An ARDL investigation into the growth-energy prices Nexus: The case of Egypt

Dr Nevin Hussein Mohamed Mahmoud
Lecturer of Economics

School of Business Administration, Ahram Canadian University

Egypt

neveinhmm@yahoo.com

المستخلص

هناك مخاوف متعددة تحيط بالاقتصاد العالمي بعد الصراع بين روسيا وأوكرانيا مما تسبب في مخاطر جديدة على الاقتصاد العالمي، حيث ارتفعت أسعار الطاقة مع بداية المشكلة وتجاوز سعر برميل النفط 100 دولار للبرميل منذ 2014، وارتفع الغاز الطبيعي الأوروبي بنسبة 62٪.

تبحث هذه الورقة تأثير التغيرات في أسعار الطاقة على النمو الاقتصادي في مصر والتعرف على الآثار السلبية للحرب الروسية الأوكرانية اقتصاديًا على العالم بشكل عام وعلى مصر بشكل خاص. كما تختبر هذه الدراسة فرضية أن النمو الاقتصادي في مصر يتأثر سلباً بارتفاع أسعار الطاقة العالمية. تستند الدراسة إلى نموذج **ARDL** في تحليل العلاقة بين أسعار الطاقة والنمو الاقتصادي في مصر.

وخلصت الدراسة إلى أن الأزمة ساهمت في رفع معدلات التضخم وخفض النمو الاقتصادي في دول العالم، كما أربكت خطط جميع أطراف صناعة البترول والغاز الطبيعي من المنتجين والمستهلكين والشركات العالمية، مما استدعى إعادة تقييم خطواتهم التالية. كما توصلت الدراسة أن هناك علاقة ارتباط معنوية بين التغيرات في كلاً من (أسعار النفط والغاز ومؤشر الطاقة العالمي) والنمو الاقتصادي في مصر خلال الأزمة الأوكرانية الروسية، وتسببت تلك الأزمة في انخفاض النمو الاقتصادي في مصر كما كان لها تأثير كبير على توافر المواد الغذائية خلال تلك الفترة.

الكلمات المفتاحية: أسعار الطاقة، النمو الاقتصادي، نموذج **ARDL**

Abstract

There are multiple concerns surrounding the global economy after the conflict between Russia and Ukraine. This crisis caused new risks to the global economy, as energy prices rose with the beginning of the problem as the price of a barrel of oil exceeded $100 a barrel since 2014, and European natural gas has risen by 62%.

This paper empirically investigates the impact of Changes in energy prices affect economic growth in Egypt and Recognition the negative effects of the Russia-Ukraine war economically on the world generally and on Egypt especially. This study tests the hypothesis, Economic growth in Egypt is adversely affected by the rise in global energy prices.

The study is based on the ARDL model in analyzing the relationship between energy prices and economic growth in Egypt.

The study concluded that the crisis contributed to raising inflation rates and reducing economic growth in the countries of the world, also confusing the plans of all parties to the petroleum and natural gas industry, including producers, consumers, and international companies, and this necessitated a reassessment of their next steps.

As there is a significant correlation between changes in both (oil and gas prices and the global energy index) and economic growth in Egypt during the Ukrainian-Russian crisis, and This crisis caused a decline in economic growth in Egypt and had a significant impact on the availability of foodstuffs during that period.

Keywords: Energy prices, Economic growth, ARDL model

1. Introduction

The world has reached a historic turning point after the Covid-19 pandemic, and the countries of the world have begun to rearrange their priorities and redraw their internal and external movements.

There are also multiple concerns surrounding the global economy during the conflict between Russia and Ukraine, after entering the war on February 20, and especially after the expansion of Western sanctions against Russia.

The world is experiencing a state of anxiety and anticipation because of the Ukrainian-Russian crisis, which affects the political, economic, and diplomatic dimensions of the world.

The crisis caused new risks to the global economy, which is already suffering from faster rates of inflation, and slower growth, as energy prices rose with the beginning of the crisis on February 24, 2022, as the price of a barrel of oil exceeded $100 a barrel since 2014, and European natural gas has risen by 62%.

The crisis may lead to disruption of the flow of Russian natural gas sent to Europe, where a third of it flows through Ukraine, and as a result, European gas stocks fell to less than 40% of their capacity in January 2022.Therefore, the International Energy Agency (IEA) has developed a plan to cut back Europe's dependence on Russian oil and gas, support the transition to clean energy, and release 60 million barrels of crude oil to reduce global oil prices.

Western countries have imposed severe sanctions on Russia to weaken its economy, but these sanctions may have repercussions on members of society in the world, from providing food to rising energy and oil prices.

The prediction of the outcome of the conflict between Russia and Ukraine is not clear. Some believe that this conflict will lead to a lack of confidence in the global economy and consequently a decline in international investment and trade, and others believe that this will lead to opening channels for trade with India and China as the beginning of a new multi-polar world order.

It seems too early to make such speculations because COVID-19 remains a major source of uncertainty, especially in the near term.

2. Research problem

Political events have confused the global oil and gas industry in recent months as a result of the repercussions of the Russian-Ukrainian crisis that erupted in February 2022 and led to a shortage of supplies offset by an increase in demand. The crisis affected the entire global economy due to the record rises in oil and natural gas prices globally.

The crisis contributed to raising inflation rates and reducing economic growth in the countries of the world, which had begun to gradually restore their natural position after the decline of the Corona pandemic globally.

The crisis also confused the plans of all parties to the petroleum and natural gas industry, including producers, consumers, and international companies, and this necessitated a reassessment of their next steps.

Does The Russian-Ukrainian crisis destabilize global oil markets, ،will it affect the Egyptian economy positively or negatively?

3. Hypotheses

The study tests the hypothesis, Economic growth in Egypt is adversely affected by the rise in global energy prices.

4. Aim

This study aims to Recognition the negative effects of the Russia-Ukraine war on global energy prices and impact of this on economic growth in Egypt, and try to find ways of addressing them to maximize our benefits.

5. Literature review

Most of the previous studies, which dealt with the relationship between economic growth in many countries and energy prices, focused on the impact of oil price shocks on economic growth or on macroeconomic variables, and a few of them dealt with the impact of changes in the prices of other energy sources. Like natural gas, this may explain the importance of oil as an energy source. Also, most studies have focused on developed countries, and most previous studies have relied on the growth of the VAR to estimate response functions, analyze variance, and measure causal relationships.

Many studies have indicated that the rise in energy prices hurts the GDP in the case of energy- imported countries and has a positive impact in the case of energy-exporting countries. also, most studies indicated There is inconsistency in the impact of oil price changes on economic activity, so high oil price has a negative sign on the growth rate, and at the same time it was found that the decline in oil prices does not cause an increase in the of economic growth rate, and we will review several studies:

- (T.K. Jayaraman, Evan Lau, Vol.2, No.2, May 17,2011) A panel analysis was applied to five Pacific Island countries, Fiji, Samoa, Solomon Islands, Tonga, and Vanuatu, with the aim of studying the impact of the oil price on economic growth. The study found that there is no long-term causal relationship between those variables, in the short term.

- A study conducted on Nigeria concluded that the government should develop the industrial sector that provides energy resources. Therefore, the government should stimulate oil refining and encourage the petrochemical industry in the country instead of exporting energy in the form of a crude product. (Emeka Emmanuel Okoro1, et al., Vol.2, No.4, October 30,2017).

- A study (Mork, Knut Anton, et al., Vol.15, No.4,1994) on the United States of America, Canada, Japan, Germany, France, the United Kingdom, and Norway concluded that increases in oil prices had a negative significant impact on economic activity in all the countries under study, with the exception of Norway, which had a positive impact because the oil sector is relatively large.

- A study (Cunadoa, J., and Perez de Gracia, F., Vol.45,2005), dealt with Japan, Singapore, South Korea, Malaysia, and Thailand and used cointegration tests and Granger causality tests, and concluded that oil prices have a significant negative impact on the GDP growth rate, but this effect is limited in the short term and is more significant when used in Model Oil prices in local currency Impact.

- A study (kliesen, April 2006) explains the impact of changes in the price of natural gas on growth in industrial production and GDP and compared the effect of changes in prices for both natural gas and oil. The study concluded that changes in natural gas prices do not have Significant impact on the industry that use intensive natural gas, while they had a significant impact on industries that use less natural gas. As well the oil prices had a significant effect on the real GDP, while changes in natural gas prices did not have the same effect.

