
WORKING PAPER

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“On the relationship of country geopolitical risk on energy inflation”

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On the relationship of country geopolitical risk on energy inflation

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Abstract

This paper addresses the effect of country geopolitical risk on energy inflation by employing a methodology that combines fixed effects panel quantile regressions and local projections. The panel covers country-level indicators for 16 OECD countries from January 1990 to December 2022. Results show that adverse country-specific geopolitical events are associated with upside risks on energy inflation whereas the analysis reveals insignificant effects for both the median and left tail of energy inflation distribution.

Keywords: Geopolitical risk; Energy inflation; Fixed effects; Panel data; Quantile regression.

JEL classification: C22; C23; E31; Q40.

1 Introduction

Geopolitical risks are defined as harmful events associated with wars, acts of terror, and conflicts between countries that affect the peaceful process of international affairs (Caldara and Iacoviello, 2022). Energy markets are particularly vulnerable to the effect of geopolitical events since these can influence the supply and demand of energy resources. From a supply-side viewpoint, major geopolitical unrest may interrupt energy supply, but even without disruption in supply, it can cause extreme fluctuations in energy prices. From a demand-side viewpoint, geopolitical tensions may impact the decision-making behaviour of economic agents and market sentiment affecting significantly energy demand.

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Research studies focusing on the impact of geopolitical risks on energy markets have been investigated by [Noguera-Santaella \(2016\)](#), [Antonakakis, Gupta, Kollias, and Papadamou \(2017\)](#), [Cunado, Gupta, Lau, and Sheng \(2019\)](#), [Qin, Hong, Chen, and Zhang \(2020\)](#), [Smales \(2021\)](#), and [Qian, Zeng, and Li \(2022\)](#), among others, but the existing literature remains scarce on the transmission of geopolitical uncertainty into inflation and, in particular, energy inflation. A recent work by [Caldara, Conlisk, Iacoviello, and Penn \(2024\)](#) investigates the effect of geopolitical risks on inflation by employing a quantile regression model, and conclude that adverse shocks to geopolitical risks are associated to high inflation episodes. The relationship between geopolitical risks and oil prices has been examined by [Yang, Dong, Du, and Du \(2023\)](#) and [Lee, Olasehinde-Williams, and Özkan \(2023\)](#) whose findings align with prior research that heightened uncertainty of geopolitical risks increases inflation. Adopting a nonlinear model, [Cheikh, Zaied, and Mattoussi \(2023\)](#) examine the dynamics of oil price and its impact on inflation to study the effects of a given shock under different geopolitical conflicts and conclude that the effect of oil price on inflation is stronger for higher levels of geopolitical uncertainty.

Despite the growing literature on the inflationary impact of geopolitical oil price uncertainty, the nature of the transmission of geopolitical risk to energy inflation remains very under-researched, and this paper aims to fill this existing gap in the literature. We analyze the impact of geopolitical risk on energy inflation for a sample of European countries using a dynamic panel quantile regression that considers country heterogeneity, country-specific geopolitical risk, the geopolitical risk index, and the climate change index, among other controls. The model's estimation requires using instrumental variables to reduce the dynamic bias in the quantile regression fixed effects estimator as observed by [Galvão \(2011\)](#). The set of instrumental variables includes several lagged regressors. Not accounting for the bias could lead to a spurious effect of geopolitical risk on energy inflation, which would be a consequence of the Nickell bias that decreases with the forecast horizon, as noted by [Franta and Gambacorta \(2020\)](#).

The rest of the paper is organised as follows. Section 2 describes the data set. Section 3 presents the empirical methodology. Section 4 discusses the empirical results, and Section 5 concludes the paper. Additional tables and figures are provided in the Supplementary

Appendix.

2 Data

The dataset comprises monthly observations of the Energy Price Index (EPI) from January 1990 to December 2022 for 16 OECD countries from [Ha, Kose, and Ohnsorge \(2023\)](#).¹ For each country considered, annualized month-on-month (*mom*) energy inflation is calculated, subjecting each series to a sequential seasonal adjustment.² Our main covariate is the country-specific geopolitical risk index (CGPR) developed by [Caldara and Iacoviello \(2022\)](#). This index is calculated as the monthly share of articles in ten representative newspapers reporting on negative geopolitical events in the respective country. In addition to these variables, we use the Global Geopolitical Risk (GPR) index from [Caldara and Iacoviello \(2022\)](#), the Chicago Board Options Exchange’s CBOE Volatility Index (VIX) from the Federal Reserve Economic Data of St. Louis, the European Extreme Events Climate Index (E3CI) indicator produced by the European Centre for Medium-Range Weather Forecasts³, and the aggregate oil demand, measured as the growth of the World Industrial Production Index (WIP), as constructed by [Baumeister and Hamilton \(2019\)](#). For a detailed description of the variables and unit root tests we refer to the Supplementary Appendix.

3 Methodology

The effects of geopolitical uncertainty on the conditional distribution of energy inflation shall be analysed by employing a quantile regression dynamic panel model with fixed effects. We assume the latter to capture some individual specific source of variability, or “unobserved heterogeneity”, that is not adequately controlled for by other covariates in the model. Our approach consists of running a sequence of quantile dynamic panel models

¹The countries included in our sample are Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, the United Kingdom, Italy, Japan, the Netherlands, Norway, Portugal, Sweden and the United States.

²We apply the X13-ARIMA-SEATS seasonal adjustment method to the energy price index ([Sax and Eddelbuettel, 2018](#)).

³The United States, Canada, and Japan are excluded from the analysis when considering this variable.

with fixed effects of energy inflation on a structural shock from country-specific geopolitical uncertainty and other covariates for different prediction horizons using local projections developed by [Jordà \(2005\)](#). The τ -th conditional quantile function of the response of the t th observation of energy inflation on the i th country up to h months ahead is formulated as follows:

$$Q_{\tau}(\pi_{i,t+h}^e | CGPR_{it}, \pi_{it-1}^e, \dots, \pi_{it-p}^e, x_{it}) = \alpha_i^h + \gamma^h(\tau)CGPR_{it} + \sum_{j=0}^p \phi_j^h(\tau)\pi_{it-j}^e + x_{it}'\beta^h(\tau) + \epsilon_{i,t+h}(\tau) \quad (1)$$

where $i = 1, \dots, N$, $t = p+1, \dots, T_i - h$, and $h = 1, \dots, 12$. The number of lags of the response variable is set equal to $p = 2$. The response variable π_{it}^e represents energy inflation, the vector of exogenous covariates x_{it} contains the VIX and the aggregate oil demand, and $\epsilon_{i,t}$ is the innovation term. The estimated parameter $\gamma^h(\tau)$ represents the effect of an average tightening of the geopolitical risk on the τ -quantile of the distribution of energy inflation h quarters ahead. We shall estimate the model for quantiles $\tau = 0.10, 0.5, 0.9$ simultaneously, assuming that the fixed effects are the same across the three quantiles while the impact of country geopolitical risk (and remaining covariates) on the future distribution of energy inflation can differ across the quantiles of interest.

[Galvão \(2011\)](#) describe that the ordinary least squares estimators bias in dynamic panel data models due to the correlation between fixed effects and unobserved initial conditions, is extended to the quantile regression fixed effects estimator for a modest time series dimension. As further noted by [Galvão \(2011\)](#) the problem of bias for the dynamic panel quantile regression can be minimized through the use of instrumental variables by incorporating lags (or lagged differences) of the endogenous variables as instruments in every quantile equation; see also [Chernozhukov and Hansen \(2005\)](#). In this work, we follow [Galvão \(2011\)](#) and estimate equation (1) using lags of the response variable and independent variables as instruments, with the lag order being equal to 2. Subsequently, we utilize smoothing regularization on the CGPR coefficients in order to compute the impulse responses, as detailed in reference [Barnichon and Brownlees \(2019\)](#). The smoothness parameter is determined by cross-validation such that it minimizes the mean squared error

of the impulse response estimator.

