27th Annual DNB Research Conference

The Macroeconomic Effects of Geopolitical Uncertainty

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Are We Fragmented Yet?
Measuring Geopolitical Fragmentation and Its Causal Effects

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Rising trend of geopolitical fragmentation

Gita Gopinath, IMF First Deputy Managing Director, Stanford Institute for Economic Policy Research, May 2024

Global economic ties are changing in ways we have not seen since the end of the Cold War...We could see a broad retreat from global rules of engagement and, with it, a significant reversal of the gains from economic integration.

Kristalina Georgieva, IMF Managing Director, World Economic Forum, May 2024

That whole issue about fragmentation in the world economy is really serious: trade and financial flows are the transmission lines of prosperity, and it would be a huge mistake to lose them.

Christine Lagarde, President of the ECB, Dubrovnik Economic Conference, June 2024

The fragmenting of a previously highly globalised world is a type of risk that advanced economies have not faced since the period after the First World War.

Rising trend of geopolitical fragmentation

- Discernible trends in geopolitical fragmentation are evident across various indicators:
  1. A global deceleration in the flows of goods and capital.
  2. Increased trade and foreign direct investment restrictions.
  3. Growing concerns related to migration.
  4. Tighter capital controls.
  5. More sanctions and conflicts.
  6. Heightened political risks and uncertainties, growing fears in sentiments...

The measurement challenge

- However, no single measure fully captures the current state of global economic integration, as it is an inherently multifaceted process:
  1. Each indicator addresses only one aspect of it. Large measurement errors.
  2. Choosing or averaging indicators to study geopolitical fragmentation can be arbitrary and may lead to incorrect conclusions or policy recommendations.
- What are the economic consequences of fragmentation?
  1. This is not a trivial question.
  2. New international trade theory suggests that welfare gains from integration are small and heterogeneous. But, the reverse may not hold, warranting careful measurement and analysis.

Our contribution

- Measure geopolitical fragmentation:
  1. Develop an index for wide use, meeting the needs of policymakers, practitioners, and academics.
  2. Compile 16 widely-used indicators of geopolitical fragmentation, each imperfect and potentially obscured by idiosyncratic noise that masks common underlying dynamics.
  3. Estimate a dynamic factor model (DFM) with time-varying parameters and stochastic volatility to extract common dynamics, accommodating varying data frequencies and missing observations.
- Measure the causal effects of geopolitical fragmentation on aggregate and sectoral macroeconomic variables across advanced and emerging countries:
  1. Our estimated index as input for standard causality analysis methods in time series (SVARs, LPs).
  2. Translate changes in the factor (e.g., $+1$ s.d.) into concrete effects on aggregate variables with a sharp economic interpretation (e.g., a 0.3% reduction in GDP).

