Електронний журнал «Ефективна економіка» включено до переліку наукових фахових видань України з питань економіки (Категорія «Б», Наказ Міністерства освіти і науки України № 975 від 11.07.2019). Спеціальності – 051, 071, 072, 073, 075, 076, 292.

Ефективна економіка. 2025. № 8.

DOI: http://doi.org/10.32702/2307-2105.2025.8.25
УДК 339.7

A. Kaminskyi,
Doctor of Economic Sciences, Professor, Professor of the Department of Economic Cybernetics, Taras Shevchenko National University of Kyiv
ORCID ID: https//orcid.org/0000-0002-6574-8138
V. Yatsenko,
PhD Student in Economics, Taras Shevchenko National University of Kyiv
ORCID ID: https//orcid.org/0000-0002-2925-7470

CURRENCY RISKS MODELLING OF UKRAINIAN AGRICULTURAL COMPANIES LISTED ON FOREIGN EXCHANGES

А. Б. Камінський,
д. е. н., професор, професор кафедри економічної кібернетики,
Київський національний університет імені Тараса Шевченка
В. О. Яценко,
здобувач ступеня доктора філософії,
Київський національний університет імені Тараса Шевченка

МОДЕЛЮВАННЯ ВАЛЮТНИХ РИЗИКІВ УКРАЇНСЬКИХ АГРОКОМПАНІЙ ПРЕДСТАВЛЕНИХ НА ЗАКОРДОННИХ ФОНДОВИХ БІРЖАХ

Due to their focus on exports, Ukrainian agricultural companies face significant currency risks. This issue is particularly crucial for public companies that issue and trade their shares on stock exchanges in Warsaw, London, and Paris. Although the effect of exchange rates on share returns is evident, modelling and managing this risk for Ukrainian companies is still underexplored, which highlights the relevance of this paper. The article aims to provide a comprehensive analysis of the exposure to currency risks faced by domestic public agricultural companies. This will help identify effective management strategies to ensure financial stability. The study employs regression analysis on the weekly stock returns of 11 companies from 2014 to 2024. We assessed how sensitive share price returns are to unpredictable fluctuations in the exchange rate of the Ukrainian Hryvnia against the US Dollar, Euro, Polish Zloty, and British Pound, as well as to the Effective Hryvnia index. Our investigation also examined the time-varying properties of these exposures, including the presence of leads and lags. The results show that the stock returns of Ukrainian agribusinesses exhibit statistically and economically significant sensitivity to exchange rate fluctuations. Positive coefficients for bilateral exchange rates indicate that a devaluation of the hryvnia boosts the market value of export-oriented companies due to increased cash inflows in national currency. Moreover, the exposure varies significantly depending on the currency: the highest sensitivity is recorded for the Polish Zloty and the Trade-Weighted Hryvnia index, while the lowest is observed for the British Pound. The analysis of time-varying properties revealed that market reactions typically occur simultaneously. The high level of exposure indicates considerable currency risks, exacerbated by the lack of a well-developed currency derivatives market in Ukraine. The study's findings suggest that companies should implement operational hedging strategies, such as balancing cash flows in different currencies, selecting favourable currencies, and managing market geography to ensure financial stability.

Стаття присвячена комплексному підходу до моделювання валютних ризиків діяльності українських агропромислових компаній, акції яких котируються на фондових біржах Варшави, Лондона та Парижу. Моделювання здійснювалось на основі оцінки еластичності дохідності акцій до непередбачуваних коливань валютних курсів, або, іншими словами, розрахунку загальних експозицій. Дослідження включає аналіз різноманітних властивостей експозицій, а саме вивчення чутливості дохідності акцій до коливань гривні з урахуванням фактору повномасштабного вторгнення росії; відмінності коефіцієнтів еластичності залежно від використання різних валют, що окрім долара США включали валюти країн-обігу акцій – євро, польський злотий та британський фунт. Окрему увагу було приділено дослідженню часових властивостей експозицій за допомогою вивчення випереджень і запізнень реакцій акцій на зміни обмінних курсів, що дозволяє розкрити нові аспекти природи цього явища. Емпірична частина спирається на регресійний аналіз із використанням тижневої дохідності акцій 11 публічних українських агропромислових компаній, акції яких торгуються за кордоном, за період з 2014 по 2024 рік. Отримані результати демонструють статистично та економічно значущу чутливість дохідності акцій вітчизняних агрохолдингів до коливань обмінних курсів. Позитивні коефіцієнти еластичності підтверджують позитивний вплив девальвації гривні на ринкову вартість компаній, що можна пояснити їхньою експортною орієнтацією. Виявлено, що рівень експозиції суттєво варіюється залежно від застосовуваної валюти: найвища чутливість зафіксована до польського злотого та реального ефективного індексу гривні, тоді як найнижча – до британського фунта, відкриваючи шляхи для диверсифікації структури валютних розрахунків. Високий рівень експозиції, управління якими ускладнюється в умовах відсутності ринку валютних деривативів, вказує на значні ризики та заохочує компанії впроваджувати операційні стратегії хеджування, як-от збалансування грошових потоків,

вибір сприятливих валют та управління географією ринку для забезпечення фінансової стабільності.

Key words: *foreign exchange rate, currency risk, total exposure to currency risk, returns, regression analysis, time series, time varying properties.*

Ключові слова: *валютний курс, валютний ризик, загальна експозиція до валютного ризику, дохідність, регресійний аналіз, часові ряди, часові властивості.*

Problem statement and its relation to scientific or empirical objectives. The agricultural industry of Ukraine plays a crucial role in the country's economy, contributing significantly to GDP and exports, foreign currency revenues, and employment. Moreover, it is vital for global food security. Traditionally, Ukraine has been a leader in producing and exporting various agricultural products, particularly sunflower oil, sunflower seeds, and meal (the top three), as well as wheat, corn, rapeseed, and barley (among the top ten) [1]. The global commodity markets' reaction to the onset of the full-scale invasion is a clear demonstration of this importance. The news of the russian attack in February 2022 led to an immediate spike in prices and shocks to several stock indices [2-5]. As the conflict escalated and export blockades from seaports became a threat to food supplies, this situation prompted the United Nations to adopt the Black Sea Grain Initiative in 2022.

