The Cost of Maintaining the Gap

US Sanctions, China, and the Economics of Technological Lead

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Executive Summary

US sanctions against China raise the cost of China's technological ascent. Restrictions on semiconductor equipment, advanced AI chips, design software, cloud access, investment, and supply-chain reconfiguration slow China's access to frontier technologies. China must spend more time, capital, workaround capacity, and domestic-substitution resources to reach the same level of performance.

The same pressure also returns to the US cost base. Semiconductor subsidies, reshoring, alliance coordination, export-control enforcement, supply-chain relocation, critical-mineral access, Taiwan defense, corporate revenue losses, and industrial-policy spending all expand as Washington tries to slow China's catch-up path. The US raises China's costs by accepting a higher burden of sustaining its own lead.

The technological frontier carries steep marginal costs. Early-stage investment can produce rapid performance gains, but near the top end each additional gain becomes more expensive. Preserving the final performance gap requires a disproportionate level of spending, coordination, and institutional support. The leading power therefore bears both the advantage and the cost of keeping that advantage in place.

China has limited incentive to carry full front-runner costs across all domains. Its stronger position lies in selective leadership combined with near-follower status across many high-cost frontier areas. While the US pays the high marginal cost of maintaining the top-end frontier, China can expand its sufficient-technology zone through domestic

substitution, workaround procurement, internal demand, third-country channels, and mature-technology absorption.

US sanctions against China create a two-sided cost-imposition mechanism. They raise China's catch-up costs and raise the US cost of maintaining the gap. Long-term competition will be shaped by cost growth, sufficient-technology thresholds, alliance coordination burdens, supply-chain replacement costs, and the cost of keeping frontier advantage strategically useful.

Rising Catch-Up Costs for China

US sanctions increase the cost of China's technological ascent. The burden appears through delayed access to equipment, restricted access to advanced chips, limits on design tools, workaround procurement costs, domestic-substitution spending, duplicated R&D, weaker production yields, and certification delays.

Semiconductor equipment sits at the center of this bottleneck. Restricted access to advanced-process equipment and software forces China to absorb longer development timelines and higher trial-and-error costs. Export controls do not fully block Chinese technological access. They raise the price and time required to reach specific technological peaks.

AI chips create a parallel constraint. Limits on advanced computing resources push Chinese firms toward model efficiency, domestic chip use, alternative architectures, data-center optimization, workaround procurement, and self-contained ecosystem development. The sanction pressure moves into the cost of climbing.

This gives China room to adjust its target. China can pursue sufficient technological capability without surpassing the US across every axis. A broad base of affordable, stable, upper-middle technology can support industry, military systems, administration, domestic markets, third-country exports, and workaround networks. Sanctions slow China's access to the peak. They leave room for continued accumulation in the middle layers.

The Rising Cost of Sustaining the US Lead

US sanctions impose costs on China and also raise the US cost of sustaining its own lead. Those costs appear in domestic industrial policy, alliance coordination, corporate revenue losses, export-control enforcement, and supply-chain reconfiguration.

Semiconductor industrial policy shows the burden clearly. To slow China's technological ascent, the US is expanding domestic semiconductor manufacturing, R&D ecosystems, workforce development, advanced packaging, equipment investment, and production incentives. This spending is a carrying cost of technological leadership.

Reshoring adds another layer. Reducing dependence on China lowers supply-chain exposure, but it also pulls production costs, wages, construction costs, environmental requirements, power-grid needs, workforce training, material procurement, and equipment acquisition back into the US. The more Washington constrains Beijing, the more expensive it becomes to maintain a resilient domestic industrial base.

Export controls also require continuous administrative capacity. The US must define controlled technologies, review export licenses, monitor workaround exports, align standards with allies, and track third-country routes. A more refined control system brings a larger enforcement burden.

Alliance coordination adds further cost. The US must coordinate export controls, equipment restrictions, critical minerals, Taiwan defense, and maritime corridors with Japan, South Korea, Taiwan, the Netherlands, major European states, Australia, the Philippines, and other partners. These states share parts of the US strategic agenda while also weighing Chinese market exposure, losses to domestic firms, energy costs, and domestic political constraints. Sanctions strengthen alliance discipline, but they also make alliance management more expensive.

China Gains More from Near-Follower Efficiency Than Full Overtaking

China's strategic advantage comes from combining selective leadership with near-follower efficiency. In electric vehicles, batteries, solar power, telecommunications equipment, drones, shipbuilding, selected AI applications, and manufacturing automation, China has secured or approached front-runner status. In cutting-edge semiconductor equipment, top-performance AI accelerators, selected design software, and extreme ultraviolet lithography, near-follower status can be the more efficient position.

This mix improves cost performance. Technological development has diminishing returns. Early investment can deliver large performance gains. Near the frontier, the same performance gain requires far greater spending. The leading power pays nonlinear marginal costs to preserve the final gap.