- This study (Kabiru Saidu Musa, et al., 2019, Volume 6) The study seeks, through the ARDL model, to study the effect of economic growth according to the model. The study concluded that the exchange rate and the price of crude oil have a significant impact on economic growth in the short and long term.

- The study (Omoregie, 21 December 2015) The study concluded that the price of oil is one of the most important single economic variables that affects the

global economy. The results of the study indicate that a drop in the oil price by $10 per barrel will lead to the transfer of about 0.5% of the global GDP from oil-exporting countries to oil-importing countries. This means that the collapse of oil prices will affect capital projects in the oil and gas industry.

- A study on Tunisia based on the VAR model (Jabir, Vol.37,2009), One of the most important results of the study is that the impact of oil price shocks does not affect economic activity directly, but there are a few indirect effects on government spending.

- This paper examines (Hakan Berument, et al., Vol.31,2010) The impact of oil price shocks on the output growth of selected16 MENA countries, relying on SVAR (structural vector autoregressive) analysis. The results indicate that the increase in oil prices had a positive impact on the following countries (Algeria - Iran - Iraq - Kuwait - Libya - Oman - Qatar - Syria - UAE). And there was a negative effect that was not statistically significant on each of (Bahrain - Djibouti - Egypt - Israel - Jordan - Morocco - Tunisia).

This study will answer the question whether the Russian-Ukrainian crisis destabilizes global oil markets, these increasing oil and natural Gas prices، will it affect the Egyptian economy positively or negatively?

6. The repercussions of the crisis on the global economy

The crisis led to a rise in the prices of grain, energy, and minerals, which led to an increase in inflation rates. There is also the exit of the hot money from emerging markets, including Egypt.

There are fears of the impact of that war on global economies and the seriousness of the economic consequences for the whole world, including the huge rise in energy prices (the price of Brent crude reached 128.98 dollars per barrel) and primary commodities, including wheat, which has inflationary effects, and it is expected that the increase in prices will continue Oil, pending a solution to the current crisis between Russia on the one hand, and Ukraine, which is backed by the United States and NATO, on the other.

And after some economic sanctions were applied on Russia, including Swift's sanctions on the Central Bank of Russia, this made it difficult for them to access the use of international reserves to support their currency and financial system, Many Russian banks have been isolated and their ability to enter the international transfer system on the SWIFT network has been limited, which

has weakened Russia's ability to cover its imports and carry out cross-border capital transfers.

The crisis brought about changes in European thinking seeking to phase out fossil fuels to face climate change. Europe began to realize the importance of energy security and to stop the use of coal because it is the largest polluter of the environment. Europe also increased investment in gas infrastructure and expanded dependence on new suppliers instead of Russia.

The United States, backed by several major consuming countries, members of the International Energy Agency, took a step to withdraw from the strategic reserves of oil to meet the expected increase in demand and to prevent further price hikes.

Concerning the size of the Russian economy, especially the volume of its foreign trade, the punishment that will be enjoined on it will affect most countries, as well as the damage that will occur due to the rise in oil and food prices on the rest of the world, especially developing countries, as Russia is one of the largest producers of wheat in the world and the second largest oil producer in the world (10.5 million barrels per day) after the United States of America (11.2 million barrels per day).

Ukraine shares its borders with four member states of NATO (formerly part of the Soviet bloc). After Russia absorbed Belarus and invaded Ukraine, does it turn its eyes toward Moldova, Romania, and perhaps Georgia?

Undoubtedly, it will take a long time to remove the economic effects of this war.

Table (1): The International Energy Agency forecasts global oil supply and demand

	2020	2021	2022	2021				2022			
				Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Global Demand	91.89	97.50	99.37	94.31	96.30	98.77	100.53	98.55	98.32	100.10	100.46
Supply outside OPEC	63.00	63.71	64.47	61.94	63.49	64.31	65.04	64.99	63.71	64.35	64.81
Natural gas liquids in OPEC	5.09	5.12	5.37	5.07	5.11	5.11	5.16	5.29	5.37	5.41	5.41
Implicitly required from OPEC crude	23.80	28.68	29.53	27.30	27.69	29.34	30.34	28.27	29.24	30.34	30.24

28.402.OPEC production of crude oil	25.69	26.39	----	25.33	25.51	26.93	27.76	28.40	----	----	----
OPEC vs. required	+1.89	-2.29	----	-1.97	-2.18	-2.41	-2.58	+0.14	----	----	----
Global Supply	93.78	95.21	----	92.34	94.12	96.36	97.95	98.69	----	----	----

Source: MEES,15th April 2022

7. Inflation

As a result of the repercussions of the Coronavirus, the year 2022 began with an increase in the volume of inflation worldwide. In many countries, it exceeded the target framework for inflation. In reference to economic theory, we find that the extensive use of fiscal and monetary policies to confront inflation will eventually lead to inflation getting out of control, as energy prices have reached their highest levels in history, as the inflation index exceeded 8% in the United States monthly. Gas and gold prices witnessed unprecedented price booms. Therefore, inflation continues with the continuation of treatment in the same manner, so the cure for inflation is production along with the balanced use of monetary and fiscal policies (Statistics, Feb,2022).

8. The repercussions of the Russian-Ukrainian crisis on global trade

In 2020, many around the world contracted due to the Covid-19 pandemic, indeed, global exports fell by about 7%. Ukraine's exports were only falling by 1.6%, while Russia's exports fell by 21% (United Nations database, 2020).

The Russian-Ukrainian conflict will have a direct global impact on many commodities such as sunflower seeds, corn, barley, and wheat.

Ukraine's total imports of goods are 53.7 billion dollars in 2020, Ukraine imports most of its goods from China at about 3.8 billion dollars, then Germany 3.5 billion dollars, Russia at 6.4 billion dollars, Poland with 1.4 billion dollars, and The United States of America is $3 billion.

Western countries have imposed severe sanctions on Russia to cripple its economy and weaken its military effort, but the economic repercussions could also have a major economic impact on Countries of the world, ranging from the availability of food to the rising costs of energy and gasoline.

There are also direct repercussions of the crisis and sanctions represented in the high cost of global energy, as it will affect the global wheat prices, as there are many countries that depend on wheat and corn from Russia and Ukraine.

On the other hand, the crisis will lead to a rise in inflation rates at the global level due to the shrinking of supply chains, low growth, and turbulence in the financial markets.

The Russian-Ukrainian crisis has affected European countries in several ways, the foremost of which is energy supplies, as the European Union depends on Russia for nearly 40% of natural gas and more than 25% of crude oil, and it is likely that the prices of oil, wheat, and industrial minerals such as nickel and aluminum and palladium will rise, and the price of gas will rise by 30%.

Russia is the largest exporter of crude oil, with exports of 5 million barrels per day of crude oil, representing 12% of world trade. It also exports 2.85 million barrels per day of petroleum products, equivalent to 15% of the refined products traded around the world.

The European Union accounted for 45 %of Russia's exports of crude and petroleum products by the end of 2021, before the Russian invasion of Ukraine, which began on February 24, 2022. The European Union also imported 2.2 million barrels per day, equivalent to 29 % of Russian crude oil in 2021.

Thus, the European Union was the largest importer of Russian oil, followed by China with a share of 22%, and then the United States with a share of 10%. The remaining percentage is divided between Asian countries with the Organization for Economic Cooperation and Development (6%), the rest of Europe (6%), and other countries (11%) (International Energy Agency, 2021)

In terms of the total volume of oil imports from Russia, Germany is in the lead with about 687,000 barrels per day of crude oil and 149 thousand of refined products, (International Energy Agency, 2021), while the Netherlands ranked second with about 414,000 barrels per day of crude oil, and 335 thousand barrels per day of Russian oil derivatives. Poland occupied third place with about 373,000 barrels per day of crude and 136 thousand refined products.

Although the United Kingdom is the first European country to announce a ban on Russian oil by the end of 2022, it imports about 56 thousand barrels per day of crude, and 114 thousand refined products, making it ranked 14th among European countries.

European Union countries that are geographically close to Russia, or are landlocked and have limited alternatives, are highly dependent on Russian oil imports. Countries on the southern route of the Druzhba pipeline, which crosses Ukraine, are also the most dependent on Russian crude.

