uses an extreme event such as COVID-19 to seek to address, and perhaps resolve, the tension in this literature.

Australia is an ideal setting to analyse investor assessment of sustainability practices during the current COVID-19 crisis for three main reasons: the relatively high contribution of Australia to the 2100 global warming targets, the modest environmental sustainability performance of Australian companies and finally the particularly intense value loss suffered by Australian listed companies during the COVID-19 market crash. Australia is a special case within the group of countries that have ratified the Paris agreement for climate change. With 420 million tons of CO<sub>2</sub> emitted from fossil fuel and cement production in 2018 (1.14 % of total world's CO<sub>2</sub> emissions), Australia ranks 17th position among the top CO<sub>2</sub> world emitters, far below US (5416 million tons) and China (10,064 million tons).<sup>7</sup> However, with a population of 25 million, Australia is the highest emitter per capita among the developed countries. In addition, as the second largest coal exporting country as per IEA data in 2019, Australia's carbon footprint in the world is significantly greater than the emissions produced by any of its neighbouring countries. Furthermore, bush fire is a major polluting factor in Australia that is much less common in other developed countries. According to the Department of Industry, Science, Energy and Resources, CO<sub>2</sub> emissions from bush fire in the 2019–20 season reached 830 million tons. Altogether, these figures suggest that Australia should carry a higher weight in the achievement of the world's global warming goals for 2100 compared to what was initially suggested by the size of its economy.

Although there has been a steady improvement in the past few years, there are signs indicating that Australian corporations do not score particularly well in environmental sustainability activities. In this regard, in Appendix A, when we compare the environmental scores from Sustainalytics between companies from Australia and the European Union, we find that Australian corporations obtain consistently significantly lower scores in all years between 2009 and 2018. Additionally, Australian firms tend to be less informative about their environmental sustainability practices as evident by the lower percentage of ASX 200 companies responding to the 2017 CDP climate change questionnaire (38 %) compared to FTSEurofirst 300 companies (86 %) and S&P500 firms (68 %). All the above figures show that Australian firms face a major challenge to improve their environmental sustainability practices and its communication to the markets. However, it also casts doubts about the importance of environmental policies to Australian investors. In the context of the COVID-19 market crash suffered by Australian corporations, which amounted for 45 % in the ASX 200 stocks and 46 % in the ASX All Ordinaries, we test the possible connection between these value losses and poor environmental performance of Australian stocks.

Independently of its causes, one of the obvious effects of the COVID-19 pandemic is the disruption on the firms' operations due to the threat posed to the health of the workforces. This effect might be especially relevant for key employees such as the CEO as suggested by the upper echelons theory (Hambrick and Mason, 1984). An abrupt CEO turnover event due to sudden illness or death is a disruptive event for the firm because of the costly and time-consuming process of an unplanned succession. An unplanned CEO change often leads to a temporary CEO succession, which is associated to lower firm's performance (Ballinger and Marcel, 2010). Even in the absence of CEO turnover, CEO illness harms her/his ability to perform managerial duties as demonstrated by the negative effect of CEO's hospitalization on the firm's performance (Bennedsen et al., 2020). Thus, the analysis of the market reaction to the sudden increase of the CEO's health risk imposed by COVID-19 constitutes an opportunity to gauge the investors view on the relevance of CEOs for the firm performance.

From the very early stages of the COVID-19 pandemic, there was a widespread notion that older adults, especially those who are over 60 years of age are exposed to fatal outcomes, i.e., death from this COVID-19. On February 14th 2020, the health officials in China disclose that the fatality rate from COVID-19 increases with age, with a substantial increase for the group of age above 60 years. There is also ample evidence indicating that older age is associated with higher disease severity and mortality from COVID-19 (Chen et al., 2020; Huang et al., 2020 and Wang et al., 2020). If the market perceives the disruptive effect of CEO health risk due to COVID-19, we expect that the market reaction to the COVID-19 crisis will be worse for firms with aged CEOs because of their higher mortality risk. Indeed, our results provide novel evidence that firms with aged-CEOs performs worse during the COVID-19.

Our paper makes several important contributions to the literature. First, we contribute to the literature on environmental sustainability and financial performance. Evidence of the impact of environmental sustainability on firm's performance is mixed and it

<sup>6</sup> The International Energy Agency (IEA) estimates a global investment of \$10.5 trillion is essential in low-carbon energy technologies over the period 2015–2030 to avoid catastrophic climate change (IEA, 2012). Similarly, the European commission estimates an annual €350 billion investments in clean energy to fulfil the 2030 target of a 55% reduction in greenhouse gas emissions. The IEA also estimates a total amount of \$304 billion investment in stranded assets derived from the transition to a low carbon economy (IEA, 2014).

<sup>7</sup> The United States signed initially the Paris agreement although under the Trump administration it has withdrawn from the agreement with effect on November 2020.

remains an open question (Chen and Metcalf, 1980; Hart and Ahuja, 1996; Orlitzky et al., 2003; Filbeck and Gorman, 2004; Moneva and Ortas, 2010; Gonenc and Scholtens, 2017). Our results indicating a positive view of investors on environmental sustainability practices during pandemic reinforce the notion that investors consider environmental performance as an important factor to lighten the current situation. In sum, the positive market's assessment of environmental sustainability practices provides a strong argument for the Australian companies to improve their environmental sustainability practices and keep their commitment with the global warming targets.

Second, we contribute to the long debate on the effect of CEO attributes on firm outcomes (Liebersohn and O'Connor, 1972; Thomas, 1988; Mackey, 2008). Evidence about the "CEO effect" is inconclusive with studies reflecting the growing influence of the CEO on the firm's affairs (Quigley and Hambrick, 2015; Quigley et al., 2017), and others suggesting that the impact of CEOs on firm performance is modest (Finkelstein and Hambrick, 1996) or mostly due to chance (Fitza, 2014, 2017). We provide novel evidence that CEOs' health risk is a significant explanatory factor of firm performance during COVID-19. Our results suggest that firms suffer higher loss when CEOs are exposed to significant health risk due to their old age.

Finally, our paper contributes to the growing literature on the COVID-19 shock and its consequences on firms (Goodell and Huynh, 2020). Similar to Fahlenbrach et al. (2020) and Ramelli and Wagner (2020), we register a positive impact of firm's liquidity and a negative effect of financial leverage on the firm's market performance during the COVID-19 market crash. In addition, we present that firm pre-COVID solvency as proxied by Altman's Z score has a positive impact on the firm's performance during the crisis.

