The Impact of GDP, FDI, and Import on Carbon Dioxide Emissions in of GCC Countries: A Panel Data Approach

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Abstract

The GCC countries' unified economic agreement which has been signed on 1981 and activated in 2002 aimed for easing free trade and attract more FDI to enhance the level of economic growth. This agreement has also emphasized on reducing levels of pollution and achieving a sustainable economic growth.

In reality, there is an increase in the level of emissions along with the level of rising of economic growth in GCC countries. Accordingly, in this study we will test the most significant variables pertaining to the increasing carbon dioxide emissions in GCC countries. The research objective is to determine how much the FDI inflows, economic growth, and commodity imports influenced the increasing level of emissions, and which variable has most effect? For this purpose, an empirical model is specified as a function of FDI inflows, per capita GDP growth rate, and commodity imports. However, we have built this model based on Environmental Kuznets Curve assumption (EKC), as well as Pollution Haven Hypothesis (PHH). It will be examined simultaneously a 66 balanced observation of the six GCC countries within the panel data technique using cross-section random effects.

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

Introduction

The GCC countries are among the top 25 countries[15], which contribute to the increasing level of carbon, and emit from 45% to 50% of the total emissions of Arab countries[16].

Over 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[17]. 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.

This paper examines the effect of economic growth, FDI, and commodity imports of the GCC countries in order to identify their impact on air pollution represented by carbon dioxide emissions. Selecting the air pollution as a dependent variable comes from its major role in the environmental pollution of the GCC countries over the period of the study.

The model of this study relies on the environmental Kuznets curve assumption (EKC) and pollution haven hypotheses (PHH). Moreover, we added two further variables, FDI inflows and commodity imports, to determine the impact of these variables on the environment in the GCC countries, where a positive sign of FDI inflows coefficients will confirm that the FDI inflows of the GCC countries have not used advanced technology over the period 1998-2008, and vice versa in terms of obtaining a negative sign. In addition, in respect of commodity imports, the model will examine the effect of these imports in terms of its relation with the environment.

However, to indicate whether the GCC countries have taken into account the environmental consideration, the negative signs reveals that these imports are friendly to the environment, and accompanied by technological transfer, where it will embody its effect on pollution over the study period.

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[15]Reiche, D. "Energy Policies of Gulf Cooperation Council (GCC) Countries—Possibilities and Limitations of Ecological Modernization in Reinter States." Energy Policy 38, no. 5 (2010): 2395-403.

[16] ibid

[17] Farid B. Chaaban, Report of Arab forum for environment and development 2008, Dubai. P47.

Literature review

The linkage between economic growth, foreign trade, and pollution usually indicates that the trade may influence the EKC relationship both positively and negatively. It also reveals that GDP has a high positive significant impact on the environment, while trade is not a significant factor[18]. Moreover, the income variable indicates that there is an EKC implication. In this respect, Bruyn[19] and Nickerson[20] stated that environmental pollution is linked to the direct relationship with economic growth. These two studies indicated that the best way to reduce the effect of environmental pollution is to increase the level of investment in high technology to achieve rapid economic growth and increase the level of value added. This leads to fast economic growth and reduces the effect of the emissions resulting from the increased production. Whereas Stern[21]revealed 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. While, trade has a neutral impact I this respect.

Mukhopadhyay[22]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 mitigate the level of pollution in the country.

Thomas[23] revealed a significant relationship between GDP and carbon dioxide emissions (CO_2), in which the data analysis shows that

[18] Abdulai, Awudu & Ramcke, Linda, The impact of trade and economic growth on the environment: revisiting the cross-country evidence, Kiel institute for the world economy, working paper, No. (1491), 2009, German

[19] Bruyn, S.M., Bergh J.C Van Den., & Opschoor, JB, Economic Growth and Emissions: reconsidering the empirical bases of Environmental Kuznets Curves. Ecological Economics, (25),1998,p161.Netherlands.

[20] Nickerson, Brian Anthony, Modeling carbon dioxide emissions: Applying empirical and economic analysis to a global environmental issue (Ohio state university, 2004).

[21]Stern, David I., Michael S. & Barbier, Edward B., Economic Growth and environmental degradation: the Environmental Kuznets Curve and Sustainable Development, world development, 1996, Vol. 24, No. 7 pp 1151-1160. UK.

[22] Mukhopadhyay, Kakali, Environmental impact of Thailand's trade with OECD, The Asian scholar e-journal, (2008) issue No.3.

[23] Thomas, Stacey M. Impact of economic growth on Co2 emissions: Trinidad case study,45th ISOCARP Congress 2009; from: http://www.isocarp.net/Data/case_studies/1598.pdf

Trinidad produced 12 times the CO_2 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.

Dinda[24]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 Co_2 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[25]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.

Copeland and Taylor[26]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 per cent and 0.5 per cent, however, this is associated with an increasing level of per capita income between 1.25 per cent and 1.5 per cent, which is limited by the advanced technologies.

Wen Chen[27]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, sold wastes, wastewater, SO_2, 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.

[24] Dinda, Soumyananda, Does environment link to economic growth? 2005 From: *http://www.pdfio.com/k-961069.html.*

[25] Ekins, P., Economic Growth and environmental sustainability- The Prospects for Green Growth, 1999, London.

[26]Copeland, B. R. & Taylor, M. S., Trade, Growth and the environment, NBER working paper series, 2003 No.9823, p.4.

[27] Wen Chen "Economic growth and the environment in China: an empirical test of the environmental Kuznets curve using provincial panel data" Annual Conference on Developing and Change (Capi town, 2007).

Jie He[28]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 SO_2 emission, where a 1 per cent increase on FDI capital stock will lead to an increase in industrial SO_2 emission by 0.099 per cent. The study confirms that the increase in the level of emissions is caused by the impact of FDI on economic growth.

Frankel and Rose[29]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.[30]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.

From the above related literature, we see that economic growth has a direct influence on the level of pollution. This pollution could decline over the time via the economic progress that occurs at the level of advanced technology. In other words, in the long-term, the continued economic growth will lead to the accumulation of advanced technologies, which replace the old technologies, and this progress could reduce the level of pollution.

