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Global and regional transmission of ESG policy uncertainty: Evidence from developed and emerging markets

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ABSTRACT

This study examines the global transmission of environmental, social, and governance policy uncertainty (ESGUI), focusing on how such uncertainty spreads across countries, regions, and structural groupings such as developed and emerging markets. Using a time-varying parameter vector autoregression model, the analysis reveals a high degree of global connectedness, with ESGUI being strongly transmitted across borders rather than remaining localised. At the country level, France and Colombia emerge as key net transmitters of ESGUI, while the UK, US, Japan, and Brazil are more often net receivers. Regionally, Europe and North America act as major sources of spillovers, whereas Asia remains a persistent net recipient. Structurally, emerging markets have shifted over time from being net receivers to net transmitters, especially after 2012, reflecting their growing influence in the global ESG landscape. These findings demonstrate the increasing globalisation of ESG policy risk and highlight the need for coordinated regulatory responses and improved risk mitigation strategies across jurisdictions. The study contributes to the literature by offering new insights into the dynamic and structural dimensions of ESG uncertainty transmission

1. Introduction

Environmental, Social, and Governance (ESG) considerations have become central to financial decision-making, regulatory frameworks, and long-term sustainability planning (Seetharam and Nyakurukwa, 2025) as governments, firms, and investors grapple with climate risks, social inequalities, and governance challenges. However, the rapid institutionalisation of ESG frameworks has also introduced a new source of uncertainty arising from inconsistent regulations, volatile policy environments, and varying enforcement mechanisms across jurisdictions (Honkaniemi, 2023). This evolving policy landscape has created uncertainty about the direction of future ESG regulations and how these policies will affect firm behaviour, investment risk, and sustainable development. While past research has examined other policy uncertainties (e.g., Hadhri, 2024; Mokni et al., 2024), the systemic transmission of ESG-related uncertainty remains largely underexplored in the academic literature.

A new composite measure, the ESG-based Sustainability Uncertainty Index (ESGUI), has recently been developed to systematically

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capture the intensity of ESG-related policy and regulatory uncertainty across countries.[1] The ESGUI combines ESG-related keywords with uncertainty terms using text-mining of Economist Intelligence Unit country reports, producing a consistent monthly time-series measure of ESG-specific uncertainty across countries (Ongan et al., 2025).

Theoretically, institutional theory (DiMaggio and Powell, 1983) posits that formal rules, norms, and pressures from institutional environments shape organisational behaviour. In the ESGUI context, national regulatory systems, disclosure mandates, and governance standards create institutional mandates that firms and investors must navigate. As ESG norms diffuse globally, their institutionalisation varies across regions due to differences in regulatory capacity, stakeholder pressure, and market maturity (Jiayu, 2024). This variation forms the structural basis for differential ESGUI shock spillovers, as countries respond to ESG mandates based on their institutional alignment.

This paper examines the connectedness of ESGUI across 12 countries, grouped into four global regions: North America, South America, Asia, and Europe, and further stratified into developed and emerging markets.[2] While ESG has been widely promoted as a global agenda, its institutional uptake and regulatory anchoring are deeply uneven. Countries differ in their ESG enforcement capabilities, investor protections, and disclosure standards, suggesting that ESGUI may propagate differently across borders (Wang et al., 2023). For instance, Europe's relatively advanced ESG regulation (e.g., the EU Sustainable Finance Disclosure Regulation[3]) may generate spillovers into less prepared markets, which must then adjust without having played a role in originating the uncertainty.

The paper provides several contributions. First, little empirical work has explored which regions or development groups systematically transmit or absorb ESGUI shocks; a gap this study addresses directly. Second, the study offers one of the earliest applications of the ESGUI in a cross-country connectedness framework, validating the index's utility for macro-financial analysis. Third, it uncovers the regional differences in ESG policy uncertainty transmission, revealing, for instance, whether Asia or Europe consistently acts as a net source of ESG shocks.

We proceed as follows: Section 2 looks at the materials and methods; Section 3 presents the results, Section 4 discusses the results, and Section 5 concludes.

