Jordan Journal of Economic Sciences, Volume **10**, No.**2, 2023**

The Effect of Macroeconomic Policy Uncertainty on Environmental Quality in Jordan: Evidence from The Novel Dynamic Simulations Approach

***Bashar Younis Subeih Alkhawaldeh*[1], *Hamzeh Alhawamdeh*[2], *Mohammad Almarshad*[3],**
***Baha Aldeen Mohammad Fraihat*[4], *Shireen Maher Mohammad Abu-Alhija*[5],**
***Abbas Mohammad Alhawamdeh*[6], *Bader Ismaeel*[7]**

[1] Ph.D. Economics of Business and Finance, Department of Financial and Banking Sciences, Faculty of Business, Jerash University, basharyounes@yahoo.com

[2] Ph,D Management, Associate professor, Business faculty, Jerash University, Jordan, Hamzeh.alhawamdeh@jpu.edu.jo

[3] Ph.D in Strategic Management, Associate Professor, Department of Financial and Administrative Sciences, Huson University college, Al-Balqa' Applied University, Jordan, dr.mohammad.almarshad@bau.edu.jo

[4] Ph.D Business Administration and Management, Assistant Professor, Department of Management Sciences, Faculty of Business, Jerash University, Jordan. Baha1f@yahoo.com

[5] Business Faculty, Jerash Unviersity, Jordan. shireen.hija@gmail.com

[6] Assistant Professor, Department of Administrative Sciences, Faculty of Business, Jerash University, Jordan. aalhawa@me.com

[7] Ph. D in Business Management, Business and Finance Faculty, The World Islamic Science and Education University (WISE), Amman, Jordan, badreddin.baniismail@wise.edu.jo

Received: 27/11/2022
Revised: 29/1/2023
Accepted: 21/3/2023
Published: 15/7/2023

Citation: Alkhawaldeh, B. Y. S. ., Alhawamdeh, H. ., Almarshad, M., Fraihat , B. A. M. ., Abu-Alhija, S. M. M. ., Alhawamdeh, A. M. ., & Ismaeel, B. . The Effect of Macroeconomic Policy Uncertainty on Environmental Quality in Jordan: Evidence from The Novel Dynamic Simulations Approach. *Jordan Journal of Economic Sciences*, *10*(2), 116–131. https://doi.org/10.35516/jjes.v10i2.1399

Abstract

Objectives: Over the past few years, Jordan's economy has grown rapidly, placing it prominently among the world's emerging markets and developing economies rapidly. The country is known for its diverse natural resources. However, the effects of macroeconomic uncertainty, energy intensity, and trade openness on the environment have received less attention than the environmental implications of energy generation. This research fills a significant gap in the literature by investigating the impact of macroeconomic policy uncertainty on Jordan's environmental Kuznets curve from 1970 to 2021.

Methods: This study adopted a methodological framework to simulate dynamic distributed self-regression.

Results: The results of the study revealed that uncertainty about the future direction of macroeconomic policy accelerates the short and long-term rate of environmental degradation; economic growth accelerates environmental degradation while the square of economic growth slows it, confirming the presence of the environmental Kuznets curve hypothesis; energy density accelerates the rate of environmental quality degradation.

Conclusions: Jordan should adopt advanced, environmentally friendly, clean technologies that transition from fossil fuels to low-carbon renewable energy sources. The government should establish strong international partnerships for technology exchange and environmental preservation. Additionally, increasing Jordan's economic complexity is crucial for achieving its environmental development goals.

Keywords: Dynamic Autoregressive Distributed Lag, Environmental Kuznets Curve, Jordan's Economy, Macroeconomic Policy Uncertainty.

أثر عدم اليقين في سياسة الاقتصاد الكلي على جودة البيئة في الأردن: أدلة من نهج المحاكاة الديناميكية الجديدة.

***بشار يونس صبيح الخوالدة*[1]*، حمزة الحوامدة*[1]*، محمد المرشد*[2]*، بهاء الدين محمد فريحات*[1]*،**
***شيرين ماهر محمد أبو الهيجاء*[1]*، عباس محمد الحوامدة*[1]*، بدر محمد اسماعيل*[3]**

[1] كلية الأعمال، جامعة جرش

[2] دكتوراه في الإدارة الإستراتيجية، أستاذ مشارك، قسم العلوم المالية والإدارية، كلية الحصن الجامعية، جامعة البلقاء التطبيقية، الأردن

[3] استاذ مساعد في إدارة الاعمال، قسم الادارة، كلية المال والاعمال، جامعة العلوم الاسلامية العالمية

ملخّص

الأهداف: على مدى السنوات القليلة الماضية، نما الاقتصاد الأردني بسرعة، مما جعله يحتل مكانة ملحوظةً بين الأسواق الناشئة في العالم والاقتصادات النامية بسرعة. تشتهر البلاد بمواردها الطبيعية المتنوعة، ومع ذلك، فإنّ آثار عدم اليقين في الاقتصاد الكلي، وكثافة الطاقة، والانفتاح التجاري على البيئة قد حظيت باهتمام أقل من التداعيات البيئية لتوليد الطاقة. يسد هذا البحث فجوة كبيرة في الأدبيات من خلال التحقيق في تأثير عدم اليقين في سياسة الاقتصاد الكلي على منحنى كوزنتس البيئي في الأردن من 1970 إلى 2021. استخدمت هذه الدراسة إطارًا منهجياً لمحاكاة الانحدار الذاتي الموزع الديناميكي. وكشفت نتائج الدراسة أنّ عدم اليقين بشأن الاتجاه المستقبلي لسياسة الاقتصاد الكلي يُسرّعُ من معدل التدهور البيئي على المدى القصير والطويل. يؤدي النمو الاقتصادي إلى تسريع التدهور البيئي بينما يؤدي مربع النمو الاقتصادي إلى إبطائه، مما يؤكد وجود فرضية منحنى كوزنتس البيئي ؛ تعمل كثافة الطاقة على تسريع معدل تدهور جودة البيئة.

الخلاصة: يجب على الأردن اعتماد تقنيات متقدمة وصديقة للبيئة ونظيفة تنتقل من الوقود الأحفوري إلى مصادر الطاقة المتجددة منخفضة الكربون. يجب على الحكومة إقامة شراكات دولية قوية لتبادل التكنولوجيا والحفاظ على البيئة. بالإضافة إلى ذلك ، فإن زيادة التعقيد الاقتصادي في الأردن أمر بالغ الأهمية لتحقيق أهداف التنمية البيئية.

الكلمات الدالة: التأخر، الموزع الديناميكي، منحنى كوزنتس البيئي، الاقتصاد الأردني، عدم اليقين في سياسة الاقتصاد الكلي.

