

DOI: <https://doi.org/10.57125/FEL.2024.03.25.08>

How to cite: Lukianykhin, V., Skorokhod, I., Vidomenko, O., Zhuzhukina, N., & Redko, K. (2024). Analyzing the Challenges of Diversifying the Future Economy of Ukraine. *Futurity Economics&Law*, 4(1). 125-143. <https://doi.org/10.57125/FEL.2024.03.25.08>

Analyzing the Challenges of Diversifying the Future Economy of Ukraine

Vadym Lukianykhin*

PhD in Economics, Associate Professor, Senior Lecturer, Educational and Scientific Institute of Business, Economics and Management of Sumy State University, Department of Management named after Oleg Balatsky, Sumy, Ukraine, <https://orcid.org/0000-0002-7436-6836>

Iryna Skorokhod

PhD in Economics, Docent, Department of Economics and Entrepreneurship, Faculty of Economics and Law Odessa I.I. Mechnikov National University, Odessa, Ukraine, <https://orcid.org/0009-0009-7375-8211>

Oksana Vidomenko

PhD in Economics, Associate Professor of the Department of Economics and Law, National University of Food Technologies, Kyiv, Ukraine, <https://orcid.org/0000-0001-7646-9882>

Natalia Zhuzhukina

PhD in Economics, Associate Professor of the Department of Economics and Law, National University of Food Technologies, Kyiv, Ukraine, <https://orcid.org/0000-0001-9125-5129>

Kateryna Redko

PhD, Associate Professor, Senior Researcher, Centre for Innovations and Technological Development, State Institution «G.M. Dobrov Institute for Scientific and Technological Potential and Science History Studies»NASU, Kyiv, Ukraine, <https://orcid.org/0000-0003-2609-3471>

*Corresponding author: lukianykhin@biem.sumdu.edu.ua.

Received: December 23, 2023 | **Accepted:** March 5, 2024 | **Available online:** March 19, 2024

Abstract. Ukraine encounters a multitude of obstacles that necessitate resolution in order to enhance its economy. Key factors such as GDP growth, foreign direct investment flows, government

efficiency, interest rates, research and development investment, and trade openness have a significant impact on diversification processes. Managing these characteristics can be highly demanding when striving to develop a resilient and diverse economic structure. The analysis illustrates the influence of several economic conditions on Ukraine's diversity from Q1-1996 to Q4-2022. The autoregressive distributed lag (ARDL) method is employed to examine the relationship between series. The ZA unit root test determines the stationarity of data using a mixed order of integration. The Gregory-Hansen and the bound ARDL co-integration tests confirm the presence of co-integration among series. The findings indicate that GDP, RIR, and TO have a detrimental influence on DIV, whereas FDI, GOVEF, and R&D have a notable beneficial impact on it. The short-term data produced comparable results, albeit in smaller amounts. The inclusion of the co-integrating element in the model facilitates the convergence towards a long-term equilibrium state with an annual growth rate of 18.39%. The utilization of the wavelet method is applied for evaluating diversification because it can identify both short-term variations and long-term patterns in non-stationary data. Overall, the research suggests that it is advisable to use thorough and flexible diversification techniques to increase the variety of traded goods and develop a strong institutional framework to minimize the effects of unforeseen disruptions and inefficient resources Ukraine.

Keywords: Diversification, Diverse economic structure, Econometrics, Economy, Economy of Ukraine, GDP; Foreign direct investment, Government effectiveness, Gregory-Hansen test, ARDL, Wavelet approach

Introduction

The global market is currently experiencing significant transformations. While knowledge-based economies and new technologies are gaining significance, traditional enterprises are losing relevance (Yang et al., 2024). This change poses both obstacles and opportunities for countries pursuing long-term economic success. Diversification is becoming more important in our fast-changing world (Crupi & Schilirò, 2023).

A diverse economy enhances its ability to withstand exogenous shocks. When a specific sector undergoes a decrease, other sectors can function as protections to lessen the total negative effect (Hynes et al., 2020). It is crucial in a globalized society where events can quickly affect multiple nations and change prices and distribution networks. Leveraging strengths and diversifying into other businesses and technology can help a country grow long-term (Nguyen & Schinckus, 2023).

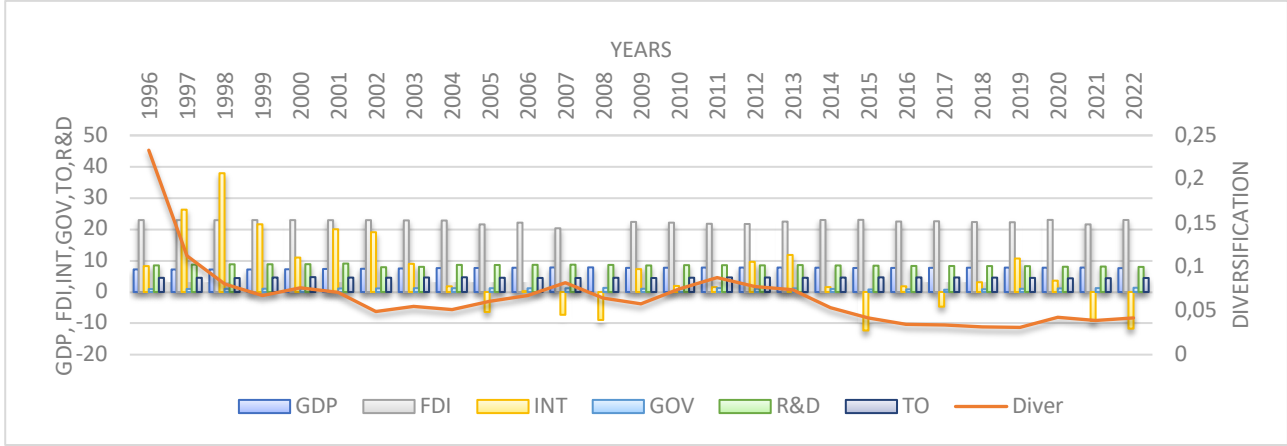
While acquiring diversity may be difficult. We need an integrated approach that considers internal and external factors. In a country, institutions, infrastructure, and financial investment in citizens are factors. External factors include global trade, FDI, and regional integration (Abam, 2022).

Ukraine serves as a prime location to examine the benefits and drawbacks of economic diversity. Following regaining independence in 1991, Ukraine initiated a transition phase aimed at reducing its dependence on heavy industries and agriculture inherited from the Soviet era. The economy faced tremendous hurdles as inflation rose and GDP dropped in the initial years (Prohorovs, 2022). Since then, Ukraine's economy has progressively shifted towards a market-oriented structure, enticing international investment and seeing phases of moderate expansion. However, there are still substantial obstacles that prevent the country from achieving a strong and diverse economy.

Ukraine is confronted with a substantial obstacle as a result of its substantial reliance on a restricted range of exports. The agriculture industry, particularly in grain production, remains the primary catalyst, making a substantial contribution to export revenue. Ukraine's economy is vulnerable to changes in global commodity prices and environment conditions because it heavily depends on these

factors. Furthermore, the crisis in eastern Ukraine has adversely affected commerce and investment, hence exacerbating the challenges associated with diversification (Snow, 2023). Figure 1 displays the data of all independent factors that are considered in this study, as well as the statistics of Ukraine's economy diversification from 1996 to 2022.

Figure 1
Relationship of diversification with considered variables



Source: WDI (2024).

