THE IMPACT OF RISING ENERGY PRICES ON PUBLIC FINANCES

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Abstract:

This study explores the dynamics of the energy market, with a particular focus on Romania, investigating factors such as demand and supply imbalances, state intervention, and the social implications of energy pricing. The analysis reveals disparities in the energy market and justifies the belated but necessary intervention of the state to protect households and establish market order, despite the budgetary strain leading to an amplified deficit.

Keywords: *Energy Market Dynamics, Romanian Energy Industry*

JEL classification: *H69, H62, N70*

Introduction

The energy system represents a complex and multidimensional structure that can only be comprehended and analyzed through a multidisciplinary approach. It encompasses all installations and processes for the distribution and utilization of energy within a specific country, region, or area. Regardless of the overall management of certain sectors, the energy system is interconnected at an international level, so crises and/or natural phenomena occurring in a particular region can lead to disruptions in the structure of the system, both at the regional and national levels, as well as internationally.

The analysis presented below aims to highlight conclusions regarding the impact of recent increases in energy market prices on national public finances. In this regard, the issue has been examined from an external perspective of the industry by identifying relevant statistical data based on general interest indicators.

By identifying, examining, and interpreting events that have caused turbulence in the energy market in relation to the general theoretical framework, an analysis of overarching issues has been conducted, along with proposing economic solutions. It is evident that energy prices serve as a means through which the impact of the economic crisis can be observed by all entities involved, ranging from individuals to legal and institutional entities. However, the pricing process in the energy sector is extremely complex and can be challenging to comprehend.

Therefore, this paper intends to contribute to the development of research aiming to identify the causes and mechanisms that could influence the dynamics of energy prices in the technological and distribution chain. This will enable us to propose relevant solutions and suggestions to positively impact public finances.

Through literature, it can be observed that economic development, as the foundation of the state budget, is built on several pillars, one of which is the maintenance and promotion of a fundamentally upward trend in the use of green energy. In the current context, the energy sector plays a crucial and even defining role for everyone, as innovation and survival in climatic conditions are dependent on it.

The study conducted by Ohio University Press, titled "Perfect Competition and the Effects of Energy Price Increases on Economic Activity" reveals a direct correlation between unfair competition generated by rising energy prices and innovation based on competition, thus contributing to long-

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term economic development. Researchers at Digitales Argchiv have successfully demonstrated a close correlation between taxes imposed on the consumption of natural gas, oil, and other derivatives, and the budget deficit on commodity markets, thereby supporting the hypothesis of this work.

Methodology and Data

To conduct tests on time series to demonstrate Granger causality, it is necessary to check the stationarity of the data using the Augmented Dickey-Fuller test (ADF). This test involves estimating the regression model below:

$$\Delta Y_t = \beta_1 + \beta_2 + \delta Y_{t-1} + \sum_{i=1}^{p} \alpha \, \Delta Y + \varepsilon_i$$

where Y_t is the variable being tested to determine if the data is stationary or not, δ emphasizes the lags used in identifying possible higher-order autocorrelations, and ε_i is the error term.

In this case, the statistical test was generated under the null hypothesis H_0 through which $\delta = 0$ compared to the alternative hypothesis H_1 through which $\delta<1$. The testing procedure used is the same as in the Dickey-Fuller test; therefore, the lower the ADF test statistic (preferably negative), the more the null hypothesis is rejected.

In the Granger approach, X is considered a cause of Y if it is used to forecast Y based on past values of Y. Thus, three different cases are identified where Granger causality can be applied:

a. For two variables and their lags;

b. For a multitude of variables;

c. For testing all variables considered (in the context of VAR).

To conduct the test, we can estimate the following Ordinary Least Squares (OLS) regressions:

$$\Delta Y_t = \alpha_0 + \alpha_1 \Delta Y_{t-1} + \cdots + \alpha_l \Delta Y_{t-1} + \beta_1 X_{t-1} + \cdots + \beta_l X_{t-1} + \varepsilon_t \, \Delta Y_{t-1}$$

$$X_t = \alpha_0 + \alpha_1 X_{t-1} + \cdots + \alpha_l X_{t-1} + \beta_1 \Delta Y_{t-1} + \cdots + \beta_l \Delta Y_{t-1} + u_t$$

Based on the estimation of OLS coefficients, we can assert the following relationships between the two variables:

1.X causes a unidirectional causality towards Y.

2.There is evidence of bidirectional causality.

3.There is no evident Granger causality in either direction.

