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Nexus Between Environmental Degradation, Unemployment and Economic Growth: Empirical Evidence from Oman

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Abstract

The Environmental Kuznets Curve posits that economic growth is positively related to environmental degradation. As employment generation is directly related to economic growth, a trade-off between environment quality and sustaining livelihoods emerges. Rahman (2021) termed this environment degradation unemployment nexus as Environmental Phillips Curve (EPC). The current study examined the asymmetrical relationship between environmental degradation and unemployment rate for Sultanate of Oman for the period 1991 to 2020. The study examined the EPC hypothesis by considering environmental quality as a function of unemployment, economic growth and trade openness. Environment quality is proxied by per capita carbon dioxide emissions, economic growth is measured as annual growth rate in real Gross Domestic Product and trade openness is defined as sum of exports and imports as a percentage of GDP. Data on all the indicators is sourced from the World Development Indicators.The study used the Non-Linear Auto Regressive Model (NARDL) proposed by Shin et al (2014). The findings of the study validated the positive relationship between unemployment, economic growth and carbon emissions. These findings highlight the need to find environmentally viable employment generation projects.

Keywords: Environmental Degradation, Unemployment, Economic Growth, Oman, NARDL

1. Introduction:

A major challenge facing global policy makers is to achieve economic growth, create employment opportunities for the masses without compromising on environmental quality. Previous studies (Grossman and Krueger 1995; Farhani and Rejeb 2012; Farhani and Ozturk 2015; Mohapatra &Giri 2015; Shastri et al. 2020) posit that economic growth is positively related to environmental degradation. As employment generation is directly related to economic growth, a trade-off between environment quality and sustaining livelihoods emerges. Rahman (2021) termed this environment degradation unemployment nexus as Environmental Phillips Curve (EPC). Kashem & Rahman (2020) opine that pollution can be reduced only at the expense of employment generation. Thus, a study examining the trade-off between environmental quality and employment is pertinent. This study is all the more important for countries like the Sultanate of Oman which is battling the twin challenges of increasing the economic growth rate and reducing unemployment.

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The Sultanate of Oman has witnessed a steady rise in population, averaging at 3.4% in the 2000s(National Centre for Statistics and Information, 2023).As a consequence, the country has witnessed pressing demand for employment generation. Governments targeted efforts increased the employment of Omani workers from 465,226 in 2019 to 752,724 in 2020 an increase of 62%. Even with this manifold rise in employment generation, Oman's male and female unemployment rates stood at 11% and 2% respectively.According to Okun's Law (Okun, 2024) "there exist a linear relation between percentage point changes in unemployment and percentage point changes in Gross National Product" The two commonly accepted indicators of economic growth, Gross Domestic Product (GDP) at constant prices and GDP per capita declined to 3.2% and 13.4% respectively (National Centre for Statistics and Information, 2023).In the Oman vision 2040 report, the Sultanate has targeted a GDP per capita increase of 30 percent and 90 percent for 2030 and 2040 respectively (Oman Vision 2040 Report, 2023).Thus, battling unemployment and increasing GDP growth rate are the prime challenges which confront Oman's policy makers.Economic growth, non-renewable energy consumption and environmental degradation go hand in hand. According to the Vision 2040 (Oman Vision 2040 Report, 2023), Oman's Environmental Performance Index declined from 116 in 2018 to 149 in 2022. Oman fosters to create a balance between environmental, social and economic development and towards this end has set a target of zero net carbon emissions by 2050.

In view of the aforementioned macroeconomic scenario and the Sultanate's vision of sustainable development, a study on the impact of increasing GDP growthrate and creating additional employment opportunities on the environmental degradation of Oman ispertinent. The current study examines the relationship between environmental degradation, economic growth and unemployment rate for Sultanate of Oman for the period 1991 to 2020. The findings will indicate the impact of growth acceleration and employment generation policies on environmental quality and help policy makers to design appropriate employment generation programs.To the best of the authors's knowledge, no study has investigated the trade-off between unemployment reduction and environmental degradation in the Sultanate of Oman.A possible reason for this may be that firstly, the EPC is a novel concept and secondly time series data on unemployment is limited.The current study by empirical investigating the unemployment, economic growth and environmental degradation tradeoff will contribute to the meagre literature on the EPC. The study assumes assymetric relationship between the variables and uses the Non Linear Auto Regressive Model (NARDL) proposed by Shin et al (2014). Empirical findings, presented in section 4, demonstrate that assuming linear symmetrical relationship leads to errorneous conclusion. Thus the findings of the study have significant policy implications.

