Inquiring the Environmental Phillips Curve: The Case of Selected Asian Countries

Hamza Rasheed[1], Arifa Saeed[2] and Muhammad Shahid Hassan[3]

https://doi.org/10.62345/jads.2025.14.3.174

Abstract

Environmental quality is among one of the major macroeconomic and environmental challenges of present time. The increasing share of carbon emissions in the air has led climatic and health related issues around the world. This research is conducted to see the roles of unemployment, regulatory quality, total natural resource rent and population density upon carbon emissions in the selected Asian Economies. The interlink between unemployment and carbon emissions will guide us about the presence/absence of Environmental Phillips curve. This study considers the cross-sectional autoregressive distributed technique over the period from 1990 to 2024 and provides the evidence of trade-off between unemployment and environmental degradation. The results further demonstrates that unemployment significantly mitigate carbon emissions and hence confirms the trade-off relation. These findings provide evidence of Environmental Phillips Curve in Selected Asian Economies. Moreover, the findings also highlight that rents from natural resources significantly accelerate carbon emissions while regulatory quality as measure of institutional quality expands carbon emissions. Based on these findings, this research proposes that unemployment may be reduced, rents from natural resources may be increased and quality of regulations are improved in such a way that it should not trigger carbon emissions in the selected sample countries.

Keywords: Environmental Phillips Curve, Regulatory Quality, Asian Economies**.**

Introduction

Phillips first proposed the Phillips curve in 1958, which depicted a negative relationship between inflation and unemployment and indicated a trade-off between the two variables. The idea of the Environmental Phillips Curve (EPC) was developed because of contemporary macroeconomic discussions that broadened the scope of the trade-off to include environmental impacts. Economists have begun to consider how environmental policies (such as lowering pollution or employing clean energy) impact the economy, such as jobs, prices, as the change in climate intensifies and nations attempt to develop in a more ecologically friendly manner. This way of thinking has produced a novel concept known as the Environmental Phillips Curve, which examines the potential trade-off between preserving the environment and preserving a robust economy. The Environmental Phillips Curve recommends a potential trade-off between economic

[1] *BS Economics Graduate, Department of Economics and Quantitative Methods, University of Management and Technology, Lahore, Pakistan. Email: jhamzarasheed@gmail.com*
[2] *Associate Professor, Department of Business Economics and Finance, Greenwich University, Karachi. Email: arfasaeed@gmail.com*
[3] *Department of Economics and Quantitative Methods, University of Management and Technology, Lahore, Pakistan. Corresponding Author Email: shahid.hassan@umt.edu.pk*

Compliance with ethical standards: There are no conflicts of interest (financial or non-financial). This study did not receive any funding.

outcomes (inflation or employment) and environmental degradation. In general, strict environmental policies such as carbon tax and regulation of industries may increase inflation and unemployment. Bovenberg and de Mooij (1994) recommended that if the government utilizes environmental taxes efficiently and in the right way, then it can achieve two major benefits at the same time, i.e. by reducing pollution environment will get better, secondly economy will be better off when tax money is used to lower other harmful taxes (income tax or payroll tax). This point concludes that protecting the environment is not always about hurting the economy.

One of the first economists that connect the environment with the economy was Nordhaus (2008), by using the DICE model. This model displays how greenhouse gas emissions can increase with economic growth, which eventually causes climate change and damage. His contribution helped many people understand that policies related to climate, e.g., putting a tax on carbon pollution, might increase prices a little, but over time, policies can result in better results. Although Nordhaus did not address the Environmental Phillips curve, his ideas helped to pave the way for it. Bowen and Stern (2010) examined how reducing carbon emissions can cause unemployment at first, especially in industries where carbon emissions are abundant. They said that this problem can be resolved or avoided if we invest in green technologies and provide training to people about clean energy & technology. An economic model developed by Heijdra and Heijnen (2013) examines the long-term effects of environmental taxes on employment, unemployment and pollution levels. They discovered that while these taxes may initially result in a slight loss of jobs, they can have a significant positive impact on the environment. Ploeg and Withagen (2014) examined how countries shift towards growth in terms of green technologies and energy (economic growth while protecting the environment) by balancing short-term and long-term goals. They warned that acting too long on climate change can result in more unemployment and lower economic growth. So, it is better to invest in green technology as soon as possible. Green fiscal policies were examined by Nguyen et al. (2021) and found that green investments may have an initial inflationary effect but ultimately, they can stabilize the environment and economy. These policies can stabilize the economy and environment, especially when it is well coordinated with central bank policies. According to Bowen and Stern (2024), new jobs are being produced in these expanding clean sectors as nations increase their investments in green industries like solar energy, wind power and electric transportation. On the other hand, conventional fossil fuel businesses such as oil drilling and coal mining are contracting. During the transition to a greener economy, this results in workers in those older sectors losing their jobs temporarily. This process is known as transitional unemployment. Government Spending on green projects such as eco-friendly infrastructure or renewable energy may initially result in a slight increase in inflation, according to Nguyen et al. (2024). However, this green spending can contribute to long-term economic and environmental stability if it is synchronized with central bank measures like interest rate policy. This demonstrates how crucial it is to collaborate on both economic and climatic goals.

This discussion guides us to investigate the Environmental Phillips Curve among the selected Asian Economies, considering regulatory quality, total natural resource rent and population density as controlling factors. The Environmental Phillips Curve has undergone a smaller number of studies and modifications as compared to conventional Phillips curve. a few studies have considered the role of regulatory quality and total natural resource rent on unemployment and environmental degradation. This study adds numerous important additions to the current knowledge on the Environmental Phillips curve. Firstly, it provides a cross-regional view by incorporating a wide panel of nations in Asia, allowing for larger and more internationally applicable results. Secondly, it includes policy-related factors such as regulatory quality and total natural resource rent, providing a more complete picture of how institutional and economic policies can impact the unemployment-environment nexus. The study employs advanced econometric tools to address endogeneity and causality concerns, hence increasing the reliability and correctness of empirical findings. This study employs the data of approximately 33 Asian countries, providing robust findings.

