FORUM STATISTICUM SLOVACUM Vol XVII (2021) No 2 pp 28-38

Do pharmaceutical companies profit from the Covid19 crisis?†
Profitujú farmaceutické firmy z koronakrízy?†

Peter Pšenák, Michal Páleník
Univerzita Komenského v Bratislave, Fakulta managementu, Odbojárov 10, 820 05 Bratislava, Slovenská republika
Comenius University in Bratislava, Faculty of Management, Odbojárov 10, 820 05 Bratislava, Slovak Republic
peter.psenak@fm.uniba.sk , michal.palenik@fm.uniba.sk

Abstract: *Investing into companies developing vaccines (pharmaceutical companies) showed significantly less profitable than investing into the conservative S&P500 index or Facebook Inc, a company providing a social media platform to spread information. This conclusion is suggested by comparing returns for these types of stock investments, controlling for daily fluctuations of stock prices (which could increase or decrease returns twofold).*

Abstrakt: *Investovanie do firiem vyvíjajúcich vakcíny (farmaceutické firmy) sa ukázalo ako menej ziskové ako investovanie do konzervatívneho S&P500 indexu alebo do Facebooku Inc., spoločnosti poskytujúcej mediálnu platformu pre distribúciu informácií. Tento záver plynie na z porovnania výnosov z investícií do týchto akcieových inštrumentov, kontrolujúc fluktuácie denných hodnôt akcí (fluktuácie by mohli dvojnásobne zvýšiť či znížiť výnosy).*

Key words: *covid19 crisis, pharmaceutical companies, stock prices development*

Kľúčové slová: *covid kríza, farmaceutický priemysel, vývoj cien akcií*

1 Introduction

Covid-19 crisis negatively affected all sectors of economy. One of the few sectors, which could be affected positively by a worldwide pandemic, should be the pharmaceutical sector. There might be a possible increase in pharmacy company revenue, which can stem from the Covid pandemic, including PCR and AG testing, treatment of this illness and vaccination. On the other hand, creating tests, treatments and vaccinations for a new disease requires additional resources for research and development. Further, the worldwide pandemic hinders the number of medical procedures of other illnesses as well as their research process.

In this paper we focus on comparing development of pharmaceutical companies during Covid pandemic in years 2020 and 2021. We do not discuss ramifications resulting from the fact that pharmaceutical sector is oligopolistic sector, which is hugely regulated, subsidized by governments and are the main

† The views expressed in this paper are not necessarily those shared by the Editorial Board of Forum Statisticum Slovacum.

customers are governments. We are discussing whether these companies outperform general market.

2 Misinformation causing delays in vaccination

Corona vaccination rollout was slowed down by misinformation, false claims, and hoaxes. A section of these misinformation[4] had wording like "I do not want to fuel pharmaceutical companies' profits therefore I will not get vaccinated". This includes two claims: "pharmaceutical companies greatly financially profit from vaccines" (which we evaluate in this paper) and "vaccines create more profits than treatments" (for pharmaceutical companies).

Price of Covid vaccines varies greatly, but one dose generally costs $15-30. We assume cost of 20 € per dose plus additional costs for administering the dose (mainly local staff salaries).

Costs of Covid treatments in hospitals again vary. In the case of Slovakia, reported prices average at 2 300 €, reaching well above 10 000 € in case of ICU (Aktuality.sk, 2021). Direct costs of non-hospitalized Covid patient are around 100€ (Darcy Jimenez, 2021).

From February 2020 until November 2021 in Slovakia, there were 63 932 hospitalized Covid patients out of 651 234 tested positive by PCR tests (Inštitút zamestnanosti, 2021; *Koronavírus na Slovensku v číslach*, 2021). So around 12 % of population in Slovakia tested Covid positive and 1.2 % of total population ended in hospital (we ignore the few repeated hospitalizations). New Covid mutations will increase the probability of hospitalization and positivity.

Therefore, average expected costs of hospitalization are 28€, average expected costs of non-hospitalization treatments are 12.3 €, totaling 40€. This estimate is extremely conservative not factoring into account secondary health treatments after overcoming the disease, costs resulting from postponing medical procedures, costs resulting from overwork and burnout of health care employees, further complications resulting from new Covid mutations etc. Also, other economic costs resulting from pandemic are not included (subsidies, lost revenues to the state budget, costs of economic downturn, long term social costs, etc.).