The structure of this paper is as follows. In Section 2, we describe the data and empirical framework to test our hypothesis. Section 3 presents our empirical results while Section 4 provides additional analysis. Finally, Section 5 concludes the paper.

## 2. Data and empirical framework

### 2.1. Data

Our sample consists of 126 observations for non-financial ASX listed companies in 2019 for which we have ESG scores. The ESG scores have been obtained from the consulting firm Sustainalytics. All data relating to the firm's board structure are from the Connect4 Boardroom database. The financial and market data which is used to determine the size of the company, its profitability, leverage, investment and growth opportunities and market adjusted returns comes from Capital IQ.

### 2.2. Measures of variables

Our paper analyzes the market assessment of firms' environmental sustainability performance and the CEO's health risk during the COVID-19 crisis.

The dependent variable is the continuously compounded cumulative abnormal returns (CAR) in the Period of COVID-19 crisis. We estimate abnormal returns as the residuals from the market model (Sharpe, 1963) using daily stock and ASX 200 index returns from 2019. The sanitary crisis started with the first cases notified in Wujian early in January 2020 and it is still in development in different geographic areas with diverse levels of intensity. Although the COVID-19 is still expanding in the world we are going to focus on the initial market reactions to the expansion of the disease from China to other countries in Asia and the rest of the continents. Thus, based on the evolution of most of the main market indexes we have selected the window starting on Feb 19th and ending on March 23th.<sup>8</sup> Our results are robust to the use of the fever period (February 24 to March 20) considered by Ramelli and Wagner (2020), the collapse period (February 3 to March 23), used by Fahlenbrach et al. (2020) or the crisis period (February 20 to March 20) considered by Garel and Petit-Romec (2020).

The first variable of interest is the firms' environmental sustainability performance. We use the natural logarithm of the environment component of the firm's weighted ESG score provided by the consulting firm Sustainalytics (ENVIRONMENT). The weighted ESG scores range from 0 to 100 with low (high) values indicating poor (strong) sustainability performance. We use also an indicator of the firm's environmental transparency (CDP) that takes the value one if the firm communicates its emissions to the Carbon Disclosure Project (CDP) through their CDP Climate Change initiative and zero otherwise. The second variable of interest is the CEO's exposure to health risk due to COVID-19. We use the natural logarithm of the CEO's age (CEO AGE) and the log transformation of the corresponding fatality rates by age group as published by the Chinese Center for Disease Control and Prevention (CDC) as of 17th February (CEO FATALITY).

We include a set of four control variables that might affect the firm's market performance. Particularly, we control firm size (SIZE = natural logarithm of the firm's book value of total revenue), profitability (ROI = the ratio of earnings before interest payments and income taxes to total assets), leverage (LEVERAGE = total liabilities over total assets ratio), growth opportunities (MKTBOOK = Equity market to Book ratio). Table 1 presents the definitions of all variables used in this study.

### 2.3. Descriptive statistics and correlations

Panel A of Table 2 shows the descriptive statistics of the variables while Panel displays B displays the Pearson coefficients of pair-

<sup>8</sup> See Figs. 1 and 2.

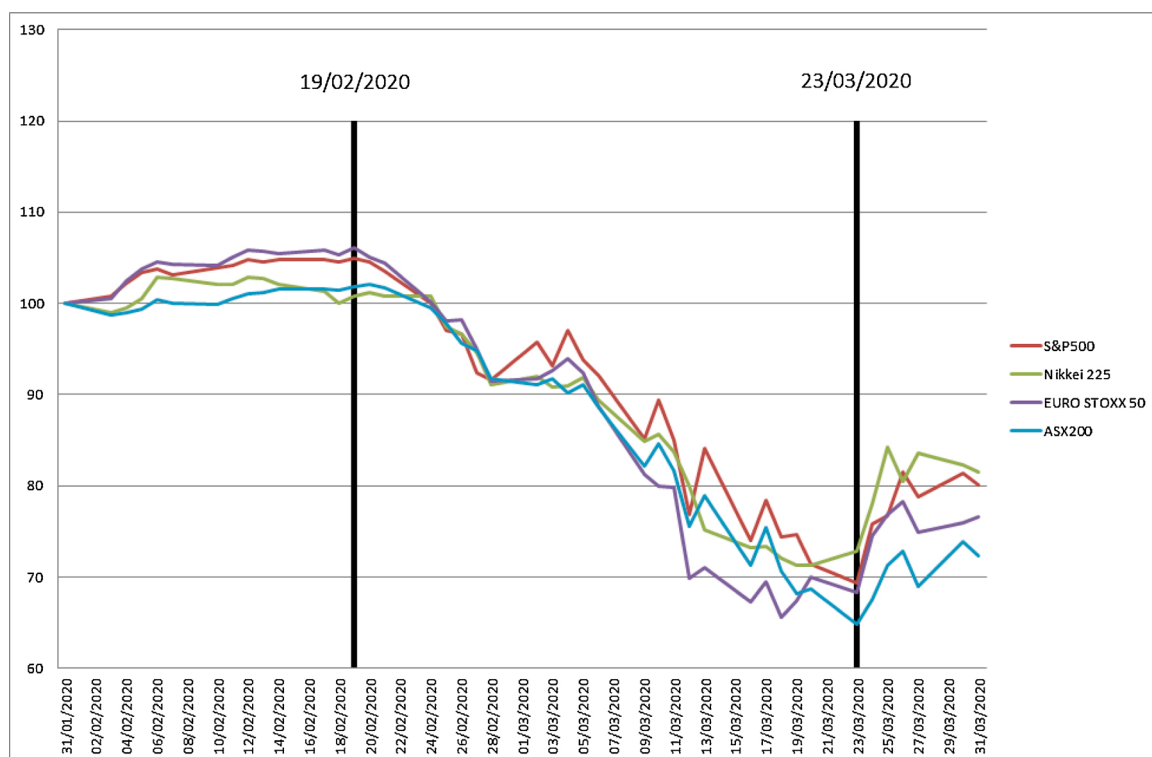


Fig. 2. Evolution of the main market indexes during the COVID-19 crisis.

Table 1

Definition of variables.