Literature Review

The impact of Unemployment on Environmental Degradation:

Kashem and Rahman (2020) investigated the impact of unemployment, GDP growth and trade GDP ratio on CO_2 emissions case of OECD and Asian NIC countries. This study found that GDP growth and trade-GDP ratio have positive impact on CO_2 emissions, whereas unemployment has negative effects on CO_2 emissions validating the Environmental Phillips curve. Rayhan et al. (2020) examined the impacts of unemployment, trade openness and energy consumption on CO_2 emissions in Bangladesh. This study finds that CO_2 emissions is negatively influenced by unemployment. The energy consumption has positive impact on CO_2 emissions, whereas trade openness has no significant effects on CO_2 emissions. The sectoral focus in this study has enhanced policy insight, helping in identifying which sector is least harming the environment. This study's statistical analysis has failed to account for dynamic changes over time in the economy. Anser et al. (2021) examined impacts of GDP, renewable and non-renewable energy on ecological footprint in BRICST countries. This study finds CO_2 emissions have an inverse relation with unemployment, renewable energy and GDP, whereas there is a positive relation between CO_2 emissions, non-renewable energy. The inverse relation between ecological footprint and unemployment has confirmed the environmental Phillips curve. This study has provided cross-national validation of EPC but overlooked the impact of green jobs and labor market reforms.

Fatt et al. (2021) examined the impacts of unemployment, GDP per capita, square of GDP per capita and clean energy on Ecological footprint. This study finds that unemployment and clean energy have negative impact on ecological footprints validating the Environmental Phillips curve. This research includes complex results which require technical interpretation, limiting the accessibility of findings to vast audiences. Tanveer et al. (2021) investigated the impact of unemployment, consumption of energy and globalization on environmental degradation. The study concludes that globalization and unemployment have negative impact on ecological footprint, validating the environmental Phillips curve in Pakistan, whereas energy consumption has positive impact on ecological footprint. This study has neglected or overlooked policy and institutional factors that affect the trade-off between ecological footprint and unemployment. This study is not generalizable to other regions except the SAARC countries. Bhowmik et al. (2022) investigated the impact of unemployment, monetary, fiscal and trade policy on CO_2 emissions. This study found that the unemployment and fiscal policy have negative impact on CO_2 emissions in long run, confirming the Environmental Phillips curve in long run. This study found that monetary policy has positive impact on CO_2 emissions. The services sector is omitted from this study, and gender specific effects of labor are not included. Shastri et al. (2022) examined the Environmental Phillips curve from a gender perspective in the economy of India. The impact of male and female unemployment on CO_2 emissions is analyzed. This study found that male unemployment has negative impact on CO_2 emissions, validating the Environmental Phillips curve, whereas there is a positive relation between CO_2 emissions and Female unemployment, invalidating the Environmental Phillips curve. This study provides a detailed understanding of the

Environmental Phillips curve from a gender perspective. This study does not consider the impact of broader policy or institutional factors on this relationship. Tariq et al. (2022) studies the impact of unemployment, GDP per capita, non-renewable and renewable energy consumption on ecological footprint in South Asian countries. The study reveals that the Environmental Phillips curve holds in these countries, as unemployment has negative impact on ecological footprint. the study found that the GDP and non-renewable energy have positive impact on ecological footprint. This study offers a policy relevant approach to sustainable employment through green technologies. This study lacks a more detailed exploration of the effects of green job creation on emissions. Xin et al. (2022) has examined the impacts of unemployment, education expenditure, literacy rate and GDP per capita on CO_2 emissions in China. This study found that unemployment and GDP have positive impact on CO_2 emissions, invalidating Environmental Phillips curve. Lastly, literacy rate and education have no impact on CO2 emissions. The incorporation of digitalization opens passages for understanding how technological advancements can affect the environment in an economy like China. This study has a short period, which may limit the ability to interpret long-term trends.

Haciimaglu (2023) investigated the applicability of the Environmental Phillips curve in N-11 countries, by studying the impact of unemployment, renewable energy, and GDP. This study found that unemployment and renewable energy have negative impact on ecological footprint, confirming the environmental Phillips curve. The GDP has positive impact on CO_2 emissions The criticism of this study is that it assumes linearity, and this study has not addressed structural breaks and crisis effects. Dastan and Eygu (2023) examined the impacts of unemployment, income and renewable energy consumption on ecological footprint. In this study, the A-ARDL model shows that the income has negative impact on ecological footprint, confirming the Environmental Kuznets Curve. The study finds an inverse relation between ecological footprint and unemployment, validating the Environmental Phillips curve. The inclusion of business cycle analysis adds realism to the study, recognizing that this relationship varies with the economic cycle. This study does not address the effects of informal employment with clarity, which can lead to an incomplete understanding of the relationship. The research by Eissa (2023) highlighted the unemployment has negative on ecological footprint and hence confirmed evidence of EPC in Egypt. According to Addison et al. (2024), unemployment helped in boosting carbon emissions, and this rejected the environmental Phillips curve idea in case of Ghana. The study further exposed that per capita GDP and intense energy were also boosting emissions, but clean energy was reducing it. In another research, Azimi and Rahman (2024) after considering G7 countries, disclosed significantly negative impact of unemployment on carbon emissions. They supported the presence of EPC hypothesis in the selected nations. Considering seven ASEAN nations like Vietnam; Thailand, Singapore, Philippines, Malaysia, Indonesia and Brunei, Hasan et al. (2024) reported that unemployment has positive impact on carbon emissions which rejected the EPC hypothesis. Kinnunen et al. (2024) investigated impact of unemployment, GDP and urbanization on greenhouse emissions. This study found that unemployment, GDP and urbanization have positive impact on greenhouse emissions, rejecting the Environmental Phillips curve hypothesis. This study does not address the role of the informal sector in emissions in Finland, and this study has data limitations for recent years. Sahin et al. (2025) explored the Environmental Phillips curve in ten emerging economies. The author is analyzing the impact of unemployment, population, Natural gas and renewable energy on CO_2 emissions. This study found that GDP and population have positive impact on CO_2 emissions. This study indicates that CO_2 emissions have an inverse relation with unemployment, renewable energy and natural gas, validating the Environmental

Phillips curve. This study has robust diagnostics, and advanced panel econometric methods were used. This study has not explored regional heterogeneity, and sector-specific employment effects were not examined on emissions.