2. Materials and methods

2.1. Data

This study uses monthly data on the ESGUI, which captures country-level uncertainty specifically related to ESG factors. The ESGUI is derived from text-mining the Economist Intelligence Unit's standardised country reports, using the frequency of ESG-related keywords appearing alongside uncertainty terms (Ongan et al., 2025). The dataset spans from November 2002 to March 2025, covering a panel of 12 countries across North America, South America, Asia, and Europe, selected based on data availability. Fig. 1 shows that the ESGUI follow a general upward trend across most countries, with particularly sharp increases in the early 2020s. Many countries experienced renewed spikes around 2020, coinciding with the onset of the COVID-19 pandemic. By 2025, ESGUI has reached some of the highest levels in several countries, signalling a growing global concern and increased policy attention.

2.2. Empirical analysis

To ensure stationarity, the time series data are first log-transformed before analysis. Our empirical investigation starts with the estimation of a TVP-VAR model, described below.

$$z_t = B_t z_{t-1} + u_t \; u_t \sim N(0, S_t)$$

$$vec(B_t) = vec(B_{t-1}) + v_t \; v_t \sim N(0, R_t) \tag{1}$$

Where:

z_t, z_{t-1} and u_t are $k \times 1$ dimensional vectors, representing all the IRS series in t, $t-1$, and the error term, respectively. B_t and S_t are $k \times k$ dimensional time-varying parameter and variance-covariance matrices, and $vec(B_t)$, v_t are $k^2 \times 1$ dimensional vectors and R_t is a $k^2 \times k^2$ dimensional parameter variance-covariance matrix. We employ the Generalised Forecast Error Variance Decomposition (GFEVD) framework, using a forecast horizon of H, as developed by Koop, Pesaran and Potter (1996) and further refined by Pesaran and Shin (1998).

$$\Theta_{ij}^{g}(H) = \frac{\sum \left((\tau)_{jj}^{-1} \sum_{h=0}^{H-1} \left(e_i' \Omega_h(\tau) \sum (\tau) e_j \right) \right)^2}{\sum_{h=0}^{H-1} \left(e_i' \Omega_h(\tau) \sum (\tau) \Omega_h(\tau)' e_j \right)} \tag{2}$$

Let e_i denote a selection vector with one in the i^{th} position and zeros elsewhere. In the variance decomposition matrix, the normalised elements are represented as follows:

[1] https://www.policyuncertainty.com/sustainability_index.html

[2] Full list of the countries and the stratification is found in Table A1 in the Appendix

[3] https://www.eurosif.org/policies/sfdr-sustainable-finance-dislosure-regulation/

