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The Effect of COVID-19 Pandemic on the Stock Market of Agri-food Companies in Poland

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Abstract:

Purpose: *The aim of this study was to compare the effect of shock related to the COVID pandemic on the rates of return from shares of agri-food companies in Poland.*
Project/Methodology/Approach: *In order to investigate the effect of the COVID pandemic on the capital market abnormal rates of return from shares were calculated as those rates of return, which may be considered the response of the market to the outbreak of the pandemic and its consequences.*
Results: *Results of this analysis indicate a considerable drop in share prices and rates of return from shares of the WIG companies and agri-food companies following the detection of the first coronavirus case. In the analysed period the rates of return from shares of agri-food companies were higher than those from the WIG companies.*
Practical implications: *This study indicates a research gap in this respect. The investigations have a huge effect on decisions of investors, enterprises from the agri-food sector and agribusiness. Results of this study will provide insight into the situation in the stock market during the pandemic, while they will also aid entities when making investment decisions and planning for the future.*
Originality/value: *The novelty of this paper is connected with the contribution to science, since it is the first empirical study concerning the effect of the COVID-19 pandemic on the stock market in the agri-food sector of Poland.*

Keywords: *Coronavirus, COVID-19, stock market, Pandemic, SARS-CoV-2, agri-food companies, Poland,*

JEL Classification: *F15, F31, G01, G02, G14.*

Paper Type: *Research study.*

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1. Introduction

The outbreak of the coronavirus (COVID-19) pandemic, which started in central China towards the end of December 2019 and has spread to almost all countries worldwide, caused over 33 million confirmed infection cases, as well as over 1 million deaths around the globe by 30 September 2020 (JHU&M, 2020). In Poland the first coronavirus case was detected on 4 March 2020 and on 30 September of that year the number of infections exceeded 91 thousand and over 2.5 thousand infected patients died. At present the pandemic has led not only to a global health crisis, but also to a global economic crisis, caused primarily by the imposed lockdowns. Although the current literature concerning the effect of the COVID-19 pandemic on the financial market is scarce, there are empirical studies indicating that the shock triggered by the pandemic enhances volatility, which may negatively affect the economic and financial systems in all countries (Jorda, Singh, and Taylor, 2020).

The huge increase in uncertainty and risk observed in the financial markets has a negative effect on earned rates of return and thus also the current market values of shares. Such a situation was also observed in Poland in the Warsaw Stock Exchange. Share prices of various companies are subjected to considerable fluctuations, while the volatility of their stock prices varies depending on the sector or branches of the economy. In previous studies no analyses were conducted on the effect of the present pandemic on shares of listed companies from the agri-food sector in Poland. It was decided in the aim of this study to determine the effect of shock caused by the coronavirus pandemic on rates of return from shares of Polish agri-food companies.

1.1 The Pandemic and Investor Behaviour on the Markets

The present-day world economy again faces a pandemic. This is the most disadvantageous shock experienced in peace time by the global economy for a century. In the globalised world the scale of the epidemic and disease is also global. These events have a dramatic effect on the economy causing a reduction of GDP, business closures, high unemployment rates, dropping incomes, poverty and high mortality rates. It also leads to disturbances in world trade, travel and tourism, stress in world financial markets as well as drastically decreasing raw material prices (WordBank, 2020). Soon after the declaration of the pandemic analyses were presented concerning the effect of the coronavirus on the economic and financial situation in individual countries and regions. Analysts used the experience collected in previous crises caused by such factors, indicating a certain pattern of their impact on the economy, including the stock exchange (Qing, Junyi, Sizhu, and Jishuang, 2020). The economic crises triggered by such events include the 1918 flu epidemic, commonly called the Spanish flu epidemic, the Ebola virus, HIV/AIDS, SARS and the current COVID-19 pandemic (Garrett, 2007; Garrett, 2008; Lee and McKibbin 2004, Grzeszak, Leśniewicz, Śliwowski, and Święcicki, 2020).

The COVID-19 pandemic lasting since December 2019 and causing pneumonia, by December 2020 covered the entire globe, with 63.7 million people diseased, 40.8 million recovered and 1.48 million dead (WHO, 2020). In 2020 the world economy practically came to a stall. Many countries imposed lockdowns as limitation on economic activity. In 188 countries schools were closed and over 3 billion people were covered by various restrictions (Hale, Angrist, Kira, Goldszmidt, Petherick, and Phillips, 2020). Air traffic was stopped, borders were closed, shops and restaurants were closed and mass events were cancelled. Grzeszak indicated the mechanism of the crisis caused by the COVID-19 pandemic dividing it into five phases (Grzeszak, Leśniewicz, Śliwowski, and Święcicki, 2020).

