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Measuring geoeconomic tension: a large-language-model approach for the euro area

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Abstract

We construct an index of geopolitical and geoeconomic tension for the euro area using Large-Language Models (LLMs) that prompt a large dataset of European, local-language newspaper articles. The resulting LLM Geoeconomic and Geopolitical Tension (LGPT) index and its subindices seek to provide an accurate narrative of tensions and their sources over the past quarter century. The multilingual LLM approach allows for a separation between geopolitical and geoeconomic tensions and for granularity in the identification of the source of such tensions including trade, energy and finance. This lends itself to more accurate economic analysis of the impact of geopolitics and geoeconomics on the euro area economy. The LLM approach is efficient and capable among other things of extracting trends regarding the international institutional actors involved in developments. We also illustrate one potential use of the index by estimating the impact of geoeconomic tensions on output and inflation in the euro area in a Bayesian structural VAR framework.

Keywords:
Geopolitics, LLMs, Index, Economic Policy, Monetary Policy

JEL codes: C43, C45, N40, H56, C30

Non-technical summary

Measuring geopolitical and geoeconomic tensions has become pertinent for economic analysis following the tectonic geopolitical shifts in recent years. This period has also been marked by unprecedented levels of digitalisation and an ever-increasing use of artificial intelligence (AI) in general and Large Language Models (LLMs) in particular, in text-based analysis and wider research. In addition to a host of indices measuring economic, financial and political uncertainty and volatility, attempts have been made to measure a variety of different aspects of geopolitical developments through the production of indices. The most frequently used terms in these research efforts include geopolitical and/or geoeconomic risk, shocks, uncertainty, volatility, pressure and tension. With regard to geopolitical risk in particular, indices have been produced using a so-called dictionary-based method.

In this paper, we bring together a large dataset of articles in local language from well-established newspapers in the four largest economies of the euro area and use two Large-Language Models (LLMs) to identify within this multilingual dataset which articles are geopolitical in a broad sense. We also identify articles which are geopolitical in a narrower sense and exclude those, in order to focus on those that are geoeconomic instead, that is, those that relate to the weaponisation of economic policy and the economy to achieve geopolitical goals. By doing so, we create indices of geopolitical tension and geoeconomic tension, respectively.

The resulting (L)LM (G)eoeconomic and Geo(P)olitical (T)ension (LGPT) index and its subindices seek to provide an accurate narrative of geoeconomic tensions and their sources over the past quarter century in the euro area. The multilingual LLM method seems more granular, efficient and malleable when it comes to text-based analysis than the dictionary-based methods mostly used so far. It allows us to produce further subindices of geoeconomic tension by identifying the source of such tensions whether they relate to trade, energy, or finance.

By way of example and illustration, we extend the approach to show that the LLMs can also be used to identify different aspects beyond the index. Among other things, the approach is capable of extracting trends regarding international institutional actors or European institutions involved in geopolitical developments. Depending on the researcher's interest, further possibilities for quantitative and qualitative analysis exist using the approach and dataset. For illustrative purposes, we also undertake circumscribed econometric analysis in a VAR framework to show that the LGPT index and its subindices lend themselves to estimating the impact of geoeconomic tensions on output and inflation in the euro area. We find that this impact varies depending on the more precise source of geoeconomic tension.

1 Introduction

Measuring geopolitical and geoeconomic tensions has become pertinent for economic analysis following the tectonic shifts that the post-WWII international economic order has witnessed in recent years. These tensions have created challenges to the open-economy paradigm and its multilateral (institutional) framework and have shocked the European Union (EU) and euro area (EA) economy in many ways and to various degrees, both on the real and the financial side.

There have been various attempts to measure developments in and the impact of geopolitics and geoeconomics using different definitions, datasets and methodologies. However, the use of artificial intelligence in general and Large-Language Models (LLMs) in particular, has not been tested for the purposes of constructing geopolitical indices. We make use of LLMs to construct an overall geopolitical tension index which we call the (L)arge-language model (G)eoeconomic and Geo(P)olitical Tension index, in short the LGPT index (see Chart 1).[1] We then separate the LGPT index into a more narrowly defined geopolitical tension index on the one hand, and a geoeconomic tension index on the other. We therefore distinguish between and measure both geopolitical and geoeconomic tensions, given the rising weaponisation of economic policy and resources in a geopolitical context. Using further the capabilities of LLMs in undertaking nuanced text-based analysis, we focus on the sources of geoeconomic tensions. We break down the geoeconomic index by providing geoeconomic tension subindices depending on the source of the geoeconomic tension. Our dataset for the indices is a very large number of European-based, newspaper articles spanning from 1999 to 2025. To our knowledge, this is a first attempt to use LLMs to measure directly and analyse geopolitical and geoeconomic tension.

1.1 Motivation

Geopolitical and geoeconomic tensions are affecting adversely the global economy, the European Union (EU) and the European Economic and Monetary Union (EMU). International economic and political fragmentation is emerging as one of the most significant challenges to the institutionalised, multilateral international economic order and its policies post-WWII. This oft-labelled neoliberal economic order (Hayek 1944, Friedman 1962, Keohane and Nye 1987) was characterized by economic openness and interdependence as well as stability-oriented macroeconomic and microeconomic policies

[1] We construct an overall LLM Geoeconomic and Political Tension index (LGPT), which is composed of a geopolitical tension index in the narrow sense (which we call LGPT-GEOPOL), and a geoeconomic tension index (LGPT-GEOECON). The LGPT-GEOECON index is then further subdivided into 4 geoeconomic subindices whose source is identified as either trade, or energy, or finance, or technology. The LGPT-GEOECON index and its sub-indices are available in dashboard format under https://lgpt-index.onrender.com/ and under https://www.geoeconomictensions.eu/ where they are updated on a weekly basis.

in what came to be known as the "Washington consensus" (Williamson 2004). The open approach to (international) economic policy spread beyond the western developed economies after the fall of the Berlin Wall in 1989 leading to a phase of unprecedented levels of global trade and finance. The so-called "hyperglobalisation" phase that ensued (Obstfeld 2024) not only benefitted the "Global North" but was driven by the emergence of the "Global South",[2] and China in particular as a new geopolitical power.

The global financial crisis in the late 2000s and its aftermath, the Covid-2019 pandemic, but most notably the increasing intensity in the geopolitical rivalry between the USA and China and their coalitions during an age of unprecedented levels of digitalisation (Fishman 2025) have led observers to wonder about the potential "fall of the neoliberal economic order" (Gerstle 2022) and the beginning of a "New Cold War" (Gopinath et al. 2025). Indeed, the level of globalisation seems to have plateaued more recently, entering a so-called "slowbalisation" phase (Panetta 2023).

In this context, the most notable geopolitical development in Europe was Russia's invasion of Ukraine in 2022, leading to severe tensions for the EU and its member states in their political relations and economic interdependencies with allies and adversaries. Especially relevant for this paper, which focuses on geoeconomic tension as opposed to more general geopolitical tensions, has also been the development of an unprecedented rise in the degree of weaponisation of economic interdependence (Farrell and Newman 2025, Bernstein et al. 2025), and the role of government policies globally and in Europe that promote strategic autonomy leading to additional feedback loops with implications for economic output, inflation and financial stability (Ioannou and Pérez 2023). Most recently, the explicit challenge by the United States administration itself - long considered "the main sponsor of post-WWII international cooperation" (Obstfeld 2024) based around the western-centric, globalised multilateral order - has led some observers to speak about a "post-American world economy" (Posen 2025).

This heightened and complex intertwining of geopolitical and geoeconomic developments has attracted the close attention of economic policy makers as the (potential) impact of geoeconomic fragmentation both on international trade and finance is assessed to be significant. In this context, there has been an increased interest in measuring accurately geopolitical and geoeconomic tensions, and to assess their impact on the economy, including from the perspective of monetary and financial stability (Fernández-Villaverde et al. 2024, IRC 2024, ECB/ESRB 2026).

[2] See Encyclopaedia Britannica on the term "Global South" and United Nations Development Programme (UNDP) on Forging the Global South, May 2003.

1.2 Contribution

There have been attempts to measure geopolitical tensions and provide indices using text-based analysis which have employed a lexicon- or dictionary-based approach. However, there has been no attempt to our knowledge to construct specifically an index of geopolitical tensions using artificial intelligence in general and large language models in particular.

We seek to contribute to this literature by adopting a Large Language Model (LLM) approach to identify and measure geopolitical and geoeconomic tensions for the purposes of conducting euro area-relevant economic analysis. We construct a dataset and an index of geopolitical and geoeconomic tensions by focusing on the four largest economies of the euro area and use European-based newspaper sources in local language. We use a (two-step) LLM approach to identify and classify tensions over time. A first contribution of the paper is to be found in the multilingual dataset of geopolitical and geoeconomic news articles from sixteen newspapers in France, Germany, Italy and Spain over the period 1999-2025, which could be regularly updated going forward. Our total time series dataset for the four countries over 25 years contains almost 20 million articles with more than 6 million articles classified as geopolitical or geoeconomic.

On the basis of this dataset, the main contribution of the paper is the LLM-based methodological approach we adopt to identify and classify tensions. We distinguish between geopolitical tension on the one hand and geoeconomic tension on the other. Furthermore, by using the text-analysis capabilities of the LLM models, we categorise geoeconomic tensions by identifying more precisely the sources of geoeconomic tension.

We thus provide an overall geopolitical index, which contains two main components, a geopolitical index in the narrow sense as explained below, and a geoeconomic index; and then four geoeconomic sub-indices capturing the underlying sources of geoeconomic tension (see Chart 1). We find that this granularity allows for more precise economic analysis, as different sources of geoeconomic tension have different significance and may affect the economy in different ways.

2 Literature review

2.1 Indices measuring geopolitical developments

Indices based on text-based analysis using newspaper articles as a dataset have been developed in the last few years following the seminal paper and related Geopolitical Risk (GPR) index by Caldara and Iacoviello (2022). This approach employs a dictionary-based, rule-driven text analysis, where predefined keywords such as, for example, war, threat, conflict, hostilities, insurrection, terrorism, are used in combination with contextual rules

to exclude non-relevant mentions. The dictionary-based indices are then usually constructed as the ratio of thus classified articles to the total number of articles in the broader dataset, yielding a time series that reflects the relative intensity of geopolitical news coverage. The indices have been used inter alia to measure the impact of geopolitical risk on economic activity and inflation (Iacoviello et al. 2025).

The performance of indices derived from text-based analysis will depend both on the quality of the underlying textual data as well as the method of extraction. Dictionary-based indices can be relatively robust and consistent over time but can have shortcomings due to the relatively simple methodological extraction and wording used. We therefore put emphasis on the LLM method of extraction which differs from the dictionary-based approach on account of its more sophisticated prompting approach and therefore also granularity which can prove critical in economic analysis. More specifically, considerations relating to dictionary- or lexicon-based indices which suggest that the use of LLMs and their specific capabilities can be particularly useful in text-based analysis include, first, the identification of positive or negative risk sentiment may be less accurate than when identified through an LLM. Second, and related, LLMs have the ability to capture "nuances often missed by conventional methods" (Audrino et al. 2024). Third, the methodology of dictionary-based indices cannot easily be modified to take account of evolving language terminology which means that it may not be capturing adequately the evolving language used over time in the press to characterize geopolitical and geoeconomic tensions. It seems, for example, that the term "geopolitical risk" was not a frequently used term in the press in the 1990s. Employing LLMs can overcome this through appropriate prompting which can also be used to avoid omissions of specific words that dictionary-based approaches are more prone to. Moreover, the LLMs we employ have the capacity to analyse text in multiple languages, ensuring consistent treatment regardless of the source language as explained in Section 3.3.

At the same time, there are challenges also to employing LLMs in structured text-based analysis because the method depends on the prompting approach taken, and therefore also the terminology used, likely more so than in dictionary-based approaches. Moreover, the approach can be resource intensive and costly, as is the relatively constrained availability of broad ranging text datasets. Nevertheless, the literature includes text-based analysis also with LLMs to identify, for example, sentiment in monetary policy communication (Chong and Ho 2022), or with regard to the impact of geoeconomic pressure on corporate earnings (Clayton et al. 2025a), with other contributions (Clayton et al. 2025b, 2024, 2023) providing a wider framework for discussing geoeconomics and how geoeconomic power is employed by countries. They also provide a theoretical explanation of how economic coercion may lead to fragmentation. Our approach relates to these authors' use of LLMs as

classifying tools for vast amounts of text, and we share their attempt to identify sources of what they call geoeconomic pressure which, however, differs from what we call geoeconomic tension. When using the LLMs, Clayton et al. (2025a) focus on identifying the sender and recipient countries, the means (usually firms) and policy instruments (such as export controls) of the pressure, based on firms' earnings calls. Thus, while our measurement of geoeconomic tension using LLMs also classifies texts, our overall objective is rather different and therefore also our "organising framework". This transforms, as Clayton et al. (2025a) correctly put it, a vast amount of text into a structured dataset, with the structure dictated by the organising framework.

There are therefore some notable differences in our approach when compared to Clayton et al. (2025a). Importantly, the primary end-objective is different: we concentrate on the measurement of geoeconomic tensions so our "organising framework" and therefore the respective prompts differ fundamentally. The text sources are also different: Clayton et al. (2025a) use firm earnings calls and classify which governments apply pressure to which foreign targets, using which instruments, firms, and products. By contrast, we use and classify newspaper articles in order to assess whether and to what degree the press describes geoeconomic developments, giving us the overall degree of geopolitical or geoeconomic tension. The detailed prompt provided in Appendix III also provides the details for differentiating between geopolitics and geoeconomics. This prompt thus distinguishes in detail which newspaper articles should be classified as geopolitical and which as geoeconomic. This is then illustrated in Chart 6, which presents the geoeconomic index and the geopolitical one, which are mutually exclusive and collectively exhaustive, and thus resulting often in different peaks but also periods where both geopolitical and geoeconomic tensions coincide and complement each other. Finally, in our framework, we go a step further by deploying the ability of the LLMs to identify whether the source of the geoeconomic tension is one of four categories (trade, finance, energy, technology). The dividing line between articles is further explained in Section 4.2 and Appendix IV which gives examples of the different labelling of articles.

2.2 Local (European-based) newspaper sources

An important consideration when using text-based analysis is the national or language origin of the news sources and the reference to foreign countries from a specific domestic perspective. Especially from a European point of view, Caldara and Iacoviello (2022),[3] for example, draw exclusively on a limited number of English-speaking, mainly US-based, newspapers. This means that the European country-specific indices produced based on the

[3] See also the related webpage with full information on their GPR index.

Caldara and Iacoviello (2022) GPR index arise from the number of relevant (geopolitical risk) articles found in US, UK and Canadian newspapers. This implies that the Caldara and Iacoviello (2022) GPR index for France is the perception of geopolitical risk in France as viewed by newspapers in the US, UK and Canada. Geopolitical tension is therefore also understood in the English language only, and perceived through the lens of journalists, observers, media centres and networks based in those countries and directed mainly also to audiences in those countries rather than the country (in this case France) that the GPR index refers to.

Against this background, and taking the lead from Caldara and Iacoviello (2022), a few further text- and dictionary-based indices have been developed which, however, differentiate themselves with regard to the data sources and specifically by using European-based datasets rather than English-language newspapers, for example, those of Bondarenko, Lewis, Rottner and Schüller (2024), Alonso-Alvarez, Diakonova and Pérez (2025), and Bijsterbosch, Falagiarda and Žídeková (forthcoming). The first contribution concentrates on local narratives by applying the dictionary-based approach to national newspapers in their original language. Comparing their results with those of Caldara and Iacoviello (2022), the authors find that the resulting geopolitical indices from local newspapers can be different to that produced by foreign newspapers, showing how this with a focus on Russia. These differences in approach to measuring geopolitical risk are not minor as they can determine whether such risk has a statistically significant impact on key macroeconomic variables or not.

Alonso-Alvarez et al. (2025) confirm this finding by showing that the differences in geopolitical-risk peaks in the time series of country-specific indices can in some cases, like India, be notable when compared to foreign-source, newspaper text-based analysis like Caldara and Iacoviello (2022). Moreover, Alonso-Alvarez et al. (2025) attempt to identify the geographical sources of geopolitical risk, by creating bilateral indices for 34 countries, covering 15 languages and 78% of global GDP, using a Factiva-based, standardized algorithm, which identifies the country-source of geopolitical risk. These results point to a much-improved precision when local source media is used in text-based analysis.

In a similar vein, Bijsterbosch et al. (forthcoming) use the dictionary-based framework of Caldara and Iacoviello (2022) to illustrate the varying regional effects of geopolitical risk, with particular reference to central and eastern European countries (CEE). By employing English-language reporting from domestic media sources, they provide additional evidence that the output response to geopolitical risk may vary depending on where the shock originates, in line with Alonso-Alvarez et al (2025). Their country-specific indicators show that the macroeconomic effects of geopolitical risk shocks exhibit substantial regional heterogeneity in terms of strength, timing, and persistence of

responses. CEE countries appear significantly more exposed to geopolitical risk on account of geographical proximity as well as global supply, trade and energy linkages.

Our approach adopts the principle of using local as opposed to foreign newspapers. We use European-based, local language newspapers to identify geopolitical tension in European countries. Specifically, we employ 16 well-established, European-based, local-language newspapers in the largest four European economies, that is, Germany, France, Italy, Spain, from 1999 to 2025.

We draw on local European languages to capture country specific developments. We also provide EA and EU aggregations. The index may also be extended to provide the perspective from these sources as regards other EU, advanced or emerging market economies, that is, to provide a European view of tensions in these other countries. The length of the period covered helps to provide a long enough, consistent, and daily/monthly/quarterly frequency time-series as appropriate also for modelling purposes. The index could also be updated with the latest data for the purposes of short-term analysis (e.g. now-casting, short-term projections), possibly also as an early indicator. The geographic coverage could be extended beyond the French, German, Italian and Spanish text media sources.