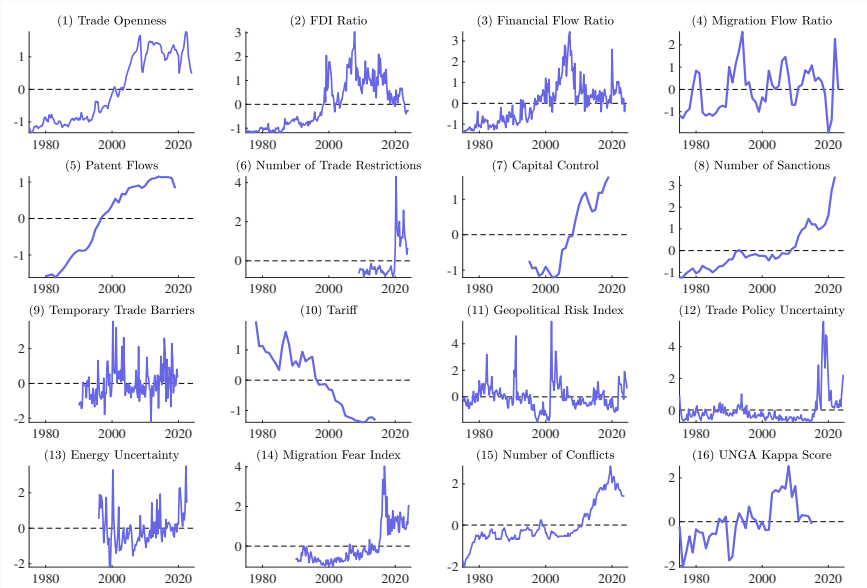
Measuring geopolitical fragmentation

Indicators of geopolitical fragmentation

Category	Individual Indicators	Sample	Freq.	ADF test (p-value)	Correlation w/ Trade Openness
Metrics of economic integration	Trade Openness	1975-2024	Q	0.17	1.00
	FDI Ratio	1975-2024	Q	0.07	0.85
	Financial Flow Ratio	1975-2024	Q	0.04	0.77
	Migration Flow Ratio	1975-2023	A	0.00	0.31
	Patent Flows	1980-2019	A	0.10	0.92
Policy implementation gauges	Number of Trade Restrictions	2009-2023	Q	0.09	-0.06
	Capital Control	1995-2019	A	0.71	0.83
	Number of Sanctions	1975-2022	A	0.99	0.79
	Temporary Trade Barriers	1990-2019	Q	0.00	0.27
	Tariff	1978-2014	A	0.11	-0.92
Text mining-derived indicators	Geopolitical Risk Index	1975-2024	Q	0.00	-0.11
	Trade Policy Uncertainty	1975-2024	Q	0.02	0.24
	Energy Uncertainty	1996-2022	Q	0.00	0.07
	Migration Fear Index	1990-2024	Q	0.13	0.49
Political reflections	Number of Conflicts	1975-2023	Q	0.16	0.71
	UNGA Kappa Score	1975-2015	A	0.01	0.67

- Varying frequencies and missing observations across indicators, with evidence of idiosyncratic behavior (including nonstationarity).

Indicators of geopolitical fragmentation



A dynamic factor model (DFM)

- We follow Sargent and Sims (1977), Geweke (1977), and Stock and Watson (1989).
- DFM linking factor f_t and the empirical indicators $y_{i,t}$:

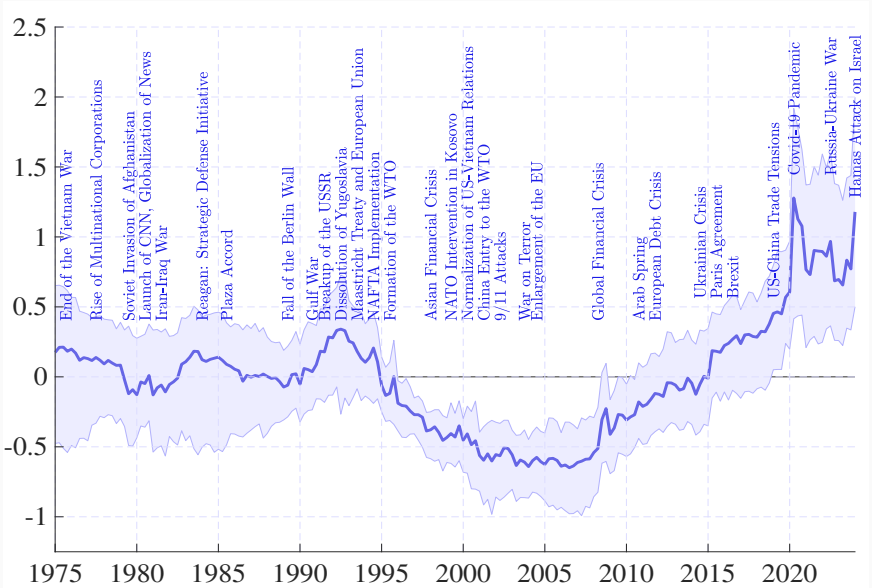
$$\underset{\text{indicator } i}{y_{i,t}} = \underset{\text{idiosyncratic deterministic dynamics}}{a_{i,t}} + \underset{\text{common dynamics}}{b_{i,t} f_t} + \underset{\text{idiosynractic stochastic dynamics}}{u_{i,t}}$$

