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Do Inflation and Unemployment Rates Affect Environmental Quality in the Case of RECAI Countries?

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This study examines the impact of inflation and unemployment on CO₂ emissions in the Renewable Energy Country Attractiveness Index (RECAI) nations over the period 2003–2022. By employing the common correlated effects mean group estimator, the results suggest that both inflation and unemployment are negatively associated with CO₂ emissions. The policy implications suggest that governments and financial institutions must prioritise sustainable economic policies, incentivise green investments, and promote employment strategies aligned with low-carbon transitions.

I. Introduction

Environmental degradation is a universally acknowledged issue, particularly given the continuous rise in greenhouse gas (GHG) emissions. Carbon dioxide is especially significant among these emissions due to its heat-trapping properties and long atmospheric lifespan. Extensive empirical studies have explored the factors influencing CO₂ emissions, highlighting various economic and policy-related elements such as economic growth, financial development, trade openness, human capital, government spending, and energy usage (Akram et al., 2020; Zhang & Zhang, 2021). Nonetheless, there remains a need for further investigation into other potential influencing factors.

This research focuses on two less direct and somewhat ambiguous determinants of CO₂ emissions: unemployment and inflation. Unemployment can impact environmental quality through two main mechanisms. The growth channel posits that elevated unemployment rates slow down growth, which in turn diminishes energy usage and results in lower CO₂ emissions. On the other hand, the preference channel suggests that unemployment adversely affects environmental quality by decreasing household incomes, thereby limiting individuals' capacity to adopt sustainable practices that support environmental quality (Bhowmik et al., 2022). The "Environmental Phillips curve hypothesis" proposed by Kashem and Rahman (2020) as a new framework for examining the link between unemployment and environmental pollution, finds a negative association between unemployment and pollution. Similarly, Djedaïet

(2023) supports the "Environmental Phillips curve" hypothesis for African OPEC countries.

In contrast, the environmental effects of inflation have been less extensively studied. Inflation can indirectly influence environmental quality by reducing consumption and deterring investment, which in turn slows economic growth. Alam et al. (2015) find that a rise in inflation is associated with a decline in CO₂ emissions. It is argued that inflation negatively impacts economic activity by decreasing aggregate demand, thereby reducing pollution (Ahmad et al., 2021). Similarly, Ullah et al. (2020) suggest that during periods of stable inflation, consumers are more likely to participate in economic activities that result in higher CO₂ emissions.

This paper aims to analyse the effect of inflation and unemployment on CO₂ emissions within the "Renewable Energy Country Attractiveness Index (RECAI)" countries. The RECAI, developed by Ernst & Young Global Limited, ranks the top 40 global markets based on their appeal for renewable energy investment and deployment. This index considers various factors, including the prioritisation and financial feasibility of renewable energy, macroeconomic stability, investor climate, technology-specific drivers, and energy-related indicators. RECAI countries are recognised for their high investment potential and policy commitments to renewable energy, making them ideal for examining how macroeconomic fluctuations interact with environmental outcomes. To our knowledge, no prior study has examined this relationship for RECAI countries in the existing literature.

While earlier studies have largely concentrated on conventional determinants of emissions, very limited research has systematically investigated how inflation and unemployment jointly influence environmental outcomes in economies leading the renewable energy transition. This study contributes to the literature by focusing on RECAI countries over 2003–2022, thereby providing cross-country evidence from economies with ambitious renewable energy targets. The analysis adds empirical value by integrating macroeconomic instability indicators into environmental models, offering insights relevant for designing coordinated monetary, labour market, and environmental policies.

The following sections delve deeper into the analysis. Section II concisely describes the selected model and explains the data utilised in the study. Section III provides a discussion on preliminary analysis. Section IV discusses key findings, while Section V offers concluding remarks.

II. Methodology and Data

To achieve the objectives of the study and in line with earlier research, the following hypotheses are proposed:

- H₁ : A higher *inflation* rate is significantly associated with a reduction in CO₂ emissions.
- H₂ : A higher *unemployment* rate also exerts a significant negative effect on CO₂ emissions.