The export orientation of domestic agricultural companies makes their performance highly sensitive to exchange rate volatility and exposes them to currency risks. This situation is particularly complex for domestic public companies. Due to immature domestic stock market and limited options for raising equity capital, many representatives from promising agricultural sector have chosen to pursue initial public offerings (IPOs) on foreign stock exchanges, such as the London Stock Exchange (LSE) or the increasingly popular Warsaw Stock Exchange (WSE). As a result, Ukrainian companies are influenced not only by

fluctuations in the Hryvnia and the US Dollar (USD) but also by the currency of the country where they are listed — either the British Pound (GBP) or the Polish Zloty (PLN). These currencies' volatility can significantly impact asset pricing, company performance, and investor decision-making. However, managing these factors proves to be a challenging process. While it is not uncommon for companies from developing countries and emerging markets to list their shares abroad, this phenomenon remains underexplored, highlighting the relevance of this study.

Literature Review. The sensitivity, or elasticity, of a company's market value and share returns to unpredictable fluctuations in exchange rates is referred to as exposure to currency risks. In the seminal papers of Adler and Dumas [6], as well as Jorion [7], this exposure is quantified using the $\beta_{ER,i}$ coefficient in one-factor (1) or two-factor (2) regressions. Specifically, $\beta_{1ER,i}$ represents total exposure. A positive value indicates that stock prices tend to rise when the exchange rate increases, which suggests a devaluation of the national currency. Conversely, a negative value implies the opposite relationship. On the other hand, $\beta_{2ER,i}$ signifies residual exposure, also referred to by Chue and Cook as marginal exposure [8, c. 1349]. This represents how an individual company's sensitivity to exchange rate fluctuations differs from that of the market portfolio [9, c. 1699, 1703]. Marginal exposure reflects the difference between total exposure and market (systematic) one [10, c. 20].

$$R_{i,t} = \alpha_1 + \beta_{1ER,i} ER_t + \varepsilon_{1i} \quad (1)$$

$R_{i,t}$ – share returns of company i, ER_t – foreign exchange rate returns, α_1 – constant, $\beta_{1ER,it}$ – total exposure to currency risk, ε_{1i} – error term, t – period; all returns are be represented by the first difference of natural logarithms.

$$R_{i,t} = \alpha_2 + \beta_{2ER,i} ER_t + \beta_{RM,i} RM_t + \varepsilon_{2i} \quad (2)$$

RM_t – stock index returns, $\beta_{RM,i}$ – the company's market or systematic risk, $\beta_{2ER,i}$ – the residual exposure to currency risk.

The commonly used method for measuring exposures to currency risks has not been empirically applied in Ukrainian academic literature, which primarily relies on Value-at-Risk (VaR) or the assessment of exchange rate fluctuations and currency positions [11-13]. This reliance may lead to suboptimal managerial decisions. Additionally, as seen in works [14, 15], Ukrainian companies have not been analysed, even in studies focused on Central and Eastern European countries.

The first attempt to calculate how Ukrainian agricultural companies' share returns are affected by the bilateral exchange rates of the Hryvnia against the US Dollar and the Euro (EUR), as well as a weighted trade index, showed statistically and economically significant total [16] and residual beta coefficients [17]. This contrasts with the puzzle of exposure to currency risks highlighted in various papers by foreign scholars and suggests a significant interest in further studying domestic business entities.

Research Gap. This study addresses several unresolved issues related to the assessment and management of currency risk exposures faced by Ukrainian agricultural companies. The research design is structured around a series of interrelated hypotheses:

Hypothesis 1. Does the volatility of the Hryvnia exchange rate impact the shares of Ukrainian companies listed abroad, particularly during the period of the full-scale invasion?

H_0^1: $\beta_1 = 0$, stock returns are indifferent to unpredictable exchange rate changes.

H_1^1: $\beta_1 \neq 0$, stock returns are sensitive to unpredictable exchange rate changes.

If we fail to accept H_0^1 at the 90%, 95%, or 99% confidence levels, a positive value of $\beta_{ER,i}$ will indicate that stock prices increase with an appreciation of the exchange rate. This suggests a devaluation of the domestic currency, as higher cash flows in the domestic currency enhance market value. In other words, it implies that the economic agent is holding a long position in foreign currency. Conversely, if $\beta_{ER,i}$ is negative, it indicates that stock values will rise with the strengthening of

the Hryvnia, suggesting a short position in foreign currency, if direct quotation is used [18, 19].

Hypothesis 2. Does the sensitivity of Ukrainian companies' stock returns vary with the rates of different currencies — USD, EUR, the Trade-Weighted index of the Hryvnia, and the currencies of the countries where the shares are quoted (PLN or GBP)?

H_0^2: $\beta_{USD,i} \approx \beta_{EUR,i} \approx \beta_{index,i} \approx \beta_{PLN,i} \approx \beta_{GBP,i}$ companies' stock returns do not depend on the choice of currency.

H_1^2: $\beta_{USD,i} \neq \beta_{EUR,i} \neq \beta_{index,i} \neq \beta_{PLN,i} \neq \beta_{GBP,i}$ stock returns of companies are influenced by the choice of currency.

If H_0^2 is rejected at the 90%, 95%, or 99% confidence level, the unequal $\beta_{ER,i}$ values will indicate that Ukrainian agricultural producers' stock prices react differently to unpredictable fluctuations in various currencies. This finding could highlight opportunities to reduce currency exposure by selecting more favorable currencies.

