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# THE LINKAGE BETWEEN TRADE OPENNESS AND ENVIRONMENTAL QUALITY: NEW INSIGHTS FROM DEVELOPING COUNTRIES

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*Whether does trade openness appear to be bad or good to the environment? The question is of great interest in international debates on climate change and environmental pollution. The results from the empirical and theoretical literature are largely inconclusive and controversial about the overall linkage between trade openness and environmental quality. The aim of this paper is to examine the possible linkage between trade openness and the environmental quality with a panel data of 53 developing countries over the period 1991-2016. In which, the research evaluates the relationship between trade openness and CO2 emissions from 1991 to 2014 and the trade openness and PM2.5 nexus between 2010 and 2016 by employed Panel vector autoregression (PVAR)along with System-GMM methods. Results indicate that there was only one-way direction causality arisen from both CO2 emissions and PM2.5 as proxies of environmental quality to trade openness.Additionally, there was no evidence of the impact of trade openness on environmental quality in developing countries. Therefore, policymakers in developing countries should control environmental quality through efficientlyutilizing clear and green energy to sustain their economic growth in the wake of international economic integration.*

***Keywords**: Trade openness, environmental quality, developing countries and PVAR*

## 1. Introduction

Trade liberalization is considered an engine for economic growth, however, international trends suggest that increasing exchange activities driving from a higher degree of trade are the potential source of environmental degradation. Therefore, the question of whether does trade openness appear to be bad for the environment becomes a dominant policy issue in recent decades. Economists and economic models related to the trade impacts believe that trade liberalization or trade openness brings multiple benefits in promoting economic efficiency and prosperity. Furthermore, the theory of comparative advantage indicates that countries participating in mutual exchanging activities benefit from specialization in commodity production that the country has a comparative advantage. However, trade theory does not take into account the external impact of trade on the environment, which is closely related to the production and consumption of goods. The production of goods used for export and import purposes will have also multiple impacts on the environment (Harris and Roach, 2017). The environmental impact of trade openness might hamper sustainable economic development in the long term. In addition, economic and environmental economists argue that trade liberalization through the effective use of resources and the maintenance of sustainable economic growth play an important role in improving environmental quality. They also argued trade liberalization and environmental protection policies will generate benefits by improving the efficiency of allocating resources, adjusting market failures and strengthening the implementation of environmental regulations. However, in fact, the wealth created by trade liberalization, in one hand, contributes to improving the quality of life and reducing poverty while also being considered as a fundamental cause of environmental degradation especially in developing countries (Shahbaz et al., 2017). Hence, whether or not the environmental degradation caused by trade openness still remains an inconclusive and questionable issue and need to be answered in order to achieve sustainable economic development without hampering the environment.

The relationship between trade openness and environmental quality relatively remains unclear and controversial in both theoretical frameworks and empirical studies.

Theoretically, the relationship between trade openness and environmental quality, environmental regulations, agreements or laws suggests that the price of environmental emissions for businesses activities is relatively low compared to the level environmental impact caused by the production process of enterprises. In the Heckcher-Ohlin (H-O) trade model, a country with a relative ratio of low input costs or a relatively high proportion of tangible capital will choose to specialize in production associated with higher environmental impact levels. Since trade liberalization has led to the specialization of commodity production which releases a higher amount of pollutants. Therefore, trade liberalization has a detrimental impact on environmental quality. In contrast, according to Stolper-Samuelson's theorem, the environmental costs will be increased as a peripheral factor in the production process of enterprises. Therefore, companies will choose technologies that cause less environmental pollution "technical effects", in which trade openness appears to be good for environmental quality (Dean, 2002). Specifically, freer trade has multiple effects on the environment that are composited into three channels namely scale, technical and composition effects (Antweiler et al., 2001). Accordingly, while scale effects of trade openness show a negative impact on environmental quality because of increasing economic expansion which is an adverse impact on the environment, due to employed environmental friendly technology, technical effects present the positive impacts of trade on the environment. Finally, composition effects have either negative or positive effects on environmental quality, which is depended on whether a country has a comparative advantage in dirty or cleaner industries and whether a country has tough or lenient environmental policies.

