THE IMPACT OF ENERGY CONSUMPTION ON ENVIRONMENTAL DEGRADATION AND ECONOMIC GROWTH IN SYRIA 1970 – 2012

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by

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LIST OF SYMBOLS AND ABBREVIATIONS

AIC	Akaike Information Criteria
ADF	Augmented Dickey-Fuller
AFPC	Al-Furat Petroleum Company
ARDL	Autoregressive Distributed Lag Model
BCF/Y	Billion Cubic Feet Per Year
BPD	Barrel Per Day
CBS	Central Bureau of Statistics
CO2	Carbon Dioxide Emissions Per Capita
CPI	Consumer Price Index
CUSUM	Aggregate sum Control Chart
DOLS	Dynamic Ordinary least squares
EC	Energy Consumption Per Capita
EIA	U.S. Energy Information Administration
EKC	Environmental Kuznets Curve
ERF	Economic Research Forum
ESC	Environmental Studies Centre
EU	European Union
FDI	Real Foreign Direct Investment Per Capita
FMOLS	Fully Modified Ordinary Least Squares
GC	Natural Gas Consumption Per Capita
GCEA	General Commission for Environmental Affairs
GCSAR	General Commission for Scientific Agricultural Research
GCT	Granger Causality Test
GDP	Real Gross Domestic Product Per Capita

IAEA	International Atomic Energy Agency
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
JJ	Johansen and Juselius
KT	kilotons
LF	Labour Force
M	Imports of Goods and Services as a Share of GDP
MTOE	Million Tonnes of Oil Equivalent
MW	Megawatts
NERC	National Energy Research Centre
NGOs	Non-governmental Organizations
OC	Oil Consumption Per Capita
OLS	Ordinary Least Squares
OPEN	Trade Openness
PD	Population Density
PEDEE	Public Establishment for Distribution and Exploitation of Electrical Energy
PEEGT	Public Establishment for Electricity Generation and Transmission
POP	Population
Quad Btu	Quad British Thermal Units
SC	Schwarz Information Criterion
SCPR	Syrian Centre for Policy Research
SPC	Syrian Petroleum Company
SYR	Syrian Pounds
VAR	Vector Autoregression Model
VECM	Vector Error Correction Model

WB	World Bank
WHO	World Health Organization

IMPAK PENGGUNAAN TENAGA TERHADAP KEROSAKKAN ALAM SEKITAR DAN PERTUMBUHAN EKONOMI DI SYRIA 1970 – 2012

ABSTRAK

Sektor tenaga merupakan salah satu penyumbang terbesar kepada ekonomi Syria. Walau bagaimanapun, terdapat penurunan yang cepat dalam pengeluaran minyak domestik yang bertepatan dengan peningkatan berterusan dalam penggunaan minyak. Ia meningkatkan bendera merah pada keselamatan tenaga pada masa depan. Kemerosotan alam sekitar telah meningkat secara berterusan sejak 1980-an disebabkan oleh peningkatan dalam liberalisasi perdagangan, pertumbuhan ekonomi dan penggunaan minyak. Tanpa mengira usaha kerajaan dalam mengubah ekonomi, ia masih menunjukkan banyak kelemahan, seperti ketidakstabilan pertumbuhan ekonomi, tahap pelaburan yang rendah dan harga tenaga yang tinggi. Sehubungan dengan itu, isu - isu utama kajian adalah bagaimana untuk meningkatkan penggunaan tenaga, mengurangkan kemerosotan alam sekitar dan meningkatkan pertumbuhan ekonomi. Oleh itu, kajian ini cuba menyiasat hubungan kausal antara penggunaan tenaga, kemerosotan alam sekitar dan pertumbuhan ekonomi di Syria. Kajian ini menggunakan model VAR, ujian punca unit ADF, ujian kointegrasi Johansen, ujian kasual granger, fungsi tindak balas impuls dan analisis penguraian varians. Hasil kajian menunjukkan pertumbuhan ekonomi dan pelaburan langsung asing sebenar per kapita (FDI) mempunyai kesan positif ke atas penggunaan tenaga per kapita (EC). Pertumbuhan ekonomi dan FDI adalah beberapa penentu EC yang paling penting di Syria. Selain itu, kemerosotan alam sekitar berkait secara positif dengan EC dan pertumbuhan ekonomi, dan berkait secara negatif dengan penggunaan gas asli per kapita (GC) dan FDI. Hasilnya menunjukkan terdapat kausaliti dua hala antara

pertumbuhan ekonomi, FDI, EC, GC, dan kemerosotan alam sekitar dalam jangka panjang, dan EC mempunyai hubungan satu arah dengan kemerosotan alam sekitar dalam jangka pendek. Pertumbuhan ekonomi, GC, dan FDI adalah antara faktor penentu kemerosotan alam sekitar yang paling ketara. Selain itu, EC, GC dan FDI mempunyai kesan positif, manakala penggunaan minyak per kapita (OC) memudaratkan pertumbuhan ekonomi. EC dan komponennya mempunyai hubungan satu arah dengan pertumbuhan ekonomi dalam jangka pendek dan jangka panjang. Wujud kausaliti dua arah antara FDI dan pertumbuhan ekonomi dalam jangka panjang. Selain itu, OC mempunyai hubungan satu arah dengan FDI, manakala pertumbuhan ekonomi mempunyai hubungan satu arah dengan EC dalam jangka pendek. Kerajaan telah membangunkan sektor tenaga dengan tumpuan khusus kepada gas asli dan transformasi ekonomi daripada perancangan pusat ke arah ekonomi pasaran sosial untuk meningkatkan pertumbuhan ekonomi dengan mewujudkan iklim FDI yang menarik dan meningkatkan liberalisasi perdagangan. Peningkatan pertumbuhan ekonomi meningkatkan penggunaan tenaga dan kemerosotan alam sekitar. Usaha kerajaan untuk mewujudkan FDI yang menarik, tarikan teknologi baru dalam gas asli dan mengembangkan penggunaan gas asli telah menurunkan kemerosotan alam sekitar dan membuktikan bahawa FDI dapat membawa teknologi hijau dari negara maju. Kesan negatif OC adalah disebabkan oleh penurunan berterusan dalam pengeluaran minyak domestik dan peningkatan penggunaan minyak. Walaupun peningkatan GC membawa pelbagai faedah, termasuk penggunaan konservasi gas asli yang banyak dan keberkesanan kos, dan yang paling penting, meningkatkan pertumbuhan ekonomi dan penurunan kemerosotan alam sekitar. Selain itu, hasil kajian menyokong keluk kuznets alam sekitar dan teori pertumbuhan. Cadangan utama kajian ini adalah kerajaan harus meningkatkan usahanya dengan membangunkan sektor tenaga melalui menambah

baik faktor pemacu penggunaan tenaga untuk memenuhi rancangan mereka mencapai tahap penggunaan tenaga yang dikehendaki di Syria. Di samping itu, kerajaan harus berusaha ke arah faktor pemacu kemerosotan alam sekitar untuk mencapai tahap pelepasan yang dirancang melalui peningkatan penggunaan gas asli dan pengukuhan pelaksanaan perjanjian alam sekitarnya.