4 Empirical results

We present the results of our baseline specification, focusing on the effect of CGPR (normalised to one standard deviation) on the conditional distribution of energy inflation (in percent) for different forecast horizons.

Figure 1 illustrates the effect of the CGPR on the 10th, 50th and 90th percentiles of energy inflation, plotted alongside the confidence bands of 90% and 68%. The confidence intervals for the local projections are created using the moving block bootstrap developed by Gonçalves (2011) for panel data regression models with individual fixed effects. Our baseline regression suggests that the CGPR mainly affects the right tail of the energy inflation distribution over the next month, while it shows insignificant effects for the median and the left tail. Specifically, a one standard deviation increase in country-specific geopolitical risk implies a four percentage point increase in energy inflation in the country concerned. This suggests that increased domestic geopolitical risk is associated with upside risks for energy inflation.

This effect is consistent with related literature that studies the impact of geopolitical risk on a measure of inflation or energy uncertainty. Caldara, Conlisk, Iacoviello, and Penn (2024) finds that a normalized CGPR shock is associated with an increase in headline inflation of 1 to 2 percentage points over a two-year period. Using an energy inflation indicator, Yilmazkuday (2024) finds that the partial effect of normalized GPR leads to an increase in global energy uncertainty (normalized) of about 1.13 units in the long run (after two years). Our results are also consistent with the literature on the significant transmission channel of geopolitical risk to other energy commodities (Qin, Hong, Chen, and Zhang, 2020; Liu, Han, and Xu, 2021; Jin, Zhao, Bu, and Zhang, 2023; Yang, Dong, Du, and Du, 2023).

To check the robustness of the 90 percentile response of energy inflation, we consider the scenario in which we control for global geopolitical risk (Figure 2b) and the E3CI (Figure 2c), both individually and jointly (Figure 2d). In all cases, the effects remain

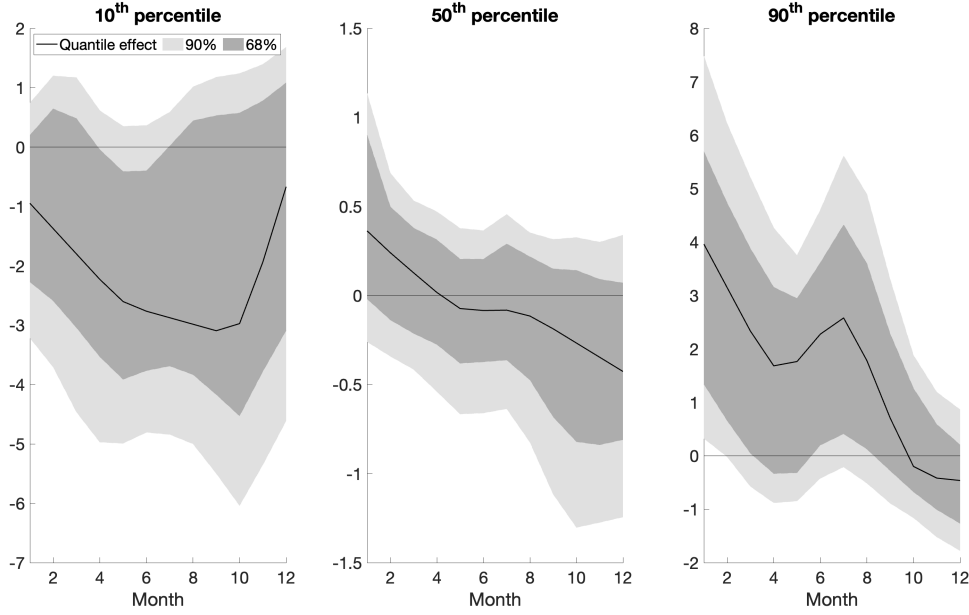


Figure 1: **Baseline specification for energy inflation.** Responses of 10th, 50th, and 90th percentiles of energy inflation to a one standard deviation of CGPR. Note: The y -axis indicates percentage point change in annualised *month-on-month* energy inflation.

regarding both sign and size. In particular, a domestic increase in geopolitical risk is found to significantly increase a country’s energy inflation even after controlling for the global GPR index, consistent with the results of [Caldara, Conlisk, Iacoviello, and Penn \(2024\)](#).

Finally, we assess how different the effect of CGPR on energy inflation and headline inflation is by applying the specification (1) to headline inflation; see the Supplementary Appendix. As expected, the effect of CGRP on inflation at the 90th percentile is smaller than the observed effect on energy inflation, which is about 0.4 percentage points in the next month. Nevertheless, we find statistically significant effects at both the 10th and 50th percentile, consistent with the results of [Caldara, Conlisk, Iacoviello, and Penn \(2024\)](#).

5 Conclusions

This paper finds that the country geopolitical risk is relevant in explaining upside risk of energy inflation in a sample of 16 OECD countries. We find that this effect is robust across different specifications. Moreover, the upside risk effect of a country-specific geopolitical shock is larger for energy inflation than for headline inflation.

Overall, our results show how sensitive energy markets are to geopolitical events, as

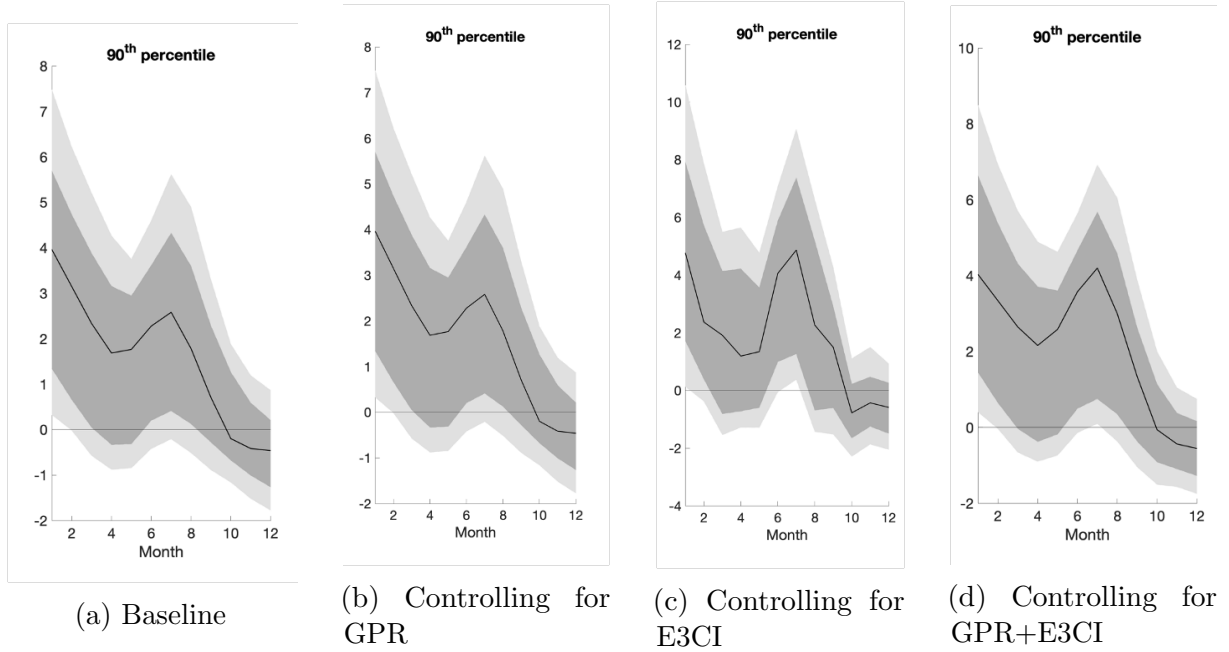


Figure 2: **Alternative specifications for energy inflation.** Responses of 90th percentiles of energy inflation to a one standard deviation of CGPR for alternative specifications, presented alongside 90% and 68% confidence bands. Note: The y -axis indicates percentage point change in annualised *month-on-month* energy inflation.

these can affect the supply and demand for energy resources. In this context, private agents and policymakers may have incentives to diversify this risk by producing, investing in, or importing energy from alternative sources.