Empirical findings on the trade-environment nexus from previous empirical studies are still controversial and inconclusivethat result from using differences of sample sizes, methodologies, and indicators of environmental quality. Hakimi & Hamdi (2016) investigated the impact of free trade on environmental quality in Tunisia and Morocco through employed the vector of error correction (VECM) method and concluded that trade openness has a negative impact on the environment. Similarly, the results from empirical studies of Shahbaz etal. (2017), Dean (2002), and Cole et al. (2000) show that trade openness deteriorates environmental quality. In contrast, Shahbaz, Tiwari & Nasir (2013) researchedthe impact of trade on the environment in South Africa by applied ARDL method provides compelling evidence that trade openness contributes to improving environmental quality through reducing fossil usage. Furthermore, trade liberalization has a positive impact on the environment is found in the studies of Antweiler et al. (2001) and Shahbaz et al. (2013). Moreover, the relationship between trade openness and environmental quality depends on different stages of economic development. Le, Chang & Park (2016) and Honma (2015) conclude that the increase in trade openness leads to environmental degradation for the global sample. However, trade openness has a beneficial effect on the environment in high-income countries, yet it has negative impacts on the environment in middle and low-income countries. Contrary to the results of this study, according to Aller et al. (2015), trade has an indirect impact on improving environmental quality in low-income countries but has a negative impact on the environment in high-income nations. Futhermore, Managi, Hibiki and Tsurumi (2009) show that trade is beneficial to environmental quality in OECD[1] countries, whereas, it is considered as the potential issue of increased carbon dioxide and

*1. OECD -The Organisation for Economic Co-operation and Development is an intergovernmental economic organisation with 34 members* sulfur emissions which leads to damage the environment in non-OECD countries.

Besides, prior studies have been neglected to explore comprehensively the trade-environment nexus in developing countries. To fill this gaps, the paper aims to enrich literature by investigating the relationship between trade openness on environmental quality through the two most common indicators of environmental quality namely carbon dioxide emissions (CO2) and particulate emissions (PM2.5). The other contribution of this paper is to employ novel econometric approaches as the panel vector of autoregression (PVAR) and system-GMM method incorporating with the up-to-date dataset of environmental quality and trade openness. This approach is also considered as the most appropriate technique to design of small-time dimension and large cross-sections. The results from this paper provide new insight evidence for policymakers in creating appropriate implications for achieving economic development in accordance with environmental protection.

The paper is organized as follows: (1) the overview of the trade-environment nexus; (2) methodology and dataset; (3) empirical findings and discussion; and (4) conclusion and policy implications.

**2. Data and research methodology**

***2.1. Empirical frameworks and econometric modelling***

The paper employs the analytical techniques related to panel data for the empirical analysis of the relationship between trade openness and environmental quality in developing countries. The use of panel data has many benefits compared to cross-sectional data and time series. For example, the use of panel data significantly increases the sample size this improves the quality of the results especially in utilizing Granger causality tests, which provide more consistent and unbiased estimators (Pao and Tsaim, 2010). Furthermore, using panel data reduces multicollinearity between independent variables, increases degrees of freedom and obtain efficient estimates rather than using cross-sectional data and time series (Wooldridge, 2010). To measure trade openness, the study selects the ratio of the value of total trade to the gross domestic product (GDP) as ((export + import)/GDP), which is the most common and best indicator to measure trade openness (Alcalá and Ciccone, 2004). In addition, trade openness is also considered as an indicator to reflect and measure trade liberalization and the level of international economic integration of a country (Hakimi & Hamdi, 2016).