2.3 Terminology

Terminology is almost by definition rather important in text-based analysis given that the measurement source depends on the word-content, composition and drafting in newspaper articles. This is even more so when employing LLMs. For this reason, we take a closer look at the terms used in the literature and choose to use the term geopolitical "tension" specifically. The word "tension" reflects somewhat more accurately in our view the broad causal link between what is found in newspaper articles and the geopolitical and geoeconomic policies, risks and events that may lead to the formation of perceptions and expectations and may impact through a variety of channels the (macro)economy.[4]

Specifically, we choose to use the term "tension" as opposed to terms found in the literature such as "risk", "shock", "uncertainty", "volatility", "fragmentation" or "pressure" for a variety of reasons. First, tension is broader than risk and shock and subsumes those terms, while risk and shock are two terms that have specific meaning in economic analysis which do not always seem to be appropriate in what is found in newspaper articles. For example, the use of the term "risk" may lead to confusion because it may be covering events that have already taken place and not events that are at risk of taking place (Caldara and Iacoviello, 2022). Moreover, risk is usually understood in economic analysis with reference

[4] The relevance of these could be linked to the role of "animal spirits" that Keynes (1936) claimed may be driving economic behaviour.

to a baseline scenario, but indices of the type discussed here do not identify such risk to begin with. In addition, geopolitical risk may remain even if the intensity of coverage by newspaper media may not. Similarly, the word shock may be confused with what is identified and measured as a shock in econometric analysis which may or may not be significant as such in the context of geopolitics (Brignone, Gambetti and Ricci 2024). The same can be true for economic uncertainty and volatility which may or may not be present in the first place in newspapers. Clayton et al. (2025a) choose to use the term "geoeconomic "pressure" to describe "the use of existing economic relationships by governments to achieve geopolitical or economic goals".

More broadly, the related economic literature varies, in some cases considerably, in the use of these terms when combined with the terms geopolitics/al and geoeconomic/s. In an extensive review, for example, Mohr and Trebesch (2024) tackle the various definitions of geopolitics and geoeconomics and define geopolitics as "the study of rivalries for power or influence over territories and the people who inhabit them" while proposing their own definition of geoeconomics as "the field of study that examines the links between geopolitics and economics". "Geoeconomics is thus concerned with how international political rivalry (including war) shapes economic policies and outcomes—and vice versa." Such a definition of geoeconomics is closely related, as the authors claim, towards the international political economy definition of Lake 2009, that is, the "politics of international economic exchange". However, these authors speak about geoeconomics as a field of study that is thus broader than geopolitics that encompasses not only research on the use of geoeconomic policy tools such as sanctions and embargoes, coercion and fragmentation, or the geopolitics of international trade and international finance, but also the research on geopolitical risk and its spillovers to the domestic economy and the economics of war.

Caldara and Iacoviello (2022), by contrast, choose to define geopolitical risk 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."

Referring to geoeconomic fragmentation instead, Gopinath et al. (2025) see it as "policy-induced changes in the sources and destinations of cross-border flows, often guided by strategic considerations, such as national and economic security." This seems to imply a differentiation between intentions and changes rather than the resulting state of affairs from such measures (Aiyar et al. 2023, Gopinath et al. 2025). Thus, Fernández-Villaverde et al. (2024) take a broader perspective to assess whether we are geoeconomically "fragmented yet" by employing a host of indicators that reflect "disruptions in trade,

finance, mobility, or political alignments" and include but go well beyond, for example, the Caldara and Iacoviello GPR index.

Given the wide variety of definitions of geopolitics and geoeconomics, and the relevance of definitions in text-based analysis, we define in this paper geopolitical tension broadly "as any perceived or actual tension between nation-states and their political and economic (institutional or otherwise) actors that are affecting, or have the potential to affect, the peaceful course of international (economic) relations through the threat of, or realisation of, (armed or other) conflict arising from public policies." Based on this definition and extending it to separate what is "geopolitical" and what is "geoeconomic", we inform appropriately the prompting of our LLMs based on the insights of the literature.

By using the term "tension", we do not claim to have found the ideal term to be used to measure geopolitical and geoeconomic fluctuations in all cases, but we see this term as more fitting and closer to what precisely we are measuring in the related newspaper articles using LLMs. We thus also remain agnostic on whether our measures of geopolitics and geoeconomics amounts ex ante to a risk or a shock in the economic sense, something which we think lends itself better to relevant econometric analysis.

Our LLM-based GeoPolitical Tension (LGPT) index thus measures the extent to which the tension, as defined in detail in our prompts, rises or falls on the basis of the relevant number of articles found in the newspapers we cover. This (daily, monthly) number over the total number of (daily, monthly) articles results in a time-series of the index for the four largest economies of the euro area, while we also provide an aggregate, European measure on the basis of the four countries.

We concur with the idea that the broader concept of geopolitics is the most encompassing in line with others who have employed the term in the construction or use of relevant indices such as Caldara and Iacoviello (2022), Bondarenko et al. (2024), Fernadez-Villaverde (2024) and Alonso-Alvarez et al. (2025). But by using the advantages of LLM text-based classification and analysis, which allow for a more granular approach, we identify both what is geopolitical tension in the general sense and also in the more specific sense, that is, a tension that arises specifically from armed conflict as well as notions like threats to peace, nuclear threat, or terrorism. By contrast, we term geoeconomic the geopolitically-derived tension in economic relations that affect mainly trade and finance, such as barriers to trade or capital flows, between states or state-like actors.

In terms of the algorithms, we follow a two-step approach by employing two LLMs in sequence, but then also use both models interchangeably to cross-check the results arising from each one. Specifically, in a first step, we identify "geopolitical" newspaper articles in a broad sense as all those dealing with both geopolitical and geoeconomic tension. In a second step, we identify, as a sub-set of the geopolitical articles, geoeconomic newspaper

articles as those that speak specifically about the weaponisation of economic means and relations, thus differentiating those from acts or threats related to armed conflict, war, invasion, terrorism and the like. For example, the threat or act of an armed invasion like the Iraq war, the Russian invasion of Ukraine or the recent armed conflict between Israel and Palestinian militias or vis-à-vis Iran is identified as geopolitical, while we seek to classify as geoeconomic the intended or imposed financial sanctions, trade barriers of all kinds, international monetary disruptions and the like resulting from these geopolitical events.

Second, in contrast to text- and dictionary-based indices, and given recent advances in LLMs, adopting an LLM-based approach thus appears promising for classifying and identifying more precisely the content of newspaper articles (Audrino et al. 2024). The approach has the potential to generate more accurate indices, as LLMs may more effectively classify whether text is relevant to geopolitical tension. Moreover, the use of an LLM-based index provides a more specific classification of tensions, allowing for a clearer distinction between geopolitical and geoeconomics and enabling the identification of their underlying drivers. This LLM approach could also be used to assess the seriousness and intensity of the geopolitical tension we identify in texts but we do not do this here.

Leveraging on the LLM's classification capabilities, we thus further distinguish the specific nature of geoeconomic tension into four geoeconomic sub-categories: energy, trade, technology and finance. These sub-categories are derived from the full set of geopolitical articles after identifying those classified as geoeconomic.

Our LGPT index is briefly compared to other relevant indices for robustness checks. Such a comparison may have itself lessons for the media landscape and sentiment in Europe in times of a changing geopolitical landscape, also when compared to that in the US.

2.4 Using Large Language Models (LLMs)

Automatic news classification has long been a central task in natural language processing, supporting applications ranging from opinion detection to topic categorization and misinformation filtering. Traditional approaches relied on methods such as support vector machines, logistic regression, and later convolutional or recurrent neural networks. However, since the emergence of transformer-based large language models (LLMs), news classification has undergone a major paradigm shift. LLMs such as BERT, RoBERTa, T5 and GPT-family models have become the dominant methodology, consistently outperforming earlier machine learning techniques.

One of the earliest applications of LLMs to news-related tasks was presented by Alhindi et al. (2020), who fine-tuned BERT for distinguishing fact-based reporting from opinion

articles. They showed that incorporating argumentation features improved performance over both traditional classifiers and a baseline transformer, particularly on articles from unseen publishers, demonstrating the advantage of combining contextual representations with explicit discourse indicators. Similar findings were observed by Escouflaire et al. (2024) in French-language news, where a transformer slightly outperformed feature-based classifiers on large datasets, but classical methods remained competitive when data was limited, suggesting that the benefit of LLMs scales with data availability.

Subsequent research has highlighted the advantages of LLMs for topic categorization. Shah et al. (2025) applied a multitask BERT architecture that simultaneously classified articles by sentiment and topic, achieving around 98% accuracy for topics and 94% for sentiment. Khosa et al. (2023) extended this line of work by evaluating sentence embeddings from several transformer architectures, including BERT, RoBERTa, MPNet, and T5, combined with ensemble classifiers. Their results showed F1 scores close to 99%, significantly exceeding those of traditional Convolutional Neural Networks (CNN) and Support Vector Machines (SVM) models, and illustrating the near-ceiling performance of LLMs for well-defined topical categories.

Beyond topic categorization, LLMs have proven crucial for misinformation detection. Roumeliotis et al. (2025) reported that a fine-tuned GPT-4 model achieved 98.6% accuracy in fake news classification, compared to 97.5% with BERT and only 58.6% with a conventional CNN. Their results highlight both the superiority of transformers over earlier models and the incremental benefits of larger generative LLMs. Interestingly, recent comparative studies suggest a trade-off: encoder models such as BERT often outperform generative models in raw classification accuracy, while GPT-style models exhibit greater robustness to noisy or adversarial inputs (Raza et al. 2024, Sun et al. 2023).

Furthermore, LLMs generalize effectively across publishers and domains, as shown in the opinion classification tasks, and they can be adapted to multitask settings without performance loss. However, the literature also identifies notable limitations. Escouflaire et al. (2024) emphasize the high computational cost of transformer models, which can be orders of magnitude slower than traditional baselines. Chen (2024) similarly observed overfitting risks when fine-tuning BERT on small datasets, underscoring the need for careful hyperparameter tuning. Moreover, context length limitations constrain models like BERT to truncated inputs, which may be problematic for full-length news articles.[5] Transparency also remains a challenge, with most LLMs operating as black boxes, although methods such as structured prompting and decomposition strategies (Sun et al. 2023) are beginning to address this.

[5] More recent architectures largely address this issue using rotary positional embeddings (RoPE; Su et al., 2021).

Finally, advances in model distillation and the integration of human-in-the-loop verification are expected to play a decisive role in enabling the scalable and trustworthy deployment of LLM-based classifiers. While these models already demonstrate clear superiority over traditional approaches in tasks such as topic categorization, opinion detection, sentiment analysis, and fake news identification, ongoing research continues to face challenges related to efficiency, robustness, and interpretability.

3 Dataset and Methodology

3.1 Dataset

For the purpose of constructing the dataset, we rely on Factiva as the main data source.[6] We extract a total of 19,689,651 articles, nominally covering 80 years but with most articles at this stage found during the period between 1999 and 2025. The articles are collected from a selection of national newspapers in the four largest euro area economies, namely France, Germany, Italy and Spain (Appendix I). The data are collected at daily frequency and in the respective local language, ensuring that the coverage reflects the national context and discourse. Given the naturally noisy nature of textual data, we rely on the processing pipeline developed by Aarab et al. (2025) which performs deduplication, near-deduplication, and the removal of low-information content. Specifically, this entails filtering out documents such as charter listings, automated earnings reports, index summaries, and articles dominated by numerical data or whitespace.

3.2 The Large-Language-Model (LLM) methodology – a two-step approach

Analysing a dataset of this size and multilingual nature is challenging both from a computational and methodological perspective. To address this, we adopt a top-down approach with the primary objective of first identifying articles that relate to geopolitical and geoeconomic tensions and subsequently extracting relevant information from them.

As a first step, we leverage the fact that Factiva applies a hybrid approach to content tagging[7] through NLP, rule-based systems, machine learning, and curated taxonomies to assign Dow Jones Intelligent Identifiers such as subjects, industries, and regions. Building on this, we select eleven identifiers that comprehensively capture potential news items relating to geopolitics and geoeconomics. This initial filtering provides a structured entry point into the dataset, reducing noise while maintaining broad coverage.

6 Factiva is a Dow Jones database providing access to global news and business sources (https://www.dowjones.com/professional/factiva/)
7 https://developer.dowjones.com/solution-patterns/solution-patterns-details-automated-data-tagging

On this basis, we then employ two Large Language Models of different generations and with complementary purposes. A fine-tuned multilingual BERT model is applied to identify and classify the relevant articles with greater precision. In a second step, we rely on the use of a protected environment API of GPT-4o model as a classifier, designed to retrieve structured content and relevant signals from the identified articles.

A pure GPT-4o approach would have the advantage of minimizing false negatives, since the model could in principle capture a very broad set of potentially relevant articles. Yet this comes with constraints for us: the computational costs would be extremely high, scalability would be difficult to achieve on a dataset of this size and multilingual nature, and processing speed would become a serious bottleneck. Moreover, using a model of this scale as a basic classifier (for example to distinguish between sports and politics) would be unnecessarily costly in terms of parameters, as such tasks can be performed effectively by smaller models.

Our two-step setup addresses these challenges more effectively. In the first stage, BERT is used to filter articles, retaining only those with a probability above 0.6[8] of being geopolitical or geoeconomic. This threshold reflects a pragmatic compromise, limiting noise without excluding too much relevant content. As a result, the volume of material passed to GPT-4o is reduced significantly[9], which lowers computational burden and increases efficiency, while still ensuring broad coverage. In the second stage, GPT-4o can then concentrate on information extraction rather than performing the full identification task.

3.3 BERT and GPT4o

Following Durrani (2025), we develop a classification model to identify articles that reflect geopolitical tension. In particular, we fine-tune the EuroBERT encoder-based transformer (Boizard et al., 2025), which integrates architectural innovations such as Rotary Positional Embeddings (RoPE) and FlashAttention to enhance scalability and computational efficiency. Moreover, EuroBERT's pre-training on a broad range of European languages makes it particularly suitable for our application, as it allows the model to perform well across multiple languages and thus avoids the need to translate articles into English.

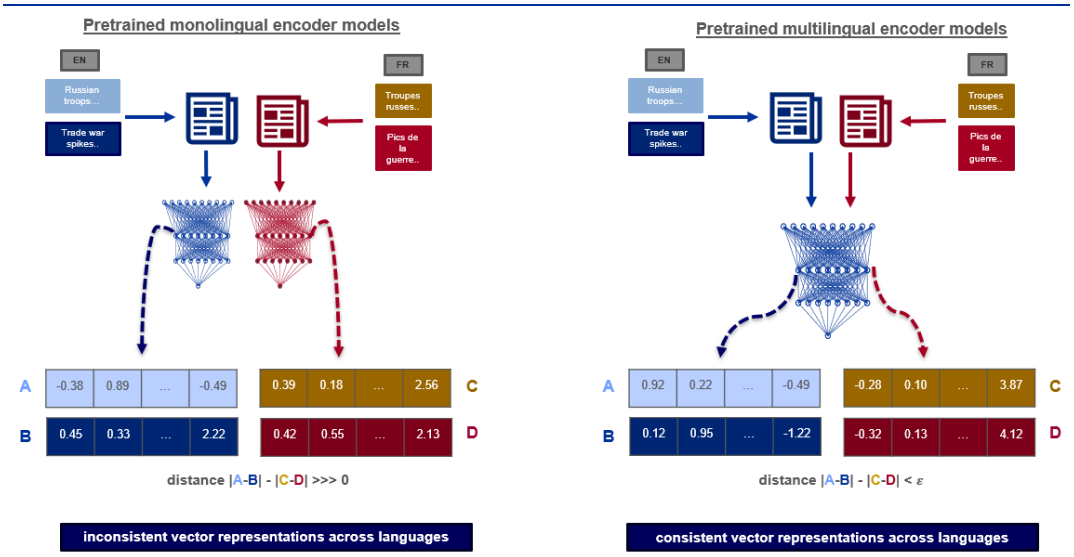
To adapt EuroBERT to our task, we fine-tune the model by adding a classification head on top of the encoder and training it on annotated English-language data. We obtain a pooled sentence representation by averaging the final-layer token embeddings (mean

[8] The 0.6 probability threshold was selected empirically to balance recall and precision, ensuring that the BERT filter reduced noise without excluding too many relevant items before the GPT-based step
[9] For details on the number of articles at different steps, see Section 3.5.

pooling), which is then passed through the classification head. The head consists of a linear transformation, a non-linear activation, and normalization layers, followed by a final linear mapping that outputs class probabilities. During fine-tuning, we freeze a portion of the lower encoder layers to preserve multilingual representations, which, as highlighted by Müller et al. (2021), are primarily stored in the lower layers of the network. This design ensures that, even though the annotated training data that we collect is in English, the model retains the ability to generalize effectively across other European languages (see Chart 0). This behaviour is confirmed through a series of validation experiments reported in Durrani (2025).

Chart 0

Pretrained monolingual versus multilingual encoder models



Source: Durrani (2025).

In the second stage of our methodology, we rely on a protected environment API for GPT-4o. Given the scale and multilingual nature of the dataset, the task of identifying and extracting information on geopolitical and geoeconomic tensions requires a tool with state-of-the-art performance in natural language understanding. GPT-4o provides such capabilities and has been shown to outperform earlier large language models in multilingual classification and extraction tasks (OpenAI 2024 and Touvron et al. 2023).

