Synergistic Effects of FDI and Cross-Border E-Commerce in China's Digital Economy: an Empirical Analysis Based on Inter-provincial Panel Data

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Abstract. Integrating the digital economy with the real economy necessitates further exploration of how foreign direct investment (FDI) and cross-border e-commerce (CE) drive China's export trade growth. This paper analyzes panel data from eastern, central and western China to assess how FDI and CE impact export trade using FMOLS and DOLS method while considering regional differences. The study's results reveal that (1) FDI and CE significantly boost export trade, with the most potent effects in the eastern region, followed by the central and western regions; (2) The impact of factors like labor resources and GDP on export trade varies significantly, with the eastern region showing the highest marginal utility; (3) The eastern region outperforms in foreign capital use and e-commerce development, benefiting from high economic openness and strong infrastructure, while the central and western regions need to improve their investment environments and infrastructure. These findings provide a basis for promoting high-quality export trade and coordinated regional economic growth.

Keywords: Digital Economy; FDI; Cross-Border E-Commerce; Export Trade; Regional Heterogeneity.

1. Introduction

With the rapid advancement of global digital transformation, the digital economy has become a key driver reshaping international trade and investment. As the world's second-largest economy, China leverages its vast market and systematic policies to attract significant FDI and expand export trade through cross-border e-commerce and other emerging modes [1]. The digital economy has transformed the global economic structure and created new opportunities for optimizing China's industrial structure and integrating FDI with cross-border e-commerce. Recognizing its importance, the Chinese government, in the 14th Five-Year Plan, emphasizes accelerating digital transformation, fostering digital industrialization, and driving industrial digitization. In this process, FDI is a vital link between domestic and international markets, introducing advanced technologies and resources. At the same time, cross-border e-commerce, by lowering trade barriers and improving efficiency, increasingly drives China's export growth [2].

Existing academic research has explored the economic effects of FDI and cross-border e-commerce on export trade from various perspective. On the one hand, FDI enhances export competitiveness through channels like technological spillover and managerial expertise diffusion [3-4]; on the other hand, cross-border e-commerce has significantly promoted the growth of export trade by reducing trade costs and expanding market coverage [5-6]. However, most existing studies focus on the individual effects of FDI or cross-border e-commerce [5], with limited research on their synergy and underlying mechanism. In particular, with the widespread application of digital technology, the interaction between FDI and cross-border e-commerce is being redefined. How the two promote export trade development through the linkage effect of key factors such as technological factors and human capital still needs furtherstudy.

In addition, the imbalance of regional development has led to significant spatial differences in the synergy between FDI and cross-border e-commerce: the eastern region, relying on its perfect digital infrastructure and industrial agglomeration advantages, is more likely to form a virtuous cycle mechanism of "technology-trade" [7]; while the central and western regions are relatively lagging in

the realization of their synergy due to the dual constraints of resource endowment and institutional environment [8].

This paper examines the synergistic effect of FDI and cross-border e-commerce on export trade growth and its regional heterogeneity using China's provincial panel data (2005-2022). Employing a fixed effects model, it analyzes key variables such as export trade volume, FDI inflows, cross-border e-commerce transactions, labor resources, technological input, knowledge capital, education level, and GDP to explore their joint impact and internal mechanisms. Additionally, the study highlights differences in export performance across eastern, central, and western regions, providing empirical evidence and policy insights to support high-quality export trade development, regional economic coordination, and the "dual circulation" strategy.

This study is significant in both theoretical and practical aspects. Theoretically, it deepens understanding of the synergy between FDI and cross-border e-commerce, highlighting their role in export trade growth within the digital economy and addressing research gaps. Practically, it empirically demonstrates their combined impact on China's export trade and provides targeted policy recommendations for the Eastern, Central, and Western regions. These insights support optimizing foreign investment and e-commerce policies, aiding the government in advancing regional coordination and the "dual circulation" strategy.

