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Abstract

This study revisits the energy-finance-carbon nexus in the Economic Cooperation Organization (ECO) economies during the period 1993-2024. Using second-generation panel econometric analysis, namely, the Westerlund cointegration tests, and the Prais-Winsten regressions with the panel-corrected standard error (PCSE), the study examines the long-run interplay between energy consumption, financial development, urbanization, trade openness, and carbon emissions. Further, for robustness, we also applied the Fully Modified Ordinary Least Squares (FMOLS) method. The empirical findings show that energy consumption has a statistically significant effect on carbon emissions, confirming the region's dominance of fossil fuel use. In contrast, financial development has a statistically significant negative impact on carbon emissions, suggesting that developed financial systems promote green investment and technological advancement. Moreover, urbanization and trade openness both exert statistically positive effects on CO2 emissions. These results highlight the importance of sustainable financial reform and energy transition policies for environmental sustainability in ECO countries. The paper therefore provides policy recommendations for entrenching green finance as a national development approach.

Keywords Energy Consumption; Financial Development; Carbon Emissions; PCSE

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Graphical Abstract

1. Introduction

Climate change is one of the most critical challenges of the 21st century. The ongoing escalation in atmospheric CO_2, largely due to burning of fossil fuels, poses significant environmental and economic challenges. A large body of empirical evidence suggest that energy consumption is the primary source of greenhouse gas (GHG) emissions in both developed and developing economies (Nasrullah et al., 2023). Energy demand is increasing due to economic growth and rising industrial activity, thereby accelerating environmental degradation. The association between economic growth and environmental quality has been a subject of extensive research in the context of the Environmental Kuznets Curve (EKC) hypothesis. According to the EKC, environmental degradation escalations with grow income, peaks, and then falls. However, mixed results persist, and they often lack uniformity across geographical settings (Stern, 2004; Ozturk and Acaravci, 2010). In recent literature, the discussion is furthered by reiterating that environmental presentation is determined by economic growth as well as structural factors for example financial growth, openness to trade, urbanization (Rehan et al., 2023). The environmental performance based on financial development. Therefore, financial deepening can stimulate industrial growth and production processes based on energy-intensive technologies, thereby increasing carbon emissions (Gul and Wahab, 2021). Conversely, when the financial system is operating well, green investments, technological development, and the uptake of renewable energy become easier, thereby reducing emissions (Anwar and Seraj, 2025). According to both developed and emerging economies, as it has been shown empirically, the environmental impacts of financial markets are not uniform with respect to the regional and institutional contexts (Habiba and Xinbang, 2022; Shahid et al., 2025). The energy-environment nexus is also complicated by trade openness. Trade integration can also increase emissions through scale effects, as higher production levels increase energy demand. It leads to the transfer of skill and the diffusion of cleaner production methods (Copeland and Taylor, 2004). On the same note, rapid urbanization often leads to increased infrastructure, high transportation demand, and energy use, all of which increase CO2 emissions (Ma et al., 2024). The recent panel research supports the idea that urbanization remains a significant driver of environmental decline, especially in the developing world (Rehan et al., 2023).

Despite the scope of global research, there has been very limited empirical evidence regarding the ECO member states. These economies are characterized by a high degree of energy reliance, transitional financial systems, and increasing trade integration between regions. Moreover, the high economic and geographic interactions among these states make cross-sectional dependence (CSD) an expected phenomenon that may bias traditional panel estimations if not adequately accounted for. To overcome these methodological challenges, the current research revisits the energy-finance-carbon nexus by using second-generation econometric tools. The panel cointegration test by

Westernlund (2007) used to regulate long-term relations in the presence of CSD, whereas the Prais-Winsten PCSE (Beck and Katz, 1995) is used to provide robust estimates of the long-term coefficients. In addition, FMOLS is used to carry out a robustness analysis. This combination of the more advanced methods of the panels shall provide more reliable, region-specific data on the environmental implications of energy use and monetary expansion in ECO member states. The contribute to the sustainable development by shedding light on whether financial development contributes to environmental deterioration or to environmental sustainability in energy-dependent emerging economies. These results have comprehensive policy implications for balancing economic, financial, and environmental protection across the ECO region.

1.1.Objectives of the Study

- To investigate the long-run association between macro-energy and macro-finance variables in the economies in the ECO region.
- To determine whether financial development reduces or increases the level of CO_2 emissions in the ECO region.

1.2.Hypotheses

- H_1: The Energy consumption has a direct effect on carbon emissions in ECO countries.
- H_2: Financial development significantly influences carbon emissions in ECO countries.

The rest of the paper is organized as follows: Section 2 shows a comprehensive literature review among energy, finance, and CO2. Section 3 provides the data, variables, and econometric approaches applied. The empirical findings are represented in Section 4. The conclusion and policy suggestions are presented in Section-5.

2. Literature Reviews

2.1 Energy Use and Carbon Emission

The interplay between energy consumption(EC) and carbon emissions (CO2) is a critical issue in both environmental and energy economics. It is well established that the use of fossil fuels is the main driver of CO2 emissions and overall environmental deterioration (Stern, 2004). As economies grow, energy demand increases with industrialization, urbanization, and the expansion of transport infrastructure, further increasing carbon emissions. Empirical evidence supports the positive association between CO2 and EC. Various studies found that long-term association between energy consumption and CO2 emissions across multiple countries (Apergis & Payne, 2009). Similarly, Ozturk and Acaravci (2010) found that energy consumption is a main supplier to CO2 in emerging economies. Balsalobre-Lorente et al. (2018) also found that reliance on fossil fuels in developing nations remains the primary driver of environmental degradation. Such results are supported by recent panel studies. The authors indicated that, even with financial development and trade openness, energy consumption has remained a strong predictor of CO2 in emerging economies. The non-renewable energy sources increases environmental pressure, the use of renewable energy sources helps in reducing emissions. This positive correlation between energy and emissions is often explained by the measure result, in which amplified economic activity increases energy demand and the pollution associated with energy use (Danish & Ulucak, 2021; Nasrullah et al., 2023). In energy-dependent areas like ECO countries, where fossil fuels support the energy framework, the positive association between EC and CO2 is likely to be more evident. Therefore, using the available literature, the hypothesis is as follows:

H1: There is a positive association between energy consumption
and carbon emission in ECO countries.

2.2. Financial Development and Carbon Emissions

Financial development and environmental quality are theoretically unclear and empirically contradictory. Financial development can be measured in several ways, each with its own environmental outcomes. Financial deepening, on the one hand, can contribute to increased carbon emissions through the scale effect of accessible credit, which can drive the development of industrial activity and investment with heavy energy consumption (Muhammad, et al. 2025; Tamazian et al., 2009). The growth of the financial sector can raise production rates, spur infrastructure development, and increase the use of fossil-based energy, thereby raising CO2 emissions. Financial development will contribute to environmental sustainability on the other side by using the technique effect. Well-established financial markets improve the distribution of capital, support green innovation (Khan et al., 2023), and fund renewable energy (RE) projects (Shahbaz et al., 2013; Zafar et al., 2025; Riaz et al., 2024). Properly functioning financial systems redirect resources to green technologies and support environmental regulations. Recent empirical evidence shows this two-fold effect. Habiba and Xinbang (2022) noted that, in developing economies, CO2 emissions decline with both financial development and technological advances. Similarly, Acheampong (2019) maintained that strong institutional structures can help maintain environmental sustainability in financial development. Other newer research gives more information (Usman et al., 2022; Safdar et al., 2026). Rehman et al. (2023) found that the impact of financial development depends on the maturity of financial institutions and the quality of regulatory measures (Khan et al., 2023). In developed

nations that emit large quantities of carbon, Anwar and Seraj (2025) and Jamal et al. (2024) found that sustainable finance is a central factor in reducing carbon emissions. However, the empirical evidence is unclear in different locations, especially in transitional economies. Financial markets in emerging economies, especially the eastern and central (ECO) countries, are changing, and their influence on environmental sustainability remains underexplored. Therefore, the impact of financial development should be tested empirically. Consequently, the suggested hypothesis of the given research is the following:

H2: Financial development exerts a strong influence on carbon emissions in ECO countries.