THE IMPACT OF ENERGY CONSUMPTION ON ENVIRONMENTAL DEGRADATION AND ECONOMIC GROWTH IN SYRIA 1970 – 2012

ABSTRACT

The energy sector is one of the largest contributors to the Syrian economy. However, there was a rapid decline in domestic oil production which coincided with a continual increase in oil consumption. That raised the red flag on future energy security. Environmental degradation has been steadily increasing since the 1980s due to an increase in trade liberalization, economic growth, and oil consumption. Regardless of the government's efforts in transforming the economy, it is still showing many weaknesses, such as economic growth instability, low levels of investments and high energy pills. In this regard, the main issues of the study are how to improve energy consumption, reduce environmental degradation and increase economic growth. Hence, this study attempts to investigate the causal nexus between energy consumption, environmental degradation and economic growth in Syria. This study utilises the VAR model, ADF unit root test, Johansen cointegration test, granger casualty test, impulse response function and variance decomposition analysis. The results of the study indicated that economic growth and real foreign direct investment per capita (FDI) have positive impacts on energy consumption per capita (EC). Economic growth and FDI are some of the most significant determinants of EC in Syria. Moreover, environmental degradation is positively related to EC and economic growth, and negatively related to natural gas consumption per capita (GC) and FDI. The results report a bidirectional causality between economic growth, FDI, EC, GC, and GC has a unidirectional relationship with environmental degradation in the short run. Economic growth, GC, and FDI are among the most significant determinant

factors of environmental degradation. In addition, EC, GC and FDI have a positive effect, while oil consumption per capita (OC) harms economic growth. EC and its components have unidirectional relationships with economic growth in the short and long run. A bidirectional causality exists between FDI and economic growth in the long run. Besides, OC has a unidirectional relationship with FDI, while economic growth has a unidirectional relationship with EC in the short run. The government has developed the energy sector with a particular focus on natural gas and transformed the economy from central planning towards a social market economy to boost economic growth by creating an attractive FDI climate and increasing trade liberalisation. The increase in economic growth increases energy consumption and environmental degradation. The government's efforts to create an attractive FDI, attract new technologies in natural gas and expand natural gas consumption have decreased environmental degradation and proved that FDI could bring greener technologies from developed countries. The negative impact of OC is due to the continuous decrease in domestic oil production and increase in oil consumption. While increased GC brought various benefits, including utilisation of the abundant natural gas conservations and cost-effectiveness, and most importantly, boosted economic growth and decreased environmental degradation. Furthermore, the results of the study support the environmental Kuznets curve and growth theories. The main recommendations of this study are that the government should increase its efforts in developing the energy sector by improving energy consumption driving factors to meet their plans of achieving the desired energy consumption levels in Syria. In addition, the government should work toward environmental degradation driving factors to reach the planned emissions levels by boosting natural gas consumption and strengthening its environmental treaty agreement implementation.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Syrian Arab Republic (Syria) is a developing country located in Western Asia and classified as a middle-income country. The energy sector plays a fundamental role in the country's economic performance. The government plans have focused on improving its energy consumption efficiency, boosting its economic growth and improving its environment. The Syrian economic system was controlled solely by the government under a central planning system, resulting in low economic growth and Foreign Direct Investment (FDI) levels. The country has transformed its economy and liberalised its trade and increased FDI and economic growth levels. Besides, the government's plan has aimed to increase its energy consumption efficiency, decrease its dependency on oil, and encourage natural gas consumption for reasons related to the environment, efficiency, cost-effectiveness, and energy security. Hence, to better understand energy consumption, environmental degradation and the role of economic growth, it is necessary to investigate factors that drive energy consumption and environmental degradation and analyse the different types of energy consumption, environmental degradation, FDI and economic growth nexus in Syria.

Very few panel-based empirical studies analysed energy consumption and environmental degradation determinants that included the Syrian data, yet they obtained different results. Hence, this study attempts to fill this literature gap by spotting the light on the country-specific analysis by investigating the energy consumption and environmental degradation determinants in Syria. In addition, this

study will be one of the first empirical studies to examine the Syrian different types of energy consumption, environmental degradation, FDI and economic growth nexus, and highlight how the Syrian government has planned to improve energy consumption and prioritise natural gas consumption, increase economic growth and FDI levels, as well as slow down environmental degradation.

1.2 Background of the study

Real economic growth is defined by the changes in the inflation-adjusted market value of outputs over time in an economy. It is usually measured as the annual percentage change in a country's Gross Domestic Product (GDP) in constant prices. GDP is the aggregated value of all goods and services that an economy generates over a specific time period. Economic growth is widely used as an indicator to test economic performance. Long-run economic growth is an essential indicator of a healthy economy. It positively impacts the employment rate and national income. These impacts would boost the standard of living and wealth. The world's economic growth has increased more than three times over the last four decades. Although economic growth increased standards of living in many nations, it was likewise the reason behind the decrease in natural resources. Some economists argued that the increase in GDP and population would result in a severe cut of natural resources that would undermine economic growth and development (Nnadozie & Jerome, 2019; Acemoglu, 2012).

Energy consumption per capita is defined as the amount of energy used in a country, including fossil fuel, nuclear power and renewable energy consumption divided by population. Fossil fuel consumption refers to the consumption of oil, coal and natural gas within a country. Nuclear power consumption refers to the

consumption of energy that is generated by a nuclear power reactor. Renewable energy consumption stands for energy consumption obtained from resources that are not depleted significantly by consumption (EIA, 2020).

Forecasts expect that by 2050, the world's energy consumption will increase by eighty per cent. Nevertheless, fossil fuel consumption most probably will remain around eighty-five per cent of total energy consumption. Environmental serious outcomes will probably happen; ozone-depleting, greenhouse gas emissions are relied upon to increment by fifty per cent by 2050 (OECD, 2012).