INTRODUCTION

There is a growing consensus that global warming and climate change must be addressed promptly (Alkhawaldeh et al., 2022). Environmental degradation no longer affects only industrialized nations, at least in terms of repercussions. Greenhouse gas (GHG) emissions on Earth affect all nations, both developed and

emerging. When discussing the causes of global warming, the "greenhouse effect" is commonly cited. Even trace amounts of greenhouse gases already present in the atmosphere are dangerous, as they contribute to extreme weather, rising sea levels, forest fires, and disruptions in food supply. More than 75% of all emissions come from carbon dioxide (CO2). In 2020, atmospheric concentrations of carbon dioxide reached 412 ppm (parts per million) (1'2). The burning of organic materials and deforestation account for the vast majority of the 43 percent increase in carbon dioxide emissions caused by human activity since the industrial period. Recent research suggests that reducing carbon dioxide emissions is essential for maintaining a healthy economy (Abdollahi, 2020; Bilgili et al., 2021; Raihan & Tuspekova, 2022). Extremely rapid increases in temperature, sea level, and carbon dioxide emissions are hallmarks of the current climate crisis. In response to climate change, various environmental laws have been enacted in the United States and other countries. Researchers, academics, and politicians are increasingly focusing on the uncertainty in policy and economic activity and are dedicated to fostering a global economic renaissance. Policy uncertainty refers to the unknown future of government policies, including regulatory, monetary, fiscal, taxation, and environmental policies, and it has gained significant attention (Atiku et al., 2021; Atiku et al., 2022; Sun et al., 2022). The impact of policy uncertainty on the overall economy has been studied using a wide range of indicators (Huynh et al., 2021; Qamruzzaman et al., 2021; Li et al., 2022). Several studies have demonstrated that policy uncertainty has a negative effect on investment (Wang et al., 2022), stock market liquidity (Roy et al., 2022), trade openness (Wang et al., 2022), and energy intensity (Shakya et al., 2022; Ismaeel & Alzubi, 2020). There is a possibility that the government's attention may momentarily shift away from environmental concerns due to the expanding policy uncertainty (MPU) and its detrimental effects on real economic activity. This could have a negative impact on regional environmental protections, as governments and corporations may reduce their efforts to mitigate carbon emissions. Additionally, the adverse consequences of increasing policy uncertainty on the economy and businesses could result in a decline in economic demand, leading to potential financial challenges for households and businesses. In times of financial strain, businesses may resort to alternative energy sources, even if it means increasing their carbon footprint. Hamilton (1983) argues that supply and demand shocks, as well as economic slowdowns, influence both commercial and household energy consumption (Liu et al., 2022; Patel & Tsionas, 2022; Syed & Bouri, 2022). A decrease in energy consumption resulting from economic distress caused by macroeconomic policy unpredictability can have a ripple effect on carbon emissions. Recent studies indicate that companies tend to adopt a more cautious approach when anticipating high profit margins. Both businesses and households are less inclined to invest and spend during times of uncertainty (Ran et al., 2022). Borrowing costs increase (Gong et al., 2022). There is an increase in cash holdings (D'Adamo et al., 2022; Al-Waely, 2021). Exchange rates and stock market volatility rise (Chen et al., 2022). Trade activity slows down (Sui et al., 2022). Therefore, this study examines the impact of Macroeconomic Policy Uncertainty on Environmental Quality in Jordan using a Novel Dynamic Simulations Approach. This study is unique and innovative as it explores the intricate interactions between macroeconomic policy uncertainty, energy intensity, trade openness, economic growth, and environmental quality in Jordan through the application of a novel dynamic simulations approach. The novelty of this study lies in its comprehensive analysis of the various factors influencing environmental quality in Jordan. By examining the combined effects of macroeconomic policy uncertainty, energy intensity, trade openness, and economic growth on environmental quality, the study offers a more complete understanding of the factors shaping the relationship between the economy and the environment. Furthermore, the study employs a dynamic simulations approach to explore the dynamic effects of these factors over time, taking into account feedback loops and interdependencies among them. This approach provides a nuanced understanding of the complex relationships between the economy and the environment, enabling the exploration of different policy scenarios to identify effective interventions. Moreover, the study's focus on Jordan, a country that has received limited attention in the environmental economics literature, offers new insights into the challenges faced by countries in the region in achieving a balance between economic growth and environmental protection. The study's findings hold significant implications for policymakers in Jordan and other countries confronting similar challenges, providing a valuable framework for the development of policies that promote sustainable economic growth while safeguarding the environment. In summary, "The Effect of Macroeconomic Policy Uncertainty, Energy Intensity, Trade Openness, and Economic Growth on Environmental Quality in Jordan: Evidence from The Novel Dynamic Simulations Approach" represents a substantial contribution to the field of environmental economics, introducing a novel approach to studying the intricate relationships between the economy and the environment.

METHODOLOGY

Variables and data sources

This study aims to empirically analyze the impact of macroeconomic policy uncertainty (M) on Jordan's environmental quality (C) from 1970 to 2021 using the state-of-the-art dynamic ARDL simulation model. Data on macroeconomic policy uncertainty were primarily collected from the World Development Indicators (2020) and https://www.policyuncertainty.com. By utilizing the composite trade intensity proposed by Squalli and Wilson (2011), this study addresses the limitations of trade intensity measures used in previous studies. Additionally, the study employs a comprehensive modeling approach to visually depict the environmental consequences of macroeconomic policy uncertainty through the channels of energy intensity (E) and trade openness (T).

The first step in analyzing the data set is to test for stationarity properties and determine the order of integration among the variables. This analysis initially employs unit root tests, including the Augmented Dickey-Fuller (ADF), the Phillips-Perron (PP), the Dickey-Fuller Generalized Least Squares (DF-GLS), and the Kapetanios and Shin Unit Root Test (KSUR). However, many researchers have concluded that conventional unit root tests produce inaccurate results as they fail to consider the possibility of structural breaks in the data (Ali, 2023; Song et al., 2023c; Alkhawaldeh et al., 2020; Ibrahim et al., 2020; Lee et al., 2023). To address this concern, this research employs the unit root tests developed by Lee and Strazicich (LS) and Clemente-Monteanes Reyes (CMR). Each method can accommodate up to two structural breaks. The model are as follows:

$$C_t = \alpha_0 + \varphi_1 G_{t-1} + \varphi_2 G^2{}_{t-1} + \varphi_3 M_{t-1} + \varphi_4 E_{t-1} + \varphi_1 T_{t-1} + \mu_t \qquad (1)$$

Despite the popularity and simplicity of using ARDL models to study the relationship between variables, interpreting their results can be challenging due to the complex structure of the models, often involving numerous or differential lags. Understanding the effect of covariates on the response variable can be a tedious task. Once the relationship between variables and its direction are identified, policymakers require knowledge of how a change in an explanatory variable will affect the response variable while holding other variables constant. To address these challenges, Jordan and Philips (2018) proposed the Dynamic Autoregressive Distributive Lag (DARDL) estimator. This estimator can estimate, simulate, and graphically display counterfactual changes in one predictor and its positive and negative effects on the response variable while keeping other variables constant. The DARDL estimator can also estimate long- and short-term connections between variables (Alkhawaldeh et al., 2020). However, before employing the DARDL estimator, the response variable must have an order of integration of I(1), while the regressors can have an order of integration of either I(1) or I(0) but not exceed I(1) (Jordan and Philips, 2018; Alkhawaldeh et al., 2020). Additionally, the studied variables must be significantly cointegrated in the long run (Alkhawaldeh et al., 2020). The DARDL technique utilizes up to 5000 simulations and is specified as follows:

$$\Delta C_t = \omega_0 C_{t-1} + \tau_1 M_t + \omega_1 \Delta M_{t-1} + \tau_2 E_t + \omega_2 \Delta E_{t-1} + \tau_3 T_t + \omega_3 \Delta T_{t-1} + \tau_4 G_t + \omega_4 \Delta G_{t-1} + \tau_5 {G^2}_t + \omega_5 \Delta {G^2}_{t-1} + \sigma ECT_{t-1} + \varepsilon_t \quad (6)$$

where, C is the Environmental Quality, M is the Macroeconomic Policy Uncertainty, E is the Energy Intensity, T is the Trade Openness, G is the Economic Growth, G is the square of Economic Growth, t is time.