CAR 19/02 to 23/03	Cumulative Abnormal return in the crash period from February 19 <sup>th</sup> to March 23 <sup>rd</sup> .
CAR 03/02 to 23/03	Cumulative Abnormal return in the collapse period from Fahlenbrach et al.'s (2020) March 2 <sup>nd</sup> to March 23 <sup>rd</sup> .
CAR24/02 to 20/03	Cumulative Abnormal return in the fever period from Ramelli and Wagner's (2020) February 24 <sup>th</sup> to March 20 <sup>th</sup> .
CAR 20/02 to 20/03	Cumulative Abnormal return in the crisis period crisis from Garel and Petit-Romec's (2020) February 20 <sup>th</sup> to March 20 <sup>th</sup> .
ENVIRONMENT	Logarithm of the environmental component of the historical weighted ESG firm's score.
CDP	Binary variable takes the value one if the firm communicates its emissions to the Carbon Disclosure Project (CDP) through their CDP Climate Change initiative and zero otherwise.
CEO AGE	Logarithm of the CEO's age.
CEO FATALITY	Log transformation CEO'S fatality rate based on fatality rates by age group published by the Chinese Centre for Disease Control and Prevention (CDC) as of 17th February.
ZSCORE	Altman's Z score.
LIQUIDITY	Logarithm of the firm's book value of cash and short-term financial investments.
LABOUR	Ratio of number of workers to the firm's book value of total revenue.
INTENSITY	
GROWTH	Ratio of market capitalization to book value of equity.
SIZE	Logarithm of the firm's book value of total revenue.
ROI	The ratio of EBIT to total assets.
LEVERAGE	The ratio of book value of total liabilities to total assets.

wise correlations.

The average abnormal return in all windows considered is negative ranging from -11 % to -16 %. The average environmental ESG score is 53.74. This score as shown in Appendix A has been growing steadily from 2009 to 2018 registering the improvement in the environmental sustainability practices of Australian firms. However, as show also in Appendix A, Australian firms score significantly below European companies all throughout this period. The percentage of firms in our sample reporting emissions to de CDP is 30 %. This is a further indication of the relatively weak environmental performance of Australian firms clearly below the 86 % among the firms included in the FTSEurofirst 300 index.

The average and median CEO's age is 56 years, slightly below the 60-year threshold considered for the population of risk. This means that a significant proportion of the CEOs in the sample of study faces a relevant health-risk from COVID-19. The average fatality

**Table 2**  
Descriptive statistics.

Variable	Obs	Mean	Median	Std. Dev.	Min	Max
CAR 19/02 to 23/03	126	−0.1333615	−0.0479111	0.3635585	−1.161535	0.5402228
CAR 03/02 to 23/03	126	−0.1664143	−0.0975283	0.3796705	−1.327525	0.5055172
CAR 24/02 to 20/03	126	−0.1664143	−0.0975283	0.3796705	−1.327525	0.5055172
CAR 20/02 to 20/03	126	−0.1170267	−0.0484302	0.3415489	−1.051925	0.4732928
ENVIRONMENT	126	53.74708	51.585	12.32107	34.257	92.78
CDP	113	0.300885	0	0.4606857	0	1
CEO AGE	102	56.41176	56.5	6.189024	37	77
CEO FATALITY	102	1.970588	1.3	1.410469	0.2	8
LABOUR INTENSITY	150	3.515136	2.106969	4.556707	0.1321533	34.11606
ZSCORE	152	1.974117	1.695735	1.374419	−0.386921	10.7637
LIQUIDITY	154	212.7884	70.39978	330.2018	4.25647	1494.3
SIZE	154	2775.496	1250.119	3708.179	0.00425	12,974
ROI	154	0.0899374	0.0891642	0.0938249	−0.4267571	0.3752292
LEVERAGE	154	0.8584167	0.3756067	1.683552	−1.473033	15.61875
GROWTH	154	4.567595	2.46569	5.807559	−21.64174	31.44674

This table presents descriptive statistics of the variables in the regression models. CAR 19/02 to 23/03 is the cumulative abnormal returns during the market crash period from February-19 to March-23 (based on the observation of stock market index returns in Figs. 1 and 2). CAR 03/02 to 23/03, CAR 24/02 to 20/03 and CAR 20/02 to 20/03 are cumulative abnormal returns in crisis period definitions of Fahlenbrach et al. (2020); Ramelli and Wagner (2020) and Garel and Petit-Romec (2020) respectively. ENVIRONMENT is the environmental component of the historical weighted ESG firm's score. CDP is a binary variable that takes the value one if the firm communicates its emissions to the Carbon Disclosure Project (CDP) through their CDP Climate Change initiative and zero otherwise. CEO AGE is the CEO's age in years. CEO FATALITY is the CEO'S fatality rate based on fatality rates by age group published by the Chinese Centre for Disease Control and Prevention (CDC) as of 17th February. ZSCORE is Altman's Z score. LIQUIDITY is the firm's book value of cash and short-term financial investments. LABOUR INTENSITY is the ratio of number of workers to the firm's book value of total revenue. SIZE is the firm's book value of total revenue. ROI is the ratio of EBIT to total assets. LEVERAGE is the ratio of book value of total liabilities to total assets. GROWTH is the ratio of market capitalization to book value of equity. All variables are defined as in Table 1 except for ENVIRONMENT, CEO AGE, CEO FATALITY, LIQUIDITY and SIZE which for the sake of clarity are not log transformed.

rates for those that are infected is 1.9 % ranging from 0.2 % in the case of the youngest CEOs to a significant 8% in the case of the eldest CEOs.

We observe in Table 3 significant positive correlations between our indicators of environmental sustainability performance (ENVIRONMENT and CDP) and the cumulative abnormal returns in the window starting in Feb 19th and ending on March 23rd (CAR 20/02 to 23/03).<sup>9</sup> This result provides support to the hypothesis that investors value positively the efforts of the companies to hold environmentally sustainable business practices. We also find negative correlations between the two proxies of CEOs' health risk (i.e. CEO AGE and CEO FATALITY) and the cumulative abnormal returns, which supports the notion that investors are aware of the health risk borne by CEOs and consequently, companies managed by older CEOs which are exposed to higher fatality rates from COVID-19, suffer higher value losses during the COVID-19 crisis. As for the variables used in the additional analyses of section 4, there are positive and statistically significant correlations between the indicators of liquidity (LIQUIDITY) and solvency (ZSCORE) and the abnormal results during the COVID-19 crisis. These positive correlations show that the market views firms with solid financial positions that hold a significant amount of liquid assets as better equipped to endure the financial tensions derived from the COVID-19 crisis. Finally, we observe a negative correlation between the ratio of the number of workers to total revenue indicating that labour intense business are subject to stronger disruption in their activities due to COVID-19 exposure of the staff and consequently suffers higher value losses during the COVID-19 crisis.