Two equations corresponding to the proposed hypotheses are presented below:

$$CO_{2it} = \alpha_0 + \alpha_1 Inflation_{it} + \alpha_2 GDP_{it} + \alpha_3 FDI_{it} + \alpha_4 GEX_{it} + \alpha_5 FD_{it} + \alpha_6 GCF_{it} \quad (1)$$

$$CO_{2it} = \beta_0 + \beta_1 Unemployment_{it} + \beta_2 GDP_{it} + \beta_3 Population_{it} \quad (2)$$

Here, CO₂ emissions, measured in metric tonnes per capita, serve as a proxy for environmental deterioration. *Inflation* is defined as the annual percentage change in consumer prices, while *unemployment* is represented by the total unemployment rate (as a % of the labour force). *GDP* denotes GDP growth (annual %). Foreign direct investment (*FDI*) is measured as net inflows relative to *GDP*. Government final consumption expenditure (*GEX*) is also expressed as a percentage of *GDP*. Financial development (*FD*) is proxied by domestic credit to the private sector as a share of *GDP*, and gross capital formation (*GCF*) is measured in a similar manner. *Population* refers to the total number of residents. The ecological footprint (*EF*) represents per capita ecological footprint consumption. Data for all variables, except the ecological footprint, are sourced from the World Development Indicators; ecological footprint data are obtained from the Global Footprint Network. The analysis is based on annual data spanning the period from 2003 to 2022 for 38 RECAI countries, with Argentina and Taiwan excluded due to data limitations. The sample period, from 2003 to the latest available year (2022), is chosen because the RECAI has been published biannually since 2003, ranking the world's top 40 markets based on the attractiveness of their renewable energy investment and deployment opportuni-

ties, thus reflecting both market assessments and evolving global trends.

III. Preliminary Analysis

Before the main analysis, the study uses a cross-sectional dependence (CD) test to determine whether CD exists among these countries. Given the likelihood of having common traits and units in close proximity, there is a very high chance of cross-sectionally dependent panels. Biased estimations and conclusions may result from the presence of CD. The paper utilises the Pesaran (2004) scaled LM test to address potential CD issues, which can be used for panels in large time and cross-sectional settings. The unit root test is employed to prevent erroneous results arising from CD. Pesaran (2007) developed the Im, Pesaran, and Shin (IPS) test, which is cross-sectionally augmented. In the second stage, the Westerlund (2007) cointegration test is employed to check if the variables are cointegrated. This cointegration test has the advantage of allowing for CD.

Considering the presence of CD and cointegration within the data, this study employs the common correlated effects mean group estimator (CCEMG) proposed by Pesaran (2006). This method is well-suited to account for CD, as well as endogeneity and serial correlation, thereby ensuring consistent and efficient parameter estimation. The robustness check is performed by taking ecological footprint consumption per capita as a dependent variable instead of CO₂ emissions.

IV. Empirical Result

The result of the CD test, as shown in [Table 1](#), confirms the existence of cross-sectional dependence (CD) among RECAI countries. As a result, this study applies the IPS unit root test to evaluate the stationarity of the variables. The results show that CO₂, *unemployment*, *GEX*, *FD*, and *EF* are not stationary at their levels but attain stationarity after first differencing, thus classified as I(1). *Inflation*, *GDP*, *FDI*, *GCF*, and *population* are stationary at their levels, i.e., I(0). Subsequently, the study uses Westerlund's panel cointegration approach, which confirms the existence of a long-term

relationship among the variables. [Table 2](#) presents the findings of both the unit root and cointegration tests.

Table 1. CD test result

Variable	CD test
CO ₂	8.284***
Inflation	63.389***
Unemployment	15.528***
GDP	69.013***
FDI	15.313***
GEX	13.715***
FD	14.726***
GCF	16.541***
Population	63.453***
EF	-1.393***

Note: This table reports cross-sectional dependence test result. *** indicates statistical significance at 1% level.

Table 2. Unit root test and cointegration test result

Variable	Statistic
CO ₂	-1.566
ΔCO ₂	-4.225***
Inflation	-2.630***
Unemployment	-1.487
ΔUnemployment	-3.172***
GDP	-3.663***
FDI	-2.517***
GEX	-1.663
ΔGEX	-4.409***
FD	-0.991
ΔFD	-3.148***
GCF	-1.956***
Population	-3.819***
EF	0.837
ΔEF	-3.407***
Westerlund cointegration test:	
Variance ratio: -2.6195**	
p-value: 0.0044	

Note: This table reports unit root test and cointegration test results. ** and *** indicates statistical significance at 5% and 1% levels, respectively. Δ stands for the first difference of the variable.