Hypothesis 3. Does the effect of unpredictable exchange rate volatility on stock returns of Ukrainian business entities have time-varying properties?

H_0^3: $\beta_{USD,i} \neq 0 \wedge \beta_{USD\pm1,i} \approx \beta_{USD\pm4,i} \approx \beta_{USD\pm12,i} \approx 0$

H_1^3: $\beta_{USD,i} \neq 0 \vee \beta_{USD\pm1,i} \neq 0 \vee \beta_{USD\pm4,i} \neq 0 \vee \beta_{USD\pm12,i} \neq 0$

To address this question, we constructed regressions with lags and leads of 1 week, 1 month, and 1 quarter. The coefficients $\beta_{+1}, \beta_{+4}, \beta_{+12}$ represent the 'Lags,' indicating the delayed reactions of stock returns, while $\beta_{-1}, \beta_{-4}, \beta_{-12}$ represent the 'Leads,' indicating the advanced responses. If H_0^3 is not accepted at 90%, 95%, or 99% confidence levels, it would suggest that there are economically and statistically significant exposures, indicating time lags between unpredictable changes in exchange rates and stock returns.

The analysis of the hypotheses mentioned above will provide us with a comprehensive understanding of the types and forms of exposure to currency risk.

Purpose of the paper. The aim of this paper is to conduct a thorough analysis of the currency risk exposures faced by Ukrainian companies in the agricultural

industry that are listed on foreign stock exchanges. This analysis is intended to support effective management of sensitivity to unpredictable exchange rate volatility, thereby ensuring the financial stability of these economic entities.

Results.

Data. The time frame of this study spans from January 3, 2014, to September 27, 2024. This period was chosen because before 2014, the Hryvnia was rigidly fixed and fluctuated within a narrow range of UAH 5 to UAH 8 per USD between 2000 and 2008 and from 2009 to 2014. These earlier years are irrelevant for analysis, but later dates do highlight companies' responses to Hryvnia fluctuations during the ongoing war.

The sample for analysis includes 11 public agricultural companies that continuously trade their shares on the LSE (Myronivsky Khliboprodukt SE, Ukrproduct Group Limited), WSE (Kernel Holding S.A., Astarta Holding PLC, Ovostar Union PCL, Agroliga Group PLC, Agroton Public Limited, MLK Foods PCL (Milkiland N.V.), KSG Agro S.A., Industrial Milk Company S.A.), and Paris EURONEXT (Agrogeneration SA). Although Agrogeneration is registered in France, it operates exclusively in Ukraine, justifying its inclusion in the analysis. Due to the inactive trading of shares and similar practices in other studies, we utilized weekly closing prices and determined stock returns by calculating the first difference of logarithms. Considering that the shares are traded on different stock exchanges and quoted in various currencies, all prices were converted into Hryvnias for uniformity in analysis.

To assess exposures, we utilized bilateral exchange rates of the Hryvnia against the US Dollar and the Euro, along with the J.P. Morgan Real Effective index. Bilateral exchange rates are presented using a direct quotation, which indicates the number of Hryvnias per unit of foreign currency. In contrast, the effective index uses an indirect quotation, with the Hryvnia serving as the base currency [20]. According to the methodology of the National Bank of Ukraine (NBU), a strengthening of the Hryvnia (indicating an increase in its exchange rate)

will, all else being equal, raise the cost of Ukrainian goods in foreign currencies and negatively impact their price competitiveness in global markets [20].

To test the H_0^2, we examined how the shares of specific companies responded to bilateral exchange rates of the currencies relevant to their quoted shares. This included the Polish Zloty for companies such as Kernel, Astarta, MLK, Ovostar, Agroton, Agroliga, KSG, and IMC, and the British Pound for Ukrproduct and MHP.

The time series for the bilateral exchange rates are represented by the mid-market spot rate, in accordance with International Financial Reporting Standards, while the Effective index is represented by the closing values.

Given the strong interrelationships among exchange rates and potential multicollinearity issues, we analyzed exposures to each currency using distinct regression models. This approach aligns with the work of Alssayah and Krishnamurti [21], while differing from the methodology outlined by Parsley and Popper, who build multiple factor regression [18].

The information was sourced from Datastream, Bloomberg databases, corporate websites, and the annual reports of companies. The calculations were conducted in the R-Studio Desktop software environment, utilizing the R programming language. Artificial intelligence was employed to correct technical errors and optimize code performance; however, its application did not influence the results obtained, nor the conclusions and proposals derived, which accurately reflect the contributions of the authors.

Results of Testing H_0^1.

The testing of H_0^1 was conducted based on the (1).

$$\begin{cases} R_{i,t} = \alpha_0 + \beta_{USD,i}\, USD\_UAH_t + \varepsilon_{0t} \\ R_{i,t} = \alpha_1 + \beta_{index,i}\, UAH\_index_t + \varepsilon_{1t} \end{cases} \quad (1)$$

$R_{i,t}$ – the return on shares of company *i;* α – constant, $\beta_{USD,i}$ *i* $\beta_{index,i}$ – the exposures of company *i*, where $i \in [1; 11]$, USD_UAH_t – bilateral exchange rate returns of the US Dollar to Hryvnia, UAH_index_t – real effective Hryvnia index

returns (closing prices). All returns are represented by the first difference of logarithms.

First of all, we note that the results do not allow us to confirm H_0^1 and the assumption of insensitivity of Ukrainian companies' stock returns to unpredictable fluctuations in the value of the Hryvnia (Fig. 1). The relevant coefficients are statistically significant, and their values are different from 0 and even close to 1, which contradicts the puzzle of exposures to currency risks and most previous studies, but resonates with [22].

