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IMPACT OF ENERGY CONSUMPTION AND TRADE ON CO_2 EMISSION IN PAKISTAN

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ABSTRACT

Trade openness is the foundation of economic growth for developed as well as underdeveloped countries. Many countries are now trying to promote their energy sector because energy is an important factor in the production process. A country can trade with other countries only if the country has a surplus of production of Goods and Services. This is the key factor for the development of a country. This study provides empirical evidence of energy use and trade openness on carbon dioxide emission in Pakistan's economy by using annual time series data from 1976-to 2019. Augmented Dickey-Fuller and Philips Perron tests are employed to check the stationary of the variables, and the ARDL method is employed to check the long-run relationship of variables. The result explores the effect of energy on the trade openness of Pakistan. Trade is the most significant variable in both the long run and short run. The CO_2 (Carbon Dioxide) becomes the cause of environmental degradation. This study recommends that government must take serious steps regarding trade policies in Pakistan. Government must also take care of the poor farmers and traders through subsidies. With good policy implications, the trade level of a country will increase.

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INTRODUCTION

Energy consumption is the most important factor which affects economic development. The factors which affect economic growth are increased in both developed as well as developing countries. Environmental squalor is due to the severe use of energy factors like coal and oil. Environment degradation is the key problem for both developed countries and under-developed countries. The other factor that affects the growth of the economy is trade openness. Trade openness also plays a very substantial role in the development or economic growth of a country. The connection between the use of energy and trade has been a very important issue in the last few years. The effect of trade on energy depends upon the economic condition of a country. Trade openness enhances the economic development of a country. In fact, trade is a crucial factor in endorsing economic development. In the long run, trade helps to increase the economic growth of an economy by providing access to goods and services. Trade openness also helps to allocate the natural or other resources and to increase the productivity of factors. Whenever there is a rise in demand for goods and services, it always places pressure to increase the export and import level to enhance the trade level. So, a country with a high trade level has good economic development. Trade openness also helps to increase technological advancement. With the help of trade openness, developed economies can raise their output and can import surplus, and also developed countries can import their advanced technology to the underdeveloped countries. With the passage of time, rise in trade openness would increase economic growth through technological advancement, improving productivity, competitiveness at the international level, and export revenues. But on the other side, trade openness has negative effects on developing countries. Some economists researched that there are significant effects of trade on economic growth (Easterly and Levine, 2001; Musila and Yiheyis, 2015). While other economists, such as Harrison and Hanson (1999) and Tekin (2012) said that there is no positive relation between trade and economic development. Vlastou (2010) also found a negative effect of trade on economic development.

Energy use is directly affected by individual consumption and industrial consumption. As understood that energy is used in the production of goods and services, a rise in the demand for goods and services will enhance energy use. An increase in production leads to increased demand for labor and capital. So people will have the opportunity to get jobs. Their lives style will also improve. So the economic growth of a country will also increase. But due to high increase in the level of energy consumption, and this will affect the

environment badly, so we can't ignore the negative side of energy consumption to produce goods.

In the economic world, energy is used in the production of goods and services. However, the industrial sector is always struggling with international trading and energy; these are the main components that are mostly used in the industrial sector for production. That's why trade and energy are considered as most extensively researched in the economics world. Oil is the main energy factor that runs economic activities. Therefore, the continuous supply of oil is very important for the economic growth of a country. Natural gas is also an important energy source and a very important factor in the production of goods and services. Furthermore, it is simple to understand that oil and gas are the main sources that make up about 60% of the global energy demand all over the world. When any country wants to develop, that country must increase its trade and use of energy factors like oil, coal, and gas. These energy factors may harm the environment of a country. Keeping in view the above discussion, this study addresses the effects of trade and energy consumption on CO_2 emissions in Pakistan. The objective of this research is (i) to investigate how trade openness will affect the environment, (ii) to investigate how Energy consumption affects the environment of Pakistan, and lastly give some policy recommendations based on the findings.

Energy use is one of the most important factors of production and has a major contribution on economic growth like capital and labor. There are following economics studies will discuss in this paper. Burakov (2018) determined the effect of energy use and international trade in the presence of exchange rate and FDI for Union State of Russia and Belarus from 1997-2017. Authors used the methodology of Error Correction Approach.

