

Growth, FDI, Imports, and their Impact on Carbon Dioxide Emissions in GCC Countries: An Empirical Study

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Abstract The Gulf Cooperation Council countries are among the top 25 countries in terms of their contribution to increasing the level of carbon dioxide emissions more than the average world. Furthermore, these countries emit from 45% to 50% of the total emissions of Arab countries, because of the significant role of extractive sectors, as major sources of income in these economies. This study examines the most important factors pertaining to the increasing carbon dioxide emissions in GCC countries over the period 1998-2008. In this paper, the research objective is to determine how much the FDI inflows, economic growth, and commodity imports influenced the increasing level of emissions during the period of study, and which variable has most effect? For this purpose, an empirical model will be estimated in order to obtain the impact of the said variables of the six member countries – United Arab Emirates, Bahrain, Saudi Arabia, Oman, Qatar, and Kuwait. The model of carbon dioxide emissions as a function of FDI inflows, per capita GDP growth rate, and commodity imports will be examined simultaneously within the panel data technique using ordinary least squares OLS.

Keywords: Carbon dioxide emissions, GCC, Growth, Panel data.

1. Introduction

The GCC countries are among the top 25 countries (Reiche, 2010), which contribute to the increasing level of carbon, and emit from 45% to 50% of the total emissions of Arab countries (ROWA, 2007).

During the period 1998-2008, the GCC countries witnessed high rates of emissions. These emissions amounted to 254 million metric tons, due to their reliance on fossil fuel and other industries associated therewith. In 2003 the UAE, Qatar, Bahrain and Kuwait emitted about 13, 9, 8, and 7 times, respectively, more than the world average. Furthermore, the emissions of these countries exceeded the world average (Chaaban, 2008). This implies that these countries are still significant contributors to environmental pollution and climate change. Therefore, this study tries to measure the important variables concerning the key reasons for air pollution. In addition, we attempt to identify how much these variables have contributed to pollution in the GCC countries over the period of study, and which variable is most significant in this respect.

2. Review of literature

Mukhopadhyay (2008) found that Thailand is a pollution haven and the effect of FDI on the environment is not friendly. His study suggests several policies; the most important is paying more attention to the environmental quality of exported goods, and creating sustainable trade development, as well as providing financial incentives to establish green industries and encourage using imported technology for the production of green products in order to reduce the level of pollution in the country.

Stern et al. (1996) found that there is an inverse relationship between environmental degradation and per capita national income, where economic growth reduces the environmental impact resulting from various economic activities. In addition, trade has a neutral impact on environmental degradation. This study used a cross sectional regression for the per capita environmental impact on per capita income.

Thomas (2009) found a significant relationship between GDP and carbon dioxide emissions (CO₂), in which the data analysis shows that Trinidad produced 12 times the CO₂ per unit compared to Uruguay and Kenya, and over 20 times more than Sri Lanka and Uganda. The rapid movement of capital and expanding industrial base positively affect the increased level of carbon dioxide emissions.

Day and Grafton (2002) tested the relationship between per capita real GDP in Canada, and the four measures that negatively impact on environmental degradation. This proved that Carbon monoxide has a reverse negative impact in the long term with an increase in per capita GDP. This study is based on the causality test to determine the relationship. It concludes that Canada does not have a high level of per capita GDP to prevent the effects of other environmental problems associated with economic growth.

Abdulai, et al. (2009) found that GDP has a high positive significant impact on the environment, while the trade coefficient is not statistically significant. Moreover, the income variable indicates that there is an EKC implication. The study concluded that solving environmental problems does not necessarily negatively affect economic growth when a country does not have the institutional capacity to set up proper environmental policies or protect certain sectors.

Bruyn et al. (1998) concluded that environmental pollution has a direct relationship with economic growth. This study indicated that the best way to reduce the effect of pollution is to increase the level of investment in high technology to achieve rapid economic growth.

Nickerson (2004) examined the linkage between per capita emissions, and per capita GDP. His study is based on the combination of two environmental theories – the environmental Kuznets curve (EKC), and the porter hypothesis.

The study found that an increase in manufacturing exports is a good factor for reducing the level of emissions through the competition between firms for high efficiency. Furthermore, it determined that the level of carbon dioxide emissions increases with a high level of income. This conclusion is the opposite of the assumptions of the EKC theory, in which the study explains that economic growth is not supported by advanced technology.

Dinda (2005) suggested that achieving sustainable economic growth could be through the protection of natural resources and optimal exploitation, which reduces the impact of climate change. He examined several variables, which are the cumulated per capita CO₂ emission, and per capita protected forest area within the country. The study result showed that the cumulated per capita carbon dioxide emissions, and per capita area of protected forests is linked to a positive economic growth rate.