Along these lines, energy policies are set to increase the efficiency of energy consumed and change it to a different type of energy consumption that is more environmentally friendly. These policies carry many advantages, including lower dependence on fossil fuels, decrease greenhouse gas emissions and energy consumption cost and guarantee a specific level of energy security. The advantages of efficient energy productivity are lower dependence on petroleum products, a decrease in carbon dioxide emissions (CO_2), potential reserve funds in fuel cost, higher shopper welfare, and guarantee a specific dimension of energy security (Geller, et al., 2006).

As fossil fuel includes several types of energy, different amounts of emissions are generated based on energy type. Natural gas emissions are comprised of CO_2 emissions and water vapour. Keeping in mind that CO_2 emissions are dangerous for the environment, natural gas that is used in more current progressively productive power plants generate somewhere in the range of fifty to sixty per cent less CO_2 emissions than customary coal plants and up to thirty per cent lower than what oil generates. Natural gas additionally generates less sulfur dioxide and nitrogen oxide than oil. Therefore, natural gas consumption is a considerably cleaner decision for the

environment than coal and oil and delivers more energy than oil and coal. For example, natural gas consumption is around ninety per cent more efficient when used for electricity generation than coal (EIA, 2017).

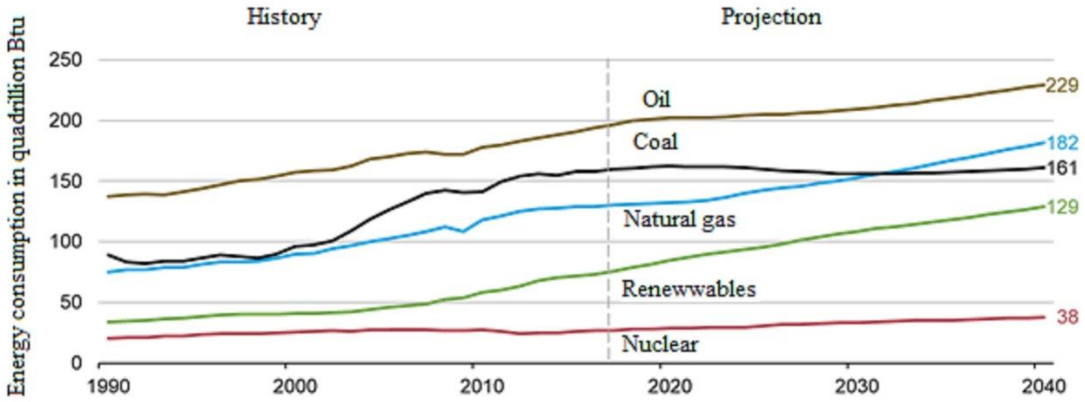

Figure 1. 1: World energy consumption by energy source (EIA, 2017)

According to the International Energy Outlook 2017 from the U.S. Energy Information Administration, world energy consumption will increase by 28 per cent over the period 2015-2040, as shown in Figure 1.1. The outlook suggested that energy consumption by source will increase except for coal, which is anticipated to remain considerably flat. The fastest-growing energy consumption by the source is renewable energy, followed by nuclear energy. Renewable energy consumption is forecasted to expand by over two per cent per year, while nuclear power consumption is expected to expand by over one per cent per year over the period 2015-2040. Even though the outlook expects that the nonfossil fuels, including renewable and nuclear, will increase quicker than fossil fuels, fossil fuels including coal, oil, and natural gas still record for more than seventy-five per cent of world energy consumption over that period. Since natural gas consumption generates less carbon dioxide emissions, rising production, abundant natural gas resources, and it is the most efficient fossil fuel type of energy consumption compared to both oil and coal consumption, it will grow at a faster rate than oil consumption by over 1.5 per cent per year over that period.

Furthermore, the world bank defines FDI as creating an investment that aims to accumulate a long-lasting management interest, which generally ranges around 10 per cent of voting stock in a business running in a different country than the investor's resident country (World Bank, 2020). FDI and trade play an essential role in the process of economic growth. Trade contributes to boosting workforce skills via the adoption of new technologies and the role of innovation. Exporters utilise innovation and new technologies in many ways, such as working as subcontractors to foreign businesses or competing in international markets. Local producers ended up with an increase in the competition of international businesses. Thus, they are perused to invest in capital-intensive facilities in an attempt to increase their competitive outputs compared to international businesses, especially in developing countries that, in general, its products are capital-intensive (Frankel & Romer, 1999). Trade openness is calculated as the sum of imports and exports over GDP. The aggregation of both capital and technology transfer could positively affect trade openness on economic growth. The prominent role of FDI is to increase the funds supply of local investment in the operation country, which could be achieved via the production chain when international investors purchase the hosted country's domestic inputs and then resale them as an intermediate input to domestic businesses. Increasing yields of foreign exchange could be achieved by FDI in developing countries when FDI increases the capacity of the hosted country's exports. Other positive impacts of FDI on the hosted country include decreasing the unemployment rate by creating new jobs and improving technology transfer and economic growth (Dhar & Wani, 2017).

Environmental degradation defines as a procedure that affects the environment and diminishes the biological variety and the general environmental health. Carbon dioxide emissions per capita are used as a proxy for environmental degradation in a

large part of the literature. Carbon dioxide emissions per capita define as the amount of carbon dioxide gas that is generated by burning fossil fuels and divided by population. Environmental degredation plays a vital role in sustainable economic development. The role of international businesses in the hosted country could improve or worsen environmental degredation. Hence, many researchers interest in the relationship between environmental degredation and different international economic activities, including capital flows (FDI inflows), export, finance, transport and energy consumption. Considering the importance of FDI in international businesses, many researchers have attempted to investigate the role of FDI in environmental degradation at single- and multi-country levels. They found that the effect of FDI on environmental degradation could be negative or positive. For example, even so, FDI plays a vital role in boosting economic growth in the hosted country; it could be harmful to the environment (Lau, et al., 2018).

1.2.1 Energy Consumption

Energy supply deficiency is deleterious to economic development in both developed and developing economies. The energy supply shortage could take many shapes, such as being over-dependent on imported energy, usage of inefficient energy equipment, power cuts, or long queues at petrol stations (Alter & Syed, 2011; Tang, 2009; Samuel, et al. 2013). Some energy economics researchers suggested that increasing future energy consumption for a nation increases the need to conserve energy consumption, which could be achieved by increasing the usage of energy-efficient means. For example, if economic growth in an economy depends on energy consumption without feedback, then energy policies that aim to decrease energy consumption will be resulted in limiting economic growth of that nation (Wong, et al., 2013; Alshehry & Belloumi., 2015; Bekun, et al., 2019). With the increase of energy

consumption faced by limited energy supply, determinants of energy consumption have gained more interest in the economic literature due to its importance in suggesting policies that ensure sustainable economic development. Many studies have attempted to investigate factors that derive energy consumption, yet the results are mixed due to different development levels among countries and various methodologies, periods, and observations (Khanna & Rao, 2009).

