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ECONOMETRIC ASSESSMENT OF THE EFFICIENCY AND VOLATILITY OF THE STOCK MARKET IN UKRAINE

ABSTRACT

The validity of published research findings is related to their demand from both investors and issuers and from the side of research scientists. The methods used make it possible to determine the general trend of market movement in the direction of increasing or decreasing its efficiency. For investors, such an assessment of the efficiency of the stock and bond markets creates a basis for optimizing the allocation of assets when building portfolio strategies, and for issuers, it is the basis for building a strategy for emission activity. It is necessary to analyze the factors affecting the efficiency of the Ukrainian market and show that the illiquidity of the Ukrainian bond and stock markets has a negative impact on the overall efficiency of the market, and therefore it is necessary to increase liquidity, which is an important factor for improving the efficiency of the market. The analysis of the efficiency of stock and bond markets is presented as an impact on the markets themselves. For research scientists, the predictability of returns, or the lack of such predictability, is critical to creating models that can accurately describe risks and returns in financial markets.

The paper proposes a different approach to the study of stock market efficiency, using a time-varying parameter model that can estimate indicators, efficiency and inefficiency as parameters change.

Keywords: stock market, shares, bonds, volatility, econometric model, index

JEL Classification: C1, G11, G14

INTRODUCTION

The fundamental basis of the concept of stock market efficiency is the existence of price efficiency, which Y. Fama divided into three levels: weak, semi-strong and strong forms of efficiency. Investigating the performance of the stock market is important for forecasting the prices of financial assets and developing investment strategies. The development of the science of financial markets in connection with the emergence of the stock market efficiency hypothesis led to the construction of pricing models for financial assets based on the price efficiency hypothesis, including the pricing model, and the testing of the efficiency of the weak form became the reason for the start of research on the efficiency of the semi-strong and strong form.

There are many scientific studies testing the efficient market hypothesis, as well as studies analyzing the behaviour of emerging stock markets and testing their efficiency.

However, the testing procedures used in most of these studies are not a fruitful approach for assessing market performance in developing countries.

The analysis of the UX index depending on the volume of trades and their profitability showed that the main components of the inefficiency of the Ukrainian stock market are shares with low trading volumes: more liquid shares showed greater efficiency and less liquid ones showed lower efficiency.

The main reason for this is that in emerging stock markets, changes in trading volume in illiquid stocks provide signals to some investors about the quality of information entering the market. A joint analysis of changes in securities prices and trading volume

can allow an investor to predict the behaviour of future returns on securities in such a market.

LITERATURE REVIEW

The riskiness of financial assets is a decisive characteristic that determines their equilibrium price. Volatility, as it is known, is measured by the standard deviation of asset returns and has some important peculiarities. The bottom line is that volatility changes over time depending on trades, the economic cycle, political events and information entering the market.

The model of autoregressive conditional heteroskedasticity (ARCH) [5] is an empirical model of financial data. Its generalization – the GARCH model [6] – is used to estimate the volatility of financial assets, such as bonds, exchange rates, stock returns, and stock indices. The model analyzes time series in which the conditional variance of the series depends on the previous values of the variances of this series [7-10].

According to the ARCH model, volatility has the following characteristics [11-13]:

1. Heavy tails: This means that asset returns usually peak;
2. Clustering: large changes in the price of financial assets cause large changes in market trends, and small changes follow small changes, which means that there are periods of low volatility and periods of high volatility.

An actual problem of the theory of financial markets is that in order to evaluate the efficiency of the stock and bond market in Ukraine, an effective toolkit for its testing based on modern econometric models is needed [13-17]. Therefore, in order to build an econometric model that allows to answer such a difficult question in economic science, analyses should take into account not only the characteristics of the market but also its qualitative characteristics [18-24].

Unresolved aspects of the problem. The procedures for verifying the efficiency of the Ukrainian stock market, outlined in the works of contemporary scientists, do not take into account the time-varying parameter models, do not reflect the dynamics of the movement towards market efficiency and are not an efficient approach to assessing the efficiency of the market from the current perspective. Due to the lack of development of theoretical, methodological and empirical aspects of stock market efficiency and volatility assessment, this study is particularly relevant for the development of stock market theory and optimization of investment strategies in the stock market.

AIMS AND OBJECTIVES

The purpose of the article is to evaluate the efficiency and volatility of shares and bonds on the basis of modern methods adapted to the modern Ukrainian stock market, to develop a multifactor strategy for its investment. The objectives of the article are to analyze the effectiveness of the Ukrainian stock market, using the example of the Ukrainian Stock Exchange, to find the main problems in the stock exchange.

METHODS

Non-parametric (series test - normality test) and parametric tests (time series stationarity test - autocorrelation function) are included in the weak form of market efficiency assessment methods. In this paper, traditional methods (tests) are included which can be used to assess the efficiency of the stock market in a weak form for the study of random walk processes. In this paper, a generalized autoregressive model with conditionally varying variance (GARCH) is used to study the efficiency of the market in a weak form and predict the volatility of the Ukrainian stock market.

RESULTS

An Empirical Study of Stock Market Efficiency and Volatility

To analyze the efficiency of the Ukrainian market, the UX index is used, which is traditionally weighted by market capitalization. The most liquid shares of the largest dynamically developing Ukrainian issuers whose types of economic activity belong to the main sectors of the economy were also used.

Stock indices of the Ukrainian Stock Exchange are key indicators of the organized securities market of Ukraine. They belong to the type of capitalization-weighted, taking into account Free-Float stock indices.

For analysis, the UX index provides daily closing prices. As a measure of efficiency and volatility, the absolute values of logarithmic returns on indices, calculated on the basis of consecutive price observations are used. To calculate a stock's daily return, the closing prices derived from the index are adjusted for non-trading days.