However, solving the pollution problems does not necessarily have a reverse effect on economic growth. In addition, it has been reported that when a country does not have the institutional capacity to set up proper environmental policies and protect certain sectors, in this case the environmental problem, it will still affect the country even though the level of income might rise. Moreover, the environmental issue needs international cooperative action to unify policies for achieving suitable economic growth with less pollution. Carbon dioxide emissions are the most widespread greenhouse gases (GHGs), in which the extractive industry and mining are highly related to CO_2 emissions resulting from oil and gas combustion in the

[28] Jie He"Pollution haven hypothesis and environmental impact of foreign direct investment; the case of industrial emissions of Sulfur dioxide (So2) in Chinese provinces" (CERDI, University of Auvergne, 2005).

[29]Frankel, Jeffery A., & Rose, Andrew K. "Is trade good or bad for the environment? Sorting out the causality" (Harvard University, 2002); from: http://www.ksg.harvard.edu/fs/jfrankel.

[30] Lee, Hyun- Hoon., Chang, Rae Kwon & Koo, Chung Mo. "On the relationship between economic growth and environmental sustainability" 5th Ministerial Conference on Environment and Development in Asia and Pacific, (26, March, 2005, Seoul, Korea).

GCC countries, which substantially affect the increasing level of air pollution. These countries contribute significantly to the global CO_2 emissions, in which the majority of their emissions are concentrated in the energy extraction and manufacturing sectors[31]. The relationship between economic growth and the environment could be positive[32] when the government pays more attention towards the environment by engaging this growth and subjecting it to the consideration of maintaining the environment[33]. Also, the negative impact of environmental regulation on FDI could lead to an increasing level of pollution emissions in the host countries. However, the linkage between GDP and the emissions could vary based on the types of pollutant and region.

Hence, it is obvious that FDI and foreign trade and their effect on pollution have an effect on environmental quality, albeit each contribution does not necessarily support PHH and EKC, and that trade assists economic growth, which, in turn, is an indirect channel of the effect on the environment. In addition, the environmental policies are a major factor in controlling pollution; in this context, income represented by real GDP can positively affect most of the criteria for environmental efficiency[34].

However, many environmental studies have been based on the assumptions of the environmental Kuznets curve (EKC) to measure the impact of growth on pollution; such studies were conducted in respect of countries that applied a strict environmental policy. The current study will be distinguished from previous contributions in several aspects. The sample adopted for the dataset is related to the GCC countries whose unified economic policy focuses on enhancing the foreign trade sector and attracting more foreign direct investment as a major means for achieving a high level of economic growth. Accordingly, and in order to continue with the related literature, this study tries to link key topics – commodity import, foreign direct investment, growth and carbon dioxide emissions. For this purpose, we will use two approaches; firstly, the analytical approach, which is enhanced by tables and figures. This approach focuses on analysis of the data of study, which will be used in the quantitative approach to provide a clear picture about the GCC economies during the period 1998 to 2008. Secondly, the quantitative approach is based on two theories, EKC and PHH. It is an

[31] Qader, Mohammed Redha "Electricity consumption and GHG emissions in GCC countries" Energies 2, 1201-1213 (MDPI 2009). From*: http://www.mdpi.com/journal/energies.*

[32]Ekins, P., 1999, Op cit.

[33] Kheder, Sonia Ben. French FDI and pollution emissions: an empirical investigation, (University of Paris Press, 2010).

[34] Lee, 2005 Op cit.

attempt to obtain findings by theoretical and empirical methods, as well as to identify the policy implications to enhance the value of this study.

Based on the above, the significance of this study comes as it deals with an important bloc in the Arab countries and Middle East in general. It provides empirical evidence for the linkage between trade and FDI, and their impact on emissions, as well as an assessment of the unified economic policy of the GCC countries and their environmental policy. Moreover, this study determines the real attitude of these countries and their world commitments in reducing emissions based on an examination and analysis of one of the most significant factors of air pollution in the GCC countries, as represented by carbon dioxide emissions. Thus, it contributes to filling the gap empirically in respect of the oil economies by analysing foreign trade and FDI and their impact on emissions of GCC countries.

Study background

As well-known, GCC countries are considered as among the main contributors to climate change because of their huge reserves of oil, which account for 40 per cent of the world's proven reserves, and 23 per cent of the world's reserves of gas[35]. These significant percentages emphasize the importance of the comparative advantage of the GCC countries in investing in the oil sector, as well as in sectors related to the oil industry, which could have an adverse impact on the environment. Therefore, we can explain whether or not there were strict environmental policies through analysing the effect of FDI on carbon dioxide emissions over the period 1998-2008. Moreover, it tackles the relation between commodity imports and air pollution, and, finally, the researcher will examine the said variables quantitatively to determine their impact on air pollution, which is represented by carbon dioxide emissions.

The rate of carbon dioxide emissions in the GCC countries exceeds the global rate, where, in 2003, the emissions rate in the UAE, Bahrain, Qatar and Kuwait was, respectively, about 13, 8, 9, and 7 times more than the world average; the GCC's emissions rate amounted to 254 million metric tonnes[36]. This confirms that the GCC countries are a significant contributor to the increase in the level of carbon dioxide emissions.

However, the study period, 1998-2008, witnessed a high increase of crude oil revenue in the GCC countries, especially the years 2002-2008, where the contribution of the oil sector in the GDP rose from 30.8 per cent in 2002 to 40 per cent in 2006. This revenue constitutes 77.4 per cent of the public revenue in 2002 and reached 86 per cent in 2006[37]. In contrast, we

[35] Reiche, 2010, Op. cit.
[36] Farid B. Chaaban, 2008, op. cit.
[37] Saif, Ibrahim, "The oil boom in GCC countries, 2002-2008"(CARNEGIE, 2008) P.13.

note that there is an increase in the level of carbon dioxide emissions over the said period, in that the carbon dioxide emission level rose in the UAE from 83.6 million metric tonnes in 2002 to 128.5 million metric tonnes in 2008. In addition, in Saudi Arabia, it rose from 323.4 million metric tonnes reaching 393 million metric tonnes for the same period. The other GCC countries, also witnessed an increase in carbon dioxide emissions[38].

The data[(*)]shows that both Saudi Arabia and the UAE represent a significant contribution, where their emissions average about 324,421.18 and 112,045.5 thousand metric tonnes, respectively, for the period 1998-2008. Kuwait has come in the third level with 73471.64 thousand metric tonnes, followed by Qatar, the carbon emissions of which increased from 32,402 thousand metric tonnes in 1998 to 56,297 thousand metric tonnes in 2008 due its high production level of natural gas, which led to more pollution during the study period.

