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Geopolitical Risk and Energy Markets: Past, Present, and Future

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ABSTRACT

Due to the most recent geopolitical events, such as the Russia–Ukraine conflict and the war between Israel and Hamas, geopolitical risk (GPR) and energy markets have been at the forefront of the academic debate. To identify the evolution of the literature inherent to GPR and energy markets, we conduct a meta-literature review—that is, including both qualitative analysis (the content analysis) and quantitative analysis (the bibliometric analysis)—with regard to a selected sample of 72 papers from the period 2018 to March 2023 (March included). We perform the co-citation and co-authorship analysis and we also identify five main research streams as follows: (1) “Oil and uncertainty in different scenarios,” (2) “Uncertainty, resources and energy,” (3) “Geopolitical risk and oil from a broader perspective,” (4) “Oil, metal markets and uncertainty,” and (5) “Uncertainty and the oil market: a geographic perspective.” Finally, we also identify the future research perspectives. Given the increasing interest in the topic in question, our work proves to be of great interest to researchers and scholars, since it identifies the past, the present, and the future research perspectives of the topic considered.

1 | Introduction

The most recent geopolitical events, such as the U.S.–China trade war, Russia's invasion of Ukraine, and the war between Israel and Hamas have driven the worldwide attention to the topic of geopolitical risk (GPR). These events, in fact, have caused an increase in uncertainty, with stronger effects on commodity markets, both in terms of supply and demand. To this regard, the war itself as well as sanctions applied to particular geographical regions can lead to supply shortages, which can translate into increases in prices and volatilities in commodity markets (Atri et al. 2021; Long and Guo 2022). With regard to the demand side, the uncertainty shocks can cause the reduction of the demand for specific commodities, since they influence firms' production and investments. Therefore, given its effects on the demand and supply factors, GPR is priced in the commodity markets. More

precisely, as shown in Cheng et al. (2023), commodities trade with a premium when GPR is higher. Given the aforementioned events which have deeply affected the global economy and geopolitical ecosystem, in the most recent years, GPR has therefore played the role of protagonist in the worldwide scenario, having consequences ranging from daily and local matters to international and decade-long issues. Moreover, GPR, which, as was mentioned earlier, is often intertwined with issues connected to commodity markets, has recently been at the center of debate due to its consequences on energy; to this regard, for example, the Russia–Ukraine conflict has once again put the spotlight on the issue of energy management in European countries.

In addition to this, several authors studied the relationship between GPR and financial markets. To this regard, in fact, Salisu et al. (2022) investigated the relationship between GPR and

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advanced economies, namely G7 countries and Switzerland, and thus concluded that the stock markets of advanced economies are GPR-sensitive and also that GPR can be employed as a valid predictor of stock returns. Moreover, GPR is among the factors considered by Wang et al. (2023) (together with natural resources and trade) taken into consideration to analyze the impact of the elements in question on financial inclusion in China. With regard specifically to GPR, according to the authors, GPR decreases the financial inclusion in the territory considered. Zhu et al. (2025) also focused their attention on China and through the employment of the improved Diebold and Yilmaz method and of five sub-market stress indices, namely banking, securities, foreign exchange, housing, and commodity, they concluded that GPR influences financial stability. Furthermore, Zheng et al. (2023) used the time-varying frequency risk spillover network model to analyze the relationship between GPR and financial markets and consequently determine that GPR actually plays a leading role in the cross-market risk spillovers in global financial markets.

It is thus clear that the concept of GPR is broad and that it encompasses a variety of elements belonging to different sectors and fields, such as technology, politics, geography as well as the banking and the financial systems. This finds confirmation in the definition of Caldara and Iacoviello (2022), who define GPR “*as the threat, realization, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political actors that affect the peaceful course of international relations*”.

As it was mentioned earlier, given the most recent events, the focus of our work is GPR and energy markets, as we will also thoroughly explain in the following sections. Even though a widespread literature investigates the relationship between GPR and commodity markets (Aizenman et al. 2024; Aloui et al. 2023; Foglia et al. 2023; Gong and Xu 2022; Hasan et al. 2025; Lo et al. 2022; Mandaci et al. 2023; Wang and Su 2023; Yang et al. 2022; Zheng et al. 2023), no one has provided a bibliometric literature review on the topic. Given the importance and the relevance of the topic in question, we incrementally contribute to the existing literature by carrying out an in-depth analysis, which highlights the role of GPR with regard to a variety of issues and elements, as we will thoroughly explain in the following paragraphs.

In this paper, we thus fill this gap and provide a meta-literature review—that is, including both qualitative analysis (the content analysis) and quantitative analysis (the bibliometric analysis)—on GPR and energy, thus identifying the main aspects of the sample of papers considered. To conduct our analysis, we select 72 papers for the period 2018 to March 2023 (March included). Through the employment of the most recent bibliometric techniques, such as the use of the software “VOSviewer,” combined with a systematic literature review, we outline the co-citation analysis, the co-authorship analysis, and the content analysis and discuss future research perspectives. Through our analysis, we find that the majority of the papers deal with oil and not with gas markets and we also identify five research streams, each addressing the topic from a different perspective. The first stream, named “Oil and uncertainty in different scenarios,” deals with the interconnectedness between oil and uncertainty measures (including GPR) applied to different contexts and scenarios. The second research stream, entitled “Uncertainty, resources and energy,” is characterized by the papers focused on the study of

the relationship between uncertainty measures, different types of resources (e.g., natural resources, renewable resources, etc.) and energy (such as electricity, energy rents, etc.). “Geopolitical risk and oil from a broader perspective” is the name of the third research stream whose primary focus is the study of the relationship between oil and GPR. Furthermore, the fourth research stream, named “Oil, metal markets and uncertainty,” is centered around the analysis of the relationship between oil and uncertainty and the relative spillovers to the markets of metals. The last research stream identified is as follows: “Uncertainty and the oil market: a geographic perspective,” which includes papers focused on specific geographic regions taken as a laboratory. As will be explained in the following sections of this paper, our research turns out to be heavily (but not only) centered on oil. This was not a foreseeable outcome, but it is the natural output produced by the different keyword research combinations employed throughout the work. For this reason, other aspects, such as gas and renewable resources, which are leading protagonists of the works of several authors, such as Su et al. (2021), Sweidan (2021), Zhao et al. (2023), Emiliozzi et al. (2024), and Wang et al. (2024), appear to be marginal elements of the five identified research streams.

After the identification of the five research streams, we also highlight the main findings of selected papers of each research stream considered. In addition to this, following an analogous procedure, we also indicate the future research perspectives derived from selected papers as well as those identified by us for each research stream; among these, we thus include also the aspects concerning the extension of the existing studies to the gas markets, which, as it was mentioned earlier, in the majority of the cases are not the specific objects of investigation of the papers we analyzed.

Through our work, we thus provide the status quo of the relevant literature regarding the topic considered as well as the future research paths that can be followed in order to acquire an in-depth understanding of the phenomena taken into account. Therefore, our work proves to be of great importance for the researchers and the scholars concentrating on the topic in question, who can thus identify the existing relevant literature, the various research streams, as well as the future research perspectives.

The remainder of the paper is organized as follows. Section 2 describes the sample selection process as well as the methodology; Section 3 presents the influential aspects of the papers belonging to the sample considered; Section 4 discusses the co-citation and co-authorship mapping and visualization; Section 5 overviews the selected influential papers of each identified research stream; Section 6 provides guidance on future research; Section 7 concludes the paper.

