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RESEARCH PAPER

COVID-19 Outbreak and Sectoral-Level Stock Returns in the Tehran Stock Exchange: An Event Study

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Abstract
This article attempts to empirically investigate the impacts of the COVID-19 pandemic on average returns and investment risk of the 33 leading industries, categorized in nine groups of industries indexes, in Tehran Stock Exchange. Using an event-study methodology, our data sample (from 2018/12/15 to 2021/04/24) was partitioned into three sub-samples, namely estimated, event, and future windows. To address the main objectives of this study, variations in actual, abnormal, and cumulative abnormal returns of the estimated (pre-event) and future (post-event) windows were analyzed for all industries. The results confirmed that the "Retail except for Vehicles" and "Real State and Housing" industries have had the highest decrease in their average returns and, conversely, the "Telecommunication and Technology," "Financial," and "Pharmaceutical and Health" industries have experienced the most considerable increase in the average returns. Furthermore, the analysis of the time required for the effectiveness of the pandemic impacts on the stock returns showed that a 14-day lag (after the exposure) is needed for various industries to respond to the event. Ultimately, our empirical evidence confirmed that the uncertainty caused by the COVID-19 outbreak has negatively affected almost all industries active in the TSE.

Keywords: COVID-19 pandemic, stock market, event-study methodology, actual returns, abnormal returns, cumulative abnormal returns.

JEL Classifications: C49, E32, D53, G14.

1. Introduction

Following the world's most devastating economic and financial crises in the last hundred years, the world has experienced global health and economic crisis, i.e., COVID-19. Starting in Wuhan, China, in December 2019, the World Health Organization declared the COVID-19 as pandemic disease. It was mainly due to its rapid and widespread outbreak that it led to the death of thousands of people worldwide (Chen & Yeh, 2021). These situations, along with a great deal of economic uncertainty, have had significant short- and long-run economic consequences for most real sectors (such as financial markets, insurance and banking industries, government budgets, etc.) throughout the world (Goodell, 2020). Due to the significant impacts of this infectious and fatal disease on both aggregate demand and supply, it can be inferred that the continuation of these conditions could drive the global economy into the next recession (Hung, 2020).

This concern was also evident in the initial reports of the International Monetary Fund (IMF) and the World Trade Organization (WTO). In April 2020, the IMF predicted that the global

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GDP growth in 2020 would decline by 3% (See World Economic Outlook[1]). Meanwhile, the WTO predictions showed that international trade could fall between 13% and 33% in 2020 (See WTO Trade Statistics and Outlook[2]). With the discovery of the vaccine for the COVID-19 and the widespread vaccination of people worldwide, however, hopes for the improvement of global economic growth and trade have increased (Phan & Narayan, 2020). Regardless of the possibility of different mutations of the coronavirus and the possible ineffectiveness of the discovered vaccines against the newly mutated species of COVID-19, the global economic growth projected for 2021 and 2022 are equal to 6%, 4.4%, respectively. Similarly, the predicted world trade growth in these years would be around 0.8% and 0.4%, successively. In the most optimistic case, regardless of the intra- and inter-country analysis, (at least) two main points can be deduced from this global statistic. Firstly, the growth of some businesses in certain sectors can improve the average global economic growth of 2021 and 2022 (albeit the projected growth does not mean the growth of all businesses). Secondly, even if we consider the projected growth rates of international trade for 2021 and 2022, the volume of world trade in the two years would not return to the pre-epidemic level. Considering this fact, the most crucial concern that must be answered in different countries would be which sectors have suffered the most and which ones have suffered the least from the COVID-19 pandemic.

In line with this, a question arises on the reason for the importance of investigating the impacts of the COVID-19 outbreak on various industries' returns in Iran. Generally, due to some compelling reasons (such as (1) stylized facts and vulnerabilities of the Iranian economy, (2) impressive characteristics and particular condition of these industries active in the TSE, (3) the role of these influential industries in strengthening the employment rate, economic growth rate, and other macroeconomic factors in Iran, and (4) frequent and severe volatilities in the returns of these industries which also significantly affect the performance of the entire Iranian economy), the careful scrutiny and well-planned management are needed to stabilize the performance of these sectors and minimize their vulnerability to different exogenous shocks (especially to the shocks that hit the country's macro-economy like COVID-19 pandemic) in the context of Iran's economy.

Accordingly, a growing number of researchers investigate the effects of the COVID-19 on stock markets. To briefly indicate the research gap, it should be noted that most previous studies have scrutinized the impacts of the coronavirus crisis on the stock market or other financial market indexes mainly at an aggregated level (See Heyden & Heyden, 2021; Iyke & Ho., 2021; Costa et al., 2021; Phan & Narayan, 2020). However, our work contributes to the growing literature mainly on the responsiveness of different industries (sector-by-sector from the stock market viewpoint) to the COVID-19. Clearly, this paper's main contributions and innovations can be divided into two parts: empirical and methodological. Firstly, the empirical contributions of this study refer to the investigation and comparison of the impacts of the COVID-19 official announcement[3] and its repercussions on the average returns[4] and investment risks[5] of different industries in the TSE. Secondly, our methodological contributions refer to applying an event-study analysis to scrutinize the impacts of the COVID-19 pandemic at the industry level in the TSE. Historically speaking, Dolley (1933), Ball and Brown (1968), and Fama et al. (1969) have been the first figures to systematically

1. World Economic Outlook, April 2020: The Great Lockdown, Chapter 1: Global Prospects and Policies, International Monetary Fund (Www.imf.org).
2. WTO Trade Statistics and Outlook, Trade set to plunge as COVID-19 pandemic upends global economy, 8 April 2020, World Trade Organization (Www.wto.org).
3. The first confirmed COVID-19 cases in Iran were identified in Qom On 19 February 2020.
4. Variations in the means of actual, abnormal, and cumulative abnormal returns.
5. Variations in the standard deviations of actual, abnormal, and cumulative abnormal returns

develop the idea of the event-study statistical method, which is widely used in the empirical studies on accounting, finance, and economics. On this basis, an event study discloses crucial details on how the value of a security responds to a significant emergency event like a disaster or exogenous shock (Liu et al., 2021).