3. Methodology

3.1. Variables and Data Source

The study we used panel data to examine the interplay among energy consumption, financial development, urbanization, trade openness, and carbon emissions in the member states of the ECO economies[1]. The data collected from World Development Indicators.

Table 1:` ***Description Of Projected Variables***

Variable	Symbol	Measurement	Source
Carbon Emissions	ln co2	CO2 emissions per capita(metric tons)	
Energy Consumption	ln energy	Energy use per capita (kg of oil equivalent)	
Financial Development	fin dev	Financial development index	WDI
Urbanization	urban	% of total population	
Trade Openness	ln trade	Trade (%of GDP)	

3.2. Model Specification

To examine the association between CO_2 emissions and its determinants, the following econometric model is specified:

Econometric Model

$$\ln\_CO2_{it} = \alpha_{it} + \beta_1 \ln\_energy_{it} + \beta_2 fin\_dev_{it} + \beta_3 urban_{it} + \beta_4 \ln\_trade_{it} + \varepsilon_{it}$$

Where:

$t =$ Represent country

$i =$ Represent time

$\alpha_i =$Capturers' country-specific effects

$\varepsilon_{it} =$ Is the error term

The coefficients β_1 *to* β_4 measure the long-run elasticities of CO2 with respect to the explanatory variables.

3.3. Econometric Techniques

To investigate the Pesaran (2004) CSD test for the ECO economies. The outcomes confirm the presence of interdependence, and applied 2nd-generation unit root. To measure the stationarity of the variables using the Pesaran's (2007) cross-sectional augmented (CIPS) unit-root test. The results reveal mixed order cointegration between variables of the study. Cointegration exists then uses an ECM-based panel cointegration test projected by Westerlund (2007). The test confirms the existence of cointegration among the variables. Thus cointegration is confirmed, long-run coefficients are estimated via Prais-Winsten regression with PCSE. The approach addresses heteroscedasticity, autocorrelation, and cross-sectional dependency. To further assess robustness, we estimate the long-run relationship using FMOLS and correct endogeneity and serial correlation in cointegrated panels. It thus provides effective and consistent long-run parameter estimates.

[1] Azerbaijan, Iran, Kazakhstan, Kyrgyz Republic, Pakistan, Tajikistan, Turkey, Turkmenistan, and Uzbekistan

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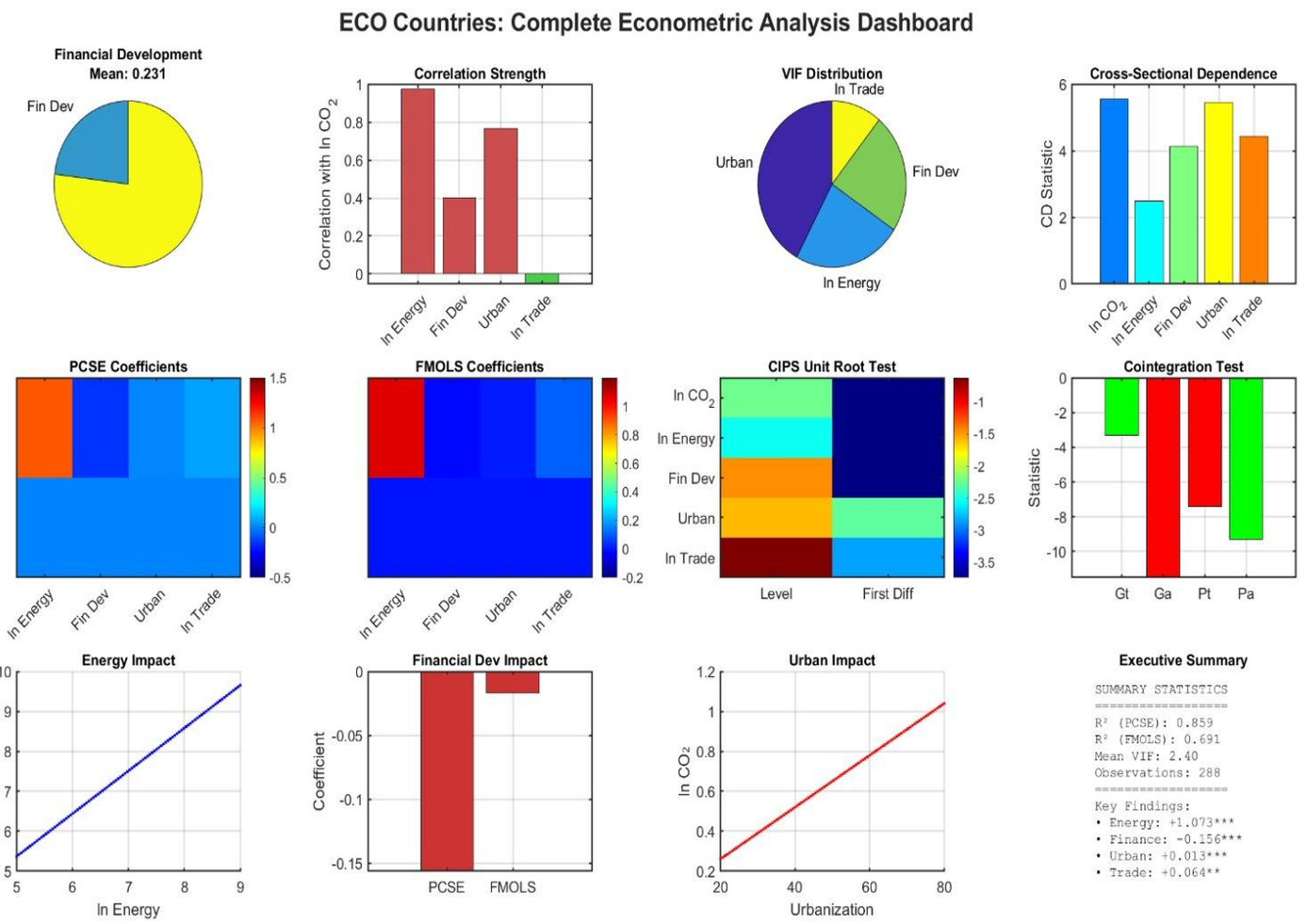

Figure 1: Complete Econometric Analysis

4. Results and Interpretations

In this research, we use panel data consisting of ECO economies. **Table 2** summarizes the descriptive statistics. The descriptive statistics provides basic information about the particular variables (Akhtar et al., 2020). The average of the natural logarithm of carbon emission (ln_CO2) is 1.113 with the standard deviation of -2.787 to 1.247, thus indicating a high inter-country dispersion. The mean energy consumption (ln energy) is 7.190, indicating a high level of energy reliance in the region. The average of financial development (fin_dev) is 0.231 and moderately varied, indicating heterogeneity in the maturity of the financial sector across ECO economies. The average urbanization rate is 49.383, indicating that 50 per cent of the population lives in urban areas; however, cross-country differences are evident. The level of trade openness (ln_trade) has a mean of 4.147, indicating variable levels of external integration. Furthermore, **Table 3** shows the correlation results, which show a positive connection between EC and CO2 (0.974), indicating that increases in energy consumption are accompanied by increases in emissions across the ECO region. "Urbanization is also positively related to CO2 (0.767), shows that urban expansion is a significant driver of environmental pressure. Financial development is positively associated with carbon emissions to a moderate degree (0.401), while trade openness is weakly related (-0.053). The VIF results, presented in **Table 4**, are used to assess multicollinearity among the explanatory variables (Gul et al., 2023). The average VIF is 2.40, and all are significantly below the traditional critical value of 10. These results indicate that there is no significant multicollinearity in the model. The regression coefficients obtained from the model can therefore be considered trustworthy and consistent. Note: **Figure 1** shows a graphical representation of descriptive statistics, while **Figure 2** displays a correlation matrix.