In Oman, the carbon dioxide emissions rose from 16,667 thousand metric tonnes in 1998 reaching 38,518 thousand metric tonnes in 2008, also in Bahrain from 98,892 to 128,501 during the period of study.

Based on the facts above, we can say that there is a significant increase in the level of carbon dioxide emissions in the GCC countries in general, accompanied by the growing levels of real GDP of the GCC countries during the period 1998-2008. In other words, we note that there is a positive relation between economic growth, as represented by GDP, and the increasing level of carbon dioxide emissions over the period of study.

Furthermore, we see that there is a positive relation between the size of GCC economies and the carbon dioxide emissions. This implies the high reliance on the mining, quarrying and fuel sectors in the GCC countries, so we note that the size of GDP reflects a high level of carbon dioxide emissions, which exceeded the average rate of world emissions, and explains the large negative impact of these emissions on the environment.

There is no doubt that the most polluting sectors in the GCC countries are the mining, quarrying and fuel sectors, as well as the manufacturing sector[39] which contributed, on average, between 25 per cent in Oman and 58 per cent in Qatar, as a ratio of total GDP. Moreover, the electricity and gas sector, which consumed a high level of oil, is also considered to be the third sector that emitted carbon dioxide into the atmosphere.

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[38] SESRIC, The database of Statistical economic and social research and training center for Islamic countries, Ankara –Turkey. From:http://www.sesric.org/index.php

[(*)] Look at table (3) p. 24.

[39] ESCWA "The environment in the trans boundary context in the ESCWA region: situation and recommendation", United Nations Economics and Social Commission for Western Asia (ESCWA 2005).

Moreover, mining, quarrying and fuel sectors represent a significant share of the total commodity sectors in GDP for the period 1998-2008, which represents the high importance in the GCC economies, especially in Qatar and Kuwait[40]. This fact confirms that these two countries depend too much on the extractive industries, which contributed about 58.1 per cent and 50.8 per cent, respectively, on average, of the total GDP over the study period [(*)].

In addition, the manufacturing industry is the second main sector, especially in Bahrain and the UAE, where it represents considerable relative importance in the total GDP, in that this sector contributed 12.9 per cent and 12.8 per cent of the GDP of the mentioned countries, respectively, during the period 1998-2008[41].

However, we can say that the high reliance on extractive and manufacturing industries are a major cause of carbon dioxide emissions, the level of which exceeds the emissions rate for the world. In other words, the economic activities in the GCC countries are considered as polluting activities compared to other sectors that can achieve a significant value added with less pollution, such as the agricultural and construction sectors, which represent very modest percentages[(**)] compared to the main sectors in the GCC countries. We note Qatar has the highest share in terms of per capita carbon dioxide emissions over the period 1998-2008, where the average of these emissions is about 51.33 metric tons[42]. This result reflects a high reliance on fossil fuel and other polluting industries, particularly the oil and gas industries.

In addition, Kuwait comes in the second level, with 31.78 metric tonnes, followed by the UAE, which falls in the third level, 30.39 on average, for the years 1998-2008. While Bahrain, Saudi Arabia and Oman show a lower share compared with the other GCC countries, representing 27.34, 14.58 and 11.31 metric tonnes, respectively.

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[40] Based on data of Arab Monetary Fund, AMF, Kuwait; www.amf.org.ae.

[(*)] The ratios calculated based on statistical data of the Arab Monetary Fund (AMF). From*: http://www.amf.org.ae*

[41]Ibid.

[(**)] For example, the average share of the agriculture sector to GDP in the GCC countries over the period 1998-2008 is as follows: UAE (0.01), Bahrain (0.003), Saudi Arabia (0.02), Oman (0.01), Qatar (0.000) and Kuwait (0.001).

Average share of construction sector to GDP is as follows: UAE (0.08), Bahrain (0.04), Saudi Arabia (0.04), Oman (0.05), Qatar (0.05), and Kuwait (0.01) "Calculated by the author based on Statistical Bulletin of Arab Countries, Arab Monetary Fund (AMF 2010), Kuwait, pp 37-58".

[42]SESRIC, The database of Statistical economic and social research and training center for Islamic countries, Ankara –Turkey. From:http://www.sesric.org/index.php

The per capita carbon dioxide emissions witnessed evident fluctuations during the period 1998-2002, especially in Qatar, Kuwait and the UAE. These changes are attributed to the volatility of economic activities that generated these emissions in that period. For the years 2002 to 2005. Based on table (4), we note a significant increase in the per capita carbon dioxide emissions by 12 per cent, where Qatar has the highest increase compared with the other GCC countries. Hence, we see that the main reason for the increase in the per capita carbon dioxide emissions is due to the increase in economic activities that depend mainly on crude oil and gas resulting from the increased global demand, which stimulated the oil and gas sectors to increase the production level, as well as the other related sectors, such as petrochemicals.

In the last two years of the study, 2007-2008, the per capita carbon dioxide emissions show an insignificant decline for Qatar, Bahrain, UAE, and Saudi Arabia. This decline can be explained by several initiatives (*) taken by the GCC countries in an attempt to reduce the level of pollution as a part of their commitment towards the global community.

In Oman and Kuwait, we note an increase in the per capita carbon dioxide emissions, which reflects failure in the efforts of these countries to adopt successful policies to reduce carbon emissions. The following figure shows the per capita real GDP in GCC countries over the period 1998-2008. However, there is an obvious increase of per capita real GDP in Qatar, the UAE, and Kuwait, compared with the per capita carbon dioxide emissions[43]. This case is considered a good indicator, and, accordingly, we can say that these countries have good motivations towards improving the environment because the growth levels are better than in Saudi Arabia, Oman and Bahrain.

Finally, it is noted that the increase in real GDP is accompanied by a positive increase in the level of carbon dioxide emissions. This means that GCC countries have not tried to use advanced technologies in their production process. Furthermore, these countries are not following a strict environmental policy, which could be enforced by foreign investors to use it in order to mitigate the level of carbon dioxide emissions.