The first phase resulted from the severed supply chains. For many economies it was an external shock. The virus originating from China initially, due to the rapid spread of the disease and high morbidity, stopped production in China. This caused limited supply of goods in China and disruption of supply chains due to stopped production in trade partners worldwide. In turn, this led to a supply shock manifested in shortages of workers due to disease, quarantine and other restrictions imposed by governments, as well as shortages of resources for production as a result of broken supply chains. In the second phase of the crisis countries introduced *lockdowns*, which aggravated the supply shock and reduced demand.

In the third phase the entire economic activity was closed except for the vital services (e.g., pharmacies, grocery shops and chemist's, medical care). In that phase next to the supply shock also the demand shock was observed. The public mood was negative. The consumer confidence decreased with the potential for panic, a decrease in the confidence among entrepreneurs and panic among investors on the financial markets as well as investment outflows from the economy. In that phase consumption dropped due to restrictions and loss of confidence, a decrease in private investments due to the deteriorating financial situation of enterprises, as well as restrictions in the availability of credits. Some branches experienced a collapse, e.g. tourism, the catering and hotel industry, as well as transport.

The fourth phase consisted in a gradual loosening of restrictions while maintaining safety rules. An increase in demand was observed as a result of unfreezing the economies and growing supply. As indicated by the practice over the last months of 2020 -2021 in many countries, the economies were alternately frozen and unfrozen. The COVID-19 virus is mutating and new cases are being recorded. This phase has not come yet. The last phase will consist in the return to normal; however, it will be the new normal.

In all the phases of the economic crisis the financial system is exposed to the risk of instability. Considerable decreases in prices of financial assets are observed along with an increased aversion to risk, reduced availability of credits for small and medium-sized enterprises, problems with liquidity and an increase in bad credits (Grzeszak, Leśniewicz, Śliwowski, and Święcicki, 2020). This results in eroded trust in

partners on the market and increased uncertainty. Żądło indicated that "trust is founded on the evaluation of the partner's credibility" (Żądło, 2014). Thus relationships in business are characterised by mutual trust (Kacperska and Łukasiewicz, 2020).

Investors on the market have greatest trust in companies if the economy is stable (Mikuła and Pietruszka-Ortyl, 2006) indicated that a low level of trust is characterised by a lack of hope, lack of faith, lack of trust, passiveness and indecision. Grudzewski, Hejduk, Sankowska and Wańtuchowicz stated that a lack of trust produces the atmosphere of suspicion and destroys enthusiasm (Grudzewski, Hejduk, Sankowska, and Wańtuchowicz, 2009). As a result of a crisis on the market, both enterprises and employees lose trust and it is trust that regulates economic decisions. A lack of trust alters decisions, which as a result may sometimes be irrational. In situations of uncertainty a loss of trust is not connected solely with attitudes, but also with actions (Zieliński, 2019). The situation of crisis enforces decision making under pressure, in view of uncertainty (Rudzewicz, 2017). A significant role is played by information. "Decisions made by economic entities require information, which facilitate taking the optimal choices" (Żochowski, 2004). Information modifies predictions concerning conditions, which will be observed in the future. Most typically economic decisions made are rational.

Rationality in the economic terms is based on the execution of an optimal approach from the point of view of maximisation of the realisation of a given goal at the available, viable inputs or reaching a specific degree of a goal at minimisation of involved inputs (Rudnicki, 2000). The foundations for decisions made by entities are provided by "the willingness to make rational choices" (Buczek, 2005). In the case of uncertainty, obtained information may result in making irrational decisions.

According to the prospect theory proposed by Tversky and Kahneman people in their assessment of chances typically are not governed by logic and probability, but rather choose simple heuristics, i.e. select easy to use rules and simplifications (Tversky and Kahneman, 1974). Uncertainty is a phenomenon considered to be undesirable by economic entities, particularly in the financial market. On the one hand, it is possible to prevent losses e.g. by buying derivatives; however, it is impossible to obtain protection against the consequences of decisions made by consumers or producers.