Matyakubor et al. (2025) investigated the relation between unemployment and CO2 emissions while considering GDP per capita. The PMG-ARDL approach found that unemployment has positive influence on CO2 emissions, invalidating the environmental Phillips curve. This study found that GDP. Per capita has positive impact on CO2 emissions and GDP per capita. This study offers important insights about the Soviet countries regarding the Environmental Phillips curve. This study has a data consistency issue that could undermine the reliability of conclusions, especially in countries with less statistical infrastructure. The discussion on environmental Phillips curve carried out by Kashem and Rahman (2020), Rayhan et al. (2020), Tanveer et al. (2021), Anser et al. (2021), Anser et al. (2021), Dastan and Eygu (2023), Eissa (2023), Fatt et al. (2021), Azimi and Rahman (2024), and Sahin et al. (2025) confirmed presence of the inverse relation between unemployment and environmental degradation which suggested evidence of environmental Phillips curve. However, the studies such as Xin et al. (2022), Yavuz et al. (2023), Addison et al. (2024), Kinnunen et al. (2024), Hasan et al. (2024), and Matyakubor et al. (2025) reported that the relationship between unemployment and environmental degradation is not always straightforward and provided evidence of positive link between unemployment and environmental degradation. This invalidated the Environmental Phillips curve.

The Impact of Population on Environmental Degradation

Anser et al. (2021) explored the impact of population on carbon dioxide emissions and found that that population has positive impact on CO_2 emissions. In South Asian countries, Tariq et al. (2022) investigated how carbon dioxide emissions are affected by population. This study finds that population has positive impact on carbon dioxide emissions. Haciimaglu (2023) aimed to investigate the effects of population on carbon dioxide emissions and found that negative relation exists between population and CO_2 emissions. Azimi and Rahman (2024) investigated the Environmental Phillips Curve in G7 countries. the author has analyzed how CO_2 emissions was affected by population. This study finds that population positively affects CO_2 emissions. Sahin et al. (2025) explored the relation between CO_2 emissions and population. This study finds that there is a positive relationship between CO_2 emissions and population. The studies like Anser et al. (2021), Tariq et al. (2022), Azimi and Rahman (2024) and Sahin et al. (2025) suggested positive impact of population on CO_2 emissions while the contribution of Haciimaglu (2023) reported negative link between population and CO_2 emissions.

The Impact of Natural Resource Rent on Environmental Degradation

Eissa (2023) conducted a study to investigate the impact of natural resource rent on environmental degradation. This study found that rent from natural resources have positive and negative impact on ecological footprint, Liu et al. (2023) disclosed the mitigating role of natural resources for carbon emissions for most polluted countries. Yavuz et al. (2024) explored examined the effects of natural resource rent and concluded that there is inverse relation between natural resource rent and load capacity factor (environmental indicator). Zhou et al. (2025) conducted research in which they suggested intense energy booted carbon emissions in most polluted economies.

The Impact of Institutional Quality on Environmental Degradation

Democracy and autocracy were used as institutional quality indicators for targeting carbon emission by Jahanger et al. (2022) in their research. They exposed that autocracy was significantly escalating carbon emissions while democracy was mitigating it. Alharthi et al. (2025) investigated the effects of institutional quality indicators in targeting environmental quality for most polluted countries. They uncovered the mitigating role of regulatory quality for carbon emissions.

Theoretical Framework of Environmental Phillips Curve

Several studies were carried out to examine the relationship between unemployment and environmental degradation i.e. Environmental Phillips Curve such as Kashem and Rahman (2020), Rayhan et al. (2020), Anser et al. (2021), Fatt et al. (2021), Tanveer et al. (2021), Bhowmik et al. (2022) and Shastri et al. (2022). These studies have reported inverse relation between unemployment and CO_2 emissions using econometric and statistical analysis such as ARDL, CS-ARDL, panel data and cointegration tests. The Environmental Phillips Curve was also studied by other studies such as Tariq et al. (2022), Xin et al. (2022), Haciimaglu (2023), Dastan and Eygu (2023), Eissa (2023), Addison et al. (2024), Azimi and Rahman (2024), Hasan et al. (2024), Kinnunen et al. (2024) using different variables such as natural resource rent, GDP, GDP per capita, renewable energy and economic growth. A few studies have studied the impact of natural resource rent, which prompted us to study this variable in context of environmental degradation. Many studies have focused on economic growth, renewable energy, GDP per capita but studies have failed to include the impact of regulatory quality on environmental degradation. As mostly studies have ignored the impact of regulatory quality and there are only few studies who studied the impact of natural resource rent, this prompted us to examine the effects of regulatory quality and natural resource rent on environmental degradation.

The present literature on the Environmental Phillips Curve has many significant research gaps that provided the potential for future investigation. Firstly, while many studies have focused on specific regions such as G7 countries, BRICST and SAARC, there is a paucity of cross-regional comparison analysis, which limits our knowledge of Environmental Phillips curve's global application. Secondly, while broad economic policies such as monetary and fiscal measures have been considered, there has been little in-depth research into the consequences of policy uncertainty and specific environmental restrictions. Thirdly, most studies have focused on total unemployment rates ignoring how various sectors such as agriculture, manufacturing or services-contribute differently to deterioration of environment. Furthermore, several analyses use cross-sectional data or short time periods, limiting the capacity to make solid long-term conclusions on unemployment-environment link. Moreover, the influence of digital economy and technical breakthroughs such as renewable energy and modernization of industries is largely unknown in Asian economies. The studies have not considered the role of rent from natural resource in polluting the environment. Lastly, some research has discussed endogeneity concerns, very few studies have used sophisticated econometric approaches address causation resulting in methodological vacuum in the field.

Methodology

This study incorporates data of 33 Asian Economies from 1990-2024. The Sample is chosen from 1990-2024 from these economies due to limitation of data availability. The data from 1990-2024 of all variables is taken World Development Indicators **(WDI).** In order to receive systematic and compatible results, all the variables are taken in the form of natural log which helps in addressing the issues of heteroscedasticity and non-linearity.