2. Literature Review

2.1. The impact of FDI on export growth

The impact of FDI on export trade is mainly reflected in three dimensions: technology spillover, industrial upgrading, and market expansion. FDI enhances host country productivity through channels like capital goods embedding, management experience diffusion, and human capital flow. Liang et al. (2021) found that FDI-driven technology transfer significantly improved manufacturing technology in Belt and Road countries, boosting the value-added of China's cross-border e-commerce exports [9]. Choi et al. (2025) showed that FDI's knowledge- and market-seeking motives enhanced export competitiveness. However, the digital economy has weakened traditional market-seeking motives while strengthening technological synergy [10]. Chen and Zhou (2023) confirmed this, showing that FDI indirectly promotes exports by improving urban innovation (e.g., patents and R&D), with more potent effects in eastern regions [11].

FDI promotes shifting from labor-intensive to technology-intensive industries, driving industrial upgrading in host countries. Zhou et al. (2024) noted that FDI in the service sector significantly increased the share of China's tertiary industry and optimized export structures [12]. Teng et al. (2023) highlighted FDI's spatial spillover effects, where agglomeration in eastern coastal cities drives supporting industries' exports in central and western regions through industrial chain extensions [13]. Under the digital economy, FDI exhibits new traits: digital technology reduces reliance on traditional factors, attracting FDI to regions with advanced digital infrastructure [7], while its integration with technologies like intelligent manufacturing and cross-border data flow fosters new forms of service trade exports.

FDI's export promotion effect is 30%-50% stronger in the eastern region due to abundant human capital and a favorable institutional environment [14]. In contrast, limited technological absorption in central and western regions weakens direct spillovers, but the "industrial transfer" model still indirectly boosts exports. Additionally, two-way FDI enhances industrial upgrading, such as the technological complementarity between IFDI and OFDI. For instance, China's OFDI in sectors like electric vehicles and TMT improves local innovation through reverse technology spillovers, optimizing export structures.

2.2. The impact of cross-border e-commerce on export growth

Cross-border e-commerce, as a key driver of digital trade, revolutionizes export growth by reshaping trade processes and reducing costs. It lowers information search, logistics, and compliance

costs through “disintermediation.” Liang et al. (2021) found that digital economy development in Belt and Road countries boosts China's cross-border e-commerce exports, with a 10% reduction in logistics costs increasing exports by 4.9% [9].

Cross-border e-commerce expands market boundaries by breaking geographical restrictions and enabling SMEs to access international markets. Ma et al. (2024) found that the "long-tail market" effect increased the average number of export target markets for Chinese SMEs by 2.3 times [15]. Armano. (2020) highlighted that cross-border e-commerce shifts China’s export structure toward high-value-added products by meeting diverse consumer demands [16], such as preferences for personalized goods in Belt and Road countries, with 3C products and customized goods growing 15 percentage points faster than traditional trade.

Eastern coastal areas dominate cross-border e-commerce exports, accounting for over 80% of the national total due to port logistics and advanced digital infrastructure [17]. In contrast, central and western regions have achieved export growth through the "cross-border e-commerce + industrial belt" model (e.g., Zhengzhou's clothing and Xi'an's agricultural products). However, higher logistics and payment inefficiencies result in unit transaction costs 12%-18% higher than in the east [18]. Additionally, cross-border e-commerce pilot zone policies have enhanced regional openness and internet infrastructure, fostering a "trade-tourism" synergy by promoting inbound tourism and trade flows.

2.3. The synergistic effect of FDI and cross-border e-commerce

Research on the synergy between FDI and cross-border e-commerce is still emerging, with a focus on the interaction between technological innovation and factor optimization. In terms of technological innovation, FDI-driven digital technologies (e.g., cloud computing and blockchain) combined with the data analysis capabilities of cross-border e-commerce create a "technology-market" dual-driving effect. Yin and Su (2024) validated this through a threshold model, showing that when urban innovation capacity exceeds a critical value, the synergy increases export growth by 25% [19].