Ekins (2000) found that the relationship between economic growth and the environment could be positive, and that the government should pay more attention to the environment. Moreover, Ekins indicated that population growth combined with an increase in the level of economic activity cause harm to the environment as a result of the high level of production and consumption, which present a major challenge.

Kheder (2010) used empirical analysis to explain the relationship between FDI, environmental regulation, and pollution, in order to shed new light on the environmental impact of pollution. The study is based on using data of French FDI outflows in a mix of developing, transition, emerging and developed countries over the period 1999-2003. The study estimated three simultaneous equations.

Copeland and Taylor (2004) concluded that when GDP increases, the greater scale of production leads directly to more pollution, but at a higher level of income per capita, the demand for health and environmental quality rises with income, which could be translated into environmental regulation. The study result shows that trade liberalisation leads to an increase in the volume of economic activity by 1% and raises the level of pollution between 0.25% and 0.5%, however, this is associated with an increasing level of per capita income between 1.25% and 1.5 %, which is limited by the advanced technologies.

Wen (2007) tested the availability of the environmental Kuznets curve in China by using provincial panel data. The study analysed the relationship between GDP per capita and the emissions of five kinds of industrial pollutants, solid wastes, wastewater, SO₂, Soot, and smoke. It found that the relationship varies depending on the types of pollutant and region. Furthermore, this study confirms that the EKC hypothesis is not clear in China, where the inverted U-shaped curve cannot be generalised for all emissions.

Jie (2006) analysed the relation between FDI, emissions, and three economic determinants of emission. The estimated model of this study includes panel data for 29 industrial provinces in China. It found a small total impact of FDI on industrial SO₂ emission, where a 1% increase on FDI capital stock will lead to an increase in industrial SO₂ emission by 0.099%. The study confirms that the increase in the level of emissions is caused by the impact of FDI on economic growth.

Frankel and Rose (2005) discussed the determinants of foreign trade and their effect on the environment by using a gravity model. This study found that trade has a beneficial effect on some measures of environmental quality, in that it supports the environmental Kuznets curve (EKC).

Lee, et al. (2005) examined the impact of income on the environment. The examination results showed that the income has a positive impact on pollution, where it has specific effects on most of the criteria of environmental efficiency. Moreover, this study explained that environmental policies often focus on how to control pollution, which is not sufficient.

The study confirmed the importance of creating a consistent situation between the economic policy and aspects of environmental efficiency.

Research gap: According to the literature review for this study it was noted that most studies have been conducted in respect of more diversified economies, and based on the assumptions of Environmental Kuznets Curve (EKC) have addressed the environment in countries that follow a strict environmental policy. In this study, the methodology of the study is based on the assumptions of EKC and PHH, in order to identify which assumptions fit the GCC countries over the period of study.

However, continuing with the literature for the study, we link the three key topics – foreign trade, foreign direct investment and growth – and to achieve the objectives of the study, we use a specific model including significant variables, which could provide a clear picture about air pollution in GCC countries, over the period 1998-2008.

3. Methodology

This study relies on hypotheses of the Environmental Kuznets Curve (EKC), and hypotheses of the pollution haven theory (PHH). Therefore, we will test three independent variables, which are: GDP, FDI inflows and commodity imports. However, obtaining a positive signal for FDI inflows will reflect that these inflows have not used advanced technology over the period 1998-2008 and vice versa in terms of a negative signal. In respect of GDP and commodity imports, the model will examine these variables in order to extrapolate whether the GCC countries have taken into account the environmental consideration and their impact on carbon dioxide emissions over the period of study. We will estimate the following model:

$$\text{Log Air} = a + b_1 (\text{GDP}) + b_2 (\text{FDIn}) + b_3 (\text{M}) + ui$$

Where:

Air: Air pollution, measured by carbon dioxide emissions.

GDP: Per capita GDP growth rate.

FDI: Foreign direct investment inflows.

M: Commodity imports, measured as a ratio of total commodity foreign trade.

a: constant.

b₁, b₂, b₃ are coefficients to be estimated.

ui: error term.

3.1 The model estimation

The model was estimated by using ordinary least squares (OLS) with panel data techniques. The dependent variable is the air pollution represented by per capita carbon dioxide emissions in GCC countries for the period 1998-2008. The independent variables are GDP per capita growth rate (GDP), foreign direct investments inflows (FDIn), and commodity imports (M). By using SPSS software, we have obtained the following model:

Table (1): Regression result of the model (*)

GCC countries	Model	Unstandardized Coefficient		t	Sig.
		B	Std. Error		
UAE	(Constant)	3.325	0.112	29.615	0.000 (**)
	GDP	9.857E-03	0.004	2.343	0.023 (***)
	M	5.974E-04	0.002	0.272	0.787
	FDIn	-1.849E-02	0.009	-1.988	0.053 (***)
Bahrain	GDP	5.608E-03	0.005	1.171	0.247
	M	-1.670E-03	0.002	-0.697	0.489
	FDIn	3.107E-04	0.001	0.608	0.546
Saudi Arabia	GDP	-5.488E-04	0.006	-0.099	0.922
	M	-4.450E-02	0.007	-6.282	0.000 (**)
	FDIn	4.346E-02	0.014	3.179	0.003 (**)

