

Role of ICT for workers' safety at the workplace during pandemics: evidence from global data

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Abstract

Purpose – This study contributes to the extant literature on ICT firms by investigating the interrelationship between the health and safety (H&S) measures, market performance, and the coronavirus (COVID-19).

Design/methodology/approach – To conduct the confirmatory analysis by testing our hypotheses, data have been collected from Bloomberg of all ICT firms from five countries. The authors gathered from 2010 until 2020 as the research sample to examine the pandemic impact on market performance and H&S measures.

Findings – First, our results reveal a significant and positive relationship between market performance (proxied by Tobin's *Q*) and the H&S measures of information technology (IT) firms. Second, the authors find that the IT firms have significantly increased the H&S measures during the COVID-19 period and were dynamic in linking employees' adaptive capabilities to positive attributes. This has contributed to business success, resiliency, and sustainability.

Research limitations/implications – The authors used a quantitative method of testing our hypotheses. Future studies may consider checking the robustness using qualitative methods such as structural or semi-structural interviews.

Practical implications – The study offers valuable insights to academics, practitioners, stakeholders, policymakers, and international entities by fostering knowledge about responses to crises, integrating digital solutions, and disseminating digital information. The study also has implications on the health, social, business, and economic levels. This study is a call for international and local humanitarian organisations such as United Nations High Commission, Care international and many more to understand the gravity of safety of the workers in the workplace during the pandemic period and introduce a firm-level policy accordingly.

Originality/value – This paper is novel considering that the paper is unique in evaluating ICT firms' market performance and H&S from a global perspective, considering the context of this historical pandemic.

Keywords ICT firms, Market performance, COVID-19, Health and safety measures, Probit model, Quantile regression

Paper type Research paper

1. Introduction

Protecting and promoting a healthy and safe workplace environment implores corporate resiliency in times of disruptions and severe health crises. Recently, the coronavirus (COVID-19) succumbs extravagant concern and economic hardship across the globe leading to sudden jumps in the unemployment rate, government budget deficits, and a slump in the

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national gross domestic product (Chen *et al.*, 2020). As a result, business challenges became top priorities on leaders' agendas, such as crisis management, supply chain, workforce, tax and trade, and financial reporting.

The COVID-19 outbreak imposed new working conditions. Social distancing norms shrunk the day-to-day commonality, and work-from-home became a valid norm. Companies had to adapt quickly to survive the crisis and avoid losing market share or going bankrupt. The World Health Organisation (WHO), Centres for Disease Control and Prevention (CDC), and labour unions published "*Operational Planning Guidelines to Support Country Preparedness and Response*," detailing best practices in fighting the pandemic. Numerous recommendations and suggestions were introduced to protect workers and all citizens (CDC, 2020; NIOSH, 2020; WHO, 2020). Yet, a holistic approach was missing, and a systems-based approach is recommended to have better outcomes (Manjourides and Dennerlein, 2019). Nonetheless, such stringent requirements caused work-related issues like skin complaints and respiratory problems due to chemical cleaning products. In addition, the work-from-home trend resulted in long and unpredictable working hours, low wages, a gender pay gap, and many inequalities (ILO, 2021).

ICT companies can play a significant role in addressing such extreme challenges and might be a few industries still standing. The shift to digital platforms, online business, and e-commerce was in vogue during the last two years (Vargo *et al.*, 2021), where digital technology serves to perform multiple tasks, including prevention and surveillance as contact tracing (Golinelli *et al.*, 2020). The role of ICT companies in pre-, during, and post-pandemic is radical as it is integrated into many businesses, social, and economic aspects (Sein, 2020). Thus, it became urgent to embark on researching the theoretical and practical implications of information management and systems under such extreme scenarios to contribute to the information systems and technology research and examine how emerging technologies can mitigate COVID-19 threats and alleviate health, social, and economic impacts (O'Leary, 2020).

To our knowledge, we are the first to investigate the role of ICT companies in alleviating the burden of COVID-19 and fostering the implementation of Health and safety measures. COVID-19 constitutes an extreme situation faced by most economies, industries, and companies. It is a proper exercise from which the whole globe should tremendously extract new lessons and measures. In this context, the research stream to explore the contextual frameworks of such extreme conditions is still in its infancy. The surge to investigate businesses' capacity and ability to adapt to uncommon and unseen conditions, monitor much-needed revenues stream, and alienate worst-case scenarios invites us to embark on testing new theories about resilience and survival. Thus, in the present paper, we hypothesise the effect on IT resiliency and market performance.