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2. Theortical Framework

This section surveys literature on the Environmental Kuznets Curve (EKC) and EPChypothesis

2.1. Relation between economic growth, trade openness and environmental degradation

The EKC hypothesis postulates an inverse U shaped relation between environmental degradation and economic growth. The theory stated that environmental emissions per capita initially rise with economic growth and after a level of growth the economy reaches a turning point and environmental quality improves. This inverse U-shaped curve was empirically validated for both countries specific and panel of countries.

For a panel of forty three countries ,including Oman, Narayan & Narayan (2010) could not validate the EKC hypothesis for Oman for the time period 1980-2004. Arouri et al., (2012) and Ozcan(2013) have confilicting evidences regarding validity of EKC hypothesis in Oman. Both the authors used a panel data for twelve Middle East and North African Countries. Arouri, Youssef, M'henni, & Rault (2012) based on panel data from 1981 to 2005 and results of boot strapping panel cointegration and Error Correction Model found weak support EKC in Oman. Ozcan (2013) estimated Westerlund Panel Cointegration, Panel Vector Error Correction Model and Fully Modified Ordinary Least Squares on 1990 to 2008 panel data. Results supported the EKC hypothesis for panel but not for Oman.Jammazi & Aloui (2015) validated the EKC hypothesis for the individual countries and entire panel of Gulf Cooperation Countries. Their inference was based on wavelet windowed cross correlation caried out on panel data from 1980 to 2012.Alsamara et al ., (2018) used carbon dioxide and sulphur dioxide as indicators of environmental degradation. Panel data from 1980 to 2017 for the six GCC countries validated the EKC. However, country specific short run results could validate EKC for Sultanate of Oman when Sulphur Dioxide was used as an indicator of pollution.According to AlKhars et al .,(2022), there is no study validating the Environmental Kuznets Curve based on time series data for Oman

Ahmad et al.,(2019) studied the relationship between carbon emission and trade openess in Sultanate of Oman. The study estimated ARDL model based on data from 1971 to 2014 sourced from World Development Indicators. The fimdings indicate a statistically significant impact of trade openess on environmental quality. The authors suggest that trade policies should be designed to minimise externalities. Karedla et al., (2021) examined the impact of trade openess on CO2 emissions in India. Using ARDL bounds testing approach and data from 1971 to 2016 sourced from World Development Indicators, the study concluded that trade openess reduces carbon emissions in India.

2.2. Relation between economic growth, unemployment and environmental degradation

Earler studies (Kahn & Kotchen, 2011; Meyer, 2016) used survey based approaches to investigate the nexus between unemplyment and pro environment behaviour. Authors (Kahn & Kotchen, 2011) use primary and secondary data sources to investigate the relation between unemployment and climate change concerns.Survey data on public opinion on climate change and key word internet searches google show that unemployment and concern for climate change are inversely related. Meyer (2016) studied the relation between pro environmental behaviour and unemplyment. The

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study used multiple regression on data collected from a thirty thousand European Union citizens. The results indicate that unemployment increases pro environment behavious which require more time and reduce those behaviours which involve cost.

Kashem & Rahman (2020) put forth the term Environmental Phillips curve. Based on panel data of thirty OECD and newly industrialised countries, the study found that environmental quality can be improved only at the cost employment.To break the tade-off, the authors opine that the countries need to treat its pollution effectively. After Kashem & Rahman (2020) put forth the Environmental Phillips Curve hypothesis, panel data studies on BRICST (Anser, Apergis, Syed, & Alola, 2021), South Asian Countries (Tariq et al., 2022) and N11 Countries (Tunahan, 2023) validated the trade off between environmental degradation and unemployment. Anser et al.,(2021) studied the validity of unemployment environmental degradation for Brazil, Russia, India, China, Soviet Union and Turkey (BRICST) for the period 1992 to 2016. After accounting for cross sectional differences in the panel, the study used the Pooled Mean Group ARDL estimation method. The results validate the EPC hypothesis for the BRICST countries. The authors opine that the share of non renewable energy sources in these countries should be increased.

Bhowmik et al., (2021) based on results of Dynamic Auto Regressive Distributed lag model conclude that trade off between environmental degradation and unemployment does not hold for USA in the short run. However in the long run the Environmental Philips Curve was validated.The authors suggest that economic growth should be spurred using energy efficient technologies.Based on panel data from 1991 to 2019 Tariq et al., (2022) validated the environmental philips curve for South Asian countries. The authors used ecological footprint as an indicator for environmental degradation. The results were estimated based on pooled mean group and country specific Auto Regressive Distributed Lag method. The authors suuggest that South Asian countries need to increase the contribution of renewable energy sources.