Ekpo et al. (2011) examined the determinants of energy consumption in Nigeria over the period 1970-2008 and found that an increase in GDP will increase energy consumption, the industrial sector's output, and population. De Vita et al. (2006) investigated the determinants of energy consumption in Namibia for the period 1980-2002 and found that GDP positively affects energy consumption and energy price negatively affects energy consumption. Tang (2009) examined the factors that derive electricity consumption in Malaysia. Several variables were used, including population, real GDP, real energy price and FDI. He found that real GDP and energy prices positively affect electricity consumption and that there is a bidirectional relationship between real GDP, FDI and electricity consumption.

Syria's energy demand is increasing in virtue of the high national birthrate and an evolving private sector. The country's energy supply has been relying on its oil and natural gas resources in the last decades; however, there was a rapid decline in the domestic oil production from 1996 until 2005 (from about 600 to 400,000 barrels per day), and it is anticipated to reach only 300 barrels per day by 2030. The primary energy is forecasted to grow at an annual average rate of 4.80 per cent, reaching 68 million Tonnes of Oil Equivalent (MTOE) by 2030, total electricity installed will be expanded optimally from 6,885 Megawatts (MW) to 19,500 MW by 2030, and the

future national energy system will rely primarily on oil and natural gas for the security of supply energy (IAEA, 2018).

Oil export disappeared in 2012 due to the steady decline in oil production, and that the nation will import around 63 per cent of its primary energy demand by 2030, generating a challenge for the country's future economy. The continuing popular rebellion has affected the security as well as financial circumstances and reform efforts of Syria. For instance, it compelled Syria to delay its long-run plan to phase out its subsidies for petroleum products (IAEA, 2018). The primary focus of the energy policy of Syria lies in ensuring supply security by making reasonably priced energy services available to the public, in line with its economic situation. Two major challenges were identified in attaining this objective; the first challenge is to expand the market for natural gas, while the second challenge is to maintain oil production. The government has introduced several measures to overcome these challenges, which includes the promotion of the use of new technology, improvement of energy efficiency, the attraction of foreign investment in the natural gas and oil sectors, combating of illegal energy use, encouragement of the use of natural gas, oil conservation and its substitution with natural gas. The government is working on increasing the nation’s gas production through several initiatives intended to develop and expand the network of domestic natural gas. Besides, the policy prioritises substituting natural gas for oil in current power stations and factories (IAEA, 2011).

1.2.2 Environmental Degradation

Global warming and air pollution have been recognized as the most international issues over the last years, and CO_2 emissions are founded to be the core of these issues. The Intergovernmental Panel on Climate Change (IPCC) 2013 report suggested that developing countries that aim to boost their economic development are

responsible for 76.7 per cent of the global CO_2 emissions. Thus, there is an increasing interest among researchers and policymakers due to the importance of the reasons behind CO_2 emissions and their relationship with economic growth and especially in developing countries. Energy consumption, especially the one derived from fossil fuels, has been recognized as an essential factor in improving economic growth. The relationship between natural resource consumption, environment and economic development has been illustrated via the environmental Kuznets curve hypothesis (Kuznets, 1955). In the beginning, when per capita income for a nation is low, it will be combined with an increase in environmental degradation and could decrease with an increase with the per capita income. In other words, early stages of development are combined with higher sentimental degradation and will begin to decrease with an increase of per capita income over time. Moreover, the Environmental Kuznets Curve (EKC) hypothesis states that the relationship between economic growth and environmental degradation takes the shape of N. Initially, an increase in environmental degradation combined with an increase in economic growth and then it will decline with less economic growth (Sarkodie & Ozturk, 2020).

Furthermore, the effect of FDI on CO_2 emissions and environmental degradation could be positive or negative. For example, Stretesky and Lynch (2009) stated that FDI decreases environmental degradation and improves environmental protection. FDI encourages production by utilizing environmentally friendly technology that could decrease CO_2 emissions. Baek and Koo (2009) founded that FDI causes CO_2 emissions in China and India. While Acharyya (2009) and Lau et al. (2014) suggested that FDI increases CO_2 emissions in an attempt to boost economic growth, which increased energy consumption. Furthermore, forging businesses could invest in developing counties to save the cost of environmentally friendly technologies. The

hosted country has insufficient environmental regulations resulted in an increase in both energy consumption and CO_2 emissions. Therefore, developing countries that have insufficient environmental regulations attract more FDI inflow, and that increases energy consumption and CO_2 emissions.

Syria has a high level of air pollution that is concentrated in big cities and industrial areas. Several factors were contributing to the air pollution, including significant industrial emissions generated from power stations and refineries, high dependency on oil to power most of the country's power generating facilities, increase population, economic growth and liberalization of the economy (Kasparek & Dimashki, 2009). The country's socialist system, where the government gained complete control of the country using a centralized planning system, had many consequences such as almost vanishing FDI, reduction of economic growth rate resulting in fewer funds allocated for environmental improvements (Ahamd, 1983; Kafri, 2004; Ehteshami, 1996). Later, the government has reformed the economy and liberalised trade, increased levels of FDI and economic growth (SCPR, 2014).