Lithuania comes in the first place, as the country most dependent on Russian crude and oil derivatives, by about 83%, followed by Finland at 80% by the end of 2021, as its imports are by sea. 74% by the end of 2021. While Poland relies on Russian oil and refined products by 58% in the fourth place, and the Maghreb comes in fifth place with about 43%, and Hungary was the country most objecting to the decision to ban Russian imports. Germany relies on Russell for 30% of its needs.

Russia uses natural gas as a geopolitical pressure card, as Russian gas Represent about 40% of the daily consumption of gas in Europe, which is produced by Gazprom, which achieved sales in 2021 of about 1.8 trillion rubles (23.2 billion dollars),

So, after the embargo decision, the European Union should look for alternative sources of Russian oil and natural gas, turning its eyes to the Middle East, Africa, and the North Sea region.

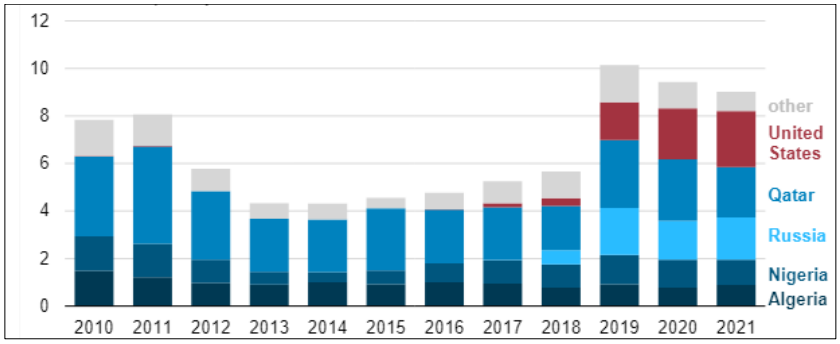
9. liquefied Natural Gas Trade

The United States, Russia, and Qatar supply about 70% of LNG supplies to Europe, and the United States had the largest share, as it acquired 26% of LNG, then Qatar followed with 24%, and finally Russia with 20%. (CEDIGAZ, 2021). The volume of liquefied gas exports from the United States of America to Europe increased from 3.4 billion cubic meters to 6.5 billion cubic meters per day by the end of January 2022. (U.S. Department of Energy, 2022)

Global LNG imports rose to 372.3 million tons in 2021, an increase of 16.2 million tons compared to the previous year, because of the continued shift from coal to gas (GIIGNL, 2022)

Russia is a main producer and exporter of metals and grains. Aluminum prices jumped by over 3% to reach $3,450 per ton on the London Metal Exchange. Platinum leaped more than 2%, while palladium more than 6%.

Figure (1): Europe (EU-27) and the UK liquefied natural gas imports by source country (2010-2021)



Source: US Energy Information Administration, International Group of Liquefied Natural Gas Importers (GIIGNL) & CEDIGAZ

Global LNG imports increased by 16.2 million tons from the previous year to reach 372.3 million tons in 2021. LNG imports increased as a result of the continued shift from coal to gas, although the annual growth rate (+4.5%) was still lower Much more than it was before the Corona outbreak. While Asia saw the strongest rise, led by China, which overtook Japan as the world's largest LNG importer, Europe struggled to draw down LNG shipments for most of the year. The recovery has been uneven across regions. Croatia has become a new LNG importer. LNG was imported through 44 markets from 19 exporting countries. (GIIGNL, 2022) . Asia accounts for 73% of the world's LNG consumption, 39% of the world's LNG supply, 136.3 MT on a spot or short-term basis, and 36.6% of all trade.

Table (2): LNG imports in 2021 (net of re-exports)

Market	10^6 m^3 Liquid	10^6 T	Global Share	Var.2020/2021
China	180.12	79.27	21.3%	15.0%
Japan	166.21	74.35	20.0%	-0.1%
South Korea	105.59	46.92	12.6%	15.0%
India	53.63	24.02	6.5%	-9.8%
Taiwan	43.43	19.44	5.2%	9.5%
Pakistan	18.45	8.19	2.2%	10.5%
Thailand	14.78	6.55	1.8%	16.8%
Bangladesh	11.52	5.10	1.4%	22.2%
Indonesia	7.58	3.31	0.9%	20.4%
Singapore	7.19	3.12	0.8%	-2.2%
Malaysia	4.73	2.02	0.5%	-21.5%
Myanmar	0.49	0.22	0.1%	19.0%
Asia	**613.73**	**272.51**	**73.2%**	**7.1%**
Europe	**170.41**	**75.05**	**20.2%**	**-8.0%**
Americas	**41.56**	**17.97**	**4.8%**	**36.33%**
Kuwait	11.9	5.34	1.4%	31.3%
United Arab Emirates	2.66	1.19	0.3%	-18.4%
Israel	0.41	0.18	0.0%	-69.4%
Egypt	0.12	0.05	0.0%	#N/A
Middle East & Africa	**15.19**	**6.76**	**1.8%**	**-2.3%**
Global Net Import	**480.88**	**372.29**	**100.0%**	**4.5%**

Source: GIIGNL Annual Report 2022 Edition

Table (3): Source of LNG imports in 2021

Country	10^6 m^3 Liquid	10^6 T	Global Share	Var.2020/2021
Pacific Basin	**323.87**	**143.87**	**38.6%**	**-1.6%**
United States	155.09	67.03	18.0%	49.8%
Russia (Europe)	44.53	19.46	5.2%	6.1%
Nigeria	36.35	16.42	4.4%	-20.1%
Algeria	26.19	11.78	3.2%	11.3%
Egypt	15.23	6.56	1.8%	390.5%
Trinidad and Tobago	14.51	6.19	1.7%	-38.6%
Angola	8.17	3.63	1.0%	-21.6%
Equatorial	6.20	2.72	0.7%	4.0%
Cameroon	2.69	1.20	0.3%	9.8%
Norway	0.53	0.24	0.1%	-92.5%
Atlantic Basin	**309.47**	**135.23**	**36.3%**	**15.2%**
Qatar	172.18	76.96	20.7%	-0.2%
Oman	22.26	10.22	2.7 %	4.7%
United Arab Emirates	13.10	6.02	1.6%	5.5%
Middle East	**207.53**	**93.19**	**25.5%**	**0.6%**
Total	**840.88**	**372.29**	**100.0%**	**4.5%**

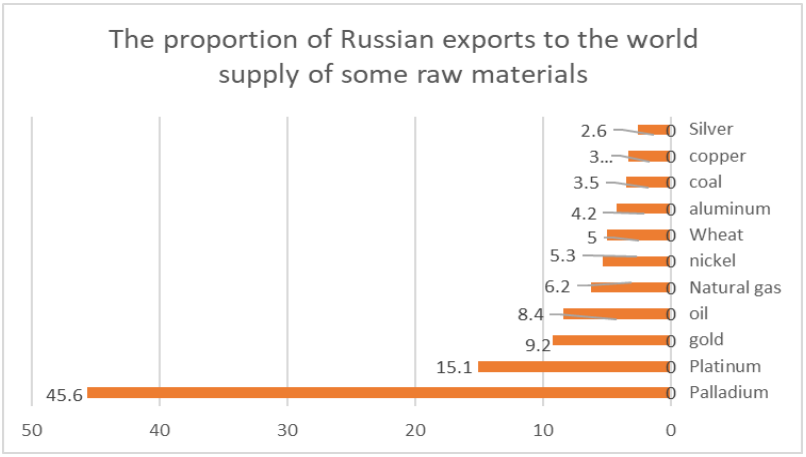
Source: GIIGNL, Annual Report 2022 Edition

10. Metal Prices

In addition to energy, Russia is a significant producer and exporter of metals and cereals. On the London Metal Exchange, aluminum prices increased by over 3% to reach $3,450 per ton. At around $25,000 per ton, nickel is currently trading at its highest level in more than ten years. Palladium increased by around 6%, while platinum increased by around 2%.

In addition to producing 10% of the world's platinum and 35% of the world's palladium, Russia also produces 6% of the world's aluminum, 5% of its nickel, and 4% of its crude steel. (Stevens, 24 Feb,2022).

Figure (2)



Source: JPMorgan Data

11. The repercussions of the Russian-Ukrainian crisis on Africa

The repercussions of the crisis do not stop at the rise in crude oil prices and inflation, rather, it extends to threatening trade in the continent of Africa, which imported agricultural products from Russia with about 4 billion dollars in 2020, and wheat takes over 90% of these imports.