There are several indicators as proxies of environmental quality from the literature such as carbon dioxide emissions ($CO_2$), sulfur dioxide ($SO_2$), nitrit (NO) orparticulate matter (PM10[2] and PM2.5[3]) in the previous empirical studies of Hakimi & Hamdi (2016); Shahbaz, Tiwari & Nasir (2013); Shahbaz and colleagues (2017); Managi, Hibiki & Tsurumi (2009) and Le, Chang & Park (2016).However, due to data availability in developing countries, the study employsparticulate matter PM2.5 from the World Bank Indicator as a proxy of environmental quality. Because particulate matter PM2.5 of air pollution are considered to be one of the main causes of environmental degradation, people's health problems, construction destruction and agricultural issues (Salvador et al., 2012). According to Miah et al. (2011), the particulate PM also directly contribute to global warming by generating a higher amount of greenhouse gas emissions. In addition, the paper also uses carbon dioxide emissions ($CO_2$) as the main measure of the quality of the environment. The main reason is that $CO_2$ emissions are a major factor affecting global warming, at the same time, the relationship between $CO_2$ emissions and climate change has been becoming a dominant concern for policymakers. Importantly, Wei et al. (2012) argue that reducing $CO_2$ emissions is the biggest strategy for policymakers, especially for developing countries with high industrialization intensity such as in China.

*2. According to World Bank Indicators, PM10 air pollution is defined as the average level of exposure of a nation's population to concentrations of suspended particles measuring less than 10 microns in aerodynamic diameter (µm)*

*3. According to World Bank Indicators, PM2.5 air pollution is defined as the average level of exposure of a nation's population to concentrations of suspended particles measuring less than 2.5 microns in aerodynamic diameter (µm)*

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The study applied the PVAR method to estimate the bidirectional causal relationship between trade openness and environmental quality. Similar to the traditional VAR estimation approach, trade openness and environmental quality indicators are treated as endogenous variables in the PVAR method that directly address the most common issue as endogeneity. Additionally, due to the time limit between 1990 and 2014, the PVAR method helps significantly increase the sample size by using panel data of 53 developing countries. The equations of the PVAR method developed by Abrigo & Love (2015) are written as follows:

$$OP_{it} = \beta_{0t} + \sum_{l=1}^{m} \beta_{lt} OP_{i(t-l)} + \sum_{l=1}^{m} \alpha_{lt} EQ_{i(t-l)} + State_i + year_i + u_{it} \quad (1)$$

$$EQ_{it} = \beta_{0t} + \sum_{l=1}^{m} \beta_{lt} OP_{i(t-l)} + \sum_{l=1}^{m} \alpha_{lt} EQ_{i(t-l)} + State_i + year_i + u_{it} \quad (2)$$

In which, OPis trade openness ([export + import]/GDP - %);

EQ denotes environmental quality as measured by the particulate matter 2.5 µm or less in diameter (PM2.5 - micrograms per cubic metre) and CO2 emissions (metric tons per capita)

*State*: Country's characteristics

*Year*: Time effects

*u*: Error term

The values of all variables in the study are converted into natural logarithms to show the continuous relatively change between dependent and independent variables and to reduce heteroskedasticity. Before estimating the relationship between trade openness and environmental quality, the study used the panel unit root tests or stationary tests through LLC's tests proposed by Levin, Lin and Chu (2002) to avoid spurious results. Accordingly, the study employs LLC tests to minimize dependency among countries in a panel dataset. Because the use of the LLC test allows the study to limit dependencies between countries by taking the first difference from the dataset. The hypothesis assumes that all data series are non-stationary, and the alternative hypothesis is that at least one time-series data contains a unit root. The next step is to examine the causal relationship between trade openness and environmental quality, the Granger causality test is used in this study. Furthermore, in order to select optimal lag lengths, the paper based on three statistical criteria namely MBIC, MAIC and MQIC from Adrew and Lu (2001). Accordingly, the optimal lag lengths are selected at which the MBIC, MAIC and MQIC statistical values are the smallest. Finally, to estimate the linkage between trade openness and environmental quality, the paper employs the system-GMM estimators approach. Because using the Ordinary least square technique might lead to erroneous estimators due to time effect and country-specific effects. The equation that estimates models (1) and (2) according to the system-GMM approach with first difference approach which directly eliminates both time and country-specific effects. The equation transformed from the panel VAR specification is written as follows:

$$Y_{it}^{*} = \overline{Y_{it}^{*}}\beta + u_{it}^{*} \quad (3)$$

Where, $Y_{it}^{*} = OP_{it} - OP_{i(t-1)}$ or $Y_{it}^{*} = EQ_{it} - EQ_{i(t-1)}$; $\overline{Y_{it}^{*}}$ is the first difference of the values at lagged m of OP and EQ, and $u_{it}^{*} = u_{it} - u_{i(t-1)}$

Therefore, the parameters β estimated from the equation (4) from the GMM estimatoris given by:

$$\beta = (\overline{Y^{*}}' Z\widehat{W}Z'\overline{Y}^{*})^{-1}\ (\overline{Y^{*}}' Z\widehat{W}Z'\overline{Y}^{*})$$

Where, $\widehat{W}$ is the weighting matrix, which is assumed to be symmetric, non-singular and positive semi-definite in the System-GMM approach and be selected to maximize efficiency,and Z is the instrument variables' matrix.

***2.2. Descriptive statistics and data source***

For the purpose of the research, all data are collected and calculated from the World Bank Indicators (WB, 2018) of 53 developing countries from 1991 to 2016. Furthermore, to avoid bias in size and population, the study uses CO2 emissionsper capita as one of the indicators for environmental quality in the model. To classify whether a country belongs to developing groups, the study is based on the national classification fromUnited Nation (2014) . The summary of the descriptive statistics of variables is presented in Table1. In which, due to data availability, trade openness was collected from 1991 to 2016, CO2 emissions were collected from 1991 to 2014 and PM2.5 data was taken from 2010 to 2016 in 53 developing countries.It is noted that the estimation of the relationship between trade openness and CO2 emissions is based on the data sample from 1991 to 2014, while the relationship between trade openness and PM2.5 is estimated using the dataset from 2010 to 2016.

**Table 1**: *Summary statistics of variables*

| Variables | Unit | Observations | Mean | Std. Dev | Min | Max |
|---|---|---|---|---|---|---|
| OP - Trade openness | %of GDP | 1378 | 78.83748 | 53.15418 | 11.46605 | 441.6038 |
| $CO_2$ - Carbon dioxide emissions | Tons per capita | 1272 | 3.256534 | 4.818475 | 0.0391788 | 29.98959 |
| PM2.5 - The particulate matter 2.5 | Micrograms per cubic metre | 371 | 36.34901 | 27.87812 | 5.656721 | 187.8714 |

*Source: Author's calculation from WB (2018)*

**3. Empitical results and discussion**

In this section, the paper presents and discusses the empirical results of the relationship between trade openness and environmental quality in developing countries through employed multiple techniques namely panel unit root tests, Granger causality and system-GMM. In the initial stage of the empirical analysis, the paper employs the panel unit root test from Levin, Lin and Chu (2002) which is reported in Table 2. The results from the test statistics indicate that the initial values of all variables after taking natural logarithms are stationary in either with a trend or no trend. In addition, the null hypothesis of unit roots or non-stationary is significantly rejected at 5% levels of significance for all the variables. This implies that all variables in the level do not contain unit roots. Therefore, the next step of the analysis has used all variables at level after taking logarithms of trade openness, $CO_2$ emissions and PM2.5.

Results from Table 3 presents three model selection criteria to determine the number of optimal lags for each nexus by Andrews and Lu (2001). In which, the optimal lags are selected at which the values of MBIC, MAIC and MQIC are the smallest. Accordingly, the first-order panel VAR is the preferred specifications, since this has the smallest MAIC, MBIC and MQIC. Therefore, the paper employs the first-order panel VAR to examine the relationship between trade openness and carbon dioxide emissions ($CO_2$) and the trade openness and PM2.5 nexus. Based on the optimal lag, the study also fits the first-order PVAR models with the first lag length being considered as an instrumental variable in utilizing system-GMM estimation to evaluate the relationship between trade openness and environmental quality in developing countries.

