The Impact of Investment in Industrial Sector on the Environmental Degradation in Jordan

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Abstract

Many international empirical studies have concentrated on the impact of industrialization and economic development on environmental degradation. This study adopted an analytical approach, using the ordinary least squares (OLS) method, in order to study the industrialization and its effect on the environment quality by examining Jordan economy to verify that the higher levels of industrial growth, led by enormous investments, are creating imbalances in the environment. We noted that the effect of each independent variable represented by industrialization, population density, number of vehicles and real GDP on the dependent variable, which are represented by CO2 emissions from fossil fuel consumption (Carbon dioxide emissions), are positive. This result is not eccentric since it matches many literature findings especially those applied on developing countries. It is worth mentioning that the industrial sector in Jordan is still undersized and witnessed a rapid growth rate, in addition to a transformation from traditional to moderate technology utilization. However, the impact of population density on the CO2 emissions has the highest significance compared with other variables. This might be an outcome of the high rate of population growth in addition to the migration of Palestinians from Kuwait in the year 1990, followed by Iraqi and Syrian refugees.

Keywords: Investments, environmental degradation, Industrialization, GDP, Jordan economy.

1. Introduction

It is obvious that the growing of economies, especially the investment sector in developed countries, is causing brutal pollution harms in the form of emissions for different types of gases like Carbon dioxide emission stemming from the burning of fossil fuels which includes carbon dioxide created during the consumption of solid, liquid, gas fuels and gas flaring. High emissions in a developing country, like Jordan, are results of high energy or fuel consumption. Moreover, moderate industrialization, higher population growth rate, and the increase in number of vehicles as results of the rapid economic development, are the main dynamic forces towards higher energy use.

In this perspective, environmental economists concur that there are environmental expenses and damages linked with rapid economic investments, which result in expanding the economic activities. The industrial sector is one of the most active sectors of the economy and plays a critical role in economic investments, the alleviation of poverty as well. If environmental concerns are not successfully integrated into the design of industrial procedures, the propositions can be manifold. It is well known that industries consume approximately 37 per cent of the world's energy and emanate 90% of the world's SO_2, 50% of the world's CO_2, and almost the entire of its toxic chemicals. Though, the severity of several local impacts of industry and the high cost of remediation industry are becoming increasingly sensitive matters. The environmental degradation can also be added to the problems of imposing higher costs on the citizens by raising the costs of health related issues. According to United Nations report, the world's poorest 20% of population acquire this burden which is a consequential of environment degradation. In addition, it is responsible about the world's 80% of the diseases due to pollution in the of air, water, and land as a result of rapid industrialization (United Nations Report, 2007).

The issue allied in the case of Jordan economy is that this country is in the stage of starting the industrialization, which is a consequential of acceptable economic growth led by changes in the structure of economic activities, higher investments and high population growth rate.

This problem is precisely related and clarified by the Environmental Kuznet Curve (EKC). Its assumption states that pollution levels rise as the country develop, but begin to decrease as rising incomes pass beyond a turning point. This is revealed as inverted-U curve, stating the relationship between pollution level and national income. This assumption was heavily proposed by Grossman and Krueger (1992) and reaffirmed by them once more in 1995. There are several factors which are driving the correlation between environment degradation and economic growth. The upward movement of the curve captures the developing nations that move from agriculturally based economy to the industrialization stage. In the next stage, the nation transforms into developed economy and then begins the downward movement of the curve with a shift towards services intensification, at which it raises the imports of industrial commodities and stabilizes the growth rates. In other words, developing nations with low levels of industrialization are steadily changing their reliance from the agricultural to the industrial sector, while developed nations, with a high level of industrialization, are changing from the industrial to the service sector.

2. The Problem of the Study

The study summarized the problem by answering the following question:
Do the higher investment activities in industrial sector in Jordan lead to a decline in environmental quality, which is represented by $CO2$ emissions from fossil fuel consumption (Carbon dioxide emissions)?