If a stock market follows a random walk pattern, it is considered to have the characteristics and effects of a weak market, that is, prices fully reflect the information contained in historical price movements, and stock prices should change only after new information about the market appears. In these circumstances, historical price information does not allow for profit. An efficient market follows a random walk and is therefore unpredictable. An efficient market is unpredictable, but it can be tested using the random walk hypothesis.

The selection of this index is based on its general characteristics, which guarantee a sufficiently long time series. To do this, the daily return of the UX index from January 1, 2020, to December 31, 2022, will be analyzed, giving a general observation ($U = 1234$).

The analysis of the profitability of the UX index was made to check the efficiency of the stock market in Ukraine and to study the presence of volatility clustering in the Ukrainian stock market. Data normality was assessed by the Harke-Behr test and stationarity by the Dickey-Fuller (ADF) test, ARCH and GARCH models were used to study the behavior of bond yields and to estimate the volatility model [25-28].

The normality test rejects the null hypothesis, the kurtosis is clearly greater than 3, especially in the case of the higher kurtosis ($14.07 > 3$) for the UX stock index and the negative skewness. Figure 1 presents a histogram of the UX index yield.

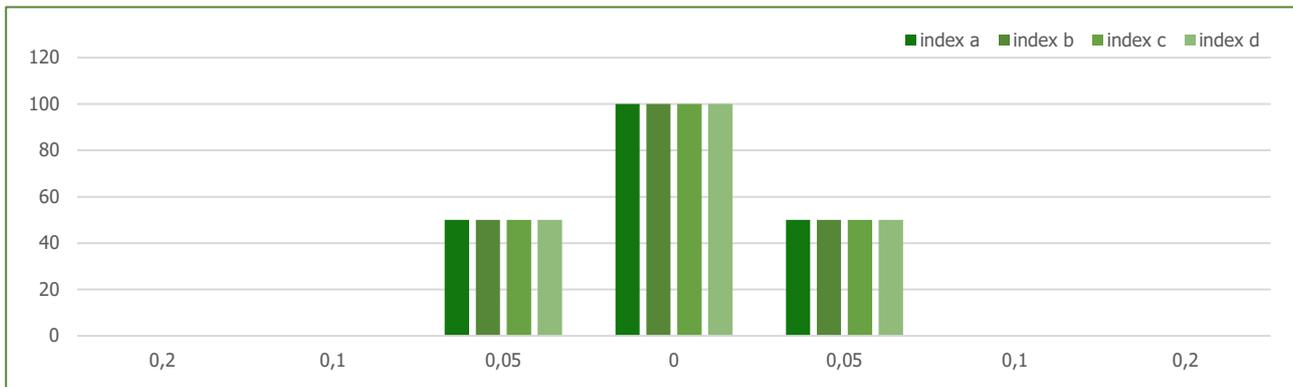


Figure 1. Histogram of the yield of the UX index.

Thus, we reject the normal distribution of returns due to the high value of the Harke-Behr statistic and conclude that the daily stock market returns do not follow a normal distribution, so stock markets are not efficient in the weak form.

On the basis of the random walk hypothesis, an empirical weak-form test of market efficiency was conducted using the Dickey-Fuller augmented test. The Dickey-Fuller test is a statistical and econometric method used to test for stationarity in financial time series. Figure 2. presents a graph of returns over the entire study period for the UX index.

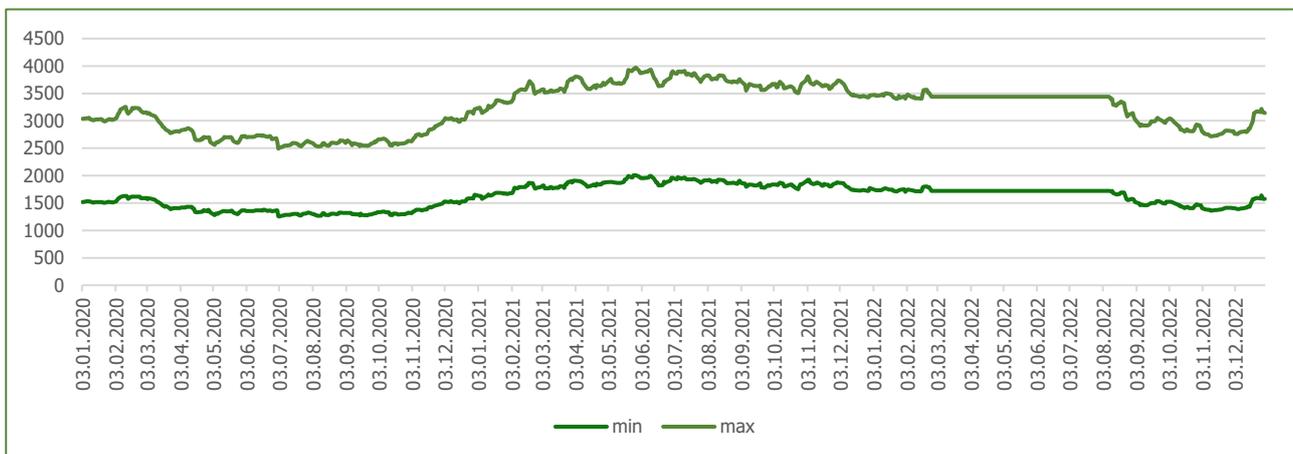


Figure 2. UX index yield minimum and maximum chart. Note: the period from 03.01.2020 to 30.12.2022.

The Y-axis represents returns (or index changes), and the X-axis represents days. From the graph, the returns appear to be constant over this period for the index. We will use the unit root test to test whether the underlying series is truly a stationary process—a precondition for a random walk process (Table 1).

