ORIGINAL PAPER



DOI: 10.26794/2587-5671-2023-27-5-128-139
UDC 339.7(045)
JEL G02, G4, G41

# Impact of Social Media and Google on Stock Markets During a Pandemic: The Case of an Airline

**A.N. Nepp**[a], **Z.F. Dzhuraeva**[b]
[a, b] Ural Federal University named after the first President of Russia B.N. Yeltsin, Ekaterinburg, Russia;
[a] Ural Institute of Management, Branch of RANEPA, Ekaterinburg, Russia

## ABSTRACT

The outbreak of the pandemic has dealt a tangible blow to the global economy, in particular by causing the collapse of stock markets. Most countries have taken measures to contain the coronavirus related to the restriction of human mobility. One of the main victims of such actions were airlines. In order to examine the direct and indirect effects of the pandemic, we investigated the long- and short-term effects on airline stock price volatility of the spread of coronavirus, social media attention to it, the vaccines against coronavirus and restrictive measures in relation to the pandemic. The ARDL model with MG and PMG estimates was applied after the preliminary stability tests for airlines in developed and developing countries. We analyzed the period of the greatest anti-COVID restrictions from 23 March 2020 to 23 March 2021. We reached the following **conclusions**. Firstly, the increase in the number of cases and deaths from COVID-19 was accompanied by a short-term increase in the volatility of airline stock prices. Secondly, Twitter's increased focus on COVID-19-related restrictive measures and vaccines against it was accompanied by a short-term increase in airline stock price volatility. Thirdly, the increasing attention at Google on airline restrictions has been accompanied by the long-term effects of rising stock volatility. Our results demonstrate that with the spread of the Internet and social media, the impact of the pandemic on stock markets occurs not only through direct effects on the determinants of Solow's economic growth model, but also through indirect effects of social media and the Internet on investor behavior through the formation of fear and hysteria in them.

***Keywords:*** COVID-19; vaccines; restrictions; attention to COVID-19; attention to vaccines; attention to restrictions; Twitter; Google Trends; stock volatility; airlines; ARDL; MG; PMG

***For citation:*** **Nepp A.N., Dzhuraeva Z.F. Impact of social media and Google on stock markets during a pandemic: The case of an airline. *Finance: Theory and Practice*. 2023;27(5):128-139. DOI: 10.26794/2587-5671-2023-27-5-128-139**

## INTRODUCTION

Globalization and interdependence of economies contributed to increased negative effects of COVID-19. Growing numbers of cases forced governments to impose restrictions on individual rights of movement, upsetting supply networks, increasing unemployment and inflation [1], and decreasing GDP and trade [2]. Coronavirus has had a strong negative impact on financial markets, increasing volatility in stock markets [3] and foreign exchange markets [4].

Measures to close borders and restrict the mobility of people have affected the tourism industry and people's desire to travel, provoked a decrease in the passenger traffic of airlines, making it one of the main affected [5, 6]. In 2020, airline stock prices fell with a significant increase in volatility [7]. Volatility increases did not always correspond to the peak COVID-19 incidence while also related to the peak Covid-19 social media attention (*Fig. 1–4*), and this has led us to assume the existence of a mechanism for the indirect influence of the pandemic on the market through panic and hype around the coronavirus. This assumption was the motivation for our article.

In the context of the development of the Internet, the functioning of social networks is increasingly consistent with the laws of the crowd [8, 9], which is characterized by the effects of hype in external shocks [10]. The risk associated with so-called effects stems, first, from the potential for mass panic to appear [11], whereby market participants act

irrationally [12]. On the other hand, the effects of hype and panic can be artificially prompted in the interests of a narrow group of market participants. As an illustration, consider Tesla's stock, whose value and volatility are greatly impacted by Elon Musk's Tweeter [13].

In order to identify the mechanisms of direct and indirect effects, we investigated the impact on airline stocks of COVID-19 cases and deaths, social media attention to the coronavirus, vaccines against Covid-19 and restrictive measures in connection with the pandemic during the period of the high anti-Covid restrictions from 23.03.2020 to 23.03.2021. We also examined how airline restrictions are affected by Google searches. The stocks of 16 airlines in developed and developing countries were analyzed.

We are based on the theories of crowd psychology [8] and behavioral finance [12], namely on the change in the rationality of behavior of market participants under the influence of the spread of fear and hysteria in an environment of external shock [11]. We apply the ARDL model with MG and PMG estimates after the preliminary stability tests.

The novelty of our research is due to the fact that we have identified the indirect effects of the coronavirus pandemic when studying corporate data on the value of stocks on the example of airlines. The main contribution of our work is that we have demonstrated the importance of the mechanism in the context of the spread of the Internet and social networks of the indirect impact of the pandemic on the shares of companies by influencing the behavior of investors through the formation of fear and hysteria in them.

The effects of new media, which we will demonstrate in our study, open up the possibility of influencing markets for the benefit of a narrow group of market participants. In such circumstances, there is a need for monitoring by financial regulators in order to minimize possible adverse effects. The paper is structured as follows. Section 2 provides theoretical and methodological justification for COVID-19's indirect impact on financial markets. Section 3 summarizes the study's data and methods. Section 4 discusses the results of empirical research. Conclusions are provided at the end.

## REVIEW OF THE LITERATURE

### Direct Effects of Disease on Markets

One theoretical basis for explaining the impact of health and, consequently, diseases on financial markets is the model of economic growth [14], according to which the direct impact of diseases is attributed to the impact on demand, output, savings and investment.

In the scientific literature, there are a large number of empirical studies justifying the direct influence of diseases [15].[1] Diseases are not only a health problem but also have an impact on economic growth [16, 17]. Public health is one of the main determinants of economic development; it affects the formation of human capital, life expectancy, and consequently consumption and GDP levels. Modern research on the effects of coronavirus confirms the results on the impact of diseases.

The COVID-19 pandemic has resulted in increased unemployment, closed more than tens of millions of enterprises [18], and reduced the countries' economic growth rates.

The restrictions, as well as the sickness itself, have resulted in a decrease in production, demaged of supply chains and increased inflation. Restrictive measures have provoked instability and increased trade costs, as well as rising interest rates and unemployment, and negatively effected sectoral trade and foreign direct investment [19]. Restrictions have led to a decline in demand for all types of travel, costing the world tourism industry more than 200 bln

[1] World Bank. The economic impact of the 2014 Ebola epidemic: short-and medium-term estimates for West Africa. 2014. URL: https://www.worldbank.org/en/region/afr/publication/the-economic-impact-of-the-2014-ebola-epidemic-short-and-medium-term-estimates-for-west-africa (accessed on 22.09.2023).

