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An empirical analysis to link Energy consumption, Renewable energies and oil prices with economic growth of Pakistan

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ABSTRACT

The purpose of this study is to estimate the relationships between crude oil price, energy consumption, renewable energy generation and economic growth in Pakistan from 1990-2020 through secondary data collected annually on these specific macroeconomic indicators. The impact of all sources of energy on economic growth is not the same. With the world becoming more globalised, energy demand is rising quickly. The majority of nations are experiencing an energy shortage, which has a negative impact on economic growth. The majority of the commercial energy infrastructure in Pakistan is still underdeveloped due to a lack of investment in the energy sector.

To organise the data, this study employed the E-views correlation model, regression model and descriptive analysis. The empirical estimate was calculated using the unit root, the Augmented Dickey-Fuller Test, and the Autoregressive distributed lag model after the series was made compatible for co-integration. The empirical models were also utilised to identify heteroscedasticity and autocorrelation.

The results shows that in developing countries like Pakistan, economic progress is counterproductive since it leads to a rise in energy demand and consumption, which has both long- and short-term negative effects. On other hand the long-term and short-term effects of rising oil prices and increased electricity production from renewable energy sources in Pakistan have quite positive effect on economic development.

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CHAPTER I

1. INTRODUCTION

1.1. Background

Since the world's significant reliance on oil products, economists have paid close attention to the relationship among oil prices and economic development over years, and there is a substantial technical literature on many facets of the issue. However, it is unclear if the oil price can be used as an indicator of economic of GDP growth (Gadea, Gómez-Loscos, & Montañés, 2016).

There is a lot of information about macroeconomic concerns associated to oil. There is considerable disagreement over how the oil price and macroeconomic indices are related. However, since the early 1970s, (Hamilton, Oil and the Macroeconomy since World War II, 2016) research on the connection among oil price shocks and the business cycle has mostly concentrated on very short time horizons. Particularly the 1970s and, to a lesser extent, the decades after the turn of the twenty-first century, have received a lot of attention.

Since the 1970s and furthermore the mid-1980s, were characterised by real variations in oil prices together with problematic oil supply shocks, which were seen as the causes of overall macroeconomic instability and recession, it is widely believed that this interest dates back to those years. Given the possibility of a replay of similar circumstance, interest has since been rekindled. A few authors have undoubtedly investigated the various effects of these two periods on the macroeconomic parameters; Two notable exceptions to this somewhat flimsy perspective are, who examines the unpredictable and consistent examples of oil price shocks using annual data from 1861 to 2008, and, more recently, who analyses the effects of oil prices on results and actual profits using a quarterly example dating back to 1946 (Besso & Pamen, 2017).

Renewable energy sources are a critical component of economic growth. The population of the planet is quickly growing, which has raised demand for energy production from scarce conventional resources. As a result, rising energy prices and environmental issues threaten the economy's long-term viability. The production of renewable energy, on the other hand, relies on replenishing natural resources, which not only improves energy security but also addresses worries about climate change and global warming. A key element of long-term economic prosperity is renewable energy (Sebri & Salha, 2013). According to the U. S. Administration of Energy Information (AIE) and Outlook of International Energy (2016), a 48 percent rise in global energy usage would be required by 2040, with a considerable decrease in carbon components.

Conventional energy is produced using finite resources and the governing body's debate how best to use it. This is termed sustainable growth if the current population's needs are met without causing instability, and the capability meets the needs of future generations. The mobility and externalities of resource consumption are essential for a sustainable economy (Moldan, Janoušková, & Hak, 2011). Moldan,Janouková,Beça and Santos proposed three components of sustainable growth: social, economic, and environmental. It is critical to consider natural deficit, as well as social welfare, in order to achieve long-term development (Beça & Santos, 2010). Economic development sustainability reveals the road to addressing weather changes and catastrophes, solutions to ecological, economic, and social problems that affect individuals are also provided (Menegaki & Tugcu, 2017).

In the manufacturing process, energy is the most important component. It serves as the backbone of the manufacturing industry. Economic development objectives cannot be attained without the use of power sources; in fact, as economic expansion accelerates, so does energy consumption, so does energy consumption, and the two rise in lockstep (Menegaki & Tugcu, 2017). Due to a shortage of investment in hydro, natural gas, and lignite resources, Pakistan is completely dependent on imported energy. The most plentiful source of energy is biomass. Because of environmental concerns, the government has decided to ban the construction of new coal-fired power plants. For a variety of reasons, public oil and gas businesses are expected to be privatised (Khan, Jamil, & Khan, 2019).

However, due to rising energy costs, fiscal sustainability has become an issue. A two-decade-old fuel mix adjustment resulted in imported furnace oil being used to generate electricity rather than hydropower, resulting in an energy shortfall. By late 2007, the current energy crisis had manifested itself.

Over time, the problem has developed from chronic power shortages to over installed capacity with inadequate financial flow to maintain it. The latter resulted in a 'circular debt' problem (Majeed, Samreen, & Aisha Tauqir, 2020). Consumers, distribution companies, and the government all postponed or failed to meet their responsibilities in Pakistan's energy supply chain, resulting in a liquidity deficit in the electrical industry. From 1.6 percent (Rs 161 billion) in 2008 to 5.2 percent (Rs 2,150 billion) in June 2020, its size has increased gradually. The current government has made removing cyclical debt a primary goal, and it is looking at a variety of options.

As one of the vital parts of energy, the significance of oil Price to financial advancement has been perceived by market analysts, strategy producers, money managers, families and scientists. After 1973s oil emergencies, a few examinations insist a backwards relationship between oil cost and monetary development. The financial experts and scientists have arrived at an agreement: oil cost instability at the same time diminishes the monetary development (GDP) (Déesa, Karadeloglou, K.Kaufmann, & Sánchez, 2007). The oil bringing in creating economies are seriously impacted by the oil cost climbs in view of lower charge share on oil cost. Additionally, the created economies have higher duty share on oil, such oil value shocks might likely at any point be relieved somewhat by suspending the expense share as oil cost rise. The emerging nations with less assessment share on oil can possibly ingest the oil cost shock. Subsequently, oil cost climb seems to have a more unfavourable effect in creating economies (Hong, Nsimba, Gray, & Diallo, 2004).

Masih & Masih claimed unidirectional causality from EG to EC in Pakistan and Indonesia, and from EG to EG in India, but none for Malaysia, Singapore, or the Philippines. (Masih & Masih, 1996) In contrast, a unidirectional causality flows from energy use to monetary development in other developed countries like France, Germany, Japan, and Turkey, according to Soytas and Sari's hypothesis (Sari & Soytas, 2004).

Assessing the impact of energy use on macroeconomic execution is one of the emerging concerns in the improvement-based writing. The main concern of this topic is that, as a key factor in overall monetary development, energy use also has an impact on the prices of goods, including oil (Dwaikat & Ali, 2018). Utilizing energy has quickly become a primary driving force behind economic activity, particularly in developing nations like Malaysia. For example, the economy as a whole cannot function efficiently and effectively without energy use. Troster, Shahbaz, and Uddin found that the amount of energy used within Malaysia's economy has grown over time. In every one of the monetary areas like help, creation, and horticulture, energy assets are expected by shoppers to embrace a few exercises (Troster, Shahbaz, & Uddin, 2018). To meet the energy prerequisites, both inexhaustible and non-environmentally friendly power assets are used. Sustainable power sources incorporate renewable energy sources including wind, solar, water, biomass, and biofuels, while non-sustainable power assets comprise of petroleum derivatives and atomic power. The two sorts of fuel sources are consumed by various monetary associations in Malaysia. Environmentally friendly power asset users have lower aggregate and per-unit costs, and as a result, have fewer expansion opportunities (Shahbaz, Hoanga, Mahalik, & Roubaud, 2017). This study aims to examine how Malaysia's economic growth rate is linked by oil prices, energy consumption, and monetary growth. This study's main claim is to determine if Malaysia's economy will benefit from lower oil prices and commodities prices. This concentrate also improves those parts of the oil sectors that have a greater influence on the price of oil and, consequently, the rate of growth.

1.2. Contextual Analysis

Energy is seen as a key driver of economic expansion, the consumption of energy has expanded dramatically as a result of several common-use inventions and advancements from the previous century (Ma & Fu, 2020). As a result, practically all human activities have become more energy-dependent. There is a critical demand for reliable and economical electricity in emerging countries in particular. Energy demand has risen in many countries as a result of increasing industry, modernised agriculture, increased trade, and improved transportation (Pavlyk, 2020).

The amount of energy produced in Pakistan is around 41,557 Megawatts according to economy survey 2020-2021. Government and the commercial sector worked together to create the energy. The government has control over the nuclear and hydroelectric power producing facilities. The government and the commercial sector jointly own thermal power plants. The largest source of energy in Pakistan, thermal power generation, generates more than 70% of all energy. The most expensive kind of energy generation is the thermal energy produced by oil and gas. The remaining 30% of energy is provided via hydropower generation, which is the most affordable method. It has been noted that Pakistan produces costly energy, which has a significant influence on macroeconomic factors and economic growth in addition to raising manufacturing costs. The primary goal of energy production is to switch from expensive thermal power generation to less expensive hydraulic power generation, which necessitates the construction of new dams (HAQ & HUSSAIN, 2008).

Being the second most important source of energy, oil is produced at a fairly steady rate. Pakistan is heavily dependent on the exporters of oil from the Middle East (Saudi Arab have a significant role). About 82 percent of the nation's need for oil and petroleum products is met by imports. In the years 2006 to 2007, Pakistan spent over 44% of its export earnings on the purchase of oil. In the years 2004 to 2005, this percentage was just 27% (MALIK, 2008). As a result, the country's macroeconomic conditions are directly impacted by the volatility and variations in the global crude price, notably the link between the oil price and GDP.

Previous studies on energy inflation have only included oil, neglecting the existence of alternative energy sources. Energy is one of the most important businesses in Pakistan since it is necessary for all economic activities. Therefore, energy inflation is top issue and preserving price stability is a significant Pakistan government priority.

1.3. Gap Analysis

Pakistan's energy issue has been a single drain on the country's economy, contributing to a drop in the country's living standards and prosperity. The issue began roughly two decades ago, when the country's dependence on thermal power generation overtook hydropower output due to a fuel-mix shift (Mumtaz & Smith, 2019). Increased generation costs, combined with line losses, resulted in tariff increases, kicking off a vicious cycle of loss for power generation, transmission, and distribution companies.

A research was conducted in Malaysia to examine the effect on inflation rate. Focus of their research was the impact of oil prices, energy use, and economic development on inflation (Talha, Sohail, Tariq, & Ahmad, 2021). And suggested that other factors in future will be studied that have an impact on economic growth. So the present study based on the same model aims to explore the impact on economic growth. This research focuses on renewable energy generation, energy consumption, oil prices and the relationship between economic developments.

