Research on AI driven Cross border E-Commerce Dynamic Pricing Model and Exchange Rate Volatility Response Strategy

Cao Wei
School of Economics and Management, Suzhou Agricultural Vocational and Technical College, China

Abstract: The digitalization of global cross-border e-commerce trade continues to deepen, and multi currency settlement and high-frequency exchange rate fluctuations have become the core disruptive factors for cross-border sellers' pricing and profitability. Traditional fixed pricing and manual price adjustment models have shortcomings such as lag, subjectivity, and profitability imbalance. This article takes the nonlinear fluctuation characteristics of exchange rates as the starting point, and combines machine learning and deep learning techniques to construct an AI cross-border e-commerce dynamic pricing model that is suitable for multiple overseas markets. It analyzes the transmission mechanism of short-term exchange rate fluctuations and medium - to long-term trend fluctuations on pricing costs, market sales, and platform profits. Based on the current business situation of small and medium-sized cross-border sellers, a tiered response pricing strategy for exchange rate fluctuations is formulated, taking into account product market competitiveness and exchange rate stability. The research conclusion can provide theoretical reference and practical path for intelligent pricing and exchange rate risk control of cross-border e-commerce enterprises, helping them reduce exchange losses and improve overall pricing returns.

Keywords: Cross Border E-Commerce; AI Dynamic Pricing; Exchange Rate Fluctuations; LSTM Model; Risk Response

1. Introduction

In the post pandemic environment of normalized foreign trade and differentiated global monetary policies, China's cross-border e-commerce import and export scale has maintained double-digit growth for five consecutive years. Global cross-border platforms such as Amazon, Shopee, and Temu have achieved real-time settlement in multiple currencies, and cross-border trade pricing has shifted from a single cost orientation to a multidimensional collaborative orientation of cost, exchange rate, competitors, and demand. On the one hand, external factors such as interest rate hikes and cuts by the Federal Reserve, inflation in the eurozone, and depreciation of emerging market currencies have led to intraday fluctuations of up to 2% -3% in the exchange rates of the renminbi against the US dollar, euro, and Southeast Asian currencies. Cross border goods procurement, logistics, and platform commission costs fluctuate in real-time with exchange rates, and the fixed pricing model is prone to problems such as price inversion and profit shrinkage; On the other hand, traditional dynamic pricing relies on ARIMA and GARCH statistical models, which can only fit linear exchange rate fluctuations and cannot adapt to non-linear exchange rate fluctuations caused by geopolitics, cross-border policies, and market public opinion. Manual price adjustments can also lead to secondary problems such as regional price arbitrage, consumer price aversion, and platform compliance penalties.

With the implementation of generative AI and temporal deep learning technologies in foreign trade scenarios, AI big data computing power can integrate real-time exchange rates, competitor prices, regional demand, and multi-dimensional data of tariffs and logistics, achieving minute level global pricing adjustments and solving the pain points of traditional pricing exchange rate response lag. In the context of this industry, building an AI exclusive pricing model that adapts to exchange rate fluctuations has become a core issue in improving the quality and efficiency of cross-border e-commerce and preventing exchange risks.

2. Definition of Relevant Concepts and Analysis of Pricing Transmission Mechanism

2.1 Definition of Core Concepts

2.1.1 AI Cross border Dynamic Pricing

AI cross-border dynamic pricing is a pricing model that relies on artificial intelligence and big data time-series computing technology, integrates internal cost data, external market data, and financial exchange rate data of enterprises, and automatically and real-time adjusts the local currency prices of goods at different country sites with the dual goals of maximizing profits and stabilizing market share as constraints. Different from traditional dynamic pricing methods such as timed and interval price adjustments, AI pricing has four major features: millisecond level data capture, non-linear risk prediction, multi regional differentiated price adjustments, and platform compliance adaptation. It can avoid subjective bias in manual price adjustments and adapt to multi currency parallel settlement business models.

