

The economic consequences of threats to energy transportation

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Pipelines, tankers and terminals are exposed

- **Nord Stream sabotage (2022)**: no immediate effect on European supplies, since Nord Stream 2 never entered service and Nord Stream 1 had been shut since August, yet gas prices surged on fears of further sabotage
- **Colonial Pipeline ransomware (May 2021)**: the largest cyberattack on oil infrastructure in US history; operations halted, fuel shortages in several states
- **Gulf of Oman (2019)**: after tanker sabotage, war risk insurance premiums for supertankers in the Persian Gulf rose from US\$50,000 to US\$185,000
- Drone warfare and piracy add to the list. Yet empirical work on the **macroeconomic and oil market effects** of such threats remains limited

Question

How do threats to energy transportation affect oil markets and the global economy?

- A new **energy transportation uncertainty (ETU) index**: news articles from over 50 global newspapers, focused on the *midstream* (pipelines, terminals, ships)
- A **Bayesian structural VAR** of the oil market (six variables, monthly, 1974–2023); the index is an external proxy that identifies an uncertainty shock through correlation restrictions
- Responses of real oil prices, oil production and inventories, world industrial production, geopolitical risk and fertilizer prices
- Variance and historical decompositions; extensions to exchange rates and natural gas prices

Preview of results

- **Real oil prices rise**: demand surpasses supply because of logistical problems in the supply chain
- **Production dips, then rebounds** to its pre-shock level; **inventories are drawn down** to smooth consumption
- **Geopolitical risk rises** and **world industrial production falls**, persistently
- The shock explains a sizeable share of historical swings in oil prices and geopolitical risk in a few episodes: the 1980s (Soviet pipeline sanctions, Tanker War) and the 2022 invasion of Ukraine and Nord Stream sabotage
- Results hold when the sample drops 2022 or the post-COVID period, and under a long list of specification changes

Identification rests on correlation restrictions with an external index; the paper discusses endogeneity and omitted factors.

Related literature and contribution

1. **Uncertainty shocks:** economic policy uncertainty (Baker et al. 2016), Federal Reserve policy (Husted et al. 2020), world uncertainty (Ahir et al. 2022), trade policy and geopolitical risk (Caldara, Iacoviello, et al. 2020; Caldara and Iacoviello 2022)
2. **News-based oil indices:** oil price uncertainty (Abiad and Qureshi 2023), OPEC news (Plante 2019), energy uncertainty (Dang et al. 2023)
3. **Supply chain disruptions:** mostly shipping costs and the recent inflation surge (Benigno et al. 2022; Finck et al. 2024); De Santis (2024) link them to energy supply for the Euro Area

Gap and contribution

Little evidence on threats to energy supply chains such as pipelines, terminals and ships. The paper contributes a **text-based measure of energy transportation uncertainty**, built in the spirit of Baker et al. (2016), and traces its effects in an oil-market SVAR.

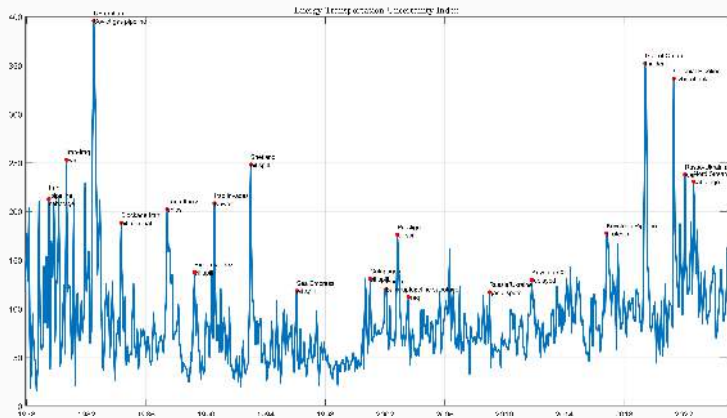
The ETU Index

Building the index: three keyword blocks

Block	Terms (examples from the paper)
Energy (E)	oil, gas, petroleum, energy; pipeline transmission of crude oil and natural gas
Transportation (T)	midstream, pipeline, transport, rail, barge, tanker, truck, shipping, storage terminal, infrastructure
Uncertainty (U)	threat, warn, fear, risk, concern

- Index: monthly **relative frequency of articles** matching the query, as in Baker et al. (2016)
- An energy term must appear in the headline or leading paragraphs, with an E and a T term within 5 words of each other; articles must exceed 150 words
- Excluded to keep **supply-side events**: news digests, calendars, routine market news, news agency material, letters, headline-only content, listings and similar
- Sources: English-language media worldwide, from the US and UK to the Gulf states, Russia, Spain, Germany and France

The index tracks identifiable events



Notes: Monthly ETU index, 1978–2024, with the main events labelled.