1.4. Problem Statement

Considering the growth rate of Pakistan and the factor that are affecting its growth, this paper examines energy consumption, renewable energy generation and crude oil prices and determines whether increased prices or use of renewable energy can help GDP growth. This report also gives an outline of Pakistan's energy industry and how renewable energy projects might help alleviate the country's energy issue (Mohiuddin, Asumadu-Sarkodie, & Obaidullah, 2016).

The environmental problem has increased global concern about reducing the usage of fossil fuels, supporting energy-saving policies, and encouraging the use of alternative energy sources in place of fossil fuels. Since the Kyoto Protocol was ratified by developed and developing nations in 1997, renewable energies have grown significantly, becoming the energy source with the fastest rate of growth with a 3% annual increase in global consumption (Behmiri & Manso, 2013).

The query of whether there is a link between energy use and economic expansion has come into sharper attention recently due to recent increases in energy prices, the depletion of current supplies, and the hunt for new energy sources and energy-saving technology. Higher growth is anticipated with energy expansion, but a lack of it might slow growth. Similarly, economic expansion may have a big impact on how much energy people want.

1.5. Research Questions

- Do there exist a positive or negative relation between economic growth and energy consumption?
- Do renewable energy sources have a positive economic impact?
- Do oil prices can help to grow GDP and what impact will have?

1.6. Research Objectives

- To examine the research question that energy consumption has influence on the economic growth.
- According to the study question, analyse the use of renewable energy sources has a beneficial economic impact.
- To illustrate that the oil prices that can help to grow GDP and what impact will have.

1.7. Significance of Study

As previously said, since there has been considerable industrialization, there has been greater urbanisation and population growth, which has led to a rise in energy consumption, particularly in emerging nations. In the past 10 years, there has been a lot of research and growing interest in the connection between energy use and economic growth (Chaudhry, Safda, & Farooq, 2012). The nature of the connection and the direction of the causation between energy usage and economic growth, however, are up for debate. Furthermore, not all of Pakistan's energy sources have been fully investigated with regard to this issue.

The energy industry in Pakistan is underdeveloped to the point that the majority of the country's commercial energy infrastructure is still in its development. The availability of inexpensive energy services is now seen as a requirement for both reducing poverty and achieving sustainable economic growth (Pakistan., 2020-2021). In order to enhance the supply of energy services to Pakistan's numerous millions of citizens, Pakistan is supporting regional energy integration.

This study aims to determine the effect of energy generation from non-renewable resources on GDP and the positive effect that can cause renewable energy resources. This report also gives an outline of Pakistan's energy sector and how oil prices projects can help alleviate the country's energy crisis. This study gives an overview to investors for make investment for long term in renewable resources and takes advantage of potential market of Pakistan as it is a developing country and the need of energy is essential to develop. Also can help policy makers to promote and focus more on generation of energy from renewable resources and provide subsidies to investors, because the thermal energy costs are increasing and that will decrease economy growth.

CHAPTER II

2. LITERATURE REVIEW

2.1. Oil prices trends

Due to its strategic importance, oil is a key commodity with considerable effect on world economies. The current account balances of nations and government revenue are impacted by changes in the price of oil around the world. In addition to their influence on fluctuations in the price of oil on a worldwide scale, they are also held responsible for changes in domestic prices, economic expansion, and worries about how the economies of countries that import and export oil are affected differently by positive oil price shocks (Eyden, Difeto, Guptaa, & E.Wohar, 2019). Oil price increases may be awful news for nations who import the fuel, but they are fantastic news for those that export the fuel. It's possible to anticipate the opposite outcome from declines in oil prices. Positive oil prices directly raise the cost of production for countries that import oil. The aggregate demand curves will dictate how much output will decline. Higher oil prices cause disposable income to decline, which lowers consumption (Wachtmeister, Henke, & Höök, 2018). Private investment decreases when rising oil prices are perceived as long-term trends. Additionally, the input cost effect results in less oil being utilised in production, a decline in both labour and capital productivity, and a reduction in potential output if the shocks are thought to endure a long time.

Gisser and Goodwin in 1986 are only a few of the research that show that increasing oil prices diminish output and raise inflation. Tax collections are reducing as a result, and budget deficits are expanding (Gisser & Goodwin, 1986). The economy and exchange rates are affected by changes in oil prices. In the medium run, it will be challenging for countries that import oil to cut back. The overall amount spent on oil imports increases when oil prices rise due to the inelastic demand curve for oil. As a result, the exchange rate is under pressure to decline, which weakens the value of the local currency. The results of the economy may suffer as a result of this devaluation. Even if depreciation rises, there may be an increase in worldwide demand for oil owing to exchange rate pass-through and a decline in production due to increased input prices (B.Kamina & H.Rogers, 2000).

The GDP of countries that export oil frequently includes a sizable share of revenue from oil production, and rises in oil prices immediately raise the country's currency value, resulting in an increase in total oil output: the income impact. On the other hand, what oil producers (often governments) do with the extra money is a major determinant of the overall effect of oil rate shocks on financial performance. Husain, Ter-Martirosyan, and Tazhibayeva claim that oil rates have an impact on economic performance through fiscal policy (Tazhibayeva, Ter-Martirosyan, & Husain, 2008). Second, the terms-of-trade impact, which is caused by high oil rates, raises real GDP by raising export earnings. Money will consequently shift from those who import oil to those that export oil, providing economic agents in those nations additional purchasing power. Third, despite the fact that currency appreciation reduces the competitiveness of non-energy businesses, a stronger local currency as a result of higher oil profits may encourage investment and lower the price of imported intermediate goods, hence increasing output. Finally, increased oil rates will almost certainly boost the energy sector's profitability. A chance exists for the business and investment sectors due to the rising need for people and capital

Systematic research on oil prices began in the middle of the 1970s, following a sharp increase in oil rates brought on by the OPEC oil embargo and a subsequent worldwide recession. In fact, a lot of exploration has been done on the effects of rising oil prices on economic activity and the channels via which they spread, especially for more developed countries. Pioneering US market researchers Burbidge and Harrison discovered a definite inverse relationship between oil prices and production. There are some differences between the research on economies outside of the United States (Burbidge & Harrison, 1984). For instance, Papapetrou finds that actual oil price swings have a negative influence on industrial production and employment when using a Vector Autoregressive (VAR) model to analyse the situation in Greece (Papapetrou, 2001). For instance, Miguel, Manzano, and Moreno conducted study in Spain. They contend that the welfare of the nation is negatively impacted by the price of oil (Miguel, Manzano, Martín-Moreno, & Ruiz, 2009). Using a domestic actual price of oil index versus a global oil price index produced different results, according to Cunado and Prez de Gracia's study of 15 European countries. They also fail to find any co-integrating long-run relationships between oil prices and economic activity, with the exception of Ireland and the United Kingdom. They consequently think that oil shocks only have a temporary impact on economic activity. Significant variations in the way the gross domestic product is calculated are also found by Levin and Loungani (GDP) of G7 countries responded to oil price shocks.

Some studies analyse the consequences of oil price shocks on oil exporting nations including Canada, Denmark, Norway, and the United Kingdom. These studies include those by Perez de Gracia and Cuñado (2003), Jimenez-Rodriguez and Sanchez (2005). Cuñado and Perez de Gracia observe the effect of oil prices on industrial production in a variety of countries, comprising Denmark and the United Kingdom, which export oil. Although the correlation factor among production growth and changes in oil prices is positive for Denmark, they claim that it is negative for the United Kingdom. Oil price shocks, according to impulsive reactions, have a detrimental influence on Danish industrial production but a positive influence on UK production (Cuñado & Gracia, 2003). In their study of the effects of oil rate astonishments on real economic activity in Norway and the UK, Jimenez-Rodriguez and Sanchez discovered that while they have an adverse effect on UK output, they have a favourable effect on Norwegian output. Jimenez-Rodriguez and Sanchez look at the connections between changes in oil prices and changes in GDP (Jiménez-Rodríguez & Sánchez, 2005).

For Canada and the United Kingdom, the estimated link among GDP development and real oil price rises is negative, whereas for Norway, the projected correlation is positive. Also studies of developed economies, several are conducted on Saudi Arabia, a nation with a less developed economy but a large oil exporting industry. According to one of these analyses, each one-dollar reduction in oil prices costs the Saudi economy 2.5 billion dollars in income per year (Brown & Yucel, 2000). According to another research, Saudi oil policy has an impact on global price rises, which in turn adds to Saudi inflation owing to imports (Aleisa & Dibooglu, 2002). The latter analysis found that oil shocks in the Saudi economy have a significant impact on output due to actual exchange rate fluctuations. Between 1999 and 2008, oil prices saw their 4^{th} surge in the past 3 decades. More study are required on the consequences of oil price fluctuations, particularly in developing nations. A research like this would not only address a vacuum in the oil macroeconomics literature, but it would also help policymakers.

2.2. Oil prices and economic growth

Given the importance of crude oil in the global economy, economists have been studying the link among oil prices and economic movement since the early 1980s. Hamilton claims that seven of the eight recessions in the United States from 1948 to 1980 were preceded by major rises in oil prices, establishing a causal oil-price-GDP relationship. Jiménez-Rodrguez and Sanchez (2005), and Lardic and Mignon (2006) conducted similar research for additional major OECD nations and found that the reduction in oil-price-GDP impact exists in practically all industrialised economies.

In addition found that trade and stock market returns were mutually significantly impacted by oil price volatility Surprisingly, findings are consistent across industrialised nations and apply to oil exporters such as the UK as well as net importers (Mork, Olsen, & Mysen, 1994). Although Blanchard and Gali acknowledge the economic sensitivity to oil shocks, they hypothesise that this sensitivity has decreased since the 1970s for a variety of reasons, including a decreased reliance on oil as an input to industrial production (Blanchard & Gali, 2007). Furthermore, fuel prices volatility has been found to have a considerable influence on stock market earnings and bilateral trade. The findings are very comparable across industrialised countries, and they apply to both net oil importers and exporters (such as the United Kingdom) (Mork, Olsen, & Mysen, 1994) . Blanchard and Gali acknowledge the economic sensitivity to oil shocks, but argue that during the 1970s, industrialised nations have grown less vulnerable for a variety of reasons, including a decreased reliance on oil as an input element in industrial production.

There is currently little information on the influence of oil price volatility and macroeconomic ambiguity on economic growth. China, in particular, being one of the world's developing economies, has a high need for crude oil. By 2015, crude oil consumption has increased to 18.1 percent of China's energy structure. Year every year, the country's reliance on imported oil grows: between 30.6 percent in 2002 and 67.4 percent in 2017, a rise of 56.5% from 2002 to 2010. In 2017, China became the world's top crude oil importer for the first time, surpassing the United States, and has held that position ever since, according to China's Petroleum Industry Development Report (2018).