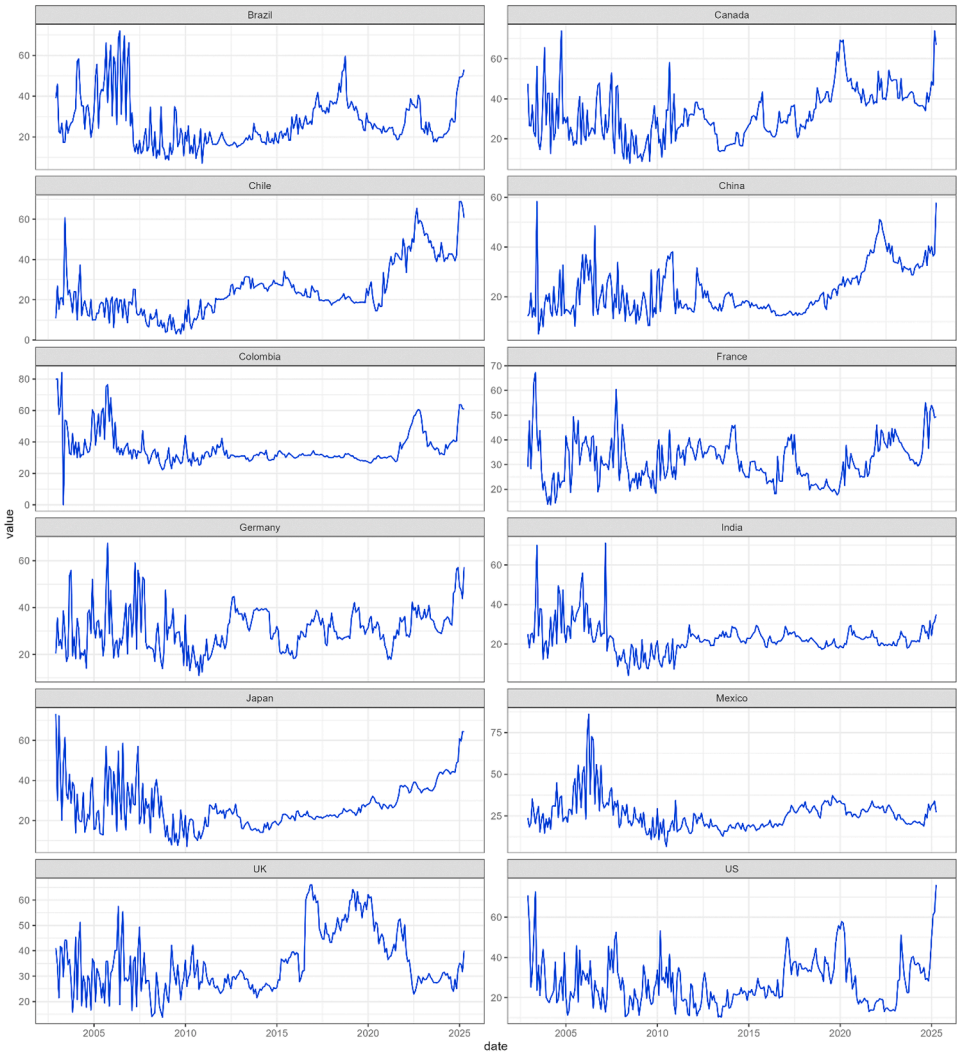


Fig. 1. Trajectories in ESGUI
Notes: The figure shows trajectories in the monthly ESGUI for the 12 countries sampled in the study.

Table 1
Static connectedness.

	Germany	France	UK	US	Canada	Mexico	China	Japan	India	Brazil	Chile	Colombia	FROM
Germany	16.56	7.51	6.53	12.04	6.08	5.73	7.78	3.43	6.87	5.03	7.14	15.3	83.44
France	8.39	15.44	8.21	6.07	7.02	12.06	7.77	4.16	7.92	4.21	8.57	10.19	84.56
UK	4.24	7.41	16.33	6.9	10.89	11.78	6.35	9.31	10.92	4.01	7.05	4.79	83.67
US	10.05	10.56	7.29	9.37	7.21	7.19	10.72	3.07	6.11	6.39	5.63	16.42	90.63
Canada	11	9.92	4.78	7.45	13.95	6.7	9.36	6.46	3.96	6.58	4.47	15.37	86.05
Mexico	5.29	8.01	8.12	5.28	10.16	17.88	9.6	9.5	7.28	6.43	3.96	8.5	82.12
China	8.33	13.93	4.27	4.52	8.48	8.2	13.67	3.37	3.98	7.67	5.16	18.43	86.33
Japan	5.86	9.04	6.65	5.46	14.73	9.6	5.37	17.49	6.53	7.2	5.14	6.95	82.51
India	7.87	9.56	6.28	8.02	10	9.12	7.09	6.7	13.77	5.04	6.94	9.61	86.23
Brazil	6.78	8.57	6.29	4.66	12.39	7.55	7.64	10.24	6.11	16.28	3.86	9.64	83.72
Chile	8.74	11.29	4.46	6.35	10.45	8.26	8.66	6.14	7.03	6.3	8.87	13.46	91.13
Colombia	9.67	14.05	4.19	5.12	8.93	6.74	11.86	3.84	3.72	8.02	4.87	18.99	81.01
TO	86.22	109.84	67.06	71.86	106.32	92.93	92.21	66.21	70.43	66.87	62.8	128.65	1021.4
Inc.Own	102.78	125.29	83.4	81.23	120.27	110.81	105.87	83.7	84.21	83.14	71.66	147.64	TCI
NET	2.78	25.29	−16.6	−18.77	20.27	10.81	5.87	−16.3	−15.79	−16.86	−28.34	47.64	85.12

Notes: Results are based on a TVP-VAR(0.99,0.99) model with a lag length of order 1 (BIC) and a 10-step-ahead forecast.

Table 2
Regional static connectedness.