Hasson and Masih (2017) analyzed the relationship between energy uses, electricity consumption, and carbon emission in South African trade. The authors used the data from 1971-2013. Lean and Smyth (2010) Aimed to find the impact of electricity use on GDP in case of Bhutan. To find the relationship, they used the data from 1980-2013. Authors also used the granger test to build the result. Their result shows that electricity has a positive impact. Fotros and Maaboudi (2010) explored the negative impact of trade openness on the environment. Their study was about Iran and he took data from 1971-2005. The authors utilized the GMM model to check the result. The results were significant between trade and CO_2. Safaynikou and Shadmehri (2014) explored the effect of trade openness and financial and economic development on energy use. For this purpose, authors used data from 1967-2010 for Iran. The authors found their results by using ARDL test and the result shows positive effects of trade and GDP (Gross Domestic Product) on energy consumption.

Keho (2017) analysed the relationship between trade openness and development by using the data for the time of 1965-2014. Authors used economic output as a dependent variable and capital, labour force, and technology as for independent variables. To find the results authors used the Autoregressive distribution Lag test, and the results were positively significant. Cevik et al. (2019) examined the impact of trade openness and economic growth. Authors used the data of Turkey for the time from 1950 to 2014. Authors used the GDP, trade, capital stock, labor, expenditure, and term of trade as dependent and independent variables. Sineviciene et al. (2017) examined the link between energy and sustainable development of the economy. The authors used data from 11 post-communist economies; they used the data from 1996-2013. Authors use energy efficiency as a dependent variable and GDP, prices of oil and gas, carbon emission, exportable technology, gross fixed capital, and dummy variables as independent variables. Authors investigated by using the method of stochastic frontier function approach and the results were positively significant for energy efficiency and the development of an economy. Shahbaz et al. (2014) determined the effects of trade and energy consumption, and financial development on growth. The authors collected the data from china for the time period 1971-2011. Domestic output was used as a dependent variable and energy, capital, and labour data were used as independent variables. Authors use ARDL bounds testing approach, and the results showed the positive impact of trade, energy use and finance on economic growth.

Alkhateeb and Mahmood (2019) explored the effect of trade openness and energy use on the development of Egypt. Authors analyzed the data from 1971-2014. Authors also used the Heckcher Ohlin theory to explain how to increase trade. The method they use for this purpose is non-linear ARDL cointegration. Authors explain in their results that trade openness has balanced effects on energy consumption, which means positive and negative impact of trade on energy. The study explained that the negative effect could happen in the long run. Parsa and Sajjadi (2017) discussed the relationship between trade openness and energy consumption and their impact on Iran's economic growth. Authors collected data from 1967-2012 for the analysis. Authors also followed the theory of Bayer and Hanck (2013). Study used the method of Variance Decomposition and impulse respose function method. Authors found the bidirectional results among energy, trade, and growth but also unidirectional Granger from trade openness on growth.

Afghah et al. (2015) examined the relationship between trade and energy for 70 countries by using the data from 1980-2010. Author used energy as a dependent, while GDP, trade and price of energy as independent variables. To find the results authors used the penal unit root test. The author's result shows that less use of energy has a negative impact on trade openness. Raza et al. (2015) discussed the impact of energy, growth rate and trade on Pakistan. Authors used the data from 1973-2013 and the nature of the data was time series. Authors used energy consumption as a dependent variable while GDP, export and import value and per capita income as independent variables. To find the results authors used the ARDL model and results showed that the energy policies have a negative impact on trade level. Due to this negative impact, economic growth is also reduced. Brini et al. (2017) explored the relationship between energy, trade, oil prices and Economic growth. Data used for Tunisia from the time period of 1980-2011. Authors used GDP as dependent variable while energy, oil prices, exports and imports as independent variables. For this purpose, the authors used the bound test approach, co-integration and ARDL method to get the results. Authors find the result, rise in oil prices will raise to the use of energy and

the unidirectional relationship between them. Tahir and Khan (2014) explored the effects of trade on economic development. The authors used the data for the Asian region. GDP was used as a dependent variable, while capital formation, labour force, institutional aspect, and education were used as independent variables. The author used an empirical test and two stages least square method. The author's result showed the positive and significant impact of trade and growth, and there was also an effect on education and economic development.