In terms of optimizing labor factors, the spillover of FDI management experience complements the skill demand of cross-border e-commerce. Wang et al. (2024) found that FDI enterprises' digital management models, such as agile supply chains, improve labor skill matching efficiency by 18% through talent flow, particularly in cross-border e-commerce pilot zones[20]. Koroma (2024) further noted that new roles created by cross-border e-commerce, such as live-streaming operations and international digital marketing, form talent networks with high-end FDI positions, boosting labor productivity in eastern export enterprises by 22% [21].

Regional synergy differences between FDI and cross-border e-commerce reflect varying developmental dynamics. In the eastern region, advanced digital infrastructure fosters a "technology agglomeration-industry cluster" synergy. An example is Zhejiang's "cross-border e-commerce comprehensive pilot zone + foreign-funded intelligent manufacturing park" model, which has driven an export growth rate 10 percentage points above the national average. Conversely, central and western regions depend more on policy-driven synergies. For instance, Chongqing has boosted automobile parts exports by integrating "China-Europe freight trains + cross-border e-commerce + foreign-funded logistics enterprises." However, its overall growth remains below that of similar industries in the east.

Overall, existing research provides important theoretical support for understanding the independent and synergistic effects of FDI and cross-border e-commerce on export trade growth. However, there is still a research gap regarding the linkage mechanism, regional heterogeneity, and targeted policy recommendations between the two in the context of the digital economy. This article is based on provincial-level panel data in China, and will further expand related research from the perspectives of synergy and regional differences, providing empirical evidence and policy implications for building a "dual circulation" development pattern.

3. Data Sources and Research Methodology

3.1. Data sources

The data of this study covers 29 provinces, municipalities, and autonomous regions in China's mainland (excluding Hong Kong, Macao, Taiwan, Xinjiang, and Tibet) from 2005 to 2022. The data sources are authoritative and comprehensive, ensuring the scientificity and reliability of the research. The export trade volume data comes from the China Statistical Yearbook, which is used to measure the export capacity of each province; the FDI inflow data is taken from the Statistical Communiqué of the Ministry of Commerce of China, reflecting the scale of foreign direct investment; the cross-border express business income data comes from the Statistical Communiqué of the Development of China Postal Industry and related industry reports, which is used to replace the cross-border e-commerce transaction volume and evaluate the level of logistics development driven by cross-border e-commerce. In addition, this paper includes several control variables, including labor resources, technology input, knowledge capital, education level, and GDP of each province. The relevant data come from the China Statistical Yearbook and other economic statistical data. These data can fully reflect the economic characteristics of each province in China and provide support for subsequent empirical analysis.

3.2. Description of variables

This paper selects export trade volume (Ex) as the dependent variable to measure the export capacity of each province. The independent variables include foreign direct investment inflow (FDI) and cross-border express business income (CE), respectively reflecting the impact of foreign investment utilization and cross-border logistics development on exports. In addition, this paper introduces multiple control variables, including labor resources (Lab), technological input (Tec), knowledge capital (Kn), education level (Ed), and GDP (GDP), to eliminate other factors that may affect export capacity. The design of these variables can help the study more accurately quantify the impact of the synergy between FDI and cross-border express business on export growth. The statistical description of each variable is shown in Table 1.

Table 1. Statistical description of variables

Variables	Obs	Mean	Std.Dev	Min	Max
Ex	2521	3335.65	5997.64	13.40	53265.80
FDI	2521	6925552.34	15463249.72	8178.94	122348949.52
CE	2521	16.01	55.20	0.00249	537.20
Lab	2521	2333.95	1229.59	143.60	6904.00
Tec	2521	1446398.78	1791523.67	23612.00	9846109.00
Kn	2521	93975.83	133707.12	89.00	993480.00
Ed	2521	9.01	1.42	3.74	12.78
GDP	2521	23816.68	29283.89	243.10	129118.58

3.3. Research methodology

This study uses the fixed effect model as the core analysis tool to eliminate the impact of regional differences and time effects, thereby ensuring the scientificity and robustness of the results. The basic econometric model is set as follows:

$$LogEx_{i,t} = a_0 + a_1 logFDI_{i,t} + a_2 logCE_{i,t} + a_3 logLab_{i,t} + a_4 logTec_{i,t} + a_5 logKn_{i,t} + a_6 logEd_{i,t} + \eta_i + \delta_t + \epsilon_{i,t}$$

Among them, $\eta_i$represents the province fixed effect, δ_t represents the year fixed effect, and $\epsilon_{i,t}$ is the random error term. All variables in the model are in logarithmic form, which can effectively reduce data volatility and heteroscedasticity problems and intuitively reflect the elastic relationship.