- Largest labelled peak: the early-1980s US embargo on the Soviet gas pipeline
- Tanker War, Exxon Valdez, Prestige, Gulf of Oman, Colonial Pipeline, Nord Stream
- **Relatively calm** from the mid-1990s to the early 2000s

Does the index measure something new?

Correlation with ETU	ρ
Economic policy uncertainty (Baker et al. 2016)	0.25
Oil price uncertainty (Abiad and Qureshi 2023)	0.21
Trade policy uncertainty (Caldara, Iacoviello, et al. 2020)	0.22

- All below 0.26: the paper reads the ETU index as a **distinct** phenomenon, focused on infrastructure and logistics in the midstream
- The Tanker War does not show up in the geopolitical risk index of Caldara and Iacoviello (2022), but does in ETU
- ETU does not account for the 2003–2008 oil price surge nor the fall after the financial crisis, which the literature attributes to demand (Kilian 2009): read by the paper as **validation**

Empirical Strategy

Model and data

- A VAR with $p = 24$ lags, standard for monthly oil-market models (Kilian and Zhou 2022); monthly data, January 1974 to December 2023 (600 observations)

$$y_t = c + \sum_{i=1}^p \mathcal{A}_i y_{t-i} + \varepsilon_t, \quad y_t \equiv (p_t^o, \Delta q_t^w, \Delta i_t^w, y_t^w, \zeta_t, p_t^f)'$$

- p^o : real oil price (US refiners' acquisition cost of imported crude, deflated by US CPI); Δq^w : growth of world oil production (EIA)
- Δi^w : change in global crude oil inventories (Kilian and Murphy 2014); y^w : world industrial production (Baumeister and Hamilton 2019)
- ζ : geopolitical risk (Caldara and Iacoviello 2022); p^f : real fertilizer price (World Bank), an anchor variable (Boer et al. 2023)

Sources

Data series

Identification and estimation

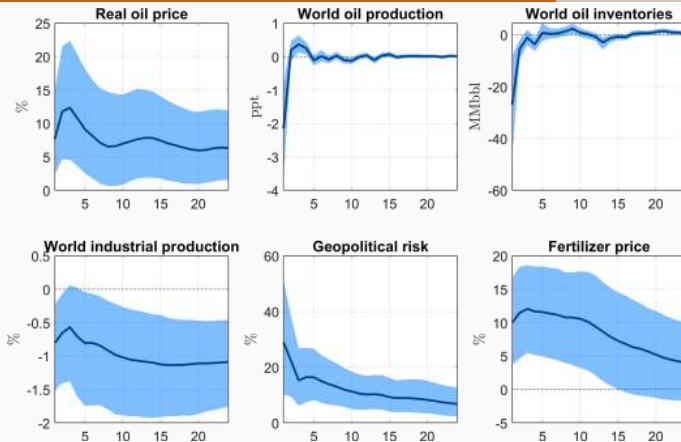
- Reduced-form innovations are combinations of structural shocks: $\varepsilon_t = A_0^{-1} \eta_t$
- The ETU index S_t is an **external proxy**. The uncertainty shock $\eta_{1,t}$ must be correlated with it (Ludvigson et al. 2021; Morão 2024):

$$\rho_1 = \text{corr}(S_t, \eta_{1,t}) \geq \bar{c}$$

- Sign restrictions are added; they come from early results with recursive identification and from economic theory
- **Bayesian estimation:** Minnesota prior (Giannone et al. 2015), sum-of-coefficients and dummy-initial-observation priors; Gibbs sampler with 4,000 iterations, 3,000 of them burn-in
- Responses are shown with 68% credible bands; the shock is normalized to raise the real oil price by 10% on impact

Results

Impulse responses to an ETU shock



Notes: Posterior median and 68% credible bands; shock normalized to raise the real oil price by 10% on impact.