RESULTS AND DISCUSSION

Table 1 presents the results of various tests conducted to identify appropriate lags. Among the different methods used, the SIC method yields the least favorable outcome, indicating a preference for a later lag selection in our analysis. The SIC method is employed in this study for lag selection (Fromentin et al., 2022; Umar et al., 2015; Kamalu et al., 2019).

Table 1 Lag Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	405.2794	NA	2.40e-15	-16.63664	-16.40274	-16.54825
1	699.6785	502.9318	5.12e-20	-27.40327	-25.76597*	-26.78453
2	756.9374	83.50263	2.27e-20	-28.28906	-25.24836	-27.13997
3	784.9628	33.86394	3.83e-20	-27.95678	-23.51268	-26.27735
4	869.9752	81.47024*	7.45e-21*	-29.99897*	-24.15146	-27.78919*

Our model is well-suited after passing all diagnostic tests. The Breusch-Godfrey LM test indicates that there is no serial correlation or autocorrelation affecting the selected model. The chosen model is free from misspecifications. Additionally, the Jarque-Bera test confirms that the residuals follow a normal distribution (Ali, 2023; Ahamd et al., 2015b; Sharma et al., 2023; Ado et al., 2020; Ekpe et al., 2020; Ekwueme et al., 2020; Mustapha et al., 2020a). It is worth noting that most economic time series data exhibits skewness (non-normal distribution) due to the presence of outliers. In our study, we assess the normality of variables within the model using coefficients of skewness and kurtosis based on the mean (Wang et al., 2023; Ado et al., 2022). However, the standard deviation in the frequency distributions indicates that the variables deviate significantly from normality. In Table 1 below, the standard deviation values showed that $C_t, M_t, E_t, T_t, G_t, and\ {G^2}_t$ are highly volatile. Furthermore, the Pearson correlation matrix in Table 3 provides information about the relationship between the series. The correlation values among the independent variables are below 0.85, indicating the absence of multicollinearity issues in the model (Bhuiyan et al., 2023; Mustapha et al., 2020b; Ado et al., 2021; Mustapha et al., 2021a; Mustapha et al., 2021b).

Table 3: Descriptive Statistics

	$\mathbf{C}_t$	$\mathbf{M}_t$	$\mathbf{E}_t$	$\mathbf{T}_t$	$\mathbf{G}_t$
Mean	0.666588	0.105649	3.984808	0.021319	3.629995
Std. Dev.	0.170997	0.031637	0.324119	0.018268	0.365519
Skewness	-0.64944	0.358317	0.223976	0.785322	0.309806
Kurtosis	2.649641	1.709374	2.018409	2.067921	1.836101
$\ln C_t$	**1.000**				
M_t	0.471*	**1.000**			
	(0.000)				
E_t	0.586*	0.433*	**1.000**		
	(0.000)	(0.000)			
T_t	0.118*	-0.466*	-0.063	**1.000**	
	(0.407)	(0.000)	(0.654)		
G_t	-0.616*	-0.342**	-0.620*	-0.279**	**1.000**
	(0.000)	(0.013)	(0.000)	(0.045)	

The results of traditional unit root tests, including DF-GLS, ADF, PP, and KSUR, which do not account for structural breaks, are presented in Table 4. The findings indicate that all variables are stationary at first difference, denoted as *I*(1). However, it should be noted that the results of these traditional unit root tests may be inconclusive in the absence of structural breaks (see Rafindadi and Ozturk, 2016; Rafindadi & Ozturk, 2017; Rafindadi & Mika'Ilu, 2019; Rafindadi & Mika'Ilu, 2019). To address this issue, the study employs the LS and CMR unit root tests, which allow for two unknown structural breaks in the series (Rafindadi & Ozturk, 2015; Rafindadi & Ozturk, 2017; Bhuiyan et al., 2023). The results of the LS and CMR unit root tests are presented in Table 5. For Jordan, the findings reveal that in the presence of two structural breaks at the level, all variables are non-stationary, indicating a unit root problem. However, at first difference, the variables are found to be stationary. Similarly, when accounting for two structural breaks, all variables in the model become stationary at first difference. Therefore, the study concludes that the series are integrated at the same order, namely *I(1).*

Table 4 Unit root tests without structural break

VARIABLES	DF-GLS	ADF	PP	KSUR
C_t	-1.186	-1.927	-1.536	-1.602
M_t	-1.839	-2.101	-1.837	-2.480
E_t	-1.040	-1.371	-1.527	-2.186
T_t	-2.168	-2.259	-2.461	-4.499*
G_t	-2.029	-1.966	-1.625	-2.191
ΔC_t	-3.494**	-4.336*	-7.610*	-5.208*
ΔM_t	-3.339**	-5.887*	-4.846*	-6.031*
ΔE_t	-4.616*	-3.674**	-7.286*	-4.804*
ΔT_t	-4.501*	-3.664**	-7.566*	-7.524*
ΔG_t	-4.644*	-3.609**	-4.087*	-4.247*

Table 5 Unit root tests with structural break

VARIABLES	LS		CMR		
	Intercept and trend	**Break-Year**	**du1**	**du2**	**Break-Year**
C_t	-5.843	1990 and 2006	0.003	-0.002	1984 and 2005
M_t	-6.310	1992 and 2005	0.001	-0.004	1985 and 2004
E_t	-6.723	2000 and 2008	0.006	-0.009	1988 and 2007
T_t	-6.152	2002 and 2013	0.007	0.003	1990 and 2004
G_t	-5.267	1987 and 1995	0.100	-0.001	1985 and 1987
ΔC_t	-8.381*	1998 and 2008	-0.038*	0.063*	1992 and 2006
ΔM_t	-7.875*	1988 and 2004	-0.082*	0.048*	1994 and 2012
ΔE_t	-9.988*	2002 and 2011	-0.265*	0.236**	2006 and 2008
ΔlnT_t	-7.457*	2000 and 2012	0.026**	-0.068**	2003 and 2006
$\Delta \ln G_t$	-7.354*	1984 and 1992	-0.762*	0.344*	1990 and 2005