Table 2: ***Descriptive Statistics***

Variable	Obs.	Mean	SD	Min.	Max.
ln co2	288	1.113	1.076	-1.247	2.787
ln energy	288	7.19	.868	5.631	8.589
fin dev	288	.231	.128	.053	.522

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urban	288	49.383	14.365	26.501	77.893
ln trade	288	4.147	.506	.867	5.202

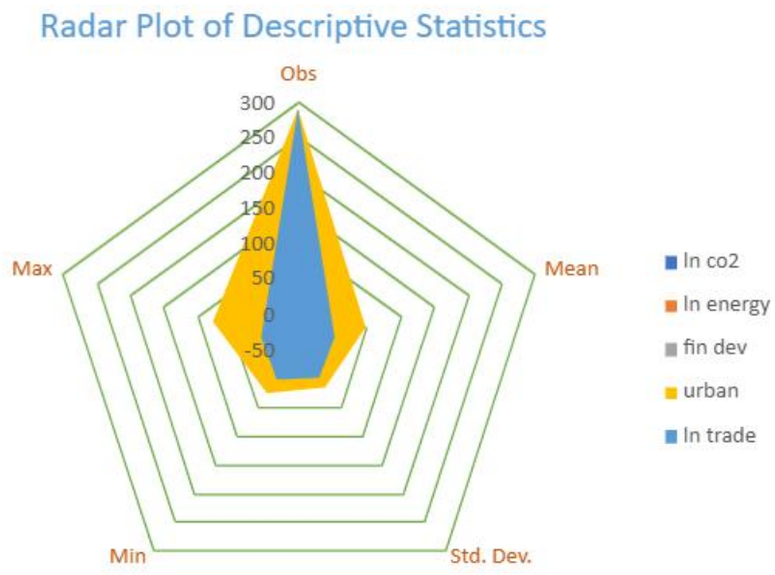

Figure 2: Reader Plot of Descriptive statistics

Table 3: ***Matrix of Correlations***

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
(1) ln_co2	1.000				
(2) ln_energy	0.974	1.000			
(3) fin_dev	0.401	0.351	1.000		
(4) urban	0.767	0.713	0.710	1.000	
(5) ln_trade	-0.053	-0.078	-0.191	-0.202	1.000

Table 4: ***Variance Inflation Factor (VIF) Results***

Variable	**VIF**	**1/VIF**
urban	4.04	0.247281
ln-energy	2.27	0.441078
fin-dev	2.24	0.446536
ln-trade	1.05	0.948822
Mean VIF	**2.40**	

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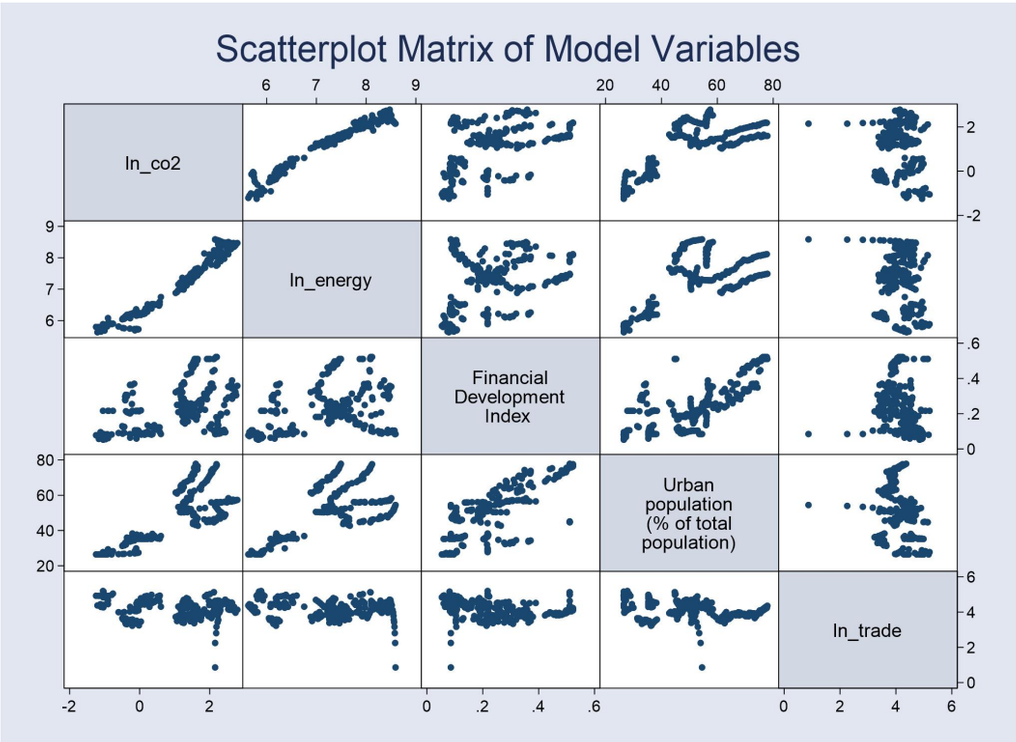

Figure 3: Scatterplot Matrix

The next step is to find out the CD in the penal data of ECO Nations. **Table 5** shows the empirical outcomes of the Pesaran CSD test. The results reveal that CSD is statistically significant for all variables, indicating widespread cross-sectional dependence among ECO members. In this regard, to apply second-generation methodology is suitable and rational within the current research. Next, to conclude the order of integration, we applied the CIPS unit root test; the results are displayed in **Table 6**. The results show a mixed order of integration among the variables. The change in CO2 and energy consumption seems to be at a given level; this remains stationary, as do financial development, urbanization, and openness to trade. Although this is of mixed order, cointegration makes long-run analysis valid.

Table 5: ***Cross-Sectional Dependence (CD) Test***

Variable	Statistic	p-value
ln co2	5.55***	0.000
ln energy	2.49**	0.013
fin dev	4.14***	0.000
urban	5.45***	0.000
ln trade	4.44***	0.000

Figure 4: VIF, CSD and CD-Test Significant Bar graphs

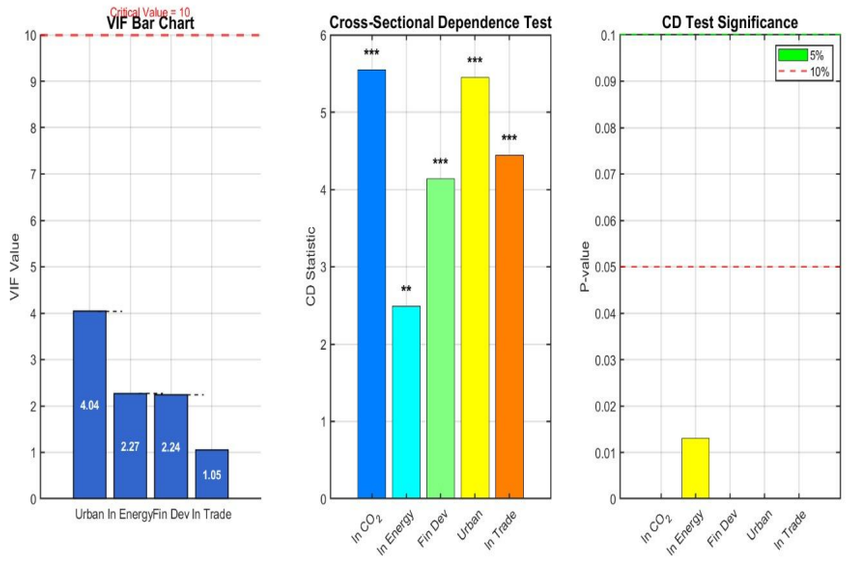

Table 6: ***Second Generation CIPS Test Result***

Variable	I(0)	I(1)
ln co2	-2.236**	-
ln energy	-2.535***	-
fin dev	-1.454	-3.738***
urban	-1.591	-2.283***
ln trade	-0.625	-2.860***

, **, and * refers the 1 %, 5% and 10% respectively.*

Table 7 displays the Westerlund-2007 results described in both statistics (Gt and Pa) are significant at the 5% level. The long-run equilibrium association exists among projected variables the ECO countries. This, in turn, has justified long-run estimation methods and has been appropriate to the analysis.

