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Emerging Technologies and Global Power Dynamics: Assessing the Geopolitical Implications of Artificial Intelligence and Semiconductor Supply Chains in US-China Competition

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ABSTRACT

The semiconductor supply chains and artificial intelligence increasingly influence the allocation of economic and strategic power. This paper will look at the effects of their interaction on competition between the United States and China. A qualitative comparative case study uses a combination of documentary analysis, systematic comparisons, and tracing of the processes of the selected policy developments between 2018 and 2025. There are similar observations in descriptive statistics up to 2024 with a historical window of 2014-2023 on patents. The analysis differentiates between technological ability, reliance on supply, and governmental control of access. The global semiconductor sales went up to US\$627.6 billion in 2024, but with significant downturns and upswings. American strengths in reported investment in private artificial intelligence and significant model production are matched with the Chinese prowess in the number of artificial intelligence patents. As it is evidenced through corporations, high manufacturing capacity and equipment continue to be internationally dispersed. The results can be interpreted to suggest the existence of selective technology fragmentation but not the total separation. The impact of export restrictions is that cost of acquiring important capabilities may be raised, although they spur substitution, organisational adaptation, and alternative systems of infrastructure. Geo political power thus is rested on a joint management of complementary resources, believable alliances as well as enduring domestic innovation. The paper concludes that diversified supply networks and effective international collaboration should be complemented with specific security protection measures.

INTRODUCTION

Artificial intelligence is currently used as a key element of modern strategic competition. It is crucial not only to the commercial success of each application. The productive power, discovery in science, administrative ability, and defence organisations can be influenced by systems that can analyse information, create content, and help in making complex decisions (Yi Zhu, 2025). They are developed based on physical and organisational infrastructure. Innovative processors, memory, production machinery, power, research skills and finance link seemingly digital abilities to material production systems. As a result, the geopolitical value of artificial intelligence cannot be interpreted outside of the context of semiconductor industries that it is supported by.

The United States and China exemplify this relationship especially well in terms of competition. The two nations are after a big share of the technological development and its economic gains. They however have different positions throughout the technological system. A nation can have good research organisations but foreign production (Liao, 2025). It can sustain large scale production with reliance on external equipment/software. The differences open up areas of influence and vulnerabilities. The strategic power comes in due to the capacity to assemble the complementary capabilities, and maintain access to those capabilities in the face of political pressure.

The consequent competition poses a basic question on globalisation. Specialisation among countries has

promoted efficiency, learning of technology and allocating production among jurisdictions (Yu, 2025). The security issues are becoming more and more driving governments to review such arrangements. Reliance on an overseas supplier may seem commercially acceptable at normal times and be strategic unacceptability when faced with a crisis. But relocation of production does not necessarily eliminate reliance. New plants are going to need skilled labor, equipment maintenance, materials, patrons, and already formed suppliers. Technological sovereignty is thus a variable then a mere issue and not a mere state of domestic possession.

An empirical context of importance is offered by semiconductor market. Worldwide sales were US\$468.8 billion in 2018 and US\$627.6 billion in 2024. The growth signifies a growing business base on technological competition. It does not demonstrate that all segments were growing steadily, or that geopolitical policies lead to the growth. The change in annual fluctuation is an indication of various factors such as product cycles, and shifting demand (Gerlich, 2024). A sound geopolitical evaluation should be able to differentiate the market size and strategic capability and distinguish between perceived development and the explanations that demand more solid evidence.

There are also many dimensions in AI competition, which are not necessarily moving in the same direction. Other activities are described as investment, development

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of models, patents, manufacturing skills and adoption (Bu, 2024). The superiority is not established by the national excellence in a single indicator. Patent counts are a measure of documented creative effort based on specific guidelines of classification. Investment amounts are reports of an investment that is taken by reporting. The number of notable models reflects output of selected research, not all of the functioning systems. The combination of such indicators will give a more informative evaluation compared to the measure of countries by one indicator (He & Ji, 2023).

This paper deals with how these unequal abilities interrelate with the politics of access to technology. The first aim of it is to determine the technological and industrial standing of the United States and China with the help of well-defined indicators (Ignatov, 2024). The second goal of it is to investigate the influence of semiconductor restrictions and industrial policies associated with the changes in the conditions of technological competition. The third purpose of it is to find out what these developments may mean to the world supply networks, partner economies and strategic stability (Ryu, 2025). These goals still have a similar emphasis on various mechanisms by which technology becomes geopolitical power.

The analysis is based on two research questions. What is the role of differentiated abilities in semiconductor supply chain and artificial intelligence on competition in US China? What role does government restrictions, domestically-based investment programmes and industrial adaptation play in technological interdependence and world power relations? Questions are related to the organisation and direction of competition. They do not suppose that the result of technology is or can be set by export restrictions or that national competition can be brought down to a two-party contest with a winner and a loser.

The period of analysis is on selected developments between 2018 and 2025. The main reason why quantitative comparisons stop in 2024 is that the datasets chosen have a common year of observations. The evidence of patents on 2014-2023 is patented historically on its own. This structure allows one to explore the changes of recent policies and does not result in the mixture of half-year data and the data that has been completed (Braun, 2025). The paper builds a conceptual explanation, procedures involved, empirical findings and implications of the findings on policy and future research.

Conceptual Foundations and Analytical Framework Technology as an organised source of power

Technology also adds to power whereby institutions have the ability to transform technical knowledge into trustworthy capabilities. Only research findings cannot give a prolonged strategic gain. Organisations have to fund development, develop infrastructure, system integration, and sustain performance (Mahmud, 2026). The activities are reliant on arrangements that spread the accountability of government agencies, firms, universities,

and infrastructure providers. A technology system is the unit of analysis of analysis and not an invention in isolation (Bartesaghi & Melgar, 2025). Its functionality can be said to embody the quality of individual elements as well as how well they are coordinated with each other. In the case of artificial intelligence, conversion involves having access to computing resources and the ability to productively utilize it. Having processors that lack appropriate software, data control or organisation knowledge can yield minimal benefits (Ryan & Burman, 2025). On the other hand, good software development might be limited by costly or random access to hardware. The complementarity is significant as one cannot lower returns on investment in other components due to weaknesses in a component (Shahrukh, 2025). The geopolitical analysis has to take into account the ability of the countries to gather the required resources at an acceptable price and maintain their consumption in the future.

