Annals of Social Sciences & Management Studies
ISSN: 2641-838X

Research Article
Volume 11 Issue 2 - December 2024
DOI: 10.19080/ASM.2024.11.555808

Ann Soc Sci Manage Stud

Analyzing the Mutual Impact between Environmental Pollution and Economic Development in The Kingdom of Saudi Arabia

Adel M. Ghanem[1]*, Mohammad Alqunaibet[2], Khalid Alrwis[1], Othman Alnashwan[2], Abdul Aziz Alduwais[2], Sahar kamara[3], Sulaiman Almojel[2], Sattam F. Almadrra[1], Sharafeldin Alaagib[1] and Nageeb M. Aldawdahi[4]

[1]*Office of Food Security Studies and Research, Vice Rectorate for Postgraduate Studies and Scientific Research, King Saud University, Saudi Arabia*

[2]*Agricultural Economics Department, College of Food and Agricultural Sciences, King Saud University, Saudi Arabia*

[3]*Egypt Ministry of Agriculture and Land Reclamation, Agricultural Economics Research Institute, Giza, Egypt*

[4]*Department of Agricultural Extension and Rural Society College of Food and Agricultural Sciences, King Saud University, Saudi Arabia*

Submission: December 10, 2024; **Published:** December 18, 2024

***Corresponding author:** Adel M. Ghanem, Office of Food Security Studies and Research, Vice Rectorate for Postgraduate Studies and Scientific Research, King Saud University, Saudi Arabia

Abstract

Using a proposed model estimated by the two-stage least squares method (2SLS) for the years 1990 to 2020, this study aimed to quantify the relationship between environmental degradation and economic development in Saudi Arabia. The study showed that an increase in domestic consumption of refined oil products by 10% increased carbon dioxide emissions by 8.05%. And increasing the estimated amount of carbon dioxide emissions by 10% leads to a decrease in the worker productivity and the invested capital productivity by 2.11% and 7.58% for each, respectively. The equations of the structural form and predicted internal variables of the proposed model showed the possibility of increasing the real GDP from 3060.53 billion riyals in 2022 to 3638.92 billion riyals in 2030, in light of reducing carbon dioxide emissions. That indicates environmental protection and economic development are two inseparable concepts in the long term, and the expected increase in GDP correlated with environmental protection. The study recommends the following: (1) Developing eco-tourism, mountain and beach, for the Red Sea and the Arabian Gulf, (2) completing the NEOM city project according to the Kingdom's 2030 vision, (3) urging foreign companies to move its headquarters to the Kingdom of Saudi Arabia.

Keywords: Environmental Pollution, Economic Development, Mutual Influence, Saudi Arabia

Introduction

The Kingdom of Saudi Arabia has achieved a developmental renaissance in various economic sectors. The total number of licensed productive factories reached 7,627, and 1203 factories obtained licenses and did not start production until 2019 [1]. With the increase in the population of the Kingdom to 35.01 million people in the middle of 2020, the state has tended to urban expansion and electricity generation General Authority for Statistics [2]. The electricity and heat generation sector is one of the main sectors responsible for carbon dioxide emissions (49.16%), followed by transportation (25.92%), manufacturing and construction industries (24.1%), then buildings and services (0.82%) [1]. Average per capita carbon dioxide emissions (CO2) increased from 10.25 tons in 1990 to 17.69 tons in 2015, then decreased to 14.15 tons in 2020. Some studies based on several gas emissions scenarios and numerical models predict that if fossil fuels continue to burn in current quantities, the proportion of carbon dioxide in the atmosphere will double by 2050, and then the temperature will rise at a rate ranging between 1.4-5.8 degrees Celsius by the end of the century current (Intergovernmental Panel on Climate Change, 2019). [3] studied the impact of air pollution and agricultural soil on social development in the Kingdom of Saudi Arabia. This study showed that an increase of 10% in the amount of chemical fertilizers and pesticides used in Saudi agriculture leads to an increase in the total number of hospitalized patients by 0.7% and 0.5% for each, respectively. Increasing air pollution expressed by carbon dioxide emissions by 10% leads to an increase in the total number of hospitalized patients by

11.1%. In addition, the estimated increase in the total number of patients by 10% leads to a decrease in the total productivity of the worker as an indicator by 1.8%. Also, a change of 10% in the value of the estimated total productivity of the worker leads to a change in the same direction of the human development index of 0.5%. Finally, this study recommended the need to reduce air pollution through the expansion of the use of natural gas in the industrial and transport sectors, in addition to limiting the use of nitrogen fertilizers and pesticides in Saudi agriculture, through the expansion of clean agriculture and good agricultural practices.

Environmental pollution is linked to various economic activities and development, such as industrial, mining, and agriculture. Also, no country can stop or limit the rates of growth and development. So as not to be poor and widen the gap with the developed countries. The accumulation of environmental problems weakens the productive capacity of economic resources (land, water, human, and capital resources), in addition to the indirect costs that the state may bear in restoring the environmental balance, which negatively affects growth rates and economic development. In the absence of environmental protection policy, environmental deterioration can occur, and result in the following: (1) a decrease in worker productivity, due to the spread of diseases and a deterioration in the level of public health, (2) a decrease in job opportunities and an increase in wage levels, due to the transfer of labor from environmentally polluted industrial areas to healthy counterpart, (3) A decrease in the rate of economic growth in the long run. The protection of the environment leads to an increase in economic growth rates. In the long run, economic growth and environmental protection become interdependent concepts [4].