Gaining a comprehensive understanding of the difficulties and opportunities associated with economic diversification is of utmost importance for Ukraine's future economic success. This knowledge may also help other emerging economies going through similar processes. Matsumoto et al. (2023) stress the importance of promoting technological growth and innovation to diversify economies following war. In a similar vein, Mohamed and Vadeveloo (2023) highlight the need of strong government frameworks and targeted initiatives in fostering diversification.

Further investigation is necessary to examine the elements that impact diversification of economy in Ukraine. This research adds to the literature on diversification in Ukraine, which needs more study. Detailed analysis of Ukraine's economic diversification difficulties and potential is the goal of this research. This will be achieved by considering GDP, FDI, government effectiveness, interest rates, R&D expenditure, and trade openness.

Research Problem

The economy of Ukraine is presently at a crucial turning point (Welfens, 2023). The nation relies on a limited range of exports, mostly agricultural commodities, while moving from Soviet industrialization. Ukraine's sensitivity to exogenous disruptions limits long-term diversification. Diversification helps build a strong future by reducing reliance on a few businesses. The composite Ukrainian situation provides enormous obstacles. Violence, slow infrastructure development, and a dynamic innovation landscape cause problems (Shubalyi & Gordiichuk, 2022). Studies show that emerging countries must priorities economic diversification (Nibedita & Irfan, 2024). This study examines Ukraine's post-conflict transition and its unique challenges. The study uses current data to show how the economy and recent events, including the fighting, are evolving. This study analyses the relationships between economic conditions and diversity to help policymakers grow the Ukrainian economy.

Research Focus

This study investigates the primary elements that contribute to economic diversification in Ukraine in order to fill the existing information gap. This study investigates the relationship GDP, foreign direct investment (FDI), government effectiveness, interest rates, investment in research and development (R&D) and trade openness. Gaining a thorough comprehension of the obstacles and prospects for Ukraine's economic development is crucial.

This study offers a thorough analysis to aid policymakers and individuals in promoting economic development by providing evidence-based suggestions for improving the stability and diversity of the Ukrainian economy in the future. The study's findings can be utilized as a beneficial point of reference.

Research Aim and Research Questions

To understand the factors influencing diversification of the Ukrainian economy from 1996 to 2022, focusing on the impact of foreign direct investment, government effectiveness, research and development, GDP, interest rates, and trade openness.

How exactly did foreign direct investment, government effectiveness, research and development, GDP, interest rates, and trade openness influence the diversification of the Ukrainian economy during this period?

How the study is organized: In Section 2, we review all relevant theoretical and empirical works. Section 3 describes the empirical technique, which includes data sources, an empirical model, and an estimating strategy. The empirical study's results and discussion are in Section 4. Section 5 presents the study's findings and policy recommendations.

Literature review

Theoretical literature

Nakibullah (2018) summarized that diversification places significant emphasis on the crucial role of economic development, which involves minimizing reliance on a restricted range of industries and exports. An examination of many fundamental principles might offer valuable understanding of the obstacles and possibilities that Ukraine encounters in its quest for increased variety.

The structural transformation theory, first introduced by Chenery and Elkington (1979) highlighted the change from an agricultural economy to one with a growing service and industry sector. Agriculture initially drives exports and jobs in emerging economies. Progress requires redistributing resources to knowledge-based services, expanding options. Agriculture's share of Ukraine's GDP has dropped, signaling an economic shift. Limited industrial diversification and a growing service sector make this shift difficult for the nation (Schlogl et al., 2020).

According to Cardoso (1977), dependency theory links emergent economies to established economies in an unfair exchange dynamic. This circumstance makes diversification difficult and promotes underdevelopment by relying heavily on exporting vital commodities.

Ukraine's strong dependence on agricultural exports raises issues about the validity of the dependency theory. It is crucial to redirect the emphasis of diversification towards diminishing the country's reliance on raw materials and fostering the enhancement of value within the country (Al-Ababneh et al., 2021).

Romer (1986) proposed the Endogenous Growth Theory, which highlights the implication of knowledge, innovation, and human capital in stimulating long-term economic growth. Diversification naturally emerges in a flourishing and inventive economy.

In order to diversify its sectors, Ukraine should allocate resources towards education, research and development, and cultivate an environment that promotes innovation (Starostina et al., 2023).

The Institutional Economics Perspective, as championed by North (1995), highlights the influence of institutions, such as property rights, contract enforcement, and government efficiency, on economic growth and change. Institutions that lack certainty might create difficulties in spending and impede the process of diversification. Starostina et al. (2023) highlight the importance of rectifying institutional deficiencies and supporting effective governance in order to increase the attractiveness of foreign direct investment (FDI), encourage entrepreneurship, and establish a favorable climate for diversification.

Empirical Literature

Ross and Werker (2024) concluded that many nations understand the need of diversifying their economy. Countries with abundant resources are undertaking measures to diversify their economies in order to improve economic performance and stabilize their financial situation. Liu et al. (2023) analyzed the relationship of the trade on the export revenues of Chinese manufacturing firms and the importance of research and development in expanding their range of exported products. Companies deeply engaged in commerce with the United States witnessed a decline in their export revenues amidst the trade dispute. However, organizations who allocated a higher amount of resources towards research and development encountered a comparatively smaller adverse impact. Furthermore, companies that make substantial investments in research and development are more likely to have a greater probability of long-term viability. This is attributed to their capacity to allure new clientele in diverse areas and efficiently exploit specialized market sectors.

Jolo et al. (2022) conducted an analysis of the links that led to economic diversity in 14 resource-rich nations from 2001 to 2019, using six different models. The model assumptions in this instance were developed using feasible generalized least squares regression. Evidence strongly economic diversity is significantly negatively affected by FDI and GDP growth.

Matallah (2022) analyzed the influence of governance on the process of economic diversification in 11 oil-rich nations in the Middle East and North Africa (MENA) region, as well as three countries (Canada, Norway, and Malaysia) that have successfully achieved economic diversification from 1996 to 2018 by employing the generalized method of moments (GMM) estimator. Diversification is often more successful in countries with robust governance, but it may not produce the same advantages in oil-exporting MENA nations grappling with elevated oil prices. The collaboration between competent governance and revenue from oil provides support for MENA oil exporting nations and similar countries to enhance their economic operations. Transitioning from the governance index of MENA oil producers to the mean governance index of Canada, Norway, and Malaysia led to a 4.5% augmentation in diversification.

Fosu (2021) examined the panel data from 29 African nations covering the period from 1971 to 2010 to estimate a dynamic model that includes the usual variables found in the Export Diversification Equation, such as foreign direct investment (FDI). Generalised Least Squares (GLS) and the two-step System Generalised approaches of Moments (SYS-GMM) are two frequently employed estimation approaches. The data indicated that there was a positive correlation between the level of foreign direct investment (FDI) and export diversification.

Espoir (2020) examined the determinants of the variations in exports among SADC (Southern African Development Community) nations from 1990 to 2018. The study employed a range of explanatory variables to examine the changes in the Herfindahl-Hirschman index, which measures the degree of export diversification, over a period of time. The results of DOLS estimation technique shows a long-term association between export diversity, per capita GDP, trade openness, human and physical capital growth, and FDI.

This study investigates the correlation between competitiveness and the efficacy of economic diversity through a meticulous empirical methodology. This study is interesting because it concurrently investigates the influence of economic factors and structural variables on economic diversity across multiple models. An analysis of the structural characteristics of resource-rich countries can offer valuable insights into their institutional frameworks, pinpointing specific areas that may require legal revisions.

