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Examining the Relationship between Manufacturing Value Added and Environmental Impact in Azerbaijan

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ABSTRACT

This research investigates the relationship between manufacturing value added (MVA) as a proportion of GDP and CO_2 emissions per capita in Azerbaijan, a prominent energy-producing country grappling with the implications of global climate change. Employing Johansen cointegration and autoregressive distributed lag (ARDL) methodologies, the analysis demonstrates a significant long-term association between MVA and CO_2 emissions, suggesting that variations in MVA are intricately linked to alterations in emissions levels. The Johansen cointegration test substantiates that CO_2 emissions per capita and MVA exhibit a tendency to co-move over time, effectively rejecting the null hypothesis of no cointegration at the 5% significance level. Furthermore, the F-bounds test of the ARDL model provides compelling evidence of cointegration, with the F-statistic surpassing the upper critical bound across all significance levels. The results from the error correction model (ECM) regression affirm the presence of a long-term adjustment mechanism, indicating that any deviations from the equilibrium relationship between CO_2 emissions and MVA will be rectified over time. These outcomes underscore the vital nexus between economic activity and environmental sustainability in Azerbaijan, highlighting the imperative for cohesive policy frameworks aimed at addressing the environmental ramifications of rising manufacturing output while fostering sustainable development.

Keywords: Manufacturing Value Added, CO_2 emissions, Johansen Cointegration, Autoregressive Distributed Lag Model, Green Economy, Azerbaijan
JEL Classifications: A12, O14, C18, Q56

1. INTRODUCTION

The research examines the presence of a long-term cointegration relationship between manufacturing value added and CO_2 emissions in Azerbaijan. Initially, it is imperative to familiarize oneself with the scientific classification of manufacturing value added as a percentage of GDP, as this concept constitutes a distinct research object within economic studies.

Value added represents the worth generated from the production of goods and services and is quantified by subtracting the value of intermediate consumption from the total output. This measure also indicates the income available to compensate labor and capital for their roles in the production process. By capturing the net economic contribution of these inputs, value added provides insights into the efficiency and productivity of various sectors (OECD, 2023). The value added of an industry, or GDP-by-industry, represents its contribution to overall GDP and comprises compensation of employees, taxes on production and imports less subsidies, and gross operating surplus (BEA, 2006). Manufacturing value-added (MVA) represents the net output of the manufacturing sector, calculated by deducting input costs, including raw materials and labor, from the total value of produced goods. This metric plays a crucial role in gross domestic product (GDP) analysis, as it signifies the manufacturing sector's impact on the economy and serves as an indicator of productivity, demonstrating how effectively resources are utilized to convert raw materials into finished products. Additionally, MVA is associated with economic development and industrial advancement, as increases in value-added typically indicate a shift toward more sophisticated manufacturing processes and higher-value products. Anyanwu (2017) conducted a comprehensive investigation within a specific regional context, emphasizing that structural transformation is crucial for economic development, with the industrial sector, particularly manufacturing, acting as a key growth driver; however, manufacturing's contribution remains limited, accounting for only 0.10% of global manufacturing value added in 2013. The study highlights positive influences on manufacturing value added, including education and trade openness, while also noting that reliance on oil and civil unrest adversely affects growth, resulting in policy recommendations aimed at strengthening the manufacturing sector.

According to the National Information Portal on Sustainable Development Goals of the Republic of Azerbaijan (NIPSDGRA, 2024) and the State Statistical Committee of the Republic of Azerbaijan (SSCRA, 2024), MVA encompasses a range of inputs, including raw materials, intermediate goods, and semi-finished products derived from industrial production and other sectors. This classification of economic activities covers various industries, such as food and beverage, tobacco, textiles, clothing, leather goods, footwear, furniture, woodworking, paper and cardboard, printing, petroleum products, chemicals, pharmaceuticals, rubber and plastics, non-metallic mineral products, metallurgy, machinery and equipment, as well as the manufacturing of computer, electronic, optical products, and electrical equipment.

Azerbaijan's economy relies significantly on the oil and gas industry, which serves as a fundamental pillar for economic growth and development. In 2020, Azerbaijan's manufacturing value added as a percentage of GDP was recorded at 6.102%, while CO_2 emissions were reported at 3.399 metric tons per capita, according to World Bank data. Figure 1 illustrates a notable visual correlation between CO_2 emissions per capita and the manufacturing sector's share of GDP in Azerbaijan. Both indicators show a marked decline during the 1990s and early 2000s, followed by a modest increase in recent years. Despite the significant progress made, it is imperative to continue the implementation of policies and strategies that promote sustainable growth and effectively combat climate change.

