

MPRA

Munich Personal RePEc Archive

Global energy crisis: impact on the global economy

Ozili, Peterson K

2023

Online at <https://mpra.ub.uni-muenchen.de/118791/>
MPRA Paper No. 118791, posted 10 Oct 2023 10:28 UTC

Global energy crisis: impact on the global economy

Peterson K. Ozili, *Central Bank of Nigeria*

Ercan Ozen, *University of Usak, Türkiye*

Abstract

This paper explores the 2021-2022 global energy crisis. The 2021-2022 energy crisis was caused by many factors including the global campaign to reduce carbon emission, the shortage in fossil fuel reserves due to divestment from fossil fuels, the halt in oil production due to the COVID-19 pandemic and the Ukraine and Russia conflict. The empirical results show that gasoline prices rose in Asia, Europe, Africa, the Middle East and the Americas. The rise in gasoline prices occurred during the period when COVID-era restrictions were lifted in 2021 and also during the Russia-Ukraine conflict in early 2022. The correlation results show that gasoline prices in Middle East, Europe, Asia and the Americas were significantly correlated but not in Africa. The findings have implications.

Keywords: COVID-19 pandemic, gasoline, energy crisis, Asia, Europe, Africa, Middle East.

JEL codes: P18.

January 2023

1. Introduction

We examine the global energy crisis that occurred between 2021 and 2022 and the effect on the global economy. The crisis was caused by fossil fuel energy shortage. The global energy crisis was triggered by three main factors, namely, (i) the global movement against carbon emission from fossil fuel energy sources which began in the early 2000s, (ii) the global supply chain disruption caused by a halt in global trade during the COVID-19 pandemic, and (iii) the insufficient fossil fuel energy to meet rising demand. These three factors played an important role in causing the global energy crisis.

Historically, fossil fuel energy has served the world for many decades beginning from the 1700s. Since the 1700s, fossil fuel energy has powered industrial production, automobiles and the activities of corporations which have contributed to GDP growth in several countries. In the late 2000s, evidence began to emerge that fossil fuel energy contributed to the increase in greenhouse gas emission and climate change and could negatively affect human life and animal life in the future (Tan, 2014; Ramanathan and Feng, 2009). This led to growing interest about the negative effect of climate change and with renewed focus on reducing carbon emission from fossil fuel usage.

Prior to the COVID-19 pandemic, there have been international efforts and consultations to respond to the threat posed by climate change on the global economy (Dietz, Shwom and Whitley, 2020). Such efforts and consultations have led to several climate change meetings held by the United Nations, the COP21 (which formed the Paris Agreement), the Intergovernmental Panel on Climate Change, etc. These efforts led to calls for a deliberate reduction in carbon emission and, more specifically, a reduction in the use of fossil fuel globally. These international efforts and consultations were supported by some countries and led to an agreement to achieve a net-zero carbon emission and to support the transition to renewable energy. Since then, there have been increased attention on renewable energy.

Renewable energy is derived from sources that can be refilled or replenished. One merit of renewable energy is that renewable energy does not release any harmful substance or pollutant into the climate or the environment, thus, making it safe and clean for human and animal life

(Lacetera, 2019). Presently, there is a lot of policy discussion about the prospects of renewable energy and how to make it a mainstream energy source in society. Some countries have issued policies that create an investment-friendly environment to entice investors to invest in renewable energy such as investment in new battery technology and investment in improvement in existing battery technologies. The purpose of renewable energy investment is to ensure that battery can store large amounts of energy for both domestic and industrial use as an alternative to fossil fuel energy. While investment in renewable energy is on the increase, investment in fossil fuel energy has decreased considerably over the years. Also, renewable energy that is powered by battery technology is not yet developed to meet global energy demand. The declining investment in fossil fuel energy led to energy shortage that could not be filled by the small and emerging renewable energy sources.

The effect of the energy shortfall was magnified during the COVID-19 pandemic. As many countries began to lift COVID-era restriction, there was a sharp surge in energy demand in many countries especially in European countries. The already depleted fossil fuel energy reserves were insufficient and could not meet the growing energy demand. Also, renewable energy sources could not be used to fill the energy shortage either because they were too small or because they were depleted too quickly or because they could not be used on a large scale compared to fossil fuel energy. The energy shortfall was responsible for the rising electricity and fossil fuel prices. The crisis was further worsened by the 2022 Russian-Ukraine War and the sanctions imposed on Russia. It disrupted the supply of Russia's fossil fuel energy to European countries that depended on Russia for energy supplies. This led to a further increase in global energy price. These events showed that the divestment from fossil fuel energy was too early because it was done at a time when the global renewable energy sector was still developing or underdeveloped.

Much of the academic literature on the energy transition has focused on how to make the energy transition work while ignoring whether the timing is appropriate and ignoring how economic and non-economic events might affect the global energy transition to clean energy. Also, there is little knowledge about the effect of this crisis on consumer welfare and for the global economy. This paper looks deeply into this issue.