2 | Methodology and Data

2.1 | Methodology

We employ a “hybrid” approach by relying on both content and bibliometric analysis techniques. This approach is not new, as it was adopted in many previous bibliometric papers such as for example, Bahoo et al. (2020), Khan et al. (2020), Patel et al. (2022), Chiaramonte et al. (2023), and Migliavacca et al. (2023), among others, and is also outlined in the papers of Paul and Criado

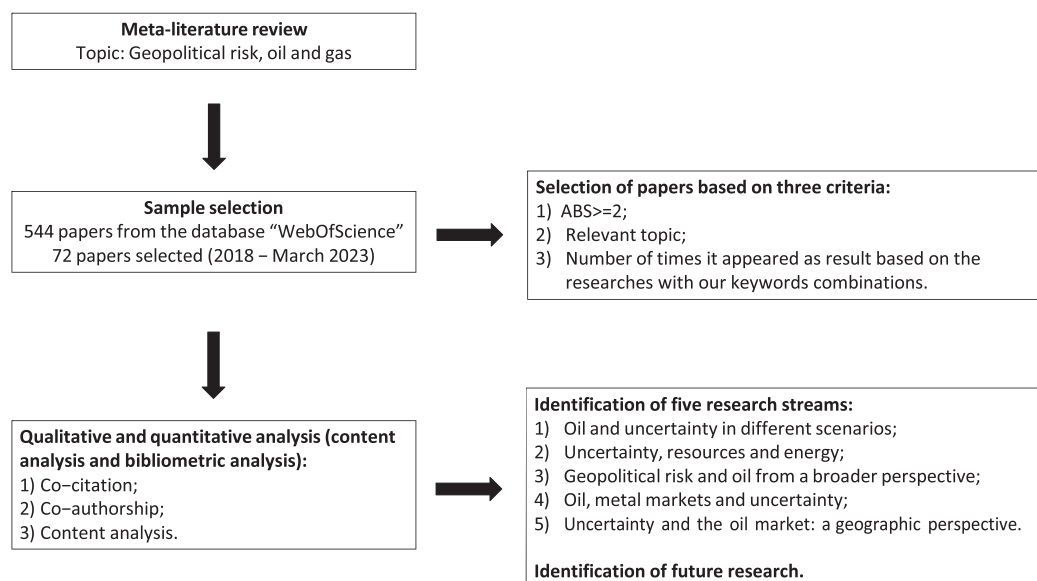


FIGURE 1 | Visual representation of the methodology we followed. This figure outlines the process we followed in our paper and also outlines the five identified research streams.

(2020), Donthu et al. (2021), and Mukherjee et al. (2022). Figure 1 provides a visual inspection of the methodology employed.

The present literature review, inherent to GPR and energy, is characterized by the inclusion of both qualitative and quantitative elements, the former represented by the content analysis and the latter by the bibliometric analysis. These approaches have been largely employed with regard also to the sectors of management, business, and finance (Zamore et al. 2018). The bibliometric analysis was first introduced by Bradford (1934) and over the years has been developed and improved also thanks to the technological advancements. To this regard, in fact, Price (1965) introduced several methods that allowed the mapping of the analyzed paper based on the number of citations (Kim and McMillan 2008) and that entailed the concept and the employment of articles as the basic unit of analysis. The bibliometric review is aimed at showing the relationship and the interconnectedness existing between the peculiar elements of the papers taken into consideration in the study, for example, keywords, specific research streams, and authors. Moreover, the content analysis, as it was mentioned earlier, can be described as a method that is aimed at assessing and confirming the soundness of knowledge and cognition in a specific field of research (Potter and Levine-Donnerstein 1999).

2.2 | Data Selection Process

To perform both the content and the bibliometric analysis, namely the two elements that are intertwined in the hybrid approach, different steps were taken into consideration; we performed these analysis steps in the month of December 2023. First, we identified, several keywords and combinations of these keywords that are inherent to GPR and energy (Table 1).

Then, we searched the keywords and their combinations on the Web of Science (WOS)¹. Equipped with our keywords, we were able to filter a total of 544 papers. The results of the queries were

TABLE 1 | Employed keywords/keyword combinations.

Keywords
Geopolitical risk brent
Geopolitical risk gas
Geopolitical risk gas covid
Geopolitical risk gas Russia
Geopolitical risk henry hub
Geopolitical risk oil
Geopolitical risk oil covid
Geopolitical risk oil Russia
Geopolitical risk ttf
Geopolitical risk wti

Note: This table indicates which are the keywords and the combinations of keywords employed for the research of the papers inherent to the topic considered.

downloaded into Excel files (one file for each research) by using the “Full record” option. We then filled with a distinct color the results of each file in “Excel format.” In other words, all the results produced given a specific research combination were highlighted in a single file in “Excel format” with the same color, which is distinct from all the other colors used for the other files in question.

We then merged all the files in “Excel format” into one single file keeping all the duplicate results (more details will be given on this aspect in the following paragraphs); the merged file consists of 905 rows (including the first row containing the title). We then took into consideration the merged file and added other data and information for each paper, which would be of vital importance in the following parts. To this regard, we added for each paper the Academic Journal Guide (AJG) ranking of the journal on which the paper in question was published; more

specifically, we assigned the values 1, 2, 3, 4, and 4* to the various papers according to the aforementioned criteria and “?” in the cases where the paper in question had, for example, been presented to a conference (for which the AJG ranking cannot obviously be identified) or had been published on a minor journal.

Following prior literature (Chiaromonte et al. 2023; Khan et al. 2020), we then filtered the selected papers based on the following criteria:

1. AJG ranking of the journal on which the paper was published, at least equal to 2;
2. Relevance of the topic of the paper and of the journal on which the paper in question was published;
3. Number of times the paper appeared in the merged file in “Excel format.” Priority was given to the specific papers that appeared more than one time in the aforementioned merged file in question.

If a paper appeared more than once in the file in “Excel format,” it meant that it could be found on the WOS database by using more than one combination of keywords (this is the reason why we did not remove duplicates in the merged file, since the greater frequency with which a specific paper appeared meant a higher number of word matching combinations and thus also cross-contextual relevance).

Following the filtering process, there remain a total of 141 papers out of 544 selected in the WOS search².

We then performed a further paper selection process. In this case, we decided to restrict the sample of papers to the last five years (January 2018 to March 2023), narrowing down our sample from 141 papers to a total of 72 papers (as indicated in the Introduction, there has recently been a boost in the number of papers published regarding this topic). Therefore, we considered the papers published close to the aforementioned recent events and not later than March 2023 to avoid issues connected to citations.

In the conclusive phase of our selection process, we considered again the 141 papers and identified the 10 top cited papers first according to the item “Cited Reference Count” and then to the item “Times Cited, WoS Core.” The same procedure was then repeated with the selected sample of 72 papers. In each of these four options, we identified the item “Keywords Plus” provided by the database “Web Of Science” and then the keywords contained inside each paper considered. In the various cases considered, we did not identify any additional keyword that could have been useful for the purpose of our analysis.

The final sample which we employed for our analysis therefore consists of 72 papers taken from the period 2018 to March 2023 (March included). Table 2 and Figure 2 contain respectively the summary information regarding the AJG scores, Journals and number of papers of the sample considered and also the timeline of the 72 papers taken into account for the purpose of the analysis.

3 | Influential Aspects of the Literature

To analyze the most influential aspects of the literature as well as the bibliometric analysis, we employ the “VOSviewer” software.

In Table 3, we list the most influential authors, while in Table 4, we identify the most influential organizations. As can be observed from Table 3, none of the authors shows a predominance in the sample considered, meaning that the papers selected are widespread across different researchers. Similar results can be deduced from Table 4 with regard to the institutions analyzed in the sample; nevertheless, Table 4 also confirms the significant percentage of Chinese authors/institutions represented in the sample taken into consideration.

In addition to this, through our analysis, we were also able to determine who are the top 10 most cited authors (Table 5). Among these, the author Sharif Arshian is the most cited author with over 800 citations, while author Zhang Yaojie is ranked in the tenth position with slightly less than 150 citations.

Furthermore, we also established which are the top 10 most cited papers belonging to our sample (Table 6). Among these, there are six papers with more than 100 citations and one of these is by far the most cited paper with over 700 citations, that is, the paper entitled “COVID-19 pandemic, oil prices, stock market, geopolitical risk and policy uncertainty nexus in the US economy: Fresh evidence from the wavelet-based approach” published in 2020 by the authors Sharif, A., Aloui, C., Yarovaya, L. on “International Review of Financial Analysis.”

4 | Bibliometric Analysis

In this section, we present the results of the bibliometric analysis. More precisely, we provide a visual interpretation of the co-citation and the co-authorship mapping.

4.1 | Co-Citation Mapping and Visualization

Co-citation is a key aspect of bibliometric analysis; to this regard, in fact, it identifies the interconnectedness among the references of each paper considered in the sample. We consider 10 as the minimum number of citations³. Figure 3 plots the output of our co-citation analysis. As one can see, we identify five research streams. We named Cluster 1 (represented in red in Figure 3) “Oil and uncertainty in different scenarios”; this research stream deals with the investigation of the relationship between oil and uncertainty measures in different contexts and scenarios. Cluster 2 (in green in Figure 3), labeled “Uncertainty, resources and energy,” is characterized by the papers which focus on the interconnectedness between the uncertainty measures, resources of different types (such as renewable resources, natural resources, etc.) and energy (e.g., electricity, etc.). Cluster 3 (in blue in Figure 3) is entitled “Geopolitical risk and oil from a broader perspective” and its main focus is the study of the relationship between oil and uncertainty measures. “Oil, metal markets and uncertainty” is the name of Cluster 4 (in yellow in Figure 3); its focus is the study of the interconnectedness between oil and uncertainty measures widened to metal markets. Cluster 5 (in

TABLE 2 | AJG scores, journal, and number of papers of the sample considered for the analysis.

