Hierarchies of Adaptation

Corporate Power in Economic Statecraft

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Abstract

When is business an extension of state power, and when does it constrain it? As states subject commerce to statecraft, this question becomes central to understanding global order. The analysis draws from an original dataset of 20,013 corporate earnings calls annotated using a novel text-as-data approach with large language models. While existing scholarship largely treats firms as passive subjects, economic shocks as uniformly positive or negative, and corporate responses as unidirectional, I demonstrate how economic statecraft is mediated by firms' morphological flexibility: their capacity to profit from or reconfigure operations around geopolitical constraints. Unlike centralized financial networks, supply chains' territorial embeddedness and decentralized governance enable adaptive reconfiguration, allowing firms to actively reshape state policy. The supply-side nature of geopolitical shocks rewards scale and indispensability, spawning a hierarchy as to who can capture rents, pass on costs, or adapt their supply chain. Defense contractors, critical infrastructure firms, high-tech manufacturers, and mining companies extract rents through strategic indispensability, while traditional manufacturers bear adjustment costs without compensating power. This creates a stark demarcation between winners and losers, which intensified after Russia's invasion of Ukraine. In brief, the paper shows that firms actively reshape state policies through their adaptive strategies.

Keywords: Geopolitics, economic statecraft, business power, international political economy, globalization, industrial policy

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Introduction

Collective economic shocks have become a mainstay of global politics. In pursuit of and in response to revisionist aspirations, states are subjugating commerce to statecraft through rafts of industrial policies, export restrictions, and tariffs in degrees not seen in a century. To quote Martin Wolf (2023), there exists a 'growing confidence in governments' ability to reshape their economies for the better', while former U.S. national security adviser Jake Sullivan (2023) has argued that the confidence for markets to 'always allocate capital productively and efficiently' has frayed. The volatile economics and geopolitics that ensue from this have animated a wave of scholarship investigating supply-side inflation (Weber et al. 2025), supply chain vulnerability (Acemoglu and Tahbaz-Salehi 2025), changing trade linkages (Gopinath et al. 2025), green industrial policies (Meckling 2025), export restrictions and economic coercion (Farrell and Newman 2023; Malkin and He 2024), and cloud infrastructure (Lehdonvirta et al. 2025).

What largely goes missing in these accounts is the role of multinational firms in channeling these shocks. The language of technological sovereignty and 'taking back control' of supply chains invokes a sense that the state is back at the commanding heights of the economy. But in a highly connected world of concentrated corporate power where states have learned to govern *through* markets, revisionist aspirations will likely be significantly distorted. The evidence bears this out. Rather than following the flag in retreat, the world is reglobalizing as firms stretch and branch their supply chains around geoeconomic fault lines, while sanctioned goods keep skirting restrictions (Alfaro and Chor 2023; Cheng et al. 2025). So far, international political economy scholarship has not accorded primacy to the 'need to revisit fundamental questions like the relationship between multinational corporations and national security, and how global firms serve as an extension of state power while also potentially undermining it' (McNamara and Newman 2020, 70). This is where the current paper steps in.

I argue that the politics of economic statecraft are structured by a hierarchy of adaptation that centers around what I term 'morphological flexibility' in corporate strategy and structure: the ability to profit from or reconfigure around geopolitical constraints. This argument comes in three parts. First, multinational firms have been part and parcel in 'the formation of political structures endowed with ever-more extensive and complex organizational capabilities' to coordinate economic activity across borders (Arrighi 2010, 15; Baldwin 2019). The supply chains that have transferred technology, capital, management, and know-how across borders emerged out of a permissive geopolitical environment where firms branched out 'in

exchange for future foreign earnings' (Gilpin 1975b, 198). Since the 1990s, global market access, network effects, and intellectual property monopolies have led to a confluence of vertical disintegration, horizontal concentration, and global dispersion as firms optimize their chains for efficiency and wealth accumulation (Durand and Milberg 2020; Schwartz 2022; Bair et al. 2023). This is the landscape that states are targeting in their geopolitical retooling efforts.

Second, as the 'geopolitics of connectivity' (Schindler et al. 2024, 1087) extend from financial and digital networks into the physical world of supply chains, growing evidence suggests that supply chains are able to resist or adapt to economic statecraft in ways that are impossible in fully digitized networks. While supply chains are structured as complex and asymmetrical networks much like payment clearing system SWIFT (Farrell and Newman 2019; Wiedmer and Griffis 2021), the former lack a central clearing house and fully digital ledger. Moreover, key choke points are often governed by private firms or capricious individuals (Gjesvik 2023; Abels 2024). Taken together, this circumscribes state power to govern access to and control over the 'inside option' (Clayton et al. 2025), thus offering far greater potential for re-routing, circumvention, and adaptation. Therefore, inferring similar geopolitics from similar network topology runs the risk of 'morphological determinism' (Fourcade 2007, 1021): How shocks propagate, how power operates, and how network structure may be reformed is ultimately a reflection of the underlying governance mechanisms that tie a network together. This increased morphological flexibility in supply chains is where corporate power resides.

Third, morphological flexibility lays bare a hierarchy of adaptation that shapes how economic statecraft operates in practice. When states attempt to instrumentalize or reshape global connectivity – whether through sanctions, export controls, or industrial policies – firms' varying capacities to reconfigure their operations create stark distributional consequences. At one end of the spectrum, sectors with high strategic value and operational *inflexibility* (through high barriers of entry such as network effects, scale, and concentration of IP) emerge as clear winners: defense contractors capitalize on increased security spending, logistics firms and fossil-based energy firms capitalize on rent extraction (Weber et al. 2025; Semieniuk et al. 2025), critical minerals supply chains have seen large windfalls (Riofrancos 2023; Vivoda et al. 2025), while high-tech manufacturers leverage their intellectual property advantages to extract subsidies from competing governments. But firms face inflexibility for different reasons – some control critical chokepoints, while others depend on them: traditional manufacturers and basic industries founder because they are caught between thin margins, specialized

equipment, and established supplier relationships that cannot be easily reconfigured. Moreover, the marginal cost of switching suppliers is inversely proportional to firm size, further favoring concentration. Indeed, firms that maintain a high degree of *flexibility* are those that act as vertically disintegrated intermediaries. As Walmart's CFO recently laid out in respect to U.S. 'liberation day' tariffs: 'We see opportunities to accelerate share gains and we're maintaining flexibility to invest in price as tariffs are applied to incoming goods' (Meyer 2025).

This hierarchy matters because it determines whether market power amplifies or constrains state objectives: strategic firms vie for subsidies, enjoy political protection abroad in exchange for state permeation, absorb shocks through scale and power over supplier networks, or reconfigure their supply chains through new jurisdictions, maintaining the market access that states seek to curtail. The result is not the straightforward subordination of commerce to statecraft that policymakers envision, but rather the transformation of global supply chains into 'crucial battle lines in modern power transitions' (Chen and Evers 2023, 164).

The paper substantiates this argument through a novel empirical approach to measure and disaggregate firm-level geopolitical sentiments. I compile an original database of corporate earnings calls transcripts (n=20,013) of 5,605 listed firms. The data has global coverage for listed firms since 2016, and includes 48,9 percent of the Fortune Global 2000 and 66,67 percent of the Forbes Global 500 lists. The database also tracks granular sector classification (NACE and NAICS codes), geography, ownership, financials (intangibles, CapEx, revenue), and market cap. Leveraging large language models (LLMs), I annotate the transcripts with categories of geopolitical sentiments (e.g., 'headwinds' or 'tailwinds'). I then construct measures of firm strategies to adapt their operations to geopolitical changes. Empirically, three broad patterns emerge. First, the main *temporal* discriminator is Russia's invasion of Ukraine. Prior to 2022, talk of and strategy around geopolitics was more limited to specific sectors, particularly in mining supply chains. Second, *sectoral* effects are the strongest driver of variation, much along the lines of the morphological flexibility argument. Third, contrary to traditional patterns where small-cap firms outperform larger ones during a recession, the supply-side nature of geopolitics rewards scale and indispensability.

Multinational firms and the geopolitics of supply chain restructuring matter for political science and political economy scholarship in three ways. First, these dynamics reinforce the winner-take-all economy where the top-1 percent of firms capture over 90 percent of corporate after-tax profits (Regan 2025), the effects of which disproportionately land on rural areas

and smaller cities, which lack large employers. Such economic shocks fuel the volatile politics that produce these policies in the first place, but are also an exponent of 'the acute mismatch between sclerotic political institutions and turbo-charged markets' (Hacker et al. 2021, 11; cf. Autor, Dorn, Katz, et al. 2020; Schwartz 2021; Cremaschi et al. 2025). Second, this study offers a conceptual framework and empirical approach to capture how economic statecraft works out in practice. Because existing theories and methods of accounting remain separated between macro-institutional processes and micro-level outcomes, they do not adequately capture firms as 'planning machines' (Bensussan et al. 2025, 2) acting as 'an important meso-level institution in itself' (Ylönen and Christensen 2024, 474). Third, the paper sheds light on new forms of state authority emerging since the 2010s (Alami and Dixon 2024; McNamara and Newman 2020; Christensen 2024). The common denominator of geoeconomic statecraft is that it must operate through multinational firms. Not only do profit-making incentives clash with state priorities; effective policies must also grapple with the coordination structures that firms have built.

The argument proceeds as follows. First, I set up my theory of morphological flexibility and formalize the hierarchy of corporate adaptation that this spawns. I then detail my data and empirical approach, after which the analysis begins in earnest. The empirics are structured around a qualitative and quantitative analysis of the earnings calls, probing the sectors that fall into the adaptive pathways my theory predicts. I then discuss the implications for IPE scholarship. The last section concludes.

Theory

There are four building blocks to arrive to the hierarchy of adaptation that this paper asserts. First, multinational firms are the meso-level coordinators of cross-border economic activities, serving as a conduit between macro-level institutional structure and micro-level agency. Second, economic statecraft policies are disrupting, reshaping, or usurping these coordination structures. Third, supply chains as complex economic networks are more adaptive than financial networks, opening a volatile space where firms position their operations to profit from or reconfirgure around geopolitical constraints. Fourth, firms' adaptability and strategic indispensability spawns four adaptive pathways that create a hierarchy of adaptation around economic statecraft.

Constructing globalization: Mutinational firms as meso-level coordinators

Multinational firms have been, to borrow from Giovanni Arrighi (2010, 15), crucial organizational vehicles to advance 'the formation of political structures endowed with ever-more extensive and complex organizational capabilities' to coordinate economic activity across borders. Through decades of efficiency-optimization, regulatory arbitrage, and political lobbying, multinational firms have become critical conduits, if not the main architects, of the complex supply chains that take center stage in contemporary geopolitics. These chains emerged from deliberate corporate strategy: the supplier hierarchies spanning multiple tiers, the technical standards governing production, the logistics networks moving goods across borders, and the intellectual property regimes controlling technology transfer (Baldwin 2019; Durand and Milberg 2020; Schwartz 2022).

Apple's operations in China are a case-in-point: By 2015, the company was investing $55bn annually, embedding engineers in supplier factories, installing proprietary machinery, and training millions of workers in advanced manufacturing techniques, constructing not just a supply chain but the coordinating infrastructure of an entire industrial ecosystem (McGee 2025). This illustrates how multinational corporations operate as 'planning machines' that make micro-level allocation decisions about where to source inputs, how to organize production, which technologies to license, and which markets to serve (Bensussan et al. 2025). These choices aggregate into the macro-level patterns of trade, investment, and technology diffusion that define international economic order (Gilpin 1975a). Understanding how firms navigate and shape economic statecraft thus requires first grasping their role as 'an important meso-level institution in itself' (Ylönen and Christensen 2024, 474): as an organizational intermediary between macro-institutional structures (Blyth and Matthijs 2017; Gabor and Braun 2025) and micro-level decisions where the messy vitality of economic agency takes shape.

This coordination architecture reflects strategic choices, not natural market evolution. In the words of Stephen Hymer (1970, 442), 'each step in the evolution of business enterprise had important implications for the structure of the international economy, just as each excursion into the international economy provided new challenges to the corporation and speeded [sic] its evolutionary development.' Since the 1990s, corporate strategy pursued three simultaneous objectives that reshaped global markets. First, *vertical disintegration*: advances in IT technologies allowed lead firms to outsource physical production while retaining control over high-value activities like design, branding, and IP ownership (Gereffi 2014; Baldwin 2019). Man-

ufacturing moved to contract suppliers operating on thin margins, transferring risk downstream while maintaining coordination from the center.

