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The Impact of RMB Settlement on China's Cross-Border E-Commerce Imports and Exports

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ABSTRACT
The current international monetary system is dominated by the U.S. dollar, whose hegemony and exchange rate fluctuations pose risks to China's cross-border e-commerce sector. Meanwhile, the application of RMB settlement in this field remains disproportionate to the scale of China's foreign trade and the rapid growth of cross-border e-commerce. Against the backdrop of the "Belt and Road Initiative" (BRI) and the development of free trade zones, this paper investigates the impact of RMB settlement on China's cross-border e-commerce imports and exports. Combining theoretical analysis and empirical evidence, the study constructs a theoretical framework based on an extensive literature review and employs monthly data from January 2020 to December 2024. Using a VAR model and relevant tests, it explores the dynamic relationships among the RMB real effective exchange rate (REER), cross-border RMB settlement volume (CSB), and B2C/B2B trade values. The findings provide reference for both the development of cross-border e-commerce and the internationalization of the RMB.

KEYWORDS
RMB internationalization; RMB settlement; Cross-border e-commerce; Import and export trade

1 Literature review

1.1 Research on RMB internationalization

Existing Chinese and foreign studies generally construct a systematic framework around the driving forces, pathways, and challenges of RMB internationalization, emphasizing that China's economic expansion and institutional reforms are the core drivers. Cui (2013) highlighted that China became the world's second-largest economy in 2010 and the largest exporter in 2009. The 2005 exchange rate reform and the 2009 pilot program for cross-border RMB settlement laid the foundation for RMB internationalization. Compared with the trajectories of the U.S. dollar and the euro, the RMB has gained initial influence in Asia via a "trade-driven" approach. Gao and Yu (2015) added that China's large foreign exchange reserves and BRI investments provided liquidity support, enabling RMB internationalization to overcome regional barriers through a "trade-and-investment dual engine," unlike Japan's yen, which relied excessively on financial liberalization. Mainstream views support a "gradual regionalization" pathway.

Cohen (2012) proposed a three-stage pathway from the perspective of currency functions, in which cross-border e-commerce serves as an important scenario for the first stage of settlement currency adoption. From 2010 to 2020, the share of RMB settlement in China's cross-border e-commerce rose from 0.5% to 15%, far exceeding the 8% share in traditional trade during the same period. Yuan. (2020) found that RMB settlement pilot policies provided internationalization application scenarios for cross-border e-commerce. Yan. (2021) argued that cross-border RMB settlement can serve as a lever for industrial upgrading in China's manufacturing-dominated exports. Bai (2021) further noted that exchange rate levels influence the extent to which cross-border e-commerce penetrates international markets.

1.2 Theoretical mechanisms of RMB settlement in cross-border e-commerce

According to the "iceberg cost" principle (Gao & Yu, 2009), eliminating the U.S. dollar as an intermediary in trade can save 15–20% in settlement costs. Cui (2013) emphasized that the CIPS system, offering 24/7 real-time clearing, reduces settlement cycles by over 60% compared with SWIFT, improving capital turnover efficiency. For example, after Alibaba International Station adopted CIPS, sellers' inventory turnover increased by 25%, while export orders grew by 18%.

Regarding exchange rate risk avoidance, Frankel (2012) introduced the "currency choice theory." Lei (2024) highlighted that offshore clearing centers in Hong Kong and Singapore facilitated platforms like Shopee and Lazada in expanding into Southeast Asia, where RMB payment adoption increased user conversion rates by 12–20% and boosted exports by 25%. Xie (2022) argued that RMB settlement reduces "logistics-finance" matching costs in the digital economy, improving inventory turnover by 12–15%. Yuan. (2020) noted that SMEs benefit from reduced costs and can reallocate resources to R&D, while Yan. (2021) observed that platform-based enterprises leverage economies of scale to amplify the cost advantages of RMB settlement.

1.3 Empirical evidence

Marconi (2017) showed that, across 11 Asian countries between 2010 and 2016, a 10% increase in RMB settlement coverage raised local export growth by 2.3–3.5 points, with Southeast Asia's elasticity (0.42) exceeding that of Central

Asia (0.35). For cost-sensitive sectors like 3C products and apparel, export prices declined by 5–8%, while orders increased by 12–15%. Shen (2022) demonstrated that RMB settlement alleviated dollar shortages in BRI regions compared with the U.S. and EU.