Table 4 presents the estimated results of the PVAR model through system-GMM approach. In this specification, the paper fits a first-order panel VAR model with the first lag of variables treated as

**Table 2**: *Results from panel unit root tests*

| Methodology | Variable | At level | |
|---|---|---|---|
| | | Constant | Constant and trend |
| Levin, Lin & Chu t* | $LnCO_2$ | -3.0010 (0.0013)*** | -1.7638 (0.0389)** |
| | LnPM2.5 | -3.9300 (0.0000)*** | -12.1815 (0.0000)*** |
| | LnOP (1991-2014) | -4.8190 (0.0000)*** | -4.7703 (0.0000)*** |
| | LnOP (2010 – 2016) | -5.3471 (0.0000)*** | -28.2704 (0.0000)*** |

*Note: The test is based on the fist lag, trend; P_values are shown in parentheses; the null hypothesis is all panels contain unit roots,*

**, **, *** denote the rejection of the null hypothesis at 10%, 5% and 1% level of significance respectively.*

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**Table 3**: *Results from optimal lag lenghts selection*

| Relationship | Lag | CD | J | J Pvalue | MBIC | MAIC | MQIC |
|---|---|---|---|---|---|---|---|
| LnOP and $LnCO_2$ | 1 | 0.9997041 | 15.26618 | 0.2272014 | -67.71059 | -8.733816 | -31.14151 |
| | 2 | 0.9997293 | 15.60645 | 0.0483722 | -39.7114 | -0.3935536 | -15.33202 |
| | 3 | 0.9997218 | 3.764914 | 0.4387551 | -23.89401 | -4.235086 | -11.70432 |
| LnOP andLnPM2.5 | 1 | 0.9995431 | 9.347028 | 0.6730385 | -46.61424 | -14.65297 | -27.60705 |
| | 2 | 0.9995412 | 5.669805 | 0.6841631 | -31.63771 | -10.3302 | -18.96625 |
| | 3 | 0.9995468 | 3.237348 | 0.5189199 | -15.41641 | -4.762652 | -9.080678 |

*Note: The optimal lag length (m) corresponding in equation 1 is 1 lag, the comparison among statistical criteria is accounted for negative sign (-), and CD is the overall coefficient of determination which captures the proportion of variation explained by the PVAR specification.*

instruments in GMM estimation. Based on the selection of optimal lags, the variation of trade openness is explained by the first lag order of its self and $CO_2$ emissions included as instruments. Results indicate that the first lag of trade openness and $CO_2$emissions exert a positive impact on trade openness at 1% and 5% levels of significance respectively. This suggests that an increase in $CO_2$ emissions leads to increased the degree of trade openness. However, regarding factors affecting $CO_2$ emissions equation, while the first lag of $CO_2$ emissions has a positive effect on $CO_2$ emissions at 1% level of significance, trade openness positively but insignificantly impacts on CO2 emissions even at 10% level of significance. This can be explained that there is only a short-term relationship between trade openness and $CO_2$ emissions, but there is no long-term relationship between them (Naranpanawa, 2011). In addition, this finding is in line with environmental economists perspective that trade openness has a negative impact on environmental quality in developing countries. Especially developed countries tend to invest in dirty industries in host countries that can worsen environmental quality (Hakimi & Hamdi, 2016). However, the empirical findings are not consistent with the study of Al-Mulali et al. (2015) that increased trade openness has led to reduced $CO_2$ emissions. In summary, the results from the study contradict previous assumptions that trade openness improves environmental quality by reducing the growth of pollutants. In the opposite direction, an increase in $CO_2$ emissions results in increased trade openness between countries.