The economic literature indicates that liberalization of the commodity trade could lead to pollution of the environment when the traded goods lead to more pollution[44]. However, this issue remains subject to the role of the economic policy towards the environment in the attempt to reduce the pollution that may be derived from these commodity imports. For example, in the early 1980s, the United States of America tried to reduce the import of

[43]SESRIC, op cit.
[44] Raouf, 2011, op. cit.

Japanese cars, as a result, the demand for American cars increased and led to more pollution, because the American cars emitted more carbon gas compared to the Japanese cars[45]. Hence, we note in this example that the adopted policy in this regard led to more pollution. However, without doubt, the economic policy has a significant role in caring for the environment and achieving a balance between the economic growth and environmental considerations, especially air pollution.

In the same way, free trade could lead to protection of the environment through liberalization of importing capital goods that have advanced technology and are friendly towards the environment. In this case, we see that the economic policy contributes in maintaining the environment by encouraging the importing of capital goods instead of old capital goods that have a technological disadvantage, and that this policy contributes to bringing new technologies rather than old polluting technologies.

Consequently, we cannot say definitely that foreign trade will lead to environmental pollution, as this issue is linked to the economic policy and its attempts to reduce the air pollution level while maximizing economic growth and per capita GDP. In other words, activating the economic sector and paying adequate attention to the environment to achieve sustainable economic growth, depends on the role of the government to follow a suitable economic policy that permits importing advanced capital goods to reduce the pollution that occurs from importing (*imported pollution*). This target could be achieved by providing incentives to the importers to encourage importing goods that have advanced technology, especially when used in production. In the GCC countries, the commodity imports, like machinery and transportation equipment, had considerable relative importance in the total commodity imports over the period 1998-2008, where these imports represent about 34.8 per cent, on average, of the total commodity imports of the GCC countries. The manufactured goods fall in the second level, which constitute 21.6 per cent of the total commodity imports.

Furthermore, Saudi Arabia dominates on 49 per cent of the total commodity imports for this country during the study period 1998-2008. Oman and Kuwait fall in the second and third level, with 41 per cent and 40 per cent, respectively, while Bahrain and the UAE represent a relatively low contribution, 28 per cent and 23 per cent, respectively. These percentages are not modest in comparison with the imports of food and beverages for the same period, which amounted to 16.1 per cent of the total commodity imports. Furthermore, from figure 3, we also see that manufactured goods come in the second rank in terms of relative importance, where the UAE

[45] Pugel, Thomas. "International Economics", twelfth edition, (Mc Graw Hill Irwan, 2004) p36.

dominates with the main share, which amounted to 31 per cent, on average, of the total commodity imports, followed by Qatar and Oman 24 per cent for both. Saudi Arabia, Bahrain, and Kuwait show ratios of 20 per cent, 15 per cent, and 13 per cent, respectively.

In addition, machinery and transportation equipment is one of the reasons for pollution because of their high relative importance in total commodity imports over the period 1998-2008, especially in Saudi Arabia, Oman and Kuwait.

The effect of commodity imports towards the environment is dependent on the size and type of these imports, as well as the environmental consideration taken by the governments of these countries. In this respect and according to figure 2 we see that the polluted commodity imports have significant relative importance, which dominate the major contribution of total commodity imports. Consequently, the commodity imports could be contributing increasingly to pollution of the environment.

Through the above, we can report that the increase in the import of machinery and transportation equipment indirectly indicates the increase of energy consumption consumed by this machinery, which, ultimately, leads to an increase in carbon dioxide emissions as the main source of air pollution in the GCC countries. Particularly, in Saudi Arabia, the UAE, and Kuwait, which have a high level of energy consumption[46].

Methodology

Dataset and variables

The model data were collected from different official sources. In respect of carbon dioxide emissions over the period 1998-2008, they were collected by the Statistical and Social Research and Training Centre for Islamic countries (SESRIC). We obtained the data for foreign direct investment inflows from the database of the Arab Investment and Export Credit Guarantee Corporation (AIECGC), while the data for commodity imports were derived from the statistical data of the Arab Monetary Fund (AMF) in Kuwait. In addition, the per capita GDP growth rate was obtained based on the data of the Joint Arab Economic Report that was issued by the League of Arab States.

The study uses a panel data approach, the cross-sections included six GCC member countries and involves a 60 balanced observations for the period 1998 -2008 (t = 1 … 11). In the panel data technique, the empirical model will be regressed for the full observations of each country selected in this study. The variables used in the model are; air pollution (AP) proxied by carbon dioxide emissions, real gross domestic product (*GDP*), FDI inflows

[46] Qader, 2009, op. cit.

(*FDin*) and commodity imports (*M*), and environmental awareness (*hth*) measured by health expenditure.

Model Specification

The variables of this model is based on a different theories. Real GDP (*GDP*) is specified due to hypotheses of the Environmental Kuznets Curve (EKC), and FDI inflows (*FDin*) is selected to examine its linkage with hypotheses of the pollution haven theory (PHH). While commodity import (*M*) has been added to check the possibility of the role of imports as a cause of air pollution[47, 48]. And health expenditure (*hth*) will be measured as an indicator of the potential for increased environmental awareness in GCC countries over the period of study. Where, environmental programs can be supported by spending on health to reduce the impacts of human actions[49, 50], and production process[51].

Therefore, we will test four independent variables, which are: *GDP*, *FDin*, *M* and *hth*. All data of the study will be subjected to the Augmented Dickey fuller test (ADF) in order to ensure the level of stationarity of all data used. 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.

$$AP = a + b_1 (GDP) + b_2 (FDin) + b3 (M)\ b4 (hth) + ui \qquad (2)$$

Where:

AP: Air pollution, measured by carbon dioxide emissions (CO_2).

GDP: Real gross domestic production (*Million USD*).

FDin: Foreign direct investments inflows, measured as a ratio of real GDP.

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

[47]Magee, S. P., & Ford, W. F. Environmental pollution, the terms of trade and balance of payments of the United States. Kyklos, 25(1), 1972: 101-118.

[48]Munksgaard, J., & Pedersen, K. A. CO< sub> 2</sub> accounts for open economies: producer or consumer responsibility? Energy policy, 29(4), 2001: 327-334.

[49]Elsabawy, Mohamed. Environmental health awareness scale: a proposed model for Egypt as a developing country, The Egyptian Journal of Environmental Change, 3 (1), 2002: 46-61.

