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Export Diversification and Its Environmental Effects in Iran

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Abstract
Investigating the effect of foreign trade on emissions of pollution is a topic that has been extensively studied in empirical research. In recent years, however, some researchers have shown that not only the quantitative development of trade but also its diversity can have significant environmental effects. For this reason, this study examines the long-term effect and short-run dynamics of export diversification along with trade openness, as the two main components of trade, on the emission of pollution in Iran during the period 1984-2016 using the Auto Regressive Distributed Lag (ARDL) model. Based on the findings of the estimation in the long run, trade openness and energy consumption have had a positive effect on emissions of pollution, but diversification of exports has reduced emissions. In addition, the negative coefficient of the interaction effect of trade openness and export diversification in the model indicates that export diversification can reduce the impact of trade openness on emissions of pollution, which can be one of the desirable effects of diversification in the export basket. The results of the error correction model also show the negative effect of export diversification growth on pollution growth, with a one-period delay. Also, the coefficient of error correction term indicates high speed of adjustment toward long-term equilibrium.

Keywords: Export diversification, Trade openness, Emissions of pollution, CO2, ARDL.

JEL Classification: F18, Q56, Q50, Q43, F41.

1. Introduction
One of the major challenges facing the global economy is environmental pollution. Most of the environmental problems are caused by the emission of greenhouse gases, especially carbon dioxide, into the Earth's atmosphere. According to the findings of most experimental studies, one of the most important variables that have a significant effect on the environment is foreign trade. The impact of trade on the environment can depend on how the country's trade develops. Therefore, not only the volume of trade but also diversification of export products can also significantly affect CO2 emissions. Trying to add new products to the export basket can lead to changes in CO2 emissions based on the type of export development and the level of development of the country (Gozgor and Can, 2016). About the impact of these variables on emissions, there is no consensus among researchers; On the one hand, diversifying exports from

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traditional primary products to industrial products can increase emissions, and on the other hand, creating more stability in export revenues and achieving higher development can increase attention to environmental considerations. Since export diversification is a strategy for achieving higher and more sustainable incomes in these countries, they should also consider the impact of the resulting environmental pollution. Therefore, addressing this issue in Iran removes the ambiguities regarding the effect of export diversification policy.

2. Literature

In general, the effects of trade openness on the environment can be summarized in three types of effects: scale effect, technology effect and composition effect. Based on the scale effect, = the expansion of trade increases the production and consumption of resources, and that environmental pollution increases accordingly (Mutascu, 2018).

In technology effect, trade transfers modern knowledge and technologies from developed to developing countries. Due to the fact that these technologies are more efficient and have less pollution in the production process, they lead to improving the quality of the environment (Stern, 2004).

The composition effect refers to a change in the structure of production and comparative advantages, such as a change from the production of basic goods (such as mining and agriculture) to industrial activities. Different industries have different levels of pollution and in the process of business development, the composition of production and resource allocation changes. If a country has a comparative advantage in the production of polluting goods, trade will increase pollution and reduce the quality of the environment. On the other hand, if the composition of production changes in favor of using less polluting sources, it will lead to a reduction in environmental pollution (Adewuyi & Awodumi, 2018).

New literature emphasizes the type and variety of trade rather than volume. In addition to expanding trade, the diversity of export products can also significantly affect CO2 emissions, as efforts to add new products to the export basket change the composition of CO2 production and emissions (Gozgor and Can, 2016).

Having more distinctive products in a country's export basket can indicate the aggregated knowledge and ability to use innovations in the production structure of that country. This enables the country to experience higher productivity in its production activities and reduce energy consumption for a certain amount of production. The quality of the environment in such countries can be improved due to the benefit of higher knowledge and technology.

What is important in the impact of export diversification on CO2 emissions is how the export basket can be diversified. If the diversity created is in favor of producing less polluting goods, the result can be in favor of environmental quality.

The first article which studies the effect of export diversification on pollution is Gozgor and Can (2016). The results of their study showed that higher diversity of exports in Turkey led to more CO2 emissions in the long run. Adewuyi and Awodumi (2018) examined the effect of export diversification on pollution in Nigeria. Based on ARDL model the results revealed that export market diversification had a significant positive effect on total carbon emissions in the long run. Apergis et al. (2018) provide evidence on the short- and the long-term effects of the export product concentration on CO2 emissions in 19 developed economies. The findings illustrate that a higher level of the product concentration of exports leads to lower CO2 emissions. Liu et al. (2019) examined the effect of trade and export diversification on CO2 emissions in 125 countries. The results of this study show that export diversity in both markets and products helps reduce pollution emissions.