AJG ranking and journals	Number of papers
AJG 3	28
<i>Energy Economics</i>	22
<i>International Journal of Finance & Economics</i>	3
<i>Annals of Operations Research</i>	1
<i>International Review of Financial Analysis</i>	1
<i>Journal of Economic Dynamics & Control</i>	1
AJG 2	44
<i>Resources Policy</i>	37
<i>Energy Policy</i>	2
<i>North American Journal of Economics and Finance</i>	2
<i>Economic Systems</i>	1
<i>International Review of Economics and Finance</i>	1
<i>Research in International Business and Finance</i>	1
Total	72

Note: This table splits the papers of the sample considered into two groups according to the AJG ranking of the journal on which they were published. Moreover, it also indicates the number of papers that belong to each of the journals taken into consideration.

TABLE 3 | Most influential authors based on the number of documents.

Authors	Number of papers
Hammoudeh, Shawkat	4
Sharif, Arshian	4
Su, Chi-Wei	4
Umar, Muhammad	4
Gupta, Rangan	3
Tiwari, Aviral Kumar	3
Ma, Feng	2
Khan, Khalid	2
Zhang, Yaojie	2
Chen, Jinyu	2

Note: This table indicates the authors who appear the most in the sample considered. Among the various authors with the number of papers equal to 2, the most cited authors were chosen.

purple in Figure 3) is entitled “Uncertainty and the oil market: a geographic perspective” and focuses on different geographical regions taken into account as a laboratory to study the relationship between uncertainty measures and the oil market. Through our analysis we also noticed that the majority of the papers deal with oil rather than with gas; for this reason, we included among the research perspectives the need to further extend the studies and research taken into consideration to the gas markets (more details are provided in Section 6).

The second step, which will be explained more in-depth in the next paragraphs, involved the content analysis of 40 papers that we identified belonging to the different aforementioned research streams.

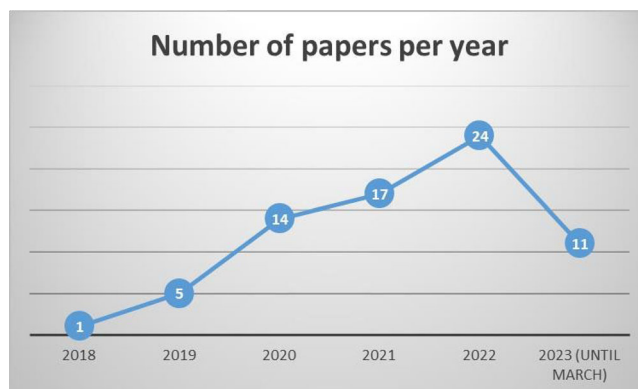


FIGURE 2 | Timeline of the sample considered for the analysis. This figure shows the number of papers belonging to our sample that were published in each of the years considered. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/terms-and-conditions)]

4.2 | Co-Authorship Mapping and Visualization

On top of the co-citation analysis, we also investigate the co-authorship, which is useful to identify and get an in-depth understanding of the relationships existing among the authors who are part of the sample considered. Through the employment of the software “VOSviewer” and with the minimum number of citations set equal to 50, we thus identify the most influential authors and the relationships among them (Figure 4).

5 | Content Analysis

As it was mentioned earlier, through the co-citation mapping and visualization, we identify five research streams. We will thus discuss in the following paragraphs the main papers

TABLE 4 | Most influential institutions based on the number of documents.

Institution	Number of papers
Qingdao University	6
Southwest Jiaotong University	5
Central South University	5
Drexel University	4
University of Pretoria	4
Sichuan University	4
Beihang University	3
Rajagiri Business School	3
Nanjing University of Science and Technology	3
China University of Geosciences	3

Note: This table indicates the institutions that appear the most in the sample considered.

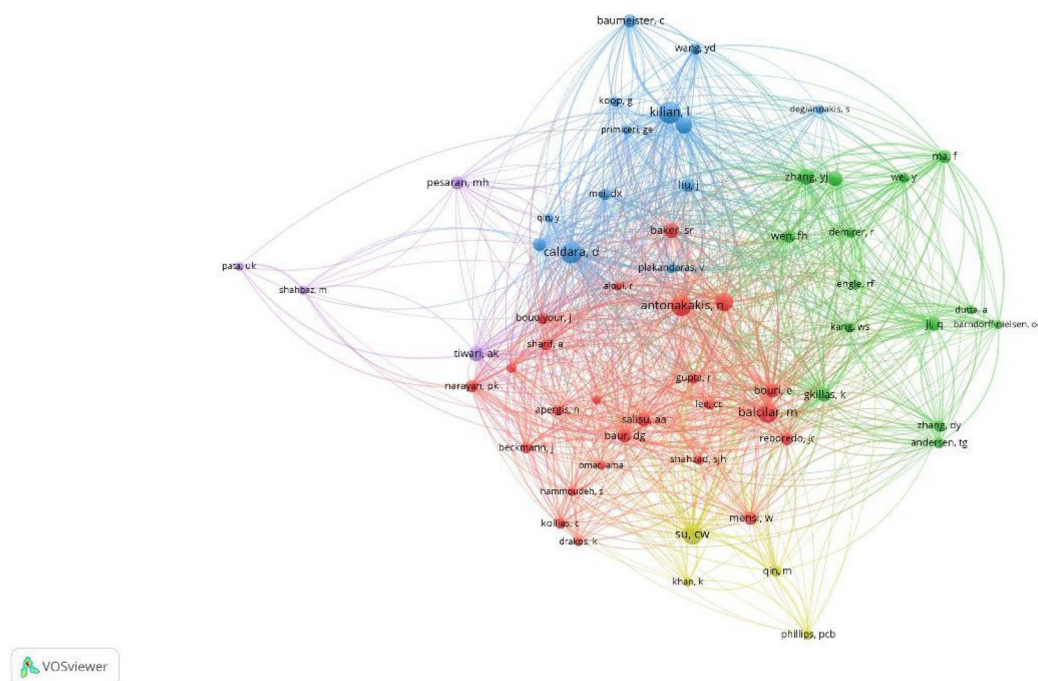


FIGURE 3 | Co-citation analysis with the software “VOSviewer.” This figure was obtained through the use of the software “VOSviewer.” It shows the interconnectedness among the references of the various papers considered in the sample. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/terms-and-conditions)]

we identified belonging to each of the five research streams (Table 7).

5.1 | Research Stream 1: “Oil and Uncertainty in Different Scenarios”

This research stream is focused on the analysis of the interconnectedness between oil and uncertainty, among which GPR appears as a measure of uncertainty. Among the various papers we selected for this research stream, the research of Kumar et al. (2021) investigates the nonlinear relationship between energy commodities (WTI, Brent, natural gas, heating oil) and the stock market for 14 emerging market indexes of oil-exporting and oil-importing countries. Their results suggest

that there is no significant relationship between oil prices and stock market returns unless GPR is injected. The effect is stronger for oil-exporting countries. Mensi et al. (2021) narrow down the perspective and analyze the impact of economic, energy, and geopolitical events on time-varying spillovers across industries. The main result of the paper underlines the importance of the oil and gas industry in transmitting volatility spillovers under bad scenarios. Spillovers are also the focus of the work of Kumar and Singh (2022) who investigate the interconnectedness among crude oil, currencies, macroeconomic measure, and GPR. The employment of the Diebold and Yilmaz (2012) connectedness-based approach allows the authors to conclude that the various currencies included in their study react differently. To this regard, they determine that the spillover relationship between Russia and crude oil is weak and consequently also that the Ruble

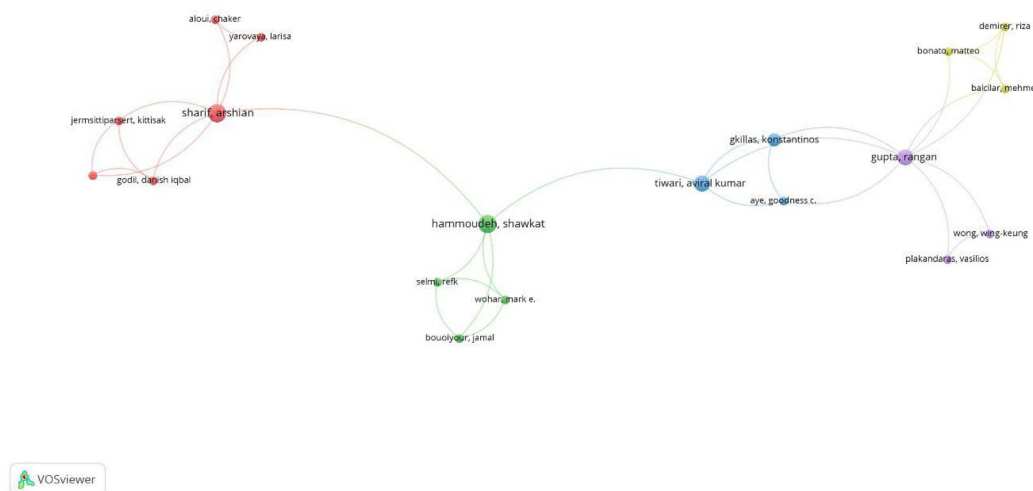


FIGURE 4 | Co-authorship analysis with the software “VOSviewer.” This figure was obtained through the use of the software “VOSviewer.” It shows the relationships among the various authors of the papers taken into account in the sample. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/doi/10.1111/joes.12697)]

TABLE 5 | Most influential authors based on the number of citations.