[50]M Jerrett, J Eyles, C Dufournaud, S Birch. Environmental influences on health care expenditures: an exploratory analysis from Ontario, Canada, Journal of Epidemiology and Community Health, 57 (5), 2003: 78-84.

[51]Grossman, G. M. and A. B. Krueger. Economic growth and the environment. The Quarterly Journal of Economics, 110(2), 1995: 353-377.

Hth: Environmental awareness measured by health expenditure as a ratio of real GDP.
Ui: Error term

Diagnostic tests and results:

In order to ensure the validity of the data of study, we have conducted several diagnostic tests such as unit root test, Hausman test. These tests infer that the variables are statistically valid, however, the Dickey Fuller test (ADF) proves the stationarity of the panel data series, and this implies there is no unit root. Moreover, to determine an ideal option between fixed effect and random effect in panel data context, the Hausman test is used. We have found that the probability is more than 0.05 (Prob. > 0.05) as shown in table 1.

Therefore, random effect regression is preferred. Based on that, the model of this study is reliable and could be used for analysing the estimated results.

Model Estimation

The regression result of the model above is statistically significant at the (0.01) level, and the estimated result confirms that the model has no auto-correlation problem, where the D.W. value amounted to about 1.77, which means that the estimated model is located in the acceptable statistical area. Based on the above indicators, we find that this model is significant, and can be used for analysing the variables of the study.

Results analysis

All of the estimated real GDP coefficients of the model were statistically significant at the 0.01 level, which reflects its major impact as the main agent of the increase in the level of carbon dioxide emissions in the GCC countries over the period studied. However, the effect of each one was different from one country to another, as follows:

The UAE

The estimated value of real GDP confirms the strength of the influence of this variable to positively affect an increase in the pollution level, where an increase in the real GDP by one time leads to an increase in the carbon dioxide emissions by 0.697 times. This result shows the real economic situation of the UAE, where the oil sector is the main factor that affects economic growth in the UAE over the period 1998-2008, which contributes significantly to the effect on the environment. In other words, the economic growth in the UAE has increased the level of carbon dioxide emissions, and, furthermore, the UAE is considered as the second producer

of the petrochemical industry[52], which is characterized as a highly polluting industry that led to environmental damage during the study period.

In addition, the estimated model has also proved that the coefficient of FDI inflows, FDI outflows, commodity imports, and environmental awareness are statistically insignificant. This means that these variables do not contribute to the increasing or decreasing level of carbon dioxide emissions in the UAE. In this context, we can explain that this result is because most of the foreign direct investments in the UAE are concentrated in the non-oil industries, such as the building and construction sector, which, on average, represents 90 per cent of the total FDI inflows to the UAE[53], as well as to other industries, such as garment industries.

However, it is worth noting that after 1999, the UAE started encouraging establishing projects that were environmentally friendly, such as projects for solar energy that are used for a variety of purposes[54]. Accordingly, we can say that the FDI inflows in the UAE have used advanced technology that keep the per capita carbon dioxide emissions at a certain level, and, thus, the air pollution in the UAE is attributed to the oil sector, which grew rapidly over the period 1998-2008.

Bahrain

In Bahrain, all of the coefficients are statistically insignificant except real GDP, which has a modest impact in comparison to the other GCC countries. This result can be explained due to the small size of the Bahraini economy, it represents only 2 per cent as a ratio of the total average of GDP in the GCC countries for the period 1998-2008. However, an increase in the level of carbon dioxide emissions by one time will lead to a rise in emissions level by 0.545 times. Consequently, the low level of oil products confirmed its weak effect on the environment over the study period. Whereas other variables did not play a role in polluting the environment.

Saudi Arabia

The estimated model shows that the real GDP variable is the major cause of environmental degradation, where its increase by one time leads to an increase in the carbon dioxide emissions by 0.724 times. In contrast, an increase in the commodity imports by one time induces a decrease in the per capita carbon dioxide emissions by 0.023 times. In fact, in the real situation

[52]DMCC, Dubai Multi Commodities Centre (2007-2008), Plastics and petrochemical, UAE, Dubai, 2009, p10. From: *http://www.dmcc.ae.*

[53]Ministry of economy- Abu Dhabi, Foreign Direct Investment in the UAE, 2008, P.11.

[54] Qader, Mohammed Redha, Electricity consumption and GHG emissions in GCC countries, Energies 2, 1201-1213 (MDPI 2009). From: *http://www.mdpi.com/journal/energies*.

we have noted already that most of the economic activities of Saudi Arabia are concentrated in the oil and petrochemical industry and oil-based industries[55], which are considered to be a significant factor that polluted the environment, and increased the carbon dioxide emissions over the period 1998-2008. Moreover, the key issue that we should focus on is the comparative advantage of Saudi Arabia, as represented by its energy resources, which encouraged foreign direct investment, in that many foreign companies preferred to invest in the oil sector and other industries that are associated with oil products, especially the petrochemical industries. This preference is attributed to the stringent environmental laws in the developed countries on the one hand, which have discouraged many investors in this field, and the lax environmental laws in the GCC countries, on the other, which have attracted more foreign direct investments to Saudi Arabia. In other words, the economic policy in Saudi Arabia does not focus on the importance of caring for the environment and creating a sustainable development, as much as focusing on achieving rapid economic growth without reducing the level of environmental degradation, as represented by the per capita carbon dioxide emissions over the study period. However, the result confirms that the GDP is the major factor of air pollution in Saudi Arabia.

In respect of the commodity imports coefficient, we note a negative relation between the increased level of imports and environmental degradation. This result reflects the substituted process of capital goods that have advanced technology instead of the polluting capital goods[56].

Finally, the FDI inflows and health expenditure variables are statistically insignificant, which indicates that there is no relation between environmental degradation and these variables as much of the emissions results from the increase in extractive industries that achieve a high level of pollution in Saudi Arabia.

Oman

The coefficient of real GDP and environmental awareness are statistically significant at the 0.01, 0.10 levels, respectively, where the effect of the GDP coefficient was positive because its increase by one time led to an increase in the carbon dioxide emissions by 0.711 times over the period 1998-2008.

In addition, the relation between environmental awareness and carbon dioxide emissions is negative, this means the environmental policy in

[55]Abdul-Rahman, A. M, Determinants of foreign direct investment in the Kingdom of Saudi Arabia, King Saud University Press, 2010.