Shruti, Mohapatra, & Giri(2023) examined the validity of Environmental Philips Curve hypothesis for India. The study used per capita carbon emissions as a measure of environmental degradation and trade openess as a control variable. Annual time series data from 1990 to 2019 was sourced from the World Development indicators. The study used the Auto Regressive Distributed Lag (ARDL) model, Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) to test the linear regression equation.The results of all the three methods show that a trade off between male unemployment and environmental degradation exists whereas the Environmental Phillips Curve could not be validated for female unemployment. Fromthe results of Block Exogenity test, it can inferred that female unemployment and per capita carbomn emissions are in a vicious cycle and female employment can be used as a tool by policy makers to improve environment quality.A study on N11countries by Tunahan (2023) validated the Environmental Philips Curve hypothesis.The study used ecological footprint as a measure of environmental degradatation.Results of Augmented Mean Group and Dynamic Common Correlated Effects validate the environmental philipps curve for N11 countries.

The available meagre literature review on environmental Phillip's curve shows mixed results for panel data and country specific studies. While panel panel data studies have validated the existence of a trade off, country specific studies on USA (Bhowmik, Syed,

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Apergis, Alola, & Gai, 2021) could only validate the EPC hypothesis in the long run and for male unemployment in India (Shruti, Mohapatra, & Giri, 2023). To the best of the authors's knowledge no study has investigated the relationship between unemployment, economic growth and environmental degradation in Sultanate of Oman. Secondly, ecological footprint is commonly used as an indicator of environmental degradation (Bhowmik, Syed, Apergis, Alola, & Gai, 2021;Tariq, Mehmood, & ul Haq, 2022). However, carbon dioxide is a major cause of global warming.Thirdly, all studies have assumed a symetrical linear relationship among the variables. The Environmental Kuznets curve postulates an inverse u shaped relationship between economic growth and environmental degradation and the linear assumption could lead to errorneous results. The current study seeks to bridge the theorotical and methodological gap in the existing literature by empirically ivestigating the non linear relationship between carbon emissions per capita,unemployment and economic growth.

3. Methodology:

3.1. Variable Description

The current study examines the relationship between environmental degradation, economic growth and unemployment rate for Sultanate of Oman for the period 1991 to 2020.Environmental Degradation (ED) is measured as Carbon Dioxide emissions in metrics tons per capita, Unemployment (U) as Percentage of the total labor force that is without work but available for and seeking employment, Economic Growth(Y) as Annual growth rate in real GDP at constant 2015 prices and Trade Openess (TO) Sum of exports and imports as a percentage of GDP. Data on all the variables, from 1991 to 2020, is sourced from World Development Indicators (https://databank.worldbank.org/source/world-development-indicators). The time period of the study is dictated by the availability of unemployment data.

For the time period of the study, the average Carbon emissions per capita was 13.07 metric tonnes. It reached a maximum of 17.13 metric tonnes per capita in 2012 and minimum of 7.32 metric tonnes per capita in 1993.During the study period, Oman had a modest unemployment rate of 3.75%. The gender segregated unemployment statistics show that male unemployment rates have been higher than female unemployment rate. Unemployment was maximum in 2003 at 4.26%. 15.5% of the population actively seeking employment lies in the age group of 15 to 24 years out of which 12.1% are male and 31.6% are female job seekers. 8.7% of the unemployed in 2020 had a bachelor's degree. The average growth rate of GDP was 3.46% with a maximum of 8.86 in 2012 and minimum of -3.38 in 2020. The following table summarises the trend of the variables used in the current study.

Table 1:Summary Statistics

	ED	Y	TO	U	U_Male	U_Female
Mean	13.07	3.46	93.51	3.75	8.98	2.82
Standard Deviation	3.57	3.19	9.62	0.66	1.63	0.81
Skewness	-0.41	-0.38	0.04	-2.03	1.44	-1.35
Kurtosis	-1.55	-0.45	-0.79	3.58	0.81	0.53

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Maximum	17.13	8.86	112.54	4.26	13.22	3.43
Minimum	7.32	-3.38	77.79	1.80	7.64	0.87

Source: Authors own calculations based WDI data
ED: Carbon Dioxide emission in metric tons per capita, Y: Growth rate of GDP (2015 prices)
TO: Trade Openess, U: Unemployment, U_Male: Male Unemployment, U_Female: Female Unemployment

