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Article

Associations and statistical inferences to the productive environment of the oil market: analysis of the world's largest producers from 1993 to 2020

Rafael Henrique Mainardes Ferreira [1], Priscila Rubbo [2] and Claudia Tania Picinin [2,*]

[1] Ph.D. Student. - Federal University of Technology – Parana – (UTFPR); ferreira.rhm@gmail.com
[2] Professor - Federal University of Technology – Parana – (UTFPR); priscilarubbo@utfpr.edu.br
[2] Professor - Federal University of Technology – Parana – (UTFPR); claudiapicinin@utfpr.edu.br
* Correspondence: ferreira.rhm@gmail.com; Tel.: +55 42 99910-1048

Abstract: The energy matrix worldwide has been going through difficulties in its discussions - such as irregular exploration, inefficient public policies, and arbitrariness concerning diplomatic and political definitions of those involved in this market. This work's general objective consists in analyzing associations and statistical inferences of the largest world oil producers, assimilating the contributions and singularities of this market from 1993 to 2020. Based on the Organization of the Petroleum Exporting Countries (OPEC), it was possible to identify the possible inferences and contributions of the ten largest oil producers in the world in more than two decades using statistical analysis through correlation, regression, and statistical analysis of variables. According to the research and the literature on the area, the oil market proposes support to its discussions, mainly in its productive approaches. It is possible to identify this market as a solid link to geopolitical actions, distributing the possibilities through economic bias and socio-cultural and historical factors on a global level.

Keywords: petroleum; oil market; oil; statistics.

1. Introduction

When discussing the fundamental aspects of the world energy matrix, it is necessary to explain the strategic differentiation through global production, where the processes of environmental potential and modifications of experimental procedures are found [1].

It is possible to reinforce the bureaucracy and verticalization of the energy matrix, where, to the detriment of more plastered public policies, less social and democratic participation is visible, disfavoring the collectivity and egalitarian market [2].

In the last two centuries, the search for refining products derived from hydrocarbons and the exploration of raw substrates have brought to light a series of possibilities for commercialization and industrial diversification processes [3].

The exploration of alternative energies, such as biodiesel and residual or renewable elements [4], is discussed. Brazilian's pre-salt is increasingly on the rise [5], and the stability of platforms is modified for sustainable service [6] to optimize the exploration, excavation, and routing processes globally.

New oil exploration models arise, favoring more significant land speculation, the opening of international public policies, and the use of technological innovations using offshore platforms and regulations that cover the maximum number of people involved in this exploration process.

This panorama reflects that the possibility of expanding the exploitation of this market was even more significant when related to weapons interventions and armed conflicts before, during, and after world wars [3].

Greater interdiction and monitoring of the processes involving this input were visible to demonstrate the power and productive notoriety.

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The technological explosion for making the said exploration platforms proposed an accompaniment of the industrial revolution and history over time [7], where periods of productive acceleration and rush to the oil market were demanded.

Also, according to the literature [7], in the historical context, oil became more than an economic accelerator on a global scale but a hegemonic agent capable of regulating.

Much more significant issues that did not influence its markets, such as government relations, population quality of life, and aspects of human or environmental development.

Figure 1 represents the historical oil world's development, considering production and distribution until the 1990s, in the face of commoditization.

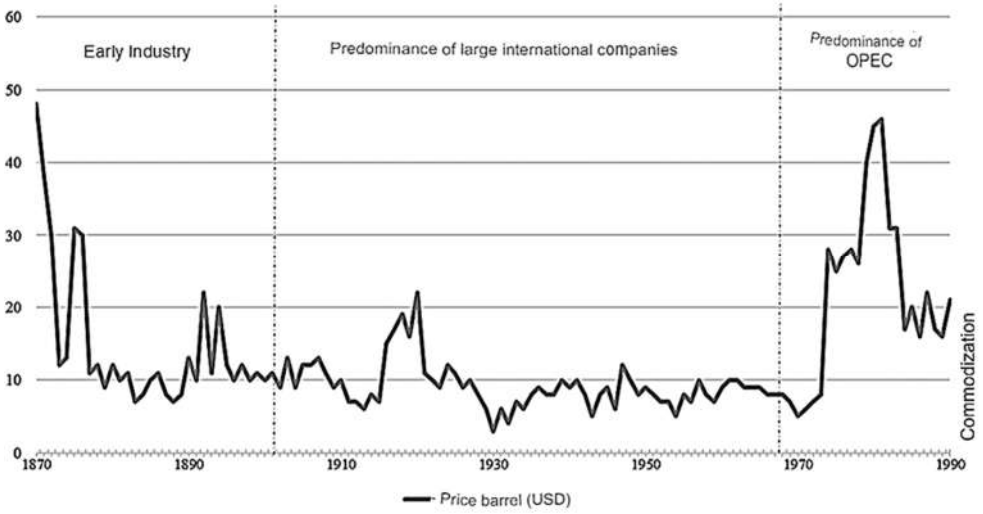

Figure 1. Configuration of oil prices over time in dollars per barrel (1870-1990).

Although other countries - Europeans - already do the crude oil refining process in advance, the historical milestone can be given by the marketing platform and modernization of logistical operations and oil refining for marketing, thus declaring the United States of America as the forerunner in the oil market [8].

