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RESEARCH ARTICLE

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The impact of the Russia–Ukraine war on stock prices, profits and perceptions in the food supply chain

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Abstract

The Russian invasion of Ukraine in February 2022 had profound consequences for the global economy. As both countries are major commodity exporters, the food value chain was also affected. This study investigates the impact of the invasion on stock prices, profitability and sentiments of agribusinesses along the food supply chain by using an event study, financial data, and a sentiment analysis of annual reports. Overall, the findings show that firms in the food value chain were negatively impacted, with regional and sector-specific differences. Agribusiness firms in Europe and Japan were more negatively impacted by the war than those in the United States. Stock prices of Brewers, Packaged Food and Meats, Soft drinks, and Tobacco firms were negatively impacted by the invasion, while other sectors experienced no or little impact on stock prices. Fertilizers and Agrochemicals firms overall achieved a higher profitability in 2022 compared to previous years. [EconLit Citations: G01, G12, E44, Q01].

KEYWORDS

agribusiness, asset prices, financial performance, food value chain, geopolitical conflict, reporting, stock market volatility

Abbreviations: AAR, average abnormal returns; AR, abnormal returns; CAAR, cumulative average abnormal returns; IFRS, International Financial Reporting Standards; ROA, return on assets.

1 | INTRODUCTION

While the world economy was still struggling to recover from the COVID-19 pandemic, Russia invaded Ukraine on February 24, 2022. International organizations, western countries, and several private companies imposed trade and financial transaction restrictions on the Russian economy in response. The United States, the European Union and Japan have led the way in enforcing economic sanctions, particularly the blockage of Russia's exports. These countries also made the decision to obstruct Russia's access to financial markets (Gaur et al., 2023). The markets for several commodities were disrupted given that both Russia and Ukraine are key exporters of commodities, such as oil, wheat, and fertilizer (Liadze et al., 2023). These disruptions translated into higher prices of semi-finished products and raw materials, higher energy prices, and supply chain disruptions. Furthermore, both countries are large consumer markets for food products (Jagtap et al., 2022).

The Russia–Ukraine war influenced equity markets globally, primarily due to the heightened uncertainty it introduced among investors regarding the future profitability of firms, subsequently leading to fluctuations in stock prices. In accordance with the efficient market hypothesis (Fama, 1970), stock prices are the direct outcome of changing expectations about future returns and risks. The food sector has unique characteristics that make it vulnerable to supply and demand shocks, as shown by the impact of COVID-19 or animal disease outbreaks on stock prices (Höhler & Oude Lansink, 2021; Pendell & Cho, 2013). The COVID-19 pandemic, for example, disrupted both food supply and demand, affecting food quantity, quality and cost, and posing a risk to household food security (Höhler & Oude Lansink, 2021). At the same time, the reaction of agribusiness stock prices on a war outbreak is still poorly understood (Clark et al., 2012). Understanding the impact of such shocks on agrifood companies is particularly important for investors, portfolio managers, and regulatory authorities (Yousaf et al., 2022).

Yousaf et al. (2022) analyzed the impact of the conflict between Russia and Ukraine on the G20 and other selected stock markets using an event study approach. Their analysis of the abnormal returns (AR) before and after the launch of the 'special military operation' by Russian military forces on February 24, 2022 shows a strong negative effect on most stock markets, particularly on those in Europe. Ahmed et al. (2023) report industry-specific reactions within the European market and demonstrate that the consumer staples industry faced the highest negative abnormal returns on the event day. Some papers examined stock price reactions in specific industries. For example, Mohammed et al. (2022) reported positive abnormal returns for renewable energy markets and negative abnormal returns in traditional energy markets in the United States. Likewise, Umar et al. (2022) found positive abnormal returns for clean energy, but almost no abnormal returns in conventional energies across the United States and Europe. Yudaruddin et al. (2023) investigated the market reaction of the consumer staples sector using a global sample of 2376 companies. Almost all industries within the consumer staples sector were negatively affected, with stock prices of beverage producers being the most severely impacted.[1]

While prior research has examined the effects of the Russia–Ukraine on the global stock market, and specific industries, such as the energy or consumer staples industry, there exists a noticeable gap in the literature concerning the impact on companies along the food supply chain. It is unclear how stock-listed companies within the industry, specifically in the United States, Europe, and Japan, were impacted by the war in Ukraine. This paper offers empirical evidence on the effects of the Russia–Ukraine war on stock-listed agribusiness firms by pursuing a threefold approach: An event study is used to investigate stock price reactions. Next, an investigation of profitability and solvency ratios shows the reaction at company level. Finally, an analysis of sentiment in the annual reports shows whether and how companies communicate the impact of the war. By combining the three analyses, the study offers a holistic assessment of war-induced impacts on firms, and enriches the literature with sector-specific insights. The findings of this research can be used by investors for portfolio rebalancing decisions. They can

[1]A number of further studies examine specific industries, such as Hasan et al. (2024) and Martins et al. (2023).

help agribusiness firms in developing effective hedging strategies, and support regulators in designing measures to mitigate the negative effects of shocks.

The remainder of this paper is structured as follows. Section 2 outlines the research design and methods, detailing the methodology of an event study and the data collected for the study. Section 3 presents the results, including the cumulative average abnormal returns (CAAR), the profitability and solvency of the companies per sector, and the sentiment analysis. This is followed by the discussion of the results, policy and business implications and the main limitations, and finally the conclusions.

2 | RESEARCH DESIGN AND METHODS

2.1 | Methodology

Event studies are widely used to assess the impact of an event of interest on the value of firms (MacKinlay, 1997). To allow for the possibility of anticipation and adjustment effects, such as news leakages before the event or delayed market reactions, the event window, which is the period over which the event is studied, also includes the days before and after the event. The event of interest in this paper was the launch of the 'special military operation' by Russian military forces on February 24, 2022. The event window consisted of 7 days, from $t-3$ to $t+3$ days, that is, from February 21, 2022 to February 28, 2022. A shorter event window might miss delayed effects while a longer window could dilute the impact of the event.

