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Covid-19 and Serbian Stock Market Response: A Panel Data Approach

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ABSTRACT

In this paper, the authors attempted to explore the relationship between the Covid-19 Coronavirus pandemic and the stock market in the Republic of Serbia. The main research variables on the stock market are the daily values of the Belex 15 and Belex Line indices and trading volume. For the pandemic variables, official daily data on the number of new Covid-19 cases in Serbia, Europe, and the world were taken. By applying the panel regression analysis for the period from 03/06/2020 to 12/30/2021, the empirical results show a positive and significant influence of the number of daily infected in Serbia and Europe on the stock market index value, At the same time, the influence of daily infected ones on trading volume is negative but statistically significant only when it comes to the new cases of coronavirus per day at the level of Europe. The presented results indicate the resilience of the Serbian capital market to internal and external shocks.

Keywords: *Covid-19, Stock market indices, Belgrade Stock Exchange, Panel data analysis*

JEL Classification: C33, D53, I10

INTRODUCTION

The Covid-19 pandemic, besides the uncertainty and panic, led to a temporary lockdown in many states and the slowdown of economic activities. Almost two years after the pandemic started, the companies' performance downfall is visible in all sectors, affecting the financial markets, specifically stock markets (Okorie and Lin, 2021). According to Zaremba et al. (2020) and Singh et al. (2020), in terms of the Covid-19 crisis, the intervention of governments and central banks of numerous countries has significantly increased the volatility of the international capital market. At the same time, the official statistics of WHO mark the increase in the daily number of infections and deaths all over the world, along with the growing resistance of the population towards vaccination (World Health Organization, 2021).

Financial markets reacted quickly, reflecting the magnitude of the crisis potential. In March 2020, the S&P 500, Euro Stoxx 600, and Nikkei 225 indices plummeted by 9.5, 8.3, and over 10%, respectively. A similar situation happened with the Chinese financial market, affecting the value of the SSE Composite Index of 7.72% and the SZSE Component Index of 8.45%. The indices of the Belgrade stock market on the Serbian capital market have experienced, during February and March 2020, a significant drop in their values, following global stock indices. Companies' stock prices and Belex 15 and Belex Line index values continually and intensively kept plunging until March 24, 2020. Since then, the values have been going up. The initial

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reaction of markets was brutal and escalated, which is commonly expected investors' behavior in times like these. On the other hand, there is an opinion that the market recovered by investors' faith in normalization time and life and economic activities (Naseem et al., 2021). Crucial psychological moments and positive signs for investors, which also transmitted to the Serbian capital market, came from the global vaccine manufacturers – first in the form of development announcements and later as the presence and distribution of Covid-19 vaccines.

Bearing in mind the current state of the pandemic and the dynamic of price movements on global stock markets, the subject of this research is the Covid-19 and Serbian stock market response through the implementation of the panel regression analysis. The goal is to investigate relations between indices values and trading volume on the Belgrade stock market on one side, and daily infections in Serbia, Europe, and the world, on the other. Following the subject and goal of the research, there are two questions: 1) Does the number of daily infected in Serbia, Europe, and the world affect the value of the Belgrade stock market index? 2) Does the number of daily infected in Serbia, Europe, and the world affect the volume of trading on the Belgrade stock market?

To answer the research questions, we structured the paper as follows: after the introduction, the second part gives a short literature review, reflecting on the most significant results; the third part presents research methods; part four exposes empirical results, while the last part portrays conclusions, restrictions, and recommendations for future studies.

