



RESEARCH ARTICLE

The Impact of the COVID-19 Crisis on Corporate Performance: The Moderating Role of Cash and Human Resources

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Abstract

The main objective of this study was to examine the impact of the COVID-19 crisis on firms' financial and market performance. The study employed quarterly data from a sample of firms listed on the Tehran Stock Exchange, covering 22 quarters 11 quarters before the COVID-19 crisis and 11 quarters during the pandemic. In total, 2,310 firm-quarter observations were analyzed using panel data methods in EViews 13 software. The findings indicated that during the quarters affected by COVID-19, the pandemic had a significant negative effect on the operating profit ratio and return on assets. In contrast, due to the inflationary conditions induced by the pandemic, COVID-19 exerted a significant positive effect on stock prices and, consequently, on firms' market performance. Moreover, the results showed that adequate cash holdings mitigate the adverse effects of COVID-19 on both financial and market performance, suggesting that sufficient liquidity can serve as a financial buffer during crises. Conversely, a larger workforce amplifies the negative effect of COVID-19 on financial performance, given that COVID-19 is a human-centered crisis, while it does not influence the relationship between COVID-19 and market performance. Beyond confirming the expected negative impact of the COVID-19 crisis on firms' financial performance, the findings highlighted two novel contributions. First, they showed that maintaining adequate cash holdings can serve as a defensive shield for firms during crises. Second, they revealed that a larger workforce may intensify the adverse effects of human-centered crises, such as the COVID-19 pandemic. Accordingly, the study suggested that firms should prioritize holding sufficient cash reserves as well as implementing human resource policies, such as training, preparedness, and succession planning, to better withstand future crises.

Keywords:

Cash Resources, Corporate Financial Performance, Corporate Market Performance, COVID-19 Crisis, Human Resources

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1. Introduction

Economic crises typically lead to a reduction in economic activities and exert significant effects on economic growth, inflation, employment, industrial production, and wholesale and retail prices. These crises, whether short-term or long-term, ultimately reduce the overall economic welfare of society (Pishbahar and Rasouli, 2019).

Crises have always impacted conventional economic frameworks and procedures. Examples of such crises include wars, floods, earthquakes, terrorist attacks, and even outbreaks of contagious diseases. One of the recent significant and influential crises affecting the global economy, including Iran's, has been the outbreak of the coronavirus (COVID-19) pandemic. The onset of COVID-19 in China and its widespread propagation in other countries exemplify a true crisis of unprecedented scale in history (Ashrafi and Kazempour, 2019). While the COVID-19 outbreak has threatened public health, its economic consequences are also highly substantial (Qin et al., 2021). Recent studies have demonstrated that exogenous shocks caused by the COVID-19 crisis have had significant negative effects on firm performance (Almustafa et al., 2023; Shen et al., 2021), corporate investment (Hajian and Hashemzadeh, 2024; Zheng and Zhang, 2021), and the efficiency of financial institutions and investment funds (Zheng and Zhang, 2021). However, to date, no study in Iran has examined the impact of this crisis on firms' financial and market performance. The findings of this research can not only enrich the existing literature but also assist companies in identifying the effects of crises and preparing for their adverse consequences. Accordingly, the first research question is formulated as follows:

Does the COVID-19 crisis affect the financial and market performance of firms listed on the Tehran Stock Exchange?

On the other hand, one of the factors that can act as a defensive shield to protect firms from the financial impacts of various crises is the availability of sufficient cash resources or financial flexibility. Cash flexibility refers to a company's ability to secure financial resources to appropriately respond to unforeseen events in order to maximize firm value (Byoun, 2011). Modern business models require sufficient flexibility to adapt to crisis conditions. Companies that are able to continue their economic activities are those that can restructure and adapt their operations to the surrounding environmental conditions (Schweizer and Nienhaus, 2017). The importance of adequate cash reserves becomes particularly evident during financial crises such as the COVID-19 pandemic, as they help reduce financial constraints caused by lower investment, increased financing burdens, and the potential loss of future investment opportunities. During high financing costs, holding cash can be a buffer for companies to strategically secure their profit margins against the negative impact of financial crises (Zheng, 2022). Nevertheless, excessive cash reserves may also increase the agency costs of shareholder interests. These costs are a consequence of holding too much liquidity, which reflects the downside of maintaining excess liquidity. Therefore, firms should strike an appropriate balance between holding and utilizing cash during crises. Cash holdings, therefore, represent a double-edged issue. On the one hand, they may mitigate the adverse effects of a crisis, while on the other hand, they may signal inefficient use of financial resources and lead to weaker performance. Examining this issue can thus provide valuable insights for firms. Accordingly, the second research question is formulated as follows:

Do higher levels of cash holdings mitigate the negative effects of the COVID-19 crisis on firm performance?

Another critical factor that may influence the extent to which firms are affected by crises, particularly human-driven crises such as pandemics, is human resources. The level of dependence on human capital varies by company based on factors such as business type, technological intensity,

operational modernization, labor- vs. capital-intensiveness, and other determinants. The greater the number of employees in a company, the more pronounced human-related challenges and crises tend to become. Although human resource challenges are diverse, they became more significant with the onset of the COVID-19 crisis (Onwuegbuna et al., 2021). Researchers such as Carnevale and Hatak (2020) have examined the prominent role of human resources in shaping how firm performance is affected by COVID-19. Jetter et al. (2020) and Mankin et al. (2020) argue that economic crises and unforeseen events generally reduce profitability and financial performance across various types of businesses, with the most severe impacts borne by companies with large workforces. Therefore, in contrast to the expectation that higher levels of cash reserves would mitigate the negative impacts of the COVID-19 crisis, a greater reliance on human resources appears to intensify the adverse effects of the crisis.