The ADF statistic of the UX index is minus 33.36337 and the p-value is less than 0.000. In addition, the result shows critical values at the 1%, 5%, and 10% levels. The absolute value of the t-statistic is significant, so we reject the null hypothesis and conclude that there is no unit root and the data series is stationary. In addition, the studied data do not follow the random walk process, and the dynamics of the stock market index are inefficient in the weak form [25, 26, 29].

Table 1. The results of the advanced Dickey-Fuller test. Note: *MacKinnon (1996) One-sided p-value

Null hypothesis: UX			
Exogenous: const			
Lag length: 0 (according to auto-SIC, max. lag = 23)			
		p - Statistics	Prb.*
Statistics for the Extended Dickey Fuller Test.		-33.36337	0
Critical value controls.	2% level	-3.24125	
	5% level	-2.64982	
	10% level	-2.31668	

Before estimating a GARCH model for a financial time series, it is necessary to check for ARCH effects in the residuals. If there is no ARCH effect in the residuals, a GARCH model is not required and is not specified. For Gaussian residuals, it is equivalent to uncorrelated independent. The residuals will not be Gaussian. The ARCH-LM test was used to test ARCH effects. As part of the ARCH-LM test, the null and alternative hypotheses for both bond indices are as follows: H0: there is no ARCH effect, H1: there is an ARCH effect. Table 2 shows that Prob. Chi-Square is responsible for the null hypothesis that there is no ARCH effect in the residuals tested. The test results reject the null hypothesis and therefore conclude that there is an ARCH effect in the financial data series on the profitability of shares of the UX index.

Table 2. Testing for the ARCH effect.

ARCH test			
A - statistics	158.4355	Prb.T(1.1407)	0.0000
Obs R-squared	146.8721	Prb.C-Square (1)	0.0000

We continue testing the weak form of the efficiency of the Ukrainian stock market using the GARCH model. ARCH model and GARCH model were used to test the null hypothesis. Data on parameter estimates are given in Table 3.

Table 3. Estimation of parameters for the GARCH model.

Dependent variable: UX				
Method: ML ARCH				
Sample: from 01.01.2020 to 31.12.2022				
total observation: 1487				
Convergence achieved in 31 iterations.				
Pre-sampling variance Parameters 0.7				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Var	Coeff	Spd.Er	a-Stat	Prb.
C	0.000161	0.000426	0.3774	0.7059
dispersion equation				
C	5.06E-06	7.76E-07	6.5264	0.0000
RESID (-1)^2	0.0587	0.006	8.8808	0.0000
GARCH (-1)	0.9283	0.007	132.11	0.0000
R-squared	-0.00047	Mean Dependent variable		-0.00022
Adjusted R-square	-0.00047	S.D. Dependent variable		0.0179
S.E. of regression	0.0179	Akaike information criterion		-5.4068
Sum of squares of residuals	0.4551	Schwartz criterion		-5.3919
Log-availability	3815.84	Hanan-Quinn criteria		-5.4013
Durbin-Watson statistic	1.8960			

Table 3 shows the conditional mean and conditional variance (volatility) model for the UX government stock index that best fits the observed data:

$$h_t = 0,000161 + r_t \quad (1)$$

$$i_t^2 = 5,06e - 06 + 0,0587 * j_t^2 + 0,9283 * r_{t-1}^2 \quad (2)$$

The coefficients for both the lagged squared residual (r) and the lagged conditional variance (β) in the variance equation are statistically significant. In addition, the sum of the ARCH and GARCH coefficients ($\alpha + \beta$) of the UX stock index is very close to one, which indicates the high persistence of volatility clusters during the sample period in the market. Large sums of coefficients mean that larger positive and negative returns will lead to the fact that the future variance forecast will be high for a long period (Figure 3).

It is possible to estimate the daily volatility of the return of the UX index based on historical data and say that the Ukrainian stock market is not efficient in a weak form [25, 30].

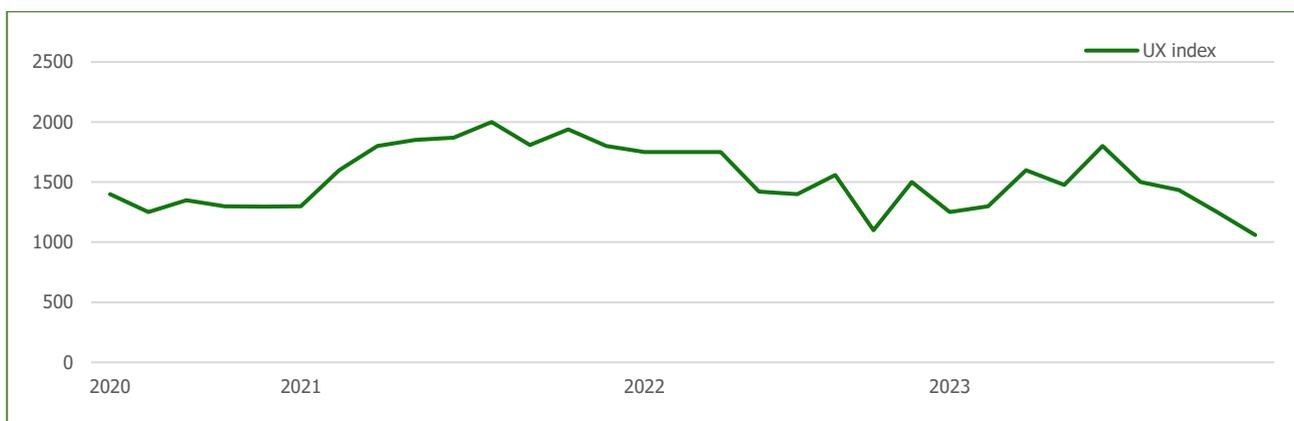


Figure 3. Volatility of the UX index. (Sources: [3])

Table 3 shows that most of the information based on forecasts of previous days is about 92% for the UX index (a fact that contradicts the hypothesis of the efficiency of financial markets), and when new information arrives, there is a minimal change, which has little effect on the long-term average variance. Thus, the results of the analysis allow stating that the Ukrainian stock market is inefficient in a weak form and shows high volatility and the absence of a stable trend.