The global oil price has a substantial impact on China's growth and inflation, whereas the latter has little impact on the world oil price. Oil shocks from various sources have distinct effects on China's output and inflation, and all these effects are time-varying. That oil prices have a considerable impact on China's actual export and trade terms, and that political economy uncertainty shocks explain for the majority of the variance in China's trade. (Zhang & Qu, The effect of global oil price shocks on China's agricultural commodities, 2015) These events and analyses demonstrate that industrialised nations' economies will stay relaying on oil, and that variations in global crude oil prices would have a greater impact on China's industry. Meanwhile, growing global commerce and political communication make being an isolated economy untenable. In this way, the term "global economic policy uncertainty" (GEPU) takes on a new meaning for China. As a result, China's industry can only cope with oil price shocks more calmly if the influence of oil price shocks and economic policy uncertainties are combined into one system (Faria, Mollick, & A.León-Ledesma, 2009).

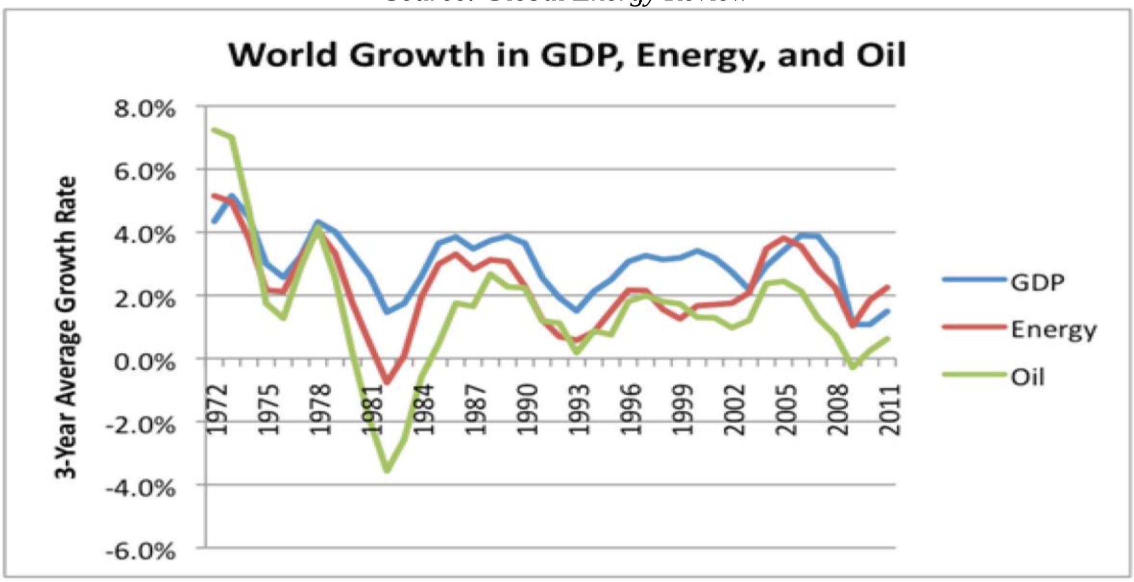
Furthermore, since discovered that a rise in the value of oil has a higher impact on a country's macro economy than a reduction, academics have focused on the asymmetric impacts of oil prices. An increase in the price of oil has a negative impact on GDP, but a drop in the oil price has still not been demonstrated to have a positive or equal influence on production (Zheng & Su, 2017). The heterogeneous effects of oil worth shocks on China's stock market in the short and long term, finding that the required side shocks have a major influence in both the short and long run, with only the cumulative demand shock having an asymmetric effect. As a result, we're interested in learning more about the asymmetric influence of crude oil in the context of the economic policy uncertainty index.

In Pakistan Zaman investigated the factors that impact oil price inflation. Data for the research was gathered from 1973 to 2013. The price of energy, as well as the price of oil, the currency rate, and the government, was all dependent variables. Revenue was the study's independent variable (Zaman, Shaheen, Haider, & Qamar, 2015). The researchers employed the enhanced dickey-fuller and Philips Perron tests to check unit roots. The results indicated that the government was highly regarded for its contributions to the country's general well-being. There was a positive correlation between all of the variables. The monetary and fiscal authorities' responses to the energy supply constraint appeared to be pro-cyclical in nature.

2.3. Oil inflation and economic growth in Pakistan

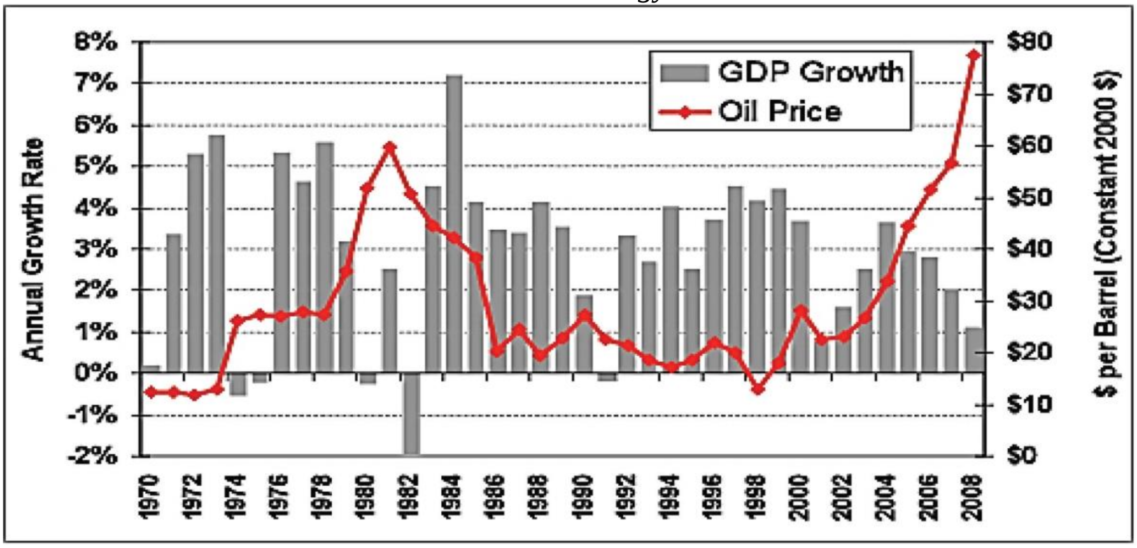
Economic demand, not the Keynesian economist state's money supply, determines oil inflation. The inflation hypothesis has an impact on pricing theory. It indicates that the price level may be used to evaluate product and service demand and supply. The demand and supply curves describe the shift in the cause of price level. According to the standard idea of the function of money when the availability of money increases, so does the price. According to Keynesian theory, comprehensive demand in fundamental and non-monetary variables ignored the impact of monetary growth on the price level. The goal of the research is to look at the consequences of higher oil prices. The economic theory of Keynesian describes how total expenditure in any economy influences production and inflation. In order to examine the Great Depression, John Maynard Keynes created Keynesian economics in the 1930s. From 1972 to 2011, Figure 1 shows the trends in GDP growth, total energy growth, and the growth rate of oil consumption.

Figure 1 World Growth in GDP, Energy, and Oil Price
Source: Global Energy Review



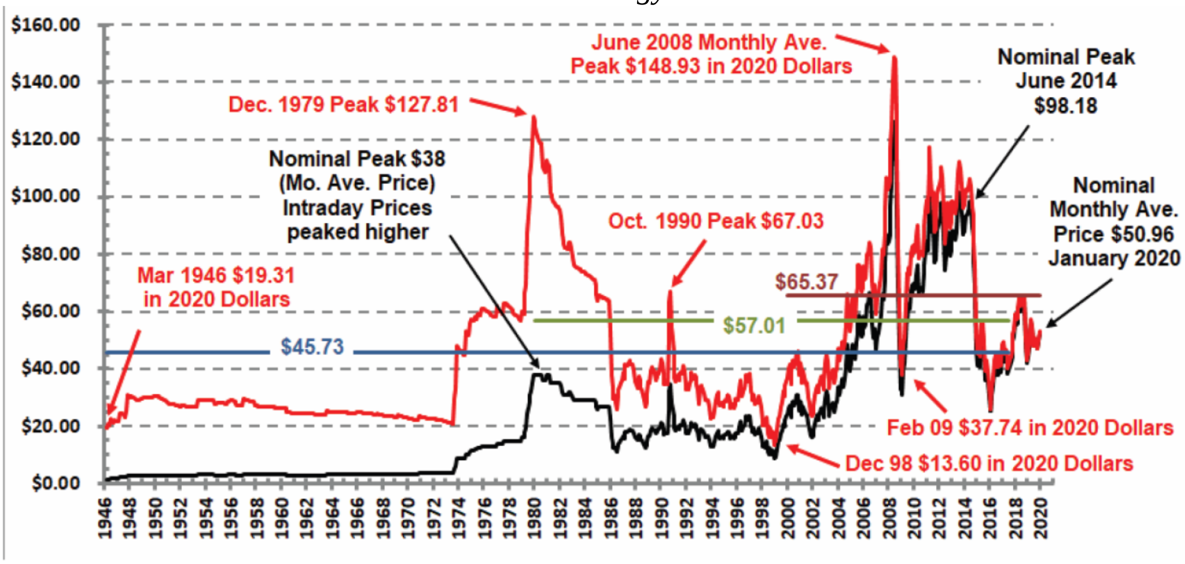
From 1970 to 2008, figure 2 depicts a lot of the same tendencies in all of the variables. Because oil is utilised as a key raw resource in industry, it is a critical component of the country's economy. Oil is a resource that is specialised in economic models and required for production. Oil is one of the most crucial resources, and the strategy is focused on the long-term sustainability of commodities.

Figure 2: Global Energy Prices and GDP Growth Trends
Source: Global Energy Review



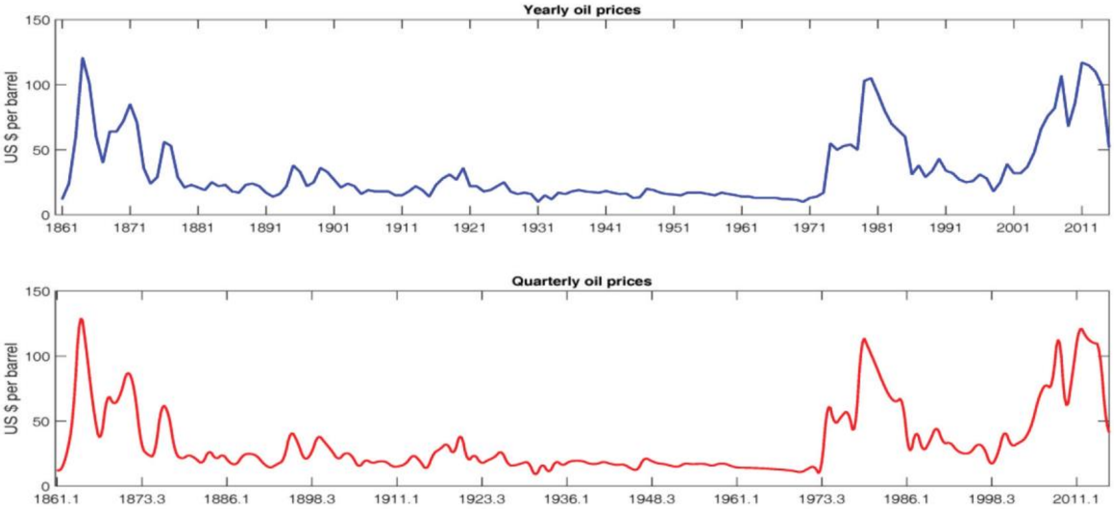
From 1946 to 2020 the rise in oil consumption in the economy of emerging nations, along with oil inflation, is considerable Prices are rising, and in the long run, oil volatility is a pure source of monetary policy. Oil is utilised in a variety of daily activities, including education, electricity, transport, recycling, preparing meals, and entertainment, when long-term high oil inflation rates exist. Lower unemployment and greater demand for fuel and pay result from increased output. Inflation in Pakistan has been influenced significantly by the price of oil. There is a strong relation among the CPI and worldwide oil prices. Because the country is a net importer of natural resources, the rising price of oil is having a substantial impact on the economy.

