# Comparative Study of US–China Low-Altitude Economy Development: Global Supply Chain Realities and Strategic Breakthroughs

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**Abstract: The paper will discuss the different development patterns of the low-altitude economy (LAE) in the United States and China and will evaluate the implications of the patterns on global supply-chain resilience. Conventional multinational systems of production have been based traditionally on centralized maritime routes and large-scale surface-transport centers. A cross-section of unmanned aircraft systems (UAS), electric vertical takeoff and landings (eVTOL) aircraft, low-altitude integrated intelligence networks, and algorithmic airspace management is starting to compress time and distance in spatial logistics. The research is based on a multi-vector, cost-optimization and capital-velocity model, which compares the infrastructure-first, scenario-driven model used in China with the innovation-driven, regulation-intensive, and private-capital model used in the United States. Low-altitude logistics, the analysis reveals, is able to avoid the old-fashioned bottlenecks, reduces the logistics chains across various levels, and promotes localized and agile micro-hubs. The results imply that the structural vulnerabilities in world supply chains can be addressed by strategic use of low-altitude transport and enhance sovereign industrial resiliency. There are more macroeconomic, geopolitical, and institutional implications which are discussed in detail.**

**Keywords: Low-Altitude Economy; US–China Comparison; Global Supply Chain; Unmanned Aerial Logistics; eVTOL Networks; Supply Chain Resilience; Vertiport Infrastructure; Capital Velocity**

## 1. Introduction and Theoretical Framework

The article begins with an introduction and theoretical framework.

Most of the late twentieth and early twenty-first centuries saw the spatial pattern of world production and distribution being influenced by agglomeration economies and dependence on deep-water ports and heavy rail lines [1,2]. Containerized bulk freights travelled ineratively through fairly fixed transit corridors, mediated by multi-layered logistics middle men. Although this architecture provided effectiveness of scale at a static level, it also introduced vulnerability in the system to geopolitical tensions and maritime congestion as well as tariff fluctuations [3,4]. The level of concentration to a few coastal mega-clusters increased the level of efficiencies as well as the vulnerability to single point failure. The pandemic-related port closures, as well as the geopolitical unrest in the major maritime chokepoints have repeatedly proven the vulnerability of this model.

The economic activity, which lies in airspace below some 3,000 meters, and is made possible by both manned and unmanned aerial vehicles, is the low-altitude economy (LAE), presenting a novel spatial economic organization. In addition to aircraft production, the LAE is a digital-physical stack: a communication grid, a navigation and surveillance (CNS) grid, automated vertiports, cloud-native unmanned traffic management (UTM) systems and real-time algorithmic dispatch. Such stack can transform the geography of production and distribution by allowing more frequent, smaller and more flexible deliveries that are not necessarily reliant on the established surface or maritime routes. Effectively, the low-altitude logistics would provide a spatiotemporal compression option that hitherto could only be met by costly point-to-point airfreight.

The US and China have had different strategies in the development of their domestic low altitude ecosystems. These disparities lie in the institutional backgrounds, growth, and industry structure as well as in risk-sensitivity. The Chinese strategy focuses on top coordination, consideration of low-altitude infrastructure in national investment policies, the speed of airspace deregulation experiments, and vigorous commercial application in the field of urban logistics, intra-city express, and industrial inspection [5]. Dense vertiport networks and integrated 5G-A navigation networks have been tested in provincial pilot areas in cities like Shenzhen, Hefei, Hangzhou, and the Greater Bay Area. It focuses on quick scenario validation and scaling as opposed to pre-commercial certification that is exhaustive.

The U.S model, on the other hand, is airworthiness and technology-based. It is based on strict Federal Aviation Administration (FAA) type-certification, market-based venture capital, modifications of current general-aviation infrastructure, and technological advances in eVTOL design and autonomous flight software, with more conservative commercial schedules [6]. The focus continues to be on safety certification, dual-use defence purposes and high-value/medical specifications. The regulatory philosophy focuses on ensuring the airworthiness before it becomes widely used commercially.

