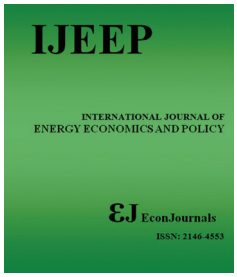

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Causality between Energy Consumption and Economic Growth: The Case of Kuwait

Mohammad Al-Zuhair[1]*, Talal Al-Bazali[2]

[1]College of Business Administration, Department of Finance and Financial Institutions, Kuwait University, Kuwait City, Kuwait, [2]College of Engineering and Petroleum, Department of Petroleum Engineering, Kuwait University, Kuwait City, Kuwait.
*Email: mohammad.alzuhair@ku.edu.kw

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ABSTRACT

The causality relationship between energy consumption and economic growth for Kuwait was investigated in this study, and the impact of increasing local energy prices on Kuwait's economic growth was examined. Our methodology relied on statistical analyses to study the causality trends between various factors such as GDP; annual oil production; oil-reserves depletion; annual energy consumption; and CO_2 annual emission, to formulate a hypothesis that determine the actual causality relationship between GPD and energy consumption without having to use the already-established statistical methods. Results showed no solid foundation to support the application of *growth* or *conservation* hypothesis. Results support the *neutrality* hypothesis which specifies no causality relationship between energy consumption and economic growth (GDP), especially from the year 2007/2008 and beyond, which allows for adopting stricter local-energy prices with no effect on the overall economic growth of the country. Results showed, however, a close relationship between oil exports (sales) and total GDP for Kuwait. The difference between total GDP and oil GDP exactly equals the non-oil related economic growth contribution to the country's economy. The findings of this study provide reliable and suitable basis for policymaking not only in Kuwait, but also in other single-source oil-producing countries such as GCC countries.

Keywords: Energy Consumption, Economic Growth, Gross Domestic Product, Middle East and North Africa region, GCC Countries
JEL Classifications: F43, H29, H60.

1. INTRODUCTION

Energy consumption and economic growth have been acknowledged to be highly interrelated. Understanding the causality relationship between energy consumption and economic growth sets in motion political, economic, environmental, and social reforms in many oil-and gas-producing countries. Namely, the type of causal and directional relationship between energy consumption and economic growth plays an important role in policy-making decisions, especially in oil producing countries.

Enormous literature has been conducted to understand this relationship, but the conclusion on the nexus is not quite clear. Three distinct hypotheses (growth, conservation, and neutral) were vastly proposed towards understanding the causality relationship between energy consumption and economic growth (Damette and Seghir, 2013; Hasanov and Mikayilov, 2017; Shahbaz et al., 2013).

Growth hypothesis proposes that energy consumption drives economic growth, and that any reduction in energy consumption by means of conservation policies will have a profound impact on economic growth (Dhawan and Biswal, 1999). This type is energy-reforms sensitive and can clearly be seen in countries such as Turkey, France, Germany, USA, and Japan.

Conservation hypothesis proposes that economic growth encourages energy consumption. Precisely, more economic production and activity promotes higher energy consumption to

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meet the ever-increasing economic output (Ozturk, 2017). This type is energy-reforms insensitive and resembles those found in countries such as Italy and South Korea.

Lastly, neutrality hypothesis specifies no causality relationship between energy consumption and economic growth (Ahmed and Azam, 2016; Chen et al., 2007; Menegaki, 2011). This type indicates that economic growth is independent from energy consumption and vice versa. Moreover, this type is clearly considered to be energy-reforms insensitive as well. Neutral causality between energy consumption and economic growth can be found in countries where oil and gas make up a huge portion of their GDP such as Gulf Cooperation Council (GCC) countries.

Depending on which hypothesis type a country belongs to, care should be taken when adopting energy conservation policies such as carbon tax, fuel price hike, and electricity and water price increases. For example, countries that follow the growth hypothesis type may slow down their economies if they adopt extreme energy conservation policies. On the other hand, energy conservation policies will have minimal or no effect on countries that fall under the conservation and neutral hypothesis types. Masih and Masih (1997) stated that if no causality relationship exists between energy and GDP, then energy conservation and economic growth may independently be practiced.

