IPRPD
International Journal of Business & Management Studies
ISSN 2694-1430 (Print), 2694-1449 (Online)
Volume 04; Issue no 02: February, 2023
DOI: 10.56734/ijbms.v4n2a1

THE IMPACTS OF ECONOMIC GROWTH ON PER CAPITA CONSUMPTION-BASED CO_2 EMISSION BETWEEN CHINA AND UNITED STATES

Qing Nie[1]

[1]*Ph.D in Economics, Texas Tech University, USA*

Abstract

This paper attempts to investigate the impact of economic growth, population, and energy consumption on consumption-based CO_2 emissions for a global panel of China and U.S. with the comparison of two dynamic models, pooled OLS and LSDV, for the period 1990–2016. The empirical evidence indicates significant positive impacts of economic growth and energy consumption and negative effect of population on CO_2 emissions for global panels. Besides, it shows the different responsibilities on reducing energy consumption and CO_2 emissions between developing and developed countries.

Keywords

Consumption-Based CO_2 Emission; Economic Growth; Population; Energy Consumption

1. Introduction

In the process of world development, mankind faces two main challenges: economic development and environmental protection. While economic development is advancing at different rates in different countries, environmental issues have become the focus of world attention. In particular, the deterioration of environmental quality has caused concerns about global warming and climate change caused by greenhouse gas emissions (Kasman & Duman, 2015; Uddin, Salahuddin, Alam, and Gow (2017). Environmental impact (I) or degradation It is generally believed to be caused by the following factors: an already very large and growing population (P), continuous economic growth or per capita affluence (A), and the application of resource consumption and pollution technologies (T) (Chertow, 2001; Huesemann & Huesemann , 2011).

The economic growth and development level of each country at any time depends on many factors, and natural resources are one of them. Therefore, in order to encourage economic growth, different countries and economies have put available potential natural resources into production. However, this growth may have a negative impact on the environment through many aspects, such as environmental conditions (pollution), excessive development of natural resources, Degradation and loss of wildlife habitat and climate change (Phimphanthavong, 2013). These are the key issues facing many countries. At the same time, in the past two decades, more and more scholars have conducted in-depth research on the causal relationship between energy consumption, environment and economic growth. Numerous studies have examined the causal relationship between energy consumption and several independent variables, such as economic growth, financial development, employment, and population. Energy is considered the lifeblood of the economy, the most important tool for social and economic development, and it is recognized as one of the most important strategic commodities (Sahir and Qureshi, 2007). Grossman and Krueger (1995) pointed out that in order for a country to achieve a high level of growth, it needs more input to expand its output, which leads to an increase in waste and emissions generated through production economic activities.

This paper explores the situations both of developing and developed countries and aims to investigate the relationship between economic growth and the pressure on nature from the environmental sustainability perspective. Considering issues on the environment, it seems that many aspects are included in environmental conditions, such as water pollution, Carbon dioxide emissions (CO_2 emissions), soil erosion, solid waste, and deforestation. However, due to our limited time and data in other areas, this study only considers per capita carbon dioxide emissions as a representative of environmental degradation, this study has focused only the consumption-based CO_2 emissions per capita because carbon dioxide (CO_2) is the primary greenhouse gas emitted through human activities (Edoja, Aye and Abu, 2016), which accounts for about 76 percent of total greenhouse gas emissions. In 2018, CO_2 accounted for about 81.3 percent of all US greenhouse gas emissions from human activities. Since the Industrial Revolution, the amount of carbon dioxide in the earth's atmosphere has been increasing (Ayoade, 2003). At the beginning of the Industrial Revolution, the CO_2 concentration was about 280 ppm, and this level lasted for about 700 years. However, around 1860, the concentration of carbon dioxide increased exponentially. The growth rate of carbon dioxide in the atmosphere is about 0.5% per year (Mohamed, Shaaban, Azza, and Mowafy, 2012). It is predicted that by 2050, the level of carbon dioxide will rise to 450 ppm (Botkin & Keller, 1997). The environmental impact of carbon dioxide emissions is huge, affecting both the ecosystem and the people who live in it. Based on the impact of carbon emissions on freshwater resources, agriculture and food supply, natural ecosystems, biodiversity and human health, it is therefore important to quantify the impact of economic growth in developing and developed countries on carbon dioxide emissions. The two major economies will become the main objects of research.