As the global energy crisis is ongoing, the challenge facing all countries is to find a way to reduce carbon emission from fossil fuel energy to achieve a net-zero carbon emission while at the same time ensuring that there are sufficient energy reserves to meet the growing demand for energy. More research is needed to suggest how this can be achieved. And even after the crisis ends, there will be greater focus on how to support the renewable energy transition while ensuring that there is sufficient energy reserve to meet any unexpected increase in energy demand during the energy transition.

The remaining sections of our paper is arranged in this order. The review of related studies is presented in Section 2. An overview of the global energy crisis is presented in section 3. The research design is stated in section 4. The findings from our analysis are reported in Section 5. The conclusion of the study is presented in section 6.

2. Review of Related Studies

Qureshi, Rasli, and Zaman (2016) examined the previous energy crisis and reforms in the world beginning from 1975 to 2012. They used the Granger causality method and show that there is causality between economic factors and electric shortage. They find also that greenhouse gas emissions contribute to the shortages in electric power transmission. In a U.S. study, Wellum (2020) showed that the energy crisis in the United States contributed to the development of the U.S. energy financial market. Islam, Al-Amin and Sarkar (2021) suggest that the solution to the shortfall between energy supply and energy consumption is to use policies that encourage energy diversification, and such diversification should be supported with strong governance in the use and distribution of energy resources. Nwedu (2021) showed that, despite the growing support for energy transition in developing countries, many developing economies are heavily reliant on fossil fuel energy sources possibly because of their failure to develop and grow their non-fossil fuel energy sources. Pietrosevoli and Rodríguez-Monroy (2019) take a look at the energy issues in Venezuela. The authors suggest the need for a careful transition to sustainable energy. Riaz, Chaudhry and Faridi (2018) examined the impact of energy crisis on GDP growth in Pakistan. The

author used yearly data from 1971 to 2015, and found a unidirectional causal effect between economic growth and the energy crisis. Fan and Hao (2020) also found a causal association between economic growth and sustainable energy growth in China, implying that economic growth and sustainable energy growth can be mutually reinforcing in China. Mahmood, Wang and Hassan (2019) also found that greater investment in human capital development leads to lower carbon pollution in Pakistan. The authors used the three-stage least square and ridge regression methods. They find that the interaction effect of income and renewable energy contribute to CO₂ emissions while human capital mitigates CO₂ emissions. Awan and Khan (2014) showed that the Pakistan energy crisis was caused by the failure to foresee an increase in the demand for energy. De Jong and Sterkx (2010) point out that the 2009 dispute between Russia and Ukraine led to a major disruption in energy to European countries. Wang, Deng, Zhou and Zhu (2011) examined the factors that drive energy consumption. The study finds that energy consumption is driven by economic growth.

3. Understanding the 2021-2022 global energy crisis

During the early stages of the 2020 COVID-19 pandemic, there was a general fall in global energy demand and a reduction in crude oil production due to COVID lockdown and trade restrictions. As countries began to lift COVID-era restrictions, global demand for fossil fuel energy began to rise. The OPEC responded slowly and did not increase oil production to meet rising demand. As a result, global demand exceeded supply. Consequently, the price of Brent oil exceeded US\$80 per barrel in September 2021. The rising Brent oil price was due to rising global demand for crude oil. The high demand for aviation fuel, rising demand for energy for domestic heating during winter and the high demand for automobile fuel contributed significantly to the rise in global energy prices. Also, global demand for fossil fuel energy exceeded supply and resulted in increase in oil price which then translated to higher fuel prices. The increase in oil price, arising from supply shock, showed that fossil fuel investment had declined over the years due to the decarbonization agenda. Many investors divested from fossil fuel to invest in renewable energy sources that offered a good rate of return.

3.1. Energy crisis in Europe

During the COVID-19 pandemic, there was a decrease in global energy demand and a reduction in electricity production from non-fossil fuel sources. As COVID-era restrictions were lifted, the rising demand led to natural gas shortage in Europe. The shortage was further worsened by the Russian military buildup on the border of Ukraine which further disrupted energy supply from Russia to European countries that depend on Russia for energy imports. This led to rising natural gas price across Europe. Due to rising gas prices, Russia's Gazprom was authorized to supply gas to European countries. The increase in natural gas supply by Russia's Gazprom led to a drop in energy prices in November 2021. But natural gas price rose again in December of 2021 due to (i) Germany's refusal to grant approval for the Nord Stream 2 natural gas pipeline, (ii) Germany's closure of nuclear power and coal plants, and (iii) Russia's military activity near the border of Ukraine. Energy prices rose even higher in early 2022 due to the sanctions imposed on Russia during Russian invasion of Ukraine in February of 2022. The invasion disrupted energy supply to European countries and led to rising gas prices and rising electricity prices. The surging energy prices led many European countries to find alternative energy sources to meet energy demand but this came at a high cost. The food and food ingredient industry in Europe were also affected by the energy crisis. It led to higher food prices in many European countries. The general effect of the energy crisis in Europe was felt through higher cost of living and increase in house prices in many European countries including Belgium, France, the United Kingdom, Germany, Moldova and Spain.