3. The Aim of the Study

The study attempts to examine the effect of investments in industrial sector on the environment degradation.

4. Hypotheses

To achieve the objectives of the study, a number of the following assumptions have been developed:

H1: There is a statistically significant effect of industrialization on the emissions resulted by fossil fuel consumption.

H2: There is a statistically significant effect of the population density on the emissions resulted by fossil fuel consumption.

H3: There is a statistically significant effect of the number of vehicles and the emissions resulted by fossil fuel consumption.

H4: There is a statistically significant effect of real GDP growth and the emissions resulted by fossil fuel consumption.

H5: There is a statistically significant effect of the combined independent variables on emissions resulted by fossil fuel consumption.

5. Methodology

The analytical method is followed in this study. The study started with the related literature review and covered a period of time from 1990 to 2012, which enclosed available data collected for the dependent variable (Carbon dioxide emissions from the burning fossil fuel in Jordan) and the independent variables, namely industrialization, population density, number of vehicles, and the real GDP. All these variables are believed to affect the dependent variable. The entire data is derived from reports issued by the official institutions in Jordan and other international sources during the time period covered in the study. Finally, the data in the study was analyzed statistically using the ordinary least squares (OLS) method, by software program (SPSS) to derive the analytical and statistical outcomes.

6. Literature Review

Barry Commoner in his study "The environmental costs of economic growth" in the year 1977, connected between economic growth and environmental pollution, and reviewed the status of the United States since 1946, and referred the environmental degradation to the increase in the emission of smoke which is associated with toxic substances such as nitrogen oxide from vehicles. In addition, Commoner stated that water pollution is caused by the use of chemical fertilizers for agricultural lands, so that the pollution level increased to 648% during the period 1949-1968. Commoner concluded that the environmental degradation which happened in the United States is due to several factors which are the population density, the production and consumption level, in addition to the change in production technology (Barry Commoner, 1977).

A study conducted by Laster B.Lave & Eugene P.Seskin in Britain entitled "Air pollution and human health" showed that there is a close association between air pollution and health.

The study revealed that up to 25% of deaths caused by lung cancer and it is possible to be avoided through a 50% reduction of air pollution, in addition to avoid 15% of the financial costs resulted by these diseases. Meanwhile, the study throughout 336,561 questionnaires found that there is a strong relationship between stomach cancer and air pollution (Laster & Eugene, 1977). But Vinod Thomas in his study found that air pollution, especially in the Third World, produces materials such as oxides of nitrogen, sulfur, carbon compounds, lead, arsenic and cadmium created by cars, industrialization and power plants (Vinod, 1985).

The publication of Robert Boorstin in 1986 regarding the federal laws and control standards which imposed on pollution spews into the atmosphere confirmed that these laws have led to a reduction in the levels of pollutants in most urban areas in the United States. But the population's dependence on vehicles has kept the level of some pollutants, up to the extent that it poses a threat to the environment. In addition, an ozone level caused by air pollution was in New York, Houston and Chicago about twice the allowed maximum in the year 1986. Meanwhile, in Los Angeles ozone level was three times the legal maximum (Robert Boorstin, 1986).

Grossman and Krueger (1992), were the pioneers to lucid the relationship between the environment degradation and economic growth using time series data analysis which known by Environment Kuznets Curve (EKC). In the same context, Kolstad and Krautkraemer (1993) demonstrate the legitimacy that there is a vigorous relationship between the environment, resource use and economic growth. They confirm that while energy sources use, it yields an immediate economic return, and ends with negative impact on the environment which might be observed in the future. Likewise, Lise and Van Montfort (2006) try to clarify the association between energy use and GDP by applying integration analysis for Turkey with annual data over the period 1970–2003. The analysis of the study illustrates that energy consumption and GDP are co-integrated and there is a probably bi-directional causality relationship between them. In this regard, Soytas and Sari (2007) examined the long run Granger causality relationship among GDP, CO_2 emissions and energy consumption in Turkey, controlling for gross fixed capital formation and labor. The study concluded that carbon emissions cause energy consumption, but not vice versa.