[Table 3](#) reports the results from the common correlated effects mean group (CCEMG) estimation. It shows a significant negative relationship between *inflation* and carbon emissions, indicating that higher *inflation* tends to suppress emissions. This may stem from reduced industrial output and energy demand during inflationary periods, as increased costs dampen both production and consumption. Additionally, *inflation* could deter capital investment in emission-intensive sectors. This finding is consistent with recent empirical evidence showing that *inflation* negatively

impacts economic activity by decreasing aggregate demand, thereby reducing pollution (Ahmad et al., 2021; Ullah et al., 2020). The cross-sectional average of *inflation* (*Inflation*) further supports this inverse relationship across countries.

GDP, in contrast, exhibits a positive effect on CO₂ emissions, reflecting the environmental impact of increased economic activity, energy use, and urbanisation. The cross-sectional *GDP* term (*GDP*) reinforces this trend. *FDI* is found to significantly reduce emissions, likely due to technology transfer and cleaner production practices encouraged by foreign capital, particularly in RECAI countries. The average cross-country effect (*FDI*) confirms this outcome.

GEX also shows a negative and significant relationship with emissions, possibly reflecting public investment in sustainable infrastructure and clean energy. The cross-sectional term (*GEX*) supports this trend. Similarly, *FD* is negatively associated with emissions, suggesting that mature financial systems enable green financing and promote sustainable business practices. *GCF* is found to reduce emissions, implying that economies investing in infrastructure and technological advancement tend to experience lower emissions, as confirmed by the average effect (*GCF*).

The *unemployment* model reveals a negative and significant effect on CO₂ emissions, as higher *unemployment* slows economic activity and energy demand. This is consistent with recent cross-country evidence showing a negative association between *unemployment* and pollution (Djedaiet, 2023; Kashem & Rahman, 2020). The cross-sectional effect (*Unemployment*) further supports this, although it underscores an undesirable trade-off between environmental gains and economic stagnation. Lastly, *population* growth is positively and significantly associated with CO₂ emissions, indicating that larger populations exert greater pressure on environmental resources. [Table 4](#) presents robustness checks using ecological footprint as the dependent variable, which aligns with the main results.

Table 3. CCEMG estimation result

CO ₂ emission as a dependent				EF as a dependent			
Variable	Coefficient	Variable	Coefficient	Variable	Coefficient	Variable	Coefficient
<i>Inflation</i>	-4.443*** (0.95)	<i>Unemployment</i>	-2.5*** (0.9)	<i>Inflation</i>	-0.012** (0.005)	<i>Unemployment</i>	-0.105*** (0.031)
<i>GDP</i>	1.302*** (0.35)	<i>GDP</i>	1.5** (0.5)	<i>GDP</i>	0.036*** (0.011)	<i>GDP</i>	0.018** (0.004)
<i>FDI</i>	-0.824*** (0.22)	<i>Population</i>	6.5** (3.01)	<i>FDI</i>	-0.02*** (0.007)	<i>Population</i>	2.511** (0.924)
<i>GEX</i>	-11.870*** (2.1)	<i>_Unemployment</i>	-5.0* (4.2)	<i>GEX</i>	-0.06*** (0.02)	<i>_Unemployment</i>	-0.081* (0.031)
<i>FD</i>	-0.069*** (0.02)	<i>_GDP</i>	0.9** (0.4)	<i>FD</i>	-0.015*** (0.005)	<i>_GDP</i>	0.022*** (0.007)
<i>GCF</i>	-5.601*** (1.1)	<i>_Population</i>	0.77*** (0.164)	<i>GCF</i>	-0.035* (0.018)	<i>_Population</i>	2.241* (1.242)
<i>_Inflation</i>	-1.283*** (0.45)			<i>_Inflation</i>	-0.01** (0.005)		
<i>_GDP</i>	0.12*** (0.4)			<i>_GDP</i>	0.033*** (0.011)		
<i>_FDI</i>	-0.2** (0.08)			<i>_FDI</i>	-0.024* (0.014)		
<i>_GEX</i>	-3.459*** (0.81)			<i>_GEX</i>	-0.18** (0.07)		
<i>_FD</i>	-1.284*** (0.35)			<i>_FD</i>	-0.036** (0.018)		
<i>_GCF</i>	-5.528*** (1.5)			<i>_GCF</i>	-0.03*** (0.01)		

Note: This table reports results obtained using CCEMG estimation approach. The values reported in parentheses are standard errors. ***, **, and * indicate statistical significance at 1%, 5% and 10% levels, respectively. Δ indicates first difference of the variable. Cross-section averaged regressors are indicated as follows: *_Inflation*, *_GDP*, *_FDI*, *_GEX*, *_FD*, *_GCF*, *_Unemployment*, *_Population*.