Therefore, greater reliance on human resources may intensify the adverse effects of crises with human origins. Iran, as one of the countries that experienced relatively high rates of mortality and illness during the COVID-19 pandemic, provides a relevant context to examine how firms' human resources affected their performance during this crisis. This issue not only highlights the importance of the human resource dimension but can also guide firms in managing future crises. Accordingly, the third research question is formulated as follows:

Do higher levels of human resources amplify the negative effects of the COVID-19 crisis on firm performance?

The rest of this paper proceeds as follows. The next section reviews the theoretical background and related literature, which leads to the formulation of six research hypotheses. Section three describes the research methodology, including the regression models and variables. Section four presents the descriptive statistics and reports the empirical findings. Section five provides a discussion of the results and concluding remarks. The final section outlines the study's implications and acknowledges its limitations.

2. Literature review

2.1. COVID-19 Crisis and Corporate Performance

In recent years, the world has witnessed the COVID-19 pandemic as one of the most severe crises in human history, which led to widespread economic devastation and caused global unrest. The disease, because of extreme contagion and virulence, forced lockdowns at global ports and airports and strict labor protocols for fear of spreading the ailment from person to person or through the air, as well as restrictions on imports and exports. Preventive measures taken around the world caused many businesses to close, creating supply and demand imbalances that contributed to serious economic difficulties and recession (Ding et al., 2021).

As news of the outbreak first began to emerge, fears of its deep economic impact gripped the world. Social distancing, self-isolation and travel restrictions reduced the availability of labor across all sectors of the economy and caused massive job losses. Schools and universities were shuttered, while demand for many goods and manufactured products fell off. On the other hand, there was a strong surge in medical supply and food products demand, which was mainly due to stockpiling behavior (Dhar et al., 2020). At the macro level, COVID-19 sparked the deepest global recession since the Great Depression. Among the pandemic's most negative consequences were declines in gross domestic product (GDP), widespread business bankruptcies, and massive job losses. However, how did COVID-19 impact corporate performance?

A 2021 Deloitte study of the COVID-19 crisis found a significant effect on firms' internal operations. This research is an obvious example of the detrimental impact that the pandemic has on

internal performance in companies. According to Deloitte's global survey conducted in the first quarter of 2020, a staggering 80% of corporate executives noted that COVID-19 negatively affected their companies' performance. The key reasons reported for this adverse effect included falling demand, operating restrictions, an inability to plan because of increased uncertainty, and changes in consumer behavior. This study demonstrates how an extraordinary and unforeseen event can cause an extreme disruption to the internal corporate operation.

In fact, the pandemic was influencing performance through multiple channels, both direct and indirect. In the short term, companies experienced waning revenues owing to a decline in consumer demand, interruptions to the supply chain, operational challenges arising from shutdowns and labor shortages and increased expenses related to public health and safety protocols. Indirect pressures from greater uncertainty and volatility in financial markets also had the effect of limiting firms' access to capital for investment and reducing overall confidence in markets. In addition, changes in consumer habits—from the acceleration of e-commerce to increased spending on essential goods—led to heterogeneous effects across sectors, with some companies thriving and others suffering losses.

Additionally, [Acharya and Steffen \(2020\)](#), researchers at Ohio State University, asserted that the COVID-19 crisis negatively impacts corporate performance. Their research explored how the pandemic helped to drive declines in profitability and financial performance across the board. The results showed that COVID-19 resulted in significant adverse impacts, such as revenue losses, higher costs, and reduced production capacities.

Additionally, [Shen et al. \(2021\)](#) studied the effects of the COVID-19 crisis on the performance of Chinese firms. The pandemic, their study also noted, negatively affected firm performance, especially for the companies with low investment capacities and lower-income levels.

Looking at the analysis of previous research in this area, the following research hypotheses are proposed:

H1: There is a significant relationship between the outbreak of COVID-19 and the financial performance of companies.

H2: There is a significant relationship between the outbreak of COVID-19 and the market performance of companies.

2.2. COVID-19 crisis and cash holdings

Crises represent exogenous shocks to economic activities, which implies that such a shock is beyond the control of managers. Therefore, organizations need strategies to enhance their resilience to mitigate the destructive effects of such crises. A severe human calamity like the COVID-19 pandemic creates various limitations and challenges for firms to face, such as reduced consumer demand, operational disruptions, planning uncertainty, changes in consumption patterns, supply chain collapse and increased operating costs, all of which further lead to a downward spiral of corporate performance. Adequate cash reserves or financial institutionalization ability is one of the crucial factors that can protect firms from the consequences of crises ([Zheng, 2022](#)).

Cash flexibility is defined as a firm's capacity to source the best available financial resources to react optimally to each contingency event maximizing firm value (Bounie, 2011). Modern business models require this flexibility to adapt and restructure operations in response to changing environmental conditions ([Schweizer and Nienhaus, 2017](#)). The importance of adequate cash reserves becomes especially clear during financial crises like the COVID-19 pandemic, as they help alleviate financial constraints caused by reduced investment, increased financing burdens, and potential loss of future investment opportunities. The advantage of keeping a liquid balance sheet is vital for a business to stay alive in bad times. In theory, financing frictions combined with deteriorating market conditions can lead to credit rationing and exacerbate refinancing risk, making externally obtained

capital more expensive than that generated internally (Zheng, 2022).