The General Authority for Statistics conducted a household environment survey in Saudi Arabia in 2021 [5]. And its results indicated that the percentage of families suffering from air pollution reached 57.37%, While for the families suffering from visual, noise and light pollution was 32.47%, 24.9%, and 5.88%, respectively [2].

The country has tended to reduce carbon dioxide emissions (CO2) by expanding the use of natural gas in electricity production, as the percentage of natural gas use increased from 33.88% in 2010 to 57.25% in 2020. On the other hand, natural gas usage decreased from 33.88% in 2010 to 57.25% in 2020. The use of diesel in electricity production increased from 21.71% in 2010 to 1.7% in 2020, and the percentage of crude oil use in electricity production declined from 40.3% in 2010 to 20.29 % in 2020. The Green Middle East initiative also included reducing carbon emissions by 278 million tons by 2030, increasing the use of renewable energy in various economic sectors, and planting 10 billion trees throughout the Kingdom, to improve air quality, reduce dust and sand storms, combat desertification, and reduce temperature. In addition to protecting 30% of land areas and marine life [1].

The study [6] aimed to measure the impact of implementing the Green Middle East initiative on sustainable development in the Kingdom of Saudi Arabia. It was found from this study that the country tended to reduce carbon emissions, by expanding the use of natural gas and reducing the use of diesel and crude oil in Electricity production due to the fluctuation and instability of the economic growth rate, the real per capita income increased at a small rate of 0.8% annually, and the Human Development Index value increased from 0.744 in 2000 to 0.855 in 2020. It was also shown that the domestic consumption of refined petroleum products increased by 10%, lead to an increase in carbon dioxide emissions by 7.97%, and that an increase in the amount of estimated carbon dioxide emissions by 10% leads to a decrease in foreign direct investment, real GDP, and the value of the human development index by rates of 4.71%, 0.36%, and 0.71%. respectively, and the Middle East Green Initiative included planting 10 billion trees, which are irrigated with unused treated wastewater amounting to 1528.49 million cubic meters, at a value of $0.56 billion. Finally, the gradual transformation of the green economy, leading to environmental sustainability and integration between the environmental, economic and social dimensions of sustainable development.

This study is linked to the Tenth Development Plan, especially with regard to the initiative to activate and enforce the general environment regulation. This initiative aims to protect and improve the environment for future generations. This is done through monitoring the environment and its enforcement mechanisms and increasing financial penalties for environmental violations, in addition to improving environmental health by reducing air polluting emissions from various means of transportation and factories (Ministry of Economy and Planning, 2019). Given the interest of this study in analyzing the interrelationships between environmental pollution and economic development in the Kingdom of Saudi Arabia, it raises several questions, the most important of which are:

i. How can the interrelationships between environmental pollution and economic development be measured?

ii. Does environmental protection lead to an increase in economic growth and development rates?

Research Objectives:

This research aimed to study the mutual impact between environmental pollution and economic development in the Kingdom of Saudi Arabia during the period 1990-2020 by studying the following objectives:

i. Listing and describing the most important variables related to environmental pollution and economic development during the study period.

ii. Estimation of the proposed model to study the

How to cite this article: Adel M. G, Mohammad A, Khalid A, Othman A, Abdul Aziz A. Analyzing the Mutual Impact between Environmental Pollution and Economic Development in The Kingdom of Saudi Arabia. Ann Soc Sci Manage Stud. 2024; 11(2): 555808. DOI: 10.19080/ASM.2024.11.555808

mutual effect between environmental pollution and economic development during the study period.

iii. Predicting the internal and external variables of the proposed model in light of the Green Middle East Initiative until 2030.

iv. Proposing recommendations that would increase the gross domestic product as an indicator of economic development, in light of reducing carbon dioxide emissions (CO2) in accordance with the Kingdom's vision 2030.

Materials and Methods

In achieving its objectives, this study relied on the data contained in: (1) the annual statistics issued by the Saudi Central Bank, (2) the open data website issued by the World Bank. This study also relied on estimating the proposed model to study the mutual impact between environmental pollution and economic development during the period 1990-2020. The structural form of the proposed model could be expressed by the following equations:

$$Y_1 = a_0 + a_1 X_1 + e_1$$

$$Y_2 = b_0 + b_1 Y_1 + b_2 Y_3 + b_3 X_2 + e_2$$

$$Y_3 = c_0 + c_1 Y_1 + c_2 Y_2 + c_3 X_3 + e_3$$

$$Y_4 = d_0 + d_1 Y_2 + d_2 Y_3 + d_3 X_4 + d_4 X_5 + e_4$$

$$Y_5 = h_0 + h_1 Y_2 + h_2 Y_3 + h_3 Y_4 + e_5$$

The proposed model includes the following variables:

i. Endogenous Variables There are five variables: the amount of air pollution expressed as the amount of carbon dioxide emissions in thousand kilotons (Y_1), the factor productivity factor, which measures how much each factor adds to the gross domestic product. It is calculated by dividing the value added by the number of employment (Y_2), the productivity factor of invested capital, and it measures the contribution of each unit of invested capital to the increase in GDP. It is calculated by dividing the added value by the total government and private investments [7] (Y_3), foreign direct investment in billion riyals (Y_4), real GDP in billion riyals (Y_5).