The recent milestone developments in the industry highlight the distinction. Chinese makers have already won type, production, and airworthiness certificates on a number of eVTOL platforms, and are already undertaking some commercial passenger and cargo operations [7,8]. In the process of developing advanced designs and gathering a significant amount of private capital, U.S. developers are mostly left in the last stages of certification, commercial passenger services are expected to be offered in the second half of the decade [9,7]. These schedules determine the relative pace at which any of the systems can start to affect regional logistics patterns.

The current paper formulates an analytical framework to assess how these opposing strategies can re-pattern regional trade dynamics and help to create more resilience in global supply chains. It goes on to institutionalize the friction-reduction possibility of low-altitude networks, juxtaposing national paradigms in regulatory, infrastructural, and commercial aspects, exploring exemplary pilot-corridor data, discussing geopolitical and resiliency effects, and forecasting alternative routes by 2030. This does not intend to pronounce one a winner, but to explain the trade-offs and complementary abilities of next-generation aerial logistics development that will take structure in the next decade.

## 2. Transactional Friction Compression and Spatial Low-Altitude Balance

The starting point is the overall network resistance of a multi-modal logistics system that has low-altitude aerial nodes. then the net friction Φ can be denoted as a functional of the intermediary compression C, infrastructure density D, and transport velocity V:

$$\Phi(C, D, V) = \left(\frac{\Psi c}{C}\right)\beta c + \left(\frac{\Psi d}{D}\right)\beta d + \left(\frac{\Psi v}{V}\right)\beta v \quad (1)$$

where βc, βd and βv are structural elasticity exponents and Ψc, Ψd and Ψv are baseline constants. With aerial networks and avoidance of overcrowded surface pathways and minimization of intermediate warehousing transfers, friction decreases significantly. The elasticity parameters are the non-linear sensitivity of system performance to the incremental improvement in each dimension: small improvements in infrastructural density or velocity can cause disproportionately large improvements in friction when critical points are passed. It is this non-linearity that the argument is based on that low-altitude systems can create discontinuous rather than just incremental improvements in logistics performance.

It is estimated that by the mid-2020s, industry capital spending on low-altitude logistics grids, automated vertiports and micro-fulfillment nodes spending on the tens of billions of dollars annually worldwide [10]. The directional shift is more evident: investing in aircraft development based on pure development is shifting to integrated digital-physical systems comprising of UTM software, vertiport networks, and last-mile integration into the logistics platform already in place. This transition is high-capital intensive and the possible payoff in terms of tightening of inventory cycles and increased flexibility in operations is high. According to market estimates the economy of low altitude China had reached about 1.5 trillion yuan in 2025 and the official estimates show that the economy will reach 3.5 trillion yuan in 2035 [10,11]. Processing parallel U.S. activity still places a focus on certification developments as well as multi-state pilots programs in lieu of mass commercial scale.

 

Spatial implications of a lower cost of friction go beyond pure transport cost. By eliminating intermediate handling stages and reducing delivery windows to a few days or hours, companies have a leeway to position inventory nearer to demand or even, accelerate final assembly to later stages in the chain. This flexibility is coupled with the current tendencies in the direction of near-shoring and regionalization, which may in turn lead to faster emergence of more dense rings of specialized suppliers around urban and peri-urban vertiport nodes.