Comparing 40 € costs of two vaccination doses with above mentions costs undoubtedly proves that vaccination is far cheaper than treatment of Covid illness.

[4] We intentionally do not make any references to sources of misinformation. We do not want to increase their citation index. Citation indexes, just like social media, do not distinguish between positive and negative citations.

In the later part of this paper, we focus on development of stock prices of pharmaceutical companies.

3 Development of pharmaceutical sector during the Covid19 crisis

For our study we have chosen a specific subset of pharmaceutical companies which we would like to analyze more deeply. We study mainly the development of these pharmaceutical companies:

PFE - Pfizer Inc.

Pfizer Inc. is an America based multinational biotechnology and pharmaceutical corporation. The company was established in 1849 (Pfizer, n.d.). With more than 100 years of their existence, they are able to produce medicines and vaccines used by the general public. It was included in Dow Jones Industrial Average stock market index (*Exxon Mobil, Pfizer Removed from Dow Jones Industrial Average; Salesforce, Honeywell Added*, 2021).

The market cap of the company at the beginning of 2020 was $204.60 B

MRNA - Moderna, Inc.

Moderna, Inc., is a biotechnological and pharmaceutical company based in Cambridge that focuses on RNA therapeutics, primarily mRNA vaccines (Moderna, 2020). Unlike Pfizer they exist only for a short amount of time being established only in 2010. The company's most notable commercial product is the Moderna COVID-19 vaccine(Kollewe, 2020). They have multiple other vaccines and different treatments in their pipeline(Moderna, 2020).

The market cap of the company at the beginning of 2020 was $41.33 B.

JNJ - Johnson & Johnson

Johnson & Johnson is an American multinational corporation, which develops pharmaceuticals, medical devices and packaged goods. It was established in 1886 and their headquarters are in New Jersey (Jonhson & Johnson, n.d.). The company’s stock is in the Dow Jones Industrial Average and is considered as a creditor with AAA rating (Fortune, 2021; *S&P Revises J&J’s Outlook to Negative after $1.5B Boost to Legal Reserve*, 2020).

J&J has announced in early November 2021 that it is planning to split into two different publicly traded companies. The sole purpose of this decision is, that one company will focus primarily on consumer products and the second will only work with pharmaceuticals (Rilley Griffin, 2021).

The market cap of the company at the beginning of 2020 was $414.30 B.

AZN - AstraZeneca PLC

AstraZeneca plc is a British-Swedish multinational biotechnological and pharmaceutical company. The company was founded in 1999 and it has its

headquarters in Cambridge (*AstraZeneca > GC Powerlist: Sweden Teams 2019*, n.d.; AstraZeneca, 2021). It has a wide portfolio of products for a wide variety of major diseases (*Key Facts - Our Company - AstraZeneca*, 2021). AstraZeneca is listed on the NASDAQ.

The market cap of the company at the beginning of 2020 was $130.98 B.

We compare this group of successful companies (from the view of vaccine development) with other pharmaceutical companies, which have not developed successful Covid vaccine yet. Comparing these two groups will allow for distinguishing the effect of vaccine development of stock prices.

Other group for comparison will be non-pharmaceutical companies represented by general stock market indexes (S&P500).

3.1 Stock prices

We understand company's stock prices as a composite indicator of current situation and expected future development of given company. Our stock prices were downloaded from Yahoo finance (*Yahoo Finance - Stock Market Live, Quotes, Business & Finance News*, 2021), with the help of R (R Core Team, 2021), R-studio and especially the quantmod (Ryan et al., 2017) and PerformanceAnalytics (Peterson et al., 2020) packages. We have chosen Yahoo for its fast API and clean data, which it provides for free (Pšenák & Pšenáková, 2018).