- **Real oil price** rises
- **Production** falls on impact and returns to its pre-shock rate; **inventories** are drawn down
- **Geopolitical risk** rises; **world industrial production** declines persistently
- **Fertilizer price** rises, in line with its energy intensity

Transmission: a flow supply shock that reaches the economy

- Higher oil price, lower production and falling inventories fit a **flow supply shock**
- Production adjusts quickly; inventories act as a buffer to smooth consumption
- Geopolitical tensions, and through them confidence, are the channel to world industrial production; the paper sees this as consistent with the uncertainty literature
- Fertilizer is energy-intensive: the paper reads its rise as a **direct cost for agriculture**, with possible effects on food prices and security (*not estimated*)

Threats to transportation behave like a supply shock, with spillovers to geopolitics and output

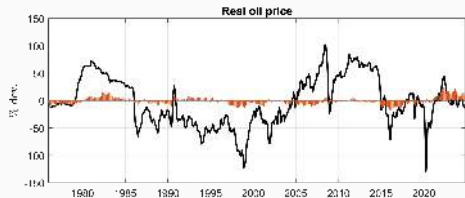
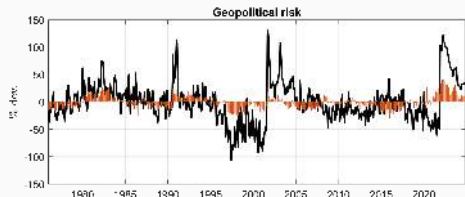
How much of the variance does the shock explain?

Horizon	Oil price	Production	Inventories	World IP	Geop. risk	Fertilizer
1 month	12.84	26.76	16.83	15.59	21.90	24.57
6 months	14.74	24.62	16.74	9.97	25.17	29.23
12 months	13.21	24.53	16.88	12.17	26.87	25.33
24 months	13.67	25.43	17.00	18.81	28.25	19.35

Notes: Median forecast error variance shares of the ETU shock, per cent.

- **Oil price**: around 13%; the paper reads this as OPEC decisions and global demand playing larger roles
- **Production** about 25% and **inventories** about 17%, across horizons
- **World industrial production**: 15.6% on impact, 18.8% at 24 months; **geopolitical risk**: 21.9% to 28.3%, which the paper suggests is a feedback loop with transportation disruptions

Historical role of the shock



Notes: Orange bars: contribution of ETU shocks; black line: actual series (% deviation).

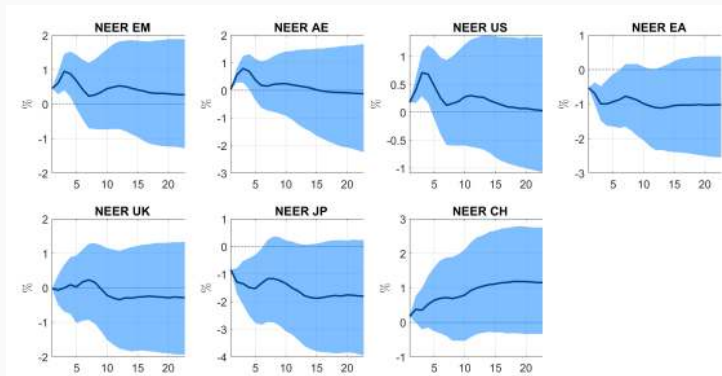
- **1980s**: US sanctions on the Soviet pipeline and the Tanker War lift oil prices and geopolitical risk, despite new production in Alaska and the North Sea
- **Mid-1990s to early 2000s**: low uncertainty contributes to low prices and risk
- **Since 2022**: the invasion of Ukraine and the Nord Stream sabotage; LNG shipping demand and insurance costs rise
- **Not** the 2003–2008 price surge, nor the fall after the financial crisis

The nature of the threat has changed

- **1980s:** conventional physical threats to tankers, pipelines and chokepoints
- **Mid-1990s to early 2000s:** stable transport systems and diverse routes; investment created backups that lowered the risk of local disruptions
- **2010s onward:** cyber vulnerability (Colonial Pipeline) and uncertainty about electricity transmission as renewables grow
- **2022:** pipeline infrastructure, sanctions and trade-flow shifts; the move from pipeline gas to LNG brings new geographical and transport risks

The model treats the shocks as structurally similar over time; the paper notes possible non-linearities or time-varying effects for future work.

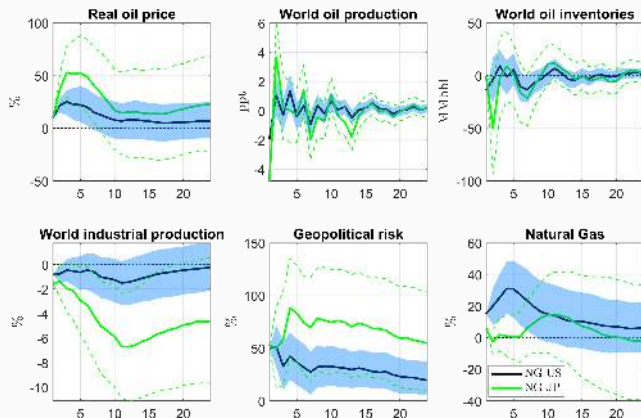
Regional heterogeneity: exchange rates



Notes: Response of nominal effective exchange rates (%), 68% bands. Panels from the paper's regional figures: emerging (EM), advanced (AE), US, Euro Area (EA), UK, Japan (JP), Switzerland (CH).