At the same time, to further ensure the robustness of the analysis results, this paper uses the fully modified least squares method (FMOLS) and the dynamic least squares method (DOLS) as supplementary methods to verify the reliability of the analysis results from multiple angles.

4. Empirical Analysis and Discussion of Results

4.1. Smoothness check

To increase the stationarity of the data, we first logarithmically transform the data and then perform a unit root test. Considering the limitations of different unit root test methods, this paper simultaneously uses the LLC test, HT test, IPS test, and A-F-C test (ADF-Fisher Chi-Swuare) 4 test methods for the unit root test; the results are shown in Table 2. The test results show that some of the sequence data in the original value have unit roots, indicating that the data is non-stationary. However, after the first-order difference, all differential data sequences passed the significance test, indicating that the differential sequence data does not have a unit root and is stationary.

Table 2. Panel unit root test

Variables	LLC	HT	IPS	AFC
ln Ex	-4.78***	-4.12***	-3.89***	85.76***
ln FDI	-4.10***	-3.95***	-3.76***	78.23***
ln CE	-2.53**	-1.82**	-2.12**	68.45**
Δln Lab	1.05***	0.48***	0.87***	12.67***
ln Tec	-7.23***	-6.82***	-6.45***	125.45***
ln Kn	-3.56***	-3.12***	-3.01***	72.34***
Δln Ed	0.89***	0.35***	0.67***	14.89***
ln GDP	-9.45***	-8.67***	-8.23***	132.67***

Note: *p<0.1, ***p<0.05, ***p<0.01, denotes first-order differencing of the serial data.

4.2. Basic regression analysis

Table 1 displays the baseline regression results, with Models (1) to (7) adding explanatory variables to evaluate their impact on export trade (ln Ex). All core explanatory variables positively influence export trade volume, and the model's goodness of fit (R^2) improves from 0.725 to 0.852 as more variables are included. In Model (1), the sole core explanatory variable (lnFDI) has a coefficient of 0.452, significant at the 1% level, indicating that foreign direct investment is vital for increasing export trade volume. This supports the open economy theory, which asserts that foreign capital provides investment and enhances technology transfer and trade efficiency.

From model (2) to model (7), the control variables ln(CE), ln(Lab), ln(Tec), ln(Kn) and ln(Ed) are introduced., Despite a decrease in the coefficients of ln(FDI), it remains significant at the 1% level, demonstrating a robust positive effect of FDI on export trade.. In model (2), the coefficient for ln(CE) is 0.325, which is also significant at the 1% level. This indicates that cross-border e-commerce has significantly promotes export trade, likely due to reduced trade costs and improved access to international market.

In models (3) to (7), which include control variables, the labor resources coefficient (ln(Lab)) is 0.178. Although this value is small, it is statistically significant, indicating a limited but essential role in export trade. The technological input coefficient (ln(Tec)) is significant and substantial, ranging from 0.458 to 0.498, highlighting its crucial role in promoting export trade. The coefficients for knowledge capital (ln(Kn)) and education level (ln(Ed)) are 0.230 and 0.124, respectively, suggesting that knowledge accumulation and human capital improvements positively enhance export competitiveness. In the complete model (7), all variables are significant, and the goodness of fit (R2) increases to 0.852, demonstrating that the added variables significantly improve the model's explanatory power.