Research Methodology

Instrument and Procedure

The study employs a comprehensive set of time series data on Ukraine, covering the period from Q1-1996 to Q4-2022, which is carefully balanced and representative. The study investigated a prolonged time, hence improving the dependability and usefulness of the findings. The Hirschman-Herfindahl index is used to measure diversity by analyzing how trade value is distributed among an exporter's partners. When a country engages in trade with multiple markets, the resulting index number will be around 1. Similarly, a country's commerce is considered fully diversified when its index approaches zero. The data is taken from world bank. The data of gross domestic production(GDP), measured in per capita (constant 2015 US\$), foreign direct investment (FDI), measured by net (BoP, current US\$) real interest rate (RIR) in %, and trade openness (TO), measured by % of GDP are retrieved from WDI (2024). Governance effectiveness is taken from worldwide governance indicators. The data used was transformed into a logarithmic form to avoid any non-linearity problems.

Data Analysis

Following the studies of (Albiman et al., 2022; Carrasco & Tovar-García, 2021; Fonchamnyo & Akame, 2017; Herzer & Nowak-Lehmann D, 2006), this study has formulated the following function:

$$DIV = f(GDP, FDI, GOVEF, RIR, R \& D, TO) \quad (1)$$

In equation (1), DIV represents the diversification, GDP is domestic gross production, FDI denotes foreign direct investment, GOVEF shows the index of government effectiveness, RIR is the real interest rate, R&D represents research and development whereas, TO is the trade openness. The study formulated the following equation for estimation.

$$DIV_t = \beta_0 + \beta_1 GDP_t + \beta_2 FDI_t + \beta_3 GOVEF_t + \beta_4 RIR_t + \beta_5 R \& D_t + \beta_6 TO_t + \mu_t \quad (2)$$

The coefficients in the equation are represented by " β ", while the error term is denoted by μ . The coefficients of all variables in Equation (2) represent the elasticity of the parameters and are all in the natural logarithm (Majid Awan et al., 2024).

After standard descriptive statistics and correlation matrix, the unit root problems are common with time series data (Awan et al., 2020). In order to find the level of stationarity of the data, this study used Zivot and Andrews (2002) unit root tests were used to Identify stationary characteristics and detect single and double structural breaks in a time series dataset. The ZA unit root test can either find

an interceptor a pattern, or it can find both. This test looks at the serial association and a single break in the structure.

This study adopted the Gregory and Hansen (1996) method that incorporates a structural break that is specified by the system itself. Gregory and Hansen utilized a residual-based methodology to tackle the difficulty of discovering co-integration relationships in the presence of structural cracks. Establishing the ADF t-statistic values is necessary to locate the structure break. Gregory and Hansen's technique considers a single structural rupture that could affect the intercept, trend, or level shift (Majid Awan et al., 2024).

The Autoregressive Distributive Lag (ARDL) bound test formulated by Pesaran et al. (2001) is also utilized for evaluating stability. ARDL enables the concurrent estimation of long-term and short-term model components, resolving problems like autocorrelations (Pata & Isik, 2021). ARDL employs a uniform economic approach for in following regression equation:

$$\begin{aligned} \Delta DIV_t = & \beta_1 + \beta_2 t + \beta_3 DIV_{t-1} + \beta_4 GDP_{t-1} + \beta_5 FDI_{t-1} + \beta_6 GOVEF_{t-1} + \beta_7 RIR_{t-1} \\ & + \beta_8 R \& D_{t-1} + \beta_9 TO_{t-1} + \sum_{a=0}^m \lambda_a \Delta DIV_{t-a} + \sum_{b=0}^m \lambda_b \Delta GDP_{t-b} + \sum_{c=0}^m \lambda_c \Delta FDI_{t-c} + \sum_{d=0}^m \lambda_d \Delta GOVEF_{t-d} \\ & + \sum_{e=0}^m \lambda_e \Delta RIR_{t-e} + \sum_{f=0}^m \lambda_f \Delta R \& D_{t-f} + \sum_{g=0}^m \lambda_g \Delta TO_{t-g} + \mu_t \end{aligned} \quad (3)$$

Where, in equation (3)

$$H_0 : \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9$$

$$H_1 : \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq \beta_8 \neq \beta_9$$

H_0 shows the null hypothesis and H_1 means alternative hypothesis

Within the context of the upper limit test for co-integration, the null hypothesis that co-integration does not exist is rejected when the value of the F-statistic is greater than the upper bound that has been predetermined by Pesaran et al. (2001). The error correction model (ECM) is utilized through autoregressive distributed lag (ARDL) when there exists a persistent association between the variables in the model (Işik, 2010). The technique ECM is significant for defining both the long-run equilibrium and short-run relationship in the model. It can be expressed as follows:

$$\begin{aligned} \Delta DIV_t = & \beta_1 + \beta_2 t + \sum_{a=0}^m \lambda_a \Delta DIV_{t-a} + \sum_{b=0}^m \lambda_b \Delta GDP_{t-b} + \sum_{c=0}^m \lambda_c \Delta FDI_{t-c} + \sum_{d=0}^m \lambda_d \Delta GOVEF_{t-d} \\ & + \sum_{e=0}^m \lambda_e \Delta RIR_{t-e} + \sum_{f=0}^m \lambda_f \Delta R \& D_{t-f} + \sum_{g=0}^m \lambda_g \Delta TO_{t-g} + \gamma ECT_{t-1} + \mu_t \end{aligned} \quad (4)$$

In equation (4), the ECT_{t-1} denotes the error correction term from the previous period in equation (27). The rate at which the system moves from a short-run equilibrium to a long-run equilibrium is represented by the acronym ECM. The γ denotes the ECM coefficient value and should have negative sign. Finally, diagnostic tests were done to confirm the structural integrity of the model. These tests included assessments of residual term normality, ARCH tests, and LM tests for serial correlation.

Results

The objective of this research is to analyze the impact of GDP, FDI, GOVEF, RIR, R&D, and TO on DIV in Ukraine from the first quarter of 1996 to the fourth quarter of 2022. This part provides a comprehensive report on the outcomes we have accomplished.

Table 1 presents the results of descriptive statistics as well as matrix correlation. Results show the maximum values for Diversification (DIV), GDP, FDI, government effectiveness (GOVEF), real interest rate (RIR), R&D and trade openness (TO): 0.2331, 7.8628, 23.0396, 1.3561, 37.9286, 9.0845 and 4.7513, respectively. The lowest possible values for the variables under consideration are 0.0310, 7.1836, 0.0000, 0.7303, -12.2829, 7.9208, and 4.3714. When it comes to GDP, FDI is at the top, with R&D coming in second. The RIR variable has a larger standard deviation compared to the others. There is a decline in DIV when GDP, FDI, and TO are examined in pairs. Gross domestic product and gross olive oil yield are positively correlated.

Table 1

Descriptive and correlation values

	DIV _t	GDP _t	FDI _t	GOVEF _t	RIR _t	R&D _t	TO _t
Mean	0.0643	7.6171	21.6019	1.0801	5.6847	8.4955	4.5679
Median	0.0618	7.7111	22.5473	1.1051	3.6087	8.5373	4.5743
Maximum	0.2331	7.8628	23.0396	1.3561	37.9286	9.0845	4.7513
Minimum	0.0310	7.1836	0.0000	0.7303	-12.2829	7.9208	4.3714
Std. Dev.	0.0313	0.2221	3.6727	0.1442	11.3118	0.2677	0.0835
DIV _t	1.0000						

GDP _t	-0.4800	1.0000					
	0.0000	-----					
FDI _t	-0.0099	-0.3226	1.0000				
	0.919	0.0008	-----				
GOVEF _t	0.0315	0.1868	-0.3374	1.0000			
	0.7495	0.0563	0.0004	-----			
RIR _t	0.3750	-0.7764	0.3193	-0.1774	1.0000		
	0.0001	0.0000	0.0009	0.0702	-----		
R&D _t	0.4602	-0.4080	-0.1299	0.0104	0.3816	1.0000	
	0.0000	0.0000	0.1864	0.9158	0.0001	-----	
TO _t	-0.0425	-0.1955	0.1683	-0.3558	0.0537	0.2567	1.0000
	0.6664	0.0456	0.0860	0.0002	0.5862	0.0082	-----

Note: Std. Dev. Standard deviation. DIV= Diversification, GOVEF = Government effectiveness, RIR = Real interest rate, TO = Trade openness.