- **Japan:** persistent depreciation, linked to its dependence on energy imports
- **Euro Area:** steady drop of about 1%, tied to pipeline vulnerability
- **US, Switzerland, advanced economies:** initial appreciation, read as safe-haven demand
- **UK:** muted; **emerging:** a rise at first, which the paper links to energy exporters
- **Bands are wide** and often include zero

Natural gas: US and Japan react differently



Notes: Black line and blue bands: US natural gas; green line and dashed bands: Japanese LNG.

- **US:** prices rise sharply, peaking at about 30% around month 5, then decline; the paper links this to a hub-based pipeline network
- **Japan:** a delayed response, near zero at first and peaking around months 10–12; the paper points to long-term contracts with price formulas that adjust only quarterly or semi-annually
- Wider bands for Japan: more uncertainty

Robustness

Check	What the paper reports
Recursive (Cholesky) ordering	Hump-shaped industrial production and oil price responses, with wider bands; the fertilizer effect vanishes in under six months
Without 2022, or without the post-pandemic period	Similar sign and size of responses
Exogenous OPU index and OPEC news	In the appendix
Lags (3, 6, 12), priors, hyperparameters, constant and trend	In the appendix
Other world activity measures (Kilian 2009; Baumeister, Korobilis, et al. 2022)	In the appendix

Overall, the paper concludes that the results are robust to the model specification.

Cholesky

Pandemic and war

OPU and OPEC

Discussion

- **Identification:** the index may capture endogenous responses to economic developments, and oil price movements may influence news coverage (reverse causality)
- Omitted factors, such as broader geopolitical developments, could move both the index and the outcomes
- The paper argues that the match with documented events and the robustness checks give confidence, and that they *help address some* of these challenges, not all
- The model treats shocks as structurally similar across time; effects may be time-varying
- Focus on oil, with an extension to two natural gas prices; 68% credible bands are wide for several responses

Policy implications and next steps

- The paper suggests that policymakers **improve the resilience of energy supply chains**: diversify energy sources and strengthen international cooperation on energy security
- Maintaining **strategic reserves** and **flexible regulation** that adapts quickly to supply changes can reduce the risk of shortages and social unrest

Next step

Use the ETU index in a panel of countries to study macroeconomic effects across economies, since energy supply disruptions can have widespread effects.

Conclusion

- A news-based **energy transportation uncertainty index** picks up the Tanker War, the Exxon Valdez spill, the Colonial Pipeline attack and the Nord Stream sabotage
- In an oil-market SVAR, an ETU shock **raises real oil prices**, briefly cuts production while inventories are drawn down, **raises geopolitical risk** and **lowers world industrial production**
- It played a significant role in oil prices and geopolitical risk in a few historical episodes
- Results are conditional on the identification with an external news index, discussed in the paper

Thank you!

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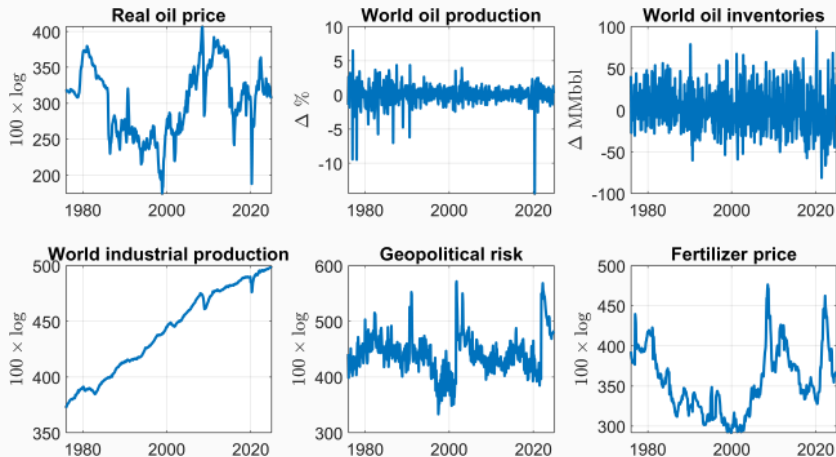
Backup