Appendix

See supplementary material.

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Supplementary material to “On the relationship of country geopolitical risk on energy inflation”

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Introduction

This document is organised as follows. Section 1 presents a comprehensive analysis and figures corresponding to the variables used in our paper. Sections 2 and 3 present supplementary results for the impulse response functions of Country Geopolitical Risk (CGPR) on energy inflation and on headline inflation, respectively.

1 Detailed data description

Our dataset covers various indicators for 16 OECD countries from January 1990 to December 2022. The countries included in the study are Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, the United Kingdom, Italy, Japan, the Netherlands, Norway, Portugal, Sweden, and the United States. The calculations and a brief description of the variables used in the empirical analysis are presented in [Table 1](#).

Inflation. We consider country-level monthly energy inflation and headline inflation indicators for 16 OECD countries from January 1990 to December 2022; see [Figure 1](#) and [Figure 2](#), respectively. The latter indicator is based on the headline Consumer Price Index (CPI), which incorporates all goods and services, while the former only includes housing, water, electricity, gas, and other fuels. This information is obtained from [Ha et al. \(2023\)](#), who gather CPI data from various countries and sources worldwide. We apply the seasonal adjustment method X13-ARIMA-SEATS to these price index ([Sax and Eddelbuettel, 2018](#)).

Geopolitical risks. To measure geopolitical risks, we utilize both the country-specific Geopolitical Risk Index (CGPR) and the Global Geopolitical Risk Index (GPR) constructed by [Caldara and Iacoviello \(2022\)](#); see [Figures 3](#) and [5](#), respectively. These indexes are expressed as a monthly share of articles in ten representative newspapers covering adverse geopolitical events. Moreover, the country-level index mainly captures the US perspective

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on risks posed by the country, as it utilizes newspapers from the US, Canada, and the UK, starting in 1985.

Oil shocks. Following the literature on oil shocks, we consider the aggregate oil demand (Figure 5), proxied by the log-difference of the World Industrial Production Index (WIP) constructed by Baumeister and Hamilton (2019); see Kilian (2009), Kilian and Manzanelli (2007) and Baumeister and Hamilton (2019) for a discussion on oil shocks. Similarly, Yang et al. (2023) uses a similar variable when studying the linkages between oil shocks, geopolitical risks, and inflation for US, China, and Eurozone.

Climate risks and financial risk. To capture climate risks, we consider the European Extreme Events Climate Index (E3CI), which provides information about the frequency and severity of weather-induced hazards over Europe (see Figure 4). As for financial risk, we consider the Chicago Board Options Exchange, CBOE Volatility Index (VIX); see Figure 5.

Table 1: Data Sources and Descriptions

Variable	Description	Source
π_{it+h}^h	Monthly annualized headline inflation: $\pi_{it+h}^h = \log(P_{it+h}^h/P_{it}^h)(12/h)100$	Based on Ha et al. (2023).
π_{it+h}^e	Monthly annualized energy inflation: $\pi_{it+h}^e = \log(P_{it+h}^e/P_{it}^e)(12/h)100$	Based on Ha et al. (2023).
agg_t	Monthly log-difference of world industrial production index.	Baumeister and Hamilton (2019).
VIX_t	Chicago Board Options Exchange, CBOE Volatility Index	FRED database.
$CGPR_{it}$	Country-specific Geopolitical Risk Index. Each index is expressed as a monthly share of newspaper articles. The resulting indices capture the U.S. perspective on risks posed by, or involving, the country in question.	Caldara and Iacoviello (2022).
GPR_t	Global Geopolitical Risk Index.	Caldara and Iacoviello (2022).
$E3CI_{it}$	The European Extreme Events Climate Index (E3CI) provides information about the frequency and severity of weather-induced hazards over Europe.	Foundation Big Data and Artificial Intelligence for Human Development.

1.1 Unit root tests

To test the stationarity of our variables, we apply the Augmented Dickey Fuller test with drift and lag selection based on the Akaike information criteria. The corresponding 5% critical value of the test is -2.87. The results are shown in Table 2. All the variables included in our analysis are I(0) with 5% significance level.

2 Additional results for energy inflation

As previously outlined in the methodology section of the main paper, we employ smoothing regularization on the CGPR coefficients to compute the impulse responses; see Barnichon and Brownlees (2019) for details on the estimation procedure. The degree of shrinkage, λ , is chosen by based on cross-validation. Figure 6 illustrates the mean weighted

absolute prediction error for our baseline specification with $\lambda \in \{0.10, 0.25, 0.50, 1, 2.5, 5\}$ across different forecasting horizons. In this regard, we set $\lambda = 5$ to compute the impulse response of CGPR on energy inflation, as it exhibits the lowest prediction error. The λ values for the rest of specifications are calculated in the same way.

Additionally, we present the complete results for the 10th, 50th, and 90th percentile response of CGPR on energy inflation, when we control for GPR (Figure 8) and E3CI (Figure 7), individually, and jointly (Figure 9).

3 Additional results for headline inflation

Again, we use cross-validation for λ to compute the impulse response of CGPR on headline inflation.

We present the complete results for the 10th, 50th, and 90th percentile response of CGPR on headline inflation for the baseline specification (Figure 10), and when controlling for GPR (Figure 12) and E3CI (Figure 11), individually, and jointly (Figure 13).

Table 2: Unit root tests

Country	Inflation		Energy inflation		GPR		CGPR	
	t	I(.)	t	I(.)	t	I(.)	t	I(.)
Belgium	-11.863458	I(O)	-11.617758	I(O)	-9.1789688	I(O)	-8.0464019	I(O)
Canada	-13.306625	I(O)	-15.818528	I(O)	-9.1789688	I(O)	-9.7293893	I(O)
Deutschland	-10.844829	I(O)	-13.920789	I(O)	-9.1789688	I(O)	-8.0732097	I(O)
Denmark	-13.012514	I(O)	-15.888043	I(O)	-9.1789688	I(O)	-10.419173	I(O)
Spain	-10.578111	I(O)	-13.97657	I(O)	-9.1789688	I(O)	-10.809931	I(O)
Finland	-9.6620497	I(O)	-13.284013	I(O)	-9.1789688	I(O)	-9.2960272	I(O)
France	-11.712241	I(O)	-14.172537	I(O)	-9.1789688	I(O)	-9.9314776	I(O)
United Kingdom	-9.1852525	I(O)	-12.551171	I(O)	-9.1789688	I(O)	-8.8112	I(O)
Italy	-8.9670401	I(O)	-12.477116	I(O)	-9.1789688	I(O)	-9.7393227	I(O)
Japan	-13.563342	I(O)	-11.755359	I(O)	-9.1789688	I(O)	-9.1811467	I(O)
The Netherlands	-13.051948	I(O)	-13.121364	I(O)	-9.1789688	I(O)	-10.541588	I(O)
Norway	-12.316721	I(O)	-15.182683	I(O)	-9.1789688	I(O)	-8.7598259	I(O)
Portugal	-6.4490977	I(O)	-12.432359	I(O)	-9.1789688	I(O)	-11.167255	I(O)
Swedeen	-9.9936467	I(O)	-17.182336	I(O)	-9.1789688	I(O)	-7.7792265	I(O)
United States	-12.083006	I(O)	-14.547507	I(O)	-9.1789688	I(O)	-8.8874815	I(O)
Country	VIX		Log-diff. WPI		E3CI			
	t	I(.)	t	I(.)	t	I(.)		
Belgium	-6.0031343	I(O)	-13.927952	I(O)	-12.954385	I(O)		
Canada	-6.0031343	I(O)	-13.927952	I(O)				
Deutschland	-6.0031343	I(O)	-13.927952	I(O)	-12.026164	I(O)		
Denmark	-6.0031343	I(O)	-13.927952	I(O)	-13.853004	I(O)		
Spain	-6.0031343	I(O)	-13.927952	I(O)	-10.740492	I(O)		
Finland	-6.0031343	I(O)	-13.927952	I(O)	-11.79259	I(O)		
France	-6.0031343	I(O)	-13.927952	I(O)	-12.618565	I(O)		
United Kingdom	-6.0031343	I(O)	-13.927952	I(O)	-14.363132	I(O)		
Italy	-6.0031343	I(O)	-13.927952	I(O)	-11.270479	I(O)		
Japan	-6.0031343	I(O)	-13.927952	I(O)				
The Netherlands	-6.0031343	I(O)	-13.927952	I(O)	-13.850531	I(O)		
Norway	-6.0031343	I(O)	-13.927952	I(O)	-13.122022	I(O)		
Portugal	-6.0031343	I(O)	-13.927952	I(O)	-13.907167	I(O)		
Swedeen	-6.0031343	I(O)	-13.927952	I(O)	-11.041101	I(O)		
United States	-6.0031343	I(O)	-13.927952	I(O)				