**Table 4**: *Estimation results of the panel vector of autoregression from Systerm-GMM between trade openness and CO2 emissions*

| | $LnOP_{t-1}$ | $LnCO2_{t-1}$ |
|---|---|---|
| $LnOP_t$ | 0.5604824 (0.1018361)*** | 0.1164072 (0.0492937)** |
| $LnCO2_t$ | 0.0983603 (0.1382889) | 0.9915564 (0.069923)*** |
| No of countries | 53 | |
| Observations | 1007 | |
| Time period | 19 | |

*Note: The study utilized the System-GMM method to estimate the first-order panel VAR specification with the same specification of instruments in investigating the relationship between trade openness and carbon dioxide emissions; fixed effects and country's characteristics are eliminated; Robust standard errors are in parentheses; and*

*, **, *** *denote the rejection of the null hypothesis at 10%, 5% and 1% level of significance respectively.*

The compelling evidence from Table 5 shows that the factors influence trade openness and PM2.5

driving from panel VAR approach included the first lag of PM2.5 and trade openness due to the selection of optimal lags. Accordingly, the first lag of PM2.5 and trade openness exerts significant impacts on trade openness at 1% level of significance. It is worth noting that PM2.5 has a negative effect on trade openness. This implies that air quality should be considered an important issue in creating trade policies in developing countries. The finding supports to the notion that countries with higher levels of air pollution tend to reduce the degree of trade openness. Regarding the determinants of PM2.5 as measured environmental quality, there is an insignificant relationship between trade openness and PM2.5. However, the sign of the coefficient is negative, thus trade openness impedes environmental quality in developing countries. The finding does not support the popular notion that rich countries often dump their pollutants to poor ones. The negative but insignificant relationship between PM2.5 and trade openness can be explained that trade liberalization has a multidimensional impact on environmental quality. In which, they have both negative and positive effects of environmental quality (Antweiler et al., 2001). Therefore, the relationship between trade openness and the environment is inconclusive when combined all channels (Dean, 2002). Furthermore, the empirical results are not in line with the conclusion from the study of (Antweiler et al., 2001) that freer trade appears to be good for the environment in overall. In summary, while PM2.5 has a negative effect to trade openness, the trade openness exerts a negative but insignificant impact on particulate matter PM 2.5.

Results of the panel Granger causality tests the interrelationship of the variables are reported in Table 6. Accordingly, results show that there is only a one-way causal relationship running from CO2 emissions to trade openness, whereas trade openness does not Granger-causes CO2 emissions in developing countries. Besides, the results of the Granger causality also show that PM2.5 Granger-causes trade openness, while there is no causal relationship in the opposite direction. This implies that trade openness does not Granger-cause environmental quality in developing countries. This finding provides further compelling evidence to support the conclusion of Shahbaz, Tiwari & Nasir (2013). Additionally, the results from the panel Granger causality test are consistent with the estimated results from the panel VAR approach. Specifically, there is one-way causal direction between environmental quality as measured CO2 emissions and PM 2.5 and trade openness.

**4. Concluding remarks and implications**

The question is whether the linkage between trade openness or free trade and environmental quality has been becoming a dominant issue of international debates and discussion related to global warming and environmental pollution among the environmentalists and economists. Although a number of empirical studies explore the relationship between trade openness and environmental quality, the empirical results are relatively inconclusive and controversial in recent years. The main reason is due to differences in sample sizes,

**Table 5**: *Estimation results of the panel vector of autoregression from System-GMM between trade openness and PM2.5*

| | $LnOP_{t-1}$ | $LnPM2.5_{t-1}$ |
|---|---|---|
| $LnOP_t$ | 0.6044997<br>$(0.1725785)^{***}$ | -0.8743686<br>$(0.1804696)^{***}$ |
| $LnPM2.5_t$ | -0.0059762<br>(0.1217757) | 1.183848<br>$(0.117576)^{***}$ |
| No of countries | 53 | |
| Observations | 265 | |
| Time period | 5 | |