Data description and sources

Label	Description	Source
p_t^o	real US refiners' acquisition cost of imported crude oil	US EIA
Δq_t^w	world oil production	US EIA
Δi_t	global crude oil inventories	US EIA; Kilian and Murphy (2014)
y_t^w	world industrial production	Baumeister and Hamilton (2019)
ξ_t	geopolitical risk, historical index	Caldara and Iacoviello (2022)
p_t^f	fertilizer price index	World Bank
$opec_t$	oil supply news index	Känzig (2021)
opu_t	oil price uncertainty index	Abiad and Qureshi (2023)

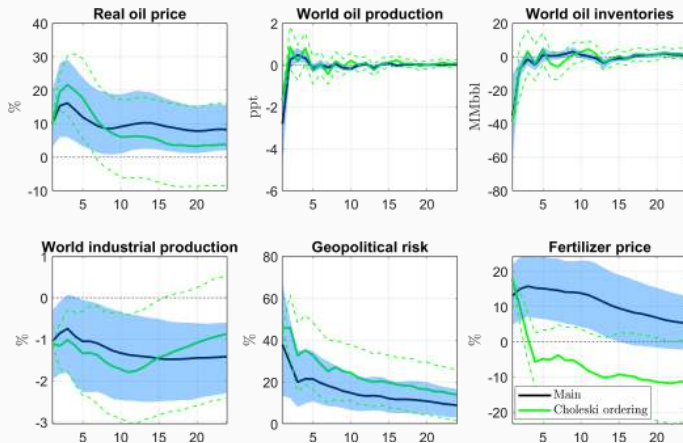
Notes: Monthly series covering 1974m1–2023m12 in the main specification.

The data series in the baseline model



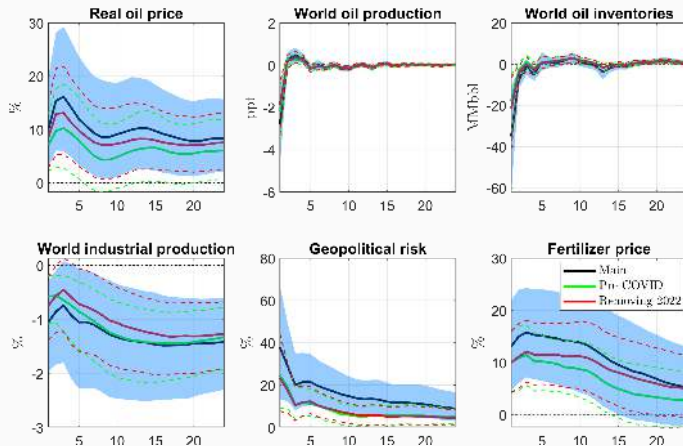
Notes: Baseline VAR series, 1974–2023.

Recursive identification



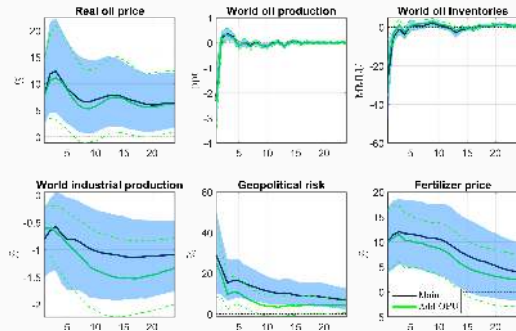
- Black line: main model (proxy identification); green: recursive ordering
- Hump-shaped industrial production; oil prices more hump-shaped, with wider bands
- A more pronounced impact response of production; the fertilizer effect vanishes within six months

Without 2022 and without the post-pandemic period

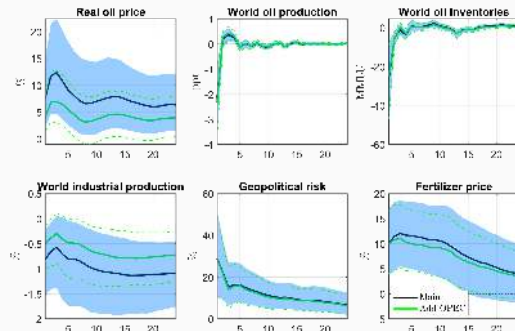


- Black line: main model; red: excluding the 2022 invasion of Ukraine; green: excluding the post-pandemic period
- Similar sign and size of the responses
- The paper reads this as: Colonial Pipeline, the war in Ukraine and Nord Stream have not altered how transportation uncertainty affects the market

Adding the OPU index or OPEC news as exogenous variables



OPU index added (green)



OPEC news added

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