All elasticity coefficients calculated for bilateral exchange rates are positive, indicating that share prices increase when the exchange rate rises. This, in turn, suggests a devaluation of the Hryvnia. Therefore, if the national currency weakens, the economic benefits should primarily accrue to export-oriented companies. This is due to improved price competitiveness of their goods abroad and an increase in cash flows that are converted into the national currency. Additionally, a weak hryvnia is likely to benefit import-competing companies, as consumers tend to prefer relatively cheaper locally produced goods over more expensive imports, particularly in the case of absolute substitutes. These findings are consistent with those of companies in the Philippines and Thailand but contradict the calculations regarding exchange rate sensitivity for firms in Malaysia [18, p. 1004].

PLN_Mid	1.017***			
	(0.088)			
EUR_Mid		0.746***		
		(0.092)		
UAH_effective			-0.987**	
			(0.099)	
Constant	-0.001	-0.001	-0.001	
	(0.003)	(0.003)	(0.003)	
Heteroscedasticity (p-value)	0.197	0.258	0.204	
Autocorrelation (p-value)	0.103	0.285	0.119	
F-statistic (p-value)	0	0	0	
R2 (%)	19.35%	10.64%	15.05%	
Adjusted R2 (%)	19.21%	10.48%	14.90%	
Observations	560	560	560	
R2	0.194	0.106	0.151	
Adjusted R2	0.192	0.105	0.149	
Residual Std. Error (df = 558)	0.071	0.075	0.073	
F Statistic (df = 1; 558)	133.905***	66.441***	98.865**	

Astarta

USD_Mid	0.976***			
	(0.210)			
PLN_Mid		1.084***		
		(0.179)		
EUR_Mid			0.913***	
			(0.179)	
UAH_effective				-1.093**
				(0.198)
Constant	-0.003	-0.003	-0.003	-0.003
	(0.006)	(0.006)	(0.006)	(0.006)
Heteroscedasticity (p-value)	0.25	0.161	0.184	0.175
Autocorrelation (p-value)	1	1	1	1
F-statistic (p-value)	4.1e-06	2.67e-09	4.61e-07	5.57e-08
R-squared (%)	3.73%	6.15%	4.46%	5.16%
Adjusted R-squared (%)	3.56%	5.99%	4.29%	4.99%
Observations	560	560	560	560
R2	0.037	0.062	0.045	0.052
Adjusted R2	0.036	0.060	0.043	0.050
Residual Std. Error (df = 558)	0.148	0.146	0.147	0.147
F Statistic (df = 1; 558)	21.645***	36.593***	26.033***	30.328**

KSG

USD_Mid	0.960***			
	(0.131)			
EUR_Mid		0.980***		
		(0.110)		
PLN_Mid			1.104***	
			(0.110)	
UAH_effective				-1.057**
				(0.123)
Constant	0.001	0.001	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.004)
Heteroscedasticity (p-value)	0.152	0.111	0.157	0.318
Autocorrelation (p-value)	0.122	0.137	0.204	0.173
F-statistic (p-value)	9.83e-13	<2e-16	<2e-16	<2e-16
R-squared (%)	8.72%	12.39%	15.39%	11.65%
Adjusted R-squared (%)	8.56%	12.24%	15.24%	11.49%
Observations	560	560	560	560
R2	0.087	0.124	0.154	0.116
Adjusted R2	0.086	0.122	0.152	0.115
Residual Std. Error (df = 558)	0.093	0.091	0.089	0.091
F Statistic (df = 1; 558)	53.319***	78.930***	101.529***	73.570**

Agroton

USD_Mid	0.937***			
	(0.082)			
PLN_Mid		1.018***		
		(0.066)		
EUR_Mid			0.818***	
			(0.070)	
UAH_effective				-1.060***
				(0.074)
Constant	-0.0004	-0.0002	0.0003	0.0001
	(0.002)	(0.002)	(0.002)	(0.002)
Heteroscedasticity (p-value)	0.383	0.197	0.109	0.284
Autocorrelation (p-value)	0.144	0.437	0.361	0.314
F-statistic (p-value)	<2e-16	<2e-16	<2e-16	<2e-16
R-squared (%)	19.09%	30.07%	19.82%	26.92%
Adjusted R-squared (%)	18.94%	29.94%	19.68%	26.79%
Observations	560	560	560	560
R2	0.191	0.301	0.198	0.269
Adjusted R2	0.189	0.299	0.197	0.268
Residual Std. Error (df = 558)	0.057	0.053	0.057	0.055
F Statistic (df = 1; 558)	131.636***	239.932***	137.932***	205.518**

*p<0.1; **p<0.05; ***p<0.01

IMC

Fig. 1. Total exposures to different currencies, OLS, weekly data, 3 January 2014 - 27 September 2024

Source: authors' calculations

Figure 1 presents only statistically valid models of some companies for general understanding; other results are available upon request.

The exposure to the Effective index of Hryvnia is negative for all analysed companies. This observation aligns with previous conclusions and assumptions, as it results from the different ways exchange rates are quoted. When bilateral exchange rates use direct quotation (where the foreign currency is the base currency, e.g., 1 USD = n UAH), the Trade-Weighted Hryvnia index behaves

conversely (with UAH in 2021 set at 100). Therefore, an increase in bilateral exchange rates suggests a decline in the value of the national currency, which would enhance the competitive position of national producers abroad. Conversely, a rise in the trade-weighted index would indicate a strengthening of the hryvnia and a decrease in price competitiveness.

The coefficients are generally consistent with theoretical frameworks and existing research; however, they contradict some studies, such as those by Chow and Chen. Their research found that Japanese firms experienced a negative β when using a direct quotation of the trade-weighted index. This indicates that the devaluation of the Japanese yen negatively affects the profitability of local companies, primarily due to their reliance on imported factors of production [22, c. 160-161].