The main question is: Did pharmaceutical stock prices increase during Covid19 pandemic? To be able to answer this question, we will use multiple visualizations and different calculations. In Fig. 1 we show all the prices of every pharmaceutical company in our dataset. As one might immediately realize, the different stock had completely different performances. One of our main analyzed companies, namely Moderna had the biggest jump of their stock prices in the selected years. This might come from the reality, that it is a young company which was between the first companies with usable vaccine for Covid pandemic. We can consider it as an extreme value. Secondly the value of REGN (Regeneron Pharmaceuticals) was extremely high even in the beginning of the pandemic. Most of the company stock values were way below 100$, and except Moderna, no other companies had such a rapid growth of stock price in the analyzed timeframe. Overall, the companies differ in the relative value of stock prices as well as the different stock price changes.

In our second analysis we normalized the values of analyzed companies to 100 $ at the beginning, so we were able to analyze only the price changes. The outcome of this normalization is shown on Figure 2. The relative change of the different stocks is showing us, that the Moderna stock price change was

extremely high in comparison to any other company. As for the other 3 companies of our main interest the changes of prices are close to zero, and there is no implicit correlation between the actual pandemic situation and their market value.

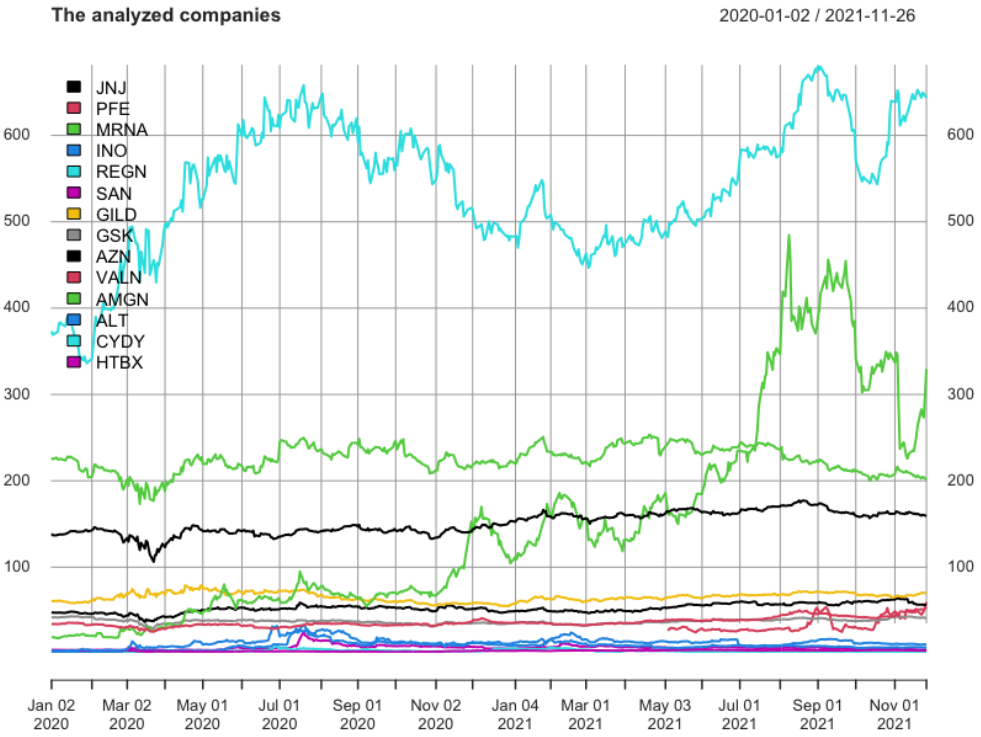

Fig. 1 Stock prices of selected companies, in $ *(Source: the authors)*

For further analysis of the stocks, we calculated some basic descriptive statistics. They helped us to decide, which companies we will analyze further, and which company values changed so extremely, that it would bias our further research. After this analysis we decided to not use MRNA for further analysis, because of it extreme values and changes.

3.2 Stock Prices in comparison to market development

As we described in chapter 3.1, stock prices of pharmaceutical companies increased during the pandemic but so did stock prices of other companies. In this chapter we study development of pharmaceutical companies' stock prices over market development: did these companies outperform general market?

Figure 3 shows traditional approach to comparing stock prices – normalized at beginning of selected period. We can see, that S&P500 (symbol GSPC) yields higher results than other stocks (except for FB).