An Empirical Study of Bond Market Efficiency and Volatility

A bond is a debt instrument that requires the issuer to repay the lender/investor receives the amount borrowed plus interest for a fixed period. As an instrument, the bond has market indicators that give the investor the property of liquidity of this instrument. The effective functioning of the bond market allows the inclusion of market mechanisms for managing debt and, therefore, the financial structure of capital [31, 32]. Therefore, the evaluation of the efficiency and volatility of the bond market is necessary for the implementation of management mechanisms embedded in the financial management system.

Long-term dependence on debt markets has important implications for market efficiency in the pricing of fixed-income securities. The efficient market hypothesis provides a standard framework for analyzing and interpreting informational efficiency in the bond market.

Changes in the volume and structure of public debt and the interest rate can affect the dynamics of the bond market, as this is an important factor affecting the efficiency of this market. Therefore, when government debt is issued for investment purposes, it is expected to affect bond prices, as the investment is expected to bring future profits, and when the Ministry of Finance issues debt instruments to finance existing debt, it can affect the stock market, as it indicates that the budget does not generate enough funds to repay the previously issued debt.

Therefore, two indices were used to analyze the efficiency of the Ukrainian bond market. The first is domestic government loan bonds - government securities placed on the domestic stock market. The domestic government loan bonds confirm the obligations of Ukraine to compensate the bearers of these bonds for their nominal value with the payment of income in accordance with the terms of placement of bonds [3].

Second - Corporate bonds. They are the main indicator of the Ukrainian corporate debt market. It includes the most liquid bonds of Ukrainian borrowers, admitted to trading on the Ukrainian Stock Exchange, with a duration of more than one year, calculated in real-time using the methods of aggregate income and net prices.

If a bond market follows a random walk pattern, it is said to have the characteristics and effects of a weak-form market, meaning that prices fully reflect the information contained in historical price movements. In these circumstances, historical price information does not allow for profit. An efficient market follows a random walk and is therefore unpredictable. An efficient market is unpredictable, but it can be tested under the random walk hypothesis [4].

The selection of these bonds is based on their general characteristics, which guarantee a fairly long time series. For our analysis, we take daily bond index returns from 2020 to 2022, giving a total observation ($U = 1234$) for government bonds and corporate bonds ($U = 1587$).

Two historical data sets of time series of government bonds, and corporate bond index were analyzed to check the efficiency of the bond market in Ukraine and the presence of volatility clustering in the Ukrainian bond market was investigated. Data normality was assessed by the Harke-Behr test and stationarity was assessed by the Dickey-Fuller (ADF) test, ARCH and GARCH models were used to study the behaviour of bond yields and to estimate the volatility model [25, 26].

Figure 4 and Figure 5 present the yield histograms of government bonds and corporate bonds.

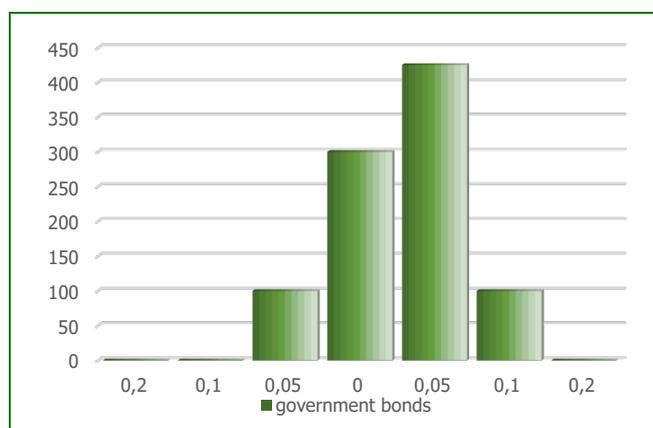


Figure 4. Histogram of the yield of government bonds.

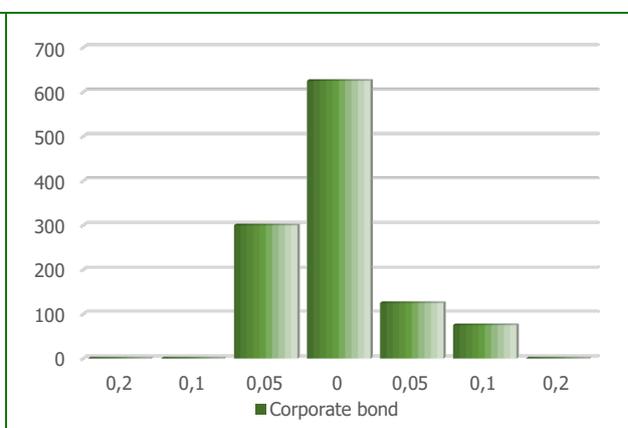


Figure 5. Corporate bond yield histogram.

The Harke-Behr test rejects the null hypothesis and the kurtosis is clearly greater than 3, especially in the case of higher kurtosis ($97.85 > 3$ for government bonds; 53.41260 for corporate bonds) and negative skewness for both, which means the residuals are not distributed correctly.

Thus, the normal distribution of returns is rejected due to the high value of the Harke-Behr statistic, and we conclude that the Ukrainian bond market is not efficient in the weak form, since the daily returns of the government and corporate bond market do not correspond to a normal distribution.

Below are graphs constructed from the logarithmic form of returns over the entire study period for the two bonds (Figure 6 and Figure 7).