In 1870 explosion of commercialization, where the company founded, called the Oil Company of Ohio, already exceeded the revenue in the millions of dollars.

This fact could provide an opportunity for more outstanding relations with England and Russia, providing partnerships for resource exploitation in the coming years and greater competition and contingency in the face of market competitors [9].

Amidst the evolution of this market at a frenetic pace, considering less than a decade of activity, a latent decadence due to state and customs aspects was visible.

As soon as it got new market ideas and refined the product considered black gold, the American industry began to feel a drop in production and revenue.

This scenario is prioritized by corrupt practices, deviation from morals and quality of life, and not being attentive to the local and global crises that interfered directly in this market [8].

Moreover, it is essential to note that OPEC's regulatory role in the 1980s was instrumental in shaping national strategies and global policies that enabled new import/export arrangements [10].

The literature [11] emphasizes that, on the one hand, one could see the dissatisfaction of the countries considered underdeveloped by the high price of oil; on the other hand, one had the strengthening of the cartel and the companies that obtained economic and diplomatic advantages among those involved.

The need for research is to identify the main points and formats for the commodity's commercialization, considering the variables needed to structure a fair and efficient market on a global level [12].

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Thus, the central objective of this work is to analyze the associations and statistical inferences of the world's largest oil producers through correlation and regression, checking the main points of contribution to the analysis of this market for the period 1993 to 2020.

As a hypothesis of the work, it's expected to identify significant correlations between variables that corroborate the development of this market.

Actions between energy consumption from fossil fuels (% total) and stratification of GDP (current US$) as a strengthening of the economic activities of each country also can represent some important straights of this market.

2. Materials and Methods

The present research establishes the statistical analysis of the panorama regarding the oil market on a global level, considering the evaluation of statistical variables directly intervening in this process.

According to OPEC [13], the largest oil producers worldwide are represented by their respective countries, in ascending order: the United States, Russia, Saudi Arabia, Canada, Iraq, China, Brazil, the United Arab Emirates, Kuwait, and Iran.

Table 1 represents the production quantification - in barrels/day - of the largest oil producers worldwide to illustrate the sample to be investigated and delimited to this market.

Table 1. World's Top Oil Producers - OPEC (2020).

Country	Production (barrels/day)	World Share (in %)
United States	12.779.000	13.55%
Russia	10.871.000	11.67%
Saudi Arabia	9.784.000	10.23%
Canada	4.630.000	4.96%
Iraq	4.500.000	4.59%
China	3.782.000	3.97%
Brazil	3.107.000	3.90%
United Arab Emirates	2.990.000	3.02%
Kuwait	2.665.000	3.01%
Iran	2.080.000	2.78%

Thus, it is necessary to analyze the convergent panoramas between them further to verify the factors that generate success for this input, considering the appropriate methodological design.

Some variables are used according to the availability of the World Bank Group [14], International Energy Agency [15], and United Nations Development Programme [16] databases. Figure 2 presents research variables, grouping information to produce this market between the years 1993 to 2020.

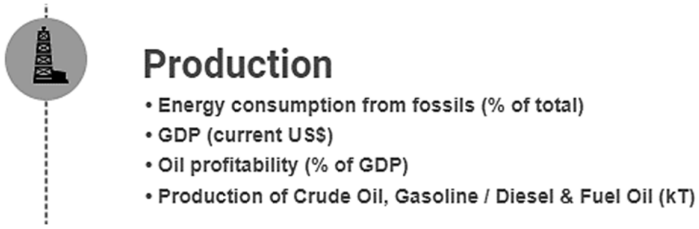

Figure 2. Variables used for the analysis of oil production.

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The period of analysis investigated reflects the period of three decades (1990 to 2020) to cover the most current practices of the research subjects and capture as much data from the platform as possible concerning the databases chosen for analysis.

This time cut is essential to visualize new methods or adaptations of the subjects found globally in contemporary processes, establishing possible completeness of the analysis [17].

To verify the results, statistical analysis will be used, summarizing the main evolutions or involutions of the oil market throughout history [14], [15].

Firstly, identifying the variables through descriptive statistics and then evaluating the variables through correlation, regression, and other multivariate statistical analyses.

It was suggested to the research to evaluate the variables using the correlation investigation, using Spearman methods, ANOVA, and definition of regression between the predictor variables and R^2.

According to Hair Jr. et al. [18], the significance and power of variables are primarily linked to their importance to analysis methods and result extraction procedures. Therefore, data completeness needs to be as close as possible to 100%.

However, even with 50% of the data, it becomes possible to identify the needs and characteristics of the sample, facing statistical inference and multivariate data analysis.

3. Results

Visual representation becomes fundamental for reaching hypotheses and targeting discussions as a criterion for observing the importance of the oil market worldwide. This way, the histograms of the ten largest oil producers are arranged, given the descriptive statistics based on frequency, using histograms.

The use of histograms still proves necessary in today's contexts, establishing scenarios and the search for greater assimilation of panoramas found in diverse cultures, regions, psychography, and political or resource apparatuses at more distinct structural levels [19].

Figure 3 presents that the more significant number of classes in each histogram, the greater the participation of the variable among the research subjects. Also, the larger (or higher) the class indicative (y-axis), the greater the manifestation of the variable to that country or period investigated.