The relationship between economic growth, energy and carbon dioxide emissions has always been an active research area (see, for example, Jumbe, 2004; Al-Iriani, 2006; Ang, 2007; Halicioglu, 2007; Halicioglu, 2009; Soytas et al., 2007). ; Sheinbaum-Pardo et al., 2012; Lean and Smith, 2009; Chang et al., 2009; Apergis and Payne, 2009, 2010; Bartleet and Gounder, 2010; Menyah and Rufael, 2010; Ozturk and Acaravci, 2010; Niu et al. , 2011; Arouri et al., 2012). In this study, our goal is to investigate the impact of economic growth and CO_2 emissions on energy consumption in China and the United States from 1990 to 2016. Therefore, we use the dynamic panel data model as the survey technique. Employing the panel data analysis, there is evidence of the significant causal relationship between consumption-based CO_2 emission, economic growth, population growth, and energy consumption. The findings emphasize the need for control of population growth and consumption at reducing emissions and sustainable economic growth. This may include energy efficiency and a switch away from non-renewable energy to renewable energy.

The rest of the study is organized as follows: Section 2 gives a brief literature review. Section 3 talks about the data and methodology used in the study. Section 4 discusses the results in detail, while Section 5 concludes the study with some policy implications.

2. Literature review

Considering that energy consumption is mainly due to production input and economic value creation, some researchers believe that economic growth and key macro variables are determinants of energy consumption, and GDP as an important indicator reflecting the level of national economic development and CO_2 emissions may exist Positive correlation. Therefore, these variables are applied to project energy consumption (Li, 2003; Crompton and Wu, 2005; Skeer and Wang, 2007). Wei (2002) studied the long-term relationship between total energy consumption and some major economic factors, such as energy prices, income, and the proportion of heavy industry in GDP, and found that on the one hand, energy consumption and main variables are cointegrated. On the other hand, if there is a reverse chain of causality from income to energy, it indicates that the degree of energy dependence is low, and therefore the adverse effect of implementing energy-saving policies on income is small or has no impact (Jumbe, 2004). Bartleet and Gounder (2010) studied the causal relationship between energy consumption and multivariate models. They found that there is a co-integration relationship between economic growth, employment, and energy consumption. The results show that economic growth leads to energy consumption, and economic activity determines energy increases in demand. Li et al. (2011) examined the long-term cointegration relationship between per capita real GDP and energy consumption in a sample of 30 provinces in China and found that there is a long-term positive cointegration relationship between variables. In most cases, increasing the consumption of renewable energy is an effort to replace it with non-renewable energy, resulting in lower CO_2 emission levels.

Farhani and Rejeb (2012) applied panel unit root test, panel cointegration method, and panel causality test to investigate the relationship between energy consumption, GDP and CO_2 emissions in 15 Middle East and North African countries from 1973 to 2008. The findings of this study show that there is no causal relationship between GDP and energy consumption, and also reveals the relationship between carbon dioxide emissions and energy consumption in the short term. However, in the long run, there is a one-way causal relationship between GDP and CO_2 emissions to energy consumption. Magazzino (2016) used the VAR team to investigate the relationship between CO_2 emissions, economic growth, and energy use in 10 Middle Eastern countries during the period 1971-2006. Both the estimation coefficient and the impulse response function indicate that for the six Gulf Cooperation Council countries, the economic growth response to carbon dioxide emissions is negative. It can be seen that carbon dioxide emissions seem to be driven by both their own past value and their energy consumption.

As researchers focus on economic growth as a factor that affects CO_2 emissions, many studies have shown that population and economic growth are both the main driving forces for increased energy use and are also the cause of CO_2 emissions. Batliwala and Reddy (1993) pointed out that energy demand depends on per capita energy use, and biofuels can meet the energy needs of many urban centers in Africa. York et al. (2003) pointed out that the use of energy and population is close to unity. Su (2011) used a cross-section of US household data to estimate the elasticity of gasoline consumption to population density y0.064 after controlling for household characteristics, highway density, and traffic congestion. These studies confirmed the empirical relationship between population density and energy use (Heres-Del-Valle and Niemeier, 2011; Liu and Shen, 2011; Vance and Hedel, 2008). Garau et al. (2013) studied that the apparent aging of the population leads to a reduction in energy use, but in principle, the increase in the elderly population leads to a shift in consumption to a more energy-intensive combination of goods and services. It can be seen that population growth does have a corresponding relationship with energy consumption and CO_2 emissions.