Wrong decisions for an enterprise may result in freezing of capital, its loss or even bankruptcy. For consumers a wrong decision may cause a loss of capital, loss of purchased investment (e.g., property at a lack of financial resources), etc. (Żochowski, 2004). For this reason in economic transactions trust in individuals and institutions is essential. It is mainly psychological in character, with the secondary role of supporting information (Zieliński, 2012). Information is interpreted in view of its importance. Sometimes it is distorted, as a result of e.g. demand and supply shocks, technological shock, monetary disturbances, psychological processes and imperfections of the market or the introduction of innovations.

In order to adequately illustrate and explain the existing process the next part of the study presents the efficient market, behavioral finance and rational prediction theories as well as the black swan theory.

According to E. Fama (1965) *"an effective market is a market, which fully reflects all available information"*. Tepper and Urbaniak indicated that "markets are efficient when all publically available information is discounted in prices. Information costs nothing and is universally available, thanks to which all investors on its basis make investment decisions. Efficiency of the market leads to the existence of specific properties of prices and stock prices change at a result of the response of investors to new information" (Tepper and Urbaniak, 2020). Fama pointed to three forms of market efficiency, weak, medium, and strong (Fama, 1970).

A weakly efficient financial market assumes that current share prices fully reflect all past information influencing prices, while changes in share prices in the past have no effect on future prices. In such a market attaining outstanding returns on past share prices is impossible (Grossman and Stiglitz, 1980). In a medium efficient market it is assumed that share prices take into consideration all publically available information, both past and present. Strong efficiency of the market is observed when share prices consider all information, both public and private (confidential). The most important condition for market efficiency is connected with the investors having equal access to information. "In an efficient market competition between intelligent participants leads to a situation, in which at any moment current share prices reflect information related with events, which took place, as well as events, which will occur in the market in the future" (Fama, 1991). The hypothesis of market efficiency is based on a rational valuation of assets by investors striving to maximise profits (Malkiel, 2003).

In the 20th century researchers pointed to psychological aspects of investment. Investigations focused on psychological, social and anthropological problems of behaviour in the financial markets and on their participants.). The behavioural theories concentrate on individual behaviour of investors in the context of making investment decisions on the capital markets (Pera, 2013).

An investor should manage risk based on the behavioural finance theory. In view of risk investors should act so as to reduce it and optimally protect themselves against its consequences (Pera, 2013). This process is influenced among other things by the behaviour of the investors in terms of propensity to risk, anomalies in the financial markets, predictions of investors, adaptation and irrational behaviour of investors (Pera, 2013). A significant role is played by anomalies in the financial markets, i.e. situations, which make it possible for investors aware of these anomalies to attain an above-average rate of return on condition they apply an appropriate strategy. They undermine the efficient market theory.

Another theory describing investor behaviour on the market is connected with the theory of rational predictions. It indicates that economic entities make decisions based on all available information on current economic conditions and on potential consequences of these decisions. They are also capable of drawing conclusions from past events, which will make it possible to predict possible future scenarios.

Investor behaviour on the market is a consequence of various influences. One of the theories describing atypical behaviour on the market is the black swan theory developed by Taleb. That researcher showed how atypically people behave when they face unexpectable events of a huge impact on reality, potentially causing revolutionary consequences, such as e.g. terrorist attacks and epidemics. The reference to a black swan is connected with historical accounts that for ages people were convinced that there were only white swans. After Australia was discovered it turned out that there are also black swans (Taleb, 2007). A typical events cause shock, fear and panic among international investors and lead to a strong response to these events in the form of huge decreases in the value of financial instruments.

According to Ngwakwe, the appearance of the coronavirus in China overwhelmed the entire global community due to its unique character, connected with high mortality and this in turn was reflected in the world stock markets (Ngwakwe, 2020). The virus appeared suddenly, taking WHO experts by surprise, until finally they declared the global pandemic. The consequences of the pandemic caused also a response on the part of investors. Burch, Emery and Fuerst analysed the price response of shares and other stocks to the 9/11 terrorist attacks of 2001 (Burch, Emery, and Fuerst, 2016). The response to this event led to rapid drops in prices of financial instruments. In turn, already after two weeks the negative trend was reversed when it turned out that the danger had passed and the investors' mood was gradually improving. Other authors analysed the effect of terrorist attacks on international stock markets (Chen and Siems, 2004). They confirmed that terrorist attacks as unexpected events seriously influence normal life, cause panic and dropping prices of financial instruments. Outbreaks of epidemics and pandemics typically have similar consequences.

