China's Low-Altitude Economy: Theoretical Foundations, Development Status, and Policy Directions

Wang Shusen*, Xing Gan

School of Applied Economics, University of Chinese Academy of Social Sciences (UCASS), Beijing, China

Abstract: *This paper delves into the evolution and defining traits of China's "low-altitude" economy and spotlights the powerful "triple engines" fueling its rise: Groundbreaking technological advancements, strategic policy support, and robust capital investment. However, despite its promise, the low-altitude sector grapples with significant hurdles, such as the risk of external coercive technological containment and sanctions, nonstandardized and underdeveloped infrastructure, untested business models, limited public acceptance, and lagging regulatory frameworks. Grounded in industrial ecosystem theory, this study analyzes the development model and real-world challenges of the low-altitude economy and argues that the seamless fusion of technological and industrial innovation is the linchpin for overcoming these obstacles. We propose bold policy recommendations across four key pillars: Amplifying pilot city initiatives, nurturing innovative enterprises and talent, fortifying regulatory and governance systems, and broadening international collaboration. By blending theoretical insight with actionable solutions, these strategies offer a clear and practical roadmap to propel the low-altitude economy toward a thriving, sustainable future.*

Keywords: *Low-altitude economy; Technological innovation; Industrial innovation; New quality productive forces*

JEL Classification Codes: O53; O31; O38

DOI: 10.19602/j.chinaeconomist.2025.11.03

1. Introduction

As a new wave of technological revolution and industrial transformation sweeps the globe, cutting-edge innovations in artificial intelligence, new energy, and the digital economy have begun to reshape traditional economic structures, heralding profound changes unseen in a century (Bai & Zhu, 2024). Against this dynamic backdrop and guided by Xi Jinping Thought on Economy, China has championed the deep integration of technological and industrial innovation. By leveraging major technological breakthroughs and addressing critical development needs, the nation aims to cultivate emerging strategic industries to forge new pathways for high-quality growth and accelerate the rise of new quality productive forces. In his article published in Issue 11 of *Qiushi* (2024), titled "Developing New Quality Productive Forces is an Intrinsic Requirement and a Key Focus for Promoting High-Quality Development", President Xi emphasized that "new quality productive forces are driven by innovation, breaking free from traditional models of economic growth and productivity development. They are characterized by high technology,

* CONTACT: Wang Shusen, email: wangshusen126@126.com.

Acknowledgement: Social Research Project of the Youth Humanities and Social Sciences Research Center, Chinese Academy of Social Sciences, "Research on Constraints and Optimization Strategies for Low-Altitude Infrastructure Construction" (Grant No. 2026QNZX028).

high efficiency, and high quality, embodying the advanced form of productivity aligned with the new development philosophy". The low-altitude economy is a primary example of these new quality productive forces, seamlessly integrating aviation technology, intelligent control, communications, navigation, and new energy. Born from scientific breakthroughs and innovative business models, this multifaceted sector aligns with China's strategic priorities and has rapidly emerged as a trillion-yuan powerhouse, fueled both by technological innovation and its inherent transformative potential (Ni et al., 2025). Recognized as a strategic emerging industry at the 2023 Central Economic Work Conference and designated a new growth engine in the 2024 *Government Work Report*, the low-altitude economy has enjoyed robust support from the Communist Party of China (CPC). Building on the foundation of traditional general aviation, it incorporates advanced technologies such as drones, intelligent control systems, and satellite navigation to create a cutting-edge, technology-driven production and service ecosystem.

Although China's low-altitude economy is still in its early stages, with market demand yet to be fully unleashed, its future seems to be brimming with potential. The Civil Aviation Administration of China (CAAC) projects that the market size will soar to 3.5 trillion yuan by 2035[1]. Far from operating in isolation, the low-altitude economy spans diverse sectors, including energy, transportation, manufacturing, agriculture, and logistics, thereby fostering a vibrant new pattern of cross-industry collaboration. Looking ahead, the sector is poised to evolve into a dynamic, composite industrial system driven by "multi-industry synergies and diverse application scenarios". By embedding itself in traditional industries, nurturing future-oriented sectors, and generating powerful spillover effects, the low-altitude economy can integrate upstream and downstream industries, unlock broader market applications, and foster integrated development across industrial chains to tap a broad spectrum of market applications.

The development of the low-altitude economy is not the result of a single company's actions. Instead, it is an emerging industrial system where diverse players, including companies, government bodies, research institutions, and financial organizations, interact and collaborate through the exchange of knowledge, technology, and capital in a dynamic environment of symbiosis, evolution, and shared value creation. Within this industrial ecosystem, the key actors are companies, government bodies, users, and research institutions, and the essential resources are technology, funding, data, and talent. In addition, the economic environment is shaped by policies, regulations, market demand, infrastructure, and social culture. Industrial ecosystem theory holds that an industry's prosperity depends on its ability to continuously engage in positive interactions with its surrounding environment and resources. By creating and exchanging value, the low altitude sector can strengthen its position within the broader ecosystem (Lou & Yu, 2009). From this viewpoint, the rapid development of the low-altitude economy is a result of its ability to draw "nutrients" from its ecosystem's resources and environment. For example, low-altitude aircraft use advanced technologies such as carbon fiber composites and intelligent coatings to improve endurance and aerodynamic performance. With policy support, innovative aircraft such as electric vertical take-off and landing (eVTOL) vehicles have begun to be piloted in various regions, showcasing the future of urban air mobility. A substantial influx of capital has also enabled deep integration between the low-altitude economy and many other fields, giving rise to new business models and service formats. This has driven the development of new aircraft such as drones, which are now widely used in industries, including logistics, tourism, agriculture and forestry, and emergency rescue.

With China's progressive airspace management reforms and low-altitude pilot programs, the low-

[1] Source: Ministry of Transport of the People's Republic of China, "Low-Altitude Economy Accelerates Takeoff," March 6, 2025, https://www.mot.gov.cn/jiaotongyaowen/202503/t20250306_4165146.html.

altitude economy has also begun to emerge as a new, distinct industrial sector from the traditional general aviation industry. This rise represents both a technological restructuring and a paradigm shift, offering a new opportunity for the deep integration of technological and industrial innovation. From a technological standpoint, the low-altitude economy integrates a new generation of information technologies, such as 5G communications, BeiDou navigation, and artificial intelligence, with cutting-edge engineering technologies such as novel composite materials, motor and electronic control systems, and aircraft miniaturization. This has broken down the barriers of fragmented, uncoordinated traditional innovation models to establish a cohesive ecosystem of technologies, platforms, and applications. This robust technical foundation provides solid support for industrial development and enables the seamless connection of key actors and resources within the low-altitude industrial ecosystem (Ouyang, 2025). From an industrial innovation perspective, the low-altitude economy has spurred deep collaboration across various sectors, including agriculture, manufacturing, services, and public administration, that has led to a continuous stream of new application scenarios (Zhao, 2025). By creating value through low-altitude services and using new scenarios as innovation testbeds, the sector facilitates policy implementation and meets market demand, linking the ecosystem's key actors with its environmental elements. The low-altitude economy is more than a newly emerging industry, it is a pivotal force poised to reshape the landscape of synergistic technological and industrial innovation that offers a strategic opportunity for China to forge new paths to leadership in emerging strategic sectors.