In Table 6, the results indicate that all variables are cointegrated (Prananta & Alexiou, 2023; Umar, 2021; Kamalu, 2022). Table 7 provides a summary of the initial analysis using the dynamic ARDL simulation model, showing the direct impact of M on C emissions and the environmental consequences of other factors. The computed coefficients for economic growth, both in the long term and short term, are positive and statistically significant, indicating that economic growth in Jordan leads to an increase in C emissions. This finding is consistent with the previous studies by Alkhawaldeh et al. (2021) and Shokoohi et al. (2022). However, the anticipated coefficients for the square of economic growth, in both the long and short term, are negative and statistically significant, suggesting that the method of growth contributes to a reduction in environmental quality in Jordan. This result aligns with the previous studies by Alkhawaldeh et al. (2021, 2022b) and Shokoohi et al. (2022). Taking into account the combined effects of the scale effect and technique effect, it can be concluded that the Environmental Kuznets Curve (EKC) hypothesis holds true in Jordan. While economic growth and C emissions tend to increase together, there comes a point where they both begin to decline simultaneously. Furthermore, the computed coefficients for macroeconomic policy uncertainty, in both the short run and long run, are positive and statistically significant, indicating that a 1% increase in M exacerbates environmental deterioration in Jordan by 0.683% and 0.529%, respectively. This result is supported by previous studies such as Adams et al. (2020), Shabir et al. (2022), and Chu & Le (2022), which found a positive effect of M on C. Like any other emerging economy, Jordan is particularly vulnerable to political and macroeconomic shocks, leading to prolonged periods of uncertainty. The country's growth forecast for 2018 was largely influenced by shaky confidence and ongoing political uncertainty. The devastating impact of the Great Recession in 2008 and the subsequent COVID-19 outbreak has prompted the government and authorities in Jordan to prioritize addressing unexpected risks. The 2008 global financial crisis resulted in severe hardships for millions of Jordanians, including the loss of life savings, homes, and jobs. As the crisis unfolded and its negative effects on the economy multiplied, the government and policymakers paid less attention to environmental preservation. The coefficients calculated for the energy intensity variable, both in the short and long term, were found to be positive and statistically significant. This finding aligns with the studies of Chu & Le (2022), Shokoohi et al. (2022), and Muhammad et al. (2022). It appears from the data that increasing energy use is the main driver of rising C emissions in Jordan. Energy consumption is crucial for production and economic growth. Given Jordan's dependence on energy for the production of essential goods, any increase in energy use will lead to a corresponding increase in C emissions. The long-run coefficients for trade openness are positive and statistically significant, indicating that a 1% increase in trade openness results in a 0.733% and 0.272% increase in C emissions, respectively. This finding is consistent with the research conducted by Udeagha and Ngepah (2022), Usman and colleagues (2022), and Wang et al. (2022). However, trade openness has negative implications for Jordan's environment due to the composition of its global export basket. The production of goods within this export basket requires significant energy input, contributing to the existing environmental degradation in the country. The constant extraction of these commodities to meet the growing demand in the global market has had a detrimental effect on Jordan's environmental quality. Our research also demonstrates that trade liberalization has an immediate and long-term negative impact on Jordan's environment. The error correction term (ECT) represents the speed of adjustment. The negative and statistically significant coefficient on ECT(-1), as shown in Table 7, indicates a long-term relationship between the variables of interest. For instance, the estimated coefficient of -0.169 in Table 7 implies that 17% of the disequilibrium is corrected in the long term. The R-squared value indicates that the factors used to explain the data in this study account for 69% of the variation in environmental quality. The calculated p-value of the F-statistics indicates that our model fits the data well. The dynamic ARDL simulations graphically depict predictions regarding the effect of a change in a regressor on the dependent variable, while holding all other explanatory variables constant.

Table 6 Cointegration test result

Cointegration Bounds Testing (k=5)	
Estimated Models	F-statistics
$C_t = f(M_t, E_t, T_t G_t, G^2{}_t)$	4.920**

Table 7 DARDL Estimates Results

Dependent variable: LNC_i		
Variables	**Coefficients**	**P-value**
M_t	0.683* (5.57)	0.000
ΔM_t	0.529** (2.12)	0.034
E_t	0.133* (3.88)	0.000
ΔE_t	0.121* (6.05)	0.000
T_t	-0.733* (4.678)	0.000
ΔT_t	-0.272** (2.50)	0.004
G_t	0.162* (5.17)	0.000

Dependent variable: LNC_i		
Variables	**Coefficients**	**P-value**
ΔG_t	0.213* (4.45)	0.005
$G^2{}_t$	-0.509* (-5.01)	0.000
$\Delta G^2{}_t$	-0.344* (-6.55)	0.000
ECT_{t-1}	-0.169* (-5.92)	0.000
R^2	0.686	
Adj-R^2	0.598	
Simulation	1000	

A graphical representation depicting the interconnections is provided, illustrating the effects of a 10% increase in economic growth, economic growth squared, macroeconomic policy uncertainty, energy intensity, and a decrease in trade openness. Figure 1 presents an impulse response plot showcasing the relationship between Jordan's macroeconomic policy uncertainty and pollution. It demonstrates that a 10% decrease in macroeconomic policy uncertainty leads to an improvement in environmental quality, while a 10% increase in macroeconomic policy uncertainty accelerates environmental degradation. Figure 2 illustrates the link between energy use and the state of the ecosystem. Increasing energy intensity by 10% has a positive impact on both short-term and long-term environmental quality, whereas decreasing energy intensity by the same amount has the opposite effect. The findings of this study suggest that reducing energy intensity has a positive impact on the environment in both the short term and the long term in Jordan. Figure 3 presents the impulse response plot of the trade openness-pollution relationship. This figure illustrates the relationship between the two variables. The graph shows that a 10% increase in trade openness has a negative impact on environmental quality in both the medium and long term, while a 10% decrease in trade openness has a positive impact on environmental quality. In Jordan, trade liberalization leads to an increase in pollution in both the short term and the long term, while reducing trade openness improves the quality of the environment. Figure 4 displays the G-C impulse response plot, showing the direct correlation between C emissions and economic growth rates. A 10% increase in economic growth indicates that economic growth enhances environmental quality in both the short term and the long term, while a 10% decrease in economic growth implies a decline in environmental quality in the short term and the long term. A 10% increase has a greater impact on the economy compared to a 10% decrease. According to the findings of this study, the environmental quality of Jordan worsens as the scale of the impacts increases but improves as the scale of the effects decreases. Figure 5 illustrates the relationship between economic expansion and ecological health in Jordan. The graph shows that a 10% increase in the scale of the economic expansion slows down environmental deterioration in both the short term and the long term, while a 10% decrease in the scale of the economic expansion accelerates it. These figures demonstrate that increasing the impact of the approach has a positive effect on the long-term and short-term quality of the environment in Jordan, while decreasing it has a negative effect on environmental quality.