	ASIA	EUROPE	NORTH AMERICA	SOUTH AMERICA	FROM
ASIA	25.99	23.93	26.04	24.04	74.01
EUROPE	21.51	30.21	26.19	22.1	69.79
NORTH AMERICA	22.02	25.01	28.4	24.58	71.6
SOUTH AMERICA	21.74	24.68	23.48	30.1	69.9
TO	65.27	73.61	75.71	70.72	285.31
Inc.Own	91.26	103.82	104.1	100.82	TCI
NET	−8.74	3.82	4.1	0.82	71.33

Notes: Results are based on a TVP-VAR(0.99,0.99) model with a lag length of order 1 (BIC) and a 10-step-ahead forecast.

$$\widetilde{\Theta}_{ij}^{g}(H) = \frac{\Theta_{ij}^{g}(H)}{\sum_{j=1}^{k}\Theta_{ij}^{g}(H)} \; with \; \sum_{j=1}^{k}\widetilde{\Theta}_{ij}^{g}.1 \; and \; \sum_{ij=1}^{k}\Theta_{ij}^{g}(H) = 1, \tag{3}$$

Spillover measures based on the GFEVD are constructed following the framework proposed by Diebold and Yilmaz (2012).

$$TO_{j,t} = \sum_{i=1,\ i\neq j}^{k}\widetilde{\Theta}_{ij,t}^{g}(H) \tag{4}$$

$$FROM_{j,t} = \sum_{i=1,\ i\neq j}^{k}\widetilde{\Theta}_{ji,t}^{g}(H) \tag{5}$$

$$NET_{j,t} = TO_{j,t} - FROM_{j,t} \tag{6}$$

$$TCI_{t} = \frac{\sum_{i,j=1,\ i\neq j}^{k}\widetilde{\Theta}_{ji,t}^{g}(H)}{k-1} \tag{7}$$

TO_j shows the effect of j on i, while FROM represents the influence of i on j.

We use the decomposition approach suggested by Gabauer and Gupta (2018). By investigating the aggregated spillovers among four regions (continents) or two development structures (developed vs emerging countries), we establish overall shock propagation mechanisms. This approach allows us to separately assess the impact of regions and development structures. We get our aggregate connectedness measures by first aggregating the GFEVD for d groups - either four regions or two development areas: $C_{mm,t}^{a} = \sum_{i\in k_m}\sum_{j\in k_m}\widetilde{\varnothing}_{ij,t}^{g}(H)$. This is followed by calculating the spillovers specific to each group as follows:

$$C_{m\rightarrow .,t}^{a} = \sum_{n=1,m\neq n}^{d} C_{nm,t}^{a} \tag{8}$$

$$C_{m\leftarrow .,t}^{a} = \sum_{n=1,m\neq n}^{d} C_{nm,t}^{a} \tag{9}$$

$$C_{m,t}^{a} = \sum_{n=1,m\neq n}^{d} C_{m\rightarrow .,t}^{a} - C_{m\leftarrow .,t}^{a} \tag{10}$$

$$C_{t}^{a} = \frac{d}{d-1}\sum_{m=1}^{d} C_{m\rightarrow .,t}^{a} \equiv \frac{d}{d-1}\sum_{m=1}^{d} C_{m\leftarrow .,t}^{a} \tag{11}$$

Where $C_{m\rightarrow .,t}^{a}$ reflects total group-specific connectedness to others, $C_{m\leftarrow .,t}^{a}$ reflects group-specific connectedness from others, $C_{m,t}^{a}$ is the net total group-specific connectedness and C_{t}^{a} is the total group-specific connectedness index.

3. Results

This section presents the results from the empirical analyses, starting with static results and subsequently dynamic connectedness results.

3.1. Static results

Table 1 shows a high degree of connectedness in ESGUI across the 12 countries, with a Total Connectedness Index (TCI) of 85.12 %. This suggests that ESG policy-related shocks arising from evolving regulations, political debates, or implementation risks are strongly

Table 3
Static structural connectedness.