In this regard, no previous studies have deeply attempted to uncover the role of ICT companies in creating digital business solutions to foster Health and Safety measures. Although the implications of such measures in the workplace are not recent, the COVID-19 scenario posits the discussion from a real case scenario. Accordingly, our study is novel and highlights ICT roles during pandemic times and their contributions to sustaining the business sector and economic growth from a global dimension. Prior studies have proposed simulations and algorithmic models to address disruptions and disturbances in the supply chains systems and cope with a shortage of essential goods like food and medicines (Breitbarth *et al.*, 2021; Singh *et al.*, 2021). Some offered conceptual models (O'Leary, 2020; Sein, 2020) and data-people-system framework (He *et al.*, 2021), yet our study sheds light on the importance of the ICT sector and digital transformation during normal and pandemic times.

We contribute to the literature on many levels. The analysis supports two important theories: the resilience and self-efficacy theories. It provides empirical evidence of the role of digital transformation and the ICT industry in shadowing almost all other sectors to cope with the new norms of social distancing and work conditions. Companies and employers are encouraged to have dynamic attitudes and link employees' adaptive capabilities to positive

attributes. This latter fact stems as one of the most contributing factors toward business success, resiliency, and sustainability. From the practical side, the study contributes to systematising and standardising international initiatives and best practices of countries' preparedness and response in fighting the pandemic. It stresses the importance of adopting innovative and digital solutions that are typical attributes of ICT companies.

Our findings shed light on digital transformation and the ICT industry in shadowing almost all other sectors to cope with the new norms of social distancing and work conditions. Under OLS and quantile regressions, we found that the implementation of H&S had contributed to higher market performance. Additionally, under OLS and probit regressions, COVID-19 has contributed to a more efficient and effective H&S application. ICT companies and employers are encouraged to have dynamic attitudes and link employees' adaptive capabilities to positive attributes. This latter fact stems as one of the most contributing factors toward business success, resiliency, and sustainability.

The rest of the paper is organised as follows. The following section presents a review of relevant literature and hypotheses, followed by an explanation of the methods, presentation of the findings, discussion, and conclusion.

2. Theoretical background and hypothesis

The implications of health and safety conditions in the workplace have long stood as one of the hottest social and health sciences debates. Yet, the onset of the COVID-19 posits the discussion from a real case scenario and puts enormous strains on ICT companies to respond and ensure digital solutions for economies, businesses, and individuals. In the same vein, data analysis and decision-making can help mitigate the cancellations of major business activities. ICT companies can run simulation exercises based on realistic scenarios to set adaptable contingency plans for the short-, medium, and long-term objectives.

Theoretically, a conceptual framework should be put in place to embrace core business objectives to survive and sustain. The resilience theory reflects vigorous actions, adaptive measures, and flexible adjustments undertaken during extreme adversity, stress, or disturbance. Norris *et al.* (2008) define resilience as "a process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance" (p. 130). It is a dynamic condition (Brown *et al.*, 2017) that represents "an indicator of preparedness and capability to cope with a crisis" (Herbane, 2019, p. 487). Bandura (2000) emphasises the perceived self-efficacy theory and sheds light on its close connectedness with resilience in the same context. Self-efficacy is instrumental in supporting one's persistence in the face of aversive experiences and obstacles (Bandura *et al.*, 1977), affecting task effort, the level of goal difficulty chosen for performance, or expressed interest (Gist, 1987). Adaptive capacity, flexibility, or fostering a culture that promotes innovation and self-efficacy are critical factors in improving organisational resilience (Brown *et al.*, 2017).