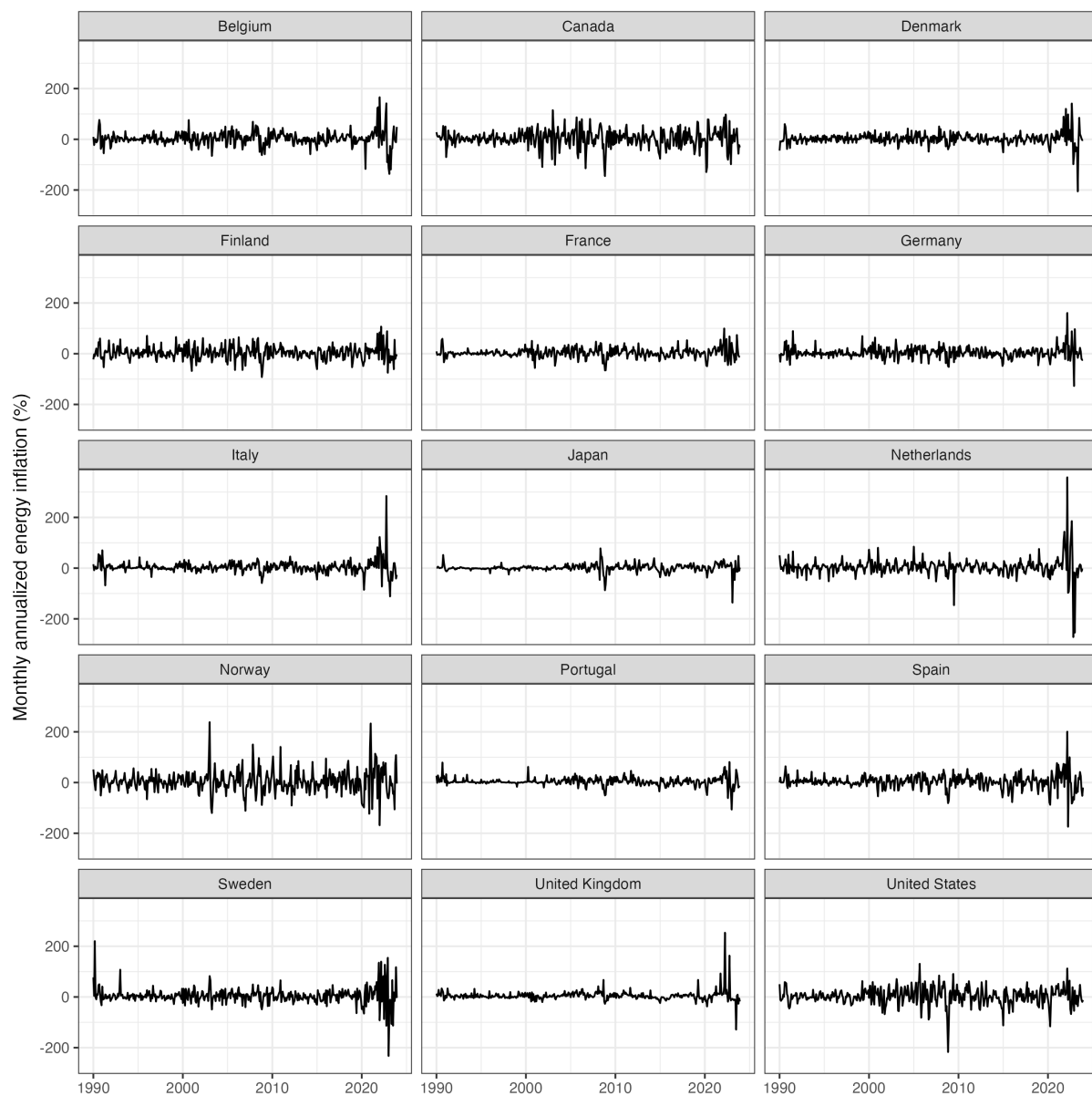


Figure 1: Monthly annualized energy inflation (%)