The impact of an event is estimated by calculating the abnormal return (AR), which is the difference between a security's actual return $R_{i,t}$ during the event window and its normal return. The market model assumes that the normal return of a security i on day t can be expressed as a linear function of the return of a reference market $R_{m,t}$:

$$AR_{i,t} = R_{i,t} - (\alpha_i + \beta_i R_{m,t}). \tag{1}$$

Normal returns are estimated based on the returns during an estimation window before the event. Following the suggestion of MacKinlay (1997), the estimation window in this paper covered 120 days before the event window, from $t-125$ to $t-6$ days, that is, from October 22, 2021 to February 18, 2022. To account for common risk factors and reduce estimation errors from ignoring these risks (Fama & French, 1993), the market model can be extended to a multi-factor model.

If the event study focusses on multi-day periods, ARs can be aggregated into cumulative abnormal returns (CARs) by summing ARs over the event window t_1 to t_2, as shown in the equation below:

$$CAR(t_1, t_2) = \sum_{t=t_1}^{t_2} AAR_t. \tag{2}$$

For a cross-sectional event study with a focus on the impact of the event on a group of N firms, ARs can be aggregated into cross-sectional average abnormal returns (AAR) on day t (Kothari & Warner, 2007):

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{i,t}. \tag{3}$$

For addressing both, multiple-day periods and cross-sectional data, the literature suggests the portfolio approach (Kothari & Warner, 2007). The approach is built on an equally weighted portfolio that groups all securities before computing the abnormal returns, and considers the portfolio as a single security (Pacicco et al., 2018). This paper used the portfolio approach and reports cumulative abnormal returns on the portfolio level. As a

consequence of the increased uncertainty caused by the invasion and following the efficient market hypothesis (Fama, 1970), we expect the war in Ukraine to have a negative impact on abnormal returns.

To complement the event study and provide additional evidence on the firm level, this paper investigated differences in financial ratios of the companies. Financial ratios provide insights into companies' financial health and performance and serve investors as a guideline for their investment decisions (Fama & French, 2015; Hull, 1999). The profitability was indicated by the return on assets (ROA), that is, the ratio of net income and total assets. The solvency was assessed as the value of equity over value of total assets. We expect that the war has created a challenging environment for agri-food businesses which led to a deterioration of both, profitability and solvency. A two-sided *t* test was used to test for statistically significant differences between the financial data in the year of the war's outbreak (2022) and previous years (2018–2021).

Besides the quantitative analyses, this paper assessed the impact of the war on the selected companies through a sentiment analysis of their annual reports. Accounting standards, such as the International Financial Reporting Standards (IFRS), require companies to assess the impact of the war and disclose financial impacts in their financial reports (Ernst & Young, 2022). The analysis involved three steps: First, localizing relevant terms and sentences in the whole document, using the search function, second, determining the emotional tone of these sentences, and third, counting the frequencies of the sentiments in the annual reports. The focus was placed on three relevant terms: 'Ukraine,' 'Russia' and 'War.' These terms were chosen for the frequency with which they are used in the context of the war in Ukraine. The sentiment analysis focussed on negative, neutral and positive emotions in sentences containing these terms. The analysis was conducted by one of the authors without relying on any software tools. For example, one report stated that "*Russia's invasion of Ukraine, which began in February 2022, had a negative effect on our fiscal 2022 operating results.*" This statement was coded as negative. Another report states that "*Although our business has not been materially impacted to date by the ongoing invasion of Ukraine by Russia, it is impossible to predict the extent to which our operations, or those of our suppliers and customers, will be impacted in the short and long term, or the ways in which the conflict may impact our business.*" This statement was coded as neutral. We expect the supply chain disruptions and increased uncertainty will lead to more companies reporting negative sentiments.

2.2 | Data

Data were collected from stock listed agribusiness firms in the United States, Japan and Europe. The selection was based on the study performed by Höhler and Oude Lansink (2021) and considered multiple criteria, including market capitalization, coverage of different regions and listing in national indices, with a specific focus on agribusiness firms. Next to the S&P 500, the sample covers the British FTSE, the German DAX, the French CAC, the Belgian BEL, the Dutch AEX, the Swiss SMI, and the Japanese Nikkei index. The indices account for a large share of the market capitalization in the respective markets. The industry classification was based on the S&P 500 as the largest index in the sample, companies in other indices were recoded accordingly. The data consists of three parts.

First, daily stock prices over the period October 2021 to February 2022 were retrieved from Yahoo! Finance and daily returns were calculated using the *quantmod* package in R (Ryan et al., 2015). The stock prices were collected over the period 2021–2022. Two companies were removed from the dataset due to missing observations. In contrast to Höhler and Oude Lansink (2021), we only included Unilever stocks listed in the UK. The final dataset included 68 companies from 11 sectors in the food supply chain, distributed among the three regions as shown in Table 1 (for more details, see Appendix 1). Most of the companies are located in the United States (30), 20 on the European continent, and 19 in Japan. The data for estimating the

TABLE 1 Distribution of companies in the dataset by sector and region.

Sector	*n*	United States	Japan	Europe
Packaged foods and meats	22	12	6	4
Food retail	11	1	4	6
Brewers	7	1	4	2
Fertilizers and agricultural chemical	7	4	1	2
Tobacco	4	2	-	2
Soft drinks	4	3	1	-
Distillers and vintners	4	2	-	2
Food distributors	3	1	2	-
Agricultural and farm machinery	2	1	1	-
Hypermarkets and super centers	2	2	-	-
Agricultural products	2	1	1	-
Total	68	30	20	18

TABLE 2 Descriptive statistics.