Azerbaijan's economic landscape has undergone significant changes, particularly in the manufacturing sector. As the country increasingly prioritizes industrialization, it faces the dual challenge of enhancing economic productivity while confronting environmental degradation. This study explores the cointegration between manufacturing value added and per capita CO_2 emissions to assess whether an increase in manufacturing output correlates with a rise in emissions. The primary objective of this research is to empirically establish the existence of robust cointegration relationships between current manufacturing value added and CO_2 emissions.

2. LITERATURE REVIEW

Manufacturing value-added as a percentage of GDP is a crucial qualitative indicator of macroeconomic development, highlighting the manufacturing sector's contribution to overall economic performance. Despite its strategic importance for economic policy and development, there is a notable lack of scientific studies that explore its relationship with other significant macroeconomic indicators. Existing research has produced mixed results, yielding both positive and negative findings regarding this issue. Xue et al. (2023) examined the relationship between natural resources, value-added manufacturing, and economic growth in European and Central Asian economies from 1989 to 2021. Their findings indicate that natural resources have a negative impact on growth, while technological innovation and gross capital formation enhance economic growth. They recommend policies that promote sustainable resource utilization, technological advancement, and capital formation to support long-term economic development. Karami et al. (2019) studied the influence of manufacturing value-added on economic growth in European economies during the period of deindustrialization (1995-2016). Their analysis found a positive correlation between manufacturing value-added and economic growth, but they also unexpectedly identified a negative relationship between investment and growth. Jebli et al. (2020) explored the relationship between CO_2 emissions, economic growth, and renewable energy consumption across 102 countries from 1990 to 2015. Their study concluded that renewable energy generally reduces CO_2 emissions, except in lower-middle-income countries. Additionally, they found that renewable energy negatively affects industrial value-added in high-income countries, while positively impacting low-income and upper-middle-income countries. The effects of service value-added varied based on income levels. These findings reflect the diversity of results in the scientific literature on these topics, indicating that further research from a broader perspective is warranted.

There are limited studies addressing the Azerbaijani context regarding agricultural manufacturing value added and CO_2 emissions. Gurbuz et al. (2021) confirmed the environmental Kuznets curve (EKC) hypothesis, showing that GDP and energy consumption increase emissions, while agricultural production and the square of GDP reduce them; their findings indicate bidirectional causality between GDP and CO_2 emissions and a unidirectional relationship from energy consumption and agricultural value added to emissions, suggesting that enhancing agricultural production could help lower CO_2 levels. Karimli et al. (2019) examined the interrelated stages of the value chain, spanning from the acquisition of raw materials to processing and sales. They highlighted how each stage plays a role in value creation and economic activity, underscoring common principles that are applicable across various countries and regions. From an overarching perspective, the research findings indicate that policymakers should prioritize the enhancement of manufacturing productivity and employment as critical strategies for achieving sustainable and competitive economic development. Such measures are essential for fostering resilience and adaptability within the economy, ultimately supporting long-term growth and stability.

The Johansen cointegration methodology has been employed in econometric analyses, particularly in studies of manufacturing value added. For instance, Ilyas et al. (2010) utilized a bounds test-based cointegration technique on annual data from 1965 to 2007, revealing that total factor productivity (TFP) is the most significant determinant of manufacturing value added in Pakistan.

Their analysis also indicated a negative relationship between investment price levels and manufacturing value added, while trade openness was deemed insignificant, leading to recommendations for enhancing TFP and stabilizing investment prices to promote growth in the manufacturing sector.