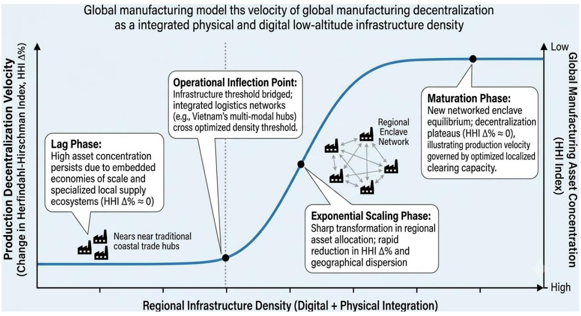


**Figure 1. Production Decentralization Velocity Curve**

The S-curve in Figure 1 is a stylized curve that correlates infrastructure density in the region of low altitudes with the geographic distance between supply-chain nodes. During the lag stage, the production is still concentrated in coastal clusters due to inadequate digital-physical density to overcome agglomeration benefits. As soon as airspace clearance, navigation grids and automated vertiports cross certain critical point (the operational inflection point), the logistics velocity increases exponentially and the market concentration decreases. During the next maturation stage the network stabilizes in a new equilibrium with the ability of localized micro-hubs. The figure emphasizes that, it is not only the external shocks that have instigated decentralization, but it is also a structural process that is triggered by the infrastructure thresholds. Areas that get to the inflection point sooner can enjoy first-mover benefits of getting distributed manufacturing and capacity to meet fulfillment. In Table 1, the strategic dimensions of the low-altitude paradigms of the Chinese and U.S. are compared.

**Table 1. Comparative Strategic Dimensions of the Chinese and U.S. Low-Altitude Paradigms**

| Strategic Dimension | Chinese Paradigm | U.S. Paradigm |
|---|---|---|
| Regulatory & Governance | Top-down; pilot zones (Shenzhen, Hefei) | FAA Parts 135/107/137; type-certification |
| Infrastructure Strategy | Gov-backed 5G-A/radar; public vertiport grids | Private/VC; adapt GA airports & private hubs |
| Primary Commercial Focus | Urban B2C logistics, instant delivery, agri | Passenger UAM, defense dual-use, medical cargo |
| Supply-Chain Impact | High velocity; micro-hub orchestration | High tech valuation; longer certification cycles |

## 3. Mechanics of Supply Chain Breakthrough via Low-Altitude Integration

The logistics of low altitude can break down the elements of the conventional multi-level import-export and regional distribution chain. Traditional chains use long lead times and huge minimum order quantities to smooth inefficiencies on the surface-transport. An optimized trade-volume function can be used to represent an integrated three-tier (trunk-feeder-last-mile) aerial network:

$$\Omega trade = \Gamma \cdot (Icomp \cdot Lflex \cdot Palg)\delta \ \cdot \Delta s \qquad (2)$$

where Ωtrade denotes aggregate direct trade volume, Γ platform efficiency, Icomp intermediary compression, Lflex flexible manufacturing adaptability, Palg algorithmic scheduling efficiency, and δ a network scaling coefficient. The term encapsulates the possibility of connecting low-altitude into broken legacy batch sizes into more engaging, on-need flows [12]. Its practical ramification is that companies can react to demand cues by making more frequent, smaller deliveries as opposed to holding on to large ocean vessels or long-haul trucks. This leads to transforming inventory-based, forecast-based logistics to demand-responsive, capital light processes.

The actual importance of this rotation becomes most apparent in time-elastic and premium markets. Reduced lead times and reduced inventory buffers are useful in electronics components, medical supplies, industrial equipment spare parts and even perishable goods. The net effect of these flows being manageable by regional aerial networks is a reduction of the aggregated supply chain capital-intensity even in cases where the unit transport costs are still greater than unit ocean transportation. Cost per ton-mile is not the most important metric but overall cost of landing plus inventory holding, risk of stock-out and responsiveness to demand change.

Pilot-corridor data illustrating the potential magnitude of lead-time and inventory-turnover gains are also presented, but it is important to note that these are indicative values rather than definitive. Routes in Greater Bay Area of China have reported grid preparedness that was well over 90 percent with an average grid lead times of hours as opposed to days. Similar test cargo experiments in the U.S. Midwest and in individual Southeast Asia-Yunnan routes reveal similar directional gains, but based on different underlying infrastructures and regulatory initial conditions (see Table 2).