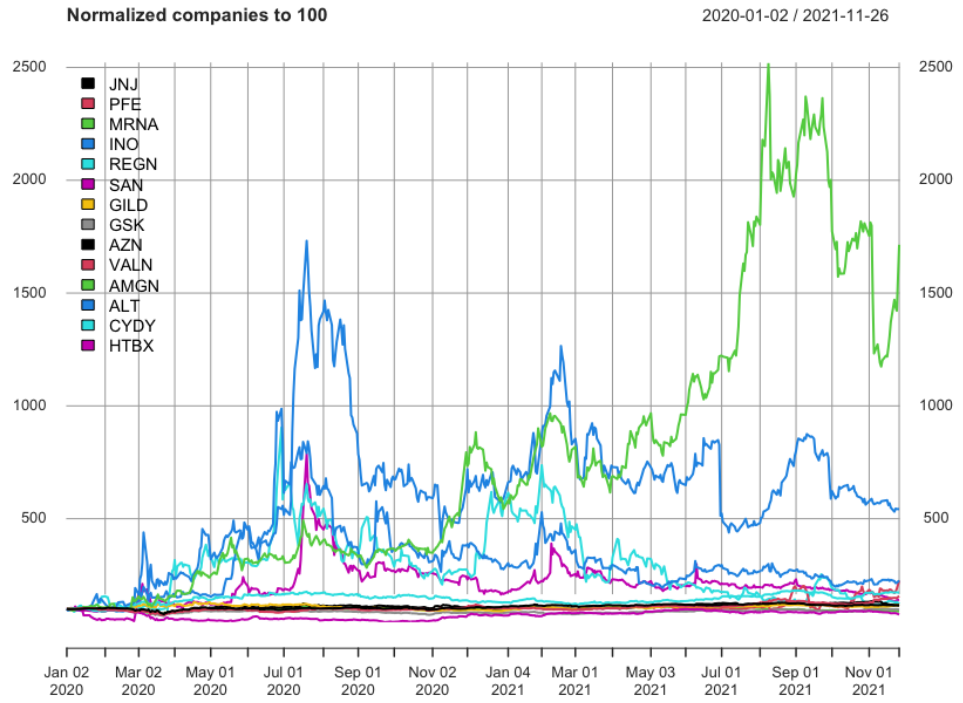

Fig. 2 Stock prices of selected companies, average of January 2020 = 100 *(Source: the authors)*



Fig. 3 Development of stock prices, January 2020 = 1 *(Source: the authors)*

The easiest way to compare performance of two stocks or portfolios is by arbitrary choosing dates for buying and selling this investment. This approach is

extremely sensitive to the choice of date – yield can vary. Table 1 describes stock prices in the month of March 2020. It is not uncommon to see differences of 30% - within one month.

Tab. 1 Statistics of stock prices in March 2020 *(Source: the authors)*

	PFE	MRNA	JNJ	AZN	GSPC
Min	25.25	21.30	106.2	36.49	2237
1st Qu	26.80	25.99	120.1	39.08	2454
Median	28.59	27.93	126.5	40.95	2606
Mean	28.57	27.15	125.2	41.58	2652
3rd Qu	30.2	29.28	130.5	43.88	2848
Max.	32.26	31.58	137.1	46.92	3130

Figure 4 shows the difference of the yearly returns based on date of stock purchase. The first black line shows an investor who would buy a PFE share at the beginning of the year 2020 and the second red line shows an investor who would buy the stock immediately after the march price fall. Both investors would keep their respective stock for the same amount of time however the second one would gain from the changes of price in late 2021, while the first investor would sell his share after a share price drop at the end of the year of 2020.