Power also relates to possibilities to influence the options of other actors (Babaoğlu & Sevinc, 2025). The suppliers of challenging substitutes can determine conditions of access, and terms of a contract, when production will take place. This influence can be strengthened by governments by the use of licensing, public procurement, and limitation of transactions. This kind of influence is conditional. Customers can re-architecture systems, find other suppliers or tolerate poor performance (Park, 2023). The strategic merit of a technological posture relies in part on the speed with which these reactions are achievable, as well as the extra expense that they might cause.

Technology leadership and the geopolitical leadership are thus allied yet different. A firm can be monopolies to control a specialised market without providing the home government direct control over customers (Gawi & Abdullahi, 2024). It can be produced in multiple legal jurisdictions in its production network. Business interests can as well be incompatible with national security goals. These institutional limits have to be reflected in a comprehensive explanation (Warren & Bartley, 2023). It has to understand as well that competing governments can take advantage of various areas of the same network, which needs to make each other vulnerable, and not dependent on each other unidirectionally.

Interdependence and technological chokepoints

Interdependence is a type of relationship where the actors enjoy the advantage of access to each other and incur expenses of disruption. These relationships are (in semiconductor production) design, fabrication, equipment, materials, memory, packaging and testing (Dr. Saira Akram *et al.*, 2025). A chokepoint is an area in which a limited ability is hard to substitute within the time frame in question. Accumulated expertise, specialisation intellectual property, complexity in production or even limited number of qualified suppliers can cause the scarcity (Zhao, 2026). Its significance cannot be

determined just on the basis of sales revenue.

The level of dependence also depends on the technological generation and the use in the end. Processors that are intended to handle heavy AI loads are different than chips implemented in standard industrial applications (Yin, 2025). Limitations towards more advanced capabilities should not thus require the elimination of trade in other products. These differences would be obscured by considering all semiconductors as being interchangeable. It would also hide the strategic significance of aspects that may not gain as much attention as publicity such as memory and packaging (Mousavizadeh, 2023). A precise framework studies functions of components in a system as opposed to just one technological label.

A chokepoint has the capability to create leverage as well as establishing incentives on its erosion. Customers might be inclined to use the known suppliers when it seems safe to get access (Nuga, 2020). Customers will be willing to pay more to be less dependent when there is a possibility of not being able to access it in the future. The first use of control can then alter the economic environment which maintains the advantage of the supplier (Withdraw, 2025). This positive feedback is not a guarantee of successful substitution. It provides a justification to investigate the influence of short-term restrictive impacts and later industrial adjustment.

Industrial policy and security competition

Industrial policy affects technological competition by altering the allocation of the investment risks and returns. Projects that are uncertain of future demand or even costs of infrastructures can be sustainable by the backing of the population (Yi Zhu, 2025). It may also enhance research facilities and development of workforce. These are different to restrictions that inhibit access of technology by competitors. An industrial strategy can have both methods jointly but the impacts ought to be evaluated individually. Creation of capacity and access denial are implemented on the basis of various mechanisms and could involve a variety of time horizons.

Security competition brings about further uncertainty about commercial decisions (He & Ji, 2023). Companies should take into account the possibility of a product, a client or a site of production being restricted in the future. Uncertainty in the regulatory environment may also affect investment prior to an official ban. Firms can re-design products, differentiate customers or postpone obligations (Liao, 2025). These reactions are possible to influence the market structure even in the case of direct trade. Policy has a geopolitical significance thus comprising expectations and planning behaviour but such effects cannot be seen through announcement of a rule.

Strategic adaptation and selective fragmentation

Strategic adaptation comprises adaptations that are meant to maintain the ability in the face of new limitation. The firms can enhance the efficiency in software, alter product architecture, create substitutes or restructure transactions (Yu, 2025). Governments can finance local sources or enhance cooperation. The actions may be carried out concurrently and may have varying results in the sectors. There are limitations which can significantly slow down access. They can have others redirecting activity, without terminating it. The analytical exercise is to determine the adjustment mechanism which is relevant and assess what the available evidence can determine regarding the functioning of the adjustment (Gerlich, 2024).

There is selective fragmentation whereby politically-sensitive operations are more heavily separated as compared to other relationships, which are still business-bound. It has the ability to generate various guidelines to advanced processors, traditional chips, cloud services and research collaboration (Ryu, 2025). Fragmentation can also be based on standards, contract requirements, or on infrastructure ecosystems as opposed to just physical trade barriers. This notion does not presuppose global integration that is not limited and the global technological differentiation (Braun, 2025). It takes in overlapping networks whereby political boundaries gain significance and still exchange international occurs.

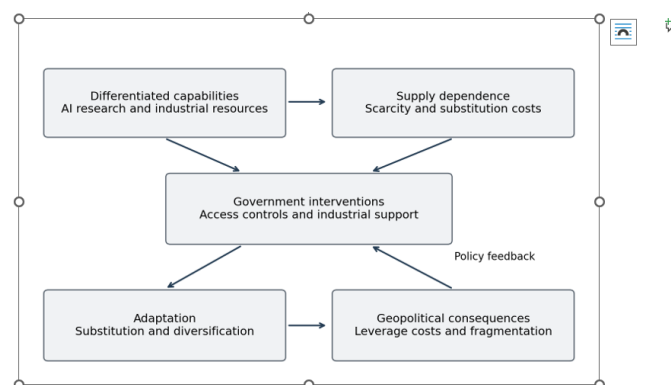


Figure 1: Analytical framework linking capabilities policy and geopolitical outcomes

Figure 1 represents the framework of analysis. Differentiated capabilities form patterns of dependence. The interventions of the government affect access and incentives to investments. The adaptation of some firms

and partner economies subsequently occurs by either substitution, diversification, or further exchange (He & Ji, 2023). The reactions of these responses influence the allocation of costs and opportunities and feed into

future policy. The model is a descriptive framework as opposed to a statistical test model. Its arrows indicate hypothesized relationships the plausibility of which is tested by comparison and in the context of policy sequences (Ignatov, 2024).