Figure 3: Inflation-Adjusted Monthly Average of Oil Prices
Source: Global Energy Review



On the other side, oil prices are rising, raising production costs since higher prices reduce output Figure 4. Although oil is utilised to generate power, as a result, oil inflation is out of control. Oil rise and electricity costs are calculated meticulously and theoretically. Producers and consumers are separated by the oil markets. Pakistan's oil consumption will grow in the next years, as required in sectors with big populations. Electricity increases the production capability of sub-sectors and businesses. This has had a big global influence on Pakistan's business. As a result, Pakistan needs to estimate oil inflation and power costs. Furthermore, rising oil costs may lead to future inflation. A lot of variables contribute to oil inflation, including crude prices, tax, GDP, oil imports, oil inflation, gas, and money supply; these are the most significant factors to consider while attempting understanding why oil prices are rising (Nawaz, Lahiania, & Roubaud, 2020). The government has been monitoring of the country's general well-being, such as a country's favourable oil inflation expectations.

Figure 4: Annual Oil Prices and Quarterly Oil Prices
Source: Global Energy Review



According to investigation they found a long-run association between the variables using time series data, and the output gap of fiscal policy inflation was extremely significant. Energy prices are affected by empirical data of greater energy inflation, and energy usage and prices have a significant influence on the economy (Ahmed, Ghauri, Vveinhardt, & Streimkiene, 2018).

2.4. Renewable Energy

Energy is a vital element of the production procedure and the base of the industrial sector. Goals cannot be accomplished in economic development without energy resources, moreover as the economy grows, energy demands too (Ma & Jiang, 2019). As demonstrated in the OECD nations during the 1973–74 oil crisis, a change in economic growth corresponds to alteration in energy consumption, according to this theory.

Renewable energy represents less than 15% of worldwide power generation, with hydropower and biomass fuels making up the great bulk in developing countries. Wind and solar electricity account for just a small portion of total energy use (Seyi, Adewale, Chigozie, & Violet, 2019). However, there is a lot of promise. And, in some places and countries, the share of renewable energy has increased significantly in recent decades, posing two fundamental obstacles to renewable energy programmes for long-term development

Renewable energy sources, such as hydro, wind, geothermal, solar, and biomass, may someday be replaced by nature. Meeting the economy's energy demands and promoting long-term economic growth are the two fundamental expectations of significant stakeholders, such as legislators and the general public, from a variety of energy sources (Bhattachar, Paramati, Ozturk, & Bhattacharya, 2016).

The point of concern is environmental preservation and protection for coming generations, as the ecosystems are deteriorating at an alarming rate as due to use of fossils fuel. Photovoltaic panels, solar design, solar water heating, desalination power plants, and artificial photosynthesis are just a few of the ever-changing and always improving technologies that absorb the sun's radiant light and heat. Solar power is a highly pleasing source of power since about 30% of solar energy is reflected back to space while the rest is collected by seas, clouds, and land masses. To convert solar energy directly into electricity, cells employ a variety of semiconductor materials. The SAARC economies are aiming to boost competition and economic growth, renewable energy plays an important role and can aid rising economies in achieving long-term economic success (Yikun, Gul, Saleem, Shabbir, Bilal, & Abbasi, 2021).

Furthermore, SAARC nations have been struggling with a severe energy crisis for decades, notably since 9/11 and the ensuing anti-terrorist campaign in Afghanistan. In some countries they are seeking to maintain their industries and economies by utilising alternative energy sources or recreating energy via a circular economy. Renewable energy use is correlated with economic development (as measured by GDP growth) and is used as a proxy for world "oxygen" levels. Renewable energy is a need for economic advancement (Yikun, Gul, Saleem, Shabbir, Bilal, & Abbasi, 2021). Despite the fact that many developing countries (especially SAARC countries) have substantial populations living in poverty, many SAARC nations are aiming to reach economic growth through industrialization, globalisation, and trade to help millions of people escape poverty.

Pakistan is capable of utilising almost all types of renewable energy sources. Examples include solar, wind, geothermal, biomass, biogas, biodiesel production, to energy production, and so on. Biodiesel and biomass energy generation are currently in the development or project implementation stages, while geothermal and tidal energy use are still in the feasibility research stage (Khan, ShuKai, Hassan, Kootwal, & Khan, 2021).

According to the growth hypothesis, 57 percent of the top 39 nations in terms of renewable energy consumption have a major impact on economic growth. In 34 OECD countries, Bulut and Inglesi-Lotz find that using renewable energy has a statistically significant and positive impact on economic development (Bulut & Inglesi-Lotz, 2019). The feedback hypothesis has proved economic development and biomass energy utilisation for the BRICS countries from Q1 1991 to Q4 2015. Long-run unidirectional causality is supported by the use of hydropower to grow the economy in Chile, Brazil, Ecuador, and Colombia, however long-run bidirectional correlation between economic growth and hydroelectricity usage was demonstrated in Venezuela and Argentina from 1970 to 2012.

Menegaki and Tugcu used seemingly unrelated and Granger causality regression to arrive at multivariable causality conclusions. Basic ISEW, which only considers economic aspects, and solid "ISEW," which considers both environmental and economic variables, were determined for the G7 countries between 1995 and 2013 (Menegaki & Tugcu, 2017).. Shahbaz et al. (2018) established a bidirectional causal relationship between the economic development and the use of renewable energy in Pakistan. They found that renewable energy use and economic growth are mutually advantageous, but the connection between the two variables in G7 countries differs by nation and by specification.

Government funded projects, such as tax breaks and grants, have assisted the rise of renewable energy in recent years. Cost-competitiveness has resulted in lower energy production costs. Renewable energy generation has largely competed with conventional energy sources in various countries. Renewable energy programmes have been launched in a number of countries, including the United States, Latin America, Africa, Europe, and Asia. This endeavour has resulted in the installation of renewable energy technologies as well as the emergence of new manufacturers. The cost of increasing renewable energy capacity, research and development (R&D), and manufacturing facilities exceeded $100 billion in 2007, with the majority of that amount ($71 billion) going toward new renewable energy capabilities for wind power and solar PV (Blunt, 2020).

2.5. Renewable energy and economy growth

Over the past several decades, many studies have conducted to determine the underlying link between renewable energy usage and economic growth. Payne claims that the results are mixed in general. Numerous studies offer thorough literature on the economic the development of renewable energy sources as well as their depletion (Apergis & Payne, 2009). The relationship among biomass energy and economic growth, as well as hydroelectricity use and economic development, has been studied in a variety of ways (Yildirim, Saraç, & Aslan, 2012) .

Furthermore, Rosenberg (Rosenberg, 1998) stated that energy consumption can improve residents' living standards, and that increased energy use leads to increased economic growth. Energy, according to Barney and Franzi (Barney & Franzi, 2002) is a fundamental component of industrial capacity and an essential factor of economic development. Grossman and Helpman underlined the importance of R&D in the advancement of the economy (Grossman & Helpman, 1990). Kraft and Kraft were the first to introduce ideas into the growth of the economy models and to explore the importance of energy in the manufacturing process.

Investors, such as commercial banks, consider clean energy investments to be risky, hence they charge a green premium fee when making such investments. Renewable energy is thought to come with a number of dangers, according to investors. (Doytch & Narayan, 2021). Some argue that weather poses a severe threat to green energy initiatives, because these projects currently rely heavily on climate elements such as the sun and wind (due to the fact that battery storage technology is still in its infancy) (Sachs, Woo, Yoshino, & Taghizadeh-Hesary, 2019). Renewable energy initiatives are also fraught with political and natural disaster concerns, which stymie private sector investment.

The most important obstacle to clean energy adoption is the cost associated with renewable energy installations. Renewable energy projects often have substantial initial costs, and even after the 30% federal investment tax credit, they might be a financial hardship for homeowners or other consumers (Shen, Liu, Luo, Wu, Chen, & Weide, 2021). Despite the fact that renewable energy consumption in the United States recently surpassed coal usage, the corporate community still believes that investment in renewable energy is too risky and expensive when compared to other energy initiatives

(Blunt, 2020)."Growth in high-income nations was fuelled by expenditure on housing and private consumption before the 2008 financial crisis, and when this fell, green financing did not catch up to replace these forms of investment," says the report (Sunio, Mendejar, & Nery, 2021)

The next impediment to clean energy adoption is that clean energy project financing does not provide a clear and relatively short-term financial return to the investor. Banks that are prepared to lend money to clean energy projects usually charge high interest rates and have short loan durations (Namahoro, Wu, Xiao, & Zhou, 2021).

Renewable energy proponents tend to be politically left-leaning, which may be perceived as "risky" by some clients and prevent them from engaging with these assets (Leonard, 2014). Moreover, costly projects in floodplains or wildfire-prone locations may deter investment. Furthermore, because of the accompanying risks (which they believe are related to high upfront expenditures and unproven technology), regular banks, which often function as the lender for these large-scale utility projects, charge a risk premium on many clean energy transactions (Tiwari, Nasreen, & Anwar, 2022).

Climate change must be combated, according to the European Environment Agency, by lowering or avoiding emissions caused by human activity. Concerns about global warming and energy security have reignited interest in renewable energy as the most efficient way to satisfy future energy needs (Stamatios, Michalis, Grigorios, & Garyfallos, 2018).

Finding a balance between the rapid degradation of the environment and attaining sustainable economic development that does not affect future generations is a major challenge for humanity in the twenty-first century. A study conducted on the EU-28 between 1995 and 2015 proved the presence of long-term positive and significant connections among renewable energy use, environmental protection, and economic growth (Manta, Florea, Bădîrcea, Popescu, Cîrciumar, & Doran, 2020). According to studies, co2 emission, real economic growth, and environmental factors seem to be the key drivers of long-term development in the European Union. As a result, by making use of alternative energy sources in EU countries, environmental pollution is reduced through a reduction in the amount of toxic compounds. As an essential and effective global strategy, these objectives must be embraced as soon as feasible by all European countries (Stamatios, Michalis, Grigorios, & Garyfallos, 2018).

