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Industrial Policy and Effective Availability in Strategic Supply Chains: Empirical Evidence from Semiconductor Trade

Savannah Yu[1], & Alexander Yu[2]

[1] College of Arts and Sciences, Cornell University, Ithaca, USA

[2] VentureLab Business & Economics, Phoenix, USA

Correspondence: Alexander Yu, VentureLab Business & Economics, Phoenix, USA.

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Abstract

Strategic supply chains have become a central concern for economic policy as geopolitical fragmentation, export controls, and industrial subsidies reshape global trade. This study evaluates how recent U.S. trade and industrial policies have affected the effective availability of semiconductor inputs—a critical determinant of productivity, innovation, and economic resilience. Using detailed bilateral trade data from UN Comtrade (2020–2024), the paper constructs a CES-based import aggregator that adjusts observed trade flows for tariffs, export controls, and geopolitical risk. The empirical results show that while nominal semiconductor imports recovered after the pandemic, policy-adjusted effective availability experienced significant volatility following the introduction of import controls and targeted tariffs. Dependence on East Asian suppliers—particularly Japan, South Korea, and the Netherlands—remains structurally high, especially for advanced equipment and lithography inputs. However, diversification toward allied and regional partners partially offset policy-induced access constraints by 2024. The findings highlight three applied insights. First, industrial policy can stabilize supply access without full reshoring when substitution elasticities are sufficiently high. Second, targeted restrictions impose short-run costs on effective availability but may accelerate long-run diversification. Third, resilience depends more on supplier substitutability and policy coordination than on import volume alone. These results inform ongoing debates on industrial policy effectiveness, strategic trade management, and supply-chain resilience in advanced and emerging economies.

Keywords: effective availability, industrial policy, semiconductor trade, supply chain resilience, trade restrictions

1. Introduction

Global supply chains for strategic intermediate goods have entered a period of structural realignment driven by geopolitical risk, industrial policy, and national security concerns (Baldwin & Freeman 2022). Semiconductors are central to this transformation, functioning as essential inputs for advanced manufacturing, digital infrastructure, and defense-related industries. Disruptions in their availability propagate rapidly across sectors, affecting productivity, inflation dynamics, and long-term growth.

Recent policy responses—including the U.S. CHIPS and Science Act and coordinated trade controls among advanced economies—aim to reduce vulnerability without abandoning global integration (White House 2024). However, the effectiveness of these interventions remains an empirical question. While existing studies document supplier concentration and reshoring trends, fewer quantify how policy measures alter the effective accessibility of imported inputs once tariffs, controls, and geopolitical risks are accounted for.

This paper contributes to applied economics and finance by empirically evaluating how trade and industrial policies reshape effective availability in the U.S. semiconductor supply chain. Building on CES-based import aggregation, the study integrates trade volumes with restriction factors derived from tariffs, export controls, and policy risk indicators. This approach moves beyond nominal import statistics to measure policy-adjusted access to strategic inputs.

The analysis addresses three questions relevant to policymakers and practitioners:

(1) How concentrated is effective semiconductor supply once policy frictions are incorporated?

(2) Do trade restrictions reduce availability or induce diversification?

(3) What role does substitution elasticity play in supply-chain resilience?

By answering these questions, the study provides evidence-based guidance for designing industrial and trade policies

that balance resilience, efficiency, and openness.

2. Method

This study develops an applied empirical framework to evaluate how industrial and trade policies affect the effective availability of semiconductor inputs in the United States. Rather than focusing solely on observed trade flows, the methodology measures how policy-induced frictions alter economic access to strategically critical inputs across different segments of the semiconductor value chain.

The approach combines three elements: (i) detailed bilateral trade data, (ii) a CES-based import aggregation framework, and (iii) policy-adjusted restriction factors that translate tariffs, export controls, and geopolitical risk into economically meaningful wedges. This structure allows for counterfactual interpretation—specifically, how supply availability would differ in the absence of policy frictions.

2.1 Data Sources and Scope of Analysis

The empirical analysis relies on annual bilateral import data from the United Nations Commodity Trade Statistics Database (UN Comtrade) covering the period 2020–2024. This time frame captures the post-pandemic semiconductor supply disruption as well as the subsequent implementation of major U.S. industrial and security-driven trade policies, providing a relevant context for assessing effective import availability under heightened supply-chain stress.

The study examines five semiconductor-related product groups selected to represent distinct segments of the semiconductor production chain. Upstream inputs include rare gases and specialty chemicals (HS 2804 and HS 2850), midstream inputs comprise doped wafers and processing materials (HS 3818 and HS 3824), and capital equipment is represented by semiconductor manufacturing machinery (HS 8486). This segmentation reflects systematic differences in technological specificity, supplier concentration, and substitution potential across production stages.

