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DETERMINANTS OF NATURAL GAS CONSUMPTION IN EUROPE: AN EMPIRICAL ANALYSIS

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ABSTRACT: *Natural gas consumption is a significant issue in European countries due to the Russia-Ukraine war crisis. Natural gas is very important both for household and commercial purposes. The primary objective of this study is to investigate the relationship between natural gas consumption and its determinants. Panel data collected from Eurostat and World Bank publications, consisting of five European countries spanning from 2009 to 2022, were used for this study. Panel data analysis, like the panel unit root test, shows that the panel data variables are integrated into order 1. This indicates that the estimators are sufficient since the variables in the panel are stationary. Johansen Fisher's panel cointegration test shows that there is a long-run association between natural gas consumption and its determinants. The Hausman test specified a panel random effect regression model to run the analysis of this paper, and the model indicates that there is a significant relationship between natural gas consumption and its determinants. The Panel regression model further reveals natural gas prices have a negative significant impact on natural gas consumption, which suggests that the consumption of natural gas reduces with an increase in its price. This is the current situation in European countries now following the effect of the Russian-Ukraine war. Besides, correlation analysis was applied and shows a negative and significant relationship between natural gas consumption and natural gas demand. Following the outcome of this research paper, it will be very important for the United Nations and the European Union to swiftly apply a drastic and lasting solution approach to the current Russian-Ukraine war in order to prevent further untold damages that the war could cause to the economy of European Countries.*

KEYWORDS: Natural gas consumption, Panel unit root test, Johansen Fisher panel cointegration, Hausman test, Panel random effect regression, Correlation analysis

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BACKGROUND OF STUDY

Europe's reliance on natural gas as a fuel source is projected to continue for the foreseeable future due to rising environmental concerns and related laws (EIA, 2019; IEA, 2020). Natural gas has a lower carbon intensity and higher fuel efficiency in power generation compared to other fossil fuels (EIA, 2020). Additionally, it is utilized as a backup fuel for intermittent renewable sources (Ghafghazi et al., 2018). Consequently, the usage of natural gas in the generation of electricity is anticipated to expand across Europe and the rest of the world (EIA, 2019). In addition to environmental issues, there are also rising tendencies in the indigenous demand for natural gas in supplier countries and the need of developing countries (Remme et al., 2017; EIA, 2019). Nonetheless, indigenous natural gas production in Europe is diminishing. Consequently, European reliance on natural gas imports is anticipated to increase (Honore, 2018; Remme et al., 2017) during a period of global rivalry for natural gas source access.

In addition, natural gas use is a vital component of human existence. A family's natural gas usage pattern can act as an indicator of their prosperity and degree of accomplishment in life. It can unleash sustainable economic growth, enhance human health and well-being, and empower every family to live more productive lives (United Nations, 2018; Corfee-Morlot, Paul, James & Famous, 2019). It is not an exaggeration to say that natural gas is a necessity for every household in Europe, as it is extremely useful for both cooking and driving, which are essential for carrying out daily activities.

In the meantime, the war between Russia and Ukraine has contributed to a dramatic increase in the price of natural gas in European nations. Russia is known to have invaded Georgia, Crimea, and now Ukraine, which has led to a significant spike in natural gas prices (Trump, 2022). The Russian invasion of Ukraine has had an impact on various commodities, including natural gas (United Nations, 2022). Nevertheless, despite being at the centre of the largest military conflict in Europe since World War II, natural gas from Russia continues to flow through Ukraine to the rest of the continent. About 40 per cent of the European Union's natural gas comes from Russian pipelines, and a quarter of that gas flows through Ukraine. Russia provides roughly half of Germany's natural gas. At the beginning of the conflict, Germany froze its participation in Nord Stream 2, a 760-mile-long gas pipeline beneath the Baltic Sea that connects Russia to Germany's coast. By 2030, the EU intends to reduce its demand for Russian gas by two-thirds and become independent of Russian fossil fuels.

Increasing energy demand is a global trend, and because fossil fuel reserves are limited, energy security has become one of the most important economic and political goals of both developed and developing nations over the past several decades (Yergin, 2016; IEA, 2019). Theoretically, the liberalization of fuel markets is deemed sufficient (Radetzki, 2017) for achieving both energy security and efficient allocation of scarce resources. However, as identified by Bilgin (2017) and Helen (2016), structural and institutional conditions frequently impede the effectiveness of fuel markets. Such structural and institutional conditions also impact the natural gas market in Europe. The prevalence of long-term contracts and market conditions such as the market power of supplier countries, the need for long-term investment pipelines across countries to facilitate cost-effective

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transportation, and the requirement for long-term investment pipelines across countries raise concerns about the market's efficiency.

In the coming decades, natural gas will likely continue to be an important energy source, and the global competition for access to natural gas sources will intensify in tandem with European demand. On the supply side, Europe's indigenous production will likely decline, while the already-few global suppliers may form cartel-like organizations. In addition, the market's physical and institutional conditions will likely necessitate long-term measures to ensure energy security. Volatility in natural gas prices or supply can have devastating effects on European economies; therefore, identifying future natural gas requirements is a crucial and urgent issue for European policymakers (Christoffersen, 2018; Bilgin, 2017).

The primary objective of this paper is to identify the key predictor variables such as natural gas demand, natural gas prices, natural gas supply, household income, and GDP growth as determinants of natural gas consumption, and to investigate their relationship using panel data analysis such as the Panel unit root test, the Panel cointegration test, and the Hausman test, as well as correlation analysis in five European countries including Russia, Ukraine, Poland, and the United Kingdom. This study's other objective is to examine the impact of the predictor variables on Europe's natural gas consumption.