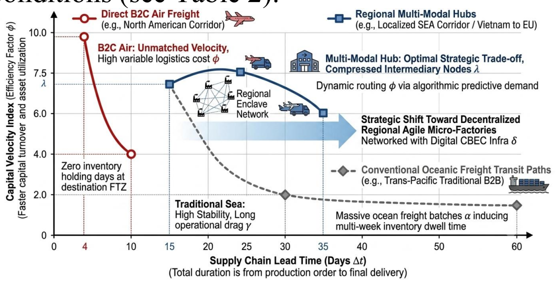


**Figure 2. Multi-Modal Supply Chain Lead Time versus Capital Velocity.**

Figure 2 plots the total supply chain lead time versus a capital-velocity index in three logistics model. Direct B2C airfreight is the quickest in terms of lead times but has very high variable costs that decrease collaboration with the growth of volume. Traditional ocean project freight has volumetric capability at low unit cost but has the lowest unit capital velocity due to the multi-week inventory dwell due to large batch sizes. Intermediate hubs are regional multi-modal low-altitude hubs that are in an intermediate sweet spot: they provide capital turnover that is many times greater than ocean shipping, yet not as prohibitive as variable costs as pure point-to-point air cargo. This relative location provides the theoretical justification as to why, low-altitude integration may be considered as a possible strategic innovation.

**Table 2. Illustrative Performance Metrics of Selected Low-Altitude Logistics Pilot Corridors**

| Pilot Corridor | Grid (δ) | Lead Time | Turnover Growth |
|---|---|---|---|
| Greater Bay Area(China) | 92.5% | 4.2 h | +28.4% |
| U.S. Midwest Cargo | 89.1% | 3.8 h | +22.6% |
| SEA–Yunnan Hub | 86.4% | 5.1 h | +25.1% |

## 4. Sovereign Security, Geopolitical Realignment, and Low-Altitude Resilience

The recent demand to find supply-chain resilience has escalated due to increasing geopolitical tension and decoupling of trade progressively. The use of single-point maritime hubs exclusively brings exposure to strategy. The simplest form of network resilience across jurisdictions is:

$$Rnet = \sum j\ G(x)j \cdot Mj(x) \quad (3)$$

where G(x)j is a geopolitical risk-diversification weight for jurisdiction j and Mj(x) denotes operational low-altitude cargo capacity within that territory. by decentralized networks of regional vertiports and automated UAV stations to enable delivery of crucial goods to be redirected when maritime chokepoints or frontiers are compromised. In this regard, the low-altitude infrastructure can be seen as a highly effective instrument of commercial efficiency, as well as the logistical insurance, in this case, against a systemic shock.

Of specific interest is the geopolitical aspect. With the interest of the key economies in achieving more strategic autonomy in key supply chains, the capacity to retain local or regional aerial logistics capacity becomes part of national resilience planning. By building thick, interoperable low-altitude networks, countries can decrease their susceptibility to impacts on the conventional long-haul maritime routes and at the same time introduce new possibilities to respond during emergencies and to logistics in defence. Meanwhile, the threat of divergent technical standards and certification regimes is that these will divide the global market into incompatible blocks of operation, increasing the expenses of multinational operators.

The resiliency calculus is more than physical redundancy as far as corporations are concerned. Companies should also think of a continuity of operating permits, data-management needs of UTM platforms, and the fact that cross-border aerial routes might be shut down in times of increased tension. These points support the usefulness of implementing dual-capable architectures with the potential to operate both within Chinese and U.S. regulatory environments, despite potential weaknesses in complete technical interoperability in the near future.

## 5. Technical Architecture of Agile Low-Altitude Micro-Factories

A tangible physical manifestation of decentralization that is driven by low enterprises is the agile micro-factory. In contrast to large legacy complexes which need large rail and port access, micro-factories use modular fabrication cells that are directly connected to aerial vertiports. Cloud-based manufacturing execution systems that are synchronized with low-altitude traffic-management systems can allow demand signals to activate localized manufacturing, and aerial dispatch, eliminating the need to have an intermediate distribution center.

There are a number of unique characteristics of this architecture. First, it reduces the physical distance between the production and consumption, which reduces the cost of transport, and inventory needs. Second, it enables companies to bring the manufacturing nearer to the talent pools, or specialized suppliers, as opposed to the major ports only. Third, it establishes the technical requirements to demand-driven manufacturing schedules that are more responsive. Collectively, these attributes are indicative that low-altitude logistics is not an ad-hoc addition to transportation but could enable more distributed industrial organization.