	DEVELOPED	EMERGING	FROM
DEVELOPED	52.81	47.19	47.19
EMERGING	46.63	53.37	46.63
TO	46.63	47.19	93.83
Inc.Own	99.44	100.56	TCI
NET	−0.56	0.56	46.91

Notes: Results are based on a TVP-VAR(0.99,0.99) model with a lag length of order 1 (BIC) and a 10-step-ahead forecast.

transmitted across borders rather than remaining confined to domestic contexts. The finding reflects the global relevance and spillover potential of ESG regulatory developments, especially in a world where financial markets and sustainability agendas are increasingly integrated. France and Colombia are identified as the top net transmitters of ESGUI. France's position likely stems from its active role in shaping EU-wide ESG regulations and disclosure mandates.[4] In contrast, the UK, the US, Japan, and Brazil act as net receivers, indicating their ESGUI is more heavily influenced by developments elsewhere. This may reflect structural dependencies, such as their exposure to foreign ESG-linked capital flows and imported policy risks (Karkowska and Urjasz, 2025).

The regional-level analysis of ESGUI spillovers (Table 2) reveals a moderately high degree of interdependence, with a TCI of 71.33 %. This suggests that ESGUI is not merely confined to regional dynamics but is meaningfully shaped by cross-regional influences. The results show that North America and Europe are net transmitters of ESGUI, with net spillover values of 4.10 and 3.82, respectively. This is consistent with their roles as global leaders in ESG regulation and disclosure practices. Asia, by contrast, emerges as a net recipient of ESGUI, with a net value of –8.74. This implies that while Asia is increasingly central to global sustainability goals, it remains more reactive to policy signals originating from Europe and North America.

The connectedness analysis between developed and emerging markets (Table 3) reveals a moderate TCI of 46.91 %. Notably, the net spillover values highlight emerging markets acting as slight net transmitters (+0.56) and developed markets as slight net receivers (–0.56). This suggests that while developed markets remain influential in shaping global ESG standards, emerging markets contribute meaningfully to the propagation of ESG policy uncertainty. The transmission from emerging to developed markets may reflect the increasing significance of ESG risks tied to regulatory changes, social and environmental challenges, and governance issues prevalent in emerging economies; risks that ripple through global supply chains and investment portfolios.

3.2. Dynamic results

Fig. 2 illustrates the net transmitter and receiver roles of various countries in the global network of ESGUI over time, with notable shifts occurring around the COVID-19 period.

Several countries demonstrate clear changes in their roles as the pandemic unfolded, reflecting how national ESGUI either influenced or responded to broader global dynamics during this crisis. Colombia, for example, remained a strong net transmitter throughout the period and continued to do so even during COVID-19, suggesting that its domestic ESG developments consistently exerted influence on others. Similarly, Mexico transitioned from being a net receiver before 2015 to a sustained net transmitter from around 2017 onward, maintaining this role through the pandemic, which points to its increasing importance in the ESG discourse within emerging markets.

Germany shows a clear trajectory change around COVID-19. After acting as a net receiver for much of the 2010s, it became a net transmitter during and after the pandemic, likely reflecting its leadership in Europe's green recovery initiatives and climate policy acceleration. In contrast, several countries that were traditionally net transmitters saw a reversal during COVID-19. France and Canada, both of which had long been net transmitters, moved into net receiver roles during the pandemic, indicating that their ESG policy uncertainty became more responsive to international developments rather than driving them. China similarly transitioned from a net transmitter to a net receiver during this period, suggesting that while it had previously shaped regional ESG policy trends, it became more influenced by external pressures and uncertainty in the global ESG environment post-2020. Countries such as Brazil, India, Chile, and Japan consistently remained net receivers throughout most of the period, including during COVID-19. This persistence suggests these countries were more likely to absorb ESG policy uncertainty rather than influence it.

Fig. 3 shows how ESGUI is transmitted across regions over time. Europe and North America have emerged as consistent net transmitters, especially in recent years, reflecting their leading roles in shaping global ESG policies. Europe's influence has been steady since the late 2000s, while North America became a strong transmitter around 2019. In contrast, Asia has remained a persistent net receiver, indicating it is more reactive to global ESG developments than a source of policy uncertainty. South America has shown more volatility, switching between transmitter and receiver roles, but has mostly been a receiver in recent years.

