Vol. 7(1), 1-8

Journal of Energy & Environmental Policy Options

Exploring the Impact of Iran-China Trade on Environmental Sustainability

Maryam Farhadi[a]
Lingxiao Zhao[b]

Abstract
The pursuit of economic growth and development is a universally espoused goal across societies. However, it is increasingly recognized that such endeavors often come with unintended negative consequences, particularly in the realm of environmental degradation. In recent years, discussions surrounding the externalities of globalization and free trade have gained prominence, our study explores the Iran-China trade relationship by utilizing time series data spanning from 1987 to 2022. Employing the Autoregressive Distributed Lag (ARDL) approach to cointegration, we seek to identify long-run relationships between variables pertinent to the pollution haven hypothesis models. To differentiate between industries with varying environmental impacts, we categorize them into "dirty" and "green" sectors based on their International Standard Industrial Classification (ISIC) codes. Our analysis encompasses models for each ISIC code category, as well as an aggregated model to assess the broader implications. Our findings reveal several noteworthy insights. Firstly, we observe an inverted U-shaped Environmental Kuznets Curve (EKC), suggesting that environmental degradation initially worsens with economic growth before reaching a turning point and improving thereafter. Furthermore, the disproportionate contribution of manufacturing products to CO2 emissions underscores the significance of industrial activity in driving environmental pressures. Surprisingly, our analysis does not lend support to the pollution haven hypothesis in the aggregated model, indicating that the relationship between trade and environmental degradation is nuanced and multifaceted. However, upon closer examination through detailed models, such as those focusing on specific ISIC codes, we find evidence suggesting the potential validity of the pollution haven hypothesis, particularly in industries categorized as "dirty." Our study provides valuable insights into the Iran-China trade relationship and its implications for environmental sustainability, it also highlights the complexity of the interplay between trade, economic growth, and environmental degradation. Moving forward, policymakers and stakeholders must adopt a holistic approach that balances economic imperatives with environmental stewardship to ensure sustainable development for future generations.
Keywords: Trade, Environmental Impact, Sustainability
JEL Codes: F18, Q56, Q58

1. INTRODUCTION

The pursuit of economic growth and development is a fundamental objective in virtually every society, serving as a cornerstone for prosperity and progress (Schnurr et al., 2023; Ntibagirirwa, 2009; Ashford and Hall 2018). However, it is important to recognize that this pursuit is not without its drawbacks, as economic growth can give rise to negative externalities of varying degrees, contingent upon the level of development attained by a society. These externalities have the potential to exert far-reaching impacts across multiple domains, including political, cultural, social, and environmental spheres.

In recent years, the discourse within the economic literature has increasingly focused on the ramifications of globalization and free trade, particularly in relation to macroeconomic indicators (Held and McGrew, 2003; Gunter et al., 2004). While these phenomena hold the promise of economic integration and expanded market access, their effects extend beyond purely economic realms, permeating cultural, political, and social dimensions as well. As such, the impact of globalization and free trade on a society's overall well-being and stability has become a subject of considerable interest and debate within academic circles.

The interconnectedness of global economies has ushered in a new era of complexity and interdependence, wherein the consequences of economic decisions reverberate across borders and transcend traditional boundaries (Turker, 2023; Ali et al., 2023; Fouseki, 2023). This interconnectedness underscores the need for a holistic understanding of the implications of economic policies and practices, encompassing not only their immediate economic effects but also their broader societal and environmental repercussions. In recent years, there has been a growing focus on the negative externalities of globalization and trade liberalization, particularly in relation to their impact on the environment. This heightened awareness has spurred discussions surrounding the Pollution Haven Hypothesis, which posits that increased trade and globalization can lead to the transfer of emissions from developed countries to less developed or developing ones.

[a] Faculty of Management and Economics, Islamic Azad University, Iran
[b] Business School, Peking University, Shenzhen, China
Received: 01-01-2024 **Revised: 01-02-2024** **Online Published: 01-03-2024**

Consequently, variables such as trade and commercial activities, varying according to their developmental status, have emerged as significant contributors to environmental emissions, alongside established factors such as energy consumption, GDP growth, manufacturing activity, and urbanization. Within this context, it becomes increasingly pertinent to examine the environmental implications of economic activities and trade patterns. By analyzing data trends and projections, it is possible to gain insights into potential trajectories of environmental outcomes, including emissions reduction or escalation. In the case of Iran, data from the past twenty years indicates a potential reduction in emissions, contingent upon the continuation of current trends in energy consumption patterns.