Egypt is one of the largest importers of agricultural products from Russia, followed by Sudan, Nigeria, Tanzania, Algeria, Kenya, and South Africa

Ukraine exported about 2.9 billion dollars in agricultural products to Africa in 2020, with wheat accounting for 48%, corn 31%, and sunflower oil, barley, and soybeans 21 %.

As a result of the ongoing crisis conditions and sanctions imposed on Russia and their impact on supply chains and the high cost of imports, this will negatively affect trade between Africa and Russia.

As for the returns that accrue to Africa from the crisis, Europe will find alternative sources of Russian natural gas in Africa. It may also benefit from the crisis natural resource exporters, led by South Africa, which is the second largest producer of palladium in the world after Russia, which is used in the automotive and electronics industries.

12. The repercussions of the crisis on the Egyptian economy

The Russian-Ukrainian crisis destabilizes global oil markets, these increasing oil prices، will it affect the Egyptian economy positively or negatively?

The Egyptian petroleum sector moved to meet the challenges of the crisis by developing new action plans to benefit from the rise in oil prices and work to increase production by exploiting possible opportunities to protect the economy from the repercussions of rising prices by intensifying research, exploration work, and pumping investments to speed up the development of new discoveries to raise Egypt's production of oil and natural gas. Especially that the current prices of crude motivate international companies to increase investments. Egypt imports amount of crude oil and petroproducts to meet the needs of the local market to maintain the stability in the local market for petroleum and gas.

Egypt's achievement of Self-sufficiency in natural gas and its conversion from an importing country to an exporting country is a strong point in facing the crisis. This opens the way for exploiting the opportunities available to increase its production of gas, as well as benefiting from the infrastructure and oil ports that have been flown and liquefaction stations in "Idku" and" Damietta", which are owned by Egypt in particular. There is a growing demand for natural gas, and consuming countries are searching for various alternatives to secure its supplies.

After achieving a growth rate of 6.6 % in 2021/22, economic activity is expected to slow down in 2022/23 due Russian-Ukrainian crisis. This will lead to raising domestic inflation in addition to long-term challenges facing Egypt, the Substandard performance of non-oil exports, and FDI that are further undermining foreign income.

After the Russian-Ukrainian crisis, the Brent Crude price was at $139 per barrel. This increase led to a rise in the cost of importing oil to Egypt, which is reflected in its budget. where appreciated a barrel of Brent crude in the general budget for 2021/22 at $60 (ministry of finance, n.d.).

Due to the Russian-Ukrainian crisis, Growth in Egypt is expected to go down to 4.8 % in 2022/23 from 6.6 % the previous year.

Egypt imports about 60% of its wheat needs, as imports about 13 million tons of wheat annually. Egypt's imports from Russia amounted to about 7.8 million tons in 2020 and about 3.3 million tons from Ukraine during the same year.

Ukraine is the main exporter of wheat to Egypt, Turkey, Italy, and African countries.

It should be noted that even though Egypt imported large quantities of wheat, it increased its storage capacity through 44 government silos in 2022, which led to an increase in its wheat storage capacity to exceed 4 million tons in 2022 from 3.6 million tons in the previous year, as part of the national project for silos. Egypt also aims to reduce the waste rate, which was up to 15%. In addition to the 44 state-owned silos, this is according to the data of the Egyptian Holding Company for Silos and Storage. (Egyptian Holding Company for Silos and Storage, 2022)

It is expected that Egyptian economic activity will recover in the medium term, as the Ramifications of the crisis will recede, export-oriented sectors set to arousal, and it goes on country continues moving forward with macroeconomic stabilization and structural reforms.

13. Study Model

The study tests the following hypotheses: Economic growth in Egypt is adversely affected by the rise in global energy prices.

The study is based on the ARDL model in analyzing the relationship between energy prices and economic growth in Egypt. The ARDL model consists of the following equations:

$$\Delta y_t = a_0 + \sum_{i=0}^{r} a_{1i}\Delta y_{t-1} + \sum_{i=0}^{r} a_{2i}\Delta p_{t-i} + \sum_{i=0}^{r} a_{3i}\Delta m_{t-i} + \beta_1 y_{t-1} + \beta_2 p_{t-1} + \beta_3 m_{t-1} + \varepsilon t \ldots\ldots\ldots\ldots(1)$$

The (Δ) is first difference of the values of the variable and (a_0) constant limit also, (r) optimal number of lag times, ($a3i$, $a2i$, $a1i$) short-term dynamic relationship parameters. (β3, β2, β1) parameters of the long-run relationship and determine the extent to which cointegration is possible. And (t) time, (εt) random error term.

In the case of co-integration between the variables of the study according to the limits test, the short-term relationship is estimated using the following error correction model:

$$\Delta y_t = a_0 + \sum_{i=0}^{r} a_{1i}\Delta y_{t-1} + \sum_{i=0}^{r} a_{2i}\Delta p_{t-i} + \sum_{i=0}^{r} a_{3i}\Delta m_{t-i} + yECT_{t-1} + \varepsilon t \ldots\ldots (2)$$

From the above Equation, we can represent the standard study model as follows:

$$\mathbf{GDP_{it} = a + \beta_1 DEX_{it} + \beta_2 GAS_{it} + \beta_3 OIL_{it} + \beta_4 INF_{it} + \beta_5 EXC_{it} + \ldots. \varepsilon_{it}} \quad \mathbf{(3)}$$

Where is (Gdp) Gross domestic product, and (Dex) Energy index, (Gas) Price of gas in US dollars, (oil) Price of oil in US dollars, (INF) inflation, (exc) exchange rate.

13.1.Study Result

Jarque-Bera test: This test aims to examine the normal distribution of the time series separately, to ensure that the data follow the normal distribution or not, it is clear from the results of the normal distribution test that all variables of the standard model follow the normal distribution, where the values of significance of the Jarque-Bera test ranged between (0.084 - 0.0.827), which is greater than 5%, which indicates that the time series of the variables follow the normal distribution.

Unit Root Test: In 1981, Dickey Fuller developed a test for the unit root, later called the Dickey-Fuller test, using a slow variable for the explanatory variables to reach the conclusion that he addressed the weakness of the simple Dickey -Fuller test represented by the problem of autocorrelation in the error term, which makes it More accurate and efficient than the simple Dickey-Fuller test, the expanded Dickey-Fuller test can be illustrated by the following equation:

$$\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{n} \theta_i \Delta Y_{t-i} + \varepsilon_t \ldots\ldots\ldots (4)$$

The following table shows the test results Dickey -Fuller test.

Table (4): ADF test results

Variables	Level				first difference				degree of integration
	Lag	Direction	T-test	p-value	Lag	Direction	T-test	p-value	
GDP	2	Constant	-4.030	0.000	0	Constant	-6.500	0.000	1(1)
gas	2	Constant	-1.750	0.401	1	Constant	-8.838	0.000	1(1)
oil	0	Constant	-1.417	0.567	0	Constant	-6.837	0.000	1(1)
Inf	0	Constant	-3.454	0.013	0	Constant	-10.002	0.000	1(1)
dex	0	Constant	-1.398	0.576	0	Constant	-6.924	0.000	1(1)
EXC	1	Constant	-0.432	0.895	0	Constant	-4.845	0.000	1(1)

Source: From E-Views 12 outputs.

It is clear from the previous table that the variables are not stable at the level, so we are taking the first difference, and after taking the first difference, those variables became stable at rank 1 (1), which supports the use of the ARDL model.

Cointegration test: To test the optimal lag of lag time lag periods, we use the Criteria Selection Order lag test based on the Akaike Information Criteria (AIC) test, Simulation results for E-Views show 12 the optimal model is (1.1.3.6.0) and expresses the lowest AIC value, so the (1.1.4.0.3.0) model is estimated in the short term.

Table (5): Result of ARDL short Model

Variable	Coefficient	St. Error	I-Statistic	Prob.•
GDP (-1)	0.803119	0.046148	17.40299	0.0000
DEX	0.057773	0.081148	3.711945	0.0006
EXC (-3)	0.223037	0.091943	2.425810	0.0199
GAS	0.122423	0.028383	-6.430678	0.0090
INF	0.021802	0.001257	-1.734329	0.0005
OIL (-1)	0.173046	0.006883	1.892350	0.0056
c	1.983967	0.464774	4.268674	0.0001
R-squared	0.796667	Durbin-Watson stat		2.169885
F-statistic	92.0506	Prob(F-statistic)		0.000000

Source: From E-Views 12 outputs.