The database was constructed using statistical data provided by Eurostat, including information on budget deficit, revenues, and expenses of our country, as well as import and export transactions between European states and Russia. Both the ANRE platform was utilized to understand the formation of various prices in our country, and the OPCOM and BRM platforms were used to collect necessary data on the current commodity market. Additionally, various data for the analyzed companies and state budget were identified and processed to obtain more information relevant to this study.

For the analys, Eviews software was employed to generate a correlation regarding the influencing factors concerning the increase in public expenditures as a percentage of GDP and market prices.

Theoretical Aspects

To gain a comprehensive understanding of the energy industry and price formation we must analyze all the process and the journey of the product. Additionally, all defining factors in price formation, such as supply and demand, weather conditions, stock market transactions, long-term contracts, and spot markets, should be included in the analysis.

In the natural gas industry, several companies operate in accordance with specific regulations of each state, with various objectives. Initially, the extraction process involves a typically large-capital company subject to strict regulations, capable of operating under adverse conditions. Subsequently, the gas is transported by specialized operators, known as Transmission System Operator (TSO), through pipelines to processing centers. It is then intermediated by a distribution company that assumes the role of administration and distribution through smaller pipelines, compared to those used in the previous stage, to deliver gas directly to consumers.

In Europe and USA, natural gas prices are determined through gas hubs - centers for trading natural gas, where producers, transporters, traders, and consumers can buy or sell gas. These are locations where prices are set based on supply and demand, enabling greater market transparency. Some examples of trading hubs include HHGP (Henry Hub Natural Gas Spot Price) in the USA, TTF (Title Transfer Facility) in the Netherlands, NBP (National Balancing Point) in the UK, or PEG (Point d'Échange de Gaz) in France.

The production and distribution of oil involve several companies and stages. After extraction from reservoirs, oil is transported through pipelines, ships, or tanker trucks to refineries. Here, it is processed to produce petroleum products such as gasoline, diesel, or kerosene. After processing, petroleum products are transported through a distribution chain that may involve multiple companies handling storage, transportation, and distribution.

These companies can be suppliers, transporters, terminal operators, or final distributors. Ultimately, petroleum products reach gas stations and other points of sale, where they are purchased by consumers.

In establishing prices for oil, the impact of OPEC (Organization of the Petroleum Exporting Countries) must also be considered. OPEC controls approximately 44% of the world's oil production and holds around 73% of global oil reserves. It can influence oil prices by regulating the quantity of oil produced and exported by its members. For example, by reducing oil production, OPEC can decrease the supply of oil in the global market, leading to price increases. Conversely, increasing production can lead to price decreases.

OPEC can also influence prices through policies and decisions regarding investments in oil production, exploration, and refining, as well as through price stabilization actions, such as reducing production or creating mechanisms for price stability.

Electricity is generated by various power plants that can use different primary energy sources such as coal, gas, hydro, nuclear energy, or renewable sources. After production, electricity is transmitted through regional and national grids to distribution companies. These companies are responsible for managing local distribution networks and supplying electricity directly to consumers, whether industrial or residential. The transmission and distribution process involves various costs, including infrastructure and transaction costs, which are included in the final price of the product.

It is important to mention that all intermediate costs are borne by the end-user, reflecting in the final product price. Additionally, some states offer partial or total subsidies for different categories of individuals or for all users.

In the context of price formation, tax implications (excises, environmental taxes, etc.) must also be considered, leading to a much higher final price for the end consumer.

Regarding theoretical concepts, understanding the basic competitive model is crucial. This model allows for an analysis of the organization and functioning of any market, consisting of a set of economic conditions that permit the existence of a large number of producers and consumers. The

price is determined through the mechanism of supply and demand. In this model, each economic agent plays a significant role in setting the price and is motivated to maximize profit by offering or buying goods and services at the most advantageous prices. Among the pillars supporting this work is the rational consumer who pursues their own interest, firms aiming to maximize profit, and markets characterized by competition.

Drawing from specialized literature, it has delineated various hypotheses regarding the purity of competition and the concept of perfect competition, including:

-Homogeneity of the Product: The product shows no differentiation among consumers in the context of pure competition. All products are regarded as identical in the eyes of consumers, thereby eliminating specific preferences.

-Unrestricted Market Entry: Any entity is legally entitled to enter the market. This condition supports the purity of competition, allowing for an open and unrestrained competition among legal entities.

-Perfect Market Transparency: In this scenario, there is no informational asymmetry between producers and consumers regarding product details. All economic agents have access to the same information, ensuring a transparent environment where buying and selling decisions hinge on identical data.