Idris et al. (2016) determined the effect of trade on the development of the economy. The authors used data for 87 countries from 1997 to 2011. They used GDP as a dependent variable while trade and real trade openness as independent variables. The author applied GMM and the dynamic penal estimation method. The result showed a positive impact on underdeveloped and OECD countries. Siddique and Majeed (2015) discussed the effect of energy use and trade on economic development by using the data for five South Asian countries from 1980 to 2010. Authors used output as the dependent variable and capital and labour as independent variables. The used method was panel cointegration, Granger and PMG methods. Results showed a positive relationship between energy, trade and economic development. Zeshan and Ahmed (2013) explained the effect of energy use, GDP and economic growth, stock and labor force in case of Pakistan. Authors used the data from 1971-2012. Vector time series as dependent variable and value of matrix lagged value as an independent variable. Authors used SVAR (structural auto-regression model) and found a positive relationship.

Gbadebo and Okonkwo (2009) explored the effect of energy consumption on economic development. Authors collected data from 1970 to 2005 for Nigeria. Output was used as a dependent variable, while gross fixed formation, labour force and energy were used as independent variables. Authors used the co-integration test and the results showed the relationship of energy use and the development of the economy. Bourdon et al. (2018) explored the effect of trade on the economy. They collected data for 169 countries from 1988-2014. Authors used GDP as dependent variable and education, population, birth rate, investment and export level as independent variables. Authors used the generalized moment estimator method to find the results. The result shows the negative linkage among the variables. Pandey and Rastogi (2019) examined the effects of energy consumption and the economic growth of an economy. Author studied about Indian economy, and they collected data from 1971 to 2017. Authors used GDP as a dependent variable and electricity and carbon emission as independent variables. Authors estimated their data by using the Dicky Fuller, Johansen co-integration and Granger test. The result showed that a reduction in carbon emission increases economic growth.

Kostyannikova (2012) determined energy use and economic development. Author collected data for 21 OECD countries from 1965 to 2011. Real GDP was selected as a dependent variable while oil, gas, and coal as independent variables. Author used Toda and Yamamoto procedure and Bounds test. The results showed that there is a unidirectional relationship between energy and economic development. Ben Jebli and Ben Youssef (2013) discussed the impact of energy, trade, and its effects on development. Authors studied five North African countries and collected data from 1980 to 2009. For testing authors assumed output as a dependent variable and capital, energy, trade level, and country's specific as independent variables. The authors used penal co-integration and unit root test and the result shows that trade openness is not beneficial for these countries.

METHODOLOGY

This paper focuses on the data of four variables, CO_2 (Carbon Dioxide) emission, energy use (per capita), gross domestic product, and trade for the time period of 1976 to 2019 for the economy of Pakistan. The secondary data of all variables were collected from WDI (World Development Indicators). This empirical model is used in which trade openness, energy use, and GDP are the functions of CO_2 (Carbon Dioxide) emission. Below is the combined and Standard equation form of the model.

$$CO_2 = \beta_0 + \beta_1 TO + \beta_2 GDP + \beta_3 EU + \mu \quad (1)$$

Where;

CO_2: CO_2 (Carbon Dioxide), EU: Energy use (per capita), T: Trade openness, GDP: gross domestic product and μ: Residual term.

CO_2 (Carbon Dioxide) emission was used as a dependent variable, and trade, gross domestic product, and energy use were used as independent variables. The study used ARDL model to find the relationship among variables.

To find the results for the empirical model (ARDL) Auto Regressive Distributive Lagged and Phillips Perron techniques are used, and for unit root test, Augmented Dicky Fuller (ADF) is used.

Augmented Dicky Fuller (Unit root test)

ADF is named for American statisticians David Dickey and Wayne Fuller, who developed the test in 1979; the Dickey-Fuller test is used to determine whether a unit root is a feature that can cause issues in statistical inference, is present in an autoregressive model. The formula is appropriate for trending time series like asset prices. It is the simplest approach to test for a unit root, but most economic and financial time series have a more complicated and dynamic structure than can be captured by a simple autoregressive model, which is where the augmented Dickey-Fuller test comes into play. The general ADF equation is given below.

$$\Delta Y_t = \alpha_0 + p_1 Y_{t-1} + \alpha_2 T + \sum_{i=1}^{k} \alpha_i \Delta Y_{t-i} + \mu_t \quad (2)$$

Philips Perron test

In statistics, Phillips Perron test (Phillips and Perron,1988) is a unit root test. That is used to test null hypothesis that a time series is integrated of order 1. It builds on Dicky Fuller test of the null hypothesis in which the first difference operator.

