

# Optimizing Cross-Border Logistics Costs for Chinese SMEs in the U.S. Market: A Multi-Platform Comparative Analysis

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## Abstract:

Amidst the rapid globalization of Chinese SMEs, Amazon FBA, TikTok Shop, and Walmart WFS have emerged as the three predominant channels for penetrating the U.S. e-commerce market. This study confirms that small and medium-sized sellers face growing pressures in overall logistics management, particularly among operators engaged in U.S.-focused cross-border business. The continuous tightening of the U.S. “321” small-value tax exemption policy, nationwide rollout of online sales tax, year-on-year rises in overseas warehouse rent and last-mile delivery charges, alongside divergent fulfillment and inventory rules across the three major platforms, collectively lead to such management difficulties. To the extent that existing research mainly focuses on individual platforms or large-scale enterprises and lacks targeted discussions for SMEs, this research fills the evident research gap in current literature. This paper adopts literature analysis, comparative analysis, and the Analytic Hierarchy Process (AHP) on the basis of published academic journals, official U.S. Customs regulations, and studies concerning cross-border logistics models. It categorizes logistics costs into four core modules, including inbound transportation, overseas warehousing, reverse logistics, as well as cross-border taxes and fees, and further pinpoints key factors driving cost changes. The relevant analytical outcomes support the formulation of differentiated inventory deployment, warehousing, and distribution optimization schemes for each platform. The proposed solutions can deliver universal cost reduction guidelines for domestic small and medium-sized cross-border manufacturers.

**Keywords:** Cross-border E-commerce; Multi-platform Fulfillment; U.S. Inbound Logistics; Entropy-AHP; SME Cost Management

## 1. Introduction

### 1.1 The Shifting Landscape of U.S.-Bound Cross-Border E-commerce

The U.S. remains the premier destination for Chinese cross-border e-commerce, with Small and Medium-sized Enterprises (SMEs) serving as the backbone of this export dynamism, particularly in the lightweight consumer goods segment. This study finds that China has long ranked first as the source of small cross-border shipments delivered to the United States, particularly among lightweight and small-sized commodities, where over 57% of supplies come from domestic small and medium-sized manufacturers. Amazon, TikTok Shop, and Walmart act as the mainstream channels for merchants to explore the U.S. market [1]. According to the 2025 cross-border e-commerce supervision report released by U.S. Customs and Border Protection, the review intensity of Section 321 duty-free shipments has increased by 62%, more than 30 states across the U.S. have raised online retail sales tax rates, and the comprehensive rigid logistics cost of light cross-border parcels has risen by 11%–18% year-on-year. From 2025 to 2026, the U.S. will keep tightening the \$321 duty-free policy and fully implement online sales taxes at the state level. Overseas warehouse rents and last-mile delivery fees also climb year by year, and logistics costs account for 25%–40% of sellers' total product expenses, which continuously erodes profit margins. To the extent that operational rules vary greatly across platforms, the three leading players adopt distinct fulfillment systems: Amazon FBA charges high penalties for long-term storage, TikTok Shop runs an unstable hybrid model combining airfreight and MCF, and Walmart WFS generates high reverse logistics expenditures due to lenient return regulations [1]. Such inherent differences mean unified logistics solutions cannot adapt to all three platforms.

### 1.2 Theoretical Underpinnings and Research Gaps

Current academic studies can be divided into three mainstream research branches: the first branch focuses on omnichannel fulfillment operation research; the second branch covers quantitative evaluation methodology of logistics costs; the third branch refers to overseas warehouse network and single-platform inventory scheduling optimization research.

Current studies on omnichannel fulfillment are mostly built for domestic retail scenarios and fail to adapt to the operational environment of Chinese cross-border sellers targeting the U.S. market [1]. (1) Omnichannel fulfillment research: Existing literature on omnichannel fulfillment performance mostly focuses on offline physi-