Overall, this study investigates how the consequences of COVID-19 affect various stock indexes in the Tehran stock market. To this end, we applied an event-study methodology based on the daily data of 33 different stock indexes[1] from 2018/12/15 to 2021/04/24. In this context, the event study methodology, through partitioning the data into three windows (i.e., estimated, event, and future), seeks to determine how the actual, abnormal, and cumulative abnormal returns of different stock indexes would be affected by the COVID-19 outbreak. Therefore, such an investigation would benefit both investors and policy-makers to manage and control the ramifications of this pandemic. This study proceeds as follows. After providing a literature review in section 2, the stylized facts that stand out about various industries in Iran are reported in section 3. Section 4 provides further details on methodology and data. Finally, section 5 concludes the article.

2. Literature Review

Generally, some emergency events, e.g., public health incidents, can significantly affect stock prices by influencing investors' sentiment and changing their expectations. Unlike the broad existing literature on the effects of emergency events on stock prices, few studies have examined the adverse effects of public health events on stock indexes. In this regard, Goodell (2020) claims the consequences of the COVID-19 pandemic on stock market indexes are likely similar to other disasters, mainly due to its effects on the investors' expectations or risk preferences that can enhance fear-induced sentiment (Goodell, 2020; Liu et al., 2021). Clearly, the COVID-19 pandemic has widely affected the supply chain and production process, international trade and shipment flow, economic uncertainty and inflationary pressure, shareholders' portfolio, and the global economy as a whole (See Chen & Yeh, 2021; Chowdhury et al., 2021; Liu et al., 2021; Yudhi & Wijaya, 2021).

From an empirical standpoint, there are a large number of studies that evaluate the repercussions of the COVID-19 pandemic. In this regard, Ahmed et al. (2021) considered different phases of lockdown (first and second waves) to investigate the effects of the COVID-19 pandemic on the Indian stock and commodity (oil and gold) markets. The results of GMM multivariate analysis demonstrated that during both phases of lockdown in India, the COVID-19 pandemic had significant effects on Indian stock and commodity markets. More precisely, while these waves of COVID-19 outbreak negatively affected stock market performance and oil prices changes, it positively affected gold prices. In line with this study, Adekoya and Oliyide (2021) explored the effects of COVID-19 on the relationship between commodity and financial markets by using TVP-VAR and causality-in-quantiles techniques. Their results, based on the Causality-in-quantiles test, supported the role of the COVID-19 pandemic as a significant factor that drove connectedness among these markets. Moreover, the findings of the TVP-VAR model confirmed the existence of strong volatility spillover across the markets. As another study, Albulescu (2021) considered the impacts of official announcements of new cases of infection and fatality ratio regarding the COVID-19 on the volatilities of the financial markets in the United States. The findings of this paper demonstrated that the sanitary crisis increased the volatilities of the S&P 500.

In other similar studies, Chen et al. (2021) confirmed the significant effects of the COVID-

1. Including 32 industries stock prices together with Tehran Stock Exchange Price Indexes (TEPIX).

19 pandemic on the Chinese stock market (negatively) and the bond market (positively). Liu et al. (2021) corroborated that the return transmission between oil prices and stock markets in Europe (the United Kingdom, German, Italy, Spain, and France) was more apparent during the Covid-19 pandemic in comparison with the pre-pandemic periods. Hung (2021) found that the COVID-19 pandemic significantly increased the stock market crash risk in the Shanghai Stock Exchange and, interestingly, the fear sentiment index exacerbated the crash risk. In a broader study, Chowdhury et al. (2021) investigated the consequences of the Covid-19 outbreak on the global stock markets and economic activities across the world (12 selective countries). This study corroborated the serious negative effects of the COVID-19 on stock market returns, especially in European countries.

Furthermore, as market risk (systematic risk), the current and future ramifications of the COVID-19 pandemic on various sectors of an economy seem undeniable. Consequently, analyzing, managing, and controlling the consequences of this pandemic for various active sectors in an economy would be a primary concern of policy-makers, business managers, shareholders, etc. (Öztürk et al., 2020). In addition, some researchers like Costa et al. (2021), Buszko et al. (2021), Salisu et al. (2021), Gunay et al. (2021), Costa et al. (2021), and Haroon and Rizvi (2020) assert various sectors of an economy will react differently to the consequences of the coronavirus pandemic. More transparently, while some sectors have been negatively affected by the pandemic (e.g., the financial and insurance industries and the transportation industry), some others have greatly benefited from this situation (e.g., telecommunications, pharmaceutical, and some specific chemical industries and high-tech and online-based businesses). Given these studies, there is also a growing need for conducting several empirical studies to assess and predict the consequences of this phenomenon in various case studies.