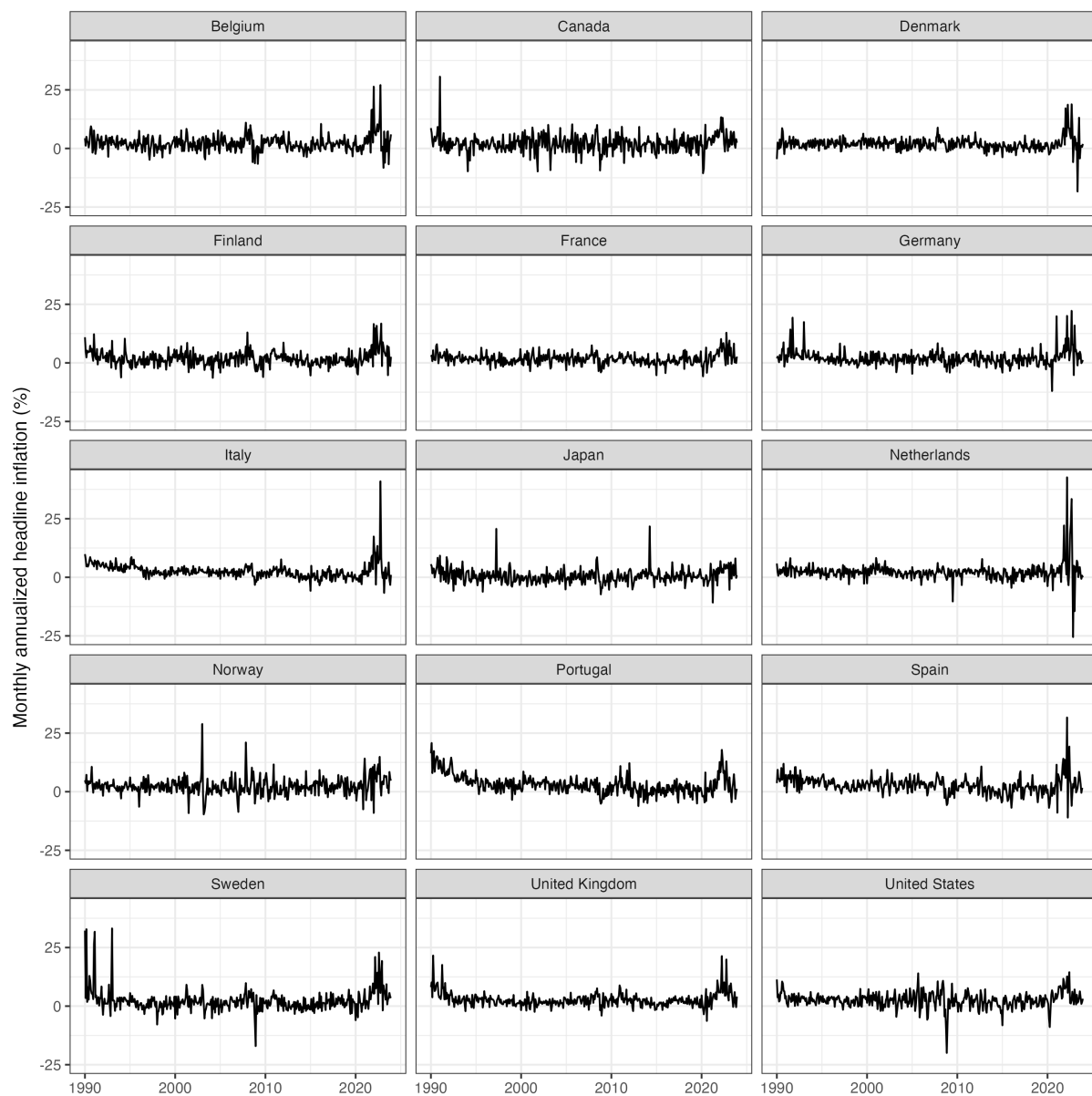


Figure 2: Monthly annualized headline inflation (%)