However, analyses focusing on stock market indexes of eight countries severely affected by the SARS epidemic showed that except for China and Vietnam that epidemic had no negative effect on stock markets in the countries suffering from that epidemic (Nippani and Kenneth, 2004). In turn, results of studies by Chen, Jang and Kim on the effect of the SARS outbreak on quotations of hotels on stock exchanges of continental China and Taiwan confirmed the definitely negative effect of the epidemic on that market (Chen, Jang. and Kim, 2007).

According to Izzeldin *et al.* (2021) a series of tests confirmed that the response of the financial markets to COVID-19 has been comparable to that observed during the previous financial crisis rather than to the previous pandemics (Izzeldin, Muradoğlu, Pappas, and Sivaprasad, 2021).

2. Research Objectives, Methodology and Data

The source of data for analyses of the capital market was provided by the database of the Warsaw Stock Exchange. In order to investigate the effect of shock in the capital market caused by the coronavirus, abnormal rates of return were calculated for shares of 22 companies from the agri-food sector, i.e., it was these rates of return, which may be treated as a response of the market to the incurred shock. Among the analysed companies twelve were operating in food production, while five came from the agricultural production and fisheries, and another five from the beverage production.

Apart from Polish companies six were Ukrainian companies, while one each came from France and Lithuania. Calculations were performed using also two stock exchange indexes of the Warsaw Stock Exchange, i.e. WIG and WIG for the food sector [WIG-SPOŻY]. The WIG index covers all companies listed at the Warsaw Stock Exchange, which meet the base criteria for index listing, whereas the WIG-SPOŻY is a sector index for companies included in the WIG index and simultaneously classified to the "food products" sector.
In order to realize the study aim the following actions were undertaken:

- the scope of research was defined,
- normal, i.e. expected rates of return from shares were calculated,
- abnormal rates of return from shares were calculated,
- abnormal cumulative rates of return from shares were calculated.

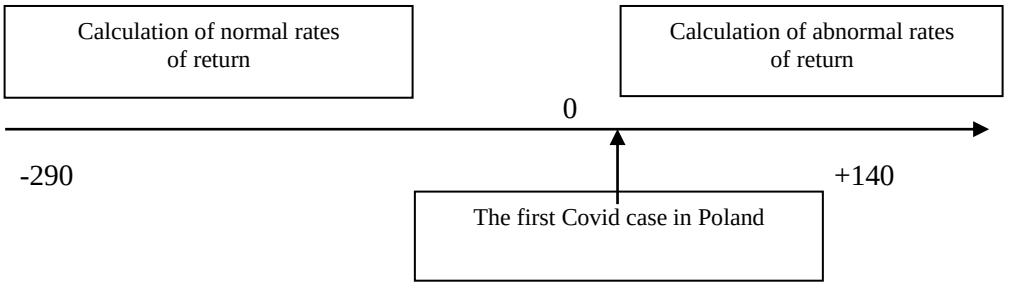
The date when the first coronavirus infection was detected in Poland was defined as the day zero. Share prices on the market capital respond to new unexpected events, including such as the information on the confirmation of the first and later successive coronavirus cases. In this analysis it was decided to investigate the period of 140 days from the day of the first COVID-19 case in Poland, for which changes were determined in cumulative abnormal rates of return from shares of agri-food companies.

The adopted 140-day period comprises both the immediate response of the capital market to the supply and demand shock caused by the coronavirus epidemic and the response of this market to the spread of COVID-19 in Poland.

In order to calculate normal rates of return the period of 290 days was adopted. This period was also the basis for the calculation of the mean rate of return in the applied mean adjusted model for shares of each of the analysed companies. Normal rates of return reflect rates of return expected by investors in the absence of unusual events, such as e.g. supply and demand shocks.

In this study the mean adjusted model was applied to calculate normal rates of return using the nomenclature and methodology proposed by Neumann (1994), Lewandowski (2001), Szyszka (2002), Ebneth and Theuvsen (2005).

Figure 1. *Time periods adopted for the calculation of normal and abnormal rates of return [in days].*



Source: *The authors' study.*

In this method actual logarithmic rates of return for individual shares are calculated first, here it is for the period of 290 days preceding the date of the first confirmed coronavirus case in Poland.

$$R_{jt} = \ln(\frac{P_t}{P_{t-1}}) \tag{1}$$

where Pt is the price of a share at day t, while Pt-1 price of this share on the preceding day.