Moreover, Focacci (2005) carries out an empirical analysis regarding the environmental and energy consumption strategies in Brazil, India and China. The study consists of ratio analysis using, emission intensity ratio and energy intensity ratio to relate to EKC model. The findings of the study show mixed results concerning application of EKC model for these three countries. It demonstrates that the results of analysis and its trends in the three countries are unlike those in the other developing countries.

In several studies, it is obvious that the emissions generally result from consumption of energy, and the reduction in energy consumption appears to be the only way of managing this problem. However, for an economy to grow up, declining the energy consumption level is not doable.

Galli (1998) argues that there are several factors led to the reduction in intensity of using fuel and energy. These factors enclose increases in the efficiency of energy use, substitution of more efficient fuels and modification in the structure of final energy demand. Kadnar (1998) concentrates in his study on the relationship between energy consumption, population growth, and GDP to predict the future short term fuel energy requirements.

Wiedmann, T.; Lenzen, M.; Turner, K. & Barrett, J. (2007) constructed an Input-output models to find the direct and indirect relationship between industries by means of various multipliers. They calculated the demand for energy (or the pollution created from it) after the expansion of any industry. These models, cannot examine the impact on energy demand related to changes in energy prices, neither can they make technical improvement as endogenous variable. On the other hand, the study by Agras and Chapman (1998), considers the price of energy; it reveals the importance of energy prices and then includes it in econometric EKC structure testing energy income and CO_2 income relationships. These price income and long run models conclude that income is no longer significant indicator of energy demand or environmental quality.

7. Theoretical framework

Jordan economy is one of the smallest in the MENA region, with limited supplies of water, oil, and other natural resources, fundamentally the government depends on foreign assistance. Other economic challenges for the country are persistent high rates of poverty, unemployment, high inflation rates, and a huge budget deficit.

According to the Central Bank of Jordan (CBJ), the consequences of unstable regional and global situation continued to affect the performance of the Jordanian economy in the previous years. In the aftermath of the global financial crises, the region was hit by economic and political instability. The political chaos in Syria in 2012 forced hundreds of thousands of refugees to flee to Jordan, which resulted in an ample anxiety on the weak economy. Still, the Jordanian economy managed to maintain an acceptable stable performance. The real growth rate crept to 2.7% in 2012 compared with 2.6% in 2011. However, the growth rate was notably below the average level during the period 2000-2008; estimated by 6.6% per annum (CBJ, annual report 2012).

It is worth mentioning that the economic growth rate in 2012 was driven by the recovery in the majority of service-producing sectors, particularly "trade, restaurants and hotels" sector which rebounded due to the improvement in tourism activities, as well as "electricity and water" to meet the growing demand of consumers. On the other hand, the commodity-producing sectors demonstrated some deterioration in their performance, mainly "mining and quarrying", agriculture, and construction sectors. Given the stable rate of population growth in 2012, estimated by 2.2 %, the per capita real GDP grew by 0.4 % to reach JD 1,646.1, compared with JD 1,639.3 in 2011(CBJ, annual report 2012).

Jordan economy achieved advanced international competitiveness indicators. The Global Competitiveness Report released by the World Economic Forum in 2012 indicated that the Jordanian economy came in the 64th rank (out of 144 countries), moving up by 7 levels compared with its rank in 2011. This enhancement was driven by the advancement in the "innovation and sophistication" as well as efficiency enhancers indicators, reflecting the improved investment's environment for attracting investments. In this regard, the government introduced a bundle of measures and legislations in 2012 to achieve a creation of an attractive economic environment to stimulate domestic and foreign investment and to sustain economic growth (CBJ, annual report 2012).