One of the leading theories regarding corporate cash balances is the Trade-off Theory. Under this theory, firms decide on the optimal amount of cash holdings by looking at the trade-off between the benefits and costs of holding cash. There are three main reasons for holding cash, including the transactional motive, the precautionary motive and the speculative motive. According to the precautionary motive, companies accumulate cash in times of high uncertainty to limit the risk of financial distress. The precautionary motive of corporate cash holds a value to firms in the bad states when firms face credit tightening and lack access to external finance (Zheng, 2022). Given that crises tend to create short-term uncertainties in business operations, maintaining a sufficient level of liquidity allows firms to cope with emergencies without dependence on external financing (Opler et al., 1999). Additionally, since some firms are more constrained than others in their ability or the cost of external financing, managers are encouraged to build up cash reserves before a contraction in credit leads to cash flow deficits. Having a prudent cash buffer enables firms to mitigate refinancing risk. In this context, Zheng (2022) and Chiappini et al. (2021) highlight the importance of corporate cash holdings in mitigating the negative effects of the COVID-19 crisis. The COVID-19 shock thus presents a unique opportunity to investigate the influence of unforeseen crises on firm performance and to assess the importance of cash reserves in shaping this impact. This issue is addressed in two hypotheses of the study as follows:

H3: The level of corporate cash holdings moderates the relationship between the COVID-19 crisis and financial performance.

H4: The level of corporate cash holdings moderates the relationship between the COVID-19 crisis and market performance.

2.3. COVID-19 Crisis and human resources

Just as the financial crisis of 2007–2009 highlighted the role of chief financial officers, the COVID-19 pandemic brought human resource (HR) managers to the forefront (Caligiuri et al., 2022) because HR management focuses on overseeing a unique resource, human capital, which is fundamentally different from financial or physical resources. While other resources enable work to be carried out, it is human resources that actually perform the work (Opatha, 2020).

COVID-19 is considered a human-centric crisis, primarily affecting people more than any other resource, thereby disrupting both organizational operations and HR functions. Although human resource challenges are diverse, the emergence of the COVID-19 pandemic has significantly intensified them (Onwuegbuna et al., 2021). Mwita (2020) found that during the COVID-19 crisis, recruitment and selection processes drastically slowed, employee training programs were canceled either to protect employees from the virus or due to limited online infrastructure, and performance management became increasingly difficult. In some organizations, financial obligations and benefit payments were also suspended. As a result, organizations were confronted with unprecedented and unconventional situations for which many of their employees had neither training nor expectations.

Although crises, particularly those with human-centric origins, such as the COVID-19 pandemic, can significantly affect employee well-being, mental health, and productivity, thereby influencing overall organizational performance, their impact appears to be more pronounced in labor-intensive firms. In such organizations, the heavy reliance on human capital makes them more vulnerable to disruptions affecting the workforce. While capital-intensive or highly mechanized firms are not entirely immune to these effects, the integration of technology and automated systems in their operations may buffer the severity of the crisis's impact. Consequently, the adverse effects of COVID-19 on performance are expected to be less severe in firms with lower human resource

dependence. For example, [Carnevale and Hatak \(2020\)](#) investigated the role of human resources in mediating the effects of external crises and unforeseen events on organizational performance. Furthermore, [Jetter et al. \(2020\)](#) and [Mankin et al. \(2020\)](#) found that the most significant declines in financial performance during economic crises were observed in firms with larger workforces.

Based on these insights, this study formulates the fifth and sixth hypotheses to explore the moderating role of human resources in the relationship between the COVID-19 crisis and firm performance. It is expected that firms with larger workforces may experience amplified negative effects of the COVID-19 pandemic on their performance.

H5: The number of human resources moderates the relationship between the COVID-19 crisis and firms' financial performance.

H6: The number of human resources moderates the relationship between the COVID-19 crisis and firms' market performance.

3. Methodology

This descriptive and post-event study is a retrospective research based on actual data extracted from financial statements. The statistical population includes all companies listed on the Tehran Stock Exchange. The accessible population for hypothesis testing was selected based on the following criteria:

1. Availability of complete financial statements;
2. Exclusion of companies in the financial sector, including banks, investment companies, holdings, insurance, and leasing firms, due to differences in financial information disclosure.
3. No change in fiscal year during the study period.
4. Fiscal year ending on March 20th.
5. No trading suspension of more than three months during the study period.

After applying the above restrictions, the final research sample includes 105 companies observed over 22 quarters (2,310 firm-quarters) from 2017 to 2022. Considering that the COVID-19 crisis began in late December 2019 and its serious effects continued until late September 2022, the 11 quarters within this period were considered the "COVID-19 period" and the 11 quarters prior as the "pre-COVID-19 period."

Part of the variable data was collected from secondary sources, including various financial databases, software platforms, and websites related to the Tehran Stock Exchange. The other part, concerning human resource variables, was manually extracted from the companies' board of directors' activity reports.