3.2. Energy crisis in Asia

Some Asian countries, such as India and China, faced their worse energy crisis in a long time. The surge in energy demand after COVID-era restrictions were lifted was so high that it exceeded the coal reserves in India and China. As a result, the authorities in China had to limit daily energy consumption. Many companies had to operate for only 3 to 5 hours in a day before shutting down operations for the day. Meanwhile, many residential users faced energy blackout for days due to the shortage of coal energy supply. In India, coal is the main source of energy. India generates 70% of its power from burning coal. India's coal reserves were severely depleted in August 2021.

Due to the coal shortage, the Indian authorities had to divert the use of coal from non-essential use to essential use. The consequence was that the use of coal was rationed during the period.

3.3. Energy crisis in Africa

During the pandemic in 2021, few African countries supplied energy products to European countries to help them refill their energy reserves during the energy shortage in 2021. Spain imported natural gas from Algeria through Morocco during the energy shortage. Morocco agreed to take a small percentage of the energy delivered to Spain – an agreement that was made in 1996. Soon after, Algeria and Morocco had a conflict that forced Spain to re-route natural gas to Spain through other channels. This was a costly decision and it led to higher gas prices in Spain. Also, some African countries rely on coal to generate electricity. Over 80% of the electricity consumed in South Africa is generated from coal. This is more than the global average of 34% and is also higher than 71% of the electricity generated from coal.

3.4. Energy crisis in the Middle East

The energy crisis also affected some Middle East countries. The crisis led to fuel scarcity in Lebanon in 2021. It also led to a shortage in electricity supply and forced many people to live without power supply. Hospitals could not function optimally because they had to ration electricity during the day. As a result of the energy crisis, Lebanon imported energy supplies from neighbouring countries such as Jordan and Syria.

3.5. The contribution of Russian-Ukraine conflict to the energy crisis

Russian invasion of Ukraine was caused by Russia's opposition to Ukraine's ambition to join the EU and NATO. Russia felt threatened that the alliance between Ukraine and NATO will pose a national security risk to Russia. Russia reacted by launching its so-called 'special military operation' in Ukraine to mitigate the supposed national security risk. The operation led to resistance by Ukraine, and also led to global energy supply disruption as major oil companies could not obtain energy supplies from Russia to distribute to European countries that depend on Russia's energy import (Ozili, 2022).

4. Methodology

Data for the price of gasoline were collected from tradingeconomics.com. This database aggregates various data collected from national statistical agencies and data from several international databases. Gasoline price data were collected from April 2021 to February 2022. The data were analyzed by comparing gasoline prices using graphical analysis and Pearson correlation methodology. The empirical analysis is reported in section 5.

5. Empirical Results

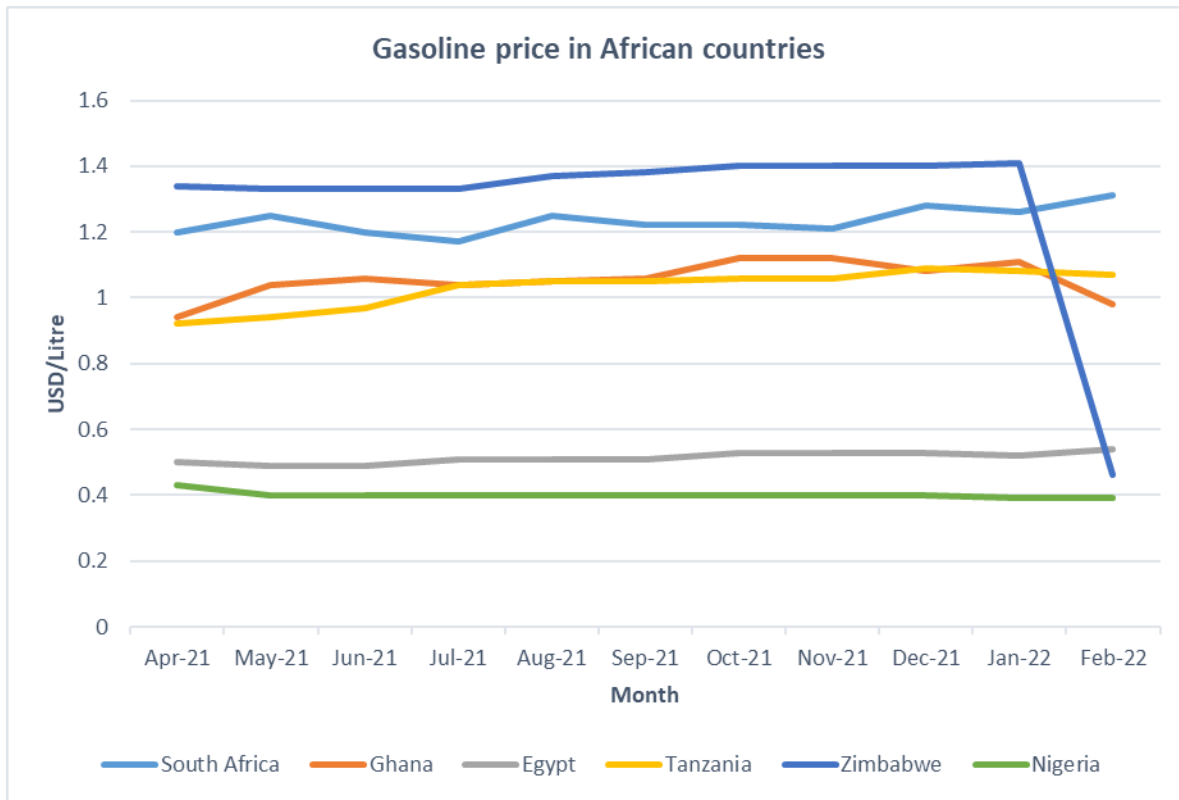
5.1. Gasoline price: some data from around the world

In this section, we analyse the trend in gasoline price in regions of the world.

