The Systemic Resilience of Multilateral Climate Finance

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Abstract

We examine how shifting donor priorities could reshape multilateral climate finance. Constructing a novel tripartite network of flows from donor governments to multilateral institutions to recipient countries (2017–2022) we analyze system concentration, centrality and resilience to institutional or donor withdrawal. Although flows are highly concentrated, with 62% channeled through the five largest institutions, the network is structurally robust: removing the twelve highest-throughput institutions leaves 93.5% of the network connected. However, financial losses are substantial and fall disproportionately on climate-vulnerable countries. Voting power analysis shows that donor countries can exert greater influence through voting behavior ("voice") than capital withdrawal ("exit"). Simulated US withdrawal does not produce governance consolidation around a new dominant actor, but leads to more pluralistic decision-making structures. These findings suggest that the long-term stability of multilateral climate finance depends less on replacing withdrawn capital than on governance reforms that raise the cost of exit, limit obstructive voice, and support pluralistic oversight.

Main

Multilateralism in climate finance is under pressure. In recent months, the current administration in the United States has abruptly shuttered USAID[1], withdrawn from the Green Climate Fund and its board[2], declined to pledge funds to the African Development Bank's latest replenishment[3], and withdrawn from the United Nations Framework Convention on Climate Change and the Paris Agreement[4]. The United States government is also conducting a broader review of its involvement across many multilateral institutions, including the multilateral development banks (MDBs) and vertical climate and environment funds (VCEFs), possibly resulting in further retrenchment[5].

As the largest historical climate finance provider, representing approximately 24% of public funding in 2023[6], the United States occupies a pivotal position in the multilateral landscape. These recent actions therefore prompt rigorous investigation into the resilience

of the global multilateral climate finance architecture to stark shifts like those observed today.

Although MDBs only accounted for approximately 19% of total tracked public climate finance flows in 2023[6] excluding mobilized private capital, they are systemically important actors in public climate finance by delivering, facilitating, and mobilizing climate finance[7]. They provide information for markets and sectors, send investment signals to crowd-in other forms of financing[8] and support high-risk and long-horizons projects otherwise unattractive to profit-maximizing actors in private capital markets[9,10]. As a result, MDBs can exert significant economic influence and concentrate donor capital against their strategic priorities.

Alongside MDBs, vertical climate and environment funds (VCEFs) such as the Global Environment Facility, the Green Climate Fund, and the Adaptation Fund play important complementary roles. They are specialist climate finance institutions mandated by the UN Framework Convention on Climate Change to support climate adaptation and mitigation projects[11], especially using concessional instruments[12]. In contrast to MDBs, their rotating boards of member regions and consensus-driven governance[13] are deliberately designed to favor donor-recipient parity in decision-making and recipient country ownership over investment objectives[14,15].

The pressure on multilateral climate finance is taking place against a backdrop of shrinking overseas development aid from major European donors due to economic pressures and changing domestic priorities[16]. According to the latest OECD data, official total development assistance, of which public climate finance is a subset, fell by 23.1% in 2025, with the five largest donors (the United States, United Kingdom, Germany, France, and Japan) simultaneously reducing contributions for the first time[7]. Amid calls for the broader development finance architecture to "do more with less,"[17] the consequences of this retreat are already visible in adjacent systems, with concern rising for the systemic collapse of aid infrastructure in health[18], child humanitarian care[1], and indirect effects cascading through the economic and political system[19,20].

We study disruptive donor behavior through Hirschman's framework of exit and voice[21], a canonical model of shareholder responses to institutional decline, commonly applied to corporates and recently applied to multilateral development banks[33]. A disruptive donor may elect to remain within a multilateral institution and leverage its votes to obstruct decision-making ("voice") or leave an institution entirely when their aims are irreconcilable ("exit"). We note that major donors may also exercise informal geopolitical influence even after formal exit, a dimension we abstract from in this analysis. Exit reduces available capital but frees governance from disruptive donor influence, while an obstructive voice threatens decision making without affecting capital. This typology motivates our two-part empirical design: we study the systems level using networks and the shareholder level using voting power indices.

Public multilateral climate finance flows can be represented as a weighted directed tripartite graph: donor governments contribute to multilateral institutions which subsequently invest the funds in recipient countries. Therefore, each transaction generates two directed edges, weighted by transaction volume (reported in million US dollars): flows from donor to institution (summed over all recipients) and flows from institution to recipient (summed over all donors). This tripartite network projection represents the in-strength (i.e. total incoming flows) and out-strength of each institution but treats donor capital as fungible and does not trace individual dollars from donor to recipient via a multilateral institution. When we examine the cascading effects of major donor withdrawal on recipients as described below, we preserve the full triplet-level data which maintains donor-to-recipient routing.

Studying the central nodes of a network can reveal vulnerability to cascading failures[22], but network analysis provides a better framework to study systemic resilience[23,24]. Given the potential for further donor withdrawal, network science yields a deeper understanding of the systems-level vulnerabilities of climate finance[25,26], by revealing statistical, dynamic, and non-linear properties in investor ecosystems. This has been demonstrated in energy efficiency[27], wind power[28], and hydropower[29], but not yet for climate finance. Network analysis reveals structural insights not apparent in aggregate

statistics and flow tables: the system-level vulnerability of a hub depends not only on its own size, but on its position relative to all other actors. Identifying institutions that bridge distinct regional clusters or specific donor-recipient pathways and whose functions cannot be absorbed by smaller peers has major policy, governance, and risk implications.

Except for in several newer MDBs[30,31], voting power in multilateral institutions is typically proportional to donor shareholding[32], meaning a small group of major donors often exerts outsize influence on boards to prioritize their interests[33], as shown systematically for the United States[34,35] and among smaller shareholders[36,37]. Despite MDBs' perceived neutrality[26,27], their lending allocations and governance often reflect political preferences and relationships between member countries[39]. However, previous studies treat shareholding as fixed and do not consider the possibility of internal obstruction[40]. We analyze the 'swing vote power' of individual donors within global and regional MDBs. As formal voting weights are a poor indicator of influence[41], we use power indices to estimate the distribution of *de facto* influence by the extent to which each actor is pivotal in determining voting outcomes[42,43]. While past applications have found that the power of large shareholders in MDBs far surpasses formal vote shares[33,44], they treat membership as fixed. We extend this approach by modelling how voting power and blocking influence shift under scenarios of shareholder withdrawal and obstruction.