For each HS category, bilateral import values are converted into country-level import weights by normalizing trade flows by total U.S. imports within the category. Table 1 summarizes the resulting data coverage and supplier structure, documenting the number of supplier countries and standard concentration measures. These descriptive statistics provide a foundation for the subsequent CES-based analysis by characterizing the degree of diversification and potential substitution constraints across input types.

Table 1. Data Coverage and Supplier Concentration by HS Category

HS Category	Sample Period	Years	Supplier Countries	Avg Import Weight	Avg HHI	Avg Top-3 Share
2804 – Rare gases (neon, argon, etc.)	2020–2024	5	7	0.143	0.305	85.8
2850 – Specialty chemicals (nitrides, silicides, etc.)	2020–2024	5	6	0.208	0.494	98.4
3818 – Doped wafers and substrates	2020–2024	5	7	0.143	0.352	84.1
3824 – Photoresists and chemical preparations	2020–2024	5	7	0.143	0.393	93.3
8486 – Semiconductor manufacturing equipment	2020–2024	5	7	0.143	0.25	72.9

Source: Avg Import Weight, Avg HHI, and Avg Top-3 Share are author calculations based on import data from the United Nations Commodity Trade Statistics Database (UN Comtrade).

2.2 Conceptual Framework: Effective Availability of Imports

Standard trade statistics measure nominal import volumes but do not reflect policy-induced access constraints. To address this limitation, the study introduces effective availability, defined as the quantity of imported semiconductor inputs that remains economically accessible after accounting for trade restrictions and supply-chain frictions.

This concept follows applied trade modeling practices in which imported inputs from multiple origins are aggregated

into a composite input that enters production (Feenstra 2018). The approach allows policy instruments—such as tariffs or export controls—to reduce effective access even when nominal trade continues.

2.3 CES-Based Import Aggregator

Import partner shares are calculated to identify the relative importance of destination markets in each year:

$$\omega_{ij} = \frac{M_{ij}(t)}{\sum_k M_{kj}(t)} \tag{1}$$

Here, $M_{ij}(t)$ denotes the import value of semiconductor category *M* from supplier country *i* to *j* in the reference year t, where the summation index k covers all exporting partners. The normalized weights therefore sum to one, $\sum_i \omega_{ij} = 1$.

To operationalize effective availability, the study constructs a constant elasticity of substitution (CES) import aggregator across foreign suppliers. The effective import aggregator is defined as:

$$I(t) = \left[\sum_i \omega_i \left((1 - \chi_i(t))M_i(t)\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{2}$$

where σ is the elasticity of substitution across suppliers (Simonovska & Waugh 2014; Ahmad & Riker 2020); $\chi_i(t) \in [0,1]$ is a restriction factor representing the share of imports rendered inaccessible by policy or logistical frictions.

This formulation allows effective availability to decline either because imports fall or because policy frictions reduce usable access to existing trade flows.

The sensitivity of effective input availability to the elasticity of substitution is characterized by the derivative

$$\frac{\partial I(t)}{\partial \sigma} = I(t) \cdot \frac{1}{\sigma(\sigma-1)} \left(\mathbb{E}_p[\ln a_i(t)] - \ln I(t)\right) \tag{3}$$

where $a_i(t) \equiv (1 - \chi_i(t))M_i(t)$represents policy-adjusted imports from source i. The expectation operator $\mathbb{E}_p[\cdot]$ is taken with respect to CES weights,

$$p_i = \omega_i a_i^{(\sigma-1)/\sigma} / \sum_j \omega_j a_j^{(\sigma-1)/\sigma} \tag{4}$$

which reflect the relative contribution of each supplier to aggregate availability. The expectation operator $\mathbb{E}_p[\cdot]$ is

$$\mathbb{E}_p[\ln a_i(t)] = \sum_i p_i \ln(a_i) \tag{5}$$

This expression shows that the impact of a marginal change in σ depends on the dispersion of policy-adjusted inputs: when effective imports are unevenly distributed across suppliers—so that the weighted mean of log inputs differs from the log of the aggregate index—increasing substitutability amplifies effective availability by allowing greater reallocation toward less-restricted sources. Conversely, when inputs are relatively homogeneous, changes in σ have limited effects. This result formalizes the role of substitution elasticity as a structural amplifier of trade-policy shocks, linking the responsiveness of effective availability to both the concentration of supply and the intensity of policy-induced restrictions within strategic supply chains.