ii. Exogenous Variables, which are five variables: total domestic consumption of refined petroleum products (not including natural gas and liquefied petroleum gas) in million barrels (X_1), the ratio of spending on the health and education sectors to total government spending (X_2), investment rate (X_3), the inflation rate prevailing in the Saudi economy, expressed as the implicit deflation factor in the GDP (X_4), the degree of economic openness expressed as the ratio of foreign trade (exports + imports) to GDP (X_5).

The structural form equations of the proposed model were determined by applying the order condition and the rank condition. If the total number of internal and external variables of the proposed model (K) minus the number of internal and external variables in the identified equation (L) is greater than the number of internal variables (M) minus one (K-L > M-1), hence the behavioral equations fulfilled the rank and order conditions and can be over identified. The discrimination is over-identified, which means that the two-stage least squares method (2 SLS) can be used to estimate the proposed model during the period 1990-2020 [8].

Result and Discussion

List and characterization of variables related to environmental pollution and economic development during the period 1990-2020

Classification of internal variables related to environmental pollution and economic development:

By studying the development of the internal variables of the proposed model, it is clear from the data contained in (Tables 1 & 2) [9,10] that the resulting carbon dioxide emissions (CO2) increased, from 257.28 thousand kilotons in 1990 to 769.72 thousand kilotons in 2016., then decreased to 525.50 thousand kilotons in 2020. The gradual decrease in carbon dioxide emissions in recent years is attributed to a group of factors, the most important of which are the following: (1) improving energy efficiency in the main energy-consuming sectors (industrial sector, buildings, and transportation); Where the efficiency improvement contributed to about 74% of the amount of reduction in emissions, (2) The decrease in the intensity of carbon emissions in the Saudi energy supply resulted in a decrease contributed to about 26% of the amount of reduction in emissions, (3) the ongoing reforms in energy price adjustment, (4) The trend towards producing electricity from solar energy [11]. In general, carbon dioxide emissions increased at an annual growth rate of 3.2%, during the period 1990-2020.

By calculating the amount that the worker adds to the GDP, it is clear from the data in Tables (1 & 2) that the value of the worker's productivity factor increased from 85.9 thousand riyals in 1990 to 242.3 thousand riyals in 2012, then decreased to 165.0 thousand riyals in the year 2020. In general, the worker productivity factor increased at an annual growth rate of 3.5% during the period 1990- 2020. On the other hand, the productivity factor of the invested capital decreased from 5.98 million riyals in 1990 to 3.35 million riyals in 2015, then increased to 4.27 million riyals by the year 2020. In general, the productivity factor of invested capital declined at an annual rate of 1.4% during the period 1990-2020.

Despite the importance of the contribution of foreign direct investment to the development of the national economy, it was instability. The foreign direct investment increased from 2.95 billion riyals in 1990 to 147.96 billion riyals in 2008, then decreased to 5.32 billion riyals in 2017, and then increased to 20.25 billion riyals in 2020. In general, the value of foreign direct investments in the Saudi economy increased with an annual growth rate of 11.1% during the period 1990 - 2020. As shown in Tables (1 & 2) , an overall increase in real GDP from 1102.23 billion riyals in 1990 to 2532.62 billion riyals in 2020, i.e. real GDP increased at an

How to cite this article: Adel M. G, Mohammad A, Khalid A, Othman A, Abdul Aziz A. Analyzing the Mutual Impact between Environmental Pollution and Economic Development in The Kingdom of Saudi Arabia. Ann Soc Sci Manage Stud. 2024; 11(2): 555808. DOI: 10.19080/ASM.2024.11.555808

annual growth rate of 7.5% during the study period. The internal variables of the proposed model were characterized by relative stability, except for foreign direct investment and real GDP, where the value of the coefficient of variation reached 133.1% and 64.5% for each, respectively.

Table 1: Descriptive analysis of the internal variables of the proposed model to study the mutual impact between environmental pollution and economic development during the period 1990-2020.

Year	CO2 emissions in thousand kilotons	Coefficient of worker productivity in thousand riyals	Capital productivity co-efficient in million riyals	Foreign direct investment in billion riyals	Real GDP in billion riyals
1990	257.28	85.9	5.98	2.95	1102.3
1995	298.36	95.7	5.74	6.93	1310.26
2000	332.59	113.2	5.76	5.82	1422.09
2005	436.33	156.4	5.18	45.37	1731.01
2010	576.42	199.5	4.09	106.08	1980.78
2015	761.80	193.0	3.35	30.53	2545.24
2016	769.72	182.1	3.83	27.95	2587.76
2017	540.70	190.0	4.08	5.32	2568.57
2018	527.05	217.0	4.73	15.93	2633.15
2019	526.84	198.9	4.53	17.11	2641.94
2020	525.50	165.0	4.27	20.25	2532.62
Average	454.64	152.22	4.88	29.73	1486.31
Standard Division	148.09	53.69	0.74	39.56	958.22
coefficient % of variation	32.6	35.3	15.2	133.1	64.5

Source: Compiled from (1) Saudi Central Bank, annual statistics 2020 [9], 31/5/2021, (2) World Bank, open data, period 2000-2020 [10].

