GCU Economic Journal, Volume LV (1&2), 2022, pp. 29-48

Impact of Financial Development and Exports on Industrial Pollution in Middle-Income Countries

Areesha Aziz* Hafiz Muhammad Abubakar Siddique**
Sumaira *** & Adiqa Kausar. Kiani****

Abstract: In recent decades, undesirable environmental changes have attracted worldwide attention. This study empirically examines the impacts of financial development and exports on industrial pollution by incorporating the role of energy use, capital, and urban population. The data from 74 Middle-Income Countries (MICs) covers the period from 1990 to 2019. In this study, panel OLS, fixed effect model, random effect model, and generalized method of moments (GMM) is applied. The empirical findings revealed that financial development and exports are the contributing factors to industrial pollution in MICs. This study suggests integrating some guidelines to reduce pollution without compromising economic growth. It is also recommended to reduce the consumption of non-renewable energy resources and to reduce the exports of goods that cause pollution during manufacturing.
Keywords: Industrial Pollution, Exports, Financial development, MICs

1. Introduction

Environmental pollution is harmful to all living organisms. It damages the quality of air, water, and land. Pollution is mainly caused by emissions, smoke, and chemicals the industries discharge into the atmosphere (Beil,

* Department of Business and Commerce, GIFT University, Gujranwala, Pakistan
Email: 192560003@gift.edu.pk
**Department of Business and Commerce, GIFT University, Gujranwala, Pakistan
Email: bakar343@gmail.com
***Department of Business and Commerce, GIFT University, Gujranwala, Pakistan
Email: sumairajaved556@gmail.com
****National Yunlin University of Science and Technology Taiwan
adiqa@yuntech.edu.tw*
(corresponding author)

2017; Carrington, 2017). Land pollution incorporates liquid chemical wastage of industries, household trash, and garbage. In this way, industries are inflicting negative impacts on human health.

The middle-income countries are facing the damages of this type of pollution. Industrial activities are the considerable root of air, water, and

land pollution, and leads to disease and sometimes loss of life for human being across the globe. The world is facing the problem of depletion of the ozone layer due to atmospheric pollution. Chlorofluorocarbon (CFCs) contains chlorine, fluorine, and carbon which are damaging the ozone layer by destroying the molecules of ozone from this layer. Depletion of the ozone layer becomes the cause of higher temperatures which leads to global warming.

Pollution from the industrial sector is also causing acid rain by burning fossil fuels, combined with the water vapors in the atmosphere from the acids like sulfur and nitrogen dioxide. CO_2 emissions in surroundings hang on plenty of elements that are responsible for pollution besides the consumption of energy, for example, trade, high-speed pattern of urbanization, capital formation, financial development, industrialization, population growth rate, etc.

Financial development is one of the more representatives that may illustrate pollution emissions. Many countries have focused on financial development to have well-balanced economic growth. In the case of economic development, development of the financial sector is liable for industrial side hazardous waste (Sehrawat et al., 2015). Jalil and Feridun (2011) propose that middle-income countries can obtain new beneficial technology through financial development. Such technological advancements lead to a decrease in pollution. Many researchers pointed out that financial development enables some industries for more

investments and expand their production capacity, potentially increasing pollution emissions (Sadorsky, 2010).

Trade liberalization and economic integration have been the most frequent trends globally. With the augmentation of the World trade organization (WTO), the consequential transformation has been assembled in a global economy. As a result, global trade diversification raises the question of whether trade is beneficial to the environment or not. Consequently, some policymakers and experts are concerned about the effects of globalization on the environment (Barrows and Ollivier, 2014). In the second half of the 20^{th} century, the production patterns of export goods industries changed in middle-income countries. These types of industries include not only traditional production patterns but also move towards capital-intensive industries that lead to the problem of pollution.