LITERATURE REVIEW

The global pandemic contributed to an increase in research on Covid-19 influence on financial markets. Analyzing key indicators of pandemic effects on overall and local levels (the number of infected, deceased, and vaccinated, in correlation with prices and yield for most relevant global and regional stock market indices), most of the obtained results show a significant correlation and the effect of a current pandemic on market volatility and stock price movements. A short review of some latest research is set hereafter. Singh et al. (2020) examined the pandemic impact on the stock markets of G-20 countries, using an event study to measure abnormal returns (ARs) and panel data regression to explain the causes of ARs. The observed window comprises 58 days after the news of the Covid-19 outbreak was released on the international media, and the estimation window consists of 150 days before the announcement. The results confirmed the recovery of stock markets from the Covid-19 negative impact. Zaren and Hizarci (2020) analyzed the possible effects of Covid-19 on stock markets using daily stock indices data. The cointegration test using Covid-19 daily infections and deaths was used to question possible outcomes on the stock markets. The SSE, KOSPI, and IBEX35 indices have a cointegration relationship with the number of infections, while FTSE MIB, CAC40, DAX30 indices don't. Onali (2020) researched the effects of the pandemic on the Dow Jones and S&P500 indices. The outcomes confirmed the Covid-19 crisis did not affect the US stock market returns. However, VAR models indicated the number of coronavirus-related deaths in Italy and France had negative implications on stock market returns and positive ones on the VIX returns. Ali et al. (2020) tested the effect of the Covid-19 crisis on the global financial market. Analyzing periods of epidemic and pandemic, they stress the substantial effects of the pandemic on commodity and stock markets. The results show a negative correlation between gold price movements and the resistance of the Chinese capital market. Baker et al. (2020) gained results of the pandemic's severe effect on the US stock market compared to the 20th-century historical crises. Höhler and Lansink (2020) measured the pandemic influence on the volatility of stocks of companies that manufacture and distribute consumer goods listed within the most relevant global stock market indices. The results show considerable effects of the pandemic on the growth of volatility of all companies' stocks, apart from the ones of companies that produce and supply food. Bai et al. (2020) used the GARCH-MIDAS model to analyze the pandemic effect on stock markets in the USA, China, Great Britain, and Japan. A significant impact on the international stock market was

evident, but individually a small effect on the Chinese stock market. Lee and Lu (2021) researched how the Covid-19 pandemic affected the Taiwanese stock market. The result was the stocks of companies with a higher level of corporate social responsibility (CSR) are more resilient to the current crisis. Ozkan (2021) tested a market efficiency hypothesis on the stock market of several developed countries. The gained results of econometric models indicate high power to predict abnormal yields during the pandemic. Hsu and Liao (2022) explored behavior in the US market, with stock volatility, trading volume, and yield as elementary variables on one side and the number of infected and deceased on the other side. There is a positive correlation between the coronavirus effect and stock price volatility and trading volume and a negative correlation between the pandemic and stock yield. Amin et al. (2021) inspected the pandemic effect on stock market indices in North, Central, and South America. Through panel regression analyses, they deducted the number of infected has a considerable bad influence on stock price volatility, except for the South American countries, with no significant statistical correlation. Sahoo (2021) and Bora and Basistha (2021) studied the Covid-19 influence on the Indian stock market, comparing stock index yields from two different periods – before the crisis and during one. The outcomes obtained by the regressional and GARCH model show a statistically significant positive correlation with stock market volatility and movements during the pandemic. Tapaloglu et al. (2021) used the panel data analysis method to present the relationship between the pandemic and stock markets in Turkey, Belgium, Germany, France, Italy, Spain, the United Kingdom, the United States, China, and the Netherlands. Covid-19 data is based on the total number of cases and the total number of deaths, while stock market data relies on major stock indices of countries. There was a negative relationship between the total number of cases and the stock market and a positive one between the total number of deaths and the stock market. Khalid et al. (2021) used a panel quantile regression model of 17 developed stock markets to show the pandemic's impact on stock market returns and volatility. They proved there is no significant impact of the coronavirus on stock returns. Moreover, it had a positive effect on stock market volatility.

RESEARCH METHODOLOGY

To analyze the relation between daily infections in Serbia, Europe, and the world and index value on the Belgrade stock market, that is, trading volume, we used daily data for the period 03/06/2020 to 12/30/2021. There is a time series *(T)* of 462 days, while the number of observed entities *(N)* is two (Belex Line and Belex 15). Therefore, the number of observations encompassed within these panel analyses is 924. Due to the robustness of the data, the dependent variables are logarithmically transformed. Data on daily infected was gathered from the web portal Our World in Data, while the information on index value and trading volume was from the Belgrade Stock Exchange web page.