-Flawless Mobility of Production Factors: The pursuit of profit is undertaken with a view to utilizing capital as efficiently as possible. This involves the seamless movement of production factors, such as labor and capital, to sectors where they can yield the highest returns.

Due to its significant importance, the state can intervene in the energy sector in cases of utmost necessity and has the authority to cap prices. This method is particularly useful in the short term, with the caveat that the imposed maximum price should closely align with the equilibrium price to avoid creating imbalances in demand or supply. In the energy sector, it is well-established that the equilibrium price can be considered one that covers production costs.

In instances of market imbalance in the energy sector, price capping should be accompanied by additional measures addressing: the quantity of goods and services that can be produced by efficiently utilizing all available resources to meet increased demand; applicable legal standards; and commitments to reduce existing climate-related issues.

To comprehensively consider the socio-economic framework, it is essential to recognize that, in general, this work is based on welfare states that aim, among other objectives, to ensure the minimum necessary for the development of all citizens and to combat poverty. In the energy market context, the European Commission has defined energy poverty as: *“Energy poverty occurs when a household must reduce its energy consumption to a degree that negatively impacts the inhabitants' health and wellbeing. It is mainly driven by 3 underlying root causes”.*

Given the vast scope of the field, we commenced with a comprehensive analysis of global energy consumption before narrowing our focus to a specific country, Romania.

Additionally, an analysis of the legislative and economic framework of the respective state is imperative to determine the variation and significance of the energy industry on its public finances. In Romania, the National Energy Regulatory Authority (ANRE) is tasked with setting tariffs for the transportation, system operation, and distribution of electricity and natural gas services. Consequently, any decision by ANRE can ultimately influence prices in the energy market. In terms of revenues flowing into the state budget, these are comprised of direct taxes on the energy supply chain and various excise duties on consumption. Due to the extensive framework and the multitude of actors involved, we will not consider indirect revenues from VAT or similar taxes.

Analysis

Regarding the approach to the current issue, the energy sector manages to prioritize collaborative efforts within the academic and specialized community to identify specific causes and generate viable solutions.

Moreover, based on the extracted data below, it is evident that a global crisis is unfolding, with more pronounced effects at the local level.

A. Globally, the crisis can be explained by the imbalance in the demand and supply ratio generated by:

1.The resumption of economic growth post the Covid-19 pandemic;

2.Increased demand in the natural gas and energy market, particularly in the Asian market (due to the replacement of coal with natural gas and renewable energy)

3.Rising electricity demand through:

-Intensification of household and industrial consumption towards this type of energy, becoming renewable in the long term.

-Emergence of major electricity consumers, such as cryptocurrency mining farms, and the digitization and automation of large industries, such as manufacturing.

Additionally, the resumption of economic growth after the Covid-19 pandemic has had an inflationary impact on price creation.

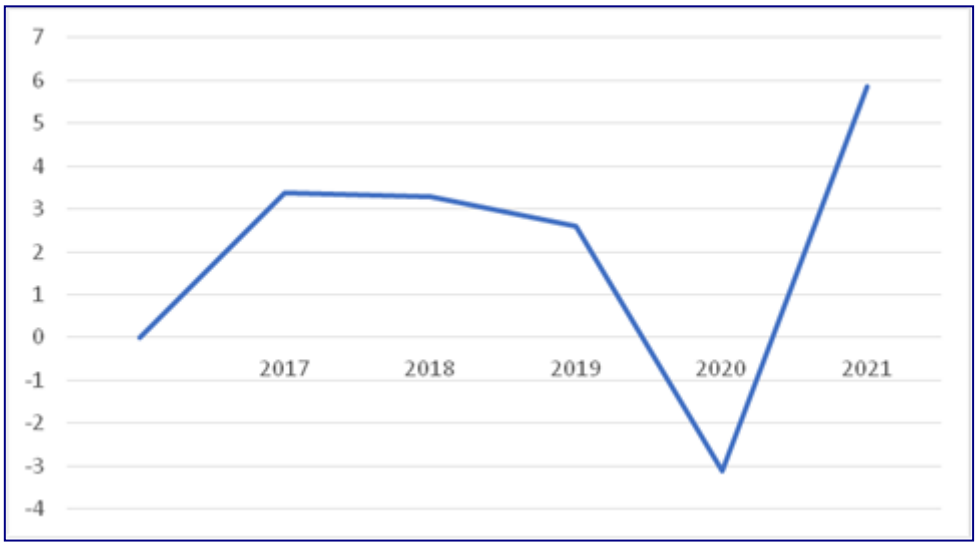

Fig.1- The global Gross Domestic Product (GDP) growth rate (%)