Author	Number of citations
Sharif Arshian	848
Aloui Chaker	761
Yarovaya Larisa	761
Gupta Rangan	273
Ma Feng	248
Umar Muhammad	238
Su Chi-Wei	227
Khan Khalid	195
Hammoudeh Shawkat	165
Zhang Yaojie	140

Note: This table indicates the top 10 most cited authors.

fall is substantially linked to macroeconomic conditions and GPR. The relationship between the stock market and crude oil and political risk is also at the center of the study of Guo et al. (2021). The authors show that the effects of political risk and oil prices are different across United States and China and that such relationships exhibit a time-varying pattern. Moreover, Mei et al. (2020) analyze the relationship between the GPR index and the volatility of oil future and thus determine that GPR positively impacts short-term oil realized volatility; in addition to this, they also conclude that the long-term oil volatility forecasting is mainly influenced by the GPR index related to action (known as GPA), rather than by the GPR index connected to threat (namely GPT). In a similar way, Bouoiyour et al. (2019) also assess the different impacts of GPR connected to threats and GPR connected to acts on the prices of oil; through their analysis, the authors determine that the influence of the former is very modest or nonsignificant at all, while the effect of the latter on the price of oil is positive. Lastly, Atri et al. (2021) and Huang et al. (2023) study the relationship between uncertainty and crude oil volatility. The authors find that uncertainty is a predictor of oil futures volatilities; to this regard, Atri et al. (2021) conclude that

COVID-19 deaths and panic negatively impact the prices of crude oil and Huang et al. (2023) determine that estimates regarding the dynamics of the Chinese crude oil futures market volatility can be obtained through the employment of also the GPR component.

5.2 | Research Stream 2: “Uncertainty, Resources, and Energy”

In this research stream, we include papers dealing with the analysis of the relationship between uncertainty, different types of resources (e.g., natural resources, renewable resources, etc.) and energy (such as electricity, energy rents, etc.); differently from Research Stream 1, here the focus is not specific on crude oil. Qin et al. (2020) analyze the impact of GPR on energy commodities (crude oil, natural gas, and heating oil). To this regard, in fact, the authors investigate this type of relationship through the employment of the quantile regression, which leads them to the conclusion that, among the various statements, GPRs negatively impact crude oil returns and positively affect crude oil volatility. The study conducted by Arendt et al. (2020), instead, is focused, among the various objectives, also on determining the way the political stability is shaped by the import–export dynamics of raw materials; the authors thus conclude that the countries that export to European countries are characterized by higher political stability. The focus of energy markets is also at the center of the paper of Assaf et al. (2021), who investigate the impact of economic policy uncertainty, GPR, world trade uncertainty, and equity market uncertainty on the behavior of the returns of the oil, gas, and coal markets. The authors determine that to different extents, all the uncertainty measures affect the dynamics of the returns of the oil, gas, and coal markets and their evolution over time. Moreover, Li et al. (2022) analyze the interconnectedness between green financing, volatility and GPR, and the investment in renewable energy sources in China; the authors thus conclude that oil price volatility and GPR negatively affect the investment dynamics for the clean energy sources in China. The issue of uncertainty and its impact is at the center of the study of Ma et al. (2022), who analyze the effect of uncertainty on European electricity markets. Through their work, the authors thus determine

TABLE 6 | Most influential documents based on the number of citations.

Title	Year	Authors	Journal	Number of citations
COVID-19 pandemic, oil prices, stock market, geopolitical risk and policy uncertainty nexus in the US economy: Fresh evidence from the wavelet-based approach	2020	Sharif, A., Aloui, C., Yarovaya, L.	<i>International Review of Financial Analysis</i>	761
Does renewable energy redefine geopolitical risks?	2021	Su, C.-W., Khan, K., Umar, M., Zhang, W.	<i>Energy Policy</i>	138
Geopolitical risk and oil volatility: A new insight	2019	Liu, J., Ma, F., Tang, Y., Zhang, Y.	<i>Energy Economics</i>	135
Geopolitical risks and stock market dynamics of the BRICS	2018	Balcilar, M., Bonato, M., Demirer, R., Gupta, R.	<i>Economic Systems</i>	133
Geopolitical risk uncertainty and oil future volatility: Evidence from MIDAS models	2020	Mei, D., Ma, F., Liao, Y., Wang, L.	<i>Energy Economics</i>	118
Asymmetric effects of geopolitical risks on energy returns and volatility under different market conditions	2020	Qin, Y., Hong, K., Chen, J., Zhang, Z.	<i>Energy Economics</i>	113
Point and density forecasts of oil returns: The role of geopolitical risks	2019	Plakandaras, V., Gupta, R., Wong, W.-K.	<i>Resources Policy</i>	93
Analyzing the impacts of geopolitical risk and economic uncertainty on natural resources rents	2021	Dogan, E., Majeed, M. T., Luni, T.	<i>Resources Policy</i>	80
Macro factors and the realized volatility of commodities: A dynamic network analysis	2020	Hu, M., Zhang, D., Ji, Q., Wei, L.	<i>Resources Policy</i>	72
Identifying price bubbles in the US, European and Asian natural gas market: Evidence from a GSADF test approach	2020	Li, Y., Chevallier, J., Wei, Y., Li, J.	<i>Energy Economics</i>	72

Note: This table indicates the top 10 most cited documents.

TABLE 7 | Main papers identified for each research stream.

Research stream	Authors	Title	Year	Journal
1. Oil and uncertainty in different scenarios	Atri, H., Kouki, S., Gallali, M. I.	The impact of COVID-19 news, panic and media coverage on the oil and gold prices: An ARDL approach	2021	<i>Resources Policy</i>
	Bouoiyour, J., Selmi, R., Hammoudeh, S., Wohar, M. E.	What are the categories of geopolitical risks that could drive oil prices higher? Acts or threats?	2019	<i>Energy Economics</i>
	Guo, Y., Li, J., Li, Y., You, W.	The roles of political risk and crude oil in stock market based on quantile cointegration approach: A comparative study in China and US	2021	<i>Energy Economics</i>
	Huang, Y., Xu, W., Huang, D., Zhao, C.	Chinese crude oil futures volatility and sustainability: An uncertainty indices perspective	2023	<i>Resources Policy</i>
	Kumar, P., Singh, V. K.	Does crude oil fire the emerging markets currencies contagion spillover? A systemic perspective	2022	<i>Energy Economics</i>
	Kumar, S., Khalfaoui, R., Tiwari, A. K.	Does geopolitical risk improve the directional predictability from oil to stock returns? Evidence from oil-exporting and oil-importing countries	2021	<i>Resources Policy</i>
	Mei, D., Ma, F., Liao, Y., Wang, L.	Geopolitical risk uncertainty and oil future volatility: Evidence from MIDAS models	2020	<i>Energy Economics</i>
	Mensi, W., Nekhili, R., Vo, X. V., Suleman, T., Kang, S. H.	Asymmetric volatility connectedness among US stock sectors	2021	<i>North American Journal of Economics and Finance</i>
2. Uncertainty, resources and energy	Arendt, R., Muhl, M., Bach, V., Finkbeiner, M.	Criticality assessment of abiotic resource use for Europe- application of the SCARCE method	2020	<i>Resources Policy</i>
	Assaf, A., Charif, H., Mokni, K.	Dynamic connectedness between uncertainty and energy markets: Do investor sentiments matter?	2021	<i>Resources Policy</i>
	Dogan, E., Majeed, M. T., Luni, T.	Analyzing the impacts of geopolitical risk and economic uncertainty on natural resources rents	2021	<i>Resources Policy</i>
	Irawan, D., Okimoto, T.	Overinvestment and macroeconomic uncertainty: Evidence from renewable and non-renewable resource firms	2021	<i>Journal of Economic Dynamics & Control</i>
	Irawan, D., Okimoto, T.	Conditional capital surplus and shortfall across renewable and non-renewable resource firms	2022	<i>Energy Economics</i>
	Li, Z., Kuo, T.-H., Siao-Yun, W., Vinh, L. T.	Role of green finance, volatility and risk in promoting the investments in Renewable Energy Resources in the post-covid-19	2022	<i>Resources Policy</i>
	Ma, R., Liu, Z., Zhai, P.	Does economic policy uncertainty drive volatility spillovers in electricity markets: Time and frequency evidence	2022	<i>Energy Economics</i>