[56]Hussein, Jasim (*in Arabic*), Foreign direct investment in the Gulf, Journal of Economic Vision (Alrroya, 2010), No.47. From: *http://www.alrroya.com/node/929*

Oman has succeeded in mitigation level of air pollution over the period 1998-2008. Thus, this result reflects the sound economic policy of Oman to treat the environmental problem, where Oman and the other GCC countries are considered as contributing considerably to air pollution due to their high reliance on the oil sector and other industries that are linked thereto. Therefore, the result of the specific model confirms that the carbon dioxide emissions result from the economic activities, while other variables, import (*M*) and FDI (*FDin*) did not influence the increase of emissions within the period of study.

Qatar

Two coefficients – real GDP and FDI inflows – are statistically significant at the 0.05 and 0.01 levels, respectively, where the real GDP confirms its positive relation to the increase in the carbon dioxide emission in Qatar over the period of study. Therefore, the estimated model reports that increasing the level of real GDP and FDI inflows by one time leads to an increase in the carbon dioxide emission of about 0.501, and 0.026 times, respectively. The evident analysis of this issue is related to the growth of GDP in Qatar, which depends significantly on the oil and gas sector. In other words, the economic growth in Qatar has led to pollution of the environment.

In addition, the effect of FDI inflows on the environment in Qatar could be related to the fact that most foreign direct investments inflows are to the gas sector and petrochemical industry, which are considered as the main cause of air pollution. It is worth noting that Qatar has the third largest global reserve of natural gas. Qatar is considered as the principal supplier of liquefied natural gas in the world[57], and this feature is the main factor that encourages foreign companies to invest in the gas sector. However, the comparative advantage of Qatar led to more pollution over the study period.

In respect of commodity imports and health expenditure, the estimated result depicts that these variables are statistically insignificant. Therefore, we can say that the main cause of increased pollution is due to GDP and FDI inflows, this result indicates that the economic policy in Qatar did not show much concern for the environmental considerations over the period 1998-2008.

Kuwait

In Kuwait, the real GDP has confirmed its effect on increasing the carbon dioxide emissions, where the estimated model indicates that increasing the real GDP by one time leads to an increase in the emissions of

[57]EIA, Energy Information Administration, Qatar energy data, statistics and analysis, EIA, 2010, P1.

about 0.767 times. This result proves the role of economic activities, which are significantly reliant on oil production and its process, in maximizing the environmental pollution. Therefore, the continuing dependency on the oil sector and its export will not achieve sustainable economic growth in Kuwait, which indicates the importance of diversification for improving the level of economic growth while reducing the carbon dioxide emissions gradually; this target can be achieved by an increase in the level of investment in the non-oil sector.

In addition, the estimated model shows that the environmental awareness variable was statistically significant at the 0.05 level, however, it has an impact of about 0.11. This implies that Kuwait has taken into account the environmental consideration over the period studied.

In regard of commodity imports, and FDI inflows the model results show that it is insignificant, and that there is no relation between the air pollution in Kuwait and commodity imports because the real GDP had the major role in pollution of the environment over the period of study.

Conclusion and policy implication

The real GDP confirms its positive effect in increasing the carbon dioxide emissions for all GCC countries during the period 1998-2008, where it was the main cause of air pollution. In addition, the econometric model indicates that a one-time increase in real GDP will lead to a positive significant influence on the carbon dioxide emission levels. Since the industrial sector shapes the high ratio of GDP for the GCC countries, the high level of economic growth of these countries will be accompanied by an increase in the level of carbon dioxide emissions. Furthermore, the FDI inflows of Qatar significantly contribute to an increase in the air pollution compared to other GCC countries. This result could be attributed to using non- advanced technologies, as well as the sectors that do pollute the environment, such as the gas and refineries sectors.

Furthermore, the commodity imports have affected the reducing level of emissions, which confirms that the economic policy has shown more concern to the environment in importing goods that cannot lead to emit more carbon dioxide. In this context, we can say that Saudi Arabia applied in practice its commitment on the unified economic policy, which is related to green economies as a main target of this agreement. We can say that these facts reflect a specific result for each country in this study, where the effect of imports in Saudi Arabia is friendly to the environment, which means that these imports are characterized by advanced technology. Finally, for both Kuwait and Oman, the environmental awareness variable (*Hth*) has contributed in reduction the air pollution, whereas the other GCC countries show an insignificant result in this respect. However, there are evident

differences in the environmental policies of GCC countries, as clearly seen in the case of Kuwait and Oman, where there is a significant linkage between environmental awareness and the level of emissions. While in the UAE, Bahrain, Saudi Arabia and Qatar, we reveal that the policy of these countries is not taking into account the high level of air pollution, in that, these countries have not achieved an important role to the decreasing level of carbon dioxide emissions over the period of study, 1998-2008.

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Appendix

Table (2): Regression result of the model 3- random effects

Dependent Variable: LOGAP
Method: Panel EGLS (Cross-section random effects)
Date: 01/25/14 Time: 22:41
Sample: 1998 2008
Periods included: 11
Cross-sections included: 6
Total panel (balanced) observations: 66
Wallace and Hussain estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDIN_Bahrain	7.41E-05	0.000257	0.288975	0.7741
FDIN_Kuwait	-0.037103	0.044489	-0.833986	0.4091
FDIN_KSA	0.015523	0.009771	1.588637	0.1198
FDIN_Oman	-0.005980	0.013025	-0.459101	0.6486
FDIN_Qatar	0.026752	0.013515	1.979400	0.0545 (**)
FDIN_UAE	-0.008613	0.009628	-0.894517	0.3763
GDP_Bahrain	0.545831	0.227356	2.400776	0.0210 (**)
GDP_KSA	0.724958	0.239497	3.027008	0.0043 (*)
GDP_Kuwait	0.767544	0.210500	3.646292	0.0007 (*)
GDP_Oman	0.711589	0.272586	2.610513	0.0126 (*)
GDP_Qatar	0.501283	0.171787	2.918055	0.0057 (*)
GDP_UAE	0.697893	0.239690	2.911652	0.0058 (*)
M_Bahrain	0.000794	0.004280	0.185589	0.8537
M_Kuwait	0.009147	0.006760	1.353186	0.1834
M_KSA	-0.023157	0.010274	-2.253905	0.0296 (**)
M_Oman	0.006997	0.008780	0.796943	0.4301
M_Qatar	8.55E-05	0.003298	0.025940	0.9794
M_UAE	0.000804	0.002834	0.283604	0.7781
HTH_UAE	-0.082814	0.121491	-0.681648	0.4993
HTH_Bahrain	-0.005869	0.059139	-0.099235	0.9214
HTH_KSA	0.060736	0.053210	1.141447	0.2603
HTH_Oman	-0.230565	0.119473	-1.929860	0.0606 (***)
HTH_Qatar	-0.013069	0.029686	-0.440249	0.6621
HTH_Kuwait	-0.111793	0.048616	-2.299511	0.0266 (**)
C	1.717381	0.891485	1.926428	0.0610 (***)