Kuwait, as well as the other GCC countries, follow the neutral hypothesis type where energy consumption is found to be independent from economic growth (GDP). Kuwait is a single-source country, and its economy relies almost entirely on oil sale and services. This single-source model works very well if oil prices remain high, where revenue from oil sales covers all expected expenditures especially those related to salaries; social benefits; etc. (Mehrara, 2007). However, recent oil price shocks (1997–1998, 2014–2015, 2020) exposed many flaws in single-source economies, such as Kuwait, where oil revenues have come short of covering expenditures. Therefore Kuwait, as well as other GCC countries, has focused on maximizing its oil revenue through increasing local-energy prices especially those related to transportation fuels and electricity and water.

A big argument has risen as to whether such a move will hurt economic growth in the future. Politician and some economists have argued that increasing local-energy prices may slow down economic growth in the future and, therefore, will have a profound impact on the economic sustainability of the entire country.

Examining the causal relationship between energy consumption and economic growth has profound implications for policy making. Thus, extensive research and numerous empirical studies have been conducted on this subject. While causality relationship between energy consumption and energy growth has been studied for the MENA region (Tang and Abosedra, 2014); emerging countries (Al-Mulali and Mohammed, 2015); and the top 10 oil-producing countries (Hasanov et al., 2017), there exists no explicit examination for such relationship for Kuwait alone.

This study investigates the causality relationship between energy consumption and economic growth for Kuwait. Moreover, this study examines the impact of increasing local energy prices on Kuwait's economic growth.

It is strongly believed that findings of this study would be a reliable and suitable basis for policymaking, not only in Kuwait but also in other single-source oil-producing countries such as GCC countries. Due to the lack of official data from governmental bodies, this study is built around data announced publicly from multiple reliable sources.

2. LITERATURE REVIEW

Current literature contains numerous studies examining the relationship between energy consumption and economic growth for many energy and non-energy economies. Kraft and Kraft (1978) investigated the causality between energy consumption and economic growth. The authors examined the direction of the causal link between gross national product (GNP) and energy consumption in the United States for the period 1947–1974. Applying Sims causality test, they found that there was a unidirectional causality running from GNP to energy consumption.

Akarca and Long (1979) have also inspected the energy consumption-growth nexus in the United States. Applying monthly data (from January 1973 to March 1978) and Granger's causality test, they found a negative causality running from energy consumption to employment. Yang (2000) found that Taiwan's economic growth (GDP) and energy consumption causality is energy-type specific. He noticed that GDP has a bidirectional causality relationship with total energy consumption; coal consumption; and electricity consumption, and a unidirectional causality relationship with natural gas consumption and oil consumption.

Wolde-Rufael (2004) results were mixed, where on one hand he detected no causality relationship between oil consumption and economic growth in Shanghai, and on the other hand he detected a unidirectional causality relationship from coal; coke; electricity; and total energy consumption to economic growth (GDP). Utilizing panel cointegration and panel error correction modelling, Lee (2005) explored the causality relationship between energy consumption and economic growth (GDP) in developing countries from 1975 to 2001 and concluded that long-and short-term energy consumption is a unidirectional causality of economic growth (GDP).

Using a Johansen-Juselius cointegration test, Mozumder and Marathe (2007) explored the causality relationship between electricity consumption and economic growth (GDP) in Bangladesh from 1971 to 1999. Their study confirmed the existence of a unidirectional causality relationship from GDP to electricity consumption.

Using vector error correction model and Granger causality test, Belloumi (2009) inspected the causality relationship between energy consumption and GDP in Tunisia for the period from

1971 to 2004. His results indicated the existence of a long-term bi-directional and a short-term unidirectional causality relationship between energy consumption and GDP.

Using ARDL test, Odhiambo (2009) considered the causality relationship between energy consumption and economic growth level (gross domestic product per capita) in Tanzania for the period from 1971 to 2006. His study confirmed an existence of a long-term relationship between the variables, and a unidirectional causality relationship from energy consumption to economic growth level.