Oman	GDP	-3.958E-03	0.003	-1.274	0.209
	M	-3.441E-02	0.004	-9.187	0.000 (**)
	FDIn	4.010E-02	0.013	3.061	0.004 (**)
Qatar	GDP	8.420E-03	0.003	2.679	0.010 (**)
	M	1.428E-02	0.005	3.146	0.003 (**)
	FDIn	5.323E-02	0.016	3.229	0.002 (**)
Kuwait	GDP	6.924E-03	0.004	1.651	0.105 (****)
	M	3.831E-04	0.005	0.074	0.941
	FDIn	0.103	0.179	0.574	0.569

Source: prepared by using SPSS software and Panel data technique.

(*) Dependent variable is Log (Air) represented by carbon dioxide emissions.

(**), (***), (****) indicate statistically significant at the (1%), (5%) and (10%) levels, respectively.

$R^2 = 0.969$ adjusted. $R^2 = 0.957$ $F = 82.273$ $\text{Sig.} = 0.000$ $D.W. = 1.780$

The regression result of the model above is statistically significant at the (0.01) level and the (F) value amounted to 82.273. In addition, the adjusted (R^2) value is about 0.957, which reflects that the independent variables affect the air pollution by 0.957, while the other factors represented less than 0.05. Moreover, the estimated result confirms that the model has no auto-correlation problem, where the (D.W.) value amounted to 1.780. This means that the estimated model is located in the acceptable statistical area. However, we found that this model is significant, and can be used in analysing the variables of the study.

3.2 Model results

UAE: The estimated result of per capita GDP growth rate in the UAE is statistically significant at the 0.05 level, where increasing per capita GDP growth rate by one time leads to an increase in the per capita carbon dioxide emissions by 0.0009857 times. This means that the economic growth in the UAE has increased the level of carbon dioxide emissions. In addition, the UAE is a second producer of petrochemical industry in GCC (DMCC, 2007), an industry that is considered as the main cause of air pollution in this country over the period of study.

Furthermore, the variable of FDI inflows is statistically significant at the 0.05 level. This indicates a negative relation between FDI inflows and carbon dioxide emissions, meaning that these investments have contributed to reducing the per capita carbon dioxide emissions in the UAE, where increasing FDI inflows by one time leads to a reduction in the per capita carbon dioxide emission by -0.001849 times. In this context, we can explain that this negative result is because most foreign direct investments in the UAE have concentrated on the non-oil industries, such as the building and construction sector, which represents 90% on average of the total FDI inflows to the UAE (Ministry of Economy, 2008).

The commodity imports coefficient is statistically insignificant, which confirms that these imports have no relation with the air pollution in the UAE over the period 1998-2008. We can explain that due to the most of capital goods have characterised in the high advanced technology, and help to maintain the environment. It is worth noting, that after 1999, the UAE started encouraging the establishment of projects, which are environmentally friendly, such as solar energy projects that are used for multiple purposes (Raouf, 2008).

Bahrain: In Bahrain, all the variables are statistically insignificant. We can analyse this result as the GDP of Bahrain is small. It represents only 2%(*), as ratio of the total average of GDP of GCC countries over the period 1998-2008. In addition, the low level of oil production confirms that this sector has no important role as a reason for air pollution in Bahrain. In other words, the low level of products does not lead to pollution of the environment, as reflected by the per capita GDP growth rate. Furthermore, the existence of increased carbon dioxide emissions in Bahrain results from trans-boundary pollution, especially from Qatar, Kuwait and Saudi Arabia.

Saudi Arabia: The estimated model indicates that the FDI inflows is the major cause of air pollution in Saudi Arabia, where increasing FDI inflows by one time leads to an increase in the per capita carbon dioxide emissions by 0.004346 time. In contrast, an increase in commodity imports by one time decreases the per capita carbon dioxide emissions by -0.004450 times.

(*) Based on Joint Arab Economic report, Abu Dhabi, different issues.

In respect of the commodity imports coefficient, we note that there is a negative relation between the increased level of imports and air pollution, where increasing these imports by one time leads to a drop in the carbon dioxide emissions by -0.004450 times. This result reflects the substituted process of advanced capital goods instead of polluted capital goods (Hussien, 2010).

Finally, the per capita GDP is statistically insignificant, which affirms that there is no relation between air pollution and per capita GDP growth, as much of this growth is resulting from the increase in oil prices to achieve a high level of GDP growth in Saudi Arabia.