Research Hypotheses

H1: There is a relationship between natural gas consumption and its determinants

H2: The predictor variables have an impact on natural gas consumption.

Limitation and Strength

This research is a new area of study and hardly can one get empirical literature reference for the relationship among the variables of interest. Meanwhile, it is of great importance as it critically looks at the current situation of natural gas consumption and its determinants in European countries considering the effect of the Russia-Ukraine war in 2022.

LITERATURE REVIEW

This study prompted the creation of research that examines the relationship between natural gas consumption and the factors that determine it in Europe. Even though some types of published materials discuss the connection between natural gas consumption, natural gas prices, natural gas demand, natural gas supply, and household income, this is not the case for all types of published materials. Shahbaz et al. (2014) developed an economic model that included income inputs, natural gas consumption, and other multivariate variables. Using this model, the researchers demonstrated that natural gas prices and supply affect natural gas consumption. Ozturk and AlMulali (2015) pointed out the existence of a significant relationship between the consumption of natural gas, the prices of natural gas, the demand for natural gas, economic growth, and the supply of natural gas over the long term. The scope of the research was expanded by Furuoka (2016), who concluded

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that there is a significant and favourable correlation between the cost of natural gas and the income of households in China. Balitskiy et al. (2016) selected panel data from 26 countries in Europe from 1997 to 2011 and studied the relationship between natural gas supply, natural gas consumption, and economic growth. The research was based on a neoclassical model of economic growth. Lee and Chang (2018) looked at the two of them together and studied their relationship.

Based on an analysis of the eight major economic regions in China, Xuna and Chuanbo (2010) concluded that the impact of energy consumption on economic growth varies from one major economic region in China to the next due to the differences in the economy. Muqiang (2013) conducted a research using time series data spanning from 1997 to 2007 to investigate the relationship between energy consumption and economic growth. His findings demonstrated that energy consumption has a direct influence on economic expansion. To be more specific, Li (2018) found evidence of the existence of a cointegration relationship between the consumption, prices, and supply of natural gas in the United States during the period from 1949 to 2010. An-bing (2013) used the panel cointegration test to verify the cointegration relationship between the consumption of natural gas and the growth of GDP in Asia from 1991 to 2011. Based on their findings, they concluded that there is a long-run association between the two variables.

As a consequence of this, the purpose of this study is to investigate the relationship between the consumption of natural gas and the factors that determine it in Europe, as well as to compare the findings with previous research and state how the study contributes to the existing body of knowledge.

DATA AND METHODOLOGY

Data

This study tends to model the relationship between natural gas consumption and its determinants such as natural gas demand, natural gas prices, natural gas supply, household income and GDP growth with the aid of econometric models. The dependent variable is natural gas consumption, while the independent variables are natural gas demand, natural gas prices, natural gas supply, household income and GDP growth. The data for this work is secondary data and will be extracted from the world development indicators database of the World Bank (data.worldbank.org) and Eurostat (https://knoema.com/atlas/sources/Eurostat?topic=Natural%20Gas) to source for natural gas consumption, natural gas demand, natural gas prices, gas supply, household income and GDP growth from 2009 to 2022. It is important to note that five European countries are considered for this study and they include Russia, Ukraine, Poland, the United Kingdom and Germany.

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Table 1: Variable Measurements

Variables	Measurements (unit)
Natural gas consumption	Percentage (%)
Natural gas demand	Percentage (%)
Natural gas prices	Euro (€)
Natural gas supply	Percentage (%)
Household income	Percentage (%)
GDP growth	Percentage (%)

Table 1 illustrates the measurements of the variables of interest in this study.

METHODOLOGY

The econometric models that will be adopted to examine the relationship between the natural gas consumption and its determinants such as natural gas demand, natural gas prices, natural gas supply, household income and GDP growth are the Panel unit root test, Panel cointegration test, and Hausman test (that will specify whether to use fixed or random effect regression model). A combination of EViews software version 11.0 and Stata version 16.0 will be used to estimate the models for this study. Meanwhile, Pearson correlation will also be performed to examine the direction and strength of association between natural gas consumption and its determinants.

Model Specification

The formulated hypotheses will be tested using the functional description of the model which can be expressed as:

Natural gas consumption = f (demand, prices, supply, income and GDP growth).

Meanwhile, econometrically, the generalized econometric model can be written as:

$$Consumption_t = \beta_0 + \beta_1 Demand_t + \beta_2 Prices_t + \beta_3 Supply_t + \beta_4 Household\ income_t + \beta_5 GDPgrowth_t + \varepsilon_t$$

where β_1 to β_4 are the coefficients of the independent variables while β_o is a constant term. ε_t is the stochastic error term that takes care of all unaccounted factors in the model.

Panel Data Analysis

The panel in this study are the five European countries namely Russian, Ukraine, Poland, United Kingdom and Germany. The period under consideration is 2009 to 2022. The year 2022 was included because we need to check the current impact of the war on the natural gas prices in Europe. The panel data analysis as well as correlation analysis that will be discussed in this section includes:

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Panel Unit Root Test

It is noteworthy that estimators are not sufficient if the variables in a panel are not stationary, except that they are cointegrated. Im-Pesaran-Shin (2003) test stated that the null hypothesis for all the panels contains a unit root. The hypothesis to accomplish the unit test can be said as follows:

H_0: Panels contain unit roots vs H_a: Panels are stationary. The Panel unit root test can be presented mathematically as:

$$\Delta Y_{i,t} = \theta + \gamma \alpha_{i,\, t-1} + \sum \beta_i \Delta Y_{i,t-1} + \omega_{i,t}$$

Where θ is a constant, γ is the coefficient of process root, β_i coefficient in time tendency, n is the lag order and $\omega_{i,\,t}$ is the disturbance (error) term.