## 2.4. Empirical framework

The following regression equation is used to test our hypotheses on the effect of the firm's environmental sustainability practices and CEO's exposure to health risk on the firms' market performance throughout the COVID-19 crisis:

$$CAR_{i,t} = \alpha_i + \beta_1(ENVIRONMENT|CEO HEALTH RISK)_i + \sum_{i=1}^8 \mu_i(CONTROLS)_i + \sum_{k=1}^8 \delta_k(INDUSTRY)_k + \varepsilon_i \quad (1)$$

where subscript i denotes individual firms. The coefficients  $\alpha$ ,  $\beta$ ,  $\mu$  and  $\delta$  are the parameters to be estimated, while  $\varepsilon$  is a disturbance term. The dependent variables represented by CAR are the cumulative abnormal returns on several windows representing the COVID-19 crisis. Our key variables of environmental sustainability and CEO's exposure to health risk are ENVIRONMENT and CEO HEALTH RISK which are indicators of environmental sustainability performance and CEOs' health risk exposure due to the COVID-19. CONTROLS comprise a total of four variables, as discussed in subsection 3.3. In addition, SIC industry dummies (INDUSTRY) are used to

<sup>9</sup> For the sake of clarity, we have only included the February 19<sup>th</sup> to March 23<sup>rd</sup> window in the correlations table because the sign and significance of the correlations was similar for all the windows considered in the regression analysis.



**Table 3**  
Correlation Matrix.

		1	2	3	4	5	6	7	8	9	10	11
1	CAR 19/02 to 23/03											
2	ENVIRONMENT	0.24***										
3	CDP	0.19**	0.52***									
4	CEO AGE	−0.19*	0.01	0.03								
5	CEO FATALITY	−0.26***	−0.06	0.02	0.9***							
6	LABOUR INTENSITY	−0.18**	−0.14	−0.08	−0.06	−0.03						
7	ZSCORE	0.18**	0.17*	0.18*	−0.1	−0.06	0.09					
8	LIQUIDITY	0.18**	0.46***	0.34***	−0.11	−0.14	−0.15*	−0.11				
9	SIZE	0.15*	0.29***	0.29***	−0.02	−0.10	−0.24***	−0.23***	0.43***			
10	ROI	0.10	−0.11	0.02	0.01	−0.01	−0.09	0.07	0.05	0.25***		
11	LEVERAGE	0.01	0.08	0.05	0.04	−0.01	0.02	−0.11	0.13	0.14*	0.05	
12	GROWTH	0.15*	−0.07	−0.06	−0.01	0.01	0.001	0.17**	−0.12	−0.22***	0.07	0.38***

This table presents correlations between the variables in the regression models. CAR 19/02 to 23/03 is the cumulative abnormal returns during the market crash period from February-19 to March-23 (based on the observation of stock market index returns in Figs. 1 and 2). ENVIRONMENT is the logarithm of the environmental component of the historical weighted ESG firm's score. CDP is a binary variable takes the value one if the firm communicates its emissions to the Carbon Disclosure Project (CDP) through their CDP Climate Change initiative and zero otherwise. CEO AGE is the logarithm of the CEO's age. CEO FATALITY is the log transformations of CEO'S fatality rate based on fatality rates by age group published by the Chinese Centre for Disease Control and Prevention (CDC) as of 17th February. ZSCORE is Altman's Z score. LIQUIDITY is the logarithm of the firm's book value of cash and short term financial investments. LABOUR INTENSITY is the ratio of number of workers to the firm's book value of total revenue. SIZE is the logarithm of the firm's book value of total revenue. ROI is the ratio of EBIT to total assets. LEVERAGE is the ratio of book value of total liabilities to total assets. GROWTH is the ratio of market capitalization to book value of equity. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10 %, 5%, and 1%, respectively.

control for industry fixed-effects.

### 3. Results

We discuss in this section the main results for the analysis of the market assessment of the firm's environment sustainability practices and CEO's health risk exposure during the COVID-19 crisis.

Table 4 shows regression results for Eq. (1) predicting the effect of the firm's environmental sustainability performance on its cumulative abnormal returns (CAR) in four windows describing different phases of the COVID-19 crisis. We display results in two panels using two different proxies of the firms' environmental sustainability performance. Panel A shows the results for the logarithm

**Table 4**

Impact of environmental sustainability on CAR during the COVID-19 crisis.

Panel A: The effect of environmental sustainability score on CAR during the COVID-19 crisis.				
	Market crash Period	collapse period <a href="#">Fahlenbrach et al.'s</a> (2020)	fever period <a href="#">Ramelli and Wagner's</a> (2020)	crisis returns <a href="#">Garel and Petit-Romec's</a> (2020)
	CAR 19/02–23/03	CAR 03/02–23/03	CAR 24/02–20/03	CAR 20/02–20/03
ENVIRONMENT	0.4463*** (2.81)	0.4142** (2.45)	0.2998** (1.99)	0.3322** (2.20)
SIZE	0.0225 (1.19)	0.0170 (0.85)	0.0240 (1.34)	0.0218 (1.22)
ROI	−0.1254 (−0.26)	−0.0093 (−0.02)	−0.1561 (−0.34)	−0.1536 (−0.34)
LEVERAGE	−0.0512** (−2.41)	−0.0520** (−2.30)	−0.0563*** (−2.80)	−0.0552*** (−2.73)
GROWTH	0.0251*** (2.67)	0.0273*** (2.74)	0.0237*** (2.67)	0.0242*** (2.71)
CONSTANT	−2.1673*** (−3.64)	−2.0504*** (−3.24)	−1.5325*** (−2.72)	−1.6587*** (−2.93)
Industry FE	YES	YES	YES	YES
Total obs.	126	126	126	126
Adjusted R <sup>2</sup>	0.148	0.119	0.132	0.128
F-statistics	3.177	2.695	2.893	2.835
p-value	0.00125	0.00529	0.00293	0.00348
Panel B: The effect of emissions communication to CDP on CAR during the COVID-19 crisis.				
	Market crash Period	collapse period <a href="#">Fahlenbrach et al.'s</a> (2020)	fever period <a href="#">Ramelli and Wagner's</a> (2020)	crisis returns <a href="#">Garel and Petit-Romec's</a> (2020)
	CAR 19/02–23/03	CAR 03/02–23/03	CAR 24/02–20/03	CAR 20/02–20/03
CDP	0.1530** (2.07)	0.1513* (1.93)	0.1016 (1.48)	0.1148 (1.66)
SIZE	0.0255 (1.30)	0.0209 (1.00)	0.0256 (1.40)	0.0235 (1.27)
ROI	0.0902 (0.20)	0.1858 (0.38)	0.0973 (0.23)	0.1070 (0.25)
LEVERAGE	−0.0525** (−2.48)	−0.0523** (−2.33)	−0.0550*** (−2.79)	−0.0524*** (−2.65)
GROWTH	0.0216*** (2.90)	0.0225*** (2.84)	0.0194*** (2.81)	0.0189*** (2.71)
CONSTANT	−0.4487*** (−2.94)	−0.4649*** (−2.87)	−0.3773*** (−2.66)	−0.3790*** (−2.65)
Industry FE	YES	YES	YES	YES
Total obs.	113	113	113	113
Adjusted R <sup>2</sup>	0.133	0.106	0.128	0.122
F-statistics	2.716	2.327	2.639	2.561
p-value	0.00535	0.0164	0.00668	0.00838