3.1. Empirical models

Based on the six research hypotheses and the two financial performance metrics, a total of nine regression models are examined as follows:

Regression equations for Hypotheses 1 and 2:

1. $OP = \alpha_1 + \alpha_2 \text{COVID19} + \alpha_3 \text{SIZE} + \alpha_4 \text{CF} + \alpha_5 \text{LEV} + \alpha_6 \text{BOI} + \alpha_7 \text{AGE} + \alpha_8 \text{INS} + \alpha_9 \text{FAR}$
2. $ROA = \alpha_1 + \alpha_2 \text{COVID19} + \alpha_3 \text{SIZE} + \alpha_4 \text{CF} + \alpha_5 \text{LEV} + \alpha_6 \text{BOI} + \alpha_7 \text{AGE} + \alpha_8 \text{INS} + \alpha_9 \text{FAR}$
3. $TQ = \alpha_1 + \alpha_2 \text{COVID19} + \alpha_3 \text{SIZE} + \alpha_4 \text{CF} + \alpha_5 \text{LEV} + \alpha_6 \text{BOI} + \alpha_7 \text{AGE} + \alpha_8 \text{INS} + \alpha_9 \text{FAR}$

Regression equations for Hypotheses 3 and 4:

1. $OP = \alpha_1 + \alpha_2 \text{COVID19} * \text{CH} + \alpha_3 \text{COVID19} + \alpha_4 \text{CH} + \alpha_5 \text{SIZE} + \alpha_6 \text{CF} + \alpha_7 \text{LEV} + \alpha_8 \text{BOI} + \alpha_9 \text{AGE} + \alpha_{10} \text{INS} + \alpha_{11} \text{FAR}$
2. $ROA = \alpha_1 + \alpha_2 \text{COVID19} * \text{CH} + \alpha_3 \text{COVID19} + \alpha_4 \text{CH} + \alpha_5 \text{SIZE} + \alpha_6 \text{CF} + \alpha_7 \text{LEV} + \alpha_8 \text{BOI} +$

$$\alpha_9\text{AGE} + \alpha_{10}\text{INS} + \alpha_{11}\text{FAR}$$

$$3. \text{TQ} = \alpha_1 + \alpha_2\text{COVID19} * \text{CH} + \alpha_3\text{COVID19} + \alpha_4\text{CH} + \alpha_5\text{SIZE} + \alpha_6\text{CF} + \alpha_7\text{LEV} + \alpha_8\text{BOI} + \alpha_9\text{AGE} + \alpha_{10}\text{INS} + \alpha_{11}\text{FAR}$$

Regression equations for Hypotheses 5 and 6:

1. $\text{OP} = \alpha_1 + \alpha_2\text{COVID19} * \text{N} + \alpha_3\text{COVID19} + \alpha_4\text{N} + \alpha_5\text{SIZE} + \alpha_6\text{CF} + \alpha_7\text{LEV} + \alpha_8\text{BOI} + \alpha_9\text{AGE} + \alpha_{10}\text{INS} + \alpha_{11}\text{FAR}$
2. $\text{ROA} = \alpha_1 + \alpha_2\text{COVID19} * \text{N} + \alpha_3\text{COVID19} + \alpha_4\text{N} + \alpha_5\text{SIZE} + \alpha_6\text{CF} + \alpha_7\text{LEV} + \alpha_8\text{BOI} + \alpha_9\text{AGE} + \alpha_{10}\text{INS} + \alpha_{11}\text{FAR}$
3. $\text{TQ} = \alpha_1 + \alpha_2\text{COVID19} * \text{N} + \alpha_3\text{COVID19} + \alpha_4\text{N} + \alpha_5\text{SIZE} + \alpha_6\text{CF} + \alpha_7\text{LEV} + \alpha_8\text{BOI} + \alpha_9\text{AGE} + \alpha_{10}\text{INS} + \alpha_{11}\text{FAR}$

Dependent variables

A. Financial performance:

This study adopted a model proposed by [Zheng \(2022\)](#), using the following two criteria to assess firm performance.

Operating Profit Ratio (OP): Calculated by dividing operating profit before depreciation by total assets.

Return on Assets (ROA): Defined as the net income of the company divided by the total assets of the company.

B. Market-based performance:

Tobin's Q Ratio (TQ): Obtained by dividing the market value of assets by the book value of assets. The market value of assets is calculated as Book Value of Liabilities + Market Value of Shareholders' Equity ([Zheng, 2022](#); [Hajian and Hashemzadeh, 2024](#)).

Independent variable

COVID-19 Crisis (COVID-19): A dummy variable that takes the value 0 for the 11 quarters prior to the COVID-19 crisis (Spring 2017 to Fall 2019), and the value 1 for the 11 quarters during the COVID-19 period (Winter 2019 to Summer 2022) ([Zheng, 2022](#); [Hajian and Hashemzadeh, 2024](#)).

Moderating variable for hypotheses 3 and 4:

Cash Holdings (CH): In line with previous research, cash holdings are calculated as the sum of cash and cash equivalents (as reported in the balance sheet) divided by total book assets ([Zheng, 2022](#)).

Moderating variable for hypotheses 5 and 6:

Number of Employees (N): Refers to the number of human resources reported annually in the Board of Directors' activity report ([Carnevale and Hatak, 2020](#)).

Control variables

Firm Size (SIZE): The natural logarithm of the total book value of the firm's assets ([Zheng, 2022](#)).

Operating Cash Flow (CF): Operational cash flows as reported in the statement of cash flows ([Zheng, 2022](#)).

Financial Leverage (LEV): Total liabilities divided by total assets of the company ([Zheng, 2022](#)).

Board Independence (BOI): The ratio of non-executive board members to total board members ([Zandi Gargari and Amirhosseini, 2016](#)).

Firm Age (AGE): The natural logarithm of the company's age from the year of establishment to the end of the study period (Hajian and Hashemzadeh, 2024).