We adopt a zero-shot[10] approach, instructing the model through a carefully designed prompt that both defines the relevant concepts and forces the model to act as classifier and extractor. To further reduce variance in the outputs, we set the temperature at 0.1, which enhances reproducibility and consistency across runs. The full prompt is reported in Appendix III.

[10] A zero-shot approach in large language models refers to the ability of the model to perform a task without task-specific training examples, leveraging only its pre-trained representations and generalization capacity.

The model is asked to deliver results in strict JSON format, which offers two major advantages. First, it guarantees a structured and machine-readable output, facilitating the direct integration of results into Python pipelines for subsequent storage and econometric analysis. Second, it reduces the risk of ambiguity that often arises when large language models are tasked with free-form responses (Brown et al. 2020; Bommasani et al. 2021). In this way, GPT-4o is effectively constrained to produce standardized information that can be aggregated over time and across countries.

In operational terms, the first task required of GPT-4o is to confirm the mBERT outcome whether an article contains a geopolitical or geoeconomic tension. This initial binary classification (geo = G or N) serves as the entry point. However, the value of GPT-4o lies in going beyond a simple yes–no distinction. Once an article is flagged as relevant, the model is instructed to classify the type of tension.

If instead it falls into the geoeconomic domain, GPT-4o is required to go deeper and allocate the article to one of four predefined sub-categories: finance, energy, trade, or technology. Within the finance category, the model also searches for references to the international monetary system (IMS) and to payment infrastructures, capturing tensions related to exchange rate regimes, reserve accumulation, foreign exchange interventions, capital flows, and cross-border payment systems. The IMS dimension therefore reflects disputes or policy actions that affect global monetary coordination and the stability of the international financial architecture. Within the trade category, the model includes not only commercial frictions and sanctions but also tensions involving raw materials, critical inputs, and commodities, which have become central instruments of economic statecraft and strategic leverage.

3.4 The LGPT index and its subindices

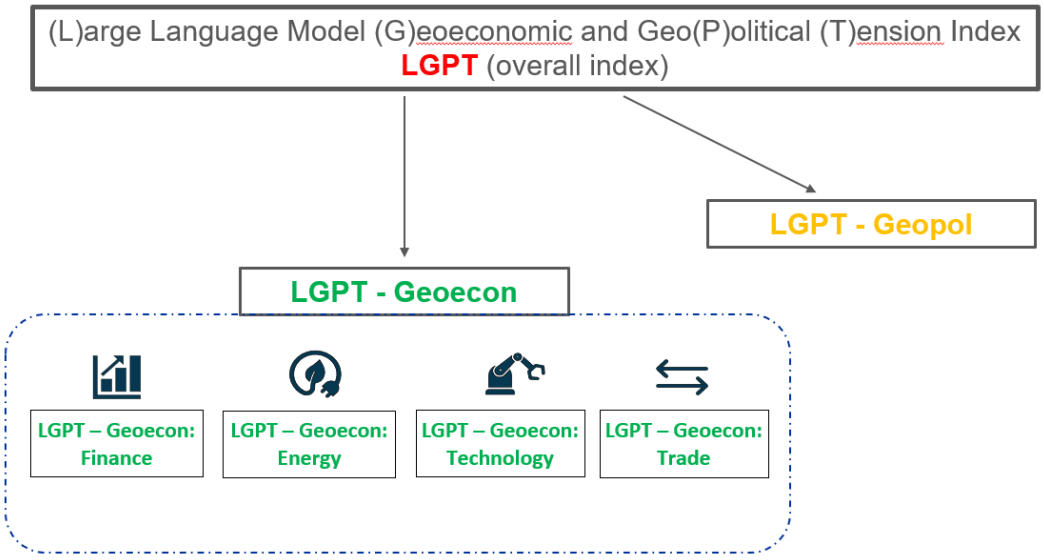
This detailed taxonomy allows us to capture not only the presence of geoeconomic risk but also its specific channel, which we argue is important and statistically significant for subsequent economic and policy analysis. For example, tensions related to trade agreements or sanctions are distinguished from those involving energy supply disruptions or financial flows. In this way, the model does not treat geoeconomics as a residual category but as a multi-faceted field with its own internal structure.

Beyond this classification, GPT-4o is also required to identify all countries involved, distinguishing between pivotal and non-pivotal actors, and to capture references to the European Union, the Euro Area, and EU institutions. It further extracts explicit mentions of international organizations such as NATO, IMF, WTO, or regional alliances, thus situating each event within its broader institutional context.

The resulting LGPT index consists of and is subdivided as follows: the overall (L)arge-language model (G)eoeconomic and geo(P)olitical Tension index (LGPT), which is composed of a geopolitical tension index in the narrow sense that picks up articles that relate to geopolitical rather than geoeconomic tensions (LGPT-Geopol), and a geoeconomic tension index (LGPT-Geoecon). The LGPT-Geoecon index is then further subdivided into four geoeconomic subindices whose source is identified as either trade, or energy, or finance, or technology.

Chart 1

The LGPT index and its geopolitical and geoeconomic subindices



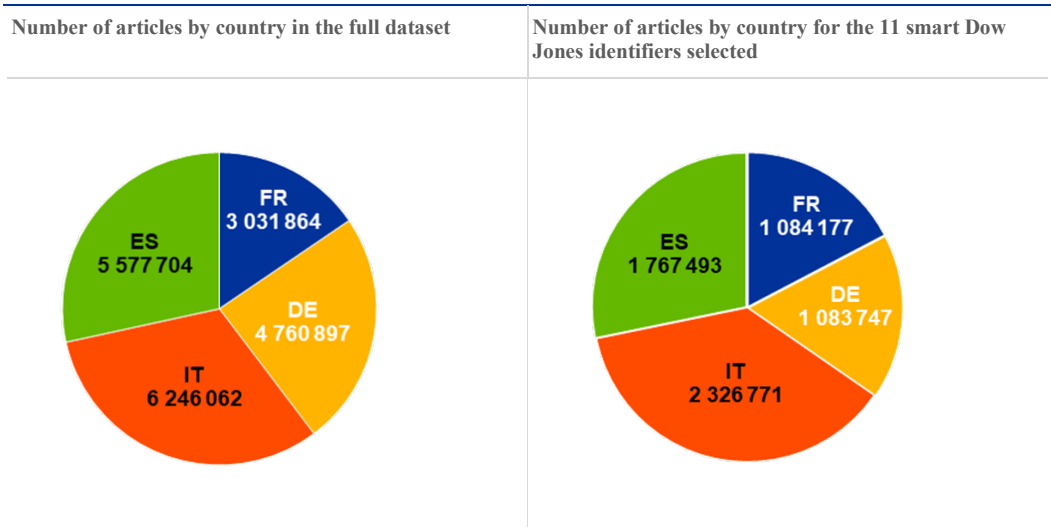
Source: Authors' illustration. The overall LGPT index (**LGPT-G**) is subdivided into a geopolitical index **LGPT-Geopol** which excludes articles that are identified as geoeconomic: these are captured instead by the **LGPT-Geoecon** index. The LGPT-Geoecon index is then further subdivided into mutually exclusive and collectively exhaustive subindices depending on the source of the geoeconomic tension, namely, finance (**LGPT-Geoecon-Finance**), energy (**LGPT-Geoecon-Energy**), technology (**LGPT-Geoecon-Technology**) and trade (**LGPT-Geoecon-Trade**). Each article labelled as geoeconomic is thus classified under one of these four categories.

3.5 *Overview of newspaper articles*

Chart 2 illustrates the distribution of articles by country in the full dataset and in the subset filtered through the eleven selected Dow Jones identifiers. The overall numbers are large for all countries, but Italy and Spain account for notably larger numbers of articles because their samples include four newspapers, compared with three from France and Germany (Appendix I). The filtering step significantly reduces the dataset size while preserving a balanced cross-country composition, which is crucial for subsequent comparability.

Chart 2

Number of total articles in the dataset by country

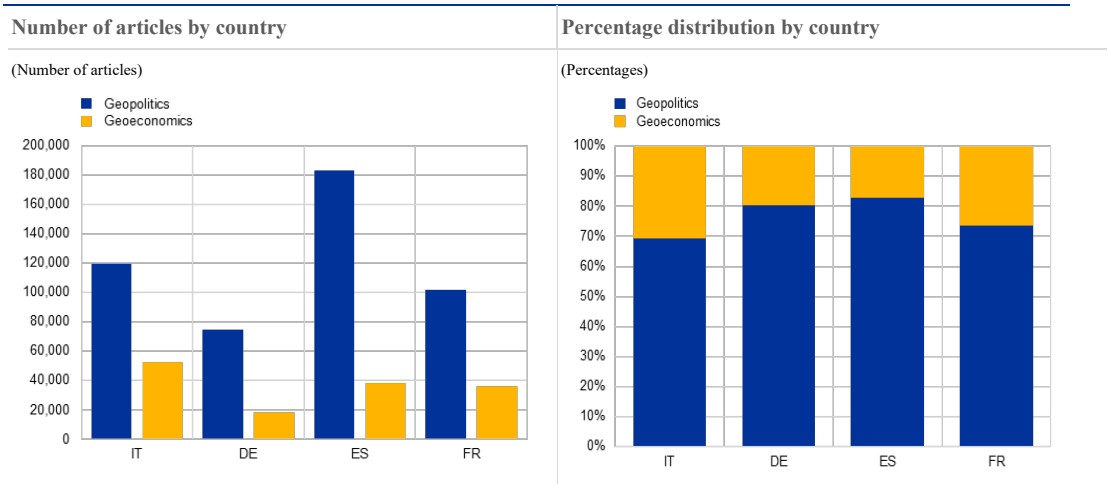


Source: Authors' calculations
Notes: Details of the selected categories are included in the Appendix I.

The number of articles retained after the GPT-4o classification is shown in Chart 3, distinguishing between those articles identified as relating to geopolitical and geoeconomic tensions. The left-hand panel displays cross-country differences in the number of identified articles, while the right-hand panel presents the relative shares of geopolitical and geoeconomic coverage across the four EA member states.

Chart 3

Number of articles in the dataset after the GPT4o classification

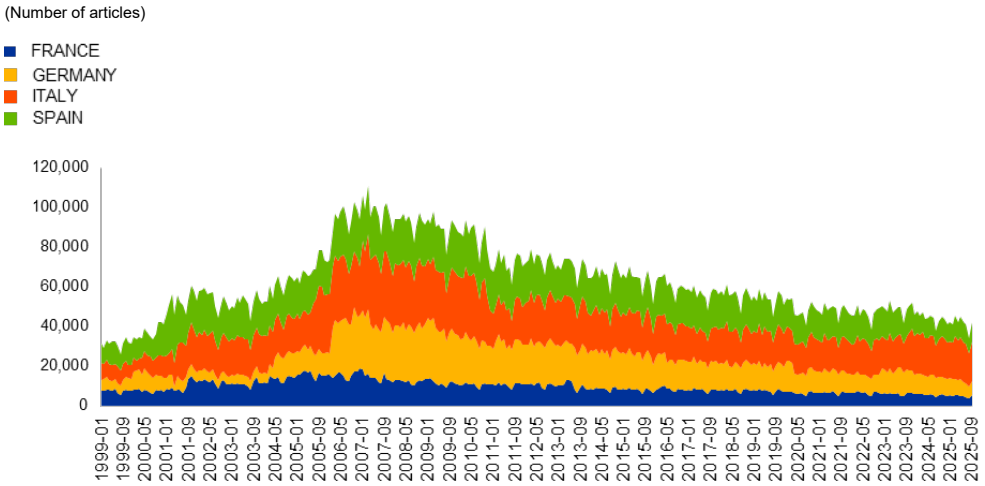


Notes: The articles are labelled after the BERT selection with a Probability of belonging to Geopolitical or Geoeconomic > 0.6.

As for the total number articles per country over time (so irrespective of whether they are geopolitical or not), Chart 4 shows the monthly number of total articles by country over the sample period 1999-2025. The data reflect over time the overall composition in Chart 2 while the pattern is similar for and consistent over all four EA member states: coverage builds up gradually from the early 2000s, with a notable increase during the global financial crisis period. From 2011 onwards the series of total articles per country indicate a gradual decline in volume.

Chart 4

Total number of articles by country, Monthly data, 1999 to 2025



Source: Authors' calculations

4 Results

4.1 The LGPT index, 1999-2025

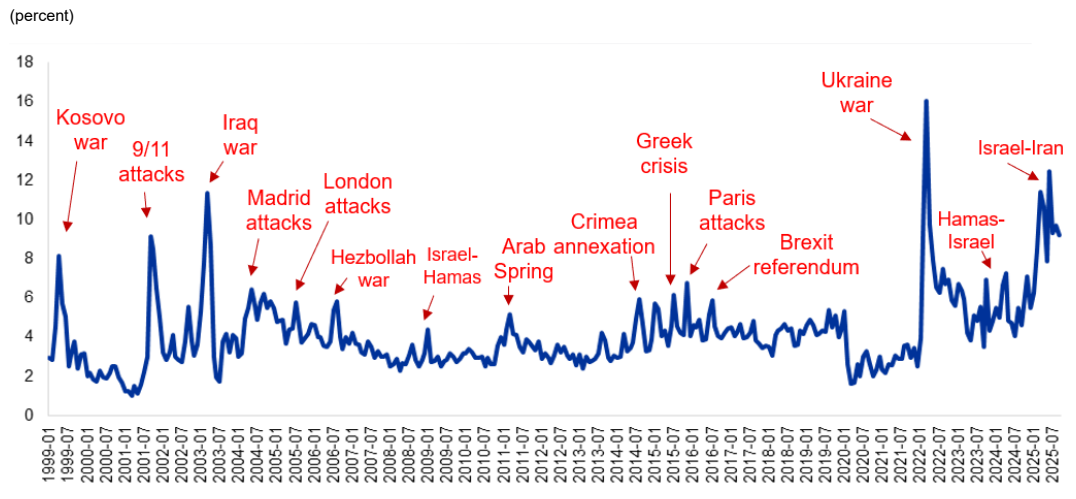
While we construct a longer historical index of geopolitical tensions, we focus on the more recent period from 1999 to 2025. As per Chart 1, we create one overall LLM GeoPolitical Tension index (LGPT), which is composed of a geopolitical index in the narrow sense (LGPT-Geopol) and a geoeconomic tension index (LGPT-Geoecon). The LGPT-Geoecon index is then further subdivided into 4 geoeconomic subindices whose source is identified as either trade, or energy, or finance, or technology.

The indices provide a country-specific measure of risk perception in the domestic press in France, Germany, Italy and Spain, capturing both common rising or falling tensions as well as heterogeneous national perspectives. We aggregate the indices to provide an approximation for the euro area as a whole.

Chart 5 shows the overall LGPT index of the euro area as a whole. It depicts all articles that the LLMs label as geopolitical in the broadest sense and following our general definition of geopolitical tensions, that is, an actual, threatened or potential conflict, armed, diplomatic or economic, between sovereign states or their official actors, including governments, state-owned enterprises, militaries, regulators, courts, intelligence agencies.

Chart 5

Euro area LGPT overall index (monthly), 1999-2025



Source: Authors' calculations

Notes: The percentage is the ratio of articles labelled and identified, on a monthly basis, as geopolitical in the broadest sense (in line with the geopolitical tensions definition and LLM prompting), divided by the total number of articles in the full database.

The series captures with precision several major geopolitical events: it spikes during the Kosovo conflict in 1999, the 9/11 attacks in 2001, and the Iraq War in 2003, while further peaks are visible around the Madrid and London terrorist attacks, the Arab Spring period, the annexation of Crimea in 2014, the Greek sovereign crisis, the Paris terrorist attacks in 2015, and the Brexit referendum in 2016. More recently, the index records a sharp surge in

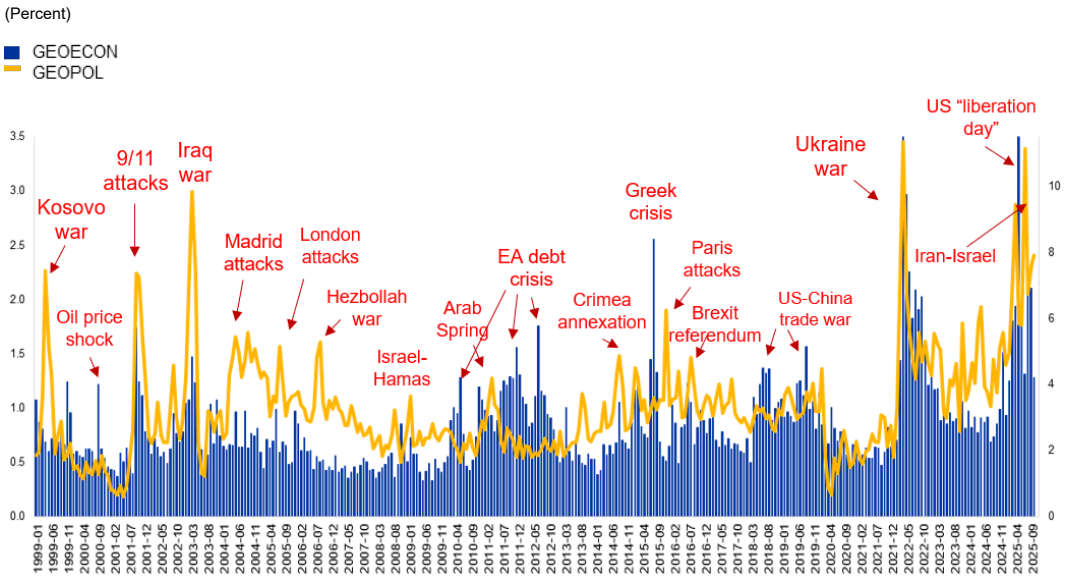
2022 with Russia's invasion of Ukraine as well as a renewed and notable increases in the first half of 2025 associated with notable geopolitical and geoeconomic pronouncements when the new US administration took office, including the period of widespread tariff announcements around so-called "liberation day" (3 April 2025).