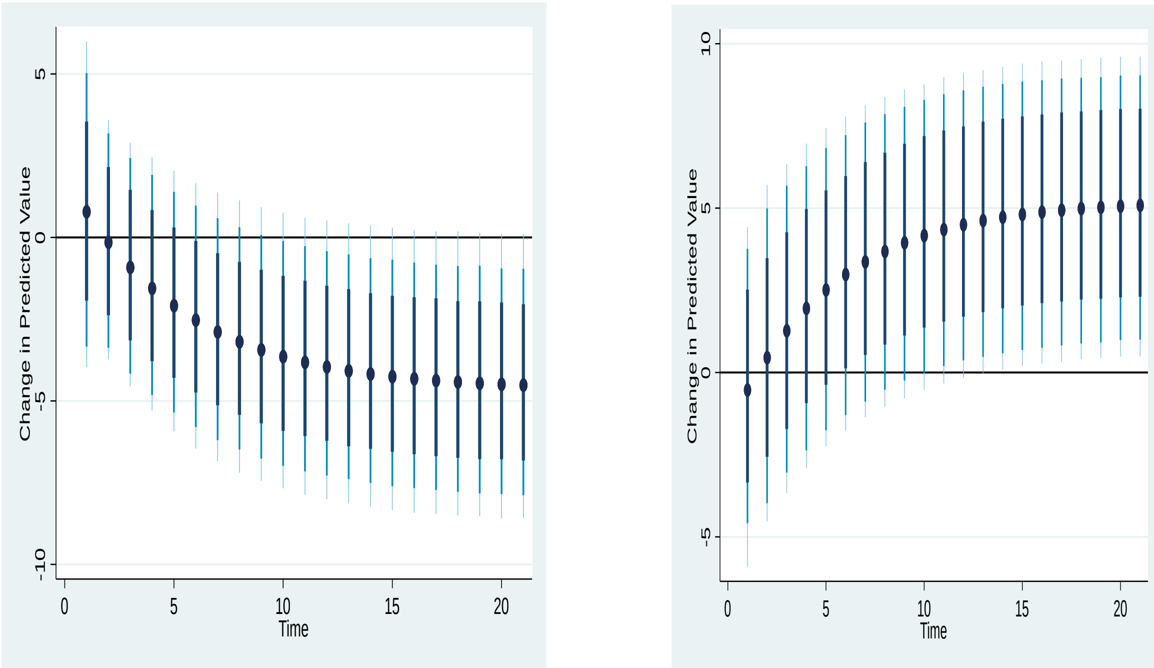

Fig. 1. Macroeconomic Policy Uncertainty and Environmental Quality

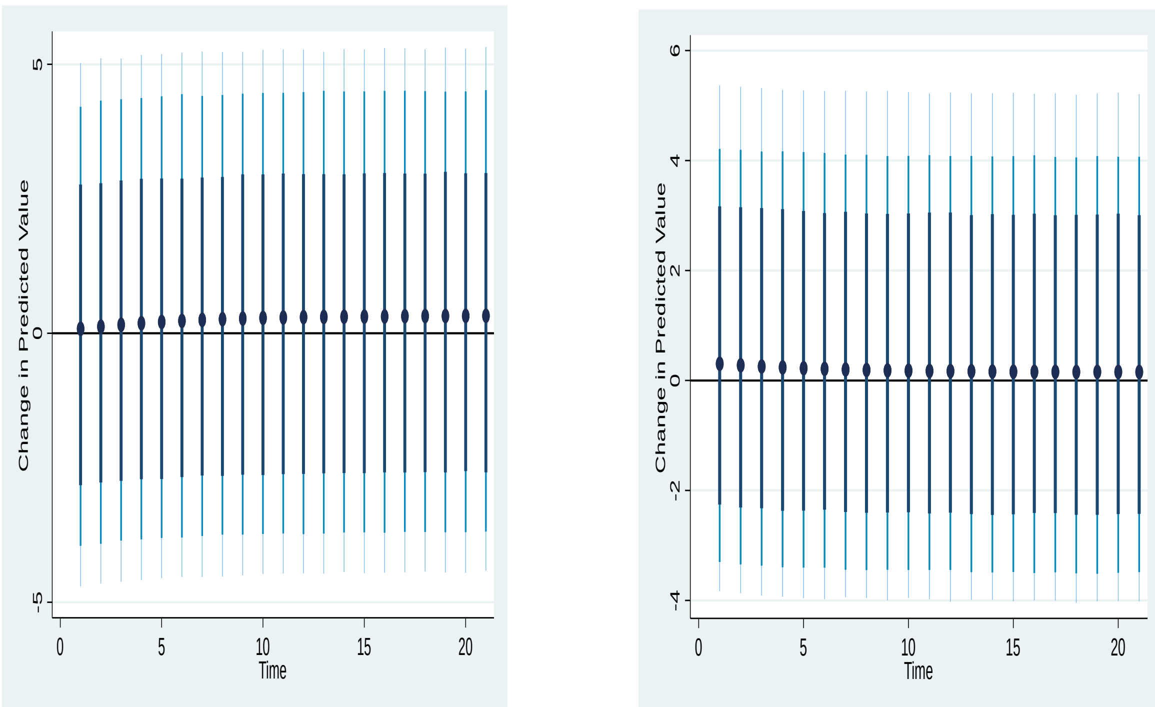

Fig. 2. Energy Intensity and Environmental Quality

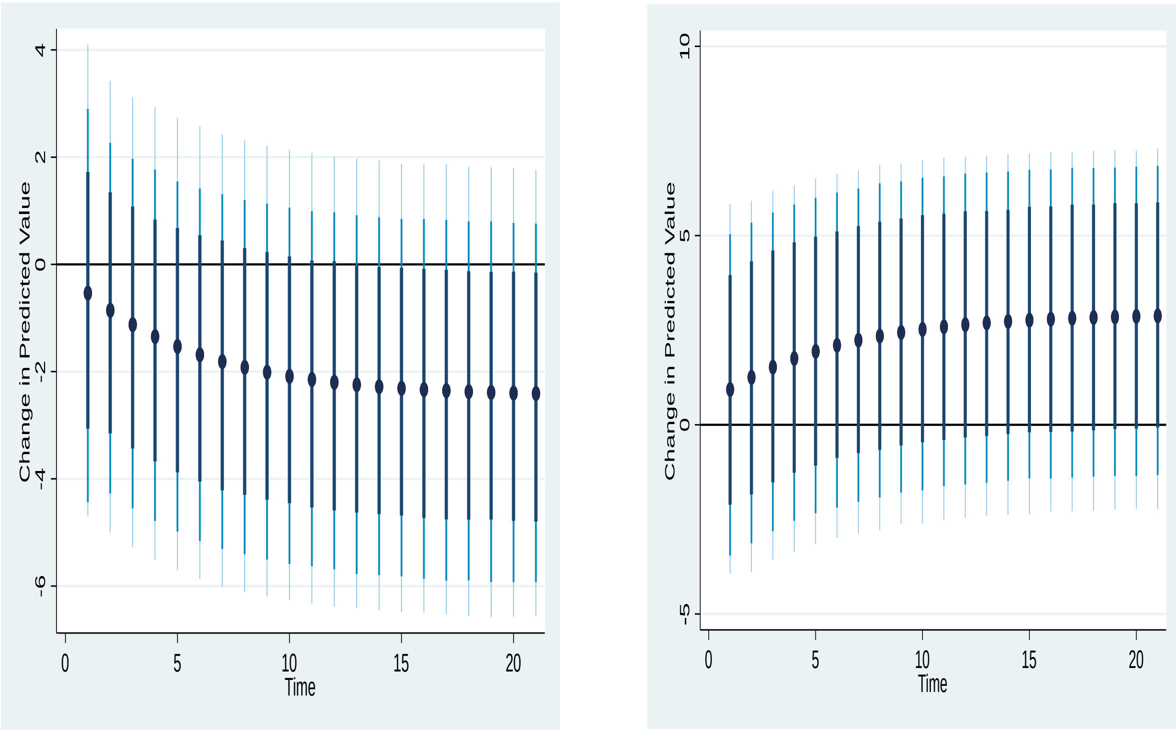

Fig. 3. Trade Openness and Environmental Quality

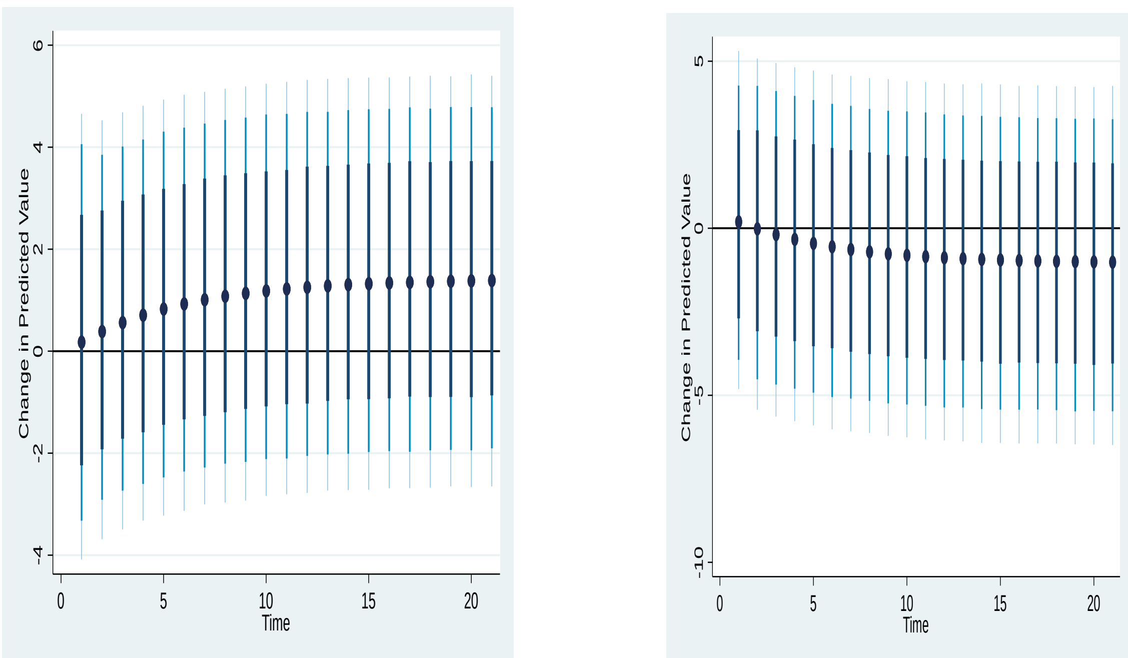

Fig. 4. Economic Growth and Environmental Quality

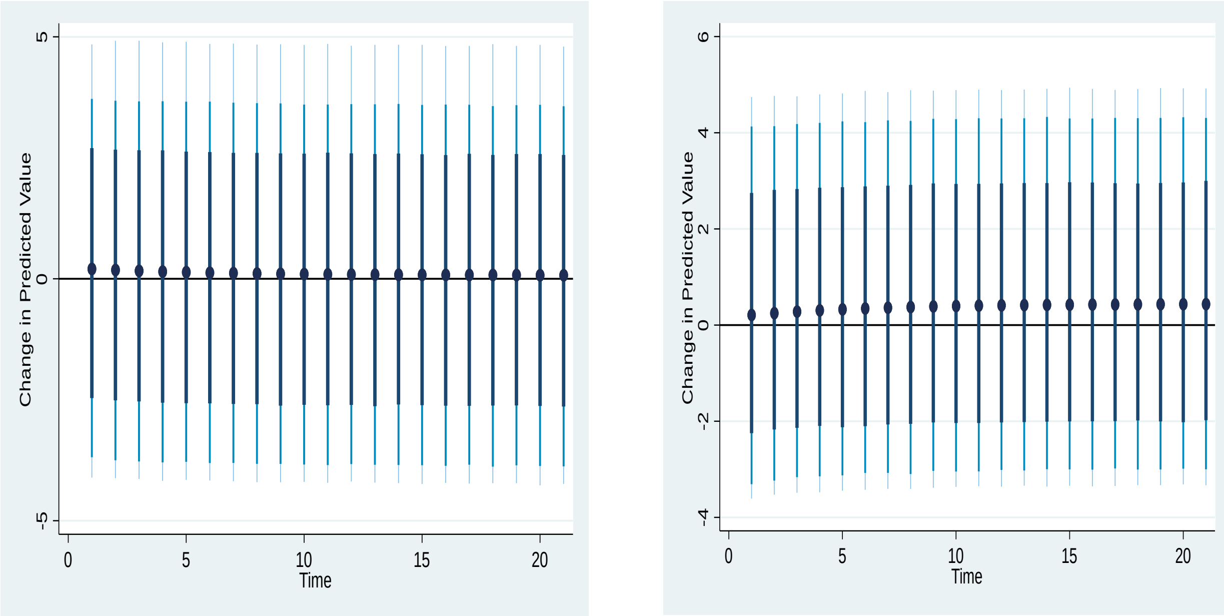

Fig. 5. Square of Economic Growth and Environmental Quality

CONCLUSION

This article examines the impact of energy intensity, trade openness, and macroeconomic policy uncertainty on Jordan's environmental quality from 1970 to 2021. To improve environmental quality, Jordan should take several steps. Firstly, it should support macroeconomic policies that promote innovation and investment in energy-efficient appliances and machinery. High energy consumption and unrestricted trade have negative consequences for the environment. Uncertainty surrounding future macroeconomic policies also contributes to environmental degradation. Therefore, Jordan should actively adopt advanced, environmentally friendly, and clean technologies that can transition from fossil fuels to low-carbon renewable energy sources. The government should establish strong international partnerships to facilitate technology exchange and environmental preservation.

Additionally, increasing Jordan's economic complexity is crucial for achieving its environmental development goals. The country's energy plans should prioritize the use of renewable energy sources as a viable option for reducing carbon dioxide emissions. Energy efficiency measures should be enhanced, and energy intensity should be reduced. Investing in research and development can facilitate the adoption of renewable and nuclear energy, contributing to the fight against climate change. Currently, over 80% of Jordan's primary energy comes from fossil fuels, highlighting the need for a transition to cleaner alternatives.

The study has several limitations that could impact the accuracy and generalizability of its findings. Firstly, reliance on secondary data sources introduces the potential for inaccuracies or incomplete information. Some crucial variables or factors influencing environmental quality may not have been included or accurately measured in the available data. Additionally, the quality of data may vary over time, and changes in measurement methods or data collection processes could affect the consistency of results. Secondly, the study focuses solely on the short-term and long-term effects of macroeconomic policy uncertainty, energy intensity, trade openness, and economic growth on environmental quality. Other factors like population growth, technological advancements, and environmental regulations may also influence environmental quality but were not considered in this analysis. Thirdly, the study's scope is limited to Jordan, which may