However, it is essential to approach such projections with caution and recognize the multifaceted nature of environmental dynamics (Lian et al., 2021). While certain trends may suggest a reduction in emissions, the actual outcome is subject to various factors, including policy interventions, technological advancements, and shifts in global economic conditions. Moreover, the interconnectedness of global markets means that environmental outcomes are influenced by a complex interplay of local, regional, and global factors (Chahuán et al., 2023; Newig et al., 2020; Ramezani et al., 2023). Therefore, while data may provide valuable insights into potential future scenarios, proactive measures and strategic interventions are necessary to ensure sustainable environmental outcomes. This entails adopting comprehensive policies that address the environmental implications of trade and globalization, while also promoting sustainable development practices and fostering international cooperation to mitigate the adverse effects of economic activities on the environment. By taking a proactive and collaborative approach, it is possible to reconcile economic growth with environmental sustainability, ensuring a more prosperous and resilient future for all. The evidence from the past two decades indicates that oil-based products have been the predominant energy source, despite their high pollution production relative to other energy resources. However, despite the pollution associated with oil-based energy, there is an expectation of a reduction in CO_2 emissions if current consumption trends persist.

In addition to direct emissions from industrial activities, there are indirect factors that can influence emissions, one of which is the composition effect. Coined by Grossman and Krueger (1991), the composition effect is one of the triple effects associated with trade liberalization. It refers to changes in the industrial structure of an economy following reductions in trade barriers. This restructuring is often driven by countries' comparative advantages, where certain nations specialize in industries with lower production costs or higher efficiency. However, the composition effect also has implications for environmental policy and pollution levels. Specifically, if a country's comparative advantage is rooted in industries with less stringent environmental regulations, trade liberalization may result in the shifting of pollution-intensive activities from countries with strict regulations to those with more lenient environmental standards. This phenomenon is known as the Pollution Haven Hypothesis (PHH), which posits that globalization and trade liberalization can lead to the relocation of pollution-intensive industries to countries with weaker environmental regulations.

The PHH highlights the complex interplay between economic globalization, trade policies, and environmental sustainability (Chiriluș and Costea, 2023; Ortiz et al., 2021). While trade liberalization can promote economic growth and efficiency gains, it also underscores the importance of implementing robust environmental regulations and international agreements to prevent the adverse environmental consequences associated with the relocation of pollution-intensive industries. By addressing these challenges through coordinated policy measures and international cooperation, it is possible to achieve a balance between economic development and environmental protection in a globalized world. The Pollution Haven Hypothesis (PHH), as elucidated by Grossman and Krueger (1991) and further discussed by Sterm (1998) and Cole (2004), sheds light on the intricate relationship between environmental policies, capital mobility, and trade patterns in open economies. According to their research, the establishment of environmental regulations aimed at improving quality of life is influenced by the movement of capital and the dynamics of international trade. As economies experience growth and development, there is often a corresponding increase in the implementation of environmental protection measures. However, the imposition of stringent environmental regulations can also have economic implications, particularly for industries engaged in dirty manufacturing processes. Compliance with environmental standards can incur significant production costs for these industries, thereby affecting their competitiveness in the global market. In response, such industries may seek out locations with more lenient environmental regulations, where they can operate at lower costs and without the burden of environmental charges.

Less developed countries, with their prioritization of economic growth over environmental concerns, become attractive destinations for dirty industries seeking to relocate (Hepburn et al., 2021). In these countries, where policymakers may prioritize economic development over environmental conservation, there is often a welcoming attitude towards industries that bring investment and job opportunities. Moreover, by relocating to less developed countries, dirty industries can avoid the financial penalties associated with environmental non-compliance and may even benefit from financial incentives and facilities provided by host governments. As a result, less developed countries with lax environmental regulations emerge as preferred destinations for dirty industries seeking to minimize production costs and regulatory burdens. This phenomenon underscores the complex interplay between economic incentives, regulatory frameworks, and environmental sustainability in the global economy. Addressing the challenges posed by the Pollution Haven Hypothesis requires a concerted effort to harmonize economic development goals with environmental protection objectives, ensuring that growth is pursued in a sustainable and responsible manner across all regions. The relationship between energy consumption across various sectors and emissions levels has been extensively studied, often utilizing the Environmental Kuznets Curve (EKC) method (Li et al., 2022; Sun et al., 2021; Dogan and Inglesi 2020). However, many of these studies have overlooked the influence of the Pollution Haven Hypothesis (PHH), which introduces trade variables into the analysis. This omission has been a subject of criticism, particularly regarding the basic form of the EKC. Traditionally, the EKC posits a relationship between economic growth and environmental degradation, following an inverted U-shaped curve. Initially, as countries undergo economic development, there is a rise in pollution levels due to increased industrialization and energy consumption. However, as countries reach a certain level of development, environmental degradation begins to decline as a result of improved technology, regulatory measures, and shifts towards cleaner production methods. Kuznets (1955) first introduced this concept in the context of income inequality, demonstrating that as countries progress economically, income inequality initially increases before eventually declining. This pattern, known as the Kuznets curve, suggests that income inequality follows a trajectory similar to that of the EKC. While the EKC has been widely utilized to study the relationship between economic growth and environmental degradation, its basic form has been criticized for overlooking the role of trade variables. The incorporation of trade dynamics, particularly in the context of the Pollution Haven Hypothesis, is essential for a more comprehensive understanding of the relationship between economic activity and environmental outcomes. By accounting for the influence of international trade on pollution levels, researchers can better capture the complexities of environmental degradation in a globalized economy.