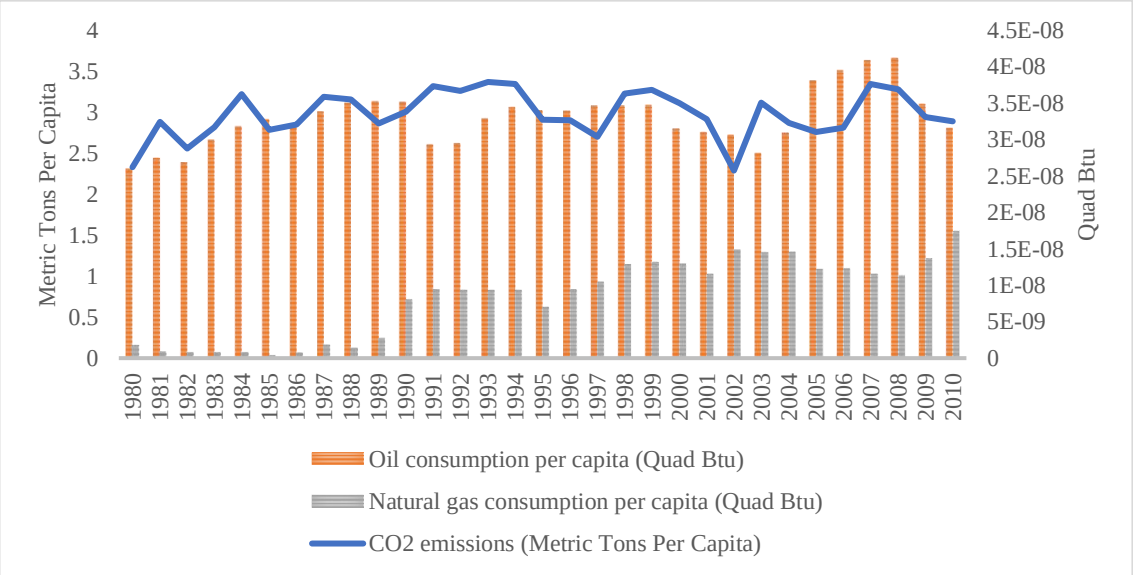

Figure 1. 2: Oil consumption per capita (Quad Btu), natural gas consumption per capita (Quad Btu) and CO_2 emissions per capita (Metric Tons) (World Bank, 2021)

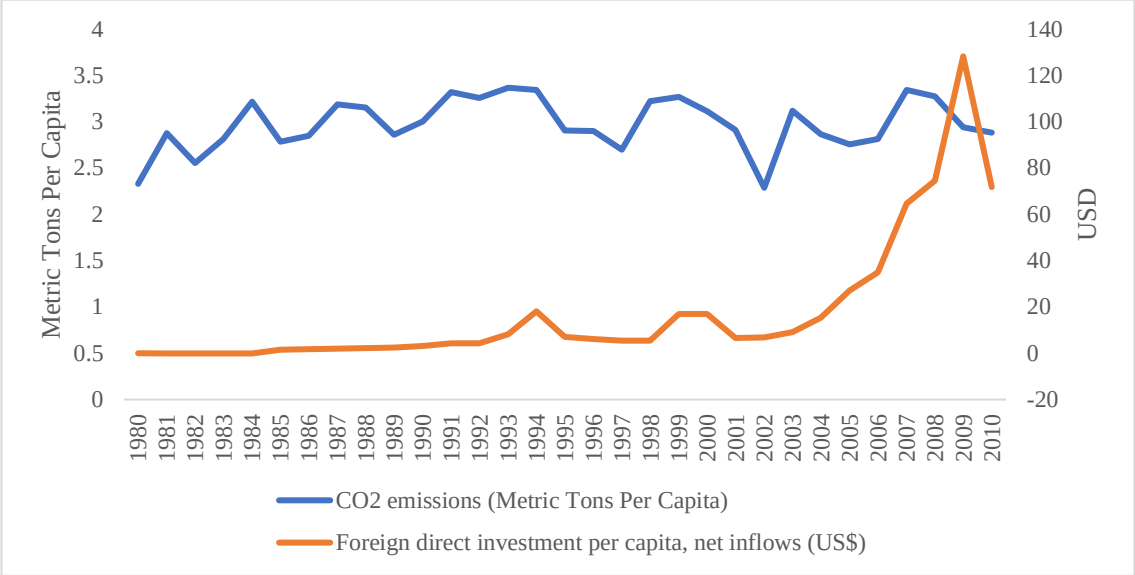

Figure 1. 3: Per capita CO_2 emissions (Metric Tons) and per capita Foreign direct investment (USD) (World Bank, 2021)

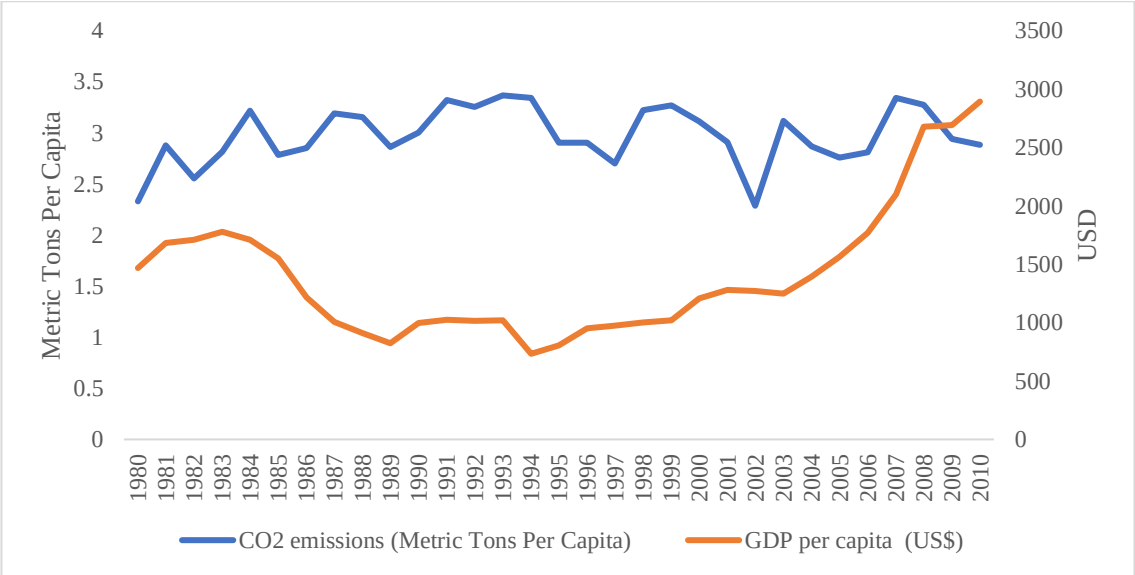

Figure 1. 4: Per capita CO_2 emissions (Metric Tons) and per capita GDP (USD) (World Bank, 2021)

Figures 1.2, 1.3, and 1.4 above show that per capita oil consumption bars and CO_2 emissions per capita line are close to each other, mainly because emissions that are generated from per capita oil consumption accounted for the most significant share of CO_2 emissions per capita. Natural gas per capita consumption is relatively lower

than per capita oil consumption and started to witness a noticeable increase in 1990; since then, it has increased gradually with slight fluctuations. CO_2 emissions per capita had fluctuated around 2.8 metric tons from 1980 to 2010. Per capita GDP decreased from 1983 to 1990 from about 1700 to 850 USD due to the country's socialist system. From 1994 to 2010, it increased from about 750 to 3000 USD after the county has reformed its economic system and liberalised its trade. FDI line was flat from 1980 to 1992 at around two USD. Despite the country's economic system reform, FDI did not witness a noticeable increase until 2002, when it increased from nearly 6.7 to 128 USD in 2009 (World Bank, 2021).