Non-stationarity caused by structural cracks can have an impact on unit root tests, resulting in unreliable predictions and outcomes (Ramzan et al., 2022). Conventional unit root tests do not consider any disruptions in the pattern of the series. Consequently, it lacks effectiveness in elucidating concepts, resulting in a heightened level of difficulty in grasping the data (Chandio et al., 2020). The ZA unit root test employs multivariate regression analysis to detect temporal discontinuities within a dataset (Işik et al., 2017). The outcomes of the ZA unit root tests are presented in Table 2.

Table 2

Results of ZA Unit Root Test

	@Level		@First difference		
Variables	t-statistics	Break Year	t-statistics	Break Year	Integration order
DIV _t	-6.436***	2013q2	---	---	I (0)
GDP _t	-2.122	2002q2	-5.6777***	2020q4	I (1)
FDI _t	-4.189	2006q2	-10.564***	2008q2	I (1)
GOVEF _t	-1.994	2011q2	-9.317***	2017q2	I (1)
RIR _t	-4.834**	2002q2	---	---	I (0)
R&D _t	-5.410***	2004q3	---	---	I (0)
TO _t	-4.776*	2018q2	---	---	I (0)

Note: The symbols ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively. The critical values for the ZA test at a significance level of 1% are -5.34, at 5% are -4.80, and at 10% are -4.58.

It is critical to select the proper latency duration before utilizing ARDL to estimate long-term parameters. Therefore, the appropriate duration of the lag is ascertained through the utilization of the VAR lag order selection criterion; the findings are displayed in Table 3.

Table 3

VAR lag length selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-82.72718	NA	1.37e-08	1.759357	1.939502	1.832303
1	1094.616	2170.005	3.38e-18	-20.36502	-18.92386	-19.78145
2	1401.569	523.6258	2.18e-20	-25.42293	-22.72075	-24.32872 ^a
3	1413.758	19.11999	4.63e-20	-24.70114	-20.73795	-23.09631
4	1436.243	32.18375	8.32e-20	-24.18123	-18.95702	-22.06577
5	1512.881	99.17870	5.39e-20	-24.72315	-18.23793	-22.09706
6	1638.054	144.8083 ^a	1.44e-20 ^a	-26.21675 ^a	-18.47050 ^a	-23.08003

Abbreviations: AIC= Akaike information criterion; FPE= Final prediction error; HQ= Hannan-Quinn information criterion; LR= sequential modified LR test statistic (each test at 5% level); SC, Schwarz information criterion. ^a Indicates lag order selected by the criterion.

The results of the co-integration test conducted by Gregory and Hansen (1996), as shown in Table 3, indicate that the ADF, Z_t , and Z_a values surpass their corresponding critical values at 1%, 5%, and 10% level of significance. This suggests that the model variables exhibit co-integration, as there is evidence of both a regime and trend in the fourth quarters of 2013 and 2008.

Table 4

Outcomes of Unit Root Test

Test	Statistic Value	Structural break	Critical Values		
			1%	5%	10%
ADF	-6.04**	2013q4	-6.05	-5.56	-5.31
Z_t	-17.12***	2008q4	-6.05	-5.56	-5.31
Z_a	-67.27**	2008q4	-70.18	-59.40	-54.38

Note: *** shows significant at 1% level and ** shows significant at 5% level.

ARDL bound test is also applied to check the robustness of the data. The outcome is presented in Table 5.

Table. 5

Results of ARDL-Bound Test

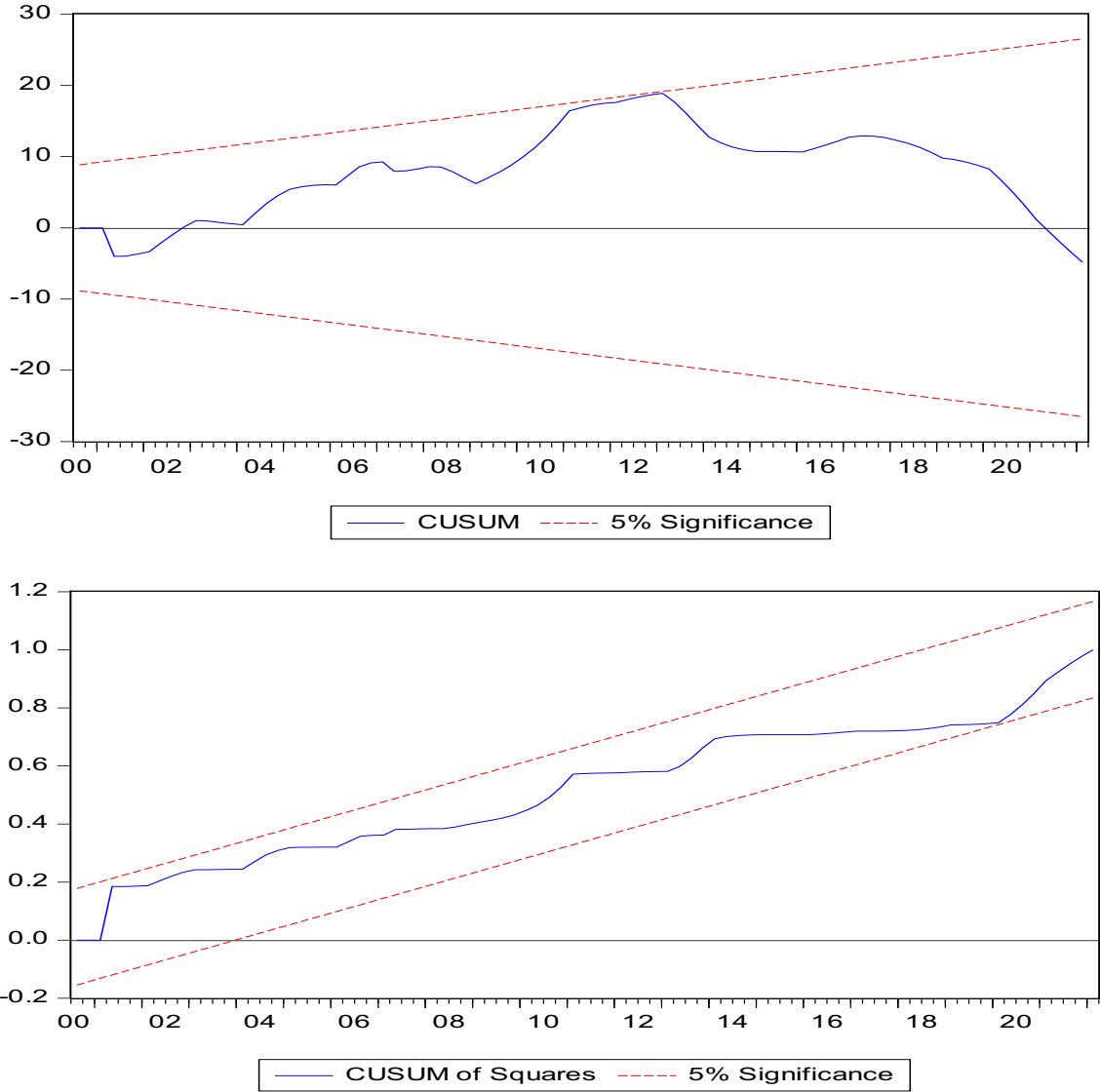
	F-statistics	Cointegration	X^2LM		X^2ARCH	X^2 Normality
	44.4203	Yes	2.5968 (0.1037)		1.5483 (0.2387)	2.4719 (0.2905)
Significance Level	10%		5%		1%	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Critical Value	1.75	2.87	2.04	3.24	2.66	4.05

Note: *** denotes the significant at 1% level. Critical values are taken from Pesaran et al. (2001).