(Continues)

TABLE 7 | (Continued)

Research stream	Authors	Title	Year	Journal
3. Geopolitical risk and oil from a broader perspective	Qin, Y., Hong, K., Chen, J., Zhang, Z.	Asymmetric effects of geopolitical risks on energy returns and volatility under different market conditions	2020	<i>Energy Economics</i>
	Drachal, Z.	Forecasting crude oil real prices with averaging time- varying VAR models	2021	<i>Resources Policy</i>
	Gu, X., Zhu, Z., Yu, M.	The macro effects of GPR and EPU indexes over the global oil market-Are the two types of uncertainty shock alike?	2021	<i>Energy Economics</i>
	Khan, K., Su, C.-W., Umar, M., Yue, X.-G.	Do crude oil price bubbles occur?	2021	<i>Resources Policy</i>
	Li, X., Liang, C., Chen, Z., Umar, M.	Forecasting crude oil volatility with uncertainty indicators: New evidence	2022	<i>Energy Economics</i>
	Liu, J., Ma, F., Tang, Y., Zhang, Y.	Geopolitical risk and oil volatility: A new insight	2019	<i>Energy Economics</i>
	Plakandaras, V., Gupta, R., Wong, W.-K.	Point and density forecasts of oil returns: The role of geopolitical risks	2019	<i>Resources Policy</i>
	Storhas, D. P., De Mello, L., Singh, A. K.	Multiscale lead- lag relationships in oil and refined product return dynamics: A symbolic wavelet transfer entropy approach	2020	<i>Energy Economics</i>
	Zhao, J.	Exploring the influence of the main factors on the crude oil price volatility: An analysis based on GARCH-MIDAS model with Lasso approach	2022	<i>Resources Policy</i>
4. Oil, metal markets and uncertainty	Bin Kamal, J., Wohar, M., Bin Kamal, K.	Do gold, oil, equities, and currencies hedge economic policy uncertainty and geopolitical risks during covid crisis?	2022	<i>Resources Policy</i>
	Cheng, S., Han, L., Cao, Y., Jiang, Q., Liang, R.	Gold-oil dynamic relationship and the asymmetric role of geopolitical risks: Evidence from Bayesian pdBEKK-GARCH with regime	2022	<i>Resources Policy</i>
	Cheng, S., Zhang, Z., Cao, Y.	Can precious metals hedge geopolitical risk? Fresh sight using wavelet coherence analysis	2022	<i>Resources Policy</i>
	Godil, D. I., Sarwat, S., Sharif, A., Jermisittiparsert, K.	How oil prices, gold prices, uncertainty and risk impact Islamic and conventional stocks? Empirical evidence from QARDL technique	2020	<i>Resources Policy</i>
	Li, Y., Huang, J., Chen, J.	Dynamic spillovers of geopolitical risks and gold prices: New evidence from 18 emerging economies	2021	<i>Resources Policy</i>
	Qin, M., Su, C.-W., Pirtea, M. G., Dumitrescu Peculea, A.	The essential role of Russian geopolitics: A fresh perception into the gold market	2023	<i>Resources Policy</i>

(Continues)

TABLE 7 | (Continued)

Research stream	Authors	Title	Year	Journal
5. Uncertainty and the oil market: A geographic perspective	Shahzad, U., Mohammed, K. S., Tiwari, S., Nakonieczny, J., Nesterowicz, R.	Connectedness between geopolitical risk, financial instability indices and precious metals markets: Novel findings from Russia Ukraine conflict perspective	2023	<i>Resources Policy</i>
	Tiwari, A. K., Aye, G. C., Gupta, R., Gkillas, K.	Gold-oil dependence dynamics and the role of geopolitical risks: Evidence from a Markov- switching time- varying copula model	2020	<i>Energy Economics</i>
	Khan, N., Saleem, A., Ozkan, O.	Do geopolitical oil price risk influence stock market returns and volatility of Pakistan: Evidence from novel non-parametric quantile causality approach	2023	<i>Resources Policy</i>
	Li, Y., Huang, J., Gao, W., Zhang, H.	Analyzing the time-frequency connectedness among oil, gold prices and BRICS geopolitical risks	2021	<i>Resources Policy</i>
	Olanipekun, I. O., Adewale Alola, A.	Crude oil production in the Persian Gulf amidst geopolitical risk, cost of damage and resources rents: Is there asymmetric inference?	2020	<i>Resources Policy</i>
	Razek, N. H. A., McQuinn, B.	Saudi Arabia's currency misalignment and international competitiveness, accounting for geopolitical risks and the super- contango oil market	2021	<i>Resources Policy</i>
	Sweidan, O. D., Elbargathi, K.	The effect of oil rent on economic development in Saudi Arabia: Comparing the role of globalization and the international geopolitical risk	2022	<i>Resources Policy</i>
	Yang, K., Wei, Y., Li, S., Liu, L., Wang, L.	Global financial uncertainties and China's crude oil futures market: Evidence from interday and intraday price dynamics	2021	<i>Energy Economics</i>
	Zhang, T., Zeng, S.	Dynamic comovement and extreme risk spillovers between international crude oil and China's non- ferrous metal futures market	2023	<i>Resources Policy</i>
	Zheng, D., Zhao, C., Hu, J.	Impact of geopolitical risk on the volatility of natural resource commodity futures prices in China	2023	<i>Resources Policy</i>

Note: This table indicates the most significant papers that we selected for each research stream. Moreover, it also indicates the authors, the title, the year, and the journal of each paper taken into account.

that the overall volatility interconnectedness among the markets in question is particularly high and also that this relationship is dependent on economic and geopolitical events. Furthermore, Irawan and Okimoto (2021) investigate the way overinvestment of companies varies according to the sector to which the company belongs. In this study, the authors consider four sectors as follows: alternative energy, forestry and paper, mining, and oil and gas producers. The main result of the work is that there is no significant relationship between global GPR and the overinvestments in the four mentioned sector; while there is a significant relationship between overinvestments and global economic and country-level governance policy uncertainty. Moreover, Irawan

and Okimoto (2022) analyze the conditional capital surplus and shortfall dynamics of renewable and nonrenewable resource firms and thus determine that commodity prices and geopolitical uncertainty positively impact the conditional capital shortfall taken into consideration in the study. Lastly, Dogan et al. (2021) focus their attention on the role of GPR and economic policy uncertainty on natural resources with regard to a group of developing countries that heavily contribute to the total global availability of natural resources. This research leads the authors to conclude that GPR has a negative impact on the natural resource rents, but also that the opposite effect characterizes the impact of economic growth on the rents of interest.

5.3 | Research Stream 3: “Geopolitical Risk and Oil From a Broader Perspective”

The papers belonging to the third research stream are focused on the relationship between oil and GPR from a broader perspective. The protagonist of this research stream is thus the interconnectedness between oil and GPR and, differently from what happens in the other research streams, the various elements that are present in the different studies are confined to minor roles. Therefore, the main focus of the present stream is the relationship between GPR and oil and so minor importance is given to the other elements included in the studies, while in the first research stream, for example, the interconnectedness between GPR, oil, and the other aspects included in the researches are all put on the same level and thus assessed and analyzed with an equal level of importance. To this research stream, for example, belongs the paper written by Storhas et al. (2020), who focus their attention on the dynamics of oil and redefined products. To this regard, in fact, through their study, the authors determine that GPRs as well as periods of economic crises affect the behavior of oil returns. Moreover, Li et al. (2022) investigate the impact of various uncertainty indicators on the crude oil volatility. The in-depth analysis carried out by the authors reveals that the GPR index performs better in forecasting the long-term volatility of crude oil compared to other uncertainty indicators. Analogously, Gu et al. (2021) study the way the economic policy uncertainty index and the GPR index affect the oil markets and thus conclude that the former has a greater impact than the latter on the oil markets taken into account in the analysis. Furthermore, Liu et al. (2019) in their research consider GPR, specifically serious GPR, to predict oil volatility. To this regard, the authors determine that both types of risks contribute to the dynamics of oil volatility but also that the serious GPR provides useful information, especially for the recent future oil volatility. The focus on the global GPRs and oil prices is at the center of the research of Plakandaras et al. (2019). Through the employment of linear and nonlinear probabilistic models, the authors determine that the GPRs linked to wars can be used to accurately predict oil returns in the short run, while the composite GPRs connected to the emerging markets have a better performance at predicting oil returns in the medium and in the long term. Furthermore, Khan et al. (2021) investigate the behavior of oil price bubbles and the factors affecting the dynamics of the bubbles in question. To this regard, through the employment of specific statistical techniques, the authors conclude that several factors, such as dollar depreciation, mismatch between demand–supply of oil and periods of crisis, affect the dynamics of the oil price bubbles. The analysis of the main factors able to influence the crude oil price volatility is also the topic of the paper of Zhao (2022); to this regard, the author concludes that in the long run, the supply and demand are the main factors influencing the oil price volatility and also that other elements, such as inventories, the US dollar exchange rate, and GPR, only affect to some extent the behavior in question. Lastly, also Drachal (2021) focuses his attention on predicting the volatility of crude oil prices and thus determines that the employment of the Vector Autoregression Approach leads to more accurate predictions compared to the use of the time-varying regression or the standard dynamic model averaging.