3. Model

In this paper, logarithm of carbon dioxide emissions (LCO2) are considered as a function of explanatory variables including logarithm of GDP per capita (Ly), logarithm of energy per capita (LE), logarithm of trade openness (LTO) and export diversification index (Div).

$$LCO2_t = f(Ly_t . LE_t . LTO_t . Div_t . LTO_t \times Div_t) \quad (1)$$

An Autoregressive Distributed Lag (ARDL) model was used to estimate this equation, and to investigate the short-run and long-run relationships between the variables.

4. Empirical Results

First, it is necessary to evaluate the degree of stationary of the variables. The generalized Dickey- Fuller test (ADF) was used for this purpose. Table (1) presents the stationary test results.

Table 1: Unit-Root Test

Variables	Test stats for level of variables	Test stats for first order difference
LCO2	-0.36	-7.06
LE	-0.05	-8.28
Ly	-0.91	-5.33
LTO	-1.08	-4.82
Div	-2.73	-6.73
Note: The critical value at 95% level is -2.94		

Source: Results of this research

The results of this test show that all variables are I (1). Therefore, none of the variables is I(2) and the bound test can be used to examine the co-integration and existence of a long-run relationship between variables.

The results of the bound test are reported in Table (2). As the results show, the F statistic is higher than the critical value at 95% confidence levels and a long-term relationship between the variables can be confirmed.

Table 2: The results of the bound test

F statistic	Critical value at 95% confidence level		Critical value at 90% confidence level	
4.430	Lower bound	Upper bound	Lower bound	Upper bound
	2.39	3.38	2.08	3

Source: Results of this study

To estimate the long-run coefficients as well as the ECM model, an ARDL model (1,2,0,1,2,0) was determined as the optimal model, in which due to the small sample size, the number of lags was selected based on the Schwartz-Bayesian criterion.

Table 3: The results of long-run coefficients estimation

Variables	**Coefficients**	**t**
Intercept	2.208***	2.795
LE	0.887***	11.750
Ly	0.168	1.397
LTO	0.560**	2.243
Div	-0.881**	-2.678
LTO*Div	-1.050**	-2.579

***Significant at 99% level, ** Significant at 95% level and * Significant at 90% level
Source: Results of this research

The results obtained from estimating the model confirm the positive effect of energy consumption on the emission of pollution in the long run. In Iran, a major share of energy consumption is fossil fuels, which are the main source of CO2 emissions. Therefore, with more energy consumption, CO2 emissions increase. The coefficient of trade openness is positive and significant. This means that the expansion of foreign trade in the period under review has increased the emission of pollutants and damage to the environment. In developing countries such as Iran, due to the lack and improper implementation of environmental laws, foreign trade expansion has been tilted towards using energy requiring processes and more polluting industries, which makes these countries a haven for pollution.

The estimated negative coefficient of export diversification indicates that diversity in exports can reduce carbon dioxide emissions. On the other hand, the coefficient related to the interactive effect of this index on trade openness, which indicates its indirect effect by changing the trade openness coefficient, is negative. In fact, the final effect of trade openness on CO2 can be obtained based on the following equation.

$$\frac{\partial LCO2_t}{\partial LTO_t} = 0.560 - (1.050 \times Div_t)$$

As it can be observed, as the export diversification index approaches one, the trade openness coefficient decreases and if it is approximately greater than 0.53, it can lead to a negative final coefficient. However, it should be noted that the export diversification index for Iran is far from this number.

After examining the long-run equilibrium relationship, we can estimate the short-term dynamics, which is interpreted as the ECM. The coefficients of this model are given in Table 4.

Table 4: ECM Estimation Results

Variables	Coefficients	t
D(LE)	0.551***	4.326
D(LE(-1))	-0.124**	-2.330
D(LTO)	0.143	1.622
D(DIV)	0.100	0.803
D(DIV(-1))	-0.473***	-3.523
Ecm(-1)	-0.721***	-7.214

***Significant at 99% level, ** Significant at 95% level and * Significant at 90% level
Source: Results of this research

What is more important in the error correction model is the coefficient of the ecm term, which shows the speed of adjustment of the imbalance process. According to the results, this coefficient was equal to -0.721, which means that in each year, 72% of the short-run imbalances are corrected and move towards long-run equilibrium.