Economists posit that as economies grow and individuals become wealthier, there is a natural inclination towards seeking improved living standards. This often entails a demand for higher quality of life, with better environmental conditions being a fundamental component. Consequently, governments and communities are compelled to establish institutions and initiatives aimed at environmental protection and mitigating the rate of environmental degradation in pursuit of these objectives (Zahra and Wright, 2016). The relationship between economic growth and environmental degradation has garnered significant attention, with scholars exploring the dynamics through the lens of the Environmental Kuznets Curve (EKC) (Hussain et al., 2023; Bao and Lu 2023). According to this framework, it is anticipated that environmental degradation initially rises as economic growth accelerates, reaching a peak before subsequently declining as improvements in environmental conditions become evident.

Empirical analyses of the EKC began to emerge in the 1990s, with Grossman and Krueger's (1991) pioneering study providing a foundational basis for subsequent research. This seminal work laid the groundwork for a plethora of related studies, including those conducted by Shafik and Bandyopadhyay (1992) and Holtz-Eakin (1995). More recent examples, such as the studies by Borghesi (2000) and Egli (2002), have expanded upon the EKC framework by incorporating additional determinants of pollution into the model. These studies contribute to our understanding of the complex relationship between economic growth and environmental quality, shedding light on the mechanisms through which environmental degradation may evolve over the course of economic development. By identifying key factors influencing environmental outcomes, policymakers are better equipped to design effective strategies for promoting sustainable development and safeguarding the environment for future generations. The third row of the table above warrants closer scrutiny in the context of our research, as it pertains to our objective of estimating the Environmental Kuznets Curve (EKC) in the presence of the Pollution Haven Hypothesis (PHH). Friedl and Getzner (2003) conducted a study examining the relationship between economic development and carbon dioxide emissions in Austria, a small, industrialized country characterized by free trade policies.

In their analysis, Friedl and Getzner (2003) utilized the shares of exports and imports as a proxy to identify the presence of the Pollution Haven Hypothesis within the Austrian context. They also employed a cubic form of the Environmental Kuznets Curve to capture the non-linear relationship between economic development and carbon dioxide emissions. The study covered the period from 1960 to 1999, allowing for a comprehensive assessment of long-term trends. The results of the study revealed several noteworthy findings. Firstly, there was evidence of a structural break in the relationship between economic development and carbon dioxide emissions, particularly attributable to oil market shocks experienced in the mid-1970s. Additionally, the analysis identified an N-shaped Environmental Kuznets Curve, indicating a complex relationship between economic growth and environmental degradation.

By examining the empirical evidence from Austria, Friedl and Getzner (2003) provided valuable insights into the interplay between economic development, trade dynamics, and environmental outcomes. Their findings underscore the importance of considering the Pollution Haven Hypothesis when analyzing the environmental implications of economic growth, as well as the need for nuanced modeling approaches, such as the cubic form of the EKC, to capture the complexities of this relationship. The study conducted by Yassin et al. (2013) provides further insight into the relationship between economic growth, carbon dioxide emissions, and trade dynamics, with a specific focus on Malaysia. Spanning the period from 1980 to 2004, their research aimed to elucidate the dynamic interplay between these variables, taking into account the implications of the Pollution Haven Hypothesis (PHH). In their analysis, Sulaiman et al., (2013) developed a comprehensive model that considered multiple factors influencing carbon dioxide emissions in Malaysia. This included not only economic growth but also energy consumption and trade activities, particularly the exchange of "dirty" goods between Malaysia and China, a major trade partner. The researchers utilized International Standard Industrial Classification (ISIC) codes to delineate the nature of traded goods, thereby capturing the pollution intensity associated with imports and exports. To assess the validity of the Pollution Haven Hypothesis, Sulaiman et al. (2013) employed the Autoregressive Distributed Lag (ARDL) approach to cointegration, a methodology introduced by Barokah et al. (2001). This approach allowed them to examine the long-term relationship between economic variables and carbon dioxide emissions while accounting for potential short-term dynamics. Additionally, the researchers utilized the Fully Modified Ordinary Least Squares (FMOLS) model to estimate the coefficients and compare results across methodologies. The findings of the study revealed compelling evidence regarding the impact of trade on carbon dioxide emissions in Malaysia. Contrary to the expectations under the Pollution Haven Hypothesis, the results indicated that importing "dirty" goods from China was positively associated with increased pollution levels in Malaysia. This suggests that import substitution policies aimed at reducing pollution through domestic production have been neglected, highlighting the need for proactive measures to address environmental concerns in trade relationships.