Regression results of Cumulative Abnormal returns (CAR) on Environmental Sustainability Scores (Panel A) and CDP emissions reporting (panel B). This table presents the OLS estimates of Eq. (1) predicting Cumulative abnormal returns using different definitions of the COVID-19 crisis period. In column 1 we use the February-19 to March-23 market crash period (based on the observation of stock market index returns in [Figs. 1 and 2](#)). In columns 2, 3 and 4, we use the crisis period definitions of [Fahlenbrach et al. \(2020\)](#); [Ramelli and Wagner \(2020\)](#) and [Garel and Petit-Romec \(2020\)](#) respectively. Variables are winsorized at the 1st and 99th percentiles. ENVIRONMENT is the logarithm of the environmental component of the historical weighted ESG firm's score. CDP is a binary variable takes the value one if the firm communicates its emissions to the Carbon Disclosure Project (CDP) through their CDP Climate Change initiative and zero otherwise. SIZE is the logarithm of the firm's book value of total revenue. ROI is the ratio of EBIT to total assets. LEVERAGE is the ratio of book value of total liabilities to total assets. GROWTH is the ratio of market capitalization to book value of equity. All models include SIC industry dummy variables. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10 %, 5%, and 1%, respectively.



of the environmental component of the firm's weighted ESG score (ENVIRONMENT) and panel B for the dummy indicating the communication of the firm's emissions to the Carbon Disclosure Project (CDP) through their CDP Climate Change initiative (CDP). We obtain positive and statistically significant coefficients across all columns for the variable environmental sustainability score (ENVIRONMENT). Given that ENVIRONMENT is log transformed, the 0.4463 coefficient in the first column indicates that a 10 % increase in the environmental score increases the cumulative abnormal return in the window between February 19th and March 20th by 4.25 %. With a median market capitalization for the sample of analysis of AU\$ 3011 million, the effect of a 10 % higher environment sustainability score would account for an AU\$ 130 million extra market value (or a similar avoidance of value loss) between February 19th and March 23th. As for the control variables we obtain evidence that companies that are less financially leveraged and those that have more profitable growth opportunities have suffered less value loss during the different windows of analysis.

**Table 5**

Impact of CEO's health risk on CAR during the COVID-19 crisis.

Panel A: The effect of CEO's age on CAR during the COVID-19 crisis.				
	Market crash Period	collapse period Fahlenbrach et al.'s (2020)	fever period Ramelli and Wagner's (2020)	crisis returns Garel and Petit-Romec's (2020)
	CAR 19/02–23/03	CAR 03/02–23/03	CAR 24/02–20/03	CAR 20/02–20/03
CEO AGE	−0.7581** (−2.47)	−0.7758** (−2.36)	−0.6453** (−2.25)	−0.5783** (−2.00)
SIZE	0.0628*** (2.98)	0.0557** (2.47)	0.0566*** (2.87)	0.0558*** (2.81)
ROI	0.4675 (0.84)	0.6219 (1.05)	0.4415 (0.85)	0.4577 (0.88)
LEVERAGE	−0.0428** (−1.99)	−0.0381 (−1.65)	−0.0459** (−2.27)	−0.0448** (−2.21)
GROWTH	0.0197** (2.47)	0.0184** (2.15)	0.0166** (2.22)	0.0171** (2.27)
CONSTANT	2.2991* (1.86)	2.3730* (1.79)	1.9558* (1.69)	1.6805 (1.44)
Industry FE	YES	YES	YES	YES
Total obs.	102	102	102	102
Adjusted R <sup>2</sup>	0.183	0.149	0.167	0.161
F-statistics	3.062	2.608	2.845	2.759
p-value	0.00159	0.00627	0.00307	0.00398
Panel B: The effect of CEO's fatality rate on CAR during the COVID-19 crisis.				
	Market crash Period	collapse period Fahlenbrach et al.'s (2020)	fever period Ramelli and Wagner's (2020)	crisis returns Garel and Petit-Romec's (2020)
	CAR 19/02 to 23/03	CAR 03/02 to 23/03	CAR 24/02 to 20/03	CAR 20/02 to 20/03
CEO FATALITY	−0.1583*** (−3.16)	−0.1650*** (−3.08)	−0.1303*** (−2.76)	−0.1225** (−2.58)
SIZE	0.0584*** (2.83)	0.0513** (2.32)	0.0530*** (2.72)	0.0525*** (2.68)
ROI	0.4930 (0.91)	0.6479 (1.11)	0.4634 (0.91)	0.4772 (0.93)
LEVERAGE	−0.0428** (−2.03)	−0.0381* (−1.69)	−0.0459** (−2.31)	−0.0448** (−2.24)
GROWTH	0.0191** (2.43)	0.0177** (2.11)	0.0161** (2.18)	0.0166** (2.23)
CONSTANT	−0.6478*** (−3.97)	−0.6415*** (−3.67)	−0.5549*** (−3.60)	−0.5669*** (−3.66)
Industry FE	YES	YES	YES	YES
Total obs.	102	102	102	102
Adjusted R <sup>2</sup>	0.215	0.182	0.189	0.184
F-statistics	3.516	3.047	3.143	3.068
p-value	0.000402	0.00167	0.00124	0.00157