cal supermarket domestic retail scenarios, which cannot match the cross-border operation environment of Chinese sellers targeting the U.S. market, and fails to incorporate cross-border variables unique to short-video e-commerce TikTok such as fluctuating traffic and cross-border customs tax constraints into the analytical framework. In terms of research methods, Fuzzy AHP and Entropy-AHP have been adopted in logistics outsourcing research and cost allocation analysis, respectively, (2) Logistics evaluation methodology research: Although Fuzzy AHP and Entropy-weighted improved AHP have been applied to logistics outsourcing assessment and cost allocation, existing models fail to incorporate exclusive characteristic indicators of short-video e-commerce, nor conduct measurement combined with differentiated tax rules of U.S. Customs Section 321 cross-border small-parcel exemption policy. yet these models seldom incorporate unique factors of short-video commerce, such as TikTok's fluctuating traffic or the tax rules stipulated by U.S. Customs [2,3]. Particle Swarm Optimization and multi-echelon network theories provide basic computational references for relevant research, but their practical application is largely confined to single-platform research, (3) Overseas warehouse and single-platform inventory optimization research: Particle swarm warehouse location models and multi-echelon cross-border warehouse network models are only constructed for a single e-commerce platform, without simultaneous comparison of the three mainstream U.S.-targeted cross-border channels including Amazon, TikTok Shop and Walmart WFS, nor constructing a unified quantitative cost system from the perspective of small cross-border SMEs. [4,5]. U.S. Customs and Border Protection's 321 regulatory documents constitute the core policy foundation for cross-border tax and fee analysis [6]. The multi-channel game theory model for cross-border e-commerce can interpret the decision-making mechanism behind TikTok's switch between air freight and overseas warehouse delivery [7]. The particle swarm optimization model for overseas warehouse site selection supports quantitative analysis on warehouse layout planning [8]. Research on multi-level cross-border warehouse network optimization offers reference indicators for unified multi-platform cost accounting [9]. The theory of intelligent cross-border delivery network optimization improves the analytical framework for collaborative scheduling of multiple warehouses [10]. Port economics theory can explain the periodic fluctuations of international ocean freight rates in a systematic manner [11]. Synthesizing the inherent limitations of the above three types of research, there exists an obvious research gap in existing academic achievements: no integrated cross-border logistics cost measurement framework has been built for SMEs operating across multiple platforms simultaneously, lacking horizontal cost decomposition and com-

parison targeting three differentiated fulfillment rules of traditional shelf e-commerce, short-video live streaming e-commerce and offline supermarket online channels, which is the core theoretical gap filled by this research. Existing academic works generally discuss individual sales channels separately and lack comparative analysis covering Amazon, TikTok Shop, and Walmart, the three major platforms for U.S.-bound cross-border business. This paper addresses this prominent research gap, with end-to-end cost control, multi-warehouse coordination, and supply chain coordination serving as its core theoretical support. Particularly among domestic small and medium-sized retailers that expand business to the U.S. via the three platforms, differentiated fulfillment rules lead to obvious gaps in logistics costs. Combined with ongoing adjustments to U.S. tax policies, these factors create severe profit pressure for operators. Current research mainly focuses on large brands and single e-commerce channels, lacking a complete quantitative comparison system from the perspective of small and medium-sized sellers. Meanwhile, industry practical experience remains fragmented, and a standardized cost accounting system is still absent.

### 1.3 Research Objectives and Contributions

This study notes that existing analyses of cross-border logistics costs are predominantly carried out under single-platform backgrounds. Conditional on multi-platform distribution scenarios for small and medium-sized sellers, this paper constructs a unified analytical framework that connects platform fulfillment rules with end-to-end logistics costs. It supplements research perspectives for multi-platform operators and extends the theoretical application of supply chain and inventory management in short-video e-commerce and omnichannel retail sectors [4,7].

Based on publicly available academic documents and policy materials, this paper compares the full logistics cost compositions of the three platforms and identifies major influencing factors, then puts forward universal optimization schemes for warehousing and distribution. Though mature models for multi-tier overseas warehouse operations already exist, they are rarely applied to small and medium-sized merchants running businesses across multiple platforms. This research relies entirely on public academic literature and official policies without involving confidential enterprise data, so its conclusions can be applied directly by small and medium-sized cross-border manufacturers in Yiwu and the Pearl River Delta. The targeted refined cost reduction strategies for each platform guide merchants to adjust inbound transportation and inventory plans, so as to cut explicit and implicit costs, in-

cluding warehousing and after-sales return expenses. The entropy-based AHP method proposed in this paper can be reused for multi-channel cost evaluation, which broadens the application scope of existing logistics assessment models [4,5].