2.4 Restriction Factors and Policy Adjustment

The restriction factor $\chi_i(t)$measures policy-induced reductions in effective access to semiconductor manufacturing inputs and is constructed as a composite index capturing three observable sources of trade friction. These include: (i) tariff-equivalent trade barriers on semiconductor-related products, measured by the average applied ad valorem tariff rate $\tau_i(t)$(WTO, 2023); (ii) export-control intensity $E_i(t)$, proxied by the share of product categories subject to licensing, technology-transfer restrictions, or advanced-node controls (BIS, 2023; White House, 2024); and (iii) broader policy and geopolitical risk $P_i(t)$, capturing sanctions exposure, regulatory uncertainty, and trade-facilitation frictions, normalized to a 0–1 scale (OECD, 2024). Formally, the restriction factor is defined as:

$$\chi_i(t) = min\left\{1,\ \alpha \frac{\tau_i(t)}{\tau^{max}} + \beta \frac{E_i(t)}{E^{max}} + \gamma P_i(t)\right\} \tag{6}$$

Each component is normalized using benchmark maxima $\tau_{\max}$and $E_{\max}$to ensure comparability across inputs and trading partners. The weights α, β, and γsum to one and are calibrated to (0.4, 0.4, 0.2), respectively, reflecting the comparable short-run impact of tariffs and export controls on transaction costs and supply reliability, alongside the more persistent but indirect influence of policy risk on expectations and contractual stability. This proportional structure is

consistent with empirical evidence on trade-cost elasticities and policy-induced frictions reported by the BIS (2023). By construction, higher values of $\chi_{ij}(t)$indicate greater policy-driven access constraints and lower effective availability within the import aggregator, allowing observed trade flows to be translated into a unified, policy-adjusted measure of semiconductor supply accessibility.

2.5 Comparison to HHI and RCA

The effective import aggregator used in this study differs from standard trade indicators such as the Herfindahl–Hirschman Index (HHI) and Revealed Comparative Advantage (RCA) in both purpose and interpretation. HHI summarizes supplier concentration but does not measure whether concentration translates into binding vulnerability (Belbali et al., 2024). It cannot incorporate policy frictions—such as tariffs, export controls, or licensing risk—that reduce usable access even when import volumes remain unchanged. As a result, identical HHI values may correspond to very different levels of effective access. RCA captures a country's export specialization and competitiveness, not its ability to secure imported inputs (Balassa 1965). Changes in RCA therefore do not map directly to supply-chain resilience or input availability for downstream production.

By contrast, the effective import aggregator is a policy-adjusted access measure. It combines import flows, substitution elasticities, and restriction factors into a single index that is directly interpretable as usable availability. This framework allows changes in access to be decomposed into trade reallocation versus policy-induced wedges, a distinction that HHI and RCA cannot make. Traditional indicators are reported for context, but effective availability is the primary outcome because it directly reflects exposure, adjustment capacity, and policy constraints.

3. Results

This section presents empirical evidence on how trade policy and supplier concentration shape the effective availability of semiconductor inputs in the United States. Following the approach used in recent applied work on industrial policy in the semiconductor sector, the results are organized around three mechanisms: baseline concentration, policy-induced access frictions, and reallocation through allied supply networks.

3.1 Baseline Concentration in Semiconductor Supply Chains

Figure 1 illustrates U.S. imports of semiconductor manufacturing materials and equipment, where panels (a)–(e) present time-series plots of trade values by destination for individual HS 8542 subcategories. Consistent with the global structure documented in recent semiconductor policy studies, U.S. imports of critical semiconductor inputs exhibit extreme supplier concentration at the technological frontier. Appendix A reports the restriction-adjusted trade weights by HS group and partner economy for the 2020–2024 period. Across all years in the sample, advanced inputs—particularly semiconductor manufacturing equipment (HS 8486) and photoresists (HS 3824)—are sourced predominantly from Japan and the Netherlands, with South Korea playing a secondary but significant role. These suppliers account for a dominant share of imports not only in value terms but also in effective availability, reflecting their irreplaceable technological capabilities.

This concentration is not uniform across the supply chain. Upstream materials such as rare gases and selected specialty chemicals display broader sourcing, including contributions from Southeast Asia and, to a lesser extent, Eastern Europe (SEMI 2023). This pattern mirrors the vertical segmentation emphasized in the industrial-policy literature: while upstream and midstream inputs allow some diversification, front-end fabrication and equipment remain structurally concentrated (ASML 2023).

Importantly, baseline concentration persists even before policy adjustments are applied, indicating that exposure to supply-chain risk is inherent to the technological organization of the semiconductor industry rather than solely a result of recent trade restrictions.