Saidi and Hammami (2015) used a dynamic panel data model estimated by the Generalized Method of Moments (GMM) to analyze the impact of global panel economic growth and carbon dioxide emissions on energy consumption in 58 countries since 1990. The results show that the carbon dioxide emissions and economic growth of the four global groups have had a significant positive impact on energy consumption. The impact of financial development, capital stock, and population on energy consumption is also positive and has a great impact. Kasman and Duman (2015) used a panel unit root test, several panel cointegration methods (especially Kao, Pedroni, Westerlund test) and a panel causality test (based on the panel error correction model) to test energy consumption and CO_2 emissions, sample The panel of 15 new EU member states and candidate countries is composed of data on economic growth, trade openness, and urbanization levels from 1992 to 2010. The results show that there is a short-term one-way panel causality from energy consumption, trade opening, and urbanization to CO_2 emissions. The results of long-term causality show that because the system deviates from the long-term equilibrium, carbon dioxide emissions, energy consumption, GDP and trade openness are important in the adjustment process.

Since energy consumption is affected by economic growth and population structure, what is the direct relationship between energy consumption itself and the CO_2 plate? Arouri et al. (2012) used the bootstrap panel unit root test and co-integration technology to study the relationship between carbon dioxide emissions, energy consumption and actual GDP in 12 Middle East and North African countries (MENA) from 1981 to 2005. Their results show that in the long run, energy consumption has a positive and significant impact on CO_2 emissions. Shahbaz et al. (2014) used panel data from 110 developed and developing economies to study the nonlinear relationship between foreign direct investment and environmental degradation. The results show that there is an environmental Kuznets curve, and foreign direct investment has exacerbated environmental degradation.

Al-mulali, Tang and Ozturk (2015) studied the impact of economic growth, renewable energy consumption and financial development on CO_2 emissions in 18 Latin American and Caribbean countries from 1980 to 2010. The results show that Kao co-integration shows that the variables are cointegrated. Then, they used a completely modified OLS (FMOLS) model to show that there is an inverted U-shaped relationship between CO_2 and GDP, financial development also has a negative impact on long-term development, and energy consumption has no long-term impact on carbon dioxide emissions. Regarding the relationship between CO_2 emissions, economic growth, electricity consumption, and financial development of Salahuddin, Gow and Ozturk in the six Gulf Cooperation Council (GCC) countries (2015) using panel data and various methods (dynamics) from 1980 to 2012 Ordinary least squares (DOLS), FMOLS and dynamic fixed effects (DFE) models) to test the long-term relationship between variables. The results show that electricity consumption and economic growth have a long-term positive correlation with carbon dioxide emissions, while financial development has a negatively significant relationship. The development of industries such as finance also affects energy consumption, leading to changes in CO_2 emissions. In Malaysia, Tang and Tan (2012) tested the impact of financial development on energy in the short and long term. Shahbaz and Lean (2012) studied the energy demand of Tunisia, and the results of the report showed that financial development has increased the energy demand brought about by economic growth. Xu (2012) used panel data and used the GMM system to study the relationship between financial development and energy consumption in 29 provinces in China from 1999 to 2009. The results show that there is a significant positive correlation between energy consumption and financial development.

From the previous results, even for some studies using similar methods, the results are mixed. This may be due to the variables included, the conversions performed, the sampling period, and/or the different panels in the country/region studied. It can be easily observed that most studies use a non-switch panel model. The few people who adopt the panel switching model rely on the Panel Smooth Transition Regression (PSTR) (2005) developed by González et al. These studies can show to a certain extent several major factors affecting CO_2 emissions, including economic growth reflected by GDP, population growth and structure, and energy consumption. These factors will also constitute the main reference factors for our subsequent model. Secondly, considering that different models have relatively large impacts on the analysis results, and we will consider the comparison between China and the United States, so we will use panel data to mainly compare the results of the two models of OLS and LSDV to draw conclusions.

3. Modeling and data

3.1 Model

The data used in this study are taken from the World Development Indicator (WDI), and cover 1990–2016. The variables used are CO_2 emissions (measured in metric tons per capita), economic growth (proxied in GDP per capita), POP refers to the total population, and energy consumption (measured in kilogram (kg) of oil equivalent per capita). The specific countries selected for the study and the time-frame was dictated by data availability.