restrict the generalizability of findings to other countries or regions with different economic, political, and environmental contexts. Environmental challenges and opportunities in Jordan may be unique and not directly comparable to other countries in the region or globally. Fourthly, the study employs a dynamic simulations approach that necessitates assumptions and simplifications to model the complex relationships between variables. The accuracy of the model's results depends on the validity of these assumptions and the quality of the data used. Lastly, the study does not account for the distributional impacts of macroeconomic policies on various socio-economic groups in Jordan. The effects of macroeconomic policies on environmental quality may not be evenly distributed among different income groups or geographic regions, and this aspect is not thoroughly explored in the study.

Based on these limitations, future researchers should consider extending the study period to cover a longer duration, as environmental effects may become evident only after several years of exposure to various economic and social factors. Additionally, exploring the impact of environmental policies and regulations on environmental quality in Jordan would be crucial, as they are likely to have a significant influence in this context. Furthermore, it would be valuable for future researchers to investigate the distributional impacts of macroeconomic policies and other factors on environmental quality by analyzing their effects on different income groups, regions, or demographic categories in Jordan. Examining the role of technological changes and innovations in shaping environmental quality in Jordan should also be considered, as they may increasingly play a vital role in mitigating or exacerbating environmental impacts. To enhance the generalizability of the study's findings, future research could explore the relationship between macroeconomic policies and environmental quality in other countries or regions. Additionally, investigating other factors that may influence environmental quality, such as natural resource endowment, climate change, and international trade agreements, would provide a more comprehensive understanding of the topic. Lastly, incorporating qualitative research methods would be beneficial for future researchers as they can provide a deeper understanding of the drivers of environmental quality and allow for contextualization of the findings within the political, social, and economic landscape of Jordan.

REFERENCES

Abdollahi, H. (2020). Investigating energy use, environment pollution, and economic growth in developing countries. Environmental and Climate Technologies, 24(1), 275-293.

Adams, S., Adedoyin, F., Olaniran, E., & Bekun, F. V. (2020). Energy consumption, economic policy uncertainty and carbon emissions; causality evidence from resource rich economies. Economic Analysis and Policy, 68, 179-190.