It is interesting to note that, over time, all the countries investigated had a peak in fossil fuel consumption sometime between 1993 and 2020. Although some countries such as China, Brazil, and Kuwait have lower indicators - considering comparisons or other countries - it is still possible to see a momentary peak in this process.

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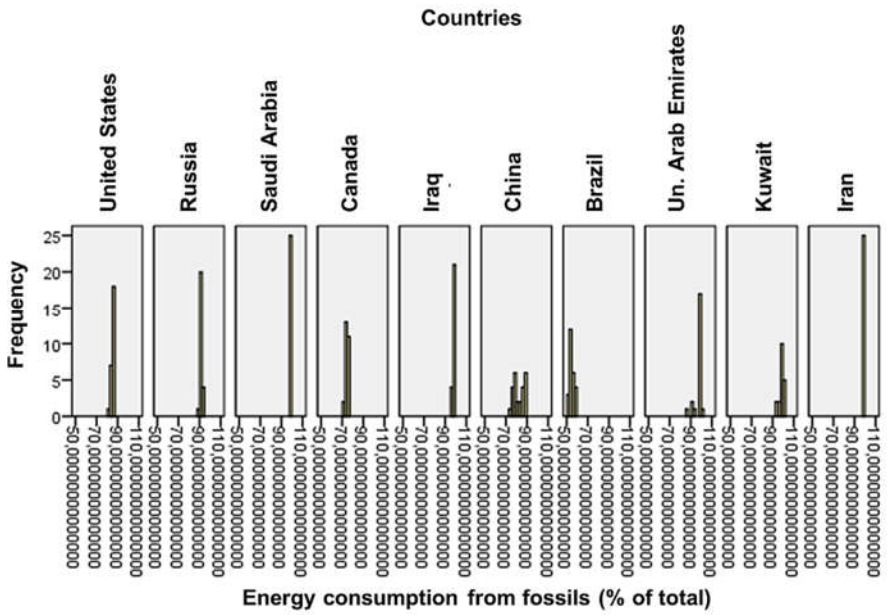

Figure 3. Histogram on energy consumption from fossil fuels (% of total).

The United States, Russia, and Canada showed an apex between 2008 and 2015, relying on a rapid decrease and liable to accelerated interruption.

The global financial crisis of 2008 triggered a strong call for oil production, especially from shale and crude oil derivatives, favoring discontinuity in the following years until the total decrease started in approximately 2013 [20].

OPEC reinforces the need for analysis regarding price variation in the excess production of shale and crude oil to the various allocations and valuations of this commodity globally, disfavoring the market prices of the entire oil environment [21].

In addition to directly affecting all OPEC participants, this commodity devaluation also brought greater price competitiveness and difficulty in adjunct countries. Also, Venezuela - which was facing processes of diplomatic resignation of this input [22] - and Middle Eastern countries in direct productive and political impacts [23].

Saudi Arabia, Iraq, Iran, and the United Arab Emirates, have demonstrated a potential for consumption and production as far as commoditization is concerned in the last years of the 2010s.

Saudi society and oil station workers relied much more on foreign labor and skilled structures for production potential to be maintained; however, in the face of economic recessions, local conflict development, and the pre-pandemic limitation brought the obstruction of these indicators at the local and global level [24].

One of the limiting factors to this panorama can also be reflected by the lack of qualified labor due to job segregation, categorization of mainly male functions, and inequality between local and foreign labor.

The unemployment rate, mainly Saudi unemployment, caused fossil fuel production to stagnate soon after the exploitations of this market in the mid-2010s [25]. Although the discussion of gender and labor qualification seems primarily removed from this picture, a direct impact on the production and consumption of these fuels at the regional level is perceived [26].

Kuwait was also strong in this period as a place of prominence and continuity with this market. However, it maintained the most confident production aspects until the pre-pandemic period.

Although Kuwait's fossil fuel production has been prominent since 1990, the peak can be referenced in the new OPEC regulations. It sets this country as a significant mover

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of crude oil, shale, and, recently, the investment in biofuel research and diplomatic relations with other Middle Eastern countries [27].

Despite the high peaks in energy consumption from the mid-2000s to 2010, there is greater budgetary security from oil ties at the regional level, favoring more significant changes in government systems, more great democratic uprisings, and social and demographic changes [28]. An example of this can be seen in actions such as the Arab Spring, which established new possibilities for local democracy and revolutions in political and economic formats at the regional level.

For its part, China strongly influenced fossil fuel burning and production from the 2000s - until about 2010. Over the past 20 years, according to the Statistical Review of World Energy - Global Statistical Energy Report [29], much of this reduction in fossil fuel energy production and consumption in China and this eastern region has come about through less centralized postures and more openness to the public diplomacy of these inputs.

As a consequence of the country's GDP reduction, the need to restructure fossil fuel production became more viable, turning the country into a balance point for pollution maintenance and political and environmental improvement [30].

Coal, oil, and natural gas eventually became less imposing on the country, focusing on specific and less centralized actions by the energy and renewable resources ministries.

When relating the Brazilian panorama, some factors can be directly related to the gradual decline of fossil fuels over the past decades: the change of economic plan at the national level; the exploration of more efficient products, such as pre-salt and the use of biodiesel; and the treaties and formalization of less environmentally harmful environments at the national level - and its relationship with other countries, diplomatically [20], [31].