The autoregressive distributed lag (ARDL) model is a statistical method employed in econometrics to examine the dynamics between time series variables in both the long run and short run. This model is especially advantageous for estimating long-term relationships among variables while also considering short-term adjustments (Economatik, 2023). Karedla et al. (2021) examined the impact of economic growth, trade openness, and manufacturing on CO_2 emissions in India. Employing the ARDL bounds test approach and utilizing annual time series data from 1971 to 2016, the study found a long-run relationship indicating that trade openness reduces CO_2 emissions, whereas manufacturing and GDP have a positive contribution to emissions over the long term. Although many articles have examined the autoregressive distributed lag (ARDL) model, there are relatively few studies that focus specifically on the long-term relationship between manufacturing value added and CO_2 emissions. Ali et al. (2019) explored the relationship between carbon dioxide emissions, gross domestic product (GDP), land under cereal crops (LCC), and agricultural value-added (AVA) in Pakistan, employing time-series data from 1961 to 2014. Their findings revealed both short- and long-run associations among these variables, indicating a positive but insignificant long-term relationship between CO_2 emissions and agricultural factors, as well as a negative and statistically insignificant short-term relationship between CO_2 emissions and GDP, highlighting the importance of developing sustainable agricultural policies in Pakistan to reduce emissions. Okere et al. (2021) investigated the interplay between finance, industrial value-added, and carbon emissions in Argentina, emphasizing their roles in sustainable development from 1971 to 2018. Utilizing dynamic Autoregressive Distributed Lag simulations, the study concludes that enhanced financial mechanisms and industrial restructuring can support a transition to low-carbon development; however, fossil fuel usage, population growth, economic development, and government expenditure intensify environmental issues, highlighting the necessity for policy measures that encourage carbon capture technologies to meet Argentina's environmental objectives.

Numerous scientific studies have utilized the ARDL approach to address various environmental issues. This methodology has proven valuable for analyzing the long- and short-term dynamics between environmental variables and economic factors, contributing to a deeper understanding of sustainable development challenges. As a noteworthy contribution to the field, Mehmood (2020) investigated the relationship between globalization and CO_2 emissions in Singapore, utilizing long-term data from 1970 to 2014. The study's findings reveal a significant association between the variables, indicating that social and economic globalization may facilitate a reduction in carbon dioxide emissions in the future, while political globalization is correlated with an increase in emissions, thus confirming the existence of an environmental Kuznets curve and offering policy recommendations for reducing air pollution. Numerous significant scientific studies have employed the ARDL approach to examine long-run relationships related to environmental issues, providing valuable insights into how various factors interact over time to influence environmental outcomes and sustainability (Kartal, 2023; Satrianto et al., 2024; Seriram et al., 2024).

3. DATA AND METHODOLOGY

The study is based on two primary variables: annual per capita carbon dioxide (CO_2) emissions and manufacturing value added (MVA) as a percentage of GDP, both specific to Azerbaijan. The CO_2 emissions variable measures the total annual carbon dioxide emissions per capita, serving as a crucial indicator of Azerbaijan's environmental footprint. This variable is particularly significant in assessing the nation's contribution to global climate change efforts. The MVA variable quantifies the proportion of manufacturing value added to the country's overall gross domestic product (GDP), reflecting the industrial sector's role in national economic output and structural transformation.

The analysis was conducted using annual data spanning the years 1990-2020. Both variables were sourced from the World Bank's (2024) global dataset, a widely utilized and reputable source of international economic and environmental statistics. The comprehensive and reliable nature of these data ensures a sound empirical foundation for analyzing the potential linkages between Azerbaijan's manufacturing-driven economic growth and its environmental impact, particularly in terms of carbon emissions. Table 1 shows that the level version of CO_2 emissions exhibits a nearly symmetrical distribution with a slight rightward skew and significant outliers, while MVA displays a more pronounced rightward skew and greater variability.

This study investigates the relationship between CO_2 emissions per capita and manufactured value added as a percentage of GDP. A comprehensive analysis was conducted using several cointegration testing methods, including the Johansen test (1988) and the autoregressive distributed lag (ARDL) model, introduced by Pesaran and Shin (1995), serves as a methodological framework for analyzing the dynamic relationships between variables across both short and long-term horizons. The primary formula of the ARDL model can be articulated as follows:

$$Y_t = \alpha + \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{j=0}^{q} \gamma_j X_{t-j} + \varepsilon_t$$

In this formula, Y_t is the dependent variable at time t, α is the intercept, β_i are the coefficients of the lagged dependent variable Y_{t_i}, X_{t_j} are the independent variables with their respective lags, γ_j are the coefficients of the lagged independent variables X_{t_j}, ε_t is the error term. By incorporating our variables into the ARDL model framework, with CO2 as the dependent variable and manufacturing value added (MVA) as the independent variable, the resulting formula can be expressed as follows:

$$CO_{2,t} = \alpha + \sum_{i=1}^{p} \beta_i CO_{2,t-i} + \sum_{j=0}^{q} \gamma_j MVA_{t-j} + \varepsilon_t$$