This paper examines the development history and current characteristics of China's low-altitude economy and presents an in-depth analysis of its drivers of growth, potential advantages, and practical challenges it faces in achieving "high-quality" development. Unlike other emerging industries such as new energy vehicles and cloud computing, the low-altitude economy, as a multi-technology converged sector, is characterized by diverse yet highly uncertain application scenarios. It remains unclear in which specific scenarios and through what models it will achieve scaled development in the future. We argue that the fundamental path for the low-altitude economy's development must be the integration of technological and industrial innovation and propose that a deep fusion of these two forms of innovation is the key to overcoming current bottlenecks. Our primary contribution is to build a theoretical framework for the "high-quality" development of the low-altitude economy from this integrated perspective and to provide concrete policy recommendations.

2. The Evolution and Defining Features of China's Low-Altitude Economy

2.1 Evolution of China's Low-Altitude Economy

The development of China's low-altitude economy has progressed through three distinct phases: nascent exploration, initial development, and rapid growth (see Figure 1).

Pre-2010: The Nascent Exploration Phase. During this period, China's aviation industry was centered on traditional general aviation. The term "low-altitude economy" had not yet been formally recognized, and related technologies were still in their infancy. Airspace management was highly centralized under military control, and cumbersome flight approval processes severely limited the growth of civil general aviation. Consequently, the sector primarily served public good or utility applications such as agricultural and forestry protection, aerial photography, and meteorological observation, with very limited commercial or civilian applications.

The period from 2010 to 2020 marked the initial development stage of the low-altitude economy industry. During this phase, significant breakthroughs were made in academic research, technological innovation, and policy support. Academic Research: Starting in 2010, the concept of the "low-altitude

economy" was first introduced and discussed within Chinese academic circles, gradually gaining public attention[2]. Technological Innovation: The rapid breakthrough of low-altitude aircraft, particularly drones, along with their integration with emerging technologies such as BeiDou navigation and 5G communications, accelerated the expansion of commercial applications. This led to significant growth in fields such as aerial mapping and surveying, agricultural plant protection, environmental monitoring, and disaster rescue (Ni et al., 2025). Policy Support: The CPC Central Committee and the State Council issued a series of policy documents to encourage the exploration and opening of low-altitude airspace resources. In 2010, the State Council and the CPC Central Military Commission jointly released the *Opinions on Deepening the Reform of Low-Altitude Airspace Management in China*, which proposed a three-phase strategy of pilot programs, broader promotion, and deepening reforms. In 2016, the General Office of the State Council issued the *Guiding Opinions on Promoting the Development of the General Aviation Industry*, which explicitly called for the further opening up of low-altitude airspace, optimizing flight services, and streamlining approval processes to create a favorable policy environment for the industry's

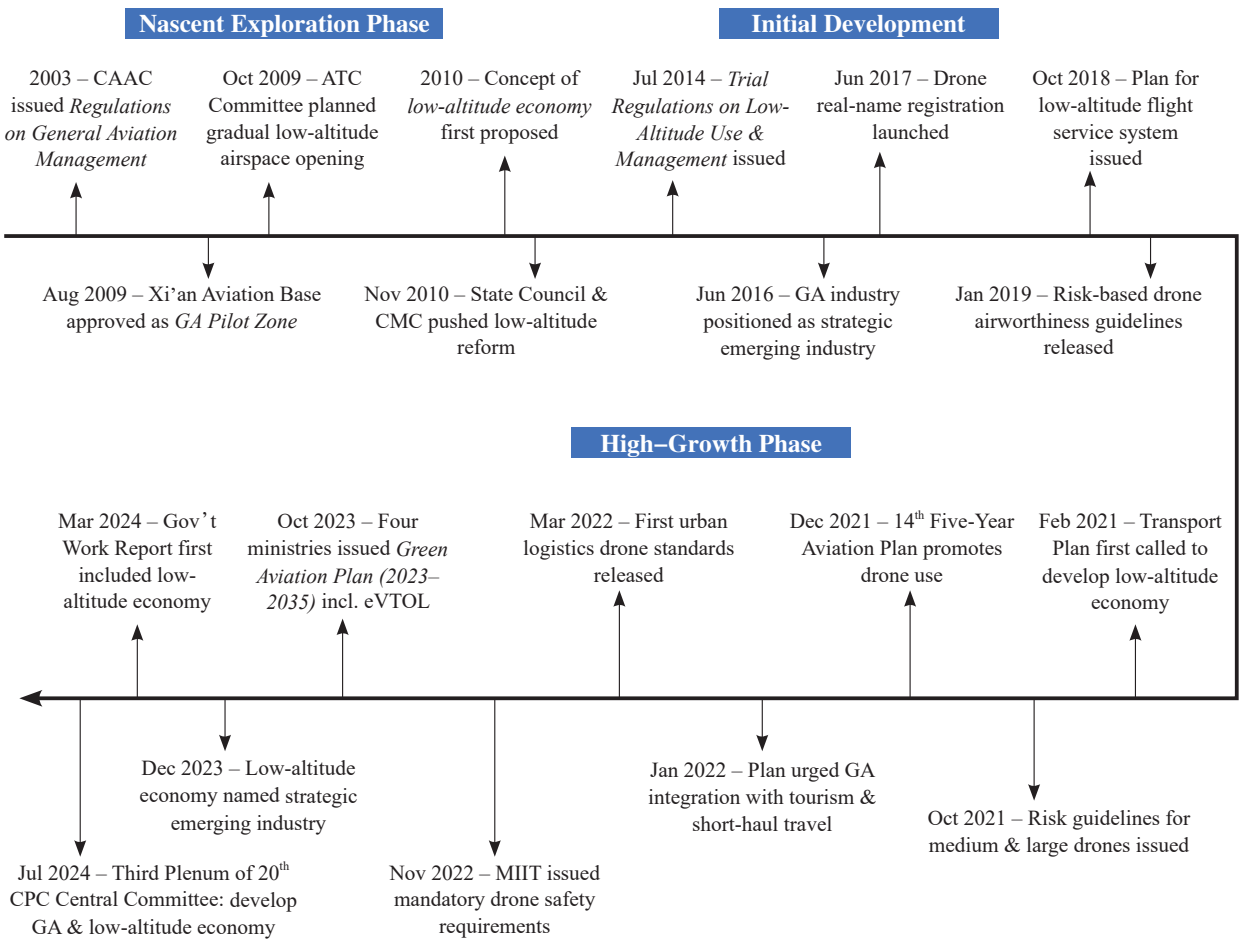

Figure 1: Development Timeline of China's Low-Altitude Economy

[2] Source: Jiangsu Science and Technology Think Tank, *A Review of the Development of China's Low-Altitude Economy and Related Industry Policies*, May 16, 2024, https://www.skzlyjy.org.cn/web/artlist/360.

development.