Next logarithmic means were calculated for rates of return for individual shares for the period preceding day zero.

$$\hat{R_j} = \frac{1}{290} * \sum_{t=-290}^{t=0} R_{jt} \tag{2}$$

$\hat{R_j}$ - mean logarithmic rate of return for the j-th share in the period of 290 days preceding day zero (confirmation of the first coronavirus case in Poland).

In the third step the abnormal rates of return were calculated both for each type of shares and for each day. They were calculated as the difference between the rate of return actually recorded on a given day and the normal rate of return.

$$r_{jt} = R_{jt} - \hat{R}_j \tag{3}$$

where: r_{jt} - abnormal rate of return from share j at time t,

The rate of return for all cases was calculated using the arithmetic mean.

$$\bar{r}_t = \frac{\sum_{j=1}^{N} r_{jt}}{N} \quad (4)$$

$\bar{r}_t$ - mean of abnormal rates of return from shares at time t,

N – number of analysed companies

Cumulative abnormal rates of return for the period from t=0 to t= +140 reflect the effect of changes in rates of return from shares of all investigated enterprises caused by the supply and demand shock in Poland and they are calculated as the sum, presented in the previous equations, of values of abnormal rates of return from the beginning to the end of the analysed period.

$$r_{t,skumul.} = \sum_{t=0}^{140} \bar{r}_t \quad (5)$$

$r_{t,skumul.}$ - cumulative abnormal rate of return from shares in the cumulation period.

3. Results and Discussion

Analyses concerning the effect of the pandemic on capital markets were conducted for various epidemics or pandemics. They showed a negative response of the stock market to the announcement of the spread of the epidemics.

Following the outbreak of the coronavirus pandemic analyses were presented showing its effect on the stock market in China and next in other countries. Analysis of share prices on the Chinese stock market in response to COVID-19 brought similar results as those reported in such investigations for the Ebola virus epidemic. Yan (2020) when analysing the response of the stock market to COVID-19 in China in the period from 20 January to 7 April 2020 stated that the virus has a negative effect on rates of return from shares; however, larger enterprises are more resistant to the shock, because they have greater resources, have monopolistic power and incur lesser losses due to the disruption of the supply chain. Similar results were also obtained by Harjoto, Rossi, and Paglia (2020), who in their study analysed the effect of the coronavirus pandemic on the stock market in more developed countries and on the emerging markets, while additionally they evaluated the response of the market to the information by FED announced on 9 April 2020 on the allocation of a support package for the American economy amounting to 2.3 trillion USD.

Those economists showed that small firms experienced greater negative shocks caused by the COVID-19 pandemic compared to large enterprises. Moreover, those researchers stated that the American stock market, thanks to the FED policy stimulating the economy, recorded higher abnormal rates of return in comparison to

other more economically developed countries and the emerging markets. However, it turned out that abnormal profits stemming from the strong stimulus provided by the FED were attained by large American companies rather than small ones, which indicates that such a radical monetary policy is nevertheless far from an ideal antidote, particularly from small firms. Analyses conducted by those authors also confirmed the results of research reported by other economists, indicating that the COVID-19 pandemic caused negative shocks on the stock markets worldwide. However, it was stated that the adverse effect of the COVID-19 pandemic on stock markets is greater in the emerging economies than in more economically developed countries (Harjoto, Rossi, and Paglia, 2020) .

Further analyses also indicated that the ties of companies from various countries with the Chinese market resulted in greater decreases in prices of their shares. When analysing the effect of the coronavirus pandemic on share prices of American companies in three different subperiods from January to 20 March 2020 (Ramelli and Wagner, 2020) stated that US firms with closer ties to China recorded greater negative abnormal rates of return in the analysed period. Moreover, they reported that at the pandemic the increasing indebtedness of enterprises and a reduction of their liquidity raise serious concerns.

The dependence between changes in the Chinese stock market and the stock markets in other countries was confirmed by the investigations conducted by Qing, Junyi, Sizhu and Jishuang (2020). Those authors performed an empirical analysis of daily rates of return from shares in the People's Republic of China, Italy, South Korea, France, Spain, Germany, Japan and the USA. They also analysed the effect of changes in the Chinese stock market on stock markets of the other investigated countries as well as the effect of changes in the markets of these countries on the Chinese stock market in the period of the pandemic. Results of their study indicate that the COVID-19 pandemic has a negative, but short-term effect on stock markets of the analysed countries, whereas a interdependence is observed between changes in the Chinese market and changes in the stock markets of the other investigated countries.