The influence of exports on pollution can be revealed using three possessions which are the composition effect, scale effect, and technological effect. In the presence of more export activities, further contributions to the manufacturing of goods are obligatory, which are the sources of substantial carbon emissions in the atmosphere called the scale effect. When economic activity upsurges it increases environmental deprivation which indicates lessened pollution. This thing is upheld through the use of those technologies which are environmentally friendly, recognized using technical effect projected by Grossman and Krueger (1991).

The composition effect justifies growing income which accelerates a rise in demand for cleaner goods. For this reason, firms employ another technique of construction that lessen pollution in the environment. As to the environmental Kuznets curve (EKC) hypothesis, the scale effect dictates the composition effect at a minor income level but as income enhances and touched peak point composition effects controls the scale effect (Halkos and Tzeremes, 2016).

This study provides the basics for almost all government policies in the system of Middle-Income countries. This study is of great benefit to prospective researchers, and institutions since it will contribute to the existing knowledge and it may open up gaps in the literature, which may oblige an additional exploration. This effort will also be abundant of significance for policymakers who make the policies regarding this zone.

This study is organized as follows: section 1 consists of the introduction and 2 presents the background. Sections 3 and 4 express the theoretical framework and methodology. Section 5 holds the data and variables of the study. Section 6 consists of results and discussions. The last section carries the conclusion and policy recommendations.

2. Literature Review

This section reviews the previous studies to check the relationship between exports, financial development, and industrial pollution. It contains two sections, section 2.1 holds the relation between financial development and pollution emissions. After that, section 2.2 contains the export and pollution emissions nexus.

2.1 Financial Development and Pollution

Shoaib et al, (2020) explored the influence of financial development (FD) on CO_2 emissions. The study aimed to inspect the associations between FD and carbon discharge in G8 and D8 states from 1999 to 2013. Second-generation unit root tests for the panel were employed to inspect the fixed level and to tackle the occurrence of cross-sectional dependency in the panels. The results of PMG and ARDL showed that financial development leads to the release of carbon emissions in the long run. Similarly, Aydin and Onay (2020) evaluated the impact of energy intensity on the association between financial development and pollution in BRICS countries from 1990-2015. Financial development specifies the capacities of the currency of a country that is significant for the countries that import

net energy. The findings of PSTR indicated that there are three energy intensity threshold points. An increase in the financial development index can cause more environmental pollution and vice versa. The experiential investigation of Shahbaz et al. (2020) confirmed that financial development enhances CO_2 emissions for the United Arab Emirates for 1975QI to 2014QIV.

Destek (2019) considered the association among financial development pointers, urbanization, income, energy use, and environmental footprint for seventeen developing economies for 1991-2013. The observed results confirm a growing total index of FD and the development of the stock market lessens the pollution while the development of the banking sector and bond markets did not hold a significant influence on environmental degradation. The study by Khan et al. (2019) investigated the link between the usage of energy, deprivation of environment, financial sector development (FD), energy use, and economic advancement for a panel set of 193 countries for 1990-2017. The outcomes of the study state that FD and CO_2 emissions are affected by each other. The consequences of Fitriyah (2019) indicate that financial development, energy consumption, and economic growth are significant factors of carbon emission in the long and short-run in Indonesia.

Li and Ouyang (2019) examined the influence of financial development and human capital on carbon emission intensity in the context of China for the time spanning 1978 to 2015. Firstly, the results of ARDL indicate that financial openness has a positive effect on carbon emissions intensity. Secondly, they establish an inverted N-shaped relationship between human capital and emissions intensity. Likewise, Atil et al. (2018) investigated the factors which influence CO_2 emission in China for 1970Q1 to 2015Q4. The nonlinear ARDL model has been engaged to know the potential asymmetric influence of the elements of carbon emission. The study found that in the short-run, economic growth and financial development (FD) are significant factors of pollution. Bass et al.

(2019) also exposed that FD, real income, and energy use are the significant factors of carbon emissions in Russia by engaging data from 1990 to 2016. Granger causality test discloses unidirectional causality running from FD to CO_2 emissions.