5.1.1. Gasoline price in Africa

The price of gasoline increased in African countries. The increase in gasoline price was due to low supply in the energy market during the pandemic. This led to a surge in the demand for gasoline when COVID restrictions were lifted. Figure 1 shows that South Africa, Ghana, Tanzania and Egypt recorded an increase in gasoline price between September and December of 2021. This was the period when economic activities resumed as COVID era restrictions were lifted. Meanwhile, the price of gasoline remained low and steady in African countries where gasoline prices are fixed and controlled by the government such as in Nigeria.

Figure 1. Gasoline price in African countries

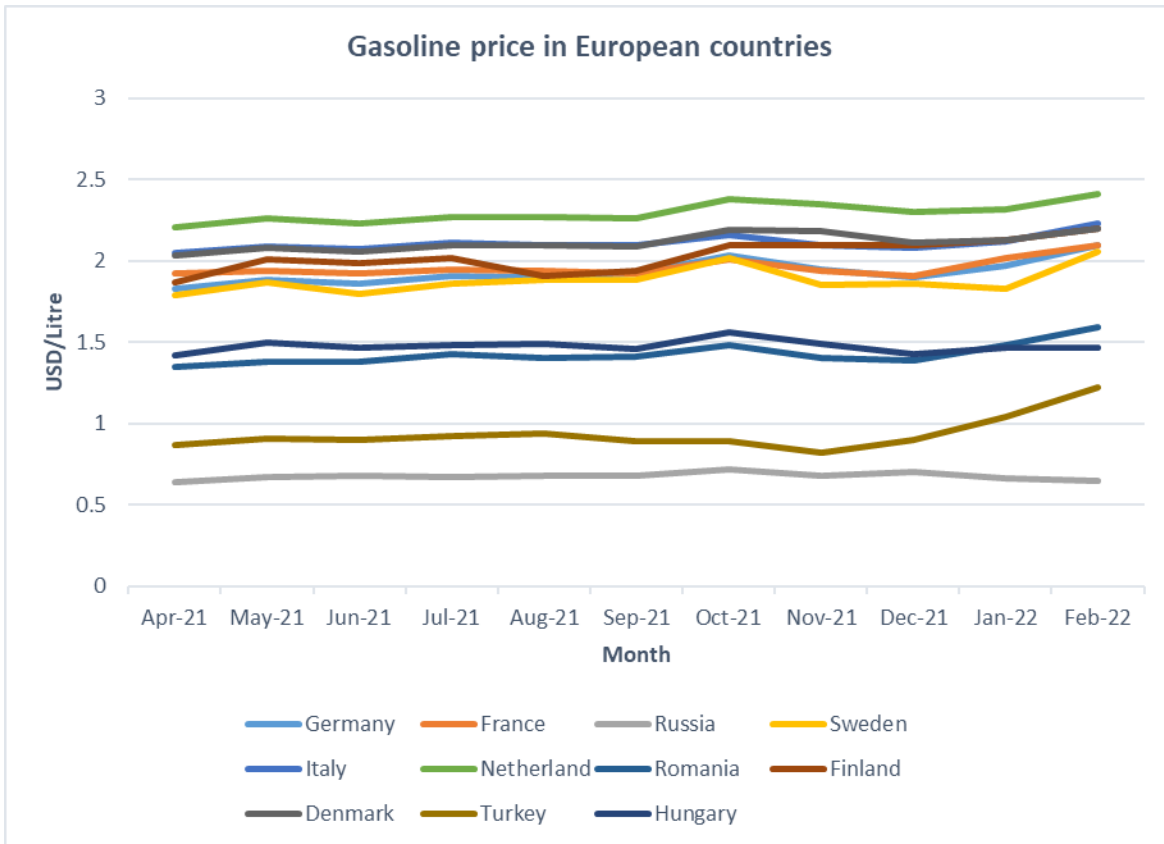


(Source: Trading Economics)

5.1.2. Gasoline price in Europe

The price of gasoline increased in Europe. Figure 2 shows that the price of gasoline rose significantly in most European countries from September 2021 up until February 2022. This was due to rising demand for gasoline at a time when fossil fuel energy reserves in Europe were significantly depleted and during the growing conflict between Ukraine and Russia from November 2021 to March 2022 when Russia invaded Ukraine. This led to a disruption in the supply of gasoline from Russia to European countries and resulted in rising gasoline price. Figure 2 shows that, although the price of gasoline rose in most European countries from September 2021, gasoline prices rose much faster in Turkey, Romania, France and Sweden.