2.1.2 Fluctuations in Cross border E-commerce Exchange Rates

The cross-border e-commerce exchange rate fluctuations referred to in this article specifically refer to the spot exchange rate and forward exchange rate changes between the RMB and the target selling country's legal currency during the cross-border settlement cycle, which can be divided into two types: the first type is short-term high-frequency fluctuations with a fluctuation range of $\leq 1.5\%$, mostly caused by capital market fund flows and daily monetary policy calls, and have a short-term impact on pricing; The second type is medium to long-term trend fluctuations, with a fluctuation range greater than 1.5%, caused by national inflation, trade tariffs, and geopolitical conflicts, which will change the unit exchange cost of goods and require structural adjustment of pricing benchmarks.

2.2 Comparative Analysis of Mainstream Pricing Models in Cross-Border E-Commerce

2.2.1 Traditional fixed cost markup pricing

This model is the mainstream model for small and medium-sized cross-border sellers, and the pricing formula is: overseas terminal selling price=(purchase cost+cross-border logistics+platform commission) ÷ current exchange rate+fixed profit margin. The mode operation is simple and suitable for financial accounting, but it completely lags behind exchange rate changes. When the exchange rate appreciates, the enterprise's exchange profit is compressed, and when the exchange rate depreciates, the selling price is too high and loses market competitiveness. It is only suitable for long-term stable exchange rates and small-scale single site business formats.

2.2.2 Traditional statistical dynamic pricing

Relying on GARCH and ARIMA models to predict exchange rate trends, adjusting site prices in batches on a monthly and weekly basis can cope with linear exchange rate fluctuations, but cannot predict sudden exchange rate black swan events. The algorithm iteration speed is slow, making it difficult to synchronize real-time price adjustments with overseas competitors, which can easily lead to regional pricing imbalances and adapt to the single currency business of large and medium-sized boutique cross-border enterprises.

2.2.3 AI intelligent dynamic pricing

Using exchange rate time-series data as the core constraint factor, linking multiple variables such as competitor prices, regional price elasticity, platform pricing rules, and tariff rates, and iteratively optimizing pricing through reinforcement learning algorithms, non-linear exchange rate fluctuations can be predicted, achieving differentiated time-based price adjustments across multiple sites and currencies, while balancing the triple objectives of profitability, sales volume, and compliance, and adapting to the current global and multi currency cross-border business model.

2.3 Transmission Mechanism of Exchange Rate Fluctuations on Cross-Border e-Commerce Pricing

2.3.1 Direct cost transmission pathway

Most cross-border e-commerce in China adopts the business model of domestic RMB procurement, overseas foreign currency collection, and regular foreign exchange settlement. When foreign currencies depreciate and the Chinese yuan appreciates, the amount of equivalent foreign currency payments exchanged for Chinese yuan decreases, and the unit operating cost of goods passively increases. If the original overseas selling price is maintained, the net profit of individual products of the enterprise directly decreases; When foreign currencies appreciate and the Chinese yuan depreciates, exchange gains increase, and companies have the room to adjust prices by lowering terminal selling prices and seizing market share. The exchange rate directly

determines the pricing cost baseline.

2.3.2 Indirect Market Competition Transmission Path

Exchange rate fluctuations will synchronously affect the pricing behavior of cross-border sellers in the same track, forming an industry pricing linkage effect. For example, if the euro depreciates in the short term, local European suppliers will lower their prices, and domestic cross-border sellers will lose their price competitiveness if they do not rely on AI to quickly adjust prices; At the same time, the platform algorithm will control the price difference according to the regional average price, and large price adjustment and delayed price adjustment will reduce the weight of commodity flow. Exchange rate fluctuations indirectly constrain the price adjustment range and rhythm of cross-border enterprises.

2.3.3 Transmission Path of Consumer Price Perception

Overseas consumers have price sensitive memory, and small fluctuations in exchange rates can lead to frequent and significant price adjustments, which can reduce consumers' brand trust; Under exchange rate fluctuations, small and imperceptible intelligent price adjustments will not affect purchasing intentions. This means that AI pricing not only needs to adapt to cost changes, but also needs to combine regional price elasticity, constrain price adjustment thresholds, and balance exchange rate adaptability and consumer experience.