Haas and Popov (2019) conducted a study to find out the impact of financial development on CO_2 emission for a panel of various countries as well as industries for the time of 1990 to 2013. Investigation at the level of the industry reported two stations. Firstly, deeper stock markets reallocate the investment to cleaner industries. Secondly, environmentally friendly technologies are encouraged in carbon-intensive industries. The findings of OLS and 2SLS indicate that FD has a direct impact on industrial pollution and confirms the concave shape of EKC. Similarly, Shah et al. (2019) analyzed the relationship between financial (FD) and the environment by including the role of economic institutions in 101 countries from 1995-2017. The results of FMOLS reported that FD significantly led to an increase the pollution. Later the attachment of economic intuitions is helpful to reduce the impact of FD on pollution. The study confirmed the existence of EKC in the case of income and FD. By the same token Raza et al. (2018) examined the influence of financial development and energy use on the environment in Pakistan. The study used the co-integration test and OLS approach on data from 1972 to 2014. The results of OLS reported that FD deteriorates the environment.

2.2 Exports and Pollution

Yasmeen *et al*. (2019) examined the trade and pollution nexus for thirty-nine countries from 1995-2009. Air pollution was taken as a dependent variable that consists of eight pathways of air pollution. The consequences of the GMM technique explored that value-added trade (VT) increases pollution. The inverted U-shaped hypothesis of EKC in the setting of trade and air pollution was validated in the entire eight air pollutants pointers.

Zamil et al. (2019) studied the trade and CO_2 emissions nexus in Oman. Their analysis concentrated to assess how trade influences carbon emissions by employing the ARDL model for 1972-2014. The consequences of the ARDL bound test indicated that GDP per capita and trade positively increase CO_2 emissions. This means that greater GDP per capita and trade reduce the environmental quality of Oman. Similarly, Mahmood et al. (2019) evaluated the trade and carbon dioxide emission nexus in Tunisia. The study used the ARDL model for the data set consisting of 1971 to 2014. The results of the ARDL model revealed that increasing trade significantly increases pollution. Further, trade has a positive impact on pollution in the nonlinear ARDL model. The findings of Fan et al. (2019) investigated that the increased trade openness reduces CO_2 emissions and that there are evident structural variances in diverse sectors with variant emission intensity in the case of twenty industrial sectors of China.

Sun *et al* (2019) investigated the relationship between trade and CO_2 emissions by keeping the role of economic growth and energy consumption for 49 belt and road countries, covering the years from 1991 to 2014. The outcomes of FMOLS report that trade openness affects the environment. The outcomes from VECM causality displayed a long-run causal effect between trade, pollution, and energy in Belt and Road as well as in high-income, middle-income, and low-income panels.

Qirjo *et al.* (2021) empirically investigated that on average, the adoption of the Comprehensive Economic and Trade Agreement (CETA) can be helpful to combat global warming. According to the estimate, bilateral trade between Canada and EU member decrease yearly per capita emissions of greenhouse gases in an average CETA member. The findings also indicated that yearly per capita emissions of GHGs would be reduced because of CETA.

Ertugrul *et al*. (2016) worked on the openness and pollution nexus, keeping the role of income and energy in the ten developing countries from 1971-2011. ARDL model for co-integration and VECM Granger causality process were applied for the annual data from 1971 to 2011. The empirical outcomes specify that trade is the contributing factor to pollution in the long run. The EKC hypothesis is validated only for four countries i.e. Turkey, India, China, and Korea.

Ullah *et al*. (2019) argue that China has remained the world's leading emitter of CO_2 while making a considerable contribution to global trade following WTO reforms. Using time-series data from 1990 to 2017, this study investigates that trade has a major impact on CO_2 emissions in the country, resulting in a rise in healthcare expenses.

Afesorgbor and Demena (2019) conducted a meta-analysis of 88 studies to review the trade-environment nexus and the overall effect is determined by three factors: scale, technique, and composition. The findings indicate that trade contributes to greenhouse gas emissions. Only CO_2 emissions are more robust than SO_2 emissions, the finding remains robust when heterogeneity is taken into account.