3. Stylized Facts Stand Out About Various Industries in Iran

On the one hand, Iran's economy is highly dependent on oil export revenues, and a significant portion of oil revenues are spent on current expenditures in its government budget. In this economy, on the other hand, taxes have always been a small part of government revenues. The outcomes of these conditions, along with fluctuations in world oil prices and international sanctions imposed on Iran economy, have been the instability of the government budget and the expansion of uncertainty into the macroeconomic atmosphere of the economy (Komijani et al., 2014). Over time, such circumstances have led to structural problems such as the Paradox of Plenty and Dutch disease in this country.

Furthermore, the industrial sector in the Iranian economy plays a prominent role in creating employment opportunities, greater income, and added value, thus affecting economic growth. The greatest vulnerability of Iran's economic growth, however, can be rooted in this part. In recent years, the industrial sector has been severely damaged by domestic and international troubles; consequently, most active industries, despite their higher potential, operate with less capacity. In this regard, various studies in this realm have emphasized that the existence of structural problems such as international sanctions, relatively inefficient monetary and fiscal policies, monopoly conditions, corruption and economic rents, inefficient pricing system, incompetent domestic banking sector with no connection with the international banking network (SWIFT[1]), etc. have also had significant effects on weakening the industrial sector in Iran. Therefore, carefully scrutinizing the effects of various shocks, like the COVID-19 pandemic, on this vulnerable sector is of the utmost importance for policy-makers and senior managers in Iran.

1. Society for Worldwide Interbank Financial Telecommunication

4. Data and Methodology

In this study, the daily data of 33 assorted stock indexes[1], categorized in nine groups[2], were applied[3] from 2018/12/15 to 2021/04/24 to address the primary purposes of this study. All the data was partitioned into three various windows through the event-study methodology, including estimated, event, and future periods. Accordingly, to accurately determine each window, the one-week period was used as the confidence interval[4]. In line with this, the official announcement of the COVID-19 date (2020/02/23), in addition to a one-week period for the confidence interval of the exact event day, was considered as the event window. In this context, the estimation window was the period between the first observation and a week before the event date (2020/02/04 to 2020/03/03). Moreover, the future window included a week after the event date up until the last observation (from 2020/03/04 to 2021/04/24). In essence, since the number of observations after the event window was 273, to avoid applying unbalanced periods at estimation and future windows, we considered 273 observations for the estimation window. Thus, the total number of observations used in this investigation was 561. On this basis, according to the event study structure, all data was separated into three parts as the following:

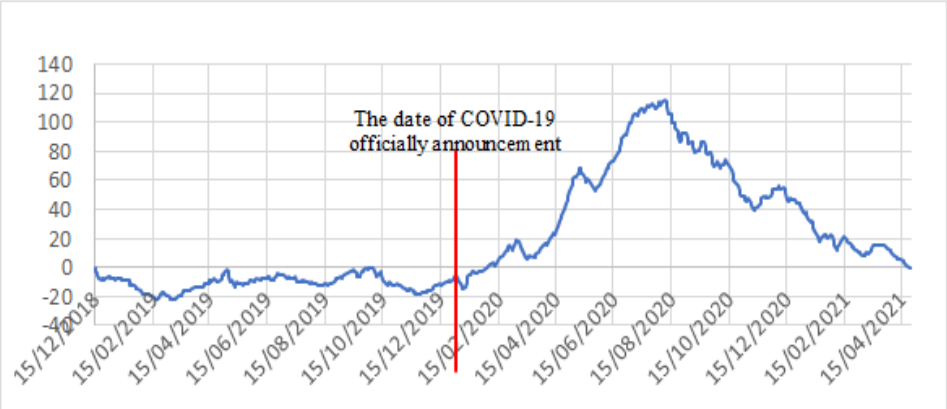
$$\begin{cases} Before\,COVID-19\,Announcement: & Estimation\,Windows & 1 \le CAR \le 273 \\ During\ COVID-19\,Announcement: & Event\,Windows & 274 \le CAR \le 288 \\ After\,COVID-19\,Announcement: & Future\,Windows & 289 \le CAR \le 561 \end{cases}$$

Furthermore, this study employed the event-study methodology to investigate the impacts of the COVID-19 pandemic on various industries of the Tehran Stock market. Generally, the major advantages that motivated the adoption of this research methodology were multifold. First, we could analyze new and significantly influential events for which there were no specific indicators to measure. Second, we might study a wide range of events such as economic and non-economic events. Third, we could examine the impacts of an event more reliably in short-horizon (instead of long-horizon event studies) where not only are less significant statistical tools available, but also the need to expedite decision-making is enormous. Finally, we could investigate the responses of a firm to an unforeseen event based on its abnormal returns, which generally seems more logical than mean return analysis in such a situation (see Heyden & Heyden, 2021; Kothari & Warner, 2006; MacKinlay 1997; Mitchell & Netter, 1994). Theoretically, the main analysis tools in the event study approach are the actual returns, abnormal returns (AR), and cumulative abnormal returns (CAR) indexes.

In this regard, the CAR index demonstrates how an event could completely adjust abnormal returns (AR) of a stock price in the determined time. Precisely, when an uncontrolled crisis like the COVID-19 occurs, its effects gradually emerge into abnormal stock returns. Whether positive or negative, abnormal returns can represent the impacts of the systematic risks rooted in the event at a specific time. On this basis, the cumulative amounts of these abnormal returns can illustrate the total effects of the event throughout the investigation period on the investment risk in an industry active in the stock market. Hence, the CAR could be an appropriate index to analyze the impacts of systematic risk, e.g., COVID-19, on various industries stock prices.