5.4 | Research Stream 4: “Oil, Metal Markets, and Uncertainty”

This research stream analyses the various aspects connected to the metal markets, the oil market, and uncertainty. Therefore, in this research stream, the connections between oil and uncertainty are widened to the metal markets. Shahzad et al. (2023) study the way precious metals and traditional energy commodities are impacted by geopolitical tension, financial instability, rising inflation, declining economic growth, and financial markets as well as the interconnectedness existing between oil and gas and metal production. According to the results of their analysis, the authors determine that there has been a strong co-movement during the Russia–Ukraine conflict between GPR, oil, gas, and silver returns, while gold has proven to be a safe haven against GPR and financial instability. Furthermore, Tiwari et al. (2020) investigate the relationship existing between gold and oil prices as well as the impact of GPRs on the connectedness between gold and oil. Through their analysis, the authors conclude that gold can be considered to be a hedge for oil returns in the short and medium term, but not in the long term. In addition to this, the authors also determine that GPR negatively impacts the dependence structure between gold and oil and therefore the inclusion of GPR in a portfolio consisting of gold and oil assets contributes to diversification benefits. In a similar way, Cheng et al. (2022) also investigate the relationship between GPR and the gold and oil markets and thus determine that in the short term, the volatility of GPR is affected by the gold–oil relationship, while the effect in question is mitigated in the medium and long terms. The interconnectedness existing between GPRs and gold prices plays the role of protagonist in the study of Li et al. (2021). To this regard, in fact, through their analysis, the authors conclude that the net spillover effect translates from the GPR to gold prices and that the effect in question is stronger in the short term during particular geopolitical events. Gold is also at the center of debate in the study of Qin et al. (2023), who analyze the relationship between the Russian geopolitical context and the gold market; among the various findings, the authors through their analysis determine that the Russian complex geopolitical situation has a positive impact on the gold market. Furthermore, the relationship between precious metals and GPR is also the object of research of Cheng et al. (2022). Through their work, the authors determine that gold and silver prove to be good assets to hedge against the dynamics of GPR both in the short and the medium term and also that all the precious metals can be employed to hedge GPR (and also the negative changes in GPR) in the medium term. The relationship between specific elements, such as, for example, gold, oil, and equities, and GPRs and economic policy uncertainty is also an issue of interest in the paper of Bin Kamal et al. (2022). To this regard, in fact, the authors conclude that oil and gold can be used as safe-haven assets but also that the safe-haven properties of gold disappeared during the COVID-19 pandemic. Lastly, the focus of the work of Godil et al. (2020) is the interaction between various factors (e.g., oil, gold, and GPR) and Islamic securities; the authors thus determine that the different elements taken into consideration affect different extents the dynamics of the Islamic securities in question.

5.5 | Research Stream 5: “Uncertainty and the Oil Market: A Geographic Perspective”

In this research stream, geographical regions are taken as a laboratory to investigate the interconnectedness between oil and uncertainty. In their study, Yang et al. (2021) analyze the interconnectedness between global financial uncertainties and the Chinese crude oil futures market. Through their study, the authors are thus able to determine that there is a significant relationship between the uncertainties of the international stock, oil, and gold markets and Chinese crude oil futures. BRICS is the target region in Li et al. (2021) to analyze the interconnectedness between gold, oil, and GPR. The authors show that the return and volatility spillovers are stronger in the short term. The region of the Persian Gulf is the laboratory of interest in the paper of Olanipekun et al. (2020), in which the authors investigate the oil market of the Persian Gulf and its relationship with the GPRs of the region. Through the employment of the nonlinear autoregressive distributed lag approach the authors determine that positive shocks in GPR negatively affect the oil production in the short run. Moving onto a different geographical area, specifically the region of Saudi Arabia, the relationship between globalization and international GPRs and Saudi Arabia's oil is the focus of interest in the work of Sweidan and Elbargathi (2022). Through the use of a time series autoregressive distributed lag model with moderation effects, the authors thus understand that there is a significant and negative relationship between oil and international GPR. Moreover, Zhang and Zeng (2023) in their paper analyze the relationship between international crude oil and the Chinese nonferrous metal futures. To this regard, the authors conclude that there is a positive interconnectedness between crude oil and China's nonferrous metals and they also determine that upside risk in the prices dynamics of crude oil can cause extreme shocks in nonferrous metals and this is substantially what happened during the COVID-19 pandemic. Furthermore, Khan et al. (2023) investigate the relationship between geopolitical oil price threats and the stock returns and volatility of the Pakistan stock market. To this regard, in fact, the authors determine that there is a causal effect between the changes in geopolitical oil prices and security returns only during normal market conditions and they also conclude that there is a causal effect on volatility in all market conditions. The Chinese future market is again taken into consideration in the work of Zheng et al. (2023); more specifically, the authors in question analyze the impact of GPR on the price volatility of coal, copper, crude oil, gold, and iron ore in the Chinese futures market. Through their analysis, the authors determine that GPR does not have a significant effect on the price volatility of copper futures, that GPR decreases the price volatility of gold and also that GPR increases the price volatility of coal, iron ore, and crude oil futures. Lastly, Razeq and McQuinn (2021) analyze the region of Saudi Arabia with regard to GPR, productivity, and oil, which is taken into consideration by the authors as both a commodity and a financial asset. Through their analysis, among the various findings, the authors conclude that exogenous factors, more specifically the global demand for oil and also the geopolitical events that decrease the competition in the oil market, are the key elements that influence the competitiveness of Saudi Arabia.

6 | Future Research

We identified a subsample of papers that we believe would be significant for future research streams (Table 8) and selected future research paths of each research stream; we also discussed future research paths based on our own analysis of the literature (Table 9). In the next paragraphs, we explain the reason for the choices in greater detail.

6.1 | Research Stream 1: “Oil and Uncertainty in Different Scenarios”

The findings of the papers belonging to this research stream have led to the understanding of the functioning mechanisms that govern the dynamics and the interconnectedness among the various elements that were illustrated in Section 5.1. A feature that appears to be missing is therefore the assessment of the long-term effects of the events and of the impact of the elements considered, since several studies do not include this type of analysis. This future research stream is also supported by Atri et al. (2021), who include in their paper the need to investigate and understand the long-term effects of the COVID-19 crisis on the oil and gold prices as well as the analysis of the way the pandemic in question is either similar or different to other periods of crisis. Moreover, the issue of the assessment of the long-term effects is also at the center of the study of Huang et al. (2023); to this regard, in fact, the authors stress the need for future studies to include the analysis of the long-term effects of climate factors on the prices, on the changes and on the dynamics of energy markets. In other cases, instead, we identified the need for future studies to analyze the way the behavior of the gas market in response to various types of crises (health crises, financial crises, etc.) differs from the one of the oil market as well as the need for future researchers to identify the effects of specific events rather than the assessment of the general dynamics. To this regard, Sohag et al. (2022) in their future research section indicate that an event study could be carried out in order to determine the impact of a specific geopolitical event on the green equity and green bonds returns. Furthermore, in other cases, we identified the need for future research to include a wider range of factors entailed in the explanation of the dynamics of specific phenomena, such as the inclusion of climatic and environmental elements in addition to the widely used uncertainty measures. This future perspective is indicated, for instance, in the work of Mensi et al. (2021), who state that future research could take into consideration also other elements that could possibly account for the asymmetries in volatility spillovers among the U.S. stock sectors.

6.2 | Research Stream 2: “Uncertainty, Resources, and Energy”

Future research perspectives of this research stream could involve the inclusion of political dynamics measures of uncertainty, such as the policy uncertainty measure, in the study of the dynamics of the relationship between uncertainty measures and their link with specific factors that are the object of analysis. This future

TABLE 8 | Main papers identified for each research stream.