Another study used annual data from the most populous African countries over a 20-year period (1996–2016) to construct a model of renewable energy use (South Africa, Nigeria, Ethiopia, and Egypt). Predictive variables were generated from socioeconomic, macroeconomic, and institutional aspects, which were simulated using Bayesian Model Averaging (BMA). According to the findings, the key predictors of renewable energy consumption in some nations include a growth in electricity consumption, urban population, and human capital. Increases in any of these determinants result in increased renewable energy use.

The new European model promotes growth that is both sustainable and inclusive. Like development, research, and human capital investment, increasing the ratio of renewable energy intake in total energy consumption improves the quality of economic growth. The researchers investigated the connection between renewable energy consumption and economic development in 10 European Union Members, Eastern and Central Europe states during 25-year period (1990–2014) using an autoregressive and distributed modelling technique. This method captures both short-term and long-term causal linkages (Musiał, Zioło, Luty, & Musiał, 2021).

GDP and consumption of renewable energy are unrelated in Romania and Bulgaria, whereas increased use of renewable energy stimulates economic growth. In Hungary, Lithuania, and Slovenia, for the analysed collection of nations, as well as seven particular Central and Eastern European countries, the long-term validity of the two-way causation theory between economic progress and the use of renewable energy sources has been proven correct. (Marinaș, Dinu, Socol, & Socol, 2018) The findings support the European Union's 2030 energy efficiency objectives. To attain these goals, public policy ideas are proposed.

In world 39 countries with the greatest renewable power consumption, has a favourable impact on economic growth, according to the study (Bhattachar, Paramati, Ozturk, & Bhattacharya, 2016). Renewable energy usage has a statistically significant and favourable impact on economic development in 34 OECD nations (Bulut & Inglesi-Lotz, 2019).

Armeanu and Vintila look into what "renewable energy" is and how it relates to long-term development. Using data from EU nations from 2003 to 2014, he uses a fixed influence model to demonstrate a positive relationship among renewable power and GDP growth. (Armeanu, Vintilă, & Gherghina, 2017). In the same manner, Anwar and Nasreen investigated the link among energy use, economic progress, and environmental quality. Between 1980 and 2012, they utilized data sets from South Asian countries as well as founder methods, to demonstrate that financial sector expansion increases quality of the environment and economic growth. They found that energy use has an adverse effect on the environmental quality and growth. (Nasreen & Anwar, 2020).

2.6. Energy consumption

When a force moves an object, work is done, and energy is the capability to do work. Every day, humans require and utilize energy in many forms. Electrical energy is the energy stored in charged particles inside an electric field. (Amri, 2017). Areas around a charged particle are known as electric fields. Simply put, charged particles produce electromagnetic current that exert force through other charged particles in the field. By forcing the charged particle to move, the electric field makes it do work. The energy system has evolved dramatically since the Industrial Revolution. We can see how global energy supply is changing in the interactive graph below. It depicts global energy consumption from 1800 to the present. (Ritchie & Roser, 2020).

As people get richer and populations rise, energy consumption is rising in many nations throughout the globe. Our worldwide energy consumption will continue to climb year after year if advancements in energy efficiency elsewhere do not balance this rising demand (Destek & PhD, 2017). Growing energy consumption complicates the transition from fossil energy to low-carbon energy sources: new low-carbon energy must meet growing demand while simultaneously aiming to replace present energy sources.

The relation among energy usage and income has been studied since the late 1970s. Kraft and Kraft (1978) were the first to determine that GNP precedes energy consumption, using data from 1947 to 1974 in the United States. Akarca and Long used monthly data from the United States from 1973 to 1979 to show that energy use precedes employment (Some economists substitute employment or output for economic expansion (Akarca & Long, 1980).

The employment of various econometric methodologies in the prior study is the main cause of the variance in results. Most of the time, without taking into consideration the particular properties of time series data, the OLS model of log-linear was used to estimate parameters and perform statistical tests. As is widely known, there may be a specious regression in the study (Granger & Newbold, 1974) and hence the preceding statistical results may be misleading.

In the last decade, time series statistical methods have advanced significantly. The link among energy economic growth and consumption was examined and statistically tested different modern time series analysis, as it has been in many other economic sectors. Masih and Masih used data from Pakistan, Malaysia, Taiwan, India, Singapore, Indonesia, Philippines, and South Korea to assess the existence of cointegration between real GDP and total energy consumption using the Johansen cointegration algorithm (Masih & Masih, 1996). The relative causal link was then tested using moreover the vector autoregressive model (VAR) or the vector error-correction model (VEC).

For Philippines and South Korea, Glasure and Lee used the cointegration technique and an error-correction model to examine the association between energy consumption and economic growth. They observed a bi-directional association in these two countries using the Granger cointegration causality test. Without taking into account the cointegration of the variables, South Korea exhibits no Granger causality, whereas the Philippines demonstrate a uni-directional causal relationship between energy use and GDP (Glasure & Lee, 1998).

Soytas and Sari investigated the causal relationship among GDP and energy consumption in the top 10 rising countries excluding China and the G-7 countries from 1950 to 1992 using vector error-correction and cointegration techniques (Sari & Soytas, 2004). They identified dual-direction causation in Argentina, uni-directional causality in West Germany, Turkey, France and Japan with energy consumption leading GDP, and dual-direction causality in Italy and Korea with GDP leading energy consumption.

Hsiao's criterion was used by Altinay and Karagol to analyse the causal relationship between GDP and energy consumption in Turkey from 1950 to 2000. They came to the conclusion that there was no evidence of a causal relationship between the two, and that the data was trend stationary with a structural break (Altinay & Karagol, 2005).

Lee studied the causal correlation among Economic growth and energy consumption in 18 developing countries from 1975 to 2001 using panel error correction models and panel cointegration. There is evidence of a unidirectional between energy and GDP in the short and long run. Energy conservation may therefore hinder the development of such emerging countries' economies. (Lee C. C., 2006) Investigated the link among energy consumption and GDP for 11 developed countries from 1960 to 2001 using the Granger causality cointegration test proposed by Toda and Yamamoto (1995). He discovered that:

I. There is no causal connection amongst the two for the United Kingdom, Germany, and Sweden
II. US data show a bi-directional causal association
III. Belgium, Canada, ,Switzerland and Netherlands show a uni-directional causal association running from energy consumption to GDP
IV. France, Italy, and Japan show a relationship with GDP leading energy consumption.

Chang and Lee on the other hand, used panel data from 22 industrialised and 18 emerging countries to study the connection between oil prices and GDP using the bivariate model proposed by Holtz-Eakin et al. in the panel VAR framework (1998). They observed a one-way causal association in developing nations between GDP growth and energy use. However, there is a dual direction correlation among the two in industrialised countries.

2.7. Economic Growth and Energy consumption

The connection between GDP development and energy use must be recognised in order to establish an efficient energy and environmental plan that would support sustainable development. Inefficient energy consumption has an influence on GDP development through causing climate change and global warming. According to four fundamental hypotheses and a policy's goals and objectives, provides an insightful study of the connection between energy and GDP growth. Four different literary genres have addressed this connection (Al-mulali, Hassan, Lee, & Sab, 2013). First, as the economy is strongly dependent on energy development, energy conservation rules that limit energy usage might have a negative effect on real GDP. Growth is fuelled by energy, which also effects it indirectly or directly in addition to other production input elements.

Second energy is said to follow growth, according to the conservation idea. It is feasible to cut energy consumption without having a negative effect on growth since the causal chain between energy and growth does not exist. Therefore, measures to reduce greenhouse gas emissions can be made without endangering growth in these circumstances. Third, according to the neutrality theory, energy use has little to no effect on GDP, suggesting that a conservative approach won't stunt growth. Therefore, there is no justification for not implementing a conservation policy when necessary. Fourth, the feedback hypothesis contends that real GDP and energy use are linked and hence complement each other since there is bi-directional causality. In that energy efficiency measures will eventually restrict growth, the feedback hypothesis has the same political consequences as the growth theory.

The empirical research on the connection among energy use and development is unclear and inconsistent. The employment of diverse econometric approaches and time periods, climate change, economic growth, and energy consumption habits vary per nation, all of which contribute to the disparity in results (Dogan, 2016). Four generations of inputs can be distinguished from a methodological standpoint.

In the first generation of investigations, Sims used a standard vector auto regression (VAR) model (1972). Kraft and Kraft for example, In the United States, a VAR model was employed to uncover evidence of causality going from GDP to energy usage from 1947 to 1974 (Kraft & Kraft, 1978). Furthermore, research from the very first phase looked at causation in the direction of the underlying variables while assuming that they were stationary (Yu & Choi, 1985).

The data had non-stationarity in the second generation, thus cointegration study was used to look at the long-term link among energy use and growth (Engle & Granger, 1987). This 2nd generation literature used the Engle and Granger 2 different approach to look for cointegration connections between pairs of variables and used standard error method to examine for Granger causality.

Multivariate estimators patterned by Johansen's work were employed in third-generation investigations (1991). The multivariate technique of Johansen allows for the inclusion of more than 2 variables in the cointegration link (Johansen, 1991). Finally, to test for regression analysis and cointegration linkages, fourth-generation studies use newly developed panel-econometric approaches. To conduct Granger causality tests, the literature calculates panel-based error-correction models (Iriani, 2006).

The fundamental connection among the use of economic development and renewable energy has been the subject of much research over the past few decades. In general, according to Payne, the outcomes are mixed (Apergis & Payne, 2009). Numerous studies provide a wealth of information on the economic development and depletion of renewable energy sources. Numerous researches have been conducted on the link involving biomass long - term economic growth, as well as the use of hydropower and economic development (Asafu-Adjaye, 2000).

A study conducted in Pakistan observed the connection between income, CO_2 emissions, foreign commerce and energy consumption, from 1972 to 2008 and found a quadratic relationship between CO_2 emissions and income (Chang, 2013). Furthermore, per capita carbon dioxide emissions have been shown. and international commerce contributed to the country's increased emissions (Nasir & Rehman, 2011). In a separate study, researchers looked at the co-integration of co2 emission, power consumption, real effective exchange rate, and financial growth in Pakistan between 1971 and 2011. With a baseline of 640 kg of oil equivalent per person, they found an inverted U-shaped relationship between CO2 emissions and energy use. They also said that the economy is now operating at a lower level than this, and that carbon emissions are anticipated to gradually grow over time till the standard level is achieved (Shahzad, Kumar, Zakaria, & Hurr, 2017) .

Academics and economists have been debating the literature on the link amongst energy usage and economic expansion for decades (Akarca & Long, 1980). This is a subject that many scholars are still researching into right now. Numerous specialists have presented various models of economic growth across time, but these theories have mostly ignored energy growth as a fundamental component of economic expansion. Technological innovation is a crucial element of economic expansion in the Solow model of development. Similarly, under Schumpeter's worldview, Innovation and wealth creation are the two most essential variables in economic progress.

