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The Challenge of Economic Growth and Environmental Protection in Developing Economies

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Abstract

The main objective of the present study is to find out a clear answer to the question raised in developing countries, that whether such developing economies could be able to achieve economic growth as well as protect their environment simultaneously or these economies still suffer from a severe conflict between environmental protection and economic growth. So, different categories of developing countries were selected and distinguished as oil-based and non-oil based countries for the period 2001-2012. The panel data regression analysis of the information collected from countries showed that the variables such as renewable energy, population growth and the size of internet users have negative and significant effects on the CO_2 emission per unit of GDP, while the share of industrial sector value added has a positive effect on CO_2 emission per unit of GDP in all categories. Moreover, the rate of urbanization has a negative effect on CO_2 emission per unit of GDP in developing but major oil importer countries.

Keywords: Developing Economies, Environment, Economic Growth, CO_2.

JEL Classification: E23, Q51, Q53.

1. Introduction

The exponential increase in energy consumption, since the beginning of the industrial revolution, has produced significant changes in the global environment, chief among which is the increase of the average concentration of carbon dioxide in the atmosphere (Michaelides, 2012: 33). All energy sources have some impact on our environment. Fossil fuels like oil and natural gases do substantially more harm than

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renewable energy sources by most measures, including air and water pollution and global warming emissions. Carbon Dioxide emission related to energy consumption is an important challenge for the world economy (Khalili et al., 2012: 28). Interest in the CO_2 pollution has risen due to the lack of appropriate regulations on its emissions at regional and country levels. These emissions are closely linked to energy consumption, economic growth and the environment as they have serious effects on temperatures, sea levels, and global air pollution, with the ultimate result of damaging human health (Ajmi et al., 2015: 629). Unfortunately, despite the efforts of the environmental community, there is not yet a global agreement for the mitigation of the effects of high carbon dioxide concentration, which poses the principal environmental threat of the twenty-first century (Michaelides, 2012: 33). Making smart policy decisions that move the earth toward a clean-energy future is crucial and necessary to identify the determinants of pollution. Obviously, many factors have impacts on air pollution. Renewable energy, the share of the industrial sector of the economy, urbanization, population growth and knowledge-based economy are some of the most important factors. These types of variables can also affect GDP growth either and so there is a systematic relationship between economic growth and environmental quality (Alam, 2014: 36). One of the most important indicators of the relationship between economic growth and the environment is CO_2 emission per unit of GDP. This indicator shows whether countries have been able to achieve economic growth without increased pollution or not.

2. Literature Review

From a sustainability perspective, the major weakness of GDP is that ignores natural resource depletion, environmental pollution, the lost value in material discards, and potential social costs such as poorer health due to occupational exposure to chemical and radioactive materials (Rauch and Chi, 2010:104). So, considering the negative externalities of economic growth and developing process is crucial. CO_2 emission per unit of GDP, as index trends over time, represents the country's success in controlling pollution in parallel with developing process. Phimphanthavong (2013) confirms the invested correlation between economic growth and environmental degradation

of EKC's hypothesis that at the early stage of economic growth increases environmental degradation, and then environmental degradation decreases after reaching a certain level of average per capita income. Moreover, other factors, such as trade openness, industrial extension, and becoming a full member of ASEAN countries, also cause an increase in environmental degradation. In order to reach the sustainable development goal, strong environmental and natural resource protection policies are suggested for the current and future development of Laos. There are many variables that effect on both variables. The most important ones are mentioned in brief.

2.1 Urbanization

Urbanization occurs as countries switch sectoral composition away from agriculture into industry, and as technological advances in domestic agriculture make laborers from agriculture to migrate to cities (Henderson, 2003: 275). Successful sectors within the city may attract further investment, generate increased demand for labor, and trigger migration to the city as a further mechanism of urban growth (Bloom et al., 2008: 2). Urbanization can cause economic growth. In fact, no country has ever attained middle-incomes without urbanizing, and none has reached a high income without vibrant cities that are centers of innovation and entrepreneurship (Marmara, 2015: 2). Therefore, urbanization and economic development have long been regarded as interconnected processes (Fhang Lo, 2010: 2). On the other hand, industrial development and urbanization also have economic externalities. In the process of the development of urbanization, the scale within the city expands constantly and then population expansion, traffic congestion, environmental pollution gradually appears.