Results of Testing $\boldsymbol{H_0^2}$**.**

To test H_0^2, (1) was augmented with similar equations to account for potential sensitivity to changes in EUR, PLN and GBP mid-market quotes (2), continuing several similar studies e.g. [18].

$$\begin{cases} R_{i,t} = \alpha_2 + \beta_{EU\ ,i}\, EUR\_UAH_t + \varepsilon_{2t} \\ R_{i,t} = \alpha_3 + \beta_{PLN,i}\, PLN\_UAH_t + \varepsilon_{3t} \\ R_{i,t} = \alpha_4 + \beta_{GBP,i}\, GBP\_UAH_t + \varepsilon_{4t} \end{cases} \quad (2)$$

$EUR\_UAH_t,\ PLN\_UAH_t,\ GBP\_UAH_t -$ bilateral exchange rate returns of EUR, PLN and GBP to UAH, $\beta_{EUR,i}, \beta_{PLN,i},\ \beta_{GBP,i} -$ the exposures of company i; the meaning of the other variables is similar.

The main assumptions at this stage of the study are twofold: first, to obtain different coefficients based on the chosen currency; and second, to identify relatively higher exposures to the currencies of countries where firms issue shares. Significant differences in the sensitivity of coefficients $\beta_{ER,i}$ could potentially explain puzzle, particularly for developing countries and emerging markets. In these regions, economic agents often opt for developed country stock exchanges for trading, which exposes them to the unpredictable volatility of various currencies.

Overall, the results obtained do not support the H_0^2 for most companies, as the sensitivity coefficients to different currencies are significantly different (as seen in Fig. 1). In absolute terms, the stock returns of Ukrainian public holdings are, on average, most sensitive to changes in the weighted hryvnia and the PLN ($\overline{\beta_{\text{index}}}$ =-1.0228 і $\overline{\beta_{\text{PLN}}}$=1.0166). The USD exhibits slightly lower elasticity with ($\overline{\beta_{\text{USD}}}$=0.9531), while the lowest sensitivities are observed for the EUR and GBP, with ($\overline{\beta_{\text{EUR}}}$=0.723 та $\overline{\beta_{\text{GBP}}}$=0.685). Consequently, an unpredictable 10% change in the relevant exchange rates is likely to produce an average share price change of 10.23%, 10.17%, 9.53%, 7.23%, and 6.85%, respectively.

Our sample of 11 companies shows significant variation in the results. For example, all $\beta_{ER,i}$ values for Kernel appeared to be completely insensitive to all currencies, likely due to a possible delisting from the WSE. In contrast, Astarta showed indifference exclusively to the USD. The company Ovostar displayed similar exposures, with the differences between the coefficients being around 2% (β_{PLN} = 1.006, β_{USD} = 1.026, β_{index} = -1.045). In comparison, companies like MLK, MHP, and UKRPRODUCT exhibited significant differences in the sensitivity of their stock returns; the deviations of their exposures to other currencies from β_{USD} ranged between 13-15%, 21-27%, and 33-35%, respectively. Moreover, the coefficient values themselves also varied considerably, ranging from the lowest $\beta_{Ukrproduct;EUR}$ at 0.636 to the highest (in absolute value) $\beta_{Agrogeneration;\,index}$ at -1.143.

The calculations confirm, to some extent, the second assumption, which is primarily applicable to companies listed on the WSE. However, this assumption does not hold true for participants on the LSE and Paris EURONEXT. Specifically, five out of seven companies on the WSE exhibit significantly higher sensitivity to PLN exchange rate fluctuations, β_{PLN}, compared to their sensitivity to USD exchange rate fluctuations, β_{USD}. The differences are as follows: Agroton by 15%; MLK by 14.52%; Agroliga by 13.43%; KSG by 11.07%; and IMC by 8.64%. This

indicates that their share prices are more responsive to unpredictable PLN volatility than to USD volatility, aligning with theoretical expectations.

Conversely, some companies show similar sensitivity to both currencies, such as Ovostar, with a difference of 1.95%, and Astarta, with a difference of 3.04%[1]. For companies on the LSE and Paris EURONEXT, the assumption is only partially valid. For instance, the sensitivities β_{EUR} for Agrogeneration and β_{GBP} for MHP and UKRPRODUCT significantly differ from β_{USD}, with differences of 16.5%, 27%, and 32.79%, respectively. However, these values are in the opposite direction; these companies exhibit less sensitivity to fluctuations in EUR and GBP compared to USD, which contradicts the expected outcome.

The results obtained in this study align well with similar research, which has shown a predominance, mostly positive, of β values related to USD in South-East Asian countries when compared to other currencies. In some cases, other reserve or regional currencies play a significant role, such as the JPY in Hong Kong and Singapore, and the EUR in Taiwan, showing little regard for GBP [18, c. 997].

Results of Testing H_0^3.

The H_0^3 test was designed to examine the assumption that unpredictable exchange rate volatility, as measured by the mid-market quotation, influences stock returns with lags $\beta_{+1,+4,+12}$ or conversely with leads $\beta_{-1,-4,-12}$ (4). This research builds on several previous studies that investigate the time-varying properties of exposures, particularly referenced in [22].

$$\begin{cases} R_{i,t} = \alpha_5 + \beta_{USD-1,i}\, USD\_UAH_{-1} + \varepsilon_{5t} \\ R_{i,t} = \alpha_6 + \beta_{USD-4,i}\, USD\_UAH_{-4} + \varepsilon_{6t} \\ R_{i,t} = \alpha_7 + \beta_{USD-\ \ ,i}\, USD\_UAH_{-12} + \varepsilon_{7t} \\ R_{i,t} = \alpha_8 + \beta_{US\ \ +1,i}\, USD\_UAH_{+1} + \varepsilon_{8t} \\ R_{i,t} = \alpha_9 + \beta_{USD+4,i}\, USD\_UAH_{+4} + \varepsilon_{9t} \\ R_{i,t} = \alpha_{10} + \beta_{USD+12,i}\, USD\_UAH_{+12} + \varepsilon_{10} \end{cases} \quad (4)$$

USD_UAH_{-1}, USD_UAH_{-4}, USD_UAH_{-12} – foreign exchange rate returns with a lead of 1, 4, and 12 weeks; USD_UAH_{+1}, USD_UAH_{+4}, USD_UAH_{+12} –

[1] Compared to β_{index}, since $\beta_{USD}$was statistically insignificant

foreign exchange returns with a lag of 1, 4 and 12 weeks; $\beta_{USD-1,i}$ and others – respective exposures; the meaning of the other variables remains the same.