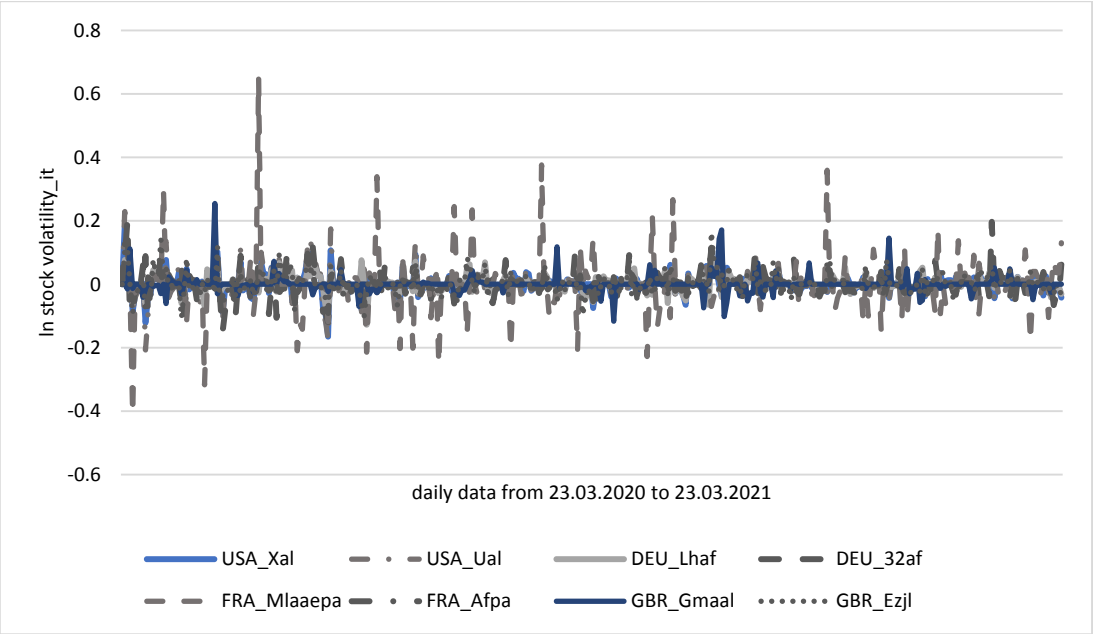



*Fig. 1.* **Volatility of Airline Stocks in Developed Countries**

*Source:* Compiled by the authors.

*Note:* $ln\ stock\ volatility_{it}$ – the logarithmic returns calculated based on the closing prices of the stock at time *t* and *t* – 1; USA_Xal, USA_UAL – USA airline; GBR_Ezjl, GBR_Gmaal – UK airline; DEU_LHA, DEU_32af – Germany airline; FRA_Afpa, FRA_Mlaaepa – France airline.

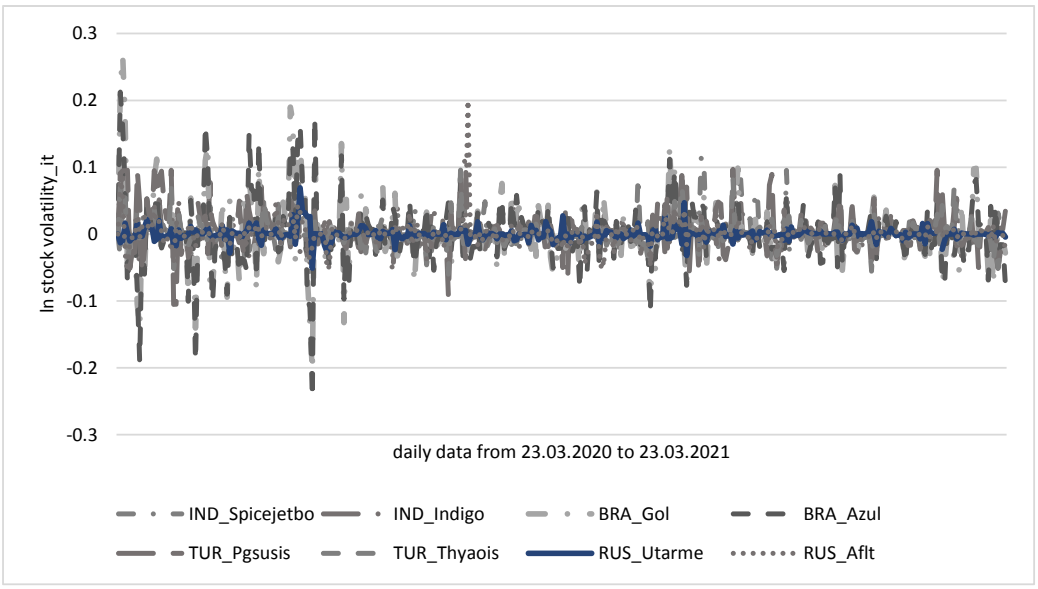



*Fig. 2.* **Volatility of Airline Stocks in Developing Countries**

*Source:* Compiled by the author.

*Note:* $ln\ stock\ volatility_{it}$ – the logarithmic returns calculated based on the closing prices of the stock at time *t* and *t* – 1; IND_Indigo, IND_Spicejetbo – India's airline; BRA_Azul, BRA_Gol – Brazilian airline; TUR_Pgsusis. TUR_Thyaois – Turkey airline; RUS_Aflt – Aeroflot, RUS_Utarme – Russian airline.