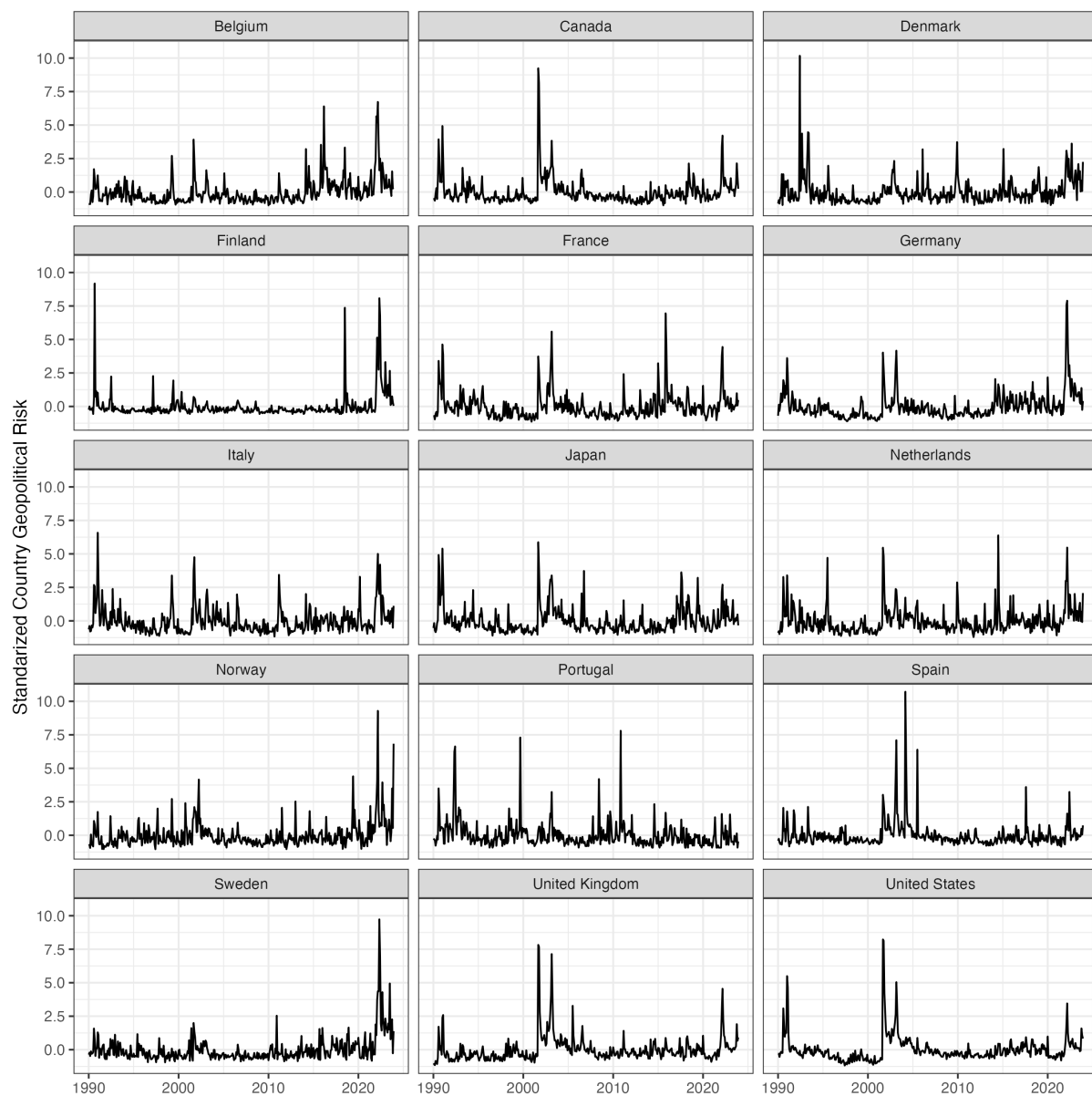


Figure 3: Country Geopolitical Risk index

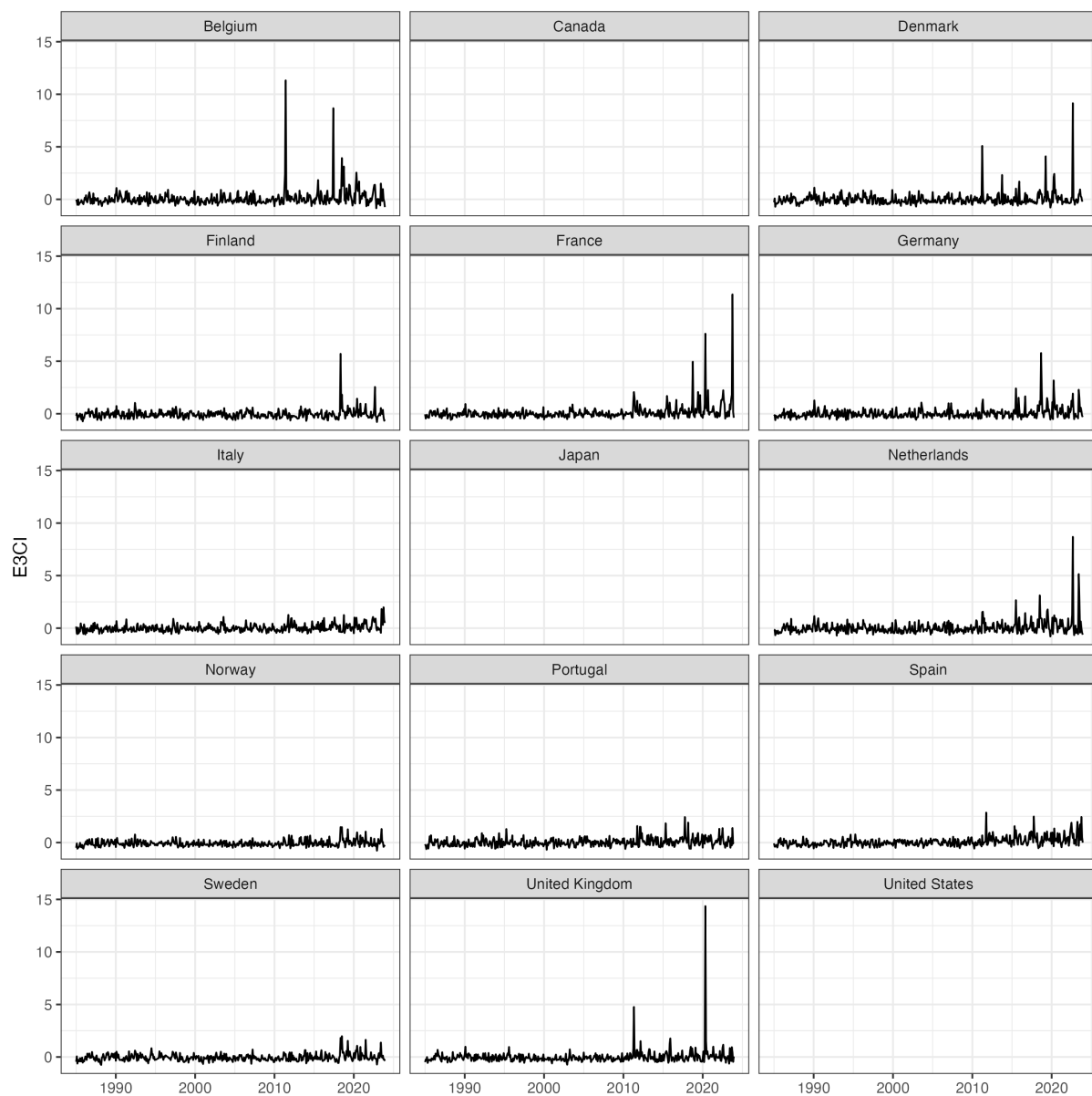


Figure 4: European Extreme Events Climate Index

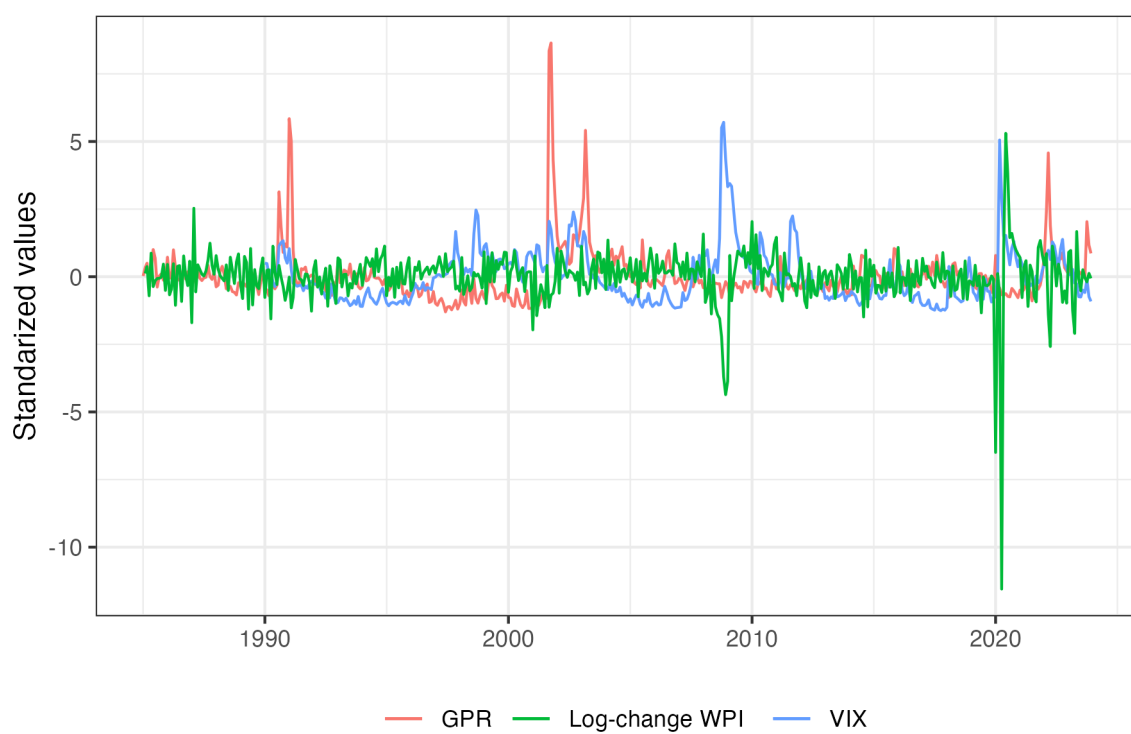


Figure 5: Other controls with variation at the time dimension

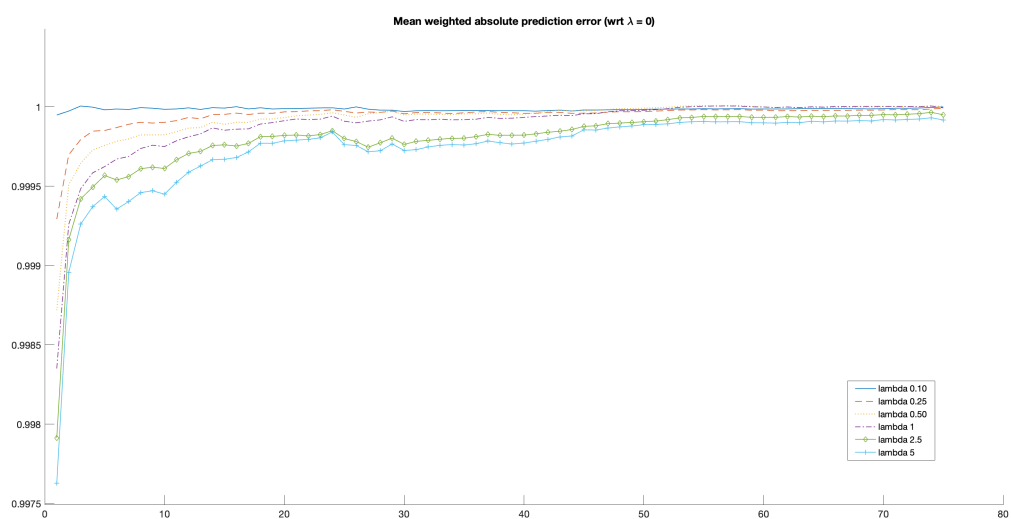


Figure 6: Cross-validation of shrinkage parameter λ for the baseline specification of energy inflation.