Following is the equation of Philips Perron test.

$$y = c + \delta t + \partial y t - 1 + e(t) \quad (3)$$

ARDL Model Estimation

When some variables are stationary on level and some are on 1st difference 2nd difference, then co-integration cannot be used to calculate the results, then ARDL is the best method to

estimate the long-run relation. The following equation is the estimation of ARDL technique.

$$\Delta lnCO_2 = \alpha + b_{11} lnTO^{\,t-i} + b_{21} GDP^{\,t-i} + b_{31} lnEU^{\,t-i} + \sum_{i=1}^{n} \alpha_{1i} \Delta lnCO_2{}^{\,t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta lnTO^{\,t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta GDP^{\,t-i} + \sum_{i=1}^{n} \alpha_{4i} \Delta lnEU^{\,t-i} + e^{t} \quad (4)$$

ARDL bounds testing

ARDL approach is a co-integration method developed by Pesaran et al. (2001) to test the presence of the long-run relationship between the variables. "This procedure, a relatively new method, has many advantages over the classical co-integration tests. Firstly, the approach is used irrespective of whether the series is I (0) or I (1).

Diagnostic Testing

Diagnostic testing is used to check the autocorrelation; in this paper ARDL model estimates Serial correlation LM test is used to check the autocorrelation. Serial correlation is the relationship between a variable and a lagged version of itself over various time intervals. Repeating patterns often show serial correlation when the level of a variable affects its future level.

Stability Diagnostics

In this paper, CUSUM and CUSUM square is used to check the stability of the data and model. The CUSUM test (Brown et al., 1975) is based on the cumulative sum of the recursive residuals. CUSUM and CUSUM square test provides the plots of the variable between the two lines of a 5% significant level; if the variable plot crossed these lines, it means that there is some structural break in data over the time period. Detail of all variables used in this study is given below.

CO_2 (Carbon Dioxide) Emission: Carbon dioxide emissions or CO_2 emissions are emissions stemming from the burning of fuels and the manufacture of different fossil goods. Include carbon dioxide produced during the consumption of solid, liquid, and gas fuel.

***Energy Use*:** The most important measure in the energy use of Pakistan is the total consumption of energy. 92.33 bn kWh of electric energy use per year. This is the average of 426 kWh of per capita. Pakistan can provide itself completely with self-produced energy. This paper use energy as the independent variable and the data collects from 1996 to 2019 for estimation.

***Trade Openness*:** Trade openness, exports plus imports of Pakistan as a percent of GDP is called trade openness. The average value of Pakistan during the time-period of 1972 was 29.56 percent with minimum of 15.82 percent and a maximum of 38.5 percent in 1993. The latest value from the time period of 2019 was 30.44 percent.

***GDP (Gross Domestic Product)*:** Gross domestic product is the monetary market value of all the final goods and services produced in a specific time period in a country. The gross domestic product can measure in three ways; all method gives the same results.

RESULTS AND DISCUSSION

Different researchers used different methods to estimate the results of their work. Estimation techniques for the model are based on the Unit Root Test, which is used to square the stationary of the data. Data can be stationary on level, 1st difference, and 2nd difference, and it can be checked on intercept, trend, or intercept or none, based on the data type.

Unit Root Test

This paper uses the Augment Dickey-Fuller test and Phillips Perron tests for the unit root test. The expanded Dickey-Fuller measurement utilized in the ADF test is a negative number, and the more negative it is, the more grounded the dismissal of the theory that there is a unit root. Table 1 explains that both ADF and PP. The results present that variables like energy use and trade openness are not stationary at level but stationary on 1st difference.

Table 1. Unit Root Test.

Variables	ADF t-Statistics (at level)	ADF t-Statistics (at 1st diff)	PP t-Statistics (at level)	PP t- Statistics (at 1stt diff)
lnCO2	-4.38*	-6.33*	-4.56*	-6.51*
GDP	-4.79*	-4.79*	-4.83*	-12.12*
lnEU	-2.76	-4.61*	-2.66	-4.69*
lnT	-2.52	-6.46*	-2.59	-6.47*

*Shows significance level at 1%.

