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Macroeconomic Consequences of the War in Ukraine on Central and Eastern European Economies: A SVAR Analysis

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Abstract
This paper investigates the short-term macroeconomic effects of the Russian invasion of Ukraine in February 2022 on the economies of Bulgaria, Czechia, Hungary, Poland and Romania and compares these effects observed in these countries with those recorded in Germany, France and Italy. The analysis relies on the estimation of Bayesian SVARs for each economy with the war shock identified using the Geopolitical Risk Index developed by Caldara and Iacoviello (2022)[8]. Simulations show that, by the end of 2022, the war contributed to a rise in inflation by 0.3-0.8 percentage points and a lower GDP by approximately 0.3 percent compared to the counterfactual "no-war" scenario. Our findings suggest a similar impact on economic activity and a larger impact on inflation in CEE countries compared to Western European economies. For core inflation, the results indicate a smaller impact than for headline inflation, but one that proves more persistent.
JEL Classification: F30, F50, G10, G14
Keywords: Ukraine war, Central and Eastern Europe, Structural vector autoregression, Geopolitical Risk, Macroeconomics.

DISCLAIMER

The views expressed in this paper represent the views of the authors and not of the institutions to which they are affiliated. Authors declare no conflict of interest with respect to the opinions expressed in this paper.

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1 Introduction

In a short span of time, Russia's invasion of Ukraine in February 2022 escalated into a high-intensity, land-based war with huge human and material losses on both Ukraine and Russia (Liadze et al., 2023[20],World Bank, 2024)[27], Tong, 2024[26]). Although the international community has made significant efforts to broker a lasting peace, more than three years later both the duration and eventual outcome of the war remain unclear.

The war has also disrupted European economies, which were closely connected to both Russia and Ukraine, and triggered severe supply chain bottlenecks once hostilities began. Sanctions imposed on Russia, along with its countermeasures, have led to a significant drop in trade between the two regions. Motivated by a combination of international sanctions and ethical considerations, many European firms have withdrawn from the Russian market.

For Central and Eastern European (CEE) countries and the Baltic states, geographic proximity to the frontlines has amplified the conflict's significance across various dimensions. These countries reacted promptly to the humanitarian and military challenges brought about by the conflict: they took in large numbers of Ukrainian refugees, supplied arms and ammunition from their own stockpiles, and coordinated logistical and military assistance within the NATO framework. Furthermore, the frontline states intensified their efforts to bolster military capabilities. According to the SIPRI database, military expenditures in CEE increased dramatically - by an average of 45 percent in 2022, followed by a further 30 percent in 2023, and an additional 25 percent in 2024, all in constant dollars.

This paper uses a Bayesian SVAR to examine the short-term macroeconomic effects of the war in Ukraine on several CEE countries, focusing on growth, inflation, and the role of energy prices in shock transmission. More specifically, it examines Bulgaria, Czechia, Hungary, Poland, and Romania, which had a combined population of 82.65 million in 2023 - accounting for 82.6 percent of the total population across CEE countries and the Baltic states.

All these countries experienced common challenges, including an influx of refugees, disruptions to supply chain, surging energy prices and deteriorating investor sentiment. The degree of exposure to war varies across countries. Hungary, Poland and Romania share a common border with Ukraine, while Romania and Bulgaria, as Black Sea states, serve as key transit points for Ukrainian maritime exports of corn, wheat and sunflower oil. By March 2025, Poland, Czechia and Romania hosted the highest numbers of Ukrainian refugees, both in absolute terms and relative to their populations[1]. All these countries are members of both NATO and the EU, but none have adopted euro as their currency[2].

Since joining the EU, CEE countries have made significant progress in narrowing the GDP-per-capita gap with Western Europe. Thus, Poland and Romania achieved GDP per capita levels at "purchasing power standards" of 79 percent of the EU average in 2024[3]. However, the Covid-19 pandemic in 2020 left deep economic scars, including large deficits, higher public debts, and sluggish productivity.

The war in Ukraine brought a new wave of challenges for these countries, with soaring energy prices raising production costs for firms while simultaneously eroding household purchasing power. These dynamics negatively affected the competitiveness of businesses and curtailed consumer spending. As Western EU countries – CEE's main trading partners –

[1]Eurostat, "Temporary protection for persons fleeing Ukraine".Online. Out of the CEE, the largest number of refugees from Ukraine are recorded in Germany, Spain and Italy.

[2]However, Bulgaria, where a currency board was set up more than two decades ago, operated under a fixed exchange rate regime.

[3]See Eurostat, "Statistics explained: GDP per capita". Online and Appendix 1.

faced their own economic disruptions, export prospects for the region declined. In response, governments implemented support measures for households and businesses, further straining public finances, while central banks tightened monetary policy to address the surge in inflation. This combination of fiscal and monetary measures highlighted the significant economic pressures faced by the CEE region amid overlapping crises.

To disentangle the impact of the war from other concurrent economic developments, we employ a standard Structural Vector Autoregression (SVAR) model. Widely used for analysing the macroeconomic dynamics of unexpected shocks (Ramey, 2016[24]; Kilian and Lütkepohl, 2017[18])), the SVAR model incorporates time series data to capture exogenous geopolitical shocks affecting those countries. A central variable in our analysis is the Geopolitical Risk (GPR) index, developed by Caldara and Iacoviello (2022)[8]), which tracks geopolitical tensions based on the proportion of English-language news articles in prominent newspapers reporting adverse events such as "wars, terrorist attacks, and any tensions among states and political actors that affect the course of international relations". Updated GPR indices are available at global, regional, and national levels, including for Poland, Hungary, Russia, and Ukraine, allowing us to focus on the specific context of the CEE region.

Our analysis builds upon and expands the study by Bruhin et al., (2023)[7], which employed the GPR index in a SVAR framework to examine the effects of geopolitical shocks on the economies of "large" Western European countries (Germany, France, Italy, and the UK) as well as Switzerland. Using time series data in the interval 1973Q1 - 2022Q4 – including several major conflicts such as the Gulf war, the Iraq war and the Ukraine War – Bruhin et al., (2023)[7] find that the Ukraine war has a significant negative impact on GDP and a positive, less persistent, but immediate effect on inflation. For instance, Germany's GDP was found to be 3.2 percent lower two years after the shock, while CPI inflation rose by 2 percentage points on impact before gradually easing.

In our study, we also adopt a two-block structure, distinguishing between "global" variables (GPR index, oil prices, US GDP and US CPI) and "country-specific" variables (GDP growth, HICP inflation, Economic Sentiment Indicator, Real Effective Exchange Rate and 3-month interbank interest rate), respectively. We additionally incorporate the global gas price among the external variables, recognizing the significant role of this source of energy in the transmission of the war shock for the EU member countries (Aizenman et al., 2024[1]). Another difference is that, while they conduct a historical analysis of the main geopolitical shocks hitting these economies after 1971, our analysis is constrained by the shorter time series available for CEE countries, given their transition to market economies in the early 1990s and their establishment as "functional market economies" around 2000[4]. The EU's 2004 enlargement to include Central European countries, followed by the accession of Romania and Bulgaria in 2007, marked the culmination of this transition. Due to this major structural change, using macroeconomic data prior to 2000 would be unsuitable for an econometric analysis. The relatively narrow data interval prompted us to opt for a parsimonious Bayesian estimation, implemented using the BEAR toolbox (Dieppe et al., 2016[14])[5].

For comparison with the analysis in Bruhin et al., (2023)[7], our analysis will also include three major EU economies: France, Germany and Italy over the same time span. These

[4]The Copenhagen criteria established in 1993, to be fulfilled by a country to access the EU include among the three essential criteria "a functioning market economy and the ability to cope with competitive pressure and market forces within the EU".Online.

[5]It might be interesting in further research, using more abundant data, to analyse whether the main results hold using a time-varying parameter SVAR as in Yang et al., (2023)[29] or Zhang et al., 2023[32]. This model may be suited for addressing certain irregularities associated with geopolitical shocks, potentially providing additional robustness in such contexts.

western EU countries, although also affected by rising energy prices and large refugee inflows, have more resilient economic foundations. They are also less exposed to instability due to their greater distance from the war area. Nonetheless, the significant costs borne by countries like Germany and Italy in cutting their dependence on Russian oil and gas, as well as the losses faced by their companies that withdrew from the Russian market in 2022, should not be overlooked.

Due to a rather limited number of war episodes included in our sample – Iraq war of 2003, Crimea annexation in 2014, Ukraine invasion in 2022 – we were unable to employ narrative restrictions as in Bruhin et al., (2023)[7]. Instead, our identification strategy relies exclusively on sign restrictions applied to the block of global variables.

In brief, our results indicate a broadly similar impact of the war in Ukraine across all CEE economies. Surging energy prices, weakening export prospects, and a decline in consumer and business confidence weighed heavily on GDP growth. Inflation, which was already elevated, accelerated sharply, driven primarily by the energy price shock. In response, central banks raised interest rates, while some central banks additionally intervened in currency markets to stabilize exchange rates and, albeit subtly, in bond markets to safeguard financial stability and ensure effective monetary policy transmission.

As the war had a contractionary effect across the region, governments implemented fiscal support measures such as energy subsidies, price caps, and targeted aid for vulnerable sectors - particularly energy-intensive industries and SMEs - to prevent bankruptcies and limit job losses. However, the increased public spending, though socially necessary, added to inflationary pressures, compounding the effects of high-energy costs. In the new context in which NATO aimed to strengthen the eastern flank, some of the additional military expenses boosted imports, while another part stimulated domestic demand.

Existing SVAR studies which analyse the Ukrainian war have emphasized its impact on energy prices and inflation (Caldara et al., 2022[8]; Lee et al., 2023[19]; Zhang, 2023[31]; Yang et al., 2023[29]; Chiaramonte et al., 2025[13]), GDP growth (Caldara et al., 2022[9], Tong, 2024[26]), commodity markets (Aizenmann et al., 2024[1]; Cheng et al., 2023[12]) and price of various financial assets (Fang and Shao, 2022[15]; Aliu et al., 2022[4]; Yilmazkudav, 2024[30]; Tong, 2024[26]). Brignone et al., (2025)[6] point out that the total effect of GPR on inflation is highly non-linear. In the special case of the Ukrainian war, their analysis points out the important supply side effect, which drives up prices, and negatively affects economic activity.

Other studies investigating the impact of the war in Ukraine have employed alternative modelling approaches, such as analysing Google search trends (Lo et al., 2022[21]), two-agent New Keynesian model (Chan et al., 2024[11]) and multiresolution data techniques (Saâdaoui et al., 2022[25]). Grabowski and Janus, (2024)[17] revealed changes in stock market connectedness after the war in 24 European countries, that they associate to the distance of the country from the warzone and the dependency on Russian energy.

It goes beyond the purpose of our paper to provide a comprehensive review of such a wide range of analyses. One widely replicated finding, presented by Caldara et al., (2025)[10], is that the war in Ukraine raised global inflation by about 1.2 percentage points and reduced global GDP by around 1 percent. Tong, (2024)[26] uses daily war news and financial asset prices to estimate the direct effect of war shocks in 86 open economies by means of local projections; his estimate of a 1.4 percent fall in average GDP by November 2022, corroborates the above-mentioned findings by Caldara et al., (2025)[10].