With the stipulation of the Real Plan in the early 1990s, the stimulus to fossil fuel production - specifically shale, shale gas, crude oil, oil sand, or bitumen - gave way to a more consistent output with greater possibilities for Petrobras [21].

Knowing this, exploring more sedimentary elements, such as the pre-salt, made it possible to trigger large-scale production until its peak in 2013 [31]. Thus, there was a lapse in production at the national level of resources and fossil fuels, giving way to new, more ecological, and environmentally viable approaches.

The depletion or obsolescence of processes solely focused on extracting petroleum, bitumen, and crude oil gradually gave way to biofuel import and export aspects that are more economical and highly valued by international economic exchanges [12].

Literature also reinforces the incurrence of incoherent public policies [12] and, consequently, increasingly volatile political plans. It made the market for these commodities highly unstable, treating the political and economic aspects in the background and favoring more excellent discussions with entities such as OPEC and Petrobras S.A. as the primary exploitation agent of this market.

The expansion and maintenance of fossil fuels until the mid-2010s is visible, with the exploration of new resources; the regulation of global pollution aspects; and the pre-pandemic economic recession, which established lower production indications and consequently lower energy consumption derived from fossil fuels, as the immediate context for the decline.

The following is the statistical discussion that relates the world's largest oil producers to Gross Domestic Product - GDP over time (1993-2020).

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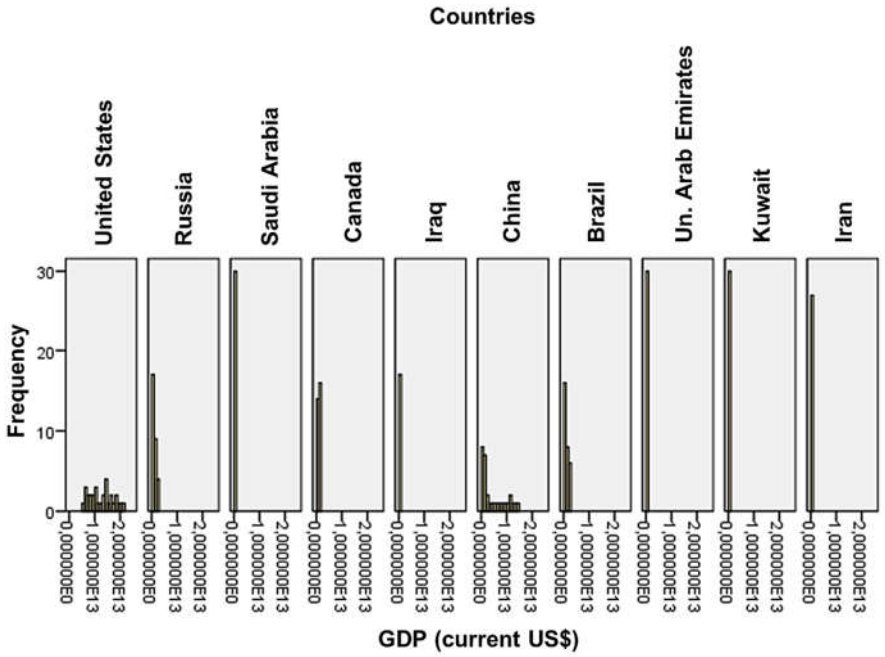

Figure 4. Histogram of GDP (current US$) among the investigated countries. Source: Own authorship (2021).

Figure 4, except for the United States and China - and partially in Brazil - shows an explosion in the Gross Domestic Product. Then its moral decline in most of the countries investigated.

In the case of Brazil, this becomes more explicit in the face of the challenges faced by the economy in the early 1990s, where the Plano Real stipulated a break in expectations and manifested more significant indicators of taxes and fees aimed at the national economy.

This scenario began to become more unstable and declined from 1994, when, compared to the 1980s, there was a decrease of 3.68% to 5% in the face of monetary instabilities and political participation [32]. This drop was already enough for decisions to be taken with various economic blocks and the search for State restructuring.

Based on Cysne's [33] studies, there was a strategic approach among countries such as Brazil, Argentina, Venezuela, and other Mercosul affiliated with the National Development Plan - PND - in the 1990s, which reformulated strategies to equalize the GDP and improve attributions related to foreign debts and international political relations.

Therefore, the end of the 1980s had at its peak the reformulation of strategic sectors, such as steel, commodities, and the petrochemical industry, mainly by appropriating search and extraction platforms from Petrobras S.A. and external agents [33].

Similarly, it is perceived that GDP remained high until the mid-2010s in the United States of America, keeping the economy heating up among these types of industries - steel, commodities, and petrochemical industry. Also, it maintains average budget agreements based on privatization, decentralization of power, and new searches for renewable resources [26], [34].

Privatization credits were widely used factors in the delimitation and association of countries in search of new economies.

The bureaucratization of these credits is noticeable in foreign trade processes between China and Brazil, for example, and the United States and China, or Brazil and Russia over these decades [35]. This factor underscores the maintenance or notoriety of these indicators with more excellent stability relative to other countries.

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The rather remarkable decline in GDP in Middle Eastern and North African countries - as shown in the histogram: Saudi Arabia, Iraq, United Arab Emirates, Kuwait, and Iran - can be further understood in two possible ways.