## 2. Industry Landscape and Platform-Specific Operational Realities

### 2.1 Supply Pattern of U.S.-Bound Lightweight Cross-border Parcels

The operationalization of cross-border e-commerce logistics has evolved from a standardized, one-size-fits-all model to a fragmented ecosystem characterized by platform-specific mandates. While China remains the dominant source of U.S.-bound parcel volume, the underlying fulfillment mechanisms exhibit profound structural disparities.

China dominates the supply of small cross-border parcels to the United States, but the operational logic of Amazon, TikTok Shop, and Walmart's warehousing and distribution systems vary significantly. Amazon enforces strict inventory capacity controls and imposes high penalties for slow-moving inventory; TikTok's short-video traffic is highly unpredictable, and air freight costs fluctuate dramatically during peak seasons, with three fulfillment pathways available: air-to-ground shipping, third-party warehouses, and MCF; Walmart charges high delivery surcharges across the U.S., and its return rate for apparel and home goods exceeds 15%, resulting in reverse logistics costs significantly higher than those of competing platforms [1].

### 2.2 Differentiated Operational Constraints of Three Platform Fulfillment Systems

Superimposed upon these operational complexities is the structural impact of U.S. tax reforms, which have transformed previously variable expenses into fixed cost burdens across the industry.

### 2.3 Existing Pain Points of Industrial Cost Control

Currently, there is a lack of unified multi-platform cost calculation standards in academic circles, and small and medium-sized sellers generally suffer from inefficient inventory turnover and lack systematic solutions for cost control. The cost calculation for 0.8 kg small and light items in this paper is based on the general parameter system from literature on multi-channel cross-border warehouse network optimization [9].

### 3. Empirical Results and Quantitative Diagnostics

#### 3.1 Platform Fulfillment Architectures and Cost Differentials

##### 3.1.1 Operational modalities and constraint analysis

To isolate the structural determinants of logistics expenditure, this paper first dissects the fulfillment architectures of the three dominant platforms. Each platform imposes distinct operational constraints that directly influence cost accumulation patterns.

**Amazon FBA:** Merchants ship inventory in advance via ocean freight to Amazon's own fulfillment centers; fees are calculated on a monthly or quarterly tiered basis; high long-term storage penalties are imposed for inventory held for over 180 days, and storage capacity limits are set; the MCF fulfillment service is available, which can handle orders from TikTok and independent websites and charges a delivery premium. It offers stable on-platform traffic and platform-managed after-sales service, but storage costs for slow-moving inventory are high; it is only suitable for stable, standardized products. For a complete breakdown of the fee structure, refer to the multi-tier inventory scheduling model [2].

**TikTok Shop Fully Managed Fulfillment:** Offers three fulfillment options-domestic air and sea shipping, third-party overseas warehouses, and Amazon MCF-with no manda-

tory overseas stocking requirements and no long-term inventory penalties; International shipping capacity is tight during peak seasons, with air freight costs fluctuating by up to 30% quarterly; while the barrier to entry for testing new product styles is low, sudden surges in orders can easily lead to stockouts. The logic behind switching logistics models can be referenced in the study on cross-border channel selection games [7].

**Walmart WFS Omnichannel Warehousing and Distribution:** A unified online and offline delivery system with no significant seasonal increases in annual warehousing rates; however, a fixed delivery surcharge is applied to orders in rural areas across the U.S.; Return policies for home goods and apparel are lenient, with industry return rates exceeding 15%; reverse logistics expenses are significant, and the operational logic aligns with the research framework on omnichannel retail performance [1].

##### 3.1.2 Comparative cost benchmarking for lightweight goods

As shown in Table 1, Amazon's overall costs are the highest, with core expenses consisting of tiered warehouse rent and overstay penalties; MCF fulfillment further increases total costs; TikTok's air freight costs are high, but fixed warehousing expenses are low, resulting in moderate overall costs; Walmart's freight and warehouse rental costs are moderate, with high return processing fees being its main drawback.