Hakimi and Hamdi (2020) shed light on the environmental effects of international trade for the panel of 143 economies, observed from 2006 to 2015 by implementing the GMM approach. The study used three models; a combined analysis of an entire sample of 143 countries, and a disaggregated analysis that consists of a sample of developed 43 countries and 100 developing countries distinctly. The results of the aggregated approach show that trade, as a key variable, has no obvious impact on the environment. On the other hand, the disaggregated inquiry demonstrates trade has harmful effects on the environment.

Tariku (2015) argued that trade liberalization stimulates economic growth but may cause to pollute the environment. Johansen co-integration and

ECM techniques were used to inspect the dynamics of time series data for Ethiopia from 1970-2010. The results of this study indicated that economic growth is positively connected to atmospheric pollution whereas, trade intensity is helpful to reduce air pollution.

Fang *et al*. (2020) conducted a study to empirically test the EKC hypothesis and the environmental impact of trade and economic growth for 261 cities in China by using the annual data from 2004 to 2013. They examined two types of pollutants, industrial wastewater, and sulfur dioxide were employed to measure the environment. The consequences of FMOLS show the EKC hypothesis holds not only for the entire economy but also for various zones. Moreover, exports are the contributing factor to reducing the quality of the environment whereas imports improve the environmental quality.

3. Theoretical Framework

A well-established financial sector diminishes the costs of the transaction, lessens the operating threats, and advances the credit network (Tamazian & Rao, 2010). One more predominant element is the financial sector development in the setting of economic advancement which is answerable for industrial pollution (Sehrawat, 2015). The environmentally pleasant technology also lessens the environmental pollutants in the production process (Birdsall & Wheeler, 1993).

The environmental deterioration as an outcome of economic progress can offer some indications of encouraging green progression and supportable improvement. The calculation of the carbon emissions in the export sector uses input-output analysis, which might be a better manner for broadly measuring the consumption of energy and embodied carbon in export and import trade. Many researchers have been employing an input-output method for the analysis of the emission of carbon (Hayami & Nakamura 2002; Davis & Caldeira, 2010; Chen & Hu, 2020; Liu et al., 2011).

Energy consumption is positively related to pollution. Long-run analysis revealed that the development of the financial sector and energy consumption are directly related to pollution at the primary level (Zafar et al., 2020). Capital formation positively affects economic growth. Financial development may draw FDI by generating commodities that consume more energy and then leads to additional pollutants (Halicioglu, 2009).

In 2014, the world's urban population was larger than 54% and it is predicted to be 66% in 2050 (United Nations Population Fund, 2014). Huge progress in urbanization needs enormous use of energy, construction material, and vehicles which generates pollution i.e. CO_2 and SO_2 emissions. This environmental condition and the increasing trend of urbanization are not good (Uttara et al., 2012; Li et al., 2016; Wang et al., 2020).

The above-mentioned indicators which affect the environment can be written in the following way,

$$IP = f(FD, EX, EN, K, UP) \ldots\ldots\ldots\ldots\ldots \quad (1)$$

From the coordination of Eq.1, the economic model for the panel of MICs builds up in the following way,

$$CO_{2\ it} = \beta_1 FD_{it} + \beta_2 EX_{it} + \beta_3 EN_{it} + \beta_4 CF_{it} + \beta_5 UP_{it} + \varepsilon_{it} \ldots\ldots\ldots\ldots \quad (2)$$

IP = Industrial Pollution

FD = Financial Development

EX = Exports of goods and services

EN = Energy use

CF = Capital Formation

UP = Urban Population

ε= Error Term

Where, the term *i* is used for countries and *t* is for the time and β_s are the slope coefficients of the explanatory variables. The dynamic relationship between financial developments (FD), Export (EX), and Industrial Pollution (IP) are examined for middle income during the period 1990 to 2019.

4. Methodology

There are a few techniques that are adopted to check out the linkage between exports, financial development, and pollution along with some control variables for Middle-Income Countries (MICs). Panel ordinary least square (OLS), fixed effects (FE) model, random effects (RE) model, and Generalized Method of Moments (GMM) are applied to estimate the results.