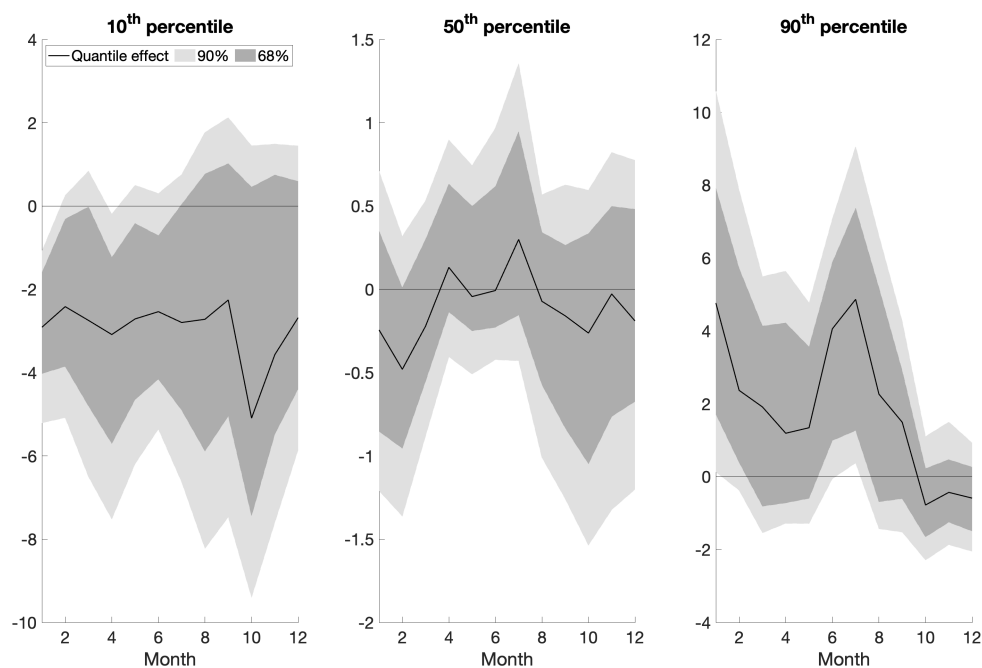


Figure 7: **Baseline specification for energy inflation with E3CI.** Responses of 10th, 50th, and 90th percentiles of energy inflation to a one standard deviation of Country Geopolitical Risk. Note: The y-axis indicates percentage point change in annualized *month-on-month* energy inflation.

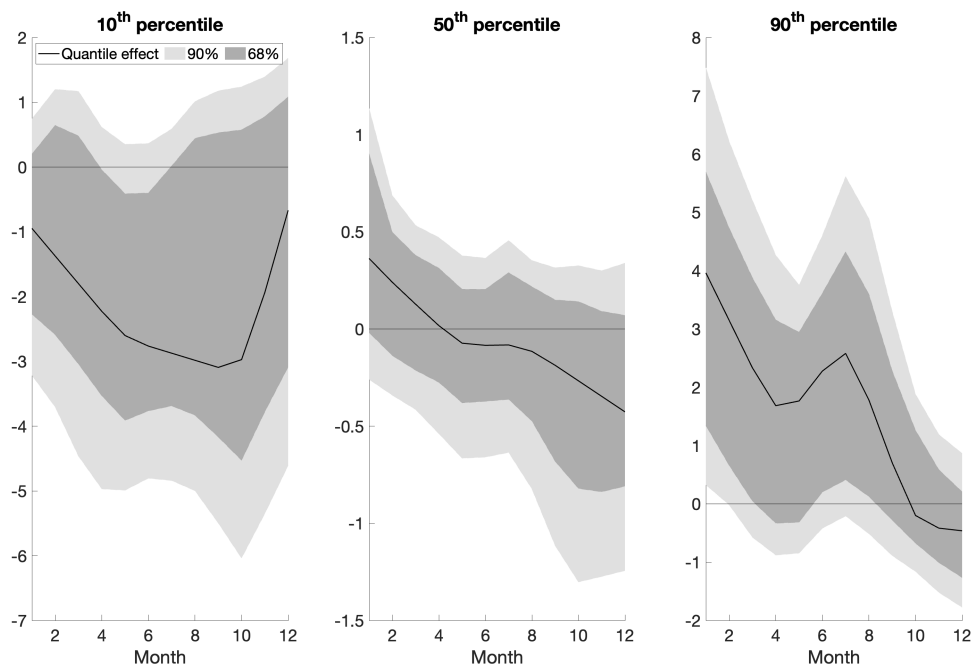


Figure 8: **Baseline specification for energy inflation with GPR.** Responses of 10th, 50th, and 90th percentiles of energy inflation to a one standard deviation of Country Geopolitical Risk. Note: The y-axis indicates percentage point change in annualized *month-on-month* energy inflation.

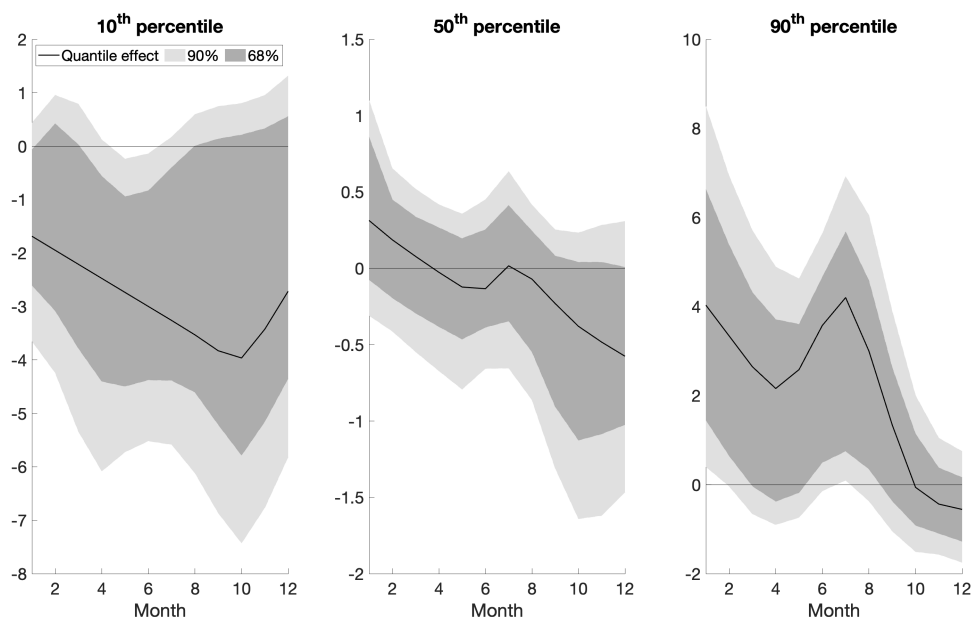


Figure 9: **Baseline specification for energy inflation with GPR and EC3I.** Responses of 10th, 50th, and 90th percentiles of energy inflation to a one standard deviation of Country Geopolitical Risk. Note: The y-axis indicates percentage point change in annualized *month-on-month* energy inflation.

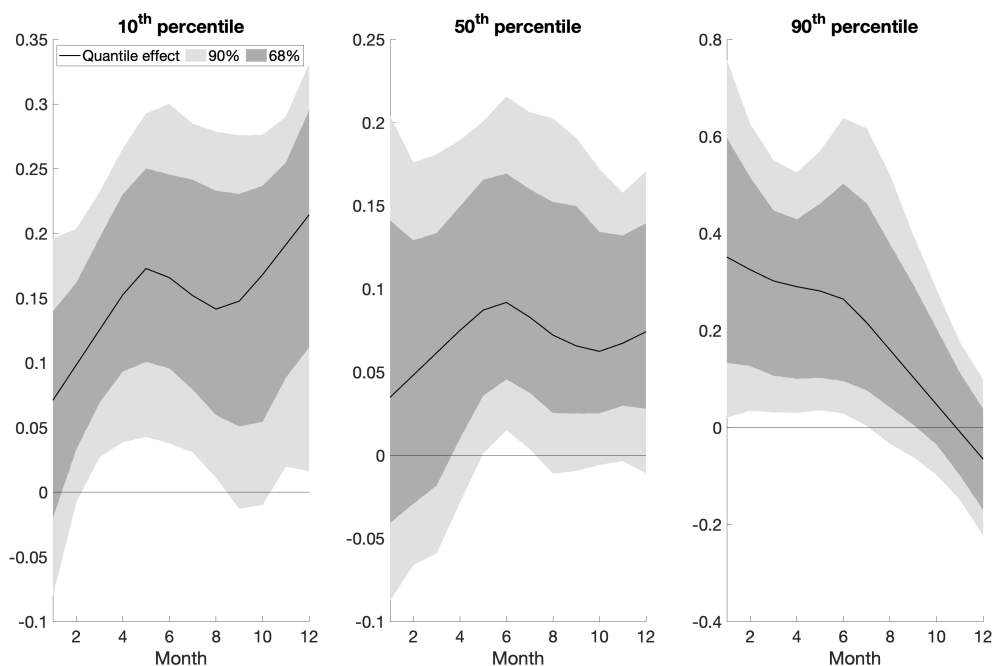


Figure 10: **Baseline specification for headline inflation.** Responses of 10th, 50th, and 90th percentiles of headline inflation to a one standard deviation of Country Geopolitical Risk. Note: The y-axis indicates percentage point change in annualized *month-on-month* headline inflation.