4.2 *Geopolitical versus geoeconomic tensions*

One of the main goals of this paper is to more precisely separate geoeconomic from geopolitical tensions. Existing indices typically aggregate both dimensions under a single heading, as we have done in Chart 5. Our approach seeks to disentangle them. By doing so, we distinguish events of a purely military, or more broadly armed conflict type of nature (including terrorist attacks), where (mostly) state power is manifested via armed means, from those developments and/or events where state power is exercised through the economy, for example, via economic coercion, strategic dependencies and leverages, sanctions, tariffs, trade barriers and controls on exports, (critical raw) materials, energies and technologies, financial restrictions, and more generally the weaponisation of economic policy and of private economic activity.[11]

Chart 6

Euro area geopolitical (LGPT-Geopol) and geoeconomic (LGPT-Geoecon) index (monthly), 1999-2025



Source: Authors calculations
Notes: The LHS axis refers to the LGPT-Geoecon index (blue bars) and the RHS axis refers to the LGPT-Geopol index (yellow line). Both are in percent of the total number of articles in the database on a monthly basis.

[11] Geoeconomic tension thus also includes notably coercive measures related to the international monetary system, cross-border financial flows, financial infrastructures, payments and payment systems.

We therefore break down the same dataset of Chart 5 into a geopolitical component (LGPT-Geopol) and a geoeconomic component (LGPT-Geoecon) shown in Chart 6 as a yellow line and blue bars respectively. The geoeconomic and geopolitical articles picked up by these two categories of tension are mutually exclusive and collectively exhaustive, so all articles are assigned either the geopolitical or the geoeconomic heading while there is no overlap of articles. We see that there are periods or peaks of strong coincidence between geopolitical and geoeconomic tensions, as well as periods of much less coincidence where geopolitical and geoeconomic events go hand in hand. One example of high coincidence and correlation is the full-scale military invasion of Ukraine followed by armed conflict that continued to take place alongside multiple rounds of economic sanctions by the EU.

At the same time, there are notable instances of contrast between geopolitical and geoeconomic tensions over the period 1999 to 2025. Moreover, financial crisis events are picked up as geoeconomic tensions in some cases but not others because their nature is different from a geoeconomic point of view, as defined above and explained below, also with reference to the global financial crisis and the euro area debt crisis.

Consequently, during the first decade of the sample, from 2000 to 2010, the most pronounced peaks are primarily geopolitical in nature, associated with events such as the Kosovo war, the 9/11 terrorist attacks in New York, the Iraq war, or the London bombings. In this period, the geoeconomic component remains relatively subdued, reflecting the fact that tensions perceived in the European press were largely driven by armed events or conflicts and traditional geopolitical crises.

In the subsequent period of the 2010s, however, geoeconomic tensions become increasingly prominent. In the first half of the decade, we see in particular a rising trend and specific spikes in the geoeconomic index (blue bars) relating to the euro area sovereign debt and financial crisis, the “whatever it takes” moment, the (second) Greek crisis. The second half of the decade is marked by the Brexit referendum in 2016 and the escalation of the US–China trade conflict in 2018-2019.

In the period 2020 to 2025, the most significant peaks and periods of increased geoeconomic tensions correlate closely with two significant geopolitical moments: the Ukraine war causes spikes both in geopolitical as well as geoeconomic terms, as does the start of the term in the first half of 2025 of the new US administration.

Interestingly, the Global Financial Crisis (GFC) of 2007–2009 does not generate a pronounced peak in the geoeconomic index in relative terms when compared to other geoeconomic events over the longer period under investigation. By contrast, the euro area sovereign debt crisis that followed in the first half of the 2010s did involve tension and dispute over cross-border and international financial assistance and austerity policy

measures, which is captured as geoeconomic friction between states (and especially under the finance subcategory – see below), through the geoeconomic prompt in the LLM models.

Against this background, to illustrate what is picked up as geoeconomic or geopolitical, we provide in Appendix IV a table of representative newspaper article excerpts, their exact source and date, and the main corresponding labels of "geopolitical" and "geoeconomic" articles, as well as an example of what is identified as neither. The excerpts are chosen to also illustrate specifically how articles on the euro area debt crisis are identified as geoeconomic because they entailed interstate geoeconomic tension in contrast to those concerning the GFC which entailed such tension much less. Moreover, in the same Appendix IV, to further pinpoint how the LLM differentiates between respective articles following our detailed prompt provided in Appendix III, we also provide newspaper article excerpts which have been assigned the more granular labels "geoeconomic-trade", "geoeconomic-energy", "geoeconomic-finance" and "geoeconomic-technology". This labelling indicates the source of geoeconomic tension identified through the LLM, as explained in the next Section.

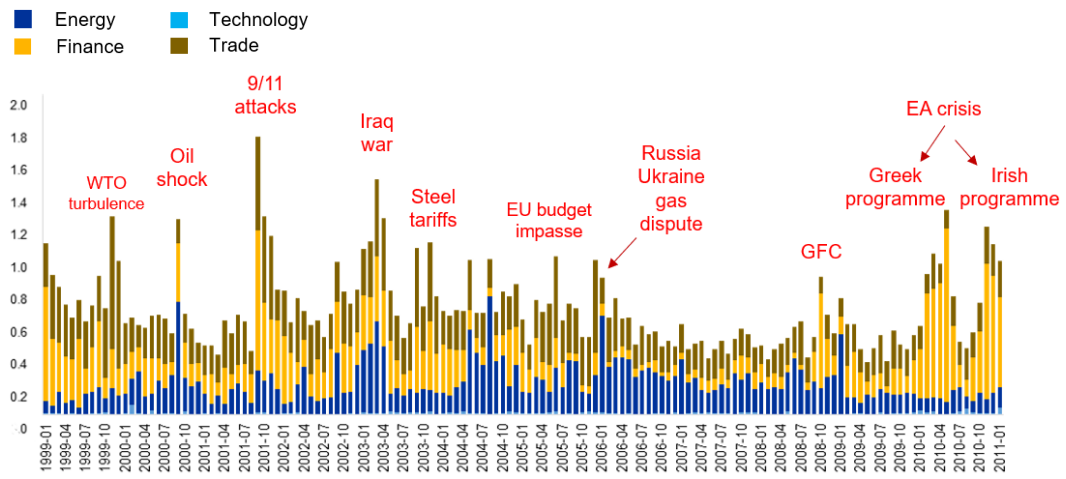
4.3 Sources of geoeconomic tensions: four main drivers

We continue the investigation by making further use of the ability of LLMs to seek nuanced information in text-based analysis and break down the aggregate geoeconomic index into four distinct categories, thereby identifying the specific sources of geoeconomic tension (as per Chart 1). Chart 7a presents the euro area geoeconomic index (LGPT-Geoecon) for the period 1999–2011, disaggregate into the four subindices of Trade (LGPT-Geoecon:Trade), Finance (LGPT-Geoecon:Finance), Energy (LGPT-Geoecon:Energy) and Technology (LGPT-Geoecon:Technology), on a monthly basis and as a percent of the total number of articles.

Chart 7a

Euro area geoeconomic (LGPT-Geoecon) subindices (monthly), 1999-2011

(Percentages)



Source: Authors calculations

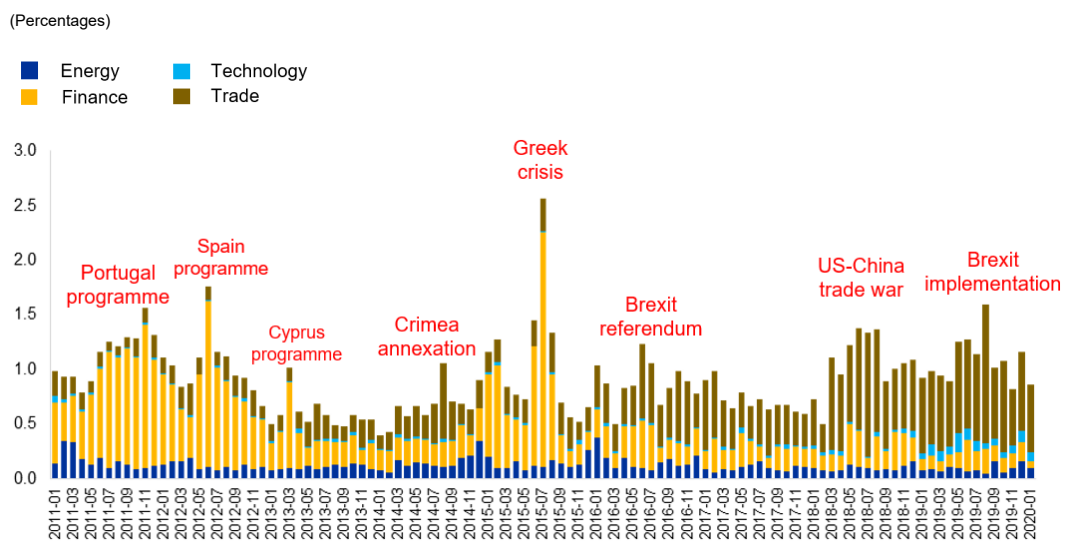
Notes: The different colours of the bars show the four sub-indices of the euro area LGPT-Geoecon index into the categories of Trade (LGPT-Geoecon:Trade – in brown bars), Finance (LGPT-Geoecon:Finance in yellow bars), Energy (LGPT-Geoecon:Energy in dark blue bars) and Technology (LGPT-Geoecon:Technology in light blue bars), on a monthly basis and as a percent of the total number of articles (see Chart 1 for a diagrammatical presentation of the index and sub-indices/sub-components).

The disaggregation shows that during the early 2000s, peaks in the index are relatively broad-based, but specific events mark identifiable peaks across categories. For example, the Iraq War in 2003 is marked by energy considerations, as shown in the relevant sub-index LGPT-Geoecon:Energy (bars in dark blue). Similarly, the Russia–Ukraine gas dispute in 2006 stands out clearly as an energy-related episode.

In the run-up to the global financial crisis, we observe a gradual increase in the finance component of the euro area geoeconomic index (LGPT-Geoecon:Finance in yellow), reflecting heightened attention in the press to financial stability considerations. The geoeconomic index and its finance subcomponent mark a local peak (i.e. the GFC) related to the most prominent event of the period, the collapse of the investment bank Lehman Brothers in September of 2008. The LGPT-Geoecon index subsides until the euro area crisis events from 2010 on, when the index rises notably to reflect multiple and often heated debates over fiscal rules, cross-border financial assistance, and institutional/coordinated responses to systemic stress. They include the Greek bilateral loans of 2010, the creation of the financial assistance institutions like the European Financial Stabilisation Mechanism (EFSM) and the European Financial Stability Fund (EFSF), and the ECB Securities Markets Programme (SMP), all in May-June 2010, and the Irish financial assistance programme in November 2010.

Chart 7b

Euro area Geoeconomic subindices (monthly), 2011-2020



Source: Authors' calculations

Notes: The different colours of the bars show the four sub-indices of the euro area LGPT-Geoecon index into the categories of Trade (LGPT-Geoecon:Trade – in brown bars), Finance (LGPT-Geoecon:Finance in yellow bars), Energy (LGPT-Geoecon:Energy in dark blue bars) and Technology (LGPT-Geoecon:Technology in light blue bars), on a monthly basis and as a percent of the total number of articles.

Chart 7b continues illustrating the evolving story of the euro area crisis in the period 2010-2013 with events and peaks in the euro area geoeconomic index (LGPT-Geoecon index) and especially the finance sub-index (LGPT-Geoecon:Finance in yellow bars) marking again, as with Greece and Ireland, the run up to and adoption of financial assistance programmes for Portugal, Spain and Cyprus and continuing financial turmoil and severe debt market tensions.

The peaks of geoeconomic/financial tension during this period are followed by falling tensions in the index during the time of agreement on initiatives inter alia for the creation of financial assistance institutions, whether the EFSF in June 2010 or the European Stability Mechanism (ESM) in October 2012. Interestingly, the euro area crisis peaks in 2010-2013 are higher than the GFC peak in 2008. This is what one may expect from a European-based perspective based on European newspaper sources, following the public view held by observers in the EU/EA at the time that the GFC's impact was mostly a US concern.

A prolonged level of relatively low tension, as chartered by the geoeconomic index (LGPT-Geoecon all bars) and its finance sub-component (LGPT-Geoecon:Finance in yellow bars), begins in 2013 and is interrupted by a new peak that is driven by the trade sub-component (LGPT-Geoecon:Trade in brown bars) instead of the finance sub-index and pertains to the annexation of Crimea by Russia in 2014.

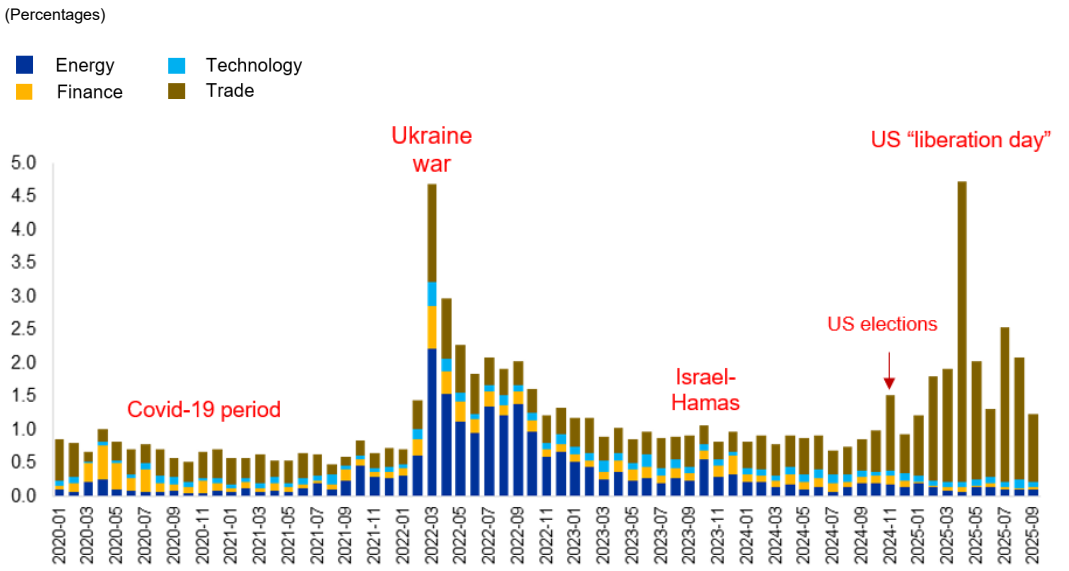
This is followed by further heightened tensions related mainly to the second Greek crisis in 2015 which proves to be, according to the index, much stronger and the result of the

highly adversarial ("Grexit") debates between Brussels and Athens and culminating in another peak in July 2015 with capital controls in Greece and the holding of a referendum.

Thereafter, the geoeconomic index and its finance sub-component evolve at lower levels while the trade sub-component (LGPT-Geoecon:Trade) becomes either equally important or noticeably more prominent than the finance sub-component for the remainder of the decade. Thus, in 2016, trade-related tensions gain in prominence with the Brexit referendum and its aftermath, and then also the escalation of global trade frictions through the US-China trade war of 2018-19 with our index capturing a growing focus on the use of economic tools as instruments of international rivalry.

Chart 7c

Euro area Geoeconomic subindices (monthly), 2020-2025



Source: Authors' calculations

Notes: The different colours of the bars show the four sub-indices of the euro area LGPT-Geoecon index into the categories of Trade (LGPT-Geoecon:Trade – in brown bars), Finance (LGPT-Geoecon:Finance in yellow bars), Energy (LGPT-Geoecon:Energy in dark blue bars) and Technology (LGPT-Geoecon:Technology in light blue bars), on a monthly basis and as a percent of the total number of articles (see Chart 1 for a diagrammatical presentation).

The most recent period of the main geoeconomic tensions index (LGPT-Geoecon), spanning from 2020 to 2025, is shown in Chart 7c. This period is dominated by the onset of the Covid-19 pandemic in Europe in early 2020 and is characterised by a relatively low degree of rivalry irrespective of the potential source of geoeconomic tension covered by the index. Indeed, while the pandemic resulted in large if not huge restrictions especially in trade and the movement of people, which could also have been the result of geoeconomic tensions seen later, the index correctly does not pick these up because these restrictions were not of a geopolitical or geoeconomic nature but were likely following a semi-formal coordination among potential geopolitical rivals, to fight the pandemic also through institutions like the World Health Organisation (WHO). By contrast, the most dramatic of

changes occurs in February-March 2022 with Russia's invasion of Ukraine, which triggers the highest spike in the entire geoeconomic series and is a combination of tensions caused mainly by the trade (sanctions) and energy subcomponents and relating mainly to European energy security, gas and oil supplies and the like, with finance and technology playing a relatively minor role.

After the Ukraine peak in 2022, the index remains elevated, though with a gradual decline, as energy tensions ease in relative terms by 2023. Thus, over 2023 and most of 2024, the overall geoeconomic tensions index remains steadily relatively low albeit higher than the first couple of years of the decade. Moreover, the distribution among sub-categories becomes once again relatively balanced. The relatively low trend is broken by a first small spike in late 2024 during the 2024 US presidential election, and then continues to rise with the arrival of the new administration and continued elaboration and implementation of a relatively highly protectionist agenda, centred around trade restrictions and tariffs in particular, which culminates with another very high peak linked to the so-called "liberation day" in April 2025.