Ado, A. B., Mohd Rashid, N. N., Mustapha, U. A., & Ademola, L. S. (2022). Audit Quality and Creative Accounting Strategy: Evidence from Nigerian Public Listed Companies. *Australasian Accounting, Business and Finance Journal*, *16*(3), 40-54.

Ado, A. B., Rashid, N., Mustapha, U. A., & Ademola, L. S. (2020). The impact of audit quality on the financial performance of listed companies Nigeria. *Journal of Critical Reviews*, *7*(9), 37-42.

Ado, A. B., Rashid, N., Mustapha, U. A., & Lateef, S. A. (2021). The Impact of Corporate Tax Planning on the Financial Performance of Listed Companies in Nigeria. *International Journal of Economics, Management and Accounting*, 273-297.

Ali, M. B. (2023). Co integrating relation between macroeconomic variables and stock return: Evidence from Dhaka Stock Exchange (DSE). IJESPG (International Journal of Engineering, Economic, Social Politic and Government), 1(1), 1-14.

Alkhawaldeh, B. Y. S., Al-Zeaud, H. A., & Almarshad, M. N. (2022). Energy Consumption as a Measure of Energy Efficiency and Emissions in the MENA Countries: Evidence from GMM-Based Quantile Regression Approach. International Journal of Energy Economics and Policy, 12(5), 352-360.

Alkhawaldeh, B. Y., & Mahmood, S. (2021). The Effect of Government Support for Fuel and Wheat on Economic Growth in Jordan: An Application of Dynamic Autoregressive-Distributed Lag.

Alkhawaldeh, B. Y., Mahmood, S., & Jakada, A. H. (2020). An Empirical Assessment of the Effect of Taxes and Interest Rate on Economic Growth in Jordan: An Application of Dynamic Autoregressive-Distributed Lag. Research in World Economy. 11(3), 1-7

Al-Waely, D., Al Hawamdeh, H., & Al-Taee 3rd, H. (2021). Designing an Investment Portfolio for Innovative Solutions to Control the Crisis Market during the Covid-19 Pandemic. Indian Journal of Economics and Business, 20(2).

Atiku, A. M. Ismail, S., & Ahmad, A. U., (2021). Energy trade amidst sustainable economic growth in regional cooperation of West African States: fresh evidence from panel CS-ARDL. International Journal of Energy Economics and Policy, 2021, 11(6), 262-269.

Atiku, A. M. Ismail, S., & Ahmad, A. U., (2022). The Effect of Electricity Distribution Loss, Electricity Power Consumption, Electricity Intensity on Energy Consumption in West Africa. International Journal of Energy Economics and Policy, 12(5), 1-7.

Bhuiyan, M. A., Kahouli, B., Hamaguchi, Y., & Zhang, Q. (2023). The role of green energy deployment and economic growth in carbon dioxide emissions: Evidence from the Chinese economy. Environmental Science and Pollution Research, 30(5), 13162-13173.

Bilgili, F., Kuşkaya, S., Khan, M., Awan, A., & Türker, O. (2021). The roles of economic growth and health expenditure on CO2 emissions in selected Asian countries: a quantile regression model approach. *Environmental Science and Pollution Research*, *28*(33), 44949-44972.

Chen, L., Wen, F., Li, W., Yin, H., & Zhao, L. (2022). Extreme risk spillover of the oil, exchange rate to Chinese stock market: Evidence from implied volatility indexes. *Energy Economics*, *107*, 105857.

Chu, L. K., & Le, N. T. M. (2022). Environmental quality and the role of economic policy uncertainty, economic complexity, renewable energy, and energy intensity: The case of G7 countries. Environmental Science and Pollution Research, 29(2), 2866-2882.

Chu, L. K., & Le, N. T. M. (2022). Environmental quality and the role of economic policy uncertainty, economic complexity, renewable energy, and energy intensity: the case of G7 countries. *Environmental Science and Pollution Research*, *29*(2), 2866-2882.

D'Adamo, I., Lupi, G., Morone, P., & Settembre-Blundo, D. (2022). Towards the circular economy in the fashion industry: The second-hand market as a best practice of sustainable responsibility for businesses and consumers. *Environmental Science and Pollution Research*, 1-14.

Ekpe, M. T., Obasi, R. O., Abdullahi, S. R., Mustapha, U. A., & Rashid, N. (2020). Earnings Surprises and Stock Price Reactions of Quoted Companies in Nigeria. *International Journal of Financial Research*, *11*(4), 306-315.

Ekwueme, C., Obasi, R. O., Abdullahi, S. R., Mustapha, U. A., & Rashid, N. (2020). The influence of cash flow patterns on random organizational development in Nigerian listed companies. *Res. World Econ*, *11*(3), 171.

Fromentin, V., Lorraine, M. S. H., Ariane, C. P. E. R., & Alshammari, T. (2022). Time-varying causality between stock prices and macroeconomic fundamentals: Connection or disconnection?. Finance Research Letters, 49, 103073.

Gong, D., Jiang, T., Li, Z., & Wu, W. (2022). Optimal loan contracting under policy uncertainty: Theory and international evidence. *Journal of International Financial Markets, Institutions and Money*, *77*, 101502.

Hu, Y., Hong, Y., Feng, K., & Wang, J. (2022). Evaluating the Importance of Monetary Policy Uncertainty: The Long-and Short-Term Effects and Responses. *Evaluation Review*, 0193841X221124434.

Huynh, T. L. D., Wang, M., & Vo, V. X. (2021). Economic policy uncertainty and the Bitcoin market: An investigation in the COVID-19 pandemic with transfer entropy. *The Singapore Economic Review*, 1-27.

Ismaeel, B., & Alzubi, M. THE ROLE OF TECHNOLOGY IN ENHANCING THE ORGANIZATION'S EFFECTIVENESS IN LIGHT OF THE CORONA-VIRUS CRISIS IN JORDANIAN INDUSTRIAL COMPANIES.

Kamalu, K., Binti Wan Ibrahim, W. H., & Umar Ahmad, A. (2022). The Effect of Remittance on Human Development in the Organization of Islamic Cooperation Member Countries: Evidence from DCCE AND CS-ARDL. Iranian Journal of Management Studies, 15(2), 405-424.

Kamalu, K., Wan Ibrahim, W. H., Ahmad, A. U., & Mustapha, U. A. (2019). Causal link between financial developments, financial inclusion and economic growth in Nigeria. International Journal of Scientific & Technology Research, 8(12), 1-7

Khan, I., Lei, H., Shah, A. A., Khan, I., Baz, K., Koondhar, M. A., & Hatab, A. A. (2022). Environmental quality and the asymmetrical nonlinear consequences of energy consumption, trade openness and economic development: prospects for environmental management and carbon neutrality. *Environmental Science and Pollution Research*, *29*(10), 14654-14664.

Lee, H. S., Chia, C. J., Liew, P. X., Lee, S. Y., & Har, W. M. (2023). The heterogeneous effect of economic growth on the ecological footprint in OECD countries. In IOP Conference Series: Earth and Environmental Science (Vol. 1135, No. 1, p. 012032). IOP Publishing.

Li, X., Li, Z., Su, C. W., Umar, M., & Shao, X. (2022). Exploring the asymmetric impact of economic policy uncertainty on China's carbon emissions trading market price: Do different types of uncertainty matter?. *Technological Forecasting and Social Change*, *178*, 121601.