Figure 2. Gasoline price in European countries

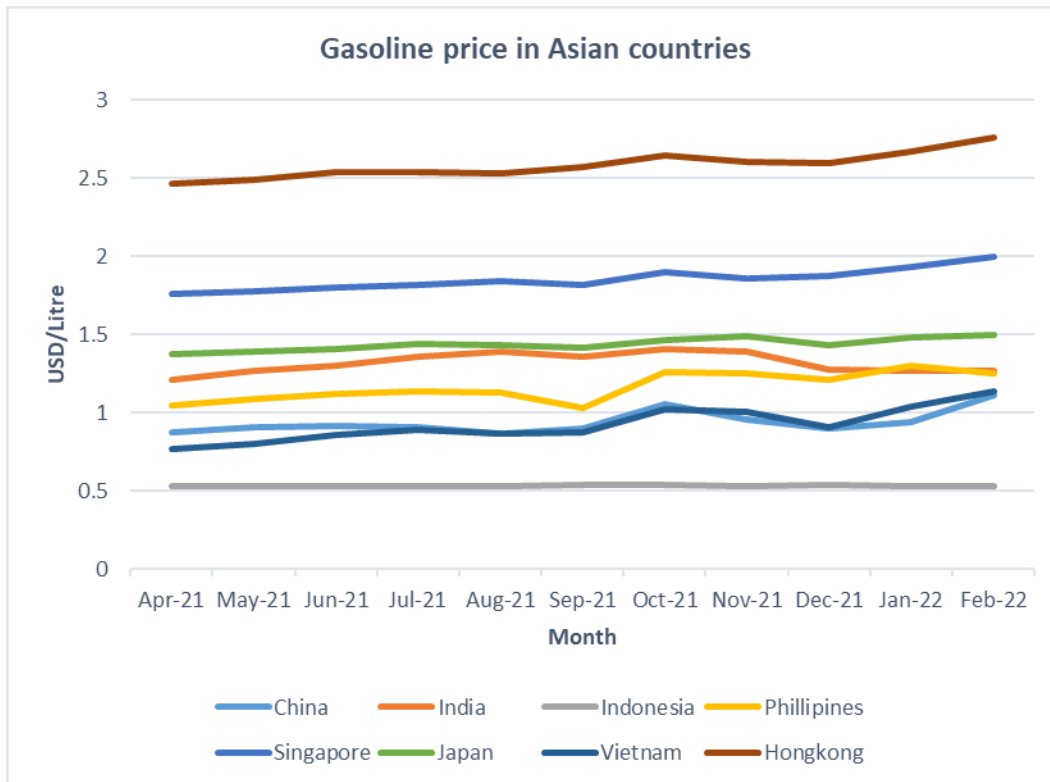


(Source: Trading Economics)

5.1.3. Gasoline price in Asia

The price of gasoline increased in Asia. The increase in the price of gasoline was due to a number of factors, including the shortfall in coal energy, the rise in the demand for gasoline as COVID restrictions were lifted as well as the energy supply chain disruption which reduced energy import to Asian countries. Figure 3 shows that the price of gasoline was much higher in Hong Kong and Singapore and much lower in Indonesia from April 2021. However, a sharp rise in the price of gasoline was recorded in Asian countries such as Vietnam, China, Philippines, Singapore and Hong Kong from September 2021 upwards. Countries like Hong Kong, Vietnam, Singapore and China witnessed a further increase in the price of gasoline in January and February of 2022 as a result of gasoline supply disruption caused by the Russian-Ukraine conflict.