Since 2021, China's low-altitude economy industry has entered a stage of rapid development. Driven by supportive government policies, technological breakthroughs, and substantial capital investment, what was once an extension of traditional general aviation has transformed into a strategic, standalone industry. The shift to a national priority was marked in February of 2021, when the CPC Central Committee and the State Council issued the *Outline of the National Comprehensive Three-Dimensional Transportation Network Plan*, officially designating the low-altitude economy as a national strategic industry and setting clear goals for its development. Years of technological progress and market exploration paved the way for explosive growth. The data underscores this remarkable progress. The number of registered drones nationwide surged by over 60% in a single year, from 517,000 in 2020 to 832,000 in 2021 and has continued to grow at an annual rate in excess of 45%. The number of licensed drone operators has also increased significantly, rising by more than 35% from 89,000 in 2020 to 120,800 in 2021. By the end of 2024, China had 2.177 million registered drones, 1.619 million registered drone owners, 273,300 licensed operators, and a total of 26.667 million flight hours logged for the year, demonstrating that the low-altitude economy was not just taking shape, but taking off[3].

In December of 2023, the Central Economic Work Conference explicitly designated the sector as a national strategic emerging industry, and in 2024, the Government Work Report identified the low-altitude economy as a "new growth engine" for the first time. Later that year, the Third Plenary Session of the 20th CPC Central Committee emphasized the need to develop general aviation and the low-altitude economy. The 2025 Government Work Report further underscored its importance, calling for the "safe and healthy development" of emerging industries, including commercial aerospace, the low-altitude economy, and deep-sea technology. Provincial and municipal governments have increasingly incorporated the low-altitude economy into their work reports and have consistently introduced dedicated development plans. This nationwide push, combined with sustained interest from capital markets and the establishment of a dedicated Low-Altitude Economy Development Department under the National Development and Reform Commission (NDRC), demonstrates that policy support is intensifying. The path forward for the low-altitude economy is becoming increasingly clear, with growing momentum driving the industry toward a vibrant future.

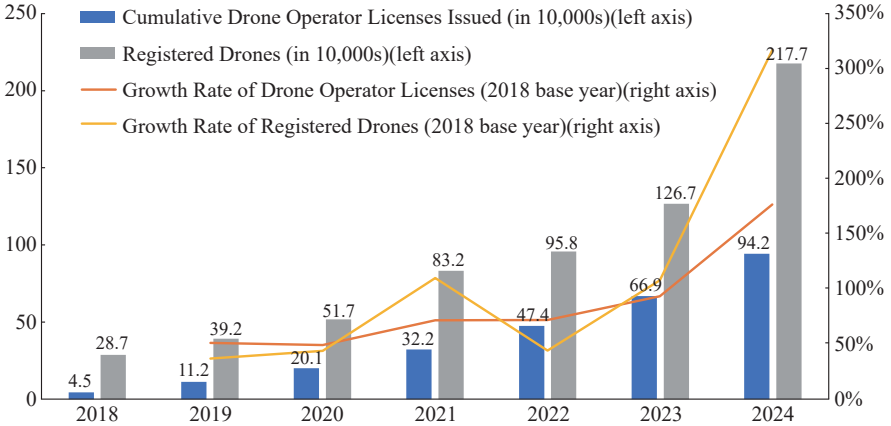

Figure 2: Growth of the Drone Industry (2018–2024)

Source: Compiled by the authors based on the *Civil Aviation Industry Development Statistics Reports* (2018–2024).

[3] Source: Compiled by the authors based on the *2024 Statistical Bulletin on Civil Aviation Industry Development*.

2.2 Defining Features of the Low-Altitude Economy

At this stage, China's low-altitude economy has established a solid foundation for achieving large-scale, regular, and sustainable development. As a crucial component of strategic emerging industries and a hallmark representative of new quality productive forces, it has rapidly transitioned from the pilot demonstration phase to widespread commercial application. With its expanding business scope and growing range of use cases, the sector is demonstrating innovative characteristics that set it apart from traditional general aviation.

From an innovation perspective, the low-altitude economy leverages information and digital technologies to expand its application scenarios, giving rise to new industry paradigms and business models (Wang & Ni, 2024). Beyond simply replacing traditional general aviation for tasks such as logistics, agricultural protection, and emergency rescue, the widespread use of information technology in drone swarms has enabled new "low-altitude+" business models. This has created innovative services such as aerial performances, cultural tourism experiences, and live streaming from above, which have significantly broadened the industry's boundaries. Additionally, as piloted flight technologies such as electric vertical take-off and landing (eVTOL) aircraft mature, the low-altitude economy shows immense potential for point-to-point urban commuting. Unlike traditional aircraft that require long runways, eVTOLs can take off and land on rooftops or in small spaces at the edge of a city. This makes them an ideal fit for densely populated urban environments.

Technological innovation within the low-altitude economy is characterized by three key features. (1) Technological Integration: The low-altitude economy integrates cutting-edge technologies from multiple fields to form a comprehensive and sophisticated innovation system. In manufacturing, advanced technologies such as lightweight composite materials, new corrosion-resistant coatings, electric propulsion systems, and high-energy-density batteries are widely used to significantly improve aircraft safety, stability, and endurance. (2) System Coordination: Relying on advanced software and hardware, such as low-altitude airspace management systems, digital twin platforms, and integrated air-to-ground communication links, aircraft can achieve highly efficient coordination with each other and with ground control systems. This significantly enhances the safety and regulatory efficiency of multiple aircraft operating simultaneously. For example, a low-altitude airspace management system ensures that multiple aircraft can operate without collisions or conflicts and are fully traceable through functions such as aircraft identity authentication, flight approval, airspace designation, trajectory tracking, and collision warnings. (3) Intelligence: Thanks to the widespread use of infrared detectors and LiDAR, along with AI algorithms and big data analytics, modern low-altitude aircraft have transitioned from manual control to autonomous systems. These systems have the ability to "[intelligently] perceive, autonomously decide, and collaboratively execute" on their own. Once a mission objective is set, the aircraft can make independent decisions, reducing reliance on remote human operation and improving flight stability and mission execution in complex environments.