Table 2: General trend equations for the internal variables of the proposed model during the period 1990-2020.

Variable	% annual growth rate	F	R^2	Equation
CO2 emissions in thousand kilotons	3.2	122.46	0.81	$Ln\ \hat{Y}_1 = 5.566 + 0.032T\ (106.67)^{**}(11.07)^{**}$
Coefficient of worker productivity in thousand riyals	3.5	113.15	0.80	$Ln\ \hat{Y}_2 = 4.398 + 0.035T\ (72.24)^{**}(10.64)^{**}$
Capital productivity coefficient in million riyals	-1.4	56.36	0.66	$Ln\ \hat{Y}_3 = 1.797 - 0.014T\ (52.97)^{**}(-7.51)^{**}$
Foreign direct investment in billion riyals	11.1	21.63	0.43	$Ln\ \hat{Y}_4 = 0.667 + 0.111T\ (2.52)^{*}(4.65)^{**}$
Real GDP in billion riyals	7.5	416.75	0.93	$Ln\ \hat{Y}_5 = 5.871 + 0.075T\ (86.87)^{**}(20.41)^{**}$

Significant at the 1% probability level, * is significant at the 5% probability level.

Characterization of external variables related to environmental pollution and economic development:

By Studying the evolution of external variables related to environmental pollution and economic development, it is clear from the data in Tables (3 & 4) that the domestic consumption of refined petroleum products (not including natural gas and liquefied petroleum gas) increased from 310.02 million barrels in 1990, to 942.7 million barrels in 2015, then decreased to 792.32 million barrels in 2020. In general, domestic consumption of refined petroleum products increased at an annual growth rate

How to cite this article: Adel M. G, Mohammad A, Khalid A, Othman A, Abdul Aziz A. Analyzing the Mutual Impact between Environmental Pollution and Economic Development in The Kingdom of Saudi Arabia. Ann Soc Sci Manage Stud. 2024; 11(2): 555808. DOI: 10.19080/ASM.2024.11.555808

of 4.1% during the study period. Due to the state's interest in the health and education sectors, the percentage of expenditures on health and education sectors increased from 12.53% in 1990 to 44.72% in 2013, and then decreased to 43.59% in 2020 In general, the percentage of expenditures on health and education sectors to total government spending increased An annual growth rate of 2.4% during the study period. The investment rate in the Saudi economy also increased from 16.98% in 1990 to 29.85% in 2015, then decreased to 23.41% in 2020. In general, the investment rate in the Saudi economy increased at an annual growth rate of 1.4% during the study period.

It is also clear from the data in Tables (3 & 4) that the rate of inflation in the Saudi economy, expressed by the implicit index (2010 = 100) increased from 39.97% in 1990 to 120.17% in 2012, then decreased to 104.15% in 2020. In general, the rate of inflation in the Saudi economy increased at an annual growth rate of 4.5% during the study period. The Saudi economy is open to the outside world, as the degree of economic openness increased, expressed in the ratio of the value of foreign trade (exports + imports) to the gross domestic product, from 58.25% in 1990 to 82.45% in 2008, then decreased to 44.34% in 2020. In general, the economic openness degree increased with a small annual growth rate of 0.32% during the study period. The external variables of the proposed model were characterized by relative stability during the study period, except the inflation rate variable (implicit index), where the estimated coefficient of variation reached 41.7%.

Table3: Descriptive analysis of the external variables of the proposed model during the period 1990-2020.

Year	Consumption of refined petroleum products in million barrels[1]	Percentage spent on health and education %	Investment Rate %	Implicit index number	Degree of economic openness
1990	310.02	12.53	16.98	39.97	58.25
1995	341.88	28.16	17.43	40.97	54.5
2000	418.53	38.75	17.35	49.97	56.82
2005	493.8	38.05	19.31	71.1	73.14
2010	723.72	39.8	24.43	100	67.78
2015	942.7	42.49	29.85	96.4	57.81
2016	908.86	43.38	26.13	93.46	50.2
2017	897.43	43.57	24.48	100.53	51.75
2018	836.46	43.6	21.12	116.29	52.83
2019	841.16	44.03	22.06	114.07	51.61
2020	792.32	43.59	23.41	104.15	44.34
Average	573.54	36.27	20.96	73.94	60.47
Standard division	216.88	7.92	3.36	30.83	10.26
Variation coefficient %	37.81	21.84	16.03	41.7	16.97

Source: compiled from:

1- The Saudi Central Bank, Annual Statistics [9], 5/31/2021.

2- The World Bank, Open Data, 2000-2020 [10].