	Mean	Standard deviation	Min	Max
Daily returns (%) Estimation window	0.07	1.59	−14.44	12.62
Daily returns (%) Event window	−0.19	2.44	−10.86	9.22
Profitability (%) 2018–2022 ($n = 66$)	5.60	6.07	−9.46	40.19
Solvency (%) 2018-2022 ($n = 66$)	36.84	17.59	−31.3	84.71

multi-factor model including the three Fama-French factors were retrieved from the French data base (French, 2023). The event study was conducted in STATA, using the *estudy* command (Pacicco et al., 2018).

Second, data on profitability and solvency from 66 of the 68 companies were collected from ORBIS (Bureau van Dijk, 2023). Both ratios are based on accounting data. Third, annual reports were retrieved from the companies' websites and they were screened for the extent to which they mentioned the war in Ukraine as a source of concern.

Table 2 provides an overview of the descriptive statistics. Daily returns are reported for the estimation window (October 22, 2021–February 18, 2022) and the event window (February 21, 2022–February 28, 2022). The profitability and solvency ratios are reported as average from 2018 to 2022. Profitability and solvency ratios per year are reported in Section 3.2.

3 | RESULTS

This section presents the results of the event study, the analysis of the changes in profitability and solvency and the analysis of the sentiments in the annual reports.

3.1 | Event study

3.1.1 | Industry-specific abnormal returns

Table 3 presents the cumulative average abnormal return (CAAR) of stocks belonging to different sectors for the event window [−3,3], that is, 3 days before the event (February 21, 2022) to 3 days after the event (February 28, 2022).

The findings show that four of the eleven industries had cumulative abnormal returns that were negative and significantly different from zero, and that these stocks reacted abnormally during the event-window around the war in Ukraine. The sectors mostly affected are *Brewers*, *Packaged food and Meat*, *Soft Drinks* and *Tobacco*. The *Hypermarkets and Super Centers* industry had a positive CAAR, but the value was not significantly different from zero.

Appendix 2 presents the cumulative average abnormal return (CAAR) of the stock prices over different event windows. When examining the window around the event day, we find that the CAAR values for all aggregated days around the event date, are negative and significant across the significance test. The largest negative impact of the Russian invasion on European firms over the sectors *Brewers*, *Distillers and Vintners*, *Soft Drinks* and *Tobacco*. The *Agricultural and Farm Machinery* sector experiences a decline in abnormal returns in the 3 days leading up to the event, but a reversal is observed on the day of the event and the days after the event. *Brewers* face a significantly negative impact in the days leading up to the event, and this impact persists in the days following the event. *Packaged Foods and Meats* have significantly negative CAARs in the days before the invasion, but this effect is undone in the 2 days thereafter.

3.1.2 | Region-specific abnormal returns

Next, we grouped the stocks in three regions, that is, United States, Europe and Japan, and computed the region-specific cumulative abnormal returns for different periods around the event day. Table 4 presents the results for CAAR in different event windows.

TABLE 3 CAAR [−3, 3] Basic model.

Security	CAAR [−3, 3]
Agricultural and farm machinery	−4.92%
Agricultural products	−0.42%
Brewers	−3.44%**
Distillers and vintners	−0.57%
Fertilizers and agricultural chemicals	−0.96%
Food distributors	−1.09%
Food retail	−1.27%
Hypermarkets and super centers	0.23%
Packaged foods and meats	−1.47%*
Soft drinks	−5.91%***
Tobacco	−5.64%***

***p value < 0.01; **p value < 0.05; *p value < 0.1.

TABLE 4 Responses of stock prices per region.

Region	CAAR[−3,0]	CAAR[−2,0]	CAAR[−1,0]	CAAR[0,0]	CAAR[0,1]	CAAR[0,2]	CAAR[0,3]
United States	−0.34%	−0.24%	−0.52%	−0.61%**	0.97%***	0.56%	1.19%**
Europe	−2.21%***	−2.35%***	−1.95%***	−2.83%***	−0.64%	−1.66%***	−3.45%***
Japan	−2.83%***	−3.20%***	−1.66%***	−1.59%***	−2.14%***	−0.94%	−1.47%**

***p value < 0.01; **p value < 0.05; *p value < 0.1.

In the United States, the event study reveals a statistically significant negative abnormal return on the day of the event [0,0], indicating an immediate market response to the invasion of Ukraine. The subsequent days exhibit a reversal in abnormal returns with positive values on the days after the event. These positive abnormal returns suggest a recovery and potential market optimism following the event.

Contrastingly, European and Japanese stocks face a more prolonged and pronounced negative impact. CAAR is significantly negative in the days before the event and on the day of the event itself. This negative effect persists in most days following the event, reaching its lowest point 3 days after the event. The statistical significance across these event windows underscores the magnitude and persistence of the adverse impact on European and Japanese stock returns. This finding is not surprising since these countries are geographically more closely located to Ukraine and Russia and likely also more economically closely connected to both countries.

Comparing the three regions, it is evident that the invasion of Ukraine has diverse and region-specific impacts on stock returns. While the United States sees a swift recovery and positive effect post-event, Europe and Japan faced more negative impacts.

3.2 | Profitability and solvency

3.2.1 | Profitability

Figure 1 shows the average annual profitability of the companies per sector in the period 2018 to 2022. The profitability is represented by return on assets (ROA) and was calculated as the ratio of net income and total assets. The period 2018-2022 was characterized by two major events, that is, the COVID-19 pandemic and the Ukraine war which started in 2022. The results in Figure 1 show a profitability drop in 2020 associated with the COVID-19 pandemic followed by a recovery in 2021. This pattern is in particular clear for *Agricultural and Farm Machinery*, *Agricultural Products*, *Brewers*, *Fertilizers and Agrochemicals*, *Food Distributors* and *Food Retailers*. The effect of the Ukraine war on profitability seems small compared to the earlier effect of the COVID-19 pandemic. Several sectors show a small decline in profitability in 2022 compared to 2021, such as *Agricultural and Farm Machinery*, *Agricultural Products*, *Brewers*, *Fertilizers and Agrochemicals*, *Food Distributors*, *Hypermarkets and Super Centers*, *Packaged Food and Meats*, *Soft Drinks* and *Tobacco*. *Food Retail* experienced a relatively large drop in profitability in 2022 compared to 2021. The sectors *Food Distributors*, *Distillers and Vintners* and in particular *Fertilizers and Agrochemicals* have fared better in terms of their profitability in 2022 compared to 2021.