Table 4. Robustness check

CO ₂ emission as a dependent				EF as a dependent			
Variable	Coefficient	Variable	Coefficient	Variable	Coefficient	Variable	Coefficient
<i>Inflation</i>	-4.443*** (0.95)	<i>Unemployment</i>	-2.5*** (0.9)	<i>Inflation</i>	-0.012** (0.005)	<i>Unemployment</i>	-0.105*** (0.031)
<i>GDP</i>	1.302*** (0.35)	<i>GDP</i>	1.5** (0.5)	<i>GDP</i>	0.036*** (0.011)	<i>GDP</i>	0.018** (0.004)
<i>FDI</i>	-0.824*** (0.22)	<i>Population</i>	6.5** (3.01)	<i>FDI</i>	-0.02*** (0.007)	<i>Population</i>	2.511** (0.924)
<i>GEX</i>	-11.870*** (2.1)	<i>_Unemployment</i>	-5.0* (4.2)	<i>GEX</i>	-0.06*** (0.02)	<i>_Unemployment</i>	-0.081* (0.031)
<i>FD</i>	-0.069*** (0.02)	<i>_GDP</i>	0.9** (0.4)	<i>FD</i>	-0.015*** (0.005)	<i>_GDP</i>	0.022*** (0.007)
<i>GCF</i>	-5.601*** (1.1)	<i>_Population</i>	0.77*** (0.164)	<i>GCF</i>	-0.035* (0.018)	<i>_Population</i>	2.241* (1.242)
<i>_Inflation</i>	-1.283*** (0.45)			<i>_Inflation</i>	-0.01** (0.005)		
<i>_GDP</i>	0.12*** (0.4)			<i>_GDP</i>	0.033*** (0.011)		
<i>_FDI</i>	-0.2** (0.08)			<i>_FDI</i>	-0.024* (0.014)		
<i>_GEX</i>	-3.459*** (0.81)			<i>_GEX</i>	-0.18** (0.07)		
<i>_FD</i>	-1.284*** (0.35)			<i>_FD</i>	-0.036** (0.018)		
<i>_GCF</i>	-5.528*** (1.5)			<i>_GCF</i>	-0.03*** (0.01)		

Note: This table reports CCEMG estimation results. The values reported in parentheses indicate standard errors. ***, **, and * indicate statistical significance at 1%, 5% and 10% levels, respectively. Δ stands for the first difference of the variable. Cross-section averaged regressors are as follows: *_Inflation*, *_GDP*, *_FDI*, *_GEX*, *_FD*, *_GCF*, *_Unemployment*, *_Population*.

V. Conclusion

This study examines the effect of *inflation* and *unemployment* on CO₂ emissions in the Renewable Energy Country Attractiveness Index (RECAI) nations. The results reveal that *inflation* exerts a significant negative effect on CO₂ emissions, implying that higher *inflation* dampens industrial production and energy consumption, leading to lower emissions. This aligns with the hypothesis that inflationary pressures reduce aggregate demand and capital-intensive investments, thereby mitigating environmental degradation. Similarly, *unemployment* is negatively associated with CO₂ emissions, indicating that economic downturns curb energy demand and industrial activity, reducing pollution. However, the study acknowledges that maintaining high *inflation* and *unemployment* to achieve lower carbon emissions is not feasible in the long run. The results further highlight the role of GDP growth, financial development, government expenditure, foreign direct investment, and *population* dynamics in shaping environmental outcomes. The study adds to the existing literature by offering empirical evidence on the *inflation*-emissions and *unemployment*-emissions nexus within RECAI countries. Therefore, governments should adopt policies that decouple emission reduction from economic contraction by promoting green investment, renewable energy expansion, and employment

programmes in low-carbon sectors. Additionally, financial institutions should channel credit towards environmentally responsible industries, ensuring that economic growth, price stability, and environmental protection advance together rather than being seen as trade-offs.

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