3. Growth Drivers and Potential Advantages of China's Low-Altitude Economy

As an emerging strategic sector, the low-altitude economy's development has been a phased expansion from localized pilot programs to a nationwide, scalable industrial system with sustained growth. However, as a complex industry at the intersection of policy, technology, and market forces, its growth and adoption are highly uncertain and intricate. Grasping the underlying logic of its evolution requires a deep understanding of the sector's growth drivers. This knowledge is essential for crafting

targeted policies and planning future industrial layouts to guide the low-altitude economy from scattered trials to widespread adoption. This section, based on the current state of China's low-altitude economy, outlines its core growth drivers and further discusses the country's potential advantages in developing the industry while considering its specific national context.

3.1 Growth Drivers of the Low-Altitude Economy

The rise of the low-altitude economy is the result of multiple factors working in concert, driven by a combination of historical opportunity and market necessity. Technological breakthroughs, policy guidance, and capital investment are the three core drivers that have propelled the low-altitude economy from its initial launch into a phase of sustained acceleration.

3.1.1 Technological breakthroughs as the primary driver

The low-altitude economy is fundamentally a technology-driven industry. Its development is highly dependent on the innovation and integration of key technologies, and it is precisely these scientific and technological breakthroughs that have made the low-altitude economy a reality. From a value chain perspective, every segment, from upstream aircraft manufacturing and midstream control and scheduling to downstream mission execution and applications, relies on technological progress. For example, in the case of drones, the use of new materials and high-energy batteries has solved previous issues of flight safety and endurance, turning the concept of aircraft manufacturing into a reality. Furthermore, the application of 5G communications and BeiDou navigation has enabled in-air information exchange and precise positioning, overcoming the limitations of traditional aviation CNS (Communication, Navigation, Surveillance) systems or radar, and allowing for real-time sensing, rapid dispatch, and mid-air collision avoidance. Additionally, thanks to computing advancements and artificial intelligence (AI), aircraft can now be simulated in virtual systems and develop autonomous decision-making capabilities through self-learning. This has dramatically expanded the range of aircraft applications. Without this complete technical framework, it would be difficult to ensure high-density, safe, and orderly low-altitude operations, posing significant public safety risks. For this reason, technological breakthroughs are the foundational and primary condition for the industry's growth and serve as the essential prerequisite for all low-altitude economic applications and business model innovations.

3.1.2 Policy guidance is the key accelerator

The low-altitude economy is not just a high-tech sector, it is also a high-risk, high-investment industry that relies heavily on a robust institutional framework. The industry faces systemic challenges, including building infrastructure, securing airspace, ensuring flight safety, conducting meteorological assessments, and navigating a complex regulatory framework. Relying on market forces alone to solve these issues would be slow, inefficient, and, in many cases, impossible. This is where government policy steps in, acting as both a catalyst for progress and a crucial safety net. As a vital national asset, low-altitude airspace needs clear rules on how it is used, opened, and regulated to ensure safe and sustainable development. In recent years, a flood of supportive policies from central and local governments, such as the *14th Five-Year Plan for General Aviation Development* and the *Interim Regulations on Unmanned Aircraft Flight Management*, has unlocked airspace for commercial use and boosted market confidence. Beyond regulatory support, the industry also requires massive investments in infrastructure, including airports, communication towers, and monitoring platforms. These projects are expensive, time-consuming, and offer low short-term returns, making them potentially unsustainable for private companies alone. By launching pilot programs and industry incubators, local governments have

significantly lowered the barriers to entry for businesses, speeding up project rollouts and fueling growth across the entire supply chain. It is for these reasons that governmental guidance has been a major driving force behind the low-altitude economy's rapid rise.

3.1.3 Capital supply as a powerful catalyst

As China's economy transitions away from traditional, energy-intensive, high-leverage, and labor-intensive sectors, its capital is actively seeking new avenues for growth, and the low-altitude economy has emerged as a prime target due to its high-tech nature, extensive value chain, and deep integration with AI and new energy. This influx of capital provides three key boosts to the industry's rapid ascent. (1) Easing Financial Bottlenecks: For startups, capital provides a lifeline during the capital-intensive phases of technology development, prototype testing, and business model validation. This funding allows companies to build technological moats, accelerate the development of core hardware and software, and shorten their time to market. It also gives them the financial runway to explore sustainable business models in areas like logistics, tourism, and urban air mobility, speeding up the industry's commercialization. (2) Raising Visibility and Sparking Policy Action: Investments from prominent funds and industrial giants have put the low-altitude economy in the national spotlight, attracting media attention and prompting a positive policy response from local governments. Cities including Shenzhen, Chengdu, and Suzhou have responded by creating their own industry plans and establishing multi-billion yuan special funds to support local businesses and build pilot airspaces. (3) Strengthening Resilience: In a fast-evolving market, a large supply of capital is not just about survival, it is about gaining a crucial "time window" Well-funded companies can weather initial losses, focus on tackling key technical challenges, and launch pilot operations to get through the industry's early "winter" phase. Projects with capital backing also tend to get government pilot licenses more easily, which accelerates the entire development process.

3.2 China's Advantages in Advancing the Low-Altitude Economy

The low-altitude economy sits at the critical intersection of multiple frontier technologies, positioning it as a key driver for nurturing "new quality productive forces". It is also a crucial force for transforming transportation, modernizing emergency response, and building smart cities. In recent years, the Chinese government has recognized this immense opportunity and elevated the low-altitude economy to an emerging strategic industry. By coordinating policy, technology, funding, and market development, the government aims to guide the industry from its exploratory phase to an orderly expansion. In this effort, China's institutional strengths, vast market size, and robust industrial base collectively form a unique advantage for fostering the "high-quality" development of the low-altitude economy (Ni & Wang, 2025).