Table 1. Description of the Variables Used in the Regression Analysis

Variable	Description	Source
BELEX 15 Indice - B15	Stocks of the 11 most liquid Serbian companies - Daily data of B15 value	Belgrade Stock Exchange https://www.belex.rs/trgovanje/indeksi/belex15/istorijski
BELEX Line Indice - BL	Stocks of the 34 Serbian companies - Daily data of BL value	Belgrade Stock Exchange https://www.belex.rs/trgovanje/indeksi/belexline/istorijski
Trading volume	Daily data of the number of stocks	Belgrade Stock Exchange https://www.belex.rs/trgovanje/indeksi/belex15/istorijski https://www.belex.rs/trgovanje/indeksi/belexline/istorijski

Variable	Description	Source
Number of new cases of Coronavirus in SERBIA	Daily data	WHO https://covid19.who.int/
Number of new cases of Coronavirus in Europe	Daily data	WHO https://covid19.who.int/
Number of new cases of Coronavirus in WORLD	Daily data	WHO https://covid19.who.int/

The dependent variables of the research are as follows: the first analysis – the Belgrade Stock Exchange index value (Belex 15 and Belex Line); the second analysis – tk trading volume. The independent variables in both analyses are the number of daily infections in Serbia, Europe, and the world. The description of variables is presented in Table 1.

The descriptive statistics of variables used in the analyses are given in Table 2. It shows calculated values of the central tendency measures and variabilities. Data on the number of observations, arithmetic mean, standard deviations, that is, the average deviation of arithmetic mean, minimal and maximal parameter values are in the columns.

Table 2. Descriptive statistics of the research variable

Variable	Obs.	Mean	Std. Dev	Min	Max
Stock Indices values	924	1156.358	426.6729	606.62	1721.16
Trading volume	924	1.08e+07	3.42e+07	26131	4.52e+08
Serbia	924	2081.121	2438.846	0	9983
Europe	924	156306	128847.1	1510	989061
World	924	540773.1	176226.8	25521	1934140

Source: Authors' calculation

The following graphs (Figure 1 and Figure 2) illustrate the movement of Belgrade stock market index value, Belex Line and Belex 15, and trading volume from March 6, 2020, to December 30, 2021. Based on Figure 1, it can be noted that the movement trend of both indices is uniform. After the start of the Coronavirus pandemic, the value of both indices decreased, and then with the stabilization of the financial market, the value of both indices increased. Živković (2022) also points to the marked volatility and uniform trend of the observed indices in the period from 2008-2022.

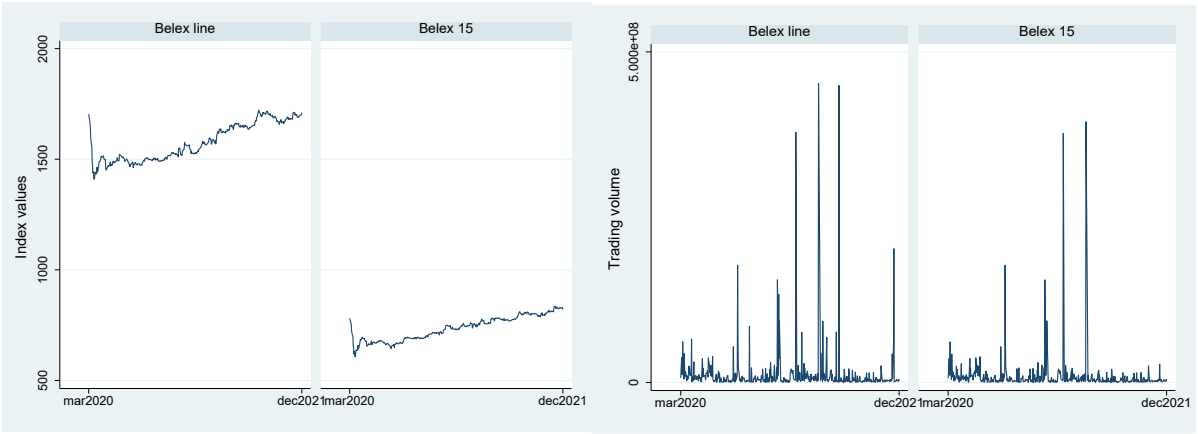

Figure 1. Movement of stock market index values and trading volume on BSE

Source: Authors

RESEARCH METHODS

Research methodology and data analyses are based on panel data, that is, on regression models of panel data (Panel Data Regression Model – PDRM). The preliminary part of econometric analysis evaluates different formulations of statistic models and then runs various tests to choose the most suitable model for research data, as well as econometrical diagnostic tests to check if the model presumptions are fulfilled (specification model errors, multicollinearity, auto-correlation, and heteroscedasticity).