Fig. 4 compares the connectedness of ESGUI between developed and emerging markets over time. In the early 2000s, developed markets were net transmitters of ESGUI, reflecting their early adoption and leadership in ESG regulation and discourse. This influence persisted through the late 2000s but began to fade after 2010, with developed markets consistently becoming net receivers in the

[4] https://journals.library.columbia.edu/index.php/CBLR/announcement/view/698



(caption on next page)

Fig. 2. Dynamic net total directional connectedness
Notes: Results are based on a TVP-VAR(0.99,0.99) model with a lag length of order 1 (BIC) and a 10-step-ahead forecast.

following years. This shift suggests that, over time, developed markets have increasingly absorbed uncertainty from other regions, possibly due to global policy convergence or internal saturation of ESG frameworks. In contrast, emerging markets started as net receivers, particularly during the 2005–2010 period. However, from around 2012 onward, emerging markets transitioned into sustained net transmitters of ESGUI. This reversal indicates a growing role for emerging markets in shaping the global ESG narrative, possibly driven by their increasing participation in international climate agreements, domestic policy reforms, or the rising importance of ESG in their investment landscapes.

To ensure the robustness of the baseline results derived from the TVP-VAR(0.99, 0.99) model with a lag length of 1 (selected via BIC) and a 10-step-ahead forecast horizon, some robustness checks were performed. The model was re-estimated using alternative lag structures (lags 2 and 3) and different forecast horizons (5 and 20 steps ahead). The connectedness patterns and directional spillover dynamics remained qualitatively consistent, confirming the stability of the findings. For brevity, these additional results are not reported but are available upon request.

4. Discussion

The results show strong global spillovers in ESGUI, with a TCI above 85 %, indicating that ESG-related shocks are not isolated but transmitted across borders. This supports institutional theory and recent evidence that ESG norms diffuse unevenly due to differences in regulatory maturity and policy coherence (Galleli and Amaral, 2025). France transmits ESGUI because it plays a leading role in shaping EU sustainability regulations.[5] Its policy changes influence global ESG standards, creating spillover effects (Fu et al., 2025). Regionally, Europe and North America are dominant transmitters due to advanced ESG frameworks and stakeholder pressure (Bax et al., 2024), whereas Asia and South America remain responsive to external shocks. The role of emerging markets as transmitters of ESG uncertainty reflects growing institutional capacity and influence, consistent with resource-based theory (Barney, 1991) and recent evidence of regulatory strengthening in these regions (Pan et al., 2020). A limitation of the study is the limited number of countries arising from data availability. Future work should explore causal ESG channels using firm-level data and assess how different ESG components drive uncertainty transmission.

5. Conclusion

This study aimed to examine the global spillover dynamics of ESGUI across countries, regions, and structural groupings, utilising both static and dynamic connectedness measures. The findings reveal a high level of connectedness, with a TCI of 85.12 % at the country level, 71.33 % at the regional level, and 46.91 % between developed and emerging markets, indicating that ESG policy-related shocks are widely transmitted rather than remaining confined within borders. Regionally, Europe and North America were the main sources of global ESGUI, while Asia remained a persistent net recipient. Over time, dynamic results show a clear shift, with emerging markets increasingly assuming the role of net transmitters, particularly post-2012, signalling their growing influence in global ESG discourse. These findings demonstrate the importance of international coordination in ESG policymaking, as domestic shocks have significant cross-border implications, and highlight the need for policymakers, especially in traditionally net-receiving regions, to strengthen resilience and responsiveness to evolving global ESG risks. The transmission of ESG policy uncertainty across countries can influence investor confidence and risk perceptions, which are critical factors for climate finance flows. Strengthening ESG policy consistency and institutional capacity may thus help create a more stable environment that supports sustainable climate investment in the future.

CRediT authorship contribution statement

Kingstone Nyakurukwa: Writing – original draft, Methodology, Investigation, Conceptualization. **Yudhvir Seetharam:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Chimwemwe Chipeta:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization.

[5] https://about.bnef.com/insights/finance/europe-leads-on-esg-policy-but-trend-promising-for-all/



Fig. 3. Aggregated regional net total directional connectedness
Notes: Results are based on a TVP-VAR(0.99,0.99) model with a lag length of order 1 (BIC) and a 10-step-ahead forecast.