3.2.1 A super-sized market that offers a dual dividend of demand and talent

According to the data from the Seventh National Population Census, China's population was approximately 1.408 billion in 2022. This enormous population creates a dual dividend of consumer demand and talent supply, which are critical for the low-altitude economy's future growth. A huge population base means a vast consumer market. As China's middle-income group expands, consumer behaviors and purchasing power continue to evolve. For the urban middle-income group in particular, personalized, convenient, and highly efficient services have become a priority. For example, drone delivery improves the speed and convenience of traditional logistics, and eVTOL passenger transport offers a faster and more efficient way to commute within cities. These applications may serve a market

of over a billion people, providing a vast "blue ocean" for companies to pursue commercialization and large-scale operations. However, the massive population also provides an abundant supply of talent, forming a solid foundation for the low-altitude economy's long-term, "high-quality" development. According to the Ministry of Education, China admitted 1.3568 million graduate students in 2024, including 171,100 doctoral students and 1.1857 million master's students. In the same year, the total number of students enrolled in graduate programs reached 4.0954 million, with 676,300 doctoral students and 3.4192 million master's students[4]. This vast talent pool can act as a "reservoir" for the future development of the low-altitude economy, ensuring that the industry not only has a sufficient workforce but can also leverage specialized skills to drive the entire development chain, from technological research to industrial implementation. Thus, China's population size signifies not only a huge market potential on the demand side but also a talent resource advantage on the supply side. This "dual dividend" represents a highly strategic, endogenous driver that gives China a unique advantage in the development of its low-altitude industry.

3.2.2 A well-established industrial chain as a foundation for growth

The low-altitude economy is a dynamic new sector that blends aerospace, new energy, communications and navigation, artificial intelligence, and other cutting-edge fields, and its success hinges on seamless collaboration and synergy between upstream and downstream players. China boasts the world's most comprehensive industrial chain, which covers 41 major categories, 207 medium categories, and 666 subcategories of production capacity. This vast network gives China a global edge in critical areas such as batteries, composite materials, navigation systems, and drone manufacturing. It also enables the smooth integration and practical use of these technologies in low-altitude applications. Beyond that, this well-rounded industrial ecosystem has fostered a thriving community of mature small and medium enterprises (SMEs) as well as support suppliers. These players deliver reliable services across the value chain, spanning aircraft design, manufacturing, R&D, testing, and maintenance. With such a broad manufacturing base and sophisticated supply chain, China can support every stage of the low-altitude economy's lifecycle, from initial design and production to downstream use. This speeds up the shift from "concept" to "real-world" and allows companies to adjust product designs and service offerings swiftly to meet market needs. In addition, a fully integrated industrial chain delivers significant cost benefits. By leveraging its robust manufacturing foundation, established supply networks, and advanced logistics, China can tap into economies of scale that drive down industry-wide costs, giving it a clear competitive advantage on the global stage.

4. Real-World Challenges in Developing a "High-Quality" Low-Altitude Economy

Driven by strong policy support, technological breakthroughs, and market demand, China's low-altitude economy has rapidly expanded to establish a presence across various regions. It stands as a prime example of how the fusion of technological and industrial innovation can cultivate new quality productive forces. However, with this rapid growth come numerous structural and institutional challenges. Clearly identifying and analyzing these real-world obstacles is crucial not only for guiding the development of the low-altitude economy but also for effectively linking the innovation chain with the industrial value chain.

[4] Source: *Statistical Bulletin of National Education Development in 2024*.

4.1 The Risk of Coercive Sanctions on Key Technologies

Thanks to its robust industrial base and comprehensive manufacturing system, China has made significant progress in drone manufacturing and flight control systems. It has achieved independent design and production for most low-altitude aircraft components, and many of its technologies are among the world's leaders. However, China still relies on imports for some high-end core components. This dependence leaves the low-altitude economy vulnerable to sanctions and coercive measures from other countries, posing three key risks to its long-term development. First, heavy reliance on high-performance aviation components: Despite major advancements in its aviation industry, China still lags behind global leaders in areas such as aircraft engines and flight control systems. Core technologies in these fields remain heavily dependent on imports (Zhang & Huang, 2024). Second, lack of autonomy in high-end flight control chips: The future of low-altitude aircraft lies in their integration with artificial intelligence, which demands increasingly powerful and stable computing and control chips. Currently, China has a significant manufacturing gap in high-end flight control chips, preventing full self-reliance. This could constrain the sustainable development of the industry over the long term. Third, gaps in precision mapping and intelligent sensors: China still trails behind more advanced nations in technologies such as high-precision mapping and intelligent sensors. Many widely used high-precision radar systems and sensors rely on mature foreign products, and the domestic substitution rate remains low. A potential supply cutoff could pose a serious threat to the safety of low-altitude flight in China (Zhang & Huang, 2024).

4.2 Slow and Uneven Development of Supporting Infrastructure

The development of China's low-altitude economy has been hampered by slow infrastructure construction and a lack of standardized norms. The total number of physical infrastructure facilities is low, their regional distribution is imbalanced, and construction standards are inconsistent. At the end of 2024, China had only 475 registered general aviation airports, a stark contrast to the 19,482 general airports in the United States (which includes 5,146 public and 14,336 private airports)[5]. Most of China's airports are concentrated in the eastern coastal and economically developed regions. In contrast, central, western, and remote areas, which have abundant airspace resources and a wide range of potential applications, have very limited airport coverage, making it difficult to support a wide-area, continuous low-altitude service network. In terms of layout, existing infrastructure often suffers from a lack of clear hierarchy, overlapping functions, and dispersed locations, leading to low operational efficiency and poor resource allocation. Furthermore, the development of new infrastructure, such as eVTOL takeoff and landing pads, fueling stations, and weather stations, has been sluggish. Even in provinces and cities that have initiated planning and bidding for low-altitude infrastructure, the lack of unified construction standards has hindered project implementation. This, to a certain extent, restricts the application scenarios and market expansion of the low-altitude economy. However, there are also shortcomings in software infrastructure. Critical support systems, such as geographical information services and airspace monitoring platforms, are still underdeveloped. The lack of data standards and inconsistent system interfaces across different regions makes it difficult to achieve seamless integration and interoperability between hardware and software, hindering the efficiency and regional collaboration of the low-altitude industry.

4.3 Immature Business Models and Narrow Profit Pathways

The low-altitude economy, although spanning fields from general aviation, drone logistics to urban

[5] Source: Federal Aviation Adminstration, "Air Traffic By The Numbers," July 30, 2025, https://www.faa.gov/air_traffic/by_the_numbers.

air mobility, remains largely in an exploratory phase. Most companies operate without a mature business system or a clear path to profitability, leaving the industry's future direction uncertain and its financial returns weak. Many general aviation and drone firms today remain dependent on local fiscal support, project funding, and policy dividends and have yet to develop self-sustaining capabilities. If policy support or funding were to slow down, some companies could face significant operational challenges, making it difficult to maintain long-term viability. Furthermore, some pilot projects, such as low-altitude tourism, are overly dependent on unique local environments. For example, a "drones + cultural tourism" model is suitable for cities with rich historical sites or a beautiful landscape. Without a standardized service model, however, these projects cannot be easily replicated in other regions, which severely limits the industry's ability to scale and expand nationwide.