The analysis uses strictly balanced datasets ("full" time series). The least-squares model (Pooled OLS – POLS), fixed-effect model (FE), and random-effect model (RE) were used for testing. The following model is specified to explain the dependent variables by using independent ones:

$$Y_{it} = \alpha + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \beta_3 X_{3,it} + u_i + e_{it} \quad (1)$$

Where:

Y_{it} – dependent variable: in the first research ln(index value – IV), in the second research ln(trading volume – TV).

i – entity (in the first analysis: 1 = Belex Line value, and 2 = Belex 15 value; in the second analysis: 1= Belex Line Trading volume, and 2= Belex 15 Trading volume);

t – time (in both analyses: 1 = 06.03.2020.... 462 = 31.12.2021.).

β – coefficient for respective independent variables;

α – intercept;

X_1 – independent variable (number of daily infections in Serbia - S);

X_2– independent variable (number of daily infections in Evropi - E);

X_3 – independent variable (number of daily infections in the world - W);

u_i – the individual impact of the ith entity;

e_{it} – the error term.

RESULTS OF ECONOMETRIC TESTS

a) **Model 1** was evaluated through econometric tests, where the dependent variable of the *stock market index value* (IV) is given as a linear stochastic function of independent, i.e., explanatory variables:

$$IV_{it} = \alpha_i + \beta_1 S + \beta_2 E + \beta_3 W + u_i + e_{it} \quad (2)$$

The random effects model was chosen as the most appropriate model (Table 4). According to the determination coefficient, for the RE model, 9% (R^2 = 0.09) variations of the dependent variable are explained based on independent variables. The values of F statistics point to statistical significance RE model (Prob > F = 0.0000). Hausman's test checked whether the individual effects are correlated with regressors, in which case the FE model would be more suitable. According to Hausman's test results, the significance is higher than 0.05 ($\chi 2$ = 0.00, p = 1.0000). Thus, we accept the null hypothesis claiming that the RE model is more appropriate than the FE model. The justification of the RE model is tested with the Breusch and Pagan LM test (Lagrange multiplier) for testing the existence of individual effects. If the test significance is > 0.05, the null hypothesis (no heterogeneity between observed entities) cannot be rejected, which means POLS is more suitable than the RE model. The test results indicate the level of significance is lower than the set level ($\chi 2$ = 2.0e+05, p = 0.0000), so we can conclude the RE model is more suitable than the POLS model. Ramsey RESET test was used to check if the model

is well-specified. The results gained (F(3, 917) = 0.62; Prob > F = 0.6049) indicate no significant variables left out of the model. In the next step, with the use of the Pasaran CD test, we looked for serial correlation problems in the model. The null hypothesis is – no serial correlation. The statistical significance of the test is higher than 0.05 (p = 0.4511), meaning the null hypothesis about the non-existence of a serial correlation can be accepted. Also, Wooldridge's test for autocorrelation in the panel data indicates there is no serial correlation (p = 0.1910). White's test was used for heteroscedasticity testing in model 1. If the $\chi 2$ statistic probability obtained by this test is higher than the error risk α (α = 5%), the null hypothesis cannot be rejected. The probability value of chi statistics in this test is 0.1121, and with the error risk of 5%, we cannot discard the null hypothesis, confirming the homoscedasticity errors in the model.

Results from the panel analysis for the RE model indicate a positive and significant influence of the number of daily infections in Serbia and Europe on the index value of the Belgrade stock market, while the effect on a global level is positive but not statistically significant.

Table 4. Evaluation of random-effect model with index value dependent variable, and diagnostic tests

Index values	Coef.	Std. Err.	t	P>|t|
Serbia	5.60e-06	8.97e-07	6.24	0.0001
Europe	2.16e-07	1.79e-08	12.10	0.0001
World	1.15e-08	1.15e-08	0.99	0.321
Constant	6.928381	.3817168	18.15	0.0001
Diagnostic tests				
Hausman's test				$\chi 2(3) = 0.00$; p = 1.0000
LM test				chibar2(01) = 2.0e+05; Prob > chibar2 = 0.0000
Ramsey RESET test				F(3, 917) = 0.62; Prob > F = 0.6049
Pasaran CD test				0.438; p = 0.4511
Wooldridge's test				F(1, 1) = 18.593; Prob > F = 0.1910
White's test				$\chi 2$ (9) = 12.60; Prob > $\chi 2$ = 0.1121

Note: R squere = 0.09; Prob > F = 0.0000; Root MSE = 0.39; Number of observations = 924.