Second, *horizontal concentration*: strengthening intellectual property regimes enabled firms to dominate multiple markets through intangible assets rather than direct ownership (Durand and Milberg 2020; Coveri et al. 2024). Network effects, IP monopolies, and brand power generated winner-take-all dynamics where superstar firms captured disproportionate profits through near-zero marginal costs of distributing knowledge – leading to a situation where disintegration and concentration go hand-in-hand (Eeckhout 2021; Schwartz 2021; Reddy 2025). Third, *geographic dispersion*: hyperglobalization and the ICT revolution made it feasible to fragment production across jurisdictions, enabling firms to optimize each function's location for tax treatment, labor costs, regulatory environment, and market access. The result was not a prophesized flat world of seamless integration, but a 'jurisdictional assemblage' (Krisch 2022) where firms deliberately engineered corporate structure to exploit differences in territorial authority while maintaining unified operational control (Bair et al. 2023).

The profit-making benefits spawned by this corporate architecture have quickly turned into liabilities under volatile geopolitics. Relentless efficiency optimization – the imperative to minimize working capital, reduce inventory, and shorten lead times by pushing risk onto suppliers throughout the chain, has created the 'excessive fragility' that scholars now recognize as endemic to just-in-time systems (Acemoglu and Tahbaz-Salehi 2025). Firms maintained minimal stock levels not because resilience was unimportant, but because investors seek capital efficiency, punishing inventory as capital that does not circulate (Milberg and Winkler 2013, ch.6; Stockhammer 2004). Additionally, the jurisdictional strategy to maximize profits through global dispersion has turned the outsized legal footprint of firms into a battleground for extraterritorial control (Woll 2023).

In turn, the coordination structures optimized for efficiency and wealth accumulation in a geopolitically permissive environment have become instruments of great power competition. But unlike the Bretton Woods institutions or other state-designed governance mechanisms, these structures remain under private control, operated by profit-seeking firms whose strategic objectives may diverge sharply from national security imperatives (e.g., Gjesvik 2023; Abels 2024). The question is not whether states can disrupt these networks; sanctions, export controls, and industrial policies clearly do. The question rather is whether states can redirect them toward security objectives, or whether firms can adapt around constraints

while maintaining the market access and just-in-time efficiency that states seek to discipline.

Economic statecraft as a problem of control

Scholarship discussing the assertion of state power over markets flies under many banners, from geoeconomics, weaponized interdependence, and state capitalism to economic statecraft. Existing literature contains copious insights documenting how great-power competition spurs resource mobilization (Aggarwal and Reddie 2020; Weiss and Thurbon 2021; Allan and Nahm 2025; Meckling 2025), how states attempt to contain the diffusion of technology (Malkin and He 2024; Beaumier and Cartwright 2024; Bown and Wang 2024), and efforts to coerce rival states by denying access to critical resources or infrastructure (Farrell and Newman 2023; Lehdonvirta et al. 2025). Invariably, these literatures see economic statecraft as a problem of control: over resources, infrastructures, and behavior of public and private actors. As the previous section has sought to argue, the common denominator for these instruments is that they must operate through the coordination structures that multinational firms have built.

A long first wave of economic statecraft scholarship has largely sidelined firms as independent actors. David Baldwin (1985)'s foundational work on focused on state-level instruments of coercion, excluding private actors from the analysis. Variation in sanctions regimes and policy effectiveness largely drove the research agenda of economic statecraft (Drezner 2003; Blackwill and Harris 2017). Farrell and Newman (2019)'s theory of weaponized interdependence has recasted the debate around coercion through economic networks, but explicitly acknowledge that their framework does not 'provide any real independent agency to businesses, treating them as the passive transmitters of state policy.' (Farrell and Newman 2021, 315). While this was a useful theoretical assumption for understanding how asymmetric network topology generates state power, it has become increasingly untenable empirically. Recent scholarship demonstrates considerable heterogeneity in when business aligns with the state's geoeconomic priorities (Chen and Evers 2023; Germann et al. 2024; Köncke and De Graaff 2024).

A second wave of scholarship has thus begun to recognize firms as strategic actors. Moraes and Wigell (2020)'s work on what they term 'corporate geoeconomics' acknowledges corporate responses to geoeconomic pressures, identifying firm strategies ranging from keeping states at distance to actively pushing for geoeconomic measures. In the spirit of open-economy poli-

tics, interest groups, lobbying, and coalition-building are key manifestations of firms' political power (Oatley 2011; Young and Pagliari 2017; Zhang 2025). For geoeconomics, too, lobbying and coalition-building are a leitmotif in the literature (Eckert 2024; Germann et al. 2024; Bauerle Danzman 2025). While the 'noisy' politics of lobbying and their 'quiet' counterpart of state-business interaction are important to understand how business and the state interact (Woll 2008; Culpepper 2015; Bohle and Regan 2021; Bayer 2023), the juxtaposition of state and firm runs into three limitations for capturing the role of firms in economic statecraft.

First, the focus on lobbying narrows primarily to studying for better outcomes or aligning with home states. As I argue in this paper, this work implicitly treats geopolitical disruption as either uniformly costly (supply chain fragmentation increases expenses) or uniformly beneficial (strategic designation attracts subsidies), missing the considerable heterogeneity in corporate outcomes. Meanwhile, firms' operational adaptation – supply chain reconfiguration, rent extraction, strategic repositioning – receives less attention than their political influence. Second, existing scholarship treats the invocation of national security as an exogenous force, defaulting to descriptions of dual-use technology or critical infrastructure without theorizing why certain sectors become battlegrounds while others remain peripheral. States invoke national security to justify subsidies for semiconductors, critical minerals, clean energy, and cloud infrastructure (Bown and Wang 2024; Meckling 2025; Riofrancos 2023; Kollar and Stokols 2025). Yet why these sectors and not others? The answer cannot be simply that these goods matter for state capacity, since virtually all industrial inputs matter to some degree. Nor can it be reduced to supply chain vulnerability, since many fragile supply chains escape policy attention. Similarly – and contrary to what some have suggested (Lee and Maher 2022; Chen and Evers 2023) – what is deemed strategic is often not the most highly value-added, given that raw materials and manufacturing do not sit at the frontier of the product cycle.

Third, the literature does not offer a political economy perspective that takes seriously the incredible concentration of profits at the apex of the corporate landscape. Recent empirical work illustrates why scale matters: Weber et al. (2025) demonstrate how supply-side cost shocks enable coordinated price increases that benefit upstream firms with market power, while Capponi et al. (2024) show that capacity-constrained suppliers systematically underinvest in resilience precisely because disruptions allow rent extraction through elevated spot prices. For supply-side shocks through economic statecraft, scale seems crucial: larger firms can absorb switching costs, maintain redundant supply chains, and pass costs to suppliers in

ways that smaller competitors cannot. Yet the literature has not systematically theorized the role of scale and firm size.

Existing frameworks attempt to categorize firms' position under economic statecraft - as sites of interstate conflict, as strategic agents lobbying for favorable treatment, or as the planning headquarters reorganizing global production (Babic et al. 2017; Moraes and Wigell 2020; Woll 2023; Bensussan et al. 2025). These typologies usefully disaggregate corporate roles, but they do not explain when and why firms occupy different positions. When do firms become passive sites of great-power competition versus active arbiters between competing state demands? What determines whether firms controlling critical infrastructure align with state security objectives or leverage their position to extract rents? Which sectors successfully convert strategic designation into subsidies versus which bear adjustment costs without compensating returns?

The answer lies in what I term morphological flexibility: firms' differential capacity to profit from or reconfigure operations around geopolitical constraints. The next session sets out to describe and formalize my theory of morphological flexibility.

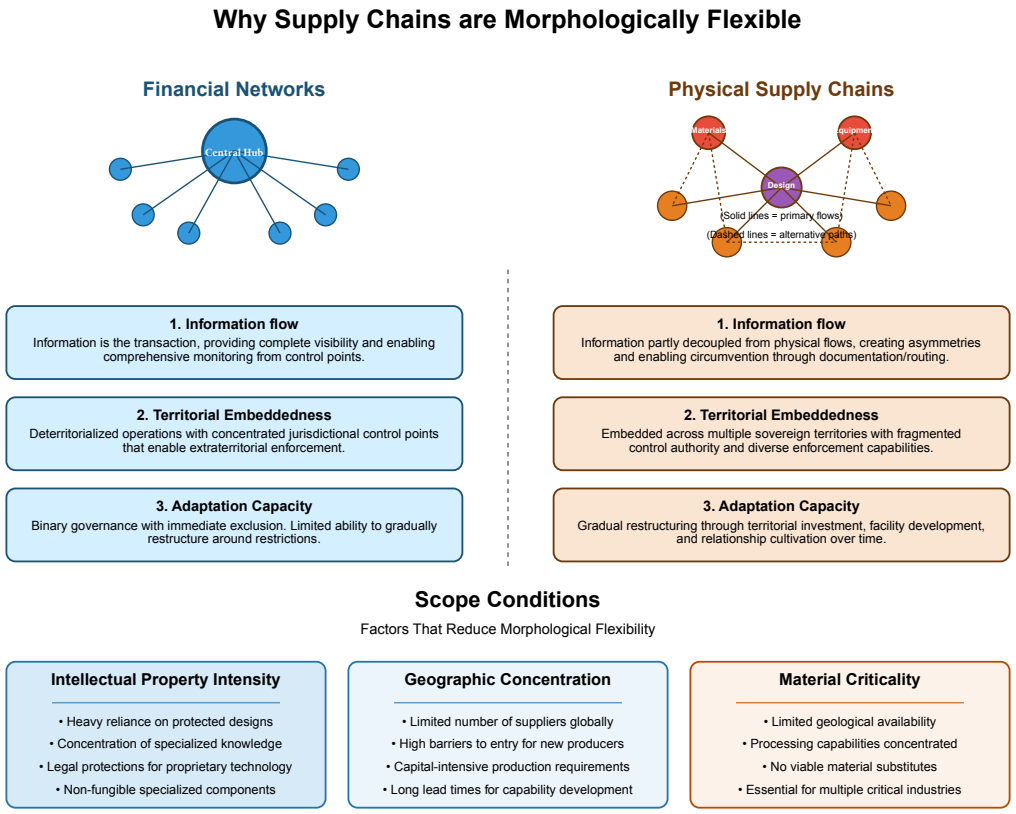
Morphological Flexibility as Corporate Power

My theory begins at a familiar starting point for economic statecraft scholarship. Scholars often use network theory to argue that scale-free topologies in complex economic networks are the locus of state power (Farrell and Newman 2019; Beaumier and Cartwright 2024; Lehdonvirta et al. 2025): when degree distributions follow power laws and a small number of highly connected hubs dominate network flows (Barabási and Albert 1999; Newman 2005), jurisdiction over such hubs allows for coercion and surveillance. These network topologies have been empirically observed in payment clearing system SWIFT (Cook and Soramaki 2014), in corporate ownership chains (Vitali et al. 2011; Garcia-Bernardo et al. 2017), and more recently, in supply chains, where Wiedmer and Griffis (2021) find scale-free and 'bow tie' structures that point to hierarchical and centralized architectures. But while topologies may be similar, this paper's key theoretical claim is that equivocating similar topology to similar geopolitics comes at the risk of 'morphological determinism' (Fourcade 2007, 1021).

The starting point, as Lehdonvirta et al. (2025, 1) argue, is to understand 'how such network topologies (…) emerge in the first place'. How network topology forms is key to understand

how shocks propagate, how power operates, how networks may be reformed, and why these features are ultimately a reflection of underlying political and governance characteristics. The supply chain structures that states now seek to weaponize or restructure are not natural economic formations but the accumulated result of decades of corporate strategic decisions under relatively stable geopolitics and a permissive macro-economic environment. Crucially, because these structures derive from strategic incentives rather than technological necessities, they remain malleable to strategic reorientation. The same corporate capabilities that created globally integrated supply chains can be redeployed to fragment, regionalize, or otherwise restructure these networks in response to changing geopolitical incentives.

Figure 1: Stylized principles of supply chain morphology



Contrasting physical supply chains with payment clearing system SWIFT illustrates these dynamics. Physical supply chains differ from financial networks along three dimensions that increase their morphological flexibility. First, while financial flows exhibit high information

transparency through digital ledgers where information is the transaction, physical flows remain partially opaque, with goods traversing multiple jurisdictions through complex documentation that obscures ultimate origins and destinations. Second, financial networks operate in largely deterritorialized space with concentrated control points, whereas supply chains remain deeply embedded in territorial production facilities, transportation infrastructure, and labor markets across multiple sovereigns. Third, financial exclusion operates as a binary mechanism – access or denial – while supply chain restructuring occurs gradually through relationship cultivation, capacity development, and learning-by-doing. This gradual adjustment enables adaptive responses to coercive pressure, as firms develop alternative suppliers, redesign products, or create workarounds, unlike the limited substitution options in financial networks. Figure 1 summarizes the comparison.