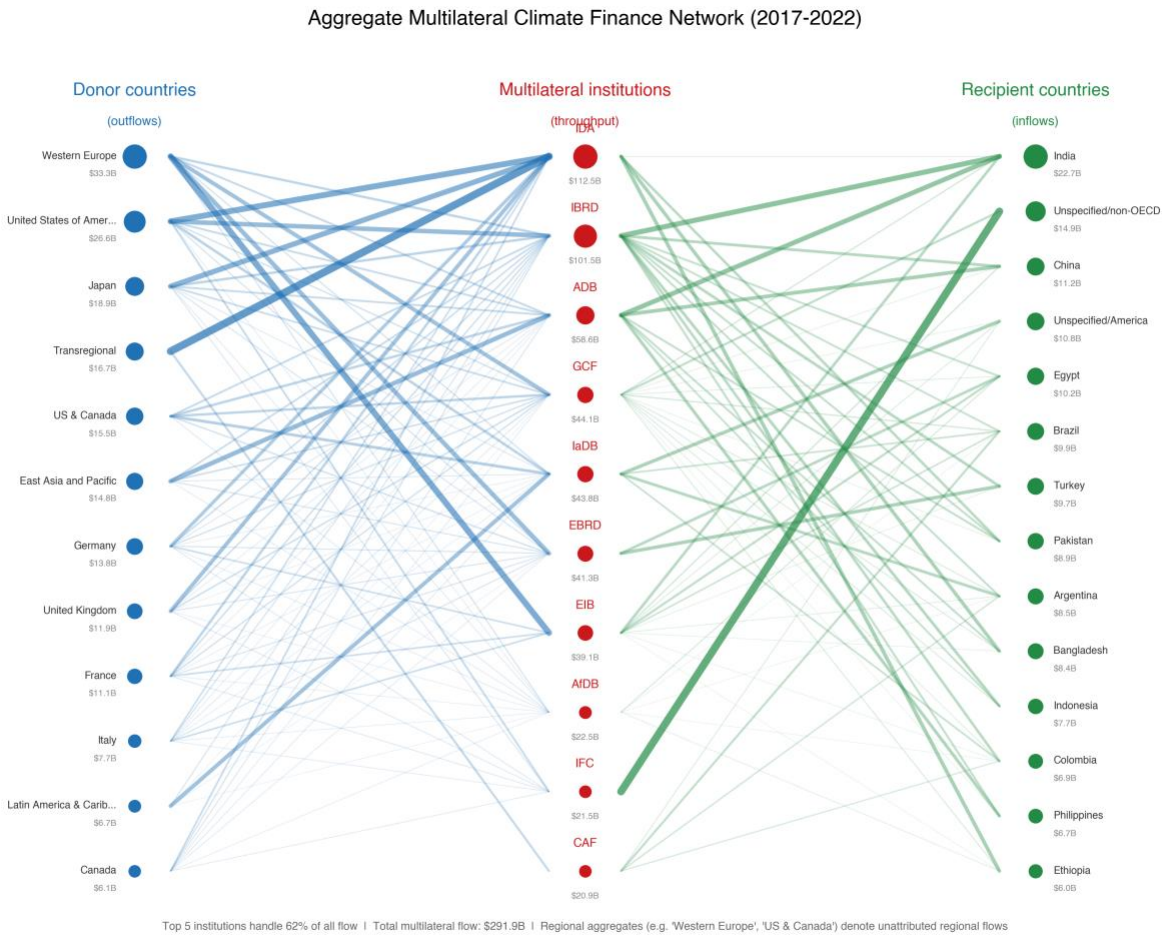
We construct a novel tripartite network of climate finance from donors to intermediary institutions to recipients. We show that despite concentration risk, the multilateral climate finance network is structurally resilient to targeted donor and institutional withdrawal, though flows are reduced significantly and losses disproportionately affect climate vulnerable countries. Voting power analysis reveals that large shareholders have stronger incentives to obstruct than to exit in most institutions, even though US withdrawal would produce a more pluralistic system. These findings reframe the current policy challenge: shoring up the multilateral climate finance system against disruptive donors requires not only more capital mobilization, but governance reforms that increase the cost of obstruction and exit.

Results

Network structure, concentration, and null comparison

The multilateral climate finance network contains 276 nodes and 3,060 directed edges carrying the equivalent of $291.9 billion of cross-border public climate finance from donors to recipients between 2017 and 2022. These figures include both concessional flows such as ODA and trust fund contributions, and non-concessional financing sourced from MDB balance sheets backed by shareholder equity and market borrowing, as tracked by the Climate Policy Initiative. See Data and Methods for more. The network's node-type assortativity, a measure of whether edges connect nodes of similar types, is -0.81, showing flows largely move from donors to institutions to recipients and validating the use of a tripartite network construction. See Figure 1.

Figure 1: Tripartite structure of the aggregate multilateral climate finance network (2017-2022)



Note: The figure displays the top 12 donor countries of origin (left, blue), top 10 multilateral institutions and climate funds (center, red), and the top 14 recipient countries (right, green), which are connected by directed, weighted edges representing public cross-border climate finance intermediated by multilateral institutions. Node size is proportional to total flow volume, edge thickness and opacity are proportional to edge weight. Source: Climate Policy Initiative Global Landscape of Climate Finance 2025, authors' analysis.

Flows are highly concentrated at every layer: a few donors (Gini coefficient, a measure of concentration: 0.86), institutions (Gini coefficient: 0.76), and recipients (Gini coefficient: 0.74) dominate total volumes. To illustrate this concentration within multilateral institutions: a single organization, the International Development Association (IDA), handles 19.3% of multilateral climate finance throughput; of the forty multilateral institutions and funds in our dataset, the top five by climate finance volume (IDA, International Bank for Reconstruction and Development (IBRD), the Asian Development Bank (ADB), the Green Climate Fund (GCF), and the Inter-American Development Bank (IaDB) handle 62% of total throughput. The Herfindahl-Hirschman Index (HHI) measures how diversified each node's connections are; 1 is perfectly concentrated, 0 is perfectly spread. Alongside the Gini measures of the whole system, the mean donor outflow HHI of 0.48 and mean recipient inflow HHI of 0.53 show that both donors and recipients are relatively undiversified against the risk of donor disruption; most donors' contributions go to just a few institutions and recipient countries' inflows are each concentrated in a few institutions.

Beyond volume concentration, smaller institutions may play systemically important bridging functions. The Adaptation Fund sits on the shortest path between donors and recipients in nearly 60% of all node pairs (maximum betweenness centrality: 0.59). Louvain community detection methods identify five clusters (modularity 0.36, where 0 indicates no structure and 1 indicates complete separation). These correspond to the regional ecosystems organized around the regional MDBs; for example, the Asian Development Bank (ADB) primarily links Asian donors to Asian recipients, and the African Development Bank (AfDB) primarily links European donors to African recipients.

Table 1: Descriptive Statistics of Aggregate Multilateral Network (2017-2022)

Statistic	***Value***
Nodes (origins / institutions / destinations)	276

Directed edges	3,060
Total disbursements (USD billions)	291.9
Node-type assortativity	−0.81
Louvain modularity (communities)	0.36 (5)
Mean donor outflow HHI	0.48
Mean recipient inflow HHI	0.53
Institution dependency (top-1 / top-3 / top-5)	19.1% / 46.3% / 62.0%

Table 2 compares observed metrics to a randomized null model; that is, the system that might emerge by chance. Every core metric is significantly differentiated from the null model and exceeds null expectations. The null model matches the observed number of connections per node, so it captures the effect of institutional mandates and geographic footprints while randomizing the edge weights between the nodes.