Source: Authors' calculation

To test linear dependence between explanatory variables, that is, to probe the existence of harmful multicollinearity in a regression model, the variance inflation factor (VIF), as well as tolerance factor – 1/VIF, were used. Based on the results in Table 5, it can conclude the model has no harmful multicollinearity.

Table 5. Multicollinearity test

Variable	VIF	1/VIF
Serbia	1.56	0.640600
Europe	1.73	0.577339
World	1.35	0.740278
Mean VIF		1.55

Source: Authors' calculation

b) **Model 2** was econometrically tested, where the dependent variable *stock trading volume* (TV) is presented as a linear stochastic function of independent variables:

$$TV_{it} = \alpha_i + \beta_1 S + \beta_2 E + \beta_3 W + u_i + e_{it} \qquad (3)$$

Table 6. Evaluation of RE model with stock trading volume-dependent variable, and diagnostic tests

Trading volume	Coef.	Std. Err.	t	P>|t|
Serbia	-.0000211	.000022	-0.96	0.338
Europe	-8.83e-07	4.38e-07	-2.01	0.044
World	-6.48e-08	2.83e-07	-0.23	0.819
Constant	15.40123	.1904107	80.88	0.0001
Diagnostic tests				
Hausman's test				$\chi2(3) = 0.00$, p = 1.0000
LM test				chibar2(01) = 8.50; Prob > chibar2 = 0.0018
Ramsey RESET test				F(3, 917) = 0.60; Prob > F = 0.5913
Pasaran CD test				0.638; p = 0.3312
Wooldridge's test				F(1, 1) = 17.904; Prob > F = 0.1477
White's test				chi2(9) = 13.20; Prob > chi2 = 0.1536

Note: R squere = 0.13; Prob > F = 0.007; Number of groups = 2; Number of obs. = 924.

Source: Authors' calculation

The random effects model was chosen as the most appropriate model (Table 6). As stated in Table 6, parameters with the independent variable are statistically significant. The coefficient determination value denotes that 13% of the dependent variable variations (stock trading volume) are explained with the RE model, and the F statistic values suggest statistical significance in the RE model (Prob > F = 0.007). By Hausman test results, the significance is higher than 0.05 ($\chi2 = 0.00$, p = 1.000), so we accept the null hypothesis the RE model is more suitable than the FE model. The Breusch-Pagan LM test results point out that the significance level is lower than the set one ($\chi2 = 8.50$, p = 0.0018), so the conclusion is the RE model is more suitable compared to POLS. The results from the Ramsey RESET test (Prob > F = 0. 5913) prove there are no significant variables left out of the model, meaning the model specification is good. Pasaran test statistical significance is higher than 0.05 (p = 0.3312), so the null hypothesis on serial correlation non-existence is acceptable. Wooldridge's test for autocorrelation in the panel data indicates there is no serial correlation (p = 0.1477). White's test was used to test the model's heteroskedasticity. The value of $\chi2$ statistics probability in this test is 0.1536, which confirms the model errors are homoskedastic.

According to the results for the RE model, trading volume on the Belgrade stock market is negative but not statistically significant for the number of daily infections in Serbia and the world, while the number of newly infected in Europe is negative on a statistically significant level.

CONCLUSION

The conducted research had a goal to probe the correlation between the index stock value of Belex15 and Belex Line, trading volume on the Belgrade stock market on one side, and the number of newly infected in Serbia, Europe, and the world, on the other side. The results gained by the panel regression analysis for the random effect model (RE), which was econometrically tested, well-specified, and most appropriate for the research, indicate a positive and significant influence of daily infections in Serbia and Europe on the Belgrade stock market index value, while the global effect is positive but not statistically significant (model 1). These results are unexpected. However, soon after the beginning of the pandemic, when the value of both indices fell, the government took preventive measures, with the aim of maintaining economic stability, by supporting micro, small and medium enterprises. This package of economic measures to