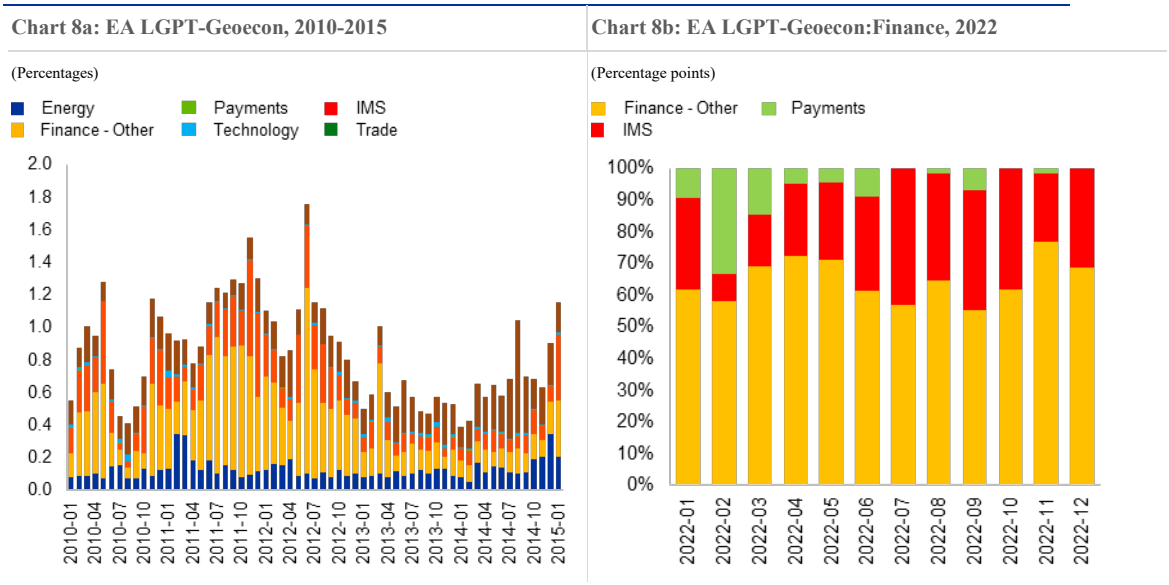
4.4 Further sources of geoeconomic tension: the IMS and payments

We try to stretch the capabilities of the LLM approach by putting further granularity in our prompting, also as a way of a kind of robustness check. We therefore attempt to identify more specifically financial sources of geoeconomic tensions by isolating and comparing further sub-indices of the LGPT-Geoecon:Finance sub-index. Specifically, we seek to identify if during particular periods, two potential sub-topics of interest i.e. "payments" on the one hand and "the International Monetary System (IMS)" on the other, were the more specific source of financial tensions. Under payments, we focus the text-derived index on frictions in cross-border payment infrastructures, settlement systems and international financial transactions. Under the IMS, we seek to identify tensions related to exchange rate regimes, reserve accumulation, monetary and macroeconomic policy cooperation, and disputes over financial governance across borders.

Chart 8a presents a focused time window of the euro area geoeconomic index (LGPT-Geoecon) during the period 2010–2015. The chart decomposes the LGPT-Geoecon:Finance sub-index into two additional sub-indices, notably, one relating to payments, another one to the IMS, and a third one to the remainder of financial sources ("other"). We maintain for comparison purposes the trade and energy sub-indices. The resulting breakdown suggests that during this period of the euro area crisis in 2010-2013, the most prominent subcomponent proves to be the IMS; payments hardly appear.

Chart 8

The euro area LGPT-Geoecon index and its IMS and Payments finance sub-indices (monthly)



Source: Authors' calculations
Notes: The LHS chart shows 3 sub-components of the LGPT-Geoecon:Finance index i.e. payments, IMS and "Finance-Other" from 2010 to 2015. The RHS chart shows the same sub-components over the year 2022 alone.

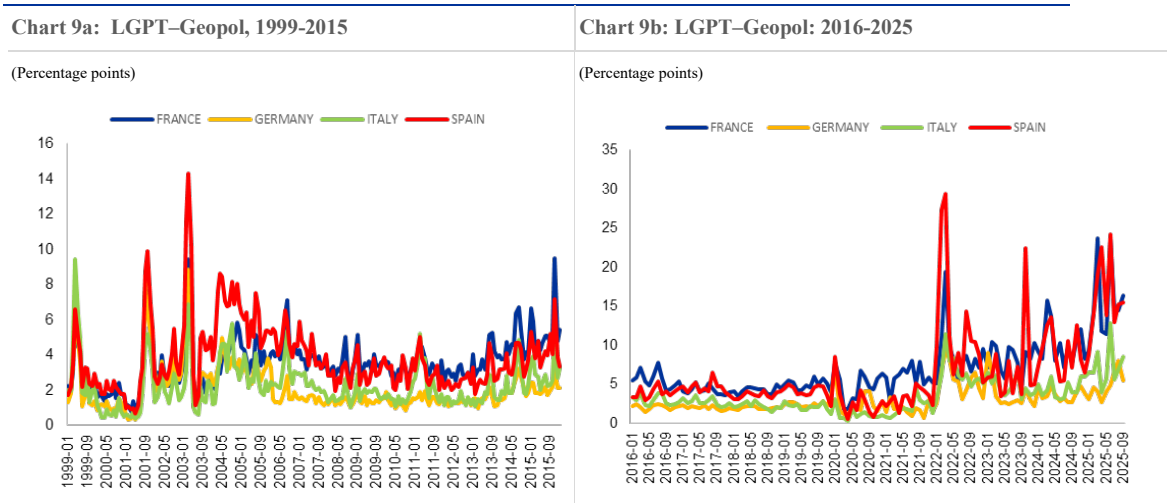
Chart 8b, which also focuses on the finance sub-index during 2022 alone, shows the relative shares of the IMS and Payments sub-categories of the geoeconomic finance sub-index. The February 2022 spike in the subcomponent coincides with the exclusion of Russian banks from the SWIFT network following the invasion of Ukraine.

4.5 LGPT indices for the four largest euro area member states

We have presented so far, the LGPT index and its subindices for the euro area as a whole. As regards the country-level LGPT indices, which may be considered relevant for country-level analysis, we find that they are broadly aligned among France, Germany, Italy and Spain, although there are occasional differences between the four largest euro area member states.

Chart 9

The LGPT-Geopol index for Germany, France, Italy and Spain (monthly)



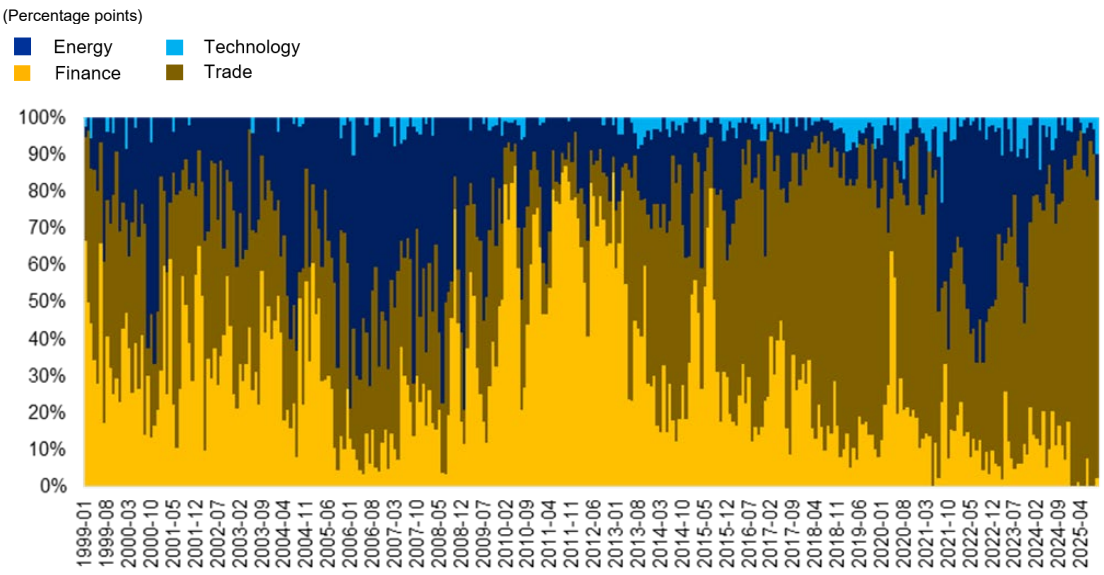
Source: Authors' calculations.
Notes: The national LGPT-Geopol indices are the ratio of purely geopolitical articles (so excluding geoeconomic articles i.e. the LGPT-Geoecon articles) and the total number of articles published in the specific month.

Charts 9a and 9b show the geopolitical index (LGPT-Geopol) for Germany, France, Italy, and Spain over two subperiods (1999–2015 and 2016–2025) using a different scale because the events of the later period produced much more tension. Across both panels, the national indices move (and peak) broadly in sync, reflecting shared exposure of the four EA member states to large geopolitical shocks such as the Kosovo war (1999), the Iraq war (2003) and the Russia-Ukraine war (2022). However, when an event is more specific for one of the four countries, the index reacts most strongly there as one would expect, producing a temporary divergence between the four national series.

This pattern is visible, for instance, during the Madrid terrorist attacks in 2004, where Spain's index (red line) shows a sharp albeit short-lived spike relative to the other three countries. The Charlie Hebdo and Bataclan attacks in Paris in 2015 prompted a visible rise in the French index (blue line) that is not as present in the other national indices. The Kosovo war in 1999 produced a common tension across all four euro-area member states, though the magnitude varied somewhat. The relative magnitude of national indices to international shocks is, according to the literature, the result of factors such as a country's foreign policy involvement or proximity. For example, Italy, whose index rises the most during this event and for the only time throughout the series, was geographically closest to the conflict and was hosting relevant NATO operational bases, shows a relatively higher degree of geopolitical tension (green line).

Chart 10

LGPT–Geoecon for Germany and its sub-components (monthly), 1999-2025



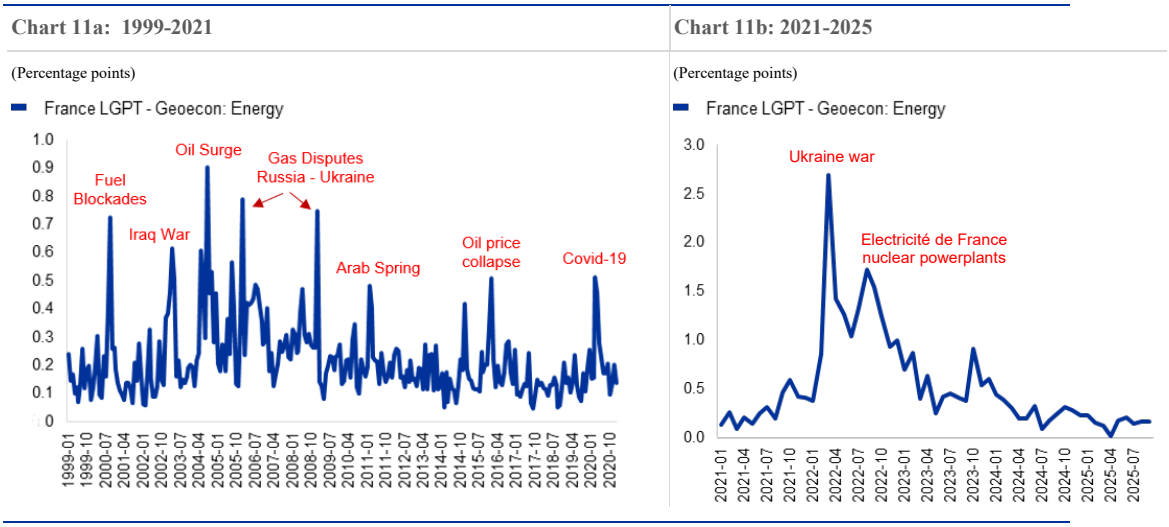
Source: Authors' calculations.
Notes: Monthly composition of the LGPT–Geoecon for Germany relative to the total number of articles classified as geoeconomic from the German press.

Looking at specific aspects in the evolution of the national indices, the breakdown of the LGPT-Geoecon index for Germany in Chart 10 illustrates by way of example how the relative weight of different geoeconomic dimensions has evolved over time. During the euro area economic crisis, the finance component clearly dominates, but as the decade progresses, energy-related tensions gain prominence, peaking around 2022 in connection with the Ukraine war and subsequent gas supply shortages. In the most recent period, trade has become almost the sole visible category, consistent with renewed concerns about multiple types of trade restrictions, industrial policy and global supply-chain disruptions, affecting Germany's export-oriented economy.

Taking a different example, Chart 11 zooms into the LGPT-Geoecon index for France that relates specifically on the energy sub-index (LGPT-Geoecon:Energy). It captures both exogenous shocks such as the oil price surges of the early 2000s and the Russia-Ukraine gas interruptions, as well as domestic developments such as the challenges faced by France's energy sector, exemplified by the Électricité de France (EDF) incidents.

Chart 11

LGPT–Geoecon:Energy sub-index for France (monthly), 1999-2025



Source: Authors' calculations.
Notes: The index is computed as the percentage of monthly articles whose source is identified to relate to tensions in the area of energy, divided by the total number of monthly published articles in French newspapers.

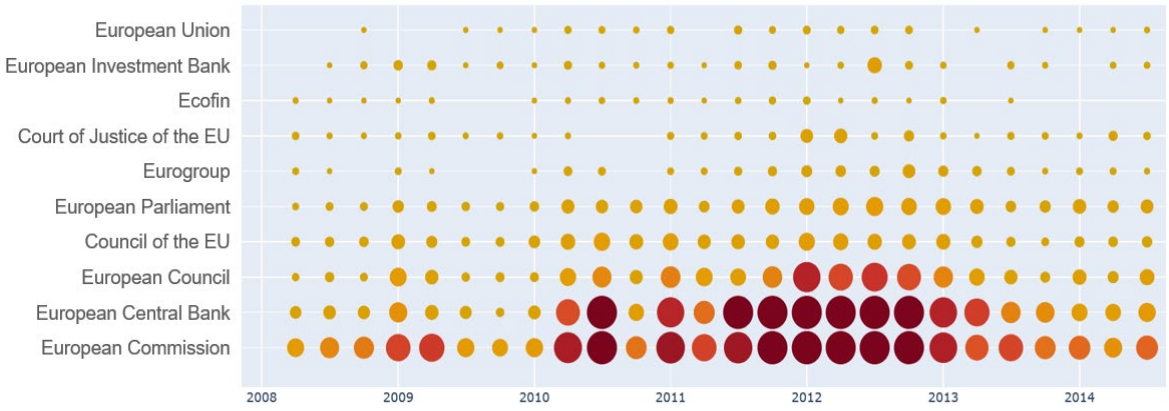
4.6 *The role of international organisations and European institutions*

One of the contributions of the LLM approach is that it can be geared towards providing more precise information about specific trends that the researcher may be interested in. We briefly make use of this ability in this paper to get a snapshot of the role of international organisations and European institutions during episodes of geopolitical and geoeconomic tension. We seek to quantify the degree to which multilateral or supranational bodies are mentioned in playing a role in decision-making, mediation and coordination according to the press narrative.

By way of example, Chart 14 shows how the European institutions drew considerable coverage in the Italian press during the crisis in the euro area in the period 2010-2013. As expected, heightened observability emerges for the Commission and ECB during the peak of the crisis as policy measures and financial assistance were prepared, but also for the European Council which met at much higher frequency than usual to provide political direction. This is combined with notable observability in the press narratives of the IMF (see Chart 15).

Chart 14

Mentions of European institutions in Italian geoeconomic articles (quarterly), 2008-2014

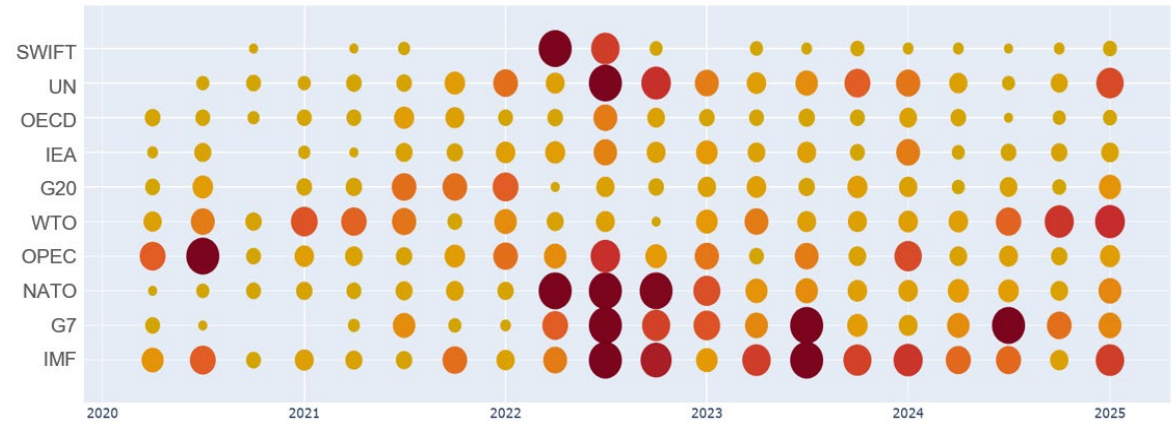


Source: Authors' calculations
Notes: The diameter of the circles is proportional to the number of articles in the Italian newspapers mentioning the institution concerned in that particular quarter.

As for international organisations, looking at the Italian press again by way of example during the period 2020-2025, Chart 15 shows how the role of organisations like the IMF, G7, NATO and the UN rose sharply in 2022 as a result of the invasion of Ukraine and the ensuing policies on e.g. security and financial measures. Notable during that time was also the mentioning of SWIFT which emerges prominently in H1 2022. The trend for the G7 and IMF and the central role they continued to play until 2024 is clearly registered.