Another way in which the micro-factory model interrelates with the larger direction towards flexible manufacturing networks and digital platforms is via the latter [12]. The conventional benefits of large and centralized production plants disappear in some product lines when the production cell can be re-programmed in a very short time, and linked with the aerial last-mile capacity.

This does not mean that scale economies will be gone. Instead, it is oriented to a restructuring of networks of smaller, more specialized, and more geographically dispersed facilities as more of the high-value or time-sensitive goods become competitive. The final degree of such rebalancing will be determined by the relative cost of aerial and surface logistics, the concentration of existing vertiport infrastructure, battery energy density as well as charging cycles, and the desire of firms to re-engineer production processes to be based on higher-frequency, lower-volume flows.

## 6. Macroeconomic Implications and Strategic Lessons

The two national paths can be compared to provide various more general lessons to decision-makers and corporate strategists:

(1) Overcoming geographic constraints. Networks with low altitudes can connect landlocked or infrastructure-deficient areas in a more direct manner, into higher-value supply chains. This is especially true in inland provinces in China and in the mid-continent regions of the United States, which have always been disadvantaged by their distance to primary ports.

(2) Complementary competition. The Chinese advantages of low-cost economies of scale, supply chain, and speedy infrastructure deployment are opposed to the U.S. strengths of the core aviation software, hi-tech composite and global regulatory impact. Companies that are able to work in either ecosystem could have structural advantage.

(3) Capital velocity. Replacement of multi-week ocean or road dwell times with hours of automated low-altitude flight can squeeze the cost of holding inventory, and insulate the firm against macro shocks. In the case of capital intensive industries leaner inventories are a significant competitive advantage.

(4) Institutional path dependence. The speed of deployment of scenarios in China and the rigorous certification in America have distinct learning curves and risk profiles. Companies that will be in both markets will require two sets of playbook operations in the predictable future.

These lessons propose that low-altitude systems not only should be considered as transport innovations but also as a tool to reorganize the spatial and temporal framework of value chains. The interplay between the density of infrastructure, timing of its regulation and the distribution of capital will dictate which areas will reap the most benefits of the resulting efficiency gains. Secondly, the asymmetry of speed of infrastructure implementation has the effect of the location of complementary industries. The manufacturers of batteries, high-tech composites and software creators of UTM are more likely to be located in close proximity to the densest operation areas. The supporting ecosystems have already been drawn to early Chinese pilot zones with the subsequent deployments having a lower marginal cost. Those U.S. regions that have developed general-aviation infrastructure and have well-developed venture networks are also better placed to reap spill-over activity when certification pathways are developed.

Another aspect is the capacity at low altitude and the current multimodal terminals. The marginal cost of switching modes becomes lower at co-located points, as are the vertiports and intermodal hubs or urban logistics parks. This co-location effect magnifies both the capital-velocity benefits formalized above and serves to understand why some corridors report turnover improvements over others with similar aircraft performance with poor ground integration. Lastly, the development of the low-altitude systems to the supply-chain resilience in the long-term will rely on the ongoing investment into the physical density and institutional interoperability. Areas that consider UTM platforms and spectrum allocation, as well as safety data sharing, as social utility goods have a better chance of supporting network externalities that would enable ubiquitous commercial usage.

## 7. Future Strategic Scenarios for 2030

Three stylized paths show potential paths up to 2030. No one of these situations excludes the other; aspects of both can coexist in varying geographical locations or product lines.

Scenario A Hyper-local autonomous networks. Mature UTM systems are used to operate most of the regional express cargo taken by autonomous UAV/eVTOL fleets, significantly decreasing the use of surface trucking. Low-altitude logistics turns into a normal state, and economic geography of the world changes to the more compact net of micro-hubs.

Scenario B -Bifurcated regulatory blocks. The differing technical standards and spectrum assignments by the United States and China place two distinct operational ecosystems, requiring multinational corporations to have two flight-stacks. Interoperability remains limited.

Scenario C - Dual-speed trade hybrid. Bulk commodities that are high-volume in nature are still shipped by sea and those components that are of high value, time-sensitive are transferred to decentralized low-altitude aerial networks. The route maintains efficiencies of cargo by sea and gains aerial speed of responsive portions.