In a study that spanned from 1975 to 2006, Kapusuzoglu and Karan (2010) found the existence of a unidirectional causality relationship from GDP to electricity consumption in Turkey, using Johansen-Juselius cointegration and Granger causality tests. Chang (2010) and Wang et al. (2011) detected evidence that favours causality from economic growth to energy consumption for China. Other studies have observed causality from energy consumption to economic growth for China (Zhang, 2011; Zhixin and Xin, 2011; Zhang et al., 2009; Al-Bazali, 2003; Crompton and Wu, 2005).

Dinçer et al. (2017) conducted a Dumitrescu Hurlin panel causality analysis to evaluate the causality relationship between energy consumption and economic growth for developed countries. Their findings revealed an existence of a bidirectional relationship between energy consumption and economic growth.

Using a panel vector error correction model and Granger causality test, Saad and Taleb (2018) analysed the short-run and long-run relationship between renewable-energy consumption and economic growth in 12 European Union countries. Their results showed the existence of unidirectional causality going from economic growth to renewable-energy consumption in the short run, and a bidirectional causal relationship between renewable-energy consumption and economic growth in the long run.

Salahuddin et al. (2018) used ARDL technique to analyse the relationship between GDP, electricity consumption, and CO_2 levels in Kuwait for the period from 1980 to 2013. Their findings showed a bidirectional relationship between electricity consumption and economic growth. Waheed et al. (2019) conducted a survey on the relationship between economic growth, energy consumption, and carbon emission. They concluded that, for the developing countries, energy consumption caused economic growth, supporting the growth hypothesis.

Singh and Vashishtha (2020) examined the relationships between per-capita energy consumption and per-capita GDP in India from 1970–1971 to 2014–2015. Results revealed the presence of unidirectional causality running from per capita GDP to per-capita energy consumption, and the absence of a long-term equilibrium relationship between the per-capita energy consumption and per capita GDP in India.

Krkošková (2021) investigated the long-run relationship between energy consumption and real GDP for V4 countries covering the period (2005 to 2019) using unit root tests, co-integration tests, and causality tests. His findings showed that, in the long run, energy consumption drives GDP in Slovakia, Hungary, and the Czech Republic. As for Poland, his results showed the absence of a noticeable relationship between energy consumption and GDP.

AL-Bazali and Al-Zuhair (2022) presented, based on fuzzy logic, an equation that combine the impact of both technical and non-technical factors on sustainability of oil and gas and economic growth. Their results showed that economic factors: oil-revenue dependence; public debt; and institutional structure, all impact oil and gas sustainability and economic growth.

3. DATA AND METHODOLEGY

Our methodology relies on statistical analyses, *through the use of descriptive graphs and tables*, that study the causality trends between various factors such as GDP; annual oil production; oil-reserves depletion; annual energy consumption; and annual CO_2 emissions in order to formulate a hypothesis that determine the actual causality relationship between GPD and energy consumption without having to use the already-established statistical methods such as panel vector error correction modelling; multivariate Johansen cointegration test; and Granger causality testing.

Statistical trends analysis can powerfully indicate the causality relationship between GDP and energy consumption and based on that one can argue how increasing local-energy prices (transportation fuels, electricity, and water) would impact Kuwait's economic growth (GDP). As stated above, the findings of this study would be a reliable and suitable basis for policymaking not only for Kuwait, but also for other single-source oil-producing countries such as GCC countries.

The sets of data used in this study come from reliable sources such as BP statistical reviews, and oil producing and exporting countries (OPEC) data base. (Table 1) shows Kuwait's annual GDP; energy consumption; and CO_2 emission for the period spanning from 1995 to 2020.

(Figure 1) shows the development of proven oil reserves for the state of Kuwait for the period from 1980 to 2020, while (Figure 2) shows the annual oil production for the period spanning from 1965 to 2019.

(Figure 3) shows the historical-actual and adjusted-for-inflation oil prices for the period spanning from 1860 to 2020.