The assessment is organised into three analytical propositions. Even the globally dispersed production can give geopolitical power through the control of scarce complementary inputs. The restrictions will generate more long-term effects when substitutes are expensive and implementation by the partners is aligned (Ryu, 2025). The continually shaky security of access adds impetus to competing technological ecosystems, though their development is limited by the capabilities and commercial circumstances (Braun, 2025). These propositions define the ways things are supposed to work but are silent about the so-called universal effects and also do not transform documentary findings into statistically-tested hypotheses.

MATERIALS AND METHODS

Research design and case selection

The research is based on a qualitative comparative case study with descriptive quantitative supplement. The United States and China are chosen due to their technological aspirations, their industrial capabilities, and the interactions in their policies that lend them an appropriate context to analyse the competition in AI and semiconductors (Sahithi, 2021). The comparison is structured in terms of shared dimensions of analysis, as opposed to national histories. The AI capability, position in the supply chain, policy instruments, adaptation incentives, and external partner consequences are these dimensions. This framework facilitates analysis of disparities, but maintains the interdependence between the two situations.

The research takes into consideration three analytical processes. Documentary analysis determines what is reported by the chosen policies and industrial disclosures. Structured comparison analyses indicators that are defined and observed over a time period explicitly. Process tracing is an assessment of particular sequences linking policy alteration to changed circumstances of access (Mellenbergh *et al.*, 2003). The processes are complementary to each other. Scale and variation are described in statistical tables and explained in qualitative analysis at the possible mechanisms. The evidence base does not include any interviews, surveys, experiments, and secret company documents.

Evidence selection and temporal boundaries

The choice of evidence involved institutional publications and official policy statements as well as corporate disclosures available publicly. The main quantitative sources were releases of SIA semiconductor, the 2025 AI Index, and the generative AI patent space of WIPO, as well as 2024 corporate reporting. Formal American and Chinese use policies provided information regarding constraints and claimed intentions. The mapping of the

semiconductor value chain was used to derive stages of production and its dependencies (Mimansha Patel & Nitin Patel, 2019). These materials were included provided there was a way to determine their reporting organisation, or period of observation, or unit, and definition, as well. The period of policy window is 2018-2025, yet the research focuses on some of the selections as opposed to asserting a complete list. The common quantitative goal is 2024. Its 2014-2023 accumulation period is used to compare the patents, and is not given as a 2024 count. The reports published at the end of an observation year are differentiated with the activity they report. This difference allows the correct identification of publication dates being confused with measurement dates and allows a uniform interpretation of annual observations being made.

Original releases and corporate reports were given priority. No secondary summaries were applied to a primary numerical statement that was available. The number that was revised was used consistently in computations, where a previous figure was revised. This was of particular concern when it came to the historical sales series. The 2019 total chosen is US 412.3 billion and the updated 2020 total is US 440.4 billion. The series does not thus confound initial and re-formulated values.

Indicator construction and comparability

Indicators were used to maintain the indicators in their units. The market sales of semiconductors are in current US dollars. The reporting framework of American and Chinese private AI investment is similar in that it is reported in US dollars. Reporting currency is the corporate sales of each firm. Counts, such as patent families and distinguished models, and percentages, such as technology revenue shares (Chen, 2023). The measures are not pooled into a unified national power score as they are various activities, and they do not have a justifiable common weighting scheme.

To compute the sales growth, the difference between the current year sales and the sales made last year was figured out, which was then divided by the sales made last year and then multiplied by a hundred. The 2018 and 2024 endpoints were used to find the compound annual growth of six intervals. Bilateral ratios are used to split the observation of one country into that of the other country. Revenue shares are in percentage point changes (Earley, 2023). The tables and descriptions retain underlying values until the last rounding to prevent any unnecessary discrepancies between tables.

The analysis identifies commercial indicators and technical capacity. Sales are not wafering production all over the world. Corporate production is not national production. Patent families are not quality patents, granted patent numbers or applications that have been completed. The portion of the wafer revenue of a company in the processes of advanced technology is not its portion in world production (Moura & Neves, 2025). All these differences are used during the interpretation. They are

needed since a number of such widely used technology indicators are prone to be inaccurate when the original denominator or classification is not included.

Documentary analysis and process tracing

In documentary evaluation, there was a structured reading framework that included the purpose of policy, the stage of technology that was impacted, the mechanism of access, and probable response to adjustment. Observed outcomes were differentiated to statements of purpose. As an example, a formal announcement about how restrictions are safeguarding national security establishes the rationale of the government (Emon, 2024). It does not in and of itself determine the size of a military effect. Corporate disclosures had also been seen as what was observed in a specific firm reporting domain instead of an overall picture of the industry in the world.

Process tracing was concerned with the shift of constraints to specific organisations to controls over more general technological capabilities and supplementary inputs. This analysis has looked at the 2019 Huawei action, the 2020 extension to include some foreign produced items, the 2022 advanced computing package, further revisions, and some 2025 developments. The Chinese restricting gallium and germanium related products provided a comparison at a lower supply chain level. The sequence facilitates analysis of policy change, but it lacks isolating the cause of each measure.

When explaining trends, alternative explanations were put into consideration. The sales of semiconductors are subject to changes due to demand cycles, prices, inventories and product composition. The capital market conditions and the disparity of disclosure may be reflected in AI investment (Kiyala, 2019). The Model counts are based on selection criteria. In this regard, parallelism between the policy and market indicators was not regarded as evidence on causation. The analysis instead determined whether documentary evidence, and observed structures were in line with the postulated

mechanisms, and concluded on finding, which could not be supported by the material available.

Research quality and ethical considerations

Quality of research is based on transparent measurement, disillusionment between evidence and interpretation, and a uniformity of handling cases. The calculated values were compared with the reported values of numbers. Comparisons are made based on the similar units they can have and justify the differences that exist (Kiyala, 2019). Evidence complicating its argument, such as unabated commercial exposure despite restriction and the difference between inventive activity and frontier model output, are considered in the analysis. These steps minimize the chances of picking exclusively those indicators that would support a predecided national ranking.