On the other hand, CO_2 emission and GDP are stationary at a level while energy (per capita) is stationary at 1st difference. So that is why this study will apply the ARDL method test. Before that paper will apply the bound test and check the short-run and long-run co-integration. For long-run and the short run relationship, we must know the value of F-statistics.

Auto Regressive Distributive Model (ARDL) Lag Selection

This paper use Schwarz Bayesian Criteria (SBC) for the selection of the lag length of all those variables which ii used in the ARDL model. Table 3 shows the long-run relationship of the ARDL (4, 4, 3, 0) by using SBC.

Bound Testing Approach

A bound test is applied to check the long-run relationship between the variables. For decision, if F-statistics is lower than the lower bound value, then no long-run relationship. If greater than there is a long-run relationship and if it lies between both critical values, then there are no decision criteria. As the value of the F stat given in Table 2 is greater

than the upper bound value, so there exists a long-run relationship between the variables.

ARDL Long Run and Short Run Representation

From Table 3, we can see that the coefficient of trade is a positive but insignificant factor of CO_2 emission in the long run. The coefficient of energy use affects CO_2 positively and significantly, as 1% increase in EU will lead to an increase 2.77 units of CO_2 emission in the long run. Similar results were given by Begum et al. (2015) and Sasana and Putri (2018); GDP is also a positive and significant contributing factor to CO_2 emission.

Table 2. Bound test.

Order of lag	F statistics
4	6.74

Table 3. Long run coefficient ARDL of (4, 4, 3, 0) model.

Dependent variable is Carbon Dioxide (CO_2) emission			
Regression Variables	Coefficient	Standard Error	t-statistics
Ln (T)	0.20	0.24	0.86*
Ln (EU)	2.77	0.38	4.01**
GDP	0.17	0.04	4.01**
C	-5.44	2.57	-2.11*

* shows insignificance at 1% level and **shows significance 5% level.

According to the results given in Table 4 shows the error correction representation of the selected ARDL model. The results show that in the short run, trade is a positive and significant contributing factor to CO_2. A 1 percent increase in trade will leads to an increase in CO_2 emission by 9.1 percent. Similar results were concluded by Shahbaz et al. (2014). Energy use is also a positive significance factor of CO_2 emission. The coefficient of GDP is the same as in the previous case of the long-run model. The value of R^2 in this model is relatively good. Durbin Watson statistics show there is no problem with autocorrelation in this model. F stat also indicates that the overall model is good explanatory power.

Table 4. Short run representation of the selected ARDL of (4, 4, 3, 0).

Dependent variable is Carbon Dioxide (CO_2) Emission			
Regression variables	Coefficient	St. Error	t-statistics
D(CO_2(-1))	-0.75	0.73	-1.02
D(T)	0.09	0.04	2.27*
D(LnEU)	0.42	0.22	2.09**
D(GDP)	0.03	0.006	3.92**
ECM(-1)	-0.16	0.06	-2.76**

R2= 0.999, Adj R2= 0.998, Prob (F-stat)= 0.00 Durbin Watson statistic= 2.123; * shows significant at 1% level and ** shows significant at 5% level.

Table 4 shows the coefficient of ECM (-1), which shows the speed of adjustment is negative as it was expected, significant at a 1 percent significance level. A negative sign represents that the series is not explosive and will reach the equilibrium point.

Stability Diagnostics

To check the stability in the model, CUSUM and CUSUM square are used. The CUSUM test (Brown et al., 1975) is based on the cumulative sum of the recursive residuals. This option plots the cumulative sum together with the 5% critical lines. The test finds parameter instability if the cumulative sum goes outside the area between the two critical lines. CUSUM and CUSUM square test provides the plots of the variable between the two lines of 5% significant level; if the variables' plot crosses these lines, it means that there is instability.

In Figures 1 and 2, CUSUM and CUSUM square test is applied. The blue plot lines of variables lie between the critical red line of 5% significant level in both CUSUM and CUSUM square tests.