Urbanization is discussed both in the context of economic modernization and as a demographic indicator in the literature. According to Poumanyvong and Kaneko (2010), there are three relevant theories that can be used to explain the possible impact of urbanization on the natural environment. The theory of ecological modernization examines urbanization as a process of social transformation and focuses on social and institutional transformations as well as economic modernization to explain the effects of modernization on the environment. The urban environmental transition theory is similar to

ecological modernity, but it mainly focuses on links between development and environmental issues at the city level. The compact city theory generally discusses the environmental benefits of high urban density as a result of economy of scale for urban public infrastructure.

The empirical relationships between CO_2 emissions and urbanization have been extensively studied in the literature. Yet Fhang Lo (2010), by using co-integration and causality tests investigated the relationship between urbanization and economic growth for 28 countries for the period 1950-2000. The causality tests further suggest that the urbanization variable Granger-causes the economic variable for developing nations; while the opposite holds for developed nations. It is, therefore, suggested that the causal relationship between the two variables is dependent upon the economic development status of a nation. Marmara (2015) studied the relationship between urbanization and economic growth. The study aims at investigating urbanization and economic growth in the context of China, for the period of 1986-2013. A time series analysis confirmed that the data are stationary and co-integrated using Engels and Granger test. Evidence from Granger Causality confirmed that bilateral causality between urbanization and economic growth exists. Bloom (2008) showed that the proportion of a country's population living in urban areas is highly correlated with its level of income. In addition, he suggested that rapid urbanization is also associated with crowding, environmental degradation, and other impediments to productivity. Overall, he found no evidence that the level of urbanization affects the rate of economic growth. Our findings weaken the rationale for either encouraging or discouraging urbanization as part of a strategy for economic growth. Sharma (2011) studies the determinants of carbon dioxide emissions for a global panel of 69 countries using a dynamic panel data (including high income, middle income, and low-income countries) model over the period 1985–2005. The main findings are that the urbanization is found to have a negative impact on CO_2 emissions in high-income, middle-income, and low-income panels. Finally, Martinez-Zarzoso and Maruotti (2011) use a STIRPAT model in a panel of 88 developing countries to analyze the impact of urbanization on CO_2 emissions over the period 1975–2003. Results showed an inverted-U shaped relationship between urbanization and CO_2 emissions.

2.2 Internet Users

The ICT revolution can be seen as a large and long-lasting positive supply shock, causing higher and possibly also more stable economic growth without extra inflation (Houben and Kakes, 2002: 544). Therefore, the internet can preserve society against economic recession and aid developing process. Internet positively impacts the economy, since it spreads information, stimulates innovation, builds up networks, fosters business, deepens capitals, improves labor markets, strengthens market competitions, and helps profit from emerging markets (Chu, 2013: 209). Besides, Infrastructure development of ICT can be useful/harmful for the environment. Social Networks and Search Engines have been contributing to environmental problems, which most people don't realize. Social Networks servers need a huge amount of data centers and IT infrastructure. It consumes significant amounts of electricity, placing a heavy burden on electric grids and contributing to greenhouse-gas emissions. Additionally, IT infrastructure hardware poses severe environmental problems both during its production and its disposal (Pandikumar et al., 2012: 17). Furthermore, Using the Internet reduces the need to travel and visit places, which causes traffic congestion and energy consumption reduces. ICT is significantly effective in the productivity of factors of production, especially energy. Therefore, expansion of Internet users may cause a reduction in air pollution. Ying Chu (2013) investigated the impact of internet on economic growth and this impact during the recession. The data were collected from World Bank Reports in a panel of 201 countries from 1988–2010. Results from an OLS model revealed that a 10 percentage point increase in internet penetration rate raises real GDP per capita by 0.57 to 0.63 percentage points. During the recession relative to expansion, the coefficient of internet facilities reduces; but it still remains statistically positive. This suggests that internet facilities provide a way to solve the problem of economic recession. Pandikumar (2012) suggested that Social Networks and Search Engines have been contributing to environmental problems, which most people don't realize. SN and SE servers need a variety of data centers and IT infrastructure. It consumes significant amounts of electricity, placing a heavy burden on electric grids and contributing to greenhouse gas emissions. Analysis of GDP data by Amiri and Reif (2013) confirms

that these countries not only have some of the highest Internet adoption, but also some of the highest GDP levels per capita globally. This data are then examined over a time series, determining not only a correlation between the two variables, but more importantly, demonstrating that Internet adoption is a direct driver of GDP growth in an economy. Szirmai and Verspagen (2011) studied 88 countries for the period 1950-2005 and indicated that manufacturing had a direct effect on growth only from 1970–1990. Since 1990, the positive effect of manufacturing on growth in developing countries has become more and more dependent on skills' accumulation. Additionally, IT infrastructure hardware poses severe environmental problems both during its production and its disposal.