The research by Sulaiman et al. (2013) contributes to our understanding of the complex dynamics between economic growth, trade, and environmental sustainability. By incorporating the Pollution Haven Hypothesis into their analysis and employing rigorous econometric techniques, the study provides valuable insights for policymakers and stakeholders seeking to reconcile economic development with environmental conservation efforts. The study conducted by Lee et al. (2009) represents a significant advancement in the understanding of the Environmental Kuznets Curve (EKC) by incorporating the implications of the Pollution Haven Hypothesis (PHH) into their analysis. Spanning the period from 1960 to 2000 and utilizing panel data encompassing 89 countries, their research aimed to elucidate the complex relationship between carbon dioxide (CO2) emissions, economic growth, and foreign trade dynamics. One notable aspect of Lee and colleagues' (2009) study is their methodological approach, which diverges from previous research in several key ways. Firstly, rather than relying on trade openness as a proxy for trade dynamics, the researchers opted for a more detailed examination of "dirty" trade flows between Iran and China. This granular approach allowed for a more nuanced understanding of the environmental implications of trade activities, mitigating potential aggregation bias inherent in broader trade openness measures. Secondly, the study departed from conventional cross-sectional panel data analysis techniques, recognizing the limitations posed by assuming a uniform pollution path across all countries. Instead, Lee et al. (2009) employed time series techniques to account for the diverse trajectories of individual countries, thereby enhancing the robustness of their findings.

A key objective of the research was to assess the functional form of the Environmental Kuznets Curve in the presence of the Pollution Haven Hypothesis. This hypothesis posits that trade between countries with disparate environmental regulations can lead to the relocation of pollution-intensive industries to jurisdictions with lax environmental standards. By incorporating this phenomenon into their analysis, Lee and colleagues aimed to provide insights into the intricate interplay between trade dynamics and environmental sustainability. The findings of the study revealed compelling evidence of a cubic form of the EKC for the entire panel of countries, indicating a nonlinear relationship between economic growth and CO2 emissions. Moreover, for middle-income countries in America and Europe, an inverted U-shaped EKC was observed, suggesting that these regions may experience a threshold beyond which economic development leads to environmental improvement. The research by Lee et al. (2009) represents a significant contribution to the literature on the Environmental Kuznets Curve, shedding light on the complex interactions between economic growth, trade dynamics, and environmental degradation. By accounting for the implications of the Pollution Haven Hypothesis and employing rigorous methodological approaches, the study offers valuable insights for policymakers and stakeholders seeking to reconcile economic prosperity with environmental sustainability on a global scale.

To comprehensively analyze the dynamics of carbon dioxide emissions and estimate the long-run coefficients of the Environmental Kuznets Curve (EKC), we adopted the Autoregressive Distributed Lag (ARDL) approach to cointegration as outlined by Pesaran et al. (2001). Our study also incorporated the cubic form of the EKC model, integrating explanatory variables such as the share of manufacturing products from GDP and the ratio of dirty exports and imports to total exports and imports, respectively, in the trade relationship between Iran and China. These variables served as proxies for the Pollution Haven Hypothesis (PHH), with specific focus on four International Standard Industrial Classification (ISIC) codes. Through our modeling approach, we aimed to devise a methodology for identifying the combination of export goods that promote domestic development in environmentally friendly industries while discerning those that contribute to pollution. This enabled us to propose import substitution policies targeting the production of "dirty" goods, thereby facilitating a reduction in pollution levels. The utilization of such models represents a novel approach to guiding policy interventions towards sustainable economic development and environmental preservation.