Panel Cointegration

Fisher (1932) created a composite test based on the findings of the independent tests. Maddala and Wu (1999) presented an alternative way to test for cointegration in panel data by integrating tests from separate cross-sections to produce test statistics for the entire panel, based on Fisher's result.

The test uses the vector autoregressive (VAR) lags idea and uses p-values for Johansen's cointegration trace test and the maximum eigenvalue test to make its decision.

Hausman Test

In panel data analysis, there is often a challenge regarding which estimator is best suited to the model. Is that a fixed effect or a random effect? The generalized model for panel data is $Y_{it} = a_i + BX_{it} + U_{it}$.

It is assumed that a_i does not correlate with the explanatory variables that form the null hypothesis. That is, a_i is independent of the explanatory variable (X_{it}) in the model against the alternative hypothesis that a_i is correlated with the independent variable.

Hausman test will therefore help us to specify whether to run the analysis with fixed effect regression or random effect model with the following hypothesis:

H0: Individual effects are random,

H1: Individual effects are constant.

Decision Rule: Reject the null hypothesis (Ho) if p-value is less than the significance level and do not reject if otherwise. The acceptable significance levels in research are 1%, 5% and 10% respectively.

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Correlation Analysis

Correlation is a measure of direction, strength and association between variables. To understand the direction of the relationship between two variables, we will adopt the Pearson correlation coefficient (r) which lies between -1 and +1 in this research paper. Besides, the test of significance of correlation has the hypothesis: *H0: P = 0* vs *H1: P ≠ 0.*

RESULT AND DISCUSSION

Table 2: Descriptive Statistics

Variables	N	Mean	SD
Natural gas consumption	70	10.70	3.29
Natural gas demand	70	19.17	4.54
Natural gas prices	70	8.25	1.22
Natural gas supply	70	14.03	4.11
GDP growth	70	10.12	3.18
Household income	70	7.46	5.52

Source: *Author's computation using Stata software*

Table 2 shows that on the average, natural gas consumption rises by about 11% of the 70 observations, natural gas demand rises by about 19% on average, natural gas price rises by about 8 Euros on average, natural gas supply rises by about 14% on average, GDP growth rises by about 10% on the average and household income rises by about 7% on the average. The summary statistics simply reveal that demand for natural gas is higher than the supply, which is very consistent with the current situation on ground due to the critical effect of the current Russia-Ukraine war.

Table 3: Panel Unit Root Test

Im-Pesaran-Shin			
Differenced Variables	Test statistic	p-value	No of panels
Natural gas consumption	-9.138	0.0000*	5
Natural gas demand	-4.175	0.0000*	5
Natural gas prices	1.633	0.0001*	5

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Natural gas supply	-8.428	0.0000*	5
Household income	-2.695	0.0035*	5
GDP growth	-4.866	0.0000*	5

where the asterisk * represents 1% significant level

Table 3 shows the panel unit root using Im-Pesaran-Shin to test the stationarity of the series for each panel variable and it shows that after the first difference, the series, such as natural gas consumption, natural gas demand, natural gas prices, natural gas supply, household income and GDP growth, become stationary which also implies that the series are integrated of order one, I(1). This indicates that the estimators are sufficient since the variables in the panel are stationary.

Table 4: Johansen Fisher Panel Cointegration Test

Hypothesized No. of CE (s)	Fisher Stat (from trace test)	p-value	Fisher Stat (from Max-eigen test)	P-value
None	58.03	0.0000	58.03	0.0000
At most 1	99.44	0.0000	88.08	0.0000
At most 2	26.68	0.0029	26.04	0.0037
At most 3	13.99	0.1735	13.99	0.1735
At most 4	42.35	0.0001	43.15	0.0265
At most 5	44.35	0.0000	44.35	0.0000

Source: *Author's computation*

The null hypothesis of no cointegration of the panel data was rejected at 1%, indicating that the variables in the panel are cointegrated, indicating a long-run relationship between the variables of interest (natural gas consumption, natural gas demand, natural gas prices, natural gas supply, household income and GDP growth), as shown in Table 4.

Hausman Test

The Hausman test ($p>0.05$) indicates that the model is not statistically significant as we can see in the appendix, and this indicates that the random effect regression model would be used to run the analysis of this research paper.

Table 5: Random Effects Regression

Natural gas consumption	Coefficient estimate	Test statistic	p-value
Natural gas demand	-0.030	-0.62	0.034**
Natural gas prices	-0.118	-0.57	0.006*

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Natural gas supply	0.673	11.91	0.000*
GDP growth	-0.042	-0.79	0.430
Household income	-0.012	-0.26	0.792
Constant	2.953	1.33	0.184
Overall p-value	0.0000	Overall R-sq = 0.7186	

where asterisks ** and * are 5% and 1% significance level respectively

Source: *Author's computation using Stata software*

We therefore write out the random effect model that determines natural gas consumption in Europe in this form: $Consumption_t = 2.953-0.030Demand_t - 0.118Prices_t + 0.673Supply_t -0.012Household\ income_t - 0.042GDPgrowth_t$, as we can see in Table 5.

From the estimated model above, we can see that natural gas consumption in Europe is 2.95% when other factors are kept constant. For an additional 1% rise in natural gas demand, natural consumption declines by 0.03%. For an additional 1 Euro in natural prices, natural gas consumption in Europe decreases by 0.118Euro. For a 1% increase in natural gas supply, natural gas consumption in Europe also increases by 0.673%. For a 1% increase in gross domestic product growth, natural gas consumption declines by 0.042% while for a 1% increase in household income in Europe, natural gas consumption declines by 0.012%.