The observed concentration significantly exceeds what the network's participation patterns alone would predict. The institution total-strength Gini coefficient is 0.76, significantly higher than the expected null mean of 0.54 ($z=9.66$, $p<0.001$). Similarly, the top 3 institutions handle 46% of all throughput, compared to just 25% in the null ($z=9.61$, $p<0.001$). These findings confirm the concentration of flows we observe is not solely a byproduct of the patchwork of donor partnerships or an uneven number of connections per node; this means that the real system does not merely reflect different institutional footprints but disproportionately routes capital through the largest nodes.

Table 2: Null Comparison

Metric	Observed	Null mean	Null SD	z
Institution total-strength Gini	*0.759*	*0.540*	*0.023*	*9.66****
Institution dependency (top-1)	*0.191*	*0.093*	*0.013*	*7.75****
Institution dependency (top-3)	*0.463*	*0.246*	*0.023*	*9.61****
Institution dependency (top-5)	*0.620*	*0.375*	*0.027*	*9.22****
Origin out-strength Gini	*0.859*	*0.702*	*0.012*	*13.01****
Destination in-strength Gini	*0.741*	*0.604*	*0.015*	*9.26****
Max betweenness centrality	*0.587*	*0.347*	*0.063*	*3.80****

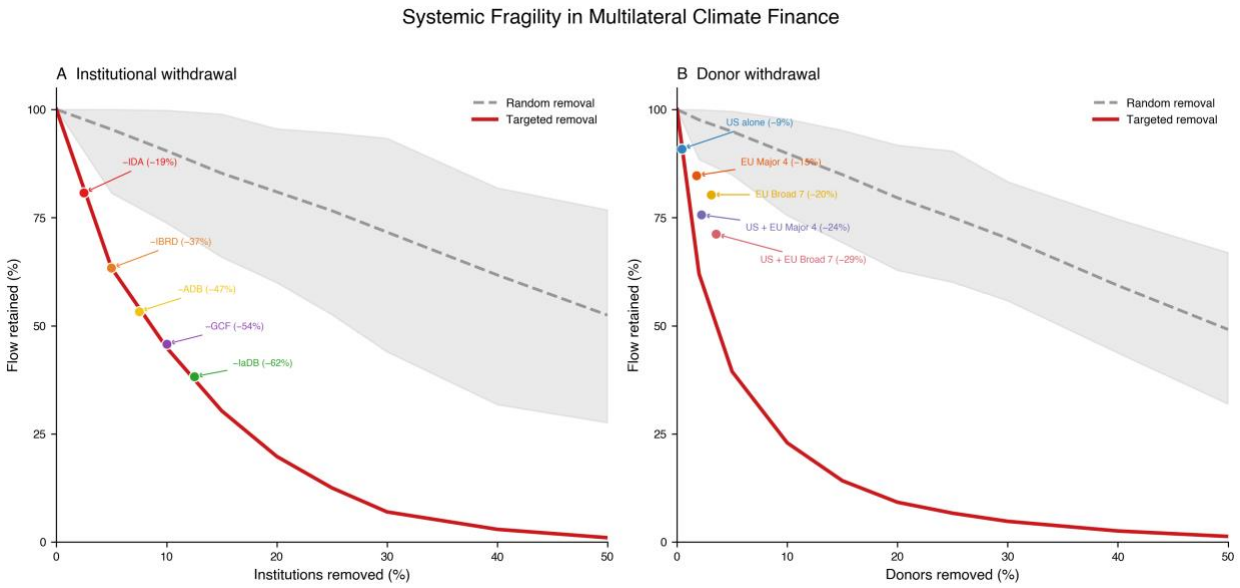
*** $p < 0.001$

Systemic robustness against institutional and donor exit

We distinguish topological resilience (the persistence of network connectivity as nodes are removed) and functional resilience (the capacity to deliver adequate volumes of donor finance to recipient countries). As detailed below, we observe a divergence in these two forms of resilience, where topological connections persist despite steep flow losses.

Figure 2 shows the difference in the robustness curves for targeted and random institutional withdrawal, donor withdrawal, and cascading risks to recipients.

Figure 2: Systemic fragility of the multilateral climate finance architecture



(A) The red curve shows weight retention under sequential institutional withdrawal, starting with the highest throughput. The dashed grey curve shows mean random withdrawal and a 95% CI. Dots mark the cumulative effect of removing the five largest institutions.

(B) The red curve shows weight retention under sequential donor withdrawal across five labeled scenarios. The dashed grey curve shows mean random withdrawal and a 95% CI. Dots mark each scenario and are plotted at their true flow loss and number of donors withdrawn. These dots sit above the targeted curve because the named donors are not the highest-ranked contributors to the multilateral system overall. The gap between each dot and the red line indicates how much less damaging each named scenario is relative to a worst-case removal of the same number of donors.

Source: Climate Policy Initiative Global Landscape of Climate Finance 2025, authors' analysis.

As shown in Figure 2A, we find severe institutional concentration risk in the multilateral climate finance system. If even a few major institutions retreat from participation in climate finance in favor of other development priorities, multilateral climate finance flows fall disproportionately. This scales quickly; for instance, just removing the IDA and the IBRD eliminates more than one-third of flows, but removing the top 5 institutions results in nearly two-thirds of flows lost. See Figure 2A.

Yet the network remains structurally intact. As shown in Table 3 below, even if the twelve largest institutions were to withdraw, decimating flows by 93%, the network

remains topologically intact: 93.5% of nodes remain in the largest connected component (versus 94.1% under the random removal scenario). This means that many smaller multilateral institutions function as intermediaries and maintain links between donors and recipients, even at severely reduced flows, assuming they remain viable.

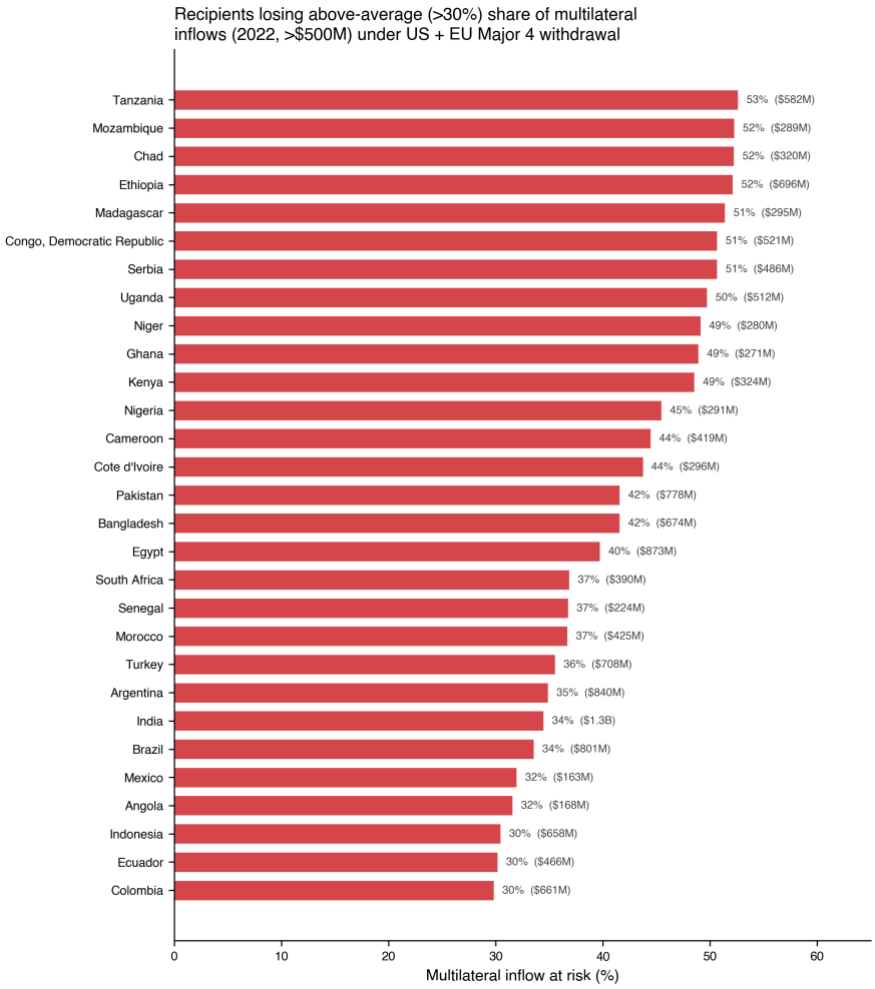
Table 3: Robustness of targeted versus random institutional removal