Empirically, there is a scarcity of research that attempts to explain the effect of health and safety measures on the market performance of ICT companies. The vector of the health and safety issues encompasses two interrelated dimensions: classic social issues like sick leave, disability, child abuse, gender discrimination, and disruptive health issues like the COVID-19 pandemic. In a systems-based approach related to human factors and ergonomic theories, multiple pathways might impact worker safety, health, and wellbeing (Sørensen and Torfing, 2016), including social-ecological models (McLeroy *et al.*, 1988; Stokols, 1996), the hierarchy of control, organisational ergonomics (McLeroy *et al.*, 1988; Stokols, 1996), participatory frameworks (Punnett *et al.*, 2020; Rivlis *et al.*, 2008), job strain (Karasek, 1990), and sociotechnical systems theory (Murphy *et al.*, 2014).

In this context, although the ICT industry has lost many income opportunities, innovative technologies have emerged and intensified to mitigate the damage of COVID-19 (O'Leary, 2020).

Telemedicine, telework, and online education have become essential (Chavez and Kounang, 2020; Loh and Fishbane, 2020; Young *et al.*, 2020). Many technologies were introduced to detect and diagnose infection. Additionally, there is an exponential rise in video calls/phone calls, digital media. Over the Top (OTT) content players, Virtual Private Networks (VPNs), cybersecurity, and data security, as most workforces operate remotely. IoT devices have offered organisations a path toward preserving revenue streams, and notably, the e-commerce sector with digital payment invaded the market [1]. In addition, some companies have reconsidered repurposing their existing intelligent design to assist in social distancing enforcement and contract tracing. Such innovative products have significantly impacted ICT companies' image and reputation, greatly affecting their performance (Najaf *et al.*, 2020; Najaf *et al.*, 2021d). The ICT industry is expected to have an enormous market boom from US\$ 131 Billion in 2020 to US\$ 295 in the next five years by 2025 due to the increased demand for software and social media platforms [2]. Yet, the pandemic is a critical case to study and assess as companies are forced to tighten their safety and health issues. From this perspective, many studies have been conducted to explore the effects of H&S on employees' well-being and companies' performance. Muchemedzi and Charamba (2006) characterised occupational safety and health "as a science concerned with wellbeing in connection with job setting." Ward *et al.* (2008) concluded that effective and efficient H&S policies affect workers' behaviour, incentivise them, and improve their sense of belonging which affect the company's performance and contributes to its success and resiliency in critical times. Dwomoh *et al.* (2013) found an inverse relationship between workplace injuries or accidents and employee performance. On the contrary, Oxenburgh *et al.* (2004), El Khoury *et al.* (2021), and Nasrallah and El Khoury (2021) discovered that workers' wellbeing and security are positively associated with firms' profitability. Thus, we propose the *first hypothesis*:

H1. Ceteris paribus, the health and safety measures are passively related to market performance.

In today's business world, the strategic role of both the office and its design engendered internal governance and governmentality perspective (Jeacle and Parker, 2013). Governmentality is exercised both through the inculcation and transmission of ideology and values but also through interventions that can take quite visible forms such as office apparatus and tools, office procedures, and occupational health and safety (OH&S) instruments and technologies (Dean and Gilbert, 2009; Miller and Rose, 1990). In addition, technologies can take various forms, including government and management discourse and messaging, training programs, and behavioural monitoring (Miller and Rose, 1990; Spence *et al.*, 2012).

From an economic perspective, entrepreneurs and employees are financially affected by shutdowns or reduced demand, especially when a large population depends on daily wages for sustenance (Block *et al.*, 2020). To fight the pandemic, ICT professionals have been innovative in introducing new products to track the virus and help predict its spread instantaneously. The main concern is to help the most vulnerable based on medical, social, and economic vulnerability. Accordingly, digital solutions were integrated to ensure the employees' health and safety measures. Such metrics became central to appease employees' morale, encourage them to pursue their jobs, and sustain their performance to avoid a complete shutdown and eventual collapse.

To successfully react to a crisis, international humanitarian service organisations must develop broad conceptual frameworks about general safety (Najaf *et al.*, 2021c; Najaf *et al.*, 2022b). A culture of cooperative and synchronised efforts should be fostered along with shared logistics services within the disaster recovery ecosystem (Arona *et al.*, 2018; Mollenkopf *et al.*, 2021). This demands a shift from the traditional, reductionist supply chain management perspective (e.g. goods delivered efficiently) to a more holistic service supply

ecosystem perspective. Organisations should weave suitable working conditions and synchronise the Human Resource (HR) efforts for health issues and the operations department for safety implementation.