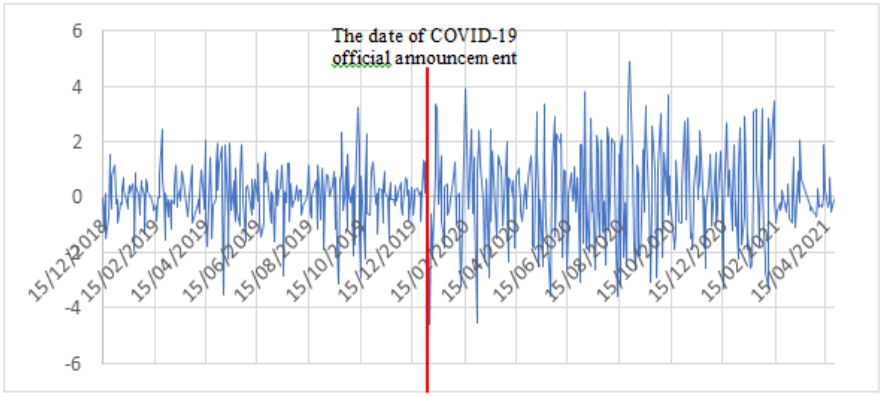
1. Including 32 industries stock prices together with the TEPIX.
2. "Telecommunication and Technology," "Financial and Insurance," "Real State and Housing," "Food," "Transportation," "Pharmaceutical and Health," "Automotive, Basic Metals, and Industrial Machinery," "Education," and "Energy and Mining" Industries.
3. Collected from Tehran Stock Exchange official website archive (www.irbourse.com).
4. In this section, we considered seven working days or seven observations as equivalent to one week.

Technically, an abnormal return is a difference between the actual return (R_t) and the expected return $(E(R_t))$. In this study, to estimate the expected returns, the Hodrick-Prescott filter was applied[1]. CAR was calculated through this equation: $CAR_t = \sum AR_t$. In this regard, scrutinizing the stock price graph, as the representative of all assorted industries active in the TSE, would almost give us a deeper insight into the issue.



Graph 1. The Actual Returns of TEPIX

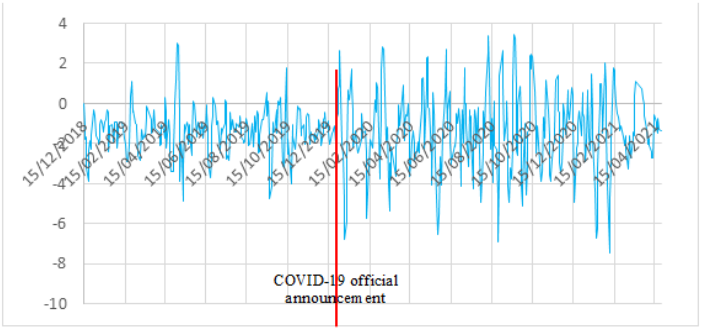
The figure above illustrates that before the COVID-19, the TEPIX returns has just experienced a slightly increasing trend. In contrast, this upward trend has intensified after the event until mid-July 2020, accompanied by a relatively downward trend. Our findings show that what can be seen in the stock price returns graph corresponds with the results of Table 1 below. To be more precise, the average amount of the TEPIX returns before the COVID-19 has been negative, whereas this amount has become averagely positive after the event.



Graph 2. The Abnormal Returns of TEPIX

Furthermore, the AR and CAR graphs of the TEPIX axiomatically display that after the COVID-19, the standard deviation (or investment risk in the case of stock indexes) of the stock market has grown up. It can be graphically supported by the wider range of the AR and CAR variations of the TEPIX.

1. More clearly, the trend of actual returns estimated through Hodrick-Prescott technique, used as the expected returns in each special time.



Graph 3. The Cumulative Abnormal Returns of TEPIX

5. Empirical Results

According to the main study question, standard deviations of the stock prices in 32 industries and the TEPIX index were presented in three different views: pre-event, post-event, and variations between pre- and post-event windows. Indeed, the results of Table 1 can transparently illustrate the changes in different stock price indexes rooted in the COVID-19 event.

Table 1. The Sectoral-Level Actual Returns in Different Windows[1]