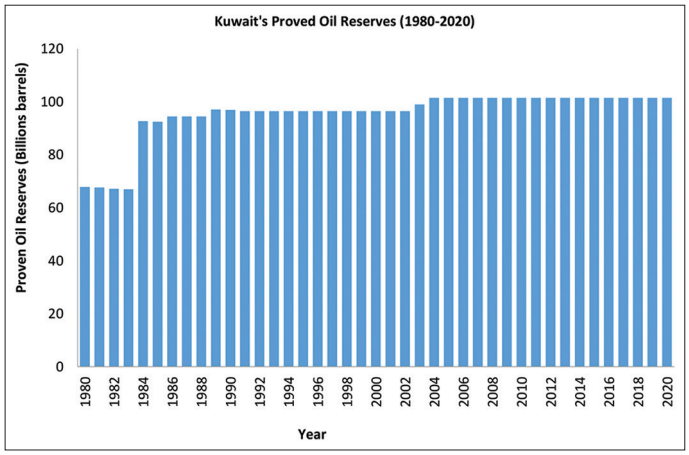
4. STATISTICAL TRENDS ANALYSIS

(Figure 4) below shows the relationship (trend) between economic growth (GDP) and energy consumption for the state of Kuwait for the period spanning from 1995 to 2020. It can clearly be seen from (Figure 4) that the relationship between GDP and energy consumption follows two distinct trends; the period prior to 2007/2008 and the one after that.

Table 1: Kuwait's annual GDP, energy consumption, and CO_2 emission for the period from 1995 to 2020

Year	GDP (Billions USD)	Energy consumption (Exa-Joules)	CO_2 emission (Million Tonnes)
1995	27.19	0.54	34.8
1996	31.49	0.54	34.4
1997	30.35	0.56	35.5
1998	25.94	0.69	42.7
1999	30.12	0.71	44.7
2000	37.22	0.76	47.6
2001	34.89	0.77	48.4
2002	38.14	0.82	52.9
2003	47.84	0.98	64.3
2004	59.44	1.09	72
2005	80.81	1.2	79.3
2006	101.56	1.16	75.2
2007	114.68	1.12	72.9
2008	147.4	1.22	77.9
2009	105.99	1.23	77.2
2010	115.4	1.41	87.8
2011	154.02	1.45	89.4
2012	174.07	1.51	92.4
2013	174.18	1.55	97.7
2014	162.7	1.57	99.5
2015	114.61	1.61	100.1
2016	109.38	1.62	100.5
2017	120.69	1.65	100.7
2018	138.2	1.65	100.7
2019	136.19	1.67	101.5
2020	105.95	1.51	91.6

Figure 1: Development of proven oil reserves for the state of Kuwait for the period from 1980 to 2020



Prior to 2007/2008, GDP is directly proportional to energy consumption. Despite this direct proportionality, one cannot be certain which factor drives the other. Namely, we cannot be sure whether GDP drove energy consumption or energy consumption drove GDP. It is interesting nevertheless to see that the trend beyond 2008 seems to break down, where energy consumption behaves independently from GDP. This might be the case for most oil-producing countries, especially those with oil sales making up a big contribution to the total country's GDP.

It is fair to state, as per (Figure 4), that there exists no solid foundation to support the application of growth or conservation

Figure 2: Annual oil production for the state of Kuwait for the period from 1965 to 2019

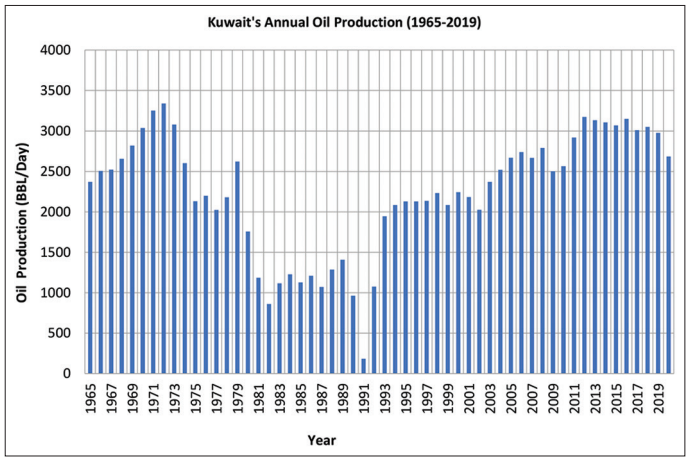


Figure 3: Historical-actual and adjusted-for-inflation oil prices for the period from 1860 to 2020