The research utilises information of the public institutions and corporations and requires no human subjects. Its major ethical issue is the correct representation. There is no respondent data, fabricated observations, and created statistical tests. There is no significance level to descriptive ratios. Scenarios are defined as analytical possibilities that are conditional and not a forecast. The constraints of the public reporting, disparate coverage of the indicators and lack of a causal identification approach characterize the extent of the conclusions.

RESULTS AND DISCUSSION

Semiconductor market scale and fluctuation

Table 1 gives the global semiconductor sales forecasts 2018-2024. It applies annual reporting in industry with the updated values in the methodology. The rates of growth are computed based on the reported sales. The table defines the market landscape on which the US China competition has evolved (Yi Zhu, 2025). It does not quantify the origin of production by the country or the worth of trade between the two nations.

Table 1: Global semiconductor sales and annual growth 2018–2024

Year	Sales US\$ bn	Annual growth %
2018	468.8	—
2019	412.3	-12.05
2020	440.4	6.82
2021	555.9	26.23
2022	574.1	3.27
2023	526.8	-8.24
2024	627.6	19.13

Note: Current US dollars. Growth is calculated from displayed revised annual values. The first observation has no preceding year within the study series.

The increment in global sales between the endpoints was US 158.8 billion, which relates to 33.87 percent. The annual rate of growth was about 4.98 per cent. Nonetheless, two contractions, in 2019 and 2023, and two robust expansions, in 2021 and 2024, exist. Such

imbalanced trend is constraining the interpretations of a continuous upward trend of strategic attention and consecutive commercial growth. The industry in which political competition was taking place still had a significant range of variation in annual income.

The industrial planning is dependent on the market pattern. Long term investors need to evaluate the future demand and the governments seek capacity goals that can be relatively constant throughout the cycle. These incentives may be avaricious (Liao, 2025). A weak near-term demand may make a firm attractive by a government when it produces something new due to security reasons. In turn, investment in areas that are not aligned with the priorities of the population may be increased more rapidly due to a commercial recovery. The aggregates series determine the relevance of these tensions but do

not measure their incidence.

The same observations can be verified as a trend chart (see figure 2). The visual exposes the gap between phases of growth and offers a counter to a mere story of unremitting growth. The maximum point in the chosen series is the year 2024. However, the chart does not reflect an inflation included output, but the current dollar revenue, technical performance or an accumulated manufacturing ability. It is descriptive and contextual in its role.

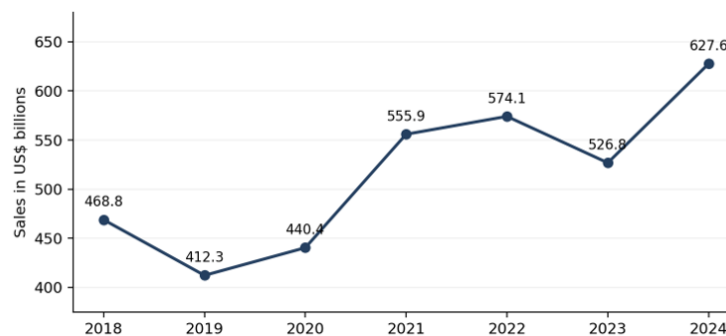


Figure 2 : Global semiconductor sales trend 2018–2024

Regional variation in the 2024 recovery

Table 2 is a comparison of the reported annual sales growth on the regional categories in the industry in 2024. The groupings are based on the original reporting structure and not to be taken as the headquarters base

of semiconductor companies (Yu, 2025). They testify of the geographical difference in market recovery. This comparison can be seen as an extension of the global totals in that the expansion was not uniform as would have been seen across reporting regions.

Table 2 : Regional semiconductor sales growth in 2024

Reporting region	Annual sales growth %
Americas	44.8
China	18.3
Asia Pacific and all others	12.5
Japan	−0.4
Europe	−8.1

Note: Reporting regions describe the sales framework, not corporate nationality or fabrication capacity.

The strongest reported growth was registered in the Americas at 44.8 percent followed by a 18.3 percent in China. All other markets such as Asia Pacific grew as well. Japan and Europe registered a decline. These disparities prove the fact that increasing total in the world may exist with opposite regional results. They fail to prove that one area was displacing another in the ability to produce fabrics (Mahmud, 2026). The regional sales movements can indicate the demand composition and commercial conditions and changes in relationships of production. The further expansion that has been realized in China makes it difficult to make a blanket argument that there are limits that have been taken away to channel its involvement in semiconductor markets. Aggregate sales involve products that have varying technological features and regulatory treatment. More sophisticated

operations can be limited as the rest of the transactions proceed. Observation hence is able to match selective fragmentation. It cannot say that restrictions were working against one particular controlled capability, as the regional total does not isolate that capability or give an unrestricted counterfactual.

AI capability indicators in comparative perspective

Table 3 shows two similar AI indicators in the year 2024. The characteristics of the research and development environment are reported by the number of models and the number of private investments. The values are based on a common reporting framework in each comparison. Their ratios are determined descriptively and not a general index of geopolitical power.

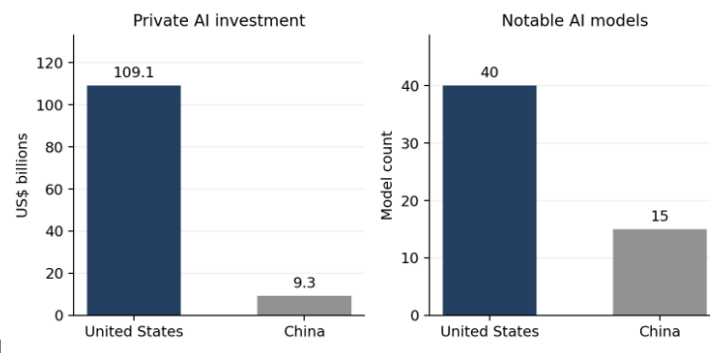
Table 3 : Comparative AI indicators for the United States and China in 2024

Indicator	United States	China	US China ratio
Private AI investment US\$ bn	109.1	9.3	11.73
Notable AI models count	40	15	2.67

Note: Both indicators refer to 2024. Ratios are descriptive. Private investment does not represent total national AI expenditure.