7.1 Gross Domestic Product (GDP)

The Gross Domestic Product (GDP), at constant market prices, was increased by 2.7 % in 2012 compared with 2.6% in 2011. Furthermore, when the "net taxes on products" excluded, which displayed a positive growth equal to 3.2% for the first time since 2009, the GDP growth at constant basic prices decelerates from 3.3 % in 2011 to reach 2.5% in 2012. The slowdown in GDP growth, at constant basic prices, was a result of the contraction in some commodity-producing sectors, such as agriculture, "mining and quarrying", the deceleration in manufacturing, on one hand, and the growth of "trade, restaurants and hotels", "electricity and water", "finance, insurance, real estate and business services", "transport, storage and communications", on the other hand (CBJ, annual report 2012).

The above mentioned statistics revealed that GDP, at current market prices, grew at 7.3% in 2012; totaling JD 21,965.5 million. This growth rate was mainly driven by the growth of the GDP deflator by 4.5% in 2012. Moreover, the Gross National Product (GNP), at current market prices, grew by .9% in 2012 compared with 8.8% in 2011; totaling JD 21,751.8 million. The aforementioned deceleration was due to the widening deficit in net factor income from abroad by JD 86.1 million, driven by the increase in interest and profit payments on foreign investments, to reach JD 213.7 million in 2012. Furthermore, when adding other net current transfers from abroad, which decreased by 17.0% to reach JD 2,868.5 million in 2012, the Gross National Disposable Income (GNDI), at current prices; grew by 3.4% to reach JD 24,620.3 million (CBJ, annual report 2012).

7.2 Industrial Sector

The industrial sector and its indicators in Jordan (see table 1), which includes both "mining and quarrying" as well as manufacturing, demonstrated a remarkable deceleration in 2012; the value added of this sector grew by just 0.5% compared with 5.22% in the year 2011. Such slowdown was an outcome of the contraction in "mining and quarrying" sector, as well as a deceleration in the manufacturing sector. Therefore, the industrial sector's contribution to the GDP growth rate, at constant basic prices, was down by 1.0% in 2012 compared with its level in 2011. In addition, the sector's relative importance in GDP, at constant basic prices, crept down to reach 22.00% compared with 22.4 % in 2011 (CBJ, annual report 2012). The aforementioned deceleration in the industrial sector was an outcome of the following sub- sectors:

7.2.1 Manufacturing sector: This sector showed a slowdown in 2012, grew by 2.3% compared with 4.0% in 2011. Therefore, the contribution of the sector to the GDP, at constant basic prices, was decreased by 0.3% below its level in the year 2011.

The deceleration of this sector was attributed, mainly to the regional instability, in addition to the slowdown in the exports of the Qualifying Industrial Zones (QIZs) which grew by 3.8% compared with 6.9% in 2011 (CBJ, annual report 2012).

7.2.2 Mining and quarrying: This sector contracted particularly in 2012 by 17.1% compared with a growth of 17.7% in 2011. As a result, this sector contributed in reducing the GDP growth rate, at constant basic prices, by 0.4%. The reduction in this sector was affected by the drop in the production of phosphate and potash by 15.9% and 19.3% compared with a growth of 16.3% and 16.8% in 2011, respectively (CBJ, annual report 2012).
Moreover, the Industrial Production Index (IPI) of both "mining and quarrying" and manufacturing sectors, collectively, was down by 0.4 % compared with a drop of 0.6% in 2011. This was an outcome of a decline in the IPI of "mining and quarrying" which fell by 16.9 % compared with a growth equal to 16.5 % in 2011, on one hand, and a growth in the IPI of manufacturing, which grew by 1.4 % compared with a drop of 2.1% in 2011, on the other hand (CBJ, annual report 2012).

However, the industrial investments benefited from the Investment Promotion Law. These investments increased by JD 623.0 million in 2012 compared to their level in 2011, totaling JD 1,269.5 million. On the other hand, the data of Amman Stock Exchange revealed that many existing companies raised their capital in 2012 (through capitalization and public offering) by JD 18.4 million compared with other companies that raised their capital by JD 19.5 million in the previous year.