- $a_{i,t} = a_{i,0} + a_{i,1} t$: deterministic time trend orthogonal to the common factor.
- $(1 - L) b_{i,t} = \sigma_{b_i} \epsilon_{b_i,t},\ \epsilon_{b_i,t} \overset{iid}{\sim} \mathcal{N}(0,1)$: slow-moving variations in factor exposures.
- $(1 - \phi_f L) f_t = \sigma_{f,t} \epsilon_{f,t},\ \epsilon_{f,t} \overset{iid}{\sim} \mathcal{N}(0,1)$: common dynamics through indicators' stationary components.
- $(1 - \phi_{u_i} L) u_{i,t} = \sigma_{u_i,t} \epsilon_{u_i,t},\ \epsilon_{u_i,t} \overset{iid}{\sim} \mathcal{N}(0,1)$: dynamics idiosyncratic to each series.
- $\sigma_{k,t} = \sigma_k \exp(h_{k,t}),\ k \in \{f, u_1, ..., u_N\}$: stochatic volatility.
- $(1 - L) h_{k,t} = \sigma_{h_k} \epsilon_{h_k,t},\ \epsilon_{h_k,t} \sim \mathcal{N}(0,1),\ k \in \{f, u_1, ..., u_N\}$: evolution of stochastic volatility.

Estimation of the DFM

- Data sample: 1975Q1-2024Q1.
- Bayesian approach. Loose priors.
  - Building on Del Negro and Otrok (2008), we enhance the Gibbs sampler to handle missing data and differing frequencies (for stock variables following Aruoba, Diebold, and Scotti, 2009).
  - Gibbs sampler to draw samples from the joint posterior distribution of parameters and latent state variables (including the factor).
- We ensure robustness (e.g., different priors, shutting down variation on b_i, varying the number of factors, allowing a stochastic trend in the factor,...).

Estimated geopolitical fragmentation index



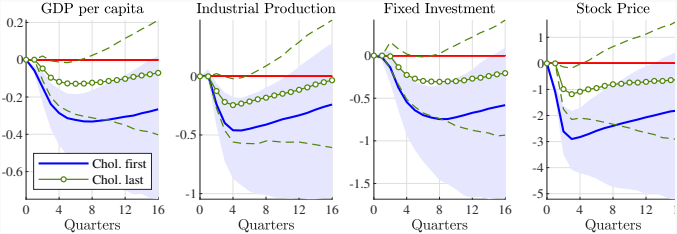
Measuring the causal effects of geopolitical fragmentation

Causal effects

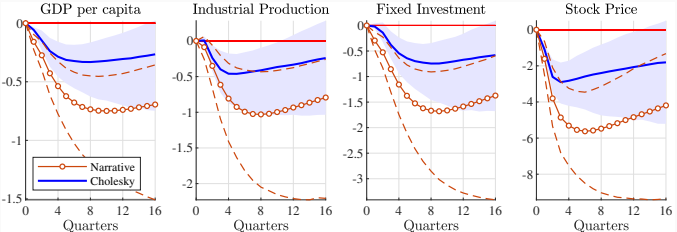
- We analyze data from 61 economies (34 AEs, 27 EMs) from 1986Q1–2024Q1 using SVARs and LPs (lag 2) to study the causal link b/w geopol. fragmentation and economic activity.
- Panel SVAR:
  - A total of 11 variables.
    - 7 global variables - GFI, VIX, S&P 500, Oil, 2-year Treasury, NFCI, World GDP.
    - 4 local variables - Stock price, IP, Investment, GDP.
  - Identification of an exogenous fragmentation shock:
    - Cholesky restrictions with varying orderings (other structural shocks, possibly arising from political processes, may contemporaneously affect fragmentation, possibly even within the same quarter).
    - Narrative restrictions, (i) war outbreaks, international conflicts, terrorism, (ii) geopolitical shifts, (iii) enactment of trade deals, currency unions, or trade restrictions, à la Mertens and Ravn, 2013.
    - Why not long-run identification, sign-restrictions, or heteroskedasticity?