First, cultural aspects and effective changes in government plans caused many of these countries to end up changing diplomatic relations and interconnections with economic blocks globally, adding to armed conflicts and political and social demonstrations for change [36].

Sequentially, it is visible that the balance of privatizations at a global level brought new approaches concerning entities such as OPEC, which allowed for greater flexibility and freedom of action of countries and current markets [37].

In just over a decade, it has been possible to verify the drastic drop in budget indicators, the need for conflict resolution, and more effective approaches for these countries [34].

A clear example of this type of manifesto was the preparation and discontinuity of actions in the 2008 crisis, which initially made explicit the North American needs, but consequently brought lower rates for the balance of trade balance globally [38].

Canada also experienced state de-bureaucratization in the face of the reshaping of hundreds of privatized companies in recent decades [39]. Several markets ended up slowing down their relations, and gradually the process of economic maintenance also became precarious [40].

In the last decade, however, this process has resumed to restabilize some companies and bring about better diplomatic, political, or economic relations with Canada's relations with the East or with the West itself [41].

Next, in Figure 5, the histogram that relates the Profitability of Oil, about the general percentage of GDP is presented for verification of this indicator for the selected countries.

It is essential to realize that this indicator reflects the specific manifestation of the oil market in the selected sample, unlike the previous histogram, which represented GDP in the face of the characterization of all available trade and budget transitions.

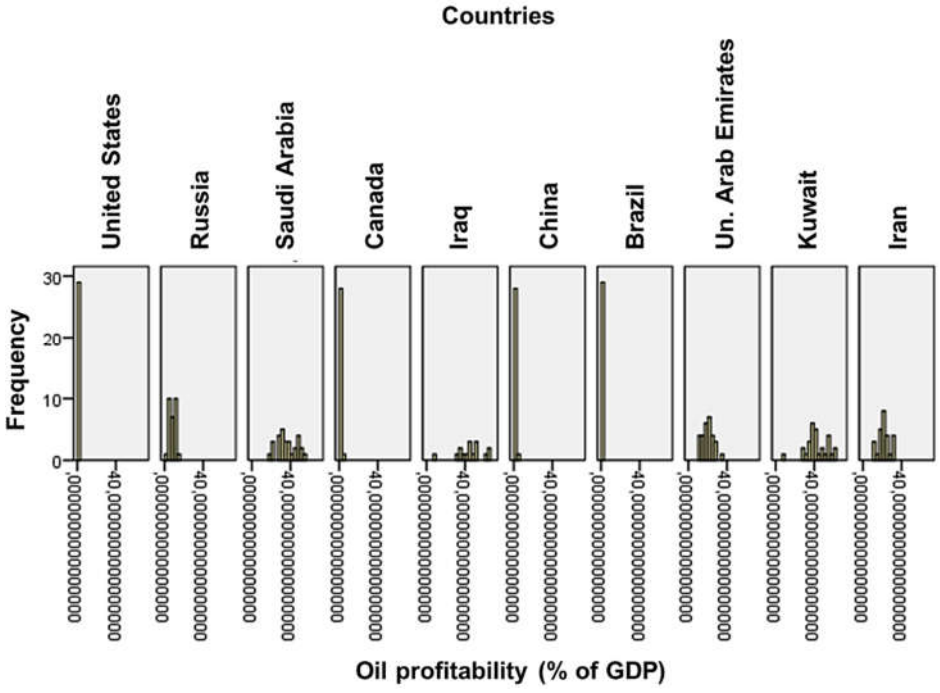

Figure 5. Histogram on Profitability of Oil (% of GDP) among investigated countries. Source: Own authorship (2021).

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Similarly, and by the principles observed by the decline in GDP and fossil fuel consumption previously discussed, the Profitability of oil - considering the GDP of the countries in the sample - is also visible in the face of two fundamental realities: rapid decline and maintenance over the decades.

The decline observed in countries such as the United States, Russia, Canada, China, and Brazil, represents a singularity regarding market modification and obtaining new policies concerning the oil market - used primarily in the 1990s as fossil fuel [41].

Until the economic recession of 2008, the discussions verified that the dynamics established in the oil market are stratified as a widely volatilized decline, i.e., giving way to new perceptions and needs along with new public policies and diplomatic relations [38].

Among the countries mentioned, Russia has managed to maintain a direct and closer relationship with the Middle East and North African countries, providing an indicator that is a little more balanced compared to the other countries. For example, the association of Russian policies concerning the United Arab Emirates provided better conditions for the exploration, maintenance, and assimilation of this market at a national level.

In contrast, countries in the Middle East and North Africa, such as Saudi Arabia, Iraq, the United Arab Emirates, Kuwait, and Iran, have maintained a more balanced indicator, demonstrating greater effectiveness in the mid-2000s.

The formal establishment of the world's largest oil plants - according to OPEC [37] data - has provided an opportunity for greater dismemberment of actions and policies focused on these countries, concentrating more significantly indicative of this commodity's wealth for international contribution.

The oil market prices also acted in a direct way to these countries, managing to concentrate up to 40% of the world production and wealth in the 2000s in countries like UAE and Saudi Arabia, along with these countries' other recurring markets (such as tourism and mineral extraction) [42].

Currently, this market's profitability foci can still be quite influential in countries like Saudi Arabia, Iraq, and Kuwait, which invest in platforms and transformation mechanisms to obtain oil in various marketing forms [24], [27].