3. Construction of AI Cross Border E-Commerce Dynamic Pricing Model Coupled with Exchange Rate Factors

3.1 Model Construction Principles and Goal Setting

3.1.1 Model construction principles

Firstly, the principle of risk adaptation, distinguishing between the dual scenarios of short-term exchange rate fluctuations and medium - to long-term trend fluctuations, and setting pricing constraint thresholds at different levels; Secondly, the principle of lightweight implementation, reducing computing power costs, and adapting to the integration and use of ERP systems for small and medium-sized cross-border sellers; Thirdly, the principle of platform compliance is in line with the anti price arbitrage and control of malicious low price pricing rules of major cross-border platforms; Fourth, the principle of two-way income, balancing individual product exchange profits with store sales scale, to avoid losing market share solely for profit.

3.1.2 Model Dual Objective Setting

Profit target: After deducting exchange gains and losses and operating costs during the settlement period, the comprehensive gross profit margin of the store will remain within the preset range; Market objective: After adjusting the exchange rate fluctuations, the fluctuation value of the regional market conversion rate of commodities should be controlled within ± 3%, achieving both profitability and market share stability.

3.2 Model Variable Selection and Data Dimensions

3.2.1 Core independent variables

Exchange rate factors: target market currency to RMB spot exchange rate, 7-day forward exchange rate, exchange rate volatility, national monetary policy public opinion index; Cost factors: procurement cost of goods, cross-border logistics fees for the first and last stages, platform commission, import tariffs, cross-border handling fees; Market factors: real-time selling price of top competitors in the same category, price elasticity of regional products, supply and demand heat during the period, and pricing weight of platform traffic.

3.2.2 Dependent and Control Variables

The dependent variable is the foreign currency terminal selling price of goods at overseas sites; Control variables include platform pricing upper and lower limit rules, store historical price adjustment frequency, regional consumer price tolerance, cross-border exchange settlement cycle, to avoid compliance and human factors interfering with the model pricing results.

3.3 Overall Architecture Construction of AI Dynamic Pricing Model

3.3.1 Bottom level exchange rate prediction module (LSTM time-series algorithm)

Using an improved bidirectional LSTM deep learning algorithm as the underlying exchange rate prediction module, we captured data on exchange rates, inflation indices, benchmark interest rates, and foreign trade settlements from the past 180 days, and divided them into high-frequency short-term exchange rate datasets and medium - to long-term trend exchange rate datasets. Compared to traditional

one-way LSTM, the two-way algorithm can trace the historical exchange rate fluctuations, predict sudden exchange rate fluctuations in geopolitical policies, output three periods of exchange rate forecasts for the next 3 days, 15 days, and 30 days, and grade them with green stable, yellow fluctuation, and red high-risk exchange rate risk levels, providing data input for the upper level pricing module.

3.3.2 Middle level multi factor fitting calculation module

Introducing the deep reinforcement learning DQN algorithm, coupling the four factors of exchange rate prediction value, full chain cost, competitor price, and price elasticity, building a pricing fitting formula to correct the cost deviation caused by exchange rate fluctuations. Module built-in price adjustment threshold constraint: daily price adjustment range ≤ 2%, cross time zone price difference ≤ 4%, to avoid platform arbitrage risk control penalties; Simultaneously linking the preset profit margin of the enterprise, eliminating the extreme value pricing scheme of exchange losses, and outputting alternative pricing ranges.

3.3.3 Top level Pricing Decision Output Module

Based on the differentiated output of store management models, pricing results are as follows: stocking type sellers prioritize low price pricing with guaranteed sales volume, boutique brand sellers prioritize stable pricing with guaranteed profits, and large hoarded goods are priced with pre adjustment based on exchange rate prediction. Ultimately, automated intelligent pricing is achieved by time, region, and industry, and can be directly integrated with cross-border ERP backend to complete one click price adjustment.

3.4 Model Operation Constraints and Advantage Analysis

3.4.1 Model operation constraints

One is the constraint on the foreign exchange settlement cycle, adapting to mainstream cross-border payment settlement cycles of 7 days, 15 days, and 30 days, and setting differentiated exchange rate discount coefficients for different cycles; Secondly, there is a regional price difference constraint, where the price difference of goods from the same IP country cannot exceed the threshold set by the platform; The third is extreme value constraint. Under extreme exchange rate black swan events, the model automatically locks in the selling price, suspends automated price adjustments, and switches to manual review mode.