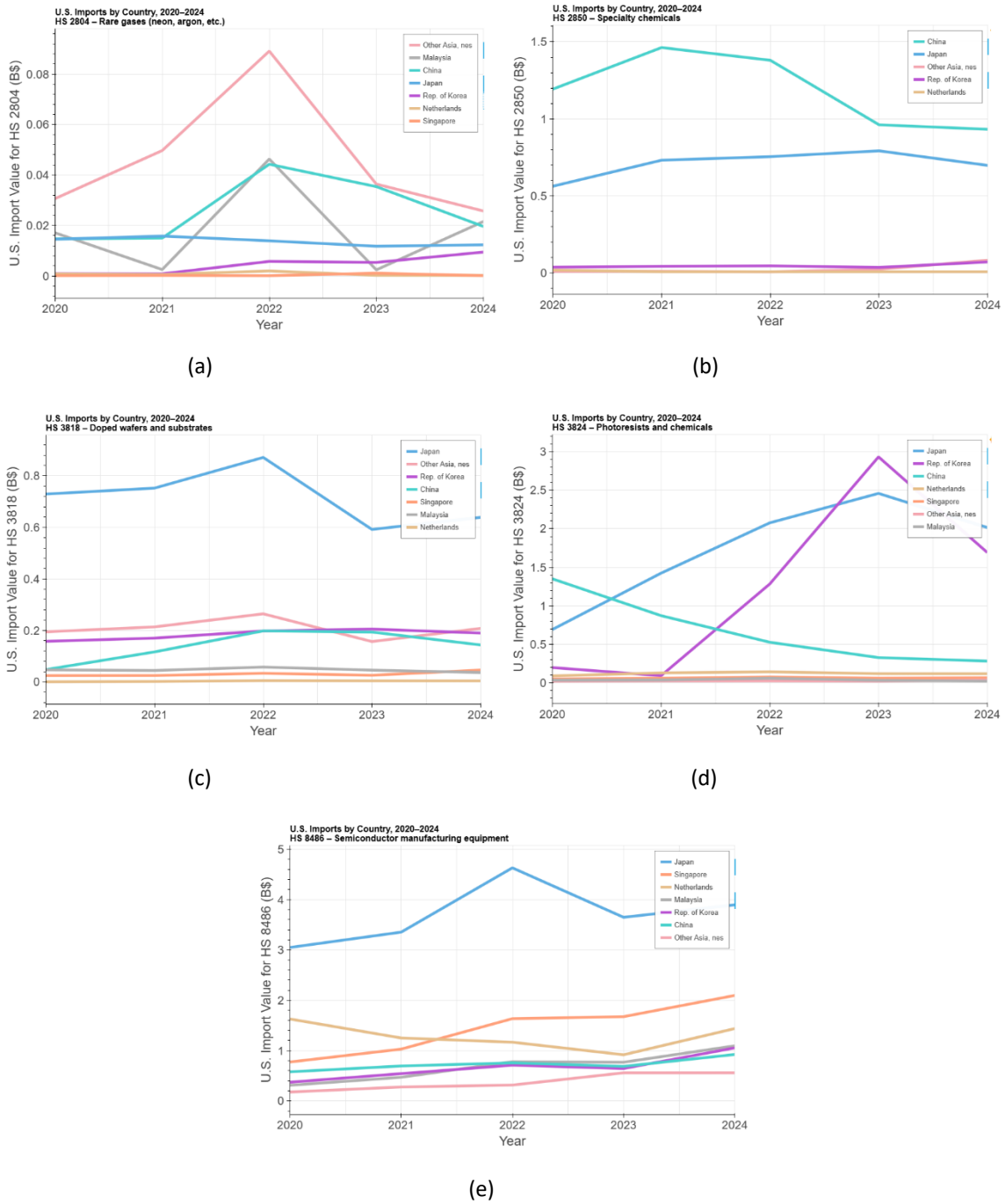


Figure 1. Import of U.S. semiconductor manufacturing materials and equipment. (a)–(e) present time-series plots of export values by destination for individual HS 8542 subcategories

3.2 Policy Frictions and the Divergence Between Nominal Imports and Effective Availability

Introducing policy-adjusted restriction factors reveals a key result emphasized in recent work on semiconductor industrial policy: nominal import volumes substantially overstate true economic access.

Between 2021 and 2022, nominal imports increase sharply across most product categories, reflecting post-pandemic recovery and emergency sourcing. However, once tariffs, export controls, and geopolitical risk are incorporated, effective availability grows at a slower pace—particularly for advanced equipment and lithography-related inputs.

After 2022, this divergence becomes more pronounced. Despite stable or rising nominal imports, effective availability stagnates or declines in categories subject to tighter export controls. This pattern suggests that policy frictions act as

quantity-equivalent barriers, reducing usable access even when goods continue to cross borders (Chor & Manova 2012).

This finding parallels the insight in the industrial-policy literature that trade restrictions often reallocate rents and risk without immediately collapsing trade flows, making policy effects difficult to detect using standard import statistics alone.

3.3 Reallocation Toward Allied Suppliers

A central question in the semiconductor policy debate is whether trade restrictions lead to outright shortages or instead induce reallocation within trusted trade networks. The results provide strong evidence for the latter.

By 2023–2024, effective availability stabilizes across most categories despite persistent policy frictions (BCG & SIA 2024). This stabilization is driven by increased sourcing from allied economies, particularly Japan, South Korea, Singapore, and Malaysia. While these suppliers do not fully replicate the capabilities of frontier producers in all segments, they partially offset access losses in midstream inputs and assembly-related equipment.

The reallocation effect is uneven across the supply chain. Categories with high technological specificity exhibit limited adjustment, while inputs with modular production stages display significant diversification. This heterogeneity reinforces the view that industrial policy effectiveness depends critically on the elasticity of substitution across suppliers.