The government plans were mainly focused on decreasing CO_2 emissions, and mainly that is generated from oil consumption. The plans also aimed to improve the efficiency of the county's power generating facilities via replacing its power source from oil to natural gas, expanding the private domestic market of natural gas and investing in green technologies, and encouraging the import of environment-friendly equipment and FDI (Kasparek & Dimashki, 2009). Despite the government plans and increased levels of FDI and economic growth (Mohsen & Chua, 2015), CO_2 emissions still recorded high levels due to many reasons as FDI lacks in promoting the usage of green technology equipment and still most of the imported equipment are not environment-friendly, low funds targeted to improve the environment, and still, more than half of the country's power generating facilities are still fuelled by oil (Deeb, 2013).

1.2.3 Economic Growth

Investigating the energy consumption and economic growth nexus is essential because it will help economies suggest energy policies and develop sustainable energy resources. Even though the relationship between energy consumption and economic

growth is well-examined, mixed and conflicting outcomes are presented even in the same country, mostly due to various periods, variables, and empirical techniques. The economic growth and energy consumption's causality and its direction are regarded as necessary by policymakers. Apergis and Payne (2009) examined the energy consumption and economic growth causal nexus and outlined directions of causality in four hypotheses. The energy conservation hypothesis indicates that economic growth invigorates energy consumption, suggesting that energy conservation policies will not adversely influence economic growth. The growth hypothesis demonstrates the other way of causality, which is running from energy consumption to economic growth and that economic growth is considered one of the main factors in economic development. Therefore, inefficient energy policies that attempt to decrease energy consumption may endanger economic growth. The feedback hypothesis suggests a bidirectional causality relationship between economic growth and energy consumption, which infers that energy consumption and economic growth are supplements, and energy conservation policies may likewise decrease economic growth. The neutrality hypothesis indicates that there is no causal relationship between economic growth and energy consumption. Hence, energy policies will not affect economic growth.

The economic growth rate in Syria has experienced many fluctuations. In the eighties, it went through several fluctuations due to the country reliance on complete government control with centralized planning under its socialist system, the sanctions imposed by European countries in 1986, and the decline in aid from Arab countries. This resulted in a slowing down of economic performance accompanied by a negative growth rate (Ahamd, 1983; Seifan, 2009). In the 1990s, the annual growth rate reached a substantial increase of 5.60 per cent, which is defined as the partial stage of economic

openness for Syria that witnessed an increase in FDI and new oil discoveries that considered as one of the most critical factors behind economic growth (Kafri, 2004). In the 2000s, the government has been gradually taking efforts in developing and reforming the Syrian economy, transforming it from a socialist economy with central planning to an economy with a social market (SCPR, 2014). Since then, it was seen that the rate of economic growth is more stable with an increasing tendency due to multiple factors, such as enabling the private sector to export industrial products from the public sector as well as disengagement between imports and exports. In addition, some of the new laws and legislative decrees were issued in the context of a monetary reform initiative that reduced income taxes and increased the minimum tax exemptions (Mohsen, et al., 2017).

Furthermore, Syria ranked after Saudi Arabia, Iran, United Arab Emirates, Kuwait and Iraq and ahead of Yemen, Jordan and Lebanon in terms of both energy production and consumption (EIA, 2019). The energy industry is, by far, the most significant contributor to the Syrian economy. Oil and natural gas are the primary natural resources in the country, and more than half of the country's exports are created from oil. However, in the 2000s, Syrian oil production has begun to decline due to overuse reserves, jeopardising the economy. With the continued decline in oil production and the depletion of oil reserves, the government has worked to increase natural gas export since it is still economical to retrieve and relatively abundant and investing in new technologies in exploring additional oil and natural gas supplies.

In 1986, the oil production in Syria was at 0.4 Quad Btu. Since then, it has increased three times until it reached its peak of 1.5 Quad Btu in 1996. Then, there continued a decline from 1.4 Quad Btu in 2001 to 1.1 Quad Btu in 2008 (EIA, 2019). On the other hand, oil consumption had continuously increased since 1980 from 0.2 to

0.8 Quad Btu in 2008. The increase in local oil consumption has led to the rise of the government fears that it will not be able to manage or meet future consumption's needs. Therefore, the government resorted to intensifying research efforts and oil exploration to address this problem (EIA, 2011). Syria is rich in oil and natural gas reserves; however, the country doesn't export natural gas in a significant amount. The government has worked toward developing natural gas to benefit from the increase in international demand for alternative energy resources (EIA, 2019).

Natural gas consumption has increased gradually since 1980. In 1994, it reached 0.12 Quad Btu. Natural gas production and consumption were equal from 1980 until 2007. In 2008, natural gas production increased promptly due to the development of several projects. Oil and natural gas consumption account for around 95 per cent on average for the period 1980-2010 of the total energy consumption by the source in Syria. Oil consumption captured the most significant share of total energy consumption. From 1970s to 1980s, oil consumption reached 99 per cent of the total energy consumption and gradually decreased with the increase in natural gas consumption. In the nineties, oil consumption reached 76 per cent of the total energy consumption, followed by 69 per cent in the next ten years. Natural gas consumption has gradually increased and reached its peak at 34.7 per cent of the total energy consumption in 2010. Other resources consumption counted less than five per cent in the last three decades (EIA, 2019). The government has prioritised the development of the energy sector by transforming and expanding its power generation plants (IAEA, 2018a; Haddad, 2011).

After all, Syria planned to substitute natural gas for oil in all of its domestic power generation and industrial consumption by 2014, but unfortunately, the war and political unrest that remains until today has held off all the plans. However, more than

half of the country's power generating facilities are still fuelled by oil, with the majority of them imported due to insufficient refining capacity (IAEA, 2018). It is vital to investigate the causality between oil consumption, natural gas consumption and economic growth due to its important policy implications. For example, if oil or natural gas consumption has a unidirectional causal relationship with economic growth, it can be said that the country is energy dependent. In this case, adopting an energy conservation policy will harm economic growth. On the other hand, if there is a unidirectional or bidirectional causal relationship between energy consumption and economic growth, adopting an energy conservation policy will not harm economic growth.