Table 1: Descriptive statistics of data variables

Variable	Mean	Median	Standard Deviation	Skewness	Kurtosis	Jarque-Bera
CO_2	3.900502	3.381556	1.438916	2.194078	6.535829	41.02075
MVA	7.966439	6.042224	4.714951	1.577201	4.460362	15.60710

Collectively, these methodologies enhance the understanding of the interactions between CO_2 emissions and manufactured value added, enabling researchers to draw well-substantiated conclusions regarding their long-term relationship. By integrating various analytical approaches, the analysis elucidates the intricate dynamics involved, thereby providing deeper insights into how manufacturing processes impact CO_2 emissions over time.

4. RESULTS AND INTERPRETATIONS

4.1. Unit Root Test

Unit root tests are essential in time series analysis to assess the stationarity of a series, determining whether its statistical properties remain constant over time. The presence of a unit root implies that shocks to the series have a lasting impact. Among the most widely used methods for unit root testing is the Augmented Dickey-Fuller test, which builds on the basic Dickey-Fuller (1979) approach by incorporating lagged differences of the series to address autocorrelation. The null hypothesis of a unit root is rejected if the test statistic is sufficiently negative, signifying that the series is stationary. Similarly, the Phillips-Perron (1988) test evaluates the presence of a unit root but adjusts the test statistics to account for serial correlation and heteroscedasticity in the error terms, making it more robust to data irregularities. The concept of stationarity is also critical in the application of the Autoregressive Distributed Lag (ARDL) model, which examines relationships between variables with differing orders of integration, specifically I(0) (stationary) and I(1) (non-stationary) variables. For the ARDL model to yield valid inferences, variables should exhibit non-stationarity at levels but become stationary after first differencing, ensuring the accurate modeling of long-term relationships.

Table 2 presents the outcomes of the unit root test, which is essential for assessing the stationarity of the time series data. The results determine whether the series contains a unit root, indicating non-stationarity. Since the unit root test reveals that the series is non-stationary at levels but becomes stationary after first differencing, this condition satisfies the prerequisites for applying the Autoregressive Distributed Lag (ARDL) model, which is suitable for analyzing variables integrated of different orders, particularly I(0) (stationary) and I(1) (non-stationary).

4.2. Research Findings from Johansen Cointegration Test

Selecting the optimal lag length is vital for VAR analysis, especially in the Johansen cointegration test, as it ensures the accurate detection of long-term equilibrium relationships between variables. Proper lag selection avoids overfitting and bias, thus enhancing the credibility and reliability of the cointegration outcomes. Table 3 shows that the optimal lag order is determined to be 1. This result is derived from the analysis of the Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn Information Criterion (HQ). These criteria, which balance model fit with

Table 2: Unit Root Test

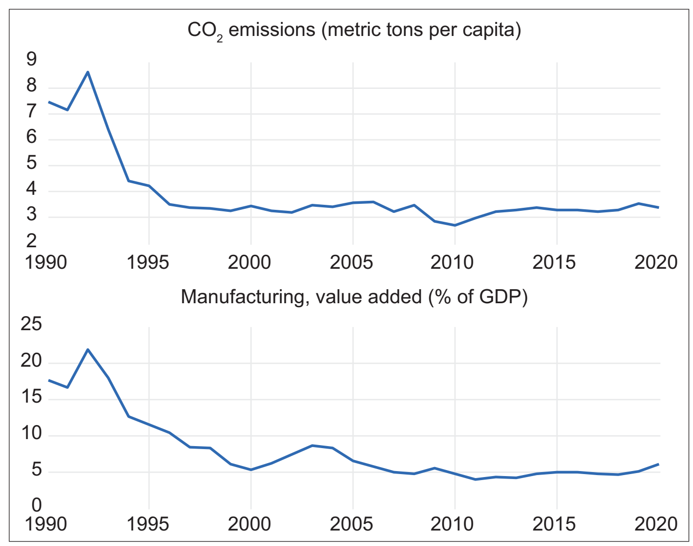
Variable	Test	Level (Trend & Intercept)	1st Difference (Trend & Intercept)
		Non-stationary	Stationary
CO_2	Augmented Dickey-Fuller	-2.064 (0.543)	-5.270 (0.001***)
	Phillips-Perron	-1.923 (0.617)	-5.287 (0.001***)
MVA	Augmented Dickey-Fuller	-0.236 (0.987)	-4.718 (0.005***)
	Phillips-Perron	-1.136 (0.905)	-5.787 (0.000***)