The leading statement of pooled estimation of the OLS technique is the slope coefficients and the intercept do not fluctuate across cross-sectional units over time. The fixed effects model is used to find out the influence of coefficients which can be variants over time. It evaluates the relation among dependent and independent variables for all cross-sectional units because every unit has its attributes that could influence independent variables. FE model controls the influence of time-uniform attributes by empowering them with the unevenness of properties in the intercept.

The random effects model is a suitable approach in case of variation over the structure that has an impact on a dependent variable. It considers time uniform limits. The leading assumption of the RE approach is the intercept of every single cross-sectional unit is randomly strained with the endless average worth of the intercept. GMM approach is also used to tackle the problem of endogeneity and to check the dynamics.

5. Data

This study is an effort to check out the impact of exports, and financial development on industrial pollution. The empirical analysis has been conducted for 74 Middle-Income Countries (MICs) from 1990-2019. The panel data set from 1990 to 2019 has been taken from WDI (2020). The data on industrial pollution (CO_2 metric tons per capita), financial development (domestic credit to the private sector as a share of GDP, in constant US$), exports (% of GDP), and energy use (kg of oil equivalent per capita), capital (% of GDP) and urban population (% of the total population) have been derived from WDI (2020). This section contains two sections, 5.1 declares the descriptive analysis for the sake of the nature of the variables, and 5.2 displays the correlation matrices of variables.

5.1 Descriptive Statistics

This section carries the descriptive statistics for middle-income countries. Industrial pollution ranges from 0.0084 to 24.3983 while its mean value is 2.4834. The maximum value of financial development is 164.6643 and the minimum value is 2.0104 and 37.1002 is its average value. The mean value of exports is 34.4810 and the minimum and maximum values are 5.083 and 125.7485 respectively. The average value and standard deviation of all the variables are also shown in Table 1.

Table 1: Descriptive Statistics

Variables	Obs.	Mean	St. Dev	Min.	Max.
IP	1980	2.4834	2.7508	0.0084	24.3983
UP	2220	51.8360	19.7698	8.8540	91.9910
FD	1760	37.1002	30.1341	2.0104	164.6643
CF	2111	24.7322	8.5705	-0.6929	77.8900
EN	1612	1106.741	994.1609	9.5480	5941.586

EX	2162	34.4810	18.1452	5.9083	125.7485

5.2 Correlation between Variables

The results of the correlation show that financial development, exports, energy, and capital have a positive relation with industrial pollution for MICs (Table 2). The signs provide the direction of the relationship in the series.

Table 2: Correlation Matrix

Variables	IP	FD	EN	EX	CF	UP
IP	1.0000					
FD	0.4604	1.0000				
EN	0.8701	0.3689	1.0000			
EX	0.6139	0.3346	0.6208	1.0000		
CF	0.1556	0.1389	0.1077	0.1436	1.0000	
UP	0.7423	0.2151	0.6655	0.4328	0.0316	1.0000

6. Results and Discussion

The empirical findings are presented in Table 3. According to the results of OLS, financial development (FD) shows a positive relationship with pollution which is consistent with the studies of Shahbaz et al., (2016), Mohammadi et al. (2017), and Jiang and Ma (2019). The coefficient of FD shows that a 1% increase in FD causes a 0.2243% rise in industrial pollution. Exports are the main source of economic growth but are also one of the reasons for increasing pollution. Feng (2013) and Wang et al. (2020) also explored a positive relationship between exports and pollution. The results show that energy use is also an increasing factor of pollution and the findings are consistent with the study of Gulistan et al. (2020). The increasing trend of capital formation enhances the level of pollution which has also been proved in the literature by Hina et al.

(2019). The urban population is the key factor in enhancing carbon emissions.