Estimation the reduced and structural form of the proposed model to study the mutual effect between environmental pollution and economic development

The proposed model was estimated by the two-stage least squares (2SLS) method to study the mutual effect between environmental pollution and economic development. After verifying the two problems of multicollinearity and autocorrelation of residuals for both the reduced and structural equations. The reduced form equations presented in Table 5 were estimated by performing the regression of each internal variable on all external variables, then taking the estimated values of the internal variables and using them as explanatory variables for the structural form equations. It is clear from the equations of the structural form of the estimated model in (Table 6) that:

[1]Does not include natural gas and liquefied petroleum gas

How to cite this article: Adel M. G, Mohammad A, Khalid A, Othman A, Abdul Aziz A. Analyzing the Mutual Impact between Environmental Pollution and Economic Development in The Kingdom of Saudi Arabia. Ann Soc Sci Manage Stud. 2024; 11(2): 555808. DOI: 10.19080/ASM.2024.11.555808

Table 4: Equations of the general trend of the external variables of the proposed model during the period 1990-2020.

Variable	% annual growth rate	F	R^2	Equation
Consumption of refined petroleum products in million barrels	4.1	556.55	0.95	$Ln\ \widehat{X_1} = 5.627 + 0.041T\ (176.93)^{**}\ (23.59)^{**}$
Percentage spent on health and education %	2.4	52.42	0.64	$Ln\ \widehat{X_2} = 3.176 + 0.024T\ (52.15)^{**}\ (7.24)^{**}$
Investment Rate %	1.4	56.21	0.66	$Ln\ \widehat{X_3} = 2.808 + 0.014T\ (82.70)^{**}\ (7.50)^{**}$
Implicit index number	4.5	226.41	0.89	$Ln\ \widehat{X_4} = 3.490 + 0.045T\ (63.37)^{**}\ (15.05)^{**}$
Degree of economic openness	0.32[2]	6.99	0.33	$\widehat{X_5} = 43.732 + 2.688T - 0.078T^2\ (8.76)^{**}\ (3.74)^{**}\ (-3.58)^{**}$

** Significant at the 1% probability level.

Source: It was collected and calculated from the data in (Table 3).

Table 5: Equations of the reduced form of the estimated model during the period 1990-2020.

Variable	Equation
CO2 Emissions	$Ln\ \widehat{Y_1} = -1.929 + 1.109Ln\ X_1 + 0.009Ln\ X_2 + 0.183Ln\ X_3 - 0.390\ Ln\ X_4 + 0.511\ Ln\ X_5$ $(-2.08)^{*}\ (4.12)^{**}\ (0.11)^{ns}\ (0.82)^{ns}\ (-2.02)^{*}\ (3.47)^{*}$ $R^2 = 0.95\ F = 109.78\ D.W = 1.71$ $LM\ test = 0.51\ Arch\ test = 1.71$
Coefficient of worker productivity (thousand riyals)	$Ln\ \widehat{Y_2} = -0.367 + 0.211\ Ln\ X_1 + 0.012\ Ln\ X_2 - 0.028\ Ln\ X_3 + 0.577\ Ln\ X_4 + 0.395\ Ln\ X_5$ $(-0.75)^{ns}\ (2.48)^{*}\ (2.29)^{*}\ (-0.24)^{ns}\ (5.68)^{**}\ (5.10)^{**}$ $R^2 = 0.98\ F = 524.03\ D.W = 1.21$ $LM\ test = 1.34\ Arch\ test = 0.91$
Capital productivity coefficient in million riyals	$Ln\ \widehat{Y_3} = 0.033 - 0.098\ Ln\ X_1 + 0.002\ Ln\ X_2 + 0.659\ Ln\ X_3 + 0.003\ Ln\ X_4 + 0.001\ Ln\ X_5$ $(565.90)^{**}\ (4.12)^{**}\ (0.11)^{ns}\ (509.10)^{**}\ (0.23)^{ns}\ (2.01)^{*}$ $R^2 = 0.98\ F = 3546.03\ D.W = 2.15$ $LM\ test = 0.66\ Arch\ test = 0.35$
Foreign direct investment in billion riyals	$Ln\ \widehat{Y_4} = -14.762 - 5.705\ Ln\ X_1 + 1.354\ Ln\ X_2 + 6.402\ Ln\ X_3 + 4.741\ Ln\ X_4 + 2.162\ Ln\ X_5$ $(-1.98)^{*}\ (-2.37)^{*}\ (1.96)^{*}\ (3.21)^{**}\ (2.76)^{**}\ (1.64)^{ns}$ $R^2 = 0.85\ F = 28.97\ D.W = 1.86$ $LM\ test = 0.02\ Arch\ test = 0.98$

[2]The annual growth rate was calculated from the following equation: $\left(\frac{dX_5}{dT} \div \overline{X_5}\right) \times 100$

How to cite this article: Adel M. G, Mohammad A, Khalid A, Othman A, Abdul Aziz A. Analyzing the Mutual Impact between Environmental Pollution and Economic Development in The Kingdom of Saudi Arabia. Ann Soc Sci Manage Stud. 2024; 11(2): 555808. DOI: 10.19080/ASM.2024.11.555808

Real GDP in billion riyals	$Ln\ \hat{Y}_5 = -1.657 + 0.545\ Ln\ X_1 + 0.109\ Ln\ X_2 - 0.018\ Ln\ X_3 + 1.089\ Ln\ X_4 + 0.096\ Ln\ X_5 + 0.838 AR(1)$ $(-0.91)^{ns}\ (2.07)^{*}\ (2.83)^{**}\ (-0.10)^{ns}\ (5.88)^{**}\ (1.51)^{ns}\ (4.28)^{**}$ $R^2 = 0.94\ F = 1222.07\ D.W = 1.84$ $LM\ test = 0.001\ Arch\ test = 0.57$

** Significant at the 1% probability level, * Significant at the 5% probability level.

Source: It was calculated from the data in my (Tables 1 & 3).