3.2. Model Specification

The EKC hypothesis postulates that environmental emissions per capita initially rise with economic growth and after a level of growth environmental quality improves.
Thus, Economic growth (Y) is related to Environmental Degradation (ED)
$ED = f(Y)$……(1)
According to Okun's Law, there exists a linear relation between unemployment (U) and economic growth
$U = f(Y)$……(2)
From the above two relationships, Kashem & Rahman (2020) inferred a relationship between unemployment and environmental degradation:
$ED = f(U)$……(3)
Ahmad, Furqan, & Mahmood (2019) found a statistically significant relation between Environment Quality and Trade Openess (TO)
$ED = f(TO)$……(4)
From 1, 2,3 and 4, the current study postulates the functional relationship:
$ED = f(U, Y, TO)$
The current study examines the functional relationship :$ED = f(U, Y, TO)$
Where ED is environmental degradation proxied by carbon dioxide emissions, U is unemployment, Y is economic growth and TO is trade Openness.
The linear transformation of this functional relationship yields:

$$ED_t = C + \beta_1 U + \beta_2 Y + \beta_3 TO + \epsilon$$

Where C is the intercept, ϵ is the error term and β are the coefficients. Trade Openness is used as a control variable.
Unemployment and Economic growth are decomposed into their positive and negative shocks so that the linear function can be rewritten in the non-linear form as:

$$ED_t = \alpha_0 + \beta_1^+ U_t^+ + \beta_2^- U_t^- + \beta_3^+ Y_t^+ + \beta_4^- Y_t^- + \beta_5 TO_t + \varepsilon_t$$

Where U^+, U^-, Y^+ and Y^- are the partial sum of positive and negative changes in unemployment and economic growth.
$U_t^+ = \sum_{j=1}^{t} \Delta U_j^+ = \sum_{j=1}^{t} Max(\Delta U_j, 0)$; $U_t^- = \sum_{j=1}^{t} \Delta U_j^- = \sum_{j=1}^{t} Min(\Delta U_j, 0)$
$Y_t^+ = \sum_{j=1}^{t} \Delta Y_j^+ = \sum_{j=1}^{t} Max(\Delta Y_j, 0)$; $Y_t^- = \sum_{j=1}^{t} \Delta Y_j^- = \sum_{j=1}^{t} Min(\Delta Y_j, 0)$
The long run cointegrating model can be rewritten as:
Equation 1:

$$\Delta ED_t = \alpha_0 + \lambda_1 \Delta ED_{t-1} + \lambda_2 U_{t-1}^+ + \lambda_3 U_{t-1}^- + \lambda_4 Y_{t-1}^+ + \lambda_5 Y_{t-1}^- \lambda_6 TO_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta \mathrm{ED}_{t-i} + \sum_{i=0}^{q-1} \varphi_i \Delta \mathrm{TO}_{t-i} + \sum_{i=0}^{q-1} (\gamma_i^+ \Delta U_{t-i}^+ + \gamma_i^- \Delta U_{t-i}^- + \theta_i^+ \Delta \mathrm{Y}_{t-i}^+ + \theta_i^- \Delta \mathrm{Y}_{t-i}^-) + \mu_t$$

Where p and q the lag length of the regressors and the dependent variable and

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determined using the Akaike Information Criterion.$\beta_2 = -\lambda_2/\lambda_1, \beta_3 = -\lambda_3/\lambda_1, \beta_4 = -\lambda_4/\lambda_1$ and $\beta_5 = \frac{-\lambda_5}{\lambda_1}$are the long run coefficients and γ *and* θ are the coefficients of short run estimates.

3.3. Procedure

The econometric methodology involved testing for stationarity, cointegration and estimation of long run coefficients. The variables were tested for stationarity using the Augmented Dickey Fuller and Phillips Perron Unit Root Test. The null hypothesis Ho: The series has unit root was tested against the alternative the series is stationary. If the calculated t-statistic and adjusted t-static under Augmented Dickey Fuller and Phillips Perron test respectively are greater than the 5% critical value, then the null cannot be rejected. In this case, the test was repeated for the first difference of the variables. Checking for stationarity is a prerequisite as ARDL estimation method assumes that none of the variables are stationary at second difference I(2).

After confirming that none of the variables were integrated at second difference, the study estimated the Non-Linear Autoregressive Distributed Lag (NARDL) model. The NARDL estimation method was selected as firstly, in this model the long run and short run asymmetries can be calculated simultaneously; secondly, the variables can be integrated at level I(0), at first difference I(1) or be a combination of I(0) and I(1); thirdly it distinguishes between the short run and long run effects of the independent variable on the dependent variable and lastly by selecting the appropriate lag length, the problem of multicollinearity can be avoided. In the current study, optimal lag length was selected using the Schwarz Information Criteria.