Thus, our proposed model, which seems to be consistent with the broader literature on the determinants of energy consumption cited above, takes the following from:

$$CO_2 = f(GDP, POP, ECONS) \quad (1)$$

This essentially states that CO_2 emission (CO_2) is a function of economic growth per capita (GDP), total energy consumption per capita (ECONS), and total population (POP).

Since our study is a panel data model, if we are using the OLS model to analyze, Eq. (1) can be written in, the following form:

$$gCO_{2i,t} = \alpha_0 + \alpha_1 * gGDP_{i,t} + \alpha_2 * gPOP_{i,t} + \alpha_3 * gECONS_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where:

i represents country (we have 2 countries, China and US);
t represents time (our time frame is 1990–2016);
gCO_2 represents the consumption-based emission in metric tons per capita;
gGDP represents GDP per capita;
gPOP represents total population for midyear estimates;
gECONS represents the use in kg of oil equivalent per capita.

However, if we are using LSDV model to compare the result, we need to write the Eq. (1) into the following form:

$$gCO_{2i,t} = \beta_0 + \beta_1 * gGDP_{i,t} + \beta_2 * gPOP_{i,t} + \beta_3 * gECONS_{i,t} + u_1 g_1 + u_2 g_2 + \varepsilon_{i,t} \quad (3)$$

Where: g_1 represents China; g_2 represents US.

According to previous research, we know that different models and detection methods will have different conclusions. However, based on the laws of economic development and the possible connections between various variables, I hope to anticipate the impact of the above variables on CO_2 emissions in advance and give an explanation of the expected conclusions in Table 1. Thus, in the end, we will see whether the conclusions drawn by the model are consistent with expectations.

Variables	Symbol	Measure	Expected sign	Economic implication
per-capita consumption-based CO2 emission	CO_2	CO_2 emissions in metric tons per capita	N/A	–
Economic growth	GDP	GDP per capita in constant 2010 US$	±	On the one hand, economic growth may increase CO_2 emissions at the cost of polluting energy consumption. On the other hand, economic growth may also improve the environment by increasing the consumption of clean energy, including reducing CO_2 emissions.
Population	POP	Total population for midyear estimates	+	High population could lead to increased demand for energy and thus CO_2 emissions.
Energy consumption	ECONS	Energy use in kg of oil equivalent per capita	±	Energy consumption will have negative effect on CO_2 emissions if the country uses friendly environment energy sources. Otherwise, it will have positive effect on CO_2 emissions

Table 1. Variable description

3.2 Data source and descriptive statistic

Table 2 describes the overall description of all variables in the model. The panel data covers all data from 1990 to 2016 in China and the United States, and refers to the same statistical standards. According to the data in the table, it can be seen that in the 26-year time span, the data of China and the US under the same variable are significantly different. The average of the total population of China in 26 years is 4.5 times the average of the US, which directly leads to the consumption-based CO_2 Per capita emissions consumption, per capita GDP, and per capita energy consumption in the US are significantly higher than China. However, it is worth mentioning that, in accordance with the laws of economic development and statistics, developed countries have the characteristics of high per capita GDP, high energy consumption, and a large volume of pollution emissions.

	CO_2 (t)	GDP ($)	POP(million)	ECONS (kWh)
Mean	12.02519	21436.65	798.9087	51157.37
Maximum	22.30977	57928	1414.05	93810.55
Minimum	1.942244	318	252.1203	6774.271
Std. Dev.	8.629458	20446.71	517.3181	37432.62

Table 2. Descriptive properties of consumption-based CO_2, GDP, POP and ECONS

Through the horizontal and vertical comparison of variables, we try to understand the difference of the same variable in different periods between developing and developed countries. Table 3 reflects the relationship between different variables. We hope to compare the correlation between different variables to help analyze the conclusion.

	CO_2	GDP	POP	ECONS
CO_2	1.0000			
GDP	0.9042***	1.0000		
POP	-0.9713***	-0.9018 ***	1.0000	
ECONS	0.9985 ***	0.8995***	-0.9739***	1.0000

Table 3. Correlation matrix

Note: p-values are in parenthesis***Indicates significance at 1%

Compared with Table 1, the growth of per capita GDP and energy consumption will indeed have an adverse impact on the environment by increasing CO_2 emissions, but population growth is negatively correlated with the per capita CO_2 emissions on the basis of consumption. On the one hand, this is related to the negative impact of population growth on per capita GDP and energy consumption. Taking into account that both GDP per capita and energy consumption per capita have a positive correlation with CO_2. If the change in the total population has a negative correlation with the first two variables, then the population variable should also be negatively correlated with CO_2 emissions. On the other hand, in relation to the specific conditions of China and the US, as a populous country, although in total GDP and energy consumption China rank relatively high in the world, there will be a significant gap with developed countries which has less population.