Table 6: Equations of the structural form of the estimated model during the period 1990-2020.

Variable	Equation
CO2 Emissions	$Ln\ \hat{Y}_1 = 1.004 + 0.805\ Ln\ X_1 + 0.628 AR(1)$ $(2.49)^{**}\ (7.44)^{**}\ (2.59)^{**}$ $R^2 = 0.95\ F = 169.19\ D.W = 1.91$ $LM\ test = 0.001\ Arch\ test = 0.01$
Coefficient of worker productivity in thousand riyals	$Ln\ \hat{Y}_2 = 4.552 - 0.211\ Ln\ \hat{Y}_1 + 0.839\ Ln\ \hat{Y}_3 + 0.164\ Ln\ X_2 + 0.853 AR(1)$ $(1.95)^{*}\ (-2.21)^{*}\ (4.70)^{**}\ (2.06)^{*}\ (2.16)^{*}$ $R^2 = 0.95\ F = 83.30\ D.W = 1.59$ $LM\ test = 0.001\ Arch\ test = 0.06$
Capital productivity coefficient in million riyals	$Ln\ \hat{Y}_3 = 3.824 - 0.758\ Ln\ \hat{Y}_1 + 0.103\ Ln\ \hat{Y}_2 + 0.5831\ Ln\ X_3$ $(1019.56)^{**}\ (-2.01)^{*}\ (2.04)^{*}\ (2.16)^{*}$ $R^2 = 0.95\ F = 4660.24\ D.W = 1.93$ $LM\ test = 0.48\ Arch\ test = 0.24$
Foreign direct investment in billion riyals	$Ln\ \hat{Y}_4 = 0.518 + 0.879\ Ln\ \hat{Y}_2 + 1.383\ Ln\ \hat{Y}_3 - 1.009\ Ln\ X_4 + 0.452\ Ln\ X_5$ $(2.67)^{*}\ (2.71)^{*}\ (2.96)^{**}\ (-3.31)^{**}\ (2.28)^{*}$ $R^2 = 0.85\ F = 33.16\ D.W = 1.58$ $LM\ test = 0.57\ Arch\ test = 0.79$
Real GDP in billion riyals	$Ln\ \hat{Y}_5 = 4.480 + 0.554\ Ln\ \hat{Y}_2 + 0.412\ Ln\ \hat{Y}_3 + 0.023\ Ln\ \hat{Y}_4 + 0.861 AR(1)$ $(6.93)^{**}\ (5.13)^{**}\ (4.33)^{**}\ (2.07)^{*}\ (8.12)^{**}$ $R^2 = 0.98\ F = 317.15\ D.W = 1.86$ $LM\ test = 0.001\ Arch\ test = 0.03$

** Significant at the 1% probability level, * Significant at the 5% probability level.

Source: It was calculated from the data in Tables (1, 3 & 5).

How to cite this article: Adel M. G, Mohammad A, Khalid A, Othman A, Abdul Aziz A. Analyzing the Mutual Impact between Environmental Pollution and Economic Development in The Kingdom of Saudi Arabia. Ann Soc Sci Manage Stud. 2024; 11(2): 555808. DOI: 10.19080/ASM.2024.11.555808

i. Increasing domestic consumption of refined petroleum products (not including natural gas and liquefied petroleum gas) by 10%, leading to an increase in carbon dioxide emissions by 8.05% at 1% significant level.

ii. Increasing the estimated amount of carbon dioxide emissions by 10% leads to a decrease in the worker's productivity factor by 2.11% at 5% significant level. As for the increase in the productivity coefficient of the estimated capital and the ratio of spending on the health and education sectors to the total government spending by 10%, it leads to an increase in the productivity factor of the worker by 8.39% at 1% significant level and 1.64% at 5% significant level for each, respectively.

iii. Increasing the estimated amount of carbon dioxide emissions by 10% leads to a decrease in the productivity of the invested capital by 7.58%, while increasing the productivity of the worker and the investment rate in the Saudi economy by 10% leads to an increase in the productivity of the invested capital by 1.03 %, 5.831% each, respectively it is significant at the 5% level.

iv. An increase of 10% in each of the estimated worker productivity coefficient, the estimated invested capital productivity coefficient and the degree of economic openness, leads to an increase in foreign direct investment in the Saudi economy by 8.79% at 5% significant level, 13.83% at 1% significant level, 4.52% at 5% significant level, respectively. As for the increase in the inflation rate, expressed in the implicit index of 10%, leads to a decrease in the value of foreign direct investment in the Saudi economy by 10.09% at 1% significant level, and these results are consistent with the findings of the study [12].

v. An increase of 10% in each of the estimated worker productivity coefficient, the estimated invested capital productivity coefficient and the estimated foreign direct investment value, leads to an increase in real GDP by 5.54% at 1% significant level, 4.12% at 1% significant level, 0.23% at 5% significant level, respectively.

vi. The equations of the reduced and structural form of the proposed model are free from the residual autocorrelation problem, according to the Breusch-God Frey serial correlation LM Test, and have no autocorrelation in the series variance, according to the Arch Test. The equations of the reduced and structural form of the proposed model also have a good efficiency in representing the data used in the estimation, according to the indicators of measuring the efficiency of the models, the most important of which is the U-Theil inequality coefficient, whose value is close to zero (Table 7).