Chart 15

Mentions of International Organizations in Italian geoeconomic articles (quarterly), 2020-2024



Source: Authors' calculations
Notes: The diameter of the circles is proportional to the number of articles in the Italian newspapers mentioning the organisation concerned in that particular quarter.

While we do not undertake this exercise here, the LLM approach could be deployed to inquire also whether the increased mention of specific organisations is, for example,

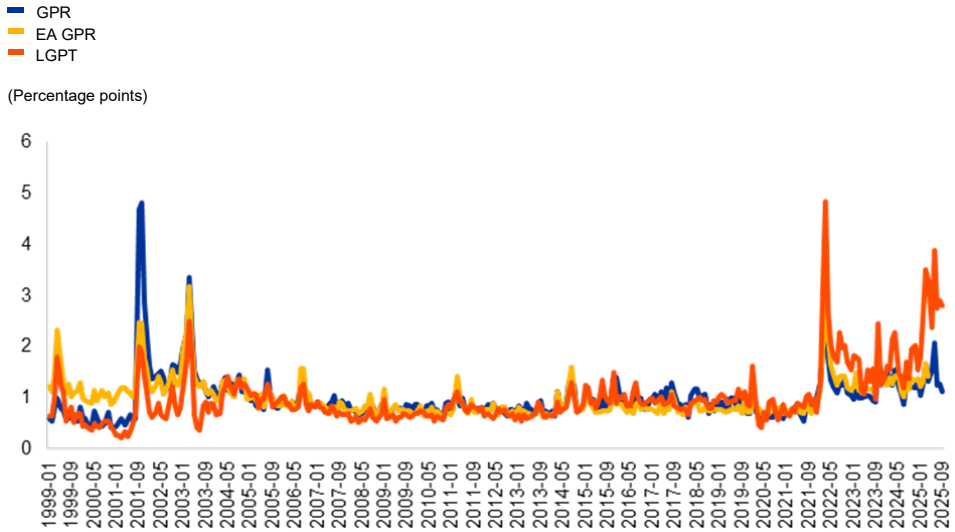
signalling a strengthening or erosion of the role of multilateral institutions in the midst of geopolitical tensions.

4.7 Comparison with other indices

In Chart 16, we compare our overall LGPT index to two measures of geopolitical risk discussed above, the Caldara and Iacoviello (2022) Geopolitical Risk (GPR) Index, and the Geopolitical Risk index for the euro area (EA GPR) by Bondarenko et al. (2024).[12] The comparison shows a broad synchronisation among the three indices with similar peaks.

Chart 16

The GPR (Caldara&Iacoviello 2022), the EA GPR (Bondarenko et al., 2024), and the LGPT index, 1999-2025

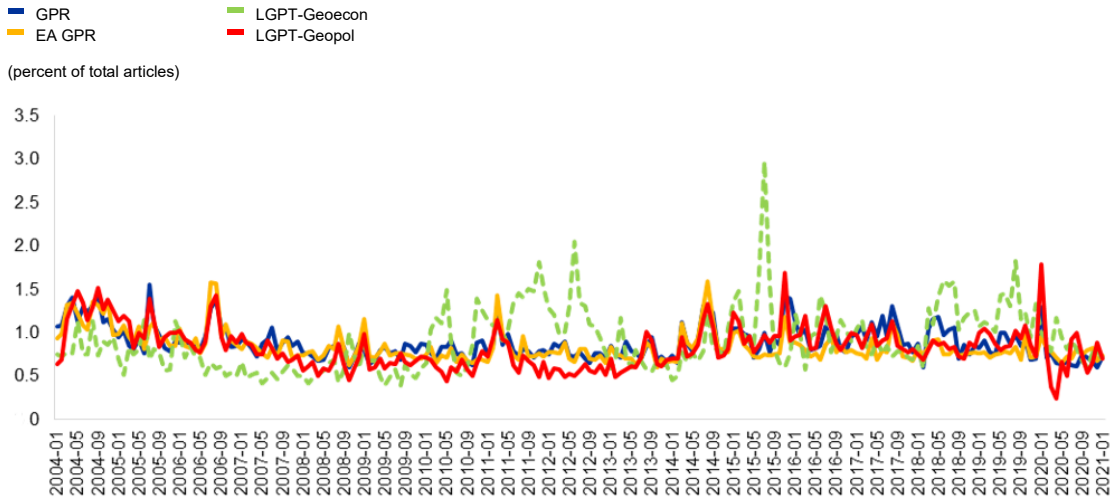


Source: Authors' calculations
Notes: For comparison, the indices have been rescaled through their historical mean value.

Turning to the noteworthy distinction between geopolitics and geoeconomics, we now separate our LGPT index into its two components, the geopolitical index (LGPT-Geopol) and the geoeconomic one (LGPT-Geoecon) in Chart 17. By zooming into the period 2004-2021, we seek to isolate the smaller peaks of this period which are not as visible if one includes the very high peaks of 2022. We thus observe two points: first, the geopolitical series, also of the LGPT, reflect the trends of the two other indices (GPR and EA GPR). However, the LGPT-geoeconomic index (dashed green line) follows a more independent trajectory with some seven peaks that are not picked up by the other indices. This reflects in our view the more nuanced capabilities of the LLM approach in separating geopolitical from geoeconomic events.

[12] To recall, the GPR is constructed through automated text-search methods on a set of international newspapers and measures the frequency of articles discussing actual or potential geopolitical tensions, conflicts, and threats. The EA GPR applies a similar approach but focuses specifically on the European dimension, capturing how global and regional events are perceived through a European lens.

Chart 17
The GPR, the EA GPR, and the euro area LGPT-Geoecon and LGPT-Geopol indices, 2004-2021, (monthly)



Source: Authors' calculations
Notes: For comparison, the indices have been rescaled by the division of their historical mean value over the period 1999-2025. The dashed green line is the LGPT–Geoecon. GPR refers to Caldara and Iacoviello (2022) and EA GPR refers to Bondarenko et al. (2024).

Table 1 reports correlations between the indices. [13] The GPR, the EA GPR, and the LGPT-Geopolitical index are highly correlated while our euro area LGPT-Geoeconomic index shows a notably weaker correlation of roughly 40% with the other two. This confirms that the geoeconomic dimension captures a distinct layer of international risk.

Table 1
Correlations, 1999-2025

EUROPE	GPR	EA GPR	LGPT-Geopol	LGPT-Geoecon
GPR	*1*	*0.77*	*0.60*	*0.37*
EA GPR	*0.77*	*1*	*0.70*	*0.41*
LGPT-Geopol	*0.60*	*0.70*	*1*	*0.60*
LGPT-Geoecon	*0.37*	*0.41*	*0.60*	*1*

Source: Authors' calculations.

Finally, we compare our euro area LGPT-Geoeconomic:Trade sub-index with the Trade Policy Uncertainty (TPU) index of Caldara et al. (2020). The TPU index is a monthly measure of uncertainty around trade policy, constructed from newspaper references to trade

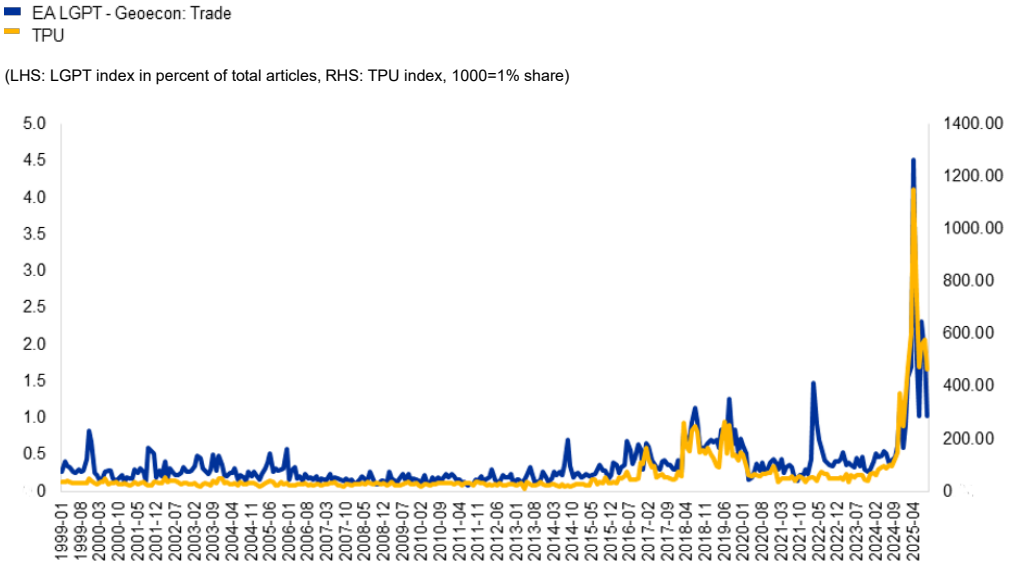
[13] See Appendix VI for the country-level correlation tables.

policy and uncertainty, and is designed to capture periods in which agents are uncertain about future tariffs and trade arrangements.[14]

Our LGPT-Geoecon:Trade index instead captures *geoeconomic tensions in trade from a European perspective, focusing on the use of trade instruments as tools of state power* rather than on uncertainty per se. It covers *episodes involving sanctions, tariffs and trade agreements, embargoes, export and investment controls, targeted taxes or duties on foreign products, non-tariff barriers, and frictions related to critical inputs and commodities*. The correlation between the two measures is at around 90.5 per cent, with many major trade related shocks visible in both indices. Our measure adds nuance on how these tensions are perceived and framed in the European press.

Chart 18

Trade Policy Uncertainty (TPU) and the LGPT-Geoecon:Trade indices, 1999-2025 (monthly)



Source: Authors' calculations
Notes: The LHS axis refers to the euro area LGPT-Geoecon:Trade index and the RHS axis to the TPU index of Caldara et al. (2020) with 1000 = 1% articles share.

5 Bayesian VAR model results

5.1 The model framework

[14] From the official www.matteoiacoviello.com website: The TPU index is based on searches of the archives of seven newspapers: Boston Globe, Chicago Tribune, Guardian, Los Angeles Times, New York Times, Wall Street Journal, and Washington Post. The measure is calculated by counting the monthly frequency of articles discussing trade policy uncertainty (as a share of the total number of news articles) for each newspaper.

To analyse the macroeconomic impact of geoeconomic tensions, we estimate a Bayesian structural vector autoregression (BSVAR) at monthly frequency. The framework emulates the model approaches used in the geopolitical risk index literature, including Caldara and Iacoviello (2022) and Bondarenko et al. (2024), while being tailored to geoeconomic rather than geopolitical tensions.

The mirroring in this paper of previous econometric approaches within this line of literature is intentional. The purpose of our paper as noted in the introduction is the adoption of a novel, two-step, multilingual LLM approach to produce - beyond a broad geopolitical index - a more focused and mutually exclusive geoeconomic index with sub-indices according to source of tension, and doing so in a multi-lingual, euro area setting through LLM prompting. Because of the nature of our dataset and LLM framework, we see this as a sound basis that may be extended according to geography and topic. Therefore, the econometric exercise in this Section, and a further exercise as regards the impact of stronger shocks resulting in non-linear shock propagation to economic variables in Appendix V, may be seen as a type of robustness check of the geoeconomic tensions index and its sub-indices in a largely comparable setting that has been used by others providing indices. This also means that beyond the circumscribed exercise of this paper, there is undoubtedly much potential in further, deeper research comparing the econometric qualities of the LGPT index with that of other indices that is beyond the scope of this paper and its length limitations.

In our VAR framework, we let y_t be a column vector of $nx1$ of endogenous variables:

$$y_t = \begin{pmatrix} GEOECON_t \\ VOLATILITY_t \\ EPU_t \\ STOCKS_t \\ EURIBOR_t \\ BOND10Y_t \\ \mathrm{GDP}_t \\ \mathrm{CPI}_t \end{pmatrix}$$

where GEOECON denotes our euro area geoeconomic tension index (LGPT–Geoecon), capturing relevant time-varying tensions as described in Section 4 above; VOLATILITY is equity-market uncertainty measured by the VSTOXX index, based on options on the Euro Stoxx 50; Economic Policy Uncertainty Index (EPU) is used as an indicator of economic policy uncertainty in Europe as per Baker et al. (2016). STOCKS refers to the Euro Stoxx 50 equity price index and EURIBOR is the three-month Euribor rate, proxying short-term monetary and funding conditions in the euro area. BOND10Y denotes the yield on the ten-year German government bond (Bund), used as the long-term risk-free

benchmark for the euro area; GDP is real euro area output and CPI is HICP euro area inflation. The structural model can be written as:

$$A_0 y_t = c + \sum_{l=1}^{p} A_l y_{t-l} + \varepsilon_t$$

where A_0 captures contemporaneous interactions, A_l are lag coefficient matrices, and ε_t is a vector of orthonormal structural shocks satisfying:

$$E(\varepsilon_t \mid \mathcal{F}_{t-1}) = 0$$
$$E(\varepsilon_t \varepsilon_t') = I_n$$

Identification is achieved through a recursive structure on A_0, imposing a lower-triangular form consistent with a Cholesky decomposition. The geoeconomic tension index is ordered first, implying that innovations to geoeconomic tensions can affect all other variables contemporaneously, while shocks to financial and macroeconomic variables affect geoeconomic tensions only with a lag.[15]

The model is estimated with $p = 10$ lags, permitting for sufficiently flexible dynamics at the monthly frequency. Impulse responses are computed over a 36-month horizon and normalized to a two-standard-deviation shock to the geoeconomic tension index (LGPT-Geoecon), facilitating comparison with existing evidence on geopolitical risk shocks.

5.2 Prior structure and Bayesian inference

Estimation is conducted in a Bayesian setting using a Minnesota-type prior combined with an inverse-Wishart prior for the reduced-form covariance matrix. For the autoregressive coefficients, the prior mean of the first own lag is set to one for all variables except the geoeconomic tension index, for which the prior mean is set to zero. The prior mean for the first lag coefficient matrix satisfies:

$$E(A_1) = diag(m_1, \dots, m_n)$$
$$m_1 = 0$$
$$m_i = 1 \; for \; i \geq 2$$

[15] This identification assumption is common in the literature on news-based risk indicators and reflects the interpretation of geoeconomic tensions as rapidly updating information shocks, driven by policy announcements, international frictions, and strategic uncertainty, rather than by contemporaneous macroeconomic conditions.

This choice reflects the empirical stationarity of the geoeconomic tension index, in contrast to standard macroeconomic aggregates, and mirrors the treatment of geopolitical risk indicators in Caldara and Iacoviello (2022) and Bondarenko et al. (2024), who explicitly depart from a random-walk prior for risk measures.[16]

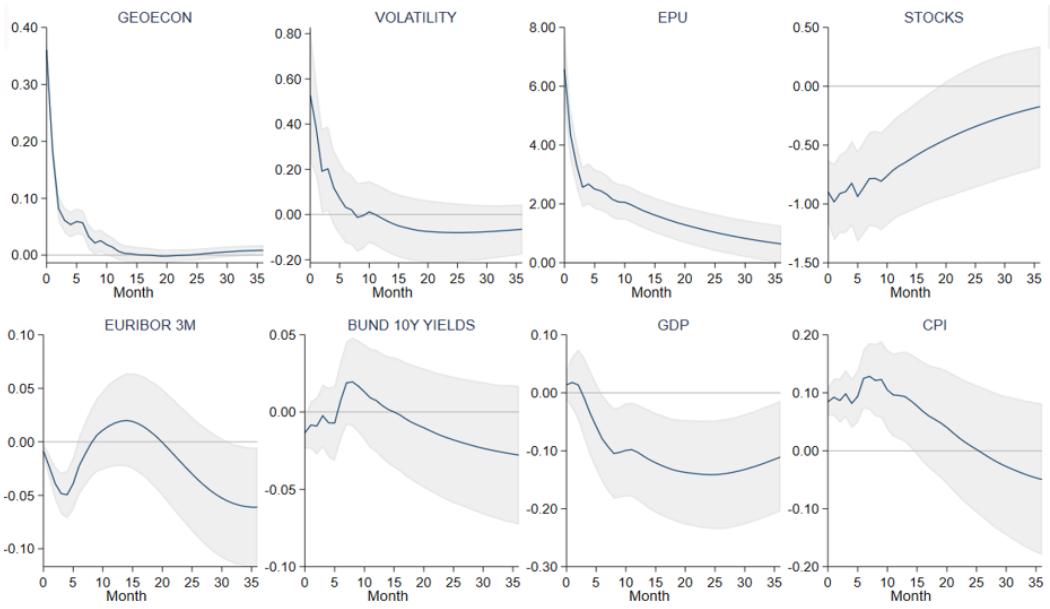
On this basis, we seek to identify possible differences between source-specific geoeconomic-tension indices. We do so by obtaining impulse responses, first, with our euro area geoeconomic tension index, that is, LGPT-Geoecon index, and then using geoeconomic sub-indices whose tension source is trade (LGPT-Geoecon:Energy) and energy (LGPT-Geoecon:Trade).

Graph 19 reports the impulse response functions for a one-standard-deviation shock in our euro area geoeconomic tension index (LGPT-Geoecon). From a macroeconomic perspective, the shock leads to a persistent contraction in real activity, while consumer prices initially rise before declining over the medium term, pointing to a stagflationary pattern in the short run.

Chart 19

Impulse Response Functions (IRFs) for a shock in the euro area LGPT–Geoecon index

(Percentage points)



Source: Authors' calculations

Notes: The IRFs are the result of a 1 s.d. shock. The shaded areas reflect 68% confidence intervals.