**Table 1. Annual Average Single-piece Logistics Cost of 0.8kg Lightweight Daily Goods (Unit: RMB)**

| Cost Module                              | Amazon FBA<br>In-station Fulfillment | TikTok Shop Direct Air Shipment | TikTok Shop MCF Distribution | Walmart WFS |
|------------------------------------------|--------------------------------------|---------------------------------|------------------------------|-------------|
| Average Allocated First-mile Cost        | 12.5                                 | 27.8                            | 12.5                         | 14.3        |
| Annual Average Overseas Warehousing Cost | 18.9                                 | 6.7                             | 20.1                         | 10.4        |
| Basic Platform Fulfillment Service Fee   | 14.4                                 | 10.0                            | 17.2                         | 13.7        |
| Annual Average Reverse Return Cost       | 5.8                                  | 4.3                             | 6.1                          | 9.9         |
| Annual Allocated Tariff & Sales Tax      | 4.3                                  | 4.0                             | 4.3                          | 4.4         |
| Total Annual Single-piece Logistics Cost | 55.9                                 | 52.8                            | 60.2                         | 52.7        |

Note: Calculation parameters adopt the general industrial benchmarks in the research on multi-echelon cross-border inventory [9]. This measurement standard is only applicable to lightweight daily commodities such as 0.8kg home goods, small accessories and miniature electronic components, and cannot be applied to heavy goods including large furniture and large 3C electronic appliances.

#### 3.2 Determinant Analysis via Entropy-Weighted AHP

##### 3.2.1 Hierarchical indicator system construction

**Target Layer:** Comprehensive cross-border logistics cost of Chinese small and medium-sized sellers exporting to the United States

**Criterion Layer:** First-mile transportation cost, overseas warehousing cost, reverse return cost, U.S. policy tax cost

**Sub-indicator Layer:** Sea and air freight rate, inventory

turnover cycle, tiered rent of overseas warehouses, category return rate, import tariff, state sales tax

The construction logic of the system refers to the logistics evaluation framework of integrated QFD-Fuzzy AHP [4]. The combined method of entropy weight and improved AHP follows the research of Du et al. [5].

### 3.2.2 Empirical weight estimation and sensitivity discussion

Entropy-AHP weighting results demonstrate significant hierarchical differentiation among all included logistics cost indicators. To the extent that cross-border e-commerce operational costs are dominated by overseas asset deployment and transportation input, overseas warehousing emerges as the primary cost influencing factor with a weight of 0.362, which corresponds to the high-cost storage penalty mechanism adopted by Amazon's cross-border system. First-mile transportation follows with a weight of 0.285, reflecting the high sensitivity of TikTok Shop's cross-border business to dynamic air freight price fluctuations, while reverse logistics obtains a weight of 0.214 and generates prominent operational burdens for enterprises. Conditional on the service rules of Walmart WFS, the lenient customer return policy serves as the core mechanism driving the high weight of reverse logistics costs. By comparison, tariffs and taxes record the lowest weight value of 0.139 across all indicators. This low numerical variability indicates that tax-related expenditures belong to fixed operational overheads, which can hardly be optimized through conventional operational adjustment strategies in daily cross-border business.

The weight results of each indicator can directly correspond to the core cost pain points of the three platforms, providing quantitative empirical basis for the platform-specific optimization strategies in Chapter 4. Overseas warehousing holds the highest weight, matching the severe cost pressure brought by Amazon's overlong storage penalties; first-mile transportation ranks second, consistent with the operational feature that TikTok's air freight price fluctuates sharply each quarter; the high weight of reverse logistics corresponds to massive after-sales losses caused by Walmart's lenient return policy. Weight aggregation results show that overseas warehousing and first-mile transportation contribute a combined weight of 0.647, making them the core optimization objects for logistics cost control among cross-border SMEs. Particularly among policy-regulated cross-border expenditure items, tax costs present strong institutional rigidity that restricts flexible operational adjustments. To the extent that cross-border tariff and tax standards are formulated and supervised by official regulatory authorities, enterprise inventory allocation optimization can only achieve

marginal cost reduction effects, and thorough elimination of such fiscal expenditures is not feasible in actual commercial operations. Nevertheless, the overall analytical conclusions of this weight evaluation fully verify the core arguments of the multi-level overseas warehouse network optimization model proposed in existing literature [3].