When investigating the effect of the COVID-19 pandemic on the stock market a question may also be asked to what extent fluctuations in share prices were caused by real changes in the economy, and to what extent it was a response to information on the pandemic provided by various sources. Interesting results of research on the subject were presented by Alfaro, Chari, Greenland, and Schott (2020). They analysed changes in the stock market w USA being a reaction to information on the current situation of the coronavirus pandemic. Those authors stated that a doubled number of infections in relation to their forecasted level on the following day results in a decrease in the value of the American stock market by 4 up to 11 percent, whereas the reduction of the actual number of new infections by half in relation to the forecasts caused a similar increase in the value of the entire market on the following day.

This indicates that the value of the stock market is increasing even at the growing numbers of infections when the disease seems less harmful than previously thought, which confirmed that opinion that information on the pandemic to a considerable extent influence the rates of return from shares. Research results presented by those authors also indicated that the reductions in value ate greater in the branches of the economy considered to be contributing to the spread of disease, such as the hospitality and entertainment industries or transport. In turn, education and financial services are less sensitive to the risk, mainly thanks to their better adaptability to continue their operations on-line.

Following the outbreak of the coronavirus pandemic studies were also presented on its effect on individual sectors of the economy, including the agri-food sector. Kerr (2020) pointed to the fact that the COVID-19 pandemic has a considerable effect on economic activity, generating imbalance between economies of individual countries. Tensions appeared also in international supply chains in the agri-food sector, initially resulting from panic buying and later – from the enforced changes in food consumption patterns consisting in the considerable shift from eating out, further reinforced by the decline in income levels. The COVID-19 crisis also highlighted the dependence of food security on foreign supply. That author forecasts that the response to the pandemic will consist in the stronger calls for greater self-reliance of individual countries, to increased use of protectionist tools and lesser involvement in international cooperation.

Hobbs (2020) in his study also referred to the effect of the COVID-19 pandemic on food supply chains, which had to adapt quickly to demand shocks, including panic buying and changes in food purchase patterns, as well as disturbances in supply caused by shortages of workforce as well as problems in transport and supply networks. That paper presented actions which need to be undertaken in order to maintain and strengthen resistance of supply chains in Canada and other countries in the current crisis.

The authors of this paper analysed the agri-food sector in Poland in an attempt to determine the response of rates of return from shares of companies in this sector to the outbreak of the COVID-19 pandemic. When investigating the agri-food sector it may be observed how many factors during the coronavirus pandemic have had an impact on the functioning of this sector. In response to the COVID-19 pandemic governments of the EU countries have undertaken several measures, including restoration of border controls and establishment of limitations on the free movement of people in their territories to reduce the spread of the disease. Imposed restrictions have contributed to such problems as clogged transport routes, long queues to border control checkpoints in the transport of goods as well as shortages of seasonal workers in agriculture. This has had a marked effect on supply chains of agri-food products, at the same time influencing the agricultural production, food processing, transport and logistics as well as final demand.

Restrictions imposed due to the coronavirus pandemic have generated considerable disturbances om trade and transport thus having a negative effect on Polish trade in agri-food products. However, data for the first eight months of 2020 indicate that the value of export of Polish agri-food goods in that period increased by 6 percent year to year to reach 21.9 billion euro. It results from data of the National Support Centre for Agriculture (NSCA, 2020) that the growth dynamics in exports exceeded the growth rate of imports. As a result the positive trade balance increased by 10.1 percent year to year and amounted to 7.4 billion euro. It also seems that the coronavirus pandemic will not contribute to the collapse of domestic demand for agri-food products.