Three scope conditions determine how easily firms can reconfigure operations. *Intellectual property intensity* determines whether firms control critical knowledge assets through patents, proprietary designs, and specialized expertise, or depend on others' IP. *Geographic concentration* of suppliers, driven by capital requirements, specialized knowledge, or economies of scale. This affects both market power and restructuring options. *Material criticality*: inputs have limited geological availability and no viable substitutes. This creates natural chokepoints that can be either controlled or endured. Together, these characteristics interact to reduce morphological flexibility, while increasing strategic indispensability.

These scope conditions generate corporate power through three mechanisms. First, rent extraction: firms controlling strategic chokepoints with high barriers to replacement extract policy-backed rents (subsidies, guaranteed demand, regulatory protection) by selling sovereignty as a service to competing states. Second, cost absorption and pass-through: large firms with market power and capital reserves absorb adjustment costs through scale economies or pass costs downstream to suppliers and customers, while smaller firms with thin margins cannot. Third, jurisdictional arbitrage: firms with geographic dispersion and substitutable inputs maintain market access by routing around restrictions, while firms with concentrated, specialized operations cannot pivot. Power through morphological flexibility thus comes in a U-shape: firms either leverage indispensability to extract concessions or deploy adaptability to circumvent constraints.

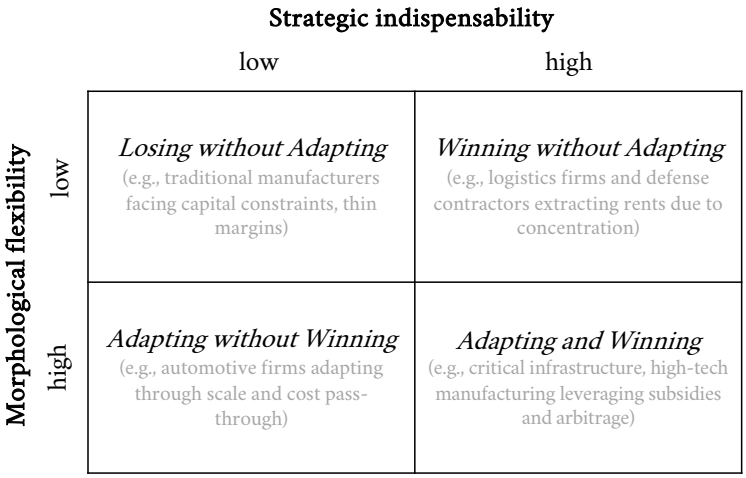
The three scope conditions map onto two dimensions that structure firms' responses to economic statecraft. Strategic indispensability, which captures the degree to which states depend

on firms' capabilities, and increases with IP intensity, material criticality, and geographic concentration when firms control the chokepoint. Defense contractors' proprietary designs, mining companies' rare earth deposits, and semiconductor manufacturers' fabrication capabilities exemplify high strategic indispensability. Conversely, morphological flexibility, which is the firm-level capacity to reconfigure operations around constraints, decreases with IP intensity, material criticality, and geographic concentration, but increases with firm scale, capital reserves, and vertical disintegration. Flexibility thus reflects not just sectoral characteristics, but also organizational capabilities: large firms can finance parallel supply chains and absorb switching costs; vertically disintegrated firms can pivot suppliers without stranded investments; capital-rich firms can weather transition periods.

Four adaptive Pathways

These dimensions work out to four quadrants that capture the position firms are in to exert power over and shape the effects of economic statecraft.

Figure 2: Hierarchy outcomes



O1 (Adapting and winning): Sectors combining strategic indispensability with operational flexibility will report and exhibit both rapid adaptation and positive outcomes.

O2 (Winning without adapting): Sectors with high strategic indispensability but low flexibility will report and exhibit positive outcomes without strategic restructuring.

O3 (Adapting without winning): Sectors with moderate flexibility but low indispensability

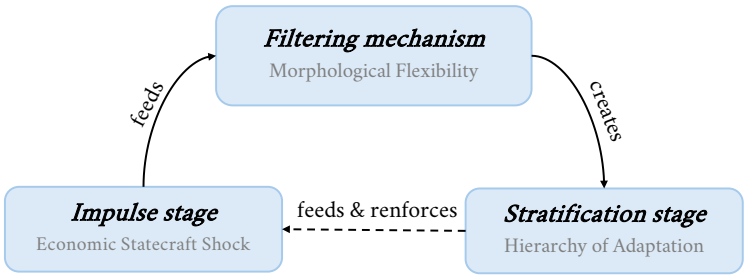
and capital/scale constraints will report and exhibit adaptation efforts without positive outcomes.

O4 (Losing without adapting): Sectors with low flexibility and low indispensability will report and exhibit persistently negative outcomes without adaptation attempts.

O5 (Temporal dynamics): Following major geopolitical shocks, the relative frequency of adaptation statements will increase across sectors as firms transition from passive exposure to active strategy, but the direction of adaptation will vary by pathway position.

These pathways exhibit temporal path dependence that intensifies hierarchy over time. Initial positioning shapes subsequent adaptation capacity: sectors that successfully extract rents or subsidies in the immediate aftermath of shocks accumulate capital reserves enabling further flexibility, while sectors bearing initial adjustment costs experience depleted reserves that constrain subsequent adaptation. This creates self-reinforcing trajectories where early winners compound advantages through resource accumulation, while early losers face compounding constraints as cascading shocks since 2018 deplete capital buffers. The supply-side nature of geopolitical adjustment thus rewards not just current scale and position, but accumulated advantages from weathering previous disruptions.

Figure 3: The hierarchy of adaptation



The hierarchy of adaptation that emerges is not simply a matter of firm size or sector, but rather reflects the interaction between structural characteristics determining strategic indispensability and organizational capabilities enabling reconfiguration. This morphological flexibility constitutes a form of corporate power over how economic statecraft takes shape: the ability to profit from constraints that others must endure, or to adapt around restrictions that others cannot circumvent.

Data and Methods

Data Sources and Sample Construction

This study leverages a corpus of corporate earnings call transcripts from all available publicly listed firms compiled from S&P's Capital IQ database. Earnings calls are quarterly or annual conference calls between corporate executives, investors, and financial analysts where firms disclose financial results and strategic outlooks. These transcripts follow a standardized format consisting of prepared management presentations followed by analyst Q&A sessions, creating a consistent structure that enables systematic comparison across companies, industries, and time periods.

The dataset spans from January 2016 up to September 2025, with comprehensive global coverage for listed firms. The sample includes 48.9% of the Fortune Global 2000 and 66.7% of the Forbes Global 500, ensuring representation of the world's largest corporations. For each firm, I collect detailed metadata including six-digit NACE sector codes, headquarters location, ownership structure, and market capitalization. A full overview of the dataset and further considerations is documented in the Appendix.

Table 1: Descriptives on dataset

# of earnings calls	Unique companies	Time span	Countries	Unique industries (NACE)	Median market cap	Mean inst. ownership
20,013	5,605	2016-01 - 2025-08	80	500	$3,841mn	48%

Methodological Rationale

Earnings calls represent a valuable data source for studying corporate responses to geopolitical pressures for three methodological reasons. First, unlike many corporate communications, these calls operate under heightened legal scrutiny. In the United States, SEC Rule 10b-5 prohibits making false or misleading statements that could deceive investors, with similar provisions existing under EU market abuse regulations. In political science and adjacent disciplines, earnings call transcripts have proven valuable for investigating whether firms coordinate price hikes after supply-side shocks (Weber et al. 2025), as well as to understand the

climate mitigation strategies of major polluters (Sautner et al. 2023; Mahdavi et al. 2022). Second, earnings calls function as a natural 'unprobed survey' of corporate responses to external shocks. When geopolitical events occur, all publicly traded companies face the same exogenous disruption, but their responses, as revealed through earnings call discussions, reflect their underlying strategic priorities, risk assessments, and adaptation capabilities. This provides a window into revealed preferences rather than stated intentions. Third, the longitudinal nature of the data permits analysis of how corporate responses evolve over time, creating a natural panel dataset with consistent measurement periods.

Natural Language Processing Approach

Following Benoit et al. (2025), I employ a scalable and reproducible natural language processing approach. To systematically analyze this large corpus, I employ a mixed-methods approach combining qualitative coding with large language model (LLM) annotation. The analysis proceeds in three stages:

Stage 1: Inductive Code Development I first conducted qualitative analysis on a random sample of 1,000 sentence triplets to develop an inductive coding scheme. Each triplet consists of a focal sentence containing geopolitical content plus the preceding and following sentences for context. This approach ensures sufficient context while maintaining computational feasibility. The qualitative coding identified five distinct categories of geopolitical sentiment that form the basis for subsequent annotation.

Stage 2: LLM Annotation Given the corpus size (29,215 sentence triplets), I employ OpenAI's GPT-4o for systematic annotation. While encoder-only models would typically be suited for classification tasks, the complexity and nuanced nature of geopolitical sentiments in corporate discourse necessitated a more sophisticated approach with more pre-trained knowledge in the model (e.g., Farrell et al. 2025).. After testing multiple models including BERT variants and other generative models, GPT-4o emerged as the most effective for capturing subtle distinctions in corporate geopolitical discourse.

The annotation categories are:

1. **Geopolitical headwinds**: Statements flagging geopolitics as general challenges affecting business operations
2. **Geopolitical tailwinds**: Statements identifying geopolitical factors as opportunities

or benefits

3. **Geopolitical choices**: Statements linking geopolitics directly to strategic decisions (e.g., supply chain diversification, reshoring)
4. **Holding strong**: Statements asserting resilience despite geopolitical pressures
5. **None**: No clear geopolitical sentiment expressed

Stage 3: Validation and Quality Assurance To validate the LLM annotations, I created a validation set of 1,000 manually coded triplets. The model achieves an accuracy score of 0.84 across all categories, with consistently high precision and recall scores indicating robust performance in identifying true positives while avoiding false negatives. The Appendix details further validation, as well as comparison with other LLMs.

Analytical Strategy

The analysis employs multiple approaches to examine patterns in corporate geopolitical responses:

Temporal Analysis: I track the evolution of geopolitical sentiments over time using both absolute frequencies and relative proportions. Moving averages (200-day) smooth short-term volatility while preserving underlying trends.

Sectoral Clustering: I aggregate the 500 unique sectors into 13 categories based on parent NACE codes. To test for statistical differences in geopolitical sentiments, I calculate odds ratio's and standardized residuals.

Named Entity Recognition: To reveal what executives say about the attractiveness of different geographies, I employ named entity recognition and sentiment analysis (Li et al. 2022).

Data Limitations and Scope Conditions

Three limitations warrant consideration. First, the sample only includes firms that were listed at a stock exchange at the time their earnings call was logged. Other types of firms, such as family-owned or state-permeated firms are excluded from the data because these firms have more limited financial transparency. Indeed, the ownership and governance of publicly listed firms necessitates a higher degree of transparency for shareholders (Morgan 2022, 546). This

introduces some selection bias, as certain geopolitically sensitive sectors such as defense and extractive industries contain more private or state-owned firms.

Second, the database contains only English-language transcripts. While this excludes some non-Anglophone firms, many large multinationals conduct earnings calls in English for international investors, and searches in Mandarin and Japanese yielded fewer than 5% additional observations.

Third, like all corporate communications, earnings calls remain performative venues where executives present information favorably and will refrain from divulging sensitive information. However, the legal constraints on material misstatements create bounded performativity that enhances reliability compared to other corporate communications.

Results

The empirics are structured around sectors, profits, and borders. First, I break these firm-level geopolitical sentiments and responses down in terms of sectors and geography, revealing considerable heterogeneity in response types across these dimensions. The second part of the empirics explores the sectoral winners and losers. It highlights sectors with high morphological (in)flexibility as the winners of economic statecraft due to their ability to adapt or their centrality to geoeconomically important networks and supply chains.