Fraction removed	*Institutions removed*	*Targeted: flow retained*	*Random: flow retained (95% CI)*	*Targeted: LCC retained*	*Random: LCC retained (95% CI)*
5%	2	63.3%	95.4% (80.7–100%)	99.3%	99.0% (97.5–99.3%)
10%	4	44.9%	90.4% (73.8–99.8%)	98.6%	98.1% (96.4–98.6%)
20%	8	19.8%	81.0% (60.0–95.5%)	95.7%	96.2% (94.6–97.1%)
30%	12	7.0%	71.6% (44.0–93.3%)	93.5%	94.1% (92.4–95.7%)
50%	20	1.0%	52.5% (27.6–76.8%)	75.7%	89.6% (87.0–91.9%)

Similarly, if even a few donor governments choose to withdraw their contributions to MDB climate finance, flow volumes fall severely at a moment in history where they are already an order of magnitude short of needs[45]. See Figure 2B. We show five scenarios of complete donor withdrawal from climate finance, with escalating effects: US only (−9%), the four largest European donors (Germany, UK, France, Italy; −15%), seven European donors (adding Spain, Sweden, Netherlands; −20%), US + EU Major 4 (−24%), and combined US + EU Broad 7 (−29%). These fall unevenly on the budgets of MDBs; for example, US withdrawal is disproportionately negative for the budget of the IFC (20.9%), IDA (15.5%), and IaDB (15.4%), whereas European donors are spread more evenly among a greater set of institutions. These estimates assume that donor withdrawal results in a proportionate reduction in institutional disbursements across all recipients, without strategic reallocation by remaining donors or institutions. In practice, MDBs facing reduced donor inflows may become more selective and prioritize higher-leverage, less concessional transactions in more strategic geographies. These estimates are not intended to represent forecasts of institutional behavior, but upper-bound estimates of the structural, proportionate impacts of withdrawal.

The effects of donor withdrawal can be traced downstream to recipient countries using the full triplet-level data, which contains 74,852 origin-institution-destination records from 2017-2022. They are diffuse but severe; under a combined US + EU Major 4 scenario, recipient countries would lose an average of 29.8% of multilateral inflows. This burden falls disproportionately on climate-vulnerable states (See Figure 3). Countries facing disproportionate exposure include fragile states (Chad, DR Congo, Ethiopia, Somalia) and major emerging economies (Turkey, Argentina, India, Brazil), underscoring the breadth of dependence on this concentrated group of donors and pointing to broader cascading risks beyond climate adaptation to human health and development, migration and stability under these exit scenarios. Fragile states depend disproportionately on concessional multilateral channels because they lack access to bilateral sovereign finance or commercial capital markets, so any multilateral shock is likely to be absorbed without buffer. Conversely, major emerging economies rank high on this list because their large absolute volumes of multilateral inflows translate to large absolute losses. These two profiles of vulnerability suggest that donor withdrawal has distributional consequences at both ends of the development spectrum.

Figure 3: Countries with significant exposure to US and EU Major 4 withdrawal (2022)



The bars show the percentage of each recipient's total multilateral climate finance inflows in 2022 only traceable to the five withdrawn donors in the US + EU Major 4 scenario. Values report the percentage of inflows at risk and the absolute loss among countries receiving at least USD $500M in that year and with inflows at risk above the mean of 29.8%. Non-country regional aggregates are excluded. Here, 2022 data are used rather than the 2017-2022 aggregate because recipient-level flows are most precisely tracked in the most recent year data is available, which is 2022. Results are broadly consistent with the aggregate period. Source: Climate Policy Initiative Global Landscape of Climate Finance 2025, authors' analysis.

Voting power in the multilateral system

The structural resilience of the multilateral climate finance network is unevenly shaped by the power of shareholders within institutions. Many countries in Figure 3 facing the greatest exposure to donor withdrawal are recipients of institutions where that same donor holds the highest swing voting power, representing a compounding vulnerability. The

following section analyzes how decision-making within institutions can amplify or constrain the vulnerability of systemic centrality in MDBs. We produced two scenarios: one representing the complete and immediate withdrawal of the United States and one representing the same action for the United States plus four major European donors. These represent a simplified upper bound and do not capture intermediate outcomes such as partial withdrawals, reallocation of funds to non-climate objectives, or the entrance of new actors.

In the baseline scenario, swing voting power is unsurprisingly concentrated among the largest MDB shareholders. The United States holds the highest normalized Banzhaf score in the World Bank Group (IFC, IBRD, and IDA) and the Inter-American Development Bank, and ties for the top value with Japan in the Asian Development Bank. Nigeria leads in the African Development Bank, China leads in the Asian Infrastructure Investment Bank, Saudi Arabia leads in the Islamic Development Bank, and Jamaica and Trinidad & Tobago tie in the Caribbean Development Bank. In the New Development Bank, the 5 founding donors tie by design. For a disruptive donor, high veto power incentivizes the use of voice rather than exit.

In the full US withdrawal scenario, the balance of swing vote power shifts in several institutions. Japan leads in the World Bank Group (IBRD, IFC, IDA) and consolidates its influence in the Asian Development Bank. Argentina leads in the Inter-American Development Bank. In the European Bank for Reconstruction and Development (EBRD), power is shared symmetrically among the largest European shareholders and Japan. Nigeria consolidates power in the African Development Bank, with a stronger Banzhaf score than when the US is present.