4.4 Low Public Acceptance and Untapped Market Demand

From a user perspective, the low-altitude economy faces a major obstacle: lack of public acceptance. Potential market demand has yet to be translated into actual consumer spending, becoming a key bottleneck for the industry's high-quality development. First, the public still has doubts about the safety of low-altitude aircraft. Unlike traditional, familiar civil aviation, these new vehicles are unproven to many. Public doubts about their stability and safety can create fear and distrust, making consumers less willing to use them. Second, the high cost of services presents a major barrier. Current low-altitude applications, such as urban air taxis and drone logistics, often come with a high price tag. Although they offer a clear advantage in saving time compared to traditional methods, they lack a price advantage, making them a luxury rather than an accessible option for the public. Additionally, daily use cases are still limited. Most low-altitude services are currently one-time experiences, far from being a part of daily life, and current low-altitude aircraft are still vulnerable to adverse weather, which renders them unable to provide the all-weather, all-day service that consumers have come to expect for logistics and commuting. This limits the industry's dynamism and broad appeal.

4.5 Legal and Regulatory Frameworks Lag Behind Market Needs

As the low-altitude economy evolves from traditional general aviation into a distinct, emerging industry, a significant disconnect has also emerged between its rapid growth and the existing legal and regulatory frameworks. These outdated rules have failed to keep pace with the regulatory needs of new technologies and business models. The expansion of the low-altitude sector has brought to the forefront urgent issues such as airspace security, privacy violations, and data sovereignty (Chen, 2025). However, current laws such as the *Civil Aviation Law of the People's Republic of China* and the *General Aviation Flight Control Regulations* lack clear guidelines and regulatory tools to address these challenges. Furthermore, the legislative landscape is "fragmented" and lacks "sufficient authority" (Jiang & Feng, 2025). Without clear guidance, this ambiguity can lead to unclear responsibilities and lack of clear legal basis for recourse for both businesses and the public in case of disputes, increasing the risk for companies engaged in low-altitude flight, logistics, or aerial tourism. Regulatory oversight has also lagged. There are no clear, enforceable rules to govern the rapid rise of emerging technologies and industries such as drones and eVTOLs. Although some local governments have launched pilot projects, the overall system lacks top-down design and unified standards, which has led to inconsistent rules and fragmented policies across different regions. For example, the approval process for large low-altitude

aircraft such as flying cars remains cumbersome and inefficient. Finally, a lack of regulatory capacity and technological tools presents another major challenge. The low-altitude sector involves a wide range of mobile products and operations, which demands real-time weather monitoring, risk warnings, and precise flight control. However, the current low-altitude air traffic management system has significant shortcomings in terms of radar coverage, data sharing, and personnel training, creating potential safety and oversight risks.

5. Integrating Tech and Industry to Boost the Low-Altitude Economy

5.1 Tackling Development Challenges through Tech and Industry Innovation

After years of rapid growth, the low-altitude economy has emerged as a powerful new driver for economic progress in China. Yet, this rapid rise has also laid bare some deep-rooted challenges. On the tech front, hurdles include "choke points" in core technologies and the steep costs of products and services. On the application side, issues range from incomplete infrastructure and untested business models to low public buy-in and outdated legal and regulatory systems. Looking through the lens of industrial ecosystem theory, these obstacles fundamentally boil down to how the ecosystem's core components, players, resources, and the surrounding environment, interact, adapt, and evolve. This theory suggests that neither tech breakthroughs nor industrial innovations alone can fully tackle the industry's current roadblocks. The real solution lies in deeply blending technological and industrial innovation, creating a cohesive cycle among ecosystem players, resources, and conditions to elevate the low-altitude sector to new heights (Li & Fan, 2025; Hong & Lv, 2017).

From a technical perspective, challenges such as core technology "choke points", high service costs, and limited public acceptance stem from the sector's immature technological foundation. This immaturity leaves the industrial chain short of full independence, fails to ease public safety worries, and keeps the marginal costs of low-altitude services high. In theory, tech innovation can tap into resources including funding, talent, and expertise to ease these pressures. But tech alone cannot fix everything; problems also tie into industrial coordination, research support, real-world applications, and workforce development, which go beyond pure technical fixes. This calls for a tighter fusion of technological and industrial efforts to ensure a smooth flow between ecosystem players and resources. Only then can the low-altitude economy break through barriers, from "R&D to market deployment". Take the issue of advanced technology bottlenecks, for example. It might seem like a narrow tech delay, but is really a symptom of bigger systemic issues: an immature high-end industrial ecosystem, patchy supporting infrastructure, and weak links between research and market-ready products. Even when breakthrough tech emerges, without a solid industrial chain, standardized production, and steady market demand, it often fails to take off in practice. Similarly, if the industrial side fails to build a strong consumer base, tech advances lack a stage for continuous testing and feedback, stalling further innovation. The path forward thus lies in weaving technological and industrial innovation together, connecting every step from research and testing to production and sales. This approach ensures control over core technologies and paves the way for the low-altitude economy's sustainable growth.

From an application perspective, the challenges facing the low-altitude economy stem from its early exploratory phase. The industry's future direction is still murky, market demand has yet to fully kick in, and some companies rely on few revenue streams, including policy support, to stay afloat. This has led to delayed institutional planning and insufficient infrastructure investment, further holding back overall

progress. These hurdles can be tackled by actively broadening low-altitude use cases and sparking innovation in industrial business models to ignite market interest. For instance, we advise China's government to boost supporting infrastructure by tailoring facilities for low-altitude operations to specific needs, thereby avoiding wasted resources and gaps from redundant construction. We also advise it to promote sustainable business models by identifying new profit pathways during industrial innovation, standardizing application scopes and service models to shape the future of the sector. It should also strengthen legal and regulatory frameworks to develop clear rules on rights and responsibilities, aligned with real-world usage and business needs, to plug institutional gaps. That said, industrial innovation should not race ahead without considering technological limitations. The path forward must be built on the current feasibility of low-altitude technologies. Only by rooting business model innovation in mature, reliable tech can these efforts deliver real results and avoid becoming "paper innovation" (Li & Xie, 2024).