The beginning of disruption

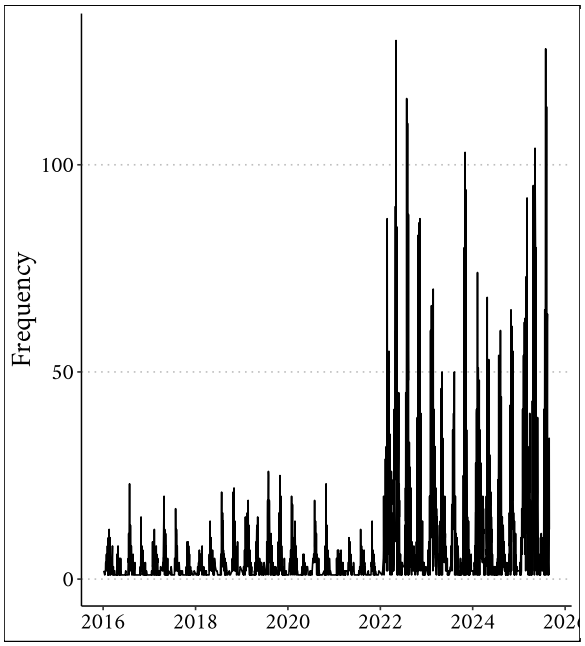
There are three ways to bookend the remaking of global supply chains. First, China's dual circulation strategy marks the earliest and arguably most coherent attempt to reshape supply chains for geostrategic purposes (Garcia-Herrero 2021). While this form of geoeconomic statecraft has existed since the late 2000s, China's dominance in raw materials processing has only recently garnered significant scholarly scrutiny (Riofrancos 2023; Seaman 2024). Second, Trump's first trade war with China spawned 'China +1' and 'just-in-case' (as opposed to just-in-time) strategies as firms sought to deal with the disruption of U.S.-China trade relations (Mercurio 2024; Zeng and Zhang 2024)[1]. Third, the covid-19 pandemic and Russia's invasion of Ukraine as the catalysts for rethinking supply chains in the West. As the U.S. quadrennial supply chain review puts it, disruptions since 2020 have 'revealed structural vulnerabilities that were decades in the making, the result of years of outsourcing, offshoring, and streamlining. These shifts had the aim of lowering upfront costs and improving regular-order efficiency, but were paired with a deep underinvestment in resilience that left increasingly complex and sprawling supply chains unable to cope with disruption' (White House 2024, 6).

At first glance, the data overwhelmingly points to Russia's invasion of Ukraine as the watershed moment for geopolitics in corporate strategy. In Q2 2022, the number of earnings calls with talk of geopolitics shoots up by a factor of 9 and has remained elevated ever since. In fact, May 2025 has seen the highest monthly count with over 1,000 earnings calls. On the one hand, it is hardly surprising that a military conflict of this scale, and geopolitical consequences this far-reaching, jumps out from the data. On the other hand, it is surprising that the across-the-board impact of geopolitics has remained muted until 2022, given that the proverbial industrial policy train had long left the station in the West at that point.

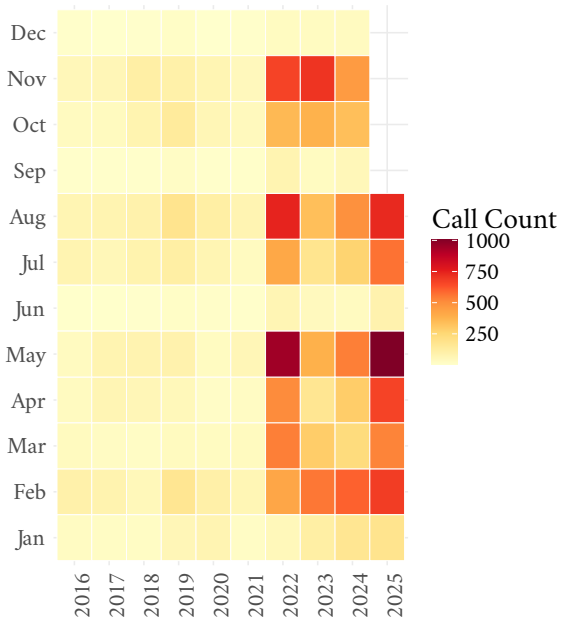
[1] This comes on top of a longer-term trend of regionalization in East-Asian supply chains (Baldwin 2024).

Figure 4: Distribution of earnings call by date.

(a) *Plot of earnings calls by date*



(b) *Heat map of earnings calls by month*



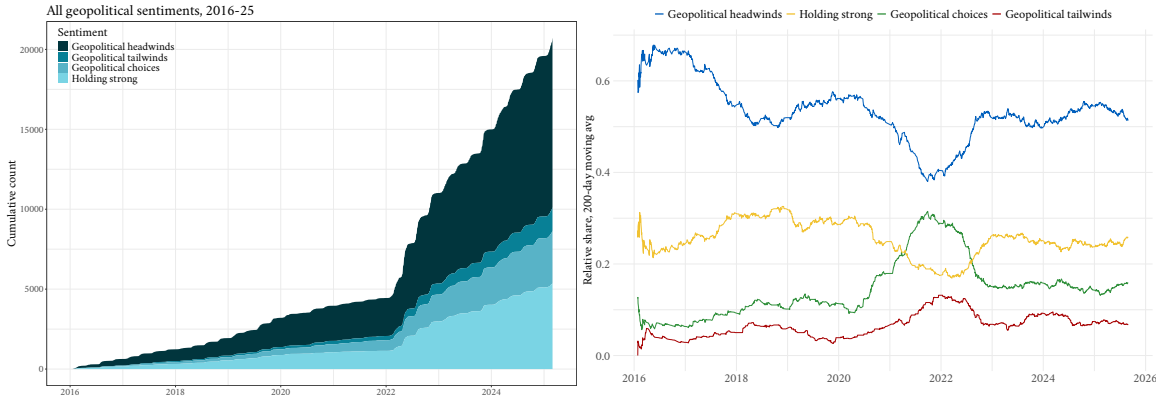
For many firms, geopolitics are a macro-level headwind that puts a drag on business. Headwinds typically stem from geopolitical uncertainty, which includes supply chain disruptions that lead to increased operational costs and longer lead times, export/import barriers that complicate market access, commodity price volatility squeezing margins, and demand shocks. Executives typically mention these headwinds in one breath with macroeconomic volatility and inflation pressures. While not directly conveying changes to strategy, uncertainty leads firms to postponing investment decisions (Baker et al. 2016). Perhaps ironically, this puts off resilience-enhancing, long-term measures. Around half of all statements convey these generally somber sentiments about challenging market conditions. Conversely, around one third of statements report to hold strong in spite of challenging geopolitical circumstances. Companies often attribute their resilience to specific structural advantages such as geographic diversification, strategic foresight, operational flexibility, or strong market positioning, suggesting that their robustness comes from built-in adaptability rather than just luck or circumstance.

Importantly, there was a qualitative shift in what firms were saying during the first year of the Ukraine war. Plotting the relative frequencies of the sentiment categories as shown in Figure 3 (right pane) shows a strong increase in the 'choices' category. Thus, in addition to talking more

about geopolitics, firms started talking differently about it. As executives point out, the risks of maintining direct U.S.-China ties have intensified: 'I think we've talked about a diversification strategy, kind of a China Plus One strategy that provides quite a bit of optionality for us. Many customers are saying they want to have at least one source in addition to buying from China due to some of the geopolitical things that are going on' (OERLIKON CORPORATION, 2022). Another executive concurs: 'We are in the process of transitioning a substantial portion of our manufacturing activities in China to contract manufacturers in order to increase flexibility and reduce geopolitical exposure' (PCTEL, INC, 2019).

Figure 5: Sentiment distribution over time.

(a) *Cumulative sentiments* (b) *Relative share (200-day moving average)*



The pace at which geopolitical risk forces firms to adapt their strategies has caught executives by surprise: 'What we didn't know when we made our decision to proceed with the next phase of our supply discipline was the pace of change that would occur in our industry because of geopolitical events that are further amplifying security of supply concerns. It's still early days, but we are seeing what we believe is an unprecedented geopolitical realignment occurring' (CAMECO CORPORATION, 2022). These realignments have clear implications: 'With the disruptions in the supply chain, the geopolitical problems, the cost of transport, the trade defence measures and all these things, most of the purchasing managers in Europe and the United States will try to diversify the suppliers and also to bring or to give a higher weight to the local or regional suppliers (…) I think that it teaches us that it's just common sense that we need to have closer suppliers' (ACERINOX, S.A., 2022), as companies "learned that you need to at least have this out of 2 factories or 2 suppliers and not just one' (EMCOR GROUP, INC., 2023). In sum, as Peter R. Orszag, chief executive of asset management firm Lazard, declared

that 'you can't make a business decision today without geopolitical considerations being taken into account' (Lazard, Inc., 2024).

Finally, a small but important subset of statements reports tailwinds connected directly to geopolitics. Geopolitical tailwinds manifest through five primary channels that create business opportunities. First, heightened security concerns drive increased defense and security spending, particularly benefiting firms in military, surveillance, and cybersecurity sectors. As one executive puts it: 'While these global events are not necessarily positive for humanity, higher defense spending in the West represents a longer-term tailwind for our business' (Moog Inc. 2022). Second, energy security imperatives accelerate both infrastructure development and energy transition initiatives, creating opportunities for firms offering energy independence solutions. Crucially, this includes both hydrocarbons and renewables: 'these may be the most geopolitically challenging times since World War II, but it's abundantly clear that all of this chaos is leading itself to a growing appetite for the most stable hydrocarbon supplies in the world, the U.S.A. in spite of government and regulatory challenges' (Enterprise Products, 2024). 'The megatrends of sustainability, electrification and geopolitical concerns creates a large demand for projects in all our markets to come' (Eolus Vind AB, 2024).

Geographic reallocation of business activities benefitting firms in stable regions and those offering supply chain alternatives represents another pathway: 'one of the reasons we are upbeat about that business is because there are favorable global geopolitical trends that - and we've been reading about many MNCs wanting to shift their manufacturing or at least expand their manufacturing beyond the traditional markets like China. And that is reflecting in the pipeline buildup that we have.' (Mahindra Lifespace Developers, 2020). Fourth, broad infrastructure development programs emerge as nations seek to secure critical supplies and resources: 'In recent years, the country has been seeing a surge in demand for data center capacity (…) We believe we are still at the nascent stage of this market, and Globe is well positioned to capture a significant portion of this growth' (Globe Telecom, Inc., 2021). Finally, market dynamics shift to favor firms offering security and stability: 'Supply chain disruption, which we're seeing a lot of at the moment because of geopolitics is actually perversely good for the business because every time you need to rehouse your supply chain, reset your suppliers, relocate, find a new distributor, find a new market to access, the trade show is a perfect route to market and a very, very efficient one.' (Informa 2025). These mechanisms often operate simultaneously, creating compound benefits for well-positioned firms.

Four sector-level pathways

The sentiment breakdown points to sectoral specificity as a driver of variation. To probe to what extent there are statistical differences in sectoral geopolitical responses, I conduct a chi-square test of independence comparing the distribution of sentiment categories (Headwinds, Tailwinds, Choices, Holding Strong) across thirteen aggregated sectors[2]. The analysis reveals a highly significant association between sector and sentiment type ($\chi^2 = 1372.7$, df = 36, $p < 0.001$, n = 23,517), with a Cramér's V of 0.24 indicating a small-to-medium effect size. To quantify the magnitude and direction of sectoral deviations, I calculate odds ratios for each sector-sentiment combination relative to the overall baseline distribution. These odds ratios indicate how much more (or less) likely each sentiment type is to appear within a given sector compared to the average across all sectors, with values above 1.0 representing over-representation and values below 1.0 representing under-representation. For instance, Defense & Aerospace firms exhibit an odds ratio of 7.88 for Tailwinds ($p < 0.001$), meaning they are nearly eight times more likely to frame geopolitics as opportunity compared to the baseline expectation. Standardized residuals confirm these patterns, with asterisks denoting statistical significance after controlling for sample size effects. This combination of effect sizes and significance markers reveals four distinct sectoral pathways in how firms navigate geopolitical pressures: *adapting and winning* (high choices and high tailwinds / low headwinds), *winning without adapting* (high tailwinds and low / normal choices), *adapting without winning* (high choices and high / normal headwinds and/or low tailwinds), and *losing without adapting* (low choices, high headwinds and / or low tailwinds). In what follows, I take a deeper dive in these four pathways[3].

Adapting and winning

High-tech manufacturers, strategic extraction and mining firms, and energy infrastructure companies emerge as the clear winners of geopolitical restructuring because they possess what states deem strategic but cannot easily replicate: operational capabilities central to technological sovereignty. The empirical pattern across earnings calls is unambiguous: these sectors exhibit statistically significant overrepresentation in both strategic adaptation (high 'Choices') and favorable outcomes (elevated 'Tailwinds,' suppressed 'Headwinds'). What unites them is

[2] I detail the aggregation choices in the Appendix.