The difference in investment was stated as US.998 billion with a ratio of American/Chinese of about 11.73. The model count ratio was estimated to be 2.67. It is analytically important that there is a gap between these ratios. The proportional relationship does not exist with financing and preferred research. The observations are not comparable project level inputs and outputs and hence cannot determine comparative efficiency. Instead, they show why investment totals cannot be considered as directly reflecting technical achievement.

In view of the fact that each indicator is represented by different units, the indicators are presented in different panels in Figure 3. The application of separate scales does not visualize the comparatively worthless billions of dollars with the number of models. It also clarifies the American advantage varies in both of the measures. The number is the comparison of activity recorded under the chosen reporting framework, not the evaluation of all models, all sources of funding, or all AI applications in the two countries.



The strategic interpretation involves taking care of conversion mechanisms. The increased financing capacities can be used to fund infrastructure, hire researchers and to absorb expensive failure in development. These advantages are basing on distribution and organisational ability. Some non-random model outputs reflect research activity but fail to reflect the entire diffusion of capabilities across firms and government bodies (Braun, 2025). National advantage thus hinges on the ability of resources to be translatable into stable systems and general productive application, which is not directly captured within these aggregate indicators.

Generative AI inventive activity

Table 4 shows the focused published generative AI patent families by inventor location in years 2014–2023. Compared to the 2024 indicators, the historical accumulation window is specifically retained. The table explains the innovative action recorded in the patent arena. It does not categorize all of its inventions as successful in the marketplace, nor does it use the numbers as a direct comparison of the performance of the models. China had 38,210 patent families relative to 6,276 in the United States, which had a ratio of 6.09. The trend of this comparison is opposite to investment and model

Table 4: Generative AI patent families by inventor location 2014–2023

Inventor location	Published patent families
China	38,210
United States	6,276
Republic of Korea	4,155
Japan	3,409
India	1,350

Note: Cumulative generative AI patent families for 2014–2023, classified by inventor location. Counts are not quality or performance measures.

indicators. This comparison confirms the conclusion that competition in technologies is multidimensional. There can be a large use of patent activity and other types of

recorded output may have various relative positions. The evidence in the evidence base is not suitable to solely indicate comprehensive technological superiority.

Corporate evidence and supply chain dependence

Table 5 combines some of the 2024 corporate indicators that are pertinent in the case of advanced fabrication and equipment provision. The observations have different units and organisational boundaries (Mahmud, 2026). They are shown side-by-side to demonstrate complementary statuses as opposed to establishing a

composite financial ranking. Revenue shares maintain original denominators and monetary values maintain reporting currencies.

In 2024, TSMC recorded consolidated revenue of US\$90.08 billion compared to US\$69.30 billion in 2023. It had 69 percent process 7 nanometre and below versus 58 percent of its wafer revenue. The eleven-percentage

Table 5: Selected corporate indicators of semiconductor interdependence

Firm and indicator	2024 value	Measurement boundary
TSMC consolidated revenue	US\$90.08 bn	Company revenue
TSMC advanced process share	69%	Wafer revenue from 7 nm and smaller processes
TSMC 3 nm process share	18%	Share of wafer revenue
TSMC 5 nm process share	34%	Share of wafer revenue
TSMC 7 nm process share	17%	Share of wafer revenue
ASML total net sales	€28.3 bn	Company sales rounded
ASML Chinese customer share	36.1%	Share of total net sales

Note: Monetary values retain reporting currencies. Process revenue shares are not shares of global capacity. ASML customer location does not identify equipment generation.

point change indicates that the firm has changed its revenue structure. It is geopolitically important because the commercial value of fabrication know-how is concentrated in a firm, crusted in global relations, as opposed to a supposedly global market share.

ASML has reported a total net sale of about 28.3 billion and Chinese customers constitute 36.1 percent of total net sales. This is reflected in the combination having high commercial exposure in an equipment supplier that is a business under politically sensitive environment (Bartesaghi & Melgar, 2025). This does not imply that all sales were of the most sophisticated equipment and were free. The observation shows rather how strained

inventory can co-exist in the same commercial network with strategic limitations and still be part of the same corporate network.

These business signals prove that competition between US and China is not only limited to the space of the two leading states. Equipment capabilities and fabrication capabilities in other locations are applicable to both. Policy power is thus based on the connection with the external jurisdictions and companies (Ryan & Burman, 2025). The capabilities distributed across the boundaries can enhance the access controls of a coalition, yet the introduction of coordination issues. Home governments should reflect on the national work force, business profits,

Table 6: Selected technology policy developments 2019–2025

Date or period	Selected measure	Principal focus
May 2019	Huawei Entity List action	Specified entities and licensing
May 2020	Huawei related foreign direct product restriction	Certain foreign produced items linked to US technology
August 2022	CHIPS and Science Act	Domestic industrial support
October 2022	Advanced computing control package	Specified chips manufacturing and related support
July–August 2023	Chinese gallium and germanium controls	Specified upstream material items
October 2023	US control revisions	Advanced computing and manufacturing items
December 2024	US complementary input controls	Equipment software and high bandwidth memory
January 2025	AI Diffusion framework	Proposed global access governance
May 2025	Rescission announcement and non enforcement instruction	Change to AI Diffusion framework approach

Note: Selected announcement periods are shown. The May 2025 entry records the announced rescission and non enforcement instruction; it does not imply removal of earlier China related controls.

legal jurisdiction, and security pledges and make choices on their reaction.

Evolution of policy instruments

Table 6 presents an overview of some policy developments in the analytical window. It documents the time and key technological emphasis of every measure. The entries establish a process tracing sequence as opposed to a comprehensive regulatory catalogue (Ryan & Burman, 2025). Where necessary, later compliance or implementation arrangements are differentiated by their publication or announcement dates.

American order shifted the action, which centered around Huawei in 2019, to be more wide-ranging, including advanced computing and production capabilities. The 2020 development took note of some of the foreign produced items that are associated with American technology. The package of October 2022 was aimed at access to specific advanced chips and manufacturing operations. The amendments that followed prove that the regulatory framework had to be modified as the products, transactions and enforcement issues changed.