Similar calculations were conducted for the exchange rates of other currencies.

Contrary to previous hypotheses, these calculations do not refute H_0^3. Although the coefficients $\beta_{\pm 1}$, $\beta_{\pm 4}$, $\beta_{\pm 12}$ do not approach zero, their values are relatively uniform and significantly lower than β_{mid}. This suggests that the lagged changes in exchange rates have an insignificant impact on the Ukrainian companies' shares returns (Fig. 2).

Nevertheless, the coefficients that differ from zero offer interesting insights that allow us to categorize companies into three classes:

1. Late Responders: these companies react with a delay of one week, β_{+1}, including Ukrproduct, Kernel, and KSG;

2. Early Responders: these companies see their stock returns react earlier—by one month β_{-4}—such as Agroliga, Ovostar, MHP, and Astarta[2];

3. Indifferent Companies: these companies show no significant response to time lags, including Agroton, MLK, and Agrogeneration.

Notably, IMC displays some variability in its results, as its dependent variable reacts to exchange rate fluctuations both late (after one week) and early (after four weeks). Additionally, only company Astarta exhibits a statistically significant β_{+12}, indicating a possible reaction lag of 12 weeks (one quarter) for its shares.

[2] 4 out of 5 MHP and Astarta models confirm a 1-month lead, while 1 model confirms a 1-week delay

EUR_Mid_lag_1	0.202**		
	(0.093)		
PLN_Mid_lag_1		0.201**	
		(0.094)	
UAH_effective_lag_1			-0.233**
			(0.103)
Constant	-0.0001	-0.0001	-0.0001
	(0.003)	(0.003)	(0.003)
Heteroscedasticity (p-value)			
Autocorrelation (p-value)			
F-statistic (p-value)			
R-squared (%)	0.84%	0.82%	0.91%
Adjusted R-squared (%)	0.66%	0.64%	0.73%
Observations	559	559	559
R2	0.008	0.008	0.009
Adjusted R2	0.007	0.006	0.007
Residual Std. Error (df = 557)	0.076	0.076	0.076
F Statistic (df = 1; 557)	4.732**	4.598**	5.108**

Kernel

EUR_Mid_lag_1	0.338***		
	(0.113)		
GBP_Mid_lag_1		0.327***	
		(0.111)	
UAH_effective_lag_1			-0.266**
			(0.128)
Constant	-0.001	-0.001	-0.000
	(0.004)	(0.004)	(0.004)
Heteroscedasticity (p-value)	0.254	0.247	0.439
Autocorrelation (p-value)	1	1	0.999
F-statistic (p-value)	0.00305***	0.00335***	0.0382**
R-squared (%)	1.6%	1.57%	0.79%
Adjusted R-squared (%)	1.42%	1.39%	0.61%
Observations	546	546	546
R2	0.016	0.016	0.008
Adjusted R2	0.014	0.014	0.006
Residual Std. Error (df = 544)	0.089	0.089	0.090
F Statistic (df = 1; 544)	8.858***	8.684***	4.319**

Ukrproduct

EUR_Mid_lag_1	0.472***		
	(0.182)		
PLN_Mid_lag_1		0.438**	
		(0.184)	
UAH_effective_lag_1			-0.457**
			(0.203)
USD_Mid_lag_1			0.420**
			(0.213)
Constant	-0.002	-0.001	-0.001	-0.002
	(0.006)	(0.006)	(0.006)	(0.006)
Heteroscedasticity (p-value)	NA	NA	NA	NA
Autocorrelation (p-value)	NA	NA	NA	NA
F-statistic (p-value)	NA	NA	NA	NA
R-squared (%)	1.19%	1%	0.9%	0.69%
Adjusted R-squared (%)	1.01%	0.82%	0.72%	0.51%
Observations	559	559	559	559
R2	0.012	0.010	0.009	0.007
Adjusted R2	0.010	0.008	0.007	0.005
Residual Std. Error (df = 557)	0.150	0.150	0.150	0.150
F Statistic (df = 1; 557)	6.713***	5.634**	5.058**	3.880**

KSG

USD_Mid_lead_4	-0.221***			
	(0.075)			
EUR_Mid_lead_4		-0.166**		
		(0.065)		
PLN_Mid_lead_4			-0.187***	
			(0.065)	
UAH_effective_lead_4				0.206***
				(0.072)
Constant	0.003	0.003	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)
Heteroscedasticity (p-value)	0.432	0.463	0.54	0.54
Autocorrelation (p-value)	0.975	0.977	0.977	0.977
F-statistic (p-value)	0.00338***	0.0104**	0.00433***	0.00428***
R-squared (%)	1.55%	1.19%	1.47%	1.48%
Adjusted R-squared (%)	1.37%	1.01%	1.29%	1.3%
Observations	551	551	551	551
R2	0.016	0.012	0.015	0.015
Adjusted R2	0.014	0.010	0.013	0.013
Residual Std. Error (df = 549)	0.053	0.053	0.053	0.053
F Statistic (df = 1; 549)	8.665***	6.617**	8.208***	8.229***

*p<0.1; **p<0.05; ***p<0.01

Ovostar

Fig. 2. Total exposure to exchange rate fluctuations, including time-varying properties (leads and lags), OLS regression, weekly data, 3 January 2014 – 27 September 2024

Source: authors' calculations

Figure 2 displays only statistically valid models of selected companies for general understanding; other results are available upon request.