Ownership Concentration (INS): Sum of the ownership percentages held by shareholders owning more than 5% of the company's shares (Hajian and Hashemzadeh, 2024).

Fixed Asset Ratio (FAR): Ratio of fixed assets to total assets (Zandi Gargari and Amirhosseini, 2016).

4. Findings

4.1. Descriptive statistics

Table 1 presents the descriptive statistics for the quantitative and qualitative variables examined in the studied companies.

Table 1. Descriptive statistics

Variable Indicator	Description	Sample Size	Mean	Median	Max	Min	Std. Dev.
OP	Operating Profit Ratio (%)	2310	0.440	0.030	18.360	-68.340	4.310
ROA	Return on Assets (%)	2310	0.360	0.020	19.180	-60.630	3.800
TQ	Tobin's Q	2310	9.600	4.190	1581.440	0.550	57.460
CH	Cash Holdings	2310	0.090	0.050	0.930	0.000	0.120
N	Number of Employees	2310	901.950	343.000	171880	22.000	2104.940
SIZE	Firm Size (log of total assets)	2310	12.910	12.830	15.330	11.080	0.640
CF	Operating Cash Flow	2310	0.060	0.040	0.750	-0.500	0.100
LEV	Financial Leverage	2310	0.550	0.580	0.980	0.020	0.210
BOI	Board Independence (%)	2310	66.440	60.000	100.000	0.000	18.160
INS	Ownership Concentration (%)	2310	68.470	72.020	99.000	0.000	18.680
FAR	Fixed Asset Ratio	2310	0.210	0.150	0.920	0.000	0.180

The dataset used in this study is quarterly, which is particularly relevant for interpreting performance-related variables. For example, the average quarterly return on assets (ROA) is approximately 0.36%, whereas the maximum observed value reaches around 19%. Descriptive statistics further reveal that the number of employees among the companies varies widely, ranging from 22 to 17,188 employees. Moreover, the average Tobin's Q ratio, which reflects the market value relative to the book value of the firms, is approximately 9.6, indicating that, on average, market value is more than nine times the book value.

4.2. Research findings

All research data have been evaluated for suitability in conducting inferential statistical analyses. To test for normality, the Jarque–Bera test was applied. The results showed that the p-values for all variables exceeded the 5% threshold, indicating no significant deviation from normality for any variable.

Spearman's rank correlation method was carried out to evaluate the extent of association between variables. Generally, the results showed no strong correlations between independent variables, which suggests that multicollinearity was not a problem here.

We analyzed heteroscedasticity with White's test, ensuring that the final regression estimations were robust against this bias, which is indicated by the presence of heteroscedasticity in our error terms. To correct for this, White–Huber robust standard errors were used.

Also, the Durbin–Watson statistic was used to assess any autocorrelation in residuals. The Durbin–Watson values for all the regression models were between 1.5 and 2.5, so it was concluded that no autocorrelation existed.

Nine panel data regression models were estimated to test research hypotheses. The outcomes of

these estimations, which also included three firm-specific performance indicators and two moderating variables, are shown in the following section.

H1 and 2:

Table 2 presents the results of regression models 1 to 3, corresponding to Hypotheses 1 and 2.

Table 2. Regression results for hypotheses 1 and 2

Variable Name	Coefficient (Model 1: OP)	Sig. (Model 1)	Coefficient (Model 2: ROA)	Sig. (Model 2)	Coefficient (Model 3: QT)	Sig. (Model 3)
COVID19	-0.380	0.010	-0.360	0.010	0.710	0.000
SIZE	3.270	0.000	2.800	0.000	-2.800	0.000
CF	0.480	0.690	0.280	0.790	6.850	0.000
LEV	0.920	0.230	0.870	0.200	-2.160	0.000
BOI	-0.000	0.710	-0.000	0.740	-0.010	0.230
AGE	-4.550	0.180	-3.220	0.310	-7.100	0.050
INS	-0.000	0.470	-0.000	0.480	0.000	0.830
FAR	0.150	0.850	0.310	0.680	-4.950	0.000
Intercept (C)	-36.250	0.000	-32.020	0.000	59.870	0.000
R ²	0.210		0.210		0.470	
Adj. R ²	0.170		0.170		0.440	
F-stat	4.660		4.550		14.970	
P-value	0.000		0.000		0.000	
DW Stat.	2.460		2.470		1.620	

The F-statistics for the panel data regression models are 4.66, 14.97, and 4.55, respectively, indicating the overall significance of all three regression models. As shown at the bottom of Table 2, the R-squared values for the models are 21%, 47%, and 21%, respectively. Therefore, in the specified regression equations, approximately 21%, 47%, and 21% of the variations in the operational performance measures (Operating Profit Ratio, Tobin's Q Ratio, and Return on Assets, respectively) of the companies under study are explained by the independent and control variables included in the models.

The results presented in Table 2 show that the significance levels for the relationship between the COVID-19 crisis and the three dependent variables—Operating Profit Ratio, Return on Assets, and Tobin's Q are 0.01, 0.01, and 0.00, respectively. All of these are lower than the 5% significance level used in this study. Thus, at the 95% confidence level, Hypothesis 1 (the impact of COVID-19 on accounting-based performance) and Hypothesis 2 (the effect on market-based performance) are statistically supported.

One significant finding from this part is that the COVID-19 crisis has a significant detrimental impact on both of the accounting-based performance measures, which are the Operating Profit Ratio and Return on Assets. By contrast, the crisis was associated with a significant positive impact in terms of firms' market-based performance as measured by Tobin's Q.