The paper is organized as follows. In Section 2 we will present the data and the methodology. The results are presented in Section 3. Section 4 is our conclusion.

2 Data and Methodology

A SVAR model is estimated individually for each CEE country (Bulgaria, Czechia, Hungary, Poland and Romania) and for three large Western European economies (Germany, France and Italy). A quarterly balanced dataset that contains both global and domestic variables was used[6]. The sample covered the period from 2000Q1 to 2024Q2 for all countries[7].

The set of global variables include the Geopolitical Risk (GPR) index, Brent, Oil and US Natural Gas prices – primarily influenced by the outbreak of the war in Ukraine – and a selection of variables representative for the global macroeconomic environment, specifically the US GDP and the US CPI. For each country, the dataset comprises key domestic macroeconomic variables: GDP growth, HICP inflation, 3-month interbank interest rate[8], Real Effective Exchange Rate (REER) and the Economic Sentiment Indicator[9] (ESI). All variables were expressed as quarter-on-quarter growth rates, except for the interest rate and the ESI, which were included in first differences.

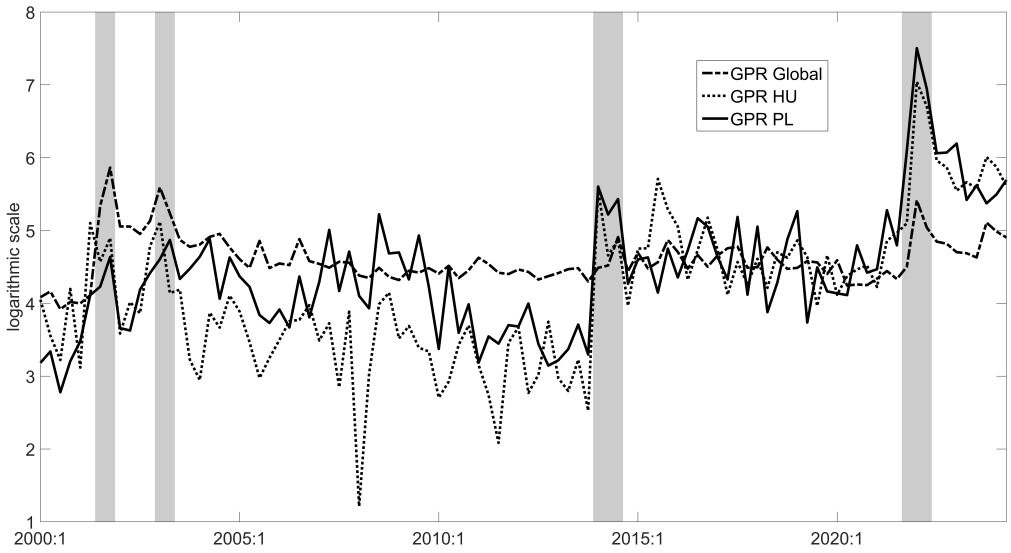


Figure 1: Global GPR index and GPR indices for Hungary (HU) and Poland (PL). The shaded areas correspond to specific events leading to a surge in the indices.

Figure 1 illustrates the Global GPR index alongside two country-specific GPR indices for Hungary and Poland, that are representative for the CEE region. The graph highlights key geopolitical events, including the 9/11 terrorist attack in 2001, the Iraq war in 2003, the annexation of Crimea in 2014, and the outbreak of the war in Ukraine in 2022. The first two events had a more pronounced impact on the global index compared to the regional ones, whereas the Russian invasion of Ukraine had a significantly stronger impact on the regional

[6]The data is available on Mendely Data at address https://data.mendeley.com/datasets/jw6sdyvywr/1

[7]Sources: Eurostat, Federal Reserve Economic Data, Energy Information Administration, World Bank Open Data and Bloomberg.

[8]For Western economies we use Wu-Xia US shadow rates (Wu and Xia, 2016[28]) to account for distortions due to interest rate lower bound and unconventional monetary policy following Bruhin et al., (2023)[7]

[9]ESI is a confidence composite indicator developed and updated since 1985 by the European Commission within its monthly business and consumer surveys. ESI combines judgements and attitudes of producers and consumers by means of a weighted aggregation of standardized input series, thus it can be viewed as a summary of five sector-specific confidence indicators with specific weights, as follows: Industrial (40%), Services (30%), Consumer (20%), Retail trade (5%) and Construction (5%).

indices. To better capture the response of key country-specific variables to a GPR shock, a regional GPR index was employed for the analysis. Specifically, for Hungary, Poland and the Western economies, their respective country-specific indices were used, while for Czechia, Bulgaria and Romania, for which country-specific indices are not available, the Polish GPR index was used as a proxy due to its heightened sensitivity to adverse events linked to the war and its geographical proximity to Ukraine[10].

The generalized form of the VAR (2) model that we use in our empirical analysis, for each country, is the following:

$$y_t = \Pi_0 + \Pi_1 y_{t-1} + \Pi_2 y_{t-2} + \varepsilon_t, \quad \varepsilon_t \sim N(0, \Sigma_t) \tag{1}$$

In our case, y_t encompasses a set of global and domestic variables. The model is therefore expressed in the following form:

$$\begin{pmatrix} g_t \\ d_t \end{pmatrix} = \begin{pmatrix} \beta_{0,g} \\ \beta_{0,d} \end{pmatrix} + \begin{pmatrix} \beta_{1,gg} & 0 \\ \beta_{1,dg} & \beta_{1,dd} \end{pmatrix} \begin{pmatrix} g_{t-1} \\ d_{t-1} \end{pmatrix} + \begin{pmatrix} \beta_{2,gg} & 0 \\ \beta_{2,dg} & \beta_{2,dd} \end{pmatrix} \begin{pmatrix} g_{t-2} \\ d_{t-2} \end{pmatrix} + \begin{pmatrix} \varepsilon_{g,t} \\ \varepsilon_{d,t} \end{pmatrix} \tag{2}$$

where g_t represents global variables while d_t denotes the vector of country-specific variables. The β's represent the model parameters, and the ε's are the residuals. Following Bruhin et al., (2023)[7], global variables are grouped into a block of exogeneity relations (see Table 1) to map their unidirectional impact on domestic variables. This grouping assumes that global factors, such as geopolitical risks, energy prices, and foreign economic indicators, impact domestic economies without being significantly influenced in return. By structuring the model in this way, the analysis isolates the external shocks' direct effects on domestic macroeconomic conditions, ensuring a clearer interpretation of how these global forces propagate through local economic channels.

The choice of a 2-quarter lag is motivated by the a short number of observations, the focus on the short-term effects and a concern for comparability with the estimates in Bruhin et al., (2023)[7] that also use two lags. However, as a robustness check, the model will also be estimated with a VAR (5) model.

The VAR model was estimated using Bayesian techniques, where the prior parameters were fine-tuned through a grid search procedure, following the methodology described in Giannone et al., (2015)[16]. This approach allows for the incorporation of prior information, enhancing the model's robustness, especially in cases with relatively short time series.

Given the limited number of war episodes included in the sample (Crimea's annexation in 2014 and the invasion of Ukraine in 2022), we did not impose any narrative restriction. Furthermore, sign restrictions were applied (see Table 2) only contemporaneously (same-quarter effect of the GPR shock) without extending to subsequent quarters. This allows for a much more reasonable computational burden, which would otherwise have become problematic given that the models were estimated independently on five countries. For each country, the analysis involved 15,000 iterations, with 30% of them being discarded during the burn-in phase. The VAR models are estimated using the BEAR toolbox (see Dieppe et al., 2016[14] for further details).

A set of sign restrictions were designed to capture the direction of the response of global variables to the GPR shock, as summarized in Table 2. In line with existing empirical

[10] As mentioned by Bondarenko et al., (2024)[5], the Geopolitical Risk Index developed by Caldara and Iacoviello, (2022)[8] comes with an Anglo-saxon bias, grounded in its data collection methodology - a survey of ten major Anglo-Saxon newspapers. These authors offer an alternative measure, based on textual analysis of local journals, in the languages of origin. Unfortunately, these closer-to-the-field measures of geopolitical risk are not yet available for the countries in our sample.

Table 1: Block of exogeneity

	GPR	Oil price	Gas price	US GDP	US CPI	REER	Interest rate	ESI	GDP	HICP
GPR		1	1	1	1	1	1	1	1	1
Oil price				1	1	1	1	1	1	1
Gas price				1	1	1	1	1	1	1
US GDP						1	1	1	1	1
US CPI						1	1	1	1	1
REER										
Interest rate										
ESI										
GDP										
HICP										

Note: The value of 1 in row i, column j indicates that variable j does not affect variable i. (e.g., GDP does not affect GPR, Oil, Gas, US GDP and US CPI).

evidence, we assumed that the war had a negative impact on the US GDP (Caldara et al., 2022[8], Tong, 2024[26], Caldara et al., 2025[10], Pinchetti, 2025[22]). This would reflect higher demand uncertainty and supply chain disruptions. At the time we performed the analysis the impact of the war on US inflation was uncertain, thus we imposed no restriction on US CPI.[11]

The war in Ukraine caused major disruptions in the supply of oil and gas from Russia to EU countries and brought about significant turmoil in energy markets (Zhang et al., 2023[31]). An ECB study notes that in the first two weeks after the invasion, the prices of oil, coal, and gas increased by around 40%, 130%, and 180%, respectively, while higher gas prices drove up wholesale electricity prices across the entire euro area (Adolfsen et al., 2022[3]). Using event analysis, Zhang et al., (2024)[32] find a positive short-term effect of the war on crude oil prices.

Pinchetti (2025)[22] provides strong evidence supporting the assumption that the short-term consequences of the war in Ukraine for the US economy were essentially transmitted through the energy channel—specifically via higher oil prices—and shows a positive impact of oil prices on goods prices. He emphasizes that geopolitical shocks transmitted through energy markets tend to have a positive impact on prices, whereas geopolitical conflicts that do not affect energy prices tend to have a negative impact.

Aizenman et al., (2024)[1] use an event study to show that the Ukrainian war entailed an increase in the price of European natural gas by 7.5%, and affected the European natural gas market more strongly than the US or Asian markets. The study reveals a smaller, yet positive, short term impact of the conflict on oil prices (2%).

In line with these observations, we assign a positive sign (+) to the restrictions on both oil and gas prices[12]. No restrictions were imposed on the country specific variables.

[11] Recent studies reveal a positive impact on global prices, which – as it will be shown later – aligns with our findings.

[12] Following the energy market channel argument, Bruhin et al., (2023)[7] imposed a positive sign on the oil price restriction.

Table 2: SVAR sign restrictions associated to a positive GPR shock

Global block variables		**Country-specific variables**	
GPR	+	**REER**	
Oil price	+	**Interest rate**	
Gas price	+	**ESI**	
US GDP	-	**GDP**	
US CPI		**HICP**	

3 Results

3.1 Impulse Response Functions

As previously noted, we applied a series of sign restrictions to capture the expected directional impacts of specific variables linked to the onset of the war - namely, the GPR index, oil prices, and gas prices - as well as that related to US economic growth, consistent with the approach outlined by Bruhin et al., (2023)[7]. The same SVAR model is estimated – using the same sign restrictions identification scheme – for all countries in the sample. For clarity and brevity, our analysis focuses on comparing results between CEE countries and major Western European economies.