Table (1) Main Indicators of the Industrial Sector 2009 – 2012

	2009	**2010**	**2011**	**2012**
Value added at current prices (JD million)	3,582.6	3,767.9	4,288.8	4,356.9
Growth rate at constant prices (%)	-4.2	3.3	5.2	0.5
The deflator of the industrial sector (1994= 100)	200.7	204.4	221.3	223.6
Industrial exports (JD million)*	3,066.0	3,595.5	4,076.1	3,963.8
"Mining & quarrying" and manufacturing Production quantity index (1999=100)	154.3	149.7	148.7	148.3

Sources: Central Bank of Jordan, Monthly Statistical Bulletin.
* Domestic exports excluding agricultural exports.

7.2.3 Electricity and Water: The "electricity and water" sector demonstrated an improvement in its performance in 2012 to grow at 6.6% compared with a growth of 5.1% in 2011. Therefore, the sector's relative importance in GDP, at constant basic prices, was a little up by 0.1% compared to 2011 to reach 2.6%. This progress was attributed to the increase in the demand for electricity and water in 2012 due to the hot weather as well as the rise in demand to meet the needs of hundreds of thousands of Syrian refugees (CBJ, annual report 2012).

7.3 Population

It is well known that the concentration of population and labor forces in urban areas is a key requirement for industrial development and its investments. Industrial activity and the rise of higher urban income, in turn, encourage further in-migration to big cities. Higher population density in cities generates essential services, especially schools and health care facilities, and higher standards of living. Meanwhile, high urban population density and their consumption behavior create different physical environmental problems such as waste disposal and vehicular emissions.

According to the OECD, World Bank, about 70% of Jordan's population is urban; less than 6% of the rural population is nomadic or semi-nomadic. The Jordanian population increased from 1990 to 2008 by 2.7 million - a 86% growth in population, compared to 39% growth in Lebanon, 56% growth in Israel, 67% growth in Syria and 106% growth in the Palestinian territories (World Bank, 2010).However, as shown in table (2), the population of Jordan increased from 4857 thousands in the year 2000 to 6388 thousands in the year 2012.

Table (2) Population Density 2000-2012
(thousands)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total	4857	4978	5098	5230	5350	5473	5600	5723	5850	5980	6113	6249	6388

Source: Department of Statistics, Annual Report, 2013.

7.4 Vehicles and pollution

Air pollution is a significant public problem in most cities of Jordan. In recent years, the demand for certain types of consumer products which have led to the development of industrial growth, has been mainly high. For instance, the automobile sector in Jordan has grown in the last five years in a rapid rate (see table 3). This growth emits several different types of gasses specially CO2 and particles which can have harmful effects on the environment. Other emissions that have an effect on human health and create pollution include ozone and carbon monoxide.

Table (3) Vehicles Number and Its Percentage Change 2001-2011

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2011	2012
Vehicles	419591	542812	566610	614614	679731	755477	841933	905592	994753	1075453	1147258
% Change	-	29.4	4.4	8.5	10.6	11.1	11.4	7.6	9.9	8.1	6.7

Source: Department of Statistics, Annual Report, 2012.

8. Statistical analysis

In this context, the statistical analysis of the available data was implemented for the time period between 1990 and 2012 and it included the following:

1 - Simple regression analysis in order to test subsidiary hypotheses.
2 - Multiple regression analysis to test the main hypothesis of the study and to analyze all the variables of the study.

The analytical technique is used to demonstrate the effect of the independent variables on the dependent variable. Data of dependent and independent variables underwent for normal distribution and (OLS) statistical analysis as well as the simple and multiple regression tests were used. This analysis carried out each variable in accordance with the assumptions listed below:

First independent variable: Industrialization.

H0: There is no statistically significant effect at level (0.05) of industrialization on the emissions resulted by fossil fuel consumption.
H1: There is a statistically significant effect at level (0.05) of industrialization on the emissions resulted by fossil fuel consumption.
The preceding assumptions were tested by t-test and ended with the following results:

Coefficients[a]

Model		Un-standardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	12096.402	824.373		14.673	.000
	Industrialization	.001	.000	.827	6.734	.000

a. Dependent Variable: Emissions

According to the statistical decision rule which says that if the P-value is less than or equal to the significance level, the null hypothesis (H0) should be rejected and the alternative hypothesis (H1) should be accepted. As a result, (H0) is rejected, but (H1) which says there is a statistically significant effect at level (0.05) of industrialization on the emissions from fossil fuel consumption is accepted.
Second independent variable: Population Density.