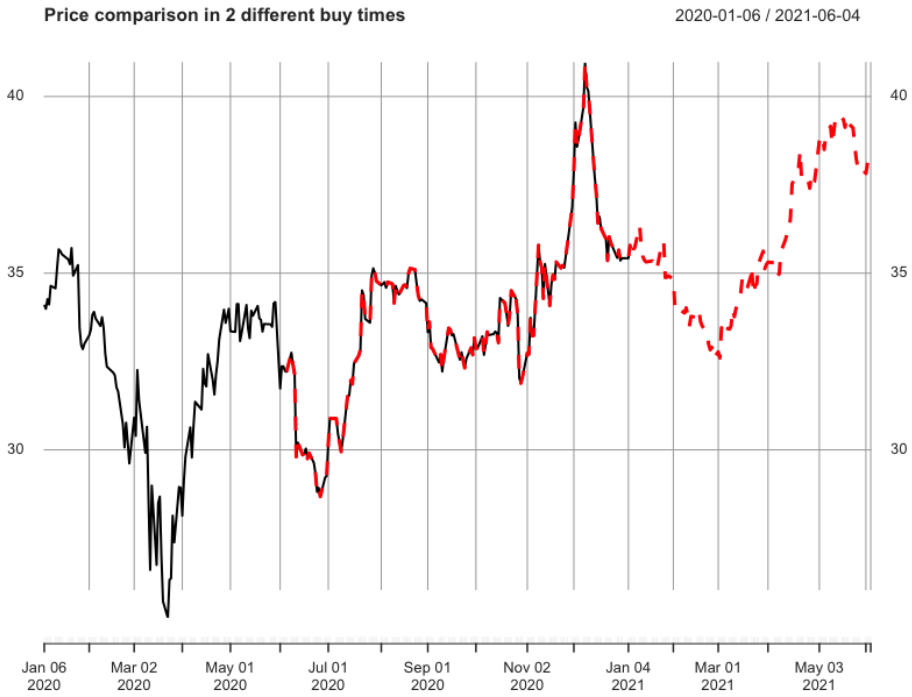

Fig. 4 Graph of yearly returns of PFE based on date of purchase *(Source: the authors)*

In March 2020, Covid was already known, and stock prices were decreasing (Lyócsa et al., 2020). An optimistic investor might expect pharmaceutical companies to increase in value. However, returns of his investments would vary based on exact date of purchase.

To overcome the volatility among dates, we calculate return in % p.a. for investment starting in every day of March 2020 and every day of November 2021.

Each dot in Fig. 5 shows yearly returns of investment of chosen companies. Start date is a day in March 2020, end date is in November 2021.

As we can see from Figure 5 and Tab. 2, the returns from investment for PFE are on average 44 %, AZN 27 %, J&J 18 %. S&P500 index performance was 46 %. Returns to an utterly useless company (at least from a vaccine development point of view) like Facebook were 63 %.

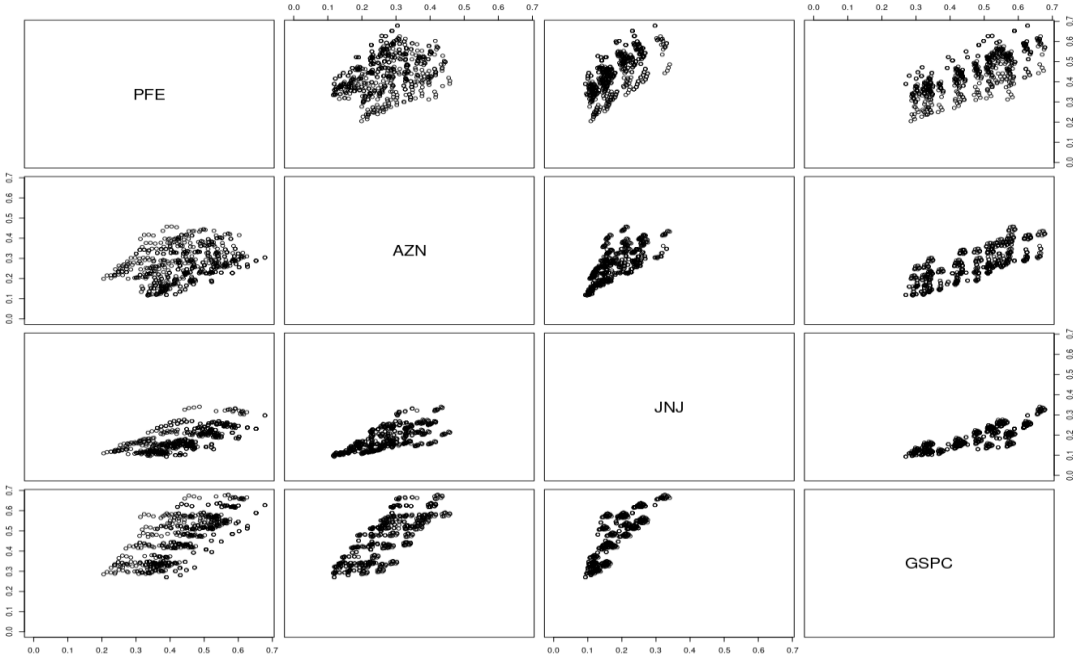

Fig. 5 Returns on investment between March 2020 and November 2021, in % p.a., each dot represents different purchase and selling dates *(Source: the authors)*