2.3 Population Growth

Dyson (2010) identified population growth, fertility and age-structural change as well as urban growth/urbanization as demographic factors that affect economic growth. Population growth in two ways can be correlated with economic growth. On the one hand, population growth in demand-side cause increase in consumption and therefore economic growth. On the other hand, population growth on the supply side has effects on economic growth as well. Quang Dao (2012) could study data relevant to variables from World Development Indicators (2010) and represented that the growth rate of per capita GDP is linearly dependent upon population growth, both the young and old dependency ratios, the mortality rate, and whether or not the rate of population growth is less than 1.2 percent per year. Shi (2001), by using a data set of 93 countries for the period of 1975–1996, showed that population growth has been one of the major driving forces behind increasing carbon dioxide emissions worldwide over the last two decades. He estimated that half of the increment in emissions by 2025 will be contributed to future population growth alone.

Martinez-Zarzoso (2007) has analyzed the impact of population growth on CO_2 emissions in European Union countries. The sample covers the period 1975–1999 for the current European Union members. Results showed that the impact of population growth on emissions was more than proportional for recent accession countries; whereas the elasticity for old members of EU, is low and not

significant when the properties of the time series and the dynamics are correctly specified.

2.4 Share of Industry Value Added to GDP

industrialization is a process of social and economic change that transforms the society from traditional (agrarian) to modern (industrial) one. In this view, industries bring about changing in three ways: modernization, a growth of large-scale and metallurgy production. These aspects were closely attached to general economic growth. It was also Kaldor (1966) who put forward the thesis that cross-country variations of economic performance were related to industrialization. Kaldor suggested that fast rates of growth are almost invariably associated with the fast rate of growth of the secondary sector, mainly manufacturing, and this is an attribute of an intermediate stage of development (Kaldor, 1966: 7; Ortiz et al., 2009: 77). The process of industrialization increases emissions in two ways: (i) through increases in the scale of production as more output is produced, and (ii) through shifts in the composition of output towards pollution intensive industrial production as capital becomes relatively more abundant. At the same time, improvements in the techniques of production from ongoing technological progress in abatement work to lower emissions (Cherniwchan, 2012: 452). The effect of industrialization on pollution and economic growth depends on the degree of openness of the economy. International trade is often viewed as a medium of improvement towards environmental quality by allowing dirty domestic production to be replaced by imports from international markets (Copeland and Taylor, 2004: 35).

Bolaky (2011) summarizes most of the empirical and theoretical arguments with respect to industrialization. He posits that there is a positive correlation between the level of industrialization and per capita income for developing countries. Empirical evidence indicate that there is higher labor marginal product in the industrial sector rather in agriculture; therefore, transferring of resources from agriculture sector to the industrial sector raises total productivity in the economy. Dhami et al. (2013) studied the relationship between industrialization and environmental degradation in India. The scope of their study was limited to the industrialization of Punjab economy and

was an attempt to investigate the association between the industrialization and environmental degradation with the help of Environmental Input-Output Analysis (EIOA). So, they selected five major industries, whose contributions to industrial sector are substantial. They found that Industrialization cannot be separated from its environmental impact. The fast growth of production and consumption can create negative externalities such as increased noise and air pollution, road congestion and water pollution. Environmental damage can have a negative effect. Cherniwchan (2012) developed a simple two-sector model of neoclassical growth and the environment in a small open economy to examine how industrialization affects the environment. The model is estimated using sulfur emissions data for 157 countries over the period 1970–2000. Results showed that the process of industrialization was a significant determinant of observed changes in emissions. That means one percent (1%) increase in industrial sector output to total output is associated with an 11.8% increase in the level of emissions per capita.

2.5 Renewable Energy

Today we primarily use fossil fuels to heat and power our homes and fuel our cars. It's convenient to use coal, oil and natural gas for meeting our energy needs; but we have a limited supply of these fuels on the Earth. We're using them much more rapidly than they are being created. Excessive use of fossil fuels has caused global warming by carbon dioxide; therefore, vast using of renewable and clean energy is eagerly required (Panwar, 2011: 1514). In this issue, renewable energy will also help us develop energy independence and security. Renewable energy uses energy sources that are continually replenished by nature like the sun, the wind, water, the Earth's heat and plants. According to empirical studies, using renewable energy can affect the environment and GDP growth at the same time. Now the release of CO_2 has been added to the long list of environmental impact that is caused by the use of fossil energy resources. Fossil fuels are not just a large source of greenhouse gases, but they are also a source of many different streams of pollutants, including heavy metals and fine particulates. Their extraction from the ground also increases their environmental impact.