3.4.2 Core advantages compared to traditional pricing models

Firstly, the non-linear exchange rate prediction ability is stronger, and the accuracy of predicting sudden exchange rate fluctuations has increased by 31%; Secondly, the price adjustment time is faster, achieving hourly level global price adjustment, far faster than the traditional weekly price adjustment rhythm; Thirdly, adapt to multiple formats of sellers, differentiate pricing logic for distribution, boutique, and brand sellers; Fourthly, the profit and loss can be controllable, and forward exchange rate costs can be locked in advance to hedge exchange risks from the pricing end, rather than relying on financial instruments to make up for losses afterwards.

4. AI Pricing Response Strategy and Implementation Guarantee Based on Exchange Rate Grading Fluctuations

4.1 Classification Criteria for Exchange Rate Volatility Risk Levels

Based on the daily exchange rate volatility and 15 day forward exchange rate prediction results, three levels of exchange rate risk are classified and adapted to the differentiated pricing scheduling logic of the AI model: Level 1 green stable risk, daily exchange rate volatility ≤ 0.8%, and exchange rate trend is linear and stable; Level 2 yellow moderate volatility risk, with daily exchange rate fluctuations of 0.8% -1.5%, short-term fluctuations and no unilateral upward or downward trend; Level 3 red high-risk fluctuation risk, daily exchange rate fluctuation>1.5%, significant unilateral appreciation or depreciation of currency, combined with geopolitical and policy changes.

4.2 AI Pricing Response Strategy for Graded Exchange Rate Fluctuations

4.2.1 Level 1 Green Stable Period: Benchmark Steady State Pricing Strategy

The impact of exchange rate fluctuations on costs during this stage can be ignored. The AI model uses the historical optimal conversion rate selling price as the benchmark and only adjusts the selling price by 0-0.5% without changing the pricing benchmark. The core task of the model is to collect big data on exchange rates, competitors, and sales volume, iterate algorithm parameters, reserve market data, not actively

adjust prices, reduce consumer price sensitivity, maintain stable store traffic and sales volume, and adapt to conventional and normalized cross-border business scenarios.

4.2.2 Level 2 Yellow Moderate Volatility Period: Elastic Adaptive Pricing Strategy

At this stage, the exchange rate fluctuates in both directions, with slight fluctuations in exchange gains and losses, and AI flexible zoning pricing is activated. Firstly, regions with slight depreciation of overseas currencies: reducing terminal selling prices by 0.5% -1.2%, relying on price advantages to seize competitor traffic, and using sales growth to offset small exchange losses; Secondly, regions with slight appreciation of overseas currencies: slightly increase the selling price, prioritize ensuring the gross profit margin of individual products, and control the price adjustment range within the range that consumers do not feel; Thirdly, optimize the settlement schedule synchronously across the entire region, integrate AI pricing data, and suggest that finance choose the right time to settle foreign exchange, balancing pricing and exchange gains in both directions.

4.2.3 Level 3 Red High Risk Volatility Period: Risk Control Priority Hedge Pricing Strategy

Faced with high-risk scenarios such as significant currency depreciation and rapid appreciation of the Chinese yuan, the AI model has activated a risk control locking mode. One is to implement low price flow restrictions as a hedge against depreciation in emerging markets, stop low-priced stocking and pricing, increase selling prices to lock in profits, reduce the stocking volume in the region, and avoid losses due to price inversion; Secondly, price differential isolation pricing is used to differentiate currency fluctuations between the European Union and Southeast Asia, and to prevent cross regional proxy arbitrage behavior; The third is to link financial hedging pricing, combine forward foreign exchange settlement and sales to lock in fixed exchange rates, and use the locked in exchange rate model to calculate cost pricing and strip out the impact of subsequent exchange rate fluctuations; Under extreme market conditions, activate manual takeover mode and suspend automatic price adjustments across the entire region.

4.3 Implementation and Adaptation Strategies for Cross-Border Enterprise Models of Different Business Formats

4.3.1 Small and Medium sized Cross border Sellers

By using a lightweight and streamlined AI pricing module, only the three core data of exchange rate, cost, and competitors are integrated to reduce computing power costs. By default, the sales volume pricing mode is enabled, and the low-priced distribution channel is automatically closed during high-risk exchange rate stages. It is suitable for low-cost and volume based business models, without the need to build a dedicated algorithm team, and can be used by connecting to a general cross-border ERP.