Model of the Study: The proposed model is as following:

$$\ln CO_2PC_{i,t} = f\,(\ln UNEMPT_{i,t}\,,\ RQ_{i,t}\,,\ \ln TNR_{i,t}\,,\ \ln POPDEN_{i,t})$$

The economic systems and policy philosophies of the most polluted nations are usually similar. Additionally, trade agreements, environmental accords and larger frameworks of economic cooperation frequently connect these economies. The CS-ARDL model, created by Chudnik and Pesaran (2015) and Cavalcanti et al. (2015) is used in this investigation due to its interdependence. This methodological technique is especially well-suited to examine both short-run dynamics and long-run equilibria while simultaneously accounting for endogeneity and cross-sectional dependence (CSD). Interdependencies between different countries in the sample may be confirmed by CSD tests. The CSD test is followed by SH test to confirm the validity of estimation. The CADF and CIPS are unit root test which are used in the study to address CSD further. Pesaran (2007) proposed these tests. Westerlund (2007) error correction based cointegration tests, which are resistant to both CSD and heterogeneity, are used to investigate cointegration among the variables. These tests reduce the possibility of false regression results and help identify long-term relationships between crucial variables. The SH test is also used in the study to look at variation in slope coefficients among nations. In order to capture the diversity in how various economies react to energy and environmental dynamics, this test is crucial for identifying structural differences in linkages.

Slope Heterogeneity Test:

This section uses the methodology put out by Pesaran and Yamagata (2008) to investigate the heterogeneity of slope coefficients. Two statistical tests are utilized to evaluate this: the adjusted test and difference test. The first test is as under:

$$\tilde{\Delta} = \sqrt{n}\left(\frac{n^{-1}\tilde{S} - k}{\sqrt{2k}}\right)$$

A standardized metric of bias dispersion is provided by this test. A standardized test for assessing slope heterogeneity is the statistic "D", where "n" is total number of participating nations. A modified form of dispersion test is represented by statistic "$\tilde{S}$". The number of slope coefficients is indicated by the variable "k, and the standard deviation obtained from the modified test is denoted by "2k." Mean and variance biases are considered when calculating these metrics.

$$\tilde{\Delta}\text{adj} = \sqrt{\frac{n(t\ +\ 1)}{t-k-1}}\left(\frac{n^{-1}\tilde{S} - k}{\sqrt{2k}}\right)$$

The Scaling factor, $\sqrt{\frac{n(t+1)}{t-k-1}}$ in the equation, is used to account for the changing structure of panel data and correct small-sample biases. When the time dimension is small, usually near "k," which stands for the number of slope parameters in the estimated model, it becomes more important. Furthermore, the test offers information about $\left(\frac{n^{-1}\tilde{S}-k}{\sqrt{2k}}\right)$ which demonstrate the dispersion test's standardization. After correcting the mean value "k", this is accomplished by scaling with the standard deviation "2k." The suggested tests are resistant to cross-sectional dependence (CSD) and heteroscedasticity.

CSD Test:

Tufail et al. (2022) stresses how important it is to take cross-sectional dependence (CSD) into account when estimating panel data, especially in the age of globalization, when cross-border economic activity is becoming more interconnected. Neglecting CSD may lead to inaccurate, biased and deceptive results (Westerlund and Edgerton 2007). The CSD test, created by Pesaran (2015), is used to evaluate if the regression model's residuals show correlation across cross-sectional units in order to address this problem. In order to guarantee the reliability and validity of econometric analysis, this test is necessary. The CSD test statistics are:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left[\sum_{i=1}^{N-1}\sum_{j=i+1}^{N} P\,\mathrm{i.j}\right] => \mathrm{N}(0,1)$$

With CD standing for cross-sectional dependence, t for the time dimension, and n for the number of cross-sectional units, the test statistic quantifies cross-sectional dependency. The average pairwise correlation of residuals across several cross-sections is captured by this term. A greater presence of CSD among the cross-sectional units is indicated by an increase in this value.

Unit Root Test:

The method developed by Pesaran (2007) is used in this work to examine the existence of unit roots while taking cross-sectional dependence (CSD) into consideration. The unit root tests are required to examine whether the variables are stationary or not. In particular, while looking for unit roots in panel data, (CADF) test is employed, which is intended to successfully handle CSD and provide more trustworthy results.

$$\Delta Y_{i,t} = \alpha_i + \rho_i Y_{i,t-1} + \delta_i \bar{Y}_{i,t-1} + \sum_{j=0}^{q} \gamma_{ij} \Delta \bar{Y}_{i,t-q} + \sum_{j=1}^{p} \varphi_{ij} \Delta Y_{i,t-p} + \epsilon_{it}$$

$Y_{i,t}$ refers to the first difference term, which displays the cross-sections and time, alpha I shows cross-section particular constant term. ρ_i & δ_i are the coefficient of dependent variable that are one year lagged. The term ρ_i is important because, if it equals unity, the existence of the unit root is verified; if not, the values will show a stationary series., otherwise the values will indicate the stationary series. The δ_i will be used to account for CSD in unit root and provide a common mean of cross-sections. The expression $\sum_{j=0}^{q} \gamma_{ij} \Delta \bar{Y}_{i,\,t-q}$ the total of the lagged differences between the dependent variable's mean and lag q is represented by t-q in expressions. Similarly, the difference between the lagged terms of the dependent variable with p lag is shown by i,t-p $\sum_{j=0}^{q} \varphi_{ij} \Delta \bar{Y}_{i,t-p}$. By resolving serial correlation issues in the chaotic term, the use of lagged terms increases test robustness. The addition of lagged terms improves test robustness by addressing serial correlation problems in the unpredictable term. An additional factor in the equation represents the error term for time "t" and cross-section "i". This will capture false noises and shocks. This test outperforms the traditional ADF unit root test since it accounts for CSD. Pesaaran (2007) developed a test that aggregates CADF data for cross-sections which is known as the modified IPS known test for CSD (CIPS), this test looks like this:

$$\text{CIPS (n, t)} = n^{-1} \sum_{i=1}^{n} t_I(\text{n, t})$$

The term t_i (n, t) characterizes CADF value, which is acquired by t-test for cross-sections i.