Additionally, the absolute values of $\beta_{\pm}$ are significantly lower than β_{mid}. The lowest elasticity for the mid-market quote is attributed to $\beta_{Ukrproduct;EUR}$ at 0.636, while the highest economically significant value is $\beta_{Ukrproduct;EUR}$ at -1.143. The

range of β values, considering lags and overshoots, varies from -0.117 for $\beta_{\text{IMC},USD\_lag\_4}$ to 0.472 for β_{KSG,EUR_lag_1}. This means that a 10% increase in the USD exchange rate could cause IMC's stock price to decline by 1.17% one week later. Conversely, if the EUR price increases, KSG's stock could rise by 4.72% four weeks later. These findings completely contradict the conclusions of Chou and Chen, who reported that less than 30% of Japanese companies react to changes in the yen exchange rate with a delay of one month, while 88.5% respond with a delay of two years. They categorize these responses as transactional and economic exposure, respectively [22, p. 160-161].

Notably, there are differences in the signs of the coefficients. While the coefficient β_{ER} is consistently positive for all bilateral exchange rates and negative for the weighted index. In contrast, the coefficients $\beta_{\pm}$ exhibit varied signs; they are mostly negative but sometimes show the opposite signs compared to the originally calculated exposures. For instance, all $\beta_{\pm}$ values for Astarta, Agroliga, and Ovostar with respect to bilateral exchange rates are negative, while their values for the Hryvnia index are positive. This is in direct opposition to the results obtained from the H_0^1 and H_0^3 tests. Conversely, the sensitivity coefficients for Kernel and Ukrproduct align completely with β_{mid}, displaying positive $\beta_{\pm}$ values for bilateral exchange rates and negative values for the weighted Hryvnia index.

The testing of hypothesis H_0^3 yields two unexpected conclusions. First, if we interpret the results of regressing stock returns on current changes in exchange rates as indicative of transactional rather than economic exposure — following the logic presented by Chou and Chen [22, p. 160-161] — then high values of β_{mid} for domestic enterprises relative to $\beta_{\pm}$ suggest the presence of transactional exposures. This stems from the inability to effectively hedge these risks in the absence of a currency derivatives market in Ukraine.

Secondly, a high positive β_{mid} may indicate temporary advantages from converting export earnings into the national currency at a favorable depreciated exchange rate for the Hryvnia. However, this positive effect of devaluation could be short-lived, as it may lead to rising prices for imported components (such as

seeds, equipment, and, most critically, fuel and energy resources), resulting in low or even negative values for $\beta_{\pm}$. In this scenario, the calculated sensitivity coefficients would confirm the existence of a related puzzle, consistent with the findings of a majority of previous studies.

Conclusions and Future Research Directions. The analysis we conducted, based on the formulation and testing of three hypotheses, enabled us to draw several conclusions regarding the management of exposure to currency risks. These conclusions can be relevant for both short-term and long-term strategies.

Given the high values of $\beta_{ER,i}$, managing exposure to currency risks should be a priority for corporate management due to the potential negative effects on the market value of companies. This task is complicated by the lack of a currency derivatives market for the Hryvnia. The first conclusion is that, under these conditions, agricultural companies should actively utilize all available instruments for operational hedging. The most common approach involves balancing incoming and outgoing cash flows, as well as assets and liabilities in different currencies. This practice is noted in nearly all annual reports of the entities analysed.

The second conclusion highlights the issue of currency deficit. While most agricultural businesses are focused on increasing Dollar revenues, some entities are seeking ways to attract Hryvnia inflows. For example, companies IMC and Agrogeneration have begun selling products within Ukraine and offering services such as storage, drying, or shipment of grain to other companies. The further expansion of these activities can ensure a consistent flow of Hryvnia revenue to meet local currency expenses, illustrating a classic example of natural hedging. KSG, for its part, has increased its focus on export expansion by broadening its market reach to generate sufficient foreign exchange. Additionally, KSG is providing land cultivation and harvesting services to other export-oriented companies. In this scenario, KSG can facilitate foreign exchange transactions, allowing external exporters to pay for services in USD from the foreign exchange proceeds they receive. This approach will help ensure a stable, albeit modest, inflow of foreign currency for the company.

The third conclusion focuses on how exposures are managed, particularly through the selection of a favourable payment currency. This strategy allows firms to capitalize on the opportunity to receive cash flows in 'exotic' currencies such as EUR, GBP, Swiss Franc (CHF), and Japanese Yen (JPY). By doing so, companies can attract cheaper debt capital or effectively cover the costs of imports.

The fourth conclusion pertains to the long-term strategies for managing currency risk in Ukrainian agricultural companies. In addition to the previously mentioned strategies, Ukrainian agrarians can consider several alternatives. These include long-term contracts that fix prices in stable currencies (as seen with Agrogeneration), incorporating currency clauses (as practiced by Ukrproduct), optimizing currency payment terms to ensure that outgoing and incoming cash flows are in the same currency but on different dates (exemplified by KSG), and employing acceleration and anticipation strategies (as implemented by MLK). Furthermore, they can price goods or services sold in the domestic market in foreign currencies or peg them to foreign currencies (as done by KSG), choose the appropriate financing currency, and manage their currency structure (with companies like Astarta raising debt capital in earned EUR, and MHP and Ovostar also participating). Almost universally applicable is the practice of netting receivables and payables in foreign currency, effectively balancing cash flows.

Future research opportunities include examining additional aspects of exposure to currency risks. This will help identify the reasons behind the sensitivity of stock returns to unpredictable exchange rate volatility and determine effective management tools.

References

1. U.S. Department of Agriculture, Foreign Agricultural Service (2022), “Ukraine agricultural production and trade”, available at: https://fas.usda.gov/sites/default/files/2022-07/Ukraine-Factsheet-July2022.pdf (Accessed 23 April 2025).