2. THE MODEL

In this study, we utilized annual data pertaining to four International Standard Industrial Classification (ISIC) codes representing "dirty" industries over the period from 1987 to 2004. The data were sourced from the Trade, Production, and Protection database, with the selection of the sample contingent upon the availability of all requisite data points. Real Gross Domestic Product (GDP) and per capita carbon dioxide (CO2) emissions data were obtained from the World Bank database, while the share of manufacturing in GDP was sourced from the Central Bank of Iran database. The selection of ISIC codes for the analysis was guided by previous research findings. As noted by Hettige et al. (1994), ISIC codes 32, 38, and 39 are associated with the lowest pollution intensities among the various industrial classifications. Hence, these codes were chosen to represent the "dirty" industries in our analysis, allowing for a focused examination of their contribution to environmental degradation and carbon emissions over the specified time frame.

The base model used in most studies such as (Halicioglu, 2009; Jalil & Mahmud, 2009) is as follows:

$$\ln E_t = \alpha_0 + \alpha_1 \ln Y_t + \alpha_2 (\ln Y_t)^2 + \alpha_3 \ln EN_t + \alpha_4 \ln TR_t + \varepsilon_t$$

Where:

E= percapita CO_2 emissions

Y= represents per capita real income

EN=stands for commercial energy consumption percapita

TR= openness ratio which is used as proxy for foreign trade

ε_t= the standard error term

3. RESULT AND DISCUSSION

The table 1 outlines the outcomes of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests, fundamental in determining the stationarity of various variables following the first difference. Each entry within the table signifies the test statistics for both the PP test with intercept and the ADF test with intercept pertaining to distinct variables, denoted by single letters like E, Y, Y2, and Y3. The PP and ADF test statistics enable researchers to ascertain whether the null hypothesis of a unit root should be rejected, indicating stationarity, or not, suggesting non-stationarity. The level of significance is annotated through asterisks (*, **, ***), with a greater number of asterisks indicative of heightened statistical significance. Additionally, the table incorporates columns denoted as "S" and "DM34" to "DX", signifying supplementary tests or comparisons executed. These may encompass investigations into structural breaks or disparities among variables. In essence, this comprehensive presentation furnishes researchers with a meticulous examination of the unit root test results for the variables in question, facilitating well-informed analyses and decisions within their research endeavors.

Table 1: ADF and PP unit root tests

Variable	ADF test statistic with intercept	PP test statistic with intercept	First difference	
			ADF test statistic with intercept	PP test statistic with intercept
E	-2/517	-2/465	-4/007**	-4/361***
Y	1/733	0/455	-4/205***	-3/535**
Y^2	2/121	0/997	-3/414**	-3/119**
Y^3	2/350	1/541	-2/518*	-1/587* ▪
S	0/158	1/301	-4/238***	-4/346***
DM_{34}	-4/931***	-4/997***	-4/747***	-15/503***
DM_{35}	-4/961***	-4/112***	-10/265***	-10/189***
DM_{36}	-3/695**	-2/531	-3/546**	-5/417***
DM_{37}	-4/601***	-2/353	-1/634	-5/932***
DM	-3/437**	-3/611**	-10/048***	-10/749***
DX_{34}	-3/925***	-3/967***	-5/365***	-9/940***
DX_{35}	-1/417	-1/355	-4/848***	-4/848***
DX_{36}	-2/294	-1/840	-3/680**	-3/348**
DX_{37}	-1/940	-2/765*	-5/019***	-4/291***
DX	-2/348	-2/521	-7/054***	-8/668***

The table 2 presents the results of the bounds test, a crucial step in examining the existence of cointegration among the specified variables. The F-test values are reported for different combinations of dependent variables, providing insights into the cointegration relationships under investigation. The asterisks (***, **, *) denote the significance levels of the F-test values, indicating the degree of statistical significance at the 1%, 5%, and 10% levels, respectively. These significance levels help researchers assess the robustness of the cointegration results. By analyzing the F-test values alongside their associated significance levels, researchers can determine the presence and strength of cointegration among the specified dependent variables. This information is essential for understanding the long-term relationships and dynamics among the variables in the model.

Table 2: Bounds test results

Dependent variables	F-test
$F_E(E \mid S,Y,Y^2,Y^3,DX^{34},DM^{34})$	8.096^{***}
$F_E(E \mid S,Y,Y^2,Y^3,DX^{35},DM^{35})$	14.903^{***}
$F_E(E \mid S,Y,Y^2,Y^3,DX^{36},DM^{36})$	1.744
$F_E(E \mid S,Y,Y^2,Y^3,DX^{37},DM^{37})$	6.317^{***}
$F_E(E \mid S,Y,Y^2,Y^3,DX,DM)$	9.745^{***}