Source: World Bank national accounts data, and OECD National Accounts data files

Known for being part of the major energy consumers, cryptocurrency mining centers have formed a notable consumer type, as indicated by the data in the table below:

Table 1

Bitcoin Energy Consumption 2018-2023

Year	Estimated TWh/ year	Minimum TWh/year
2018	62.52112191	40.10674184
2019	63.95641494	44.34568118
2020	70.29231902	49.13453667
2021	134.015419	45.69561958
2022	161.2063544	65.05523027
2023	89.52930318	89.52930318

Source: https://digiconomist.net/bitcoin-energy-consumption

Table 2

Ethereum Energy Consumption 2018-2023

Year	Estimated TWh/year	Minimum TWh/year
2018	16.88188057	10.97785186
2019	7.920307651	2.722878796
2020	9.072771097	3.399765091
2021	39.03850898	10.27581623
2022	58.71332048	11.71750345
2023	0.013306308	0.00070967

Source: https://digiconomist.net/bitcoin-energy-consumption

In terms of the reduction in energy consumption for ETH, this shift is attributed to market changes, where the mining of this currency is currently prohibited, allowing only trading activities.

B. On a broader European scale, beyond the impact of the pandemic and the economic revival, notable effects stem from policies addressing climate issues, particularly in the supply sector.

These effects include:

1.Renewable Energy Instability: Disruptions in renewable energy production, aligned with the phase-out of conventional energy production methods.

2.Market Reconfiguration: Significant changes in the electricity and natural gas markets, characterized by:

-A rising trend in short-term operations and transactions for natural gas and electricity supply.

-A strategic shift to decrease the share of long-term contracts, facilitating the integration of reusable electric energy into the market. This shift is evident in the decisions of the U.S., Qatar, and Norway to move away from traditional long-term contracts indexed to oil prices.

-A relaxation of requirements regarding the establishment of winter and buffer deposits.

Furthermore, due to the Russo-Ukrainian War, there has been a substantial decline in natural gas supplies from Russia, impacting numerous European countries, including Germany, Italy, France, Austria, Slovakia, Poland, Hungary, the Czech Republic, Romania, and Bulgaria.

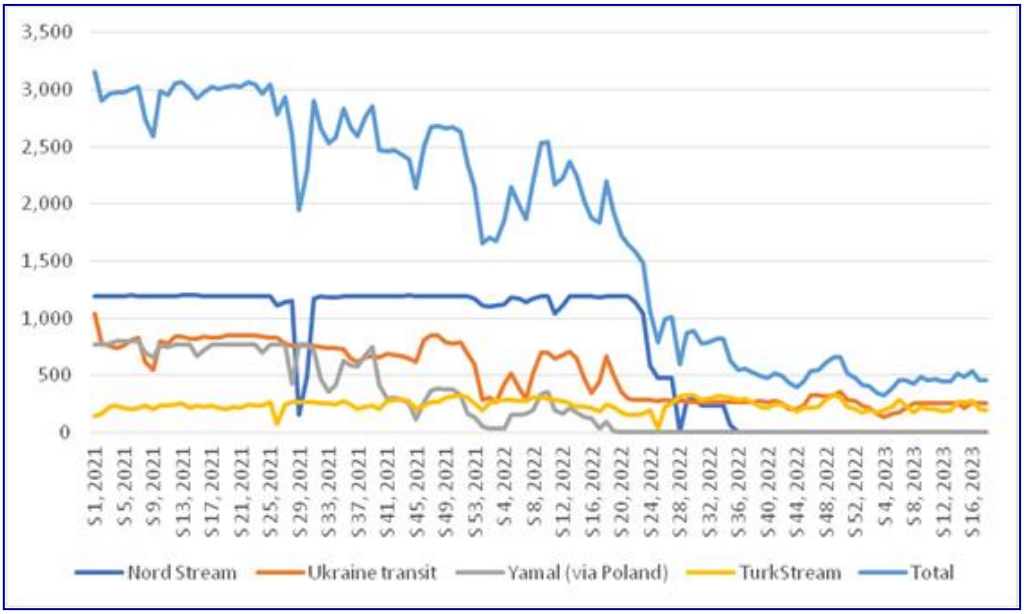

Figure 3 - Imported Gas from Russia (million cubic meters)

Source: Bruegel European Natural Gas Demand Tracker

All of the above had direct consequences regarding price formation, as follows:

EQUINOR (Norway) sells:

70% at the next-day price, compared to 25% in the previous period;

Due to limited supply and increased demand, prices surged even by 304.39% in the third quarter of 2022 compared to the same period the previous year and by 2920% compared to Q3 of 2020.