Figure 4 summarizes the comparison for the seven MDBs with US membership in the source data. Panel A shows the maximum normalized Banzhaf score among all shareholders, comparing the baseline and the “No United States (NOUS)” scenario. This reveals how concentration of swing vote power changes when the US exits. Panel B shows the United States’ own normalized Banzhaf in the baseline scenario, providing context for

interpreting the magnitude of the US presence. The gap between the US baseline Banzhaf (Panel B) and the next-largest shareholder's score under US withdrawal (Panel A) indicates how much governance gets more concentrated or pluralistic under a US exit scenario. Comparisons of influence between banks should be interpreted cautiously because membership size, decision quotas, and other dynamics differ.

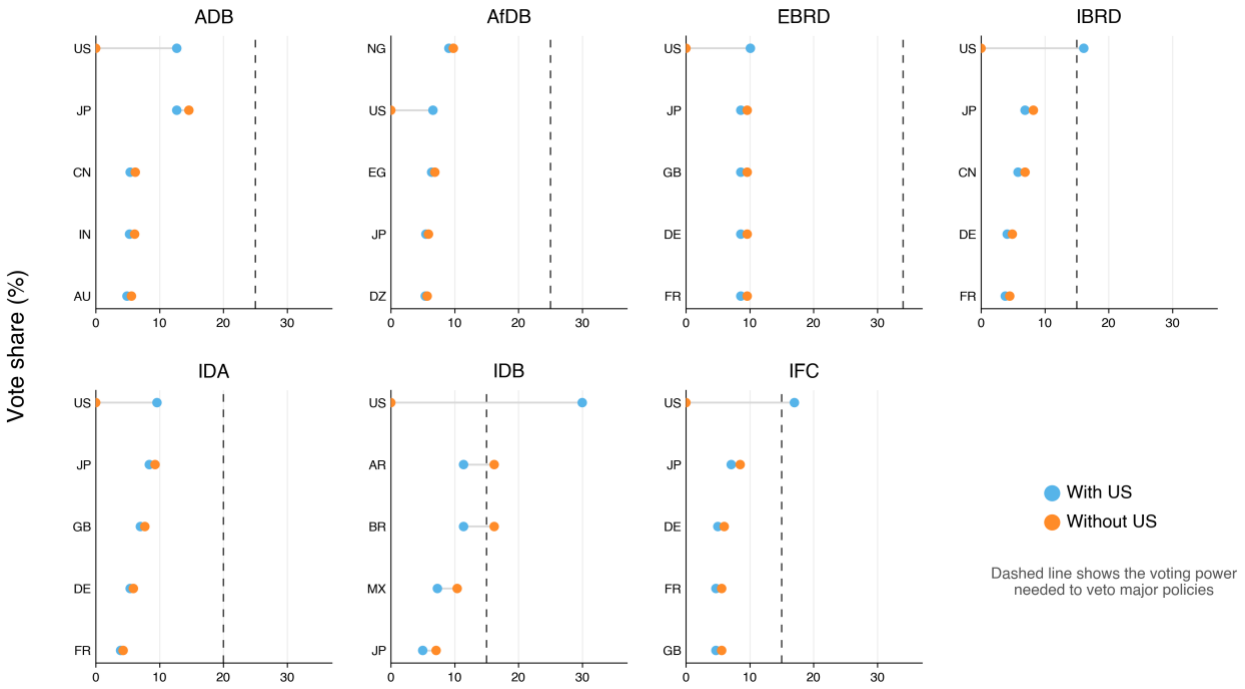
Figure 4: Voting power with and without the United States



A US exit produces more pluralistic governance structure across the MDBs with power dispersed across a wider coalition of mid-weight shareholders (Fig 5). In most institutions, no member state gains veto power. Contrary to narratives in which US

retrenchment cedes influence to China, the rescaled distribution suggests no major power center that consolidates control and can direct decisions.

Figure 5: Voting power of top 5 institutions before and after US exit, by multilateral institution



The one exception is the IDB, where the US withdrawal gives veto power to both Argentina and Brazil due to their already high baseline shares. However, a US exit from the IDB would be costly; given that the IDB is headquartered and majority funded in the US, a threat of exit would likely call into question the institution's future and governance. Further, most MDBs contain withdrawal clauses that mandate long periods of arrears and continued liability for callable capital. In the United States, membership and capital subscriptions are legislative acts and major changes require an act of Congress[34]. These features raise the cost of exit substantially and make the formal threat of withdrawal less credible. Veto powers and the difficulty of exit suggest that for large shareholders, there is a greater incentive for governance obstruction than exiting institutions.

Discussion

We construct the first tripartite network analysis of structural concentration and systemic risk in multilateral climate finance, and the first to integrate network resilience

with voting power indices to assess both the structural and governance dimensions of donor-driven disruption. Where prior applications of network science to climate finance have examined technology-specific funding landscapes, this paper focuses on the multilateral architecture as a system, tracing pathways from donors through institutions to recipient countries. We show that the system is far more resilient to donor withdrawal than to institutional withdrawal. This asymmetry is not self-evident from the data: the five largest institutions disburse 62% of total tracked flows and the largest donor controls nearly a quarter of public climate finance, which suggests donor withdrawal is the more destabilizing shock. This is because donors connect to the network through multiple institutions, diluting any single donor's structural footprint, while institutions are the irreplaceable intermediaries whose removal severs entire donor-recipient pathways simultaneously. Removing the top 5 institutions by volume eliminates 62% of flows, while the withdrawal of the eight largest donors reduces flows by less than half that share (~29%). The topology of the network, represented by the share of nodes which are part of the largest connected component, remains remarkably intact through the shocks. This follows a well-documented pattern in network science: that scale-free and heavy-tailed networks are robust in the face of randomized shocks but vulnerable to targeted ones[22].

These findings point to the need for strong diversification in the institutional layer. The creation of new or separately governed regional development banks, specialized funds, or national-level subsidiaries would help to buffer the risk of shocks to major institutions propagating through the system, likely more effectively than larger, consolidated institutions might. Our community detection results support this recommendation. The five Louvain clusters we identify correspond to recognizable regional ecosystems organized around a dominant regional MDB and entrenched donor-recipient relationships. This segmentation implies that under a stressed scenario, the multilateral system would not collapse uniformly but would more likely fragment along regional lines. Institutional diversification strategies should be designed with this regional architecture in mind by building redundancy within these communities. We recognize this recommendation runs counter to current calls for institutional consolidation to lower

transaction costs and improve recipient access. We see these two objectives as complementary: consolidation at the operational level through mutual reliance, shared platforms, and harmonized reporting for efficiency alongside diversification of governance for resilience.

Our power indices analysis shows that a disruptive donor can affect outcomes more effectively through voice than exit. Although calls for multilateral reform are widespread[13,30,45], the recommendations may differ when faced with a disruptive donor. Reforms that limit obstruction and broaden participation become as critical as reducing the ease of exit. US withdrawal is bad for climate finance flows but not catastrophic for institutions in the short run, but governance reforms matter more for long-run stability than the mobilization of replacement capital.