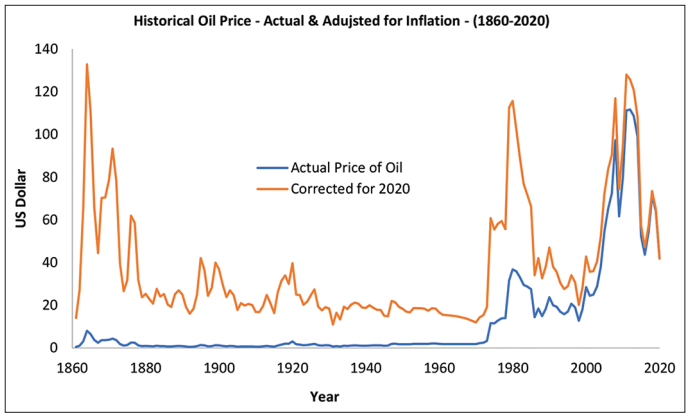
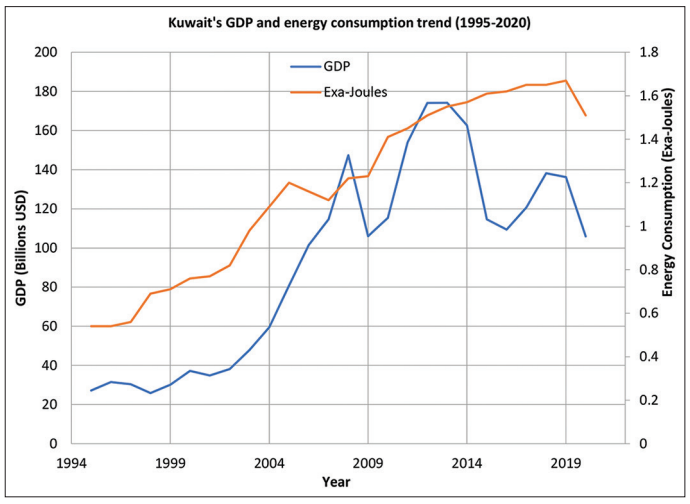


Figure 4: The relationship (trend) between economic growth (GDP) and energy consumption for the state of Kuwait for the period from 1995 to 2020



hypothesis on Kuwait's economy. In fact, (Figure 4) supports the neutrality hypothesis which specifies no causality relationship between energy consumption and economic growth (GDP), especially from the year 2008 and beyond. This means that

adopting stricter local-energy prices might not affect the overall economic growth of the country since it is solely driven by oil export. *Thus, Kuwait can improve its revenue by increasing the prices of transportation fuels, electricity, and water*. This increase will improve its revenue and help balance its budget, *without an adverse effect on economic growth*.

Increasing local-energy prices will also have a positive impact on Kuwait's environment. Burning less oil and gas for transportation, electricity, and water will drop the level of CO_2 emission in the atmosphere (Al-Bazali, 2022). (Figure 5) shows the development of CO_2 level in Kuwait's atmosphere for the period (1995–2020).

Reducing the level of CO_2 in the atmosphere will have an added economic value to Kuwait's economy and gain international approval and support. This could encourage international companies to invest in Kuwait, which in turn enhances Kuwait's economic activities.

According to BP Statistical Review of World Energy (2021), Kuwait has one of the highest primary-energy consumptions per capita, where per capita energy consumption reached 352.9 Gigajoule in 2020. This high level of energy consumption correlates very well with the increase in CO_2 concentration level in the atmosphere as shown in (Figure 6) below.

Therefore, increasing the prices of local-energy in Kuwait should prove to be environmentally and economically beneficial and, at the same time, will not hinder economic growth since energy consumption and economic growth seem to be independent of each other (neutrality hypothesis).