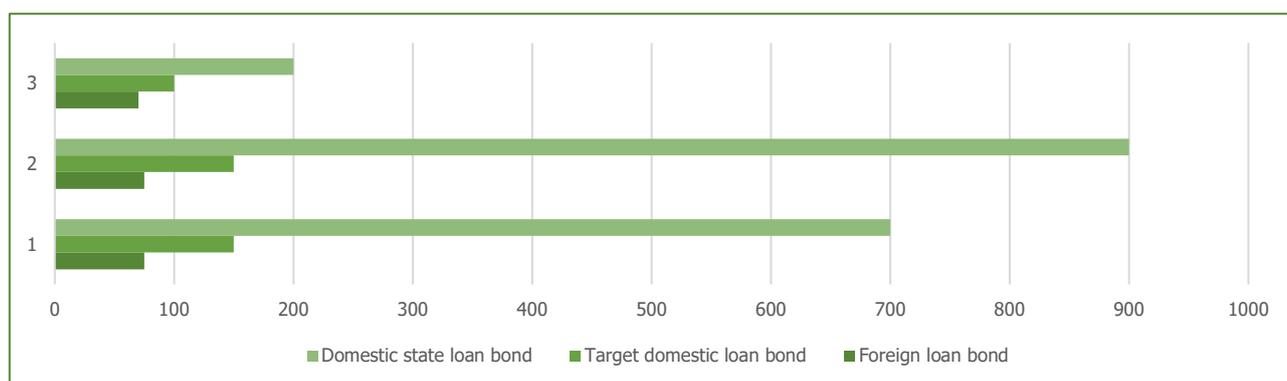


Figure 6. Changes in government bond yield.

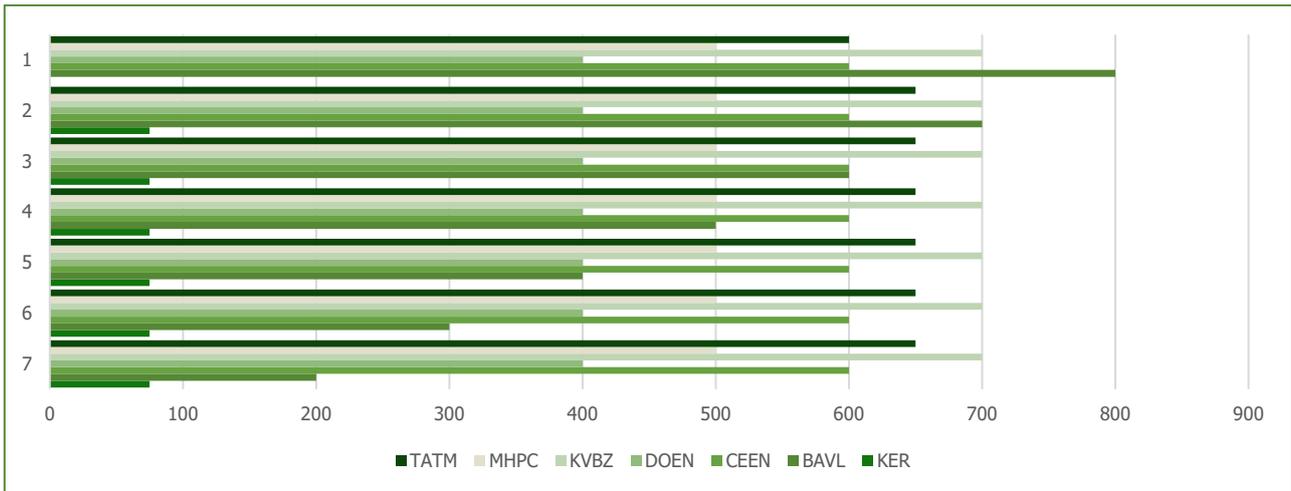


Figure 7. Change in the yield of corporate bonds.

From the graph, the yield is constant for this period of both bonds. We will use the unit root test to check whether the underlying series is truly a stationary process, a precondition for a random walk process.

In Table 4 the ADF statistic for bonds is -10,387 and the p-value is less than 0.0001. It also shows critical values at the 2%, 5% and 10% levels; the absolute value of the o-statistic is significant and rejects the null hypothesis. This means that there is no unit root and the data series is stationary; furthermore, the data do not follow a random walk process and government bonds are weakly inefficient.

Table 4. Results of the extended Dickey-Fuller test of government bonds. Note: *MacKinnon (1996) One-sided p-value			
Null Hypothesis: OBDL has a root			
Exogenous: fixed			
Lug length: 4 (according to auto-SIC, max. lug = 23)			
		o-Statistic	Prb.*
ADF test		-10,387	0.000
Critical value of the test	2% lvl	-3.434	
	5% lvl	-2.863	
	10% lvl	-2.567	

In Table 5 the statistical value of the ADF of corporate bonds rejects the null hypothesis of the existence of a unit root in corporate bond yields, in addition, the studied data do not follow a random walk process, and corporate bonds are inefficient in the weak form.

Table 5. Results of the Dickey-Fuller extended test of corporate bonds. Note: *MacKinnon (1996) One-sided p-value			
Null Hypothesis: OBDL has a root			
Exogenous: fixed			
Lug length: 2 (according to auto-SIC, max. lug = 23)			
		o-Statistic	Prb.*
ADF test		-19.621	0.000
Critical value of the test	2% level	-3,434	
	5% level	-2,863	
	10% level	-2,567	

To estimate a GARCH model for a financial time series, it is necessary to check whether there is an ARCH effect [5] in the residuals. If there is no ARCH effect in the residuals, a GARCH model is not required and is not specified. For Gaussian residuals, uncorrelated means independent. Therefore, the residuals are not Gaussian.

In Tables 6 and 7 Prb. Chi-Square is responsible for testing the null hypothesis that there is no ARCH effect in the residuals. Government bonds and corporate bonds gave similar results. According to the results of the testing, it was concluded that

the null hypothesis is rejected, therefore, the ARCH effect is present in the series of financial data on bond yields of both indices.