Table 5 also shows that demand for natural gas has a negative significant impact on natural gas consumption, and this implies that natural gas consumption decreases with unit increase in the demand for natural gas in European countries (see Table 5). Natural gas prices have a negative significant impact on natural gas consumption, which suggests that the consumption of natural gas reduces with an increase in price of natural gas (see Table 5). This is the current situation in European countries now following the effect of the Russian-Ukraine war. Besides, the natural gas supply has a positive significant impact on the consumption of natural gas in European countries, and this suggests that when there is an increase in supply of natural gas, the consumption will also increase as people can only consume what is available.

The overall model p = .0000 indicates that the specified random effect regression model is statistically significant and this shows that there is a significant relationship between natural gas consumption, natural gas demand, natural gas prices, natural gas supply, household income and GDP growth. This supports the hypothesis that there is a significant relationship between natural gas consumption and its determinants.

Meanwhile, overall R-squared = 0.7186 indicates that about 72% variability in natural gas consumption in European countries can be attributed to natural gas demand, natural gas prices, natural gas supply, household income and GDP growth. The R-squared is relatively high and the overall model is significant, suggesting that the model is a good fit for the data and it is very appropriate for future prediction of natural gas consumption.

In order to ensure that we have a valid and robust random effect regression model, the normality diagnostic is very necessary.

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Table 6: Correlation Analysis

	Natural gas consumption	Natural gas demand	Natural gas prices	Natural gas supply	GDP growth	Household income
Natural gas consumption	1.000					
Natural gas demand	-0.042**	1.000				
Natural gas prices	-0.281*	-0.071	1.000			
Natural gas supply	0.843*	-0.010	-0.279	1.000		
GDP growth	0.1311	-0.067	-0.074	0.212	1.000	
Household income	-0.085	-0.070	0.429*	-0.059	0.001	1.000

where asterisk ** and * represent 5% and 1% significance levels respectively

Table 6 shows ($r = -0.042$, $p<0.05$) which implies that there is a negative and significant relationship between natural gas consumption and natural gas demand. This suggests that the higher the demand for natural gas, the lower the consumption. The result from Table 6 ($r = -0.281$, $p<0.01$) indicates that there is a negative and significant relationship between natural gas prices and consumption. This means that the higher the price of natural gas, the lower the consumption, and this is very supportive to the current situation in European countries due to the untold effect of the Russia-Ukraine war. More so, the result ($r = 0.843$, $p<0.01$) implies that there is a positive and significant relationship between natural gas supply and consumption. This tells us that when there is an abundant supply of natural gas, there will also be an increase in the rate of the consumption.

Meanwhile, the result ($r = 0.429$, $p<0.05$) indicates that there is a positive and significant relationship between prices of natural gas and household income. This implies that the higher the natural gas prices, the higher the household income. This is very consistent with the work of Furuoka (2016).

Table 7: Normality Test (Shapiro-Wilk)

Variable	N	P-value
Natural gas consumption	70	0.211
Natural gas demand	70	0.547
Natural gas prices	70	0.013
Natural gas supply	70	0.435
GDP growth	70	0.044
Household income	70	0.349

Source: *Author's computation using Stata software*

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Table 7 shows the normality test using Shapiro Wilk approach and we can see that p>0.05 for natural gas consumption, natural gas demand, natural gas supply and household income while p>0.01 for natural gas prices and GDP growth, which implies that the panel data variables for this study are normally distributed at 5% and 1% respectively. This satisfies the normality assumption.