		Pre-event (estimation window)		Post-Event (future window)		Variations in mean and SD (post-pre)	
	Index	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
	TEPIX	-0.39	1.25	0.33	2.12	0.72	0.87
1	Means of communication	0.32	3.23	0.69	4.84	0.37	1.61
	Engineering	0.47	2.61	0.22	3.56	-0.25	0.95
	Information & communication	0.13	2.55	0.27	3.43	0.14	0.88
	Computer	0.26	1.56	0.19	2.23	-0.07	0.67
	Radio	0.34	1.74	0.18	3.16	-0.16	1.42
2	Managing financial markets	0.67	1.95	0.27	2.41	-0.40	0.46
	Insurance & retirement	0.57	1.95	0.28	2.23	-0.29	0.28
	Financial	0.39	1.58	0.62	2.01	0.23	0.43
	Other financial	0.44	2.12	0.19	2.19	-0.25	0.07
	Bank	0.36	1.84	0.51	2.53	0.15	0.69
	Investment	0.48	1.46	0.36	1.73	-0.12	0.27
3	Mass housing Construction	0.56	2.13	0.36	2.19	-0.20	0.06
	Cement	0.66	1.9	0.29	1.95	-0.37	0.05
	Ceramic tile	0.8	2.4	0.28	2.99	-0.52	0.59
4	Retail except vehicles	2.19	2.46	0.36	2.97	-1.83	0.51
	Food except sugar	0.61	1.69	0.26	2	-0.35	0.31
	Sugar	0.65	2.1	0.25	2.58	-0.40	0.48
5	Transportation	0.51	2.44	0.14	3.36	-0.37	0.92
6	Pharmaceutical materials	0.59	1.97	0.22	2.07	-0.37	0.10
7	Basic metals	0.39	1.56	0.37	2.85	-0.02	1.29
	Car	0.45	2.27	0.41	2.77	-0.04	0.50
	Electrical devices	0.63	2.41	0.13	2.99	-0.50	0.58
	Machinery	0.64	1.8	0.22	1.93	-0.42	0.13
	Tire	0.55	2.24	0.34	2.36	-0.21	0.12
8	Publication	0.59	2.89	0.01	3.07	-0.58	0.18
9	Petrochemical	0.36	1.37	0.32	2.54	-0.04	1.17
	Oil extraction except discovery	0.4	3.02	0.16	3.83	-0.24	0.81
	Non-metallic mineral	0.7	1.73	0.26	1.87	-0.44	0.14
	Metallic mineral	0.35	3.1	0.26	3.41	-0.09	0.31
	Petroleum	0.52	2.89	0.46	3.08	-0.06	0.19
	Coal	0.75	3.01	0.16	3.33	-0.59	0.32
	Other mineral	0.32	3.23	0.69	4.84	0.37	1.61

Source: The study findings

1. The categorized industries are separated in this table and each group of industries is differentiated with different colors. The numbers of these categorized industries (from 1 to 9 in the first column) are described as follows.

1: Telecommunication and Technology Industries, 2: Financial and Insurance Industries, 3: Real State and Housing Industries, 4: Food Industries, 5: Transportation Industries, 6: Pharmaceutical and Health Industries, 7: Automotive, Basic Metals, and Industrial Machinery Industries, 8: Education Industry, 9: Energy and Mining Industries.

The table above interestingly confirms that most industries' average returns after the COVID-19 have experienced a decline compared to the pre-epidemic period, except for the returns of the "Information & Communication," "Bank," "Other Minerals," "Financial," "Means of Communications," and "TEPIX" indexes. More clearly, the returns of "Retail Except for vehicles" in the food industry category have plunged around -1.83 percent, from average returns of 2.19 percent before the COVID-19 announcement to 0.39 percent after this event. However, the other members of food industries return, namely "Sugar" and "Food Except for Sugar," have decreased by approximately -0.4 percent.

Moreover, the variations in the means of different industries actual returns shows that after the COVID-19, the highest decrease in the actual returns is related to the "Retail Except for Vehicles" industry and, conversely, the "Means of Communication" industry experiences the most considerable increase in the actual returns. In particular, the COVID-19 afflicted the actual returns of the "Coal," "Publication," "Ceramic Tile," "Electrical Machinery," and "Managing Financial Markets" with an average decline rate of 0.6 to 0.4 percent, while the average returns of the "Cement," "Transportation," "Pharmaceutical Materials," "Insurance & Retirement," "Engineering," "Other Financials," "Oil Extraction," "Tire," "Mass Construction," "Radio," and "Investment" indexes have fallen down with a rate of -0.2 to -0.4 percent after the pandemic. Another interesting point here is that although most of the targeted stock industries faced a sharp decline after the COVID-19, some industries like "Metallic Minerals," "Computer," "Petroleum," "Car," "Petrochemical," "Basic Metals," and "TEPIX" have experienced just a slight decrease between -0.2 to -0.02 percent.

Furthermore, the variations in the SDs of all stock indexes from the pre-event to the post-event windows (the last column in Table 1) reveal a far remarkable point that the SDs of all industries have raised right after the COVID-19. Thus, since the SD is, statistically, one of the risk representative criteria, these findings corroborate that the COVID-19 has been a sort of systematic risk for the whole stock market; consequently, under such circumstances, market participants may experience significant abnormal profits or losses. Indeed, more risk in this situation does not necessarily mean more profits or actual stock returns. Theoretically, when an uncontrolled systematic crisis like the COVID-19 occurred, the relationship between risk and rewards would not follow the "Portfolio Theory" (see Yudhi & Wijaya, 2021). On the contrary, such a risk would bring about volatility in the stock returns or, more accurately, it would probably make high volatile abnormal returns. Hence, the abnormal returns of the targeted stock indexes are considered in the following table.

When it comes to abnormal returns of targeted stock indexes in estimation and future windows, it can be stated that the TEPIX has the greatest change (i.e., -0.86%). After this index, the "Retail Except Vehicles," "Ceramic Tile," "Cement," "Investment," "Engineering," "Machinery," "Basic Metals," and "Car" have, respectively, had the highest reduction rates (from -0.48 to -0.1 percent). However, some industries have a slight decline between -0.1 to -0.01 percent like the "Tire," "Mass Construction," "Publication," "Oil extraction," "Transportation," "Petrochemical," "Other Mineral," "Sugar," "Metallic Mineral," "Radio," "Food Except Sugar," "Electrical Devices," "Petroleum," "Insurance & Retirement," "Coal," and "Non-Metallic Mineral."