Table 7: ***Westerlund Co_Integration Test***

Statistic	Gt	Ga	Pt	Pa
Value	-3.294	-11.503	-7.420	-9.314
p-value	0.040**	0.180	0.484	0.032**

, **, and * refers the 1 %, 5% and 10% respectively.*

Table 8 presented the outcomes of the Prais-Winsten estimation with PCSE. The direct impact on CO2 from energy consumption is high and significant: a 1% increase in EC leads to a 1.07 per cent rise in emissions. Another positive, but important, influence is produced by the urbanization process, which leads to environmental pressure. The effect of trade openness is positive and significant, indicating that financial development lowers emissions, as evidenced by a negative coefficient and significance. The R-squared is very large (0.859), indicating strong explanatory power. For robustness, we use the FMOLS test results displayed in **Table 9**. The results also align with the PCSE estimate. Energy consumption continues to contribute positively and significantly to emissions, whereas financial development remains a negative and significant contributor. There are also positive long-run effects of urbanization and trade openness. The stability of the estimation methods enhances the validity of the empirical findings.

Table 8: ***Prais-Winsten Regression, Correlated PCSEs***

Variable	Coefficient	SD	Z-t	p-value	CI-95%
ln_energy	1.073	0.054	19.93	0.000	[0.968 1.179]
fin_dev	-0.156	0.035	−4.46	0.000	[-0.22 -0.087]
urban	0.013	0.003	3.74	0.000	[0.006 0.019]
ln_trade	0.064	0.026	2.43	0.015	[0.012 0.116]
_cons	-7.447	0.279	-26.64	0.000	[-7.995 -6.899]
Other statistics					
Mean dependent variable		1.113	Obs.		288
R^2		0.859	-		-
$\chi 2$		1305.443	Prob > $\chi 2$		0.000

Table 9: ***FMOLS Results***

Variable	Coefficient	SD	Z-t	p-value	CI-95%
ln_energy	1.064***	0.031	34.630	0.000	[1.004 1.124]
fin_dev	-0.017**	0.007	2.428	0.015	[-0.031 -0.003]
urban	0.013***	0.002	5.380	0.000	[0.008 0.018]
ln_trade	0.102***	0.036	2.820	0.005	[0.031 0.172]

_cons	-7.586***	0.222	-34.230	0.000	[-8.021 -7.152]
Other statistics					
R-Squared	.691	Adj-R^2	.686	Obs.	288

, **, and * refers the 1 %, 5% and 10% respectively.*

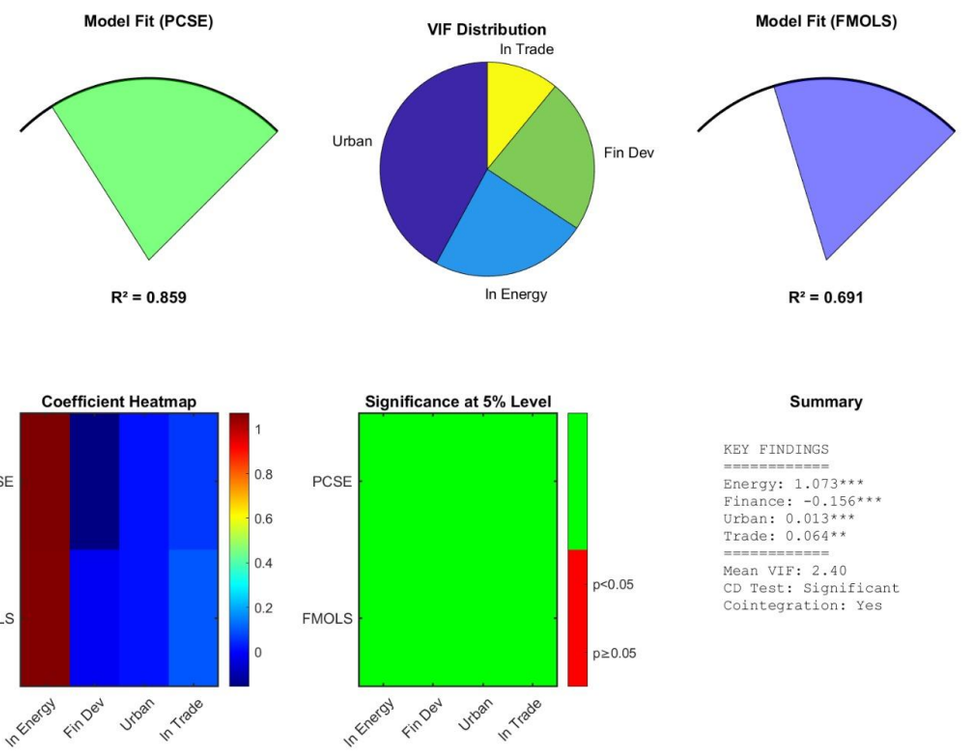

Figure 5: Econometric Model representation of the PCSE and FMOLS Model

4.1. Results Discussion

The empirical results show a robust and significant connection between energy use and carbon emission in the ECO countries, thus supporting Hypothesis 1. Uninterrupted findings from the Pooled Cumulative Sum of Errors (PCSE) and FMOLS estimators suggest that EC significantly increases CO_2 emissions, and thus, fossil-fuel dependency is a major cause of environmental destruction in the region. The study results are consistent with the previous studies, including Apergis and Payne (2009); Ullah, et al. 2023 and Nasrullah et al. (2023), who also found that energy use is the most common cause of carbon emissions in developing economies. Due to the energy-intensive nature of the production framework and the reliance on traditional energy sources in ECO countries, the scale effect prevails in the system. With regard to financial development, analyses of the inverse relationship between CO2 and financial developing are statistically significant in both PCSE and FMOLS specifications, supporting the suggestion that financial deepening can indeed improve environmental quality. “This observation can be interpreted to mean that a more advanced financial infrastructure in the ECO region can spur technological innovation, green investment, and the effective distribution of funds”. These results are consistent with the hypotheses of Habiba and Xinbang (2022) and Anwar and Seraj (2025), who argue that this is made possible by sustainable financial development that promotes environmental sustainability via green financing systems. “The salient effects on carbon emissions are also caused by urbanisation and trade openness. The growth of cities and the subsequent increase in their energy needs increase emissions, as supported by Danish and Ulucak (2021)”. Trade openness provides a significant effect, suggesting the combination of scale and technology-transfer mechanisms, as argued by Copeland and Taylor (2004). In general, empirical research indicates the critical roles of structural change and the development of the financial sector in achieving environmental sustainability in ECO countries.

5. Conclusion and Policy Recommendations

This study investigates the energy-finance-carbon nexus in ECO countries. We used panel data estimation methods, including the Westerlund cointegration test, Prais-Winsten regression with PCSE, and FMOLS, to ensure robustness. The empirical findings confirm a long-run association among energy consumption, financial development, urbanization, trade openness, and carbon emissions. The EC is recognized as a significant contributor to carbon emissions because it depends on fossil fuels. Therefore, environmental degradation appears to be mitigated by financial development, suggesting that a stronger financial sector can support sustainable investment and technological advancement.