Effects Specification	S.D.	Rho
Cross-section random	1.000936	0.9970
Idiosyncratic random	0.054568	0.0030

Weighted Statistics

R-squared	0.821335	Mean dependent var	0.077945
Adjusted R-squared	0.716750	S.D. dependent var	0.102705
S.E. of regression	0.054661	Sum squared resid	0.122499

F-statistic	7.853319	Durbin-Watson stat	1.776978
Prob(F-statistic)	0.000000		
Unweighted Statistics			
R-squared	0.257497	Mean dependent var	4.742571
Sum squared resid	8.834053	Durbin-Watson stat	0.024641

Source: prepared by using E-Views software and Panel data technique.
(**),(***), (****) indicate statistically significant at the (1%), (5%) and (10%) levels, respectively.

Table (1): Summary of Hausman Test

Correlated Random Effects - Hausman Test Test cross-section random effects			
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	2.279007	3	0.5166

Source: By the author based on Eviews software.

Table (3): Carbon Dioxide emissions in GCC countries 1998-2008 (thousand metric tonnes)

Year	UAE	Bahrain	Saudi Arabia	Oman	Qatar	Kuwait
1998	98892	18405	207288	16667	32402	36421
1999	89038	18020	227229	20818	31408	66002
2000	126754	19758	297749	22057	34730	71107
2001	113783	15082	295843	20444	28001	67465
2002	83659	16824	323459	25544	28012	63982
2003	106365	17580	323697	31943	30564	73263
2004	112878	18056	346047	30971	40286	81338
2005	115628	19684	367067	34176	56820	89878
2006	121462	21294	384386	39717	49541	86343
2007	135540	22464	402450	37319	63054	86145
2008	128501	21879	393418	38518	56297	86244
98-2008	112045.5	19004.18	324421.18	28924.91	41010.45	73471.64

Source: SESRIC, The database of Statistical economic and social research and training centre for Islamic countries, Ankara –Turkey. http://www.sesric.org/index.php

Table (4): Per capita carbon dioxide emissions in the GCC countries 1998-2008 (metric tonnes)

Year	UAE	Bahrain	Saudi Arabia	Oman	Qatar	Kuwait
1998	34.16	29.62	10.52	7.19	57.03	31.29
1999	29.05	28.35	11.25	8.82	53.27	31.33
2000	39.15	30.4	14.42	9.18	56.31	32.47
2001	33.33	22.68	14.02	8.37	43.19	29.65
2002	23.3	24.73	15.01	10.28	40.92	27.4
2003	28.25	25.26	14.69	12.65	41.78	30.57

2004	28.7	25.37	15.36	12.05	50.54	33.07
2005	28.28	27.05	15.88	13.06	64.17	35.45
2006	28.7	28.64	16.23	14.87	49.51	33.22
2007	31.06	29.58	16.66	13.69	55.43	32.35
2008	29.88	29.11	16.44	14.28	52.47	32.78

Source: SESRIC, The database of Statistical economic and social research and training centre for Islamic countries, Ankara –Turkey. http://www.sesric.org/index.php

Table (5): Level of real GDP of GCC countries, 1998 – 2008, constant prices 2005. (Million USD).

Year	UAE	Bahrain	KSA	Oman	Qatar	Kuwait
1998	118793	10948	248474	25556	26704	53209
1999	124002	11602	246614	25400	27848	52258
2000	139151	12416	258611	26577	30084	54706
2001	141065	12726	260027	28059	31257	54825
2002	144490	13152	260359	28638	33502	56480
2003	157214	13980	280301	28739	34748	66263
2004	172254	14956	306240	29719	41426	73048
2005	180610	15968	328461	30904	44530	80797
2006	198300	17001	346779	32614	56184	86870
2007	204700	18411	367558	34807	66290	92075
2008	211230	19559	398533	39389	77998	94358

Source: SESRIC, Database of Statistical, Economics and Social Research and Training for Islamic Countries. www.sesric.org/baseined-step3.php

Table (6): commodity imports in GCC countries, 1998-2008 (million USD)

Year	**UAE**	**Bahrain**	**KSA**	**Oman**	**Qatar**	**Kuwait**
1998	34093.96	4025.53	28743.12	5026.06	3321.84	8214.41
1999	32587.92	3477.66	30012.55	5825.72	3356.79	8617.03
2000	24972.18	4272.90	28032.00	4674.33	2499.56	7616.39
2001	26717.03	4832.98	30197.35	5130.79	3252.20	7156.13
2002	30076.02	4305.41	31181.55	5796.17	3724.29	7872.58
2003	37533.02	5012.36	32290.13	6005.20	4052.03	9000.01
2004	45824.37	5657.24	36916.00	6572.17	4897.34	10985.15
2005	63430.91	6484.49	47375.73	8615.60	6004.45	12630.57
2006	74494.21	7946.25	59462.67	8827.05	10060.71	15801.03
2007	86118.45	8943.62	69707.10	10897.53	12614.01	15951.70
2008	12110.00	11515.20	90156.80	12112.20	20934.53	23587.70