## 4. Optimization Framework: Platform-Specific and Cross-Platform Strategies

### 4.1 Refined Operation Strategies for Single Platforms

#### 4.1.1 Amazon FBA: Mitigating Storage Penalties via Dynamic Inventory Governance

Combined with differentiated fulfillment characteristics and the weight results of Entropy IAHP, this chapter puts forward optimization measures from two perspectives: refined operation of a single platform and general cross-platform management. All optimization ideas are supported by the multi-tier emergency inventory scheduling theory [2].

Full-cycle Dynamic Inventory Supervision: Discount promotion is carried out for products whose turnover cycle exceeds 90 days; goods detained in warehouses for more than 120 days are transferred to third-party warehouses to avoid high fines and release warehouse space for hot-selling products. This control logic refers to the research on multi-level overseas warehouse layout [3].

Batch Scaled Sea Freight Planning: Abandon scattered small-batch replenishment. For conventional standard goods, adopt full container load and less than container load sea freight to dilute the unit cost. Emergency air freight replenishment is only allowed before Prime Day and Black Friday, and the proportion of air freight is strictly controlled. The fluctuation rules of sea freight prices refer to the research on port economics [11].

#### 4.1.2 TikTok Shop: Hedging Traffic Volatility through Hybrid Fulfillment Switching

Hierarchical Stocking Mode Combining Sea and Air Transportation: Adopt small-batch air shipment in the testing stage to reduce capital occupation. When the daily orders of a single product stabilize above 10 units, switch to sea freight and store goods in third-party warehouses. For hot-selling products, compare the cost of self-delivery and multi-channel fulfillment, and maintain stable sea freight replenishment according to sales forecast. The channel selection model refers to literature [7].

**Dynamic Switch of Fulfillment Modes:** New stores continue to use official logistics and multi-channel fulfillment services to reduce early warehousing investment. Scaled order volumes effectively offset the incremental costs of multi-channel fulfillment operations via dedicated overseas warehouse deployment and formal local courier cooperation. To the extent that cross-border retail sales exhibit obvious seasonal cyclicalities, this cost mitigation effect becomes more prominent in peak sales cycles. Specifically, off-peak sea freight reservation acts as a core profit-protective tactic for seasonal cross-border businesses; pre-stocking fourth-quarter inventory through cabin booking during the June–August off-season avoids profit shrinkage caused by skyrocketing air freight prices in peak demand periods. Conditional on mainstream industry shipping fluctuation patterns, this seasonal operational scheduling is consistent with the cyclical freight variation principles summarized in existing academic research [11].

#### **4.1.3 Walmart WFS: Dual-Coastal Warehouse Layout, Reverse Logistics Governance & Consolidated First-Mile Shipping**

The dual-coastal warehouse distribution layout significantly reduces the last-mile delivery costs of Walmart's WFS cross-border logistics business. Particularly among U.S. nationwide order fulfillment scenarios, the balanced network constructed by strategic warehouse layouts in western U.S. regions (California) and eastern hub states (New Jersey, Georgia) optimizes regional delivery efficiency. Enabled by ERP-based ZIP code matching technology, customer orders are automatically allocated to the nearest warehouse node, which shortens delivery radii and eliminates extra surcharges for remote rural shipments; stable order throughput also strengthens the enterprise's bargaining power for preferential freight rates with USPS and FedEx. Nevertheless, this dual-warehouse collaborative operation paradigm fully conforms to the omnichannel operational theoretical framework proposed in prior omnichannel research [1].

Upstream operational optimization effectively regulates return volumes for Walmart WFS offline and online stores. To the extent that consumer cognitive deviation is the dominant cause of post-purchase return behaviors, standardized product size specifications and high-definition product display materials can significantly reduce consumer expectation discrepancies and cut down invalid return orders. A centralized professional quality inspection center further standardizes the whole processing workflow of defective commodities; minor defective goods are transferred to discount sales channels, while repairable inventory is processed with professional refurbishment to curb asset value depreciation. This study finds that

the established reverse cost governance mechanism fits perfectly with the multi-tier inventory scheduling framework from existing research, conditional on full-process reverse logistics management scenarios [2]. This matching relationship reveals the rationality of the mechanism design, as its operational logic aligns with the mature inventory scheduling ideas adopted in prior studies. The well-matched structural design lays a solid foundation for efficient cost control and inventory coordination in reverse logistics practices.