Table 3: VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	−100.77	NA	0.094	3.312	3.411	3.338
1	−60.671	30.386*	0.030*	2.199*	2.493*	2.277*
2	−59.707	5.215	0.033	2.258	2.748	2.388

*Indicates lag order selected by the criterion

Figure 1: CO_2 emissions and manufacturing value added (% of GDP) in Azerbaijan (1995-2020)



Data source: World Bank

Figure 2: Inverse roots of AR characteristic polynomial

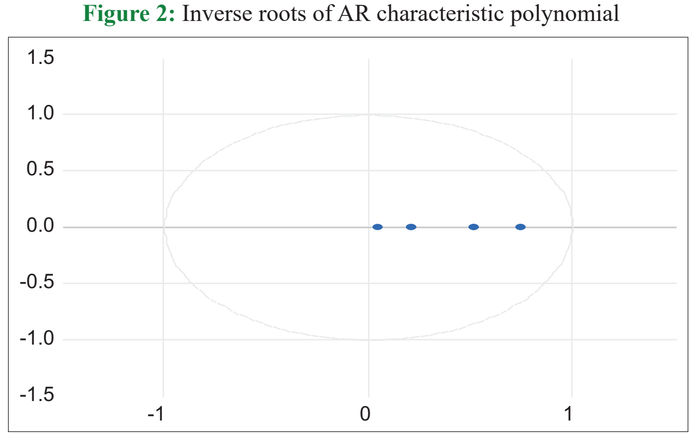


Table 4: Johansen cointegration rank test

Panel 1.				
Hypothesized	**Eigenvalue**	**Trace statistic**	**0.05 critical value**	**P-value**
None	0.892	73.580	15.494	0.0000*
At most 1	0.331	11.261	3.841	0.0008*
Panel 2.				
Hypothesized	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**P-value**
None	0.892	62.319	14.264	0.0000*
At most 1	0.331	11.261	3.841	0.0008*

*Indicates rejection of the null hypothesis at the 0.05 significance level

Table 5: F-bounds test

Test statistic	Value	Significance (%)	Lower bound	Upper bound
F-statistic	21.423	10	3.02	3.51
k	1	5	3.62	4.16
		1	4.94	5.58

Table 6: Levels equation

Variable	Coefficient	Std. Error	t-Statistic	P-value
MVA	0.053429	0.02919	1.83039	0.0821
C	3.000537	0.174736	17.17185	0

Table 7: ECM regression

Variable	Coefficient	Std. error	t-statistic	P-value
D (MVA)	0.057411	0.039669	1.447264	0.1633
D (MVA[−1])	−0.068503	0.037931	−1.805981	0.086
D (MVA[−2])	0.024642	0.02305	1.06903	0.2978
D (MVA[−3])	0.033822	0.02062	1.640274	0.1166
CointEq(−1)*	−0.810041	0.096339	−8.408267	0

*Significant at 1%, 5%, 10%

complexity, indicate that a lag of 1 provides the most parsimonious and well-specified model for the cointegration analysis.

Figure 2 illustrates that the inverse roots of the autoregressive (AR) characteristic polynomial are all located within the unit circle, signifying the stability of the VAR model. Such stability implies that the model's forecasts are consistent and dependable across time.

In Table 4, the results of the Johansen cointegration test reveal a significant long-term relationship between CO_2 emissions per capita and manufactured value added as a percentage of GDP in Azerbaijan. Both the Trace and Maximum Eigenvalue statistics reject the null hypothesis of no cointegration at the 5% significance level. This finding indicates that these two variables exhibit a tendency to move together over time. Consequently, it suggests that fluctuations in the manufacturing sector's contribution to GDP are associated with corresponding changes in CO_2 emissions over the long term.

4.3. Research Findings from ARDL Method

Hasanov et al. (2024) employed the ARDL model and its associated diagnostics to examine the long-term cointegration between the Human Development Index and CO2 emissions in Azerbaijan. This research study was also conducted using the same methodology and principles, but with a different variable.