Table7: Indicators for measuring the efficiency of the equations of the reduced and structural form of the estimated model during the period 1990-2020.

Index	Equations of reduced form				
	Frist	Second	Third	Fourth	Fifth
The Square Root of the Mean Squared random Error, R.M.S.E.	0.065	0.034	0.0006	0.583	0.065
Mean Absolute Error M.A.E.	0.052	0.027	0.0005	0.513	0.056
Mean Absolute Error Percentage M.A.P.E.	0.868	0.563	0.031	12.963	0.787
Coefficient of Inequality (U) Theil	0.005	0.003	0.002	0.102	0.005
Index	**Structural form equations**				
	Frist	**Second**	**Third**	**Fourth**	**Fifth**
The Square Root of the Mean Squared random Error, R.M.S.E.	0.094	0.172	0.0006	0.588	0.059
Mean Absolute Error M.A.E.	0.081	0.149	0.0005	0.507	0.049
Mean Absolute Error Percentage M.A.P.E.	1.324	2.973	0.036	13.755	0.660
Coefficient of Inequality (U) Theil	0.031	0.013	0.0002	0.099	0.004

Source: It was collected and calculated from the equations of the reduced and structural form of the proposed model mentioned in my (Tables 5 & 6).

Predicting the internal and external variables of the proposed model in the light of the Green Middle East Initiative

From the above, it is clear that the carbon dioxide emissions amounted to 525.5 thousand kilotons in 2020. In light of the Green Middle East initiative, which aims to eliminate carbon emissions until they become zero in 2060, the implementation of the green middle east initiative requires a reduction of carbon emissions by 13.14 thousand kilotons annually. The proposed model external variables predicted until 2030, except for the consumption of refined petroleum products, where their consumption began to decline since 2018, in light of the annual growth rates mentioned in (Table 4), and the following growth equation [13]:

$$Y_{t+1} = Y_t (1+r)^n$$

Where Y_{t+1} represents the value of the variable in the comparison year, Y_t represents the value of the variable in the base year (2020), r represents the annual growth rate, n represents the difference between the comparison year and the base year.

How to cite this article: Adel M. G, Mohammad A, Khalid A, Othman A, Abdul Aziz A. Analyzing the Mutual Impact between Environmental Pollution and Economic Development in The Kingdom of Saudi Arabia. Ann Soc Sci Manage Stud. 2024; 11(2): 555808. DOI: 10.19080/ASM.2024.11.555808

It is clear from the data in (Table 8) that the spending ratio on the health and education sectors to government spending increased from 45.71% in 2022 to 55.26% in 2030. It is expected that the investment rate in the Saudi economy will increase from 24.07% in 2022 to 26.9% in 2030. The standard implicit index expected to increase from 113.73% in 2022 to 161.74% in 2030. Finally, it is expected to increase the degree of economic openness from 44.62% in 2022 to 45.78% in 2030.

Through the predictive values of the external variables and the equations of the structural form of the proposed model, it is clear from the data in (Table 8) a decrease in carbon dioxide emissions from 499.22 thousand kilotons in 2022 to 394.10 thousand kilotons in 2030. It is expected that the worker's productivity factor will increase from 167.41 thousand riyals in 2022 it will reach 188.36 thousand riyals in 2030. It is also, expected to increase the productivity of the invested capital from 4.47 million riyals in 2022 to 5.77 million riyals in 2030. It is also, expected to increase foreign direct investments in the Saudi economy from 56.27 billion riyals in 2022 to 63.00 billion riyals in 2030. Finally, the real GDP is expected to increase from 3,060.53 billion riyals in 2022, to 3638.92 billion riyals in 2030, with an annual average estimated at3,334.62 billion riyals during the period 2022-2030.

Table 8: Prediction of the external variables of the proposed model until 2030.

Year	Percentage spent on health and education %	Investment Rate %	Implicit index number	Degree of economic openness
2022	45.71	24.07	113.73	44.62
2023	46.80	24.41	118.85	44.77
2024	47.93	24.75	124.20	44.91
2025	49.08	25.10	129.79	45.05
2026	50.26	25.45	135.63	45.20
2027	51.46	25.80	141.73	45.34
2028	52.70	26.16	148.11	45.49
2029	53.96	26.53	154.78	45.63
2030	55.26	26.90	161.74	45.78

Source: collected and calculated from the data in (Table 3 & 4).