For imports, Marconi (2017) found that RMB settlement improved inventory turnover by 12–15%, reduced stockout rates from 15% to 8–10%, and shortened procurement cycles (e.g., Thai durian imports from 45 to 36 days). Yuan. (2020) estimated that RMB settlement pilots increased exports by about 23.5%, with stronger growth in labor- and capital-intensive products. Xie (2022) calculated that bonded imports using RMB settlement reduced procurement cycles by 20% and stockout rates by 8–10%.

2 Empirical design

This paper employs a VAR model to analyze the dynamic relationships among RMB internationalization, outward FDI, and cross-border e-commerce trade. The key variables include:

Table 1 Variable description and data source

Variable	Measurement methods	sources of date
B2C	Personal cross-border e-commerce commodity import and export trade volume	China General Administration of Customs
B2B	Cross-border e-commerce B2B import and export trade volume	China General Administration of Customs
REER	Real effective exchange rate of RMB	bank for international settlement
CSB	Cross-border RMB settlement amount	People's Bank of China

Monthly data from January 2020 to December 2024 (60 observations) are logarithmically transformed to reduce heteroskedasticity.

3 Empirical results and analysis

3.1 ADF unit root test

In order to avoid spurious regression, the variable is first tested for stationarity, and the results are as follows:

Table 2 ADF test for unit roots of variables

variable	ADF price	1%Critical value	5%Critical value	10%Critical value	P value	conclusion
lnB2C	-3.907	-4.130	-3.491	-3.175	0.0119	stationary
dlnB2C	-11.301	-4.132	-3.492	-3.175	0	stationary
lnB2B	-2.302	-4.143	-3.497	-3.178	0.4328	Non-stationary
dlnB2B	-6.327	-4.146	-3.498	-3.179	0	stationary
lnREER	-1.693	-4.130	-3.491	-3.175	0.7539	Non-stationary
dlnREER	-6.095	-4.132	-3.492	-3.175	0	stationary
lnCSB	-6.604	-4.130	-3.491	-3.175	0	stationary
dlnCSB	-11.395	-4.132	-3.492	-3.175	0	stationary

The unit root test results indicate that among the original series, only lnB2C and lnCSB are stationary at the 1% significance level, while lnB2B and lnREER are non-stationary.

After first-differencing, all variables reject the null hypothesis of "unit roots" (p=0), demonstrating that the first-differenced series is stationary and meets the modeling requirements for VAR models.

3.2 Model building

After the unit root test of variables, the basic econometric model is established, and the expression can be obtained:

$$\begin{bmatrix} \ln B2C_t \\ \ln B2B_t \\ \ln REER_t \\ \ln CSB_t \end{bmatrix} = \alpha_0 + A_1 \begin{bmatrix} \ln B2C_{t-1} \\ \ln B2B_{t-1} \\ \ln REER_{t-1} \\ \ln CSB_{t-1} \end{bmatrix} + \ldots + A_p \begin{bmatrix} \ln B2C_{t-p} \\ \ln B2B_{t-p} \\ \ln REER_{t-p} \\ \ln CSB_{t-p} \end{bmatrix} + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \\ \mu_{4t} \end{bmatrix}$$

3.3 Determination of lag order

Based on the results of the stationarity test, we construct a VAR model containing lnB2C, lnB2B, lnREER and lnCSB. The optimal lag order is determined by information criteria:

When lag 3 is lagged, FPE(5.4e-09) and AIC (-7.72889) both reach the minimum value, and LR test is significant (p= 0.001), indicating that VAR (3) model can best capture the dynamic relationship between variables.

Table 3 Optimal lag selection for model optimization

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	65.6911				1.0e-0.6	-2.46764	-2.40939	-2.31468
1	210.117	288.85	16	0.000	5.9e-09	-7.60466	-7.31342*	-6.83985*
2	225.408	30.583	16	0.015	6.1e-09	-7.57631	-7.05208	-6.19966
3	245.408	39.692*	16	0.001	5.4e-09*	-7.72889*	-6.97166	-5.74039
4	253.152	15.858	16	0.463	8.0e-09	-7.40606	-6.41583	-4.80571

3.4 Test of stability

To optimize the lag order selection, we constructed a third-order VAR model based on the data results. After determining the appropriate lag order, we conducted stationarity tests on the model. As shown in Figure 1, all characteristic roots of the model lie within the unit circle, indicating that the model is stationary and ready for further analysis.