[3] For reasons of space and scope, the services sectors remain out of the main analysis. The simultaneous presence of high 'Headwinds' and 'Holding Strong' sentiments indicates subsectoral heterogeneity. An exploratory analysis in Appendix X reveals a split between … and . In finance, asset management outperforms commercial banking, indicating that the former are more apt in capitalizing on disruption and new growth opportunities.

Figure 6: Sectoral responses to geopolitical pressures

their ability to sell sovereignty as a service. High-tech manufacturers control intellectual property chokepoints in semiconductors, encryption platforms, and advanced electronics that governments have explicitly designated as strategic infrastructure. Mining companies command deposits of critical minerals that, as one uranium mining executive described, have become 'highly coveted' amid 'heightened security of supply concerns,' with customers explicitly willing to pay premiums for 'assets like ours that are strategic (…) and that are located in geopolitically attractive jurisdictions.' (Cameco, 2024). Meanwhile, energy and infrastructure firms own the physical assets - pipelines, grids, LNG terminals - that states view as bulwarks against adversarial supply dependence. And while geological deposits of rare earths might be dispersed, ownership and control is highly concentrated (Lapeyronie et al. 2025). In each case, concentrated control over capacities that states cannot easily replicate at home confers a key role to firms in these sectors. Nvidia's Jensen Huang touring capitals to pitch 'sovereign AI'

while data center construction spending skyrockets captures this dynamic: well-placed firms actively sell the promise of technological autonomy to governments worldwide (Cornish et al. 2025; Hawkins et al. 2025).

This success illustrates the power of morphological inflexibility: concentrated stacks of intellectual property, infrastructure, or processing of resources confer entry power, where state-business relations revolve around tying down privatized capabilities in pursuit of strategic goals. Intel, Samsung, and TSMC have captured $33bn in CHIPS Act outlays in the U.S., but also capture large subsidy sums in the European Union, South Korea, and Japan (Hawkins et al. 2024). Semiconductor manufacturers explicitly market multi-region facilities as offering 'geopolitically dependable capacity' (Texas Instruments, 2022), while miners actively rebalance portfolios toward 'safe' jurisdictions (North America, Australia, EU) and tout 'Tier 1 assets' as insurance against supply disruptions, with one executive noting that 'geopolitical risk profile' directly affects company valuations and capital access (Centerra Gold, Inc., 2022). As such, firms use this indispensability to vie for government programs to increase geographic flexibility, positioning manufacturing across jurisdictions. Executives describe their firm's 'China Plus One strategy that provides quite a bit of optionality' as a positive selling point driving new contract wins (OC Oerlikon AG, 2022). Post-2022, the qualitative shift in earnings calls from discussing geopolitical *headwinds* to announcing strategic *choices*—diversifying suppliers, building redundancy, investing in secure jurisdictions—demonstrates how adaptation itself became a competitive advantage. As Sikander Rashid, chief investment officer of asset manager Brookfield's infrastructure arm has argued 'we are really excited about what is ahead of us in the next two to three years because of the trends of decarbonisation, digitisation and deglobalisation to come' (Gara and Darbyshire 2023).

The differential policy treatment these sectors enjoy paints a clear image of hierarchy. Since the start of U.S. President Trump's second trade war, a bifurcation between sectors has emerged. While traditional manufacturers face punitive tariffs on electrical equipment, high-tech manufacturing operates in a protected sphere with comprehensive import exemptions that have enabled computer imports to surge (Politano 2025). This asymmetry reveals that even the second Trump administration cannot afford to disrupt supply chains undergirding AI infrastructure, defense systems, and energy security, although it subjects less critical sectors to heavy trade restrictions (Monroe 2025). Meanwhile, there are many reasons to doubt the effectiveness of export controls and trading restrictions for microelectronics - both

through firms' ability to redesign products to meet security thresholds, by the availability of transshipment and smuggling routes, and by obfuscated ownership ties that keep supplying sensitive hardware to firms on the Entity List (Patel et al. 2024; Wu and Olcott 2025). The result is a bifurcated market where firms controlling strategic chokepoints extract policy-backed rents in the form of subsidies, guaranteed demand, and protection from competition, while others bear adjustment costs.

Winning without adapting

Defense & Aerospace emerges as the quintessential 'winning without adapting' sector, exhibiting exceptionally strong tailwinds 7.88 times above baseline with no significant increase in strategic restructuring (odds ratio 1.17, n.s.). The Big Five defense contractors (Lockheed Martin, RTX, General Dynamics, Boeing, Northrop Grumman) generated combined profits of $380+ billion during 2022-2024, with 2022 alone producing $196 billion—a 125% increase over 2021 (Kolchev 2024; Hartung and Semler 2025). Stock prices surged 16-37% in the first month after Russia's Ukraine invasion, dramatically outperforming broader markets by 12-24 percentage points, while CEOs explicitly acknowledged geopolitical tensions as profit opportunities in earnings calls. The sector's high IP intensity and steep barriers to entry demonstrates morphological inflexibility dynamics where states cannot replace contractors, enabling rent extraction through strategic indispensability. Contrary to high-tech manufacturers and infrastructure companies, however, capital expenditure has not only remained low relative to cash flow; it is also 5-6 times smaller than payouts to shareholders, and these patterns remain stable post-2022 (e.g., Lockheed Martin 2024, 2025).

Maritime & Logistics displays an even more dramatic rent-extraction dynamic through choke point positioning. Container shipping generated $208 billion in profit during 2022, exceeding the entire 2010-2020 decade's combined $37.5 billion (Sea-Intelligence 2023), while executives explicitly frame 'the otherwise quite unfortunate geopolitical developments' (Tsakos Energy Navigation Limited, 2024) as earnings drivers. However, when overcapacity emerged in 2023, the industry swung to a -$1.4 billion loss, with freight rates collapsing 90%, revealing prior profits as rents from disruption-induced scarcity rather than sustainable competitive returns. As also visible in more disaggregated terms in Figure 5, these sectors exemplify the hierarchy of adaptation where inflexible lead firms controlling critical infrastructure extract windfall profits during volatility, capitalizing on what one executive termed 'healthy arbitrage economics and geopolitical tensions' (Dorian LPG, 2025).

Adapting without winning

Industrial machinery and automotive & transport sectors exhibit elevated strategic adaptation (odds ratios of 1.18** and 1.37*** for 'Choices') yet face persistently negative outcomes. Three factors feed into the predicament these sectors face. First, automotive and machine building sectors depend on structurally complex supply chains spanning thousands of parts across 3-4 supplier tiers, with many relationship-specific investments risking to be stranded. Second, and related, time inconsistencies create risks for adaptation. As one executive laments, 'How can we plan if we do not know what the tariff situation is for the next five years? Factory and supply chain sourcing decisions cannot be changed at moment's notice' (Azzimonti et al. 2025). Third, the sectors are physical-capital intensive, and operate on lower margins than IP-intensive and extractive sectors (Schwartz 2022). Cascading shocks since 2018 have also depleted capital reserves among firms in these sectors. Low margins and smaller scale prevents absorption of or passing down of adaptation shocks. In a recent supply chain survey, 57% of firms cite cost as the primary reshoring barrier and small manufacturers report being 'incredibly tapped out' with 'nowhere to absorb' increases (LaRocco 2025). Meanwhile, 'only GM, Ford and Stellantis have excess capacity to increase US production' (Brinley 2025).

In brief, the mechanism preventing adaptation from generating benefits operates through capital and scale constraints that eliminate morphological flexibility for mid-sized manufacturers caught between inflexible specialists capturing rents and flexible multinational giants able to absorb or pass on costs. Mid-sized manufacturers possess neither advantage: without specialized irreplaceability, they cannot command premium pricing; lacking scale, they cannot finance parallel supply chains or absorb transition costs that 'could as much as double' production expenses (LaRocco 2025). For many firms, capital constraints render inventory buffers, rapid supplier switches, or geographic diversification hardly viable in the longer run. What is more, even successful cost pass-through fails to address demand destruction. As one steel industry executive notes, 'the bigger concern is what will the impact be on the overall demand' (Azzimonti et al. 2025) - creating a chasm between the far ends of supply chain morphology.

Losing without adapting

The final set of sectors (agriculture & food, heavy industry and materials, and general manufacturing) are stuck in an even harsher predicament. Not only do they report elevated headwinds (1.30***, 1.40***, 1.18***, respectively). They also report far lower tailwinds and do

not show a statistically meaningful increase in strategic choices. In many ways, these sectors are bearing the brunt of adjustment costs. The supply-side nature of geopolitical adjustment puts the often smaller firms in these sectors at an even greater disadvantage: they lack the scale and bargaining power to absorb or pass on costs, hold smaller cash reserves to stave off or wither adjustment, and lack complex supply chains and capacity to plan their way out of the geopolitical labyrinth. This overrides historical patterns where medium-sized firms outperform larger firms during economic shocks (Conlon 2025) - and illustrates the hierarchical nature of geopolitical adaptation.

Geographic concentration further intensifies exposure, given that rural areas lack large employers and manufacturing tends to cluster regionally (Autor, Dorn, Hanson, et al. 2020). The textile industry offers an illustration: while the sector paid $11.9 billion in tariffs at 14.6% average rates in 2024, very large manufacturers such as Nike are able to shift supply chains away from China (Lu 2025). The result is plant closures even without viable alternatives emerging. In sum, the hierarchy between sectors and between bigger and smaller firms persists precisely because capital-intensive, margin-compressed manufacturers cannot pivot to alternative suppliers, leaving them trapped between rising input costs and competitive output markets that prevent cost pass-through.

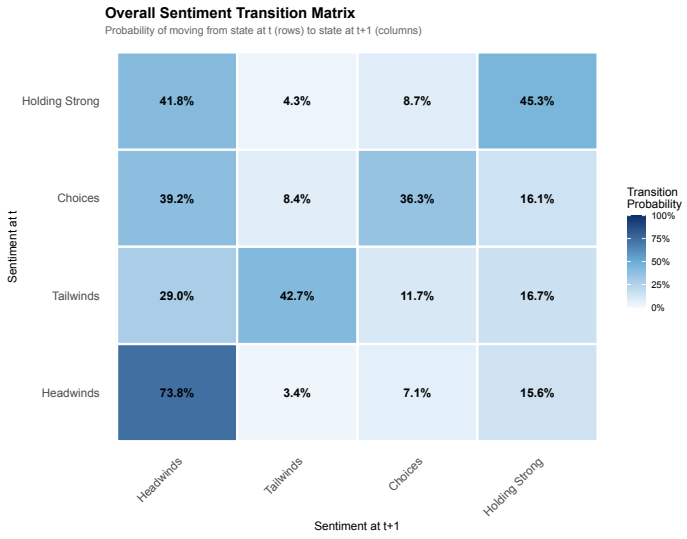
Strategic persistence: Transition dynamics across sectors

The morphological flexibility framework predicts not just differential positioning at any moment, but differential capacity to maintain favorable positions or escape adverse ones over time. To examine this temporal dimension, I analyze quarter-to-quarter sentiment transitions within firms. By tracking how companies' modal sentiments shift (or persist) from one quarter to the next, we can observe strategic persistence as a revealed measure of morphological flexibility. Sectors with genuine adaptability should exhibit strategic fluidity—transitioning from Headwinds through Choices to favorable outcomes. Conversely, sectors facing morphological constraints should display either entrapment in adverse positions or, when advantaged, durable persistence requiring minimal active adaptation.

The analysis aggregates individual earnings call statements to firm-quarter observations, using modal sentiment where concentration exceeds 40% (see Methods). This yields 4,847 firm-quarter observations with valid consecutive-quarter pairs, enabling construction of transition matrices showing the probability of moving from state *i* at time t to state *j* at *t+1*. The over-

all transition matrix (Table 1) reveals striking asymmetries. Headwinds exhibits the highest persistence (73.8%), while Choices shows the lowest (36.3%), consistent with its character as an active response rather than equilibrium state. Notably, Headwinds acts as an absorptive state: multiple pathways lead into it (39.2% from Choices, 29.0% from Tailwinds, 41.8% from Holding Strong), but exit probabilities remain low.