Looking at the results for profitability at company level reveals large differences (for more details, see Appendix 3). BASF's profits decreased substantially, according to the annual report because they are a major energy and raw material company, which faced significant challenges due to the reduction of Russian gas deliveries and rising energy prices in Europe. Besides winding down its operations in Russia and Belarus, the company faced high impairments on Wintershall Dea's Russian assets, financing of Nord Stream 2, Wintershall Dea's participating interest in Nord Stream AG, and assets in the German gas transportation business. Where the invasion of Ukraine caused problems for BASF, the companies CF industries Holdings and the Mosaic Company made huge profits in

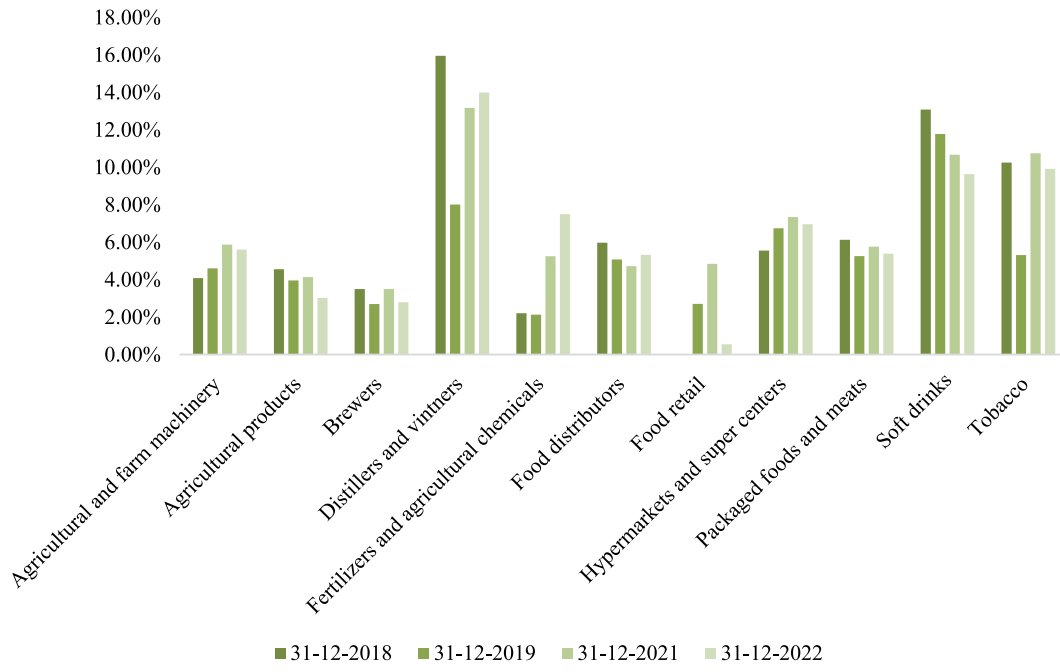

FIGURE 1 Profitability per sector 2018–2022.

TABLE 5 Results of the *t* test for differences in profitability in 2022 versus earlier years.

	2018	2019	2020	2021	2022
Mean	0.065	0.053	0.056	0.069	0.064
Variance	0.002	0.001	0.002	0.001	0.001
p Value two-sided	0.977	0.435	0.646	0.749	

****p* value < 0.01; ***p* value < 0.05; **p*- value < 0.1.

the year 2022. The results in Figure 1 also show that profitability of *Agricultural Products*, *Food Distributors* and *Hypermarkets and Super Centers* were relatively stable in the period 2018–2022.

Next, a *t* test was conducted to compare the means of profitability in 2022 with earlier years. The results of the *t* test in Table 5 show that the *p* values are all well above the critical 10% value, indicating that none of the differences is statistically significant at 10%. Overall, the *t* test shows that there is no statistically significant difference between the average profitability in 2022 and previous years.

3.2.2 | Solvency

The data presented in Figure 2 show the solvency ratios (value of equity over value of total assets) per sector. The overall observation is that the solvency ratios for most sectors remain relatively stable in the period 2018–2022, reflecting very small effects of the COVID-19 pandemic and Ukraine war. Some sectors, such as *Food Distributors* and *Packaged Foods and Meats*, show improvements in their solvency over the years. The