The previous table shows that the significance of the estimation coefficients ranges between (0.0199 - 0.000), which is less than 5%, which indicates that all the estimation parameters are significant.

These coefficients show that there is a direct relationship between the energy index and economic growth in Egypt. There is also a direct relationship between the exchange rate and economic growth at three lag periods during the period from 1965 to 2021. Gas prices and the inflation index also affect economic growth positively. And Positive between oil prices and economic growth at one lag period.

F-test statistical value was 92.05, and the probability value was 0.00, which is significant at the 5% level, and the estimated R2 value was 0.79, meaning that 79% of the changes that occur in economic growth in the short term are due to the variables of the estimated model, and the remaining value is due to other factors that were not included in the study model, and from the above, we can express the study model as follows:

$GDP_{it} = 1.98+ 0.05\ DEX_{it} + 0.122\ GAS_{it} + 0.173\ OIL_{it} + 0.021\ INF_{it} + 0.22\ EXC_{it} + \ldots. \varepsilon_{it}$

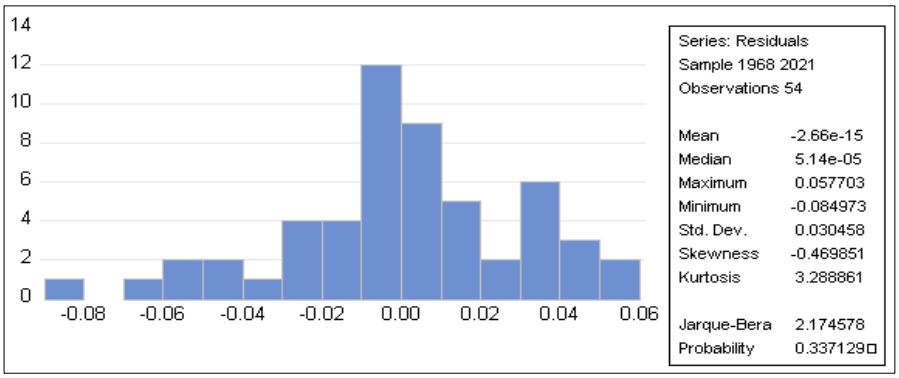
Bound Test: This test aims to determine whether there is a long-term relationship between the variables of the model or not, as this test depends on the results of the F-test analysis and their comparison with tabular values, if the calculated F exceeds the tabular critical value, then the null hypothesis is rejected and the alternative hypothesis is accepted.

It is clear from the previous results that the value of the calculated F-test is (12.51), which is greater than the upper limit of the tabular value at all levels of significance (1%-2.5%-5%-10%), as a result, the alternative hypothesis is accepted while the null hypothesis is rejected., which states the existence of an equilibrium relationship long term between model variables.

13.2.Study model tests

To verify the validity of the estimated model, its integrity and its absence from various measurement problems, a set of tests were performed as follows:

Figure (3): Jarque-Bera test results



Source: From E-Views 12 outputs.

The previous figure shows the results of the Jarque-Bera test, as it aims to test the normal distribution of the study model, and the Jarque-Bera value was (2.174), with a probability value (p = 0.337) which is greater than 5%, which indicates that the residuals follow the normal distribution. Below are the results of the Heteroskedasticity test.

Table (6): Heteroskedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

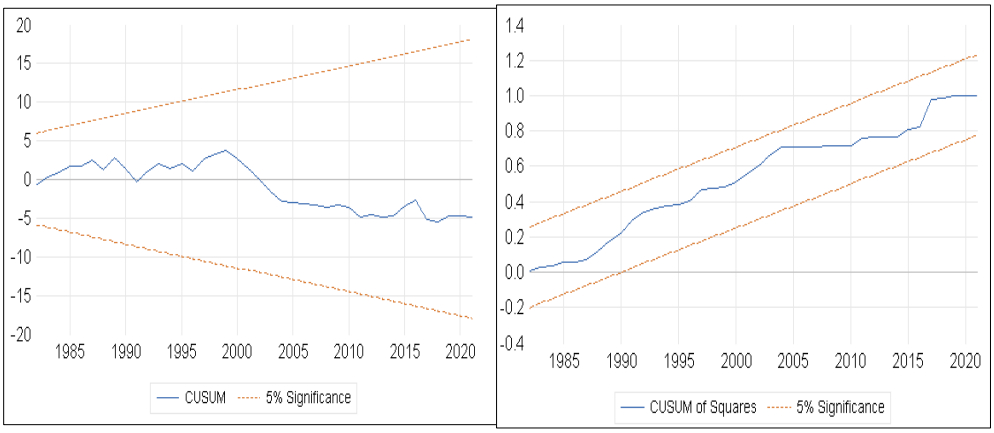
F-statistic	1.172152	Prob. F(13,40)	0.3337
Obs*R-squared	14.89647	Prob. Chi-Square(13)	0.3139
Scaled explained SS	9.354167	Prob. Chi-Square(13)	0.7457

Source: From E-Views 12 outputs.

It is clear from the results of the stability of variance test that the value of the F-Test amounted to (1.172) with a probability value of (0.3337), which is greater than 5%, which indicates that the model does not have a problem of stability of variance, and therefore the previous tests confirm the quality of the estimated standard model, and it is free from measurement problems.

Test for stability model: The model stability test (structural stability of the estimated features) represented by the CUSUM test and the CUSUMSQ test.

Figure (4): CUSUM & CUSUMQ Test



Source: From E-Views 12 outputs.

The previous figure shows that the model is stable and there is no structural change in the model, as the CUSUM & CUSUMQ curves are located within the critical limits, which are the lower and upper limits, at a significant level of 5%. Therefore, the estimated model coefficients are structurally stable during the period of the study, which is from 1965 to the year 2021, which indicates that there is harmony between the long- and short-term results of the estimated model.

13.3. Estimation of long-term Coefficient

Table No (5) shows the results of model Coefficient estimates in the long term, to determine the direction of the relationship between the variables of the study model.

Table (7): Results of estimating long-term Coefficient.

Variable	Coefficient	St. Error	I-Statistic	Prob.
DEX	**-0.293441**	**0.40707**	**4.720861**	**0.019**
EXC	**-0.554353**	**0.105331**	**5.262971**	**0.000**
GAS	**0.021109**	**0.142655**	**7.436159**	**0.006**
INF	**-0.010792**	**0.006084**	**1.773794**	**0.004**
OIL	**0.208667**	**0.414353**	**5.503598**	**0.004**
c	**0.076995**	**0.122904**	**81.99099**	**0.000**

Source: From E-Views 12 outputs.

The results of the previous table indicate that all the variables of the model are statistically significant at the level of significance of 5%, where the values of significance range between (0.019 - 0.004), and the results also show that there is a direct relationship in the long term between each of (gas prices - and oil prices) and economic growth, and the relationship between the variables (energy index - exchange rate - index Inflation) and economic growth has changed in the long run, and the relationship between them has become an inverse relationship.

13.4. Summary Coefficient table

Table (8): Results Coefficient

estimating Short-term Coefficient		estimating long-term Coefficient	
Variable	Coefficient	Variable	Coefficient
DEX	0.057773	DEX	-0.293441
EXC(-3)	0.223037	EXC	-0.554353
GAS	0.122423	GAS	0.021109
INF	0.021802	INF	-0.010792
OIL(-1)	0.173046	OIL	0.208667
c	1.983967	c	0.076995

Source: From E-Views 12 outputs.

From the previous table we conclude the following:

- The energy index explains the value of (0.05) in the short term and (-0.29) in the long term of the change in economic growth during the period from 1965 to 2021, which indicates that energy index in the

short term has a positive relationship with economic growth, but in the long run the relationship becomes inverse according to the study model.

- It also explains the exchange rate (0.22) of the change in economic growth in the short term, while in the long term it explains (-0.55), which indicates that exchange rates in the short term have a positive relationship with economic growth due to attracting foreign investments, but in the long run the relationship becomes inverse according to the study model.
- Gas prices explain (0.122) of the change in economic growth in the short term and explain (0.021) of economic growth in the long term, while oil prices explain (0.173) of the change in economic growth in the short term and in the long term explains (0.208) changes in economic growth.
- The inflation index explains (0.02) and (-0.010) the change in economic growth in Egypt during the study period in the short and long terms, this indicates that inflation rates in the long run have an inverse relationship with economic growth.