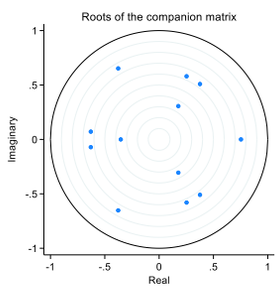

Figure 1 Model stability test

3.5 Johansen cointegration test

The trace statistic was used to test the long-term equilibrium relationship between variables. The results showed that there was a cointegration relationship (trace statistic=56.82>47.86, p=0.003), indicating that there was a long-term stable cointegration relationship among lnB2C, lnB2B, lnREER and lnCSB. Therefore, the vector error correction model could be constructed:

$$\ln(B2C) = 0.1439\ln(B2B) - 0.4669\ln(REER) + 1.7508\ln(CSB) + 0.0192$$

The revised model equation reveals that when B2C trade volume is the dependent variable, a 1% increase in lnB2B corresponds to a 0.1439% change in lnB2C, indicating a weak stimulative effect of B2B supply chain expansion on B2C retail. This may be attributed to B2C order growth driving upstream B2B procurement. The error correction coefficient for REER (Export Relevance Error) stands at 0.4669, demonstrating that RMB appreciation exerts greater impact on exports than imports. This amplifies export costs, reduces price competitiveness of exported goods, and consequently restrains B2C trade growth. The error correction coefficient for CSB (China Service Balance) reaches 1.7508, revealing a positive correlation between CSB and B2C trade.

3.6 Granger causality test

The Granger causality tests were conducted on the B2C and B2B cross-border e-commerce trade volumes respectively, and the following relationships were obtained:

Table 4 B2C coordination equation data results

Excluded	Chi-sq	df	Prob.
lnB2B	1.16	5	0.9491
lnREER	15.04	4	0.0102
lnCSB	36.85	5	0.0000
ALL	56.96	21	0.0000

Table 5 B2B coordination equation data results

Excluded	Chi-sq	df	Prob.
lnB2C	9.51	5	0.0903
lnREER	15.12	5	0.0098
lnCSB	33.89	5	0.0000
ALL	82.36	21	0.0000

The results indicate:

CSB and REER demonstrate Granger causality in B2C/B2B relationships ($p<0.01$). Notably, the causal strength of CSB on

B2C (Chi-sq=36.85) is 2.45 times greater than REER's (15.04), suggesting that the RMB settlement system has a more significant impact on cross-border e-commerce.

While no statistically significant difference exists between B2B and B2C in relative terms ($p>0.05$), their growth rates show a clear B2B> B2C relationship ($p<0.05$). This phenomenon likely stems from differences in customer bases and payment cycles between the two sectors. The weak causal relationship ($p<0.05$) between B2C and B2B indicates that B2C retail growth exerts a delayed effect on B2B through supply chain backward transmission, though not yet reaching statistical significance.

3.7 Analysis of variance decomposition

Table 6 and Table 7 are the variance decomposition analysis for B2C and B2B respectively.

Table 6 B2C variance decomposition results

Step	B2C	B2B	REER	CSB
0	0	0	0	0
1	1	0	0	0
2	0.905214	0.006373	0.000029	0.088384
3	0.831596	0.036385	0.004327	0.127692
4	0.78044	0.046234	0.004637	0.16869
5	0.779981	0.055046	0.00469	0.160253
6	0.774123	0.055859	0.004413	0.165605
7	0.753319	0.056881	0.005197	0.184603
8	0.732424	0.066295	0.005078	0.196202

Table 7 B2B variance decomposition results

Step	B2C	B2B	REER	CSB
0	0	0	0	0
1	0.17047	0.982953	0	0
2	0.12112	0.95697	0.026034	0.004884
3	0.015094	0.948133	0.020939	0.015834
4	0.015088	0.951918	0.016735	0.016259
5	0.012846	0.955755	0.017808	0.013592
6	0.012924	0.959037	0.016118	0.011921
7	0.011316	0.963805	0.014361	0.010518
8	0.0010215	0.966822	0.013573	0.009389

Variance decomposition results indicate that, at the aggregate level, fluctuations in B2C trade are primarily driven by the sector's own dynamic inertia and the cross-border settlement of the renminbi (CSB), suggesting that individual cross-border e-commerce transactions exhibit strong market stickiness and are significantly influenced by the RMB cross-border payment system. In contrast, fluctuations in B2B trade are almost entirely attributable to the B2B sector itself, with B2C contributing very little. This implies that B2B trade is characterized by a strong path dependence of its own, and that demand transmission effects from B2C are weak.