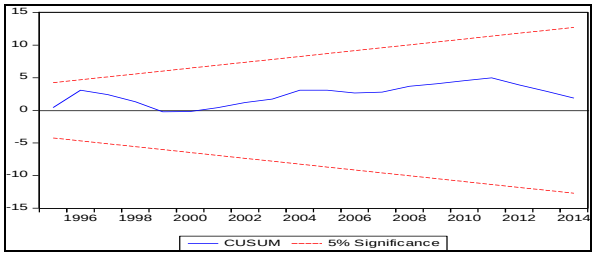

Figure 1. CUSUM.

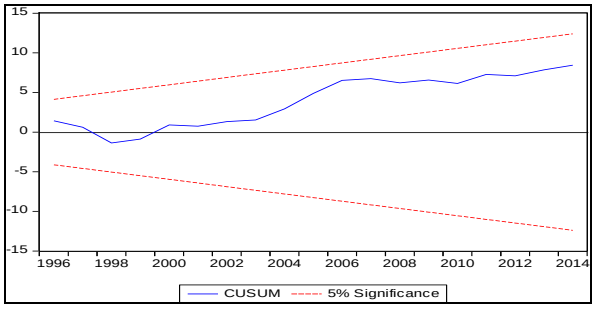

Figure 2. CUSUM Square.

CONCLUSIONS

Trade plays a key role in the economic growth of developing countries, but this growth results in intensive use of energy items like oil, coal, and gas as these energy items are required to accelerate industrialization. More use of energy leads to distorting the environment, especially CO_2 emission. The interrelationship among trade, energy consumption, and CO_2 emission is still debatable. Therefore, this study is presented to examine empirical evidence to prove an association between trade openness, energy use, and CO_2 emission in Pakistan. The estimation results were according to the expectations. Both trade openness and energy consumption are positive and significant factors of CO_2 emission in Pakistan. To increase trade, more energy is used, which put a negative impact on the environment in Pakistan. So, this study must use renewable energy recourses to overcome the negative impact of energy. Government must take serious steps regarding trade policies in Pakistan. Free trade can be better if the policies regarding trade are efficient and reliable. Government must take care of the poor farmers and traders who are essential in the production of goods related to trade. With good policy implications, the trade level of a country will increase. Despite the results, this study suffers from some limitations. The empirical analysis has been conducted using trade at the aggregate level. An area of productive future research would be to analyze the trade composition in terms of goods and its impact on economic growth. Such an analysis provides useful information about what underpins the positive impact of trade on economic growth.

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REFERENCES

Afghah, S.M., Barzega, S., & Shahri, Z., 2015. The causal relationship between the consumption of energy and trade. Int. J. Bus. Technopreneurship. 5(3), 325-342.

Alkhateeb, T.Y., Mahmood, H., 2019. Energy consumption and trade openness nexus in Eypt. Energies, 12, 1-10.

Bayer, C., Hanck, C., 2013. Combining non-cointegration tests. J. Time Ser. Anal. 34, 83–95.

Begum, R.A., Sohag, K., Abdullah, S.M.S., Jaafar, M., 2015. CO_2 emissions, energy consumption, economic and population growth in Malaysia. Renew. Sustain. Energy Rev. 41, 594–601.

Ben Jebli, M., Ben Youssef, S., 2013. Energy consumption, output and trade nexus in North Africa. MPRA Paper No. 47965.

Bourdon, H. M., Le Mouël, C., Vijil, M., 2018. The relationship between trade openness and economic growth: Some new insights on the openness measurement issue. The World Econ. 41(1), 59-76.

Brini, R., Amara, M., Jemmali, H., 2017. Renewable energy consumption, International trade, oil price and economic growth inter-linkages: The case of Tunisia. Renew. Sustain. Energy Rev. 76, 620–627.

Brown, R.L., Durbin, J., Evans, J.M., 1975. Techniques for testing the constancy of regression relationships over time. J. R. Stat. Soc. Ser. B 37, 149–163.

Burakov, D., 2018. Energy consumption, trade openness and exchange rate impact on foreign direct investment in Union State of Russia and Belarus. Int. J. Ener. Econ. Policy. 8(4), 76-82.

Cevik, E.İ., Atukeren, E., Korkmaz, T., 2019. Trade openness and economic growth in Turkey: a rolling frequency domain analysis. Economies 7, 41. doi.org/10.3390/economies7020041.