A recent systematic review on the COVID-19 pandemic and mental health by [Vindegaard and Benros \(2020\)](#) and a narrative review related to mental health effects in the workplace by [\(Giorgi et al., 2020\)](#) also concluded that the pandemic has resulted in increased levels of depression, anxiety, and poor sleep quality. In as much, it crippled companies' ability to serve clients and manage businesses. Companies suffered from disruption in their primary activities leading to an adverse effect on sales ([Garzillo et al., 2020](#)), volume and cash flows leading to significant risks in coping with the supply of raw materials. In this sense, there is a challenge for companies to instruct their Health and Safety departments (OH&S) to develop safer ways of working to mitigate the risks of contagion ([Godderys and Luyten, 2020](#)) and support companies in the face of this challenge ([Gharibi et al., 2020](#); [Garzillo et al., 2020](#)). Notwithstanding, the ICT sector played a significant role in the medical field and digital health. It contributed to disseminating information like the World Health Organisation's websites that offer rolling updates and top stories on the coronavirus. Yet, ICT employees were not highly engaged in remote work, and only 0.2 percent is highly productive. In comparison, 99.8 percent are incapable of working from home, according to the study by research-backed innovative venture SCIENCE MindMatch. This has incentivised us to test the health and safety measures undertaken by ICT companies to cope with the COVID-19 pandemic and strive to generate additional revenues and incremental profits.

Thus, we propose our [second hypothesis](#):

H2. Ceteris paribus, the ICT firms have significantly increased health and safety measures during COVID-19.

3. Method, sample, and data

We examine the ICT firms based on the market performance and impact of COVID-19 on health and safety measures. We attempt to test both hypotheses empirically using the OLS and Quantile regression models. The validity, reliability tests, and study variables are given below.

3.1 Dependent variable

Following prior literature, we use Tobin's Q as the dependent variable to measure market performance ([Atayah et al., 2021a, b](#); [Dhifaf et al., 2021](#); [Najaf et al., 2021a](#); [Najaf and Atayah, 2021](#); [Najaf et al., 2021b](#)). Tobin's Q is widely used in several studies as a proxy for market performance, and it does reflect not only the current company's profitability but also its future potential growth. Tobin's Q is calculated as $\text{Market Cap} + \text{Total Liabilities} + \text{Preferred Equity} + \text{Minority Interest} / \text{Total Assets}$ ([Blundell et al., 1992](#)).

Our dependent variable is "health and safety" for the [second hypothesis](#). We proxy it by taking the listed ICT firms' health safety and human rights policies. Health safety policy means a firm has recognised its health and safety risks and responsibilities and is making efforts to improve employee health and employee safety management. Similarly, human rights policy assesses whether the company has implemented many initiatives to protect all employees' rights. Both are dummy variables, where "1" means the firm has a health safety policy or human rights policy and "0" otherwise.

3.2 Independent variable

As defined above for the [first hypothesis](#), our independent variables are H&S measures. Whereas for our [second hypothesis](#), we used COVID-19 as a dummy. The prior literature

takes a dummy of “1” if the year is 2020 and “0” otherwise to show the yearly impact of COVID-19 on the dependent variables (Atayah *et al.*, 2021a, b; Yiwei *et al.*, 2021).

3.3 Firm-level control

We control four firm-level variables. First, the firm's growth is measured by the yearly percentage change in total sales (Delmar *et al.*, 2003). Second, we control the firm's size proxied by the natural log of total assets to weigh the reaction of large versus small to COVID-19 (Dang *et al.*, 2018). Third, we control Big4 to consider if there is an impact on auditing firms. Shareholders' perceptions of good efficiency might better influence sustainability policies based on the (Big4) audit companies' claims. We assign a dummy variable of “1” when financial statements are audited by one of the *big4*, otherwise zero. In the end, we control abnormal loss for the year if the firm faced any loss in the year (Net profit < 0) = “1” otherwise zero (Ball and Shivakumar, 2005).

3.4 Country and time-variant effects

We gathered a sample of ICT firms spread over five countries from 2010 until 2020, making it important to introduce country- and year dummies to account for any unobserved country- and time-variant effects. Following the prior work, we used four dummies for five countries and ten dummies for 11 years.