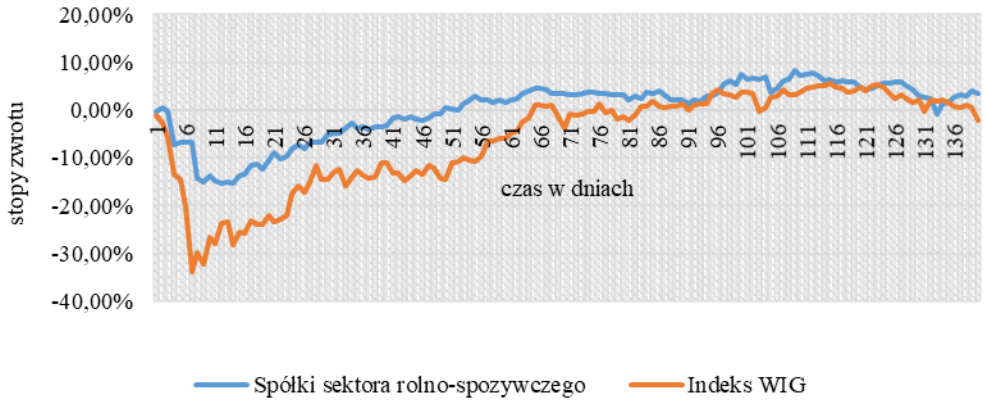
In the first weeks of the imposed social distancing measures in the beginning of March and April 2020 retailers recorded a rapid increase in food turnover, particularly goods with extended shelf life. Despite logistic challenges farmers, transport service providers and retailers were generally able to ensure good stocking of products in shops. Changes are also expected to continue in the purchasing habits of consumers. In view of changes taking place in the agri-food sector the authors made an attempt to assess the effect of the pandemic on changes in rates of return from shares of companies in that sector. This analysis was conducted in relation to all agri-food companies, comparing them to the index of all listed companies.

Moreover, agri-food companies were analysed by branches, while the response to the pandemic was also investigated for Polish companies and foreign companies listed in the Warsaw Stock Exchange. When comparing the economic results of the agri-food sector in response to the pandemic and the cumulative rates of return from shares in that sector it may be stated that share prices were to a greater degree influenced by the information on the outbreak and course of the pandemic rather than the actual supply and demand shocks. These results are consistent with the conclusion of Alfaro, Chari, Greenland and Schott (2020). Those researchers indicated that information on the detection of the first case and the spread of the pandemic in Poland contributed to a considerable decrease in share prices, and thus the rates of return from shares of various companies, also those from the agri-food sector.

The greatest decrease in abnormal cumulative rates of return calculated from the WIG index was recorded on the 7th day after the confirmation of the first coronavirus case in Poland and it amounted to almost -33.8 %. Shareholders in agri-food companies suffered slightly lesser losses. The greatest decrease in abnormal cumulative rates of return was observed 14 days after the virus detection in Poland and it amounted to -15.26 %. In the following days abnormal cumulative rates of return increased both in the case of agri-food companies and the entire WIG index. For agri-food companies this increase lasted up to 109 days from day zero and on that day it was 8.33 %, while for the WIG index day 123 after the detection of the first coronavirus case was the best for shareholders, since abnormal cumulative rates of return from shares on that day were 5.24 %.

In the successive days a decrease in cumulative rates of return was again observed due to the coronavirus pandemic and it was both for companies from various sectors and within the agri-food sector.

Figure 2. *Mean cumulative abnormal rates of return from shares of analysed companies purchased in the period from day 0 (confirmed first COVID-19 case in Poland) to day 140.*



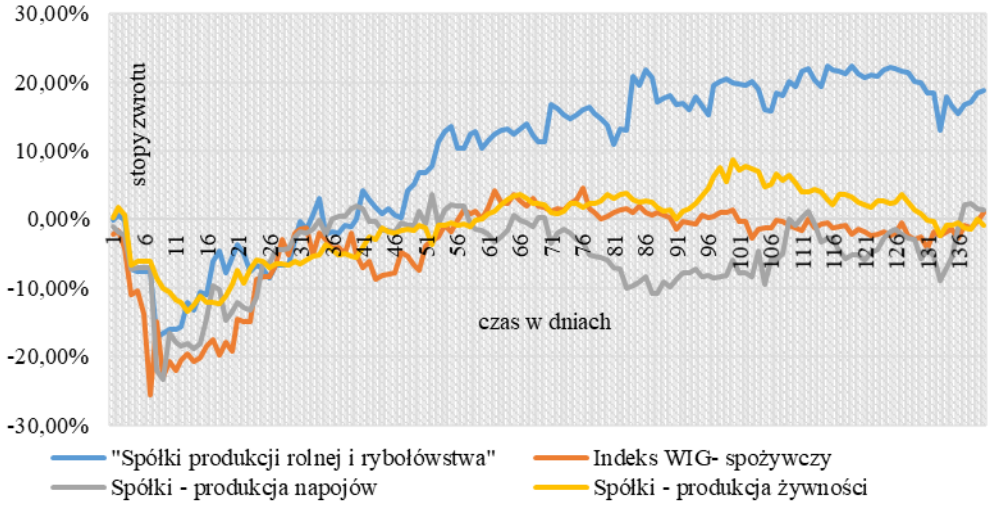
Source: *the authors' calculations based on data obtained from the Warsaw Stock Exchange.*

When analysing companies from various branches in the agri-food sector it may be stated that the greatest decrease in abnormal cumulative rates of return was recorded for companies producing beverages and shareholders of these companies on the day of the detection of the pandemic in Poland or shortly before its declaration would profit from selling them within the period of around a dozen days counting from day 37 from the declaration of the pandemic.