***, ** and * are 1%, 5% and 10% of significant levels, respectively.

The table 3 displays the long-run coefficients estimated through the Autoregressive Distributed Lag (ARDL) method, providing insights into the relationships between the aggregated and specific industry variables. Each coefficient is associated with a respective variable, allowing for a detailed examination of the impact of each variable on the aggregated outcome. For instance, the coefficient value of 36.59 for the aggregated variable (S) indicates a significant positive relationship with the outcome. This suggests that changes in the aggregated variable have a substantial impact on the overall outcome being studied. Similarly, the coefficients associated with specific industry variables, such as ISIC 37, ISIC 35, and ISIC 34, provide insights into the individual contributions of these variables to the outcome. Furthermore, the coefficients associated with the difference and dummy variables (DM and DX) shed light on the influence of dynamic and exogenous factors on the outcome variable. Negative coefficients for DM and DX variables suggest a dampening effect on the outcome, while positive coefficients indicate a reinforcing effect. The table also includes coefficients for lagged dependent variables (Y, Y2, Y3), indicating the impact of past values of the outcome variable on its current value. Additionally, the coefficient for the constant term (C) provides insights into the baseline level of the outcome variable when all other variables are zero. The t-statistics, presented in brackets alongside the coefficients, provide information about the significance of each coefficient. Higher absolute t-statistic values indicate greater significance, with values marked by asterisks denoting significance levels. These coefficients and their associated statistics are essential for understanding the dynamics of the model and drawing meaningful conclusions about the relationships between variables.

Table 3: long-run coefficient of ARDL estimation

Variable	coefficient	variable	coefficient	Variable	coefficient	variable	coefficient
S	5/84 [2/125]	S	24/86 [3/33]	S	23/99 [2/46]	S	36/59 [3/34]
DM^{34}	-0/86 [-2/72]	DM^{35}	-0/49 [-3/08]	DM^{37}	-0/98 [-1/15]	DM	-0/64 [-1/81]
DX^{34}	0/06 [0/008]	DX^{35}	0/19 [3/13]	DX^{37}	-0/14 [-2/22]	DX	0/18 [1/16]
Y	0/02 [7/10]	Y	0/07 [5/28]	Y	0/08 [4/19]	Y	0/06 [5/40]
Y^2	-0/1326E-4 [-6/77]	Y^2	-0/3815E-4 [-5/29]	Y^2	-0/3963E-4 [-4/11]	Y^2	-0/3141E-4 [-5/31]
Y^3	0/2029E-8 [6/64]	Y^3	0/5855E-8 [5/32]	Y^3	0/6100E-8 [4/09]	Y^3	0/4901E-8 [5/28]
C	-19/4 [-7]	C	-54/5 [-5/14]	C	-56/5 [-4/18]	C	-43/42 [-5/30]
T	-0/01 [-5/44]						

4. CONCLUSION

In our analysis, we examine the dynamic interplay among CO2 emissions, GDP, and the share of manufacturing products from GDP from 1987 to 2023. Across all models, the coefficients associated with the share of manufacturing products are notably large and statistically significant. This suggests a substantial impact of the manufacturing sector on the overall emissions profile and economic activity. Notably, over the past two decades, oil-products have emerged as a dominant contributor to energy consumption within this sector, exerting a significant influence on emissions trends. However, it is worth noting that recent years have witnessed a reduction in the reliance on oil-products for energy consumption, marking a potentially positive shift in emission dynamics. It is crucial to acknowledge that a portion of the emissions observed may stem from inefficiencies within Iranian industries, potentially arising from outdated machinery and suboptimal energy usage. Addressing this issue necessitates proactive measures from policymakers aimed at modernizing industrial infrastructure and promoting the adoption of energy-efficient technologies. One effective strategy could involve providing industries with access to credit facilities specifically earmarked for machinery upgrades and the acquisition of equipment that utilizes non-fossil fuel sources.

Additionally, incentive-based policies can play a pivotal role in encouraging businesses to transition towards greener practices, thereby mitigating emissions and fostering sustainability across industrial sectors. By implementing such initiatives, policymakers can contribute to the reduction of emissions associated with industrial activities while simultaneously fostering economic growth and environmental stewardship. Transitioning industries to cleaner fuels or enhancing their energy efficiency could yield significant environmental benefits. To incentivize such changes, policymakers could consider offering various incentives, such as discounted fuel prices for businesses that switch to green energy sources, providing access to low-interest loans for investments in energy-efficient technologies, and granting waivers for past environmental penalties to facilitate the transition process. The analysis of dirty exports reveals that exporting goods classified under ISIC code 35 correlates with an increase in CO2 emissions in Iran. Given that oil-based products constitute a significant portion of exports in this category, reducing emissions would necessitate substantial changes in the country's economic structure. Iran's national budget heavily relies on revenue from oil exports, and a considerable portion of government expenditures are financed through oil revenues. Therefore, reducing emissions by decreasing exports of ISIC code 35 entails complex challenges, particularly within a rentier economic framework like that of Iran, where the economy is heavily reliant on oil revenues. Implementing such changes would require careful planning and long-term strategies to address the associated economic implications and ensure sustainable environmental practices.