It is expected for single-source oil-producing countries to rely heavily on oil production and oil prices for their total revenue, as expressed by GDP. Kuwait is no exception as it gets more than 90% of its revenue from oil sales. Eltony (2007) argues that Kuwait is a typical example of an oil-based economy, where the oil sector contributes to over one-third of GDP and over 90% of total exports. This has made its GDP very sensitive to oil prices and the level of oil production.

A drop in oil prices, such as those witnessed during the 1997–1998 crises and 2020 Covid-19 related oil slump, has dropped Kuwait's GDP by as much as 50%. Other single-source countries (i.e., GCC), face the same dilemma despite their efforts to diversify away from oil. If oil sales make up more than 40% of the country's total export, then that country will always be under pressure when oil prices or its own production drop (Wood and Alsayegh, 2014). (Figure 7) shows Kuwait's GDP in relation to its oil production and oil prices for the period between 1995 and 2020.

It can be clearly deduced from (Figure 7) above that Kuwait's GDP follows the same trend as oil price and oil production. This is not surprising since most single-source oil-producing countries tend to concentrate their investment and economic activities around oil and its derivatives (Al-Kawaz, 2008).

(Figure 8) below shows a correlation between the total GDP, which includes all revenues from oil and non-oil related economic activities; and oil GDP, which only considers economic growth

Figure 5: Development of CO_2 levels in Kuwait's atmosphere for the period (1995–2020)

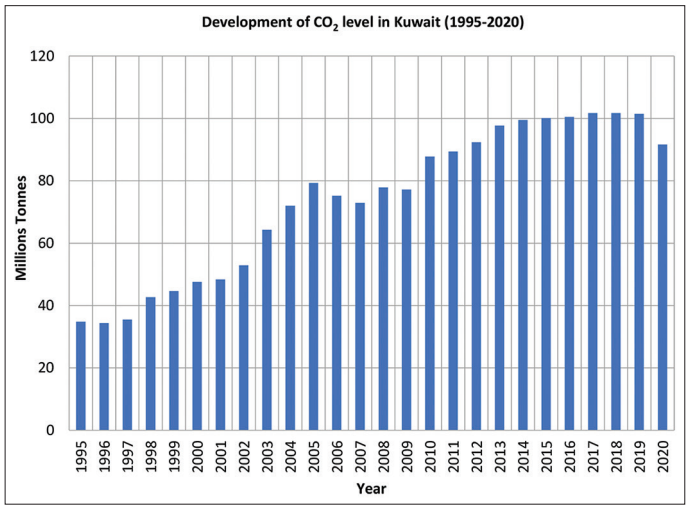


Figure 6: CO_2 concentration levels (Millions of Tonnes) in response to energy consumption (Exa-Joules) for Kuwait (1995–2020)

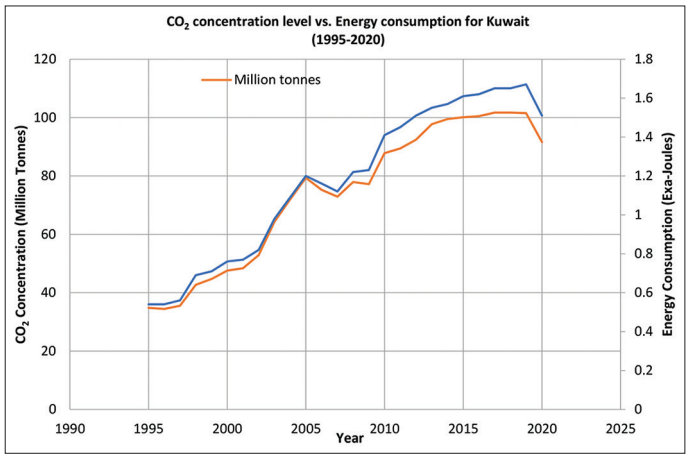


Figure 7: Kuwait's GDP in relation to its oil production and oil prices for the period between 1995 and 2020