The shock decays relatively quickly, consistent with the interpretation of geoeconomic tensions as measured here as fast-moving information shocks. Financial uncertainty is immediate and significant, with both equity-market volatility and economic policy uncertainty rising sharply in the short run. Equity prices decline on impact and recover only

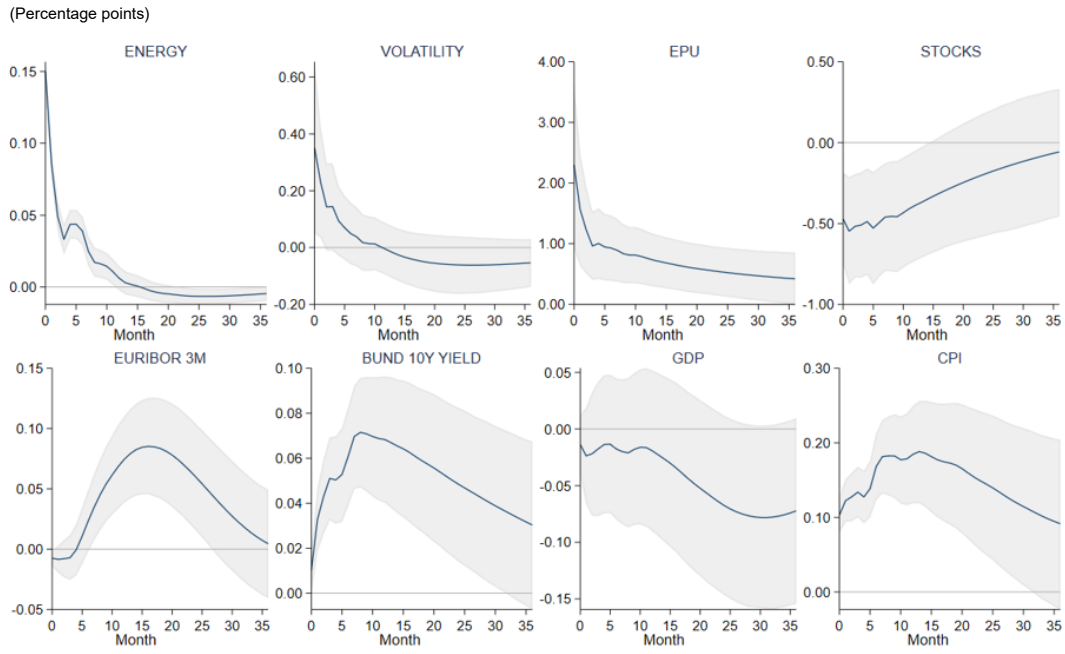
[16] Bayesian estimation is conducted using the first 2,500 iterations as burn-in and retain 10,000 posterior draws for inference.

slowly. The reaction of short and long-term yields may be due to different transmission channels at work. The response of bond yields may depend on the relative importance of the energy-related versus trade-related components of the LGPT–Geoecon index.

We therefore conduct the same exercise using instead our energy (LGPT-Geoecon:Energy) and trade (LGPT-Geoecon:Trade) subindices. The related impulse responses are shown in Charts 20 and 21 respectively. In both cases, the shocks are sharp and transitory. Financial uncertainty is higher in the case of the energy shock while economic uncertainty is in both cases persistent. The impact on equity-markets is strongly negative with the energy shock and less so for the trade shock which reverts quickly to the steady state possibly suggesting that trade-related tensions may be generating less persistent financial stress.

Chart 20

IRFs for a shock in the euro area LGPT–Geoecon:Energy sub-index



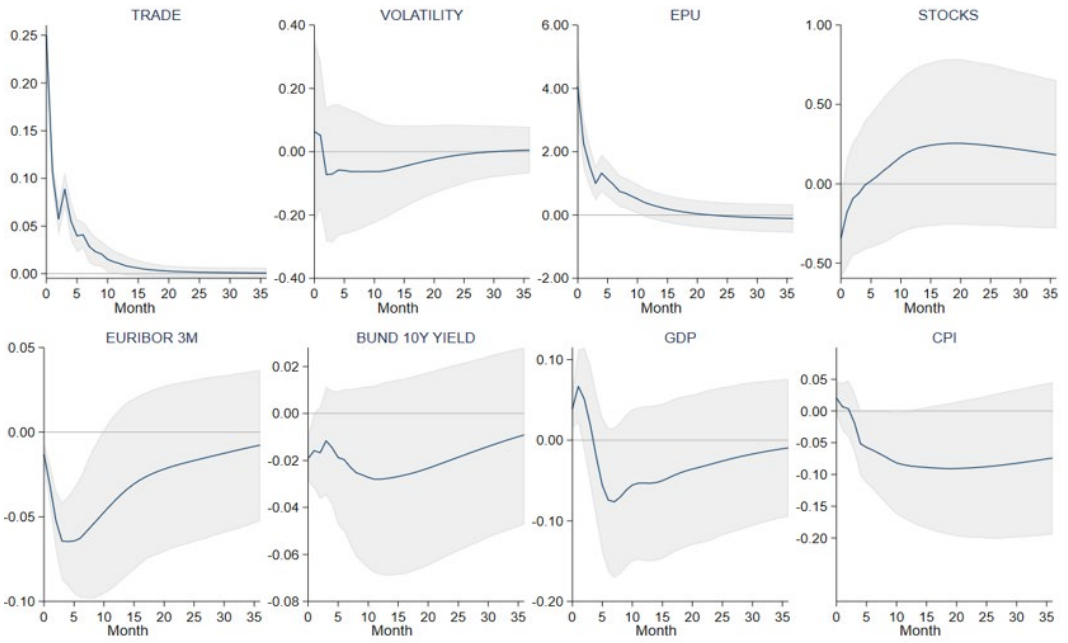
Source: Authors' calculations
Notes: The shaded areas reflect 68% confidence intervals.

The transmission of the energy shock to short-term and long-term interest rates both increase following an energy-related shock, suggesting the involvement of cost-push channels.

Chart 21

IRFs for a shock in the euro area LGPT–Geoecon:Trade sub-index

(Percentage points)



Source: Authors' calculations

Notes: The shaded areas reflect 68% confidence intervals.

By contrast, short and long-term interest rates decline following a trade-related shock, consistent with a demand-driven transmission mechanism. The energy shock causes a rather persistent consumer prices rise while real activity contracts in a sustained manner. The same is true for the trade shock's impact on economic activity but the negative demand channel in this case suggests disinflationary pressures.

In Appendix VI, we undertake an additional exercise to test how the index performs in a setting where the effects of geoeconomic shocks are non-linear. The exercise is based on the framework of Brignone et al. (2024) and tests the properties of the LGPT-Geoecon index, given its low and high peak fluctuations. We find supporting evidence that geoeconomic tensions as portrayed by the LGPT index may become macroeconomically relevant only after they reach sufficiently large magnitudes. Specifically, when comparing Chart 19 with the results of this exercise in Chart 22 of Appendix VI, we see that responses to moderate shocks are broadly aligned with those obtained from the linear BSVAR framework while large shocks generate substantially stronger and more persistent effects.

Overall, the results suggest that energy-related geoeconomic tensions seem to play a significant role in shaping the bond market and inflation responses. Moreover, taken together, the impulse response results seem to confirm the view that while energy shocks primarily operate through inflationary and financial channels, trade-related shocks exert their effects mainly through real activity and disinflationary pressures.

From the perspective of the use of the index, the findings reinforce our hypothesis that disentangling the sources of geoeconomic tensions and providing more granular sub-indices can prove relevant when assessing the macro-financial transmission and impact of geopolitical and geoeconomic shocks.

6 Conclusions

The emergence of explicit rivalry in the international relations of major powers has led to renewed attempts to measure risk, uncertainty, volatility, shocks, tensions and the like related to geopolitics using different definitions, datasets and methodologies. This paper puts together a new, large, newspaper-article dataset as the source for producing a geopolitical tension index and geoeconomic tension subindices. We use Large-Language Models (LLM) to construct the geoeconomic tension subindex and its subindices which identify the source of tension described in the written press. The sources of geoeconomic tension are identified under the headings of trade, energy, finance and technology.

Our approach differs from related research so far on account of the new dataset and in particular because we employ the LLM methodology to prompt and analyse the data. The approach can be scaled up to cover more data for more countries also beyond the euro area. The approach lends itself to identifying nuances in text-based analysis. It is flexible in terms of inputs and outputs and therefore in terms of how one chooses to prompt the data through the LLMs in order to focus on specific geoeconomic themes and issues of interest. The aim of this paper is to create an accurate measure of geoeconomic tensions using a two-LLM framework that can assess text in a consistent manner in four different languages using local newspaper sources. Therefore, the use of a Bayesian VAR framework is employed only in order to make a first, limited attempt to test the performance of the resulting geoeconomic index and its sub-indices and in a similar setting followed by other authors in the related literature. We therefore see the further development and refinement of the LGPT index, and LLM approach more generally, as a promising avenue for further research. Moreover, having only scratched the surface in terms of econometric analysis using the index and comparing it to other indices, we see considerable room for further, detailed research, using also alternative and deeper econometric frameworks.

APPENDIX

I. List of newspapers from which newspaper articles are drawn

German language (3): Die Welt, Suddeutsche Zeitung, Der Tagesspiegel

Spanish language (4): El País – Nacional, El Mundo, La Vanguardia, Expansión

French language (3): Le Figaro, Le Monde, Les Echos

Italian language (4): Corriere della Sera, La Repubblica, La Stampa, Il Sole 24 Ore

II. The BERT classification

To develop a classifier capable of identifying articles reflecting geopolitical tension, we fine-tune EuroBERT (Boizard et al., 2025). The optimization process involves adapting the pre-trained language model to our domain-specific classification task by jointly updating the encoder parameters alongside an added classification head. We apply mean pooling over the final-layer embeddings (each of dimension 768), which are then passed through the classification head to produce a probability distribution over the target labels. Specifically, let the encoder comprise L stacked transformer layers, each characterized by parameters $\boldsymbol{\theta} = \{\theta^{(1)}, \ldots, \theta^{(L)}\}$, indexed from the bottom (layer 1) to the top (layer L). Given a tokenized input sequence $\boldsymbol{x} = (x_1, \ldots, x_n)$ of length n, the encoder produces contextual embeddings $\boldsymbol{H} = (\boldsymbol{h_1}, \ldots, \boldsymbol{h_n})$, where each embedding $\boldsymbol{h_i} \in R^{768}$. We compute a mean-pooled representation:

$$\bar{\boldsymbol{h}} = \frac{1}{n}\sum_{i=1}^{n} \boldsymbol{h_i}$$

This pooled vector is subsequently passed through a classification head comprising a linear transformation, GELU activation, and layer normalization:

$$\boldsymbol{u} = LayerNorm(GELU(\boldsymbol{W_1}\bar{\boldsymbol{h}}))$$

Followed by a final linear layer mapping to class logits:

$$\boldsymbol{z} = \boldsymbol{W_2}\boldsymbol{u} + \boldsymbol{b_2}$$

Where $\boldsymbol{z} \in R^k$ are the logits of k classes. We compute the loss using cross-entropy:

$$L = -\sum_{j=1}^{k} y_j \log\left(softmax(\boldsymbol{z})_j\right)$$

Parameters are optimized via gradient descent, employing a learning rate schedule that incorporates a warm-up phase followed by linear decay to enhance convergence and stability.

To select appropriate learning rates and batch sizes, we conduct a grid search over a range of hyperparameter combinations, evaluation performance on a held-out validation

set. Specifically, we consider learning rates $5\,x\,10^{-6}, 6\,x\,10^{-6}, 1\,x\,10^{-5}, 2\,x\,10^{-5}, 3\,x\,10^{-5}, 5\,x\,10^{-5}\}$ and batch sizes in $\{4, 8, 16, 32, 64, 128, 256\}$ using gradient accumulation to simulate larger effective batch sizes when memory constraints arise. We utilize Microsoft's Azure Machine Learning platform to perform both training and inference on NVIDIA A100 GPUs.

III. The LGPT index prompt in GPT4o

0. ROLE
You are an assistant that classifies newspaper articles for the presence
and nature of geoeconomic and geopolitical tension and returns a single JSON object.
No extra commentary.

---

1. WHEN IS geo = "G" ? // This passage is to pre-screen the article
- Any actual, threatened or potential conflict—armed, diplomatic or economic—between sovereign states or their official actors (government, central bank, state-owned firm, military, parliament, party leadership, regulator, court, intelligence, etc.).
- Includes coercive policies (sanctions, embargoes, tariffs, asset freezes, export controls), military build-ups, alliance shifts, hostile cyber-ops, debt-for-influence deals, energy leverage, retaliatory trade measures, sovereignty disputes and comparable events that may disrupt peaceful international relations.
- If ≥ 1 such element appears, set "geo": "G"; otherwise "N".

---

2. CATEGORIES OF GEOPOLITICAL TENSION (VERBATIM)

2(i) MILITARY / POLITICAL / DIPLOMATIC (GEOPOLITICAL)
a. Worsening or improving political, geopolitical or military relations, incl. foreign-policy or defence-policy cooperation.
b. Bilateral or multilateral context (incl. alliances such as NATO) and relations with third countries or blocs deemed allies or enemies.
c. Arms build-up (army, navy, air force) or mobilisation of personnel.
d. Changes in financing of armed conflict or war.
e. Changes in military-industrial production, technology or employment.
f. Events causing migration or immigration.

2(ii) ECONOMIC / GEOECONOMIC (state power via the economy)
ECONOMIC or geoeconomic risks or events that affect economic interactions in terms of:
1. The International Monetary System (IMS) including foreign exchange arrangements including foreign exchange interventions and currency arrangements (e.g. currency pegs), foreign exchange policies, official foreign reserves, monetary policies, economic policies
2. Financial flows, including capital flows, the financial account, balance of payments (BoP), foreign direct investment (FDI), foreign investments, financial regulation policies.
3. Financial Market Infrastructures and payment systems (e.g. SWIFT, clearing platforms)
4. Trade in goods or services, trade flows, or trade policies and trade policy regulation, trade relations more generally through the use of geoeconomic policy tools such as
   a. sanctions,
   b. tariffs or trade agreements
   c. embargoes or blockages
   d. domestic taxes or duties, also against foreign products
   e. export controls or investment controls
   f. sabotage, espionage and cyberattacks

g. foreign aid
h. currency dominance and financial hegemony
i. non-tariff barriers (NTBs) to trade in goods or services of any kind including domestic policies that penalise foreign economic activity in the domestic economy

5. Energy supplies, sources and resources, energy provisions and energy policies.
6. Critical raw materials and critical inputs.
7. Technologies (e.g. military technologies, artificial intelligence).

---

3. COUNTRY & EU DIMENSION
- List states in ISO-3166-1 alpha-2.
- Flag if the article involves specifically EU and/or the euro area (EA).
- EU institutions only if explicitly named:
  European Commission, European Council, Council of the EU, EP, ECJ, ECB, CoR, EESC.

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4. EU INSTITUTIONS CHECKLIST

European Commission - European Council - Council of the EU (Council of Ministers) - European Parliament (EP) - Court of Justice of the EU / ECJ - European Central Bank (ECB) - European Committee of the Regions - European Economic and Social Committee (EESC)
(Also accept historic names such as "European Economic Community ", "Commission of the European Communities ", etc.)

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5. INTERNATIONAL ORGANISATIONS
Record only if explicitly named. Accepted tags: UN, UNSC, IMF, World Bank, WTO, OECD, NATO, G7, G8, G20, BRICS, SCO, OIC, AU, ASEAN, OPEC, IEA, AIIB, EIB, BIS, etc.