The consequences of the fixed effects model indicate that the coefficients show that FD, exports, and energy consumption contribute to industrial pollution. The coefficient of capital formation (CF) and urban population (UP) indicate that a 1% increase in CF and UP cause a 0.1199% and 0.5185% increase in pollution. Jiang and Ma (2019) also established the same relationship between financial development, urban population, and carbon emissions. Similarly, the Findings of the random effects model show that financial development (FD), exports, energy, capital, and urbanization are the polluting factors of the environment with the consistency of the findings of Destek (2019).

The results of the GMM model for MICs show that FD and exports positively affect carbon emissions and the coefficients show that a 1% rise in FD and exports cause a 0.05% and 0.11% increase in pollution, respectively and the results are consistent with Bayar et.al (2020) and Feng et al. (2013). Findings also investigated that energy, capital and urbanization are the sources of pollution in MICs, and the results are consistent with the literature (Bayar & Maxim, 2020; Hina et al. 2019).

Table 3: Results of OLS, FE, RE, and GMM Model

Dep. Variable: Industrial Pollution (IP)				
Variables	**OLS Model**	**FE Model**	**RE Model**	**GMM Model**
IP(-1)				0.3838***
				(0.0000)
FD	0.2243***	0.0849***	0.0873***	0.0528***
	(0.0003)	(0.0350)	(0.0022)	(0.0023)
EN	0.8492***	0.3905***	0.4179***	0.2894***

	(0.0020)	(0.0087)	(0.0079)	(0.0000)
EX	0.0560***	0.1797***	0.1464***	0.1081***
	(0.0432)	(0.0057)	(0.0033)	(0.0001)
CF	0.2015***	0.1199***	0.1233***	0.0824**
	(0.0120)	(0.0011)	(0.0420)	(0.0550)
UP	0.7689***	0.5185***	0.7290***	0.2788***
	(0.0320)	(0.0000)	(0.0000)	(0.0000)
C	-4.7771***	-3.9879***	-4.0330***	
	(0.0000)	(0.0000)	(0.0000)	
N	1067	1067	1067	970
R^2	0.8374	0.8752	0.5065	

Note: P-values in parentheses *p<0.10, **p<0.05, ***p<0.01

7. Conclusion

Exports and financial development not only accelerate economic growth but also have a significant impact on pollution and are expected to increase substantially in the future. The study is an effort to seek an association between exports, financial development, and industrial pollution for middle-income Countries (MICs) for the period of 1990 to 2019. Various techniques are employed to find out the association between the indicators. For the empirical analysis, OLS, fixed effects (FE) and random effects (RE) model, and GMM model have been employed. The empirical findings exposed that financial development, exports, energy consumption, capital, and urbanization are the increasing factors of industrial pollution in the MICs.

Based on the results, the study suggests limiting the negative effects of pollution. The financial sector enhances industrial pollution by the provision of credit to the polluting industries. The pollution-eradication policies should establish that discourage the financial sector from lending to polluting projects. The financial sector can be used as a tool to boost

economic growth by providing the resources to promote green production. Environmental regulations, along with the supervision of the financial sector can help to ensure long-term development. As the high-carbon exports have an advanced volume in middle-income countries, the government of these countries should recover the carbon emissions by amending the structure of exports. The study also recommends controlling the increasing level of urbanization to control pollution.

References

Afesorgbor, S. K., & Demena, B. A. (2019). The effect of trade on the environment: evidence from meta-analysis. 2019 Annual Meeting, Agricultural and Applied Economics Association, 21–23 July, Atlanta, GA.

Atil, A., Bouheni, F. B., Lahiani, A., & Shahbaz, M. (2018). Factors Influencing CO_2 Emissions in China. *The Journal of Energy and Development*, *44*(1/2), 95-128.

Aydin, C., & Onay, R. D. (2020). Does Energy Intensity Affect the Relationship Between Financial Development and Environmental Pollution?. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, *11*(1), 144-156.

Barrows, G., & Ollivier, H. (2014). Product mix, trade, and the environment: theory and evidence from Indian manufacturing. *Manuscript*, *7*(45), 1-53.