*Note: The study utilized the System-GMM method to estimate the first-order panel VAR specification with the same specification of instruments in investigating the relationship between trade openness and environmental quality; fixed effects and country's characteristics are eliminated; Robust standard errors are in parentheses; and*

**, **, *** denote the rejection of the null hypothesis at 10%, 5% and 1% level of significance respectively.*

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**Table 6**: *Panel Granger causality results*

| Causality direction → | Chi 2 | P_value |
|---|---|---|
| LnOPLnPM2.5 → | 0.002 | 0.961 |
| LnPM2.5LnOP → | 23.474 | 0.000 |
| LnOPLnCO2 → | 0.506 | 0.477 |
| $LnCO_2LnOP$ → | 5.577 | 0.018 |

*Note: The research based on the panel Granger causality tests; Values of P_values for Wald tests with the optimal lags selected from three statistical criteria namely MAIC, MBIC andMQIC;H0: excluded variable does not Granger-cause equation variable*

**, **, *** denote the rejection of the null hypothesis at 10%, 5% and 1% level of significance respectively;*

*the direction of Granger causality running from*

methodologies, the selection of indicators as measured environmental quality and trade openness. Furthermore, prior studies have been neglected to investigate the relationship in developing countries. Therefore, to fill this gaps and enrich the literature, the paper, for the first time, examine the relationship between trade openness and environmental quality in developing countries over the period 1991-2016 by employed the most recent technique namely the panel vector of autoregression (PVAR). The main results of the study from 53 developing countries are: First, there is only one-way causal relationship from PM 2.5 to trade openness. Similarly, there is also only one-way causal relationship from CO2 emissions to trade openness. Second, the results from the GMM method to estimate the linkage between environmental quality and trade openness through the PVAR model indicate that there is no evidence of the impact of trade on environmental quality. Third, environmental quality exerts a significant impact on trade openness. Specifically, while CO2 emissions have a positive impact on trade openness, there is a negative relationship between PM2.5 and trade openness. Therefore, the paper suggests that to maximize benefits from trade liberalization for sustainable economic development, countries should invest in the clean and friendly energy usages replacing traditional fossil sources to improve environmental quality that directly attracts foreign investors. Future research may consider expanding the scope of the study to all countries in the world and increasing sample sizes with up-to-date a dataset and using various indicators of environmental quality.◆

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**Summary**

Độ mở thương mại ảnh hưởng xấu hay tốt đối với môi trường? Vấn đề này đang là mối quan tâm lớn trong các cuộc tranh luận quốc tế về biến đổi khí hậu và ô nhiễm môi trường. Các kết quả từ lý thuyết và các nghiên cứu thực nghiệm trước đó chưa thuyết phục và gây tranh cãi về mối quan hệ tổng thể giữa thương mại và chất lượng môi trường. Mục đích của bài viết này nhằm ước lượng mối liên kết giữa độ mở thương mại và chất lượng môi trường tại 53 quốc gia đang phát triển trong giai đoạn 1991-2016. Cụ thể, nghiên cứu đánh giá mối quan hệ giữa độ mở thương mại và khí thải CO2 từ 1991 đến 2014 và giữa độ mở thương mại và bụi PM2.5 từ 2010 đến 2016 thông qua mô hình PVAR và phương pháp GMM. Kết quả chỉ ra rằng chỉ có mối quan hệ nhân quả một chiều phát sinh từ khí thải CO2 và bụi PM2.5 đến độ mở thương mại. Tuy nhiên, không có bằng chứng về tác động của độ mở thương mại đến chất lượng môi trường ở các quốc gia đang phát triển. Do đó, các nhà hoạch định chính sách ở các quốc gia đang phát triển nên chú trọng kiểm soát chất lượng môi trường thông qua sử dụng hiệu quả các nguồn năng lượng xanh để duy trì tăng trưởng bền vững trong bối cảnh hội nhập kinh tế quốc tế.

**TRAN VAN NGUYEN**

***1. Personal Profile:***

- Name: ***Tran Van Nguyen***
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