At first glance, the deep-rooted issues holding back China's low-altitude economy might seem to reside in either technology or industry alone. But in reality, those issues are tightly interwoven. Industrial innovation can reshape the landscape by improving the ecosystem's environment. Yet, without breakthroughs in key technologies and the foundational support they bring, these efforts risk falling flat or becoming "empty innovation". However, technological advances without industrial validation and institutional backing cannot unlock their full potential. Tackling these challenges requires a synchronized push in both technological and industrial innovation. This dual approach is the only way to break through current bottlenecks, fine-tune the industrial ecosystem, refine business models, and unlock lasting market growth. In essence, the development of the low-altitude economy hinges on a "double-helix" evolution in which tech and industry innovation twist together to drive progress forward.

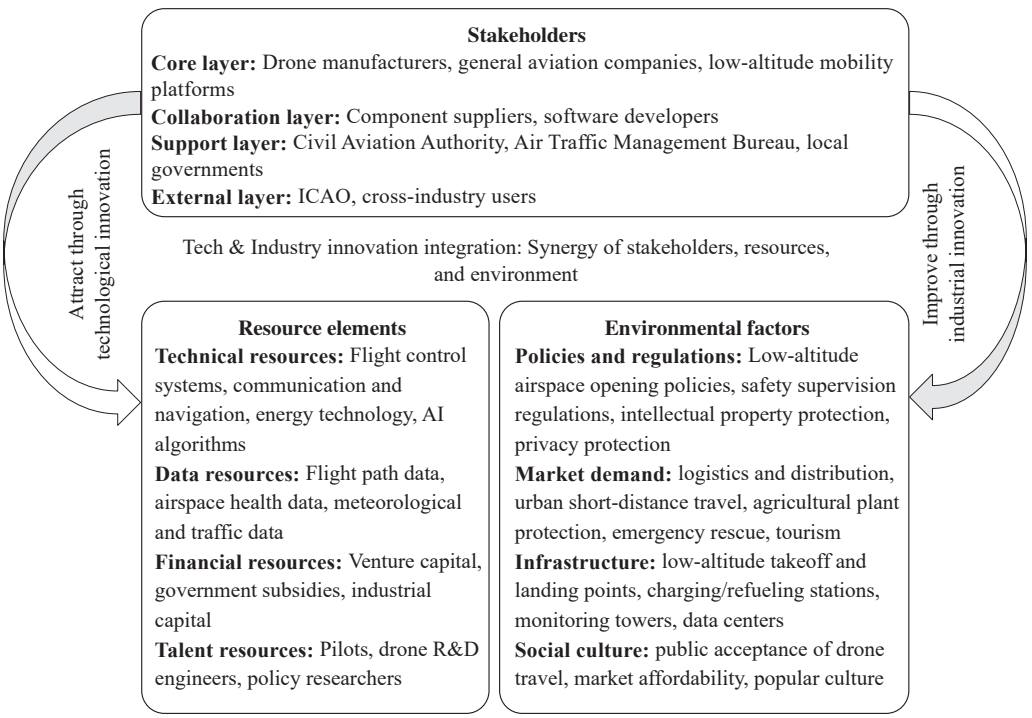

Figure 3: Integrated Paths to High-Quality Development of the Low-Altitude Economy

5.2 Policy Recommendations for the Low-Altitude Economy

5.2.1 Pioneering growth with pilot cities

The maturation and large-scale adoption of application scenarios are crucial for turning technological breakthroughs into real-world productivity. Pilot cities, in this sense, can act as trailblazers, providing a template for nationwide adoption of low-altitude solutions. The Central Air Traffic Management Committee has already designated six cities as initial eVTOL pilot sites: Hefei, Hangzhou, Shenzhen, Suzhou, Chengdu, and Chongqing. The CAAC also issued the *Guidelines for the Construction of Civil Unmanned Aviation Test Bases (Test Zones)*, approving 17 test zones and 3 test bases. These cities and regions can lead the way in exploring business models, urban applications, infrastructure, legal frameworks, and safety regulations. By being the first to break through institutional bottlenecks, they can help to create a predictable and enforceable regulatory environment for the low-altitude economy. Once pilot programs mature and standardized processes are established, tailored application scenarios can be promoted based on each region's unique resources and industrial strengths. The most promising sub-sectors can then be chosen for demonstration operations. For instance, Beijing and Shenzhen, with their strong R&D capabilities, can focus on pioneering cutting-edge technologies and setting industry standards. Chengdu and Chongqing, as populous urban centers, can prioritize applications such as urban commuting and logistics, and Xi'an and Luoyang, with their rich cultural and tourism resources, can explore new business models such as low-altitude sightseeing and drone light shows. China's western regions can focus on geological exploration and disaster monitoring. Moreover, agricultural provinces in China's Central Plains can pilot smart agricultural machinery and drone-assisted farming. By using this "pilot first, then scale" strategy, cities can create replicable models that accelerate the low-altitude economy's transition from "local trials" to "nationwide adoption".

5.2.2 Building a diverse low-altitude innovation ecosystem

The ultimate success of technological and industrial innovation depends on both companies and skilled professionals. Therefore, China should actively implement the national strategies of "revitalizing the nation through science and education" and "strengthening the country with talent" to build a strong pool of innovative talent and enterprises for the low-altitude economy. The government should establish dedicated funds or programs for the low-altitude sector to support tech-focused small and medium-sized enterprises (SMEs). By providing financial support, tax breaks, and fast-tracked approval processes, these policies may encourage startups to tackle key technologies and foster a new generation of industry leaders with strong homegrown innovation capabilities. Universities should be also encouraged to establish relevant disciplines in low-altitude economy management, aircraft manufacturing, intelligent control, and data processing. They should create integrated training bases and joint programs with industry partners to cultivate well-rounded professionals who understand technology, operations, and regulations. Since low-altitude flight routes and applications often cross regional boundaries, regions should strengthen the collaborative flow of talent and projects. By leveraging key industrial parks and free trade zones, they can build low-altitude innovation ecosystems and regional alliances that promote the efficient convergence of talent, capital, and technology. Finally, attracting top overseas talent to participate in low-altitude technology and standards development may help to create an open and inclusive innovation environment, providing a continuous source of internal momentum for the low-altitude economy.