In a first step, the estimated model is used to forecast the effect of a GPR shock of one standard deviation on the various endogenous variables, for each country. The full set of impulse response functions is presented in Appendix A2.

Figure 2 illustrates the Impulse Response Functions (IRFs) for Romania, corresponding to a GPR shock equal to one standard deviation. In this case, the magnitude represents approximately the cumulative increase in the index observed between 2021Q4 and 2022Q2. The median of each distribution is considered as the Bayesian estimator. In line with standard practice in the Bayesian literature, the 68% and 50% confidence intervals are derived using the 16^{th}–84^{th} and 25^{th}–75^{th} percentiles, respectively.

In response to this shock, commodity prices rose significantly, with oil price increasing by 18 percentage points and gas price by 32.8 percentage points. As expected, the response of gas prices is larger, reflecting the war in Ukraine's more pronounced impact on gas markets compared to oil markets.

Given the imposed sign restrictions, GDP in the US decreases first, followed by a contraction in Romania's domestic output. Albeit we did not impose restrictions on the US CPI, the model reveals an increase in US prices, in line with findings in recent studies (Yang, 2023[29], Tong, 2024[26], Caldara et al., 2025[10]).

The Romanian GDP falls by nearly 1.6 percentage points, while the US experiences a somewhat smaller decrease of around 1.3 percentage points[13]. Among the unrestricted variables, the ESI index exhibits the most pronounced response, falling by nearly 7 points as elevated geopolitical risks prompt greater investor caution. Meanwhile, the responses of the interest rate and that of REER are statistically insignificant. The war outbreak also directly impacts inflation, primarily through the raw materials channel. US inflation shows a significant response, with quarterly inflation rising by 1.1 percentage points following a GPR shock. Romanian HICP inflation exhibits a similar magnitude of response. However, the confidence intervals for the IRF are wider, indicating a higher degree of uncertainty.

[13]This figure is not far from the 1.8 percent US GDP reduction as estimated by Bruhin et al., (2023)[7] in their analysis for the large Western European countries.

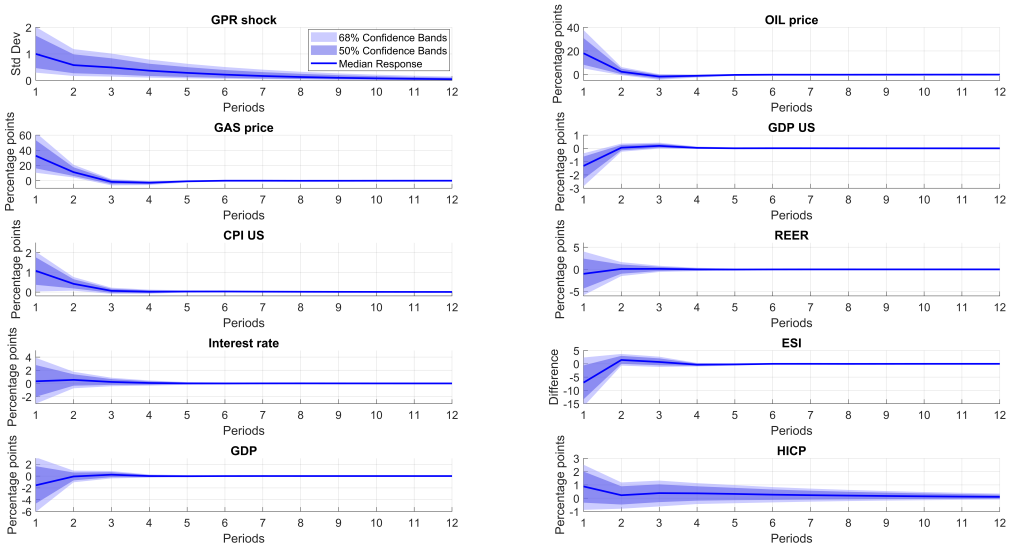


Figure 2: Romania. Impulse response functions for one standard deviation GPR shock. Each graph shows the median response and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

For Czechia, the outcome of block exogenous variables is quite similar to those of Romania (see Appendix, Figure A2.1). However, some differences are notable: the HICP inflation response is only slightly positive and largely insignificant, as indicated by the wide uncertainty bands. As expected, the ESI responses are negative, though their magnitude is nearly half that observed in Romania.

The results for Hungary (Appendix, Figure A2.2) are broadly consistent with those for Czechia, although the GDP response is more pronounced. In contrast, Poland's outcomes (Appendix, Figure A2.3) more closely resemble Romania's, except for GDP, where the response is smaller and statistically insignificant. For Bulgaria (Appendix, Figure A2.4), the IRFs indicate largely insignificant effects on both the ESI and HICP inflation, while GDP shows a negative response, similar to the patterns observed for Romania and Poland.

It is worth noting that, across all countries, the median response of HICP inflation displays the expected positive sign, but the confidence bands are relatively wide. However, for Romania and Poland, confidence bands barely include the null value, making the responses relatively more significant than in the case of the other three countries.

Among the large EU economies (Figures A2.5 – A2.7), the median GDP contraction reaches approximately 2 percentage points, while inflation rising by a similar magnitude - though the effect is notably smaller in Italy. Germany emerges as the most severely impacted large economy in response to the geopolitical risk shock. Additionally, the wider confidence intervals suggest that inflation could rise by as much as 4 percentage points. Compared to CEE countries, the estimated responses for Western economies show commodity prices effects that are nearly twice as strong, while changes in the interest rate and the REER are statistically insignificant.

3.2 Counterfactual Analysis

In a second step, we provide estimates of counterfactual series for each variable of interest - namely GDP, ESI, and prices (both in levels and annual inflation). To do so, we proceed in a standard way, by removing the contributions of GPR shocks from the historical decomposition of the respective variable over the period 2022Q1 to 2022Q2. This approach allows us to isolate the specific impact of geopolitical risk shocks on these key economic indicators. By comparing the actual series with the counterfactuals, we provide better intuition about the extent to which these shocks contributed to deviations from expected economic trends. Results are illustrated in Figure 3 for Romania and Figures A3.1 – A3.7 in the Appendix A.3 for all other countries.

It turns out that for Romania, the GDP in 2022 would have been 0.36 percent higher in the absence of the war in Ukraine. Given the methodology employed - specifically, the exclusion of these shocks from the actual observed data - the resulting output loss is treated as permanent. This implies that the conflict introduced a lasting downward shift in the level of economic activity, rather than a temporary deviation from trend.

As regards consumer prices, inflation would have increased by nearly 0.5 percentage points less than actually observed. Importantly, the confidence bands are skewed to the right, suggesting that the impact of the war may have been even more pronounced - potentially lowering inflation by as much as 1.7 percentage points compared to recorded values. Regarding economic sentiment, the ESI would likely have remained above 100 - its long-term average - had the war not occurred, indicating a more optimistic outlook among businesses and consumers in a no-conflict scenario.

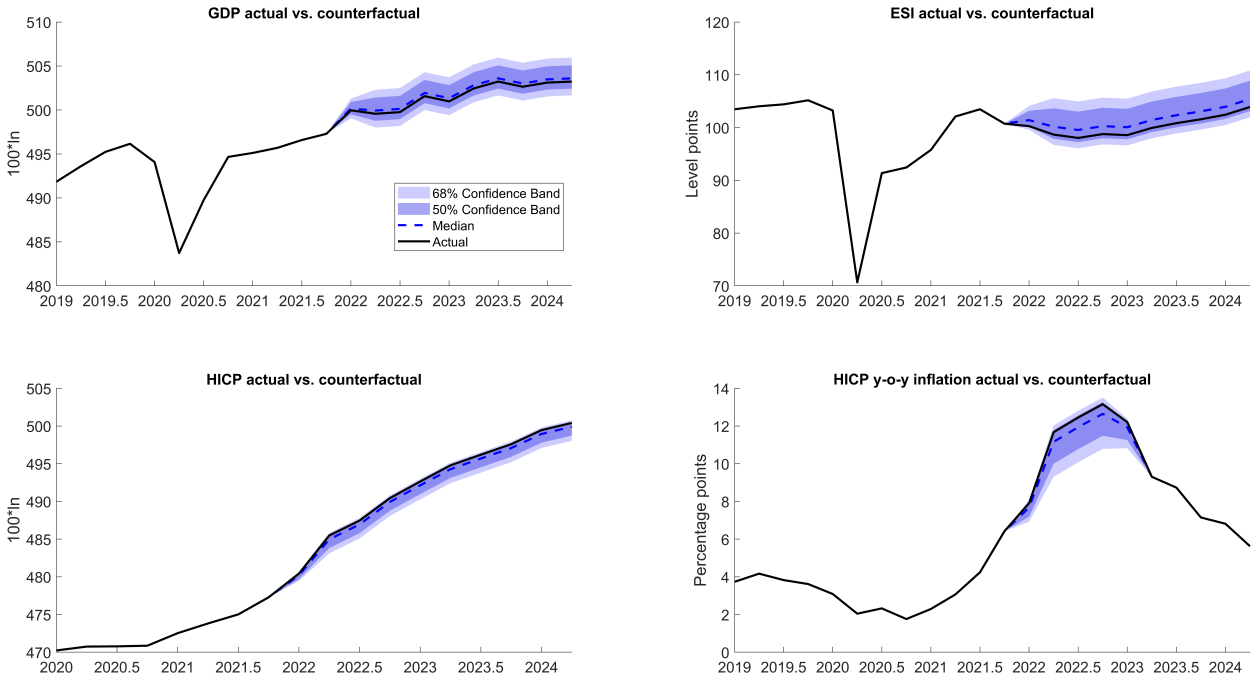


Figure 3: Romania. Actual and counterfactual series if Russia had not invaded Ukraine. Each counterfactual series is represented by the median outcome and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

Table 3 offers an alternative, more concise way of presenting the counterfactual results for all countries in the sample (Bruhin et al., 2023[7]). It shows the differences, computed in 2022 Q4, between the counterfactual no-war series and the actual series for HICP and GDP. The values represent the median percentage difference, along with the associated 50%

confidence intervals. The figures reveal by how much the GDP would have been higher compared to the actual series. Also, they reveal by how much the inflation rate would have been lower compared to the actual series. Reported counterfactual effects in both the CEE and the Western countries build on estimates of the same model, on the same period (2000Q1 to 2024Q2).

Table 3: Median percentage difference between the no-war counterfactual and the actual GDP/inflation by 2022Q4, under the benchmark specification. 50% confidence intervals are shown in brackets.