The economy's growth is heavily reliant on energy sources. Khuong and Shabbir looked into whether there was a link among the utilisation of energy sources and economic development. Energy is a required input in the manufacturing of commodities, and without it, numerous economic activities cannot expand (Khuong, Shabbi, Sial, & Khanh, 2021). Furthermore, energy is required for industrial progress, productivity, and commerce in today's economy. Shabbir investigated the causes and consequences of economic growth and energy consumption, discovering that economic growth dramatically increases energy usage, which, in turn, significantly enhances GDP growth.

2.8. Hypothesis

We applied the following modified economic development model to test the H1 hypothesis and further analyse the primary determinants of environmental sustainability:

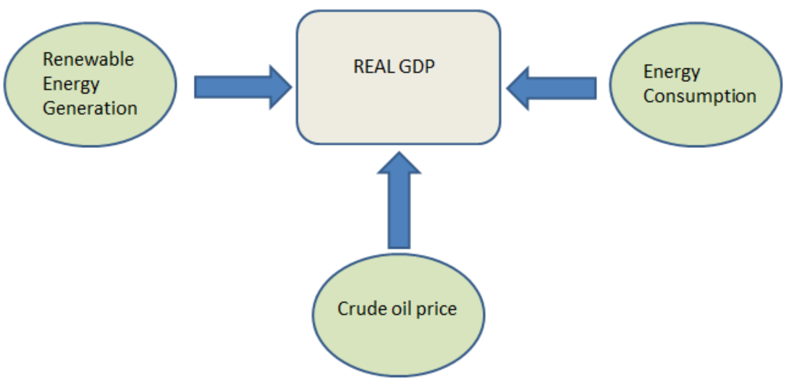
$$GDP = F(RE, EC, COP)$$

GDP stands for gross domestic product and RE is renewable energy generation in total energy consumption. EC stands for energy consumption, whereas COP stands for crude oil price. The following four assumptions were tested:

H1: EC have a positive effect on GDP;
H2: RE have a positive effect on GDP;
H3: COP have a positive effect on GDP;

2.9. Theoretical Frame work

Figure 5 Theoretical Frame Work



2.10. Theory

Many ideas, including the asymmetry theory of economic developing, the rebirth of growth theory, and the linear symmetric connection theory, have been utilised to assess the details of the correlation between oil price and GDP growth. Variations in oil prices are to blame for changes in GDP growth, claim proponents of the linear/symmetric connection growth (A.Hooker, 1996). In light of this, the hypothesis contends that an rise in oil rates and GDP development have a significant inverse relationship. The asymmetry-in-effect economic growth theory, on the other hand, argues that although an rise in oil prices has a clear influence on future GDP growth, a fall in oil prices has an unclear consequence.

However, because it makes distinctions across variables and includes both symmetric and asymmetric theories, the Lee and Ratti renaissance growth theory is particularly significant in our study (Lee, Ni, & Ratti, 1995). Despite the differences between the aforementioned ideas, Ibrahim research supports the claim that changes in the price of crude oil have an impact on economic development (Ogboru & Rivi, 2017). In order to assess the effects of crude oil price shocks on Pakistan's economic growth, we thus look at numerous related studies from both developed and developing countries.

The energy industry is responsible for a large portion of a country's economic development. By emphasising the connections between energy transitions, energy consumption, oil prices and long-term economic development, this study adds to the field of sustainability theory (Altinay & Karagol, 2005). The data for each variable is transformed into logarithmic form for the dynamic interpretation of the study's coefficients.

Our starting point for modelling economic development is Solow's neoclassical growth theory (Arbex & S.Perobelli, 2010). This theory has evolved over the past several years, making significant contributions to issues like as energy, the environment, and economic development exploitation and development of natural resources.

The other theory in use is neoclassical, which studies how an economy grows through time as the amount and quality of various inputs to production change. A constant-sized work force utilising produced capital creates output equal to economic output in the simplest scenario. The neoclassical model predicts that as the quantity of capital employed increases, production grows at a slower pace.

CHAPTER III

3. RESEARCH METHODOLOGY

3.1. Research Design

The study model was based on secondary data, analysing the results obtained the hypothesis will be approved or not. According to this method, independent factors eventually influence dependent factors. After an empirical methodology of the results, solution is found, and the results are openly debated and published.

3.2. Data and sample

This study begins with an examination of renewable energy production (GWh), energy consumption (GWh) that comprises the consumption of wind, geothermal, hydropower, solar, bio-fuel and biomass. The crude oil rate per barrel in US dollars and it's impact on economic growth. This part gives a clear and brief account of the experimental findings, their interpretation, and the implications that can be taken from the research.

The influence of three independent factors on Pakistan's economic development is examined annually between 1990 and 2020 in this research. We based our findings on data from the "World Development Indicators" (WDI), and the Pakistan Bureau of Statistics and National Transmission & Despatch Company Limited. We utilised GDP in US dollars as a measure of economic growth because it has been used in various other research.

3.3. Instrument

The data used, is collected primarily from secondary sources. From WDI website collected the annual GDP. The data of energy consumption and renewable energy was collected through NTDCL. For last to discovery the oil price data will be collected through U.S EIA (Energy Information administration).

3.4. Data Analysis

For data analysis used the modified function as panel co-integration equation to illustrate the impact of energy consumption. The economic research technique known as linear regression establishes a connection between changes in one variable (the series of data that recurs repeatedly at regular intervals) and changes in another variable or group of variables. It is clearly a linear link because of the association's retention of linearity. The following linear regression model is used for the analysis:

$$GDP = \beta_0 + \beta_1 EC + \beta_2 RE + \beta_3 COP + \varepsilon$$

- COP: Crude Oil Price
- RE: Renewable energy generation
- EC: Energy consumption

Where β0 is the intercept; β1, β2, and β3 are particular slope factors of EC, COP and RE; and ε is the presumed-to-be-stationary random error term. The Augmented Dickey-Fuller Test was used in the current study to explore the stationarity of the variables (ADF). Below is the estimate equation:

$$d(Y_t) = \alpha_0 + \beta t + YY_{t-1} + d\big(Y_t(-1)\big) + \boldsymbol{\varepsilon_t}$$

The individual ADF equations are provided here since the stationary of the variable has been evaluated separately:

$$d(GDP_t) = \alpha_0 + \beta t + YGDP_{t-1} + d\big(GDP_t(-1)\big) + \boldsymbol{\varepsilon_t}$$

$$d(EC_t) = \alpha_0 + \beta t + YEC_{t-1} + d\big(EC_t(-1)\big) + \boldsymbol{\varepsilon_t}$$

$$d(RE_t) = \alpha_0 + \beta t + YRE_{t-1} + d\big(RE_t(-1)\big) + \boldsymbol{\varepsilon_t}$$

$$d(COP_t) = \alpha_0 + \beta t + YCOP_{t-1} + d\big(COP_t(-1)\big) + \boldsymbol{\varepsilon_t}$$

With the use of the ARDL model, the research has looked at the relationships between the variables.

3.5. ARDL Modelling Framework

This study will employ the theoretical and empirical methodologies listed below. Utilizing the distributed Lag method, several time-series statistics are computed, this method assumes that independent factors eventually influence dependent factors. For cointegration, the ARDL (Autoregressive Distributed Lag) a procedure developed by Pesaran et al(2001) will be used. The single ARDL equation at the foundation of the ARDL technique decreases the number of parameters that need to be determined. (Pesaran, Shin, & Smith, 2001). The endogeneity issue of the explanatory variables may be resolved by the ARDL, which can also avoid the glitches with unit root pre-testing, because the test can be carried out irrespectively of whether the series are order I(0) or order I(1). Last but not least, the ARDL approach is appropriate for small sample datasets like those used in this work and corrects for serial correlation and endogeneity since it includes a sufficient number of lags (Avom, Miamo, Achuo, & Dinga, 2020). The distributed lag model demonstrates the existence of lag for the independent variable in a regression equation.

Short run Specification of ARDL equation

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta EC_{t-1} + \sum_{i=1}^{p} \alpha_{2i} \Delta RE_{t-1} + \sum_{i=1}^{p} \alpha_{3i} \Delta COP_{t-1} + \varepsilon_t$$

Long run Specification of ARDL equation

$$GDP_t = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} EC_{t-1} + \sum_{i=1}^{p} \lambda_{2i} RE_{t-1} + \sum_{i=1}^{p} \lambda_{3i} COP_{t-1} + \varepsilon_t$$

Every variable is specified as before; the first difference operator is shown; p=lag order selected by the AIC model; α0 is the intercept; ε_t is the stochastic error term; α_i=1,2,3, are the short-run dynamic coefficients; λ_i= 1,2,3 are model's long-run coefficients.

After estimating the equations, we check for cointegration between the shown variables. This is accomplished by using the ARDL Bounds test, which is based on Pesaran (Pesaran, Shin, & Smith, 2001). The claim that there is no long-term connection between the variables (H0). The result rule is to accept the null hypothesis if the estimated F-statistic is below the lower critical constraints or reject it if it exceeds the higher critical bounds. If the F-statistic is contained within the bounds, the Bounds test is, nonetheless, inconclusive (lower bound and upper bound). Thus, if long-run cointegration is confirmed, we proceed to estimate the error correction model (ECM), which is derived from equation (2), in the manner shown below:

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta EC_{t-1} + \sum_{i=1}^{p} \alpha_{2i} \Delta RE_{t-1} + \sum_{i=1}^{p} \alpha_{3i} \Delta COP_{t-1} + \lambda ECT_{t-1} + \varepsilon_t$$

Where: λ=rate of parameter modification; The delayed error correction term is $ECTt_{-1}$. The individual coefficients of the lag components represent short-run dynamics, while the ECTt-1 contains information about long-run causation. Furthermore, a significant non-zero but negative ECT_{t-1} indicates long-term causation among modelled variables, whereas the importance of a delayed explanatory variable shows short-term causality.

CHAPTER IV

4. RESULTS AND ANALYSIS

4.1. Descriptive Statistics

Table 1 provides a quantitative description of a data set provided by descriptive statistics, such as the GDP, EC, RE, and COP for the years 1990 to 2020. The table displays the mean and standard deviation for all elements. The mean shows a sensible measure and the SD specifies variation of significant worth from the mean. The average specifies the values, standard deviation, Skewness, and Kurtosis of the variables that were not taken into account. The results obtained show a mean of 146.442 for GDP, 59.5936 for energy consumption, 26.63 renewable energy generation and 47.50 for crude oil price. And the median 120.05, 55.27, 27.47, 41.51 respectively. Further the SD obtained for each variable is 91.13, 20.29, 6.76, and 28.19 respectively.

Table 1: Descriptive analysis

	Description	Mean	Median	Std. Dev.
GDP	Real gross domestic product in Billion US$	146.442	120.055	91.132
EC	Energy consumption (GWh)	59.5936	55.278	20.299
RE	Renewable energy generation(GWh)	26.632	27.477	6.767
COP	Crude Oil Price	47.505	41.510	28.197

4.2. Correlation Analysis

The table 2 displays the strength of the correlation between the variables. Correlation analysis is used to look at the relationship between the variables. Numerical numbers and value ranges between (-1, +1) are used to illustrate the connection between values. They demonstrate how these factors are positively connected. The following table displays whether or not the variables have a positive association. GDP and EC have a positive correlation of 0.957, showing that both are moving in the same direction as well as having a very strong relationship. The fact that COP and GDP move in the same direction is shown by their positive correlation of 0.669. GDP and RE have a positive correlation of 0.903, indicating that they move in opposing directions.