Cointegration Testing:

The use of heterogeneous estimate methodologies is crucial because of the existence of slope heterogeneity (SH) and cross-sectional dependency (CSD), according to Kao et al. (1999), Larsson (2001), and Pedroni (2001, 2004). The Westerlund (2007) co-integration test, which is used in this work to investigate if there is a long-term equilibrium relationship between the explanatory variables and environmental quality across the chosen sample of nations, successfully addresses these problems. Based on following group mean and panel statistics, the tests are presented below:

$$G_t = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{\hat{\lambda}_i^k}{s.e(\hat{\lambda}_i^k)}\right)$$

$$G_a = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{t\hat{\lambda}_i^k}{\hat{\lambda}_i^k\,(1)}\right) \; where \; \hat{\lambda}_i^k\,(1) = \frac{\hat{\omega}_{ui}}{\hat{\omega}_{yi}}$$

Variance estimators are indicated by the symbols $\hat{\omega}_{ui}$ and $\hat{\omega}_{yi}$. Group-mean tests are represented by "**Gt**" and "**Ga**," where normalized coefficients adjusted for estimating errors across panel units are aggregated by "Gt." The normalized long-run variance is captured by "Ga," which is used to take into consideration both heteroscedasticity and autocorrelation. The Term $\hat{\lambda}_i^k$ indicates the adjustment towards the long-run equilibrium., which reflects the error correction component. This $s.e(\hat{\lambda}_i^k)$ is a representation of the relevant standard error. The long-run variance unique to cross-section I is indicated by the expression $\hat{\lambda}_i^k\,(1)$. Here, "t" stands for time, and number of CS units are represented by n. Panel co-integration tests are presented after the group test discussion. Co-integration is assessed for the entire panel using the statistics "**Pt**" and "**Pa.**" The error correction coefficients across cross-sections are assumed to be homogeneous in these tests. In particular, the "**Pt**" statistic evaluates the pooled error correction coefficient, whereas the "**Pa**" statistic offers a comparable evaluation that has been modified for the time dimension.

$$P_{t=} = \frac{\hat{\lambda}_i^k}{s.e(\hat{\lambda}_i^k)}$$

$$P_a = t\ \hat{\lambda}_i^k$$

CS-ARDL Test:

This research uses the sophisticated CS-ARDL technique, which is based on applying the Westerlund (2007) co-integration paradigm to construct long-term partnerships. The analysis adheres to the Chudik and Pesaran (2016) CS-ARDL model, which distinguishes itself from traditional methods by successfully resolving several econometric concerns, including endogeneity, non-stationarity, slope heterogeneity, mixed-order consolidation, cross-sectional dependence and non-stationarity (Wang et al., 2021). The impact of important explanatory variables is estimated using the CS-ARDL technique on carbon emissions, including energy intensity, clean energy, and dirty energy. Chudik and Pesaran (2015) first proposed this strategy, which is especially reliable because of its capacity to account for CSD brought on by frequent shocks that go unnoticed. Generalized form of CS-ARDL is as below

$$Y_{i,t} = \alpha_i + \lambda_i y_{i,t-1} + \delta_i \bar{y}_{t-1} + \sum_{j=0}^{p} \beta_{ij} x_{i,t-j} + \sum_{j=0}^{q} \varphi_{ij} \bar{x}_{i,t-j} + \varepsilon_{it}$$

The dependent variable $Y_{i,t}$,which is described in the generalized CS-ARDL model, α_i is the cross-section-specific intercept that captures national heterogeneity. The coefficient λ_i represents the average impact of the lagged dependent variable across nations and δ_i refers to the lagged dependent variable (autoregressive term). The model also incorporates terms $\sum_{j=0}^{p} \beta_{ij} x_{i,t-j}$ that show the impacts of the explanatory factors in short run on the dependent variable and the term $\sum_{j=0}^{q} \varphi_{ij} x_{i,t-j}$ shows the average impact. Finally, ε_{it} represents the error term that captures unpredictable disturbances for cross-section i and time t.

Results and Discussion

Table 1 shows the statistics for each variable used in the estimation process. Variables including the natural log of unemployment (lnUNEMPT) and natural log of population density (lnPOPDEN) have mean larger than their standard deviation, which indicates that all these variables are under-dispersed (mean is greater than dispersion). Some variables including the natural log of Carbon Emissions (ln CO_2PC), natural log of total natural resource rent (lnTNR) and natural log of Regulatory Quality, have means smaller than their standard deviation, which means that these variables are over-dispersed (meaning that dispersion is greater than mean). Mean is used for comparison among groups, time-periods and regions, mean also helps in interpreting, whereas standard deviation is used to measure how values are spread out from mean value. The mean of lnCO2pc is 1.2641, the mean of lnunempt is 1.2989, and the mean of lnpopden is significantly greater at 4.8075.

Table 1: Descriptive Statistics

Variables	Mean	Standard Deviation	Skewness	Kurtosis	Sample Size
LNCO2PC	1.2641	1.5280	-0.4181	2.4521	1155
LNUNEMPT	1.2989	0.9883	-0.7767	3.5076	1155
LNTNR	0.7189	2.6862	-1.1994	4.1817	1155
RQ	-0.0305	0.7588	0.1886	3.8199	1155
LNPOPDEN	4.8075	1.4663	0.1230	3.6106	1155

Table 2: VIF Matrix

Variables	LNUNEMPT	LNTNR	RQ	LNPOPDEN
LNUNEMPT	-			
LNTNR	1.0626	-		
RQ	1.0003	1.0928	-	
LNPOPDEN	1.0143	1.5482	1.0893	-

Table 2 presents the results of VIF. For calculating the degree of inter-connection between variables, Variance Inflation Factor is used. All the VIF values of given variables ranges from (1.0003 to 1.5482), which are less than 10 suggesting that each variable is not highly connected with each other. Specifically, the VIF values of lnunempt with other variables such as lntnr (log of total natural resource rent), RQ and lnpopden (log of population density) are (1.0626), (1.0003) and (1.0143) respectively, which are less than 10 confirming the absence of multicollinearity. The VIF values of lntnr with other variables such as lnunempt (log of unemployment), RQ and lnpopden (log of population density) are (1.0626), (1.0929) and (1.5482) which are less than 10 eliminating the presence of multi-collinearity. The VIF values of RQ with lnunempt (1.0003), lntnr (1.0928) and lnpopden (1.0893) are less than 10, confirming the absence of multi-collinearity. The Variance Inflation factor in-terms of connection between lnpopden with lnunempt (1.0143), lntnr (1.5482) and RQ (1.0893) are less than 10 which eliminates the chances of presence of multi-collinearity between variables.

Table 3 shows the unit root test conducted at two different specifications: at level and at 1st difference. The unit root test is used to determine if a data series is non-stationary and has a unit root. To test whether variable is non-stationary or stationary, Cross-section Augmented Dickey-Fuller test (CADF) and CIPS which is the extension of Im-Pesaran-Shin (IPS) test and both tests are used for panel unit root testing. Upon testing CADF and CIPS, table 3 at level specification shows that variables such as carbon emissions, unemployment, and population density are non-stationary while rent from natural resources and quality of regulation are stationary data series. All these data series turn to be stationary at first difference. The results suggest that panel series consider in this research has mixed order of integration.