Bass, A., Burakov, D., & Freidin, M. (2019). Does financial development matter for environmental Kuznets curve in Russia? Evidence from the autoregressive distributed lag bounds test approach. *International Journal of Energy Economics and Policy*, *9*(4), 334.

Bayar, Y., & Maxim, A. (2020). Financial development and CO2 emissions in post-transition European Union countries. *Sustainability*, *12*(7), 2640.

Beil, L., (2017). *Pollution killed 9 million people in 2015. Science News. Retrieved 1.*

Birdsall, N., & Wheeler, D. (1993). Trade policy and industrial pollution in Latin America: where are the pollution havens?. *The Journal of Environment & Development*, *2*(1), 137-149.

Carrington, D. (2017). Global pollution kills 9m a year and threatens survival of human societies.

Chen, H., & Hu, W. (2020). Determining Whether Trade Can Affect Regional Environmental Sustainability from the Perspective of Environmental Pollution. *Sustainability*, *12*(5), 1746.

Davis, S. J., & Caldeira, K. (2010). Consumption-based accounting of CO2 emissions. *Proceedings of the national academy of sciences*, *107*(12), 5687-5692.

De Haas, R., & Popov, A. A. (2019). Finance and carbon emissions.

Destek, M. A. (2019). Financial development and environmental degradation in emerging economies. In *Energy and environmental strategies in the era of globalization* (pp. 115-132). Springer, Cham.

Ertugrul, H. M., Cetin, M., Seker, F., & Dogan, E. (2016). The impact of trade openness on global carbon dioxide emissions: Evidence from the top ten emitters among developing countries. *Ecological Indicators*, *67*, 543-555.

Fan, B., Zhang, Y., Li, X., & Miao, X. (2019). Trade openness and carbon leakage: Empirical evidence from China's industrial sector. *Energies*, *12*(6), 1101.

Fang, Z., Huang, B., & Yang, Z. (2020). Trade openness and the environmental Kuznets curve: evidence from Chinese cities. *The World Economy*, *43*(10), 2622-2649.

Feng, Z., Xue, J., & Song, Y. E. (2013). Research on carbon emissions in China's export trade based on input-output model. *Chinese Journal of Population Resources and Environment*, *11*(1), 1-9.

Fitriyah, N. (2019). Financial Development and Environmental Degradation in Indonesia: Evidence from Auto Regressive Distributed Lag Bound Testing Method. *International Journal of Energy Economics and Policy*, *9*(5), 394-400.

Grossman, G. M., & Krueger, A. B. (1991). Environmental impacts of a North American free trade agreement. *Nber Working Paper* 3914.

Gulistan, A., Tariq, Y. B., & Bashir, M. F. (2020). Dynamic relationship among economic growth, energy, trade openness, tourism, and environmental degradation: fresh global evidence. *Environmental Science and Pollution Research*, *27*(12), 13477-13487.

Halicioglu, F. (2009). An econometric study of CO2 emissions, energy consumption, income and foreign trade in Turkey. *Energy policy*, *37*(3), 1156-1164.

Halkos, G., & Polemis, M. (2016). Examining the impact of financial development on the environmental Kuznets curve hypothesis. *MPRA paper 75368*.

Hakimi, A., & Hamdi, H. (2020). Environmental effects of trade openness: what role do institutions have?. *Journal of Environmental Economics and Policy*, *9*(1), 36-56.

Hayami, H., & Nakamura, M. (2002, October). CO2 emission of an alternative technology and bilateral trade between Japan and Canada: relocating production and an implication for joint implementation. In *Proceedings of the 14th International Conference on Input-Output Techniques*.

Jalil, A., & Feridun, M. (2011). The impact of growth, energy and financial development on the environment in China: a cointegration analysis. *Energy Economics*, *33*(2), 284-291.

Jiang, C., & Ma, X. (2019). The impact of financial development on carbon emissions: a global perspective. *Sustainability*, *11*(19), 5241.