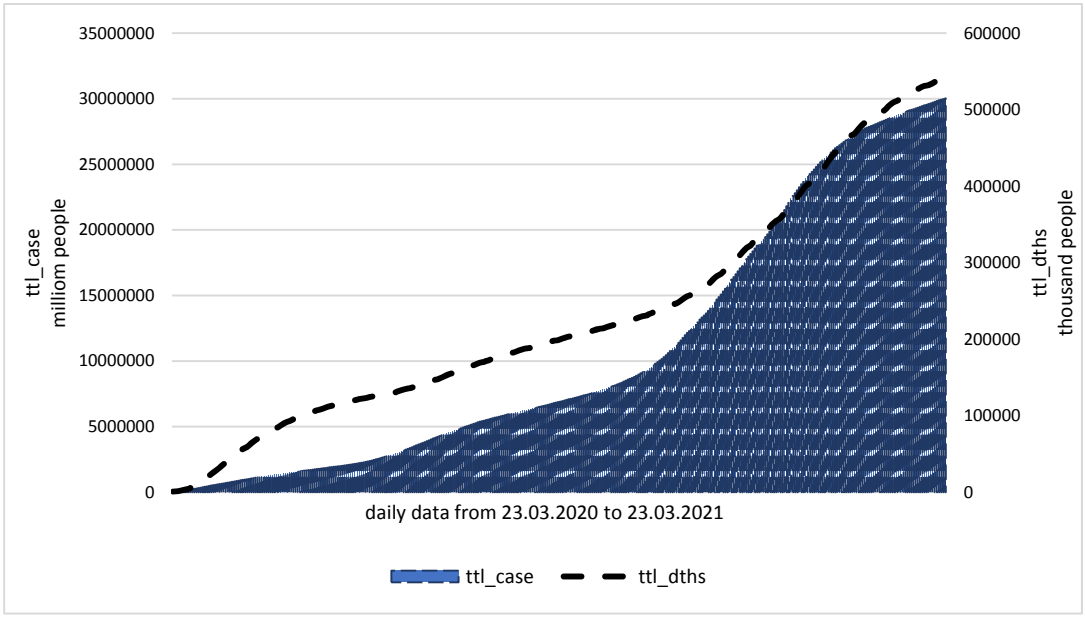



*Fig. 3.* **The Number of Confirmed Coronavirus Cases and Deaths**

*Source:* Compiled by the authors.

*Note:* $ttl\_case$ – number of confirmed coronavirus cases (cumulative total), million people/per day; $ttl\_dths$ – number of confirmed coronavirus deaths (cumulative total), thousand people/per day.

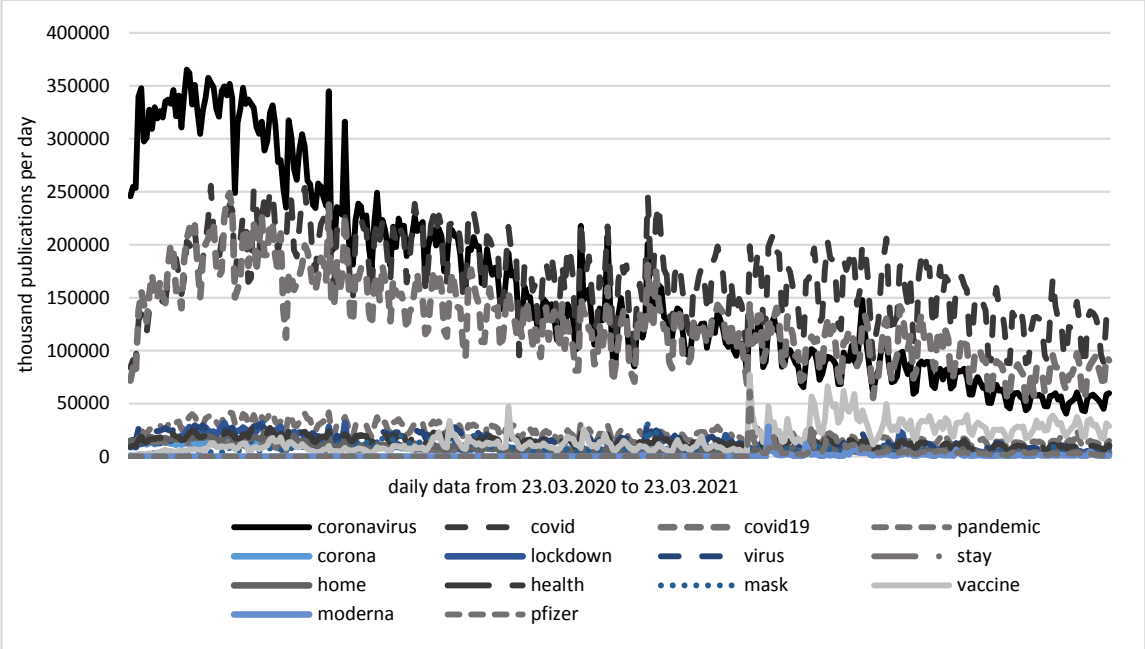



*Fig. 4.* **Attention on Twitter to the Spread of Coronavirus, to Vaccines Against COVID-19 and Pandemic Restrictions***

*Source:* Compiled by the author.

*Note:* * the number of times the term is used daily on Twitter in the research countries: "coronavirus", "Covid", "Covid19", "pandemic", "corona", "virus", "lockdown", "stay", "home", "mask", "health", "vaccine", "moderna", "pfizer".

dollars in losses [20]. Overall, the pandemic contributed to the economic collapse.

The scientific literature we have reviewed provides numerous evidence of the direct effects of the pandemic. However, the analysis of stock market dynamics (see *Fig. 1, 2*) demonstrates the inability to fully explain the increased volatility in the stock market by direct-impact mechanisms: the peaks of volatility do not coincide with the peaks of coronavirus cases and deaths from it. At the same time, comparing peak volatility in airline stock prices with social media attention to the pandemic, vaccines against COVID-19 and restrictive measures related to it (see *Fig. 1–4*) gives us reason to assume that there is a mechanism for the indirect impact of the pandemic on the markets.

### Indirect Effects of the Pandemic: The Role of the Internet and Social Media

Through the indirect impact of the pandemic on the markets, we understand the influence of the coronavirus on the mood of investors and ordinary citizens through the media, the Internet, and social networks, whose role in modern society is increasing.

The media influences markets through news and television programs, affecting the psychological state of its participants. Increased pessimism in the media is causing market prices to fall. The news media predict a subsequent decline in stock market volatility, while social media — predicts a rise in stock volatility [21].

Internet technologies have reached into people's lives and are frequently used to define and shape market participants' behavior. The mood of investors is influenced by news on the Internet. When considering the role of the Internet for markets, we will separate social networks, which serve not only as a channel through which investors receive information that shapes their rational expectations but also as a channel that affects their behavior. By researching social networks, it is possible to analyze the trust of market participants in the asset as well as its popularity among investors [10]. Social networks can act as a tool for forecasting the stock market [5]. A high level of positive social media posts predicts short-term stock growth, while negative sentiment has a long-term negative impact [22]. Based on concern indicators on different topics on Twitter and Google, it is possible to predict stock price movements [5].