The December 2024 package expanded focus on complementary inputs, such as high bandwidth memory, manufacturing equipment, and the appropriate software. This addition is consistent with the school of thought that when capability lies on a broader system restricting one element can be inadequate (Bartesaghi & Melgar, 2025). It does not prove that all the impacted transactions were stopped and the consequences of the technical effect were homogenous. Those conclusions would involve extensive evidence regarding the implementation, substitution, inventories and operation of specific firms. In July 2023 Chinese controls were announced and enforced in August which covered gallium and germanium related items. These materials take up another component of the technological circuit, compared to the sophisticated

AI processors. Their incorporation demonstrates that policy competition may both incorporate upstream inputs and finished products. The actions are not to be viewed as a decrease in all semiconductor material or as a sign that the availability of the material is the sole factor of successful AI development.

Chosen 2025 developments indicate further uncertainty in the development of regulations. In January, the American AI Diffusion framework was announced, and the government rescinded it and ordered officials to not implement it in May. The instability of one of the suggested approaches to global access governance is the relevant finding (Ryan & Burman, 2025). This episode cannot be confounded with the lifting of all previous China related controls. It shows how crucial differentiation between individual instruments is in a shifting policy setting.

Industrial policy and mechanism synthesis

A clear example of industrial support is the way the American CHIP system works. The Department of Commerce programme allocation includes US\$139 billion on manufacturing incentive and US\$11 billion research and development. These figures are programme resources, not confirmed expended funds or operational output. They determine the magnitude and fragmentation of a policy determination that aims to enhance domestic capacities. This difference is preserved in the analysis when the correlation between the industrial support and strategic resilience is considered.

Table 7 of the mechanism synthesis relates the evidence with the analytical framework. It determines the influence that specific instruments can have on incentives and what circumstances restrict the conclusion. This table, in contrast to the previous numerical tables, includes qualitative interpretations. It is not an index of calibrated policy impacts. It aims to render the explanatory argument

Table 7: Interpretation of geopolitical mechanisms and their limits

Instrument or condition	Plausible mechanism	Limit on interpretation
Access restrictions	Higher acquisition costs or delayed access	Effect depends on implementation and alternatives
Industrial incentives	Lower investment risk and domestic capacity building	Programme resources are not completed production
Material controls	Upstream supply leverage	Customers may develop alternative sources
Supplier diversification	Reduced exposure to one source	Upstream concentration may persist
International coordination	More consistent access governance	Partners face different costs and legal constraints

Note: Analytical synthesis of mechanisms, not estimated treatment effects or statistically tested relationships.

transparent and allow making comparisons between the various types of intervention.

The synthesis suggests that access controls, industrial incentives and supply diversification affect various aspects of competition. Controls operation on availability

and transaction conditioning. The incentives influence feasibility of investments and the placement of capacity. Diversification transforms vulnerability to disturbance (Shahrukh, 2025). They can result in greater resilience by interacting but also increase costs or promote unnecessary

investment. The mere fact that one can see a number of instruments does not constitute the need to assume that they support each other.

In general, the findings are inclined to support the uneven interdependence with fragmentation being selective. The numeric pointers specify varying country strengths. Evidence in the corporation shows the existence of persisting cross border commercial exposure. The development of policies displays efforts to regulate the access to strategically significant capabilities (Park, 2023). These results go hand-in-hand. They explain how the competition is intensifying to determine specific relationships and a substantial portion of the economic and technical ties underpinning production is organised on an international scale.

RESULTS AND DISCUSSION

The relationship between technological resources and geopolitical influence

The results endorse a relational conceptualization of technological power. Resources at national levels are important, but their strategic value relies on access to complementary capabilities. The financing benefits can make possible costly research without eliminating reliance on outside fabrication (Gawi & Abdullahi, 2024). There can be a great deal of creative effort and an increase in the knowledge pool that does not solve equipment limitations. Governments are thus competing in the structure of a technological system, and even the size of home activity. This difference is the reason why AI and semiconductor policies are more and more discussed on the same strategic platform.

The geopolitical power is most effective when the control of an input touches on an activity that is valued and cannot be easily substituted by another player. The variable of interest is the adjustment cost over a politically significant time frame. A narrow product can be substitutable (technically) but can be hard to scale. On the other hand, a very advanced input can create small leverage when the customers already possess inventories or are able to redesign workloads. Evaluation must focus on time, performance, and interrelationship of system components (Warren & Bartley, 2023).

Export controls as a mechanism of competition

Export controls aim at impacting the terms according to which the given technologies were made accessible. Their immediate process is different to that of research funding. Acquisition, deployment, and alternative products can be affected by restrictions, increasing costs, increasing delay, or necessitating different products. The existence of these effects is determined in relation to whether the activity is constrained (Dr. Saira Akram *et al.*, 2025). Any small delay may make a difference in critical development cycle. The presence of a large procurement burden can be mitigated by strategy provided the impacted organisation is able to offset it with other assets or with more focused goals. The policy sequence observed may be related to an

attempt at dealing with the broader system underpinning advanced computing (Zhao, 2026). An emphasis on equipment, software and memory acknowledges that capability cannot be controlled purely by one type of processor. This does not imply that an extensive system of controls is easily imposed. The technical thresholds need to be updated, the transaction frameworks are altered and the enforcement roles are shared. Maintenance of regulations is thus included in the policy mechanism and not an administrative peripheral action.

Suppliers and partners are also subject to costs due to controls. Unrealized sales can prove detrimental in terms of resources to conduct research and complicated compliance may deter transactions that are legal. Security benefits should not be thought to diminish these effects. They are to be factored in the assessment and not excluded (Yin, 2025). An authoritative evaluation measures capability-constrained vis-a-vis commercial and institutional expenses of attaining this constraint. The current paper acknowledges this tradeoff but fails to estimate a net security benefit.

Adaptation and the durability of advantage

Incentives can be enhanced by restrictions to create substitutes. This reaction is a result of an anticipated access security shift as opposed to an assurance of technological prosperity. When there is more political risk in dependence, the firms might be ready to invest in less efficient products in their home countries (Mousavizadeh, 2023). This willingness can be strengthened by the support of the population which will decrease the cost of investments. Nevertheless, the industrial learning, qualification and scale are still required. The ability to create a copy on a dependable basis should be differentiated, though, with policy induced demand of a substitute.