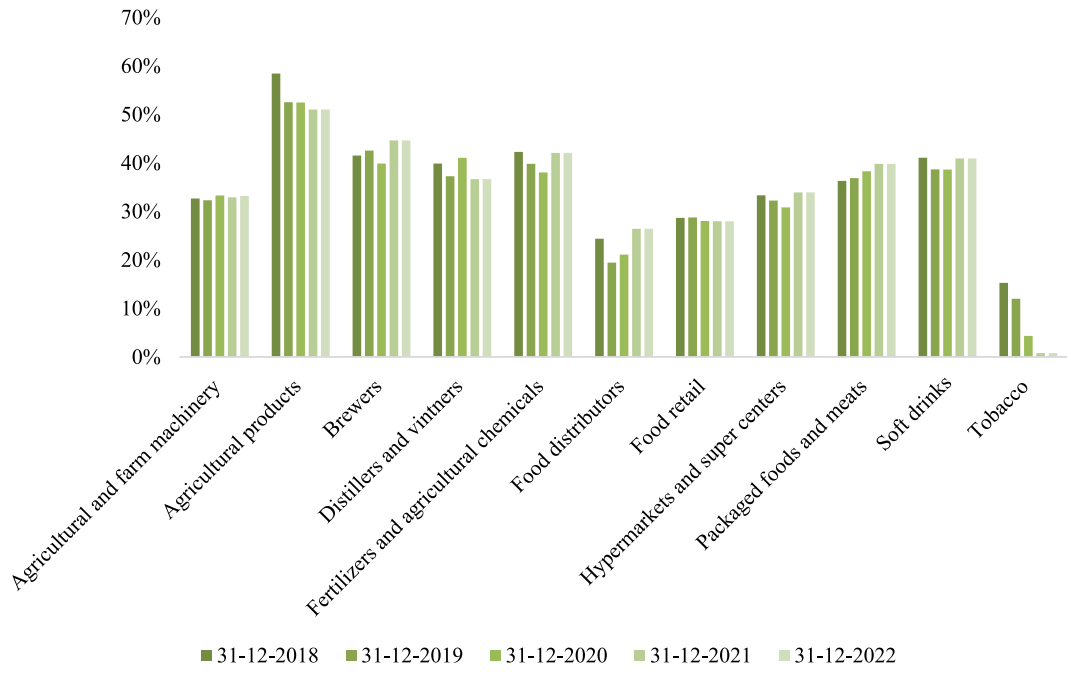

FIGURE 2 Solvency per sector 2018–2022.

Tobacco industry stands out with a significant decline in the solvency ratio, which is directly linked to the Ukraine war.[2]

As with the profitability of the companies, a *t* test was used to analyze whether there was a statistically significant difference between the solvency of the companies in 2022 and previous years. In summary, the data suggests variations in the mean values over the years, but the *t* test results and associated probabilities indicate that, in most cases, there is not enough evidence to reject the null hypothesis of no significant difference between the means, as can be seen in Table 6.

3.3 | Sentiment analysis

Table 7 summarizes the results of the screening of the financial reports of the companies for the way the companies describe the effect of the Ukraine war on their performance. The sentiment is categorized as positive, neutral, negative or not mentioned. The sentiment analysis across the various sectors suggests a common negative impact of the Ukraine war on the performance in almost all sectors, particularly in sectors such as *Brewers*, *Packaged Foods and Meats*, *Soft drinks* and *Tobacco*. This indicates that companies in these sectors experiences negative impacts on their financial performance due to the war in Ukraine.

Further investigation of the sector-specific impacts, as revealed through reading the financial reports, suggests that the war in Ukraine has exerted a profound economic impact on companies, which is reflected in increased costs, disrupted supply chains, and inflationary pressures. Responding to the sanctions imposed from the authorities in Western countries, companies opted to shut down or exit operations in Russia and Belarus. Financially,

[2]The large impairment on assets in the tobacco industry are due to sales of assets of tobacco companies that have decided to withdraw from Russia.

TABLE 6 Results of the *t* test for differences in solvency in 2022 versus earlier years.

	2018	2019	2020	2021	2022
Mean	0.369	0.358	0.360	0.373	0.377
Variance	0.008	0.008	0.007	0.007	0.007
p Value two-sided	0.830	0.617	0.638	0.902	

****p* value < 0.01; ***p* value < 0.05; **p* value < 0.1.

TABLE 7 Sentiment per sector 2022.

Security	N	#Positive	#Neutral	#Negative	#Not mentioned
Agricultural and farm machinery	2	-	-	1	1
Agricultural products	2	-	1	1	-
Brewers	7	-	-	4	3
Distillers and vintners	4	-	1	2	1
Fertilizers and agricultural chemicals	7	-	-	4	3
Food distributors	3	-	1	-	2
Food retail	11	-	2	3	6
Hypermarkets and super centers	2	-	-	1	1
Packaged foods and meats	22	-	-	13	9
Soft drinks	4	-	-	3	1
Tobacco	4	-	-	4	-

companies grapple with substantial impairment charges, losses, and additional cost, varying in direct exposure through assets in Russia, Ukraine and Belarus or dealing with indirect exposure through supply chain disruptions. To counter the impacts, operational adjustments were made which include diversifying raw material suppliers and embracing technological innovation to decrease the dependency on gas. Other short-term supply chain disruptions are related to material and packaging availability.

4 | DISCUSSION

This paper analyzed the impact of the Ukraine war on stock listed agribusiness firms from Europe, Japan and the United States. The study looked into the impact on stock prices before, and after the beginning of the war, the profitability and solvency, and into the way the companies have reported the impact of the war in their annual reports.

This paper uses the same listed companies as Höhler and Oude Lansink (2021), who examined the stock price reactions and profitability impacts of COVID-19. As with COVID-19, a heterogeneity in the stock reaction to the Ukraine war can be observed depending on sector and region. In contrast to the first months of COVID-19, during which lower returns were recorded in the United States compared to Europe and Japan, the results show that agribusiness firms in Europe and Japan were overall more negatively impacted by the outbreak of the war than agribusiness firms in the United States. This finding is in line with Yousaf et al. (2022), who find that European countries were particularly affected and who attribute this finding to close trade links with Russia.