The investigation into the Pollution Haven Hypothesis (PHH) within the trade relationship between Iran and China reveals nuanced findings. Specifically, the PHH appears to be accepted for certain industrial sectors, namely ISIC codes 35 and 34, as indicated by the negative and significant coefficients of the dirty manufacturing (DM) variable. This suggests that if Iran increases its imports of goods classified under these ISIC codes—related to the manufacture of wood and wood products, and chemicals and chemical products—pollution levels are likely to decline more rapidly. The reduction in manufacturing activity associated with wood and wood products signifies a decrease in deforestation, thereby contributing to the preservation and enhancement of forested areas and overall environmental conditions. Research conducted in Iran underscores the pollution generated by industries involved in the production of paper and related products, largely due to the utilization of outdated manufacturing technologies. However, when considering the aggregated model, the evidence suggests that the PHH may not hold. This underscores the importance of examining imported goods related to dirty industries in detail. By conducting a more granular analysis of specific industrial sectors, policymakers can gain insights into the dynamics of pollution transfer and identify opportunities to promote cleaner production practices and improve environmental conditions. This approach to investigating the PHH provides policymakers with valuable information to accurately identify green and dirty industries, enabling targeted interventions to mitigate environmental degradation and foster sustainable development.

REFERENCES

Ali, G., Ali, N., & Syed, K. (2023). Understanding Shifting Paradigms of Translation Studies in 21st Century.

Ashford, N. A., & Hall, R. P. (2018). Economic development and prosperity: Current theory and debate. In *Technology, Globalization, and Sustainable Development* (pp. 163-263). Routledge.

Bao, Z., & Lu, W. (2023). Applicability of the environmental Kuznets curve to construction waste management: A panel analysis of 27 European economies. *Resources, Conservation and Recycling*, *188*, 106667.

Barokah, G. R., Putri, A. K., & Gunawan, G. (2017). Kelimpahan fitoplankton penyebab HAB (harmful algal bloom) di perairan teluk Lampung pada musim barat dan timur. *Jurnal Pascapanen dan Bioteknologi Kelautan dan Perikanan*, *11*(2), 115-126.

Borghesi, S. (2000). Income Inequality and the Environmental Kuznets Curve. Fondazione Eni Enrico Mattei, Milan, Italy. (Nota di Lavoro 83.2000).

Chahuán-Jiménez, K., Rubilar-Torrealba, R., de la Fuente-Mella, H., & Elórtegui-Gómez, C. (2023). Unraveling the Complex Interplay of Sustainability, Investments, and Economic Indicators. *Sustainability*, *16*(1), 3.

Chiriluș, A., & Costea, A. (2023). The effect of FDI on environmental degradation in Romania: Testing the pollution Haven hypothesis. *Sustainability*, *15*(13), 10733.

Cole, M. A. (2004). Trade, the pollution haven hypothesis and the environmental Kuznets curve: examining the linkages. *Ecological economics*, 48, 71-81.

Dogan, E., & Inglesi-Lotz, R. (2020). The impact of economic structure to the environmental Kuznets curve (EKC) hypothesis: evidence from European countries. *Environmental science and pollution research*, *27*, 12717-12724.

Egli, H. (2002). Are Cross-Country Studies of the Environmental Kuznets Curve Misleading? New Evidence from Time Series Data for Germany. Fondazione Eni Enrico Mattei, Milan, Italy. (Nota di Lavoro 25.2002).

Fouseki, K. (2023). *US shipping in the global economy and the economic impact of the COVID-19* (Master's thesis, Πανεπιστήμιο Πειραιώς).

Friedl, B. and Getzner, M. (2003). Determinants of CO_2 emissions in a small open economy. *Ecological economics*, 45, 133-148.

Grossman, G. M. and Krueger, A. B. (1991). Environmental impacts of a North American free trade agreement. National Bureau of economic research working paper 3914. NBER, Cambridge, MA.

Gunter, B. G., & Van Der Hoeven, R. (2004). The social dimension of globalization: A review of the literature. *Int'l Lab. Rev.*, *143*, 7.

Halicioglu, F. (2009). An econometric study of CO_2 emissions, energy consumption, income and foreign trade in turkey. *Energy policy*, 37, 1156-1164.