Regression results of Cumulative Abnormal returns (CAR) on CEO's age (Panel A) and CEO's fatality rate (panel B). This table presents the OLS estimates of Eq. (1) predicting Cumulative abnormal returns using different definitions of the COVID-19 crisis period. In column 1 we use the February-19 to March-23 market crash period (based on the observation of stock market index returns in Figs. 1 and 2). In columns 2, 3 and 4, we use the crisis period definitions of Fahlenbrach et al. (2020); Ramelli and Wagner (2020) and Garel and Petit-Romec (2020) respectively. Variables are winsorized at the 1st and 99th percentiles. CEO AGE is the logarithm of the CEO's age. CEO FATALITY is the log transformation of CEO's fatality rate based on fatality rates by age group published by the Chinese Centre for Disease Control and Prevention (CDC) as of 17th February. SIZE is the logarithm of the firm's book value of total revenue. ROI is the ratio of EBIT to total assets. LEVERAGE is the ratio of book value of total liabilities to total assets. GROWTH is the ratio of market capitalization to book value of equity. All models include SIC industry dummy variables. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10 %, 5 %, and 1 %, respectively.

Coefficients in panel B are all positive across all columns and results statistically significant in the first and second columns that predict cumulative abnormal returns on the windows that start respectively on the 19th and 2nd of February and finish on the 23rd of March. The coefficient in column one indicates that a company that communicates its emissions to the CDP's Climate Change initiative presents an average 15 % higher return in these windows. This translates into an AU\$ 487 million extra market value (or a similar avoidance of value loss) for the median-sized firm in the sample.

These results provide strong support to the notion that the market has evaluated positively the firm's efforts to maintain environmentally sustainable practices and to communicate its environmental footprint. In the present situation when firms are pressed by the need to cut expenditures so as to offset the loss in revenues derived from the COVID-19 crisis, the investors see the value of environmental sustainability. This positive view on environmental sustainability during the COVID-19 crisis is consistent with energy prices' evidence provided by [Corbet et al. \(2020\)](#) who revealed that in a state of declining global growth derived from COVID-19, investors saw renewables as more reliable to generate long-term supply compared to oil. It is also in line with results from [Umar et al. \(2021\)](#) who found evidence that the environmental social and governance (ESG) investments presented some hedging potential during the COVID-19 crisis. The public understanding that the COVID-19 health and economic crisis is closely related to environmental unsustainable business activities has made investors to value favourably the firms' efforts to avoid the poor environmental conditions that have led to the current crisis.

[Table 5](#) shows regression results for Eq. (1) predicting the effect of the CEO's health risk due to COVID-19 on the firms' cumulative abnormal returns in four windows describing different phases of the COVID-19 crisis. We display results in two panels using two different proxies of the CEO's health risk exposure. Panel A shows the results for the logarithm of CEO's age (CEO AGE) and panel B displays results for the corresponding logarithm of COVID-19 fatality rates by age group published by the Chinese Centre for Disease Control and Prevention (CDC) as of 17th February (CEO FATALITY).

We obtain negative and statistically significant coefficients across all columns for the log transformation of the CEO's age. These results suggest that the market perceives the higher health risk of older CEOs exposed to the COVID-19 and provides support to the notion that a higher risk of an unplanned and disruptive CEO's substitution due illness or sudden death will harm the firm's market valuation. The size of the coefficient in the first column indicates that a 10 % increase in the CEO's age is linked to a negative 7% cumulative abnormal return in the window from February 19th to March 23rd. For instance, an increase in the CEO's age from its median value of 56 years to 61 years would be associated to a reduction of AU\$ 209 million in the firm's value.

Panel B shows the effect of the COVID-19 log transformed fatality rates corresponding to the CEO's age group (CEO FATALITY). We obtain negative coefficients in all estimations. These coefficients are statistically significant across all columns. The coefficient in the first column indicates that a 10 % increase in the fatality rate of the CEO due to the COVID-19, which is approximately the increase expected per additional year of age ([Goldstein and Lee, 2020](#)) is associated to a negative cumulative abnormal return of -1.5 % or AU\$ 45 million for the median-size company in our sample. Altogether, our results support our hypothesis that an increase in CEO's age is perceived as a risk factor in the current crisis and this risk factor corresponds to the higher fatality rates of older adults when exposed to the COVID-19.

As an additional test relating the relationship between health risk and the firms' market performance during the COVID-19 crisis, we have estimated the effects of hospital capacity in the state where the company has its headquarters. We have used the number of hospital beds per 1000 people as our proxy of hospital capacity. Our results (untabulated) reveal a positive and statistically significant relationship between this variable and the firms' cumulative abnormal return during the crash period from Feb-19th to March 23rd, which provides further support to our previous results on the negative effect of health risk on the firm's market performance during the COVID-19 crisis.

#### 4. Additional analyses

This section provides additional analysis on the effects of two different firm's risk elements during the COVID-19 crisis, namely: financial strength (i.e. solvency, and liquidity) and labour intensity. The COVID-19 shock to the business activity suggests that companies with a strong financial situation will be better equipped to face the current financial restrictions characterised by the lack of cash inflows. In this case we expect the firm's cumulative abnormal returns during the COVID-19 crisis to relate positively to the firm's solvency proxied Altman's Z score (ZSCORE) and to the firm's liquidity proxied by the log transformation of the firm's cash and short term financial investments (LIQUIDITY).

The exposure of the firm's staff to the health risk caused by the COVID-19 constitutes also a disruptive factor that alters the firm's normal operations. The outbreak of the COVID-19 crisis has forced a reorganization of the firm's labour force, often resorting to on-line work when possible, reducing the presence of workers at firm's premises and adopting hygiene and safety plans that have altered the normal working conditions. The infection of staff members by COVID-19 often forced the temporary cessation of activities and caused serious health consequences for the workers. Therefore, higher firm's labour-intensity will be associated to more severe disruption in the business activities and thus to lower market performance during the COVID-19 crisis. We expect the firm's cumulative abnormal returns during the COVID-19 crisis to relate negatively to the firm's labour intensity proxied by the ratio of the firm's workers to total revenue (LABOUR INTENSITY).