Both urbanization and trade openness exert statistically significant effects on carbon emissions. These outcomes highlight the importance of combining financial sector reform with environmental sustainability policies in emerging economies. ECO economies should encourage green financial development by encouraging banks and other financial institutions to lend to renewable energy projects, energy-saving technologies, and sustainable infrastructure. A finance system can also contribute to carbon reduction by reinforcing its role in issuing green bonds and environmental credit guidelines, as well as in climate-risk disclosure frameworks. Such policies have the potential to promote the decoupling of economic growth from environmental degradation and to maintain financial stability.

6. References

1. Acheampong, A. O. (2019). Modelling for insight: does financial development improve environmental quality?. *Energy economics*, *83*, 156-179.
2. Akhtar Gul, S. H., Ali, H., & Zahra, F. (2020). COVID-19 impact on poverty and unemployment levels: A case Pakistan. *Journal of Research and Reviews in Social Sciences Pakistan*, *3*(2), 879-893.
3. Apergis, N., & Payne, J. E. (2009). CO2 emissions, energy usage, and output in Central America. *Energy Policy*, *37*(8), 3282-3286.
4. Balsalobre-Lorente, D., Shahbaz, M., Roubaud, D., & Farhani, S. (2018). How economic growth, renewable electricity and natural resources contribute to CO2 emissions?. *Energy policy*, *113*, 356-367.
5. Copeland, B. R., & Taylor, M. S. (2004). Trade, growth, and the environment. *Journal of Economic literature*, *42*(1), 7-71.
6. Fatima, M., Naz, S., & Khan, S. U. (2023). Energy Consumption, Economic Growth and Environmental Quality in South Asian Developing Countries: A Panel Data Analysis. *Research Journal of Social Sciences and Economics Review*, *4*(2), 244-258.
7. Grossman, G. M., & Krueger, A. B. (1991). Environmental impacts of a North American free trade agreement.
8. Gul, A., & Khan, A. W. (2021). The Effect of Small-Scale Industries on Employment Level in Pakistan. *Journal of Research and Reviews in Social Sciences Pakistan*, *4*(2), 1393-1404.
9. Gul, A., Khan, S. U., & Abbasi, R. A. (2023). Vicious circle of health expenditure: Time series evidence from Pakistan. *Journal of Contemporary Macroeconomic Issues*, *4*(1), 57-77.
10. Gul, A., Sadiq, S., & Khan, S. U. (2023). Conflicts and The Structure of Economy: A Case of Trade in Pakistan. *Journal of Development and Social Sciences*, *4*(4), 23-42.
11. Habiba, U., & Xinbang, C. (2022). The impact of financial development on CO2 emissions: new evidence from developed and emerging countries. *Environmental Science and Pollution Research*, *29*(21), 31453-31466.
12. Jamal, F., Zhijun, Y., Khan, U. U., Zubair, M., Ahmad, S., Sultan, F., & Ullah, I. (2024). The impact of finance, infrastructure and training on the performance of SMEs in Pakistan. *South Asian J Soc Stud Econ*, *21*(4), 4.
13. Khan, H. U., Khan, S. U., & Gul, A. (2023). The dance of debt and growth in South Asian economies: Panel ARDL and NARDL evidence. *Qlantic Journal of Social Sciences*, *4*(3), 112-123.
14. Khan, M. Z., Khan, Z. U., Khan, A. U., & Gul, A. (2023). Unpacking Informality Dilemma in Private Equity Markets. *Journal of Applied Economics & Business Studies (JAEBS)*, *7*(2).
15. Khan, U. S., Khan, Z. M., & Gul, A. (2023). Democracy's Role in Shaping Pakistan's Economic Growth: An Empirical Evidence From Pakistan. *International Journal of Contemporary issues in social sciences*, *2*(3), 356-367.
16. Ma, B., & Ogata, S. (2024). Impact of urbanization on carbon dioxide emissions—Evidence from 136 countries and regions. *Sustainability*, *16*(18), 7878.
17. Muhammad, N., Khan, Z. U., Iqbal, M. A., Ullah, I., & Ahmad, N. (2025). Impact of Energy Consumption and Economic Growth on Environmental Degradation: Evidence from South Asian Countries. *Journal of Asian Development Studies*, *14*(1), 320-334.
18. Nasrullah, N., Husnain, M. I. U., & Khan, M. A. (2023). The dynamic impact of renewable energy consumption, trade, and financial development on carbon emissions in low-, middle-, and high-income countries. *Environmental Science and Pollution Research*, *30*(19), 56759-56773.
19. Ozturk, I., & Acaravci, A. (2010). CO2 emissions, energy consumption and economic growth in Turkey. *Renewable and Sustainable Energy Reviews*, *14*(9), 3220-3225.
20. Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. Journal of applied econometrics, 22(2), 265-312.
21. Pesaran, M. H., & Xie, Y. (2004). A bias-corrected CD test for error cross-sectional dependence in panel data models with latent factors.

22. Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. Journal of econometrics, 142(1), 50-93.
23. Rehan, M., GUNGOR, S., Qamar, M., & Naz, A. (2023). The effects of trade, renewable energy, and financial development on consumption-based carbon emissions.
24. Rehman, A., Alam, M. M., Ozturk, I., Alvarado, R., Murshed, M., Işık, C., & Ma, H. (2023). Globalization and renewable energy use: how are they contributing to upsurge the CO2 emissions? A global perspective. *Environmental Science and Pollution Research*, *30*(4), 9699-9712.
25. Riaz, S., Khan, S. U., Khan, A. U., & Khan, H. U. (2024). Analysing the impacts of fiscal decentralisation on public services delivery: Evidence from health sector in Pakistan. *Qlantic Journal of Social Sciences*, *5*(1), 141-157.
26. Safdar, S., Gul, A., & Khan, S. U. (2026). The Role of Green Finance in Advancing Sustainable Development: An Analysis of Financial Instruments and Their Impact on Economic and Environmental Goals. In *Green Policies for a Sustainable World* (pp. 295-330). Cham: Springer Nature Switzerland.
27. Seraj, M., & Seraj, F. T. (2025). The impact of sustainable financial development and green energy transition on climate change in the world's highest carbon-emitting countries. *Sustainability*, *17*(9), 3781.
28. Shahid, S., Ullah, I., & Munib, F. (2025). Asian Countries Analysis on Climate Change Impact on Growth of Economy and Food Security. *Review of Economic Trends*, *2*(2), 11-21.
29. Stern, D. I. (2004). The rise and fall of the environmental Kuznets curve. *World development*, *32*(8), 1419-1439.
30. Ullah, I., Nosheen, M., Shah, K. R., & Ahmad, N. (2023). Nexus between economic growth, energy consumption and environmental degradation: empirical evidence from economic cooperation organization countries. *PAKISTAN ISLAMICUS (An International Journal of Islamic & Social Sciences)*, *3*(2), 310-334.
31. Ulucak, R. (2021). A revisit to the relationship between financial development and energy consumption: Is globalization paramount?. *Energy*, *227*, 120337.
32. Usman, O. (2022). Modelling the economic and social issues related to environmental quality in Nigeria: the role of economic growth and internal conflict. *Environmental Science and Pollution Research*, *29*(26), 39209-39227.
33. Westerlund, J. (2007). Testing for error correction in panel data. *Oxford Bulletin of Economics and statistics*, *69*(6), 709-748.
34. Zafar, S., Ullah, I., Khan, K. S., & Khattak, H. (2025). Artificial Intelligence Patents and Economic Growth: A Growth Framework for OECD Countries. *Journal of Asian Development Studies*, *14*(4), 35-44.