Where politically salient, broadening shareholding to include South-South contributions or leveraged private capital could help to soften blunt swing vote power through more pluralistic governance. Other reforms could include limiting single-donor veto power and advancing more pluralistic governance models. This is particularly relevant for the institutions where the US retains veto power (IBRD, IDB, IFC), even if a disruptive donor might threaten exit. This is politically fraught as it necessarily entails redistributing formal or informal power, but has precedent in the push towards country-led programming platforms. For similar reasons, the New Development Bank was designed from the outset with a voting system where no single withdrawal would cause new veto powers[30].

A second set of reforms should make exiting from VCEFs harder to reduce the risk of sudden capital withdrawals. When the cost of exit is low, it becomes the default response to short-term political shifts rather than an act of considered strategic retrenchment. VCEFs are particularly exposed because their voluntary contribution structures and rotating consensus-based boards leave little incentive for a disruptive shareholder to engage constructively through voice. If exit becomes meaningfully costlier than voice, donors with temporary political differences will remain and negotiate rather than withdraw. Just as the first Trump administration's efforts to leave the Paris Agreement were partially hampered by its four-year exit timeline[46], the exit timelines could be extended and

transition periods for capital commitments and board rights could be mandated. These mechanisms would not prevent exit but could incentivize engagement for those who are disruptive due to short-term political priorities rather than more fundamental issues.

The current pullback suggests that criticism of piecemeal reforms[35,47] which enabled donors to retain significant power were justified. Although multilateral climate finance may be structurally resilient at the network level, it may be undermined by the fragility of governance at the institutional level. Stronger governance is not just a matter of equity, but a prerequisite for system resilience.

Acknowledgements

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Supplemental Information

Supplemental appendices are in preparation and available upon request.

Data and Methods

Global Landscape of Climate Finance Data

We leverage transaction-level data collected by the Climate Policy Initiative team for the Global Landscape of Climate Finance report[6] and graciously shared with us for this analysis. We retain only public finance transactions flowing across borders through multilateral channels (Multilateral Development Finance Institutions and Multilateral Climate Funds; see the Climate Policy Initiative's tracking methodology[48]). Institution-type classifications follow the source methodology and were not independently validated. Because coverage improves in later years, we collapse temporal trends and construct the network using aggregate tracked flows from 2017-2022, the most recent year for which data was available.

Flow share figures cited in the introduction are drawn from the CPI Global Landscape of Climate Finance 2025 and refer to cross-border public climate finance intermediated through multilateral channels. Definitions of what constitutes "multilateral finance" vary across tracking frameworks, and the share of total finance, including domestic flows and mobilized private capital, attributable to multilateral channels is substantially lower.

A portion of flows are attributed to regional aggregates (e.g. “Western Europe” or “US & Canada”) rather than specific countries. These represent disbursements where the source data identifies a donor region but not an individual donor government; we retain these regional aggregates as distinct nodes to favor completeness on total volumes and remain conservative on donor centrality metrics for countries that are treated as both individual nodes and part of regional aggregates, including the United States.

For the recipient-level exposure analysis in Figure 3, we use 2022 flows only, as this year provides the most complete and precise recipient-level attribution in the CPI dataset. The aggregate network structure and robustness results use the full 2017–2022 dataset.

Networks to estimate systemic risk

To test whether the network intermediation layer is highly concentrated, we assess if:

1. The concentration of flows through institutions is significantly higher than a randomized null case which preserves the same number of connections per node
2. Targeted removal of the highest throughput institutions causes disproportionate flow losses compared to random institutional failure
3. Complete withdrawal of major donor governments (notably the US and major European donors) cascades through the institutions and produces severe concentrated losses among dependent geographies

We also measure concentration and structural vulnerability using several families of metrics:

- Concentration: We compute a Gini coefficient for donor out-strength, institution total strength, and recipient in-strength. We also compute a Herfindahl-Hirschman Index (HHI) to measure the diversification of donor outflows and recipient inflows.
- Centrality and Brokerage: We compute betweenness centrality measures to calculate how often a node sits on the shortest weighted path between other nodes. In our tripartite network, high betweenness centrality for institutions indicates they bridge flows from many donors to many recipients.
- Institutional Dependency: We compute the share of total institutional throughput channeled through the top 1, 3 and 5 institutions by volume.
- Community detection: We compute the network's Louvain modularity[49] to detect communities of donors, institutions and recipients that may be segmented regionally or thematically.

Null model design

Some level of concentration in the multilateral climate is to be expected given the different regional footprints and mandates of each institution. To identify whether the level of systemic concentration is greater than what these patterns would produce, we build a randomized baseline using the Maslov-Sneppen double-edge swap procedure[50]. This approach repeatedly shuffles edges of the original network and randomly reassigns edge weights but does not change the degree of each node. This results in a "rewired" network with the same total flow and the same distribution of transaction volumes but randomly distributed. We generate 200 of these shuffled networks for each configuration, compute the concentration metrics on each, and compare these to the metrics of our original network using z scores:

$$z = \frac{(x_observed - \bar{x}_null)}{s_null}$$

A z-score above 1.96 means the observed concentration is significantly higher than the randomized baseline at $p < 0.05$.

Robustness to Shocks

We test robustness to two shocks: institutional withdrawal from climate finance and donor withdrawal from key multilateral institutions.

To test robustness to institutional withdrawal from climate finance, we rank institutions by total strength (the sum of inflows and outflows) and delete them from the network sequentially. At each step, we measure what fraction of total flow survives (weight retention) and what fraction of nodes remain in the largest connected component (LCC retention). We compare this targeted removal to random removal, averaged over 100 random distributions with 95% confidence intervals. The gap between the two curves indicates how much worse targeted removal focused on the largest actors is than random attrition, a representation of the network's hubs' vulnerability[22].

To test robustness to the complete withdrawal of specific donor governments from the multilateral system, we use the full triplet-level data to trace cascading impacts to recipient countries. When a donor exits, all flows originating from that donor are removed with them, both reducing the budget of every institution that donor funded and reducing overall flows to the recipients. We report aggregate flow loss, institutions and recipients that lose all multilateral funding, mean and median throughput losses at the institutional and recipient levels, and the share of recipients' total multilateral inflows exposed to the withdrawing donor. We run scenarios for five groups of donor withdrawal: 1) United States 2) Germany, UK, France, Italy 3) Germany, UK, France, Italy, Spain, Sweden, Netherlands 4) US, Germany, UK, France, and Italy, and 5) all eight countries listed.

Voting shares data

We compiled a database of the voting shares of donor governments for 14 regional and global multilateral development banks (Supplementary Information 1). These data are drawn from the institutions' annual reports and published voting power tables for the latest year available, ranging from 2024 to 2026. While these figures reflect formal voting power, the requirement of simplifying assumptions for comparative analysis means they do not capture coalition practices and differences in governance systems such as double majority rules. Although critiqued for ignoring institution-specific decision procedures and

inadequacy in capturing the strategic behavior of voting blocs[55], these dynamics cannot be observed externally since boards typically avoid formal votes unless outcomes are already assured[39] and most MDBs do not routinely publish voting records. Major decision thresholds (e.g., supermajority requirements) are proxied and treated as the decision quota in a weighted voting game expressed in percentage points of total voting power. See supplemental materials for this data.