Table 3: Unit Root Test:

At level				At 1st Difference			
Variables	CIPS*	CADF	p-value	Variables	CIPS*	CADF	p-value
lnCO2pc	-1.9450	-1.8300	0.3580	ΔlnCO2pc	-4.9240	-4.9600	0.0000
Lnunempt	-1.5840	-1.5050	0.9470	Δlnunempt	-5.2140	-5.2170	0.0000
Lntnr	-2.3070	-2.1560	0.0090	Δlntnr	-5.5530	-5.4270	0.0000
RQ	-2.7810	-2.8950	0.0000	ΔRQ	-6.0850	-6.0850	0.0000
Lnpopden	-1.8730	-1.8730	0.2640	Δlnpopden	-2.5510	-3.3220	0.0000
At 01, 05, 10 level of significance, critical values are -2.2300, -2.1100, -2.0500 respectively							

Besides this, cross-sectional dependence is investigated by conducting two types of tests i.e., Pesaran (2015, 2021) also known as CD test and CDw+ (CDw with power enhancement from Fan et al. (2015). All variables including ln CO_2PC, lnunempt, RQ, lntnr and lnpopden exhibit statistically significant probability values in case of both tests. This confirms that CSD does exist in the panel data series taken in this research. The results are presented in the table 4.

Table 4: Testing for Cross-Sectional Dependence

Variables	CD	p-value	CDw+	p-value
lnCO2pc	23.7100	0.0000	1599.7100	0.0000
Lnunempt	10.0100	0.0000	1157.0400	0.0000
Lntnr	34.6100	0.0000	1326.7000	0.0000
RQ	2.1700	0.0300	1078.8200	0.0000
Lnpopden	84.2500	0.0000	2828.0300	0.0000

P-value are in parenthesis

In order to test weak cross-sectional dependence, two types of tests are conducted i.e., Pesaran (2015, 2021) also known as CD test and CDw+ (CDw with power enhancement from Fan et al. (2015). All variables including ln CO_2pc (0), lnunempt (0), RQ, lntnr (0) and lnpopden (0) exhibit statisitically significant CSD based on values derived from CD tests. But RQ shows relatively low and negative value (-0.03) which indicates that weak cross-sectional dependence. The findings of CDw+ indicate that all the variables exhibit p-values less than 0.05, which indicates the existence of cross-sectional dependence. The values of CD and CDw+ are given in above table 4.

Table 5: Slope Heterogeneity test

Statistics	Model
Δ (P. Values)	44.6120 (0.0000)
Δadjusted (P. Values)	49.0100 (0.0000)

Table 5 shows slope heterogeneity test of model i.e., lnCO_2pc. The findings of the test indicates that the statistics of Δ (44.6120) while adjusted Δ (49.0100) for model are positive, high and significant probability values. This confirms that slopes of this model are heterogeneous. Based on these findings, we will proceed with cross-sectional auto regressive distributed lag model to estimate long and short run coefficients. Table 6 shows the cointegration test of model 1 and model 2. Keeping in view the z-value of Gt, Ga, Pt and Pa, cointegration exists or not can be determined. In given model, the statistics of Gt (-0.818) and Pt (2.686) tests are insignificant which confirms absence of cointegration while Ga (-1.759) and Pa (-10.259) statistics are significant which confirm that cointegration exists between carbon emissions and its determining indicators.

Table 6: Westerlund's Cointegration Test:

Test Statistics	Model (lnCO_2pc)	
	z-value	P. Value
Gt	-0.8180	0.207
Ga	-1.7590	0.0393
Pt	2.6860	0.996
Pa	-10.2590	0.000

Table 7: Long run Estimates of Model lnCO_2pc.

Dependent Variable: lnCO2pc					
Variables		Coefficient	Std. Error	z-value	Prob.
lr_lnpopden		-0.3040	0.8641	-0.3500	0.7250
lr_lntnr		0.0680	0.0233	2.9100	0.0040
lr_lnunempt		-0.1318	0.0686	-1.9200	0.0550
RQ		0.0940	0.0420	2.2500	0.0240
Diagnostics					
R-Square	0.2900	CD Statistic	-1.0800	P-Value	0.2780
R-Square (MG)	0.9600		Root MSE	0.0600	

In table 7, the coefficients of explanatory variables for environmental quality are reported. The coefficient of lnunempt (-0.1318) indicates that significant inverse relation exists between lnCO2pc and lnunempt. It means that increase in unemployment by 1% can decrease the carbon dioxide emissions per capita by (0.1318%) and vice versa. Higher unemployment means that economic activity is slow leading to lower production in industries and reduced energy demand. Slower economic activity and lower industrial production can lead towards less usage of fossil fuel and decline of emissions. The decline in consumption of fossil fuels and emissions were experienced by whole World during financial crisis and COVID-19 lockdowns. The Inverse relation between CO2 emissions and unemployment is supported by Environmental Kuznets Curve, which asserts an inverted U-shape relation between income and pollution. Some interpretations of this curve states that as economies invest in cleaner technologies and modernize, there is increase in employment in green sectors.

Another theory that supported the inverse relation between CO2 emissions and unemployment is Green Growth theory, which states that environmental protection and economic growth go hand in hand. This theory suggests that investment in greener technologies and renewable energy can create new job opportunities. The coefficient of regulatory quality (0.0944), indicating that regulatory quality has positive relation with CO2 emissions. These findings show that better regulations & policies can increase CO2 emissions whereas worse regulations can decrease CO2 emissions. The positive relation between CO2 emissions and regulatory quality is backed by these two theories i.e., Regulatory Capture theory and Environmental Federalism theory. The regulatory capture theory states that regulations are biased in favour of corporate interests and industries, regulators being captured by the very same businesses they are meant to oversee. The Environmental Federalism theory suggests that at local level of government, decentralized regulations may result in uneven and inadequate enforcement. The coefficient of total natural resource rent indicates positive relation with CO2 emissions. During the expansion of fossil fuels extraction, natural resource rents become higher due to increased production and exports of fossils. Natural resource such as oil, coal and gas extraction generate higher resource rents which ultimately boosts the extraction of fossil fuels and consumption. The enhanced extraction and consumption of fossils tends to increase CO2 emissions. The Resource research theory recommends that countries having rich natural resources experience higher levels of corruption, weaker institutions and low economic growth. This can lead to deterioration of environment due to weaker regulations and high levels of corruption of government officials. The coefficient of population density (-0.3036609) indicates insignificant inverse relation between CO2 emissions and population density.