Table 5 presents the results of the ARDL model's long-run form and bound test, which examines the presence of a long-run relationship (cointegration) between the variables. The F-bounds test is used to determine whether cointegration exists, with the F-statistic of 21.423 indicating the strength of this relationship. The significance levels (10%, 5%, 1%) provide critical values for the F-statistic, while the lower and upper bounds are calculated based on the sample size and number of variables. Since the F-statistic exceeds the upper bound at all significance levels, the test confirms strong evidence of cointegration. This result implies that the variables share a stable long-run equilibrium relationship, validating the use of error correction models to capture short-term deviations and their convergence to the long-run equilibrium.

Table 6 reveals a positive long-run relationship between MVA and CO_2, as indicated by the coefficient of 0.053429, which suggests that a 1-unit increase in MVA corresponds to a 0.053429-unit increase in CO_2 emissions. The t-statistic of 1.83039, along with a P = 0.0821, indicates significance at the 10% level, reflecting a marginally supportive conclusion.

The error correction term (EC) is defined by the equation:

$$EC = CO_2 - (0.0534 \times MVA + 3.0005)$$

This equation reflects the short-term deviations of carbon dioxide (CO_2) emissions from their long-run equilibrium relationship with Manufacturing Value Added (MVA). A positive EC indicates that CO_2 emissions are currently above their equilibrium level, whereas a negative EC suggests they are below this level. The model posits that, over time, these deviations will correct, leading CO_2 emissions to adjust towards the long-term equilibrium established by MVA.

The Error Correction Model (ECM) serves as a statistical framework for examining the short-term dynamics alongside the long-term relationships of non-stationary time series variables. The regression results presented in Table 7 indicate that the coefficient for CointEq(−1) is both negative and statistically significant, signifying an adjustment mechanism in the long run between CO_2 emissions and manufacturing value added. This negative coefficient implies that any deviations from the long-term equilibrium will be rectified over time, resulting in a reduction of CO_2 emissions toward their equilibrium level. Furthermore, the significance of the CointEq(−1) term highlights the robustness of this relationship, offering compelling evidence of cointegration between the examined variables.

5. CONCLUSION

The empirical analysis presented in this study elucidates the complex interplay between Manufacturing Value Added (MVA) and CO_2 emissions per capita in Azerbaijan, revealing a significant long-term positive association. The outcomes derived from the Johansen cointegration test confirm that fluctuations in MVA are intricately linked to corresponding changes in CO_2 emissions, indicating that the expansion of the manufacturing sector inherently contributes to increased emissions. The robust F-statistic observed in the ARDL model further substantiates the established cointegration, suggesting that the variables not only exhibit a contemporaneous relationship but also converge towards a shared long-run equilibrium. Additionally, findings from the Error Correction Model (ECM) reveal an adjustment mechanism that facilitates a return to this equilibrium, whereby short-term deviations in CO_2 emissions are expected to correct over time.

These insights highlight the imperative for policymakers to incorporate environmental considerations into economic strategies aimed at enhancing the manufacturing sector. Consequently, this research underscores the critical need for sustainable practices in manufacturing, advocating for the adoption of environmentally friendly technologies and policies to mitigate the adverse effects of industrial expansion on CO_2 emissions. Overall, the findings serve as a foundation for future research and policy development, addressing the urgent challenge of reconciling economic growth with environmental sustainability in Azerbaijan.

REFERENCES

Ali, S., Ying, L., Shah, T., Tariq, A., Ali Chandio, A., Ali, I. (2019), Analysis of the nexus of CO_2 emissions, economic growth, land under cereal crops and agriculture value-added in Pakistan using an ARDL approach. Energies, 12(23), 4590.

Anyanwu, J.C. (2017), Manufacturing value added development in North Africa: Analysis of key drivers. Asian Development Policy Review, 5(4), 281-298.

BEA. (2006), What is Industry Value Added? Available from: https://www.bea.gov/help/faq/184

Dickey, D.A., Fuller, W.A. (1979), Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association, 74(366a), 427-431.

Economatik. (2023), Using Variables for ARDL Testing: A Comprehensive Guide. Available from: https://economatik.com/news/1040611/variables-for-ardl-testing-a-guide

Gurbuz, I.B., Nesirov, E., Ozkan, G. (2021), Does agricultural value-added induce environmental degradation? Evidence from Azerbaijan. Environmental Science and Pollution Research, 28, 23099-23112.