Figure 6 visualizes performance differences as well as fluctuations of various assets. As we can see, extremely lucky investor investing into PFE could achieve returns of 67 %, unlucky investor 20 %, averaging at 44.5 % (depending on the choice of dates). Investing into JNJ would yield between 9 % and 34 % with average of 18 %. However, investing into Facebook would give returns between 39 % and 82 % (average 63 %). So an extremely lucky investor into JNJ would be outperformed by anyone investing into the Facebook company, which was accussed of allegedly providing a platform to spread misinformation and hoaxes.

Tab. 2 Returns on investment between March 2020 and November 2021, in % p.a., each dot represents different purchase and selling dates *(Source: the authors)*

	PFE	AZN	JNJ	FB	SP500
Min	20.51	11.63	9.301	39.41	27.02
1st Q	37.46	21.66	13.485	52.62	34.66
Median	44.41	26.39	16.626	64.04	47.80
Mean	44.66	26.67	18.114	63.05	46.52
3rd Q	52.11	32.81	23.027	72.98	55.13
Max	67.81	45.82	34.016	82.73	67.79

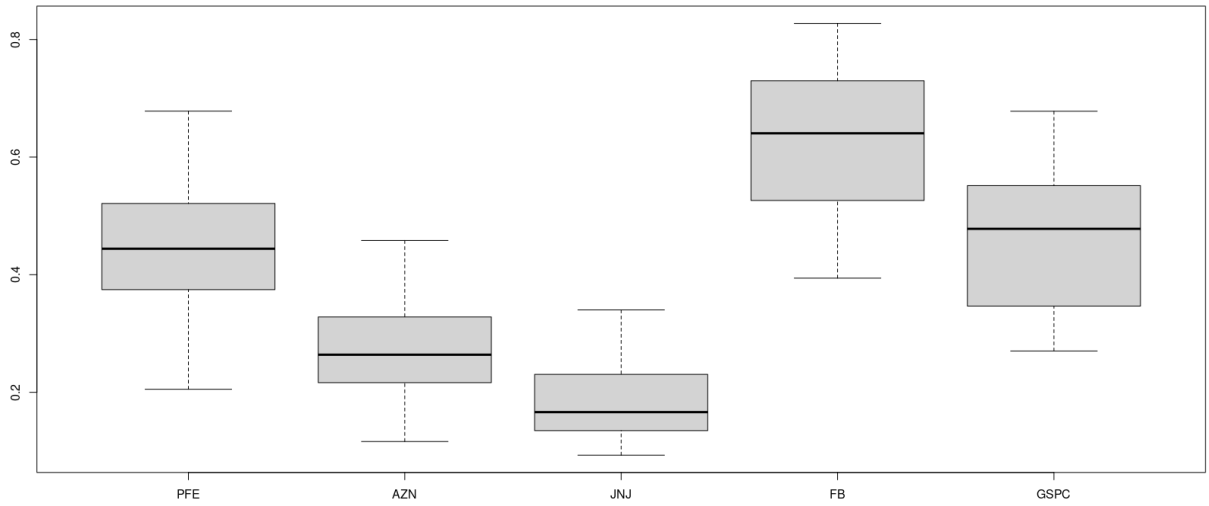

Fig. 6 Returns on investment between March 2020 and November 2021, in % p.a. *(Source: the authors)*

4 Conclusions

In this paper we compared development of stock prices of pharmaceutical companies. We accounted for stock market fluctuations by calculating returns to investment between all days in March 2020 and November 2021. These daily fluctuations in connection to stock market development in March 2020 could increase yearly returns twofold to fourfold. This averaging allowed us to calculate more robust results.