Liu, Z., Pang, P., Fang, W., Ali, S., & Anser, M. K. (2022). Dynamic common correlated effects of pandemic uncertainty on environmental quality: fresh insights from East-Asia and Pacific countries. *Air Quality, Atmosphere & Health*, 1-17.

Muhammad, S., Pan, Y., Agha, M. H., Umar, M., & Chen, S. (2022). Industrial structure, energy intensity and environmental efficiency across developed and developing economies: The intermediary role of primary, secondary and tertiary industry. Energy, 247, 123576.

Mustapha, U. A., Rashid, N., Ado, A. B., & Ademola, L. S. (2020). Development of Corporate Governance and the Effect of Corruption on the Nigerian Financial Institutions. *Journal of Advanced Research in Dynamical & Control Systems, DOI*, *10*.

Mustapha, U. A., Rashid, N., Bala, H., Musa, H. (2020). Corporate governance and financial performance of Nigeria listed banks. *Jour of Adv Research in Dynamical & Control Systems*, *12*(1).

MUSTAPHA, U. A., RASHID, N., RABIU, S., & ABDULLAHI, R. O. O. (2021b). The Influence of CEO Characteristics on Financial Reporting Quality in Nigerian Non-Financial Listed Companies. *Journal of Contemporary Issues in Business and Government| Vol*, *27*(2), 118.

MUSTAPHA, U. A., TAIB, F. M., & RASHID, N. (2021a). The Effects of 2011 Revised Code of Corporate Governance on Financial Reporting Quality in Nigeria: The Role of Board of Directors and Audit Committee Members. *Journal of Contemporary Issues in Business and Government| Vol*, *27*(2), 219.

Nchofoung, T. N., & Asongu, S. A. (2022). Effects of infrastructures on environmental quality contingent on trade openness and governance dynamics in Africa. *Renewable Energy*, *189*, 152-163.

Patel, P. C., & Tsionas, M. (2022). Macroeconomic uncertainty and risk: Collective optimism of small-business owners. *Entrepreneurship Theory and Practice*, *46*(5), 1402-1422.

Prananta, B., & Alexiou, C. (2023). Exchange rates, bond yields and the stock market: nonlinear evidence of Indonesia during the COVID-19 period. Asian Journal of Economics and Banking.

Qamruzzaman, M., Tayachi, T., Mehta, A. M., & Ali, M. (2021). Do international capital flows, institutional quality matter for innovation output: the mediating role of economic policy uncertainty. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(2), 141.

Raihan, A., & Tuspekova, A. (2022). Nexus between economic growth, energy use, agricultural productivity, and carbon dioxide emissions: new evidence from Nepal. *Energy Nexus*, *7*, 100113.

Ran, G., Zixiang, Z., & Jianhao, L. (2022). Consumption–investment comovement and the dynamic impact of monetary policy uncertainty in China. *Economic Modelling*, 105908.

Roy, P. P., Rao, S., & Zhu, M. (2022). Mandatory CSR expenditure and stock market liquidity. *Journal of Corporate Finance*, *72*, 102158.

Salahuddin, M., Habib, M. A., Al-Mulali, U., Ozturk, I., Marshall, M., & Ali, M. I. (2020). Renewable energy and environmental quality: A second-generation panel evidence from the Sub Saharan Africa (SSA) countries. *Environmental research*, *191*, 110094.

Shabir, M., Ali, M., Hashmi, S. H., & Bakhsh, S. (2022). Heterogeneous effects of economic policy uncertainty and foreign direct investment on environmental quality: Cross-country evidence. Environmental Science and Pollution Research, 29(2), 2737-2752.

Shabir, M., Ali, M., Hashmi, S. H., & Bakhsh, S. (2022). Heterogeneous effects of economic policy uncertainty and foreign direct investment on environmental quality: Cross-country evidence. *Environmental Science and Pollution Research*, *29*(2), 2737-2752.

Shakya, S. R., Adhikari, R., Poudel, S., & Rupakheti, M. (2022). Energy equity as a major driver of energy intensity in South Asia. *Renewable and Sustainable Energy Reviews*, *170*, 112994.

Sharma, P., Shrivastava, A. K., Rohatgi, S., & Mishra, B. B. (2023). Impact of macroeconomic variables on sustainability indices using ARDL model. Journal of Sustainable Finance & Investment, 13(1), 572-588.

Shokoohi, Z., Dehbidi, N. K., & Tarazkar, M. H. (2022). Energy intensity, economic growth and environmental quality in populous Middle East countries. Energy, 239, 122164.

Song, Y., Tang, X., Wang, H., & Ma, Z. (2023). Volatility forecasting for stock market incorporating macroeconomic variables based on GARCH- MIDAS and deep learning models. Journal of Forecasting, 42(1), 51-59.

Sui, H., Li, X., Raza, A., & Zhang, S. (2022). Impact of trade policy uncertainty on export products quality: new evidence by considering role of social capital. *Journal of Applied Economics*, *25*(1), 997-1024.

Sun, Y., Guan, W., Cao, Y., & Bao, Q. (2022). Role of green finance policy in renewable energy deployment for carbon neutrality: Evidence from China. *Renewable Energy*, *197*, 643-653.

Syed, Q. R., & Bouri, E. (2022). Impact of economic policy uncertainty on CO2 emissions in the US: Evidence from bootstrap ARDL approach. *Journal of Public Affairs*, *22*(3), e2595.

Udeagha, M. C., & Ngepah, N. (2022). Does trade openness mitigate the environmental degradation in South Africa?. Environmental Science and Pollution Research, 29(13), 19352-19377.

Umar, M. B., Dayyabu, S., Gambo, A., Danlami, M., & Ahmad, A. (2015). An empirical study on the relationship between financial intermediaries and economic growth in Nigeria: A cointegration and causality analysis. Journal of Economics and Finance. Volume, 6(4), 15-31

Umar, N., Sambo, I., Ahmad, A. U., & Hassan, A. (2021). Financial Development and Economic Growth in Nigeria: New Evidence from a Threshold Autoregressive and Asymmetric Analysis. International Journal of Business, 8(3), 207-218.

Usman, M., Kousar, R., Makhdum, M. S. A., Yaseen, M. R., & Nadeem, A. M. (2022). Do financial development, economic growth, energy consumption, and trade openness contribute to increase carbon emission in Pakistan? An insight based on ARDL bound testing approach. Environment, Development and Sustainability, 1-30.

Wang, L., Liu, G., Alkhatib, S., Wang, X., Dai, J., Abbas, S. Z., & Khan, Y. A. (2022). The impact of foreign direct investment on environment: evidence from newly industrialized countries. *Environmental Science and Pollution Research*, 1-12.

Wang, R., Laila, U., Nazir, R., & Hao, X. (2023). Unleashing the influence of industrialization and trade openness on renewable energy intensity using path model analysis: A roadmap towards sustainable development. Renewable Energy, 202, 280-288.

Wang, W., Rehman, M. A., & Fahad, S. (2022). The dynamic influence of renewable energy, trade openness, and industrialization on the sustainable environment in G-7 economies. Renewable Energy, 198, 484-491.

Wang, W., Rehman, M. A., & Fahad, S. (2022). The dynamic influence of renewable energy, trade openness, and industrialization on the sustainable environment in G-7 economies. *Renewable Energy*, *198*, 484-491.

Zakari, A., Adedoyin, F. F., & Bekun, F. V. (2021). The effect of energy consumption on the environment in the OECD countries: economic policy uncertainty perspectives. *Environmental Science and Pollution Research*, *28*(37), 52295-52305.