The F-statistics value of 44.4203 surpasses the crucial value upper bound for a significance level of 1%. Ukraine has changes in diversification, GDP, FDI, government efficiency, interest rates, R&D, and trade openness throughout time. Table 5 presents the long-term elasticity and accompanying statistics of the ARDL model after the diagnosis. The test findings clearly demonstrate that the long-term connection model is reliable for policy planning at the health-environment nexus. The graphs of CUSUM and CUSUMSQ, depicted in Figure 2, demonstrate the existence of stable parameters.

Figure 2

CUSUM and CUSUMSQ



Source: Analyzed by Authors in EViews

ARDL is applied to predict the short-term and long-term relationships between model variables after identifying co-integration. An essential aspect of studying time series data is comprehending the relationship between short-term and long-term trends. The long-term trend provides a comprehensive view of the direction and organization of data over a prolonged duration. In essence, it determines the main pattern or tendency and indicates whether the series is experiencing growth or decline. Short-term trends focused on unique qualities. Data fluctuations are usually generated by stochastic events, natural events, or transient disturbances. This method allows for the distinction between temporary and permanent changes. The results of both short-term and long-term interactions are presented in Table 6.

Table 6

Long-run and short -run Estimates

Dependent Variable= DIV								
Variable	Coefficient		Std. Error		t-Statistic		Prob.	
	Short-run	Long-run	Short-run	Long-run	Short-run	Long-run	Short-run	Long-run
GDP _t	-0.0027*	-0.0150*	0.0016	0.0088	-1.6713	-1.7028	0.0979	0.0918
FDI _t	0.0002**	0.0112**	0.0001	0.0051	2.1944	2.1467	0.0306	0.0343
GOVEF _t	0.0120***	0.0655***	0.0024	0.0141	4.8259	4.6415	0.0000	0.0000
RIR _t	-0.0008**	-0.0149**	0.0004	0.0073	-2.0595	-2.0410	0.0421	0.0490
R&D _t	0.0062***	0.0341***	0.0015	0.0078	4.0167	4.3547	0.0001	0.0000
TO _t	-0.0086**	-0.0471**	0.0035	0.0192	-2.4349	-2.4463	0.0167	0.0162
ECT (-1)	-0.1839***		0.0101		-18.170		0.0000	

Note: ***, ** and * show significance level at 1%, 5% and 10%, respectively.

The long-run ARDL results indicate in Table 6 show that GDP has a significantly negative relationship with diversification in Ukraine. A one percent increase in GDP decreases diversification by 0.0150 %. These results are similar to the study of Carrasco and Tovar-García (2021). When the Gross Domestic Product (GDP) is at a high level, well-established industries have the ability to exert dominance. However, Ukraine's GDP has not yet reached that threshold. Following the Soviet Union's dissolution, Ukraine acquired a highly advanced economy focused on the manufacturing of specialized products, such as steel and machinery. Venturing outside our familiar surroundings and embracing novel possibilities might present difficulties.

The assessed results show a positive and significant relationship between FDI and diversification in Ukraine during Q1-1996 to Q4-2022. A 1% upsurge in FDI increases diversification by 0.0112%. The results of this study are in line with the study of Albiman et al. (2022). FDI facilitates the introduction of novel instruments and knowledge from foreign nations. This could facilitate the development of new products and creative production methods for Ukrainian enterprises, thereby allowing them to grow their international market presence. Foreign corporations possess the capacity to distribute information to other companies. Ukrainian enterprises can enhance their skills, knowledge, and best practices by collaborating with overseas peers or within the same industry. This can facilitate the generation of innovative ideas and foster the expansion of their firm.

Table 6 shows that government effectiveness has significantly positive impact on diversification in Ukraine during studied time. A 1% increase in GOVEF increase the DIV by 0.0655%. Same results were obtained by Nguyen and Schinckus (2023). Effective governments provide transparent and stable economic strategies that facilitate commercial operations. This fosters investment from both domestic and international sources across a wide range of sectors, leading to enhanced variety. Robust institutions that effectively enforce contracts and protect property rights provide an environment in which businesses can flourish and engage in innovative activities. Diversification is achieved by generating new products and expanding into foreign markets, which is vital.

The long-run ARDL results show that real interest rate has significant and negative relationship with diversification in Ukraine during last 25 years trimestral data. A one percent increase in real interest rate decrease the diversification up to 0.0149%. The results are similar to the study of Evans and Saibu (2017). During periods of high real interest rates, monetary policies usually become more

stringent. This action has the potential to decrease the total credit available in the economy. Securing capital for the development of new export products and expansion into new markets becomes increasingly difficult for inventive businesses, which ultimately hampers diversification. When the nominal interest rate exceeds the inflation rate, the real interest rate increases, resulting in higher borrowing costs. This may discourage corporations from investing in new areas, especially those that require significant upfront costs and have long payback periods, such as research and development-focused industries that are important for extending their range of products or services. Regions that have well-developed infrastructure and technology that are familiar to investors may become more appealing when the level of investment risks decreases.

The estimated results of Table 6 indicated that R&D has significantly positive relationship with diversification in Ukraine during 1996- 2022. A one percent increase in R&D increase the diversification by 0.0341 percent. Same results were found by the study of Rauf and Bao (2023). Increasing investment in R&D results in the creation of innovative products and technologies that may be export to other countries. Consequently, Ukraine has the potential to diversify its exports outside traditional sectors such as mining and steel. Research and development (R&D) can enhance the technological sophistication and value-added of Ukrainian enterprises' products. This can enhance Ukraine's position in the global market and generate additional revenue through exports, hence facilitating diversification.

The results of long-run ARDL shows that trade openness has significant and negative relationship with diversification in Ukraine. A 1% increase in trade openness decrease the diversification by 0.0471%. The same relationship was found by Albiman et al. (2022). Ukraine has abundant natural resources, including minerals and fertile land. By liberalizing trade, these products have the potential to become more appealing for export. The Ukrainian currency may appreciate if more natural resources are exported. This could have a significant effect on the export activities of other companies, especially those that heavily depend on a big number of employees, thereby reducing their competitiveness in the worldwide market. When the value of the currency increases and profits from resource extraction rise, businesses may choose to prioritize these areas above investing in other export sectors. Over time, this can result in a reduction in diversification.

Table 6 also displays the immediate results of applying the ARDL approach to Ukraine over the study period. The results demonstrate a substantial negative correlation between GDP, RIR, and TO with DIV. FDI, GOVEF and R&D all display a substantial and positive link with DIV. The ECMt-1 coefficient of -0.1839 is both negative and statistically significant, suggesting a clear tendency towards long-term equilibrium. Brief deviations from long-term equilibrium are quickly corrected, with 18.39% of cases returning to equilibrium.