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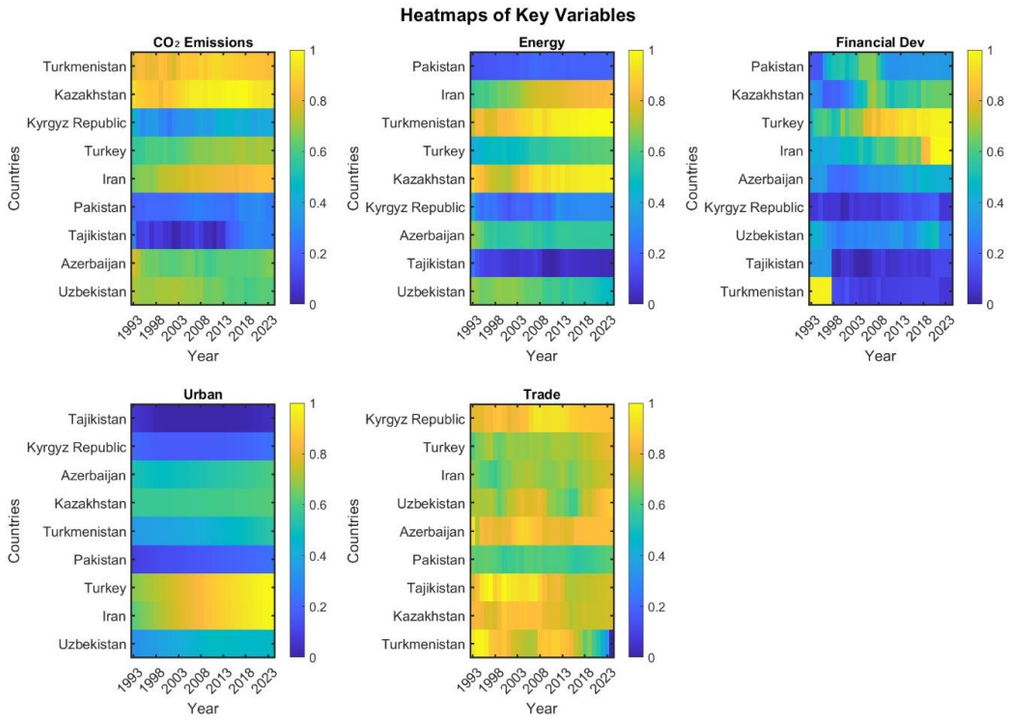

Figure 6: Heat maps of key variables (Based on Countries and Years)

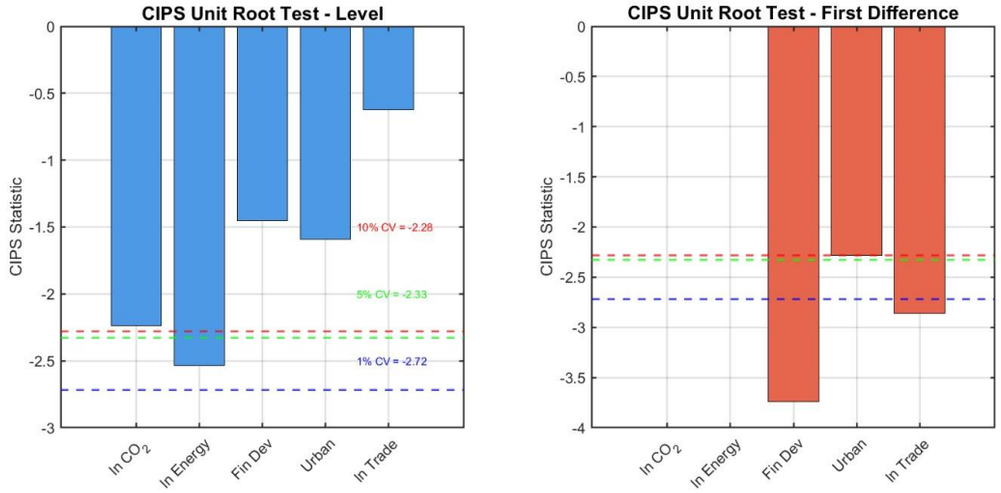

Figure 7: Unit Root Test of CIPS results with Level and First Difference

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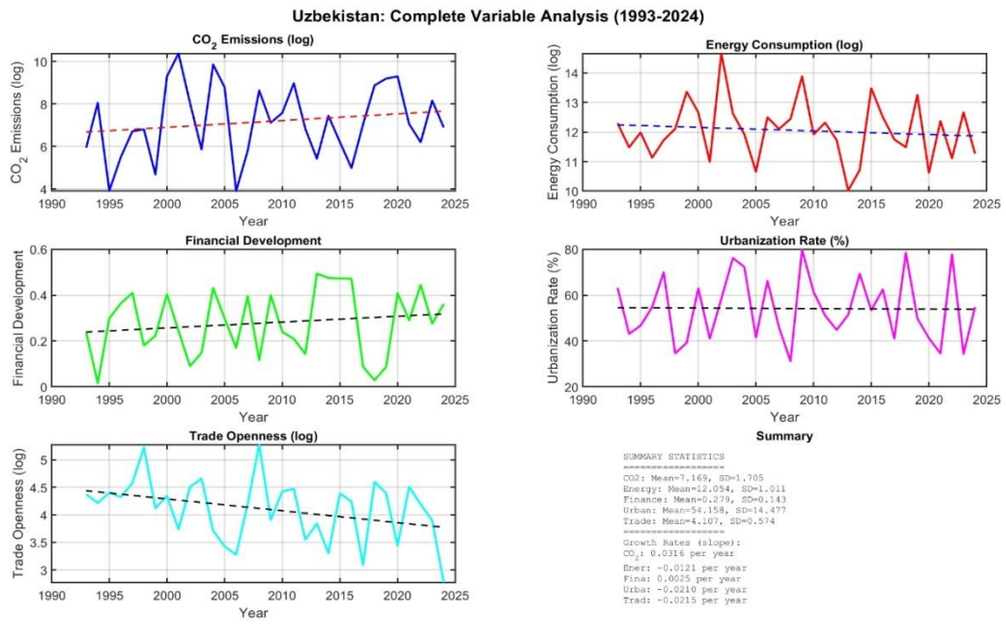