Figure 3. Gasoline price in Asian countries

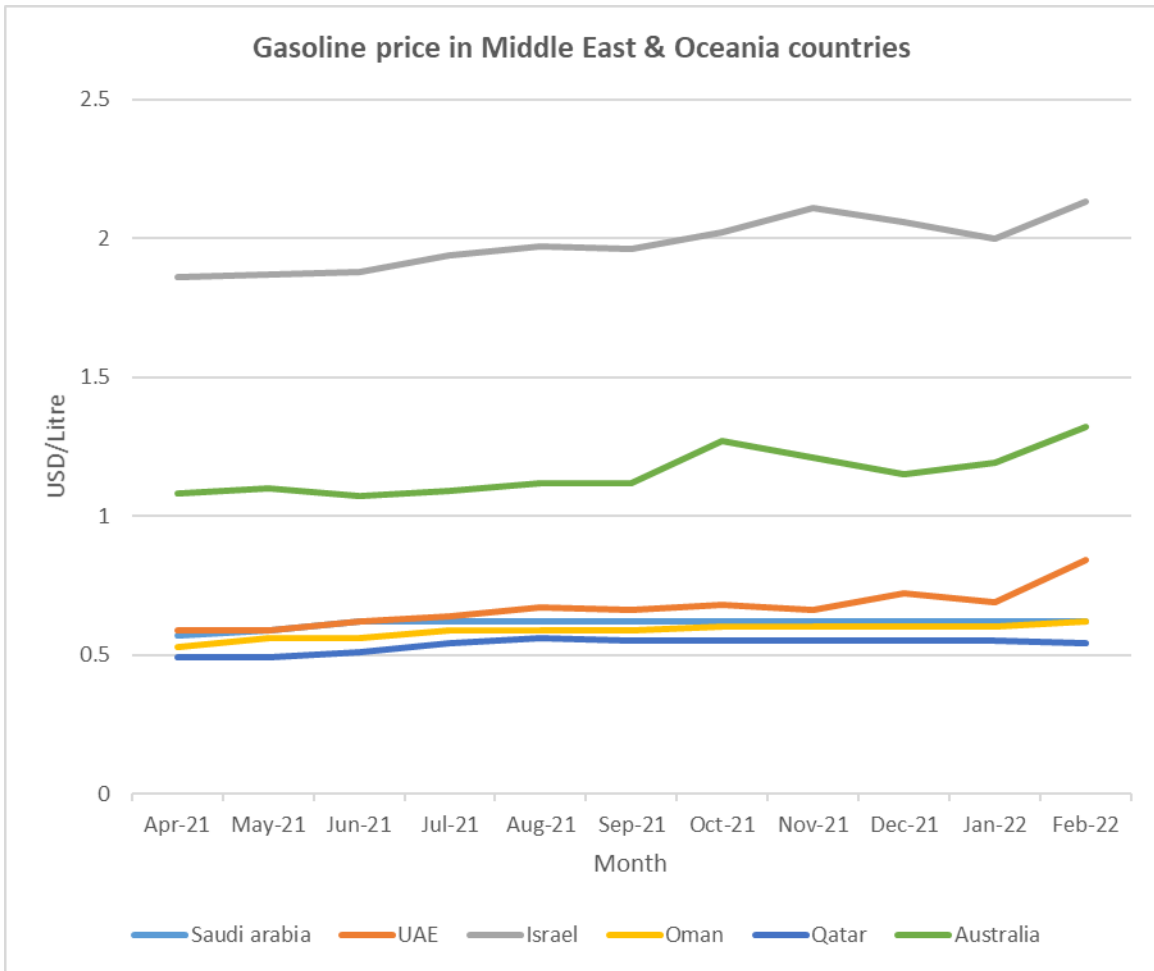


(Source: Trading Economics)

5.1.4. Gasoline price in Middle East countries

Some Middle Eastern countries witnessed rising gasoline price (see figure 4). This was largely due to the restriction placed on oil production quota among OPEC countries. The quota restriction led to a reduction in oil production at a time when global oil demand fell during the 2020 COVID pandemic. As global economic activities revived in September of 2021, OPEC countries did not resume production immediately. This led to a surge in the demand for gasoline while supply remained low. This led to increase in the price of gasoline in countries such as Israel, Qatar and the United Arab Emirates.

Figure 4. Gasoline price in Middle East & Oceania countries



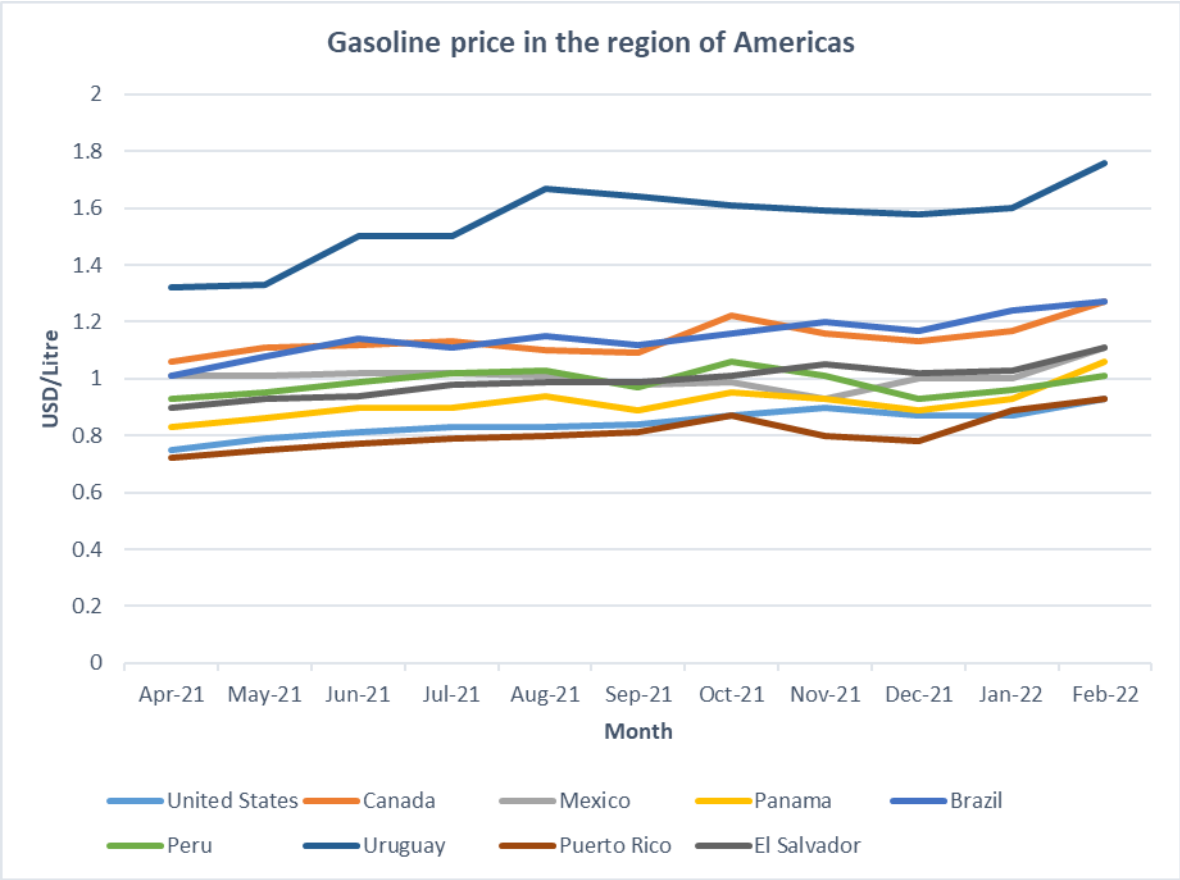
(Source: Trading Economics)