Countries	**HICP**	**GDP**
BG	-0.43%	0.34%
	[-1.63%, 0.22%]	[-0.24%, 1.18%]
CZ	-0.80%	0.32%
	[-2.00%, -0.12%]	[-0.28%, 1.28%]
HU	-0.61%	0.37%
	[-1.83%, 0.04%]	[-0.40%, 1.47%]
PL	-0.74%	0.25%
	[-1.87%, -0.13%]	[-0.48%, 1.10%]
RO	-0.51%	0.36%
	[-1.67%, 0.11%]	[-0.80%, 1.84%]
DE	-0.72%	0.39%
	[-1.51%, -0.19%]	[-0.16%, 1.20%]
FR	-0.37%	0.29%
	[-0.93%, -0.06%]	[-0.31%, 1.11%]
IT	-0.33%	0.13%
	[-0.98%, 0.00%]	[-0.60%, 1.13%]

It turns out that the impact on inflation was relatively stronger in the CEE economies, compared to France and Italy. However, the impact of the war on inflation in the gas-dependent Germany was quite strong. A negative effect on GDP was recorded in all countries, without a significant difference between Western and Eastern economies. Across countries, the GDP effects are relatively similar, averaging around 0.3 percent. However, confidence intervals tend to be wider for Central and Eastern European (CEE) economies, with Romania standing out due to particularly high uncertainty around the estimates. By contrast, the median inflation impact is generally higher in CEE countries than in Western economies such as France and Italy, underscoring the region's heightened exposure to external price shocks triggered by the war in Ukraine.

In Table 4, we compare our benchmark results for Germany, France and Italy with the estimates of Bruhin et al., (2023)[7]. We recall that our estimates are based on short time series (2000Q1 to 2024Q2, while their estimates are based on long data series (1973Q1-2022Q4). Additionally, our specification includes gas prices as an extra variable. Moreover, in our study, inflation is measured using the HICP methodology, rather than the country-specific CPI used in other studies. Given these differences, the inflationary effect of the war appears stronger in our data.

However, the signs of the effects on inflation and GDP in these major economies are similar in our short-term analysis compared to their historical analysis. While the upper bounds of the inflation impact are broadly in line with those reported by Bruhin et al.,

(2023)[7], our lower bounds are notably more negative, reflecting a greater degree of right-skewness in the distribution.

In terms of output, the estimated impact on GDP is smaller for Germany and Italy compared to Bruhin et al., (2023)[7], but larger for France - both in magnitude and in the width of the confidence intervals.

Table 4: Median percentage difference between the no-war counterfactual and the actual GDP/inflation by 2022Q4, based on benchmark specification and results compared to the results from Bruhin et al. (2023). 50% confidence intervals are shown in brackets.

Countries	**Benchmark specification**		**Results from Bruhin et al. (2023)**	
	HICP	**GDP**	**CPI**	**GDP**
DE	-0.72%	0.39%	-0.36%	0.7%
	[-1.51%, -0.19%]	[-0.16%, 1.20%]	[-0.6%, -0.15%]	[-0.26%, 1.75%]
FR	-0.37%	0.29%	-0.28%	0.08%
	[-0.93%, -0.06%]	[-0.31%, 1.11%]	[-0.53%, -0.07%]	[-0.4%, 0.62%]
IT	-0.33%	0.13%	-0.17%	0.33%
	[-0.98%, 0.00%]	[-0.60%, 1.13%]	[-0.4%, -0.01%]	[-0.43%, 1.2%]

3.3 Robustness checks

This section presents several robustness checks as applied to our findings.

3.3.1 A one-year shock instead of two quarters

To better account for the persistent effects of the conflict, we extend the period over which the GPR shocks are extracted from the historical decomposition to include two additional quarters, thus covering the entirety of 2022. This extended approach allows for the identification of more persistent and delayed economic responses, acknowledging that the consequences of the war continued to unfold well beyond its initial outbreak.

Table 5 provides the results based on the extended specification. For the CEE, the one year effect of the war on the GDP is consistent with the results from the benchmark analysis, with some variation across the different countries. For Western European countries, excluding the GPR shock throughout 2022 results in a smaller estimated impact on GDP - the median effect even switches sign for France and Italy - revealing the higher ability of these countries to absorb and dissipate the shock. In this alternative specification, the war's influence on inflation is more pronounced, with higher estimated impacts across all countries. Within the CEE region, Hungary stands out - based on the lower bound of the confidence interval, consumer prices could have been up to 4 percentage points lower by the end of 2022 in the absence of the shock. Among Western economies, Germany remains the most affected in terms of inflation; however, it is noteworthy that Italy's inflation impact nearly doubles, suggesting delayed transmission of the war's effects on prices.

Table 5: Median percentage difference between the no-war counterfactual and the actual GDP and inflation by 2022Q4, based on a one-year GPR shock (extended model). 50% confidence intervals are shown in brackets.

Countries	**HICP**	**GDP**
BG	-0.75%	0.27%
	[-2.48%, 0.32%]	[-0.68%, 1.46%]
CZ	-1.11%	0.23%
	[-2.82%, 0.02%]	[-0.76%, 1.59%]
HU	-1.68%	0.38%
	[-4.04%, -0.31%]	[-1.08%, 2.20%]
PL	-1.20%	0.45%
	[-2.94%, -0.22%]	[-0.69%, 1.78%]
RO	-0.70%	0.12%
	[-2.57%, 0.33%]	[-1.78%, 2.23%]
DE	-0.96%	0.24%
	[-2.21%, -0.13%]	[-0.87%, 1.54%]
FR	-0.48%	-0.01%
	[-1.34%, 0.02%]	[-1.26%, 1.34%]
IT	-0.84%	-0.16%
	[-2.12%, -0.16%]	[-1.79%, 1.63%]

3.3.2 Five lags instead of two

The second robustness check re-estimates the model using a five lag VAR instead of two lags. The results are summarized in Table 6, both for the benchmark model (a two-quarter GPR shock) and for the extended model (a one-year shock). Regarding the effect on GDP, the benchmark estimates are broadly consistent with those reported in Table 3 for all countries in our sample. We remind that a positive value indicates that the GDP would have been higher without the war. Notably, for Romania the median value increases from 0.36% to 0.53%. Furthermore, the lower bound of the confidence interval nearly halves, suggesting greater confidence in the direction of the effect. Similar effects are observed in the extended specification for all the CEE countries and Germany; however the negative effect of the war on France and Italy appears to be weaker than in the benchmark model.

As for the inflation counterfactual - revealing how large would have been inflation without the war, increasing the number of lags in the VAR model does not challenge the benchmark results. In particular, the signs of the lower bounds shift to negative for Romania and Bulgaria (but not for Hungary), which reinforces confidence in the negative sign, characteristic of lower inflation without the war. The median impact on inflation is in general stronger, revealing the persistence of the impact of the war on inflation in these countries.

Table 6: Median percentage difference between the no-war counterfactual and the actual GDP and inflation based on a 5-lag model (instead of 2), separately for the benchmark model (two quarters GPR shock) and the extended model (one year GPR shock). 50% confidence intervals are shown in brackets.

Countries	**Benchmark (Q1 and Q2)**		**One-year shock**	
	HICP	**GDP**	**HICP**	**GDP**
BG	-0.57%	0.20%	-0.93%	0.15%
	[-1.57%, -0.02%]	[-0.26%, 0.93%]	[-2.47%, 0.01%]	[-0.66%, 1.22%]
CZ	-1.00%	0.37%	-1.27%	0.38%
	[-2.16%, -0.31%]	[-0.22%, 1.37%]	[-3.02%, -0.15%]	[-0.62%, 1.82%]
HU	-0.61%	0.37%	-1.72%	0.48%
	[-1.77%, 0.06%]	[-0.35%, 1.46%]	[-4.01%, -0.32%]	[-0.88%, 2.30%]
PL	-0.65%	0.22%	-1.12%	0.44%
	[-1.72%, -0.10%]	[-0.48%, 1.03%]	[-2.83%, -0.19%]	[-0.68%, 1.74%]
RO	-0.67%	0.53%	-0.98%	0.34%
	[-1.76%, -0.08%]	[-0.44%, 1.93%]	[-2.70%, -0.03%]	[-1.40%, 2.41%]
DE	-0.72%	0.35%	-1.00%	0.24%
	[-1.43%, -0.22%]	[-0.22%, 1.18%]	[-2.15%, -0.23%]	[-0.84%, 1.56%]
FR	-0.38%	0.37%	-0.49%	0.08%
	[-0.88%, -0.08%]	[-0.32%, 1.39%]	[-1.25%, -0.03%]	[-1.34%, 1.65%]
IT	-0.32%	0.17%	-0.85%	0.01%
	[-0.90%, -0.01%]	[-0.63%, 1.30%]	[-2.02%, -0.18%]	[-1.68%, 1.94%]

3.3.3 Core HICP inflation instead of HICP inflation

Given its relevance as a measure of persistent inflationary pressures and its importance for monetary policy, it is particularly useful to examine the war's effect on core inflation. Compared to HICP inflation used in the main analysis, core inflation excludes food, energy and tobacco.

Therefore, in a new estimate of the SVAR model we replace HICP inflation with core HICP (Table 7). Across all countries analysed, core inflation generally responds less to the geopolitical shock than headline inflation. For Western European countries, the median impact tends to be more pronounced under the *Core (2022)* specification, suggesting that the war's inflationary effects were more persistent. However, these results are accompanied by considerably wide confidence intervals, indicating substantial uncertainty.

At the same time, for CEE countries, the estimated impact becomes significantly larger when the GPR shock is excluded across the entire year 2022. Notably, the confidence bands in these cases often shift into negative territory, as seen in Czechia and Hungary. Exceptions to this pattern include Bulgaria and Romania, where the upper bounds of the confidence intervals rise slightly relative to the lower bounds, pointing to a more muted response. For Poland, the upper bound remains negative, consistent with the benchmark specification.

Table 7: Median percentage difference between the no-war counterfactual and the actual GDP/inflation by 2022Q4 (core inflation). 50% confidence intervals are shown in brackets.

Countries	HICP (Q1 and Q2)	Core (Q1 and Q2)	Core (2022)
BG	-0.43%	-0.20%	-0.48%
	[-1.63%, 0.22%]	[-1.06%, 0.32%]	[-1.83%, 0.34%]
CZ	-0.80%	-0.45%	-0.85%
	[-2.00%, -0.12%]	[-1.34%, 0.03%]	[-2.19%, -0.08%]
HU	-0.61%	-0.31%	-0.91%
	[-1.83%, 0.04%]	[-1.05%, 0.08%]	[-2.29%, -0.09%]
PL	-0.74%	-0.49%	-0.90%
	[-1.87%, -0.13%]	[-1.30%, -0.07%]	[-2.31%, -0.16%]
RO	-0.51%	-0.10%	-0.22%
	[-1.67%, 0.11%]	[-0.72%, 0.38%]	[-1.31%, 0.57%]
DE	-0.72%	-0.18%	-0.31%
	[-1.51%, -0.19%]	[-0.58%, 0.12%]	[-1.01%, 0.21%]
FR	-0.37%	-0.16%	-0.24%
	[-0.93%, -0.06%]	[-0.45%, 0.04%]	[-0.72%, 0.12%]
IT	-0.33%	-0.19%	-0.32%
	[-0.98%, 0.00%]	[-0.63%, 0.21%]	[-1.21%, 0.43%]

4 Conclusion

To the best of our knowledge, this is likely the first paper to date which uses a SVAR model, to analyse the effect of the war in Ukraine on CEE economies. These countries are significantly exposed to this geopolitical risk, owing to their geographic proximity to the conflict zones and a history of tensions with Russia after the WW2, against the background of their new membership in both NATO and the EU.