Table 6. Testing government bonds for the ARCH effect.				Table 7. Testing corporate bonds for the ARCH effect.			
Heteroskedasticity test: ARCH			Prb.	Heteroskedasticity test: ARCH			Prb.
Q-Statistic	4.254	Prb.U(1.1382)	0.039	H-Statistic	26.406	Prb.F(1.1424)	0.000
Obs*R-squared	4.247	Prb.Chi-Square (1)	0.039	Obs*R-squared	25.961	Prb.Chi-Square (1)	0.000

To test the weak form of efficiency of the domestic bond market the GARCH model [6] was used. ARCH model and GARCH model were used to test the null hypothesis.

Table 8 shows the conditional mean and conditional variance model for government bonds that best fits the observed data:

$$f_t = 0,00041 + y_t \tag{3}$$

$$\alpha_t^2 = 3,44E - 07 + 0,2491 * o_t^2 + 0,7414 * \alpha_{t-1}^2 \tag{4}$$

The α and β parameters of the GARCH model are positive and statistically significant for government bonds. This means that the GARCH model represents well the behaviour of daily government bond returns, as it successfully shows the time dependence of the index yield volatility. As a result, the value of $(\alpha + \beta)$ is very close to 1 for government bonds, indicating a high persistence of cluster volatility in the market over the sample period. As we can estimate the daily volatility of the bond's yield, we can find an investment strategy in the market and get excess returns. Thus, the Ukrainian government bond market is inefficient in the weak form [25, 26].

Table 8. Parameter estimation for the GARCH model (government bonds).				
Dependent Variable: OBDL				
Method: ML ARCH				
Included observations: 1385				
Presample variance: parameter = 0.7				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Var	Coeff	Spd.Er	a-Stat	Prb.
C	0.00041	4.99E-05	8.246	0.000
Variance Equation				
D	3.44E-07	3.89E-08	8.826	0.000
RESID (-1)^2 α	0.2491	0.0183	14.124	0.000
GARCH (-1) β	0.7414	0.0140	53.421	0.000
R-squared	-0.00056	Mean Dependent variable		0.00030
Adjusted R-square	-0.00056	S.D. Dependent variable		0.00471
S.E. of regression	0.00471	Akaike information criterion		-8.8205
Sum of squares of residuals	0.03073	Schwartz criterion		-8.8054
Log-availability	6112.25	Hanan-Quinn criteria		-8.8149
Durbin-Watson statistic	1.8235			

Table 9 shows the conditional mean and conditional variance model for corporate bonds that best fits the data:

$$o_t = 0,00036 + \varepsilon_t \tag{5}$$

$$\alpha_t^2 = 1,15E - 08 + 0,1667 * l_t^2 + 0,8231 * \alpha_{t-1}^2 \tag{6}$$

The lagged squared residual (α) and lagged conditional variance (β) coefficients in the variance equation are both statistically significant. In addition, the sum of the ARCH and GARCH coefficients ($\alpha + \beta$) of corporate bonds is very close to unity. Large coefficient sums mean that larger positive and negative returns will cause the future variance forecast to be high over a longer period. It is possible to estimate the daily volatility of bond yields based on the data and say that the Ukrainian corporate bond market is inefficient in its weak form.

Table 9. Estimation of parameters for the GARCH model (corporate bonds).

Dependent Variable: OBDL				
Method: ML ARCH				
Included observations: 1427				
Presample variance: parameter = 0.7				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)				
Var	Coeff	Spd.Er	a-Stat	Prb.
U	0.00036	2.46E-05	14.61	0.000
Variance Equation				
C	1.15E-08	1.84E-09	6.227	0.000
RESID (-1)^2 α	0.1667	0.0110	16.021	0.000
GARCH (-1) β	0.8231	0.0078	109.287	0.000
R-squared	-0.00016	Mean Dependent variable		0.00033
Adjusted R-square	-0.00016	S.D. Dependent variable		0.00208
S.E. of regression	0.00208	Akaike information criterion		-10.3033
Sum of squares of residuals	0.00622	Schwartz criterion		-10.2886
Log-likelihood	7355.46	Hanan-Quinn criteria		-10.2978
Durbin-Watson statistic	2.2373			

Thus, from Tables 8 and 9 information based on the previous day's forecasts shows that about 65% of the information is for corporate bonds and 85% for government bonds, which is contrary to the fact that the assumed efficiency of financial markets changes little with new information and has little impact on the long-run mean variance.

DISCUSSION

Considering certain aspects of the current state of the Ukrainian stock market and investment portfolios, it should be noted:

- most Ukrainian companies do not use the stock market to attract long-term investments;
- despite the significant impact of negative factors (high volatility, lack of a stable trend), the Ukrainian stock market remains very attractive for Ukrainian and foreign investors.

The bond market in Ukraine has been growing steadily as the lower inflation environment leads to enhanced planning by investors and borrowers due to the provision of some government support [8, 11-13].

Government bonds play a significant role in the debt market, accounting for approximately half of issued debt securities [9, 10, 16-18]. Their yield is widely used as a benchmark for private bonds of companies with low credit risk. Oil and gas, construction and development companies accounted for 75% of bonds issued by non-financial companies.

Systemic financial risk can be assessed and forecast using econometric models. Volatility risk and uncertainty in financial systems are interrelated and may contribute to more frequent defaults on payments to agents in other markets [19-23]. Large-scale risks of this kind (financial crises) can lead to crises in economic activity in the real sector (initially due to liquidity), which makes them the main point of consideration in the Ukrainian market.

CONCLUSIONS

Based on the theoretical analysis, the characteristics of the stock market efficiency hypothesis and the approach to efficiency testing were considered - simultaneously on two markets: shares and bonds.