3.5 Sample and data

We extracted the data from Bloomberg of ICT firms to empirically test both hypotheses. At the same time, five countries consist of India, China, US, Ireland, and Germany. We selected these countries as these are the top five listed ICT firms globally, as per the Bloomberg database. We excluded firms with missing information on Bloomberg.

We gathered the first year from 2010 until 2020 as the research sample to examine the pandemic impact on H&S and H&S's impact on the market performance. The reason for selecting 2010 years as the sample period is to avoid the volatility of 2008–2009 financial crisis. We use stratified sampling, and collection strata of ICT firms from the pool of all listed firms at Bloomberg terminal.

We have 2,480 firms with a total number of year*firms observations of 19,880 (Year-firm). Most ICT firms belong to the US region. The highest number of ICT firms is 1,192 from the United States, 791 from China, and 357 from India. In contrast, the last number of ICT firms are from Ireland. Overall, we have the same number of firms throughout the study period.

3.6 Validity and reliability tests and study model

While we gather the data from a secondary source (such as Bloomberg), we can still face many issues pertaining to the reliability and validity of data. These biases in the dataset are caused by multicollinearity among the independent variables. In this context, variance inflation factors (VIF) and the Pearson correlation test are used to identify multicollinearity, which is a condition when two or more independent variables are highly correlated. The VIF level is far below the tolerance limit in all regression tests (Najaf *et al.*, 2022a). It is clear from the correlation coefficient table that the independent variables are not substantially associated with one another.

Despite this, heteroscedasticity is a bias that must be considered to ensure that hypotheses are tested fairly. Heteroscedasticity is a statistical term that describes how much the variation between the values of independent and dependent variables differs. This leads to biased empirical findings due to inaccuracy in standard errors (Thompson, 2011). Three methods are used to deal with the heteroscedasticity problem in this study. First, the researcher checks

Waldman (1983) and finds no heteroscedasticity among the variables. A strong *t*-statistic is reported at the company level in this research. Third, the researcher uses the quantile regression model at different cutoff points.

We apply a random OLS regression model over a fixed panel regression as our study includes dummies variables, and the “fixed regression model” does not fit. Similarly, the random regression model provides an accurate picture of a pool of observations.

3.7 Descriptive statistics

Table 1 describes our sample. We report our study variables’ mean, standard deviation, min, max, p1, p99, skewness, and kurtosis. The mean value of our focused variables, human rights, and health safety, are 0.40 and 0.63, respectively, implying that companies in our sample are allocating more attention to health safety. The minimum and maximum values are 0 and 1 for H&S variables. The mean of Tobin’s *Q* is 1.81, with a minimum of 19.87 and a maximum of 56.74. In addition, the skewness and kurtosis values for Tobin’s *Q* show that this variable is not normally distributed. Therefore, we needed to winsorise all the variables at 1% percent on both sides of the distribution.

3.8 Correlations

Table 2 shows two-tailed tests for Pearson and Spearman-rank (italicised) correlations of all the study variables. Following the prior studies, we test correlation via Pearson and Spearman-rank to address any multicollinearity issues (Dharmasiri *et al.*, 2021). Our results reveal no difference in the results from Pearson and Spearman-rank correlations. The correlations between Tobin’s *Q* and loss are 0.342 (Pearson) and 0.7391 (Spearman-rank), significant at the $\alpha = 0.05$ level. Overall, there is no significant correlation above 0.50 among our control variables which means our sample is free from multicollinearity issues.

4. Empirical findings

First, our results reveal a significant and positive relationship between market performance (proxied by Tobin’s *Q*) and the health and safety measures of information technology (IT) firms. It implies that the shareholders prefer to see the health and safety of workers, which facilitates an increase in IT firms’ market performance. Second, we find that the IT firms have significantly increased the health and safety measures during the COVID-19 period.