While firms made less money during the COVID-19 period, this means market participants may have had more optimistic or forward-looking expectations, which put upward pressure on the valuation of the market despite weak financial results.

Hypotheses 3 and 4:

Table 3 presents the results of regression models 4 to 6, corresponding to Hypotheses 3 and 4.

Table 3. Regression results for hypotheses 3 and 4

Variable Name	Coefficient (Model 1: OP)	Sig. (Model 1)	Coefficient (Model 2: ROA)	Sig. (Model 2)	Coefficient (Model 3: QT)	Sig. (Model 3)
Covid19 * CH	6.200	0.000	5.450	0.000	-3.200	0.020
COVID19	-0.930	0.000	-0.820	0.000	0.740	0.140
CH	-5.030	0.000	-4.510	0.000	0.490	0.720
SIZE	2.840	0.000	2.430	0.000	-3.110	0.000
CF	0.630	0.610	0.600	0.580	7.390	0.000
LEV	1.290	0.070	1.150	0.070	-2.780	0.000
BOI	-0.010	0.19	-0.000	0.200	-0.020	0.000
AGE	-3.590	0.520	-2.840	0.560	-8.500	0.420
INS	0.000	0.660	0.000	0.650	0.000	0.310
FAR	0.150	0.850	0.290	0.670	-5.450	0.000
C (Constant)	-31.950	0.000	-27.780	0.000	66.000	0.000
R-squared	0.190		0.190		0.490	
Adjusted R-squared	0.140		0.140		0.460	
F-statistic	3.610		3.540		14.380	
Prob(F-statistic)	0.000		0.000		0.000	
Durbin-Watson stat.	2.400		2.410		1.680	

According to Table 3 and the corresponding models, the significance levels for the relationship between the COVID-19 crisis and firm performance (Operating Profit Ratio and Return on Assets) as well as market performance (Tobin's Q), considering the moderating variable of cash holdings, are 0.00, 0.00, and 0.02, respectively. These values are below the 5% significance level adopted in this study. Therefore, at the 95% confidence level, the null hypothesis—stating that cash holdings do not moderate the effect of the COVID-19 crisis on firm performance is rejected, and the main research hypothesis is confirmed. Cash holdings weaken the negative relationship between the COVID-19 crisis and financial performance, and weaken the positive relationship between the COVID-19 crisis and the market-based performance of the firms.

Hypotheses 5 and 6:

Table 4 presents the results of regression models 7 to 9, corresponding to Hypotheses 5 and 6.

According to Table 4 and the aforementioned models, the significance levels between the COVID-19 crisis and the company's financial performance (Operating Profit Ratio and return on assets), as well as the company's market performance (Tobin's Q ratio), considering the interaction coefficient of the moderating variable number of human resources—are -0.01, -0.03, and -0.95, respectively. These values indicate statistical significance for the two financial performance variables, except for Tobin's Q. Therefore, at a 95% confidence level, Hypothesis 5, which posits that the number of human resources moderates the impact of COVID-19 on firm performance, is confirmed. Specifically, given the negative coefficients, a greater number of human resources intensifies the negative relationship between the COVID-19 crisis and the company's financial performance. Thus, the main hypothesis for Tobin's Q is rejected, indicating that the number of human resources does not significantly moderate the relationship between the COVID-19 crisis and market performance.

Table 4. Regression results for hypotheses 5 and 6

Variable Name	Coefficient (Model 1: OP)	Sig. (Model 1)	Coefficient (Model 2: ROA)	Sig. (Model 2)	Coefficient (Model 3: QT)	Sig. (Model 3)
Covid19 * Nit	-0.010	0.010	-0.030	0.000	-0.950	0.310
COVID19	-0.190	0.030	0.520	0.000	-0.190	0.030
N	-0.000	0.000	-9.120	0.600	-0.000	0.000
SIZE	1.380	0.000	-2.780	0.000	1.210	0.000
CF	1.140	0.520	8.620	0.000	0.920	0.250
LEV	1.980	0.140	-1.780	0.000	1.700	0.000
BOI	0.000	0.460	-0.010	0.090	0.000	0.660
AGE	0.580	0.360	-3.590	0.120	0.570	0.380
INS	-0.000	0.430	-0.000	0.870	-0.000	0.510
FAR	1.260	0.190	-5.600	0.000	1.160	0.040
C	-20.180	0.000	52.790	0.000	-17.610	0.000
R-squared	5%		46%		4%	
Adjusted R-squared	4%		43%		4%	
F-statistic	12.250		16.400		12.020	
Significance (P-Value)	0.000		0.000		0.000	
Durbin-Watson Statistic	2.160		1.750		2.170	

5. Discussion and conclusion

According to economic experts, the risk posed by the coronavirus is significant enough to be considered the onset of a global economic recession. The analysis examines whether the COVID-19 crisis has a significant impact on company performance at both financial and market levels. Based on the results obtained, COVID-19 has a significant negative effect on firms' financial performance. The findings showed that the outbreak of the coronavirus disease has reduced companies' profitability and return on assets. These results are consistent with studies by [Zheng \(2022\)](#), [Acharya and Steffen \(2020\)](#) and [Shen et al. \(2021\)](#), which indicated a significant decline in corporate profitability during the COVID-19 crisis.