The empirical analysis employs a two-block Bayesian SVAR model, similar to that of Bruhin et al., (2023)[7], but extended to include gas prices among the global variables. This methodological choice is justified by the central role of the gas supply in the context of the Russian invasion, reinforced by the high dependence of CEE and other EU countries on Russian energy.

The results confirm that the war had a substantial negative short-term effect on GDP in the EU area, of similar magnitude in both Western and CEE economies. The counterfactual analysis suggests that, in the absence of Russia's invasion of Ukraine, the real GDP of all countries in the sample would have been about 0.3% higher. Confidence intervals are generally wider for CEE countries, with Romania standing out due to the particularly high uncertainty surrounding its estimates.

By contrast, the median inflation impact is generally higher in CEE countries than in Western economies such as France and Italy (though not Germany), underscoring the region's greater vulnerability to the war shock. In the absence of the war, inflation would have been 0.3 to 0.8 percentage points lower across the countries analysed. The model also indicates that the war in Ukraine had a positive impact on US prices. Several robustness checks corroborate these findings.

The study did not consider the longer-term effects of the war, which is driving a major reconfiguration of trade and investment links between the EU and Ukraine. Another critical structural dimension involves the significant defence efforts being undertaken by

CEE countries to meet NATO standards and address emerging threats. These efforts entail increased public spending and substantial investment in military infrastructure and the defence-industrial base, which will have a lasting effect on the region. Conversely, the war may present some positive opportunities for CEE economies. These include the relocation of Western firms previously operating in Ukraine or Russia to the region, increased investment in the defence sector (Ramey, 2011[23]), which could boost short-term economic growth (though budget constraints may impair resource allocation to civilian sectors), and the advancement of strategic projects under strengthened NATO cooperation.

Despite these limitations, our analysis offers a rigorous estimation of the macroeconomic losses imposed by this major shock on the CEE economies and should help policymakers calibrate their policies in support of the population and business sector.

References

[1] Aizenman, J., Lindahl, R., Stenvall, D., & Uddin, G. S. (2024). Geopolitical shocks and commodity market dynamics: New evidence from the Russia-Ukraine conflict. *European Journal of Political Economy*, **85**, 102574.

[2] Aizenman, J., & Saâdaoui, F. (2024). The Resilience of Central, Eastern and Southeastern Europe (CESEE) Countries During ECB's Monetary Cycles. *National Bureau of Economic Research*, No. w32957.

[3] Adolfsen, J. F., Kuik, F., Lis, E. M., Schuler, T. (2022). The impact of the war in Ukraine on euro area energy markets. *ECB Economic Bulletin*, **4**.

[4] Aliu, F., Hašková, S., & Bajra, U. Q. (2022). Consequences of Russian invasion on Ukraine: evidence from foreign exchange rates . *Journal of Risk Finance*, **24**(1), 40–58.

[5] Bondarenko, Y., Lewis, V., Rottner, M., & Schüler, Y. (2024). Geopolitical risk perceptions. *Journal of International Economics*, **152**, 104005.

[6] Brignone, D., Gambetti, L., & Ricci, M. (2025). Geopolitical risk shocks: when the size matters. *Bank of England*, Staff Paper nr. 1118, February.

[7] Bruhin, J., Scheufele, R., & Stucki, Y. (2023). The economic impact of Russia's invasion of Ukraine on European countries–a SVAR approach. *SNB Working Papers*, 4/2023.

[8] Caldara, D., & Iacoviello, M. (2022). Measuring geopolitical risk. *American Economic Review*, **112**(4), 1194–1225.

[9] Caldara, D., Conlisk, S., Iacoviello, M., & Penn, M. (2022). The effect of the war in Ukraine on global activity and inflation. *FEDS Notes*. Board of Governors of the Federal Reserve System, Washington. https://doi.org/10.17016/2380-7172.3141. May 27, 2022.

[10] Caldara, D., Conlisk, S., Iacoviello, M., & Penn, M. (2025). Do geopolitical risks raise or lower inflation? *Working paper*, Federal Reserve Board of Governors. www.matteoiacoviello.com/research_files/GPR_inflation_paper.pdf.

[11] Chan, J., Diz, S., & Kanngiesser, D. (2024). Energy prices and household heterogeneity: Monetary policy in a gas-tank. *Journal of Monetary Economics*, **147**, 103620.

[12] Cheng, D., Liao, Y., & Pan, Z. (2023). The Geopolitical Risk Premium in the Commodity Futures Market. *Journal of Futures Markets*, **43**, 1069–1090.

[13] Chiaramonte, L., Mecchia, F., Paltrinieri, A., & Sclip, A. (2024). Geopolitical Risk and Energy Markets: Past, Present, and Future. *Journal of Economic Surveys*.

[14] Dieppe, A., van Roye, B., & Legrand, R. (2016). The BEAR toolbox. *Working Paper Series*, 1934, European Central Bank.

[15] Fang, Y., & Shao, Z. (2022). The Russia-Ukraine conflict and volatility risk of commodity markets. *Finance Research Letters*, **50**, 103264.

[16] Giannone, D., Lenza, M., & Primiceri, G. E. (2015). Prior Selection for Vector Autoregression. *The Review of Economics and Statistics*, **97**(2), 436–451.

[17] Grabowski, W., & Janus, J. (2024). Tail dependence in European stock markets amidst the Russo-Ukrainian war: Shifting linkages and their determinants. *ISEG-Lisbon School of Economics and Management*, No. 2024/0360.

[18] Kilian, L., & Lütkepohl, H. (2017). Structural Vector Autoregressive Analysis. Cambridge University Press.

[19] Lee, C. C., Olasehinde-Williams, G., & Özkan, O. (2023). Geopolitical oil price uncertainty transmission into core inflation: evidence from two of the biggest global players. *Energy Economics*, 106983.

[20] Liadze, I., Macchiarelli, C., Mortimer-Lee, P., & Sanchez Juanino, P. (2023). Economic costs of the Russia-Ukraine war. *The World Economy*, **46**(4), 874–886.

[21] Lo, G. D., Marcelin, I., Bassène, T., & Sène, B. (2022). The Russo-Ukrainian war and financial markets: the role of dependence on Russian commodities. *Finance Research Letters*, **50**, 103194.

[22] Pinchetti, M. (2025). Geopolitical Risk and Inflation: The Role of Energy Markets. *Banque du France*, Working Paper, 1005.

[23] Ramey, V.A. (2011). Identifying Government Spending Shocks: It's all in the Timing. *Quarterly Journal of Economics*, **126**, 1–50.

[24] Ramey, V.A. (2016). Chapter 2 - Macroeconomic Shocks and Their Propagation. *Handbook of Macroeconomics*, **2**, 71–162.

[25] Saâdaoui, F., Jabeur, S. B., & Goodell, J. W. (2022). Causality of geopolitical risk on food prices: Considering the Russo–Ukrainian conflict. *Finance Research Letters*, **49**, 103103.

[26] Tong, E. (2024). Repercussions of the Russia–Ukraine war. *International Review of Economics and Finance*, **89**, 366–390. https://doi.org/10.1016/j.iref.2023.07.064.

[27] World Bank (2024). Ukraine: Third Rapid Damage and Needs Assessment February 2022 – December 2023. Report by the World Bank, EU, and UN. https://ukraine.un.org/sites/default/files/2024-02/UA%20RDNA3%20report%20EN.pdf.

[28] Wu, J.C., & Xia, F.D. (2016). Measuring the macroeconomic impact of monetary policy at the zero lower bound. *Journal of Money, Credit and Banking*, **48**(2-3), 254-291.

[29] Yang, T., Dong, Q., Du, M., & Du, Q. (2023). Geopolitical risks, oil price shocks and inflation: Evidence from a TVP–SV–VAR approach. *Energy Economics*, **127**, 107099.

[30] Yilmazkudav, Hakan. (2024). Geopolitical Risks and Exchange Rates. Available at SSRN: https://ssrn.com/abstract=

[31] Zhang, Z., Wang, Y., Xiao, J., & Zhang, Y. (2023). Not all geopolitical shocks are alike: identifying price dynamics in the crude oil market under tensions. *Resource Policy*, **80**, 103238.

[32] Zhang, Q., Hu, Y., Jiao, J. (2024). The impact of Russia–Ukraine war on crude oil prices: an EMC framework. *Humanities and Social Sciences Communications*, **11**(1).

Appendix

Appendix.1 Main Economic Indicators for the CEE

Table A1: Statistics

	GDP / capita (PPP)		Growth rate		Inflation rate (HICP)		Unemployment rate	
	2019	**2022**	**2019**	**2022**	**2019**	**2022**	**2019**	**2022**
EU-27	31300	35400	1.9	3.5	1.4	9.2	6.8	6.2
Bulgaria	16600	24200	3.8	4.0	2.5	13.0	5.2	4.2
Czech Republic	29200	32000	3.6	2.8	2.6	14.8	2.0	2.2
Hungary	22900	26900	5.1	4.3	3.4	15.3	3.3	3.6
Poland	22800	28200	4.6	5.3	2.1	13.2	3.3	2.9
Romania	21800	26700	3.9	4.0	3.9	12.0	4.9	5.6
	Public Deficit (%)		**Public Debt (%)**		**Military Spending Current mil.$***		**Military Spending Percent of GDP***	
	2019	**2022**	**2019**	**2022**	**2019**	**2022**	**2019**	**2022**
EU-27	-0.5	-3.2	77.4	82.5				
Bulgaria	2.2	-2.9	20.1	22.5	2158	1436	3.13	1.59
Czech Republic	0.3	-3.1	29.6	42.5	2910	4005	1.15	1.38
Hungary	-2.0	-6.2	65.0	73.8	2190	3256	1.34	1.84
Poland	-0.7	-3.4	45.2	48.8	11786	15341	1.98	2.23
Romania	-4.3	-6.4	35.0	47.9	4613	5188	1.84	1.72

*Military spending is SIPRI Data, consistent with NATO Methodology. Eurostat is publishing some more "conservative" statistics https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_expenditure_on_defence