Results for the effect of the firm's financial strength (solvency and liquidity) are shown respectively in panels A, B of [Table 6](#) while the estimations for labour intensity are shown in [Table 7](#). The coefficients for the log transformation of cash and short term financial investments (LIQUIDITY) are positive and statistically significant across all columns suggesting that the market estimates that companies holding large deposits of liquidity will have a better position to keep their payments and therefore to maintain business activities during the COVID-19 crisis. The coefficient in the first column suggests that a 10 % increase in the liquidity deposits will be

**Table 6**

Impact of firm's financial strength on CAR during the COVID-19 crisis.

Panel A: The effect firm's liquidity on CAR during the COVID-19 crisis.				
	Market crash Period	collapse period Fahlenbrach et al.'s (2020)	fever period Ramelli and Wagner's (2020)	crisis returns Garel and Petit-Romec's (2020)
	CAR 19/02 to 23/03	CAR 03/02 to 23/03	CAR 24/02 to 20/03	CAR 20/02 to 20/03
LIQUIDITY	0.0550** (2.22)	0.0598** (2.31)	0.0389* (1.68)	0.0406* (1.75)
SIZE	0.0199 (1.12)	0.0113 (0.61)	0.0234 (1.41)	0.0215 (1.30)
ROI	0.2474 (0.79)	0.3094 (0.95)	0.1320 (0.46)	0.1747 (0.60)
LEVERAGE	-0.0375** (-1.98)	-0.0370* (-1.87)	-0.0433** (-2.46)	-0.0412** (-2.34)
GROWTH	0.0141** (2.52)	0.0155*** (2.66)	0.0139*** (2.67)	0.0139*** (2.66)
CONSTANT	-0.5837*** (-4.41)	-0.5793*** (-4.19)	-0.4694*** (-3.82)	-0.4806*** (-3.90)
Industry FE	YES	YES	YES	YES
Total obs.	154	154	154	154
Adjusted R <sup>2</sup>	0.107	0.0997	0.105	0.102
F-statistics	2.531	2.412	2.491	2.442
p-value	0.00474	0.00714	0.00544	0.00645
Panel B: The effect firm's solvency on CAR during the COVID-19 crisis.				
	Market crash Period	collapse period Fahlenbrach et al.'s (2020)	fever period Ramelli and Wagner's (2020)	crisis returns Garel and Petit-Romec's (2020)
	CAR 19/02 to 23/03	CAR 03/02 to 23/03	CAR 24/02 to 20/03	CAR 20/02 to 20/03
ZSCORE	0.0552** (2.37)	0.0639*** (2.64)	0.0390* (1.81)	0.0423* (1.96)
SIZE	0.0556*** (2.69)	0.0520** (2.41)	0.0433** (2.25)	0.0442** (2.29)
ROI	0.1040 (0.33)	0.1523 (0.47)	0.0268 (0.09)	0.0626 (0.22)
LEVERAGE	-0.0283 (-1.48)	-0.0270 (-1.36)	-0.0353** (-1.99)	-0.0332* (-1.86)
GROWTH	0.0121** (2.08)	0.0134** (2.20)	0.0119** (2.19)	0.0119** (2.18)
CONSTANT	-0.6633*** (-4.09)	-0.6843*** (-4.04)	-0.4877*** (-3.23)	-0.5150*** (-3.41)
Industry FE	YES	YES	YES	YES
Total obs.	152	152	152	152
Adjusted R <sup>2</sup>	0.100	0.104	0.0851	0.0874
F-statistics	2.404	2.465	2.171	2.205
p-value	0.00740	0.00600	0.0162	0.0145

Regression results of Cumulative Abnormal returns (CAR) on firm's liquidity (Panel A) and firm's solvency (panel B). This table presents the OLS estimates of Eq. (1) predicting Cumulative abnormal returns using different definitions of the COVID-19 crisis period. In column 1 we use the February-19 to March-23 market crash period (based on the observation of stock market index returns in Figs. 1 and 2). In columns 2, 3 and 4, we use the crisis period definitions of Fahlenbrach et al. (2020); Ramelli and Wagner (2020) and Garel and Petit-Romec (2020) respectively. Variables are winsorized at the 1st and 99th percentiles. LIQUIDITY is the logarithm of the firm's book value of cash and short term financial investments. ZSCORE is Altman's Z score. SIZE is the logarithm of the firm's book value of total revenue. ROI is the ratio of EBIT to total assets. LEVERAGE is the ratio of book value of total liabilities to total assets. GROWTH is the ratio of market capitalization to book value of equity. All models include SIC industry dummy variables. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10 %, 5%, and 1%, respectively.

rewarded with an extra 0.5 % of market performance, which supposes an extra AU\$ 15 million for the median-sized company in our sample.

Panel B shows the relationship of the firm's cumulative abnormal returns during the COVID-19 crisis and the firm's solvency proxied by Altman's Z score (ZSCORE). The coefficients for Z are all positive and statistically significant. This result indicates that firms with a sounder financial position will suffer less value losses derived from the COVID-19 crisis. The coefficient in the first column indicates that a 10 % increase in the Z score is associated to a 0.5 % higher market return or AU\$ 15 million of extra market value for the median-sized company in our sample. This result reinforces the previous evidence obtained for liquidity and suggests that higher firm's solvency either short-term or long-term is valued as a very desirable feature to cope with the financial restrictions originated by COVID-19.

Finally, Table 7 reports our results for the effect of the firm's labour intensity on the market reactions during the COVID-19 crisis. As expected from the health risk to the staff, the coefficients obtained for the labour intensity proxy (LABOUR INTENSITY) are all negative

**Table 7**

Impact of firm's labor intensity on CAR during the COVID-19 crisis.