3.4 Elasticity, Adjustment Costs, and Resilience

Figure 2 illustrates the normalized CES import aggregators for five semiconductor-related HS categories under alternative elasticity assumptions ($\sigma = 2$ to $\sigma = 6$). Across all categories, the intertemporal dynamics of effective import availability are largely invariant to the choice of σ, with year-to-year movements substantially exceeding cross-elasticity dispersion. This pattern indicates that aggregate shocks and sourcing dynamics dominate the evolution of effective availability, while reasonable variation in substitution elasticity primarily affects levels rather than trends (Acemoglu *et al*. 2012).

At the same time, varying σ highlights an important distinction emphasized in recent applied research: short-run rigidity versus medium-run adaptability. For lower elasticity values, the CES framework penalizes concentration more strongly, implying larger effective availability losses when suppliers face policy or market disruptions. As σ increases, these losses are attenuated, reflecting greater assumed flexibility in reallocating sourcing across countries. Empirically, however, the attenuation effect is modest for most categories, suggesting that substitution margins are not strongly binding during the sample period.

This limited σ sensitivity is particularly evident for HS 2804 (rare gases), HS 2850 (specialty chemicals), and HS 3818 (doped wafers and substrates), where import sourcing is relatively diversified and production technologies exhibit overlapping capabilities across suppliers. In these categories, changes in σ rescale the aggregator without materially altering its trajectory, indicating that effective availability responds primarily to aggregate demand and supply shocks rather than to elasticity-driven substitution constraints.

By contrast, categories characterized by higher technological specificity—such as photoresists (HS 3824) and semiconductor manufacturing equipment (HS 8486)—display slightly greater dispersion across σ values, though still small relative to intertemporal variation. This asymmetry suggests that while substitution elasticity matters more for technologically complex inputs, the observed shocks during the study period did not generate extreme divergence across elasticity assumptions.

The assumption of a common substitution elasticity within each HS category is a structural simplification imposed by the CES framework. In practice, substitution margins likely differ across technologies and suppliers, particularly for highly specialized inputs such as advanced lithography equipment or EUV-compatible photoresists. The elasticity sensitivity analysis should therefore be interpreted as reflecting average substitution capacity at the category level rather than product-specific flexibility. Future research using more disaggregated or firm-level data could estimate differentiated elasticities to better capture technological heterogeneity and asymmetric adjustment responses.

At the aggregate level, the effective availability index remains above its 2020 baseline by the end of the sample period. However, this outcome masks substantial compositional adjustment. Gains in resilience are achieved not through insulation from shocks, but through reallocation across suppliers and input categories, often accompanied by adjustment costs that are not visible in aggregate import volumes alone.

4. Discussion

The results highlight a central tension in contemporary industrial policy: measures designed to enhance long-run resilience often impose short-run access costs that are invisible in standard trade statistics. By distinguishing nominal import volumes from policy-adjusted effective availability, this study clarifies how trade restrictions, export controls,

and allied re-orientation interact with supplier concentration and substitution capacity in strategic supply chains.