Apergis and Danuletiu (2014) indicated that there is long-run positive causality running from renewable energy to real GDP for the total sample as well as across regions. The empirical findings provide strong evidence that the interdependence between renewable energy consumption and economic growth indicates that renewable energy is important for economic growth, and likewise economic growth encourages the use of more renewable energy source. The presence of causality provides an avenue to continue the use of government policies that enhance the development of the renewable energy sector. Ocal and Aslan (2013) examined the causal relationship between renewable energy use and economic growth in Turkey. Using the ARDL approach and Toda-Yamamoto causality tests, the authors found that there exists a unidirectional causality running from economic growth towards renewable energy consumption, in order to conserve the hypothesis. Lean and Smyth (2013) focused on a single country that is Malaysia. They applied a disaggregated energy type of framework, while they used an augmented production function approach to examine the relationship between disaggregated energy consumption by fuel type and economic growth in Malaysia. The main finding of the study was that diesel and motor petrol were the major contributors to economic growth in the long-run. Their results suggested that the challenge moving forward for Malaysia would be to replace diesel and motor petrol with cleaner bio-diesel alternatives, which would not adversely affect Malaysia's growth rate. Menegaki (2011) by employing a random effect model to co-integration and a panel error correction model framework for a group of 27 European countries, did not confirm any Granger causality direction between renewable energy and economic growth. Her results provided support to neutrality hypothesis, implying that the lower levels of renewable energy consumption across Europe could not play a significant role in promoting economic growth.

3. Materials and Methods

Based on a simple growth model equation like Cobb- Douglass, GDP could be introduced as a function of two fundamental factors that are labor and capital. In addition, the productivity of two above mentioned factors that affect GDP could be illustrated as Eq.1.

$$GDP = f(L, K, PL, PK) \quad (1)$$

Where, PL and PK are indicators of productivity of labor and productivity of capital, respectively. Although there are many variables that have an effect on the productivity factors of production, recent studies such as Marmara (2015) and Amiri and Reif (2013) emphasize on the most important one, including industrialization, population growth, urbanization, energy consumption and ICT which is added in this study.

Obviously, when GDP is a function of productivity of labor, and the productivity of capital productivity of production factors are functions of variables like industrialization, GDP is a function of these variables.

$$GDP = f(RE, UR, PG, IND, IU) \quad (2)$$

On the other hand, the added variables also can affect CO_2 emission that is explained before.

$$CO2 = f(RE, UR, PG, IND, IU) \quad (3)$$

So, the cooperating CO_2 and GDP, CO_2 emission per unit of GDP (CG) as an index emerges.

$$CG = f(RE, UR, PG, IND, IU) \quad (4)$$

In order to study the impact of the Urbanization (UR), Internet users (IU), Population growth (PG), share of industry value added of GDP (IND) and renewable energy (RE) as independent variables on the amount of CO_2 emission per unit of GDP (CG), the panel data model was formed as Eq. 5.

$$CGit = \beta 0 + \beta 1URit + \beta 2IUit + \beta 3PGit + \beta 4INDit + \beta 5REit + \varepsilon it \quad (5)$$

This study sought to investigate the trends of CO_2 emission per unit of GDP (CG) over time and evaluate the factors that affect CO_2 emission per unit of GDP of three groups of countries during the period 2001–2012. Countries were divided based on oil trade. The first category includes Germany, Spain, France, Italy, Japan, Australia, Britain and South Korea, which are developed and major oil importer countries. The second includes Argentina, China, India, Brazil, Indonesia, Philippine, Malaysia and Turkey, called for developing and major oil importer countries. The third includes Iran,

Iraq, Saudi Arabia, Libya, Kuwait, Qatar, Emirates and Venezuela, called for developing and major oil exporter countries.

Further, according to the data published by the World Bank for the years of 2001–2012, separated for 24 member countries, panel data were formed, and the generalized least square method (GLS) was used to estimate the intended coefficients. Before estimating the model's coefficients of variables, one must examine the stationary status of the variables. Since the study period is 12 years and the stationary is a long-run term issue, there is no need to examine the stationary. In order to examine the homogeneity of cross sections, the Leamer F Test is used. Based on homogeneous cross sections, it is rejected and therefore it is concluded that the panel method would be an accurate method for the estimation in all models. In what follows, to determine whether the random effect or the fixed effect performance is sufficient for a good estimation of the models or not, Hausman test is designed.