Next, Figure 6, with a specific focus on the market production, given the petroleum products and their primary form. Thus, data is shown between 1993 and 2020 among the producing countries in this market for the production focus on Crude Oil, Gasoline or Diesel Oil, and Fuel Oil.

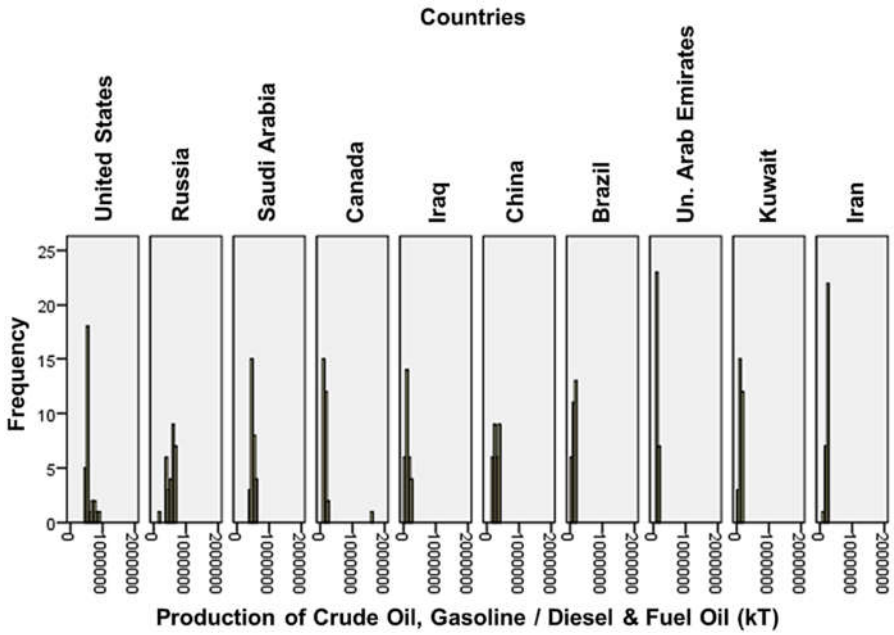

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Figure 6. Histogram on the Production of Crude Oil, Gasoline/Diesel, and Fuel Oil (in kT) among investigated countries.

Again, the designation of decreasing indicators is noticeable over the years, causing countries to have an apex and, sequentially, a decline according to some factors that can be correlated with various discussions with these countries.

The capitalization of crude oil and oil derivatives remained as standards for the constancy of the search for new sources of oil and natural gas worldwide. As a prominent example, Brazil took the pre-salt explorations as a phenomenon of withdrawal of crude oil and derivatives from the market, establishing new commercialization aspects and a significant decrease in the organic exploration of the material [31].

In most countries, operational efficiency was based on new exploration methods and earmarking new bases to capitalize on alternative energy to move to new markets and explore new diplomatic movements globally [32].

Even if the market was prepared for refinery outages and the gradual decrease in organic elements of petroleum [12], the reserve capacity and potential for extraction and development of mechanisms on behalf of this market had already proven to be quite deficient for decades [22].

Countries like the United States, the United Arab Emirates, Iran, and Iraq were impacted by this drop in demand, manifested by the need for new production reserves and the possibility of new environments for extraction and commodification of this input.

Elements thought to be highly profitable to the oil market - such as shale oil, crude without primary refining, and commercial shale gas - have lost market value as new practices have been established, considering the elements of international globalization [26].

Artificial Intelligence mechanisms were fundamental for establishing new refineries and the practice of separation, valuation, and logistics destination of crude oil and its derivatives to several countries [22]. Some software started the projection of more sustainable indicators - verticalizing actions such as the contribution of refineries and the collection of this waste with less environmental impact - enabling, on a large scale, the exposure to the aspects of responsible marketing and better use of ecological resources.

Next, the correlation of data for production shows, considering energy consumption from fossil fuels (% of total), Profitability of oil (% of GDP), and Production of Crude Oil, Gasoline/Diesel, and fuel oil (in kT). Spearman's correlation was chosen, given the non-parametric arrangement of data [43].

Spearman's correlation, or Spearman's ϱ, is indicated for obtaining analysis and relationship between variables as to their order indication. Thus, it primarily means a monotonic function, i.e., linear or non-linear [43].

Some analyses are drawn in front of the correlation, using the base values +1 - where the correlation presents itself as statistical strength and better apprehension of data - and -1 - where the correlation is contrary and does not present a direct and affirmative relationship for the variables discussed.

Table 2 demonstrates the correlation between the variables observed, providing an opportunity to see their interrelationships and discussions.

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Table 2. Correlations among production variables.