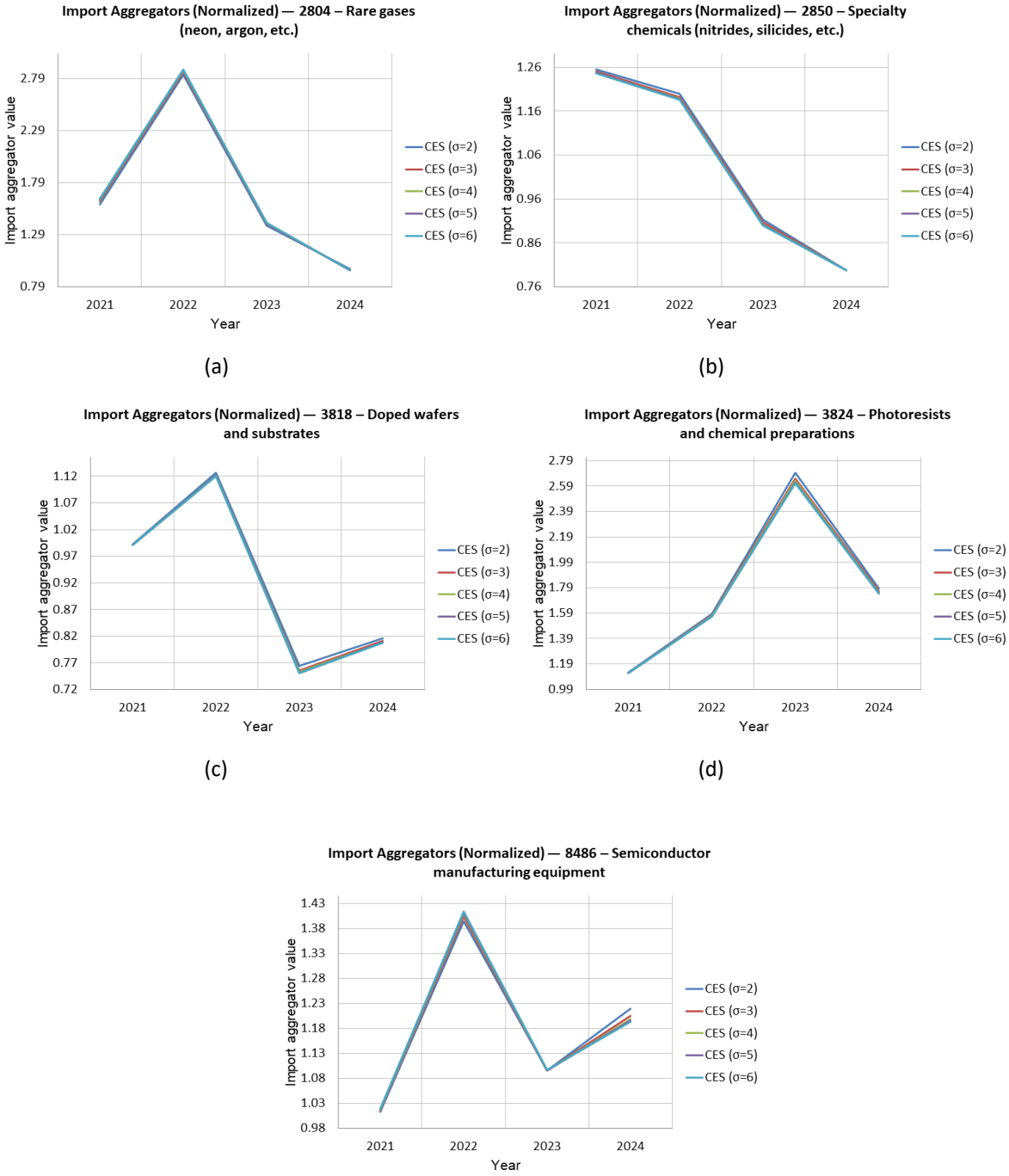


Figure 2. U.S. Semiconductor Import Aggregator (Normalized to 2020). (a)–(e) present time-series plots of export values by destination for individual HS 8542 subcategories. *Source*: Author’ s calculations based on the CES-based import aggregator model described in Section 2.2, using trade data from the UN Comtrade Database.

4.1 Effective Availability versus Nominal Resilience

A key insight from the analysis is that resilience inferred from nominal import recovery can be misleading. Although U.S. semiconductor imports rebounded rapidly after the pandemic, effective availability exhibited substantial volatility following the introduction of export controls and security-driven trade measures. This divergence underscores the importance of measuring usable access rather than physical trade flows alone.

From a policy perspective, this finding helps reconcile two seemingly contradictory narratives in the semiconductor debate. On one hand, aggregate trade data suggest that supply chains remained functional despite geopolitical tensions. On the other hand, firms report heightened uncertainty, licensing risk, and adjustment costs. The effective availability framework shows that both can be true simultaneously: imports continue, but the economic reliability of those imports deteriorates.

4.2 Concentration as a Technological, Not Merely Geographic, Constraint

The persistence of high effective concentration in advanced equipment and photoresists—even after diversification efforts—suggests that vulnerability is rooted less in geographic exposure per se than in technological bottlenecks. For inputs such as lithography equipment and chemically specialized photoresists, the set of viable suppliers is intrinsically limited by intellectual property, tacit knowledge, and cumulative innovation.

This result qualifies policy arguments that emphasize geographic reshoring or partner diversification as universal solutions. For highly specialized inputs, diversification margins are narrow in the short to medium run, and policy-induced restrictions translate more directly into effective availability losses. In contrast, upstream and midstream inputs with more modular production technologies exhibit greater scope for substitution, making them more responsive to allied reallocation strategies.

4.3 Trade Restrictions as Catalysts for Reallocation, Not Autarky

The stabilization of effective availability by 2023–2024 indicates that trade restrictions did not generate sustained shortages but instead accelerated reallocation within trusted trade networks. This pattern aligns with the notion of "friend-shoring," where policy frictions redirect sourcing rather than suppress it outright.

Importantly, this adjustment is uneven across input categories. For inputs with relatively high substitution elasticities, firms respond by shifting sourcing toward allied economies, thereby attenuating access losses. In contrast, where substitution elasticities are low, policy frictions operate more like binding access constraints. This heterogeneity implies that the effectiveness of industrial policy cannot be evaluated at the aggregate level alone, but depends critically on the technological and substitutability characteristics of individual inputs.

4.4 Substitution Elasticity as a Policy Constraint

The weak sensitivity of the CES import aggregator to the substitution elasticity parameter σ reflects structural features of U.S. semiconductor imports during the study period. In CES settings, σ matters primarily when substitution constraints bind—either because sourcing is extremely concentrated or because policy frictions create sharply asymmetric access across suppliers. The results indicate that neither condition is dominant for the HS categories examined.