In the rest of the period cumulative abnormal rates of return from shares of these companies were negative. A different situation was observed for abnormal cumulative rates of return for companies involved in agricultural production and fisheries. A reduction in their rates of return caused by the supply and demand shock was the smallest and already starting from day 40 from the detection of the first coronavirus case until the end of the analysed period their abnormal cumulative rates of return were positive and sometimes even exceeded 20%.

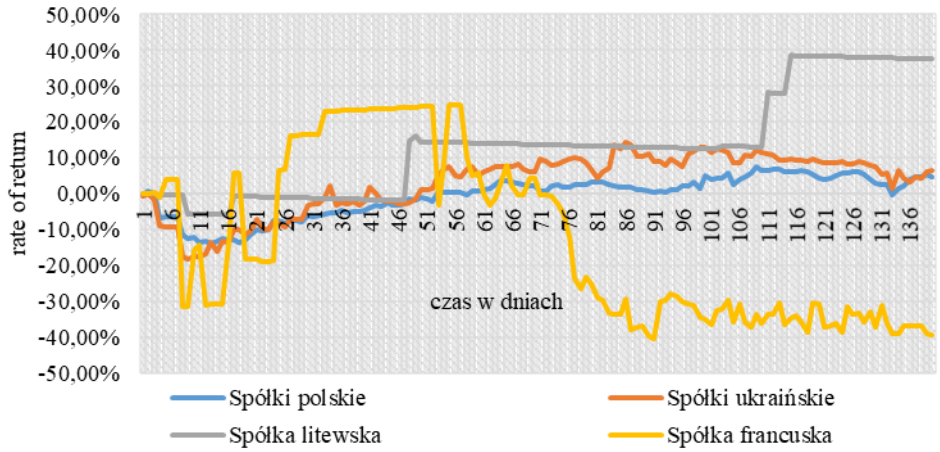
It also needs to be stressed that agri-food companies from Ukraine at the beginning lost more as a result of the coronavirus pandemic than it was for Polish companies; however, already starting from day 16 from the detection of the first case until the end of the analysed period their abnormal rates of return were higher than those of Polish companies.

Figure 3. *Mean cumulative abnormal rates of return from shares of analysed companies purchased in the period from day 0 (confirmed first COVID-19 case in Poland) to day 140 – by branches.*



Source: *The authors' calculations based on data obtained from the Warsaw Stock Exchange.*

Figure 4. *Mean cumulative abnormal rates of return from shares of analysed companies purchased in the period from day 0 (confirmed first COVID-19 case in Poland) to day 140 – companies by country of origin.*



Source: *The authors' calculations based on data obtained from the Warsaw Stock Exchange.*

4. Conclusion

The current COVID-19 pandemic, although still in progress, is already termed as damaging at an unprecedented scale, and its consequences as well as potential effects

of other known diseases may not be reliably predicted. Certain consequences for the economy or the financial markets brought by unexpected global events such as e.g., pandemics may be determined using the black swan theory as referred to economics, the behavioural theory or the capital market efficiency theory. Unexpected events caused supply and demand shocks and this in turn has led to a global crisis. However, as indicated by this analysis collapses in the capital markets were caused to a greater extent by behaviour and fears of investors and their irrational decisions rather than real changes in the economy.

Results of this analysis indicate a considerable decrease in share prices and rates of return from shares of the WIG listed companies and agri-food companies after the detection of the first coronavirus case. With the outbreak of the COVID-19 pandemic most investors acted in accordance with the behavioural finance theory. Investors followed their emotions, instincts and personal convictions. In their actions, decisions and financial behaviour they were not always rational and their perceptions and mood had a huge impact on the stock exchange.

Moreover, the efficient market hypothesis was also confirmed. The pandemic caused numerous fluctuations and declines in the markets, as evidenced by share prices. All information concerning the pandemic, e.g. the number of deaths, the number of new cases and other market factors were reflected in share prices. Thus each investor purchasing shares is aware that the price of any share available on the market is clearly reflected in the current market conditions.

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