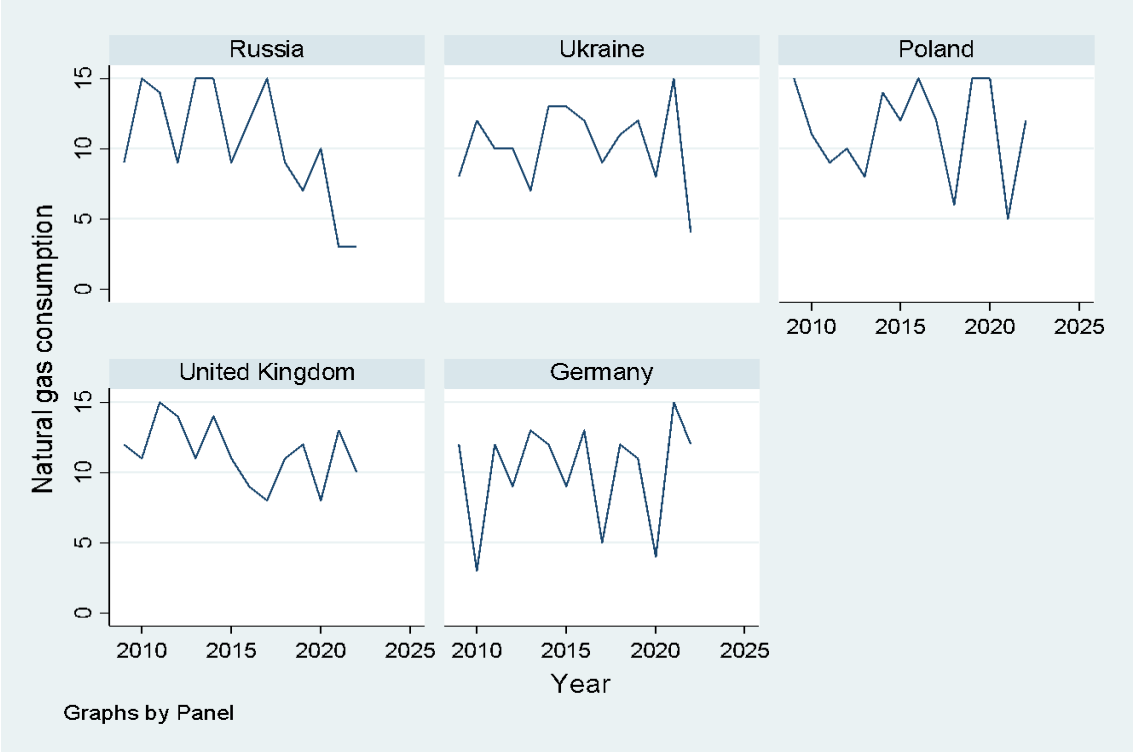

Figure 1: Graph of Natural Gas Consumption by Panel

Figure 1 shows that natural gas consumption has a major decline in 2022 due to the Russia-Ukraine war effect for the five European countries under review and 2022 is currently in the mid-year. And particularly, Russia and Ukraine indicated the major decline in the natural gas consumption due to the adverse effect of the war.

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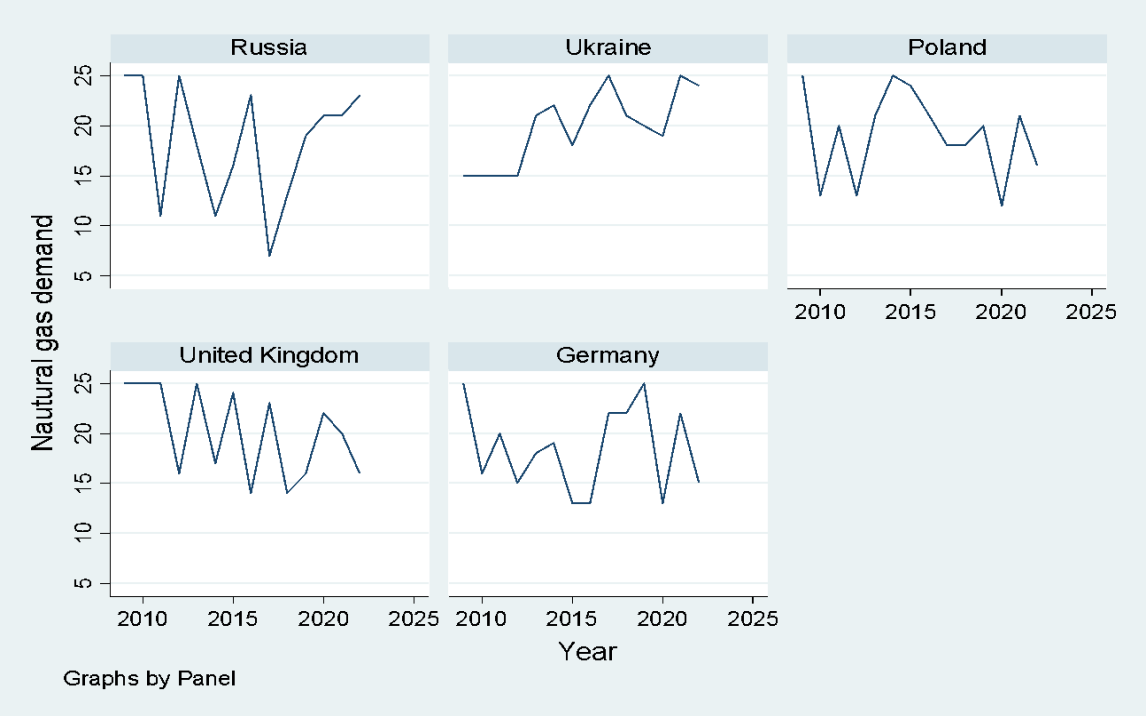

Figure 2: Graph of Natural Gas Demand by Panel

Figure 2 shows that natural gas demand has a slight decline in 2022 due to the Russia-Ukraine war effect for the five European countries under review, and 2022 is currently in the mid-year. Russia still indicated a slight increase in demand for natural gas (see Figure 2).

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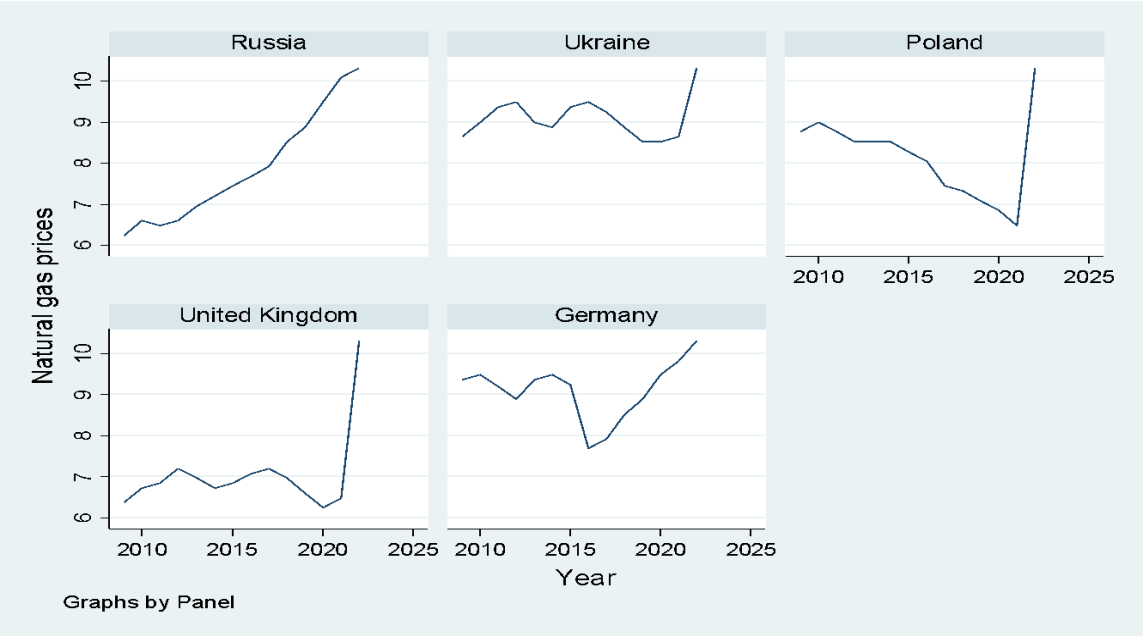

Figure 3: Graph of Natural Gas Prices by Panel

Figure 3 shows that the prices of natural gas rises sharply in 2022 for all the European countries under study, and this is due to low availability and supply of natural gas as a result of the effect of the Russian-Ukraine war effect.