Easterly, W., Levine, R., 2001. What have we learned from a decade of empirical research on growth? It's Not Factor Accumulation: Stylized facts and growth models. World Bank Econ. Rev. 15, 177–219.

Fotros, M.H., Maaboudi, R., 2010. The impact of trade openness on CO_2 emissions in Iran, 1971-2005. Presented at the 13th Annual conference on global economic analysis, Penang, Malaysia.

Gbadebo, O. O., Okonkwo, C., 2009. Does energy consumption contribute to economic performance? Empirical evidence from Nigeria. J. Econ. Int. Finance. 1(2), 44-79.

Harrison, A., Hanson, G., 1999. Who gains from trade reform? Some remaining puzzles. J. Dev. Econ. 59, 125–154.

Hasson, A., Masih, M., 2017. Energy consumption, trade openness, economic growth, carbon dioxide emissions and electricity consumption: evidence from South Africa based on ARDL. MPRA paper No. 79424.

Idris, J., Yusop, Z., Habibullah, M.S., 2016. Trade openness and economic growth: A causality test in panel perspective. Int. J. Bus. Soc. 17, 281-290.

Keho, Y., 2017. The impact of trade openness on economic growth: The case of Cote d'Ivoire. Cogent Econ. Financ. 5, 1332820. doi.org/10.1080/23322039.2017.1332820.

Kostyannikova, D., 2012. Economic growth and energy consumption in OECD countries; a causality analysis. Dissertations and Theses, City University of New York.

Lean, H.H., Smyth, R., 2010. CO_2 emissions, electricity consumption and output in ASEAN. Appl. Energy 87, 1858–1864.

Musila, J.W., Yiheyis, Z., 2015. The impact of trade openness on growth: The case of Kenya. J. Policy Model. 37, 342–354.

Pandey, K.K., Rastogi, H., 2019. Effect of energy consumption & economic growth on environmental degradation in India: A time series modelling. Energy Procedia 158, 4232–4237.

Parsa, H., Sajjadi, S.Z., 2017. Exploring the trade openness, energy consumption and economic growth relationship

in Iran by bayer and hanck combined cointegration and causality analysis. Iran. Econ. Rev. 21, 829–845.

Pesaran, M.H., Shin, Y., Smith, R.J., 2001. Bounds testing approaches to the analysis of level relationships. J. Appl. Econom. 16, 289–326.

Phillips, P.C.B., Perron, P., 1988. Testing for a unit root in time series regression. Biometrika 75, 335–346.

Raza, S.A., Shahbaz, M., Nguyen, D.K., 2015. Energy conservation policies, growth and trade performance: Evidence of feedback hypothesis in Pakistan. Energy Policy 80, 1–10.

Safaynikou, H., Shadmehri, M.T., 2014. Relationship between energy consumption, economic growth financial development and trade openness in Iran. Int. Res. J. Financ. Econ. 122, 120-132.

Sasana, H., Putri, A.E., 2018. The increase of energy consumption and carbon dioxide (CO_2) emission in Indonesia, in: E3S Web of Conferences. EDP Sciences, 31, 1008. Doi 10.1051/e3sconf/20183101008.

Shahbaz, M., Nasreen, S., Ling, C.H., Sbia, R., 2014. Causality between trade openness and energy consumption: What causes what in high, middle and low income countries? Energy Policy. 70, 126–143.

Siddique, H.M.A., Majeed, M.T., 2015. Energy consumption, economic growth, trade and financial development nexus in South Asia. Pakistan J. Commer. Soc. Sci. 9, 658–682.

Sineviciene, L., Sotnyk, I., Kubatko, O., 2017. Determinants of energy efficiency and energy consumption of Eastern Europe post-communist economies. Energy Environ. 28, 870–884.

Tahir, M., Khan, I., 2014. Trade openness and economic growth in the Asian region. J. Chinese Econ. Foreign Trade Stud. 7(3), 136-152

Tekin, R.B., 2012. Development aid, openness to trade and economic growth in least developed countries: bootstrap panel Granger causality analysis. Procedia-Social Behav. Sci. 62, 716–721.

Vlastou, I., 2010. Forcing Africa to open up to trade: is it worth it? J. Dev. Areas 44, 25–39.

Zeshan, M., Ahmad, V., 2013. Energy consumption and economic growth in Pakistan. Bull. Energy Econ. 1, 8–20.