S.V. Egorova and A.N. Nepp [23] defend the probability of indirect effects on markets by summarizing the work on crowd psychology and behavioural finance. The appearance of the shock event causes the rise of fear and hysteria in market participants, which, according to the Le Bon crowd theory [8] in online communities [9], creates conditions for irrational decision-making [12]. In the context of our research, we examine the probability of indirect effects on the stock market based on microdata, with a focus on airline stocks as one of the main victims of the epidemic and the restrictive measures implemented.

## METHODOLOGY OF RESEARCH

### Hypothesis

Despite the growing number of publications on the impact of the coronavirus on the stock markets [5, 6, 11], we have not found any papers that investigate the stocks of individual companies, especially airlines. We developed our initial hypothesis to fill this gap:

*Hypothesis 1.* The rise in COVID-19 cases and deaths has led to increased volatility in airline stock prices in developed and developing countries.

Investors' sentiment plays an important role in market decisions. The behavior of market participants can be studied by analyzing posts and reposts on social media. Sentiment analysis on Twitter can be useful to forecast stock market movements [24]. To study the impact of social network users' feelings on airline stocks, we formulate the second hypothesis:

*Hypothesis 2.* Increased attention to the coronavirus, the vaccine against it and the

pandemic restrictive measures among Twitter users is accompanied by rising volatility of the airline's stock price.

Another tool for analyzing the attention of market participants is Google search queries as determinants in the forecasting models of the stock, oil [25] and foreign exchange markets [26].

In order to address the impact of Google search queries on coronavirus restrictions on the volatility of individual companies' stocks, we have formulated our third hypothesis.

*Hypothesis 3.* Increased Google searches about coronavirus restrictions are accompanied by rising volatility in airline stock prices.

The proposed hypotheses will be verified with the database presented in the following subsection.

## Data

We are reviewing the stocks of 16 airlines from developed[2] and developing[3] countries during the period of pandemic peak and restrictive measures from 23.03.2020 to 23.03.2021.

When examining stock volatility as a dependent variable [27], we use logarithmic returns $ln\left(\frac{P_t^{close}}{P_{t-1}^{close}}\right)$ $\left(ln\, stock\ volatility_{it}\right)$ based on the Yahoo finance.

In order to verify the hypotheses in the model integrated the vector of the control variables $control_{it}$. The vector includes the price of Brent oil ($brent_{it}$) as an indicator of the cost of fuel, which is of great significance for the financial performance of airlines [28].

In the context of the pandemic, restrictive measures [29] have had a significant impact on the development of tourism and the transport sector, for which we have considered the Strigency Index of the University of Oxford on the Strength of Governmental Restrictive Measures against COVID-19 as a control determinant [30] ($str_{it}$).

The intensity of deterrent measures has declined following the development of vaccination programmes, which have ultimately had a positive impact on air transport [31], which has led to the inclusion of the share of citizens vaccinated against COVID-19 $control_{it}$ in the vector ($vac_{it}$) according to Our World in Data.

When we test the H1 hypothesis, we analyze the vector variable characterizing the spread of the coronavirus ($spread\_covid_{it}$, which includes the number of cases by ($ttl\_case_{it}$) and deaths ($ttl\_dths_{it}$) by the coronavirus (increasing) in the analysed countries. To verify the hypotheses of H2 as the variables being studied, we consider the vectors of variables characterizing: a) social network attention to COVID-19 ($attention\_covid_{it}$); b) attention to restrictive measures ($attention\_restriction_{it}$); c) attention to the vaccine against COVID-19 ($attention\_vaccine_{it}$). To investigate the H3 hypothesis, we analyze the vector of variables characterizing attention in Google to restrictions in airlines ($ggl\_search_{it}$) based on Google Trends. To fill in the vector variables formulated for the second hypothesis, we analyzed Twitter, which has proven itself well in the study of users' attention to the coronavirus [11]. Guided by the paper [32], 14 most frequently occurring terms in English have been identified in posts about:

- coronavirus (vector $attention\_covid_{it}$): coronavirus ($cvrs_{it}$), covid ($cov_{it}$), covid19 ($cov19_{it}$), pandemic ($pdc_{it}$), corona ($crn_{it}$), virus ($vrs_{it}$);
- restrictive measures (vector $attention\_restriction_{it}$): lockdown ($ldwn_{it}$), stay ($sty_{it}$), home ($hme_{it}$), health ($hlth_{it}$), mask ($msk_{it}$);
- coronavirus vaccines (vector $attention\_vaccine_{it}$): vaccine ($vcne_{it}$), moderna ($mdrn_{it}$), pfizer ($pfzr_{it}$).

For the formation of the vector $ggl\_search_{it}$ [5] the most frequent queries related to

[2] USA — NYSE ARCA Airline index (USA_Xal), United Airlines Holdings, Inc. (USA_UAL); UK — easyJet plc (GBR_Ezjl), Gama Aviation Plc (GBR_Gmaal); Germany — Deutsche Lufthansa AG (DEU_LHA), Aegean Airlines S.A. (DEU_32af); France — Air France-KLM SA (FRA_Afpa), Caire (FRA_Mlaaepa).

[3] India — InterGlobe Aviation Limited (IND_Indigo), SpiceJet Limited (IND_Spicejetbo); Brazil — Azul S.A. (BRA_Azul), Gol Linhas Aéreas Inteligentes S.A. (BRA_Gol); Turkey — Pegasus Hava Tasimaciligi Anonim Sirketi (TUR_Pgsusis), Türk Hava Yollari Anonim Ortakligi (TUR_Thyaois); Russia — Aeroflot — Russian Airlines (RUS_Aflt), UTair Aviation (RUS_Utarme).

restrictions in the airline during the period under investigation such as "flight status" ($ggl\_fsts_{it}$), "flight cancellation" ($ggl\_fcanl_{it}$), "booking a flight" ($ggl\_fbkg_{it}$) and "flight reservation" ($ggl\_fres_{it}$) have been identified.

### Selection of Method and Modelling Methodology

For our study, we have focused on the ARDL model with MG and PMG [33], because the MG-PMG designation enables long-term and short-term relationships to be evaluated, which appears to be important in the study of the effects of fear, hysteria, and hype, which can be of a short, impulsive nature.