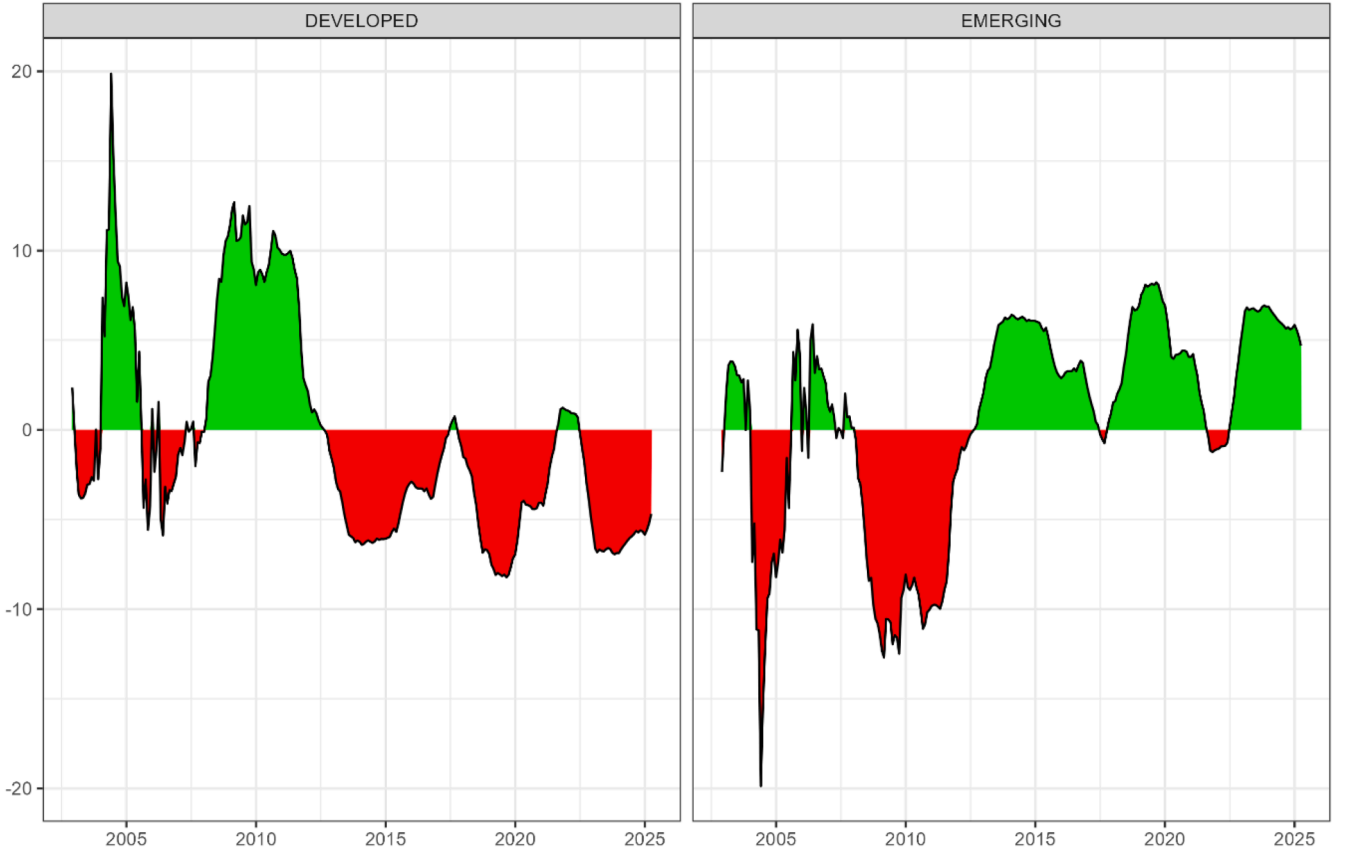


Fig. 4. Aggregated structural net total directional connectedness
Notes: Results are based on a TVP-VAR(0.99,0.99) model with a lag length of order 1 (BIC) and a 10-step-ahead forecast.

Appendix

Table A1.

Table A1
Sampled countries.

Country	Region	Structure
USA	North America	Developed
Canada	North America	Developed
Mexico	North America	Emerging
Germany	Europe	Developed
UK	Europe	Developed
France	Europe	Developed
China	Asia	Emerging
Japan	Asia	Developed
India	Asia	Emerging
Brazil	South America	Emerging
Chile	South America	Emerging
Colombia	South America	Emerging

Data availability

Data will be made available on request.

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