H0: There is no statistically significant effect at level (0.05) of the population Density on the emissions resulted by fossil fuel consumption.

H1: There is a statistically significant effect at level (0.05) of the population Density on the emissions resulted by fossil fuel consumption.

The preceding assumptions were tested by t-test and ended with the following results:

Coefficients[a]

Model		Un-standardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	-5245.212	1190.251		-4.407	.000
	Population	4.400	.236	.971	18.672	.000

a. Dependent Variable: Emissions

According to the statistical decision rule which says that if the P-value is less than or equal to the significance level, the null hypothesis (H0) should be rejected and the alternative hypothesis (H1) should be accepted. As a result, (H0) is rejected, but (H1) which says there is a statistically significant effect at level (0.05) of population Density on the emissions from fossil fuel consumption is accepted.

Third independent variable: Vehicles

H0: There is no statistically significant effect at level (0.05) of the number of vehicles on the emissions resulted by fossil fuel consumption.
H1: There is a statistically significant effect at level (0.05) of the number of vehicles on the emissions resulted by fossil fuel consumption.

The preceding assumptions were tested by t-test and ended with the following results:

Coefficients[a]

Model		Un-standardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	10575.818	715.157		14.788	.000
	Vehicles	.011	.001	.906	9.790	.000

a. Dependent Variable: Emissions

According to the statistical decision rule which says that if the P-value is less than or equal to the significance level, the null hypothesis (H0) should be rejected and the alternative hypothesis (H1) should be accepted. As a result, (H0) is rejected, but (H1) which says there is a statistically significant effect at level (0.05) of vehicles on the emissions resulted by fossil fuel consumption is accepted.

Fourth independent variable: Real GDP

H0: There is a statistically significant effect at level (0.05) of real GDP growth on the emissions resulted by fossil fuel consumption.
H1: There is a statistically significant effect at level (0.05) of real GDP growth on the emissions resulted by fossil fuel consumption.
The preceding assumptions were tested by t-test and ended with the following results:

Coefficients[a]

Model		Un-standardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	6080.824	751.166		8.095	.000
	GDP	1.929	.129	.956	14.906	.000

a. Dependent Variable: Emissions

According to the statistical decision rule which says that if the P-value is less than or equal to the significance level, the null hypothesis (H0) should be rejected and the alternative hypothesis (H1) should be accepted. As a result, (H0) is rejected, but (H1) which says there is a statistically significant effect at level (0.05) of real GDP on the fossil fuel consumption is accepted.

The dependent variable: Emissions resulted by fossil fuel consumption

H0: There is no statistically significant effect at level (0.05) of the combined independent variables represented by industrialization, population, vehicles, and GDP on the dependent variable represented by emissions resulted by fossil fuel consumption.
H1: There is a statistically significant effect at level (0.05) of the combined independent variables represented by industrialization, population, vehicles, and GDP on the dependent variable represented by fossil emissions resulted by fuel consumption.
The preceding assumptions were tested by F-test and ended with the following results:

ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	3.253E8	4	8.133E7	193.760	.000[a]
	Residual	7555827.078	18	419768.171		
	Total	3.329E8	22			

$R^2 = 0.977$

a. Predictors: (Constant), Industrialization, Population, Vehicles, GDP

b. Dependent Variable: Emissions

Statistically, if the P-value is less than or equal to the significance level, the null hypothesis (H0) should be rejected and the alternative hypothesis (H1) should be accepted. As a result, (H0) is rejected, but (H1) which says there is a statistically significant effect at level (0.05) of all combined independent variables on the emissions from fossil fuel consumption is accepted.