5.1.5 Gasoline price in the region of the Americas

The region of the Americas was not immune from the rising price of gasoline in other regions. Figure 5 shows that the price of gasoline in the region has been rising since April 2021. The price of gasoline rose sharply in Canada, Peru, Panama and Puerto Rico in September of 2021. This was due to the global energy shortage which reduced energy import to South American and North American countries. Also, the price of gasoline further increased in January and February of 2022 due to the spillover effect of the energy supply disruption caused by the escalating conflict

between Russian and Ukraine. A notable increase in gasoline price during this period was recorded in Puerto Rico, Panama, El Salvador, Canada and Uruguay.

Figure 5. Gasoline price in the region of Americas



(Source: Trading Economics)

5.2. Regional Correlation

The Pearson correlation result below shows that the rise in gasoline price in the Middle East also led to a rise in gasoline price in other regions. This was as a result of low energy supply during the COVID-19 pandemic. The low energy supply caused gasoline shortage which had spillover effects to other regions as shown in the correlation matrix in table 1. The price of gasoline in the Middle East and Europe is positive and significantly correlated at 87.3%. This indicates that the rise in gasoline price in the Middle east is correlated with high gasoline prices in Europe. Also,

gasoline prices in the Middle East and Asia is positive and significantly correlated at 93.6%. This indicates that the rise in gasoline price in the Middle east is correlated with higher gasoline prices in Asia. Similarly, price of gasoline in the Middle East and the Americas is positive and significantly correlated at 94.2%. This indicates that the rise in gasoline price in the Middle East is correlated with high gasoline price in the Americas region.

Table 1. Regional correlation of gasoline price (Pearson correlation analysis)

Region	Middle East and Oceania	Asia	Region of the Americas	Africa	Europe
Middle East and Oceania	1.000 ----- -----				
Asia	0.936*** (8.02) ((0.00))	1.000 ----- -----			
Region of the America	0.942*** (8.48) ((0.00))	0.938*** (8.16) ((0.00))	1.000 ----- -----		
Africa	-0.160 (-0.48) ((0.63))	-0.134 (-0.41) ((0.69))	-0.274 (-0.85) ((0.41))	1.000 ----- -----	
Europe	0.873*** (5.37) ((0.00))	0.927*** (7.41) ((0.00))	0.914*** (6.78) ((0.00))	-0.394 (-1.28) ((0.22))	1.000 ----- -----

***, **, * represent statistical significance at 1%, 5% and 10% levels. T-statistics are reported in single parenthesis. The p-values are reported in double parentheses.

5.3. Granger Causality test

We run a granger causality test using the average gasoline price for each region in table 2. The result indicates that there is a uni-directional causality between gasoline prices in the Middle East and in Asia. This means that rising gasoline price in the Middle East causes rising gasoline price in Asia. This confirms that the decrease in oil production by major countries in the Middle East led to a rise in gasoline prices from September as COVID-era restrictions were lifted. The increase in gasoline prices then led to an increase in gasoline price in other regions particularly in Asian countries.

Table 2. Gasoline Price - Granger Causality Tests

Lags: 2

Null Hypothesis:	Observation	F-Statistic	Prob.
ASIA region does not granger cause MIDDLE EAST region	9	4.22	0.10
MIDDLE EAST region does not granger cause ASIA region		13.95**	0.02
AMERICAS region does not granger cause MIDDLE EAST region	9	2.17	0.22
MIDDLE EAST region does not granger cause AMERICAS region		1.71	0.28
AFRICA region does not granger cause MIDDLE EAST region	9	6.15***	0.06
MIDDLE EAST region does not granger cause AFRICA region		2.99	0.16
EUROPE region does not granger cause MIDDLE EAST region	9	1.89	0.26
MIDDLE EAST region does not granger cause EUROPE region		5.63	0.07
AMERICAS region does not granger cause ASIA region	9	0.62	0.58
ASIA region does not granger cause AMERICAS region		0.11	0.89
AFRICA region does not granger cause ASIA region	9	43.27***	0.00
ASIA region does not granger cause AFRICA region		1.15	0.40
EUROPE region does not granger cause ASIA region	9	0.81	0.51
ASIA region does not granger cause EUROPE region		1.32	0.36
AFRICA region does not granger cause AMERICA region	9	2.08	0.24
AMERICA region does not granger cause AFRICA region		3.58	0.13
EUROPE region does not granger cause AMERICA region	9	0.57	0.61
AMERICA region does not Granger Cause EUROPE region		0.74	0.53
EUROPE region does not granger cause AFRICA region	9	0.93	0.47
AFRICA region does not granger cause EUROPE region		18.12***	0.00