Figure 3 shows Ukraine's diversification from 1996 to 2022 using maximum overlap discrete wavelet transform multi-resolution analysis (MODWT-MRA). The variable has four scales: D1, D2, D3, and D4. For long-term analysis, MODWT-MRA uses eight asymmetric wavelet filters. The long-term trend is represented by non-stationary smooth components S4. The smooth trend (S4) indicates a consistent decrease in diversification for Ukraine from 1996 to 2022. Consequently, Ukraine's exports have experienced a decline in diversification over the course of time. Previously, several potential options were deliberated upon, which encompass: Ukraine's focus on well-established industries, such as steel and minerals, may have prevented investment in emerging export areas. Resource dependence: Excessive reliance on exporting primary commodities may have hindered investment in the development of new products for export. Trade partner concentration: Ukraine's heavy reliance on a small number of export partners, notably Russia, may have exposed it to economic volatility in those nations.

The detail scales (D1-D4) in Figures 3 depict variations around the long-term pattern, illustrating periods of accelerated or decelerated diversification.

D1 (Highest Frequency): This scale exhibits rapid and abrupt variations in a short period of time. There appears to be a marginal rise in volatility throughout the years 2008 (global financial crisis) and 2014 (Ukrainian crisis). These findings indicate that significant economic events may have had immediate effects on the patterns of diversification.

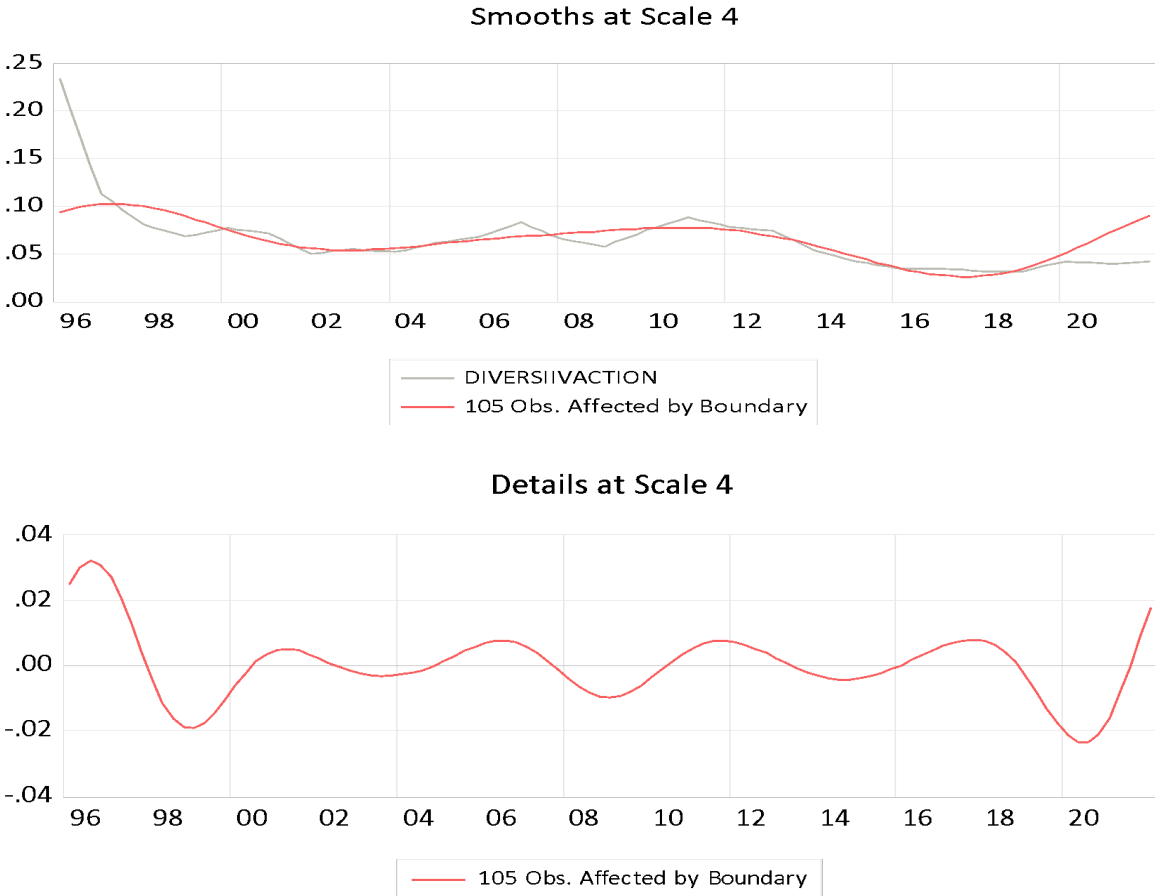
D2 and D3 (Medium Frequency): These scales exhibit more consistent variations in comparison to D1. Recurring seasonal trends or cycles may have an influence on diversification throughout these specific durations. Further examination is required to discern precise patterns.

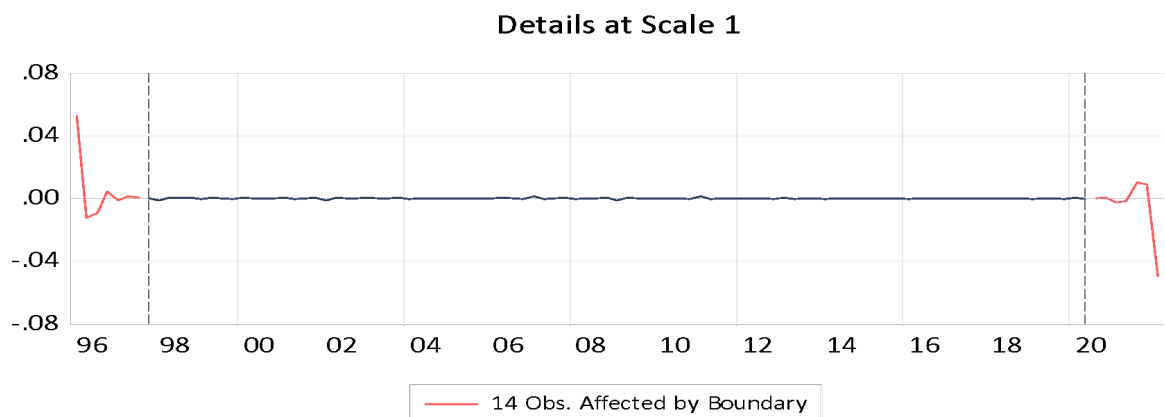
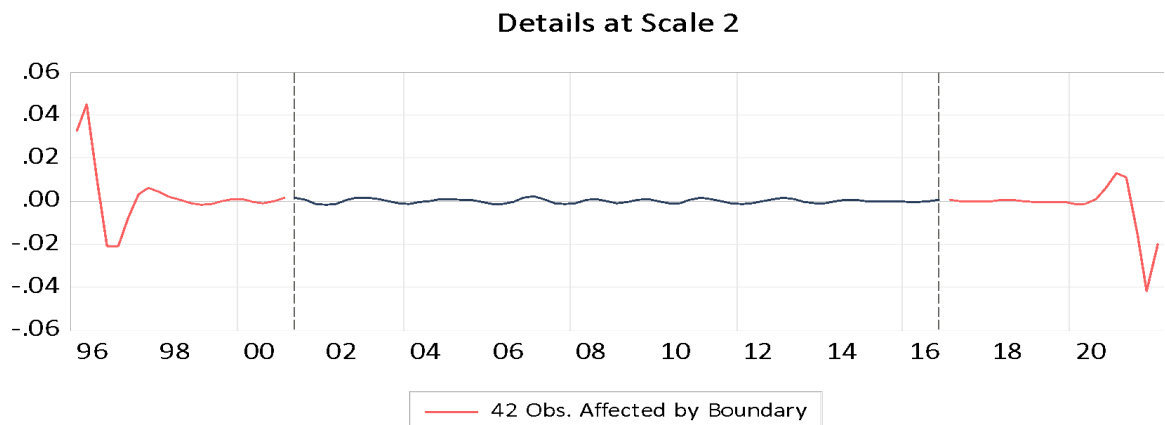
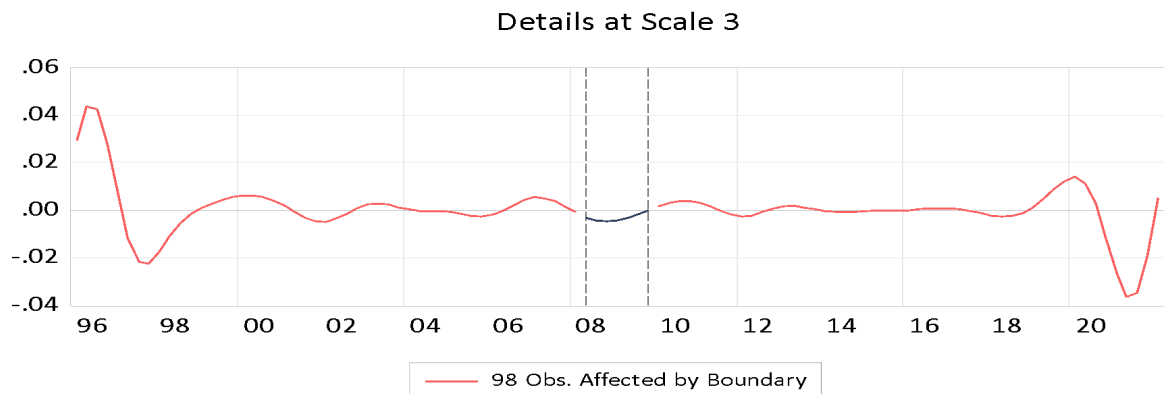
D4 (Lower Frequency - Not Shown Here): This scale, which is not depicted in the provided photos, captures even more gradual variations than D2 and D3. It may indicate medium-term patterns of diversity in addition to the long-term decline.