The US pays to maintain the top-end zone. China pays to widen the sufficient-technology zone. These are different cost curves. US spending moves into technological peaks, equipment development, research failure, standard-setting, alliance management, and enforcement. Chinese spending moves into domestic substitution, sufficient-technology acquisition, internal demand, mature-technology absorption, workaround procurement, and third-country networks.

Immediate full overtaking would transfer frontier-maintenance costs to China. Beijing can allow the US to open the frontier and then absorb papers, patents, standards, open-source systems, equipment knowledge, talent movement, mature technologies, and workaround channels that emerge from that process. The aim is to reduce the strategic utility of the US peak while avoiding the full cost of carrying that peak.

Containment Makes the US Cost Base Heavier

US sanctions raise China's catch-up costs and also raise the US cost of maintaining the lead. This is the central paradox of the sanctions regime.

Semiconductor export controls restrict China's access to advanced chips. They also reduce China-related revenue for US semiconductor firms and equipment suppliers, while creating coordination burdens with allied suppliers. To slow China's technological ascent, the US limits parts of its own firms' market access and then offsets the loss through industrial policy and domestic investment.

Critical minerals show the same pressure pattern. Reducing dependence on China requires alternative mines, refining facilities, supply contracts, inventory buffers, environmental approvals, financing channels, and logistics networks. Lower exposure to China brings higher industrial-maintenance costs for the US and its allies.

Taiwan defense also belongs inside this cost equation. Constraining China's military expansion requires Taiwan's defense capacity, US force posture, regional alliance networks, weapons production, and stable sea lines of communication. Taiwan is tied to semiconductor supply chains, alliance credibility, China's unification narrative, and the security calculations of Japan and the Philippines. Each layer adds cost to deterrence.

Beijing can exploit the placement of these costs. Export controls reduce US corporate revenue. Reshoring raises US production costs. Alliance coordination creates political friction. Critical-mineral diversification requires long-term investment. The space opened by these burdens supports China's push into sufficient technology, domestic substitution, internal-market replacement, and third-country routing.

From Damage Absorption to Cost Transfer

China is moving beyond passive absorption of sanctions. It can use its own supply-chain bottlenecks as tools of economic pressure.

The available instruments include rare earths, critical-mineral processing, intermediate goods, the internal market, manufacturing equipment, cybersecurity rules, data-center procurement rules, and countermeasures against extraterritorial jurisdiction. These instruments can shift costs back toward the US and its allies.

When China adjusts rare earths and critical-mineral processing, the US and its partners must pay for alternative supply chains. When China restricts foreign advanced components, US firms face reduced access to the Chinese market. When China pressures firms relocating supply chains, multinational companies face added costs between US regulation and Chinese market access.

Beijing is institutionalizing economic pressure in its own terms. The US raises the cost of China's technological ascent. China raises the industrial-maintenance costs, supply-chain diversification costs, corporate revenue losses, and critical-mineral access costs of the US and its allies.

US-China competition is therefore moving toward mutual cost imposition. The US raises China's catch-up costs. China raises the US cost of sustaining its lead. Both sides face limits in fully cutting off the other, so the competition increasingly works through the cost of keeping the opponent's core functions operational.

Strategic Gaps Narrow as Gap-Maintenance Costs Rise

The US still holds an advantage across many advanced-technology frontiers. The decisive variable is the cost and utility of that advantage. As technological development produces diminishing returns, the cost of maintaining top-end advantage rises and the practical gap created by that advantage narrows.

China can operate without matching US performance across every domain. Social, industrial, military, administrative, energy, and logistics systems run on technologies that are stable enough, cheap enough, and scalable enough. Frontier technology matters, but broad deployment of upper-middle technologies can reduce dependence even while the US retains the top end.

This compression matters over the long term. US export controls may slow China's access to the peak, while China continues accumulating middle-layer technologies. Mature technologies, legacy chips, domestic equipment, indigenous AI models, industrial robots, electric vehicles, batteries, solar power, shipbuilding, drones, and internal platforms can preserve substantial operating capacity outside the US technology sphere.

The practical effect of sanctions is to make China slower, more expensive, and more constrained. As China's sufficient-technology zone widens, US advantage can remain while its strategic pressure declines.

The US dilemma sharpens here. Washington understands that sanctions against China involve corporate losses, supply-chain reconfiguration, alliance-management costs, and industrial-policy spending. Yet the available choices are constrained. Allowing China's technological ascent to continue unchecked weakens US strategic advantage. Constraining China more aggressively raises the cost of sustaining the US lead.

China can operate inside that dilemma. It can maintain selective front-runner status while using near-follower efficiency in high-cost frontier areas. While the US pays high marginal costs to maintain the top-end frontier, China can expand the sufficient-technology zone and reduce the strategic utility of US advantage.

The core variable in US-China competition is the cost of maintaining the gap. A successful US effort to raise China's catch-up costs also raises the US cost of sustaining the lead. If China uses this asymmetry, US advantage can remain while the strategic pressure created by that advantage weakens.

The long-term structure of competition is determined by the rate of cost increase, sufficient-technology thresholds, alliance coordination costs, supply-chain replacement costs, and frontier-maintenance costs.