Figure 7: Transition matrix

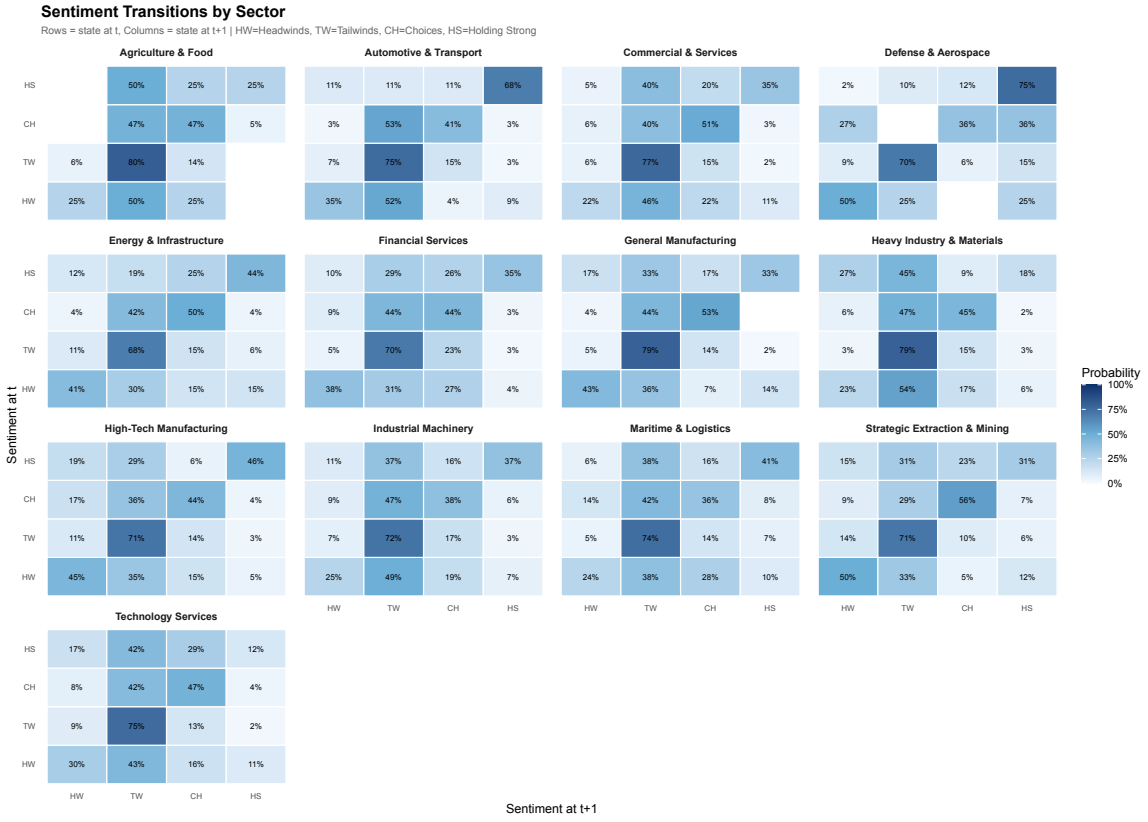


However, these aggregate patterns mask profound sectoral heterogeneity. Figure X presents transition matrices for all thirteen sectors, revealing that strategic persistence varies systematically along the lines predicted by morphological flexibility theory. Rather than experiencing uniform adjustment pressures, sectors occupy distinct positions in the hierarchy of adaptation based on their strategic indispensability and capacity for operational reconfiguration.

Defense & Aerospace exemplifies "winning without adapting" through exceptional strategic persistence. The sector exhibits 75% persistence in Holding Strong—by far the highest across all sectors—alongside 70% persistence in Tailwinds. When Defense firms do encounter Headwinds (rare in this sample), half transition out within one quarter, with 25% moving directly to Tailwinds. This pattern reveals morphological inflexibility operating as a source of power: the sector's concentration of IP, high barriers to entry, and designation as critical supplier create positions requiring minimal active adaptation. Maritime & Logistics displays similar but more volatile dynamics. The sector shows 74% Tailwinds persistence, but only 6% Holding Strong persistence, with 41% transitioning from Holding Strong back to Headwinds. This pattern re-

flects rent extraction through choke point control rather than durable competitive advantage. The low Holding Strong persistence indicates that resilience claims prove performative: these firms capitalize on disruption but cannot maintain advantage through stability.

Figure 8: Sectoral transition matrices



High-Tech Manufacturing and Energy & Infrastructure occupy the "adapting and winning" quadrant, but their transition patterns reveal a more precarious position than their elevated Tailwinds rates suggest. Both sectors show substantial Tailwinds persistence (71% and 68% respectively), validating their earlier designation as winners. However, they exhibit surprisingly high transitions from Holding Strong to Headwinds: 46% for High-Tech and 44% for Energy. This instability suggests these sectors must continuously adapt to maintain advantage. Unlike Defense's durable position, High-Tech firms navigate between competing state subsidies and volatile export control regimes. The 44% Choices persistence for High-Tech (versus 36% overall) indicates active strategic repositioning.

Strategic Extraction & Mining displays a different adaptation profile. The sector shows 50%

Headwinds persistence, the highest across all sectors, indicating that geological constraints and processing bottlenecks create persistent operational challenges. However, when firms in this sector reach Choices (announcing diversification, new capacity, or jurisdictional repositioning), 56% transition to Holding Strong, the highest Choices→Holding Strong rate observed. The sector's 71% Tailwinds persistence confirms that firms controlling critical mineral deposits, once established, maintain strategic value.

Automotive & Transport and Industrial Machinery exhibit the predicted "adapting without winning" pattern, but with important sector-specific differences. Automotive shows 53% Choices persistence, the highest across all sectors, combined with merely moderate Tailwinds persistence (76%) and very low Holding Strong stability (only 11% persistence). This indicates firms actively attempt strategic repositioning (announcing supply chain diversification, regional production mandates, electrification pivots), but adaptation attempts neither resolve into clear success nor revert to crisis. Instead, firms remain suspended in a state of ongoing adjustment.

Industrial Machinery shows similar Choices persistence (47%) but different directionality. From Headwinds, 48% transition to Tailwinds within one quarter – the highest Headwinds escape rate outside services sectors. However, this apparent fluidity may reflect further heterogeneity: machinery encompasses both specialized equipment manufacturers (capital goods facing structural demand from reshoring mandates) and general-purpose machinery producers (commodity competition). The 37% Holding Strong → Headwinds rate suggests resilience claims prove difficult to sustain, consistent with the sector's position between specialized capabilities and competitive pressures.

General Manufacturing and Heavy Industry & Materials occupy more ambiguous positions. General Manufacturing shows only 43% Headwinds persistence—well below the 73.8% overall rate—with 36% transitioning to Tailwinds. Heavy Industry displays even lower Headwinds persistence (23%), with 54% moving to Tailwinds. These patterns initially appear inconsistent with the "losing without adapting" classification. However, closer examination reveals these transitions may reflect sectoral heterogeneity rather than widespread success. The substantial Holding Strong → Headwinds transitions (33% and 27%) suggests many firms attempt adaptation without maintaining favorable outcomes.

The transition analysis demonstrates that morphological flexibility operates not as static posi-

tioning but as differential capacity for strategic persistence. Three patterns warrant emphasis. First, Tailwinds compounds advantages: sectors showing high Tailwinds persistence (Defense 70%, Mining 71%, Maritime 74%, Automotive 76%) demonstrate that initial favorable positions become self-reinforcing.

Second, Holding Strong proves largely performative, except where supported by genuine structural indispensability. Only Defense (75%) maintains resilience claims across quarters. All other sectors show Holding Strong as an unstable state, with firms reverting to Headwinds at rates of 27-46%. This suggests executives' assertions of supply chain resilience, operational flexibility, or market strength serve signaling functions to investors and customers rather than describing durable organizational capabilities.

Third, Choices operates as a crossroads, not a pathway. The low overall persistence (36.3%) validates its characterization as transitional. However, sectoral variation reveals crucial differences: High-Tech (44%), Automotive (53%), and Mining (56% → Holding Strong) use Choices to navigate toward favorable positions, while other sectors show Choices announcements dispersing across outcomes without clear directionality. This distinction separates genuine morphological flexibility from strategic rhetoric disconnected from material capabilities.

These temporal dynamics reveal the self-intensifying hierarchy in economic statecraft. The supply-side nature of geopolitical adjustment rewards not just current scale and position, but accumulated advantages from weathering previous disruptions. Sectors that successfully extracted rents or captured subsidies in 2022 built capital reserves enabling flexibility in 2024-2025, while sectors bearing initial adjustment costs face depleted reserves constraining subsequent adaptation. The transition matrices thus reveal morphological flexibility as both cause and consequence: firms adapt because they possess organizational capabilities, but successful adaptation further enhances those capabilities. Meanwhile, firms trapped in Headwinds face compounding constraints as cascading shocks deplete buffers, rendering each subsequent disruption harder to absorb.

Conclusion

Economic statecraft sweeps across supply chains as states try to remake global interdependencies, bring back jobs, and accelerate decarbonization. Supply chains are deeply privatized but increasingly matter for national security. While existing economic statecraft scholarship has

largely sidelined private firms as relevant actors that shape policy outcomes, this paper puts them center stage. I theorize the role of firms as channeling policies through morphological flexibility: the capacity to profit from or restructure around geopolitical constraints. More than passive subjects or agents that lobby for better outcomes, my paper casts firms as active planners that constantly adapt to state policy - seeking market access, policy-backed rents, or simply to offload costs connected to adapting supply chains. Because only firms with strategic indispensability or a larger scale to offload costs are capable of adapting, economic statecraft policies spawn a hierarchy of adaptation among the corporate landscape.

The empirical analysis demonstrates how this hierarchy operates through two complementary findings. First, the sectoral heterogeneity in geopolitical sentiments maps onto four adaptive pathways structured by strategic indispensability and morphological flexibility. Defense contractors and critical infrastructure firms extract policy-backed rents through irreplaceability. High-tech manufacturers and mining companies combine indispensability with adaptation capacity, leveraging subsidies while maintaining jurisdictional flexibility. Traditional manufacturers and basic industries bear adjustment costs without compensating power, caught between thin margins and specialized equipment. Second, the transition dynamics reveal this is not merely heterogeneity but self-reinforcing hierarchy. The supply-side nature of geopolitical adjustment rewards not just current scale and position, but accumulated advantages from weathering previous disruptions.

These patterns require two theoretical corrections to prevailing frameworks. First, against the weaponized interdependence literature's acknowledgment that firms lack "real independent agency" (Farrell and Newman 2021, 315; Farrell and Newman 2019), this paper demonstrates that morphological flexibility constitutes structural power—the ability to profit from constraints that others must endure, or to circumvent restrictions that others cannot navigate. Unlike the instrumental power emphasized in lobbying studies, adaptive capacity does not require coordination or collective action. Firms exercise power through organizational capabilities: financing parallel supply chains, absorbing switching costs, pivoting suppliers without stranded investments. This power operates precisely where state authority proves most limited: in the gradual reconfiguration of territorial production facilities, relationship cultivation, and learning-by-doing that characterizes supply chain restructuring. States can impose sanctions; they cannot prevent adaptive routing.

Second, the efficiency-security dilemma that dominates contemporary economic statecraft

debates (Christensen 2024) operates not as an aggregate tradeoff but as a distributional hierarchy. Some sectors profit from insecurity: defense contractors capitalize on elevated threat perceptions, logistics firms extract rents from disruption-induced scarcity, fossil fuel producers benefit from energy security premiums. Other sectors arbitrage between competing state demands: semiconductor manufacturers capture subsidies from multiple governments while maintaining operational flexibility, critical minerals firms command premiums for "geopolitically attractive jurisdictions" (Cameco 2024). Traditional manufacturing simply absorbs costs, lacking both the scale to finance adaptation and the specialized capabilities to command state support. Economic statecraft thus accelerates winner-take-all dynamics rather than resolving security-efficiency tensions.

These dynamics explain two political puzzles that existing frameworks struggle to address. First, why does economic nationalism persist despite limited effectiveness in achieving security objectives? The hierarchy of adaptation creates concentrated beneficiaries with strong interests in expanding statecraft—defense contractors securing guaranteed demand, high-tech manufacturers extracting competing subsidies, logistics firms capitalizing on fragmentation—while dispersing costs across traditional manufacturing sectors whose fragmentation precludes effective political organization. The policies become self-reinforcing even when aggregate welfare effects remain negative or security gains prove elusive. Second, why does populist backlash intensify precisely in regions targeted for manufacturing revival? The geographic and firm-size distribution of winners and losers maps directly onto existing cleavages. Large firms in urban clusters capture rents and subsidies; small and mid-sized firms in peripheral regions—precisely the communities that industrial policy ostensibly aims to revive—bear adjustment costs without compensating returns. This amplifies the economic geography of political polarization (Autor, Dorn, Hanson, et al. 2020; Cremaschi et al. 2025) that produced these policies in the first place.