4. Findings and Results

As an introductory finding of the research, the trend of CO2 emission per unit of GDP index during the period of study, has been calculated and reported in table 1.

Table 1: Trend of CO_2 Emission Per Unit of GDP Index

Year	Developed and major importer of oil countries	Developing and major importer of oil countries	Developing and major exporter of oil countries
2001	0.337939	1.129682	1.318008
2002	0.333456	1.110272	1.334955
2003	0.329449	1.13365	1.470095
2004	0.325968	1.159641	1.342203
2005	0.316847	1.117815	1.319567
2006	0.307709	1.084251	1.234737
2007	0.300744	1.066286	1.069773
2008	0.294399	1.077005	1.155418
2009	0.286277	1.07695	1.224881
2010	0.284264	1.035524	1.233034
2011	0.277726	1.054879	1.294036
2012	0.276642	0.978386	1.158191
Average	0.305952	1.085362	1.262908

Source: Research Findings

In addition, table 2 shows the average growth of CO2 emission per unit of GDP index by each country is quite important to assess the effort of countries to protect the environment during the study period.

Table 2: Growth Co_2 Emission Per Unit Of Gdp Index From 2001 To 2012

Developed and major importer of oil countries			Developing and major importer of oil countries			Developing and major exporter of oil countries		
Country	**Growth 2001 to 2012**	**Average Growth**	**Country**	**Growth 2001 to 2012**	**Average Growth**	**Country**	**Growth 2001 to 2012**	**Average Growth**
Germany	-0.25	-0.007	China	-0.17	-0.03	Iran	-0.05	-0.012
Spain	-0.21	-0.005	India	-0.22	-0.03	Iraq	-0.03	-0.004
France	-0.19	-0.003	Brazil	-0.11	-0.004	S Arabia	-0.05	-0.006
Italy	-0.1	-0.002	Indonesia	0.02	0.002	Libya	-0.33	-0.03
Japan	-0.098	-0.002	Philippine	-0.28	-0.02	Kuwait	-0.07	-0.007
Australia	-0.17	-0.008	Malaysia	-0.03	-0.003	Qatar	-0.28	-0.025
Britain	-0.28	-0.006	Turkey	-0.02	-0.001	Emirates	0.11	0.007
South Korea	-0.16	-0.009	Argentina	-0.12	-0.007	Venezuela	-0.24	-0.029

Source: Research Findings

In order to estimate each model using the correct method, coefficients of variables are estimated as shown in table 3 and table 4.

Table 3: Developed And Major Importer Of Oil Countries (Germany, Spain, France, Italy, Japan, Australia, Britain and South Korea)

Variable	Coefficient	T statistic	Prob.
RE	-0.006	-2.18	0.02
UR	0.23	2.01	0.04
PG	-0.04	-2.80	0.00
IU	-0.03	-2.96	0.00
IND	0.14	2.30	0.02
R^2		0.95	
D.W		1.86	
Leamer F Test	Chi-Sq.	20.21	0.00
Hausman test	Chi-Sq.	4.36	0.35

Source: Research Findings

Table 4: Developing And Major Importer Of Oil Countries (Argentina, China, India, Brazil, Indonesia, Philippine, Malaysia and Turkey

Variable	Coefficient	T statistic	Prob.
RE	-0.04	-4.55	0.00
UR	-0.09	-3.16	0.00
PG	-0.05	-4.53	0.00
IU	-0.01	-2.03	0.04
IND	0.15	3.38	0.00
R^2		0.92	
D.W		1.90	
Leamer F Test	Chi-Sq.	31.20	0.00
Hausman test	Chi-Sq.	19.87	0.00

Source: Research Findings

As it is clear from table 1, all the independent variables showed meaningful effects on the dependent variable at the 5% level test. Variables UR and IND have negative effects and others have positive effects. In addition, D.W statistic expresses that there is no auto-correlation in this model. Also, according to the result of Hausman test, the random effect method is suitable for this model. In table 2, apart from variable IND which has a positive effect, all variables have negative and significant effects on the independent variable. The results of Hausman test also show that the fixed effect method is suitable for this model.