4.1 Test of first hypothesis- impact of health and safety of workers on the market performance of IT firms’

Table 3 shows the relationship between the H&S and market performance of the ICT firms. We used a pool OLS regression model to test the relationship among the focused variables. All other firm-level variables equal, our regression results show that human rights positively

Table 1.
Descriptive statistics
(total number of
firms = 2,480)

Variables	Mean	Std.Dev.	Min	Max	p1	p99	Skew	Kurt
Human right	0.40	0.49	0.00	1.00	0.00	1.00	0.40	1.16
Health safety	0.63	0.48	0.00	1.00	0.00	1.00	−0.55	1.30
Tobin’s <i>Q</i>	1.81	19.87	24.08	56.74	1.92	8.30	8.47	20.70
Loss	0.42	0.49	0.00	1.00	0.00	1.00	0.31	1.09
Size	13.37	1.93	1.00	4.00	2.18	2.00	2.90	7.76
Big4	0.21	0.41	0.00	1.00	0.00	1.00	1.43	3.04
Growth	19.92	61.80	−1.00	51.99	−1.00	51.99	1.74	4.23

correlate with Tobin's Q (Model 1). Similarly, the health safety of ICT firms is contributing significantly to the market performance of Tobin's Q (Model 2). Yet, health safety has a greater impact. This fact indicates ICT companies' ability to adapt and apply vigorous actions, adaptive measures, and flexible adjustments during extreme adversity, stress, or disturbance and showcases their resilience (Norris *et al.*, 2008). In addition, ICT companies have demonstrated self-efficacy in the face of aversive experiences and obstacles (Bandura *et al.*, 1977). Their dynamic environment has well resonated in front of COVID-19 by clearly showing their preparedness and capability to cope with the crisis (Brown *et al.*, 2017). To conclude, their adaptive capacity, flexibility, and nurturing of the culture of innovation and self-efficacy have contributed to improving organisational resilience (Brown *et al.*, 2017), reflected through their market performance. Additionally, Oxenburgh *et al.* (2004) discovered that workers' well-being and security are positively associated with firms' profitability. The empirical corroborates our [first hypothesis](#).

On the other hand, the company size also affects Tobin's Q under both models, consistent with (Dang *et al.*, 2018), whereas the fact that the auditing firm is one of the big four is only affecting Tobin's Q for firms applying the human rights. The company sales growth significantly affects Tobin's Q in companies using Health safety but insignificance for companies involving human rights. Thus, we pursue our analysis and test the

Variables	Code	1	2	3	4	5	6	7
Human right	1		<i>0.4642*</i>	<i>0.1999*</i>	<i>0.2179*</i>	<i>0.3034*</i>	<i>0.0316*</i>	<i>0.2056*</i>
Health Safety	2	0.149*		<i>0.1102*</i>	<i>0.1103*</i>	<i>0.2364*</i>	<i>0.0798*</i>	<i>0.1713*</i>
Tobin's Q	3	0.234*	0.095*		<i>0.7361*</i>	<i>0.6346*</i>	<i>0.1456*</i>	<i>0.2284*</i>
Loss	4	0.153*	0.144*	0.342*		<i>0.5455*</i>	<i>0.001</i>	<i>0.1957*</i>
Size	5	0.034*	0.112*	0.043*	0.070*		<i>0.2717*</i>	<i>0.3771*</i>
Big4	6	0.052*	0.078*	0.047*	0.064*	0.143*		<i>0.2207*</i>
Growth	7	0.488*	0.046*	0.02	0.025*	0.094*	0.063*	

Note(s): *shows significance at the 0.05 level

Table 2.
Correlation coefficients
(Pearson and
Spearman-rank
(*italicised*) correlations
are presented)

$$Performance_{it} = \alpha + \beta_1 H\&S_{it} + \sum_{i=1}^{n=4} Controls_{it} + \delta 1 Year_i + \delta 2 Country_i + \varepsilon_{it}$$

Where $Performance_{it}$ is a continuous variable proxied by the Tobin's Q of a firm(i) in the year(t). Whereas $H\&S_{it}$ is measured by human right and health safety of a firm (i) in the year (t). The $Controls_{it}$ is a set of firm-level (*Loss, Size, Big4 and Growth*). Also, we take into account unknown country and year bias with *country* and *time* fixed effects. We clustered the standard errors at the firm level. All variables are winsorised at 1% and 99%. The variance inflation factors (VIF) are well below the tolerance level, and the superscript asterisks ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively

Variables	Tobin's Q Model 1	Tobin's Q Model 2
Human right	<i>2.938** [2.290]</i>	
Health Safety		<i>5.565*** [24.893]</i>
Loss	5.940*** [25.136]	0.001*** [5.946]
Size	0.001*** [6.064]	1.172*** [8.055]
Big4	1.014*** [8.080]	0.001 [0.928]
Growth	0.001 [0.937]	2.985** [2.525]
Constant	-4.610*** [-17.148]	-4.721*** [-17.770]
SE Clustered	Firm	Firm
Time and Country Fixed effects	Yes	Yes
R^2 Squared	26.89%	32.26%

Table 3.
Regression analysis of
Performance with
COVID-19 – [First
Hypothesis](#)
(firms = 2,480)

implementation magnitude of each H&S component under COVID-19 circumstances to explore the companies' behaviour and attitude.

4.2 Test of Second hypothesis- impact of COVID on health and safety of IT firms'

We test our [second hypothesis](#) using the OLS regression model. Being all other firm-level variables equal, our regression results show that human rights and health safety are positively impacted by COVID-19 (Model 1 of [Table 4](#)). In addition, key firms' factors contribute to the implementation of H&S measures. Loss, size, and growth are all critical indicators of the ability of ICT companies to embrace such measures. Big4 variable is only affecting human rights application. ICT companies have integrated intelligent design to assist social distancing enforcement and contract tracing. Our results suggest that the ICT firms have increased their health and safety measures during the pandemic compared to the last ten years of their operations. This is interesting as we believe that the H&S provides these firms with a protective shield against the negative impact of the COVID-19. Effective and efficient H&S policies have improved occupational job settings and contributed to the wellbeing of the workforce. This finding is consistent with [Muchemedzi and Charamba \(2006\)](#) and [Ward et al. \(2008\)](#).

$$H\&S_{it} = \alpha + \beta_i COVID_{it} + \sum_{i=1}^{n=4} Controls_{it} + \delta 1 Country_i + \epsilon_{it}$$

Where COVID_{it} period (year 2020) = "1" and "0", otherwise. All other variables are same as in [Table 3](#). We clustered the standard errors at the firm level. All variables are winsorised at 1% and 99%. The variance inflation factors (VIF) are well below the tolerance level, and the superscript asterisks ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively

Table 4.
Regression analysis of
H&S with COVID-19 –
[Second Hypothesis](#)
(firms = 2,480)

Variables	Human right Model 1	Health safety Model 2
COVID	0.171*** [9.101]	0.163*** [7.671]
Loss	0.156*** [9.165]	0.264*** [17.252]
Size	0.000*** [6.318]	0.000*** [7.037]
Big4	0.059*** [4.006]	0.015 [1.041]
Growth	0.000* [1.759]	0.000* [1.900]
Constant	0.471*** [27.647]	0.179*** [12.730]
SE Clustered	Firm	Firm
Country Fixed effect	Yes	Yes
R ² Squared	22.89%	42.21%

4.3 Robustness tests for both hypotheses

To check the validity of our baseline results for both hypotheses, we run the robustness tests. For this purpose, we alter the method of OLS regression to quantile regression for the [first hypothesis](#) robustness test. Similarly, we change the econometric model of OLS regression to the Probit model for robustness purposes.

As per the results of our [first hypothesis](#), there is a positive and significant relationship between market performance (proxied as Tobin's Q) and H&S variables (measured as human rights and health safety policies). Now we change the OLS regression to Quantile regression; the reason for switching is that the quantile regression is a non-parametric test and can divide the dependent variable into different quantiles. [Table 5](#) shows the impact of H&S on market performance.

Being equal to other firm-level variables, our robustness tests corroborate our baseline results. They show that the H&S has a positive and significant impact on Tobin's Q. Human

rights are positively influential at all quantiles of Tobin's Q (Model 1–3). Similarly, the health safety policy is also positively related to the market performance (Model 5–8). Interestingly, the company's size does not affect Robin's Q under the highest quantile under both H&S measures. ICT companies with High Tobin's Q are financially capable of adapting and responding to extreme crises regarding H&S measures. This finding is inconsistent with (Dang *et al.*, 2018). Companies' financial health can also act as a shield in times of constraints in small, medium, or large companies.