Oman: the coefficients of FDI inflows and commodity imports are statistically significant at the 0.01 level. This means that the effect of FDI inflows is positive, where increasing by one time will lead to an increase in the per capita carbon dioxide emissions by about 0.004010 times over the period 1998-2008.

In addition, the relation between commodity imports and the level of pollution is negative, where increasing it by one time leads to a reduction in the carbon dioxide emissions by -0.003441 times. In addition, the imported capital goods characterised in advanced technology lead to reduced per capita carbon dioxide emissions over the said period.

The estimated model also shows that the GDP coefficient is statistically insignificant, which reflects that the Omani GDP has no effect on air pollution due to its small size compared with Saudi Arabia and the UAE. Therefore, the result of the specific model confirms that the carbon dioxide emissions are resulting from the FDI inflows to Oman, which is the main reason for air pollution in Oman over the period of study.

Qatar: the three variables, (GDP, FDI, M) are statistically significant at the 0.01 level, where the per capita GDP growth rate confirms its positive relation in increased per capita carbon dioxide emission in Qatar over the period of study. Therefore, increasing the level of per capita GDP growth rate by one time leads to an increase in per capita carbon dioxide emission of about 0.0008420 times. In this context, we can say that this issue is related to the growth in the GDP in Qatar, which significantly depends on the oil and gas sector. In other words, the economic growth in Qatar has led to pollution of the environment.

Furthermore, the FDI inflows in this country are considered a secondary reason for air pollution, where increasing it by one time leads to an increase in per capita carbon dioxide of about 0.005323 times. This result can be explained in the direction of most foreign direct investment inflows towards the gas sector, as well as the petrochemical industry, which is considered as the main reason for air pollution. It is also worth noting that Qatar has the third largest global reserve of natural gas. It is considered to be the first supplier of liquefied natural gas in the world (EIA, 2011), and this feature is the main factor that encouraged the foreign companies to invest in the gas sector. However, the comparative advantage of Qatar has led to more pollution over the study period.

In respect of commodity imports, the estimated result indicates that an increase by one time leads to an increase in the per capita carbon dioxide emission by 0.001428 times, with a positive relation between the two variables. Therefore, we can say that the main cause of increased pollution is due to importing polluted capital goods, such as transportation equipment, and other capital goods that are characterised by disadvanced technology.

Kuwait: in Kuwait, the per capita GDP growth rate has confirmed its effect on increasing per capita carbon dioxide emissions, where the estimated model indicates that increasing per capita GDP growth rate by one time leads to an increase in the per capita carbon dioxide of about 0.0008420 times. This result proves the role of economic activities, which significantly rely on the oil sector. Therefore, the existence of a high share of the oil sector and its export will not achieve sustainable economic growth in Kuwait.

In addition, the estimated model shows that the FDI inflows coefficient is statistically insignificant, which we conclude is due to the low level of FDI inflows over the period 1998-2008.

In respect of commodity imports, the result of the model indicates that it is also insignificant and that there is no relation between the air pollution in Kuwait and commodity imports because the GDP is the major cause of air pollution in Kuwait over the period of study.

4. Conclusions

a. The GDP per capita growth rate confirms its positive effect on increasing per capita carbon dioxide emissions in Qatar, Kuwait and UAE during the period 1998-2008, where it is the main cause of air pollution in these countries.

b. FDI inflows to the UAE are significantly contributed in reducing the air pollution over the study period. This result could be attributed to using advanced technology, as well as the fact that most of the FDI inflows are concentrated in sectors that have no major impact on increasing the level of pollution, such as real estate and the construction sector. In contrast,

there is no relation between FDI inflows and air pollution in Kuwait and Bahrain because of the low level of these inflows over the period 1998-2008.

c. The increased inflows of FDI in Saudi Arabia, Oman and Qatar significantly contribute to raising the per capita carbon dioxide emissions more than the contribution of other independent variables, namely, GDP and imports. This result confirms that the FDI inflows to the said countries have not used advanced technology, and, consequently, did not lead to sustainable economic growth during the period 1998-2008.

d. In both Kuwait and Bahrain, the FDI inflows and commodity imports have no relation with the air pollution, where the cause of pollution in Kuwait is related to per capita GDP growth rate, which reflects the economic activities. The Bahrain per capita GDP growth is insignificant because of the small size of GDP, and, in addition, the oil sector is not considered the main sector in Bahrain, where the model shows that the GDP has no effect on air pollution over the period 1998-2008.

e. The variable of commodity imports shows its inverse effect in Saudi Arabia and Oman. This means that these imports have advanced technology. While in Qatar we note that there is a positive impact, which implies it leads to an increase in the per capita carbon dioxide emissions. In addition, these imports have not advanced technology. Moreover, the model shows that there is no relation between commodity imports and carbon dioxide emissions in Bahrain, Kuwait and the UAE.

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