Khan, S., Peng, Z., & Li, Y. (2019). Energy consumption, environmental degradation, economic growth and financial development in globe: Dynamic simultaneous equations panel analysis. *Energy Reports*, *5*, 1089-1102.

Li, P., & Ouyang, Y. (2019). The dynamic impacts of financial development and human capital on CO2 emission intensity in China: an ARDL approach. *Journal of Business Economics and Management*, *20*(5), 939-957.

Mahmood, H., Maalel, N., & Zarrad, O. (2019). Trade openness and CO2 emissions: Evidence from Tunisia. *Sustainability*, *11*(12), 3295.

Qirjo, D., Pascalau, R., & Krichevskiy, D. (2021). Comprehensive Economic and Trade Agreement (CETA) and air pollution. *Journal of Environmental Economics and Policy*, *10*(3), 293-323.

Raza, S. A., & Shah, N. (2018). Impact of financial development, economic growth and energy consumption on environmental degradation: evidence from Pakistan. *MPRA paper 87095.*

Sadorsky, P. (2010). The impact of financial development on energy consumption in emerging economies. *Energy policy*, *38*(5), 2528-2535.

Sehrawat, M., Giri, A. K., & Mohapatra, G. (2015). The impact of financial development, economic growth and energy consumption on environmental degradation: Evidence from India. *Management of Environmental Quality: An International Journal*, *26*(5), 666-682.

Shahbaz, M., Haouas, I., Sohag, K., & Ozturk, I. (2020). The financial development-environmental degradation nexus in the United Arab Emirates: the importance of growth, globalization and structural breaks. *Environmental Science and Pollution Research*, *27*(10), 10685-10699.

Shahbaz, M., Shahzad, S. J. H., Ahmad, N., & Alam, S. (2016). Financial development and environmental quality: the way forward. *Energy Policy*, *98*, 353-364.

Shoaib, H. M., Rafique, M. Z., Nadeem, A. M., & Huang, S. (2020). Impact of financial development on CO 2 emissions: A comparative analysis of developing countries (D 8) and developed countries (G 8). *Environmental Science and Pollution Research*, *27*(11), 12461-12475.

Sun, H., Attuquaye Clottey, S., Geng, Y., Fang, K., & Clifford Kofi Amissah, J. (2019). Trade openness and carbon emissions: evidence from belt and road countries. *Sustainability*, *11*(9), 2682.

Tamazian, A., & Rao, B. B. (2010). Do economic, financial and institutional developments matter for environmental degradation? Evidence from transitional economies. *Energy economics*, *32*(1), 137-145.

Tariku, L. (2015). The Impact of Trade Liberalization on Air Pollution: In Case of Ethiopia. *New Media and Mass Communication, 40,* 43-55.

Ullah, I., Ali, S., Shah, M. H., Yasim, F., Rehman, A., & Al-Ghazali, B. M. (2019). Linkages between trade, CO2 emissions and healthcare spending in China. *International journal of environmental research and public health*, *16*(21), 4298.

Uttara, S., Bhuvandas, N., & Aggarwal, V. (2012). Impacts of urbanization on environment. *International Journal of Research in Engineering and Applied Sciences*, *2*(2), 1637-1645.

Wang, S., Tang, Y., Du, Z., & Song, M. (2020). Export trade, embodied carbon emissions, and environmental pollution: An empirical analysis of China's high-and new-technology industries. *Journal of Environmental Management*, *276*, 111371.

Yasmeen, R., Li, Y., & Hafeez, M. (2019). Tracing the trade–pollution nexus in global value chains: evidence from air pollution indicators. *Environmental Science and Pollution Research*, *26*(5), 5221-5233.

Zafar, A., Ullah, S., Majeed, M. T., & Yasmeen, R. (2020). Environmental pollution in Asian economies: does the industrialisation matter?. *OPEC Energy Review*, *44*(3), 227-248.

Zamil, A. M., Furqan, M., & Mahmood, H. (2019). Trade openness and CO2 emissions nexus in Oman. *Entrepreneurship and Sustainability Issues*, *7*(2), 1319-1329.