Long run relationship was examined through the Bounds test. The null of no long run cointegration or from equation 1

Ho: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = 0$

The above hypothesis is tested using the t_{BDM}-statistic(Banerjee, Dolado, & Mestre, 2001) and F_{PSS}-statistic (Pesaran, Shin, & Smith, 1998). If the absolute value of the t-statistic and F-statistic lies above the 5% I(1) bounds, then the null cannot be accepted and long run cointegrating relation can be inferred. In the presence of long run cointegrating relationship, the short run error correction model was estimated.

The residuals of the model were tested for normality, serial correlation and heteroscedasticity. Normality of the residuals was tested using Jarque Berra normality test. The null hypothesis for the Jarque Berra normality test is the residual are normally distributed. If the calculated Jarque Berra statistic is above the 5 percent significance level than the null cannot be rejected. For the Breusch Pagan Serial Correlation LM test, the study hypothesized that H0: No serial correlation at upto two lags. If the F-statistic is greater than 5% critical value, than the null cannot be rejected. Hetroscedasticity was tested using the Breusch Pagan Godfrey test which hypothesizes that the model is

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homoscedastic.

Parameter stability was tested through The Cumulative Sum (CUSUM) and Cumulative Sum of Squares test (CUSUM of Squares). Both these test present the CUSUM and CUSUM of Square graph with the 5 percent upper and lower critical boundaries. Parameter stability can be inferred if both the Cumulative Sum and Cumulative Sum of Square lie within the 5 percent critical boundary.

4. Results:

The first step in the analysis was to determine that none of the variables were integrated at level two i.e. I (2). The results of the ADF and PP indicate the presence of unit root at level. However, the series are stationary at first difference.

Table 2:Results of Unit Root Test

	ADF Test t Statistic		PP-Test Adj t Statistic		Inference
Variables	Level	FD	Level	FD	
ED	-1.15	-4.55***	-1.15	-4.50***	I(1)
Y	-3.06	-6.71***	-3.14	-6.94***	I(1)
U	0.62	-5.01***	-1.74	-9.65***	I(1)
TO	-1.73	-5.63***	-1.47	-9.98***	I(1)

Source: Author's own calculation using E-views 12
ADF:Augmented Dickey Fuller Test, PP: Phillips Perron Test, FD: First Difference
*** and ** indicates significant at 1% and less than 5% level respectively
The Null Hypothesis for ADF and PP test is Ho: The series has unit root
FD denotes first difference

The long run relationship was examined using the Long Run Form and Bounds test. The findings show that for the linear model there is no sufficient evidence to reject the null hypothesis of no levels relation. However, for the non-linear model, the F-statistic (F_{PSS}=5.91)andthe absolute value of the *t* statistic (t_{BDM}= -5.24) is above the 5% and 1% upper bound critical values respectively. Thus, the null hypothesis of no levels relationship cannot be accepted. These results support the use of NARDL estimation method.

Table 3: Results of Long Run Cointegration Test

	Bounds Test		5% F Critical		1% t Critical	
Model	F-Statistic	t-Statistic	I(0)	I(1)	I(0)	I(1)
$\mathbf{P_t = f(U, Y, TO)}$	2.28	-2.51	2.86	4.01	-3.43	-4.6
$\boldsymbol{P_t = f(U^+, U^-, Y^+, Y^-, TO)}$	5.91**	-5.24**	3.13	4.61	-3.43	-4.79

Source: Author's own calculation using E-views 12
** indicates significant at 5% level
Null Hypothesis for Bounds test is Ho: No levels relationship

After inferring long run relationship, the study estimated the long and short run coefficients which are presented in table 5:

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Before drawing inferences from the long and short run coefficients, the study evaluated the robustness of the model. The R squared and Adjusted R squared values show that 98% and 97% of variation in environment degradation can be explained by economic growth, unemployment and trade openness. The statistically significant F statistic illustrates that the explanatory variables are jointly significant in explaining the dependent variable. From the Durbin Watson statistic, absence of serial correlation among the error terms can be inferred.

The residuals of the model were tested for normality, serial correlation and heteroscedasticity.

Table 4: Residual Diagnostic Test Results

Diagnostic Test Indicator	Statistic	Inference
Normality	JB=0.06(p=0.97)	Residuals are normally distributed
Heteroscedasticity	Scale explained SS =6.52 P(Chi Square 12)=0.89	Model is homoscedastic
Serial Correlation LM test	F=1.24, P(2,12)=0.32	No serial correlation up to two lags.