Also, the results of Cumulative Sum (CUSUM) and Cumulative Sum of Square (CUSUMQ) tests are presented in Figure 1. The findings of these two tests point to the stability of the estimated coefficients.

Finally, the results of diagnostic tests are indicative of the reliability of the model coefficients.

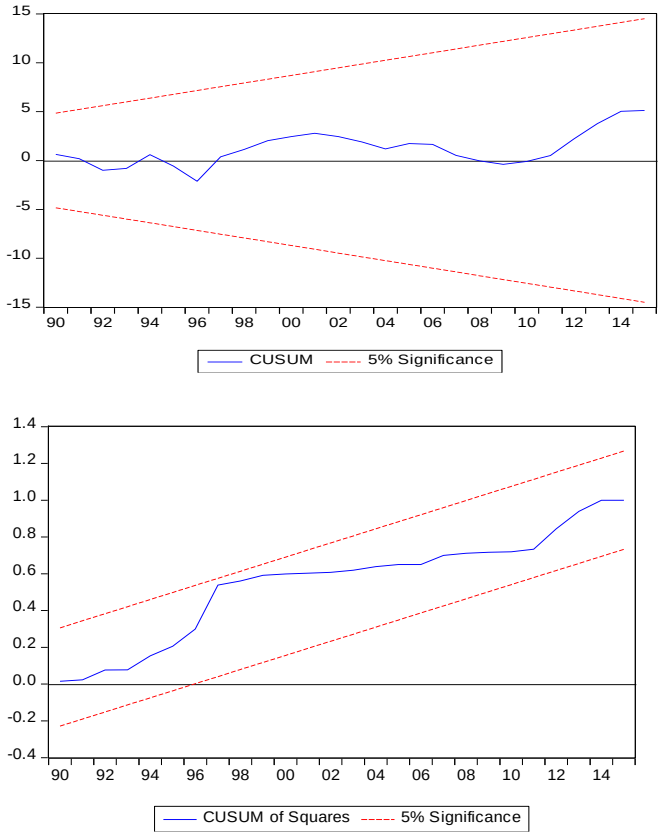

Fig. 1: CUSUM and CUSUMQ tests results

5. Conclusion

This study investigated the effect of two important components of trade, namely trade openness and export diversification, on the emission of pollution in Iran during the period 1984-2016. According to the findings of this study, trade openness has increased pollution in this period. It seems that due to various restrictions on the expansion of trade, less attention has been paid to environmental considerations and this has led to an increase in pollution. Since Iran's exports are highly concentrated on the oil, gas and petrochemical sectors and these sectors are highly polluting, diversifying the export has been able to reduce CO2 emissions. In addition, export diversification can reduce the impact of trade openness on emissions, which can be due to the positive effect of diversifying the export basket. Accordingly, the direction and size of trade openness effect depend on the diversity of the country's exports. Thus, creating diversity in the export basket, especially if it is in line with using the potentials of other less polluting sectors, can help to improve the quality of the environment.

References

Adewuyi, A. O., & Awodumi, O. B. (2018). Analysis of the Environmental Pollution Effect of Nigeria's Export Diversification Drive. *The Nigerian journal of economic and social studies.*

Apergis, N., Can, M., Gozgor, G., & Lau, C. K. M. (2018). Effects of export concentration on CO 2 emissions in developed countries: an empirical analysis. *Environmental Science and Pollution Research*, *25*(14), 14106-14116.

Gozgor, G., & Can, M. (2016). Export product diversification and the environmental Kuznets curve: evidence from Turkey. *Environmental Science and Pollution Research*, *23*(21), 21594-21603.

Liu, H., Kim, H., & Choe, J. (2019). Export diversification, CO 2 emissions and EKC: panel data analysis of 125 countries. *Asia-Pacific Journal of Regional Science*, *3*(2), 361-393.

Mutascu, M. (2018). A time-frequency analysis of trade openness and CO2 emissions in France. *Energy policy*, *115*, 443-455.

Stern, D. I. (2004). The rise and fall of the environmental Kuznets curve. *World development*, *32*(8), 1419-1439.