Adaptation can be done both in terms of software and organisational adjustment as well as replacement of hardware. Researchers are able to change model architectures, control available processors differently or target applications that have lower computational needs. Such adaptations can retain certain functions and decrease performance in other areas. The presence of them does not prove the ineffectiveness of restrictions (Nuga, 2020). It demonstrates that efficiency should be calculated with respect to a particular goal. Blocking access to a commodity, hindering a functionality, and destroying technology is yet another thing.

The changes in leverage are affected by the way these adjustments evolve and determine its durability. In case substitutes are still expensive and untrusted, an input might still go under control. Provided that adaptation becomes cost-effective, the constraint might decrease reliance in the future. This policy may thus have varied short- and long-term implications (Withdraw, 2025). The facts that have been collected here do not give any estimate of the rate of this transition. It defines the reason policy evaluation should be evaluated repeatedly,

not just upon the initial announcement, in which a value is derived.

Partner economies and the distribution of bargaining power

The significance of the fabrication and equipment of foreign competence implies that the US China competition is not bilateral only. The availability of complementary resources is affected by partner economies. Their governments have interests that overlap and need not necessarily duplicate those of the main competitors. Security collaboration does not imply no anxiety over the lost markets or diversion of investments (Yi Zhu, 2025). The knowledge of these interests is needed in explaining the coordination of restrictions and the reason as to why policy arrangements can vary amongst jurisdictions.

The ability to negotiate with a partner economy can be enhanced by having a specialised industrial capability. The influence is dependent on the replacement challenge and the exposure of the partner to the disruption in itself (Liao, 2025). The jurisdiction with a critical production can become the target of investment and diplomacy but under the pressure of increased security. There is thus the potential of commercial significance both to form influence and vulnerability. The geopolitical outcome is no automatic handing over of power to all the specialised producers; it depends on the political and economic affiliations.

The location of Taiwan is particularly topical, since more sophisticated fabrication is a component of the technological system that is taken into account. The business data indicates the importance of innovative processes in the revenue of TSMC. It fails to give a quantitative guess to geopolitical deterrence or formulate how technological dependence would impact decisions in the course of a crisis (Yu, 2025). These decisions deal with greater security considerations. The work then regards production concentration as a point of exposure that needs to be analyzed as opposed to a quantifiable assurance of stability.

New investment, chances at suppliers as well as developing infrastructure can make other economies more diversified. These advantages require local preparedness. It is not enough to host a facility where electricity, water, logistics, technical training, and regulatory procedures will not help to provide reliable functioning. Production can be geographically dispersed, with its upstream requirements concentrated (Gerlich, 2024). Its strategic worth should then be evaluated by the wholeness and replaceability of the resulting network, rather than the number of countries to which announcements go.

Fragmentation and the global economic system

Selective fragmentation has the ability to produce a different rule technological environment that applies to various activities. By contrast to more traditional products, advanced computing can be heavily controlled as regular products have been popularly traded. Other areas may

continue with research cooperation but be limited in other areas (Bu, 2024). Companies working between these borders are forced to deal with classification, the verification of customers, and the fluctuating jurisdictional demands. This introduces administrative expenses besides physical cost of production. The impact will probably be imbalanced among companies of varying sizes and technological divisions.

In the smaller economies, rival systems may pose challenging investment and access decisions. The choice of a single supplier ecosystem can enhance short term affordability with implications on compatibility in the future or regulatory exposure. Having multiple systems may help retain flexibility but escalate expenses (He & Ji, 2023). These choices cannot be sufficiently defined as mere correspondence to a single dominant force. They encompass realistic assumptions concerning infrastructure, skills, demand and reliability of the contract. This agency should be noted in policy analysis as opposed to third countries being seen as passive receivers of geopolitical pressure actors.

AI diffusion and strategic stability

The geopolitical impact of artificial intelligence varies in part based on the extent of diffusion of capabilities. A few organisations might come up with challenging frontier systems, and lots of users depend on applications readily available. We can then censor the most advanced inputs and still have diffusion of the useful AI. This difference is important in the consideration of both the economic and security goals (Ignatov, 2024). Limits set to fit within a specific frontier ability are not to be taken as a control over all types of artificial intelligence deployment. There is a possibility of strategic instability where governments take technological advancements as a sign that they are losing relative position. They could react either by increased investment or wider prohibition. Partners can be made more uncertain by such responses as they can embolden other competitors to do the same. This feedback is determined by the study as a possible mechanism and not a numerical relationship that has been observed (Ryu, 2025). Determining its magnitude would involve information concerning process of decision-making, threat analysis, and when certain actions are implemented by governments.

Effective cooperation is applicable in competition. The uncertainty can be minimized through arrangements related to incident reporting, research safety, and technical measurement, and predictable licensing procedures, without needing consensus on all the issues of strategy (Braun, 2025). The cooperation might be most possible in places where the parties have an interest to prevent accidents or essential commercial functions. This implies that the presence of rivalry and coordination may exist on various levels. The capacity of technological governance to deal with concrete risks in this complex relationship should be evaluated.

Policy Implications and Analytical Scenarios

Implications for the United States

The American policy must consider limitations in terms of well-identified capabilities and time limits. An indicator that is aimed at stalling advanced deployment must be evaluated based on pertinent procurement and performance data instead of a nationwide technology rating. Substitution, supplier costs and implementation by the partners should be evaluated (Mahmud, 2026). This kind of evaluation may aid in making modifications in case of the change in technical conditions. It further diminishes the risk of sustaining a measure largely due to its seeming strategic strength in spite of its poor evidence regarding its contribution.

The domestic support should relate the manufacturing incentives to research, infrastructure, and workforce development. When the production facilities are operating in a reliable manner, and when they get incorporated in a qualified supply network, they will be strategically helpful (Bartasaghi & Melgar, 2025). The monitoring of a programme should, therefore, look into the milestones in operation and the preparation of suppliers and announcements of investments. Resilience can be enhanced through public support without considering domestic location as a precondition to security. Concentrated equipment or material dependence may remain even after fabrication moves.