The impact of the Russian-Ukrainian crisis on international crude oil and natural gas prices and growth rates in Egypt

To study this effect, correlation coefficients were used between the variables of the study during the period from January 2022 to September 2022, and the results were as follows:

Table (9): correlation coefficients Test

Correlatio

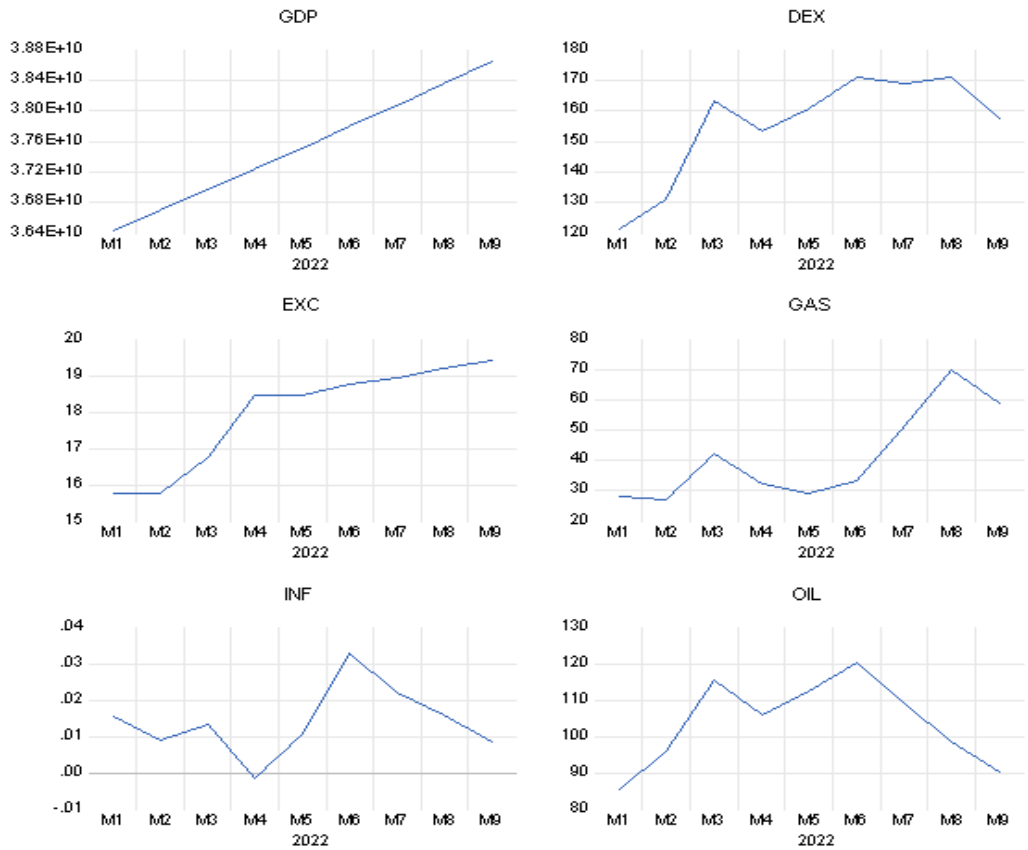
	GDP	DEX	EXC	GAS	INF	OIL
GDP	1.000000	0.749331	0.928084	0.804687	0.217851	0.100348
DEX	0.749331	1.000000	0.818313	0.573000	0.369205	0.693097
EXC	0.928084	0.818313	1.000000	0.629410	0.154333	0.298964
GAS	0.804687	0.573000	0.629410	1.000000	0.110406	-0.153880
INF	0.217851	0.369205	0.154333	0.110406	1.000000	0.390739
OIL	0.100348	0.693097	0.298964	-0.153880	0.390739	1.000000

Source: From E-Views 12 outputs.

There is a significant correlation between changes in both (oil and gas prices and the global energy index) and economic growth in Egypt during the Ukrainian-Russian crisis, and the reason for the lack of economic growth in

Egypt during that period is because the crisis had a significant impact on foodstuffs in Egypt.
While energy prices did not affect Egypt significantly because of the Egyptian government supporting energy prices for citizens.

Figure (5): chart for all variables (during the period from January 2022 to September 2022)



The previous chart shows the fluctuations in the energy, oil and gas price index and inflation rates in Egypt.

14.Conclusion & Recommendations

There is a significant correlation between changes in each of (oil and gas prices and the global energy index) and economic growth in Egypt during the Ukrainian-Russian crisis, and economic growth in Egypt decreased during that period because of the crisis. This caused a significant increase in food prices in Egypt. And The confusion that is currently happening in the oil and gas markets reflects the political events in the oil and gas industry, which may continue with the escalation of the crisis and the absence of any indication of the possibility of ending it.

The results of Table (7) indicate that all the variables of the model are statistically significant at the level of significance of 5%, where the significance values range between (0.019 - 0.004), and the results also show that there is a direct relationship in the long run. The term between each of (gas prices - and oil prices) and economic growth, and the relationship between the variables (energy index - exchange rate - inflation index) and economic growth has changed in the long term, and the relationship between them has become an inverse relationship. Also, there is a significant correlation between changes in both (oil and gas prices and the global energy index) and economic growth in Egypt during the Ukrainian-Russian crisis, and the reason for the lack of economic growth in Egypt during that period is that the crisis had a significant impact on foodstuffs in Egypt.

The results of the measurement concluded that oil and gas prices have a direct impact on economic growth, whether in the short or long term, due to the fluctuations that occur in oil and gas prices globally. Prices, which mainly affects economic growth

Russia's dominance in global commodity markets will lead to higher energy costs for a longer period, in addition to pressure on supply chains, and thus the world will be affected by the war crisis and supply chains, and it will increase inflation in commodity prices.

Recommendations:

Gas plays a leading role in Egypt, but the sharp decline in old fields may severely hinder its ambitions to increase liquefied natural gas exports, which is what the Egyptian Ministry of Petroleum is seeking to increase the efficiency and development of old wells and increase search and exploration rates for new oil wells.

The need to support incentives for energy production through wind and solar energy by reducing production costs, which contributes to reducing the share of coal and nuclear energy in energy production. Certainly, Egypt must consider the repercussions of the Russian-Ukrainian crisis and its impact on the opportunities and challenges that some may present, and therefore it is necessary to exploit these opportunities.

Employing the tools of Egyptian foreign policy at the regional and international levels to take advantage of the changes brought about by the Russian-Ukrainian crisis, especially with the countries that were dependent on Russia and Ukraine to provide some of the goods and services they need.

We must develop a policy to prepare to face the increasing price pressures, by identifying opportunities to develop old production areas and increase their production with modern technologies, which contributes to enhancing local production and thus reducing the import bill.

References

Administration, US Energy Information. (Feb22,2022). Three Countries Provided almost 70% of liquefied natural gas received in Europe in 2021.

CEDIGAZ. (2021). Retrieved from https://www.cedigaz.org/.

Central Bank of Egypt. Retrieved from https://www.cbe.org.eg/en/EconomicResearch/Statistics/Pages/Inflation.aspx.

Cunadoa, J., and Perez de Gracia, F. (Vol.45,2005). Oil Prices, economic activity, and inflation: evidence for some Asian countries. *The Quarterly review of Economics and Finance*, pp.65-83.

Egyptian Holding Company for Silos and Storage. (2022). Retrieved from https://www.ehcss.com/en/our-silos/.

Emeka Emmanuel Okoro1, Adewale Dosunmu2, Kevin Igwilo1, Paul A. L. Anawe1, Angela O. Mamudu3. (Vol.2, No.4, October 30,2017). Economic Advantage of In-Country Utilization of Nigeria Crude Oil. Open Journal of Yangtze oil and Gas.

Gabriel Di Bella, Mark Flanangan, Karim Foda, Svitlana Maslova, Alex Pienkowski, Martin Stuermer and Frederik Toscani. (Jul 2022). Natural Gas in Europe- The Potential Impact of Disruptions to Supply. International Monetary Fund, Working Paper/22/145, p6.

GIIGNL. (2022). The LNG industry, GIIGNL Annual Report. p:6.

Hakan Berument, Nildag Ceylan and Nukhet Dogan. (Vol.31,2010). The Impact of Oil Price Shocks on the Economic Growth of Selected MENA1 Countries. The Energy Journal, pp149-176.