Table 6 changes the econometric modelling method from OLS regression to the probit model. We cannot use the quantile regression as the dependent variables (human rights and health safety policies) are dummy variables. The empirical results show the same results as OLS and suggest that the ICT firms have increased their H&S during the pandemic period (Model 1 and 2). This robustness regression confirms our initial findings. The instance of COVID-19 appears as a driver to fostering H&S implementation and instructing H&S departments to develop safer ways of working to mitigate the risks of contagion. This is consistent with the findings of (Godderis and Luyten, 2020; Garzillo *et al.* 2020). Loss, size, and growth are also associated with H&S application. Companies suffered from disruption in their primary activities leading to an adverse effect on sales (Garzillo *et al.*, 2020), volume and cash flows. Big4 is only affecting human rights applications under COVID-19 circumstances.

5. Conclusion

During the last two years, ICT companies have played an important in addressing the COVID-19 pandemic. Their pre-, and post-pandemic role is radical as it is integrated into many businesses, social, and economic aspects. Our study provided empirical research by studying 2,480 ICT firms from five countries from 2010 to 2020. We have supported our analysis by relying on new theories about resilience and survival.

Our paper is novel as it contributes to understanding the role of ICT companies in alleviating the burden of COVID-19 and fostering the implementation of Health and safety measures. Thus, we tested the effect of COVID-19 on increasing H&S measures on the one hand and the effect of H&S measures on market performance on the other hand.

Our findings shed light on the role of digital transformation and the ICT industry in shadowing almost all other sectors to cope with the new norms of social distancing and work conditions. Under OLS and quantile regressions, we found that the implementation of H&S

$$P(H\&S_i|COVID_i)_t = \alpha(t) + \beta_1(t)COVID_i + \beta_2(t) \sum_{i=1}^{n=4} Controls_{it} + \delta 1(t)Country_i + \varepsilon_{it}$$

We use probit regression model for our [second hypothesis](#). All dependent, explanatory and control variables are the same as those in the earlier tables. The superscript asterisks ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively

Variables	Human right Model 1	Health safety Model 2
COVID	0.523*** [8.038]	0.456*** [7.631]
Loss	0.348*** [7.529]	0.709*** [14.448]
Size	0.000*** [8.386]	0.000*** [8.685]
Big4	0.108*** [2.600]	0.009 [0.228]
Growth	0.000** [2.091]	0.000* [1.924]
Constant	−0.061 [−1.360]	−0.880*** [−17.755]
SE Clustered	Firm	Firm
Country Fixed effects	Yes	Yes
Pseudo R2	7.89%	5.26%

Table 6.
Robustness test for
[Second Hypothesis](#)
(firms = 2,480)

had contributed to higher market performance. Additionally, under OLS and probit, we discovered that COVID-19 has contributed to a more efficient and effective H&S application. ICT companies and employers are encouraged to have dynamic attitudes and link employees' adaptive capabilities to positive attributes. This latter fact stems as one of the most contributing factors toward business success, resiliency, and sustainability. From the practical side, the study contributes to systematising and standardising international initiatives and best practices of countries' preparedness and response in fighting the pandemic. It stresses the importance of adopting innovative and digital solutions that are typical attributes of ICT companies.

The study results were vital as they highlighted the role of ICT firms in offering insights to academics, practitioners, policymakers, and stakeholders by fostering knowledge about responses to crises, integrating digital solutions, and disseminating digital information. Our study has implications on the health, social, business, economic, and global levels. It calls for the integration of innovative technologies to redesign the public health system to be more proactive and adaptive in pandemic circumstances. Additionally, this research has demonstrated the importance of digital readiness and the necessity to cooperate on the global echelon, build a digitised world, embrace an inclusive approach to technology governance, and enforce health and safety measures in work environments. Due to the unpredictable nature of the world, it's important to make sure that humanitarian workers are informed of the types of natural disasters that may arise. For future research, we suggest including some other control variables. Also, we used a quantitative method of testing our hypothesis; future studies may consider checking the robustness using qualitative methods such as structural or semi-structural interviews. Also, we gathered data until 2020 as we conduct this research during 2021; the future studies can extend the sample period of this study and can run regression on larger datasets.

Notes

1. <https://fractal.ai/covid-19-consequences-opportunities-for-ict/>
2. Impacts of COVID-19 on the Information Technology (IT) industry (marketdataforecast.com).

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