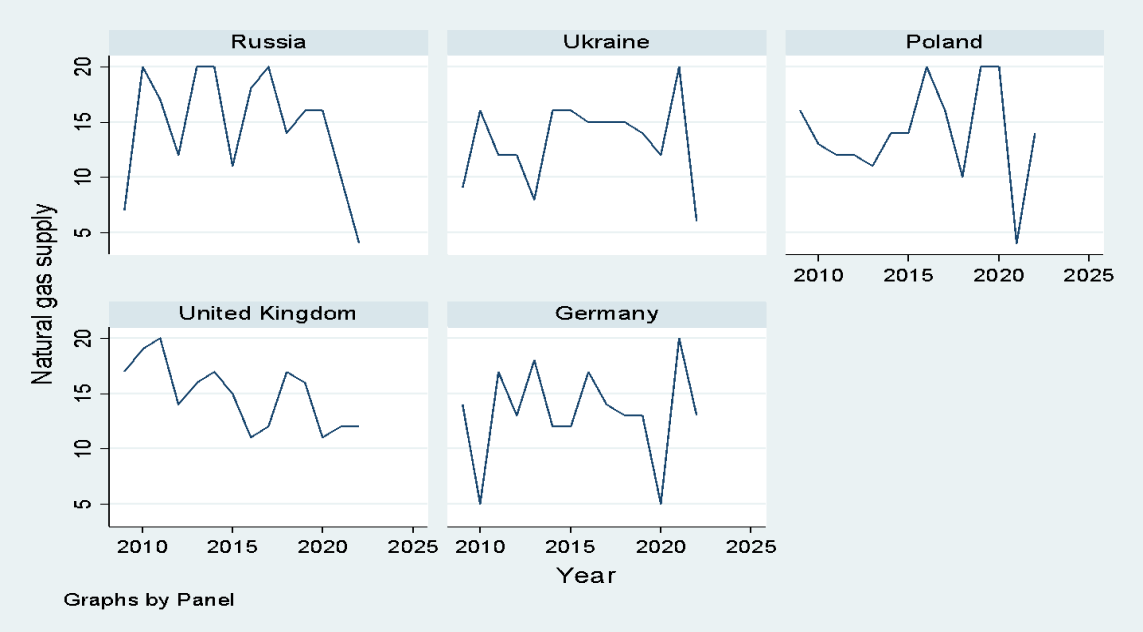

Figure 4: Graph of Natural Gas Supply by Panel

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Figure 4 shows that natural gas supply has a major decline in 2022 due to the Russia-Ukraine war effect for the five European countries under review, despite 2022 still being at the mid-year. And particularly, Russia and Ukraine indicated a major decline in the natural gas supply due to the fact the demand is even higher than what is supplied to the two countries.