Hanafi, M. (feb24,2022). Egypt says no Worries over Suez Canal amid Russian-Ukrainia standoff. Al- Monitor.

International Energy Agency. (2021). Retrieved from https://www.iea.org/data-and-statistics.

Jabir, R. (Vol.37,2009). Recent Oil Price Shock and Tunisian Economy. Energy Policy, pp.1041-1051.

Kabiru Saidu Musa, Rabiu Maijama, Hassan Usman Shaibu, Abdurrahman Muhammad. (2019, Volume 6). Crude Oil Price and Exchange Rate on Economic Growth: ARDL Approach. Open Access Library Journal, p.1.

kliesen, k. (April 2006). The economy overcomes hurricanes and rising energy prices. *The Regional Economist*, p18.

Ministry of finance. Retrieved from https://www.mof.gov.eg/en/posts/stateGeneralBudget/5fdab2567452020007052b5b/%D9%85%D9%88%D8%A7%D8%B2%D9%86%D8%A9%20%D8%B9%D8%A7%D9%85%D8%A9%202021%2022.

Mork, Knut Anton, Oystein Olsen, and Hans Terje Mysen. (Vol.15, No.4,1994). Macroeconomic Responses to Oil Price Increases and Decreases in Seven OECD Countries. The Energy Journal, pp.19-35.

Omoregie, U. (21 December 2015). The Oil Price Crash of 2014: Implications for a Multi-Billion Dollar LNG Project. *Scientific Research Publishing*, p 577.

Refinitiv Eikon. (2022, February). Retrieved from https://www.refinitiv.com/en/financial-data/eikon-datasets.

Resnick, D. (feb25,2022). What does the war in Ukraine mean for Africa? Brookings.

Statistics, U. o. (Feb,2022). CPI Report. Retrieved from U.S. Bureau of Labor Statistics: https://www.bls.gov/cpi/#tables

Stevens, P. (24 Feb,2022). Metal prices surge on fears of supply disruption, aluminum hits record. cnbc.

Sunny Oswal, Kushagra Goel. (Oct. 24, 2019). Crude Oil Prices: An Asset Class Analysis on Monetary Policy, Currency Exchange Rate and Nifty 500 with Respect to the Indian Economy. *Theoretical Economics Letters*, p2678.

T.K.Jayaraman,Evan Lau. (Vol.2, No.2, May 17,2011). Oil Price and Economic Growth in Small Pacific Island Countries. Modern Economy, p:160.

United Nations database. (2020). Retrieved from https://www.un.org/ar/library/page/databases.

U.S. Department of Energy's. (2022). Retrieved from https://www.energy.gov/.

World Bank. (2022). Economic report on Egypt.

Appendix

Table 1: World total primary energy consumption by region (Quadrillion British thermal units)

Region	2020	2025	2030	2035	2040	2045	2050	Average annual percentage change, 2020–2050
OECD								
OECD Americas	118.2	126.0	127.5	130.9	134.6	139.7	145.2	0.7
United States	92.9	98.4	98.6	100.0	101.9	105.0	108.7	0.5
Canada	14.6	15.4	16.1	16.8	17.5	18.3	19.0	0.9
Mexico and other OECD Americas	10.6	12.1	12.9	14.1	15.1	16.4	17.6	1.7
OECD Europe	77.6	82.1	83.3	85.9	88.0	90.7	94.1	0.6
OECD Asia	37.2	39.9	40.5	41.0	41.2	41.5	42.0	0.4
Japan	18.3	18.7	18.4	18.1	17.7	17.4	17.2	-0.2
South Korea	12.0	13.5	13.9	14.2	14.3	14.5	14.7	0.7
Australia and New Zealand	6.9	7.7	8.2	8.7	9.1	9.6	10.1	1.3
Total OECD	232.9	248.0	251.3	257.7	263.8	272.0	281.3	0.6
Non-OECD								
Non-OECD Europe and Eurasia	52.6	54.8	56.9	59.5	61.9	64.1	66.0	0.8
Russia	34.4	36.3	37.6	39.2	40.5	41.6	42.3	0.7
Other Europe and Eurasia	18.2	18.5	19.2	20.3	21.4	22.5	23.7	0.9
Non-OECD Asia	230.3	267.2	292.8	320.8	349.4	378.5	402.8	1.9
China	156.4	169.2	174.6	180.7	187.1	193.5	196.9	0.8
India	31.5	46.5	59.8	74.4	89.3	105.2	119.8	4.6
Other Asia	42.5	51.6	58.5	65.7	73.0	79.8	86.1	2.4
Middle East	35.2	40.3	41.7	43.3	46.1	47.6	48.3	1.1
Africa	22.9	26.6	29.6	33.2	37.0	41.1	46.0	2.4
Non-OECD Americas	27.6	30.8	32.9	35.0	37.2	39.5	42.0	1.4
Brazil	14.9	16.7	17.7	18.7	19.6	20.2	20.8	1.1
Other Non-OECD Americas	12.7	14.1	15.1	16.2	17.7	19.4	21.2	1.7
Total Non-OECD	368.6	419.6	453.9	491.7	531.7	570.8	605.1	1.7
Total World	601.5	667.5	705.2	749.5	795.4	842.8	886.3	1.3

Sources: U.S. Energy Information Administration (EIA), Annual Energy Outlook 2021, (February 2021).
* (OECD): the Organization for Economic Cooperation and Development

Table 2: World natural gas production by region (Trillion cubic feet)

Region	2020	2025	2030	2035	2040	2045	2050	Average annual percentage change, 2020–2050
OECD								
OECD Americas	**41.0**	**43.4**	**45.8**	**47.6**	**49.7**	**52.0**	**53.7**	**0.9**
United States	33.9	36.3	37.9	38.6	39.9	41.5	43.0	0.8
Canada	6.2	6.1	6.7	7.5	8.1	8.6	8.9	1.2
Mexico and other OECD Americas	0.9	1.0	1.2	1.5	1.7	1.9	1.8	2.4
OECD Europe	**8.6**	**8.4**	**7.1**	**6.1**	**5.3**	**5.0**	**5.0**	**-1.8**
OECD Asia	**5.6**	**6.1**	**6.3**	**6.9**	**7.2**	**7.1**	**7.2**	**0.8**
Japan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
South Korea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Australia and New Zealand	5.5	6.0	6.2	6.8	7.1	7.1	7.1	0.8
Total OECD	**55.3**	**57.8**	**59.2**	**60.7**	**62.2**	**64.1**	**65.9**	**0.6**
Non-OECD								
Non-OECD Europe and Eurasia	**31.5**	**35.6**	**37.4**	**39.4**	**41.9**	**44.4**	**46.2**	**1.3**
Russia	24.2	27.5	29.3	30.5	32.2	34.0	35.5	1.3
Other Europe and Eurasia	7.3	8.2	8.2	8.9	9.8	10.4	10.6	1.3
Non-OECD Asia	**18.7**	**20.4**	**22.2**	**22.4**	**22.3**	**23.5**	**26.2**	**1.1**
China	6.6	7.4	8.5	8.6	8.3	8.9	10.2	1.5
India	1.0	1.1	1.6	1.9	2.2	2.9	4.0	4.7
Other Asia	11.1	11.9	12.2	11.9	11.8	11.6	12.0	0.3
Middle East	**23.0**	**24.4**	**26.5**	**26.6**	**27.9**	**28.4**	**28.8**	**0.8**
Africa	**7.2**	**8.1**	**8.8**	**9.8**	**11.0**	**11.4**	**12.1**	**1.7**
Non-OECD Americas	**6.1**	**6.2**	**6.0**	**6.0**	**6.1**	**6.2**	**6.7**	**0.3**
Brazil	1.0	1.1	1.0	0.9	0.8	0.8	0.9	-0.3
Other Non-OECD Americas	5.0	5.0	5.0	5.1	5.2	5.4	5.8	0.4
Total Non-OECD	**86.4**	**94.6**	**101.0**	**104.2**	**109.3**	**114.0**	**120.0**	**1.1**
Total World	**141.7**	**152.4**	**160.2**	**164.9**	**171.4**	**178.1**	**186.0**	**0.9**

Sources: U.S. Energy Information Administration (EIA), Annual Energy Outlook 2021, (February 2021).
* Natural gas production numbers exclude non-hydrocarbon gases.