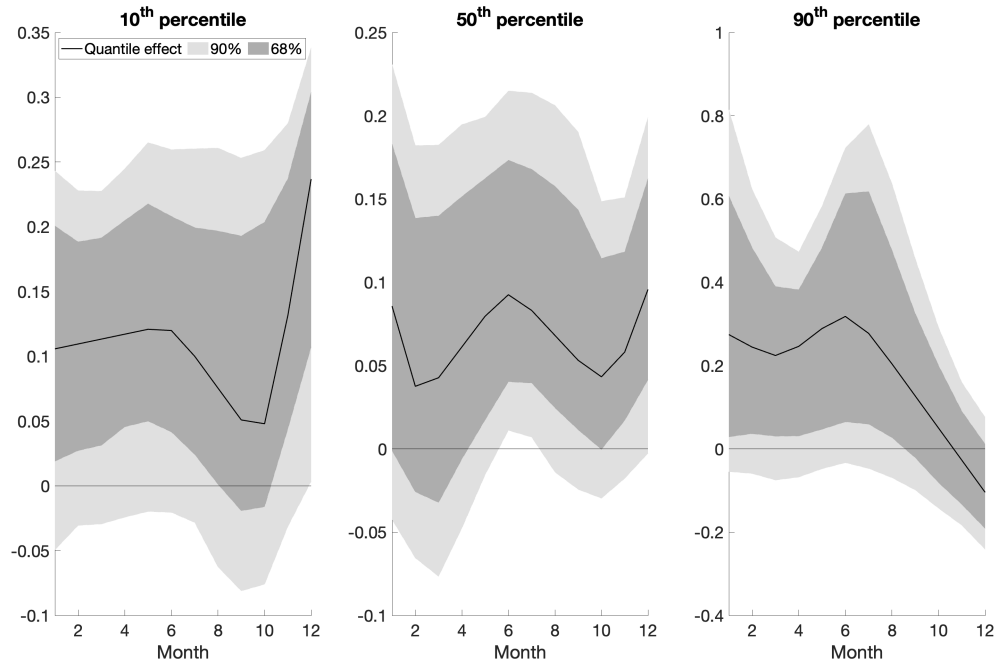


Figure 11: **Baseline specification for headline inflation with E3CI.** Responses of 10th, 50th, and 90th percentiles of headline inflation to a one standard deviation of Country Geopolitical Risk. Note: The y-axis indicates percentage point change in annualized *month-on-month* headline inflation.

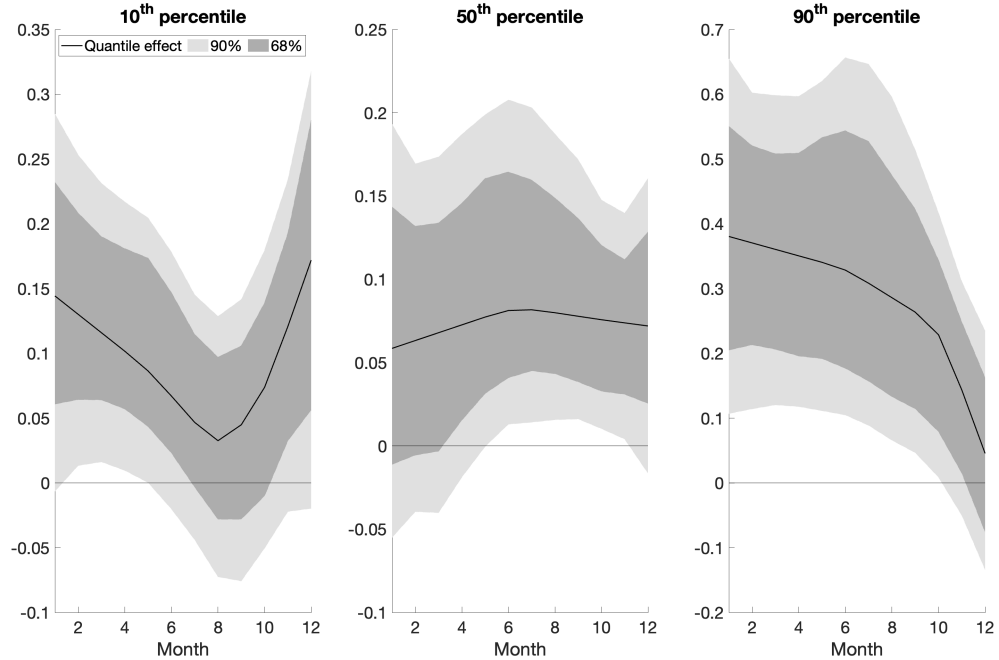


Figure 12: **Baseline specification for headline inflation with GPR.** Responses of 10th, 50th, and 90th percentiles of headline inflation to a one standard deviation of Country Geopolitical Risk. Note: The y-axis indicates percentage point change in annualized *month-on-month* headline inflation.

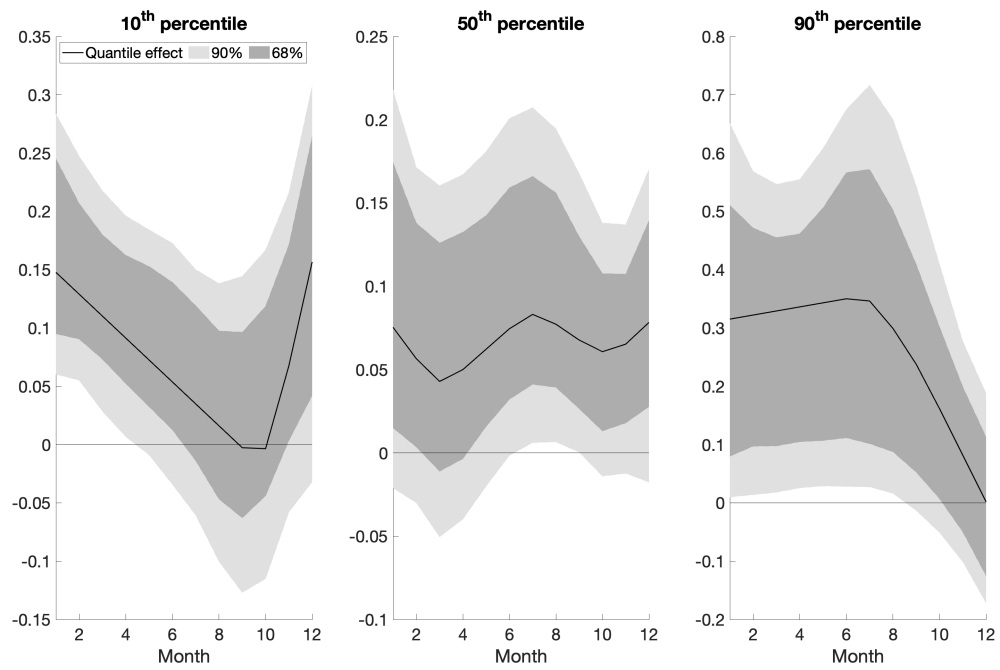


Figure 13: **Baseline specification for headline inflation with GPR and EC3I.** Responses of 10th, 50th, and 90th percentiles of headline inflation to a one standard deviation of Country Geopolitical Risk. Note: The y-axis indicates percentage point change in annualized *month-on-month* headline inflation.

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