In contrast, the findings suggested that the COVID-19 pandemic had a significant positive influence on Tobin's Q ratio, reflecting enhanced market performance of firms. This outcome aligns with studies in developing economies, where the pandemic triggered inflationary trends that contributed to higher firm valuations and Tobin's Q ratios. For example, [Ashrafi and Kazempour \(2019\)](#), in a domestic study, identified positive effects of the pandemic on Tobin's Q based on expert survey responses.

However, this finding is different from the evidence observed in developed countries, such as [Bose et al. \(2022\)](#), who downloaded Tobin's Q for Australian firms in the COVID-19 crisis, suggesting market reactions may differ depending on economic conditions.

Across the dangerous secrets, the findings showed that the COVID-19 pandemic is detrimental to firms' financial performance while positively contributing to their market performance. This means that, on average, the stock market reacted positively to the outbreak and subsequent economic shutdowns, yielding substantial returns even as firms' financial performance withered.

In relation to cash holdings as a moderator, the results showed that cash holdings weaken the relationship between the COVID-19 crisis and firms' financial performance. That is, the incidence and spread of COVID-19 have brought less harm and a slight negative variation in the performance of firms with large cash reserves. Companies with more cash are less exposed to the fallout of the COVID-19 crisis because they're financially better positioned. These results were in line with the studies of [Zheng \(2022\)](#), [Stephen \(2020\)](#), [Shen et al. \(2021\)](#), and [Sabouri \(2022\)](#). Additionally, although firms' performance in the market had beneficial results, the inflationary conditions within the COVID-19 crisis and its negative effect on liquidity decreased these effects.

Furthermore, the results examining the moderating effect of the number of human resources on the relationship between the COVID-19 crisis and firm performance indicated that the COVID-19 outbreak exerted a more pronounced negative impact on the financial performance of firms with a higher number of employees. In other words, the results indicated that the number of human resources strengthens the negative relationship between the COVID-19 crisis and firm performance. However, this effect was not supported for the market performance variable (Tobin's ratio). It can be argued that since employees are directly affected by stress, illness, mortality, and other human-related consequences of crises such as COVID-19, firms with a larger workforce are more vulnerable to such disruptions, resulting in weaker overall financial performance. Nevertheless, market performance appears to remain unaffected by the stress, illness, or mortality of employees. Although workforce-related problems may disrupt internal operations, the firm's market performance or stock returns are not directly driven by such issues. In fact, capital market participants, both actual and potential investors, make buy and sell decisions based on observable and expected financial indicators, which ultimately determine the stock value of the firm. Investors are generally not informed about the internal workforce-related challenges caused by COVID-19, and even when informed, such factors do not significantly influence their trading decisions. Therefore, the results stated that the number of employees does not moderate the relationship between the COVID-19 crisis and firms' market performance.

The test results were consistent with [Shinde et al. \(2020\)](#), who demonstrated the negative effects of the COVID-19 crisis on employee performance. Further, the results aligned with [Shinde et al. \(2020\)](#), in which human resource management practices during the COVID-19 crisis and implications for employee welfare and job security perceptions were investigated. The high rate of psychological disorders and low resilience seen during the pandemic support these conclusions. This aligns with the findings of research by [Nasirzadeh et al. \(2020\)](#), which also pointed to the importance of psychological interventions.

6. Limitations and implications

This study faced several data-related limitations that may have implications for the findings. First, the research relied on quarterly financial statement data; in Iran, six-month and twelve-month financial statements are audited, whereas three-month and nine-month financial statements are not. Therefore, for the 3- and 9-month quarterly data, we had to rely on unaudited financial statements, which may introduce some measurement error in the financial performance indicators. Second, quarterly data on the number of human resources were not available, as Iranian Accounting Standard 22 (Interim Financial Reporting) does not require disclosure of human resources information in interim reports. Consequently, annual human resources data and board of directors' activity reports were used as proxies. Such a substitution could limit the accuracy of the analysis between workforce size and firm performance by potentially underestimating or overestimating the moderating role of HR on COVID-19 effects. Although these measures are the best data available, readers should interpret the findings cautiously because of these limitations.

These findings had significant implications for different interests of company stakeholders, regulatory authorities and developers of corporate strategy. Given the moderating effect of cash holdings in alleviating the impact of these gradual changes stemming from the COVID-19 crisis on firms' financial performance, we argued that managers should ensure optimal short-term liquidity levels to reduce liquidity risk exposure to unexpected crises. In this way, firms are poised to meet their debt obligations during crises and also minimize liquidity risk as much as possible. In addition, considering the role of cash holdings as a buffer moderating the negative effects of crises, regulators have to incentivize or mandate firms to hold sufficient liquidity to withstand sudden disruptions. On

the other hand, considering the intensified adverse effects of human crises such as pandemics in firms with a larger workforce, it is recommended that firms with a significant number of employees implement human resource training programs, succession planning, and replacement management strategies. Such measures would enable other employees to temporarily assume the responsibilities of those affected during workforce disruptions.

7. Robustness tests

Following Zheng (2022), we conducted additional sensitivity analyses and robustness tests by examining the heterogeneous effects of COVID-19 across different industries and firm sizes. Tables 5 and 6 present regression results that incorporate interaction terms between the COVID-19 period and industry categories as well as firm size groups.