The MODWT MRA research does not explain the underlying causes of the diversification patterns. It discerns the patterns of alteration. Further economic data and analysis are required to identify the precise variables that are causing the decrease in diversification found in Ukraine. One could investigate the potential correlation between the different levels of detail (D1-D4) and specific economic events or policies that influenced the diversification of Ukraine. To enhance the study, it is advisable to juxtapose the results of the MODWT MRA with other indicators of diversification.

Figure 3

MODWT coefficients for diversification in Ukraine





Source: Authors own compilation in EViews

Conclusions and Implications

In uncertain economic times, businesses need a diversified portfolio to minimize risks and build resilience. Diversifying investments across industries and assets protects against bad luck and creates long-term development potential. Stressing the importance of economic growth and wealth.

The association between GDP, FDI, government efficiency, real interest rate, R&D, trade openness, and diversification in Ukraine is examined from Q1-1996 to Q4-2022.

This analysis used Zivot-Andrew unit root to find structural fractures. The Gregory and Hansen Test for Co-integration with Regime Shifts is used when the unit root test shows mixed order integration. This study shows that break variables are co-integrated. The ARDL bound estimation approach, if F-

statistical values exceed 1%, ensures stability. The ARDL test examines immediate and long-term correlations between research variables.

Long-term estimates show that diversification lowers trade openness, interest rates, and GDP. Diversification in Ukraine was positively correlated with FDI, government efficacy, and R&D throughout the sample period. Diagnostic methods such as series residual analysis, the Breusch-Godfrey serial correlation LM test, and the Arch heteroskedasticity test yield significant findings.

Applying the Wavelet technique, MODWT MRA, which employs 8 asymmetric filters, to examine the expanded patterns in Ukraine's diversification. The findings indicate that the variable being studied shows wavelet long-term patterns from 1996 to 2022.

The comprehensive investigation conducted in this paper demonstrates that economic diversification is highly influenced by GDP growth, FDI inflows, and the efficacy of government. It is crucial to emphasize macroeconomic stability and strong institutions. The effects of interest rates, R&D spending, and trade openness show how complex the policies and market dynamics needed to preserve diversified economies are. This provides policymakers and stakeholders with crucial views to boost long-term economic growth.

By examining the obstacles related to diversity and the corresponding ideas, it is possible to develop a thorough set of policy suggestions specifically designed for Ukraine. It is crucial to consider both the elements that existed before the war and those that occurred after the conflict in order to create a strategy for economic growth that is dependable and flexible.

Before the conflict, Ukraine may have aimed to increase Foreign Direct Investment (FDI) by introducing targeted measures such as tax incentives and streamlined regulations, especially in critical areas identified through market analysis for diversification purposes. The primary objective should be to improve government efficiency by streamlining regulations and procedures, combatting corruption, and allocating resources towards public goods such as technology parks and research institutions. This would facilitate innovation and promote the creation of new export products. Ukraine has the potential to become a significant participant in emerging markets by exporting innovative technologies through the implementation of tax incentives and collaborations between the public and private sectors, which would promote research and development (R&D).

However, Ukraine faces unique difficulties once the fighting ends that require a more complex approach in policy development. When pursuing foreign direct investment (FDI), government should prioritize industries that can help to post-war reconstruction and long-term diversification, while also considering the current degree of risk. Emphasis should be placed on prioritizing technologies for research and development that have both military and commercial applications. Collaboration with other nations is essential to get funding for restoration activities and to attract investment in industries that foster economic growth. It is imperative to make necessary arrangements for possible trade disruptions and actively seek out new export markets and partnerships in order to adapt to global changes. Through the implementation of these innovative ideas, Ukraine may successfully tackle the obstacles of post-war recovery and provide the foundation for long-term economic growth and diversification.

Suggestions for future research

Consider analyzing diversification at a more granular level, such as by sector or export product category. This would provide deeper insights into the specific areas where diversification is most needed and the factors impacting them.

Analyze the role of institutions like property rights enforcement and contract law in promoting diversification. A strong institutional framework can encourage investment in new export sectors.

Investigate the impact of skilled labor availability and workforce education on diversification. A skilled workforce is crucial for developing and exporting new products.

Use other econometric techniques alongside wavelet analysis for a more robust understanding of the relationships between the variables and diversification.

Cost-Effectiveness Analysis: Evaluate the cost-effectiveness of different policy interventions aimed at promoting diversification. This would help policymakers prioritize policies with the greatest potential impact.

Acknowledgements

None.

Conflict of Interest

None.

Funding

The Authors received no funding for this research.