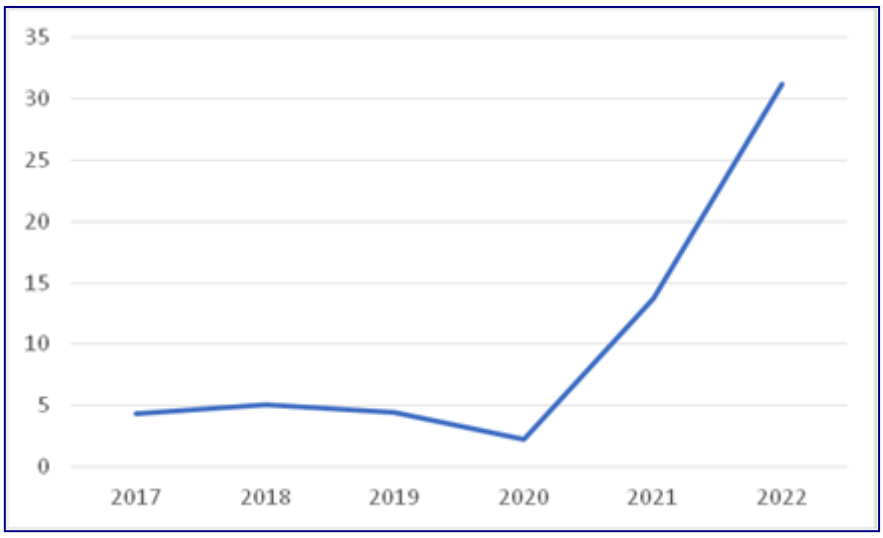

Figure 4 - Domestic Price of Natural Gas Reported ($/MMBTU)

Source: Equinor Investor Relations

The purchase price of natural gas for immediate delivery (spot price) increased by over 1250% in Q3 of 2022 compared to the same period in 2020 or 2021, according to the graph below:

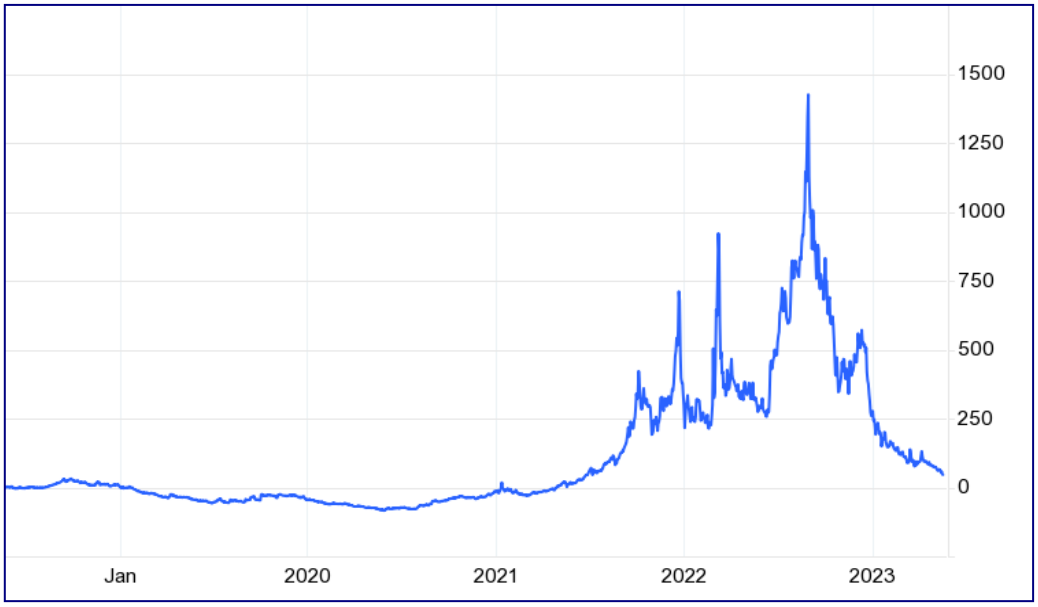

Figure 5 - Spot Price of Natural Gas in Norway,

Source:Trading Economics

Regarding the energy market in Romania, constant price increases have been observed since 2020. These have been exacerbated due to the liberalization measures promoted during this period and implemented under precarious conditions – the studies, analyses, and predictions regarding the practical energy market being insufficient.