Source: Author's own calculation using E-views 12

From the Jarque Berra normality test, Breusch Pagan Serial Correlation LM test and Breusch Pagan Godfrey heteroscedasticity it can be inferred that the residuals are normally distributed, there is absence of serial correlation up to two lags and the model is homoscedastic. Parameter stability was assessed through the Cumulative Sum (CUSUM) and Cumulative Sum of Squares graph (CUSUM of Squares). As both the CUSUM and CUSUM of Squares lies within the 5% significance boundary, parameter stability can be inferred.

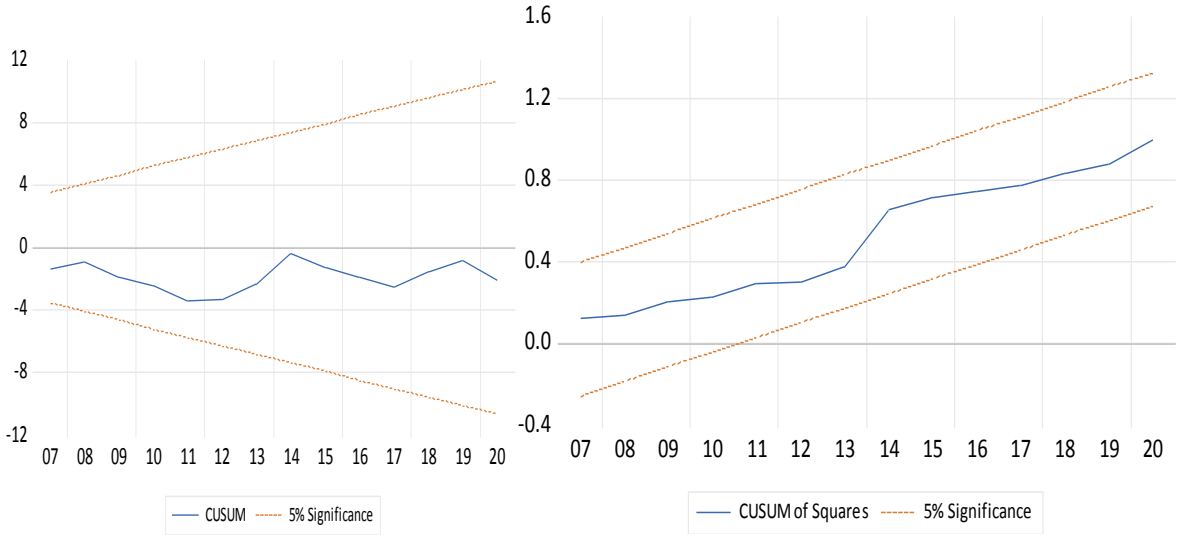

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Table 5:Long and Short Run Estimates

Variable	Coefficient	Std.Error	t-statistic	Probability
Long Run Estimates				
Y^+	0.4938	0.0569	8.68	0.00
Y^-	0.1272	0.0628	2.02	0.06
U^+	7.8895	2.4398	3.23	0.01
U^-	4.5557	1.1514	3.9568	0.00
TO	-0.03	0.0280	-1.18	0.26
Short Run Estimates				
ΔY^+	0.1189	0.0526	2.26	0.04
$\Delta Y^+(-1)$	-0.5075	0.0856	-5.93	0.00
ΔU^+	5.3937	1.0543	5.12	0.00
ΔU^-	5.0387	0.8353	6.03	0.00
$\Delta U^-(-1)$	-9.6023	1.4885	-6.45	0.00
ΔTO	0.0652	0.0187	3.50	0.00
C	11.8210	1.6476	7.17	0.00
Robustness Indicators				
R-Squared=0.98	Adjusted R-Squared =0.97			
Fstatistic=78.56(P=0.00)	DW=2.36			

Source: Author's own calculation using E-views 12

The long run positive coefficient of economic growth is positive (0.4938). An increase in per capita GDP is positively related to environmental degradation. The long negative coefficient of economic growth (0.1272) is also positive.Thus, a negative shock from per capita GDP also leads to increase in carbon emissions per capita. The negative coefficient is weakly significant at less than the 10% level, highlighting the role of economic growth in environmental degradation. The positive and negative coefficients of unemployment are positive and statistically significant. The coefficient of positive shock (7.8895) is greater than the coefficient of negative shock (4.5557) implying that increase in unemployment leads to greater environmental degradation. Trade openness has no long run statistically significant impact on environmental degradation. The short run coefficients have the same sign as long run coefficients.Trade openness is positive and statistically significant in the short run, from which we can infer that increase in

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trade leads to environmental degradation.