References

- Abam, C. A. (2022). *An Analysis of the Relationship between Institutions and Foreign Direct Investment in Cameroon, 1960-2020* Southern University and Agricultural and Mechanical College.
- Al-Ababneh, H. A., Osmonova, A., Dumanska, I., Matkovskiy, P., & Kalynovskyy, A. (2021). Analysis of export of agricultural products in the context of the global food crisis. *Agricultural and Resource Economics: International Scientific E-Journal*, 7 (4), 5-26.
- Albiman, M. M., Yussuf, H. A., & Hemed, I. M. d. (2022). The Effect of Foreign Direct Investment and Trade Openness on the Firms' Export Competitiveness and Products Diversification Among East African Community Members. In *Trade and Investment in East Africa: Prospects, Challenges and Pathways to Sustainability* (pp. 185-212). Springer.
- Awan, A. M., Azam, M., Saeed, I. U., & Bakhtyar, B. (2020). Does globalization and financial sector development affect environmental quality? A panel data investigation for the Middle East and North African countries. *Environmental Science and Pollution Research*, 27, 45405-45418.
- Cardoso, F. H. (1977). The consumption of dependency theory in the United States. *Latin American Research Review*, 12(3), 7-24.
- Carrasco, C. A., & Tovar-García, E. D. (2021). Trade and growth in developing countries: the role of export composition, import composition and export diversification. *Economic Change and Restructuring*, 54, 919-941.
- Chandio, A. A., Magsi, H., & Ozturk, I. (2020). Examining the effects of climate change on rice production: case study of Pakistan. *Environmental Science and Pollution Research*, 27(8), 7812-7822. <https://doi.org/10.1007/s11356-019-07486-9>
- Chenery, H. B., & Elkington, H. (1979). Structural change and development policy. (*No Title*).
- Crupi, A., & Schilirò, D. (2023). The UAE Economy and the Path to Diversification and Innovation. *INTERNATIONAL JOURNAL OF BUSINESS MANAGEMENT AND ECONOMIC RESEARCH*, 2286-2300.
- Espoir, L. M. (2020). Determinant of export diversification: An empirical analysis in the case of SADC countries. *International Journal of Research in Business and Social Science (2147-4478)*, 9(7), 130-144.

- Evans, O., & Saibu, O. (2017). Quantifying the impact of monetary and exchange rate policies on economic diversification in Nigeria. *Nigerian Journal of Economic and Social Studies*, 59(1), 131-152.
- Fonchamnyo, D. C., & Akame, A. R. (2017). Determinants of export diversification in Sub-Sahara African region: a fractionalized logit estimation model. *Journal of Economics and Finance*, 41, 330-342.
- Fosu, A. K. (2021). Infrastructure and the impact of foreign direct investment (FDI) on export diversification: Evidence from Africa. *Journal of African Development*, 22(1), 102-123.
- Gregory, A. W., & Hansen, B. E. (1996). Residual-based tests for cointegration in models with regime shifts. *Journal of Econometrics*, 70(1), 99-126.
- Herzer, D., & Nowak-Lehmann D, F. (2006). What does export diversification do for growth? An econometric analysis. *Applied economics*, 38(15), 1825-1838.
- Hynes, W., Trump, B., Love, P., & Linkov, I. (2020). Bouncing forward: a resilience approach to dealing with COVID-19 and future systemic shocks. *Environment Systems and Decisions*, 40, 174-184.
- Işik, C. (2010). Natural gas consumption and economic growth in Turkey: a bound test approach. *Energy Systems*, 1, 441-456.
- Işik, C., Kasımatı, E., & Ongan, S. (2017). Analyzing the causalities between economic growth, financial development, international trade, tourism expenditure and/on the CO2 emissions in Greece. *Energy Sources, Part B: Economics, Planning, and Policy*, 12(7), 665-673.
- Jolo, A. M., Ari, I., & Koç, M. (2022). Driving factors of economic diversification in resource-rich countries via panel data evidence. *Sustainability*, 14(5), 2797.
- Liu, D., Wang, Q., Wang, A., & Yao, S. (2023). Export profitability and firm R&D: on China's export diversification under trade war. *Structural Change and Economic Dynamics*, 67, 151-166.
- Majid Awan, A., Khan, M. A., & Khan, S. (2024). Estimating the health production function for Pakistan: Do environmental factors matter? *Review of Development Economics*, 28(1), 216-241.
- Matallah, S. (2022). Economic diversification and governance challenges in MENA oil exporters: A comparative analysis. *The Journal of Economic Asymmetries*, 26, e00255.
- Matsumoto, Y., Suge, A., & Takahashi, H. (2023). Analysis of the relationship between technological diversification and enterprise value using patent data. *Information Technology and Management*, 1-24.
- Mohamed, N., & Vadeveloo, T. (2023). Diversifying Local Government Funding in Implementing Green Open Space for Green City Development: A Systematic Literature Review. *Journal of Academic Research in Accounting Finance and Management Sciences*, 13(2), 960-975.
- Nakibullah, A. (2018). Economic diversification in Bahrain. *Applied Economics and Finance*, 5(5), 67-74.
- Nguyen, C. P., & Schinckus, C. (2023). How do countries deal with global uncertainty? Domestic ability to absorb shock through the lens of the economic complexity and export diversification. *Quality & Quantity*, 57(3), 2591-2618.
- Nibedita, B., & Irfan, M. (2024). Energy mix diversification in emerging economies: An econometric analysis of determinants. *Renewable and Sustainable Energy Reviews*, 189, 114043.
- North, D. C. (1995). The new institutional economics and third world development. *The new institutional economics and third world development*, 21, 31-40.
- Pata, U. K., & Isik, C. (2021). Determinants of the load capacity factor in China: A novel dynamic ARDL approach for ecological footprint accounting. *Resources Policy*, 74, 102313.

- Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, 16(3), 289-326.
- Prohorovs, A. (2022). Russia's war in Ukraine: Consequences for European countries' businesses and economies. *Journal of Risk and Financial Management*, 15(7), 295.
- Ramzan, M., Iqbal, H. A., Usman, M., & Ozturk, I. (2022). Environmental pollution and agricultural productivity in Pakistan: new insights from ARDL and wavelet coherence approaches. *Environmental Science and Pollution Research*, 29(19), 28749-28768.
- Rauf, A., & Bao, Y. (2023). Assessing the effect of domestic and foreign R&D on export: empirical evidence from China. *International Journal of Emerging Markets*, 8(3), 25-37.
- Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of political economy*, 94(5), 1002-1037.
- Ross, M. L., & Werker, E. (2024). Diversification in resource-rich Africa, 1999–2019. *Resources Policy*, 88, 104437.
- Schlogl, L., Sumner, A., Schlogl, L., & Sumner, A. (2020). Economic development and structural transformation. *Disrupted Development and the Future of Inequality in the Age of Automation*, 11-20.
- Shubalyi, O., & Gordiichuk, A. (2022). The Socio-Economic Consequences of the War in Ukraine: the National, Regional, and Global Dimensions. *Barometr Regionalny. Analizy i Prognozy*, 18(1), 19-37.
- Snow, M. S. (2023). The Invasion of Ukraine and the Global Food Crisis of 2022: Responding to Food Supply Shocks. In *The Great Power Competition Volume 5: The Russian Invasion of Ukraine and Implications for the Central Region* (pp. 351-387). Springer.
- Starostina, A., Bugrov, V., Kravchenko, V., Gatto, G., & Kochkina, N. (2023). Entrepreneurial university: Exploring its essence, phases of development, and operating mechanism during wartime in Ukraine. *International Journal of Educational Development*, 103, 102895.
- WDI. (2024). *The World Bank database*. Retrieved from <https://databank.worldbank.org/source/world-development-indicators>
- Welfens, P. J. (2023). Turning points in the Russo-Ukrainian war. In *Russia's Invasion of Ukraine: Economic Challenges, Embargo Issues and a New Global Economic Order* (pp. 45-68). Springer.
- Yang, G., Zha, D., Cao, D., & Zhang, G. (2024). Time for a change: Rethinking the global renewable energy transition from the Sustainable Development Goals and the Paris Climate Agreement. *The Innovation*, 5(2), 100582.
- Zivot, E., & Andrews, D. W. K. (2002). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of business & economic statistics*, 20(1), 25-44.