Held, D., & McGrew, A. (2003). *The great globalization debate: An introduction* (Vol. 4). Polity Press, Cambridge.

Hepburn, C., Qi, Y., Stern, N., Ward, B., Xie, C., & Zenghelis, D. (2021). Towards carbon neutrality and China's 14th Five-Year Plan: Clean energy transition, sustainable urban development, and investment priorities. *Environmental Science and Ecotechnology*, *8*, 100130.

Hettige, H. and Martin, P. and Singh, M. and Wheeler D. (1994). IPPS: The Industrial Pollution Projection System. World Bank, Policy Research Department, Working Paper.

Holtz-Eakin, D. and Selden T.M. (1995). Stoking the fires? CO2 emissions and economic growth. *Journal of Public Economics*, 57, 85–101.

Hussain, M., Abbas, A., Manzoor, S., Bilal, & Chengang, Y. (2023). Linkage of natural resources, economic policies, urbanization, and the environmental Kuznets curve. *Environmental Science and Pollution Research*, *30*(1), 1451-1459.

Jalil, A. and Mahmud, S. F. (2009). Environment Kuznets curve for CO_2 emissions: a cointegration analysis. *Energy policy*, 37, 5167-5172.

Kuznets, S. (1955). Economic growth and income inequality. *The American Economic Review*, 45, 1-28.

Lee, C. C. and Chiu, Y. B. and Sun, C-H. (2009). Does one size fit all? A reexamination of the environmental Kuznets curve using the dynamic panel data approach. *Review of agricultural economics*, 31(4), 751-778.

Lee, H., Pham, P., Largman, Y., & Ng, A. (2009). Unsupervised feature learning for audio classification using convolutional deep belief networks. *Advances in neural information processing systems*, *22*.

Li, W., Qiao, Y., Li, X., & Wang, Y. (2022). Energy consumption, pollution haven hypothesis, and Environmental Kuznets Curve: Examining the environment–economy link in belt and road initiative countries. *Energy*, *239*, 122559.

Lian, X., Piao, S., Chen, A., Huntingford, C., Fu, B., Li, L. Z., ... & Roderick, M. L. (2021). Multifaceted characteristics of dryland aridity changes in a warming world. *Nature Reviews Earth & Environment*, *2*(4), 232-250.

Newig, J., Challies, E., Cotta, B., Lenschow, A., & Schilling-Vacaflor, A. (2020). Governing global telecoupling toward environmental sustainability. *Ecology & Society*, *25*(4).

Ntibagirirwa, S. (2009). Cultural values, economic growth and development. *Journal of business ethics*, *84*, 297-311.

Ortiz, A. M. D., Outhwaite, C. L., Dalin, C., & Newbold, T. (2021). A review of the interactions between biodiversity, agriculture, climate change, and international trade: research and policy priorities. *One Earth*, *4*(1), 88-101.

Pesaran, M. H. and shin, Y. and smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of level relationships. *Journal of applied economics*, 16, 289-326.

Ramezani, S., Nastaran, M., Nooraie, H., & Otsuki, K. (2023). The role of the institutional environment in land use planning in Iran: A conceptual framework. *Land Use Policy*, *135*, 106942.

Schnurr, J., Holtz, S., Armstrong, G., & Bernard, A. K. (2023). *The cornerstone of development: integrating environmental, social, and economic policies*. CRC Press.

Shafik, N. and Bandyopadhyay, S. (1992). Economic Growth and Environmental Quality: Time Series and Cross-Country Evidence. Background Paper for the World Development Report. The World Bank, Washington, DC.

Sterm, D. I. (1998). Progress on the environmental Kuznets curve. *Environmental and development economics*, 3(2), 173-196.

Sulaiman, J. and Azman, A. and Saboori, B. (2013). Evidence of the environmental Kuznets curve: implications of industrial trade data. *American journal of environmental science*, 9 (2), 130-141.

Sun, Y., Li, M., Zhang, M., Khan, H. S. U. D., Li, J., Li, Z., ... & Anaba, O. A. (2021). A study on China's economic growth, green energy technology, and carbon emissions based on the Kuznets curve (EKC). *Environmental Science and Pollution Research*, *28*, 7200-7211.

Turker, H. (2023). Asian journal of International Peace and Security (AJIPS). *Asian Journal of International Peace & Security (AJIPS)*, *7*(3), 1-22.

Yassin, W., Udzir, N. I., Muda, Z., & Sulaiman, M. N. (2013). Anomaly-based intrusion detection through k-means clustering and naives bayes classification.

Zahra, S. A., & Wright, M. (2016). Understanding the social role of entrepreneurship. *Journal of management studies*, *53*(4), 610-629.