In addition, the average abnormal returns of the "Managing Financial Markets," "Information & Communication," "Pharmaceutical materials," "Other Financial," "Bank," "Computer," "Means of Communication," and "Financial" industries have raised from the estimation period to the future one. Interestingly, among these stock indexes with positive average abnormal return variations, the financial one has the highest increase (around 0.73 percent). The other critical point is that from pre- to post-pandemic window, the SD variations of all stock industries (the last column in Table 2) have considerably amplified. This finding

proves that the COVID-19 has come to be known as an uncontrolled systematic risk by almost all stock market participants, i.e., policymakers, government, investors, and company managers. Accordingly, it should not be ignored that in the high-risk periods, while some groups would have received a large sum of positive abnormal returns, some others would have encountered a significant number of negative ones. Thus, the cumulative abnormal returns analysis will be provided in the following lines to have a chance of more accurate insight into the sectoral-level of the total abnormal returns.

Table 2. The Sectoral-Level AR in Different Windows

		Pre-event (Estimation window)		Post-event (future window)		Variations in mean and SD (post-pre)	
	Index	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
	TEPIX	0.49	1.11	-0.37	1.66	-0.86	0.55
1	Means of communication	-0.09	2.87	0.13	4.12	0.22	1.25
	Engineering	0.21	2.33	-0.08	3.08	-0.28	0.75
	Information & communication	-0.89	2.28	-0.86	2.93	0.04	0.65
	computer	-0.10	1.43	0.11	1.80	0.21	0.37
	Radio	-0.14	1.53	-0.17	2.63	-0.03	1.10
2	Managing financial markets	-0.11	1.54	-0.08	1.78	0.03	0.24
	Insurance & retirement	-0.24	1.68	-0.26	1.86	-0.02	0.18
	Financial	-0.28	1.58	0.45	2.01	0.73	0.43
	Other financial	-0.85	1.78	-0.78	1.87	0.08	0.09
	Bank	-0.10	1.63	0.04	1.99	0.14	0.36
	Investment	-0.08	1.22	-0.36	1.32	-0.29	0.10
3	Mass housing construction	-0.77	1.78	-0.85	1.95	-0.08	0.17
	Cement	-0.47	1.57	-0.78	2.46	-0.31	0.89
	Ceramic tile	-0.48	1.99	-0.81	2.53	-0.33	0.54
4	Retail except vehicles	-0.42	2.45	-0.90	2.66	-0.48	0.21
	Food except sugar	-1.05	1.44	-1.08	1.66	-0.03	0.22
	Sugar	-0.33	1.78	-0.38	1.80	-0.05	0.02
5	Transportation	-0.05	1.98	-0.12	2.73	-0.06	0.75
6	Pharmaceutical materials	-0.31	1.60	-0.27	1.68	0.04	0.08
7	Basic metals	-0.37	1.39	-0.50	2.31	-0.13	0.92
	Car	-0.88	1.96	-0.98	2.04	-0.10	0.08
	Electrical devices	-0.02	2.13	-0.04	2.54	-0.02	0.41
	Machinery	-0.70	1.52	-0.83	1.80	-0.13	0.28
	Tire	-0.80	1.91	-0.88	1.94	-0.08	0.03
8	Publication	-0.44	1.68	-0.51	2.56	-0.08	0.88
9	Petrochemical	-0.37	1.20	-0.42	2.10	-0.05	0.90
	Oil extraction except discovery	-1.65	2.72	-1.73	3.33	-0.07	0.61
	Non-metallic mineral	-0.53	1.62	-0.54	2.36	-0.01	0.74
	Metallic mineral	-0.38	2.79	-0.41	2.83	-0.03	0.04
	Petroleum	-0.12	2.70	-0.14	2.93	-0.02	0.23
	Coal	-0.07	2.89	-0.07	3.38	-0.01	0.49
	Other mineral	-0.83	1.42	-0.88	2.40	-0.05	0.98

Source: The study findings

Table 3. The Sectoral-Level CAR in Different Windows

		Pre-event (estimation window)		Post-event (future window)		Variations in mean and SD (post-pre)	
	Index	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
	TEPIX	1.38	1.23	-1.02	1.94	-2.40	0.70
1	Means of communication	-0.25	3.57	0.37	4.36	0.61	0.79
	Engineering	0.58	2.70	-0.22	3.64	-0.80	0.94
	Information & communication	-2.50	2.60	-2.41	3.19	0.10	0.58
	Computer	-0.28	1.60	0.31	1.87	0.59	0.27
	Radio	-0.38	1.74	-0.47	2.01	-0.08	0.27
2	Managing financial markets	-0.30	1.89	-0.22	2.30	0.07	0.41
	Insurance & retirement	-0.67	2.13	-0.72	2.40	-0.05	0.27
	Financial	-0.79	1.84	1.25	2.62	2.04	0.78
	Other financial	-2.39	2.11	-2.18	2.09	0.21	-0.03
	Bank	-0.27	1.95	0.12	2.44	0.39	0.49
	Investment	-0.22	1.53	-1.02	1.74	-0.80	0.22
3	Mass housing construction	-2.15	2.19	-2.39	2.21	-0.23	0.02
	Cement	-1.33	1.95	-2.19	1.98	-0.86	0.03
	Ceramic tile	-1.35	2.48	-2.27	2.50	-0.92	0.02
4	Retail except vehicles	-1.18	2.70	-2.53	3.03	-1.35	0.33
	Food except sugar	-2.95	1.80	-3.03	1.83	-0.08	0.03
	Sugar	-0.93	2.25	-1.06	2.52	-0.13	0.28
5	Transportation	-0.14	2.42	-0.32	3.10	-0.18	0.67
6	Pharmaceutical materials	-0.85	2.19	-0.75	2.22	0.11	0.03
7	Basic metals	-1.04	1.61	-1.39	2.74	-0.36	1.13
	Car	-2.47	2.37	-2.75	2.42	-0.28	0.05
	Electrical devices	-0.06	2.32	-0.12	2.81	-0.06	0.48
	Machinery	-1.95	1.89	-2.32	2.06	-0.37	0.17
	Tire	-2.23	2.34	-2.46	2.48	-0.23	0.14
8	Publication	-1.23	3.14	-1.44	3.25	-0.22	0.10
9	Petrochemical	-1.04	1.35	-1.19	2.46	-0.14	1.11
	Oil extraction except discovery	-4.62	2.99	-4.83	3.70	-0.21	0.71
	Non-metallic mineral	-1.49	1.96	-1.51	1.84	-0.02	-0.12
	Metallic mineral	-1.06	2.92	-1.15	4.42	-0.09	1.50
	Petroleum	-0.33	3.33	-0.39	3.39	-0.06	0.07
	Coal	-0.18	3.25	-0.21	3.71	-0.02	0.46
	Other mineral	-2.34	1.53	-2.48	2.75	-0.14	1.22