As we saw in chapter 3, pharmaceutical companies with vaccines did not outperform the general stock market. Even if an investor bought pharmaceutical stocks in the lowest prices (March 2020) and sold them in November 2021, investing to general S&P500 index would yield higher returns than Pfizer, 2 times higher p.a. returns than AstraZeneca or Johnson & Johnson. So pharmaceutical companies did not profit from Covid pandemic more than the general stock market.

5 References

Aktuality.sk (2021). *Koronavírus: Poisťovne dali na liečbu pacientov s COVID-19 takmer 60 miliónov eur*. Aktuality.sk. https://www.aktuality.sk/clanok/891228/koronavirus-poistovne-dali-na-liecbu-pacientov-s-covid-19-takmer-60-milionov-eur.

AstraZeneca (2021). *Contact information*. https://www.astrazeneca.com/investor-relations/annual-reports/annual-report-2016/contact-information.html.

AstraZeneca > GC Powerlist: Sweden Teams 2019 (n.d.). [cit. 2019, Nov 30] https:// www.legal500.com/gc-powerlist/sweden-teams-19/astrazeneca-3.

Darcy Jimenez (2021). *Covid-19: Vaccine pricing varies wildly by country and company*. https://www.pharmaceutical-technology.com/analysis/covid-19-vaccine-pricing-varies-country-company.

Exxon Mobil, Pfizer removed from Dow Jones Industrial Average; Salesforce, Honeywell added (2021). USA TODAY. https://www.usatoday.com/story/money/2020/08/25/exxon-pfizer-dow-jones-industrial-average-salesforce-djia/5630916002.

Fortune (2021). *Fortune 500*. Fortune. https://fortune.com/fortune500/2021.

Inštitút zamestnanosti. (2021). *Covid na Slovensku—Inštitút zamestnanosti*. https:// www.iz.sk/korona.

Jonhson & Johnson (n.d.). *Johnson & Johnson our story*. [cit. 2019, Nov 30] https:// ourstory.jnj.com/our-beginning.

Key facts — our company — AstraZeneca (2021). https://www.astrazeneca.com/investor-relations/key-facts.html.

Kollewe, J. (2020, Nov 16). Covid vaccine: Who is behind the Moderna breakthrough? *The Guardian*. https://www.theguardian.com/world/2020/nov/16/covid-vaccine-who-is-behind-the-moderna-breakthrough.

Koronavírus na Slovensku v číslach (2021). Koronavírus a Slovensko. https://korona.gov.sk/koronavirus-na-slovensku-v-cislach.

Lyócsa, Š. et al. (2020). Fear of the coronavirus and the stock markets. *Finance Research Letters*, *36*, 101735.

Moderna (2020). *Moderna. Form 10-K 2020.* https://www.sec.gov/ix?doc=/Archives/edgar/data/0001682852/000168285221000006/mrna-20201231.htm.

Peterson, B. G. et al. (2020). *PerformanceAnalytics: Econometric tools for performance and risk analysis*. R package 2.0.4. https://cran.r-project.org/package=PerformanceAnalytics.

Pfizer (n.d.). *Pfizer. Form 10-K 2020.* (Washington, D.C. 20549).

Pšenák, P., Pšenáková, I. (2018). Az R-rel szebb a statisztika. *InfoDidact 2018: 11*, 169–175.

R Core Team (2021). R: *A language and environment for statistical computing.* R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org.

Rilley Griffin (2021, Nov 12). Health-care giant J&J to split into drug and consumer compa-nies. *Bloomberg.Com*. https://www.bloomberg.com/news/articles/2021-11-12/johnson-johnson-to-split-into-two-companies-shares-rise.

Ryan, J. A. et al. (2017). *quantmod: Quantitative financial modelling framework*. R package 0.4-12 https://cran.r-project.org/package=quantmod.

S&P revises J&J's outlook to negative after $1.5B boost to legal reserve (2020). https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/ s-p-revises-j-j-s-outlook-to-negative-after-1-5b-boost-to-legal-reserve-60982518.

Yahoo Finance — stock market live, quotes, business & finance news (2021). https://finance.yahoo.com.