Appendix.2 Impulse Response Functions

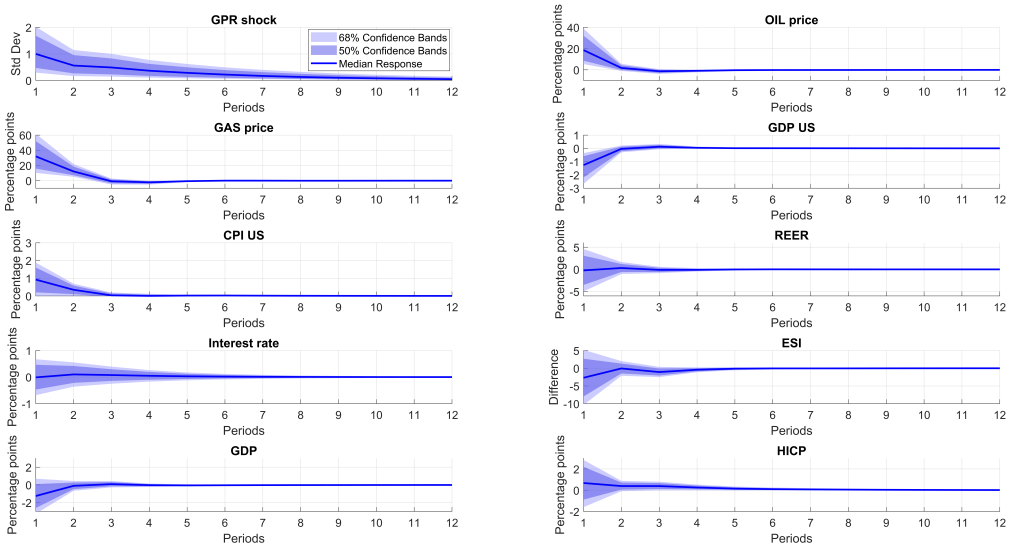


Figure A2.1: Czech Republic. Impulse response functions for one standard deviation GPR shock. Each graph shows the median response and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

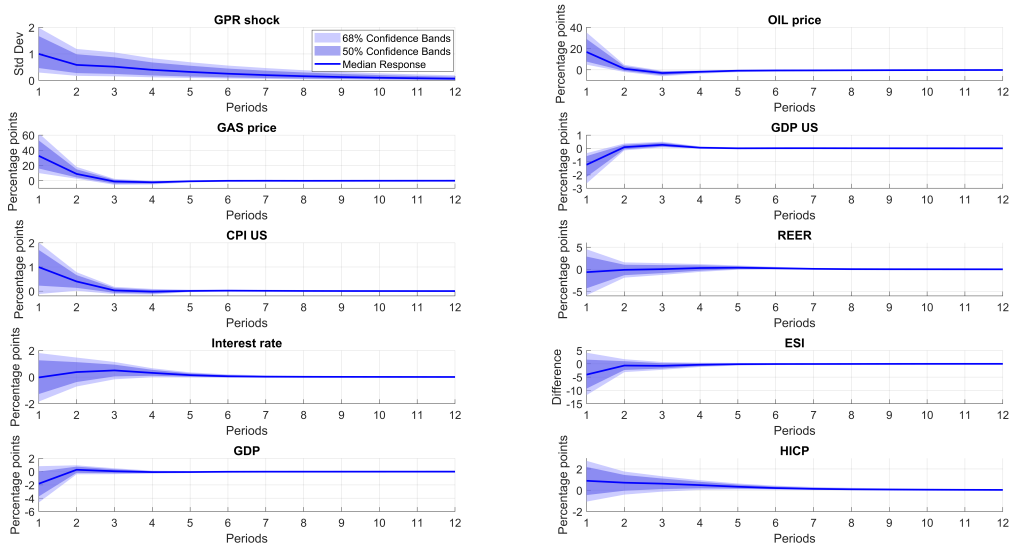


Figure A2.2: Hungary. Impulse response functions for one standard deviation GPR shock. Each graph shows the median response and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

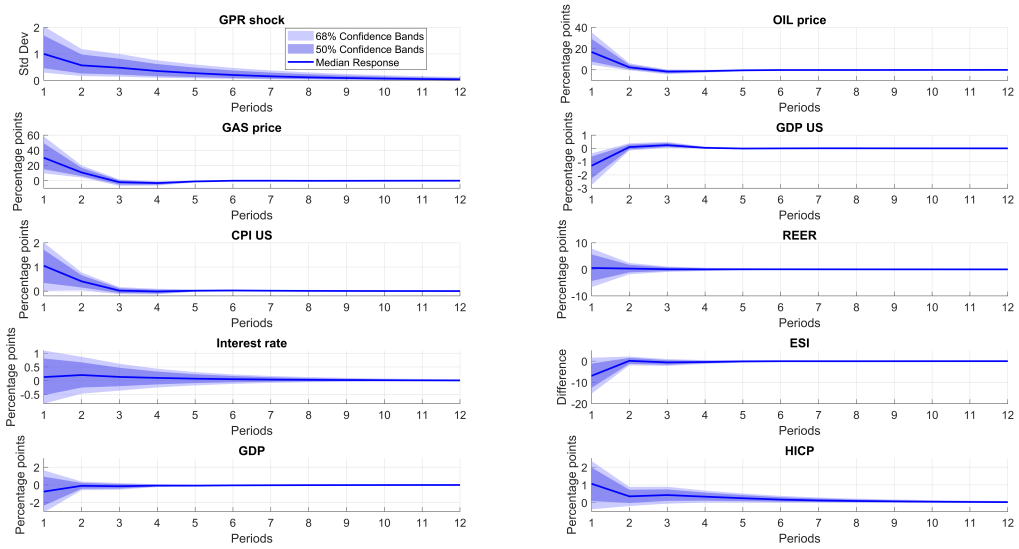


Figure A2.3: Poland. Impulse response functions for one standard deviation GPR shock. Each graph shows the median response and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

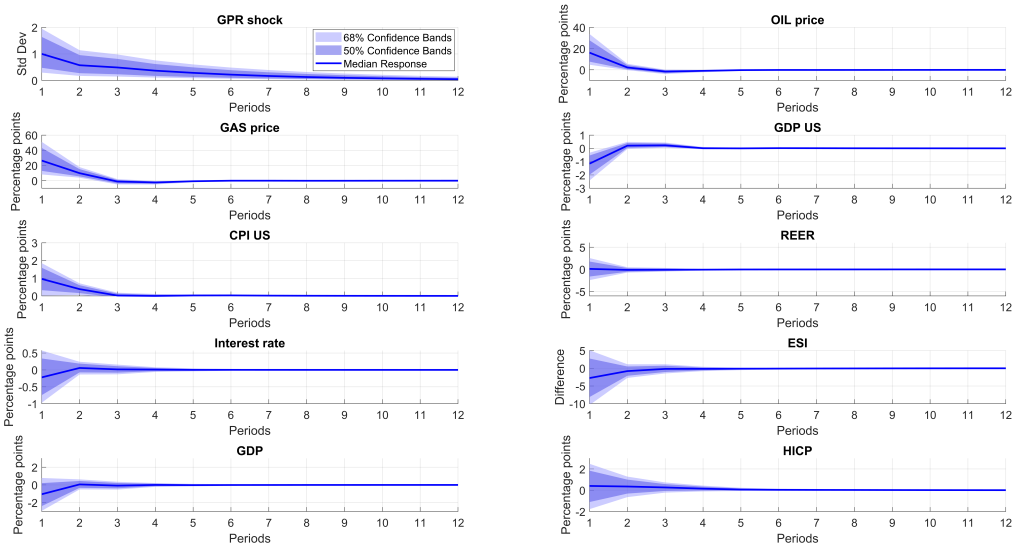


Figure A2.4: Bulgaria. Impulse response functions for one standard deviation GPR shock. Each graph shows the median response and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

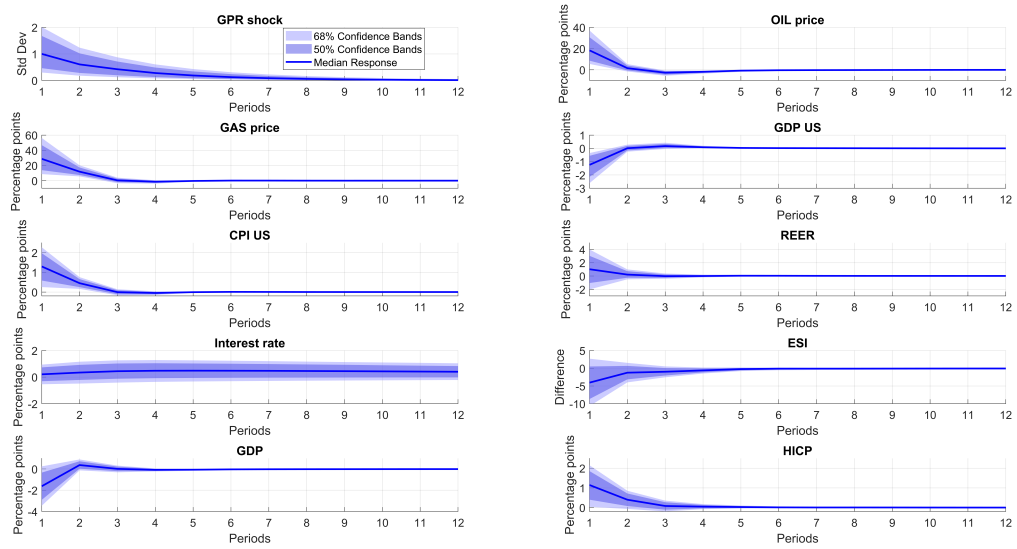


Figure A2.5: Germany. Impulse response functions for one standard deviation GPR shock. Each graph shows the median response and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

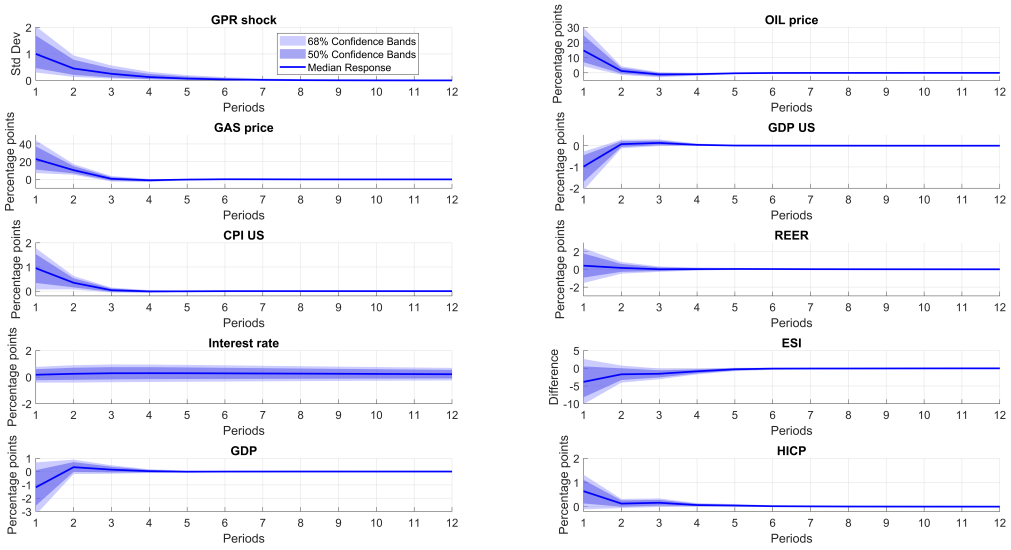


Figure A2.6: France. Impulse response functions for one standard deviation GPR shock. Each graph shows the median response and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