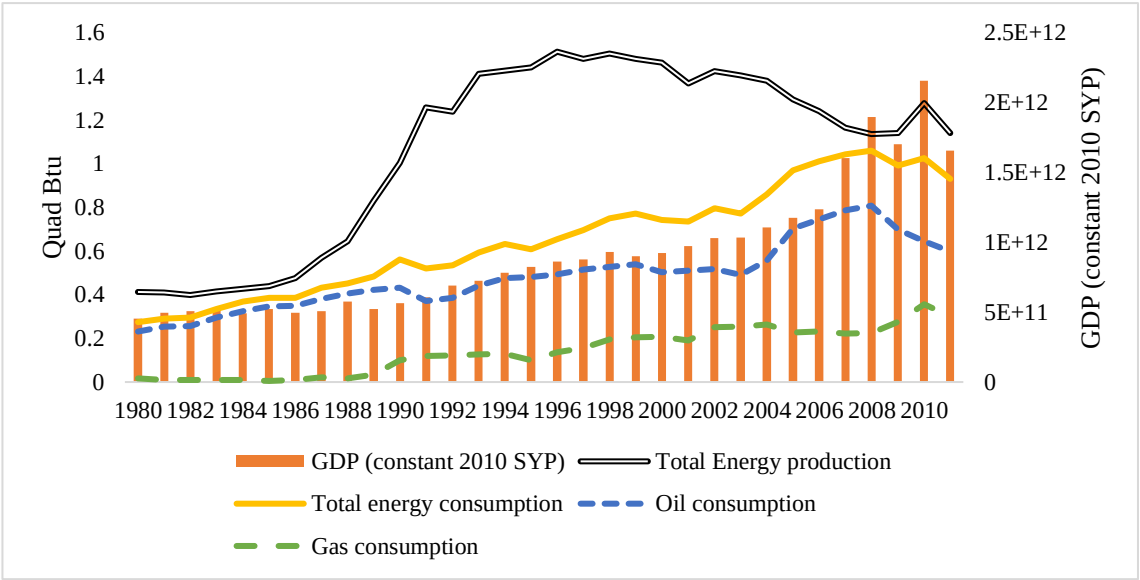

Figure 1. 5: GDP, total energy consumption, total energy production, oil consumption, and natural gas consumption in Syria (EIA, 2019)

Figure 1.5 combines GDP, total energy consumption, total energy production, oil consumption, and natural gas consumption in Syria. The energy variables, namely energy consumption, energy production, oil consumption, and natural gas consumption, are measured in Quad Btu for a better comparison, and GDP is constant.

Foreign investment plays a vital role in economic growth. Numerous economists stated that the rate of economic growth is determinant by the rate of capital formation (Ekanayake, et al., 2003; Omri, 2014). For instance, De Long et al. (1992) stated that economic growth is casually related to equipment investment. Sarker and Khan (2020) found that an increase in FDI will boost the economic growth of Pakistan. The same result was obtained by Abdouli and Hammami (2017) in MENA countries and found that FDI causes economic growth in most MENA countries, including Syria. Gokmenoglu and Taspinar (2016), Linh and Lin (2014) and Pao and Tsai (2010) found a bidirectional relationship between FDI and economic growth. Furthermore, Tang (2009) claimed that FDI and energy consumption direction and causal relationship studies are considered nascent and found that an increase in FDI inflow is resulted in expanding the development of several sectors, including transportation, industry, and manufacturing sectors.

Syria ranked among the least countries in terms of its economic freedom (Gwartney, et al., 2012; Ismaily, et al., 2012). After the government has reformed its economic system, opened up its economy, liberalised its trade and increased energy consumption, FDI and economic growth increased. From 1999 until 2009, FDI had continually and significantly increased until it reached a peak in 2009 (Hopfinger & Boeckler, 1996; Joya, 2007).

Despite that, the annual average Syrian exports accounted for about 32 per cent of GDP in 2000, which meant that the Syrian economy depends to a certain degree for growth and development on the foreign market; the economy has depended on the oil exports for a long time which accounted about 75 per cent of total exports in 2000. Nevertheless, since 2004, non-oil exports have become more important than oil exports (World Bank, 2021). Which was in line with the Syrian government plans of

attracting FDI in the energy sector that encourages the usage of natural gas for reasons related to efficiency and cost-effectiveness and reducing its dependency on the oil sector and reform the Syrian economy in order to improve other sector returns (Bruck, et al., 2007; Mohsen & Chua, 2015).

1.3 Problem statement

The energy sector plays an essential role in the Syrian economy. The government has been working on developing the energy sector with a particular focus on energy consumption. This is accomplished by meeting future local energy consumption, increasing energy exports, reducing energy imports, attracting foreign direct investment and increasing economic growth. Despite all these efforts, the energy sector still faces many challenges, primarily the insurance of supply security through making reasonably priced energy services available to the public. Consequently, it is essential to examine the determinants that shape energy consumption in Syria.

Syria is not a major contributor to the emissions of greenhouse gases. However, like other countries, Syria is affected by the impact of environmental degradation. The greenhouse gas emissions have been steadily increasing since the 1980s due to increased population, trade liberalization, economic growth, and oil consumption. The energy sector is the biggest producer of greenhouse gas emissions and accounts for nearly 70 per cent of total greenhouse gas emissions, with CO_2 emissions representing 90 per cent of total emissions on average over the period of study from 1970 to 2012. The government has planned to improve the efficiency of its power plants by shifting from fuel oil to natural gas, expanding the private domestic market of natural gas and investing in green technologies, and encouraging the import of environment-friendly equipment and FDI. Despite all the efforts, more than half of the country's power

generating facilities are still fuelled by oil, high levels of CO_2 and most of the imported equipment is still not environment friendly. Therefore, it is important to find out what factors derive the environmental degradation in Syria and how environmental degradation is causally interacting with different types of energy consumption, FDI and economic growth.