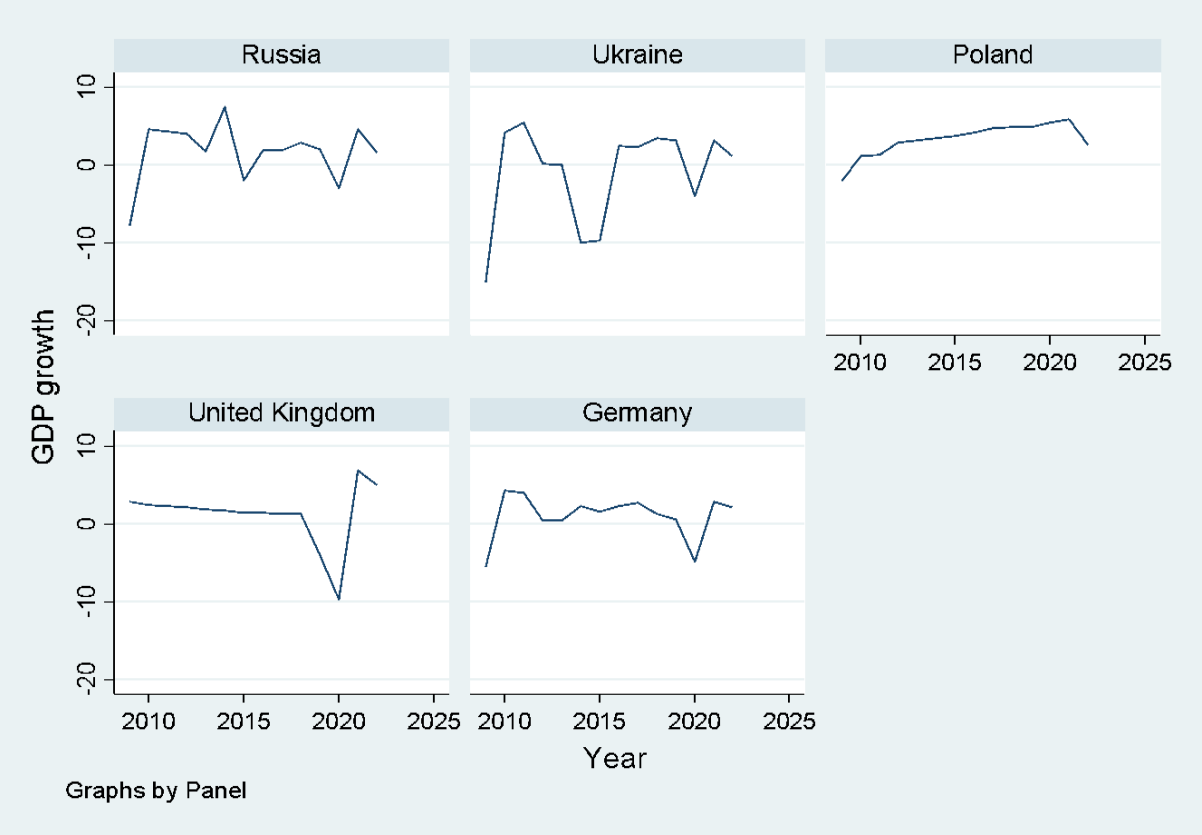

Figure 5: Graph of GDP Growth by Panel

Figure 5 shows that gross domestic product (GDP) growth has a slight decline in 2022 due to the Russia-Ukraine war effect for the five European countries under review, and 2022 is currently in the mid-year.

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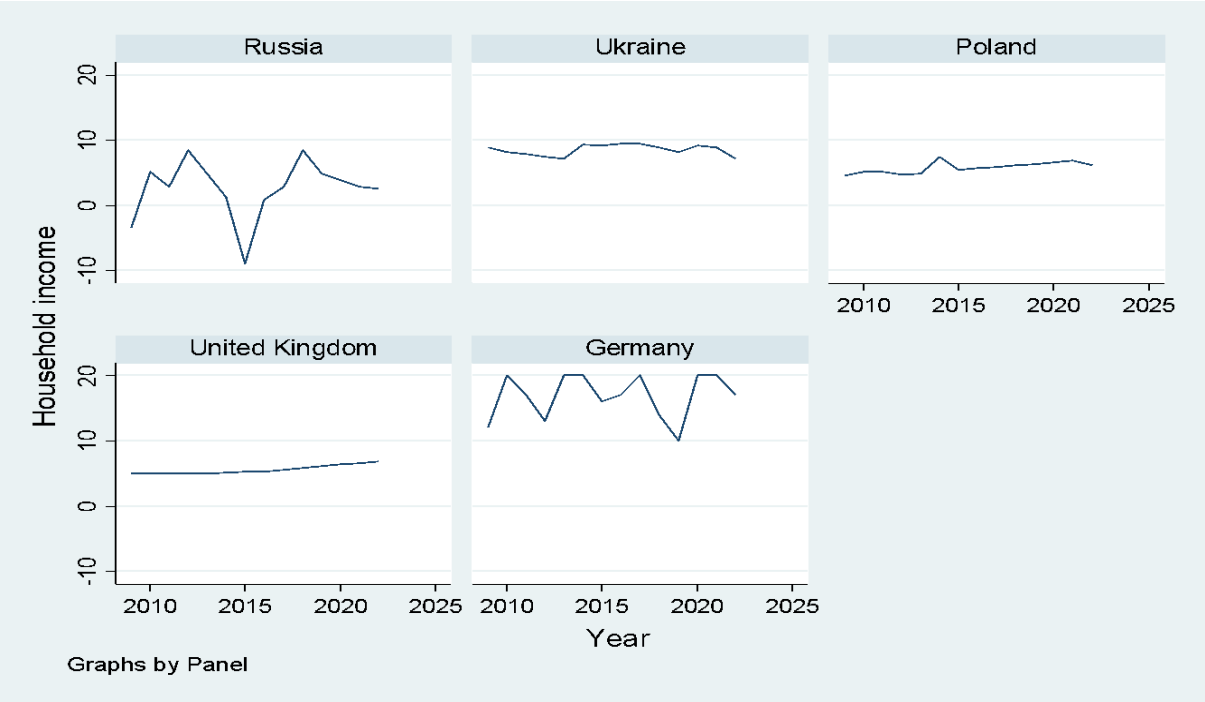

Figure 6: Graph of Household Income by Panel

Figure 6 shows that Russia indicated a major decline in the household income followed by Ukraine; the United Kingdom still maintained a slight and parallel increase in the household income in the country while Poland and Germany still indicated a slight decline in their household income.

DISCUSSION OF FINDINGS

Based on the result of the analysis above, the following are the notable findings:

The summary statistics show that the demand for natural gas is higher than the supply, which is very consistent with the current situation on ground due to the critical effect of the current Russia-Ukraine war.

The Hausman test specified a random effect regression model which indicated that there is a significant relationship between natural gas consumption, natural gas demand, natural gas prices, natural gas supply, household income and GDP growth. This supports the hypothesis that there is a significant relationship between natural gas consumption and its determinants. This is also very consistent with the work of AlMulali (2015).

Meanwhile, the demand for natural gas has a negative significant impact on natural gas consumption and this implies that natural gas consumption decreases with a unit increase in the

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demand for natural gas in European countries (see Table 5). Natural gas prices have a negative significant impact on natural gas consumption, which suggests that consumption of natural gas reduces with an increase in the price of natural gas (see Table 5). This is the current situation in European countries now following the effect of the Russian-Ukraine war. Besides, the natural gas supply has a positive significant impact on the consumption of natural gas in European countries and this suggests that when there is an increase in the supply of natural gas, the consumption will also increase as people can only consume what is available.