Hasanov, R.I., Giyasova, Z., Azizova, R., Huseynova, S., Zemri, B.E. (2024), Long-term dynamics between human development and environmental sustainability: An empirical analysis of CO_2 emissions in Azerbaijan. Challenge Sustainability, 12(4), 273-280.

Ilyas, M., Ahmad, H.K., Afzal, M., Mahmood, T. (2010), Determinants of manufacturing value added in Pakistan: An application of bounds testing approach to cointegration. Pakistan Economic and Social Review, 48, 209-223.

Jebli, M.B., Farhani, S., Guesmi, K. (2020), Renewable energy, CO_2 emissions and value added: Empirical evidence from countries with different income levels. Structural Change and Economic Dynamics, 53, 402-410.

Johansen, S. (1988), Statistical analysis of cointegration vectors. Journal of Economic Dynamics and Control, 12(2-3), 231-254.

Karami, M., Elahinia, N., Karami, S. (2019), The effect of manufacturing value added on economic growth: Emprical evidence from Europe. Journal of Business Economics and Finance, 8(2), 133-147.

Karedla, Y., Mishra, R., Patel, N. (2021), The impact of economic growth, trade openness and manufacturing on CO_2 emissions in India: An autoregressive distributive lag (ARDL) bounds test approach. Journal of Economics, Finance and Administrative Science, 26(52), 376-389.

Karimli, I., Eyvazov, E., Azizova, R., Rizayeva, V., Mazanova, O. (2019), The creation and increase of value added in the value chain and its impact on the price. Wseas Transactions On Business And Economics, 19, 1967-1978.

Kartal, M.T. (2023), Production-based disaggregated analysis of energy consumption and CO_2 emission nexus: Evidence from the USA by novel dynamic ARDL simulation approach. Environmental Science and Pollution Research, 30(3), 6864-6874.

MacKinnon, J.G. (1996), Numerical distribution functions for unit root and cointegration tests. Journal of Applied Econometrics, 11(6), 601-618.

Mehmood, U. (2021), Globalization-driven CO_2 emissions in Singapore: An application of ARDL approach. Environmental Science and Pollution Research, 28(9), 11317-11322.

NIPSDGRA. (2024), Build Resilient Infrastructure, Promote Inclusive and Sustainable Industrialization and Foster Innovation. Indicator 9.2.1 Manufacturing Value Added as a Proportion of GDP and Per Capita. Available from: https://sdg.azstat.gov.az/en/indicators/471/manufacturing-value-added-as-a-proportion-of-gdp-and-per-capita

OECD. (2023), Value Added by Activity. Available from: https://www.oecd.org/en/data/indicators/value-added-by-activity.html

Okere, K.I., Onuoha, F.C., Muoneke, O.B., Oyeyemi, A.M. (2021), Towards sustainability path in Argentina: The role of finance, energy mix, and industrial value-added in low or high carbon emission-application of DARDL simulation. Environmental Science and Pollution Research, 28(39), 55053-55071.

Pesaran, M.H., Shin, Y. (1995), An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis. Vol. 9514. Cambridge, UK: Department of Applied Economics, University of Cambridge. p371-413.

Phillips, P.C.B., Perron, P. (1988), Testing for a unit root in time series regression. Biometrika, 75(2), 335-346.

Satrianto, A., Ikhsan, A., Abd Samad, K. (2024), Analysis of renewable energy, environment quality and energy consumption on economic growth: Evidence from developing countries. International Journal of Energy Economics and Policy, 14(4), 57-65.

Seriram, N., Zainuddin, M.R.K., Hamidi, H.N.A., Abdullah, A.H. (2024), Impacts of renewable energy transitions on the economic growth in Malaysia: A dynamic ARDL simulations. International Journal of Energy Economics and Policy, 14(5), 251-258.

SSCRA. (2024), Economic Statistics. Available from: https://www.stat.gov.az/?lang=en

World Bank. (2024), Data, Azerbaijan. Available from: https://data.worldbank.org/country/azerbaijan

Xue, P., Du, J., Liu, J., Li, Z., Albahooth, B., Yang, Y. (2023), Natural resources and economic perspective: Manufacturing value added for Europe and Central Asian economies. Resources Policy, 86, 104132.