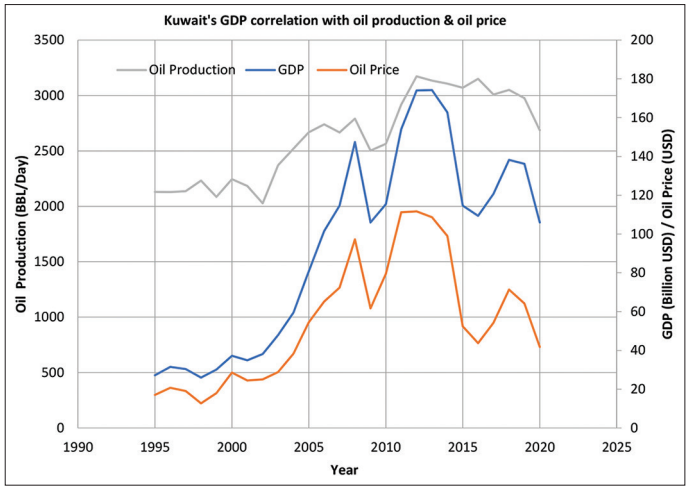
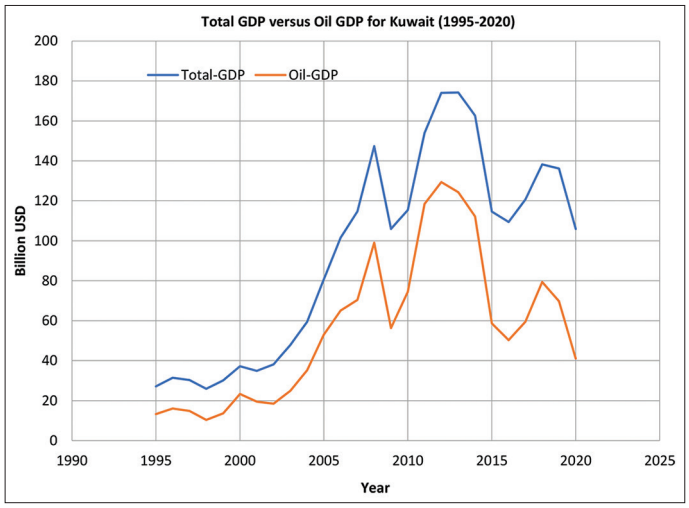


Figure 8: Total GDP versus Oil GDP for Kuwait for the period between 1995 and 2020



related to oil activities. It shows the close relationship between oil exports (sales) and total GDP for the state of Kuwait. The difference between total GDP and oil GDP exactly equals the non-oil related economic growth contribution to the country's economy.

As we can see, the contribution of non-oil related economic activities pales in comparison with the contribution of oil sales to the total GDP. It is interesting to notice that the total GDP trend, as shown in (Figure 8), mimics that of the oil GDP which proves the entire dependency of Kuwait economy on oil sales.

This solidifies the existence of a neutrality hypothesis when it comes to the causality relationship between economic growth and energy consumption. Precisely, energy consumption does not drive economic growth in Kuwait since economic growth (GDP) is closely related to oil sales and exports as seen in (Figure 8). Consequently, increasing the prices of local energy in Kuwait should prove to be economically beneficial and, at the same time, will not hinder economic growth since energy consumption does not greatly affect economic growth.

(Figure 9) below shows a regression analysis for total GDP and oil GDP for the state of Kuwait during the period spanning from 1995 to 2020. As seen in (Figure 9), there exists a close relationship between total GDP and oil GDP for Kuwait's economy. In fact, the trendline equation follows a polynomial type of the order of 2 (with a R-squared value of 0.9546) as follows:

$$GDP_{total} = 0.0034GDP_{oil}^{2} + 0.074GDP_{oil} + 11.357 \quad (1)$$

As seen in (Figure 9), the R-squared value is high, reflecting the close relationship between total GDP and oil GDP. Therefore, a reduction in oil sales (revenue) will definitely hurt the overall economic growth for Kuwait.