---

6. OUTPUT SCHEMA (fixed order)

```
{{
 "geo": "G",
 "tension_type": "GEOPOLITICAL",
 "geoecon_category": null,
 "countries_named": ["US", "CN"],
 "countries_pivotal": ["US"],
 "countries_not_pivotal": ["CN"],
 "country_involvement_type": {{
  "US": "geopolitical",
  "CN": "unclear"
 }},
 "EU_involved": "no",
 "EU_institutions_involved": [],
 "EA_involved": "no" ,
 "International_organizations_involved": []
 }}
```

7.1 Is the article about geopolitical tensions?
If yes : "geo": "G" If no : "geo": "N"

7.2 Type of tension
If Section 2(i) applies then "tension_type": "GEOPOLITICAL"
If Section 2(ii) applies then "tension_type": "GEOECONOMIC"
If GEOECONOMIC, also state the **single best** sub-category in "geoecon_category" using exactly one of:
"IMS" | "Finance" | "Payments" | "Trade" | "Energy" | "Critical inputs" | "Technology"

7.3 Country analysis

(i) List **all** implicated countries.
(ii) Among those, state:
1. "countries_named" (all countries named in the text)
2. "countries_not_pivotal" (named but not pivotal)
3. "countries_pivotal" (central to the story)

(note that "EU" is not a country, do not include it)

7.4 EU dimension
"EU_involved" "yes" | "no" (if at least a country of EU is involved)
"EU_institutions_involved" [list any from Section 4]
"EA_involved" "yes" | "no" (if at least a country of Euro area is involved)
(note: EU is not a country)

7.5 International organizations
"International organizations" [list any from Section 5]
RETURN ONLY VALID JSON
BEGIN ARTICLE:
{article_content}

END ARTICLE:

IV. Table of representative newspaper article excerpts

Label	Article excerpt
Geopolitical	Zelenski urge a sus aliados europeos a acelerar la ayuda militar durante la Conferencia de Seguridad de Múnich. El presidente ucranio advierte de que "cada día importa" frente a Rusia y reclama más apoyo para garantizar la seguridad de Ucrania y de Europa, en un contexto de presión sobre la defensa aérea y el suministro de armamento. (El País, 14/02/2026)
Geoeconomic	Deutschland und Griechenland streiten weiter über den Kurs in der Eurokrise, nachdem Athen auf Schuldenerleichterungen drängt und Berlin weitere Reformen fordert. Während die Bundesregierung einen echten Schuldenschnitt ablehnt, warnt der IWF, dass Griechenlands Schulden ohne Entlastung kaum tragfähig bleiben. (Die Zeit, 21/08/2015)
Non-geoeconomic or geopolitical	Une banqueroute de Lehman Brothers serait la plus importante de l'histoire financière américaine. Placée sous contrôle judiciaire, sa liquidation posera d'innombrables problèmes. La banque disposait, fin mai, de 640 milliards de dollars d'actifs. (Le Monde, 15/09/2008)
Geoeconomic-energy	L'Italia ha firmato ad Algeri un accordo sul gas con l'Algeria per aumentare le forniture attraverso Eni e Sonatrach. Draghi ha dichiarato che il governo vuole ridurre rapidamente la dipendenza dal gas russo dopo l'invasione dell'Ucraina. (La Repubblica, 11/04/2022)
Geoeconomic-trade	Donald Trump menace d'imposer des droits de douane de 50 % sur les produits européens. Les Vingt-Sept n'ont pas encore déclenché de représailles, alors qu'une nouvelle phase de confrontation commerciale s'ouvre entre Washington et l'Union européenne. (Le Monde, 23/05/2025)
Geoeconomic-finance	Grecia se sumerge en el caos financiero y ordena un "corralito" bancario. El Gobierno limita las retiradas de efectivo a 60 euros diarios, mientras Atenas negocia bajo presión con sus acreedores europeos y el FMI. (El Pais, 29/06/2015)
Geoeconomic-technology	Jensen Huang kritisiert die US-Exportkontrollen für hochentwickelte KI-Chips nach China und warnt vor Milliardenverlusten. Im Zentrum steht der Konflikt um Halbleiter, künstliche Intelligenz und technologische Abhängigkeiten zwischen den USA und China. (Handelsblatt, 22/05/2025)

V. VARX Framework with Non-linear Geoeconomic Shocks

We assess the qualities of the LGPT Geoeconomic tensions index in line with the findings of Brignone et al. (2024), by testing whether relatively minor geoeconomic shocks may have relatively inconsequential outcomes when compared to large-scale shocks that

generate substantial and widespread economic disruptions through non-linear effects. We follow their two-step procedure. In the first step, a reduced-form VAR, mirroring our baseline BSVAR specification in Chapter 6, is estimated including the geoeconomic tension index G_t , ordered first in the system:

$$y_t = A(L)y_{t-1} + u_t$$

where $y_t = \begin{pmatrix} G_t \\ z_t' \end{pmatrix}$ and z_t denotes the vector of macroeconomic and financial variables.

In the second step, the dynamic effects of geoeconomic shocks are analysed using a VARX specification in which the identified shock u_t^g (the first element of the reduced-form residual vector u_t) enters as an exogenous driver. This specification explicitly allows for nonlinear effects through the inclusion of a quadratic term:

$$z_t = \sum_{j=1}^{P} A_j z_{t-j} + \sum_{k=0}^{P} B_k u_{t-k}^g + \sum_{k=0}^{P} C_k \left(u_{t-k}^g\right)^2 + \varepsilon_t$$

Notably, the inclusion of the quadratic term implies that the marginal effect of a shock is state-dependent. The total contemporaneous impact of a shock of size *s* can be expressed as:

$$\text{Effect(s)} = B_0 \cdot s + C_0 \cdot s^2$$

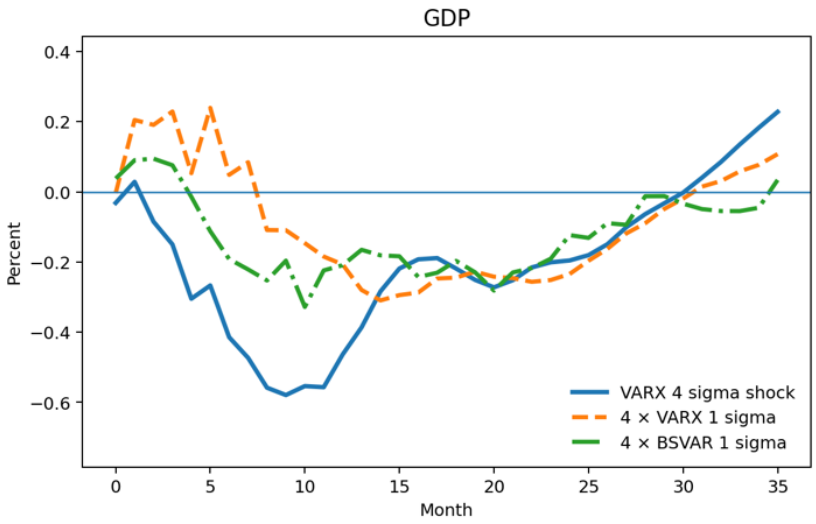
such that larger shocks may generate disproportionately stronger effects relative to smaller shocks.

We compare responses to a baseline 1σ shock and a large 4σ shock. Chart 22 reports the GDP response to the 4σ shock alongside four times the 1σ VARX response and four times the median BSVAR response. Under linearity, these three lines would coincide; any wedge between the 4σ response and the scaled 1σ/BSVAR responses isolates the non-linear effect. The 4σ response troughs near −0.6% at around 12 months, about twice as deep as the scaled linear benchmarks, suggesting that large geoeconomic shocks propagate disproportionately through the economy, particularly at shorter horizons.

Chart 22

VARX IRFs for euro area output using the LGPT–Geoecon tensions index

(Percentage points)



Source: Authors' calculations

Notes: The residuals in the impacts with respect to the VARX 4σ represent the non-linear term contribution.

VI. Index correlations

Country Pearson Correlations, 1999 - 2025

FRANCE	GPR	GPR EUROPE: BUBA	EA LGPT - GEOPOL	EA LGPT - GEOECON
GPR	*1*	*0.40*	*0.52*	*0.30*
GPR EUROPE: BUBA	*0.40*	*1*	*0.03*	*-0.04*
EA LGPT - GEOPOL	*0.52*	*0.03*	*1*	*0.60*
EA LGPT - GEOECON	*0.30*	*-0.04*	*0.60*	*1*

GERMANY	GPR	GPR EUROPE: BUBA	EA LGPT - GEOPOL	EA LGPT - GEOECON
GPR	*1*	*0.72*	*0.76*	*0.65*
GPR EUROPE: BUBA	*0.72*	*1*	*0.66*	*0.55*
EA LGPT - GEOPOL	*0.76*	*0.66*	*1*	*0.62*
EA LGPT - GEOECON	*0.65*	*0.55*	*0.62*	*1*

ITALY	GPR	GPR EUROPE: BUBA	EA LGPT - GEOPOL	EA LGPT - GEOECON
GPR	*1*	*0.55*	*0.64*	*0.41*
GPR EUROPE: BUBA	*0.55*	*1*	*0.37*	*0.12*
EA LGPT - GEOPOL	*0.64*	*0.37*	*1*	*0.38*
EA LGPT - GEOECON	*0.41*	*0.12*	*0.38*	*1*

SPAIN	GPR	GPR EUROPE: BUBA	EA LGPT - GEOPOL	EA LGPT - GEOECON
GPR	*1*	*0.47*	*0.37*	*0.21*
GPR EUROPE: BUBA	*0.47*	*1*	*0.29*	*0.29*
EA LGPT - GEOPOL	*0.37*	*0.29*	*1*	*0.61*
EA LGPT - GEOECON	*0.21*	*0.29*	*0.61*	*1*

Source: Authors' calculations

References

Aarab, I., Bańbura, M., Bobeica, E., Leguay, E. (2025). Monitoring attention to inflation in the news. European Central Bank, Economic Bulletin, Issue 6/2025

Aiyar S. et al. (2023), Geoeconomic Fragmentation and the Future of Multilateralism, IMF Staff Discussion Notes 2023/001, January.

Alhindi, T., S. Muresan, D. Preotiuc-Pietro (2020), Fact vs. Opinion: The role of argumentation features in news classification. *Proceedings of the 28th International Conference on Computational Linguistics (COLING 2020)*, 6139–6149.

Alonso-Alvarez I., M. Diakonova, J. J. Pérez, (2025), Rethinking GPR: The sources of geopolitical risk, Documentos de Trabajo No. 2522, May, Banco de España.

Andres-Escayola E., C. Ghirelli, L. Molina, J.J. Pérez, E. Vidal (2022), Using newspapers for textual indicators: which and how many? Documentos de Trabajo No. 2235, October, Banco de España.

Attinasi M.G., M. Mancini, et al. (2024), Navigating a fragmenting global trading system: insights for central banks, ECB IRC Workstream on Trade Fragmentation, ECB Occasional Paper Series No 365, December.

Audrino F., J. Gentner, S. Stalder (2024), Quantifying uncertainty: a new era of measurement through large language models, SNB Working Paper Series. Issue 2024-12, October.

Baker S. R., N. Bloom, S. J. Davis (2016), "Measuring Economic Policy Uncertainty." Quarterly Journal of Economics 131 (4): 1593–1636.

Bekaert, G., M. Hoerova, M. Lo Duca (2014), Risk, Uncertainty and Monetary Policy. Journal of Monetary Economics, 68, 1-15.

Bernstein M., J. Meyer, K. O'Rourke, M. Schularick (2025), Economic Insecurity: Trade Dependencies and Their Weaponization in History, Kiel Working Papers, 2295.

Bijsterbosch M., M. Falagiarda, L. Žídeková (forthcoming), From Headlines to Hard Data: Mapping the Uneven Impact of Geopolitical Risk in Europe.

Blackwill, R. D., J. M. Harris (2016). War by Other Means: Geoeconomics and Statecraft. Harvard University Press.

Bloom N., S. Davis, S. Baker (2015), Migration fear index.

Bommasani R. et al. (2021). On the opportunities and risks of foundation models. arXiv preprint arXiv:2108.07258.

Bondarenko Y., V. Lewis, M. Rottner, Y. Schüler (2024), Geopolitical risk perceptions, Discussion paper 37/2024, Bundesbank.

Bremmer, I., P. Keat (2009), The Fat Tail: The Power of Political Knowledge for Strategic Investing. Oxford University Press.

Brignone D., L. Gambetti, M. Ricci (2024), "Geopolitical risk shocks: When the size matters, January.

Brown T. et al. (2020). Language models are few-shot learners. In Advances in Neural Information Processing Systems *(NeurIPS 2020)* (Vol. 33, pp. 1877–1901). Curran Associates, Inc.

Caldara D., M. Iacoviello, P. Molligo, A. Prestipino, A. Raffo (2020), The economic effects of trade policy uncertainty, Journal of Monetary Economics, Volume 109, January

Caldara D., M. Iacoviello (2022), "Measuring Geopolitical Risk," American Economic Review, April, 112(4), pp.1194-1225.

Caldara D., S. Conlisk, M. Iacoviello, M. Penn (2026), "Do Geopolitical Risks Raise or Lower Inflation?", Journal of International Economics, Volume 159, January.

Chen Y. (2024), A study on news headline classification based on BERT modelling. In Y. Wang (Ed.), Proceedings of the 2024 2nd International Conference on Image, Algorithms and Artificial Intelligence (ICIAAI 2024) (pp. 346–355). Atlantis Press.

Chong E. and Sui-Jade Ho (2022), Measuring text-based sentiments from monetary policy statements – a Malaysian case study using natural language processing, BIS

Cisneros M. A., F. Caselli (2017), Geopolitical Risk and the Oil Market: A New Perspective. Energy Economics, 63, 342-350.

Clayton C., A. Coppola, M. Maggiori, J. Schreger (2025a), Geoeconomic Pressure, June, downloaded from https://globalcapitalallocation.s3.us-east-2.amazonaws.com/CCMS_AI_Draft.pdf.

Clayton C., M. Maggiori, J. Schreger (2025b), The Political Economy of Geoeconomic Power, AEA Papers and Proceedings, 115: 588-592.

Clayton C., M. Maggiori, J. Schreger (2024), "A Theory of Economic Coercion and Fragmentation." NBER Working Paper 33309.

Clayton C., M. Maggiori, J. Schreger (2023), "A Framework for Geoeconomics." NBER Working Paper 31852.

Dang, T.H.-N., C.P. Nguyen, G.S. Lee, B.Q. Nguyen, T.T. Le (2023), Measuring the energy-related uncertainty index, Energy Economics, Volume 124, 106817 (August).

ECB/ESRB (2026), Report on Financial Stability Risks from Geoeconomic Fragmentation, ECB/ESRB workstream on financial stability risks from geoeconomic fragmentation, 22 January.

Escouflaire, L., Descampe, A., Fairon, C. (2024), Automated text classification of opinion vs. news French press articles: A comparison of transformer and feature based approaches. *Language & Communication, 99*, 129–140. https://doi.org/10.1016/j.langcom.2024.09.004

Farrell H., A. Newman (2025), The Weaponized World Economy: Surviving the New Age of Economic Coercion, Foreign Affairs, 19 August.

https://doi.org/10.1162/ISEC_a_00351

Fernández-Villaverde J., T. Mineyama, D. Song (2024), Are we fragmented yet? Measuring geopolitical fragmentation and its causal effect, NBER Working Paper Series 32638.

Fishman E. (2025), Chokepoints: American power in the age of economic warfare, Penguin Random House.

Forni M., L. Gambetti, L. Sala (2022), Nonlinear impulse response analysis in structural VAR models.

Friedman M. (1962), Capitalism and Freedom, University of Chicago Press.

Gartzke E. (2007). The Capitalist Peace. American Journal of Political Science, 51(1), 166-191.

Gerstle G. (2022), The Rise and Fall of the Neoliberal Order, OUP.

Gopinath G., P-O. Gourinchas A.F. Presbitero, P. Topalova (2025), Changing Global Linkages: A New Cold War?, Journal of International Economics, December.

Hayek F. (1944), The Road to Serfdom, Routledge, England.

Iacoviello M. (2025), Geopolitical Risk (GPR) Index webpage.

Ioannou D., R. Prioriello, A. Durrani (2026), Dashboard of the Large-language-model Geoeconomic and Geopolitical Tension (LGPT) index webpage.

Ioannou D., J.J. Pérez, et al. (2023), The EU's Open Strategic Autonomy from a central banking perspective, ECB IRC Workstream on Open Strategic Autonomy, ECB Occasional Paper Series No 311, March.

Keohane R.O., J.S. Nye (1987), Power and Interdependence revisited, *International Organization*, Volume 41(4): 725-753, doi:10.1017/S0020818300027661.

Keynes J.M. (1936), The General Theory of Employment, Interest and Money.

Khosa S. N., A. Mehmood, M. Rizwan (2023), Unifying sentence transformer embedding and softmax voting ensemble for accurate news category prediction. *Computers, 12*(7), 137.

Manias G., A. Reshef (2020), Integrating Quantitative Indices and Expert Surveys for Geopolitical Risk Assessment. Journal of Risk Analysis, 40(3), 456-472.

Miranda-Agrippino S. (2024), Comment on: Do Geopolitical Risks Raise or Lower Inflation? by D. Caldara, S. Conlisk, M. Iacoviello & M. Penn, at the Global Research Forum on International Macroeconomics and Finance 2024, European Central Bank, 12-13 November 2024.

Mohr C. and C. Trebesch (2024), Geoeconomics, CESifo Working Paper Series No. 11564, December.

Obstfeld M. (2024), Economic multilateralism 80 years after Bretton Woods, Oxford Review of Economic Policy, Oxford University Press and Oxford Review of Economic Policy Limited, vol. 40(2), pages 307-328.

Oetzel J. and K. Getz (2012), Why and How Might Firms Respond Strategically to Violent Conflict? Journal of International Business Studies, 43(2), 166-186.

OpenAI. (2024), GPT-4o system card. OpenAI.

Panetta F. (2024), The future of Europe's economy amid geopolitical risks and global fragmentation, Lectio Magistralis, 23 April.

Panetta F. (2023), United we stand: European integration as a response to global fragmentation, Speech, 24 April.

Posen A. S. (2025), The New Economic Geography; Who Profits in a Post-American World?, Foreign Affairs, 19 August.

Roubini N., B. Rosa (2008). Geopolitical Risk and the Financial Markets. Global Economy Journal, 8(3), 1-20.

Roumeliotis K. I., N. D. Tselikas, D. K. Nasiopoulos (2025), Fake news detection and classification: A comparative study of convolutional neural networks, large language models, and natural language processing models. *Future Internet, 17*(1), 28.

Saiz A., U. Simonsohn (2013), “Proxying for Unobservable Variables with Internet Document-Frequency.” Journal of the European Economic Association 11 (1): 137–65.

Shah P., H. Patel, P. Swaminarayan (2025), Multitask sentiment analysis and topic classification using BERT, *EAI Endorsed Transactions on Scalable Information Systems, 12*(1), e5287.

Sun X., X. Li, J. Li, F. Wu, S. Guo, T. Zhang, G. Wang (2023), Text classification via large language models. *Findings of the Association for Computational Linguistics:EMNLP*, 603, 3919–3933.

Touvron H. et. al. (2023), LLaMA: Open and Efficient Foundation Language Models. arXiv preprint arXiv:2302.13971.

Uppsala Conflict Data Program, Number of international conflicts.

Williamson J. (2004), "The Washington Consensus as Policy Prescription for Development," lecture delivered at the World Bank on 13 January.

Wolfers A. (1962), Discord and Collaboration: Essays on International Politics, Johns Hopkins University Press.

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