Factors affecting market efficiency in Ukraine were considered. The main indicators and factors of the stock market in Ukraine, which have the greatest influence on the efficiency/inefficiency of the market, are analyzed, including liquidity, trading volume, capitalization size, transparency and global factors in the international stock market. Based on the analysis, evidence is provided that low liquidity in the Ukrainian bond and stock market negatively affects market efficiency, therefore increasing liquidity is an important factor in increasing market efficiency.

The effectiveness of the stock and bond markets in Ukraine was tested and the results of its practical approbation on the stock and bond market were displayed. An additional GARCH model for volatility modelling is also built and substantiated, which shows high volatility and no stable trend.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally

REFERENCES

1. Verkhovna Rada of Ukraine (2006). On Securities and Stock Market: № 3480-IV from February 23, 2006. *Bulletin of the Verkhovna Rada of Ukraine*, 31, 268. <https://zakon.rada.gov.ua/laws/show/3480-15?lang=en#Text>
2. Ministry of Finance of Ukraine (2023). Official site. <https://www.mof.gov.ua/uk>
3. Ukrainian Exchange (2023). Official site. <https://www.ux.ua/>
4. Amenc, N., Goltz, F., & Lodh, A. (2012). Choose Your Betas: Benchmarking Alter-native Equity Index Strategies. *Portfolio Management Journal*, 39, 88-111. <http://dx.doi.org/10.3905/jpm.2012.39.1.088>
5. Engle, R. F. (1982). Autoregressive conditional variance with estimated variance of the UK inflation rate, 50(4), 987-1008. <https://doi.org/10.2307/1912773>
6. Bollerslev, T. (1986). Generalized autoregressive conditional variance, *Journal of Econometrics*, 31(3), 307-327. http://public.econ.duke.edu/~boller/Published_Papers/joe_86.pdf
7. Garbowski, M., Mironova, D., Perevozova, I., Khrushch, N., & Gudz, I. (2019). The impact of IPOs on countries' macroeconomic security. *Journal of Security and Sustainability Issues*, 8(4), 841-853. [http://doi.org/10.9770/jssi.2019.8.4\(24\)](http://doi.org/10.9770/jssi.2019.8.4(24))
8. Hutsaliuk, O., Koval, V., Tsimoshynska, O., Koval, M., & Skyba, H. (2020). Risk Management in Integrated Corporate Strategy Formation of Enterprises. *Tem Journal*, 9(4), 1514-1523. <https://doi.org/10.18421/tem94-26>
9. Nitsenko, V., Mukoviz, V., & Sharapa, O. (2017). Accounting of transaction expenses of economic entities. *Bulletin of Polysia Science*, 4(12/2), 71-78. [https://doi.org/10.25140/2410-9576-2017-2-4\(12\)-71-78](https://doi.org/10.25140/2410-9576-2017-2-4(12)-71-78)
10. Danyliuk, V., Riepina, I., Shafalyuk, O., Kovylyna, M., & Nitsenko, V. (2020). Functional and investment strategies for enterprise technology development. *Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu*, 3, 115-121. <https://doi.org/10.33271/nvngu/2020-3/115>
11. Shkolnyk, I., Frolov, S., Orlov, V., Dziuba, V., & Balatskyi, Ye. (2021). Influence of world stock markets on the development of the stock market in Ukraine. *Investment Management and Financial Innovation*, 18(4), 223-240. [https://doi.org/10.21511/imfi.18\(4\).2021.20](https://doi.org/10.21511/imfi.18(4).2021.20)
12. Nitsenko, V., Chukurna, O., Mardani, A., Streimikis, J., Gerasymchuk, N., Golubkova, I., & Levinska, T. (2019). Pricing in the cognitive marketing concept in the context of globalization: theoretical, methodological and applied aspects. *Montenegrin Journal of Economics*, 15(4), 131-147. <https://doi.org/10.14254/1800-5845/2019.15-4.10>
13. Boungou, W., & Yatié, A. (2022). The impact of the Ukraine-Russia war on world stock market returns. *Economics Letters*, 215, 110516. <https://doi.org/10.1016/j.econlet.2022.110516>
14. Gaio, L.E., Stefanelli, N.O., Pimenta, T., Bonacim, C.A.G., & Gatsios, R.C. (2022). The impact of the Russia-Ukraine conflict on market efficiency: evidence from developed equity markets. *Finance Research Letters*, 50, 103302. <https://doi.org/10.1016/j.frl.2022.103302>
15. Bazaluk, O., Zhykharieva, V., Vlasenko, O., Nitsenko, V., Streimikiene, D., & Balezentis, T. (2022). Optimization of equity in the construction of investment portfolios of shipping companies. *Mathematics*, 10(3), 363. <https://doi.org/10.3390/math10030363>
16. Najaf, K., Joshipura, M., & Alshater, M. (2023). War build-up and stock returns: evidence from Russian and Ukrainian stock markets. *Journal of Risk Finance*, 24(3), 354-370. <https://doi.org/10.1108/JRF-05-2022-0107>
17. Obi, P., Waweru, F., & Nyangu, M. (2023). Event study of equity and commodity market reactions to