Our results also showed that stock prices of *Brewers*, *Packaged Food and Meats*, *Soft drinks* and *Tobacco* firms were negatively impacted by the war. This finding is in line with Ahmed et al. (2023) who reported the highest impact of the war on stock prices of businesses in consumer staples. The results are also in agreement with Yudaruddin et al. (2023) who found the highest negative impact in the beverage sector. Our findings suggest that these industries also had a lower profitability in 2022 than in 2021. Furthermore, these industries reported a negative impact of the war on their performance in their annual reports. Compared to the study of Höhler and Oude Lansink (2021), *Brewers* faced a similar negative impact, while *Packaged Food and Meats*, *Soft Drinks* and *Tobacco* firms were among the industries with an increased profit during COVID-19 times. The firms in the sector of *Fertilizers and Agrochemicals* overall had a larger profitability in 2022 than in previous years. Soni (2022) wrote already back in May 2022 in a news article that the fertilizer sector settled for the biggest profits in years due to the Russia–Ukraine conflict. Vertically integrated companies like Mosaic and Nutrien, which mine their own potash, primarily for agricultural fertilizers, should feel the cost inflation less than CF who still needs to buy natural gas to make nitrogen. Soni (2022) also described that European fertilizer producers wowed investors in that month, with Germany's K + S AG raising its full-year core profit forecast by 40%; Norway's Yara International ASA posted a stronger-than-expected core profit even as it flagged higher natural gas costs. However, within this sector results are also mixed, as for example BASF had much a lower profit and reported significant impairments related to the Ukraine war. In contrast, companies in this sector reported lower profits during COVID-19 than before COVID-19 (Höhler & Lansink, 2021). This sector was also relatively heterogeneous in terms of reporting the consequences of the war in their annual reports, with 56% of the firms reporting a negative impact, whereas 44% of the firms not mentioning the war in their annual reports.

Most sectors in our sample had a lower profit in 2022 than in 2021, however there are also sectors which seemed to have benefited from the war. These are the *Food Distributors*, *Distillers and Vintners* and in particular *Fertilizers and Agrochemicals* who had a higher profitability in 2022 than in 2021. The sectors *Agricultural and Farm Machinery* and *Distillers and Vintners* showed a negative impact on stock prices in the days before the war but not thereafter, suggesting investors expected a negative impact on these industries in the days before the war. The profitability of these sectors was slightly lower for *Agricultural and Farm Machinery* and higher for *Distillers and Vintners*. The expectation of investors before the war was in line with the way companies reported the consequences of the war for the performance in their annual reports. Three out of five companies in these two sectors reported negative consequences and the remaining two did not mention the war.

Overall, we found no statistically significant decreases in profitability and solvency in 2022 compared to previous years. The observed trends can be influenced by various factors, including operational efficiency, debt management, market and industry-specific dynamics. These factors could also explain why the negative effects described in the financial reports are not reflected in the financial ratios. Further analysis and industry context would provide a more comprehensive understanding of variation in profitability and solvency over time.

5 | CONCLUSION

This paper analyzed the impact of the Russia–Ukraine war on stock listed agribusiness firms by investigating stock price reactions, the effects on profitability and solvency ratios and the way the companies have described the impacts of the war in their annual reports. The empirical analysis focused on 68 stock listed agribusiness companies in Europe, Japan and the United States. The analysis of stock price reactions showed that agribusiness firms in Europe and Japan were overall more negatively impacted by the war than agribusiness firms in the United States. However, there were also notable differences between agribusiness firms. In particular, stock prices of *Brewers*, *Packaged Food and Meats*, *Soft drinks* and *Tobacco* were negatively impacted by the war. Firms in the other agribusiness sectors experienced little to no impact on stock prices after the outbreak of the war. *Fertilizers and Agrochemicals* firms overall had a larger profitability in 2022 than in previous years, although some firms

experienced profound negative impacts on their profitability. Firms in this sector also reported heterogeneously about the impact of the war in their annual reports. Whereas most sectors had a lower profit in 2022 than in 2021, some sectors seem to have benefited, such as *Food Distributors*, *Distillers and Vintners*, *Fertilizers and Agrochemicals*.

The negative stock price reactions following the invasion of the Ukraine highlights the need for cautious investment decisions and diversification during geopolitical conflicts. Companies with close trade links to Russia and Ukraine seem to be particularly vulnerable. Policymakers in these countries can address supply chain disruptions by prioritizing food security, while companies can do so by diversifying their sourcing.

This study contributed to the literature by being the first to analyze the effect of the war on agribusiness firms through three different pathways, that is, the effect on stock prices, profitability and solvency and the way the war has been documented in the annual reports. However, the study does have a few limitations that could be addressed in future research. First, the paper only looked into the effects of the war on a small sample of large stock-listed agribusiness firms. The vast majority of the agribusiness firms are, however, not stock-listed and often have ownership structures such as family businesses and cooperatives. These firms were also impacted by the war and they could be the focus of future research, for example based on a survey of owners and managers. Future studies should also aim for a larger sample size to account for the industry specificity of financial ratios (Hull, 1999). Second, the analysis of the effect on profitability and solvency was restricted to 1 year only, that is, 2022. However, some of the effects of the war such as the effects of sanctions and impairments will materialize in the long term and have not yet been captured by the effects in 2022. A comparison of war-affected and non-affected businesses could be used to asses these long-term impacts. Moreover, profitability and solvency might still be impacted by the repercussions of the COVID-19 pandemic. Hence, future research could also take a larger time span after the war into consideration.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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APPENDIX

Table A1, Table A2, Table A3

TABLE A1 Companies included in the study.