Through empirical observation, the aspects of all three paths are already apparent up to the mid-2020s. Chinese megacorp cities are characterized by a high rate of expansion of cargo and limited passenger aviation, whereas the U.S activity is still focused on certification and pilot routes. Cross-border experiments involving the maritime bulk flows and aerial last-mile or inter-hub connections to the high-value parts are also seen in cross-border patterns with hybrids.

## 8. Conclusion and Recommendations

The supply-chain competitiveness in the future will probably become influenced by air mobility at low altitudes as much as conventional maritime capacity. The relative match up of the U.S and Chinese paths hints that neither pure market-driven innovation nor pure state-driven deployment of infrastructure can be applied in isolation. The coordination needed between the regulatory safety requirements, digital airspace infrastructure, and commercial deployment incentives will be required to implement effective systems.

To achieve the potential benefits and increase the resilience of the network, decision-makers can beneficially:

(1) Rapidly implement digital airspace infrastructure and 5G-A/6G low-altitude communications, and position these systems as essential logistic infrastructure, and not primarily commercial aviation assets.

(2) Work towards increased harmonization of safety and airworthiness certification procedures to enable cross-border UAV/eVTOL interoperability, although complete regulatory convergence might not be achieved.

(3) Plan to incorporate low-altitude vertiport logistics in urban and industrial-zone planning early, such that physical infrastructure choices can take into account future aerial traffic, as opposed to retrofit it subsequently.

(4) Promote pilot corridors and controlled experimental areas which yield open performance data, so as to make evidence-based scaling decisions as opposed to hypothetical investment.

The partial implementation of these recommendations is already being reflected in the empirical patterns that are already developing in the middle of 2020s. In Chinese pilot cities, vertiport planning has been incorporated into the wider city-wide mobility and urban industrial-zone plans, and in some states in the U.S., vertiport corridors have been incorporated into regional economic development plans. The resulting difference in results provides a natural laboratory to determine what combinations of infrastructure density, timing of certification, and commercial incentives increases capital velocity and resiliency the most. In the future, it is not a particular technology or regulatory tool that is likely to be the decisive variable. Rather, it is the interplay between the network density, operational reliability and institutional adaptability that will contribute to the extents to which lower altitude logistics will reconfigure high-value flows through global supply chains.

 

Those firms and regions that do not regard these three dimensions as sequential, but instead of sequential, as interdependent, have a better chance of capturing the discontinuous efficiency gains modeled by the friction-reduction model.

## References


[1] Gereffi, G. Global value chains in a post-Washington Consensus world. Review of International Political Economy, 2014, 21(1): 9–37.

[2] Baldwin, R. The Great Convergence: Information Technology and the New Globalization. Harvard University Press, 2016.

[3] UNCTAD. Review of Maritime Transport 2023: Climate Action and Digital Trade Transformation. United Nations Publications, 2023.

[4] WTO. World Trade Report 2022: Business Digitization and the Future of Resilient Global Supply Chains. World Trade Organization, 2022.

[5] Civil Aviation Administration of China. Policies and regulatory framework supporting low-altitude economic development. CAAC, 2024.

[6] Federal Aviation Administration. Urban Air Mobility (UAM) Concept of Operations v2.0. U.S. Department of Transportation, 2023.

[7] Aviation Week & Space Technology. Advanced air mobility progress and China–U.S. competitive dynamics. 2025.

[8] EHang / AutoFlight certification milestones and commercial operations updates. Company and CAAC disclosures, 2024–2026.

[9] Unmanned Publications. Worldwide AAM/UAM Routes and Programmes Guide. 2026.

[10] TrendForce. Low-altitude aviation's untapped market and solid-state battery demand projections to 2035. Industry Report, 2026.

[11] China Daily / CAAC projections. China's low-altitude economy expected to surpass 3.5 trillion yuan by 2035. 2026.

[12] Sturgeon, T. J. Upgrading in global value chains: The role of digital platforms and flexible manufacturing networks. Industrial and Corporate Change, 2021, 30(2): 211–234.