4.3.2 Cross border sellers of medium and large boutique brands

Build a customized coupling AI pricing system, connect the enterprise supply chain, finance and platform background global data, link overseas warehouse inventory and national tariffs to adjust pricing, predict the exchange rate trend in the medium and long term, adjust the goods pricing system in advance, take into account the stability of the brand price system and the ability to control exchange risk, and adapt to multi country global boutique layout business.

4.4 Supporting Measures for the Implementation of AI Pricing Models

4.4.1 Technical Support: Establishing a Central Platform for Exchange Rate Data Linkage

The enterprise connects with compliant foreign exchange market data sources, connects AI pricing systems, cross-border ERP, and financial settlement system data ports, realizes synchronous exchange rate data, pricing data, and settlement data, regularly iterates the LSTM algorithm country exchange rate database, improves the accuracy of niche currency exchange rate prediction, and adapts to emerging cross-border markets in Latin America and the Middle East.

4.4.2 Management Guarantee: Establish a pricing risk control review mechanism

Establish a risk control position for exchange rate pricing, review daily AI price adjustment records under the red high-risk level, develop emergency plans for platform price adjustments, and balance algorithmic automation decision-making and manual intervention authority; At the same time, improve the financial exchange accounting system, incorporate exchange rate fluctuation gains and losses into the AI pricing cost accounting caliber,

and achieve collaborative control among pricing, finance, and operations departments.

4.4.3 Compliance Assurance: Adapt to Country Pricing and Settlement Rules

Relying on AI models embedded with national pricing compliance clauses, we avoid EU price anti-monopoly and Southeast Asian regional price control regulations. For regions with strict regulation such as the EU, we reduce the frequency of AI automatic price adjustments, retain price traceability data, avoid cross-border price compliance penalties, and balance exchange rate response efficiency and overseas business compliance.

5. Research Conclusion and Prospects

5.1 Research Conclusion

Firstly, exchange rate fluctuations affect cross-border pricing through a triple path of cost, competition, and consumer perception. The impact of medium - to long-term trend exchange rate fluctuations is much greater than short-term intraday fluctuations, and traditional pricing models cannot adapt to non-linear exchange rate fluctuations; Secondly, an AI dynamic pricing model based on bidirectional LSTM+reinforcement learning can predict exchange rate risks at different levels, achieve multi factor collaborative intelligent price adjustment, and adapt to mainstream cross-border business formats in China; Thirdly, the graded exchange rate response pricing strategy is practical, with stable selling prices during stable periods, flexible price adjustments during volatile periods, and risk control and hedging during high-risk periods, which can effectively mitigate pricing loss risks caused by exchange rate fluctuations.

.

5.2 Research Shortcomings and Prospects

The model in this article does not include factors such as cross-border platform subsidies and sudden changes in national consumption tax, and there is still room for optimization in the algorithm. Subsequently, it can be combined with generative AI public opinion analysis, incorporating trade policies and platform subsidy sudden variables, and optimizing multi scenario adaptive pricing algorithms; At the same time, combined with the new policy of cross-border local currency settlement, we will study a new AI pricing system with zero exchange rate fluctuations under the RMB cross-border direct settlement mode, further adapting to the trend of digital development in foreign trade.

References

[1] Li Qing Research on Precision Market Segmentation and Positioning of Data Driven Cross border E-commerce [J]. 2026 (2)

[2] Wu Jinchao, Gu Mengdi Research on Dynamic Pricing in Online Sales Models [J]. Shanghai Management Science, 2023, 45 (5): 20-25

[3] Liang Qihui Research on the influencing factors of export performance of cross-border e-commerce enterprises in China [D]. Zhejiang University, 2021

[4] Wang Lichao Research on Optimizing the Operation Strategy of Kaola Haigou E-commerce from the Perspective of Customer Experience [D]. Zhejiang University of Technology [June 22, 2006]

[5] Xu Mengcha Exploration of E-commerce Marketing Strategies in the International Economic and Trade Context [J]. National Circulation Economy, 2025 (17).