Sector	Company	Ticker Symbol	Index	Region
Agricultural and farm machinery	Deere & Co.	(DE)	S&P 500	United States
	Kubota	(KUBTY)	Nikkei225	Japan
Agricultural products	Archer-Daniels-Midland Co.	(ADM)	S&P 500	United States
	Nisshin Seifun Group	(NSFMF)	Nikkei225	Japan
Brewers	AB InBev	(ABI.BR)	BEL	Europe
	Asahi Group Holdings	(ASBRF)	Nikkei225	Japan
	Heineken	(HEIA.AS)	AEX	Europe
	Kirin Holdings	(KNBWY)	Nikkei225	Japan
	Molson Coors Brewing Company	(TAP)	S&P 500	United States
	Sapporo Holdings	(SOOBF)	Nikkei225	Japan
	Takara Holdings	(2531.T)	Nikkei225	Japan
Distillers and vintners	Brown-Forman Corp.	(BF-B)	S&P 500	United States
	Constellation Brands	(STZ)	S&P 500	United States
	Diageo	(DEO)	FTSE 100	Europe
	Pernod Ricard	(RI.PA)	CAC40	Europe
Fertilizers and agricultural chemicals	BASF	(BAS.DE)	DAX	Europe
	Bayer	(BAYN.DE)	DAX	Europe
	CF Industries Holdings Inc	(CF)	S&P 500	United States
	Corteva	(CTVA)	S&P 500	United States
	FMC Corporation	(FMC)	S&P 500	United States
	Sumitomo Chemical	(SOMMY)	Nikkei225	Japan
	The Mosaic Company	(MOS)	S&P 500	United States
Food distributors	Marubeni	(MARUY)	Nikkei225	Japan
	Sojitz	(SZHFF)	Nikkei225	Japan
	Sysco Corp.	(SYY)	S&P 500	United States
Food retail	AEON	(AONNY)	Nikkei225	Japan
	Ahold Delhaize	(AD.AS)	AEX	Europe
	Carrefour	(CA.PA)	CAC40	Europe
	Colruyt	(COLR.BR)	BEL	Europe
	Isetan Mitsukoshi Holdings	(3099.T)	Nikkei225	Japan
	J. Front Retailing	(JFROF)	Nikkei225	Japan
	Kroger Co.	(KR)	S&P 500	United States

TABLE A1 (Continued)

Sector	Company	Ticker Symbol	Index	Region
	Ocado	(OCDO.L)	FTSE 100	Europe
	Sainsbury's	(SBRY.L)	FTSE 100	Europe
	Seven & i Holdings	(SVNDY)	Nikkei225	Japan
	Tesco	(TSCO.L)	FTSE 100	Europe
Hypermarkets and super centers	Costco Wholesale Corp.	(COST)	S&P 500	United States
	Walmart	(WMT)	S&P 500	United States
Packaged foods and meats	Ajinomoto	(AJINY)	Nikkei225	Japan
	Associated British Foods	(ABF.L)	FTSE 100	Europe
	Campbell Soup	(CPB)	S&P 500	United States
	Conagra Brands	(CAG)	S&P 500	United States
	Danone	(BN.PA)	CAC40	Europe
	General Mills	(GIS)	S&P 500	United States
	Hormel Foods Corp.	(HRL)	S&P 500	United States
	JM Smucker	(SJM)	S&P 500	United States
	Kellogg Co.	(KLG)	S&P 500	United States
	Kikkoman	(KIKOF)	Nikkei225	Japan
	Kraft Heinz Co.	(KHC)	S&P 500	United States
	Lamb Weston Holdings Inc.	(LW)	S&P 500	United States
	McCormick & Co.	(MKC)	S&P 500	United States
	Meiji Holdings	(MEJHY)	Nikkei225	Japan
	Mondelez International	(MDLZ)	S&P 500	United States
	Nestlé	(NSRGY)	smi	Europe
	Nh Foods	(NIPMY)	Nikkei225	Japan
	Nichirei	(NCHEY)	Nikkei225	Japan
	Nippon Suisan Kaisha	(1332.T)	Nikkei225	Japan
	The Hershey Company	(HSY)	S&P 500	United States
	Tyson Foods	(TSN)	S&P 500	United States
	Unilever	(UL)	FTSE 100	Europe
Soft drinks	Coca-Cola Company	(KO)	S&P 500	United States
	Coca-Cola HBC	(CCH.L)	FTSE 100	Europe
	Monster Beverage	(MNST)	S&P 500	United States
	PepsiCo Inc.	(PEP)	S&P 500	United States
Tobacco	Altria Group Inc.	(MO)	S&P 500	United States
	British American Tobacco	(BTI)	FTSE 100	Europe
	Imperial Brands	(IMB.L)	FTSE 100	Europe
	Philip Morris International	(PM)	S&P 500	United States

TABLE A2 The sectoral responses of stock prices in different time windows.

Security	Pre-event days CAAR [−3,0]	CAAR[−2,0]	CAAR [−1,0]	Event day CAAR[0,0]	Post-event days CAAR[0,1]	CAAR[0,2]	CAAR[0,3]
Agricultural and farm machinery	−4.99%**	−3.44%*	−1.63%	0.70%	1.15%	2.62%	2.29%
Agricultural products	−0.52%	−0.37%	−0.40%	0.19%	0.32%	1.55%	1.82%
Brewers	−1.89%*	−2.17%**	−0.81%	−2.00%***	−1.32%*	−1.65%*	−2.41%**
Distillers and vintners	−0.68%	−0.015%	−1.82%**	−1.88%***	0.30%	−0.68%	−1.28%
Fertilizers and agricultural chemicals	−0.41%	0.78%	0.49%	−0.01%	−0.18%	0.08%	0.36%
Food distributors	−0.94%	−1.49%	−1.31%	−0.01%	−0.44%	−0.53%	−0.40%
Food retail	−0.02%	−0.01%	−0.01%	−0.01%	−0.10%	1.46%	0.45%
Hypermarkets and super centers	−1.30%	−1.29%	−0.21%	−0.18%	0.34%	0.16%	1.59%
Packaged foods and meats	−1.09%*	−1.63%***	−1.54%***	−1.76%***	−0.37%	−0.01%	−0.99%*
Soft drinks	−2.81%**	−3.18%***	−2.57%***	−1.96%***	0.61%	−2.77%***	−4.04%***
Tobacco	−4.98%***	−4.99%***	−4.28%***	−4.70%***	−2.46%***	−4.51%***	−3.85%***

***p value < 0.01; **p value < 0.05; *p value < 0.1.

TABLE A3 Results profitability.