Source: The study findings

The results of Table 3, together with the CAR graph, are entirely in line with the findings of the abnormal returns analysis. Indeed, although there is a marked difference in the range of changes, the order of both ARs and CARs are the same for almost all indexes. On the one hand, the range of the CARs mean variation is approximately between -2.4 to 2.04 percent, whereas the AR mean variation range is approximately between -0.86 to 0.73 percent. On the other hand, the comparison of the ARs and CARs SD variation demonstrates that while those of ARs are all positive, there are two negative CAR SDs related to the “Other Financial” and “Non-Metallic Mineral” industries. More transparently, the SD variation ranges of these industries have decreased -0.03 and -0.12, respectively. This finding demonstrates that despite such a significant systemic risk, i.e., the Covid-19 pandemic, the trends of investment risk in these two industries are generally reduced after the COVID-19 official announcement.

The sectoral-level abnormal returns in different windows after event day is presented in Table 4 to analyze the number of days that a pandemic could significantly affect the performance of various industries. The results of assorted stock indexes ARs after the COVID-19 demonstrates that a day after its announcement (+1), a significant change has not been observed among the ARs of targeted stock indexes, and this can be seen on the next second (+2) and seventh (+7) days as well. However, from (+14) to (+30) days, the impacts of the COVID-19 on the abnormal returns of almost all industries and the TEPIX can be considered because the variations of their abnormal returns have dramatically changed. In essence, our finding shows that assorted stock market industries have reacted to the very event by around a 14-day lag.

Table 4. The Sectoral-Level AR in Different Windows after Event day

	Index	AR(0)	AR(+1)	AR(+2)	AR(+7)	AR(+14)	AR(+21)	AR(+30)
	TEPIX	2.45	-0.61	1.46	-2.40	-1.31	-1.12	-1.79
1	Means of communication	0.73	1.68	0.57	-1.51	2.70	1.03	1.62
	Engineering	6.41	-1.96	2.39	4.37	2.88	-1.97	-1.49
	Information & communication	2.25	-1.88	0.29	3.11	-4.07	-1.06	-6.72
	Computer	3.62	0.27	2.88	0.44	-1.43	-0.26	-0.77
	Radio	4.90	-2.34	0.15	2.79	-3.23	-0.60	-1.26
2	Managing financial markets	3.07	-0.25	-0.75	-0.40	-3.48	-2.51	-2.43
	Insurance & retirement	3.12	1.75	3.12	1.88	-2.13	0.81	-2.78
	Financial	1.16	0.87	4.04	2.65	-1.89	3.51	-0.14
	Other financial	0.16	-0.24	1.93	0.97	-4.90	-0.01	-2.59
	Bank	-1.02	0.39	4.75	2.24	-2.42	1.52	-2.12
	Investment	2.45	-1.39	1.23	2.73	-2.64	-1.08	-0.74
3	Mass housing construction	3.22	0.15	1.54	3.41	-2.80	-1.76	-3.66
	cement	2.91	0.09	1.78	1.57	-1.03	-1.59	-0.49
	Ceramic tile	-0.60	-2.13	-0.87	3.00	0.26	-2.40	-1.57
4	Retail except vehicles	-1.30	-1.79	0.63	0.02	0.97	-1.34	5.37
	Food except sugar	2.58	1.08	1.39	1.39	-3.75	-1.14	-1.43
	Sugar	3.20	-0.13	0.96	1.24	-0.85	-0.92	-0.46
5	Transportation	5.79	-2.27	-2.07	3.93	-2.58	-0.44	0.92
6	Pharmaceutical materials	6.55	1.00	1.17	2.14	-3.42	-2.07	-1.88
7	Basic metals	2.87	0.11	1.27	2.26	-0.61	-1.30	-2.06
	Car	2.60	0.19	2.12	2.29	-2.04	-0.51	-1.54
	Electrical devices	-14.23	-11.40	-7.00	1.64	-0.82	-1.97	-2.45
	Machinery	2.02	-0.57	0.40	1.57	-0.70	-1.27	-0.79
	Tire	5.53	2.09	1.89	1.01	-3.71	-1.15	1.53
8	Publication	-14.14	-11.36	-5.07	2.39	0.27	-1.59	-5.60
9	Petrochemical	1.84	-1.40	1.98	2.91	-0.19	-0.90	-2.58
	Oil extraction except discovery	11.92	-2.48	-0.76	4.93	-4.06	-0.47	-0.30
	Non-metallic mineral	3.93	0.31	0.51	1.61	-2.60	-1.72	-1.89
	Metallic mineral	-16.80	-16.12	-11.96	1.46	-0.58	-0.10	-2.91
	Petroleum	6.11	0.32	1.50	2.35	-4.42	-0.17	-5.60
	Coal	-2.40	-2.67	1.94	1.95	-4.56	-1.97	-2.79
	Other mineral	0.25	1.65	2.13	1.79	-0.69	-0.71	0.32