According to Table 6, the contribution of B2C's own dynamics to B2C trade volatility declines from 100% in the first period to 73.24% in the eighth period, yet remains at a relatively high level. This indicates that the contribution of B2C's own dynamics to its trade volume is relatively significant, and its explanatory power exceeds that of the RMB internationalization index and external environmental factors. The contribution of CBDS rises from 8.84% in the second period to 19.62% in the eighth period, suggesting that the influence of the RMB settlement system on B2C trade is becoming increasingly pronounced, with growing explanatory power over time. The contribution of the REER remains consistently below 0.51%, indicating that its explanatory power for B2C cross-border e-commerce trade volume is very weak. A plausible explanation is that most B2C cross-border e-commerce enterprises have already established and refined exchange rate risk-hedging mechanisms, thereby minimizing their exposure to exchange rate fluctuations.

According to Table 7, B2B trade fluctuations can explain approximately 98.30% of the variance over 21 observations, though this figure declines to 96.68% by the eighth period—still a high value. This suggests that the B2B trade model continues to rely heavily on its endogenously developed supply chain and client relationship networks. The maximum contribution of CSB and REER is only 1.63% and 1.35%, respectively, indicating that RMB settlement has a relatively low penetration rate in China's B2B sector and thus plays a limited role.

Overall, the results of variance decomposition provide evidence consistent with the Granger causality tests: the various modes of cross-border e-commerce are driven by different factors. B2C is primarily influenced by the RMB settlement system and its own dynamic inertia, whereas B2B trade relies mainly on its internal business foundations rather than demand transmission from downstream B2C. Moreover, B2B trade shows even lower dependence on foreign exchange, with limited sensitivity to settlement currency and exchange rate fluctuations.

4 Conclusion

In recent years, cross-border e-commerce has grown rapidly in China, becoming a key driver of both foreign trade expansion and high-quality development. Using monthly data from January 2020 to December 2024, this study employs a VAR model with the Johansen cointegration test and finds a significant long-term cointegration relationship among the RMB Real Effective Exchange Rate (REER), cross-border RMB settlement volume (CSB), and B2C and B2B cross-border e-commerce trade volumes. The impact of REER on both B2C and B2B trade is weaker than that of CSB, indicating that in the cross-border e-commerce sector, the choice of settlement currency has a greater effect on trade volumes than exchange rate fluctuations. As shown in Table 6, the results of the Granger causality test and variance decomposition suggest that the scale of RMB settlement has a substantial influence on the import and export trade of B2C e-commerce goods, far exceeding the impact of REER. This finding underscores the role of RMB settlement in fostering the development of cross-border e-commerce platforms and highlights the positive significance of further expanding cross-border e-commerce activities. In contrast, the contribution of CSB in B2B trade scenarios remains around 1.36%. This low penetration of RMB settlement in large-scale transactions may be due to the prevalence of long-term contracts, under which multinational buyers prefer traditional currencies such as the U.S. dollar and the euro for cross-border payments. Moreover, B2B supply chains often involve multiple distribution layers and large capital flows, with frequent currency conversions and relatively high transaction costs, making it difficult to break through the dollar- and euro-dominated settlement channels in the short term. Variance decomposition results further show that the maximum contribution of CSB to B2B trade fluctuations is 1.36%, whereas its contribution to B2C trade fluctuations reaches 96.68%, suggesting that B2B trade is largely driven by downstream retail demand rather than by the choice of settlement currency.

Overall, the expansion of RMB settlement has a significant positive effect on B2C trade volumes, while RMB appreciation exerts a stronger negative impact on exports than on imports. This raises export costs, weakens price competitiveness, and suppresses the growth of cross-border e-commerce trade. For B2B trade, neither RMB settlement nor REER shows a significant effect, though B2C trade volumes exert some influence on B2B trade.

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