2. Boungou, W. and Yatié, A. (2022), “The impact of the Ukraine–Russia war on world stock market returns”, *Economics Letters*, vol. 215, 110516. https://doi.org/10.1016/j.econlet.2022.110516

3. Chowdhury, E.K. and Khan, I.I. (2023), “Reactions of global stock markets to the Russia–Ukraine War: An empirical evidence”, *Asia-Pacific Financial Markets*, vol. 30(4), pp. 775-794. https://doi.org/10.1007/s10690-023-09429-4

4. Ngwakwe, C. (2022), “Stock market volatility during rumours of war and actual war: Case of Russia-Ukraine conflict”, *Acta Universitatis Danubius. Œconomica*, vol. 18(3), pp. 170-181.

5. Kurmanaev, A. and de la Baume, M. (2022), “Ukraine invasion threatens global wheat supply”, *The New York Times*, 24 February, available at: https://www.nytimes.com/2022/02/24/business/ukraine-russia-wheat-prices.html (Accessed 23 March 2025).

6. Adler, M. and Dumas, B. (1984), “Exposure to currency risk: Definition and measurement”, *Financial Management*, vol. 13(2), pp. 41-50.

7. Jorion, P. (1991), “The pricing of exchange rate risk in the stock market”, *Journal of Financial and Quantitative Analysis*, vol. 26(3), pp. 363-376.

8. Chue, T.K. and Cook, D. (2008), “Emerging market exchange rate exposure”, *Journal of Banking & Finance*, vol. 32(7), pp. 1349-1362. https://doi.org/10.1016/j.jbankfin.2007.10.003

9. Pritamani, M.D. Shome, D.K. and Singal, V. (2004), “Foreign exchange exposure of exporting and importing firms”, *Journal of Banking & Finance*, vol. 28(7), pp. 1697-1710. https://doi.org/10.1016/S0378-4266(03)00155-2

10. Al-Shboul, M. and Anwar, S. (2014), “Foreign exchange rate exposure: Evidence from Canada”, *Review of Financial Economics*, vol. 23(1), pp. 18-29. https://doi.org/10.1016/j.rfe.2013.11.002

11. Pyvovarova, H.B. (2019), “Hedging the currency risks of the credit portfolio of JSC “Ukrzaliznytsia”, *Efektyvna ekonomika*, [Online], vol. 12, available at: https://doi.org/10.32702/2307-2105-2019.12.155

12. Fesenko, V.V. (2018), “Analysis of exchange rate differences as an internal audit procedure for a group of related enterprises”, Economic Analysis: Collection of Scientific Works, vol. 28, no. 2, pp. 191-199.

13. Artym-Drohomyretska, Z.B. (2017), “Modeling the assessment of currency risks of a banking institution”, *Materialy naukovo-tekhnichnoi konferentsii «Prykladna matematyka ta kompiutynh»* [Materials of the Scientific and Technical Conference "Applied Mathematics and Computing"], Ternopil National Technical University, Ternopil, Ukraine, pp. 15-17, available at: http://elartu.tntu.edu.ua/bitstream/lib/23411/2/MNK-ME_2017_Artym-Drohomyretska_Z_B-Modeling_estimates_15-17.pdf (Accessed 27 April 2025).

14. Kaminskyi, A. and Nehrey, M. (2023), “The Analysis and Visualization of CEE Stock Markets Reaction to Russia’s Invasion of Ukraine by Event Study Approach”, *Advances in Artificial Systems for Logistics Engineering III. ICAILE 2023. Lecture Notes on Data Engineering and Communications Technologies*, vol. 180, Springer, Cham, Switzerland, pp. 426-436. https://doi.org/10.1007/978-3-031-36115-9_39

15. Asif, R. and Frömmel, M. (2022), “Exchange rate exposure for exporting and domestic firms in central and Eastern Europe”, *Emerging Markets Review*, vol. 51(PA).

16. Yatsenko, V.O. (2024), “Total exposures to currency risks of Ukrainian public agricultural companies”, World of Finance, vol. 3(80), pp. 20-29. https://doi.org/10.35774/sf2024.03

17. Yatsenko, V.O. (2024), “Residual exposures to currency risks of Ukrainian agro-industrial companies”, Visnyk of the Lviv University. Series Economics, vol. 66. https://doi.org/10.30970/ves.2024.66.0.6611

18. Parsley, D.C. and Popper, H.A. (2006), “Exchange rate pegs and foreign exchange exposure in East and South East Asia”, *Journal of International*

Money and Finance, vol. 25(6), pp. 992-1009. https://doi.org/10.1016/j.jimonfin.2006.07.008

19. Aggarwal, R. Chen, X. and Yur-Austin, J. (2011), "Currency risk exposure of Chinese corporations", *Research in International Business and Finance*, vol. 25(3), pp. 266-276. https://doi.org/10.1016/j.ribaf.2011.02.002

20. National Bank of Ukraine (2022), "Main provisions of the methodology for calculating the real effective exchange rate (REER) and nominal effective exchange rate (NEER) indices of the Hryvnia", available at: https://bank.gov.ua/admin_uploads/article/REER_methodology.pdf (Accessed 25 March 2025).

21. Alssayah, A. and Krishnamurti, C. (2013), "Theoretical framework of foreign exchange exposure, competition and the market value of domestic corporations", *International Journal of Economics and Finance*, vol. 5(2), pp. 1-14. https://doi.org/10.5539/ijef.v5n2p1

22. Chow, E.H. and Chen, H.-L. (1998), "The determinants of foreign exchange rate exposure: Evidence on Japanese firms", *Pacific-Basin Finance Journal*, vol. 6(1-2), pp. 153-174.

Стаття надійшла до редакції 26.07.2025 р.