6. Conclusion

The study examined the recent global energy crisis which was caused by many factors including the campaign to reduce carbon emission, the shortage in fossil fuel reserves due to divestment from fossil fuels, the halt in oil production due to the COVID pandemic and the Ukraine and Russia conflict. The empirical results show that gasoline prices rose in Asia, Europe, Africa, the Middle East and in the Americas regions. The rise in gasoline prices occurred during the period when COVID-era restrictions were lifted in 2021 and also during the Russia-Ukraine conflict in early 2022. The correlation results show a positive correlation between the gasoline prices in Middle East, Europe, Asia and the Americas but not in Africa.

The energy crisis leaves behind important lessons regarding the energy transition. One important lesson we learn from the crisis is that the energy transition process will have disruptive effects through supply shocks, rising energy demand and rising prices. Policy makers need to find a way to make the energy transition less painful by ensuring that there are enough energy reserves in order to meet energy demand during the transition process. Future studies can re-examine this global energy crisis and assess how it affects societal welfare.

Reference

- Awan, A. B., & Khan, Z. A. (2014). Recent progress in renewable energy—Remedy of energy crisis in Pakistan. *Renewable and Sustainable Energy Reviews*, 33, 236-253.
- De Jong, S., & Sterkx, S. (2010). The 2009 Russian-Ukrainian gas dispute: Lessons for European energy crisis management after Lisbon. *European Foreign Affairs Review*, 15(4), 511-538.
- Dietz, T., Shwom, R. L., & Whitley, C. T. (2020). Climate change and society. *Annual Review of Sociology*, 46, 135-158.
- Fan, W., & Hao, Y. (2020). An empirical research on the relationship amongst renewable energy consumption, economic growth and foreign direct investment in China. *Renewable Energy*, 146, 598-609.
- Islam, M. S., Al-Amin, A. Q., & Sarkar, M. S. K. (2021). Energy crisis in Bangladesh: Challenges, progress, and prospects for alternative energy resources. *Utilities Policy*, 71, 101221.
- Lacetera, N. (2019). Impact of climate change on animal health and welfare. *Animal Frontiers*, 9(1), 26-31.
- Mahmood, N., Wang, Z., & Hassan, S. T. (2019). Renewable energy, economic growth, human capital, and CO2 emission: an empirical analysis. *Environmental Science and Pollution Research*, 26(20), 20619-20630.
- Nwedu, C. N. (2021). Will a Transition to Renewable Energy Promote Energy Security Amid Energy Crisis in Nigeria?. In *Energy Transitions and the Future of the African Energy Sector* (pp. 231-263). Palgrave Macmillan, Cham.
- Ozili, P. K. (2022). Global economic consequence of Russian invasion of Ukraine. Working Paper. Available at SSRN. Ozili, Peterson K, Global Economic Consequence of Russian Invasion of Ukraine (2022). Available at <http://dx.doi.org/10.2139/ssrn.4064770>

Pietrosemoli, L., & Rodríguez-Monroy, C. (2019). The Venezuelan energy crisis: Renewable energies in the transition towards sustainability. *Renewable and Sustainable Energy Reviews*, 105, 415-426.

Qureshi, M. I., Rasli, A. M., & Zaman, K. (2016). Energy crisis, greenhouse gas emissions and sectoral growth reforms: Repairing the fabricated mosaic. *Journal of Cleaner Production*, 112, 3657-3666.

Ramanathan, V., & Feng, Y. (2009). Air pollution, greenhouse gases and climate change: Global and regional perspectives. *Atmospheric environment*, 43(1), 37-50.

Riaz, S., Chaudhry, M. O., & Faridi, M. Z. (2018). Energy Crisis and Economic Growth: Empirical Investigation from Pakistan. *International Journal of African and Asian Studies*, 47, 40-50.

Tan, Z. (2014). *Air pollution and greenhouse gases: from basic concepts to engineering applications for air emission control*. Springer. Cham.

Wang, S., Deng, L. H., Zhou, W. T., & Zhu, Z. Y. (2011, November). Empirical research on the relationship between energy consumption and economic growth in Heilongjiang province. In *Proceedings of International Conference on Information Systems for Crisis Response and Management (ISCRAM)* (pp. 76-81). IEEE.

Wellum, C. (2020). Energizing Finance: The Energy Crisis, Oil Futures, and Neoliberal Narratives. *Enterprise & Society*, 21(1), 2-37.