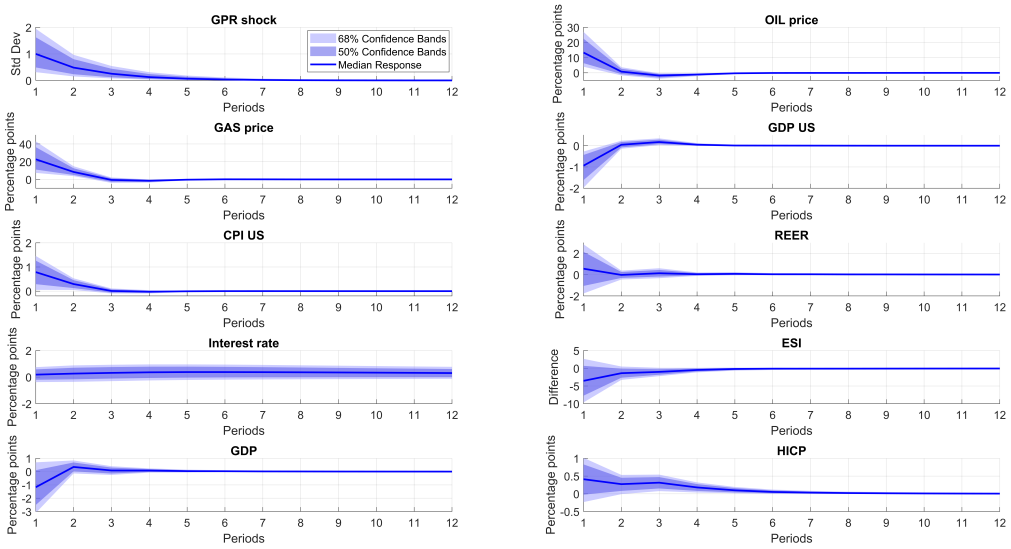


Figure A2.7: Italy. Impulse response functions for one standard deviation GPR shock. Each graph shows the median response and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

Appendix.3 Counterfactual series

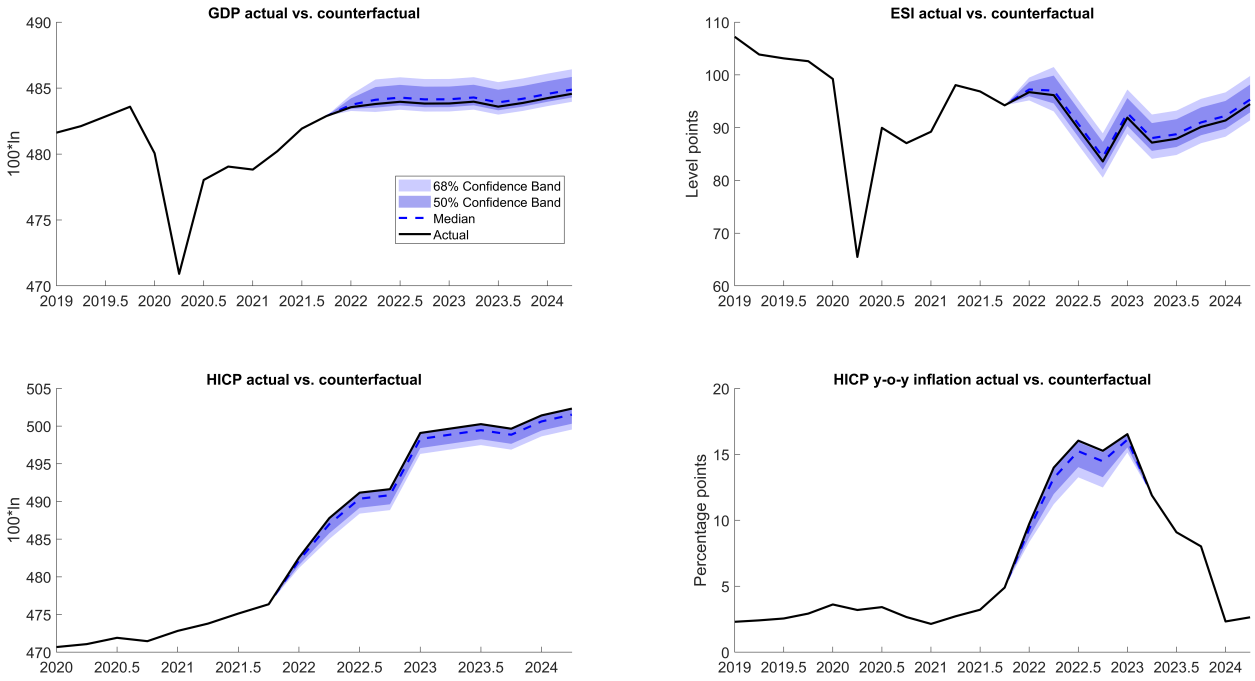


Figure A3.1: Czech Republic. Actual and counterfactual series if Russia had not invaded Ukraine. Each counterfactual series is represented by the median outcome and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

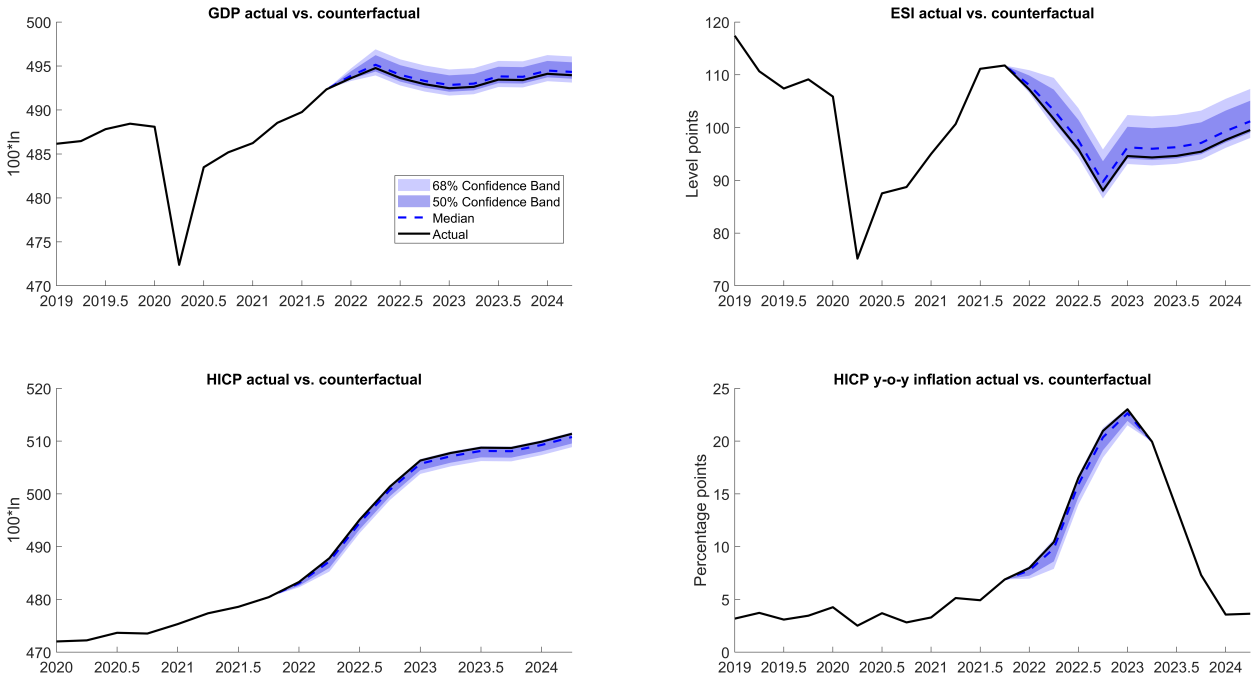


Figure A3.2: Hungary. Actual and counterfactual series if Russia had not invaded Ukraine. Each counterfactual series is represented by the median outcome and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

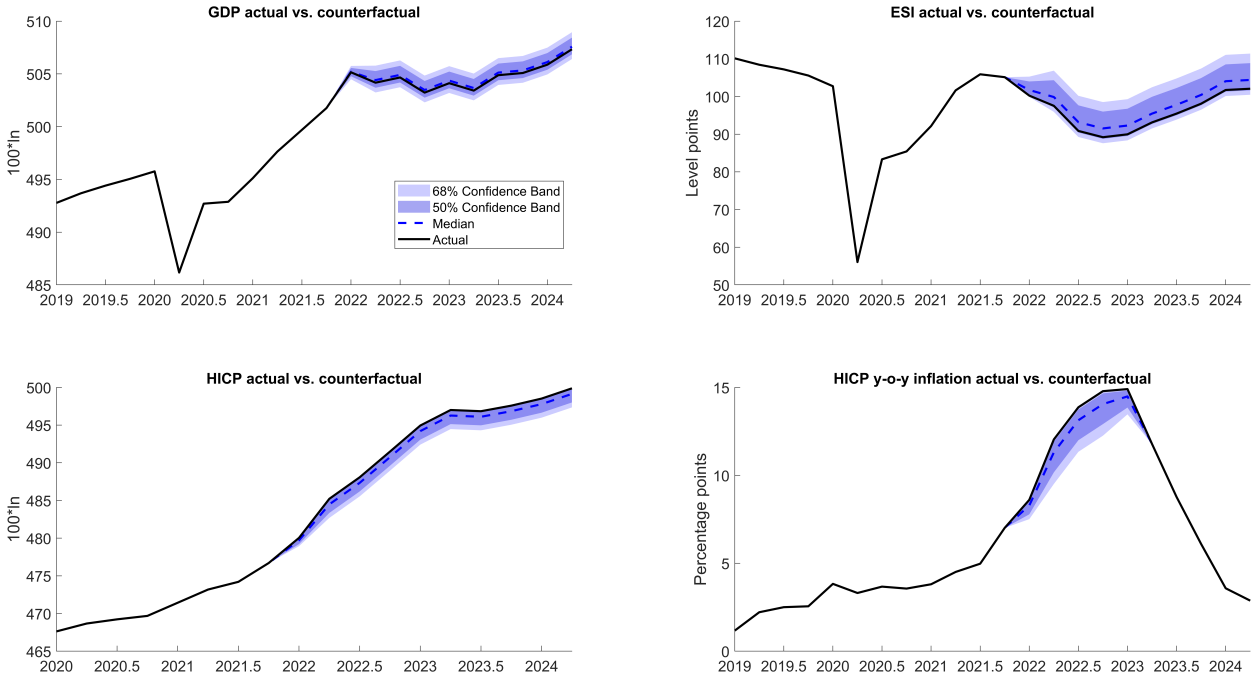


Figure A3.3: Poland. Actual and counterfactual series if Russia had not invaded Ukraine. Each counterfactual series is represented by the median outcome and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