5. Discussion:

A major challenge confronting policy makers is to achieve economic growth, lower unemployment levels without compromising on the environmental quality. As employment generation is directly related to economic growth, a tradeoff between environment quality and sustaining livelihoods emerges. Rahman (2021) termed this environment degradation unemployment nexus as Environmental Phillips Curve. The current study examined the asymmetrical relationship between environmental degradation and unemployment rate for Sultanate of Oman for the period 1991 to 2020. By empirically investigating the unemployment, economic growth and environmental degradation tradeoff, the study contributed to the meagre literature on the EPC hypothesis.

The results indicate a positive association between economic growth and environmental degradation. Omans economic growth is dependent on oil export revenues (Kulkarni & Shastri, 2019) Oil production involves increased carbon dioxide emission and environmental degradation. Secondly, Oman's manufacturing sector is dependent on non-renewable energy consumption which lead to greater carbon emissions. Thirdly, economic growth is associated with rising population and urbanisation. The consequent rising demand for housing and transportation services leads to environmental degradation. These findings highlight the importance of switching to renewable energy sources such as solar energy and wind energy. Policy makers need to encourage investment in less polluting industries.

Both positive and negative shocks in unemployment lead to increase in pollution.Thus, there is a need to spread awareness on environmental conscious practices. Increase in unemployment is associated lower consumer spending on environmental friendly goods. Thus, employment generation can be used as a tool for improving environment quality. The use of environmental friendly goods should be encouraged by offering them at subsidised prices. Social entrepreneurship can be used as a tool for environmental friendly employment generation (Kulkarni, Varshney, & Al Amri, 2022).Investments in enterprises focusing on recycling and better waste management should be encouraged.

The following policy implications arise from the study. The vision 2040 (Oman Vision 2040 Report, 2023) foresees 91.6% GDP contribution from the non-oil sector. Policy makers can impose carbon taxes on non –oil sector industries and subsidise environmentally viable technologies. This market mechanism of reward and penalty will encourage environment friendly industries. Secondly, Oman envisions self-employment as pillar of labour market growth. Self employed labour force participants should be encouraged to use environmentally safe business practices.

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The study is an initial investigation in the unemployment, economic growth and environmental degradation nexus. A major constraint encountered is limited availability of unemployment data. Further studies can overcome this time series data limitation by using panel data. The current study used CO2 emissions as an indicator of environmental degradation. Further studies can use other indicators such as ecological foot print. Research on the impact of renewable and non-renewable energy on economic growth will lend empirical support to the policy implications suggested by the current study

References:

Aloui, C., & Jammazi , R. (2015). Environment degradation, economic growth and energy consumption nexus: A wavelet-windowed cross correlation approach. *Physica A: Statistical Mechanics and its Applications*, 110-125.

Ahmad, M. A., Furqan, M., & Mahmood , H. (2019). Trade openness and CO2 emissions nexus in Oman. *Entrepreneurship and Sustainability Issues*, 1319-1329.

AlKhars, M. A., Alwahaishi, S., Fallatah, M. R., & Kayal, A. (2022). A literature review of the Environmental Kuznets Curve in GCC for 2010–2020. *Environmental and Sustainability Indicators*, 1-21.

Alsamara, M., Mrabet, Z., & Saleh, A. S. (2018). The environmental Kuznets curve relationship: a case study of the Gulf Cooperation Council region. *Environ Sci Pollut Res*, 33183–33195.

Anser, A. K., Apergis, N., Syed, Q. R., & Alola, A. A. (2021). Exploring a new perspective of sustainable development drive through environmental Phillips curve in the case of the BRICST countries. *Environ Sci Pollut Res Int., 28*(35), 48112-48122. doi:10.1007/s11356-021-14056-5

Arouri, M., Youssef, A. B., M'henni, H., & Rault , C. (2012). Energy consumption, economic growth and CO2 emissions in Middle East and North African countries. *Energy Policy*, 342-349.

Banerjee, A., Dolado, J., & Mestre, R. (2001). Error-correction mechanism tests for cointegration in a single-equation framework. *Journal of Time Series Analysis*, 267-283. doi: https://doi.org/10.1111/1467-9892.00091

Bhowmik, R., Syed, Q. R., Apergis, N., Alola, A. A., & Gai, Z. (2021). Applying a dynamic ARDL approach to the Environmental Phillips Curve (EPC) hypothesis amid monetary, fiscal, and trade policy uncertainty in the USA. *Environmental Science and Pollution Research*, 14914-14928.

Gujrati, D. N. (2003). *Basic Econometric.* Mc Graw Hill.

Kahn, M., & Kotchen, M. (2011). Business Cycle Effects On Concern About Climate Change: The Chilling Effect of Recession. *Climate Change Economics*, 257-273.