- the outbreak of the Russia-Ukraine conflict. *Journal of Risk and Financial Management*, 16(5), 256. <https://doi.org/10.3390/jrfm16050256>
18. Zayed, N.M., Mohamed, I.S., Islam, K.M.A., Perevozova, I., Nitsenko, V., & Morozova, O. (2022). Factors Influencing the Financial Situation and Management of Small and Medium Enterprises. *J. Risk Financial Manag.*, 15, 554. <https://doi.org/10.3390/jrfm15120554>
 19. Plastun, A., Makarenko, I., Huliaieva, L., Guzenko, T., & Shalyhina, I. (2023). ESG and traditional indices: A comparison of effectiveness in the Ukrainian stock market. *Investment Management and Financial Innovation*, 20(2), 1-15. [https://doi.org/10.21511/imfi.20\(2\).2023.01](https://doi.org/10.21511/imfi.20(2).2023.01)
 20. Reznik, N., Abuselidze, G., Ostapchuk, A., & Tkachuk, V. (2019). Experience with state regulation of stock exchange activities in Ukraine. *SHS Web of Conferences*, 71, 02002. <https://doi.org/10.1051/shsconf/20197102002>
 21. Ahmed, S., Hasan, M.M., & Kamal, Md. R. (2022). Russia-Ukraine crisis: Impact on European equity markets. *European Financial Management*. <https://doi.org/10.1111/eufm.12386>
 22. Caporale, G., Gil-Alana, L., Plastun, A., & Makarenko, I. (2013). Long memory and financial crisis on the Ukrainian stock market. Working Paper, 13-27. <http://dx.doi.org/10.2139/ssrn.2504985>
 23. Perevozova, I., Malynka, O., Nitsenko, V., Kryshchal, H., Kostyuk, V., & Mishchenko, V. (2023). Analysis of Mortgage Trends in the Agricultural Sector in Ukraine. *J. Risk Financial Manag.*, 16, 255. <https://doi.org/10.3390/jrfm16050255>
 24. Blikhar, M., Vinichuk, M., Patsula, O., & Shevchenko, N. (2022). Methods of assessing the market capitalization level of joint stock companies: economic and managerial aspects. *Economics. Ecology. Socium*, 6, 65-75. <https://doi.org/10.31520/2616-7107/2022.6.4-6>
 25. Hall, S. G., & Miles, D. K. (1992). Measuring Efficiency and Risk in the Major Bond Markets. *Oxford Economic Papers*, 44(4), 599–625. <http://www.jstor.org/stable/2663381>
 26. Adekoya, O. B., Oliyide, J. A., Asl, M. G., & Jalalifar, S. (2021). Financing the green projects: Market efficiency and volatility persistence of green versus conventional bonds, and the comparative effects of health and financial crises. *International Review of Financial Analysis*, 78, 101954. <https://doi.org/10.1016/j.irfa.2021.101954>
 27. Levytska, S., Pershko, L., Akimova, L., Akimov, O., Havrilenko, K., & Kucherovskii, O. (2022). A risk-oriented approach in the system of internal auditing of the subjects of financial monitoring. *International Journal of Applied Economics, Finance and Accounting*, 14(2), 194-206. <https://doi.org/10.33094/ijaefa.v14i2.715>
 28. Mironova, N., Koptieva, H., Liganenko, I., Sakun, A., & Chernyak, D. (2022). Modeling the selection of innovative strategy for development of industrial enterprises. *WSEAS Transactions on Business and Economics*, 19, 278-291. <https://doi.org/10.37394/23207.2022.19.26>
 29. Kulikov, P., Aziukovskiy, O., Vahonova, O., Bondar, O., Akimova, L., & Akimov, O. (2022). Post-war economy of Ukraine: Innovation and investment development project. *Economic Affairs*, 67(5), 943-959. <https://doi.org/10.46852/0424-2513.5.2022.30>
 30. Melnyk, D. S., Parfylo, O. A., Butenko, O. V., Tykhonova, O. V., & Zarosylo, V. O. (2022). Practice of the member states of the European Union in the field of anti-corruption regulation. *Journal of Financial Crime*, 29(3), 853-863. <https://doi.org/10.1108/JFC-03-2021-0050>
 31. Sytnyk, H. P., Zubchuk, O. A., & Orel, M. H. (2022). Conceptual Understanding of the Peculiarities of Managing Innovation-Driven Development of the State in the Current Conditions. *Science and Innovation*, 18(2), 3-15. <https://doi.org/10.15407/scine18.02.003>
 32. Kalina, I., Khurdei, V., Shevchuk, V., Vlasiuk, T., & Leonidov, I. (2022). Introduction of a corporate security risk management system: The experience of Poland. *Journal of Risk and Financial Management*, 15(8). <https://doi.org/10.3390/jrfm15080335>

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ЕКОНОМЕТРИЧНА ОЦІНКА ЕФЕКТИВНОСТІ ТА ВОЛАТИЛЬНОСТІ ФОНДОВОГО РИНКУ В УКРАЇНІ

Актуальність результатів представленої дослідження пов'язана з їхньою затребуваністю і з боку інвесторів та емітентів, і з боку вчених-дослідників. Методики, що використовуються, дозволяють визначити загальний тренд руху ринку в бік підвищення або зниження його ефективності. Для інвесторів така оцінка ефективності ринків акцій та

облігацій створює базу для оптимізації розподілу активів при побудові портфельних стратегій, а для емітентів є основою побудови стратегії емісійної діяльності. Проаналізовано чинники, які впливають на ефективність українського ринку, і показано, що неліквідність українського облігаційного та фондового ринку негативно впливає на загальну ефективність ринку, а тому необхідно підвищувати ліквідність, яка є важливим фактором для зростання ефективності ринку. Аналіз ефективності ринків акцій та облігацій представлено як вплив на самі ринки. Для вчених-дослідників передбачуваність прибутковості або відсутність такої передбачуваності має визначальне значення для створення моделей, які здатні точно описати ризики й прибутковість на фінансових ринках.

У статті пропонується застосувати інший підхід до дослідження ефективності фондового ринку, використовуючи модель параметрів, що змінюється в часі, яка може оцінювати індикатори, ефективність і неефективність при зміні параметрів.

Ключові слова: фондовий ринок, акції, облігації, волатильність, економетрична модель, індекс

JEL Класифікація: C1, G11, G14