4. Evaluation and result

4.1 Pooled OLS & LSDV model

Taking into account the differences in the results of the previous panel data research, we compare the deviation and statistical significance of the pooled OLS and LSDV models to find a suitable analysis method to draw more convincing conclusions. Table 4 shows the results according to the two methods.

	Pooled OLS	LSDV
GDP per capita	.00002 ($p < 0.044$)	.0001 ($p < 0.000$)
population	.00067 ($p < 0.248$)	-.0108 ($p < 0.000$)
Energy consumption	.00023 ($p < 0.000$)	.00032 ($p < 0.000$)
Overall intercept (baseline intercept)	-.6874 ($p < 0.423$)	-7.114 ($p < 0.000$)
China		19.993 ($p < 0.000$)
Degrees of freedom (error)	50	49
SSE (Sum of squares error)	11.1443	7.1068
F-test	5885.88 ($p < 0.000$)	6790.80 ($p < 0.000$)
Root MSE	0.47211	0.38084
R2	0.9972	0.9982
Adjusted R^2	0.997	0.9981
N	54	54

Table 4. Comparing Pooled OLS and LSDV

In the OLS model, we can see that without considering other factors, per capita GDP and energy consumption have a positive impact on consumption-based CO_2 emissions. For a one thousand unit increase in GDP per capita, the per capita CO_2 emissions are expected to increase by 0.02 units, holding all other variables constant (p<.044). Whenever per capita energy consumption increases by one thousand units, the per capita CO_2 Emissions will increase by 0.23 units, holding all other variables constant (p<.000). At the same time, population growth will have a positive impact on per capita CO_2 emissions. If the population increases by one thousand units, the per capita CO_2 emissions can increase by 0.67 units (p<.248), which is inconsistent with the conclusion of the correlation matrix of the variables.

In the LSDV model, the overall intercept is -7.114, and this deviation is statistically significant at the .05 significance level (p<.000). Consistent with the OLS model, the per capita GDP, and energy consumption show the effects of consumption-based CO_2 emissions positive influence. For one thousand units increase in GDP per capita, the per capita CO_2 emissions are expected to increase by 0.1 units, holding all other variables constant (p<.000). Whenever per capita energy consumption increases by one thousand units, the per capita CO_2 Emissions will increase by 0.32 units, holding all other variables constant (p<.000). At the same time, population growth will have a negative impact on per capita CO_2 emissions. If the population increases by one unit, the per capita CO_2 emissions can decrease by 0.0108 units (p<.000), The parameter estimate of China (dropped dummy) is presented in the LSDV intercept (19.993), which is the baseline intercept (reference point).

According to the comparison, the LSDV model fits the data better than does the pooled OLS in Table 4. The F statistic increased from 5885.88 to 6790.80 (p<.0000); SSE (sum of squares due to error or residual) decreased from 11.1443 to 7.1068; and R^2 increased from 0.9972 to 0.9982. Due to the dummies included, this model loses one degree of freedom (from 50 to 49). Besides, the data about the impacts of variables on CO_2 emissions are consistent with the conclusions of the correlation matrix, and has statistical significance.

4.2 Results

Consumption-based CO_2 emissions are affected to varying degrees by factors such as per capita GDP, population growth, and per capita energy consumption. Because the variables we analyzed are mainly based on per capita data, we must take into account the impact of the population variable on other independent variables. On the one hand, population growth has a negative impact on per capita GDP and energy consumption, which is particularly evident in China's data. On the other hand, the effect of the population variable on the first two variables further strengthens its impact on consumption-based CO_2 emissions. Under the same statistical significance, the impact of population changes on CO_2 emissions is significantly higher than other variables.

In short, the LSDV model shows that demographic factors have a negative effect on consumption-based CO_2 emissions. At the same time, the effect is a greater influence than per capita GDP and energy consumption factors, which is affected by the correlation and also reflects the difference in results caused by the difference in population between China and US.

The positive correlations between GDP per capita with consumption-based CO_2 emissions and energy consumption per capita with consumption-based CO_2 emissions reflect the importance of the relationship between economic development and environmental protection. Whether it is a developing country represented by China or a developed country represented by the US, economic growth is accompanied by energy consumption and environmental pollution, although CO_2 emissions are only a small part of environmental pollution. According to our data, the positive impact of per capita GDP and the energy consumption is weak, but the result once again conveys to us the importance of paying equal attention to the economy and the environment.