Boserup's Theory of Population and Technological Change suggests that increased population density could lead to technical advancements and more effective use of resources and land. Environmental impact may be compensated in highly populated places by the adoption of sustainable urban designs, green technology and efficient agriculture production. Therefore, population density does not lead to deterioration of environment. The value of R-squared is 0.29, which means that about 29% of the variation in CO2 emissions is explained by the explanatory variables. The R-squared (Mean Group) value is 0.96, which means that model fits very successfully and well across individual cross-sections. The cross-section dependency statistic has a value of (-1.08), indicating that there is no substantial cross-sectional reliance, implying that shocks in one unit have no meaningful effect on other units. The value of Root MSE is (0.06) indicating low residual error, supporting the accuracy of model.

Table 8: Short-Run Estimates of Model lnCO2pc

Dependent Variable: dlnCO2 pc				
Variables	Coefficient	Std. Error	z-value	Prob.
dL2.lnCO2pc	0.4213	0.0350	12.0400	0.0000
dlnunempt	-0.0562	0.0261	-2.1500	0.0320
dRQ	0.0438	0.0235	1.8700	0.0620
dlntnr	0.0270	0.0134	2.0200	0.0430
dlnpopden	0.0931	0.4240	0.2200	0.8260
ecm(t-1)	-0.5787	0.0350	-16.5400	0.0000

Table 8 shows the short-run estimation for model 2. L2.lnCO2pc refers to the value of lnCO2pc two periods ago. The coefficient of L2.lnCO2pc (0.4212773) indicates positive relation between lnCO2pc and lagged lnCO2pc in the short run. Holding other things constant, 1% increase in lagged CO2pc tends to increase current CO2 emissions per capita. CO2 emissions are persistent over time as suggested by the positive coefficient. The coefficient of lnunempt (-0.0561668) indicates that unemployment has negative impact on CO2 emissions in the short run. It means that 1% increase in unemployment can decrease the CO2 emissions by 0.0562%.
The coefficient of RQ (0.0438092) represents the positive relation between CO2 emissions and regulatory quality. Better regulatory quality can help to increase CO2 emissions, due to better regulations industries and business are working efficiently without any difficulties or insecurity. The coefficient of total natural resource rent (0.0270) indicates a positive relation with CO2 emissions, meaning that 1% increase in lntnr will increase the CO2 emissions by 0.0270% and vice versa. The coefficient of population density (lnpopden) (0.0931) indicates that insignificant positive relation exists between CO2 emissions and population density. Lastly, the error correction term is negative and significant, which indicates that 57.87% of the deviation from long-run equilibrium is corrected within single period, exhibiting strong and rapid adjustment dynamics. About 57.87% is the speed of adjustment, indicating that CO2 emissions rapidly connect back to its long-run path after shock.

Conclusion

The present research conducts a comparative inquiry into environmental Phillips curve framework in selected Asian Economies. After using Cross-Sectionally Augmented Autoregressive Distributed Lag (CS-ARDL) method over the period from 1990 to 2024, this study confirms the evidence of Environmental Phillips curve. Empirical results further disclose that natural resources rent significantly escalate carbon emissions while regulatory quality is increasing carbon emissions. More earnings through natural resources rent can lead to escalate aggregate demand and may trigger prices on the one side and on the other side it may allow masses to increase use of nonrenewable items which may elevate carbon emissions. The quality of regulations may boost the confidence of investors via which they may increase production. Due to increase in aggregate supply, prices may come down while increase in production may increase carbon emissions due to the reason that produces may utilize fossil fuel related inputs during production process. The findings further expose that population density has insignificant impact on carbon emissions in his study.

Policy Implications

This study identifies the trade-off between environmental deterioration and unemployment. By considering the inverse relationship between CO_2 emissions and unemployment, the study suggests that policy makers and government may put focus on investing in green technology and sustainable environmental practices. The study proposes that government may follow steps that may reduce natural rate of unemployment by giving jobs in sectors that are environment friendly. Investments in spreading awareness regarding consumption and production of green products or environment friendly goods may be encouraged. This will help in avoiding usage of plastic bags, bottles etc. The steps may be taken to work and invest in green technology, to reduce unemployment by keeping environmental degradation as low as possible. The findings of this study suggest that earning through natural resources may lead to degrade environment in selected Asian Economies. Therefore, steps may be taken that may increase the earnings from natural resources in a greater proportion as compared to increase in carbon emissions. Another finding of this research is that due to expansion in quality of regulations environmental degradation is expanding. It is also proposed that steps may be taken to establish strong accountability in public administration to guarantee better regulatory rules and regulations. Besides this, for targeting environmental degradation, steps including creating clear and scientifically grounded emission regulations and carbon pricing schemes may help in giving companies dependable and long-term signals to transform themselves from nonrenewable to clean energy. Clarity in regulations help in giving confidence to businesses to invest in technologies that possess low carbon, which eventually helps in lowering CO_2 emissions.

Reference

- Addison, R., Akutcha, E., & Debrah, G. (2024). Does the environmental Phillips curve hypothesis hold within the Ghanaian context? *Scientific African*, *26*, e02400.
- Alharthi, M., Hassan, M. S., Huang, J., Mahmood, H., & Arshad, H. (2025, May). Institutional quality and environmental sustainability nexus: fresh evidence of most polluted countries in a CS–ARDL framework. In *Natural Resources Forum* (Vol. 49, No. 2, pp. 2048-2066). Oxford, UK: Blackwell Publishing Ltd.
- Anser, M. 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. *Environmental Science and Pollution Research*, *28*(35), 48112-48122.
- Azimi, M. N., & Rahman, M. M. (2024). Examining the environmental Phillips curve hypothesis in G7 nations: critical insights from wavelet coherence and wavelet causality analysis. *Quality & Quantity*, *58*(6), 5683-5713.
- Bhowmik, R., Syed, Q. R., Apergis, N., Alola, A. A., & Gai, Z. (2022). 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*, *29*(10), 14914-14928.
- Boserup, E. (1965). *The conditions of agricultural growth: The economics of agrarian change under population pressure*. Aldine Publishing Company.
- Bovenberg, A. L., & De Mooij, R. A. (1994). Environmental levies and distortionary taxation. *The American Economic Review*, *84*(4), 1085-1089.
- Bowen, A., & Stern, N. (2010). Environmental policy and the economic downturn. Oxford *Review of Economic Policy*, 26(2), 137–163.