Spearman's Rho			Consumption of energy from fossil fuels (% of total)	GDP (US$ current)	Profitability of oil (% of GDP)	Production of Crude Oil, Gasoline / Diesel & Fuel Oil (kT)
Consumption of energy from fossil fuels (% of total)		Coefficient Correlation	1,000	-0,691 **	0,784 **	0,046
		Sig. (bilateral)	.	0,000	0,000	0,476
		N	243	228	228	243
GDP (US$ current)		Coefficient Correlation	-0,691 **	1,000	-0,803 **	0,502 **
		Sig. (bilateral)	0,000	.	0,000	0,000
		N	228	284	274	284
Profitability of oil (% of GDP)		Coefficient Correlation	0,784 **	-0,803 **	1,000	-0,174 **
		Sig. (bilateral)	0,000	0,000	.	0,004
		N	228	274	274	274
Production of Crude Oil, Gasoline / Diesel & Fuel Oil (kT)		Coefficient Correlation	0,046	0,502 **	-0,174**	1.000
		Sig. (bilateral)	0,476	0,000	0,004	.
		N	243	284	274	300

** The correlation is significant at the 0.01 level (bilateral).

Some significant statistical correlations appear, the main one being the relationship between the variables Fossil Fuel Energy Consumption (% of total) and GDP (current US$), with a very high significance index.

It can be quite discussed by obtaining refineries over the last decades worldwide, favoring the exploitation of this market on a large scale and the diffusion of practices and mechanisms with crude oil, shale extraction, and base mineral oil for refinery products [21].

The energy consumption from fossil fuels has been closely linked to the stabilization of each nation's Gross Domestic Product (GDP), instituting practices in this market that reflect aspects of economic, commercial, and market development at a macro-structural level.

Another notable correlation between the GDP variables (current US$) and the Production of Crude Oil, Gasoline/Diesel, and Fuel Oil (in kT) can be considered. Besides the fundamental consumption aspects, production was also highly related to this market, symbolizing, explicitly, the demand and supply relation for this market, as well as its direct contribution to the national GDP and its specificities.

Furthermore, a significant correlation was also found between the variables profitability of oil (% of GDP) and Energy consumption from fossil fuels (% of total).

The perception of Profitability for this market is one of the prerequisites for the stability of diplomatic relations between countries and economic blocks that use this commodity. Thus, Profitability is one of the fundamental factors for the display of global panoramas of each region, establishing its strengths and main weaknesses.

Both variables can predict some aspects of negotiation, marketing, and the manifestation of needs, considering each country's percentage character and primary structural designation.

The statistical correlation analysis also identified the regression between the variables, with the GDP (current US$) as the dependent variable.

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The regression made it possible to observe that all variables were inserted into the analysis, with no variable removal or cancellation. In addition, the linear method was used to verify results better.

When summarizing the model summarization results, it founds that the R-squared manifestation represented an adjusted and statistically significant value (R = 0.998). This value presents the continuity of the analyses in the face of statistical significance in response to the averages observed.

According to the literature [43], the R-squared associations are significantly interrelated with the explained variation and the total variation of the model. Thus, to the fitted model, a range of 0 to 100% is recommended, establishing greater statistical significance to the model that can reach the threshold closest to 100% or 1.

Taking the significance of the model as a premise, it was also possible to identify the differences in means among the groups of variables. Enabling the comparison and development of new discussions, the Analysis of Variance - or ANOVA appears, adding to the regression analysis elements/variables of quality of life and governance that can add further talks to the research scope.

Considering the significance index (Sig) and variation of the Mean Squares, it verifies that the means have a distinction among themselves, rejecting the null hypothesis and suggesting the manifestation of new analyses to identify sets, models, or comparisons between groups of variables.

It is important to note that the dependent variable chosen refers to the GDP (current US$) because of its participation and particularities among the models and statistical features presented previously. All the other variables were obtained as predictions for analysis, contemplating a more complete and robust Analysis of Variance.

ANOVA[1]

Model	Sum of Squares	gl	Mean Square	F	Sig
Regression	2,662E+27	12	2,219E+26	2292,353	,000[2]
Residue	1,016E+25	105	9,679E+22		
Total	2,673E+27	117			

[1] Dependent variable: GDP (current USD).

[2] Predictors: (Constant), Total life expectancy (and men), Population (total), Energy consumption from fossil fuels (% of total), Adjusted savings: expenditure on education (current US$), Total unemployment (full - % total labor force participation) – national estimate, Production of Crude Oil, Gasoline / Diesel & Fuel Oil (kT), Profitability of oil (% of GDP), Political stability and absence of violence/terrorism: estimate, Estimated Control of Corruption, Human Development Index (HDI), General government final consumption expenditures (US$ at current prices), Government Effectiveness – Estimate.

Table 3. Analysis of Variance - ANOVA - for Production axis

Once the basic analysis model has been summarized and the Analysis of Variance applies to the investigated elements, space is made for the verification of standardized and non-standardized coefficients, considering the predictors and the dependent variable - GDP (current US$) - in the regression.

It is possible to observe the significance level of each variable and its standardization - or non-standardization -taking into account the constants and the standard error.

In addition, the t-test variations can also represent the main results, where the differentiating relationships regarding the null hypothesis of each variable group are visible.

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4. Discussion

According to statistical literature [43], if $p < 0.05$, you get the coefficients different from zero and amenable to analysis and correlation adjusted to the summarized model.

Most of the variables and coefficients are significant, although the Sig value for the constant was $p = 0842$, allowing further analysis and different correlations to this model.

Considering the general analyses of the Production axis, it was possible to finally perform the regression demonstration between the variables and illustrate them in front of a scatter plot.

The following graphical model, in Figure 7, demonstrates this analysis in a complementary way.