Table 2: Correlation analysis

	GDP	EC	COP	RE
GDP	1.00			
EC	0.957	1.000		
RE	0.903	0.939	1.000	
COP	0.669	0.619	0.606	1.000

4.3. Unit Root Analysis

Based on the data and methods section, the researcher does a panel unit root test to confirm data stationarity. The test demonstrates that the amount of GDP growth is non-stationary, there is no unit root, and the p-value is significantly higher than (0.05). Energy use is stationary at the first difference (0.0072), and the trend intercept p-value is less significant than (0.05). Renewable energy generation is stationary at 1st difference (0.0019) and has the unit root, the p-value is less than (0.05).Crude oil Price at 1st difference is stationary (0.0008) and has the unit root, and the p-value is less than (0.05).

Table 3 Unit root test

	Trend and intercept		**INTERCEPT**		**Decision**
	t-statistics	**p-value**	**t-statistics**	**p-value**	
GDP at level	-2.1748	0.4850	-0.2151	0.9261	
GDP at 1st difference	-3.3320	0.0809	-3.4584	0.0168	I(1)
EC at level	-2.3743	0.3841	0.2938	0.9740	
EC at 1st difference	-4.4525	0.0072	-4.4482	0.0015	I(1)
RE at level	-2.4231	0.3611	-0.1746	0.9315	
RE at 1st difference	-5.0134	0.0019	-5.0103	0.0003	I(1)
COP at level	-1.4247	0.8325	-1.5048	0.5175	
COP at 1st difference	-5.3773	0.0008	-5.3721	0.0001	I(1)

*Note: *p-value. Significant at the 0.05 level*

4.4. Bounds Test to Cointegration

To determine the ideal lag length parameters. the ARDL approach is crucial. As a result. it is feasible to calculate the model's maximum number of lags by using the unconstrained vector auto regression (VAR) selection criterion; Table 4 lists these criteria. The Schwarz information criterion and Akaike information criterion (AIC) are the two metrics that are most frequently utilised (SIC). In this study. we employed AIC lag selection tests to find appropriate delays in the model. The related value for each variable determined by the impacts of the AIC has been set to "4". The AIC criteria have been applied to earlier research (Farhani & Ozturk, 2015) to determine the ADF lag duration number.

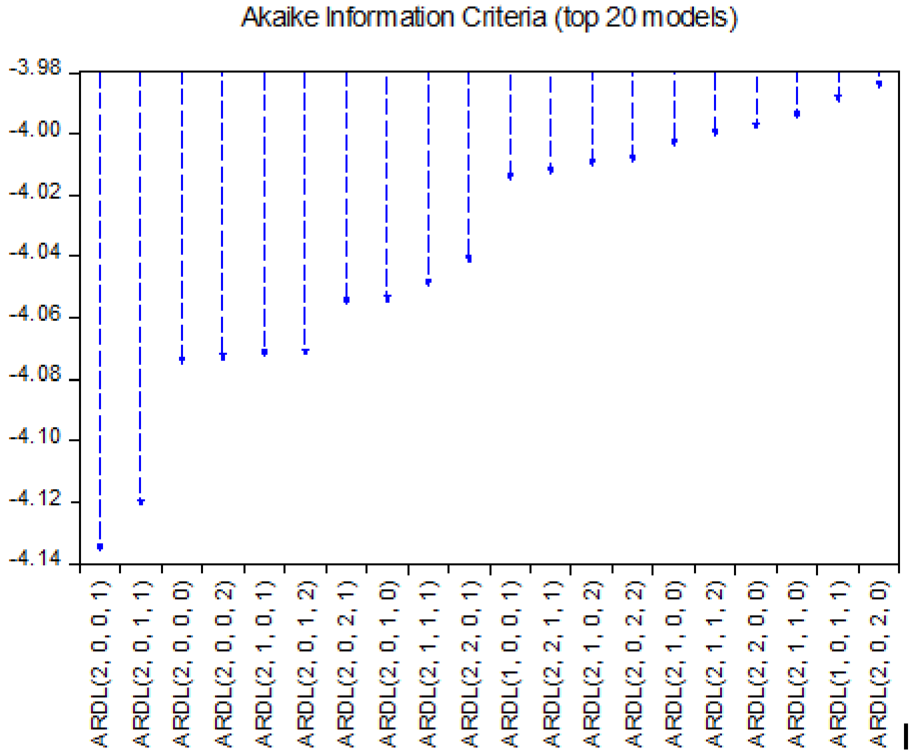
Table 4: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-267.63130	NA	6.434.72300	20.12084	20.31281	20.17792
1	-175.75550	149.72350	23.71696	14.50441	15.46029*	14.78583*
2	-165.78840	13.28951	40.51609	14.94729	16.67507	15.46105
3	-138.74480	28.04518*	22.76380*	14.12924	16.62493	14.87134
4	-121.20770	12.99040	34.92705	14.01539*	17.27898	14.98582

Note: LR: sequential modified LR test statistic (each test at 5% level). FPE: Final prediction error. AIC: Akaike information criterion. SC: Schwarz information criterion. HQ: Hannan-Quinn information criterion

The top twenty eligible delays for the ARDL approach are displayed in Figure 4 To choose the best ARDL lag order model. we employed AIC (2.0.0.1). Similar results have been calculated in prior study work by authors like (Koondhar, Qiu, Li, Liu, & He, 2018).

Figure 4: Lag Length Graph



4.5. Cointegration Analysis - Bound Test

Following the unit root test. the ARDL bound test method was employed. AIC and SIC are typically used in this test procedure since they are more efficient. The null hypothesis of no cointegration is rejected in cases. when the measured F-statistic value is bigger than the upper critical limit value. After the calculated F-statistical significance falls below the critical bound value. the outcome is inconclusive. The lower and upper critical levels are larger than the F-statistical value.

Table 4 findings demonstrate that the empirical F-statistical values (9.86) are higher than the upper bound I(1) values (4.35). which affirm that there is a long-term connection between GDP. EC. RE and COP in Pakistan. The results support the alternative cointegration hypothesis and point to a refusal of the null hypothesis that there is no cointegration.

Table 5: Bound test result

F-Bounds Test				Null Hypothesis: No levels relationship
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	9.868980	10%	2.72	3.77
K	3	5%	3.23	4.35
		2.5%	3.69	4.89
		1%	4.29	5.61

4.6. Error correction Model estimates

According to the short-run results in Table.6 there is long-run cointegration between the independent variables and real GDP since the coefficient of the lagged error correction term. ECT (-1) is negative and statistically significant at 5%. Furthermore. the outcomes display that current lag values of crude oil and energy consumption at the 1% have significant effects on real GDP while for RE there is evidence at the 5% level of significance on GDP.

The GDP is significantly impacted negatively by EC. The short-run results show that a 1% rise in EC reduces GDP by 0.238%. and the positive impact of COP on gross domestic product (GDP). Short-term estimations' findings indicate a rise in Renewable energy generation. respectively. of 1% in GDP by 0.44%. COP has a positive effect on GDP. A 1% increase in COP would increase GDP by 0.1%.

Table 6: Short run test result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EC)	-0.002388	0.000747	-3.198428	0.0043
D(COP)	0.001250	0.000379	3.294102	0.0035
D(RE)	0.004454	0.002230	1.997113	0.0589
CointEq(-1)	-1.504817	0.274658	-5.478867	0.0000
R^2=0.72				

The long-run relationship in Table 7 indicates that the GDP in Pakistan are significantly influenced by three variables (EC. RE and COP). The findings show that a 1% increases in EC decrease the GDP by 0.2%. A 1% increase in free trade would result in a 0.4 percent boost in GDP. according to RE. which has a statistically significant and positive coefficient. Additionally. the findings of the long-run coefficients show a considerable long-term positive relationship amongst the price of crude oil and real GDP. the effects of COP result in a 1% increase GDP by 0.125%. Evidence suggests that a 10% rise in crude oil prices has the potential to enhance Pakistan's real GDP by 1.25 percent over the long term at the 1% level of significance.

Table 7: Long-run test result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EC	-0.002388	0.000747	-3.198428	0.0043
COP(-1)	0.000567	0.000282	2.008273	0.0576
RE	0.004454	0.002230	1.997113	0.0589
D(COP)	0.001250	0.000379	3.294102	0.0035

4.7. Stability test

Additionally the Cumulative Sum (CUSUM) and the CUSUM squares of recursive residuals stability tests were used to confirm the model's stability. These tests reveal that all of the estimated model's coefficients lie within the 5 percent critical bounds. supporting the existence of a long-run connection between the modelled variables and the stability of the estimated coefficients (Alimi, 2014).