The liberalization process had an unexpected effect – price increases (contrary to the market competition principle mentioned above). Among the causes triggering this rise are the lack of information provided by suppliers to consumers and the absence of protective legislation for the end consumer. In the same context, major producers and distributors recorded profits, supporting the unjustifiability of the increase that would lead to a higher final price.

Regarding the energy taxes imposed, they vary depending on the type of energy in question, as seen in the data presented in the table below:

Table 3

Excise Duties on Energy Consumption

Year	Natural Gas For Commercial Use	Natural Gas For Non-commercial Use	Electricity For Commercial Use	Electricity For Non-commercial Use	Gasoline	Diesel
MU	GJ		Mwh		Tone	
2021	0.89	1.68	2.61	5.23	2372.91	1981.75
2022	0.93	1.74	2.71	5.42	2458.10	2052.89
2023	1.03	1.94	3.03	6.05	1931.61	1931.61

Source: https://mfinante.gov.ro/

In 2020, the energy sector experienced a significant contraction in total excise revenues, marking a -12.6% decrease compared to the previous year. This decline was primarily attributed to the reduced consumption of gasoline and diesel amid the pandemic. In 2021, the Romanian government, aiming to stimulate business activities, took the initiative to refund amounts collected through diesel excise. Despite this, energy products saw a noteworthy 13.6% increase, driven by the normalization of consumption compared to the preceding year. Excise revenues for 2021 totaled 34.48 billion RON.

Moving into 2022, the second quarter witnessed excise revenues amounting to 8.28 billion RON. This downturn was influenced by the adverse trajectory of excises from the sale of energy products, particularly diesel and gasoline.

Simultaneously with the recording of low excise revenues, one of the economic activities that experienced significant growth was the electricity and thermal energy sector, as well as gas, hot water, and air conditioning. This surge was justified by both the increase in prices despite stagnant costs and the deregulation of prices in the gas sector. In the preceding year (2021), Law No. 259/2021 was enacted, taxing additional incomes of electricity producers, contributing a surplus of 0.6 billion RON to the state budget in the following year (the second quarter).

Regarding producers in the petroleum and gas production sector, companies with a surplus of over 20% from the average taxable profits for the financial years 2018-2021 pay an additional tax of 60% on that portion. Taxes in the energy sector play a crucial role, being one of the essential industries generating a significant portion of the annual budget revenue. In Romania, these taxes amount to 16% for enterprises with a turnover exceeding 500,000 euros and 1% for firms with employees and a turnover below 500,000 euros.

In 2022, OMV Petrom, one of the major players in the energy market, contributed 7% to Romania's fiscal revenues, totaling over 19 billion RON. This had a direct impact on public finances and overall budgeting.

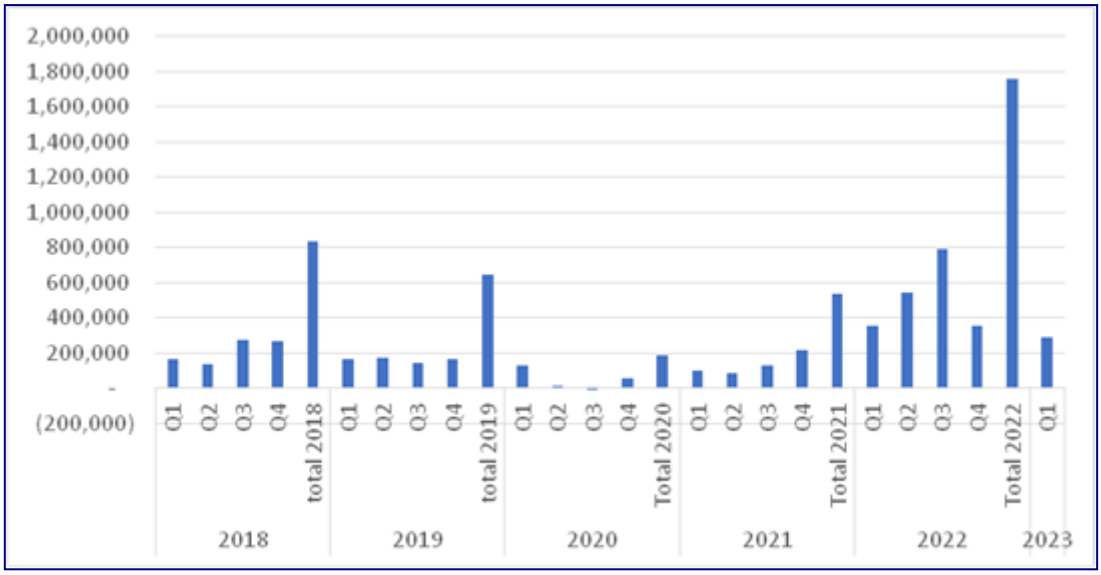

Figure 6 - Corporate Income Tax Paid by OMV Petrom (RON)