By the same token, (Figure 10) below shows a regression analysis for total GDP and energy consumption for the state of Kuwait

Figure 9: Regression analysis for total GDP and oil GDP for the state of Kuwait during the period from 1995 to 2020

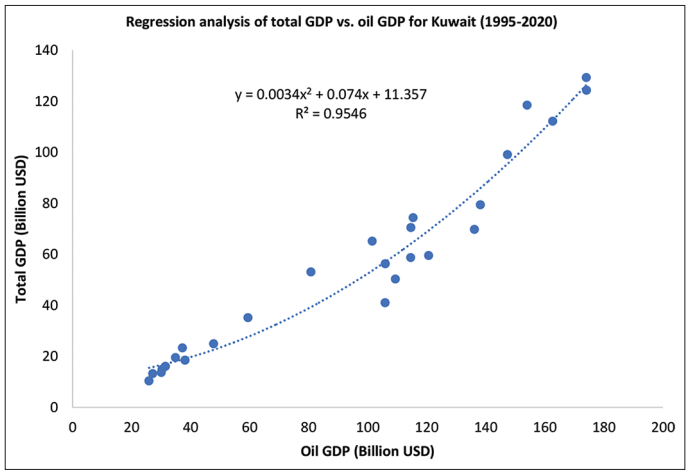
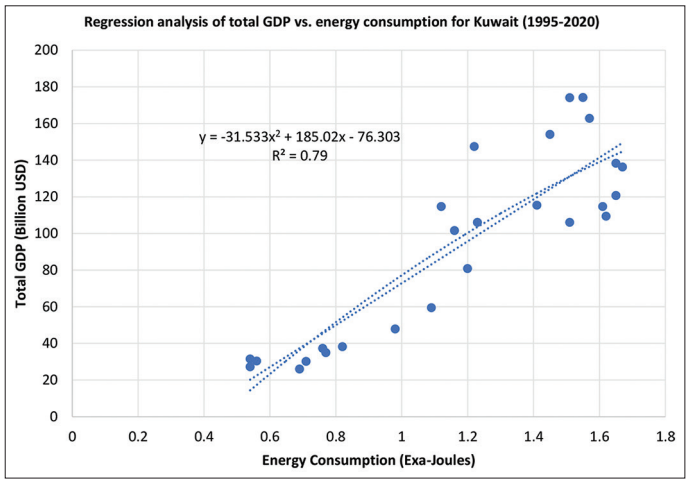


Figure 10: Regression analysis for total GDP and energy consumption for the state of Kuwait during the period spanning from 1995 to 2020



during the period spanning from 1995 to 2020. The trendline equation follows a polynomial type of the order of 2 (with a R-squared value of 0.79) as follows:

$$GDP_{total} = -31.533(\text{Exa-Joules})^{2} + 185.02(\text{Exa-Joules}) - 76.303 \quad (2)$$

As stated previously, equation (2) shows that there does not exist a strong relationship between total GDP and energy consumption as expressed by the equation R-squared value of 0.79. This confirms our argument that increasing local-energy prices will not hurt the total GDP of Kuwait.

5. CONCLUSIONS

The following conclusions can be deduced from this work:

- There exists no solid foundation to support the application of *growth* or *conservation* hypothesis on Kuwait's economy. In fact, results support the *neutrality* hypothesis, which specifies no causality relationship between energy consumption and economic growth (GDP) especially from the year 2007/2008 and beyond

- Adopting stricter local-energy prices might not affect the overall economic growth of the country since it is solely driven by oil export
- There exists a close relationship between oil exports (sales) and total GDP for the state of Kuwait
- Increasing local-energy prices will have a positive impact on Kuwait's environment since burning less oil and gas for transportation, electricity, and water will certainly drop the level of CO_2 emissions in the atmosphere
- The difference between total GDP and oil GDP exactly equals the non-oil related economic growth contribution to the country's economy
- Energy consumption does not drive economic growth in Kuwait since economic growth (GDP) is closely related to oil sales and exports
- The findings of this study would be a reliable and suitable basis for policymaking not only in Kuwait, but also in other single-source oil -producing countries such as GCC countries
- Increasing the prices of local energy in Kuwait should prove to be economically beneficial and, at the same time, will not hinder economic growth since energy consumption does not greatly affect economic growth.

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