Figure 8: Entire variable analysis of Uzbekistan with year

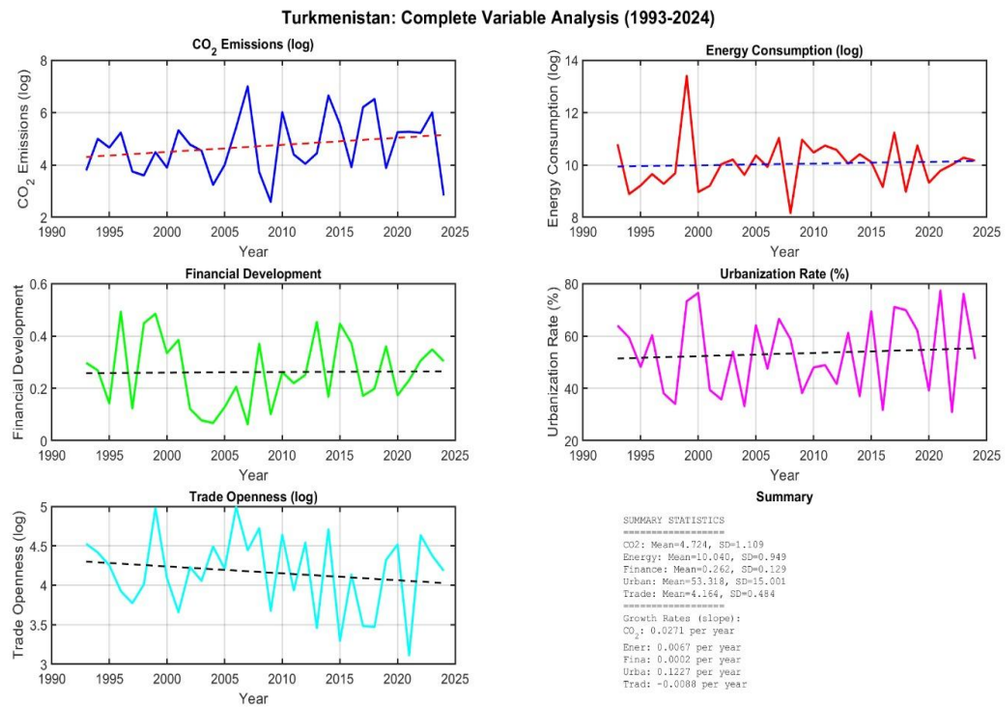

Figure 9: Entire variable analysis of Turkmenistan with year

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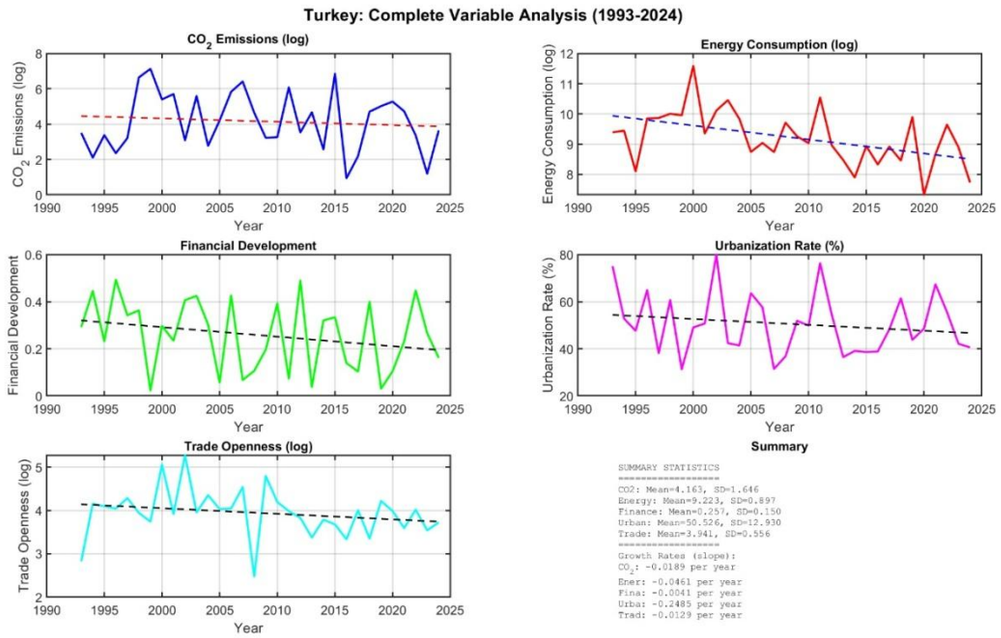

Figure 9: Entire variable analysis of Turkey with year

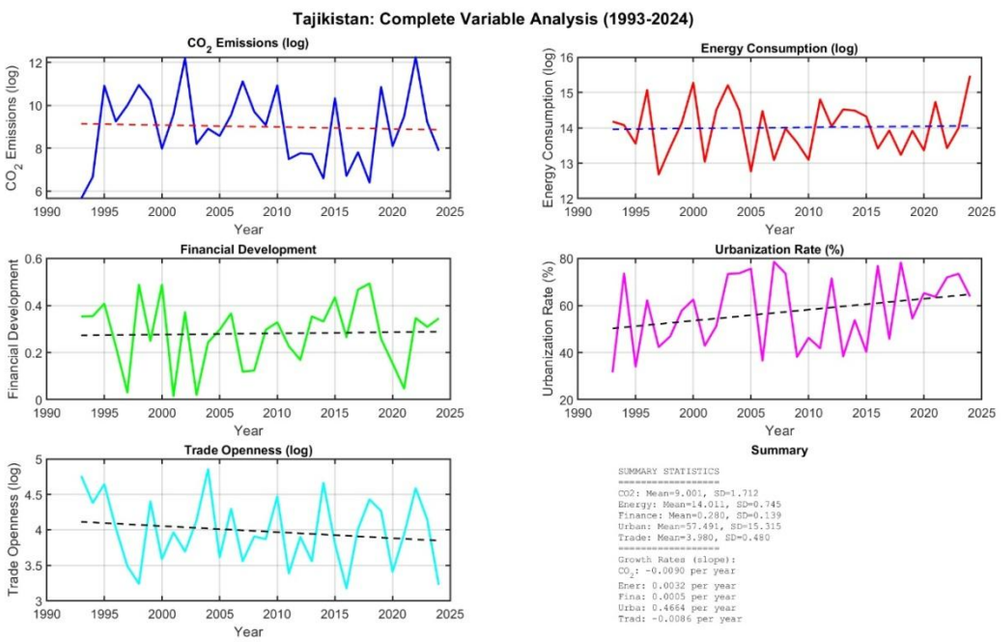

Figure 9: Entire variable analysis of Tajikistan with year

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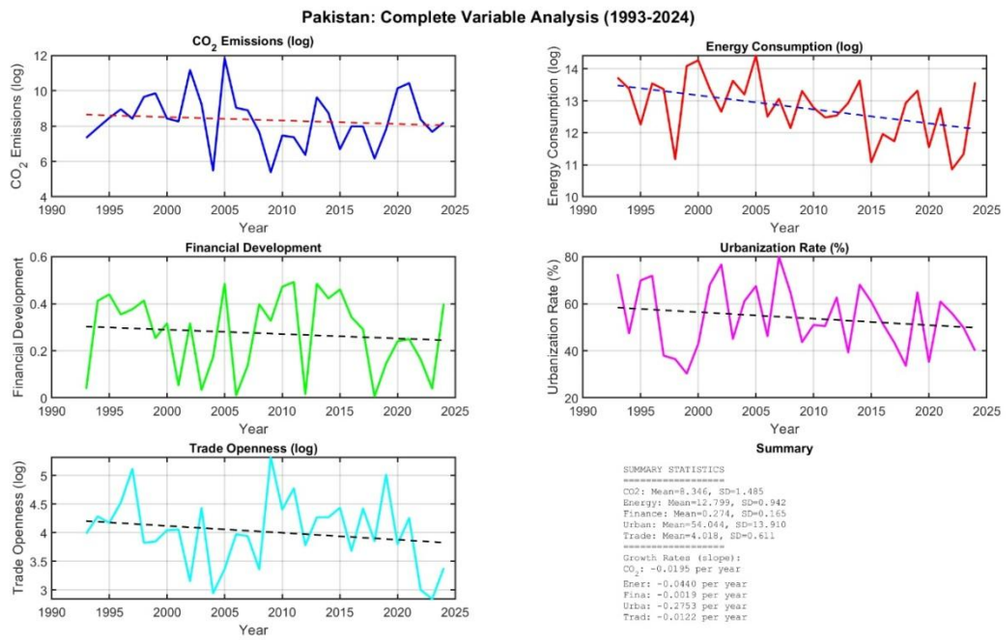