Security	2018	2019	2020	2021	2022
Agricultural and farm machinery					
Deere & Co.	3.38%	4.46%	3.66%	7.09%	7.92%
Kubota	4.79%	4.75%	4.03%	4.65%	3.30%
Agricultural products					
Archer-Daniels-Midland Co.	4.43%	3.13%	3.56%	4.83%	7.26%
Nisshin Seifun Group	4.69%	4.78%	3.77%	3.44%	−1.21%
Brewers					
AB InBev	1.87%	3.88%	0.62%	2.15%	2.80%
Asahi Group Holdings	4.91%	4.53%	2.09%	3.38%	3.14%
Heineken	2.29%	2.34%	−0.24%	3.40%	2.56%
Kirin Holdings	7.13%	2.47%	2.93%	2.42%	4.37%
Molson Coors Brewing Company	3.71%	0.84%	−3.47%	3.64%	−0.68%
Sapporo Holdings	−0.13%	0.70%	−2.61%	2.07%	0.85%
Takara Holdings	4.71%	4.11%	4.36%	7.45%	6.49%

TABLE A3 (Continued)

Security	2018	2019	2020	2021	2022
Distillers and vintners					
Brown-Forman Corp.	16.25%	14.34%	13.85%	13.15%	10.07%
Constellation Brands	11.75%	−0.04%	7.37%	−0.16%	−0.29%
Diageo	31.12%	16.69%	31.55%	34.15%	40.19%
Pernod Ricard	4.69%	1.04%	4.06%	5.54%	6.00%
Fertilizers and agricultural chemicals					
BASF	5.37%	9.69%	−1.32%	6.32%	−0.74%
Bayer	1.34%	3.24%	−8.97%	0.83%	3.32%
CF Industries Holdings Inc.	2.29%	4.05%	2.64%	7.41%	25.13%
Corteva	−4.66%	−2.26%	1.60%	4.15%	2.69%
FMC Corporation	5.03%	4.84%	5.41%	6.90%	6.59%
Sumitomo Chemical	3.72%	0.85%	1.15%	3.76%	0.17%
The Mosaic Company	2.34%	−5.53%	3.37%	7.40%	15.32%
Food distributors					
Marubeni	3.39%	−3.12%	3.25%	5.14%	6.83%
Sojitz	3.07%	2.73%	1.17%	3.09%	4.18%
Sysco Corp.	9.32%	0.95%	2.45%	6.15%	7.76%
Food retail					
AEON	0.26%	0.24%	0.24%	−0.62%	0.06%
Ahold Delhaize	4.47%	4.26%	3.43%	4.91%	5.24%
Carrefour	−1.18%	2.19%	1.35%	2.25%	2.38%
Colruyt	9.22%	9.44%	7.99%	5.12%	3.26%
Isetan Mitsukoshi Holdings	1.08%	−0.91%	−3.43%	1.06%	2.66%
J. Front Retailing	2.66%	1.71%	−2.07%	36.00%	1.27%
Kroger Co.	8.16%	3.67%	5.31%	3.37%	4.52%
Ocado	−3.33%	−9.29%	−3.35%	−5.09%	−9.46%
Sainsbury's	na	−0.15%	1.82%	0.86%	−8.13%
Seven & i Holdings	3.50%	3.64%	2.58%	2.41%	2.66%
Tesco	2.24%	1.83%	13.08%	3.00%	1.61%
Hypermarkets and super centers					
Costco Wholesale Corp.	8.06%	7.20%	8.45%	9.11%	9.12%
Walmart	3.04%	6.29%	5.35%	5.58%	4.80%
Packaged foods and meats					
Ajinomoto	2.13%	1.39%	4.15%	5.20%	6.22%
Associated British Foods	6.38%	2.73%	2.83%	3.54%	5.54%

(Continues)

TABLE A3 (Continued)

Security	2018	2019	2020	2021	2022
Campbell Soup	1.61%	13.16%	8.54%	6.37%	7.12%
Conagra Brands	3.05%	3.77%	5.85%	3.96%	3.10%
Danone	5.32%	4.25%	4.57%	4.24%	2.12%
General Mills	5.82%	7.08%	7.35%	8.71%	8.25%
Hormel Foods Corp.	12.43%	12.07%	9.17%	7.16%	7.52%
JM Smucker	3.08%	4.59%	5.38%	3.94%	−0.61%
Kellogg Co.	7.51%	5.47%	6.95%	8.19%	5.19%
Kikkoman	7.18%	6.73%	7.11%	7.73%	7.72%
Kraft Heinz Co.	NA	NA	NA	NA	NA
Lamb Weston Holdings Inc	15.70%	7.85%	7.55%	4.85%	15.47%
McCormick & Co.	9.10%	6.78%	6.18%	5.85%	5.20%
Meiji Holdings	6.16%	6.74%	6.15%	7.83%	6.11%
Mondelez International	5.29%	6.09%	5.24%	6.41%	3.82%
Nestlé	7.40%	9.86%	9.86%	12.15%	6.86%
Nh Foods	2.64%	2.50%	3.95%	5.24%	1.71%
Nichirei	5.29%	5.03%	5.23%	5.47%	4.72%
Nippon Suisan Kaisha	3.22%	3.00%	3.04%	3.42%	3.87%
The Hershey Company	NA	NA	NA	NA	NA
Tyson Foods	10.20%	6.02%	5.98%	8.39%	8.79%
Unilever	15.33%	0.62%	8.25%	8.06%	9.82%
Soft drinks					
Coca-Cola Company	7.73%	10.33%	8.87%	10.36%	10.29%
Coca-Cola HBC	6.53%	5.94%	5.48%	6.43%	4.22%
Monster Beverage	21.94%	21.51%	22.73%	17.65%	14.37%
PepsiCo Inc.	16.12%	9.31%	7.66%	8.25%	9.67%
Tobacco					
Altria Group Inc	12.56%	−2.62%	9.42%	6.26%	15.60%
British American Tobacco	4.12%	4.05%	4.65%	4.95%	4.34%
Imperial Brands	4.44%	3.05%	4.63%	9.74%	5.07%
Philip Morris International	19.88%	16.76%	17.97%	22.06%	14.67%

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