Besides, the overall R-squared = 0.7186 indicates that about 72% variability in natural gas consumption in European countries can be attributed to natural gas demand, natural gas prices, natural gas supply, household income and GDP growth. The R-squared is relatively high and the overall model is significant, which suggests that the model is a good fit for the data and it is very appropriate for future prediction of natural gas consumption.

The correlation analysis results from Table 6 ($r = -0.281$, $p<0.01$) indicate that there is a negative and significant relationship between natural gas prices and consumption. This means that the higher the price of natural gas, the lower the consumption, and this is very supportive of the current situation in the European countries due to the untold effects of the Russia-Ukraine war. More so, the result ($r = 0.843$, $p<0.01$) implies that there is a positive and significant relationship between natural gas supply and consumption. This tells us that when there is an abundant supply of natural gas, there will also be an increase in the rate of consumption.

CONCLUSION AND POLICY IMPLICATION

Natural gas consumption is a serious concern in European countries owing to the Russia-Ukraine war crisis. Natural gas is very vital both for domestic and business needs. It is essentially vital for domestic cooking, filling of the gasoline automobile and powering of electricity among others. This research work has critically analyzed the relationship between natural gas consumption and its factors in European countries. The findings suggest that there is a strong relationship between natural gas consumption and its determinants as well as the existence of a long-run association between them, which is extremely compatible with the work of Li (2018) and AlMulali (2015). The specified random effect regression analysis also shows that natural gas prices have a negative significant impact on natural gas consumption, which suggests that consumption of natural gas declines with an increase in the price of natural gas. This is the present condition in European countries following the effect of the Russian-Ukraine war. Besides, the natural gas supply has a positive significant impact on the consumption of natural gas in European countries and this suggests that when there is an increase in the supply of natural gas, the consumption would also increase as people can only consume just what is available.

Consequently, to escape the untold misery that the Russian-Ukraine war might inflict on European citizens owing to the long-run effect of the crisis on their economy, the European Union should create a drastic and proper method to halt the war.

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REFERENCES

An-bing, Wu. (2013). Study on the dynamic equilibrium and cointegration between natural gas consumption and economic growth. Guide Bus. 23, 108–111.

Balitskiy, S. (2016). Energy efficiency and natural gas consumption in the context of economic development in the European Union. Renew. Sustain. Energy Rev. 55, 156–168.

Bilgin, M. (2019). Geopolitics of European Natural Gas Demand: Supplies from Russia, Caspian and Middle East. Energy Policy, 2009, 37, 4482-4492.

Christoffersen, G. (2018). China's Intentions for Russian and Central Asian Oil and Gas. The National Bureau of Asian Research, Vol. 9, No: 2, 1-34.

Corfee-Morlot, J., Paul P., James, O. & Famous, A. (2019). Achieving clean energy access in sub-Saharan Africa A case study for the OECD, UN Environment, World Bank project: "Financing Climate Futures: Rethinking Infrastructure"

EIA. (2019). US Energy Information Administration, 2019. International Energy Outlook 2019. DOE/EIA-0484(2019).

Furuoka, F. (2016). Natural gas consumption and economic development in China and Japan: an empirical examination of the Asian context. Renew. Sustain. Energy Rev. 56, 100–115

Ghafghazi, S., Sowlati, T., Sokhansanj, S. and Melin, S. (2018). Techno-economic analysis of Renewable energy source options for a district heating project. International Journal of Energy Research, 34(12), 1109-1120.

Helen, H. (2016). The EU's Energy Security Dilemma with Russia. University of Leeds, PolisJournal, Vol. 4, 1-40.

Honore, A. (2018). European Gas demand, Supply and Pricing: Cycles, Seasons and the Impact of LNG Price Arbitrage. Oxford University Press: Oxford, UK,

IEA. (2020). International Energy Agency, 2010. World Energy Outlook 2010. International EnergyAgency: France.

Li, Z. (2018). Empirical research on the relationship between natural gas consumption and economic growth in the Northeast Asia. Energy Environ. 29 (2), 216–231.

Muqiang, Z. (2013). Energy consumption, economic growth and carbon emissions in five ASEAN countries: an empirical study based on environmental kuznets curve. Around Southeast Asia 9, 57–61

Ozturk, I and Al-Mulali, U. (2015). Natural gas consumption and economic growth nexus: Panel data analysis for GCC countries. Renew. Sustain. Energy Rev. 51, 998–1003.

Radetzki, M. (2017). European natural gas: market forces will bring about competition in any case. Energy Policy, 1999, 27, 17-24.

Remme, U., Markus, B. and Fahl, U. (2017). Future European Gas Supply in the Resource Triangle of the Former Soviet Union, the Middle East and North Africa. Energy Policy, 36, 1622-1641.

Trump, D. (2022). "Only Trump Can Stop Putin From Invading Ukraine". Worldupdatesnow.

Xuna, C and Chuanbo, L. (2010). An empirical study on the relationship between regional economic growth and energy consumption - based on panel data of eight major economic regions in China. Statis. Decis. 1, 113–115

Yergin, D. (2016). Ensuring Energy Security. Foreign Affairs, 2006, 85, 69-75.

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APPENDIX

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. hausman fixed random
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	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
Demand	-.0410439	-.0300303	-.0110136	.
Price	-.2002165	-.1182232	-.0819933	.1096526
Supply	.6872916	.6729655	.0143261	.
GDPgrowth	-.0358606	-.0421545	.0062939	.0142807
Wage	-.153683	-.0115625	-.1421205	.0735359

```
                b = consistent under Ho and Ha; obtained from xtreg
     B = inconsistent under Ha, efficient under Ho; obtained from xtreg

  Test:  Ho:  difference in coefficients not systematic

               chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                       =        6.23
             Prob>chi2 =      0.2848
             (V_b-V_B is not positive definite)
```


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