Figure 6: CUSUM test

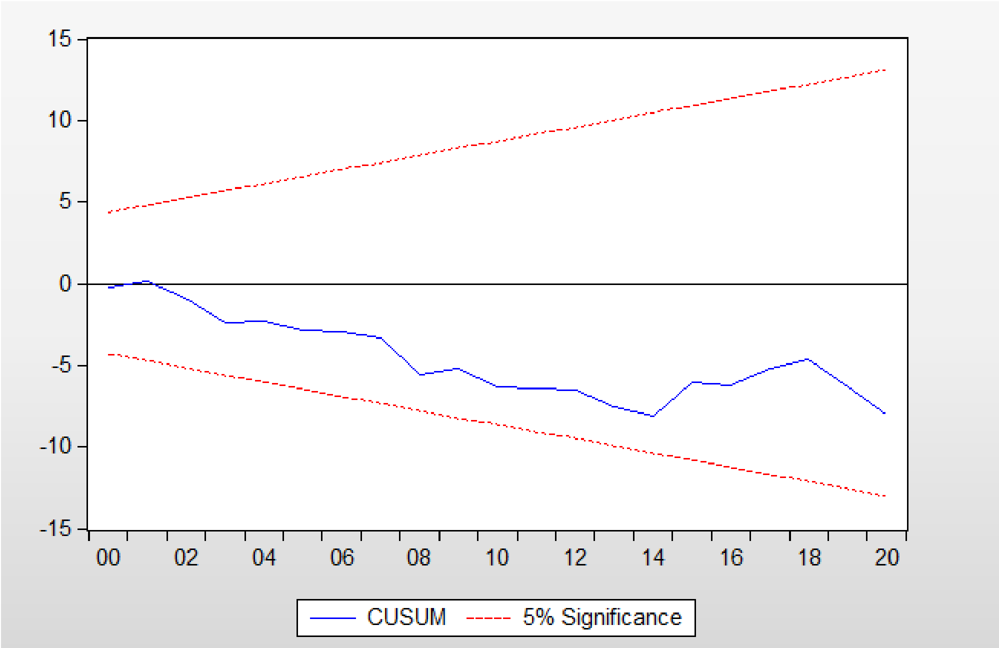
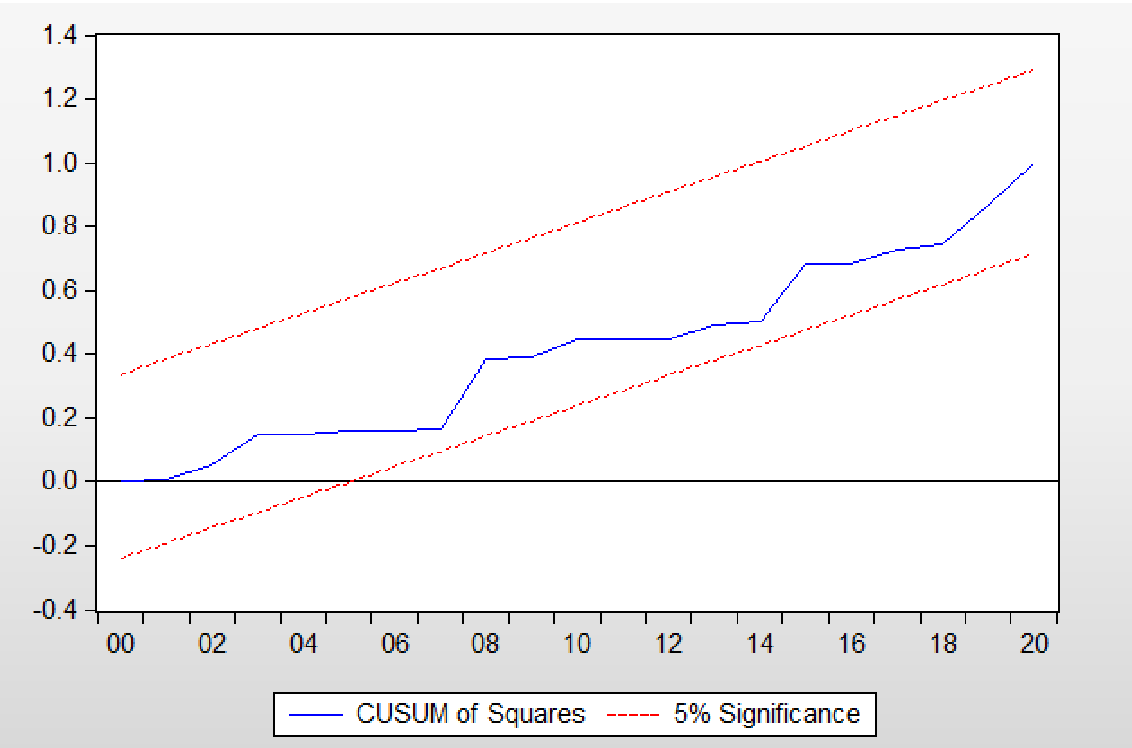


Figure 7: CUSUMsq test



Additionally. the total sum of the residual squares (CUSUM) and the total sum were employed in the model reliability implementation. CUSUM and CUSUMsq tests are suggested by (Brown, Durbin, & Evans, 1975) to assess the effectiveness of the entire model. In figures it can be observed that all coefficients of the estimated model lie within the 5 percent critical bounds. thereby demonstrating the stability of calculated coefficients and the presence of a long-run and short-run relationship between modelled variables. To assess the stability of the model. several researchers additionally examined CUSUM and CUSUMsq (Rehman, Rauf, Ahmad, & Chandio, 2019).

CHAPTER V

5. DISCUSSION AND CONCLUSION

5.1. Discussion of the Findings

The study gives outcomes that show that oil prices have a positive relationship with the economic growth. There is indication that the rise in oil price level leads to an increase in economic development as the oil is consumed by many economic organizations for energy purposes. The rise in crude oil price also rises the price of different products. These results are in line with the past study of (Sachs, Woo, Yoshino, & Taghizadeh-Hesary, 2019). Which shows that since oil is used as an energy resource in various economic organizations. The rise in oil prices brings an excessive change in economic growth.

The result showed energy generated from renewable energy resources has a positive influence on economic growth. The outcomes demonstrated the importance of the long-term bidirectional link between the variables. Because renewable energy is a clean form of energy with little influence on the environment. It is crucial for the majority of the researched nations to boost their investments in renewable energy because this helps to promote GDP growth. These results are supported by previous study of (Al-mulali, Hassan, Lee, & Sab, 2013). which shows that countries generating more quantity of energy from renewable resources have a more positive impact on economic growth.

Also in this report we find an evidence of that electricity consumption is having a negative impact on GDP. That is due to that most proportion of Pakistan is being produced by thermal energy and the rises of fossil fuels price effect negatively economic development. Recent years have seen one of the biggest electrical crises in Pakistan. The ensuing load shedding that results in power outages not only interferes with people's daily lives but also seriously harms the economy industrial and agricultural sectors. This eventually has adverse implications on the nation's economic growth, which has serious repercussions for unemployment and the nation's social situation. In support of these findings there have been previous studies which analyses electricity consumption and its relationship with economic growth in Pakistan consumption (Javid, Javid, & Awan, 2013).

5.2. Conclusion of the Study

This study's primary goal was to examine how Pakistan's economic development was impacted by the price of crude oil, energy use and renewable energy output. The research employed the ARDL estimation method and employed annual tie series data for the core and control variables to provide empirical support for the link. The study's data set included the years 1990 through 2020.

Researches from the past have correctly asserted a crucial relationship amongst economic growth, energy consumption and oil prices. with both a positive and a negative relationship among them. This study rejected the H1 and accepted the second and third hypothesis and made the relationship between its variables. The research sought to determine the consequences of rising oil prices and the production of renewable energy. Which will help economists and financial professionals establish an appropriate approach to implement these results. This research also considered several plausible explanations for refusal to proceed and it concluded that increase in energy consumption is the cause of reduction of GDP due to the expensive production of energy.

The results suggest that renewable energy production and crude oil price increase the real GDP in a positive and significant way; whereas energy consumption is connected negatively to the GDP in the long run. Growth and energy are closely tied to one another. Therefore the energy policies that are implemented can have a big impact on how fast the economy is growing. In 2021 the share of renewable generation in total power generation was 33.5% and the thermal was 61%. Thus the excessive generation of power from thermal to full fill the demand of energy leads to reduce the economic growth as the energy generated cost is affected by the crude oil prices. That means the increase in oil price will provoke more expensive thermal energy and that will impact negatively the economic growth. This argument holds that energy has a very strong impact on economic growth and that the rate of economic growth has an impact on traditional energy-based policy.

Based on the findings of our research, we have highlighted a number of policy implications. First we advise Pakistani officials to keep up their initiatives to offer incentives in the form of tax breaks, subventions and other financial benefits. Therefore as their long-term economic influence on the economy and governmental policies promoting alternative energy sources cannot be disregarded. renewable energy sources grow increasingly alluring for business. Secondly the findings of our study support the significance of renewable energy sources. Since it can be assumed that these sources would both alleviate the pressure on politicians to improve the environment and contribute to the economic expansion of the country.

5.3. Limitation of the Study

There are several limitations in the current study that will encourage researchers to try to address issues while updating the study's hypotheses in the future. With that said, from 1990 to 2020 years were employed to collect the study's data and the method used for analysis was ARDL. Validity and completeness are both restricted in the data collected during the short time span. Researchers will thus need to collect data over a significantly longer time period in the future and more methods will be have to use to ensure the results. The influence on GDP is determined by three economic variables, including oil prices, energy consumption and the generation of renewable energy. which are the only ones that the present study has shed light on. This research ignores a number of additional economic factors that have a significant influence on economic development which can be considered in future studies.

5.4. Theoretical/Practical Implications

In Pakistan they are not prior studies considering the rises of oil prices, electricity consumption and renewable energy generation. This study is providing an empirical evidence of existing positive relationship between crude oil price, renewable energy production and economic growth. Also a negative relation between electricity energy consumption and economic development. Furthermore, shown that Pakistan has a lack of power and the industry only runs at capacity margins. Infrastructure development needs to be planned for and funded if the demand for power is to be met. In order to guarantee a sustainable electrical supply, the government should develop a new policy.

5.5. Recommendations

The study has shown that Pakistan's power sector is highly dependent on fossil fuels which reduce the economic development. In order to increase economic growth Pakistan should cut its energy import bill in half, and with the aid of the private sector. the government should launch new initiatives and put additional generation capacity on stream. The following are some of the key concerns and recommendations for policy-makers based on the thorough examination of the power sectors in Pakistan.

The most crucial task is to end load shedding and make sure that the public has seamless uninterrupted access to power for economic growth. By resolving the problem of cyclical debt and improving the transmission network according to priority this issue may be remedied. It is best to upgrade the distribution network and install additional generating facilities at the same time. The development of hydropower should be prioritised because the supply is abundant and the cost of production is extremely low.

The support of private sector engagement is crucial for the production of power from renewable sources. To encourage investment in this industry the government should provide attractive packages, incentives and give investors guarantees. The state should also take the initiative to support the development of small-scale power production facilities in rural regions. That can meet the local community's electrical needs without placing an additional stress on the national grid.

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7. ANNEXURE

Year	RE	EC	COP	GDP (billions US$)
1990	16.925	29.078	24.53	40.01042397
1991	18.298	31.951	21.54	45.6252347
1992	18.647	34.657	20.58	48.88460685
1993	21.111	36.268	18.43	51.80994933
1994	19.436	36.93	17.2	52.29345691
1995	22.858	40.016	18.43	60.63602242
1996	23.206	41.824	22.12	63.32012281
1997	20.858	48.666	20.61	62.43330034
1998	22.06	50.84	14.42	62.19195581
1999	22.448	51.543	19.34	62.97385572
2000	19.288	40.91	30.38	82.01774342
2001	17.259	43.384	25.98	79.48440398
2002	19.062	45.204	26.18	79.90498538
2003	22.35	47.421	31.08	91.76054294
2004	27.477	51.492	41.51	107.7596839
2005	25.671	55.278	56.64	120.055292
2006	30.855	62.405	66.05	137.2640611
2007	31.942	67.48	72.34	152.3857163
2008	28.667	66.539	99.67	170.0778141
2009	28.183	65.286	61.95	168.1527753
2010	28.492	68.878	79.48	177.1656351
2011	31.99	71.672	94.88	213.5874132
2012	28.727	71.368	94.05	224.3836208
2013	30.286	70.508	97.98	231.2185672
2014	32.865	76.543	93.17	244.3608888
2015	33.76	78.113	48.66	270.5561317
2016	36.132	81.737	43.29	278.6546377
2017	34.996	86.763	50.8	304.5672532
2018	32.38	97.197	65.23	314.5675416
2019	36.4179	99.046	56.99	279.0566089
2020	42.956	98.407	39.16	262.6100029