Figure 9: Entire variable analysis of Pakistan with year

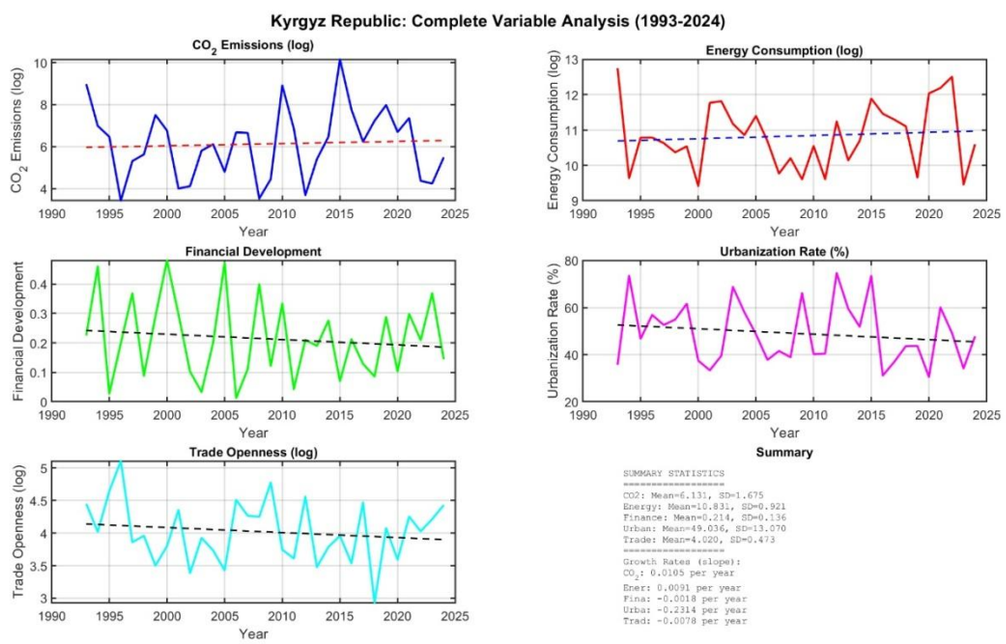

Figure 9: Entire variable analysis of Kyrgyz Republic with year

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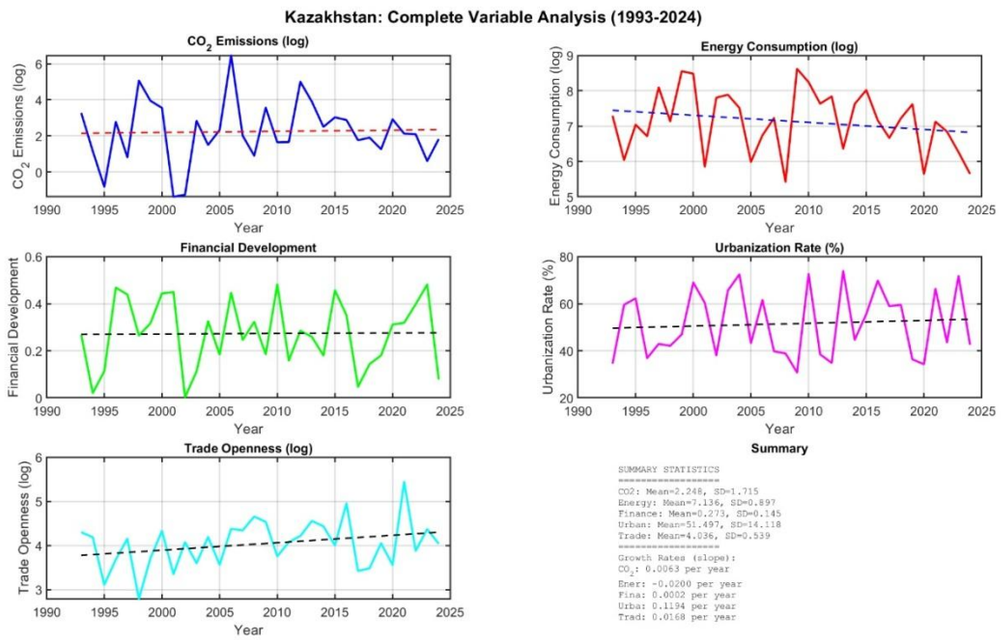

Figure 9: Entire variable analysis of Kazakhstan with year

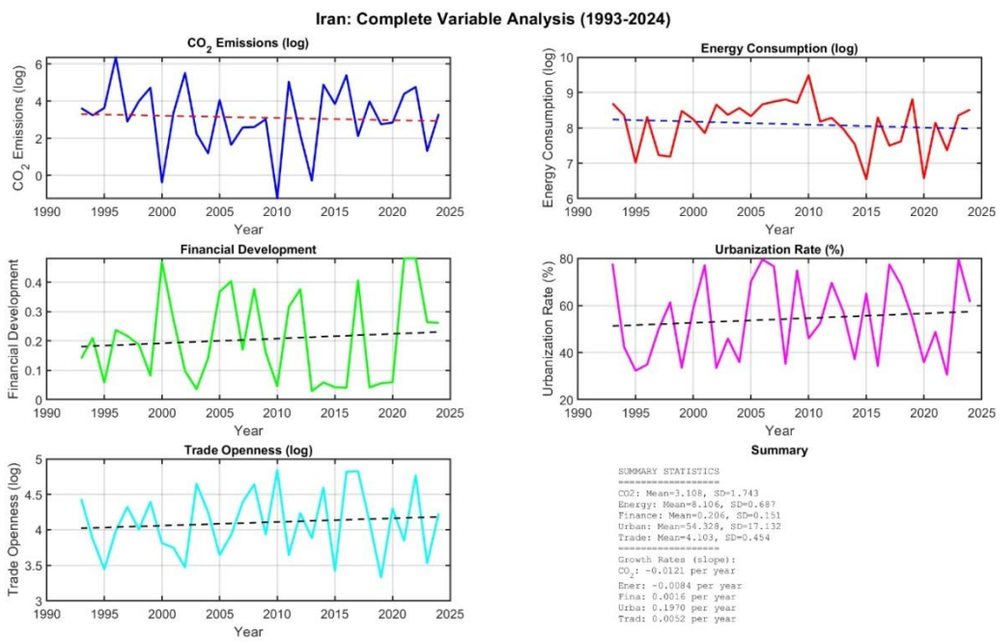

Figure 9: Entire variable analysis of Iran with year

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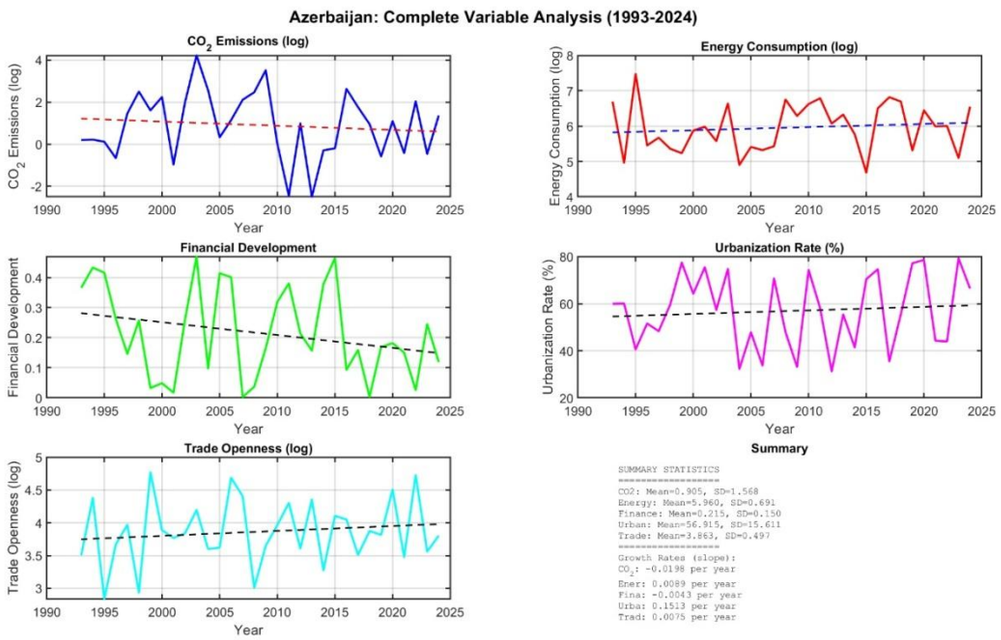

Figure 9: Entire variable analysis of Azerbaijan with year