5.2.3 Streamlining low-altitude regulation

The healthy development of the low-altitude economy depends on a safe, standardized, and efficient governance environment. Currently, China's low-altitude airspace management is fragmented across multiple authorities, including military and civil aviation. This fragmented structure, with its complex and time-consuming approval processes, has become a significant bottleneck that hinders the implementation of technological advancements and the expansion of the industry. To address this, we recommend that the State Council lead the formation of a cross-departmental regulatory body. This new agency may be able to unify the management of both military and civilian airspace resources, establishing a clear, responsive, and efficient service and oversight system. At the central level, it could manage core functions such as airspace designation, flight approvals, real-time monitoring, and data security. Corresponding low-altitude regulatory agencies would be established at the provincial level to coordinate with the newly formed Low-Altitude Economy Development Department under the National Development and Reform Commission (NDRC), thus breaking the fragmented oversight structure. A unified regulatory framework could set clear standards and streamline processes, providing the institutional foundation for the integrated development of technological and industrial innovation. This body should also act as a bridge, promoting information sharing and joint standard-setting among the government, businesses, and research institutions that could foster a two-way innovation mechanism for flight testing and operational demonstrations, potentially creating a supportive policy and market ecosystem for the "high-quality" development of the low-altitude economy.

5.2.4 Forging global partnerships for market growth

With its technology-intensive, application-rich, and industry-driving traits, the low-altitude economy is a key strategic frontier that countries around the world have been vying to dominate. Currently, the United States and European countries have more mature general aviation industries and have established robust technical standards and regulatory systems for airworthiness certification, airspace management, and aircraft manufacturing. China, although holding advantages in aircraft production, new energy, and communications, still faces choke points in critical technologies such as chips and engines. To secure a leading position in this new round of global competition, China needs to participate in and influence the formulation of global industry rules. Domestic research institutions and leading enterprises should be encouraged to conduct joint R&D and collaborative research with top international institutions and high-tech companies. Establishing platforms such as an "International Joint Laboratory for the Low-Altitude Economy" or a "Global Low-Altitude Technology Innovation Fund" could help tackle core challenges in next-generation aircraft and system architecture. China should also leverage national strategies such as the "Belt and Road Initiative" to create multilateral technological cooperation mechanisms. By launching major collaborative projects with BRICS nations, the European Union, and other partners, China may be able to co-develop low-altitude economy technical standards, achieve mutual recognition of these standards, and enhance its rule-making influence in the sector.

6. Conclusion and Outlook

The low-altitude economy, which blends multiple frontier technologies, stands out as a prime example of "new quality productive forces" and a key driver for China's future high-quality economic growth. China's low-altitude sector has moved beyond "conceptual exploration" into "industry building" and has ridden a

wave of policy support, tech breakthroughs, and capital investment that hint at a leapfrog surge. This paper examined China's low-altitude economy through five lenses: Its development journey, current traits, growth drivers, potential strengths, and real-world challenges. Using industrial ecosystem theory as a guide, it outlined a development roadmap and policy suggestions focused on tightly weaving together technological and industrial innovation. As a critical frontier for nurturing new quality productive forces, the low-altitude economy offers unmatched strategic opportunities alongside complex practical challenges. Only by pushing forward with both tech and industrial innovation can China forge a dynamic, interconnected ecosystem that links players, resources, and conditions to turn the low-altitude economy into a strategic pillar for China's path to modernization and global competitiveness.

Looking ahead, China's low-altitude economy should anchor itself in domestic demand while also keeping an eye on global competition. A few key trends stand out. (1) The rise of a vast commercial ecosystem: The future low-altitude economy will not just be about selling individual products like drones or eVTOLs. It is likely to evolve into a full-fledged industrial ecosystem that covers aircraft manufacturing, smart air traffic systems, tailored application services, and the creation of legal and technical standards. It is also set to team up with emerging tech such as AI, big data, and the Internet of Things to play a role in shaping smart cities. (2) A new strategic frontier in global competition: Europe and the United States currently lead in traditional general aviation, aircraft engines, and chips, and China shines in new-energy propulsion and communication-navigation systems. With global rules yet to fully take shape, the low-altitude economy brings both risks and opportunities. If China can set international standards, crack core technologies, and dominate industrial chains, it could forge new paths to leadership. By tapping into initiatives such as the Belt and Road, China could widen its global market and boost its industrial clout. (3) Profound impacts on daily life and governance: As uses such as low-altitude travel, aerial logistics, emergency response, environmental monitoring, and cultural-tourism experiences grow and become mainstream, the sector could shift from "niche trials" to "everyday applications", weaving into how people work, live, and move. It can become a game-changer for handling crises, modernizing urban governance, and supporting green, low-carbon shifts by offering fresh tools to enhance national governance systems and capabilities. CE

References:

Bai X. J., Zhu Z. Y. Innovation Development Model and Future Directions of China's New Energy Vehicle Industry [J]. China Economist, 2024(6): 31-57.

Chen Y. W. Regulatory Challenges, International Experience, and Collaborative Governance Pathways for China's Low-Altitude Economy [J]. Journal of Dongbei University of Finance and Economics, 2025(4): 31-45.

Hong S., Lv R. S. A Review of Research on China's Industrial Innovation Ecosystem [J]. Inquiry into Economic Issues, 2017(5): 38-44+50.

Jiang Z. Q., Feng X. Basic Conceptions for a Low-Altitude Economy Promotion Law: Positioning and Systematic Expansion [J/OL]. Science and Management, 1-12.

Li M. N., Xie T. Q. China's Development Path for the Low-Altitude Economy: Leveraging Technological Self-Reliance to Build New Quality Productive Forces [J]. Science and Technology Management Research, 2024(17): 1-9.

Li T. H., Fan Z. S. Logical Framework, Practical Dilemmas, and Strategic Choices for High-Quality Development of the Low-Altitude Economy [J/OL]. Journal of Xichang College (Social Sciences Edition), 2025: 1-10.

Lou M. Z., Yu G. F. Industrial Ecosystem Theory and Its Applications [J]. Contemporary Finance & Economics, 2009(1): 116-122.

Ni H. F., Wang S. S., Song C. C. The Unique Advantages and Major Measures of China's Low-Altitude Economy Development [J]. Globalization, 2025(3): 71-82+135.

Ouyang R. H. How the Low-Altitude Economy Drives the Formation of New Quality Productive Forces: Mechanisms and Pathways [J]. Journal of Xinjiang Normal University (Philosophy and Social Sciences Edition), 2025(1): 118-131.

Wang S. S., Ni H. F. Conceptual Analysis and Economic Implications of the Low-Altitude Economy [J/OF]. Journal of Xi'an University of Finance and Economics, 2025: 1-14.

Zhang X. L., Huang W. R. Global Trends, China's Current Situation, and Promotion Strategies for Low-Altitude Economy Development. Economic Review, 2024(8): 53-62.

Zhao J. L. High-Quality Development of the Low-Altitude Economy: Connotations, Constraints, and Breakthrough Paths. Contemporary Economic Research [J], 2025(4): 27-42.