5. Conclusion

Consumption-based CO_2 emissions are affected by economic growth, population growth, and energy consumption growth. Among them, population changes have a negative impact on per capita CO_2 emissions. The average per capita CO2 emissions of the US from 1990 to 2016 was 20.45 tons, which is 5.68 times the average of China, but the average population of China is 4.5 times that of the US. On the one hand, China's population advantage underestimates China's actual total CO_2 emissions to a certain extent. That is, China, as one of the countries with the faster economic growth in the world, must be accompanied by a large number of environmental pollutant emissions, however, the large population makes it inconspicuous compared with the US. On the other hand, although the per capita calculation method has reduced the volume of China's total emissions, the United State with a larger economy, cannot conceal the fact that developed countries have more pollutant emissions

Through the LSDV model, we can analyze and draw the conclusion that economic growth and energy consumption increase consumption-based CO_2 emissions and population changes have a negative impact on per capita CO_2 emissions. At the same time, we can compare the differences in populations between China and the United States, as well as the difference in per capita CO_2 emissions and energy consumption, it is not difficult to see that developed countries still have a heavier responsibility for reducing energy consumption and pollution emissions.

The disadvantage of this paper is that we did not compare the relationship between total consumption-based CO2 emissions and total GDP, population, and energy consumption, which can help us understand the difference in the impact of different variables on CO_2 emissions without the impact of population on GDP and energy consumption.

Works Citation

Abbasi, F., & Riaz, K. (2016). *CO_2 emissions and financial development in an emerging economy: An augmented VAR approach*. Energy Policy, 90, 102–114

Antonakakis, N., Chatziantoniou, I., & Filis, G. (2017). *Energy consumption, CO_2 emissions, and economic growth: An ethical dilemma.* Renewable and Sustainable Energy Reviews, 68, 808–824.

Boutabba, M. A. (2014). *The impact of financial development, income, energy and trade on carbon emissions: Evidence from the Indian economy*. Economic Modelling, 40, 33–41.

Conservation Energy Future (CEF). (2016). *What is environmental degradation?* Retreived from https://www.conserve-energy-future.com/causes-and-effects-of-environmental-degradati on.php.

Charfeddine, L. (2017). *The impact of energy consumption and economic development on Ecological Footprint and CO_2 emissions: Evidence from a Markov Switching Equilibrium Correction Model*. Energy Economics, 65, 355–374.

Charfeddine, L., & Mrabet, Z. (2017). *The impact of economic development and social-political factors on ecological footprint: A panel data analysis for 15 MENA countries.* Renewable and Sustainable Energy Reviews, 76, 138–154.

Everett, T., Ishwaran, M., Ansaloni, G. P., & Rubin, A. (2010). *Economic Growth and the Environment. Department for Environment Food and Rural Affairs. Evidence and Analysis Series.* Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69195/pb 13390-economic-growth-100305.pdf.

Farhani, S., & Rejeb, J. (2012). *Link between economic growth and energy consumption in over 90 countries.* Interdisciplinary Journal of Contemporary Research in Business, 3, 199–210.

Heidari, H., & Turan Katircio lu, S., & Saeidpour, L. (2015). *Economic growth, CO_2 emissions, and energy consumption in the five ASEAN countries.* International Journal of Electrical Power & Energy Systems, 64, 785–791.

Kahia, M., Aïssa, M. S. B., & Lanouar, C. (2017). *Renewable and non-renewable energy use - economic growth nexus: The case of MENA Net Oil Importing Countries*. Renewable and Sustainable Energy Reviews, 71, 127–140.10.

Lotfalipour, M., Falahi, M., Ashena, M.(2010). *Economic growth, CO2 emissions, and fossil fuels consumption in Iran.* Energy 35, 5115–5120.

Magazzino, C. (2016). *CO_2 emissions, economic growth, and energy use in the Middle East countries: A panel VAR approach*. Energy Sources, Part B: Economics, Planning, and Policy, 11, 960–968.

Niu, S., Ding, Y., Niu, Y., Li, Y., Luo, G.(2011). *Economic growth, energy conservation and emissions reduction: a comparative analysis based on panel data for 8 Asian-Pacific countries.* Energy Policy 39, 2121–2131.