- Bowen, A., & Stern, N. (2024). *Managing the green transition in labor markets*. Climate Policy Institute.
- Chudik, A., & Pesaran, M. H. (2016). Theory and practice of GVAR modelling. *Journal of Economic Surveys*, *30*(1), 165-197.
- Clarida, R., Gali, J., & Gertler, M. (1999). The science of monetary policy: a new Keynesian perspective. *Journal of economic literature*, *37*(4), 1661-1707.
- Cole, M. A. (2004). Trade, the pollution haven hypothesis and the environmental Kuznets curve: examining the linkages. *Ecological economics*, *48*(1), 71-81.
- Daştan, M., & Eygü, H. (2024). An empirical investigation of the link between economic growth, unemployment, and ecological footprint in Turkey: Bridging the EKC and EPC hypotheses. *Environment, Development and Sustainability*, *26*(7), 18957-18988
- Hacıimamoğlu, T. (2023). A new approach to sustainable development: Analysis of the environmental Phillips curve hypothesis. *Sosyoekonomi*, *31*(56), 11-25.
- Hasan, Z., Sari, D. W., Azzahra Tarbiyah Islamiya, H., & Masnan, F. Unraveling the Environmental Phillips Curve in ASEAN: The Impact of Unemployment and Green Technology on Carbon Emissions. *Available at SSRN 5213053*.
- Heijdra, B. J., & Heijnen, P. (2013). Environmental abatement and the macroeconomy in the presence of ecological thresholds. *Environmental and Resource Economics*, *55*(1), 47-70.
- Kao, C., Chiang, M. H., & Chen, B. (1999). International R&D spillovers: an application of estimation and inference in panel cointegration. *Oxford Bulletin of Economics and statistics*, *61*(S1), 691-709.
- Jahanger, A., Usman, M., & Balsalobre-Lorente, D. (2022). Linking institutional quality to environmental sustainability. *Sustainable Development*, *30*(6), 1749-1765.
- Kashem, M. A., & Rahman, M. M. (2020). Environmental Phillips curve: OECD and asian NICs perspective. *Environmental Science and Pollution Research*, *27*(25), 31153-31170.
- Kinnunen, J., Georgescu, I., & Nica, I. (2024). Evaluating the environmental Phillips Curve hypothesis in the STIRPAT framework for Finland. Sustainability, 16(11), 4381.
- Larsson, T. B. (2001). Biodiversity evaluation tools for European forests. *Criteria and indicators for sustainable forest management at the forest management unit level*, *75*, 952-9844.
- Matyakubov, U., Ibadullaev, E., Rajabov, A., Nurjonov, J., & Matkarimov, F. (2025). The relationship between Central Asia's CO_2 emissions, unemployment rate, and economic development: ARDL-PANEL approach. Advances in Nonlinear Variational Inequalities, 28(6s), 1–9.
- Nguyen, H. T., Ponta, L., & Fanti, L. (2024). Inflationary impacts of green fiscal spending: A macroeconomic assessment. *Journal of Environmental Economics*, 31(2), 110–128.
- Nordhaus, W. (2008). *A question of balance: Weighing the options on global warming policies*. Yale University Press.
- Pedroni, P. (2001). Fully modified OLS for heterogeneous cointegrated panels.
- Pedroni, P. (2004). Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric theory, 20(3), 597-625.*
- 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.*

- Pesaran, M. H. (2015). Testing weak cross-sectional dependence in large panels. *Econometric reviews, 34(6-10), 1089-1117.*
- Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of econometrics, 142(1), 50-93.*
- Phillips, A. W. (1958). The relationship between unemployment and the rate of change of money wages in the United Kingdom 1861-1957. *economica, 25(100), 283-299.*
- Tufail, M., Song, L., Umut, A., Ismailova, N., & Kuldasheva, Z. (2022). Does financial inclusion promote a green economic system? Evaluating the role of energy efficiency. *Economic research-Ekonomska istraživanja*, *35*(1), 6780-6800.
- Westerlund, J. (2007). Testing for error correction in panel data. Oxford Bulletin of Economics and statistics, 69(6), 709-748.
- Westerlund, J., & Edgerton, D. L. (2007). A panel bootstrap cointegration test. Economics letters, 97(3), 185-190.
- World Bank. (2025). World Development Indicators. *International Economics Department. Development Data Group, World Bank.*
- Zhou, Z. Z., Hassan, M. S., Saeed, M. I., Mahmood, H., Kalim, R., & Houaneb, A. (2025). From pollution to sustainable environment: unlocking the role of energy intensity and renewable energy in highly pollutant nations. *Environmental Research Communications*, *7*(2), 025004.

Annexure: List of Selected Asian Economies

SR. #	Country	Unemployment	SR. #	Country	Unemployment
1	Armenia	12.9224	18	Lebanon	9.0072
2	Azerbaijan	6.5188	19	Malaysia	3.4420
3	Bahrain	1.1444	20	Myanmar	1.0878
4	Bangladesh	3.8253	21	Nepal	10.7137
5	Brunei Darussalam	6.0401	22	Oman	3.7464
6	Cambodia	0.6535	23	Pakistan	1.9993
7	China	4.0694	24	Philippines	3.3571
8	Georgia	13.0759	25	Qatar	0.5402
9	India	7.2932	26	Russian Federation	6.9246
10	Indonesia	5.0121	27	Saudi Arabia	5.7204
11	Iran, Islamic Rep.	10.9843	28	Singapore	3.9629
12	Japan	3.6540	29	Sri Lanka	7.3234
13	Jordon	15.4341	30	Thailand	1.2787
14	Kazakhstan	6.9471	31	Türkiye	9.8064
15	Korea, Rep.	3.3243	32	United Arab Emirates	2.4051
16	Kuwait	1.6358	33	Viet Nam	1.8869
17	Kyrgyz Republic	2.6343			