A single root test was carried out for the stability of the variables. Based on the selected method and the variables being analyzed, the vector model takes the form:

$$\begin{aligned}\ln stock\ volatility_{it} = \\ \sum_{j=1}^{p}\alpha_i \ln stock\ volatility_{i,t-j} + \sum_{j=0}^{q}\delta_{ij} spread\_\mathrm{cov}id_{i,t-j} + \\ + \sum_{j=0}^{q}\delta_{ij} attention\_\mathrm{cov}id_{i,t-j} + \sum_{j=0}^{q}\delta_{ij} attention\_restriction_{i,t-j} + \\ + \sum_{j=0}^{q}\delta_{ij} attention\_vaccine_{i,t-j} + \sum_{j=0}^{q}\delta_{ij} ggl\_search_{i,t-j} + \mu_i + \varepsilon_{it},\end{aligned} \quad (1)$$

where $\alpha_i$ — the coefficient of the dependent variable with the lag; $\delta_{ij}$ — coefficient vectors $k \times 1$; $\mu_i$ — fixed effects for a specific unit (company); $\varepsilon_{it}$ — member error, $i = 1,\ldots N$; $t = 1,\ldots T$; $p$ and $q$ — optimal number of lag.

To analyse the potential impact between developed and developing countries, the database is divided into two panels. Panel *a* includes companies from developed countries, Panel *b* — from developing countries. Assuming the possibility of a hidden multicollinearity between the variables under investigation, a model containing the vector of the control variables $control_{it}$, is successively integrated with one variable of the vectors of the variable under examination. For example, for $ttl\_case_{it}$ the model takes the form:

$$\begin{aligned}\ln stock\ volatility_{it} = \alpha_0 + \alpha_1 ttl\_case_{it} + \alpha_2 ttl\_case_{it-1} + \\ + \alpha_3 ttl\_case_{it-2} + \gamma_4 vac_{it} + \gamma_5 vac_{it-1} + \gamma_6 vac_{it-2} + \\ + \gamma_7 str_{it} + \gamma_8 str_{it-1} + \gamma_9 str_{it-2} + \gamma_{10} brent_{it} + \\ + \gamma_{11} brent_{it-1} + \gamma_{12} brent_{it-2} + \varepsilon_{it}.\end{aligned} \quad (2)$$

## RESULTS AND DISCUSSION

In all models, $brent_{it}$ has demonstrated importance for both developed and developing countries. Growth $brent_{it}$ in the short-term effects study was accompanied by an increase $ln\ stock\ volatility_{it}$, which corresponds to the [28] results on the impact of oil prices on the financial performance of airlines. At the same time, in the analysis of long-term effects, we observed a decrease in the volatility of airline stock prices, which did not meet our expectations. Such results could have been caused by the stronger influence of social media and Internet attention to COVID-19 and coronavirus-induced restrictions.

When the index $str_{it}$ increases, we find a rise $ln\ stock\ volatility_{it}$, which was observed in both short- and long-term models and consistent with our expectations of a deterioration in the financial performance of airlines due to restrictive measures and, as a result, increased volatilities in the price of shares, the results correspond to the result [29]. The results of the study of the index $vac_{it}$ were unstable in the analysis of long-term effects, such results may be due to the existence of a mechanism of indirect influence of the coronavirus through influence on the psychological state of market participants.

### The Results of Hypothesis H1

In formulating the first hypothesis of our study, we assumed that the rise in COVID-19 cases and deaths would be accompanied by an increase in airline stock volatility. During the verification of the hypothesis, we revealed that the increase in the share volatility in the analysis of short-term effects for developing countries was accompanied by the growth in the growth of the $ttl\_case_{it}$ and $ttl\_dths_{it}$ which corresponds to the results [11]. At the same time, an adverse relationship was found in the investigation of long-term consequences. We justify the results obtained,

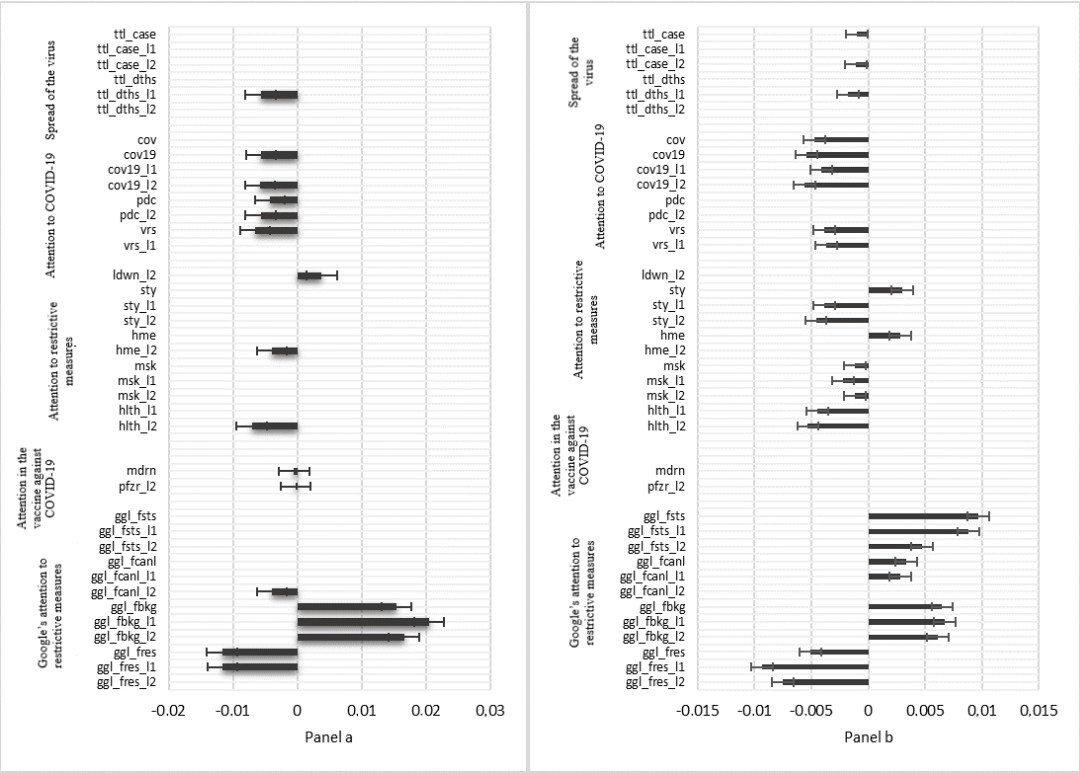



*Fig. 5.* **Long-term Effects on Airline Stock Volatility from Coronavirus Spread, Twitter Attention to COVID-19, Vaccines Against Coronavirus, Restrictive Measures, and Google Attention to Airline Restrictive Measures**

*Source:* Compiled by the author.

first, by the impulsive nature of the effects studied, and second, by a distortion resulting from the existence of a mechanism of indirect influence of the coronavirus on the volatility of the shares studied by influencing investor sentiment via the Internet and social networks.