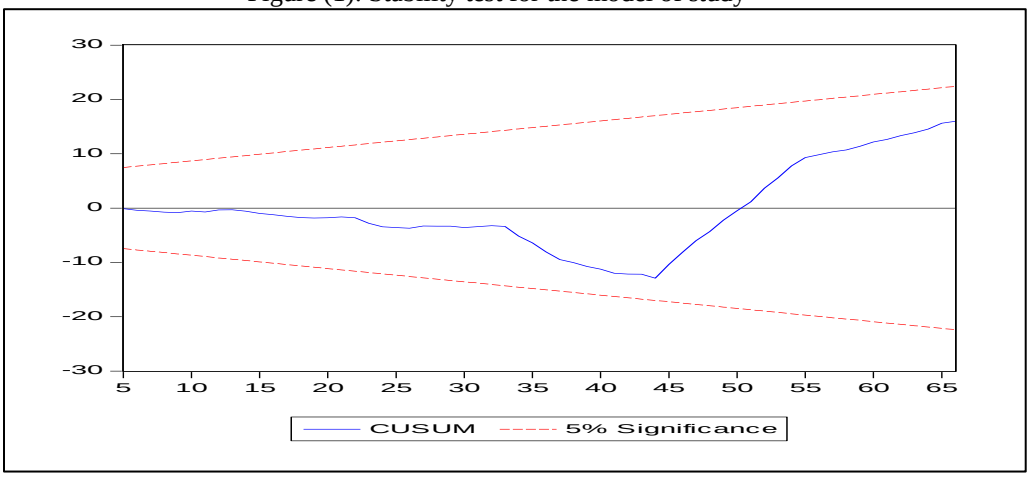
Source: Based on data of foreign trade of GCC countries, Arab monetary fund, AMF, Kuwait.
League of Arab states, (2006) Joint Arab economic report, (AMF, Abu Dhabi), p 153.

Table (7): FDI inflows to the GCC countries 1998-2008 (million USD)

Year	UAE	Bahrain	KSA	Oman	Qatar	Kuwait
1998	257.66	179.52	94.00	101.44	347.30	59.06
1999	-985.34	453.72	123.00	39.01	113.25	72.28
2000	-506.33	363.56	183.00	83.20	251.60	16.30
2001	1183.84	80.40	504.00	5.20	295.52	-175.00
2002	1314.27	217.02	453.00	122.24	623.92	3.62
2003	4255.96	516.70	778.46	26.01	624.92	-68.00
2004	10004.08	865.31	1942.00	111.05	1198.97	23.75
2005	10899.93	1048.67	12097.00	1538.36	2500.00	234.00
2006	12805.99	2914.89	17140.00	1596.88	3500.00	122.00
2007	14186.52	1756.11	22821.07	3331.60	4700.00	116.00
2008	13700.00	1793.88	38151.47	2358.91	4107.00	-51.00

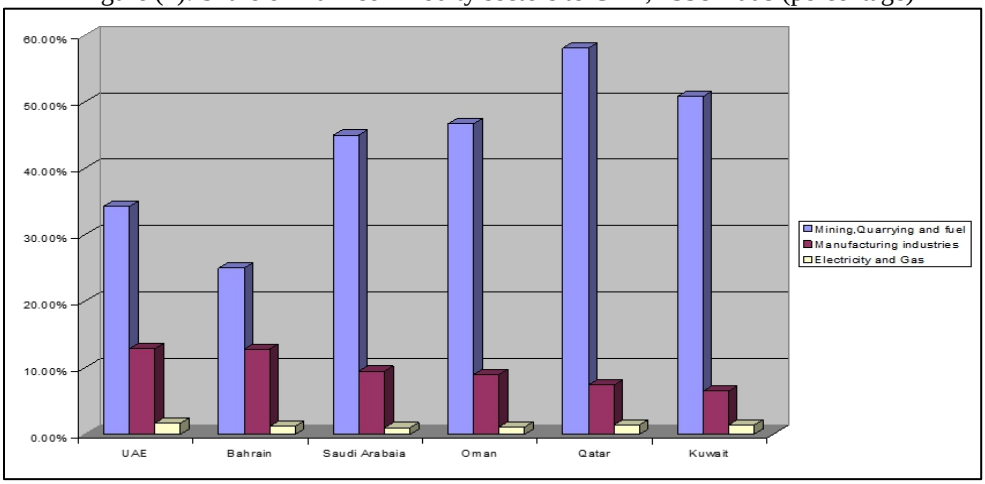
Source: UNCTAD, Database of FDI.
AIECGC, (2010), Statistics of Arab Investment and Export Credit Guarantee Corporation.
SESRIC, Database of Statistical, Economics and Social Research and Training for Islamic Countries.

Figure (1): Stability test for the model of study



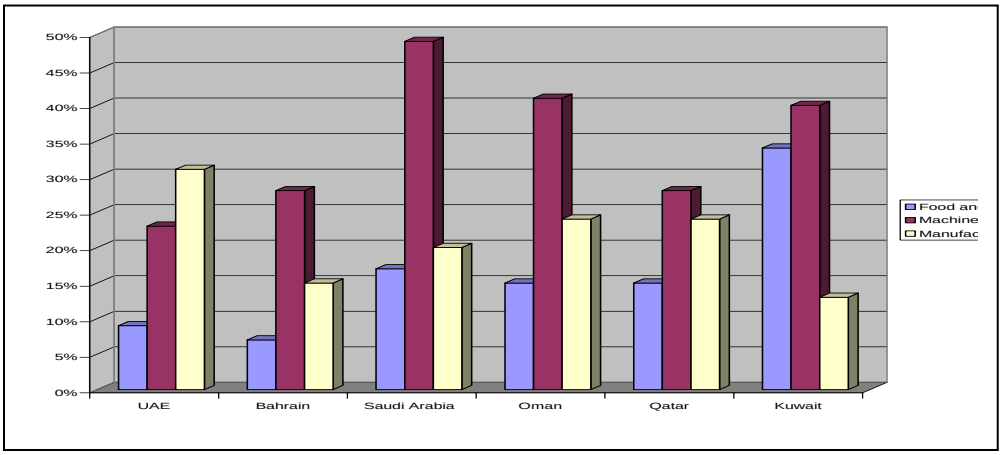
Source: By the author based on Eviews software.

Figure (2): Share of main commodity sectors to GDP, 1998-2008 (percentage)



Source: By the author based on data of Arab Monetary Fund, AMF, Kuwait; www.amf.org.ae

Figure (3): Main commodity imports of the GCC countries, 1998-2008 (percentages)



Source: By the author based on data of foreign trade of GCC countries, Arab monetary fund, AMF, Kuwait (www.amf.or.ae)

League of Arab states, (2006) Joint Arab economic report, (AMF, Abu Dhabi), p 153.