First, import sourcing is relatively diversified among technologically advanced economies with overlapping capabilities. Even in strategically critical segments such as semiconductor manufacturing equipment and photoresists, no single supplier dominates sufficiently to generate large non-linear penalties under lower elasticity assumptions. As a result, changes in σ mainly rescale the level of effective availability without altering its trajectory.

Second, trade restrictions during the sample period appear to have affected major suppliers in broadly similar ways within each category. When policy frictions are not highly asymmetric, variation in σ has little effect on relative access, further limiting cross-elasticity dispersion.

This robustness strengthens the interpretation of the results: observed declines and recoveries in effective availability reflect genuine changes in trade flows and sourcing patterns rather than sensitivity to parameter choice. At the same time, the findings do not generalize to settings with extreme concentration or highly asymmetric export controls, where effective availability would be expected to depend much more strongly on substitution assumptions.

4.5 Policy Coordination and the Design of Strategic Trade Measures

The results emphasize that effective availability depends more on policy coordination than on import volume targets or concentration thresholds. Restrictions imposed unilaterally or without aligned allied capacity exacerbate short-run access losses, while coordinated measures facilitate smoother reallocation. In this sense, industrial policy operates less as a shield against shocks and more as a mechanism that reshapes the geography and reliability of access over time.

The effective availability framework provides a practical metric for evaluating such trade-offs. By integrating tariffs, export controls, and geopolitical risk into a single access measure, it enables policymakers to assess whether interventions enhance resilience through diversification or merely reallocate risk within a constrained supplier set.

4.6 Broader Implications for Strategic Supply Chains

Although the analysis focuses on semiconductors, the findings generalize to other strategic industries characterized by technological concentration and policy sensitivity, such as advanced batteries, aerospace components, and critical

minerals. In these sectors, resilience hinges less on reducing trade exposure and more on expanding the feasible set of suppliers through innovation, coordination, and long-term capacity building.

Overall, the discussion reinforces a central conclusion of the study: industrial policy can stabilize strategic supply access without full reshoring, but only when substitution margins exist and policies are coordinated. Effective availability—not nominal trade volume—should therefore be the benchmark for evaluating resilience in an era of fragmented globalization.

This study evaluates the effects of recent trade and industrial policies on U.S. semiconductor supply chains using a policy-adjusted measure of effective availability. The results provide several insights that refine prevailing narratives about decoupling, reshoring, and supply-chain resilience.

5. Limitations

The analysis relies on annual trade data, which may obscure short-run disruptions, inventory buffering, and within-year adjustment dynamics that are particularly relevant in semiconductor supply chains. As a result, some transitory access constraints and rapid reallocation responses may not be fully captured.

The use of annual HS-level trade data may smooth short-lived disruptions arising from licensing delays, regulatory changes, or temporary logistical constraints. Semiconductor supply chains often adjust within months through inventory management and rapid sourcing shifts, dynamics that annual aggregation cannot fully capture. Incorporating higher-frequency trade data in future research would allow for more precise identification of short-run policy effects and adjustment speeds.

The restriction factor is constructed from observable policy and risk proxies and therefore abstracts from firm-level heterogeneity in compliance costs, licensing outcomes, and contractual arrangements. Effective availability may differ across firms even within the same product category, particularly for highly specialized inputs subject to discretionary export controls.

The CES framework assumes a common substitution elasticity across suppliers within each HS category. While sensitivity analysis suggests that the main results are robust to plausible variation in elasticity values, this assumption may mask supplier-specific or technology-specific substitution constraints that matter in narrower segments of the production chain.

Finally, the analysis focuses on the import side of the supply chain and does not explicitly model domestic production expansion, stockpiling behavior, or dynamic investment responses induced by industrial policy. Consequently, the results should be interpreted as short- to medium-run access effects rather than as a full general-equilibrium assessment of semiconductor industrial policy.

6. Conclusion

This study examined how recent U.S. trade and industrial policies have reshaped access to strategic semiconductor inputs by moving beyond nominal trade flows to a policy-adjusted measure of effective availability. Using a CES-based import aggregator calibrated with bilateral trade data and restriction factors, the analysis shows that observed import recovery after the pandemic mask substantial variation in economically usable access driven by export controls, tariffs, and geopolitical risk.

The findings indicate that industrial policy does not operate through simple import compression or reshoring alone. Instead, policy frictions initially reduce effective availability but subsequently induce reallocation toward allied suppliers, stabilizing access where substitution margins exist. At the same time, inputs characterized by high technological specificity remain structurally concentrated, limiting the scope for diversification in the short to medium run (Barrot & Sauvagnat 2016).

More broadly, the results highlight that supply-chain resilience depends less on aggregate import volumes or concentration indices than on substitution capacity and policy coordination across supplier networks. Effective availability provides a practical metric for evaluating these trade-offs, capturing dimensions of access that standard indicators overlook.