Oil and natural gas are considered the most vital natural resources and jointly account for over 95 per cent of Syria's energy sources. The energy sector is one of the largest contributors to the economy, where its major exports are generated from oil. However, there was a rapid decline in domestic oil production from 1996 until the oil export disappeared in 2011, which coincided with a continual increase in oil consumption. That raised the red flag on future energy security; it is estimated that by 2030, the country will import approximately 63 per cent of its primary energy demand. Therefore, the government has planned to substitute natural gas for oil in all of its domestic power generation facilities and industrial consumption for many reasons, including the abundance of unused natural gas and its high efficiency and cost-effectiveness, and ensure energy supply security and boost economic growth. Many challenges have emerged; among others, more than half of the country's power generating facilities are still fuelled by oil products, with most imported. The government has introduced several measures to overcome these challenges, including global expansion of the natural gas market, the attraction of foreign direct investment for natural gas, encouragement of the use of natural gas domestically and development of economic growth. Furthermore, Syria was under socialism, where the government gained full control of the country using a centralized planning system, resulting in a decrease in the economic growth rate and investment levels. In the 2000s, the government spent many efforts to reform its economy, transitioning it from a socialist

economy to a social market economy. This was achieved by decreasing government interventions in economic activities, creating an attractive investment climate, increasing foreign direct investment, developing main economic sectors with a special focus on the energy sector, trade liberalization and many more. Regardless of the government efforts, the economy is still showing many weaknesses, such as economic growth instability, low levels of investments, trade deficit and high energy imports. Hence, in line with the government efforts and strategies in achieving economic growth, developing its energy sector and increasing the flows of FDI, it is essential to establish the economic growth, FDI and different types of energy consumption nexus.

1.4 Research Questions

1. What factors drive the Syrian energy consumption?
2. What factors drive environmental degradation in Syria?
3. What is the energy consumption and economic growth nexus in Syria?
4. How does oil consumption, in comparison with natural gas consumption, casually interact with economic growth in Syria?
5. What is environmental degradation and economic growth nexus in Syria?
6. How does energy consumption casually interact with environmental degradation compared to natural gas consumption in Syria?
7. How does FDI causally interact with different types of energy consumption, environmental degradation and economic growth.

1.5 Research Objectives

The primary objective of this research is to investigate the nexus between energy consumption, environmental degradation and economic growth in Syria. The specific objectives of this study are presented as follows:

1. To investigate the determinants of energy consumption in Syria.
2. To examine the determinants of environmental degradation in Syria.
3. To analyse the different types of energy consumption, environmental degradation and economic growth nexus in Syria.

Table 1.1 below illustrates the linkage between research questions and objectives.

Table 1. 1: Research objectives and questions

Research objectives	Research questions
1. To investigate the determinants of energy consumption in Syria.	1. What factors drive the Syrian energy consumption?
2. To examine the determinants of environmental degradation in Syria.	2. What factors drive environmental degradation in Syria?
3. To analysis different types of energy consumption, environmental degradation, FDI and economic growth nexus in Syria.	3. What is the energy consumption and economic growth nexus in Syria? 4. How does oil consumption, in comparison with natural gas consumption, casually inetact with economic growth in Syria? 5. What is environmental degradation and economic growth nexus in Syria? 6. How does energy consumption casually interact with environmental degradation compared to natural gas consumption in Syria? 7. How does FDI causally interact with different types of energy consumption, environmental degradation and economic growth.

1.6 Significance of the Study

Determinants of energy consumption and environmental degradation have important policy implications for a country due to their vital role in matching the level of energy consumption demand and supply to illustrate key factors that determine energy consumption and their impact on the environment. Furthermore, the relationship between energy consumption and economic growth and its direction possesses crucial policy implications. On the condition that, for instance, a unidirectional Granger causality exists and runs from economic growth to energy consumption, policies of energy consumption conservation may be implemented with little to no effects on economic growth. In the instance of adverse causality running from economic growth to energy consumption, economic growth could rise if energy conservation policies were to be implemented. On the contrary, energy consumption reduction could lead to a decrease in economic growth if unidirectional causality runs from energy consumption to economic growth. The neutrality hypothesis, where no causality is found in either direction, would imply that energy conservation policies do not impact economic growth. Moreover, the long and short-run and the direction of the relationships between different types of energy consumption, environmental degradation, FDI and economic growth have important policy recommendations to ensure sustainable economic development.

There are a few empirical studies that are based on panel data that have included Syria in their investigation of the economic growth-energy consumption-CO_2 emissions nexus, including Al-mulali et al. (2013), Omri (2014), Shahateet (2014), and Abdouli and Hammami (2017), have obtained different results for Syria. To the best knowledge of the researcher, no empirical study is found attempted to investigate nexus with a country-specific analysis. Besides, no study has been done on

the literature that investigates the Syrian disaggregated level of energy consumption, which includes oil and natural gas consumption and their causal relationship with economic growth, FDI and CO_2 emissions using a country specific analysis. Therefore, this study will be among the earliest empirical studies to examine the Syrian economic growth, different types of energy consumption, FDI, and environmental degradation nexus, and to show how the Syrian government has planned to improve economic growth and levels of FDI, expand natural gas consumption, and decrease environmental degradation.

Moreover, unlike most previous empirical studies, this study utilised one of the most advanced econometric techniques using cointegrations test, granger-causality test and the bound tests to investigate the short and long-run relationships as well as the causal direction between the variables.

Furthermore, the results of this study will abet policymakers in the following years to assist the situation before the war to develop comprehensive policies after considering the determinants of environmental degradation and energy consumption as well as the role of economic growth to rebuild and improve the economic development in Syria.

1.7 Scope of the Study

This research focuses on investigating the determinants of energy consumption per capita and, as well as the determinants of environmental degradation and the effects of economic growth, FDI and different types of energy consumption on environmental degradation and analysing the long and short run of the causal relationships between economic growth, FDI and different types of energy consumptions per capita in Syria.

The period of this study stretches from 1970 to 2012 since the Syrian oil industry took off and began its energy production locally, although Syria did not begin exporting oil until the mid-eighties. It also covers the FDI raises after reforming the country's economic system and liberalizing trade. On the other hand, the Syrian economy witnessed a new situation quite different from before 2010 because of the war that remains until now. The Syrian energy sector is suffering in production where oil and natural gas production fell to nearly zero as well as FDI due to the economic sanctions imposed on Syria since 2010, while oil and natural gas consumption have increased with a deficiency of refined products, and since 2013 it has become challenging to obtain the data (EIA, 2015), raising the issue of the availability of the data since the war has started. Hence, this study uses all the up-to-date available data. The vector autoregressive (VAR) model will be utilised in this study, along with the Granger-causality and bounds tests.

1.8 Organization of the Study

Overall, this research is divided into six chapters. Chapter One began with the background of the study, taking into account the energy sector, environmental degradation and economic growth. The chapter also included the problem statement, research questions, and research objectives, followed by significance and the scope of the study. Chapter Two discusses the background of the Syrian economy. It begins with an overview of the Syrian economy and discussed its energy sector, environment and economic growth. Chapter Three discusses the literature review. It begins with a theoretical review highlighting economic growth theories, economic growth and energy consumption hypotheses, FDI and economic growth theories, and environmental degradation theories. Besides, it presents empirical studies, followed