As we move into a more openly political form of capitalism where charismatic authority and transactional dealmaking replace rule-bound bureaucratic authority, understanding the role of firms in reshaping these dynamics becomes even more important. To borrow a phrase from Schumpeter (2010, 75): discussing present geoeconomic statecraft without multinational firms is like Hamlet without the Danish prince.

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Appendix to: Hierarchies of Adaptation: Corporate Power in Economic Statecraft

A. Data Collection and Corpus Construction

A.1 Data Sources and Sample Composition

This study analyzes 29,215 earnings call transcripts from 5,605 unique publicly traded companies spanning January 2016 to August 2025. The data collection process involved systematic extraction of earnings call transcripts from S&P Global Market Intelligence, focusing on companies that mentioned geopolitical terms in their quarterly and annual earnings communications.

Temporal Coverage: The dataset exhibits substantial temporal variation, with notable concentration in recent years. The distribution across years reveals:

- 2016-2021: 4,505 calls (15.4%)
- 2022: 7,566 calls (25.9%)
- 2023: 4,560 calls (15.6%)
- 2024: 5,334 calls (18.3%)
- 2025: 6,385 calls (21.9%)

This distribution reflects both the increased salience of geopolitical discourse in corporate communications following the Russian invasion of Ukraine in February 2022, and expanded data collection efforts in recent periods. On average, each company appears 5.2 times in the dataset, providing sufficient within-firm variation for longitudinal analysis.

Geographic Distribution: The sample spans 80 countries, with substantial representation across major economic regions. The United States accounts for the largest share (9,323 calls, 31.9%), followed by India (3,255 calls, 11.1%), Canada (1,396 calls, 4.8%), Germany (1,291 calls, 4.4%), and the United Kingdom (1,167 calls, 4.0%). European firms collectively represent approximately 20% of the sample, while Asian companies (excluding China) constitute roughly 25%. A small proportion of observations (8.6%) have incomplete geographic metadata.

Industry Composition: The dataset covers 17 NACE sections and 500 distinct NACE codes, ensuring broad sectoral representation. The largest industry concentrations are:

- Manufacturing (Section 2): 9,362 calls (32.0%)
- Financial and insurance activities (Section 6): 6,157 calls (21.1%)
- Information and communication (Section 5): 2,914 calls (10.0%)
- Mining and quarrying (Section 1): 1,783 calls (6.1%)
- Transportation and storage (Section 4): 1,623 calls (5.6%)

The most frequently represented specific industries include monetary intermediation (6.2%), electronic components manufacturing (4.7%), software publishing (2.8%), and sea freight transport (2.3%).

Firm Characteristics: Market capitalization data is available for 82% of the sample (23,950 observations). The distribution reveals:

- Mean market cap: $23,875 million
- Median market cap: $3,841 million
- 25th percentile: $882 million - 75th percentile: $14,830 million
- Range: $0 to $3,438,438 million

Size categorization shows the sample includes micro-cap firms (<$300M, 10.8%), small-cap ($300M-$2B, 19.5%), mid-cap ($2B-$10B, 25.3%), and large-cap firms (>$10B, 26.4%). This distribution ensures representation across the firm size spectrum, though with a slight skew toward larger, more established corporations.

Ownership Structure: For the subset of firms with available ownership data, institutional investors represent the dominant shareholder category, with mean institutional ownership of 48.0% and median of 42.5%. Institutional investors are the largest shareholder type for 56.0% of firms in the sample. Individual and insider ownership averages 8.2%, while corporate ownership (private and public combined) represents substantial stakes in many firms. State ownership is present in 39.5% of firms but exceeds 50% in only 1.1% of cases. The Herfindahl Index of ownership concentration has a mean of 3,797 and median of 2,966, indicating moderately dispersed ownership structures on average.

A.2 Data Extraction Pipeline

The data processing workflow consists of three integrated stages: PDF extraction, text preprocessing, and triplet identification. Figure 6 provides a schematic overview of this pipeline.

Stage 1: PDF Text Extraction

Earnings call transcripts were obtained as PDF documents organized by date of publication. The extraction process employed PyMuPDF (fitz) to systematically parse document structure and extract relevant content fields:

1. **Metadata Extraction:** For each document, the script identifies the stock exchange ticker by locating patterns matching the format EXCHANGE:TICKER (e.g., NYSE:PG, NASDAQGS:AMBA) from the document header. Company names are extracted from the first page header, with careful attention to removing fiscal quarter designations, preliminary labels, and year suffixes that could interfere with subsequent company matching.

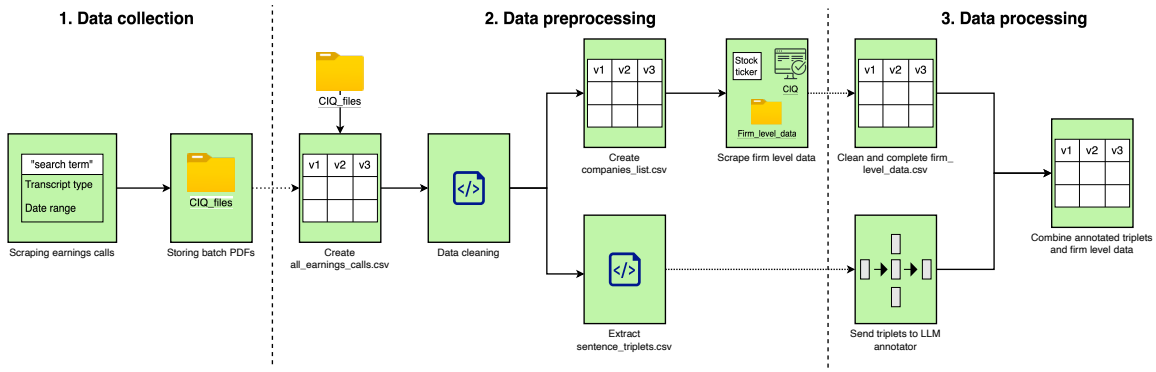
2. **Date Standardization:** Earnings call dates are extracted from document headers and converted to ISO 8601 format (YYYY-MM-DD) to enable temporal sorting and analysis. The extraction process handles various date formats and removes extraneous text such as "PRELIMINARY COPY" designations.

3. **Section Segmentation:** Each transcript is divided into two primary sections: the "Presentation" (prepared management remarks) and "Question and Answer" (analyst Q&A session). The script identifies section boundaries by detecting specific header patterns and page breaks, accumulating text content for each section separately.

4. **Text Cleaning:** Copyright notices, page numbers, and other boilerplate content are systematically removed using regular expressions. The script specifically targets S&P Global copyright statements and standardizes whitespace to ensure clean text for subsequent analysis.

The PDF extraction process generated an interim CSV file (all_earnings_calls . csv) containing 29,215 earnings call records with the following fields: Company, Stock Exchange, Date, Presentation, and Q&A. This intermediate format facilitates quality control inspection and enables parallel processing of subsequent analytical steps.

Figure 9: Data collection and analysis



Stage 2: Triplet Extraction

To identify relevant text passages, the corpus was processed using spaCy's sentence segmentation to detect mentions of geopolitical terminology. The extraction algorithm operates as follows:

1. **Keyword Identification:** The script searches for sentences containing any of the following terms: "geopolitics," "geopolitical," "geopolitically," or "geoeconomic." These terms were selected to capture explicit invocations of geopolitical framing rather than implicit references to international political economy.

2. **Context Window Construction:** When a keyword match is identified, the algorithm extracts a three-sentence window: the sentence containing the keyword (focal sentence), the immediately preceding sentence (providing context), and the immediately following sentence (capturing consequences or elaboration). This triplet structure ensures sufficient context for semantic classification while maintaining manageable text lengths for annotation.

3. **Parallel Processing:** Given the computational intensity of processing nearly 30,000 earnings calls, the script implements multiprocessing with configurable worker processes. The default configuration utilizes n-1 CPU cores, with progress tracking via tqdm to monitor extraction status.

4. **Deduplication:** The extraction process yields 29,215 unique sentence triplets, indicating an average of approximately one geopolitical reference per earnings call. Each triplet is assigned a unique identifier and retains metadata linking it to the source com-

pany, stock exchange, date, and original document.

The output of this stage (all_extracted_triplets .csv) serves as the input for LLM-based sentiment classification. The triplet format balances the competing demands of providing sufficient context for accurate classification while avoiding the prohibitive costs and rate limits associated with processing full earnings call transcripts.

A.3 Company-Level Data Integration

To enable firm-level analysis, the extracted triplets were matched with comprehensive company metadata from multiple sources:

Firm-Level Metadata: For each company, Excel-format company reports from S&P Global Market Intelligence were parsed to extract:

- Formal company name and stock ticker
- Primary industry classification (Market Intelligence taxonomy)
- NACE and NAICS industry codes
- Headquarters location (city, country)
- Market capitalization in millions USD

The matching algorithm first attempts to join on stock exchange ticker, then falls back to fuzzy company name matching for firms without reliable ticker data. For companies with missing or invalid data in primary sources, two supplementary Excel files provide corrected market capitalization values and NACE codes.

Ownership Data: Ownership structure information was extracted from S&P Global ownership reports, which decompose equity ownership into standardized categories:

- Institutional investors
- Individual and insider shareholders
- State-owned shares
- Private and public corporations
- Venture capital and private equity firms (>5% stakes)

- Hedge fund managers (>5% stakes)
- Employee stock ownership plans (ESOP)
- Sovereign wealth funds (>5% stakes)
- Company-controlled foundations

For each firm, these ownership percentages were integrated into the analysis dataset. Missing ownership values were coded as zero, under the assumption that unreported categories indicate negligible shareholdings.

Geographic Variables: The company matcher script implements sophisticated location parsing to convert raw headquarters strings into standardized country names and continental classifications. The algorithm:

1. Applies common abbreviation mappings (e.g., USA → United States, UK → United Kingdom)
2. Attempts pattern matching using the pycountry library
3. Implements special case handling for ambiguous or non-standard location strings
4. Generates continent-level categorizations (North America, South America, Europe, Asia, Africa, Oceania)
5. Creates separate categories for China and United States given their theoretical importance
6. Produces binary dummy variables for each geographic category

Temporal Variables: To enable analysis of the Ukraine invasion as a critical juncture, a binary indicator (post_invasion) was created, coded as 1 for all earnings calls dated February 24, 2022 or later, and 0 otherwise. This threshold date corresponds to the Russian military invasion of Ukraine, which triggered unprecedented Western sanctions and export controls.

Industry Clusters: To facilitate industry-level analysis, firms were assigned to industry clusters based on their NACE codes using a separate cluster classification file. Binary dummy variables were created for each cluster, enabling both cluster-level comparisons and within-industry fixed effects specifications.

The final integrated dataset (analysis_combined . csv) contains all extracted triplets linked to firm identifiers, firm characteristics, ownership structure, geographic location, and temporal markers, providing a comprehensive panel structure for empirical analysis.

B. Classification Scheme and Coding Protocol

B.1 Conceptual Framework

The classification scheme distinguishes among five categories based on the relationship between geopolitical references and corporate strategy articulation:

Category 1: Geopolitical Headwinds. The triplet contains factual statements identifying geopolitics and geopolitical factors—such as war, sanctions, supply chain disruption, or regulatory uncertainty—as general challenges that increase business environment volatility and uncertainty. Crucially, this category captures discussions of difficulties *without* specification of strategic responses or adaptive measures.

Example: "And I think that's where the closure of courts and some of the uncertainty still lingering post COVID continues to drive that uncertainty. What I would also say is that we do think that the geopolitical shifts that we're seeing occurring right in front of our eyes, as we look at today, continue to drive this focus around the uncertainty underlying these loss cost trends. So that's broadly what I would say to you."

Category 2: Geopolitical Tailwinds. The triplet contains factual statements identifying geopolitics and geopolitical factors as creating general opportunities or favorable business conditions. Like Category 1, this captures opportunity framing *without* explicit strategic actions to capitalize on these conditions.

Example: "Today, global defense spending is on the rise, driven by the Ukraine war, shifts in geopolitical dynamics and the U.S. Department of Defense modernization priorities. Allison is poised to capture growth in this cycle by continuing our long-standing partnership with the U.S. Department of Defense."

Category 3: Geopolitical Choices. The triplet invokes geopolitics as a factor directly informing business and investment decisions. This category captures active strategic responses, including but not limited to: supply chain diversification, geographic risk mitigation, inventory stockpiling, reshoring or nearshoring initiatives, market entry or exit decisions, compli-

ance with local content requirements, enhanced risk monitoring, and supplier relationship restructuring.