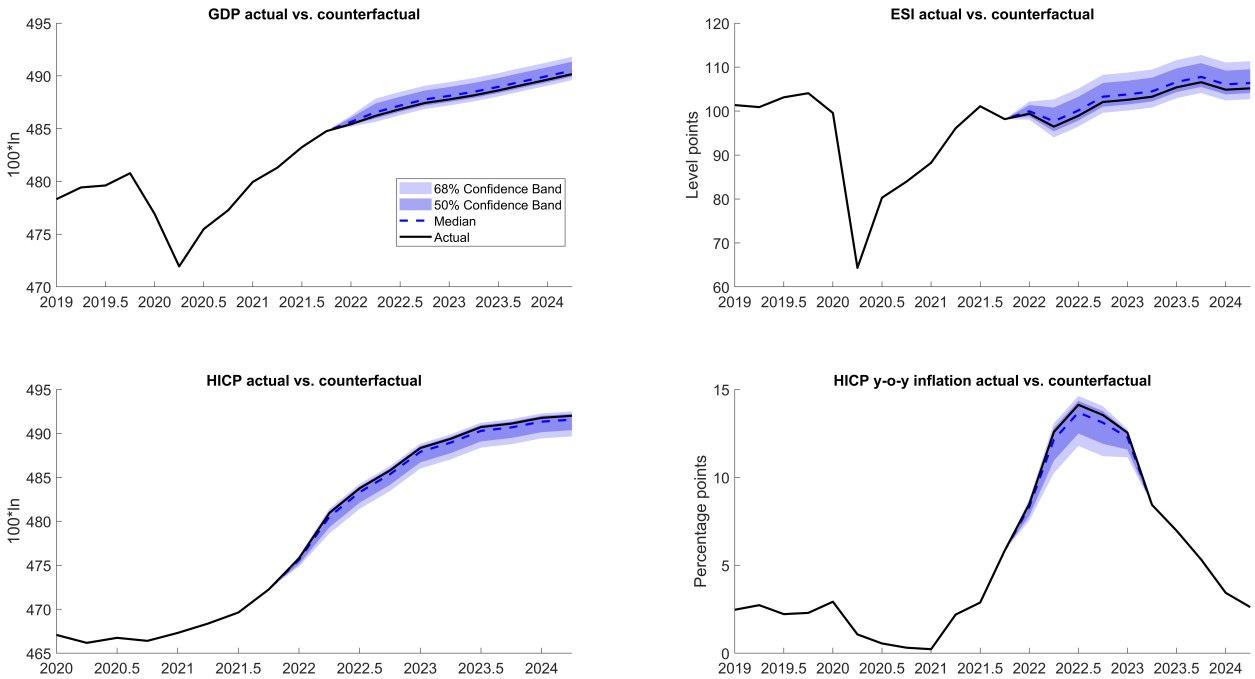


Figure A3.4: Bulgaria. Actual and counterfactual series if Russia had not invaded Ukraine. Each counterfactual series is represented by the median outcome and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

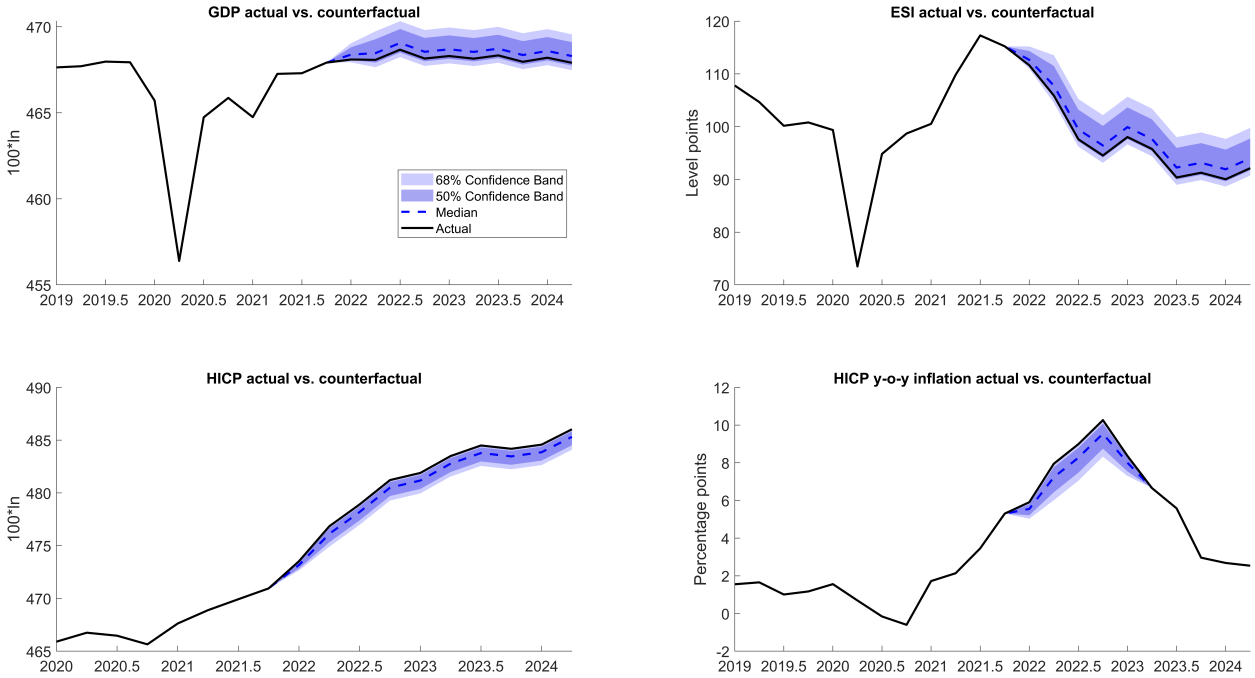


Figure A3.5: Germany. Actual and counterfactual series if Russia had not invaded Ukraine. Each counterfactual series is represented by the median outcome and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

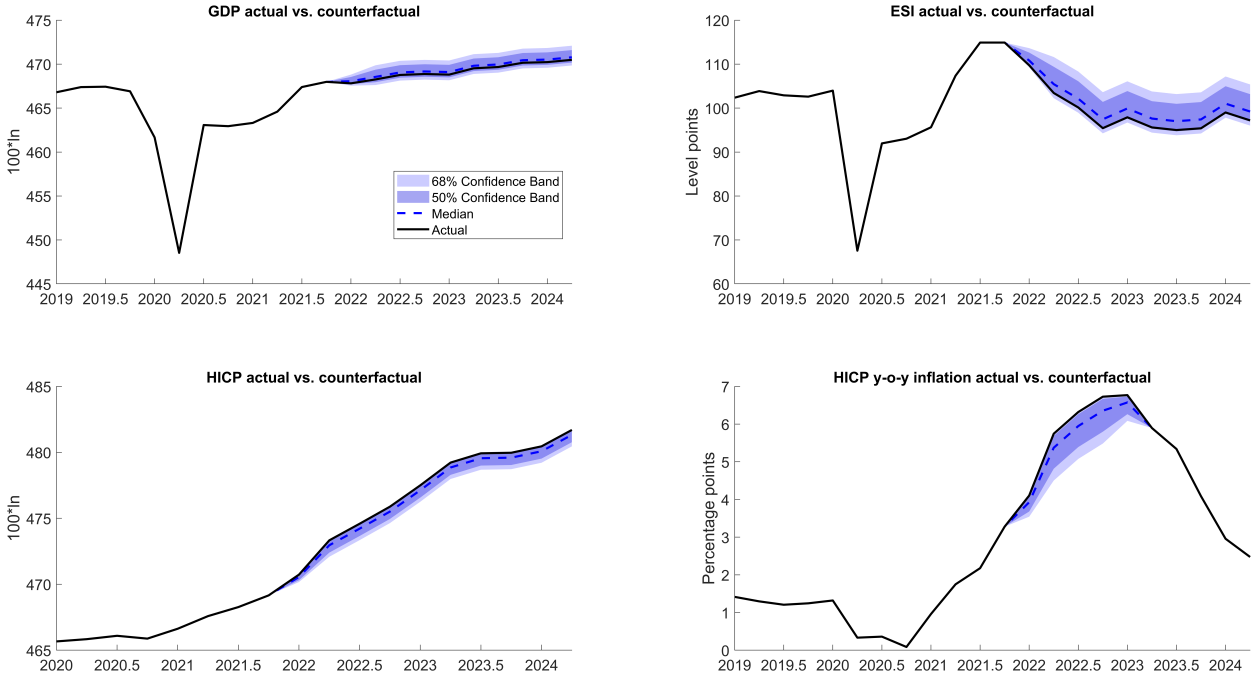


Figure A3.6: France. Actual and counterfactual series if Russia had not invaded Ukraine. Each counterfactual series is represented by the median outcome and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

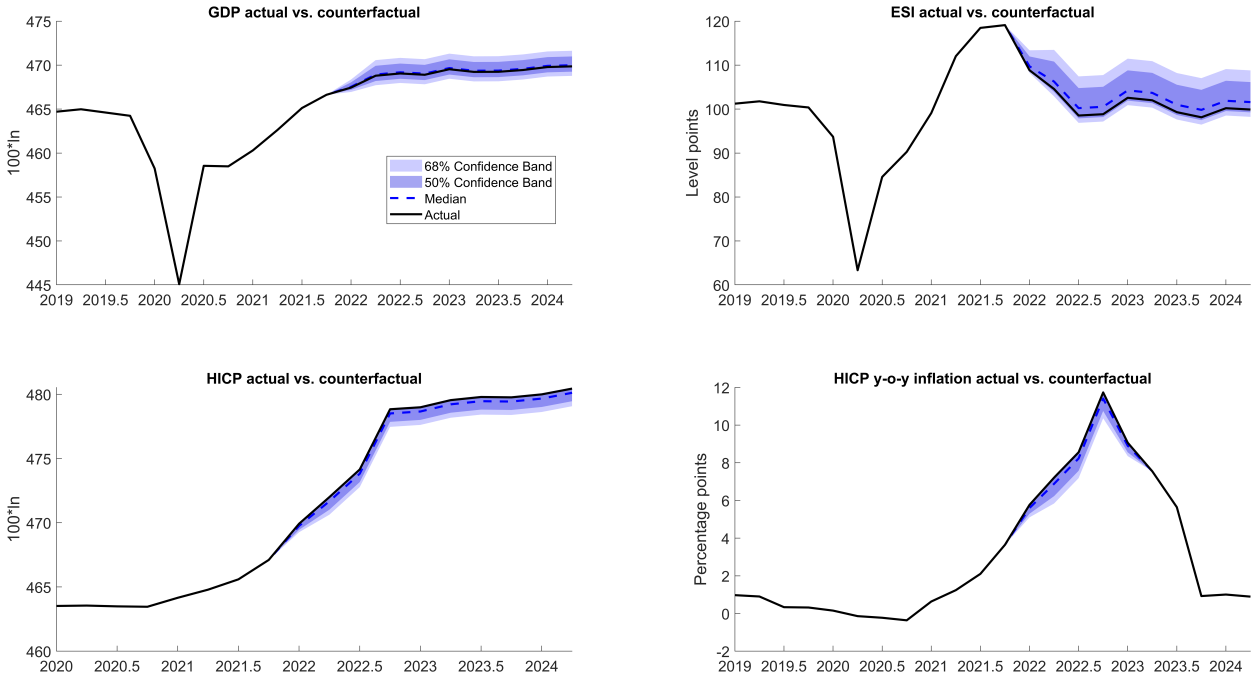


Figure A3.7: Italy. Actual and counterfactual series if Russia had not invaded Ukraine. Each counterfactual series is represented by the median outcome and the corresponding confidence bands with associated probability of 50% and 68%, respectively.

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