Power indices for influence within existing governance structures

While network analysis captures the structural resilience and centrality of multilateral flows, it does not consider how institution-specific governance decisions shape these flows or explain what institutions may be affected. Ray (2021) applied the Penrose-Banzhaf and Shapley-Shubik power indices to twenty-eight multilateral institutions and found that global MDB governance is creditor-led, while regional MDBs generally have more borrower-friendly governance[33]. Using similar methods, Ray and Kamal find that CAF and the IsDB extend substantially greater board representation to borrowers than Global North-anchored MDBs due to their unique tiered voting systems[44].

We therefore complement the previous approach with an analysis of shareholder influence and blocking power for each MDB under different scenarios of donor withdrawal. For each MDB with a defined quota, we define a cooperative game in which the players are shareholders with voting weight formed into all possible coalitions. Coalitions "win" if their total weight meets or exceeds the stated decision quota. The number of coalitions for which a shareholder is pivotal (meaning joining the coalition turns a losing coalition into a winning one) comprise that shareholder's raw Banzhaf score. We report a normalized Banzhaf index by dividing each shareholder's raw Banzhaf count by the sum of raw counts across all players, so the indices sum to one within each institution. We also report the absolute Banzhaf probability: raw count divided by 2^(n-1) for n players. Using Python 3 standard libraries, Banzhaf values are computed with dynamic programming on the distribution of coalition weights below the quota.

As noted above, these power indices approximate actual decision-making dynamics; they also simplify more complex governance structures, such as double-majority voting or other compound rules.

Power indices for influence within a full US withdrawal scenario

We also construct a counterfactual in which the United States exits every MDB in which it is a member by removing US shareholding and renormalizing remaining members so their voting weights sum to 100 percent.

$$p_i' = \frac{p_i}{1 - p_{US}}$$

We hold the decision quota unchanged in all institutions, and do not change shareholding in MDBs where the US is not a member. This scenario isolates how swing voting and obstruction power shift when the US is absent, but relative weights amongst remaining shareholders are preserved, serving to capture the mechanical effect of US exit. It necessarily abstracts from long-run capital changes and possible institutional negotiations. We then reapply the Banzhaf index to distinguish the adjusted blocking power of remaining member states in a scenario of complete US withdrawal from multilateralism. For slight institution-specific changes to this formula, see supplementary methods.

Limitations

This analysis has several limitations.

1. This analysis focuses exclusively on multilateral climate finance and does not include bilateral flows. This means our estimates of recipient vulnerability may overstate dependence on multilateral channels for countries that also receive significant bilateral climate finance from the same withdrawing donors. It also means we cannot assess whether donors choosing to withdraw from multilateral channels concurrently increase bilateral donor flows, which could offset the modeled impacts.

2. While the Climate Policy Initiative's Global Landscape of Climate Finance dataset represents the most comprehensive tracking of flows to date, earlier years have sparser reporting, which inflates apparent year-on-year growth. We mitigate this by aggregating all available years (2017-2022) into a single network.
3. Where the source country is not fully certain, flows are attributed in the source data to regional aggregates (e.g. "US & Canada"). This results in conservative donor exit estimates, as they do not capture the portion of flows from donor countries included in these regional aggregates.
4. The network projection treats donor capital as fungible, capturing aggregate structural relationships but not tracing donor-specific flows. This may overstate connectivity and understate bilateral dependencies; we partially address this by using triplet-level data to trace donor-specific shocks to recipient outcomes. Relatedly, the network is constructed as a static aggregate and does not capture temporal dynamics in donor behavior or institutional roles.
5. The exit scenarios assume complete, immediate, and irreversible exit, rather than phased approaches, partial pullbacks, or replacement by other donors. These findings should therefore be interpreted as an upper bound rather than a forecast, as they do not incorporate phased withdrawal, substitution by other donors, or institutional adaptation. The randomized null model isolates the role of network topology but does not preserve geographic or institutional constraints that may shape observed patterns.
6. Voting power indices approximate formal influence under simplified assumptions and do not capture coalition dynamics, informal governance practices, or institution-specific decision rules. In addition, our analysis focuses on aggregate flows and does not distinguish between financial instruments, which may affect exposure patterns. These limitations suggest caution in interpreting magnitudes, but do not alter the qualitative patterns we identify.
7. We disaggregate the components of the World Bank Group, treating IDA, IBRD, and IFC as distinct nodes, consistent with their separate balance sheets, governance,

and mandates. This may modestly overstate institutional diversification. Sensitivity analysis grouping these three entities as a single node would be expected to increase the measured institutional HHI and raise the share of flows through the top institution above the 19.3% we report. This is an area for future work.

Works Cited

1. Balakrishnan, V. S. USAID funding freeze fails children globally. *Lancet Child Adolesc. Health* **9**, 220–221 (2025).
2. U.S. Department of the Treasury. Treasury Announces the United States' Immediate Withdrawal from the Green Climate Fund. https://home.treasury.gov/news/press-releases/sb0352 (2025).
3. Miriri, D. Exclusive: US Treasury has not pledged funds to AfDB's 2025 ADF financing round, spokesman says. *Reuters* (2026).
4. The White House. Putting America First in International Environmental Agreements. https://www.whitehouse.gov/presidential-actions/2025/01/putting-america-first-in-international-environmental-agreements/ (2025).
5. President of the United States. *Withdrawing the United States From and Ending Funding to Certain United Nations Organizations and Reviewing United States Support to All International Organizations*. https://www.govinfo.gov/content/pkg/DCPD-202500222/pdf/DCPD-202500222.pdf (2025).
6. Climate Policy Initiative. *Global Landscape of Climate Finance 2025*. https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2025/ (2025).

7. https://www.oecd.org/en/data/insights/data-explainers/2026/04/a-historic-decline-in-foreign-aid-preliminary-2025-oda-data.html

8. Broccolini, C., Lotti, G., Maffioli, A., Presbitero, A. F. & Stucchi, R. Mobilization Effects of Multilateral Development Banks. *World Bank Econ. Rev.* **35**, 521–543 (2021).
9. Geddes, A., Schmidt, T. S. & Steffen, B. The multiple roles of state investment banks in low-carbon energy finance: An analysis of Australia, the UK and Germany. *Energy Policy* **115**, 158–170 (2018).
10. Haralampieva, V. & Herrera-Martínez, A. Multilateral development banks and their role in channelling climate finance. in *Research Handbook on Climate Finance and Investment Law* 77–128 (Edward Elgar Publishing, 2025).
11. Kalinowski, T. The Green Climate Fund and private sector climate finance in the Global South. *Clim. Policy* **24**, 281–296 (2024).
12. Cui, L., Sun, Y., Song, M. & Zhu, L. Co-financing in the green climate fund: lessons from the global environment facility. *Clim. Policy* **20**, 95–108 (2020).
13. Browne, K. E. Rethinking governance in international climate finance: Structural change and alternative approaches. *WIREs Clim. Change* **13**, e795 (2022).
14. Kalinowski, T. Institutional Innovations and Their Challenges in the Green Climate Fund: Country Ownership, Civil Society Participation and Private Sector Engagement. *Sustainability* **12**, 8827 (2020).