Impulse responses based on panel SVARs

(A) Cholesky restrictions in identification

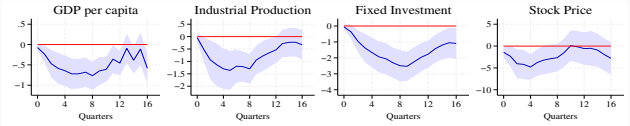


(B) Narrative restrictions in identification

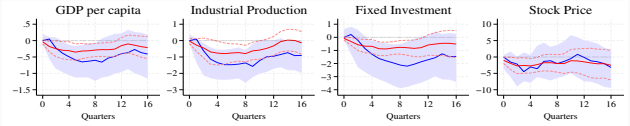


Impulse responses based on panel LPs

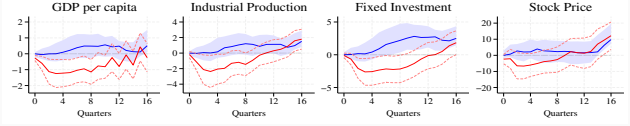
(A) All countries



(B) AEs (**red**) vs. EMs (**blue**)

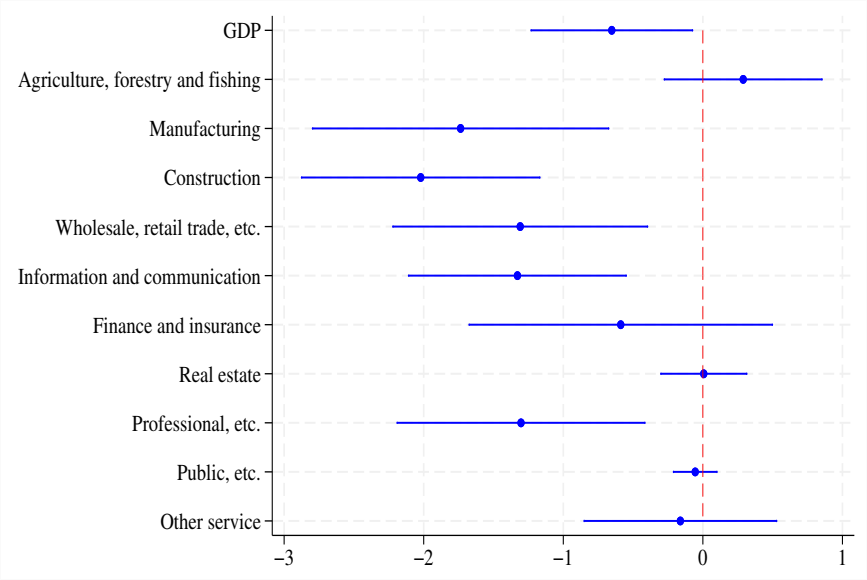


(C) Fragmentation (**red**) vs. globalization (**blue**): All countries



- LP based on the "cleaned" fragmentation shock—the residual from regressing the SVAR fragmentation shock on military spending (Ramey) and MP (Jarocinski-Karadi) shocks.

Sectoral impact: The OECD



Measuring geopolitical bloc fragmentation

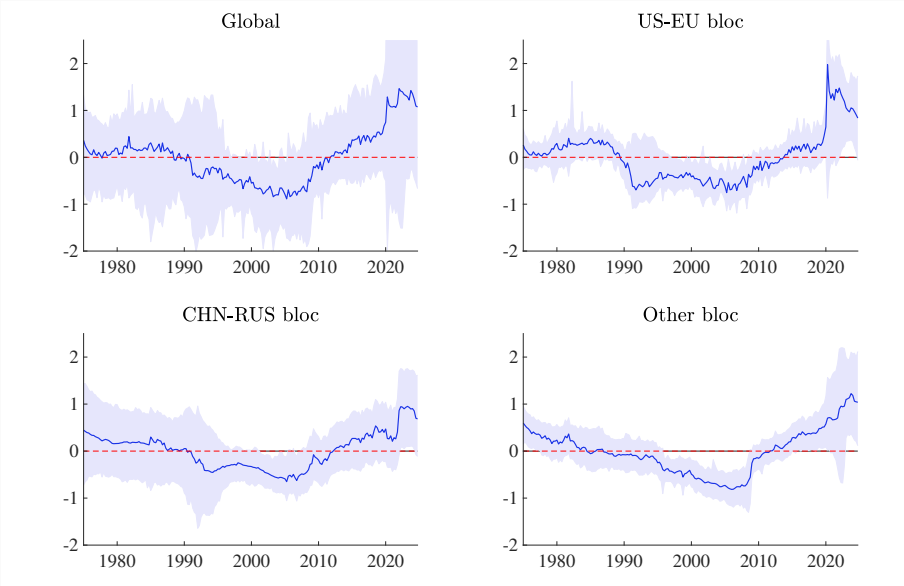
- We explore fragmentation in geopolitical blocs by extending the baseline analysis to answer how global fragmentation is distributed worldwide.
- For each bloc $j \in \{\text{US-EU,CHN-RUS, Others}\}$, we assume the same DFM structure as before:

$$\text{Each bloc } (j): \quad y_{i,t}^{(j)} = a_{i,t}^{(j)} + b_{i,t}^{(j)} f_t^{(j)} + u_{i,t}^{(j)},$$

$$\text{Global bloc:} \quad y_{i,t} = a_{i,t} + b_{i,t} \left(\sum_{j \in \{\text{US-EU,CHN-RUS,Others}\}} w_j f_t^{(j)} \right) + u_{i,t}.$$

  - For each bloc, we collect twelve empirical indicators: trade openness, FDI ratio, financial flow ratio, migration flow ratio, patent flows, trade restrictions, capital control measures, sanctions, temporary trade barriers, tariff, geopolitical risk index, and UNGA Kappa score.
  - Estimate the entire specification jointly by imposing the prior $w_j \sim \mathcal{N}\left(\frac{1}{3}, \frac{1}{100}\right)$ for the weights.

Estimated geopolitical bloc fragmentation indices



Causal effects of geopolitical bloc fragmentation: Identification

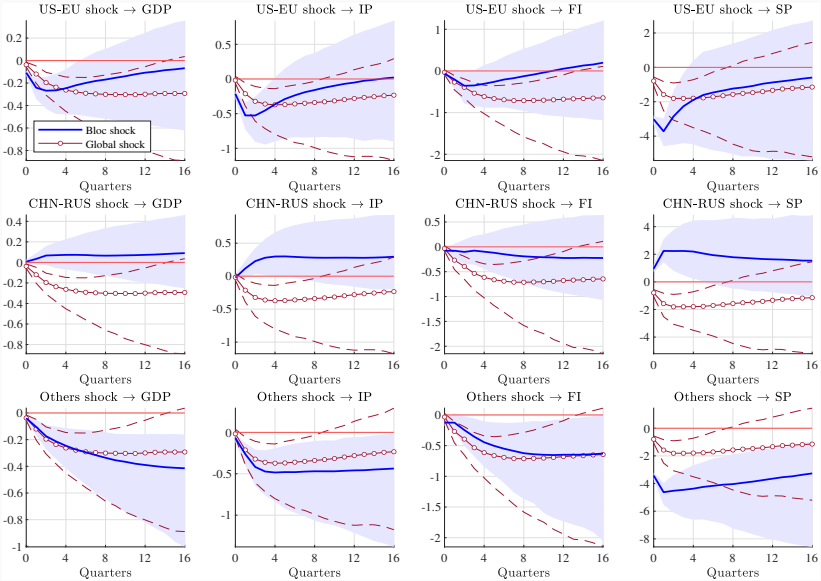
- Local fragmentation shocks are defined as those that increase (decrease) global fragmentation and render the own bloc more (less) fragmented than other blocs:

$$\begin{bmatrix} u_t^{\text{US-EU}} - u_t^{\text{Global}} \\ u_t^{\text{CHN-RUS}} - u_t^{\text{Global}} \\ u_t^{\text{Others}} - u_t^{\text{Global}} \\ u_t^{\text{Global}} \\ \vdots \end{bmatrix} = \begin{bmatrix} + & ? & ? & \cdots \\ ? & + & ? & \cdots \\ ? & ? & + & \cdots \\ + & + & + & \cdots \\ \vdots & \vdots & \vdots & \ddots \end{bmatrix} \begin{bmatrix} \varepsilon_t^{\text{US-EU}} \\ \varepsilon_t^{\text{CHN-RUS}} \\ \varepsilon_t^{\text{Others}} \\ \vdots \end{bmatrix},$$

  where $u_t^{(j)}$ is the reduced-form residuals from the VAR and $\varepsilon_t^{(j)}$ is the bloc-driven fragmentation shocks. The sign restrictions are imposed for four quarters after the shock.

- Then, the identified local fragmentation shocks are added to the baseline panel VAR.

Economic impact of bloc-driven fragmentation



Conclusion

- Global economic integration has shifted towards fragmentation in recent years.
- We have built a measure of geopolitical fragmentation using various indicators to grasp its impact on the global economy. Our DFM with time-varying parameters and stochastic volatility captures its evolving dynamics effectively.
- We show that increased fragmentation negatively impacts the global economy, especially affecting emerging economies more than advanced ones, with immediate adverse effects and gradual benefits from reduced fragmentation over time.
- Finally, we examine the interaction between fragmentation and the economic dynamics of regional economic blocs, highlighting significant differences in the impacts across various geopolitical blocs.
- The big picture.

Appendix

A two factor model

- A two-factor extension:

$$
\begin{aligned}
y_{i,t} &= a_{i,t} + b_{i,t} f_{1,t} + c_{i,t} f_{2,t} + u_{i,t}, \\
a_{i,t} &= a_{i,0} + a_{i,1} t, \\
f_{1,t} &= \phi_{f_1,1} f_{1,t-1} + ... + \phi_{f_1,p} f_{1,t-p} + \sigma_{f_1,t} \epsilon_{f_1,t}, \quad \epsilon_{f_1,t} \sim \mathcal{N}(0,1), \\
f_{2,t} &= \phi_{f_2,1} f_{2,t-1} + ... + \phi_{f_2,p} f_{2,t-p} + \sigma_{f_2,t} \epsilon_{f_2,t}, \quad \epsilon_{f_2,t} \sim \mathcal{N}(0,1), \\
b_{i,t} &= b_{i,t-1} + \sigma_{b_i} \epsilon_{b_i,t}, \quad \epsilon_{b_i,t} \sim \mathcal{N}(0,1), \\
c_{i,t} &= c_{i,t-1} + \sigma_{c_i} \epsilon_{c_i,t}, \quad \epsilon_{c_i,t} \sim \mathcal{N}(0,1), \\
u_{i,t} &= \phi_{u_i,1} u_{i,t-1} + ... + \phi_{u_i,q} u_{i,t-q} + \sigma_{u_i,t} \epsilon_{u_i,t}, \quad \epsilon_{u_i,t} \sim \mathcal{N}(0,1), \\
h_{j,t} &= h_{j,t-1} + \sigma_{h_j} \epsilon_{h_j,t}, \quad \sigma_{j,t} = \sigma_j \exp(h_{j,t}), \quad \epsilon_{h_j,t} \sim \mathcal{N}(0,1).
\end{aligned}
$$

- Identification assumptions on $b_{i,t}$ and $c_{i,t}$.
- Furthermore, we need a normalization that separates both factors.

Exclusion restrictions on factor loadings

- A simple (and intuitive) normalization is that all variables classified under the "metrics of economic integration" always load on the first factor.
- 40 possible cases for how the remaining three categories ("policy implementation gauges," "text-mining-derived indicators," "policy reflections") can load on both factors.

Category	$(I1)$		$(I2)$		$(I3)$		$(I4)$	
	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}	1^{st}	2^{nd}
Metrics of economic integration	1	0	1	0	1	1	1	0
Policy implementation gauges	0	1	0	1	1	0	1	1
Text-mining-derived indicators	0	1	1	1	1	1	1	1
Political reflections	0	1	0	1	1	0	1	1

Estimated factors under various identification assumptions on factor loadings