Table 3: World natural gas consumption by region (Trillion cubic feet)

Region	2020	2025	2030	2035	2040	2045	2050	Average annual percentage change, 2020–2050
OECD								
OECD Americas	38.40	39.60	40.40	41.80	43.80	45.80	47.40	0.70
United States	30.80	30.80	31.00	31.40	32.70	34.10	35.40	0.50
Canada	4.30	4.60	4.90	5.40	5.90	6.30	6.60	1.50
Mexico and other OECD Americas	3.40	4.20	4.50	5.00	5.20	5.40	5.40	1.50
OECD Europe	19.00	20.00	20.30	20.20	20.20	20.70	21.30	0.40
OECD Asia	7.80	7.70	7.70	7.30	7.00	6.70	6.70	-0.50
Japan	3.80	3.50	3.50	3.20	2.90	2.80	2.70	-1.10
South Korea	2.20	2.20	2.30	2.20	2.10	2.00	2.00	-0.30
Australia and New Zealand	1.80	1.90	2.00	2.00	2.00	1.90	2.00	0.30
Total OECD	65.20	67.30	68.40	69.30	71.00	73.10	75.50	0.50
Non-OECD								
Non-OECD Europe and Eurasia	24.40	25.20	26.30	27.00	27.70	28.40	29.20	0.60
Russia	17.60	18.00	18.90	19.40	20.10	20.70	21.20	0.60
Other Europe and Eurasia	6.80	7.20	7.40	7.50	7.60	7.80	8.00	0.60
Non-OECD Asia	23.00	27.70	31.50	33.80	36.60	39.40	42.50	2.10
China	11.00	14.00	16.20	17.40	18.60	19.90	21.00	2.20
India	2.00	2.70	3.50	4.30	5.10	6.00	7.00	4.30
Other Asia	10.10	11.00	11.70	12.20	12.80	13.50	14.50	1.20
Middle East	18.30	20.80	21.70	21.70	22.50	23.00	23.30	0.80
Africa	5.40	5.80	6.50	7.20	7.60	7.80	8.70	1.60
Non-OECD Americas	5.40	5.70	5.70	5.90	6.10	6.30	6.80	0.80
Brazil	1.30	1.70	1.60	1.50	1.50	1.40	1.50	0.60
Other Non-OECD Americas	4.20	4.00	4.10	4.40	4.60	4.90	5.30	0.80
Total Non-OECD	76.50	85.20	91.80	95.60	100.50	105.00	110.50	1.20
Total World	141.70	152.40	160.20	164.90	171.40	178.10	186.00	0.90

Sources: U.S. Energy Information Administration (EIA), Annual Energy Outlook 2021, (February 2021).

♦ Natural gas consumption excludes non-hydrocarbon gases.

Table 4: Total world delivered energy consumption by end-use sector (Quadrillion British thermal units)

Sector and fuel	2020	2025	2030	2035	2040	2045	2050	Average annual percentage change, 2020–2050
Residential								
Liquid fuels	9.6	8.8	9.0	9.2	9.3	9.4	9.5	-0.1
Natural gas	24.3	24.7	25.6	26.1	26.7	27.0	27.6	0.4
Coal	5.4	5.1	5.0	4.9	4.8	4.7	4.7	-0.5
Electricity	22.6	25.2	28.1	31.4	35.1	39.2	43.1	2.2
Renewables	1.5	1.5	1.6	1.6	1.6	1.6	1.7	0.3
Total	**63.5**	**65.5**	**69.3**	**73.1**	**77.5**	**81.9**	**86.5**	**1.0**
Commercial								
Liquid fuels	3.9	3.5	3.6	3.7	3.8	3.8	3.8	-0.1
Natural gas	10.1	10.7	11.0	11.2	11.5	11.6	11.8	0.5
Coal	1.7	1.7	1.7	1.7	1.7	1.8	1.8	0.1
Electricity	17.2	19.4	21.0	22.6	24.4	26.3	28.1	1.7
Renewables	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
Total	**33.1**	**35.6**	**37.6**	**39.5**	**41.7**	**43.8**	**45.8**	**1.1**
Industrial								
Liquid fuels	61.7	70.8	77.3	83.3	88.7	93.8	98.3	1.6
Natural gas	58.2	66.5	71.1	76.0	80.9	85.3	89.3	1.4
Coal	64.4	68.6	71.0	73.8	76.7	80.1	83.3	0.9
Electricity	36.1	41.6	43.9	46.6	49.2	51.6	53.6	1.3
Renewables	20.7	24.3	26.9	29.5	32.0	34.5	36.9	2.0
Total	**241.0**	**271.8**	**290.4**	**309.3**	**327.4**	**345.1**	**361.3**	**1.4**
Transportation								
Liquid fuels	102.1	119.6	123.1	125.9	128.9	132.7	135.8	1.0
Natural gas	4.1	5.1	6.0	7.2	8.8	10.5	12.5	3.8
Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electricity	1.6	2.0	2.7	3.8	5.0	6.3	7.6	5.4
Renewables	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**107.8**	**126.7**	**131.9**	**136.9**	**142.7**	**149.5**	**155.9**	**1.2**
All end-use sectors								
Liquid fuels	177.4	202.8	213.1	222.2	230.7	239.6	247.4	1.1
Natural gas	96.6	107.0	113.7	120.5	127.8	134.4	141.1	1.3
Coal	71.6	75.4	77.8	80.4	83.2	86.6	89.8	0.8
Electricity	77.4	88.3	95.8	104.4	113.7	123.4	132.3	1.8
Renewables	22.4	26.1	28.8	31.4	33.9	36.4	38.8	1.9
Delivered energy	445.4	499.7	529.2	558.8	589.2	620.3	649.5	1.3
Electricity-related losses	151.1	163.1	170.0	183.4	197.9	213.1	226.5	1.4
Discrepancy	5.0	4.7	6.0	7.2	8.3	9.4	10.4	2.4
Total	**601.5**	**667.5**	**705.2**	**749.5**	**795.4**	**842.8**	**886.3**	**1.3**
Electric power								
Liquid fuels	4.9	7.0	3.0	1.4	0.7	0.4	0.3	-9.0
Natural gas	52.0	52.7	54.0	52.1	51.7	52.0	53.4	0.1
Coal	87.0	84.9	80.5	84.1	87.1	89.8	88.8	0.1
Nuclear	26.8	30.0	30.7	32.1	32.4	31.7	31.7	0.6
Renewables	65.1	84.2	104.8	125.2	146.8	169.8	191.7	3.7
Total	**235.8**	**258.7**	**273.0**	**295.0**	**318.8**	**343.6**	**365.9**	**1.5**
Total energy consumption								
Liquid fuels	182.4	208.8	215.6	223.4	231.6	240.5	248.5	1.0
Natural gas	147.3	158.4	166.5	171.4	178.1	185.1	193.2	0.9
Coal	155.6	157.8	155.8	162.3	168.3	174.4	176.7	0.4
Nuclear	27.5	30.9	31.7	33.2	33.5	32.7	32.7	0.6
Renewables	88.7	111.7	135.6	159.3	183.9	210.1	235.2	3.3
Total	**601.5**	**667.5**	**705.2**	**749.5**	**795.4**	**842.8**	**886.3**	**1.3**

Sources: U.S. Energy Information Administration (EIA), Annual Energy Outlook 2021, (February 2021).

*End-use sector electricity consumption does not include electrical system energy losses incurred in the generation, transmission, and distribution of electricity.

Table 5: Liquefaction plants in Egypt

Country	Name	Liquefaction		storage		Owner(s)	operator	MT-LT Buyer(s)	Start-up date
		Number of trains	Nominal Capacity (MTPA)	Number of tanks	Total Capacity (Liq m^3)				
Egypt	Damietta*	1	5	2	300,000	**SEGAS** (ENI 50%, EGPC40%, EGAS10%)	SEGAS SERVICES	BP, ENI	2005
	Idku T1	1	3.6	2	280,000	**Egyptian LNG** (Shell 35.5%, Petronas35.5 %, EGPC12%, EGAS12%, total Energies 5%)	Egyptian LNG	Tola Energies	2005
	Idku T2	1	3.6			**Egyptian LNG** (Shell 38%, Petronas38%, EGAS12%, EGPC12%)		Shell	

Source: GIIGNL Annual Report 2022 Edition

* Damietta liquefaction plant in Egypt resumed operations in February 2021, after the 5 MTPA terminal was shut down in December 2012.