15. van Kerkhoff, L., Ahmad, I. H., Pittock, J. & Steffen, W. Designing the Green Climate Fund: How to Spend $100 Billion Sensibly. *Environ. Sci. Policy Sustain. Dev.* **53**, 18–31 (2011).
16. Boussichas, M., Cabrillac, B. & Pugnet, C. *How the Closure of USAID Will Affect the Allocation of Global Official Development Assistance*. (2025).
17. Attridge, S., Dahan, F. & Getzel, B. Concessional but catalytic? Insights on DFI blended concessional finance practice. Preprint at https://odi.org/en/publications/concessional-but-catalytic-insights-on-dfi-blended-concessional-finance-practice/ (2025).
18. Brink, D. ten *et al*. Impact of an international HIV funding crisis on HIV infections and mortality in low-income and middle-income countries: a modelling study. *Lancet HIV* **12**, e346–e354 (2025).
19. Haug, S., Novoselova, A. & Klingebiel, S. *Trump's Assault on Foreign Aid: Implications for International Development Cooperation*. *IDOS Discussion Paper 4/2025* https://www.idos-research.de/discussion-paper/article/trumps-assault-on-foreign-aid-implications-for-international-development-cooperation/ (2025) doi:10.23661/IDP4.2025.
20. Hayward, R., Klimek, P. & Naqvi, A. United States and European Union aid cuts risk exacerbating links between aid, trade, and human and environmental crises. *Commun. Sustain.* **1**, 12 (2026).
21. Hirschman, A. O. *Exit, Voice, and Loyalty: Responses to Decline in Firms, Organizations, and States*. (Harvard University Press, Cambridge, Mass, 1970).

22. Albert, R., Jeong, H. & Barabási, A.-L. Error and attack tolerance of complex networks. *Nature* **406**, 378–382 (2000).
23. Morin, J.-F. & Kim, R. E. Too Complex to Fail: The Stability of Global Environmental Governance Beyond Hegemony. *Glob. Policy* **16**, 1087–1093 (2025).
24. Bowman, M. & Minas, S. Resilience through interlinkage: the green climate fund and climate finance governance. *Clim. Policy* **19**, 342–353 (2019).
25. Kartun-Giles, A. P. & Ameli, N. An Introduction to Complex Networks in Climate Finance. *Entropy* **25**, 1371 (2023).
26. Ameli, N., Kothari, S., Larosa, F., Rickman, J. & Sciarra, C. Complexity in low-carbon finance markets. in *The Elgar Companion to Energy and Sustainability* 340–355 (Edward Elgar Publishing, 2024).
27. Ameli, N., Kothari, S., Livan, G. & Caldarelli, G. The Hidden Structure Of Energy Efficiency Finance. SSRN Scholarly Paper at https://doi.org/10.2139/ssrn.3913781 (2021).
28. Rickman, J., Larosa, F. & Ameli, N. The internal dynamics of fast-growing wind finance markets. *J. Clean. Prod.* **375**, 134129 (2022).
29. Larosa, F., Rickman, J. & Ameli, N. Finding the right partners? Examining inequalities in the global investment landscape of hydropower. *Glob. Environ. Change* **74**, (2022).
30. Biswas, R. *Reshaping the Financial Architecture for Development Finance: The New Development Banks*. https://ideas.repec.org//p/ehl/lserod/61120.html (2015).
31. Chin, G. T. Asian Infrastructure Investment Bank: Governance Innovation and Prospects. *Glob. Gov.* **22**, 11–25 (2016).

32. Kaya, A. Climate finance and the multilateral development banks. in *Handbook of Aid and Development* (eds Desai, R. M., Devarajan, S. & Tobin, J. L.) 383–402 (Edward Elgar Publishing, 2024). doi:10.4337/9781800886810.00030.

33. Ray, R. Who Controls Multilateral Development Finance? *Glob. Gov.* **27**, 118–143 (2021).

34. Fleck, R. K. & Kilby, C. World Bank Independence: A Model and Statistical Analysis of US Influence. *Rev. Dev. Econ.* **10**, 224–240 (2006).

35. Vestergaard, J. & Wade, R. H. Protecting Power: How Western States Retain The Dominant Voice in The World Bank's Governance. *World Dev.* **46**, 153–164 (2013).

36. Kilby, C. Donor influence in multilateral development banks: The case of the Asian Development Bank. *Rev. Int. Organ.* **1**, 173–195 (2006).

37. Kaya, A., Kilby, C. & Kay, J. Asian Infrastructure Investment Bank as an instrument for Chinese influence? Supplementary versus remedial multilateralism. *World Dev.* **145**, 105531 (2021).

38. Reinsberg, B. Foreign Aid Responses to Political Liberalization. *World Dev.* **75**, 46–61 (2015).

39. Verdier, P.-H. International Finance and the Return of Geopolitics. *Am. J. Int. Law* **119**, 229–278 (2025).

40. Barnett, M. & Finnemore, M. *Rules for the World: International Organizations in Global Politics*. (Cornell University Press, 2004).

41. Strand, J. R. Measuring voting power in an international institution: the United States and the inter-American development bank. *Econ. Gov.* **4**, 19–36 (2003).

42. Shapley, L. S. & Shubik, M. A Method for Evaluating the Distribution of Power in a Committee System. *Am. Polit. Sci. Rev.* **48**, 787–792 (1954).

43. Laruelle, A. & Widgrén, M. Is the allocation of voting power among EU states fair? *Public Choice* **94**, 317–339 (1998).

44. Ray, R. & Kamal, R. Can South–South Cooperation Compete? The Development Bank of Latin America and the Islamic Development Bank. *Dev. Change* **50**, 191–220 (2019).

45. Bhattacharya, A., Songwe, V., Soubeyran, E. & Stern, N. *Delivering an Integrated Climate Finance Agenda in Support of the Baku to Belém Roadmap to 1.3T*. (2025).

46. Zhang, Y.-X., Chao, Q.-C., Zheng, Q.-H. & Huang, L. The withdrawal of the U.S. from the Paris Agreement and its impact on global climate change governance. *Adv. Clim. Change Res.* **8**, 213–219 (2017).

47. Reisen, H. Will the AIIB and the NDB Help Reform Multilateral Development Banking? *Glob. Policy* **6**, 297–304 (2015).

48. Climate Policy Initiative. *Global Landscape of Climate Finance 2025: Tracking Methodology*. https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2025-tracking-methodology/ (2025).

49. Blondel, V. D., Guillaume, J.-L., Lambiotte, R. & Lefebvre, E. Fast unfolding of communities in large networks. *J. Stat. Mech. Theory Exp.* **2008**, P10008 (2008).

50. Maslov, S. & Sneppen, K. Specificity and Stability in Topology of Protein Networks. *Science* **296**, 910–913 (2002).

51. Garrett, G. & Tsebelis, G. Even More Reasons to Resist the Temptation of Power Indices in the EU. *J. Theor. Polit.* **13**, 99–105 (2001).