Source: The study findings

6. Conclusions

This research contributes to the increasing literature on the relationship between the COVID-19 outbreak and the average returns and investment risk of various industries in the TSE. To this end, we applied an event-study methodology based on the daily data of 33 different stock

indexes categorized into nine groups. This data was partitioned into three sub-samples, including the estimated, event, and future periods. On this basis, the confidence interval considered for the event window acted as a separating impulse that divided the research period into two separate windows, i.e., the estimated and future ones. Accordingly, the variations in the actual, abnormal, and cumulative abnormal returns of the estimated (pre-event) and future (post-event) windows were analyzed for all 33 indexes to explore the ways different industries reacted to the consequences of this pandemic.

In this context, our findings demonstrated that the results of variations in the actual, abnormal, and cumulative abnormal returns have been largely consistent with each other. Precisely, most industries have almost simultaneously experienced a significant increase in standard deviation and a decline in the mean of their actual returns, abnormal returns, and cumulative abnormal returns. Furthermore, the "Retail Except for Vehicles" and "Real State and Housing" industries have had the highest decrease in their average returns and, conversely, the "Telecommunication and Technology," "Financial," and "Pharmaceutical and Health" industries have experienced the most considerable increase in the average returns. Under such circumstances, these results confirm that the "Telecommunication and Technology," "Financial," and "Pharmaceutical and Health" industries have been among the most interesting investment options for potential investors. Interestingly, the highest increase in the average returns has been related to the financial industry, with around 0.73 percent growth.

In addition, comparing the variations in the standard deviations of all industries' ARs and CARs show that despite the positiveness of standard deviations of all industries' abnormal returns, which indicates the existence of lots of high-risk days in the stock market, the cumulative abnormal returns' SD of the "Other Financial" and "Non-Metallic Mineral" industries have been negative. This means that although all sectors have experienced different high-risk days, there has been a downtrend in the high-risk days (as the results of CARs' SD variations show) for the two mentioned industries. Thus, it can be inferred that the investment risk in these two industries is generally reduced after the COVID-19. Finally, as our results support, a 14-day lag (after the COVID-19 pandemic exposure) is required for the effectiveness of the pandemic impacts on the stock returns.

Empirically speaking, our results suggest some sectors that experienced the biggest and lowest changes in the average returns in response to the COVID-19 outbreak. There are some primary reasons behind these results that are achieved after the pandemic. On this basis, the industries that inherently have had the potential and necessary infrastructures related to the existing working climate and businesses with remote working platforms have benefited more from the new pandemic conditions. Moreover, some industries owe their higher average returns and lower investment risk in the post-COVID period to the fact that their supply and demand are not highly sensitive to the conditions caused by this disease. Therefore, due to the exponential rate of coronavirus spread and its various mutations, it is necessary to pay special attention to future public health issues and financial and economic concerns.

Overall, we can transparently draw four specific policy and practical implications based on our findings. First, our results would assist the government (in coalition with the central bank and other macro decision-makers) in adopting quick policies to support the vulnerable industries through some incentive packages (like free-interest loans or tax deductions). This way, the government can also set flexible guidelines for such events in the future. Second, considering a fourteen-day lag for the consequences of the pandemic to affect the returns of various industries helps us provide another very important recommendation in finalizing investment, development, or policy decisions to investors, senior decision makers of the stock market and various industries, as well as macroeconomic policymakers. Third, accelerating

the public vaccination rate, immediately informing citizens about health care protocols without triggering uncertainty, closely monitoring the number of patients and their geographical distribution to provide conditions for their recovery, etc., can also be some effective recommendations to reduce public panic and restore stability to the various industries active in a country. Finally, since stock price movements are generally considered a signal for market expectations about the future performance of different companies, tracking the movements in the stock prices can be a reliable measure to evaluate government actions against the pandemic. Empirically, from the investors perspective, refraining from buying "Retail Except for Vehicles" and "Real State and Housing" industries shares and, conversely, investing in the "Telecommunication and Technology," "financial," and "Pharmaceutical and Health" industries will be an attractive short-term recommendation to get very high returns in the post-pandemic period (during the first stage). Then, as the conditions improve, the investors should reduce their shares in these industries and turn to stocks highlighted by the government. Finally, it should be avoided to invest in stocks with high-risk factors (for example, those with high CMV, high P/B and P/E ratios, low net assets, etc.) in the middle and late of the crisis.

Ultimately, like other studies, our investigation has its limitations. We have focused on the short-term and immediate impacts of the COVID-19 on various industries in the TSE owing to the short window of observations (small sample size). However, such attempts can pave the way for other researchers to analyze its long-term effects on different economic sectors. Another research limitation is that there was no opportunity to investigate the demographic variables (like gender, age, experience, education level, and type of investors) because of the lack of data and information.

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