According to results of the model (3) which is represented in table 5, all the independent variables showed meaningful effects on the dependent variable and as the first model, Variables UR and IND have negative effects and others have positive effects. According to the results of Hausman test, the random effect method is suitable for this model. In all models, R^2 represents the explanatory power of the model. On the other hand, one of the most crucial items in regression analyses is D.W. In all models, the numbers of D.W statistic represent all models estimated without the auto-correlation problem. Also, prob of Leamer F Test in all models is under 5%, which show us the models must be estimated by using panel data method.

Table 5: Developing And Major Exporter Of Oil Countries (Iran, Iraq, Saudi Arabia, Libya, Kuwait, Qatar, Emirates and Venezuela)

Variable	Coefficient	T statistic	Prob.
RE	-0.04	-2.61	0.01
UR	5.30	2.83	0.00
PG	-0.02	-3.03	0.00
IU	-0.01	-3.29	0.00
IND	0.54	2.15	0.03
R^2		0.93	
D.W		1.90	
Leamer F Test	Chi-Sq.	2.94	0.00
Hausman test	Chi-Sq.	3.25	0.07

Source: Research Findings

Since the study attempts to investigate, whether the economy could grow without harming the environment, and what are the variables that affect CO_2 emission per unit of GDP in developing and developed economies, economies were divided based on oil trade and levels of development. The trend of CO_2 emission per unit of GDP index during the period of the study has been calculated and reported in table 4. As we can see in table 4, among the three groups of countries, developed and major oil importer countries have the best performance in order to protect the environment at the same time with GDP growth process. The average CO_2 emission per unit of GDP index for developed countries from 2001 to 2012 is 0.305 which is almost one-third of developing and major oil importer countries and almost one-fourth of developing and the major exporter of oil countries.

In addition, the report of this index by country and the average growth of it is vital to investigate the effort of countries to protect the environment during the study period which is reported in table 5. Referring to the table 5, results show that most of the countries reduced CO_2 emission per unit of GDP index from 2001 to 2012.

Table 6 is also about the independent variables. Another vital related issue is the factors that can affect this index by affecting on GDP and CO_2 emission at the same time. The study shows that the variable named as the ratio of industry sector value added to GDP has positive and the variables named population growth, renewable energy and internet users have significant and negative effects on CO_2 emission per unit of GDP in all groups of countries. However, urbanization has a significant and negative impact in Developing and major oil

importer countries and significant and positive impact on other groups. This study has found that developed and major oil importer countries, developing and major oil importer and exporter countries have the best performance in protecting the environment, in parallel with GDP growth process, respectively.

5. Conclusion

The natural environment is central to economic activity and growth, providing the resources we need to produce goods and services, and absorbing and processing unwanted byproducts in the form of pollution and waste. While economic growth has produced benefits – raising standards of living and improving quality of life across the world – it has also resulted in the depletion of natural resources and degradation of ecosystems. There has been much debate over whether it is possible to achieve economic growth without unsustainable degrading the environment or not, and a growing realization that economic growth at the current rate of depletion and degradation of environmental assets cannot continue indefinitely.

As a result, the most effective variables in each category are industrialization and urbanization. This information leads us to understand why developing countries have the best performance to protect the environment while their economy's growing up. The history of economic development has shown that in the process of economic development, industrialization and ultimately urbanization intensifies. In this process, when an economy reaches a certain level of development, industrialization and urbanization are almost unchanged. So, while developing countries develop their industrial sector, they can hardly get success to control CO_2 emission, unless codification strictly against pollutant industries. On the other hand, emphasis on the service sector and knowledge-based economy, may aid developing countries to speed up the developing process without industrialization.

Industrialization, as a factor that is effective in air pollution, has declined during the study period in most selected countries; whereas oil exporter countries have sped up industrialization process. In developing and oil importer countries, industrialization process decreased apart from China and India. It seems that substituting

service sectors instead of industry aid countries to protect their environment in parallel with the economic development process. During the period 2001–2012, renewable energy usage in oil exporter countries is inconsiderable and frustrating; while the use of renewable energy in developed countries is reasonable. Although the oil price in world markets decreased in recent years and it is expected that the price will be sticky due to Shell oil, renewable energy usage in most countries has not changed much. So, one of the best reasons for good performance of selected developed countries in environmental protection, maybe their renewable energy usage strategy.

Other effective factors on index among all categories have processed approximately the same. As a result, using renewable energy and industrialization are two factors that make a difference between the countries performance in environmental protection, at the same time with their economic development process.

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