The result of the ANOVA table analysis shows a significant effect of all independent variables on the fossil fuel consumption where R2 equals 0 .977 indicates that the independent variables explained 97.7% of variance in emissions from fossil fuel consumption (F=193.76, P<.05), where the coefficient analysis shows the effect of industrialization (β =.827, P<.05), population density (β =.971, P<.05), number of vehicles (β =.906 , P<.05), and real GDP (β =.956, P<.05).

We noted that the effect of each independent variable represented by industrialization, population density, number of vehicles and real GDP on the dependent variable are positive. This result is not eccentric since it matches many literature findings, especially those applied on developing countries. It is worth mentioning that the industrial sector in Jordan is still undersized and witnessed a rapid growth rate, in addition to a transformation from traditional to moderate technology utilization. However, the effect of population density on the dependent variable has the highest significance compared with other variables. This might be an outcome of high rate of population growth in addition to the migration of Palestinians from Kuwait in the year1990 followed by Iraqi and Syrian refugees.

9. Conclusion and Recommendations

Many international empirical studies have concentrated on the impact of industrialization and economic development on environmental degradation; this study adopted an analytical approach in order to study the industrialization and its effect on the environment quality by examining Jordan economy to verify that the higher levels of industrial growth led by enormous investments create imbalances in the environment.

However, the study found the effect of population density on the CO2 emissions has the highest significance compared with other variables followed by GDP, number of vehicles, and industrialization sequentially. It is worth mentioning that each independent variable has a significant effect on the pollution level in the atmosphere but the industrial sector has the lower effect among them. This is due to undersized and a rapid growth rate in addition to a transformation from traditional to moderate technology utilization. The problem with industrial establishments in Jordan is that they are not aware of the potential of preventive measures for both reduction of excess process inputs and utilization of non-product outputs to meet environmental standard.

Furthermore, they do not have information about the latest techniques and technologies and in other cases they ignore the environmental and financial benefits of cleaner production activities. In this case, they must understand that cleaner production techniques and technologies are appropriate for their situations.

Regarding the population which has the highest effect on the CO2 emissions and cause serious allegation for the environment, it is essential to call for a reduction in population growth rate by education and awareness, better health facilities and accessibility to birth control methods.

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Appendix

Year	CO2 Emissions[1] (kt)	Industrial Production (000JD) [2]	Population (Thousands)[2]	Number of vehicles[2]	Real GDP (million JD)[2]
1990	10403.3	2,531,131	3468	254777	2968.4
1991	9798.2	2,581,911	3701	257518	3035.9
1992	12266.1	2,641,915	3844	262502	3398.1
1993	12101.1	2,630,812	3993	263600	3516.7
1994	13633.9	2,661,914	4139	265441	3690.4
1995	13556.9	2,972,758	4264	269472	3958.2
1996	14187.6	2,957,682	4383	297664	4035.2
1997	14418.6	3,150,958	4506	306911	4180.3
1998	14543.3	3,250,742	4623	318512	4310
1999	14569.1	3,295,424	4738	321512	4446.9
2000	15507.7	3,443,096	4857	372517	4660.1
2001	16002.8	3,696,430	4978	419591	4930
2002	16886.5	4,031,749	5098	542812	5251.3
2003	17469.6	4,277,090	5230	566610	5476.5
2004	19240.7	5,401,278	5350	614614	5952.5
2005	21026.6	6,345,213	5473	679731	6404.2
2006	20733.2	7,267,691	5600	755477	6919.6
2007	21540.1	8,544,277	5723	841933	7419.9
2008	20762.6	11,349,245	5850	905592	7914.4
2009	21253.9	10,558,209	5980	994753	8083.4
2010	20821.2	12,114,558	6113	1075453	8358.2
2011	21342.1	14,160,229	6249	1147258	8575.3
2012	21353.3	16,011,129	6388	1227539	8806.8

Sources:

[1]Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States, 2013.
[2]Department of statistics, Annual Reports, 2013