	Market crash Period	collapse period <a href="#">Fahlenbrach et al.'s</a> (2020)	fever period <a href="#">Ramelli and Wagner's</a> (2020)	crisis returns <a href="#">Garel and Petit-Romec's</a> (2020)
	CAR 19/02 to 23/03	CAR 03/02 to 23/03	CAR 24/02 to 20/03	CAR 20/02 to 20/03
LABOUR INTENSITY	−0.0123*	−0.0129*	−0.0137**	−0.0138**
	(−1.89)	(−1.89)	(−2.27)	(−2.28)
SIZE	0.0466**	0.0414*	0.0357*	0.0361*
	(2.02)	(1.72)	(1.68)	(1.70)
ROI	0.3399	0.3642	0.2356	0.2685
	(1.09)	(1.12)	(0.82)	(0.93)
LEVERAGE	−0.0305	−0.0302	−0.0360**	−0.0341*
	(−1.60)	(−1.51)	(−2.05)	(−1.94)
GROWTH	0.0139**	0.0153**	0.0128**	0.0129**
	(2.39)	(2.52)	(2.38)	(2.41)
CONSTANT	−0.5210***	−0.5013**	−0.3587**	−0.3789**
	(−2.74)	(−2.52)	(−2.04)	(−2.15)
Industry FE	YES	YES	YES	YES
Total obs.	150	150	150	150
Adjusted R <sup>2</sup>	0.0672	0.0626	0.0738	0.0719
F-statistics	2.073	1.996	2.188	2.154
p-value	0.0305	0.0381	0.0219	0.0242

Regression results of Cumulative Abnormal returns (CAR) on firm's labor intensity. This table presents the OLS estimates of Eq. (1) predicting Cumulative abnormal returns using different definitions of the COVID-19 crisis period. In column 1 we use the February-19 to March-23 market crash period (based on the observation of stock market index returns in [Figs. 1 and 2](#)). In columns 2, 3 and 4, we use the crisis period definitions of [Fahlenbrach et al. \(2020\)](#); [Ramelli and Wagner \(2020\)](#) and [Garel and Petit-Romec \(2020\)](#) respectively. Variables are winsorized at the 1st and 99th percentiles. LABOUR INTENSITY is the ratio of number of workers to the firm's book value of total revenue. SIZE is the logarithm of the firm's book value of total revenue. ROI is the ratio of EBIT to total assets. LEVERAGE is the ratio of book value of total liabilities to total assets. GROWTH is the ratio of market capitalization to book value of equity. All models include SIC industry dummy variables. Levels of significance are indicated by \*, \*\*, and \*\*\* for 10 %, 5%, and 1%, respectively.

and statistically significant. This result suggests that the changes in the firm's operations derived from new safety protocols and the disruption caused by COVID-19 infection has more pronounced effects on firms with labour intense operations. The coefficient in the first column indicates that a one standard deviation in the ratio of employees to total firm's revenue is associated to a 5.6 % of value loss during the COVID-19 crisis or an AU\$ 163 million value loss for the median-sized company of our sample.

## 5. Conclusion

The outbreak of the COVID-19 crisis has caused a worldwide deterioration of health and economic conditions in an unprecedented scale. The inexistence of an effective medical treatment during the first wave and the disruptive effects of lockdowns and closures of national borders have caused a major crash in all markets. Australia has been no exception to the effects of the pandemic entering a recession for the first time in thirty years and suffering a 45 % value loss of the ASX 200 index from February 20th to March 23rd.

The deterioration of the economic and financial conditions, externally induced by the COVID-19, provides us with an opportunity to examine different aspects of the firm's management. In this crisis, it results of particular interest the analysis of the firm's environmental sustainability practices, since contaminated air accelerates the COVID-19 spread ([Coccia, 2020](#)) and poor environmental conditions intensify its mortality ([Conticini et al., 2020](#); [Wu et al., 2020](#) and [Travaglio et al., 2021](#)) as exposure to air pollution acts as a risk factor for many chronic diseases that increase the probability of becoming seriously ill from COVID-19. Also, the increase in CEO health risk imposed by COVID-19 provides us with a fertile setting to test "the CEO effect" as the market might discount the effects of the variation in the firm's exposure to their CEOs due to COVID-19 infection. Thus, our paper analyses for a sample of ASX 200 non-financial companies the market assessment of the firm's environmental sustainability performance and the CEOs health risk during the COVID-19 crisis.

Our results indicate that investors value positively the corporate efforts to maintain environmentally sustainable activities. We also obtain evidence indicating that firms whose CEOs are exposed to high health risk due to COVID-19 suffer higher market value losses. The avoidance of very relevant value losses by environmentally friendly stocks provides a strong case in favour of the formation of a green economy. It also suggests that in face of the current pandemic, firms are better off by holding their commitment with environmental sustainability rather than abandoning these plans for the sake of attaining short term cost savings. The value loss experienced by companies run by aged CEOs exposed to high health risk from COVID-19 suggests that the markets are aware of the disruptive impact that this pandemic has on the firm's performance through key elements of the firm's staff. Moreover, the notion of the negative impact of the health risk extends to all the companies' staff since we obtain evidence that labour intense firms suffer more during the COVID-19 crisis.

Our findings add valuable insights for regulators and practitioners in the growing debate about the commitment with the global warming targets of the Paris agreement. The need to reactivate the economy after the COVID-19 crash has increased the pressures for

less restrictive environmental business regulations. However, the positive view that investors have on environmental sustainability provides regulators with a strong argument to keep the commitment of Australia with the global warming targets.

We acknowledge that the analyses performed are limited by the use of initial market reactions to the COVID-19 crisis. Therefore, it conveys the investors' assessment of the effects of COVID-19 with the limited information available at the time of the analysis. A natural extension of this paper could be the analysis of the long-term effects of the COVID-19. In the first place, it results of the most relevance to study how the pandemic might affect the investments needed to comply with the global warming targets and its effect on firms' performance. Also, it results of the upmost interest to extend current evidence on the CEO's health risk due to COVID-19 by analysing the different ways in which companies have managed this health risk for the workforce and its relation with the corporate governance structure of the firm.

### CRedit authorship contribution statement

**Carlos Fernández-Méndez:** Conceptualization, Investigation, Data curation, Writing - original draft, Writing - review & editing.  
**Shams Pathan:** Conceptualization, Investigation, Writing - original draft, Writing - review & editing.

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### Appendix A. Differences in Environmental Sustainability scores between European and Australian firms 2009–18

Year	European Firms	Australian Firms	difference	t
2009	53.59	48.2	-5.39***	-7.81
2010	54.05	49.85	-4.2***	-9.03
2011	54.86	50.87	-3.99***	-10.06
2012	57.86	51	-6.86***	-21.97
2013	57.65	51.39	-6.26***	-20.2
2014	58.53	51.94	-6.59***	-20.93
2015	59.06	51.86	-7.2***	-23.19
2016	60.57	51.81	-8.76***	-29.17
2017	62.59	53.15	-9.44***	-28.83
2018	63.6	54.77	-8.83***	-24.33

This table presents annual evolution of the environmental component of the historical weighted ESG firm's scores provided by the consulting firm Sustainalytics for the sample of Australian and European listed firms. Columns 4 and 5 present the mean's differences between these groups and t statistics respectively.

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