### The Results of Hypothesis H2

The main results are presented in *Fig. 5*, *6*.

The vector of variables $attention\_covid_{it}$, characterizing attention to COVID-19, in the analysis of long-term effects showed a negative correlation with the volatility of airline shares in both developed and developing countries. The discovered association was unstable in the study of short-term impacts: the effects changed signs in the models. The model results were opposite to expectations in the H2 hypothesis, which we attribute to market participants being terrified not so much of the coronavirus itself, but of the prospect of restrictive measures imposed by it. In the study of the vector $attention\_restriction_{it}$, which characterizes attention to restrictive measures, we find confirmation of the H2 hypothesis in almost all models. In models for both developed and developing countries, increased attention to coronavirus-related restrictions was accompanied by a short-term increase in volatility, confirming the negative impact of COVID-19 restrictive measures on tourism [20] and, in particular, on traffic volumes. Considering the long-term impacts, we discover a negative relationship between the volatility of airline stocks and compliance of regulations. These results confirm our hypothesis that behavioral elements, particularly the attention to restriction measures against COVID-19, have an impulsive and temporary effect, as shown, for instance, in the paper [11]. On the other hand, we associate this result with the fact that society has eventually realized the positive role of restrictions in the fight against the pandemic. Similar effects we encounter in vector $attention\_vaccine_{it}$. analysis. The H2 hypothesis was supported by the short-term increase in share value volatility that corresponded

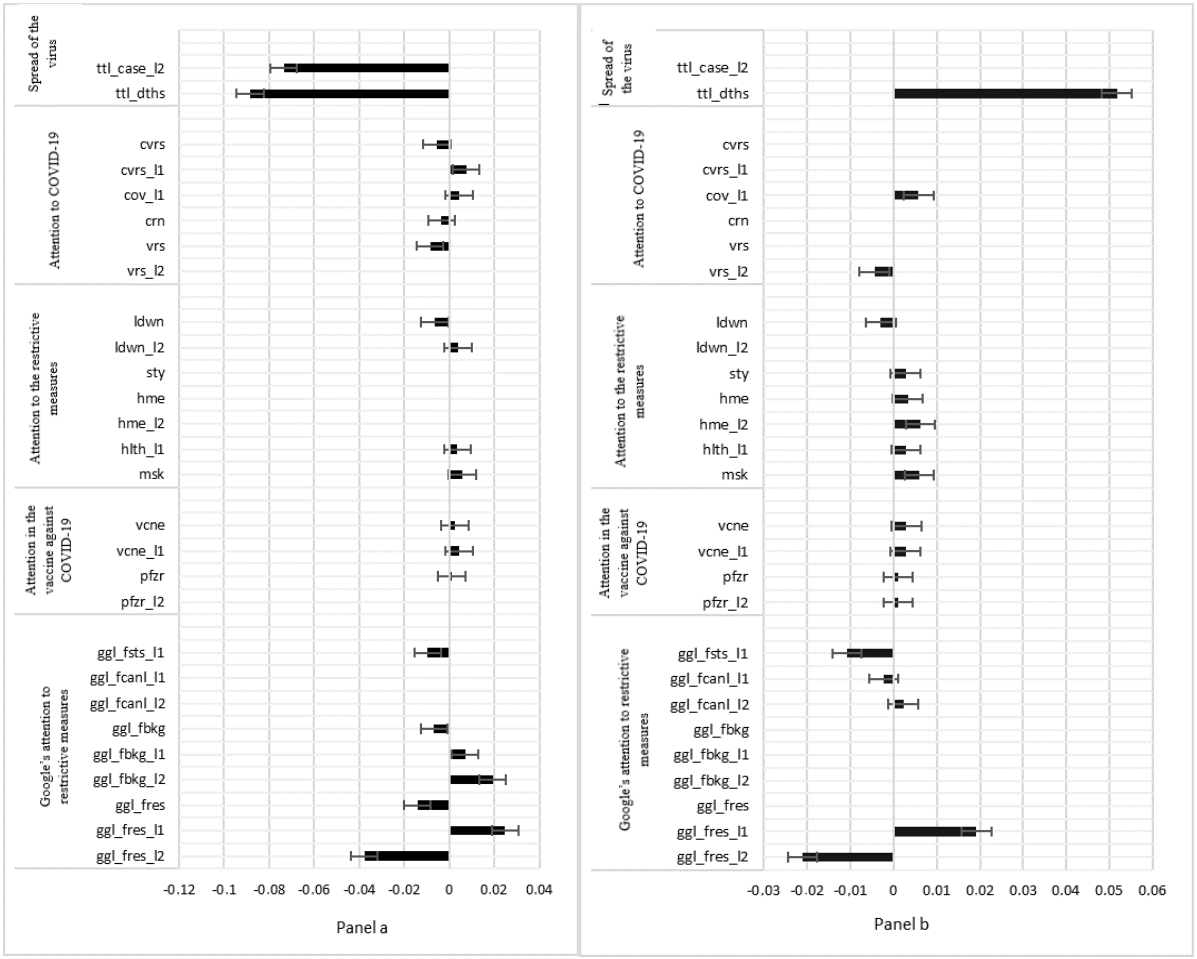



*Fig. 6.* **Short-term Effects on Airline Stock Volatility from Coronavirus Spread, Twitter Attention to COVID-19, Vaccines Against Coronavirus, Restrictive Measures, and Google Attention to Airline Restrictive Measures**

*Source:* Compiled by the authors.

with the focus on vaccines. Restrictive measures to stop the epidemic included airline rules that only vaccinated passengers could board aircraft. Therefore, it seems quite logical that the results of models with the vector $attention\_vaccine_{it}$ were very similar to the result of the vector $attention\_restriction_{it}$ . A negative correlation between stock volatility and attention to vaccines was found in the analysis of long-term effects, which confirmed the results of models for the COVID-19 $attention\_covid_{it}$ vector and $attention\_restriction_{it}$. vector. Such results can be attributed to the long-term positive role of vaccines, as well as restrictive measures in pandemic deterrence, which have had a "calming" effect on stock price volatility. Our results are consistent with the findings [31] on the long-term positive impact of vaccination on air transport.