Karedla, Y., Mishra, R., & Patel, N. (2021). The impact of economic growth,trade openness and manufacturing on CO2 emissions in India:an autoregressive distributive lag (ARDL)

Submitted: 27 April 2023, Revised: 09 May2024, Accepted: 18 May 2024, Published: June 2024

bounds test approach. *Journal of Economics, Finance and Administrative Science, 26*(52), 376-389. doi:10.1108/JEFAS-05-2021-0057

Kashem, M. A., & Rahman, M. M. (2020). Environmental Phillips curve: OECD and Asian NICs perspective. *Environ Sci Pollut Res Int, 27*(25), 31153-31170. doi:10.1007/s11356-020-08620-8

Kulkarni, N. A., & Shastri, S. (2019). Relationship Between Oil Revenues and Gross Domestic Product of Oman: An Empirical Investigation. *International Journal of Economics and Financial Issues, 9*(6), 195-201. doi:https://doi.org/10.32479/ijefi.8805

Kulkarni, N. A., Varshney, S. M., & Al Amri, S. (2022). Study of Social Entrepreneurship Amongst Youth in Oman. In H. Magd (Ed.), *International Perspectives on Value Creation and Sustainability Through Social Entrepreneurship.* Muscat: IGI Publications.

Kulkarni, N. A., Varshney, S., & Khalfan, S. A. (2023). Relation between government expenditure and economic growth of Sultanate of Oman:An empirical examination. In A. S (Ed.), *International Conference on Banking Finance and Business "Enhancing Economic Competitiveness in the Digital Era: Innovative Models and Strategies* (p. 81). Muscat: College of Banking and Financial Studies.

Kulkarni, N., Varshney, S., & Ravindra, K. (2023). Factors affecting Fintech Adoption in Post Covid Oman. In P. Gupta (Ed.), *International Conference on Business,Innovation and Sustainability in Digital Era* (p. 114). Alliance University.

Meyer, A. (2016). Is unemployment good for the environment. *Resource and Energy Economics, 45*(C), 18-30. doi:10.1016/j.reseneeco.2016.04.001

Ministry of National Economy. (2023). *Oman Vision 2040 Report.* Muscat: Implementation Follow Up Unit.

Narayan, P., & Narayan, S. K. (2010). Carbon dioxide emissions and economic growth: Panel data evidence from developing countries. *Energy Policy, 38*(1), 661-666. Retrieved from https://EconPapers.repec.org/RePEc:eee:enepol:v:38:y:2010:i:1:p:661-666.

National Centre for Statistics and Information. (2023). *Statistical Year Book* (Vol. 52). Muscat: National Centre for Statistics and Information.

National Centre of Statistics and Information. (2017). *Statistical Year Book.* Oman: National Centre of Statistics and Information. doi:www.ncsi.gov.om

Okun, M. A. (2024, Febuary 21). *The Library of Economics and Liberty.* Retrieved from EconLib: https://www.econlib.org/library/Enc/bios/Okun.html

Ozcan, B. (2013). The nexus between carbon emissions, energy consumption and economic growth in Middle East countries: A panel data analysis. *Energy Policy, 62*, 1138-1147. doi:https://doi.org/10.1016/j.enpol.2013.07.016

Pesaran, M. H., & Shin, Y. (1999). An autoregressive distributed lag modelling approach to cointegration analysis. In S. Strom, *Econometrics and Economic Theory in the 20th Century:The Ragnar Frisch Centennial Symposium.* Cambridge: Cambridge University Press.

Submitted: 27 April 2023, Revised: 09 May2024, Accepted: 18 May 2024, Published: June 2024

Pesaran, M., Shin, Y., & Smith, R. J. (1998). Bounds testing approaches to the analysis of level relationship. *Journal of Applied Econometrics, 16*(3), 289-326.

Shruti, S., Mohapatra, G., & Giri, A. K. (2023). The Environmental Philips Curve from a gender perspective: empirical evidence from India. *Environmental Science and Pollution Research, 30*(7), 17487–17496. doi:10.1007/s11356-022-23336-7.

Tariq, S., Mehmood, U., & ul Haq, Z. (2022). Exploring the existence of environmental Phillips curve in South Asian countries. *Environ Sci Pollut Res*, 35396–35407.

Tunahan. (2023). A New Approach to Sustainable Development: Analysis of the Environmental Phillips Curve Hypothesis. *Sosyoekonomi,*, 11-25.

Submitted: 27 April 2023, Revised: 09 May2024, Accepted: 18 May 2024, Published: June 2024