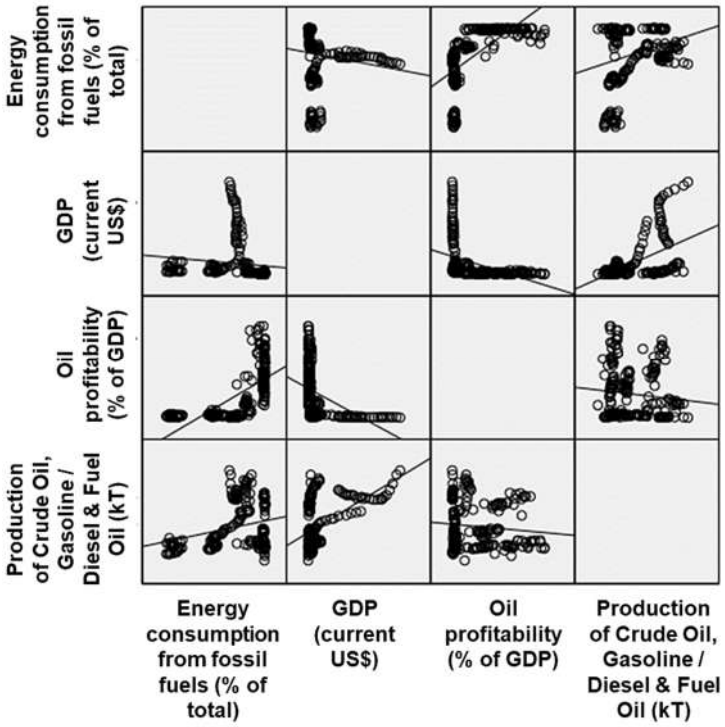

Fig. 7 Scatter plot for the Production variables.

Before outlining an analysis of the elements and variables instituted in a statistical model, it is crucial to realize the breadth and general context of the global oil market. The multifaceted relationships between countries and designations to this commodity bring a more subjective orientation to this analysis.

They, therefore, require a more excellent perception of factors intervening in the production of this market.

Punctually, it is possible to verify in the correlation model that some directions are taken as the positive correlation between the variables: Profitability of oil (% of GDP) and Energy Consumption from fossil fuels (% of total); the positive correlation between the Production of Crude Oil, Gasoline, Diesel and Fuel Oil and the Energy Consumption from fossil fuels (% of total); and the positive correlation between the Production of Crude Oil, Gasoline, Diesel and Fuel Oil and the variable Profitability of oil (% of GDP).

Besides this, as models of negative correlations, it is possible to verify the variables: GDP (current US$) and fossil fuel energy consumption (% of total); Profitability of oil (% of GDP) and GDP (current US$); and Production of Crude Oil, Gasoline, Diesel and Fuel Oil and the fossil fuel energy consumption (% of total) and the variable Profitability of oil (% of GDP).

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The multicollinearity between some variables can be defined according to the definitions of [44], where the oil market volatility allows it to pass over several points of politics, economy, and society. Thus, the wide range of relationships between production indicators allows, in an updated manner, a series of estimates and connections between those involved in this market.

The disconnection between variables such as Profitability of oil (% of GDP) and GDP (current US$) follows an example of mutability of indicators, favoring volatile and, for now, shaky hands to the production of this input, requiring more in-depth study of those involved in this production.

Residues in correlations such as the Production of Crude Oil, Gasoline, Diesel, and Fuel Oil and the Consumption of energy from fossil fuels (% of total), and the variable Oil Profitability (% of GDP) allow us to make in-depth analyses and studies about the investigated characteristics, favoring aspects of public policies, natural reserves, or the use of alternative resources in the last decades.

Most of the correlations and statistical inferences can still reflect different environmental manifestations and instabilities of recent years. In the face of recession and economic and social insecurity, this panorama also proved fragile and inconsistent [28].

5. Conclusions

Oil, as well as its priority relationship with the current energy matrix, has become an element of geopolitical modification, adding not only the financial character but also the socio-cultural one along its historical course [45]. In this way, new forms have been speculated, and the search for products that could be equivalent to these commodities in the global market.

It is common for academic discussions to refer to and treat the oil market in terms of specific clusters, given a historical or regional precept.

An example of this can be seen currently in the number of scientific discussions that reference oil production in Venezuela and the Middle East [46], [47] to make explicit the regional aspects of raw material (in its abundance or scarcity process); diplomacy and political apparatuses with other regions; or even cultural elements that corroborate the need for in-depth analysis among the stakeholders of this process.

The pessimistic view about the future of oil and the notoriety of its scarcity in a near scenario is widely discussed [48] to outline new approaches for those involved in these processes, whether human or institutional.

The present work had as its primary purpose the statistical explicitness of the oil market among the leading world producers, according to OPEC, bringing the framework of discussions among its variables in a more robust and systematized way.

It is possible to perceive some linearities regarding the production aspects of this market, strengthening the analysis of variables such as GDP, energy consumption, and fossil fuel production in the investigated countries.

It is necessary to analyze in greater depth the elements corroborating this panorama, focusing on its complexity of relationships and listing aspects such as governance, quality of life, and diplomacy in this market. Thus, new research is suggested to understand these interrelationships and enable further statistical discussions because of more complex variables.

According to the positive manifestations of the investigated production variables, the research hypothesis proved to be effectively fulfilled, bringing together the historical-economic evolution of this market worldwide.

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