Example: "The geopolitical tensions may amplify the supply chain challenges mentioned above, which we address with our supplier risk mitigation strategy, buying key products from multiple regions and manufacturers."

Category 4: No Geopolitical Sentiment. The triplet mentions geopolitical terms but does not express a clear sentiment or strategic orientation toward geopolitics. This category should be used only when the text provides insufficient information to determine whether geopolitical factors are framed as challenges, opportunities, or strategic considerations.

Category 5: Holding Strong. The triplet states that geopolitical factors and geopolitical dynamics—such as war, sanctions, supply chain disruption, or regulatory uncertainty—do not materially affect business performance or strategy, or that business performance has remained strong despite these factors. This category captures narratives of resilience and insulation from geopolitical turbulence.

Example: "We delivered another quarter of strong financial results despite market concerns about slowing demand, broader macroeconomic challenges and the various global geopolitical issues. In fact, indicators of demand both from customers and in the market generally remain healthy."

B.2 Classification Instructions

The classification protocol implemented the following standardized instructions across all LLM annotation runs:

System Prompt: "You are a research assistant to a social scientist. You will be provided with texts from corporate earnings calls that mention 'geopolitics'. Classify the following text into one of the given categories: [categories]. [definitions]. Only include the number of the selected category in your response and no further text."

Temperature and Sampling: All classifications were performed with temperature=0.0 and fixed random seed (seed=42) to maximize reproducibility and consistency. For OpenAI models, frequency_penalty and presence_penalty were set to 0 to avoid biasing against repeated category assignments.

Output Format: Models were instructed to return only the category number (1, 2, 3, 4, or 5) with no additional explanation or justification. This constraint reduces API costs and standardizes output parsing.

C. Model Selection and Validation

C.1 Model Comparison

The selection of an appropriate classification model involved systematic evaluation of multiple approaches: fine-tuned transformer models, open-source large language models, and proprietary LLM services. The evaluation focused on three dimensions: classification accuracy, category-level performance balance, and practical feasibility given computational constraints.

Models Evaluated: 1. **GeoBERT:** A custom-trained BERT-based classifier fine-tuned on a hand-labeled training set of 500 triplets. This model represents the traditional supervised learning approach and provides a benchmark for open-source, fully reproducible methods.

2. **GPT-3.5 Turbo:** OpenAI's previous-generation model, offering a mid-tier LLM baseline with lower API costs.

3. **GPT-4o (gpt-4o-2024-08-06):** OpenAI's multimodal flagship model, representing state-of-the-art performance but with higher computational costs.

4. **Mixtral 8x7B:** An open-source mixture-of-experts model that balances performance and accessibility, offering a viable alternative to proprietary services.

Evaluation Methodology: Model performance was assessed on a held-out validation set of 300 manually annotated triplets, ensuring no overlap with any training data used for fine-tuning GeoBERT. Three aggregate metrics were calculated: - **F1 Macro:** Unweighted average of category-level F1 scores, treating each category equally - **F1 Micro:** Overall F1 computed from aggregate true positives, false positives, and false negatives - **Balanced Accuracy:** Average recall across categories, accounting for class imbalance

Additionally, category-specific precision, recall, and F1 scores were computed to identify systematic biases or weaknesses in particular classification contexts.

C.2 Performance Results

Table 2 presents aggregate evaluation metrics for GPT-4o, which emerged as the superior performer:

Table 2: Aggregate Model Evaluation Metrics (GPT-4o)

Metric	Value
F1 Macro	0.86
Balanced Accuracy	0.84
F1 Micro	0.88

Table 3 disaggregates performance by category, revealing consistently strong results across all five classification types:

Table 3: Category-Level Model Evaluation Metrics (GPT-4o)

Category	Precision	Recall	F1
Headwinds	0.90	0.96	0.93
Tailwinds	0.92	0.65	0.76
Choices	0.85	0.92	0.91
Holding Strong	0.84	0.91	0.87
None	0.84	0.76	0.81

Figure 7 visualizes comparative performance across all evaluated models. Panel (a) shows aggregate metrics, where GPT-4o substantially outperforms alternatives on balanced accuracy and F1 scores. GeoBERT achieves respectable performance (F1 macro □ 0.72) but lags GPT-4o by approximately 14 percentage points. GPT-3.5 and Mixtral fall between these extremes.

Panel (b) reveals critical differences in category-level performance. All non-GPT-4o models exhibit marked difficulty correctly identifying Category 4 (No Geopolitical Sentiment) and Category 2 (Tailwinds). GeoBERT and Mixtral show F1 scores below 0.50 for the "None" category, indicating systematic over-classification of neutral statements as containing geopolitical sentiment. GPT-4o maintains F1 scores above 0.75 for all categories, demonstrating more balanced performance across the classification space.

C.3 Category Imbalance and Abstraction

The training and validation data exhibit substantial class imbalance, with Categories 1 (Headwinds) and 3 (Choices) comprising approximately 60% of observations, while Categories 2 (Tailwinds) and 4 (None) represent roughly 10% each. This imbalance poses challenges for standard classification approaches, which tend to over-predict majority classes.

C.4 Reproducibility and Reliability Considerations

Reproducibility Challenges: A key limitation of using proprietary LLM APIs is reduced reproducibility. While API requests specify temperature=0 and fixed random seeds, requests may be routed to different server instances with potentially varying model weights. OpenAI does not guarantee bit-exact reproducibility across API calls, even for identical inputs and parameters.

To partially address this concern, a subsample of 100 triplets was re-classified three times with GPT-4o to assess consistency. The three runs produced identical classifications for 94% of cases, with the six discrepant cases all involving boundary distinctions between Categories 3 and 5. This suggests high but imperfect stability.

Inter-Coder Reliability Analogy: Törnberg (2024) argues that LLMs 'fit poorly into our existing epistemic frameworks for text annotation' because they cannot be evaluated using traditional inter-coder reliability metrics designed for human annotators. LLMs do not exhibit random measurement error in the classical sense; instead, their errors are systematic and deterministic given fixed prompts and parameters.

Rather than computing Cohen's kappa or similar statistics, validation focuses on comparing LLM output against a gold standard labeled dataset. The key question is not whether the LLM agrees with itself (which it largely does given temperature=0), but whether its classifications align with human expert judgment on held-out cases.

Fortuitous Bias: Boelaert et al. (2024) note that LLMs exhibit 'machine bias' characterized by low variance in repeated classifications—a property that can be advantageous for research applications where consistency is valued over capturing human-like disagreement. For this project, the deterministic nature of LLM classification (given prompt and parameters) ensures that results are stable within a given model version, though not necessarily across model versions or providers.

C.5 Prompt Engineering

The final prompt design emerged from iterative experimentation with prompt phrasing, definition specificity, and output constraints. Key design choices included:

1. **Role Specification:** Framing the LLM as a 'research assistant to a social scientist' establishes an academic rather than commercial tone, potentially improving attention to conceptual nuance.

2. **Explicit Category Definitions:** Providing detailed definitions with concrete examples reduces ambiguity and guides the model toward theoretically grounded classifications.

3. **Output Constraint:** Requiring only the category number (no explanations) reduces API costs and prevents the model from generating post-hoc rationalizations that may not reflect the actual classification logic.

4. **Negative Instructions:** Initial prompt versions included instructions to "think carefully" or "explain your reasoning," but these instructions increased API costs without improving accuracy. The final prompt prioritizes efficiency while maintaining performance.

Alternative prompt structures were tested, including chain-of-thought prompting (asking the model to explain its reasoning before providing a classification) and few-shot learning (including example classifications in the prompt). Neither approach improved performance sufficiently to justify increased token costs.

D. Data Processing Implementation

D.1 Annotation Pipeline

The sentiment classification pipeline implements a robust batch processing system designed to handle large-scale annotation while managing API rate limits and costs:

File Splitting: The 29,215 extracted triplets were divided into smaller files of 1,000 rows each, sorted chronologically by earnings call date. This chunking strategy enables parallel processing, incremental progress saving, and failure isolation.

Checkpoint System: Each split file maintains a checkpoint CSV that records partial progress.

If processing is interrupted (due to API rate limits, network failures, or manual termination), the script resumes from the last successfully classified row rather than restarting the entire file.

Rate Limit Management: The script implements a configurable batch size (default: 100 classifications) after which it saves progress and introduces a 0.5-second delay. This throttling prevents API rate limit violations while maintaining reasonable throughput.

Error Handling: Individual classification failures (due to malformed API responses or unexpected outputs) are logged but do not terminate processing. Failed classifications receive a default value, ensuring the dataset remains complete.

Model Flexibility: The pipeline supports multiple LLM providers (OpenAI, Anthropic, Perplexity) through a unified interface. Provider-specific API clients and prompt formats are abstracted behind a common function signature, enabling easy model comparison and provider switching.

D.2 Final Dataset Structure

The analysis dataset contains the following variable categories:

Identifiers:

- #id: Unique triplet identifier
- Company: Company name as extracted from earnings call
- Stock Exchange: Stock ticker (e.g., NYSE:PG)
- Date: Earnings call date (YYYY-MM-DD format)

Text Content:

- Sentences: Three-sentence triplet containing geopolitical reference

Classification:

- gpt_4o_2024_08_06: GPT-4o classification (1-5) - Additional model classification columns if multiple models were used

Firm Characteristics:

- Company Name from Excel: Standardized company name
- Industry: Primary industry classification
- NACE Code: European industry classification code
- NAICS Code: North American industry classification code
- Market Cap: Market capitalization in millions USD
- Headquarters: Raw headquarters location string
- HQ_clean: Standardized country name
- HQ_continent: Continental classification

Ownership Structure:

- Institutions : Percentage institutional ownership
- Individuals / Insiders : Percentage insider ownership
- State Owned Shares: Percentage state ownership
- Corporations (Private): Percentage private corporate ownership
- Corporations (Public): Percentage public corporate ownership
- Hedge Fund Managers (>5% stake): Percentage hedge fund ownership
- ESOP: Percentage employee stock ownership
- Sovereign Wealth Funds (>5% stake): Percentage SWF ownership
- Company Controlled Foundation: Percentage foundation ownership

Geographic Indicators:

- United_States : Binary indicator for US-headquartered firms
- China: Binary indicator for China-headquartered firms
- Europe: Binary indicator for Europe-headquartered firms
- Asia: Binary indicator for Asia-headquartered firms
- North_America: Binary indicator for North America

- South_America: Binary indicator for South America
- Africa : Binary indicator for Africa
- Oceania: Binary indicator for Oceania

Temporal Indicators:

- post_invasion : Binary indicator for earnings calls after February 24, 2022

The final dataset dimensions are 29,215 observations × ~80 variables, providing a rich panel structure for cross-sectional and longitudinal analysis.

E. Limitations and Future Directions

Coverage Limitations: The sample is limited to publicly traded companies with earnings calls covered by S&P Global Market Intelligence. Private firms, state-owned enterprises without public listings, and smaller public companies with limited analyst coverage are systematically underrepresented. This selection may bias findings toward larger, more internationally integrated firms.

Language Constraints: The analysis is restricted to English-language earnings calls, potentially excluding important geopolitical discourse in non-English corporate communications. Multinational firms headquartered in non-English-speaking countries may frame geopolitical issues differently in domestic versus international communications.

Temporal Specificity: While the dataset spans 2016-2025, the concentration of observations in 2022-2025 limits the ability to identify long-term trends or compare multiple geopolitical shock episodes. Future extensions could expand temporal coverage or focus on specific historical periods (e.g., US-China trade war, COVID-19 pandemic).

Measurement Validity: The classification scheme relies on explicit geopolitical terminology, potentially missing implicit discussions of international political economy that do not use the keywords "geopolitics" or "geopolitical." Alternative text mining approaches (topic modeling, semantic similarity) could complement the keyword-based extraction strategy.

Model Dependency: Results depend critically on GPT-4o's classification accuracy. While validation metrics are strong, systematic errors or biases in LLM classifications could propa-

gate through the analysis. Future work might combine LLM classifications with human coding of a larger validation set to assess and correct for systematic biases.

Causal Identification: The observational nature of earnings call data precludes strong causal claims. Firms that discuss geopolitics may differ systematically from those that do not, and the decision to emphasize geopolitical factors in investor communications is endogenous to firm strategy and performance. Robustness checks and quasi-experimental designs (difference-in-differences, event studies) are necessary to strengthen causal inference.

Despite these limitations, the dataset represents the most comprehensive systematic analysis of corporate geopolitical discourse to date, providing novel insights into how firms across industries and geographies understand and respond to contemporary economic statecraft.