Following a summary of the H2 hypothesis test results, we are able to report that there has been a short-term increase in airline stock price volatility, which is consistent with our expectations under H2 and the conclusions [20] on the pandemic's effects on travel and tourism. This increase was associated with a rise in Twitter attention to restrictive measures related to COVID-19 and vaccines against it. At the same time, we note that the H2 hypothesis was not confirmed in the analysis of long-term effects. Such results are explained by the impulsive short-term nature of the effects studied, which confirms the results [11].

### The Results of Hypothesis H3

In a study of the short-term relationship between airline stock volatility and Google searches

$ggl\_fcanl_{it}$, $ggl\_fres_{it}$. and $ggl\_fbkg_{it}$ for flights, we did not observe sustainable effects. The factors studied and their lies changed signs in different models. Such results were quite expected, against the background of the volatility of regular flights any positive, however, as well as negative, information about the status, booking, reservation and cancellation of the flight caused a quick response (impulsion) for the volatility of the stocks. Results from long-term effects analysis are more unambiguous. We have observed an increase in airline stocks volatility for developing countries in addition to an increase in Google queries on flight status, cancellations, and flight bookings. In developed countries, increased volatility was attributed to flight bookings. The decline in stock volatility against the backdrop of increased attention in Google to $ggl\_fres_{it}$ in the countries we associate with the fact that during the pandemic the stock market needed some positive news, for example, the growth of reservations in airlines against the background of negative news about the cancellation and status of flights. Most results confirm the H3 hypothesis: an increase attention in Google to status, cancellation, and flight reservations was accompanied by a long-term rise in stock volatility. These results confirm our findings during the testing of the effects of Twitter attention to COVID-19-related restrictive measures under the H2 hypothesis and are consistent with the results [20] on the impact of restrictions on traffic volumes and tourism.

## CONCLUSION

We reached at the following conclusions after studying the factors behind the pandemic's direct and indirect effects on airline stocks:

- firstly, the increase in COVID-19 cases and deaths was accompanied by a short-term rise in airline stock volatility;
- secondly, Twitter's attention to COVID-19 restrictions and vaccines was accompanied by a short-term rise in airline stock volatility. The results of hypothesis 2 confirmed the impact of social media on stock indices;
- thirdly, an increase attention in Google to status, cancellation, and flight bookings was accompanied by the long-term effects of increased stock volatility.

The obtained results demonstrate that in conditions of spread of Internet and social media, the impact of the pandemic on stock markets occurs not only in the form of direct impact on the determinants of economic growth model, but also indirectly through social media and Internet on investor behaviour by creating fear and hysteria among them.

Our results can be of practical interest to stock market participants and its regulators to forecast and minimize the possible negative impact of social media on stock markets.

## ACKNOWLEDGEMENTS

The reported study was funded by the Russian Foundation for Basic Research under the scientific project No. 20–04–60158. Ural Federal University named after the first President of Russia B.N. Yeltsin, Ekaterinburg, Russia.

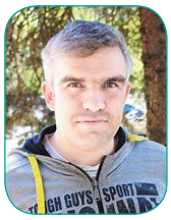
## REFRENCES

1. Nguyen T.N., Pham T.T.X., Nguyen T.C. Forecasts of GDP growth and inflation under the influence of the COVID-19 pandemic: The case of Vietnam. In: Ngoc Thach N., Ha D.T., Trung N.D., Kreinovich V., eds. Prediction and causality in econometrics and related topics (ECONVN 2021). Cham: Springer-Verlag; 2021:483–497. (Studies in Computational Intelligence. Vol. 983). DOI: 10.1007/978–3–030–77094–5_38
2. Martinho V.J.P.D. Impact of COVID-19 on the convergence of GDP per capita in OECD countries. *Regional Science Policy & Practice*. 2021;13(S 1):55–72. DOI: 10.1111/rsp3.12435
3. Al-Awadhi A.M., Alsaifi K., Al-Awadhi A., Alhammadi S. Death and contagious infectious diseases: Impact of the COVID-19 virus on stock market returns. *Journal of Behavioral and Experimental Finance*. 2020;27:100326. DOI: 10.1016/j.jbef.2020.100326