Source https://www.omvpetrom.com/ro/investitori/rapoarte-si-prezentari

In the case of Romgaz, a significant Romanian producer, majority-owned (70%) by the government through the Ministry of Economy, Trade, and Business Environment, its contribution to the state budget amounted to around 3 billion RON. This underscores its substantial impact on public finances and overall budgetary considerations.

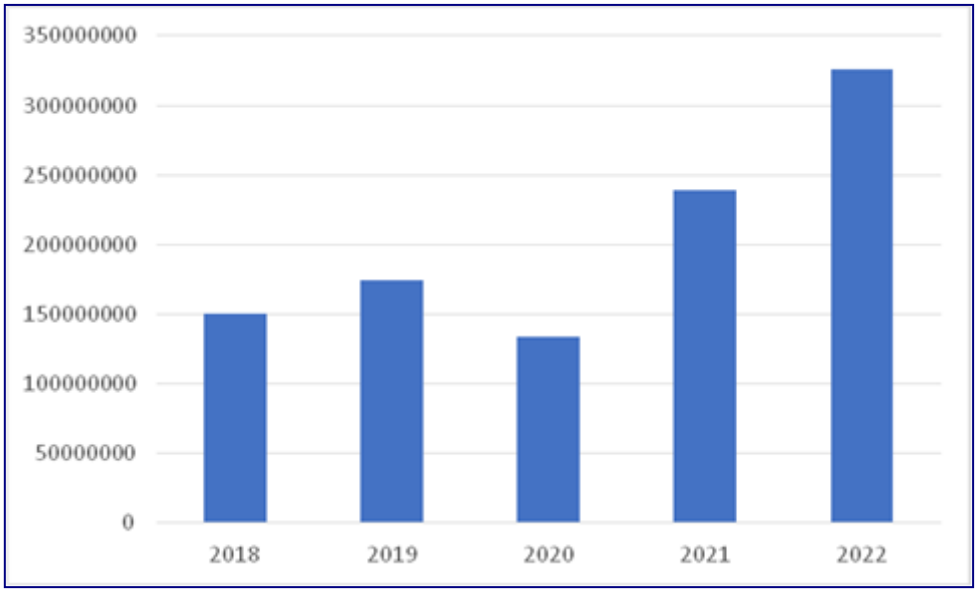

Figure 7 - Taxes Paid by Romgaz (RON)

Source: https://www.romgaz.ro/rapoarte-anuale

The distinction between these two competitors lies in the breadth of the energy spectrum they navigate, with OMV Petrom emerging as a key player in the domestic oil and natural gas industry.

Despite continuous efforts by the Romanian government to consistently model energy prices for both the general population and businesses, providing subsidies, these measures have not significantly impacted the bills paid by end consumers. This is evident in budgetary expenditures, as illustrated below, expenses that have been directly correlated with the increase in energy prices. Utilizing a price index established with the assistance of average quotations of NDI (the price for the next day represents the wholesale market component for electric energy with firm hourly transactions for active electric energy, with delivery on the day following the transaction) on a monthly basis, we managed to estimate a general price index (a proxy variable) for all forms of generated energy, considering the January 2019 average as a reference value numerically equal to 100. As a result, we generated the following prices using the formula:

$$the\ price\ index\ for\ the\ previous\ day * \frac{NDI_0}{NDI_1}$$

After collecting and analyzing the data through Granger causality, a notable trend emerged: as the price index increases, there is a direct and corresponding rise in budgetary expenditures. This analysis spanned multiple quarters from 2019 to the close of 2022, with a confidence level set at 10%.