Conclusion and Recommendations

Given the mutual impact between environmental pollution and economic development, international documents issued calling on all governments and international organizations to take measures to protect the environment and save humanity from natural disasters. The Intergovernmental Panel on Climate Change [14] stated that if fossil fuels continue to burn at current quantities, the proportion of carbon dioxide (CO2) will double in the atmosphere by 2050, and the temperature will rise at a rate ranging between -1.4 5.8 degrees Celsius by the end of this century.

In the Kingdom of Saudi Arabia, the Green Middle East Initiative was announced on March 27, 2021, to address climate change by intensifying efforts and enhancing cooperation among the regional countries. The green middle east initiative tended to reduce carbon emissions by 278 million tons by 2030, increasing the use of renewable energy in various economic sectors, and planting 10 billion trees throughout the Kingdom, to improve air quality, reduce dust and sand storms, combat desertification and reduce temperature, in addition to protecting 30% of Terrestrial areas and marine life.

In the Kingdom of Saudi Arabia, the Green Middle East Initiative was announced on March 27, 2021, to address climate change by intensifying efforts and enhancing cooperation among the regional countries. The green middle east initiative tended to reduce carbon emissions by 278 million tons by 2030, increasing the use of renewable energy in various economic sectors, and planting 10 billion trees throughout the Kingdom, to improve air quality, reduce dust and sand storms, combat desertification and reduce temperature, in addition to protecting 30% of Terrestrial areas and marine life.

To achieve the expected increase in GDP, in light of the protection of the environment, this study recommends searching for additional sources of GDP, the most important of which are the following: (1) developing ecological, mountain and beach tourism for the Red Sea and the Arabian Gulf, (2) completing the NEOM city project in accordance with the vision Kingdom 2030, and it represents one of the major projects of the Public Investment Fund. It relies on renewable energy, provides 380,000 job opportunities, and adds 180 billion riyals annually to the gross domestic product [15], (3) Urging foreign companies to move their headquarters to the Kingdom of Saudi Arabia, which increases the flow of foreign direct investment to the Saudi economy.

Acknowledgement

The authors extend their sincere appreciation to the Deanship of Scientific research at King Saud University for supporting the work.

How to cite this article: Adel M. G, Mohammad A, Khalid A, Othman A, Abdul Aziz A. Analyzing the Mutual Impact between Environmental Pollution and Economic Development in The Kingdom of Saudi Arabia. Ann Soc Sci Manage Stud. 2024; 11(2): 555808. DOI: 10.19080/ASM.2024.11.555808

References

1. Ministry of Environment, Water and Agriculture (2020) Executive summary of the national environmental strategy.
2. General Authority for Statistics (2020) Electric power statistics. Riyadh Saudi Arabia.
3. Ghanem AM, Khalid N, Sahar, AK, Sharafaldin A, Nageeb M (2022) Measuring Impact of Air and Agricultural Soil Pollution on Social Development in Saudi Arabia. Journal of experimental Biology and Agricultural Science 10(3): 575-583.
4. Al-Nashwan OS, Ghanem AK (2010) Environmental Economic Policies and Measurements - An Applied Study in the Kingdom of Saudi Arabia and Egypt, First Edition, Dar Al-Moayyed Publishing and Distribution, Kingdom of Saudi Arabia.
5. General Authority for Statistics (2021) Survey of the home environment. Riyadh Saudi Arabia.
6. Ghanem AM, Alamri YA (2023) The impact of the Green Middle East initiative on sustainable development in the Kingdom Saudi Arabia. Journal of the Saudi Society of Agricultural Sciences 22(1): 35-46.
7. Khatib H (2003) Economic evaluation of projects in the electricity supply industry (No. 44). IET.
8. Gujarati DN, Porter DC (2009) Basic Econometrics, Fifth Edition, London, MC Grow-Hill International Book Company.
9. The Saudi Central Bank (2021) Annual Statistics 2020, 31/5/2021.
10. World Bank (2020) Open data 2000-2020.
11. Howarth N, Lanza A, Shehri T (2019) What is the reason for the recent decline in carbon dioxide emissions levels in Saudi Arabia, King Abdullah Petroleum Studies and Research Center (KAPSARC), View on Events, December 5, KS-2019- 1116.
12. Rahma ST (2020) Determinants of Foreign Direct Investment in the Kingdom of Saudi Arabia (1985-2017), Arab Democratic Center, Berlin, Germany, International Journal of Economic Studies, Issue Thirteen, p: 47-67.
13. Gujarati DN (2022) Basic econometrics. Prentice Hall.
14. Masson-Delmotte V, Zhai P, Portner HO, Roberts DC, Skea J, et al. (2018) Global warming of 1.5° C: Summary for policy makers.
15. Nazmi N (2022) NEOM: Vision 2030 has developed in all sectors of the Saudi economy.

DOI: 10.19080/ASM.2024.11.555808

How to cite this article: Adel M. G, Mohammad A, Khalid A, Othman A, Abdul Aziz A. Analyzing the Mutual Impact between Environmental Pollution and Economic Development in The Kingdom of Saudi Arabia. Ann Soc Sci Manage Stud. 2024; 11(2): 555808. DOI: 10.19080/ASM.2024.11.555808