Research stream	Authors	Title	Year	Journal
1. Oil and uncertainty in different scenarios	Atri, H., Kouki, S., Gallali, M. I.	The impact of COVID-19 news, panic and media coverage on the oil and gold prices: An ARDL approach	2021	<i>Resources Policy</i>
	Huang, Y., Xu, W., Huang, D., Zhao, C.	Chinese crude oil futures volatility and sustainability: An uncertainty indices perspective	2023	<i>Resources Policy</i>
	Mensi, W., Nekhili, R., Vo, X. V., Suleman, T., Kang, S. H.	Asymmetric volatility connectedness among US stock sectors	2021	<i>North American Journal of Economics and Finance</i>
	Sohag, K., Hammoudeh, S., Elsayed, A. H., Mariev, O., Safonova, Y.	Do geopolitical events transmit opportunity or threat to green markets? Decomposed measures of geopolitical risks	2022	<i>Energy Economics</i>
2. Uncertainty, resources and energy	Dogan, E., Majeed, M. T., Luni, T.	Analyzing the impacts of geopolitical risk and economic uncertainty on natural resources rents	2021	<i>Resources Policy</i>
	Irawan, D., Okimoto, T.	Overinvestment and macroeconomic uncertainty: Evidence from renewable and non-renewable resource firms	2021	<i>Journal of Economic Dynamics & Control</i>
	Li, Z., Kuo, T-H., Siao-Yun, W., Vinh, L. T.	Role of green finance, volatility and risk in promoting the investments in Renewable Energy Resources in the post-covid-19	2022	<i>Resources Policy</i>
	Su, C.-W., Khan, K., Umar, M., Zhang, W.	Does renewable energy redefine geopolitical risks?	2021	<i>Energy Policy</i>
3. Geopolitical risk and oil from a broader perspective	Li, X., Liang, C., Chen, Z., Umar, M.	Forecasting crude oil volatility with uncertainty indicators: New evidence	2022	<i>Energy Economics</i>
	Ozcelebi, O., Tokmakcioglu, K.	Assessment of the asymmetric impacts of the geopolitical risk on oil market dynamics	2022	<i>International Journal of Finance & Economics</i>
	Plakandaras, V., Gupta, R., Wong, W.-K.	Point and density forecasts of oil returns: The role of geopolitical risks	2019	<i>Resources Policy</i>
	Storhas, D. P., De Mello, L., Singh, A. K.	Multiscale lead- lag relationships in oil and refined product return dynamics: A symbolic wavelet transfer entropy approach	2020	<i>Energy Economics</i>
4. Oil, metal markets and uncertainty	Bin Kamal, J., Wohar, M., Bin Kamal, K.	Do gold, oil, equities, and currencies hedge economic policy uncertainty and geopolitical risks during covid crisis?	2022	<i>Resources Policy</i>
	Li, Y., Huang, J., Chen, J.	Dynamic spillovers of geopolitical risks and gold prices: New evidence from 18 emerging economies	2021	<i>Resources Policy</i>
	Shahzad, U., Mohammed, K. S., Tiwari, S., Nakonieczny, J., Nesterowicz, R.	Connectedness between geopolitical risk, financial instability indices and precious metals markets: Novel findings from Russia Ukraine conflict perspective	2023	<i>Resources Policy</i>

(Continues)

TABLE 8 | (Continued)

Research stream	Authors	Title	Year	Journal
	Tiwari, A. K., Aye, G. C., Gupta, R., Gkillas, K.	Gold-oil dependence dynamics and the role of geopolitical risks: Evidence from a Markov- switching time- varying copula model	2020	<i>Energy Economics</i>
5. Uncertainty and the oil market: A geographic perspective	Khan, N., Saleem, A., Ozkan, O.	Do geopolitical oil price risk influence stock market returns and volatility of Pakistan: Evidence from novel non-parametric quantile causality approach	2023	<i>Resources Policy</i>
	Razek, N. H. A., McQuinn, B.	Saudi Arabia's currency misalignment and international competitiveness, accounting for geopolitical risks and the super-contango oil market	2021	<i>Resources Policy</i>
	Yang, K., Wei, Y., Li, S., Liu, L., Wang, L.	Global financial uncertainties and China's crude oil futures market: Evidence from interday and intraday price dynamics	2021	<i>Energy Economics</i>
	Zheng, D., Zhao, C., Hu, J.	Impact of geopolitical risk on the volatility of natural resource commodity futures prices in China	2023	<i>Resources Policy</i>

Note: This table indicates the most significant papers that we selected for each research stream with regard to future research. Moreover, it also indicates the authors, the title, the year, and the journal of each paper taken into account.

research stream is included in the work of Dogan et al. (2021) with regard to natural resource rents. To this regard, the authors explain that, since the primary objective of their work was to understand the impact of economic growth, GPR, and policy uncertainty on natural resource rents and their dynamics and behaviors with regard to various developing countries, the focus of future research could be understanding the impact of other factors, such as globalization and financial development, on the interconnectedness between the variables in question and natural resources rents. In addition to this, we also noticed that the assessment of the impact of uncertainty measures as well as international factors (e.g., globalization) on the gas markets is missing and therefore could potentially be at the center of future studies. Moreover, many studies that belong to this research stream focus on a restricted number of observations, be they the number of companies involved in a specific analysis or the time period considered. For example, Li et al. (2022), who concentrate their attention on the region of China, state at the end of their paper that future studies could involve a greater number of listed firms in China as well as the inclusion of other elements in the analysis part, such as the aggregate term for clean energy investment. The importance of the inclusion of a wider range of elements is also stressed by Irawan and Okimoto (2021), who explain that future research should include also strategic factors that belong to the sector in which the firms operate, for example, as the authors notice, industry structure, and market share. Moreover, the authors also indicate that future researchers should focus their attention on investigating the overinvestment behavior of other sectors in order to have the possibility to compare the results across different sectors. In a similar way, Su et al. (2021), with regard to their study, indicate that future research could focus

on the assessment of the mutual relationship between GPR and renewable energy at the regional and country level.

6.3 | Research Stream 3: “Geopolitical Risk and Oil From a Broader Perspective”

Given the general terms with which the authors of the papers belonging to this research stream tackled the analysis of the relationship between uncertainty measures and oil, we believe that future research perspectives could involve the employment of variations from the technical point of view of the analysis that has been carried out in the different papers in question as well as the extension of the study of the issues considered to the gas markets. To this regard, Storhas et al. (2020) indicate that the employment and the application of symbolic wavelet transfer entropy to intraday data could help uncover further multiscale short-term relations. In a similar way, at the end of their work also Plakandaras et al. (2019) include technical suggestions for future research and thus indicate the need to use higher-frequency geopolitical risk index data in order to understand the impact of GPR at a higher frequency on the dynamics as well as volatility of oil markets. Technical suggestions are also provided by Li et al. (2022), who indicate that, as stated also by Ma et al. (2023), the assessment of the impact of positive and negative changes of an uncertainty measure on asset volatility as well as the determination of the possible dynamics of the Markov state switch probabilities in the forecasting process should be taken into consideration in the future studies. Lastly, the technical issue of timespan is addressed by Ozcelebi and Tokmakcioglu (2022), who explain how future research should be carried out

TABLE 9 | Future research perspectives for each research stream.

Research stream	Selected future research perspectives from the papers and future research perspectives identified by us
1. Oil and uncertainty in different scenarios	• What are the long-term effects of COVID- 19 on the prices of oil and gold? • How do the different types of crises (economic crises, health crises, etc.) affect the oil market? • Is the reaction of the gas market to the various types of crises (economic crises, health crises, etc.) different from the one of the oil market? • How do international uncertainty measures affect the Chinese oil market? • How do uncertainty measures deriving from conflicts in a specific geographical area affect the oil market in a distinct area? • How do the effects of uncertainty measures on oil markets change according to the specific country taken into account in the study (for instance, developing country, etc.)? • Do the reactions of the gas market to uncertainty measures depend on the specific country taken into consideration in the study (e.g., developing country, etc.)? • In what way do the different types of crises impact the interconnectedness between the U.S. stock sectors?
2. Uncertainty, resources, and energy	• How do international factors, such as globalization, affect the relationship between geopolitical risk, economic policy uncertainty, and natural resource rents? • Do international factors, for example, globalization, affect the behavior of the gas market? • How do local policies of developing countries affect the impact of geopolitical risk and economic policy uncertainty on natural resource rents? • How do overinvestment dynamics vary across sectors outside of the natural resource sector? • How do uncertainty measures, such as economic policy uncertainty, impact the gas market? • How do investments in renewable energy resources vary in China in the period before 2015? • If a greater sample of listed energy firms in China as well as the aggregate term of clean energy investment are taken into consideration, how do investments in renewable energy resources vary in China in the post-COVID-19 period? • How does the relationship between geopolitical impact and renewable energy transition vary across different geographical areas?
3. Geopolitical risk and oil from a broader perspective	• How do the dynamics between geopolitical risk and oil markets of BRIC countries vary if a longer time span and models dealing with regime changes are employed? • How do different types of geopolitical risk and other uncertainty measures affect (and to what extent) the oil markets in BRIC countries? • How is the behavior of the gas market in Russia influenced by the uncertainty measures of the BRIC countries? • What is the difference in behavior between the interconnectedness between geopolitical risk and oil markets in BRIC countries and in other geographical regions? • What is the impact of the local and national policies of the BRIC countries on the Russian gas market? • What is the behavior of the relationship between oil prices and news-based indices of global geopolitical risks at high frequencies? • How do other uncertainty measures interact with the interconnectedness between oil prices and news-based indices of global geopolitical risks?