Pairwise Granger Causality Tests
Date: 05/18/23 Time: 01:11
Sample: 2019Q1 2022Q4
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
CHELTUIELI does not Granger Cause INDICE_DE_PRET	14	0.14095	0.8704
INDICE_DE_PRET does not Granger Cause CHELTUIELI		7.21127	0.0135

Figure 8 - Granger Causality

Source: Report based on MFP database, Eviews software

Drawing on the information above, it becomes evident that, from an energy perspective, the imposition of additional taxes is not only justified but also yields a substantial impact on the state budget, warranting encouragement. Nevertheless, Romania presently grapples with the escalating challenge of a growing budget deficit, a predicament exacerbated beyond the dimensions instigated by the Covid pandemic. As expenditures rise to sustain the economic landscape and households in the realm of energy, the budget deficit undergoes expansion.

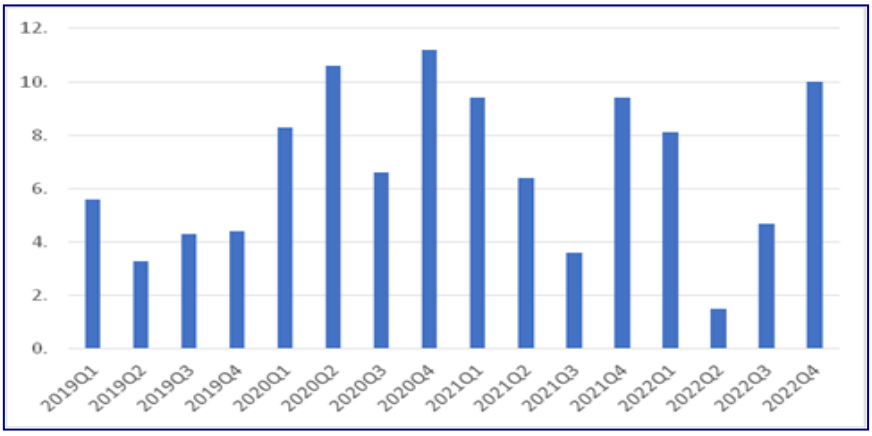

Figure 9 - Quarterly Budget Deficit (2019-2022)

Source: Eurostat

Budgetary expenses are fundamental to the operation and progress of any state. Hence, an alternative avenue for their utilization could be directed towards investments. However, to reach this stage, implementing temporary price controls might be necessary until the market achieves values similar to the norm. This approach mirrors the situation observed earlier this year in the natural gas market, where the freezing of prices for natural gas producers contributed to a gradual stabilization of both supply and demand.

Conclusions

The analysis conducted in the study has yielded several conclusions, such as the existence of disparities between demand and supply in the energy market. The state's intervention, albeit belated, in the energy markets is justified for the protection of households and the establishment of market order, even with a budgetary effort that has exacerbated the deficit, but carries a social character for the population.

A direct correlation has been identified between public expenditures as a share of GDP and energy prices, but not a substantial increase in income. This leads to the conclusion that the profits obtained by companies in the energy industry, whether producers, suppliers, or distributors, have an immoral component, as production costs are not directly impacted by the factors mentioned.

Looking ahead, it is anticipated that measures to protect households, with a direct impact on the budget balance, will be maintained, and the energy market will undergo a self-regulation process.

Bibliography

1.Energy poverty in Sweden: Using flexibility capital to describe household vulnerability to rising energy prices Jenny von Platten, 15 July 2022
2.Keˇcek, D. The Effects of Rising Energy Prices on Inflation in Croatia. Energies 2023, 16, 1583
3.Mary G. Finn, Journal of Money, Credit and Banking, Vol. 32, No. 3, Part 1 (Aug., 2000), pp. 400-416
4.Mikhaylov, Alexey (2019). Oil and gas budget revenues in Russia after crisis in 2015
5.OMV Petrom – Rapoarte și prezentari
6.OPCOM – Tranzacții - Rezultate
7.Robertson, B. (2021, 09 04). economic-extern/cresterea-globala-a-pretului-gazelor-naturale-risca-sa-afecteze-revenirea-economica--774027

8.Saidi Kaisn, Hammami Sami Faculty of Economics and Management, University of Sfax, Tunisia, Bulletin of Energy Economics (BEE), 2015, vol. 3, issue 3, 91-104, The Effect of Energy Consumption and Economic Growth on Co2 Emissions: Evidence from 58 Countries
9.Stephen P.A. Brown*, Mine K. Yu¨cel, Energy prices and aggregate economic activity: an interpretative survey, The Quarterly Review of Economics and Finance, Volume 42, Issue 2, Summer 2002, Pages 193-208
10.The spillover effects of rising energy prices following 2022 Russian invasion of Ukraine Michiyuki Yagi ∗ , Shunsuke Managi Urban Institute & Department of Civil Engineering, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka, 819-0395, Japan