Anticipated communication with partner economies is also crucial. There must be a level of confidence that objectives, definition, and responsibility of implementation will be understandable when there are coordinated restrictions. The policy changes that happen regularly may undermine this trust and make it difficult to plan commercial activities. Partners should be taken into consideration in terms of industrial interests and legal constraints (Ryan & Burman, 2025). An enduring coalition has to rely on maintaining collaboration between actors that incur varying costs, and not on the belief that consensus regarding general security issues leads to the same national policies.

Implications for China

Substitution should be evaluated in Chinese policy on the basis of technical performance and commercial sustainability. Domestic expansion that spares certain vulnerabilities without introducing indefinite costs that undermine the downstream users is worthwhile (Shahrukh, 2025). Qualification, trustworthy servicing, and the emergence of specialised suppliers should be supported. An announced output, or patent totals should not replace evidence of usable capability. It takes a sustainable strategy to question the performance of new products in the actual industrial systems.

Domestic capability building can be supplemented with the diversification of relationships. Total substitution of all of its external inputs might not be possible or cost-effective in a certain time interval. A more discriminating measure would locate those areas where substitutes are

necessary and where diversified imports are feasible. The difference facilitates the distribution of resources based on vulnerability as opposed to symbolical self-sufficiency (Babaoğlu & Sevinc, 2025). It also appreciates the fact that the ability to innovate can be enhanced by international exchange even in cases where access to the chosen capabilities is politically unpredictable.

The criteria to check controls on upstream materials should be considered in the light of customer adaptation and credibility of long-term supply relations. Short-term leverage can promote buyer financing options. The ultimate decision will be determined by the availability, quality, and the cost of such substitutes (Park, 2023). A cautious approach would hence cause short term bargaining outcomes and long-term outcomes to the industrial relations. The current results uphold this method of evaluation without estimating the effectiveness of a specific material restriction.

Implications for partner and developing economies

Dependencies by technology level and by suppliers should be mapped by partner economies as opposed to using aggregate import values alone. A specialised component could be of strategic value even with the relatively low financial value on exposure. The switching costs, maintenance needs, the probability of service disruption should be evaluated in procurement planning (Gawi & Abdullahi, 2024). These evaluations can validate diversification in which they provide some tangible advantages and in which costly duplication is offloaded where viable options grant little more security.

The economies of the third world need to assess AI infrastructure initiatives with their local economic intention. It should be invested in accordance with the anticipated workloads, availability of electricity, and technical capacity as well as maintenance (Warren & Bartley, 2023). Without such foundations, joining a complex supply chain can present a costly reliance on external assistance. Increasing the capacity of implementation can be more short-term than trying to replicate all frontier technology stages. The concerned goal is credible access and effective utilization in an attainable national development plan.

Governments too must maintain space to informed commercial choice. Firms operating across competing systems can have less uncertainty in place through transparent procurement requirements and data governance (Dr. Saira Akram *et al.*, 2025). Local collaboration could assist in consolidating training, technical evaluation or buying knowledge. Such assumptions must be crested on grounded needs and not assumptions that smaller economies should assume a homogenous geopolitical stance. The ability to bargain on trustworthy access is in itself a valuable aspect of technological independence.

Conditional scenarios

Managed competition is one of the possible trajectories.

In such a scenario, high-tech capabilities can be viewed as a target of protection and non-targeted trade and limited cooperation persist. It gains credibility by the presence of its rules, which must be credible, and tolerance to continue activities that are not in the most sensitive categories. Rivalry would not be eliminated by the scenario. It would include a number of its economic spillovers and decrease the ambiguity regarding common commercial relations (Zhao, 2026).

The second path is more separation of ecosystem. Greater limitations and ongoing security threats of access may promote incompatible infrastructure, overlapping suppliers, and national support of greater scope. This would be determined by the cost of substitutes and the technical feasibility. It may augment freedom in certain areas and augment expenses in others. The situation is not unconditional and it cannot be projected as the unavoidable outcome of the series of policy actions that are analyzed in the present paper.

The third pathway blends the focused frontier development and broader application diffusion. With a small group of organisations, they may be left with development that cannot be diluted as systems that are available across the borders (Yin, 2025). In this scenario, adoption, services and institutional integration and hardware control would be increasingly a source of geopolitical advantage. The scenarios are used to determine various mechanisms which the future evidence may evaluate. They are not probability estimates and the current study does not give a forecast on any of them.

Limitations and Future Research

The study is limited by the coverage of public evidence. The kinds of public or private support may not always be reflected in investment statistics (Yin, 2025). Model classifications make selections of outputs. Patent data comprise a window that is historical and cannot create a commercial value. Corporate disclosures explain individual organisational, as opposed to national totals. These constraints cannot nullify the indicators, but tend to limit the conclusions that can be drawn based on the indicators. It is better to interpret them separately than have an unjustified composite ranking.

Future studies can look at particular technology phases and companies and track the changes. The benefits would be a delay of procurements, alternative suppliers capable, operating costs, and alteration in the ability to deploy. Cooperation could be measured by comparative research on partner economies to determine the impact that domestic industrial interests have. The connection between the location of hardware and actual customer access could be researched in relation to AI services. Such extensions would translate these general mechanisms observed here into specific empirical questions.

CONCLUSION

The global power is affected by artificial intelligence and supply chains of semiconductors as complementary and

conditional features and the political status of access. The comparative evidence reveals that the American and Chinese advantages vary in terms of financing, model production, and innovative activity. The distribution of industrial capabilities is still international and the commercial relations do not stop along with the prohibition of the sensitive technologies. These results suggest an explanation of unequal interdependence and selective fragmentation.

An important aspect of strategic value of a technological position is its substitutability, adjustment time and collaboration between the jurisdictions that provide complementary inputs. Restrictions can distort costs and opportunities, but can only be enduring with changes. Capacity can be enhanced by industrial assistance, and declared resources do not determine operational achievement. The economies of partners still maintain a role since their contribution of specialisation applies to both main competitors.

Policy ought to be a blend of focused protection, sustained innovation, diversification of suppliers, and coordination with other states depending on deeply defined vulnerabilities.

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