4. Benzid L., Chebbi K. The impact of COVID-19 on exchange rate volatility: Evidence through GARCH model. *SSRN Electronic Journal*. 2020. DOI: 10.2139/ssrn.3612141
5. Deb S. Analyzing airlines stock price volatility during COVID-19 pandemic through internet search data. *International Journal of Finance & Economics*. 2021;28(2):1497–1513. DOI: 10.1002/ijfe.2490
6. Atems B., Yimga J. Quantifying the impact of the COVID-19 pandemic on US airline stock prices. *Journal of Air Transport Management*. 2021;97:102141. DOI: 10.1016/j.jairtraman.2021.102141
7. Baker S., Bloom N., Davis S.J., Kost K., Sammon M., Viratyosin T. The unprecedented stock market reaction to COVID-19. *The Review of Asset Pricing Studies.* 2020;10(4):742–758. DOI: 10.1093/rapstu/raaa008
8. Le Bon G. The crowd: A study of the popular mind. Transl. from French. New York, NY: Macmillan & Co.; 1896. 219 p.
9. Dong X., Bollen J. Computational models of consumer confidence from large-scale online attention data: Crowd-sourcing econometrics. *PLoS ONE*. 2015;10(3): e0120039. DOI: 10.1371/journal.pone.0120039
10. Nepp A., Karpeko F. Hype as a factor on global market: The case of Bitcoin. *Journal of Behavioral Finance*. 2022. DOI: 10.1080/15427560.2022.2073593
11. Nepp A., Okhrin O., Egorova J., Dzhuraeva Z., Zykov A. What threatens stock markets more — the coronavirus or the hype around it? *International Review of Economics & Finance*. 2022;78:519–539. DOI: 10.1016/j.iref.2021.12.007
12. De Bondt W.F.M., Thaler R. Does the stock market overreact? *The Journal of Finance*. 1985,40(3):793–805. DOI: 10.1111/j.1540–6261.1985.tb05004.x
13. Ivanik E.D. The impact of social networks on stock markets. *Biznes-obrazovanie v ekonomike znanii.* 2021;(2):68–71. (In Russ.).
14. Solow R.M. A contribution to the theory of economic growth. *The Quarterly Journal of Economics.* 1956;70(1):65–94. DOI: 10.2307/1884513
15. Bloom E., De Wit V., Carangal-San Jose M.J. Potential economic impact of an avian flu pandemic on Asia. ERD Policy Brief. 2005;(42). URL: https://www.adb.org/sites/default/files/publication/28082/pb042.pdf
16. Peixoto H.M., Gallo L.G., Nascimento G.L., de Oliveira M.R.F. Economic impact of Zika virus infection and associated conditions. In: Martin C.R., Hollins-Martin C., Preedy V.R., Rajendram R., eds. Zika virus biology, transmission, and pathology. Vol. 1: The neuroscience of Zika. London; San-Diego, CA: Academic Press; 2021:63–74. DOI: 10.1016/B 978–0–12–820268–5.00006–7
17. Gaffeo E. The economics of HIV/AIDS: A survey. *Development Policy Review*. 2003;21(1):27–49. DOI: 10.1111/1467–7679.00197
18. Hyman M., Mark C., Imteaj A., Ghiaie H., Rezapour S., Sadri A.M., Amini M.H. Data analytics to evaluate the impact of infectious disease on economy: Case study of COVID-19 pandemic. *Patterns.* 2021;2(8):100315. DOI: 10.1016/j.patter.2021.100315
19. Hayakawa K., Lee H.-H., Park C.-Y. The effect of COVID-19 on foreign direct investment. Asian Development Bank Economics Working Paper Series. 2022;(653). URL: https://www.adb.org/sites/default/files/publication/781381/ewp-653-effect-covid-19-foreign-direct-investment.pdf
20. Ozili P.K., Arun T. Spillover of COVID-19: Impact on the global economy. *SSRN Electronic Journal*. 2020. DOI: 10.2139/ssrn.3562570
21. Jiao P., Veiga A., Walther A. Social media, news media and the stock market. *Journal of Economic Behavior & Organization*. 2020;176:63–90. DOI: 10.1016/j.jebo.2020.03.002
22. Katsafados A.G., Nikoloutsopoulos S., Leledakis G.N. Twitter sentiments and stock market indexes: A COVID-19 analysis. *Journal of Economic Studies.* 2023. DOI: 10.1108/JES-09–2022–0486
23. Egorova Yu.V., Nepp A.N. The impact of epidemics on economic development and financial markets: A structured review. *Moscow University Economics Bulletin.* 2021;(6):28–53. (In Russ.). DOI: 10.38050/0130010520216.2
24. Pagolu V.S., Reddy K.N., Panda G., Majhi B. Sentiment analysis of Twitter data for predicting stock market movements. In: 2016 Int. conf. on signal processing, communication, power and embedded system (Paralakhemundi, October 03–05, 2016). Piscataway, NJ: IEEE; 2016:1345–1350. DOI: 10.1109/SCOPES.2016.7955659

25. Lin Y., Han D., Du J., Jia G. The mechanism of Google trends affecting crude oil price forecasting. *SN Computer Science*. 2022;3(4):294. DOI: 10.1007/s42979–022–01195-w
26. Fan Chiang H.-C., Jiang P.-X., Chang C.-C. Google search trends and exchange rate volatility — evidence from India's currency market. In: Lee C.-F., Yu M.-T., eds. Advances in Pacific Basin business, economics and finance. Bigley: Emerald Publishing Ltd; 2021;9:195–210. DOI: 10.1108/S 2514–465020210000009010
27. Ederington L. H., Guan W. How asymmetric is US stock market volatility? *Journal of Financial Markets*. 2010;13(2):225–248. DOI: 10.1016/j.finmar.2009.10.001
28. Yun X., Yoon S.-M. Impact of oil price change on airline's stock price and volatility: Evidence from China and South Korea. *Energy Economics*. 2019;78:668–679. DOI: 10.1016/j.eneco.2018.09.015
29. Bakry W., Kavalmthara P. J., Saverimuttu V., Liu Y., Cyril S. Response of stock market volatility to COVID-19 announcements and stringency measures: A comparison of developed and emerging markets. *Finance Research Letters*. 2022;46(Pt.A):102350. DOI: 10.1016/j.frl.2021.102350
30. Aggarwal S., Nawn S., Dugar A. What caused global stock market meltdown during the COVID pandemic — lockdown stringency or investor panic? *Finance Research Letters*. 2021;38:101827. DOI: 10.1016/j.frl.2020.101827
31. Mishra R., Sharma R., Karedla Y., Patel N. Impact of COVID-19 cases, deaths, stringency and vaccinations on the US stock market. *Vision*. 2022. DOI: 10.1177/09722629221074901
32. Banda J. M., Tekumalla R., Wang G. et al. A large-scale COVID-19 Twitter chatter dataset for open scientific research — an international collaboration. *Epidemiologia*. 2021;2(3):315–324. DOI: 10.3390/epidemiologia2030024
33. Pesaran M. H., Smith R. Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics*. 1995;68(1):79–113. DOI: 10.1016/0304–4076(94)01644-F
34. Im K. S., Pesaran M. H., Shin Y. Testing for unit roots in heterogeneous panels. *Journal of Econometrics*. 2003;115(1):53–74. DOI: 10.1016/S 0304–4076(03)00092–7

## ABOUT THE AUTHORS



***Alexander N. Nepp*** — Cand. Sci. (Econ.), Senior Researcher, Ural Federal University named after the first President of Russia B.N. Yeltsin, Ekaterinburg, Russia; Assoc. Prof., Ural Institute of Management, Branch of RANEPA, Ekaterinburg, Russia
https://orcid.org/0000-0002-7226-2689
anepp@inbox.ru

***Zarnigor F. Dzhuraeva*** — Research Engineer, Ural Federal University named after the first President of Russia B.N. Yeltsin, Ekaterinburg, Russia
https://orcid.org/0000-0002-3722-189X
*Corresponding author:*
juraevaz96@gmail.com

*Conflicts of Interest Statement: The authors have no conflicts of interest to declare.*

*The article was submitted on 14.03.2023; revised on 19.04.2023 and accepted for publication on 26.04.2023. The authors read and approved the final version of the manuscript.*