mitigate the consequences of the coronavirus included: tax policy measures (such as, for example, deferring the payment of payroll taxes), direct assistance to companies for employees (e.g., direct assistance to entrepreneurs who are taxed at a flat rate and who pay income tax real income, to micro, small and medium-sized enterprises in the private sector - payment of assistance in the amount of the minimum), measures for liquidity of the economy (e.g. support to the economy through the Development Fund of the Republic of Serbia) and other measures (e.g. payment of 100 euros to all citizens of legal age). These preventive measures obviously had a positive impact on the Serbian capital market. The obtained results are in accordance with the research results of Waheed et al. (2020), who examined the impact of the covid pandemic on the Karachi stock exchange and concluded that the covid pandemic has a diverse impact on developing economies, compared to developed economies, which faced serious declines in this period.

In the second analysis (model 2), econometric tests also proved it is best to use the model with random effect (RE). The results gained by the panel regression analysis for the random effect model (RE) indicate a negative but statistically insignificant correlation between the number of newly infected in Serbia and the world and the trading volume on the Belgrade stock market. The number of newly infected in Europe correlates negatively with the trading volume on the Belgrade stock market on a statistically significant level. The obtained results are consistent with the results of research on other stock markets, where we refer to Öztürk *et al*. (2020), Zaren and Hizarci (2020), Onali (2020), Đorđević and Stanković (2021), Naseem *et al.* (2021), who have empirically gained similar conclusions.

According to the research results, R square records small values for both models (9% for the first and 13% for the second model). This means that only a small percentage of the variations of the dependent variable (in the first model stock market index value, and in the second stock trading volume) can be explained by means of independent variables (the number of daily infected in Serbia, Europe, and the world). This speaks in favor of the fact that variations in the capital market in Serbia depend on other important explanatory variables, which should be included in the model. However, according to the subject of the research, only Covid 19 variables were included in the research, and it can be concluded that these variables can explain a very small part of the variations in the Serbian stock market.

Historically speaking, after the initial panic and significant fall of the Belex 15 stock index (fall of over 200 index points) in February/March 2020, the Serbian stock market recovered and somewhat adapted to the uncertainty caused by the pandemic. In 2021, there were two strategic moves to develop the capital market in Serbia: 1. Consolidation of the Commercial Bank (listed on The Belgrade Stock Exchange: KMBN) by the Slovenian NLB Group, and 2. The strategic partnership of the Belgrade and Athens stock market (Greece) was one of the ways to improve the capital market and set the stock market as a central piece of the Serbian economy. This move would contribute to better visibility and attractiveness of home market securities to foreign investors who are present and trade in inconsiderable volume, not accounting for the current conditions (BBC News, 2021). We can conclude that, under the current turbulent conditions, there has been a quick recovery of the stock market, there was no greater capital outflow from the Belgrade stock market, and the shock hasn't been enormous and devastating.

Simultaneously, in 2020/2021, all other significant stock indices in Europe and the world recorded a swift recovery and growth, a characteristic of stock markets. Favorable information gained in 2020 from the Covid-19 vaccination manufacturers (Phizer, Astra Zeneca), and a set of economic measures of many countries, contributed to a better investors' psychological climate in all markets. In a crisis, panic in the market is not in compliance with long-term investment strategies. The current pandemic is not only a possibility but also a necessity for investors to consider their investment portfolios and carry out a hedge and optimize. Many authors and stock market analysts highlight the inclusion of gold as a safe asset, futures and options trade,

and also the inclusion of some cryptocurrencies into portfolios for diversification and reduction of risk to a minimum.

The limitations of this research are in its sensitivity to new information and data. For that, we need further research that would include new information and data on the subject, like stock yield and trading analysis, number of deaths, number of vaccinated people in Serbia, Europe, and on the global level, to secure valid information for politicians, investors, portfolio managers and CEOs in the decision-making process. The crucial implication of this research is a further study on factors connected with pandemic waves that affect the volatility of the Serbian stock market.

In the end, the results of this study will be of use to the domestic and foreign professional public because they will provide valuable information on the behavior of financial markets in developing countries during the crisis. Also, the study can be helpful to state decision-makers to implement the necessary activities and reduce the potential undesired effects of the current health crisis.

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