Table 5. Regression results by industry (COVID-19 Interaction Effects)

Industry	COV×IND (OP)	Sig.	COV×IND (ROA)	Sig.	COV×IND (QT)	Sig.	Interpretation
1. Pharmaceuticals and Chemicals	-0.010	0.404	0.079	0.032	-0.183	0.592	Pharmaceutical and chemical companies with significantly higher profitability (ROA) during the COVID-19 period.
2. Automotive and Parts	-0.017	0.217	0.049	0.266	-0.075	0.833	The automotive sector had an overall insignificant impact on its performance.
3. Metals and Mining	-0.008	0.642	0.092	0.047	0.246	0.550	Metal and mining companies achieved higher profitability (ROA) during the pandemic.
4. Cement, Tile, and Construction Materials	0.002	0.879	0.152	0.004	-0.498	0.223	The financial performance (ROA) of construction-related companies improved.
5. Food and Beverages	-0.029	0.025	0.016	0.655	-0.284	0.790	The operational performance (OP) of food companies weakened during the COVID-19 period.
6. Machinery and Equipment	-0.036	0.013	0.026	0.569	-0.495	0.239	The operational performance (OP) of this sector, industrial investment and equipment saw a significant decline.

Table 5 shows the regression results by industry, capturing the interaction effects of COVID-19. Other Industries, Holdings, and Agriculture (IND7) were excluded due to multicollinearity. The results highlighted heterogeneous industry-level responses to the COVID-19 pandemic. While the pharmaceutical, chemical, metal, and construction sectors experienced stronger profitability, the food and machinery industries were negatively impacted. However, the overall market valuation effect (Tobin's Q) remained statistically insignificant for any of the examined industries.

Table 6. Regression results by firm size (COVID-19 Interaction Effects)

Firm Size Category	COV×SIZE (OP)	Sig.	COV×SIZE (ROA)	Sig.	COV×SIZE (QT)	Sig.	Interpretation
Medium Firms (SIZE2)	0.009	0.372	0.301	0.269	6.749	0.015	A positive and significant market reaction.
Large Firms (SIZE3)	-0.015	0.398	0.984	0.0505	13.662	0.000	A significant market gain during the pandemic.

Table 6 presents the regression results by firm size, capturing COVID-19 interaction effects. Firms were classified into three categories: small, medium, and large, based on their total asset size. Small firms (SIZE1) were excluded due to multicollinearity. Medium firms (SIZE2) display positive and statistically significant effects only in the market-based model (Tobin's Q), indicating that they reap benefits from optimism by investors. The results showed that large firms (SIZE3) that gained on the market in fact present smaller or insignificant OP and ROA effects. In general, the COVID-19 effects depend on firm size, while investors preferred medium and large firms in market reaction terms, market analysts relied on operational restrictions.

Pre- vs. Post-COVID analysis

A comparison was performed between the pre- and post-COVID-19 periods. In more detail, we estimated the OP, ROA, and Tobin's Q models for the 11 quarters before and after the onset of COVID-19 (i.e., onset = 01Q21). It also allows us to explore how the drivers of firm performance and market value may have shifted in light of the pandemic. The results of this split-period regression analysis are shown in Table 7. Comparing the two mentioned periods reveals significant changes in the strength and significance of several explanatory variables.

Table 7. Performance models (Post- vs. Pre-COVID-19)

Variable	OP Post-COV	Sig	OP Pre-COV	Sig	ROA Post-COV	Sig	ROA Pre-COV	Sig	QT Post-COV	Sig	QT Pre-COV	Sig
SIZE	0.020	0.008	0.035	0.000	2.829	0.000	0.548	0.000	-2.791	0.000	-2.061	0.000
CF	0.693	0.000	0.587	0.000	3.194	0.000	0.488	0.000	4.616	0.000	10.113	0.000
LEVERAGE	-0.052	0.011	-0.081	0.000	1.068	0.260	-0.070	0.290	-1.444	0.010	-0.284	0.390
BOI	0.000	0.310	0.000	0.200	-0.009	0.640	0.000	0.520	-0.030	0.060	0.033	0.008
AGE	-0.578	0.000	0.254	0.050	-8.398	0.320	-1.267	0.001	-22.714	0.000	8.260	0.030
INS	0.000	0.480	0.000	0.410	0.000	0.980	-0.001	0.340	0.032	0.040	-0.031	0.100
FAR	-0.106	0.000	-0.086	0.000	0.384	0.610	0.093	0.270	-4.211	0.000	-4.291	0.000
Intercept (C)	0.670	0.006	-0.691	0.000	-25.552	0.050	-5.640	0.000	79.097	0.000	25.516	0.000
R ²	0.567	-	0.475	-	0.211	-	0.194	-	0.494	-	0.553	-
Adj. R ²	0.521	-	0.420	-	0.127	-	0.109	-	0.440	-	0.505	-
F-stat	12.310	-	8.510	-	2.510	-	2.270	-	9.170	-	11.600	-
DW Stat	2.330	-	2.430	-	2.500	-	2.460	-	1.590	-	2.010	-

Table 7 shows that firm size and cash flow consistently remain the most significant determinants of firm performance, both before and during the COVID-19 pandemic. Larger firms and those with stronger cash flows tend to perform better and maintain higher performance levels, underscoring their resilience amid market fluctuations. Interestingly, the impact of leverage and firm age on performance has become more pronounced in the post-COVID period. This suggests that firms with higher debt levels faced increased financial strain during the crisis, while older, more mature firms demonstrated different sensitivities, potentially due to their established structures and experience in navigating turbulent environments. In contrast, other factors such as board independence, fixed asset ratio and

ownership concentration exhibited limited or inconsistent effects on firm outcomes across the two periods. These results highlighted how the pandemic has intensified the importance of financial health and firm maturity while diminishing the relative influence of ownership structure on firm performance during this challenging time.

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