(Continues)

TABLE 9 | (Continued)

Research stream	Selected future research perspectives from the papers and future research perspectives identified by us
4. Oil, metal markets, and uncertainty	• What are the long-term effects of different periods of crisis (COVID-19 pandemic, etc.) on oil prices and the overall economy in the United States? • Apart from gold, oil, equities, and currencies, which are already studied, what are the other factors that could be taken into consideration to hedge economic policy uncertainty and geopolitical risks during the COVID-19 pandemic? • Do gold, oil, equities, and currencies hedge economic policy uncertainty and geopolitical risks during financial crises? • What are the spillover effects between gold prices and risk indicators (e.g., economic policy uncertainty, financial pressure index, national political risk, etc.)? What is the impact of the dynamics of the metal markets on the behavior of the gas market? • What is the relationship between the gold market, the oil market, and geopolitical risk in the BRICS countries? • What is the behavior of the interconnectedness between uncertainty measures, the gold market, and the gas market? • How do crises that originate as health crises (e.g., the COVID-19 pandemic) affect the precious metals markets? • How does the behavior of the interconnectedness between the gold market, the oil market, and geopolitical risk vary across different geographical regions?
5. Uncertainty and the oil market: A geographic perspective	• What are the dynamics of the relationship between geopolitical oil price risk and stock market returns in regions different from Pakistan? • What are the implications of the cooperation between OPEC+ and G20 members, Saudi Arabia's efforts to diversify its energy mix and invest in renewables, the dynamics of the relationship between Saudi Arabia and Russia in affecting oil prices, and Russia's international competitiveness? • How do the oil markets and gas markets react to geopolitical risk dynamics? • How do Chinese internal policies affect the interconnectedness between global financial uncertainties and China's crude oil futures market? • How do the behaviors of the oil and the gas markets depend on the specific geographical regions considered? • What are the specific signs of the shocks from global financial uncertainties to the price dynamics of China's crude oil futures? • What is the behavior of the interconnectedness between geopolitical risk and gas markets in different geographical regions? • How does the impact of geopolitical risk on the volatility of natural resource commodity future prices in China differ from the one in other geographical regions during periods of crises?

Note: This table indicates the questions we created as well as the questions we selected from the various papers belonging to our sample for each research stream considered.

with regard to a longer time span and should also include models incorporating regime changes in order to acquire a sound knowledge of the impacts of GPR on oil market dynamics.

6.4 | Research Stream 4: “Oil, Metal Markets, and Uncertainty”

For the fourth research stream, we identified the need for future research to adopt analytical variations from a technical point

of view in the different analyses and approaches used by the authors. Our suggestion finds evidence, among the others, in the work of Shahzad et al. (2023), who stress the importance of analysing the relationship between uncertainty indices and large metals and renewable and nonrenewable energy by employing the interday data and realized semivariance; in addition to this, the authors also indicate the future perspective which consists in adopting recent analysis techniques, such as quantile vector autoregressive (QVAR) (Ando and Matthew Greenwood-Nimmo 2022; Chatziantoniou et al. 2022). Technical suggestions for future

research perspectives are also provided by Tiwari et al. (2020), who suggest the analysis of the relationship between gold–oil dependence and GPR also with regard to higher moments between the two assets as well as the inclusion of other types of uncertainty measurements. In addition to the future research involving the technical perspectives, we also identified the need for future researchers to analyze the issues addressed in the studies of this research stream with regard to the gas markets; furthermore, we also stress the need for the inclusion of additional elements in the different analyses, such as a multitude of uncertainty measures rather than one single or few uncertainty measures and a wider range of commodities, in order to acquire a deeper knowledge of the studied phenomena. This is what is also indicated by Li et al. (2021), who state that future research could involve the study of gold prices and the relationship with other uncertainty measures, such as, for example, economic policy uncertainty, financial pressure index, and national political risk. In addition to this, the authors also suggest that the future research involving the sound understanding of these dynamics and the analysis of the spillover effects among the aforementioned elements translates into important implications for investors in gold. Lastly, Bin Kamal et al. (2022) include their suggestions for future research in the last part of their paper, where they highlight the importance for future researchers to study also other financial assets and commodity markets and their relationship with other economic and policy uncertainty measurements and indexes with regard to a longer data range.

6.5 | Research Stream 5: “Uncertainty and the Oil Market: A Geographic Perspective”

Given the centrality of the different geographical regions in the papers belonging to this research stream, we believe that future research could involve the study of different areas and the comparison of findings deriving from different regions. This future research perspective finds confirmation in the study of Khan et al. (2023), who analyze the impact of GPR on the returns and the volatility of the Pakistan stock market and indicate in the future research section that future studies could deal with a longer time range and also focus on different countries. Since the geographical regions are the laboratory taken into consideration to study the interconnectedness between the oil market and the uncertainty measures, the inclusion in the analysis of the elements that are peculiar to the region taken into account could represent future research perspectives. To this regard, Razek and McQuinn (2021), whose work is focused on the region of Saudi Arabia, indicate that future research could study the impact of cooperation between OPEC+ and G20 members as well as Saudi Arabia’s efforts to diversify its energy mix and invest in renewables on the economy and on the competitiveness of Saudi Arabia. Finally, future research could include the extension of these studies to the gas markets with regard to specific geographical regions as well as the focus on different theoretical models and on a wider range of variables in order to precisely assess the specific behavior of the analyzed dynamics. This suggestion finds confirmation in the work of Zheng et al. (2023), who state that future research could study and assess the impact of GPR on the spot prices of natural resource commodities and this would help to acquire a sound understating of these phenomena, and also in the work of Yang et al. (2021), who indicate that future researchers

should focus their attention on determining the peculiar signs of the shocks of global financial uncertainty measures on the behavior of the prices of Chinese crude oil futures.

7 | Conclusion

In this work, we conducted a meta-literature review containing both qualitative analysis (the content analysis) and quantitative analysis (the bibliometric analysis) regarding the topic of GPR and energy. In order to perform the analysis, we selected a sample of 72 papers taken from the period 2018 to March 2023 (March included) from the database “WebOfScience.” We employed a co-citation, co-authorship, and content analysis with VOSviewer. We identified five research streams as follows: (1) “Oil and uncertainty in different scenarios,” (2) “Uncertainty, resources and energy,” (3) “Geopolitical risk and oil from a broader perspective,” (4) “Oil, metal markets and uncertainty,” and (5) “Uncertainty and the oil market: a geographic perspective.” Finally, we highlighted the future research perspectives. Through our work, we thus carried out an in-depth analysis of the topic of GPR and energy, which has recently been at the forefront of public and academic debates. Moreover, through our analysis, we also identified the main aspects and the research streams that are the focus of past and modern research and also the research gaps and the future research perspectives that still need to be explored in order to have a sound understanding of the phenomena considered. Even though our in-depth analysis proves to be very detailed and enabled us to identify the aforementioned research streams, the topic in question is rapidly evolving, given also the importance of the relevant issues. For this reason, future authors might also focus their attention on the new emerging paths of literature and unexplored issues, which might be studied and developed in future research works.

Through our work, we provide the status quo of the relevant literature on the topic in question and, given also the increased tensions across states and regions, we believe that our analysis thus proves to be of great interest for other researchers and scholars interested in this topic.

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Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Endnotes

¹WOS is used in many bibliometric reviews as, for example, in Khan et al. (2020) and Chiaramonte et al. (2023).

²This is the number of single and individual observations, obtained by deleting the duplicates in the merged file.

³The identification obtained with 10 set as the minimum number leads to 59 results.

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