Taken together, the evidence suggests that well-coordinated industrial and trade policies can enhance resilience without full disengagement from global supply chains, but their effectiveness is inherently constrained by technological bottlenecks and adjustment costs. Future research incorporating firm-level behavior, higher-frequency data, and dynamic investment responses would further refine the assessment of industrial policy in strategic sectors.

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Authors' contributions

Savannah Yu and Alexander Yu jointly designed the study, developed the analytical framework, and conducted the data collection and empirical analysis. Both authors contributed to the interpretation of results, discussion, and revision of the manuscript. The manuscript was jointly drafted and revised by the authors. All authors read and approved the final manuscript. The authors contributed equally to this study.

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Data sharing statement

No additional data are available.

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Appendix A

This appendix reports the estimated restriction-adjusted trade weights used in the construction of the effective availability index. The Table 2 presents CES weights and corresponding import shares by HS group and partner economy over the 2020–2024 period.

Table 2. Estimated Restriction-Adjusted Trade Weights by HS Category and Partner Economy, 2020–2024
Source: Author's calculations based on UN Comtrade

HS_Category	Country	Wt.	Share (%)	Wt.	Share (%)	Wt.	Share (%)	Wt.	Share (%)	Wt.	Share (%)
2804	JPN	0.18	18.48	0.19	18.67	0.07	6.91	0.13	12.70	0.14	13.85
	NLD	0.01	1.05	0.01	0.67	0.01	0.97	0.00	0.26	0.00	0.23
	SGP	0.00	0.15	0.00	0.23	0.00	0.05	0.01	1.17	0.00	0.13
	CHN	0.19	18.61	0.18	17.73	0.22	21.98	0.38	38.20	0.22	22.03
	KOR	0.01	1.11	0.01	0.99	0.03	2.86	0.06	5.78	0.11	10.62
	MYS	0.22	21.68	0.03	2.98	0.23	23.00	0.03	2.59	0.24	24.23
	S19	0.39	38.91	0.59	58.73	0.44	44.24	0.39	39.29	0.29	28.91
2850	JPN	0.31	30.99	0.33	32.53	0.34	34.49	0.44	43.57	0.39	38.93
	NLD	0.01	1.04	0.00	0.04	0.00	0.00	0.00	0.26	0.52	52.00
	CHN	0.66	65.68	0.65	65.04	0.63	63.07	0.53	52.86	0.04	3.99
	KOR	0.02	2.06	0.02	1.92	0.02	2.11	0.02	1.99	0.00	0.45
	S19	0.00	0.23	0.00	0.46	0.00	0.32	0.01	1.32	0.05	4.63
3818	JPN	0.61	60.70	0.57	56.83	0.54	53.52	0.48	48.38	0.50	50.42
	NLD	0.00	0.05	0.00	0.14	0.00	0.32	0.00	0.36	0.00	0.33
	SGP	0.02	2.05	0.02	1.88	0.02	2.06	0.02	2.12	0.04	3.64
	CHN	0.04	3.98	0.09	8.81	0.12	12.17	0.16	15.82	0.11	11.33
	KOR	0.13	13.12	0.13	12.85	0.12	12.15	0.17	16.77	0.15	14.97
	MYS	0.04	3.90	0.03	3.36	0.04	3.55	0.04	3.74	0.03	2.89
	S19	0.16	16.19	0.16	16.14	0.16	16.24	0.13	12.81	0.16	16.41
3824	JPN	0.28	28.35	0.54	53.87	0.50	49.51	0.41	41.28	0.48	47.58
	NLD	0.04	3.72	0.05	4.92	0.03	3.42	0.02	2.01	0.03	2.81
	SGP	0.02	2.14	0.02	2.28	0.02	1.83	0.01	1.02	0.02	1.56
	CHN	0.55	55.27	0.33	33.01	0.13	12.57	0.06	5.51	0.07	6.69
	KOR	0.08	8.14	0.04	3.52	0.31	30.61	0.49	49.23	0.40	39.95
	MYS	0.01	1.48	0.01	1.45	0.01	1.42	0.01	0.57	0.01	0.55
	S19	0.01	0.89	0.01	0.95	0.01	0.63	0.00	0.37	0.01	0.86
8486	JPN	0.44	44.23	0.44	43.99	0.46	46.31	0.41	40.98	0.35	35.20
	NLD	0.24	23.62	0.16	16.42	0.12	11.68	0.10	10.31	0.13	13.00
	SGP	0.11	11.23	0.14	13.52	0.16	16.36	0.19	18.81	0.19	18.95
	CHN	0.08	8.40	0.09	9.12	0.08	7.58	0.08	7.72	0.08	8.35
	KOR	0.05	5.41	0.07	7.13	0.07	7.12	0.07	7.25	0.10	9.53
	MYS	0.05	4.53	0.06	6.18	0.08	7.80	0.09	8.64	0.10	9.91
	S19	0.03	2.58	0.04	3.65	0.03	3.17	0.06	6.28	0.05	5.06