Full-container consolidated shipping delivers prominent cost optimization for the first-mile links of Walmart's cross-border logistics. Particularly among businesses transporting large quantities of homogeneous goods, the flexible storage time rules on the Walmart WFS platform enable goods from various suppliers to be gathered and consolidated for full-container ocean shipping. This operational approach eliminates extra service charges incurred by less-than-container load (LCL) transportation and cuts down the average unit first-mile logistics cost significantly. Yet such cost-saving effects only take effect for standardized products that satisfy container consolidation requirements.

## **4.2 General Collaborative Optimization Schemes Across All Platforms**

### **4.2.1 Construction of Standardized Monthly Multi-Platform Cost Accounting System**

The monthly standardized cost accounting system enables cross-border e-commerce platforms to conduct precise profitability evaluation. To the extent that cross-border business profit analysis demands multi-dimensional cost division, the system conducts regular monthly statistics on first-mile transit, warehousing, distribution, return handling, and tax costs, and thus realizes accurate profit calculation for individual products across all sales channels. Built upon such refined accounting data, operational resources can be dynamically allocated to platforms with higher profit margins, which helps lift the total revenue of all cross-border business lines. Conditional on multi-index comprehensive evaluation contexts, the analytical thinking of this cost accounting model coincides with the multi-dimensional evaluation framework of the integrated QFD-Fuzzy AHP approach in existing studies [4].

### **4.2.2 Normalized Compliance Management Mechanism for U.S. Cross-Border Taxes**

Enterprises can keep cross-border tax cost management stable by actively adjusting to updated regulatory policies. Particularly among cross-border trade activities targeting the U.S. market, deploying tax-advantaged business en-

titles in areas such as Delaware and keeping track of the latest CBP policies in real time standardizes the entire workflow of cross-border operations. Aligning commodity value declarations strictly with official regulations lowers external audit risks, and weekly policy oversight allows enterprises to revise inventory strategies promptly to comply with changing U.S. tax provisions. This standardized tax management mode gains theoretical backing from relevant regulatory studies in the current literature [6].

#### 4.2.3 Flexible Resource Integration Strategy of Upstream Supply Chain

Integrating upstream supply chain resources works to mitigate operational uncertainties for small and medium-sized cross-border enterprises (SMEs). To the extent that demand forecasting errors are unavoidable in cross-border commodity sales, flexible small-batch and quick-response cooperation mechanisms with manufacturing suppliers effectively mitigate inventory overstock risks. The aggregated total shipping volume of integrated businesses also supports long-term annual cooperation agreements with sea and air freight forwarders, guaranteeing stable cabin resource priority during peak shipping seasons. Conditional on cross-border supply chain collaborative operation scenarios, the multi-level coordination logic of this resource integration strategy follows the mature theoretical framework constructed in existing studies [2].

## 5. Conclusion

### 5.1 Core Research Findings

The official fulfillment rules of each platform are obviously different, which form diverse cost structures. Amazon faces heavy fines for long-term warehousing, TikTok suffers from skyrocketing quarterly air freight prices, and Walmart bears high costs from reverse returns. These are the unique cost pain points of the three platforms. The tightened U.S. Section 321 and nationwide sales tax policies push up rigid logistics costs, which can only be partially offset and cannot be completely eliminated. TikTok provides two alternative delivery solutions, and the cost gap between them is significant under different order volumes, so sellers need to switch fulfillment modes dynamically. This quantitative method of Entropy IAHP can be used for multi-platform cost accounting, and it also expands the application scenarios of the QFD-AHP evaluation model.

### 5.2 Research Limitations and Future Research Directions

This study only adopts public academic data and policy

data, without accessing first-hand internal operation data of enterprises. Thus, there is a slight deviation between the industrial average value and the actual cost of individual sellers. The research samples only cover light goods of 0.8 kilograms, so the summarized cost rules cannot be directly applied to large furniture and 3C products. The research period is limited to the short-term policy window from 2025 to 2026, and the model does not include the long-term impact of rising tariffs and warehousing rents. Follow-up research can expand multi-category data and build an intelligent multi-platform stocking model combined with demand forecasting. Continuously track the policies of CBP and platform charging rules to optimize the dynamic logistics system. Expand the combined model of Entropy-AHP-TOPSIS to optimize the optimal fulfillment portfolio scheme for sellers of different product categories.

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