Table 4. Benchmark regression analysis

Variable and Model	Model(1)	Model(2)	Model(3)	Model(4)	Model(5)	Model(6)	Model(7)
lnFDI	0.452***	0.387***	0.354***	0.332***	0.320***	0.315***	0.310***
	(0.062)	(0.058)	(0.056)	(0.053)	(0.052)	(0.052)	(0.0551)
lnCE		0.325***	0.295***	0.278***	0.270***	0.265***	0.260***
		(0.049)	(0.047)	(0.046)	(0.045)	(0.044)	(0.043)
lnLab			0.212**	0.196**	0.185**	0.182*	0.178*
			(0.065)	(0.062)	(0.060)	(0.059)	(0.058)
lnTec				0.498***	0.475***	0.465***	0.458
				(0.064)	(0.061)	(0.060)	(0.059)
LnKn					0.244***	0.238***	0.230***
					(0.043)	(0,042)	(0.041)
LnEd						0.129**	0.124**
						(0.052)	(0.051)
LnGDP							
Constant	-4.215***	-3.852***	-3.625***	-3.450***	-3.312***	-3.245***	-3.185***
	(0.543)	(0.526)	(0.512)	(0.501)	(0.495)	(0.488)	(0.482)
Provienc-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2521	2521	2521	2521	2521	2521	2521
R^2	0.725	0.786	0.803	0.820	0.835	0.843	0.852

Note:*10% significance level; **5% significance level; **1% significance level; Standard error shown in parentheses

4.3. Robustness test

This study has taken rigorous measures to ensure the reliability of our findings. We conducted extensive robustness checks on the province and year-fixed effect model results. This involves two econometric techniques: fully modified and dynamic ordinary least squares. The implementation of fully modified ordinary least squares and dynamic ordinary least squares is crucial to verify the integrity of the inferences of the province and year fixed effect models [22]. Adopting these methods enhances our results' reliability and reflects our commitment to the highest standards of empirical rigor and methodological thoroughness. This data verification method is the foundation for the credibility and reliability of our conclusions. The specific content of these research results is systematically summarized in Table 5.

The robustness test results show that the core variables lnFDI and lnCE have a significant and consistent positive impact on export trade volume, whether it is FMOLS or DOLS method, which further verifies the reliability of the benchmark regression results. At the same time, the introduction of control variables, cointegration relationship, and residual normality test all support the robustness of the model. These results show that foreign direct investment and cross-border e-commerce are the key driving forces for China's export trade growth, providing an important empirical basis for policymaking. The convergence of the results of these methods indicates that the initial province and year fixed effects model is well-designed and successfully captures the basic dynamic characteristics of the variables under consideration. This comprehensive cross-validation process, integrating multiple analytical techniques, enhances the reliability and validity of the research conclusions. This multi-faceted analytical approach ensures the integrity and reliability of the research results.

Table 5. Results of robustness test.

Variable and model	Fully modified ordinary least squares	Dynamic ordinary least squares
FDI	0.351***	0.368***
	(6.153)	(6.231)
EC	0.478***	0.471***
	(3.784)	(3.691)
cv	Yes	Yes
Test 1	0.061***	0.075***
Test 2	5.536***	5.572**
c	-2.461**	-2.505*
	(-2.133)	(-1.778)
R^2	0.829	0.821

*10% significant level; ** 5% significant level; *** 1% significant level; t-statistical value shown in parentheses; cv control variable; c constant (Test 1: In our co-integration examination, we adopted the Hansen parameter instability test. This test operates under the null hypothesis, which assumes the presence of co-integration within the time series data, a concept supported by the findings of Stojanovic et al. (2020)[23]; Test 2—To evaluate the data's normality, we conducted the Jarque–Bera test, which operates on the null hypothesis that posits a normal distribution of the residuals).

4.4. Regional heterogeneity analysis

China is a vast country officially divided into three distinct regions: the East, the Central, and the West. The Eastern region is the pinnacle of China's development, encompassing its most economically developed regions. Conversely, the Central region is considered to have moderate development, while the Western region often suffers development gaps. Although these regions belong to the same country, they present different characteristics, ranging from economic growth trajectories, state-led policy details, and infrastructure development gradients to their inherent geographical characteristics. To explore the multifaceted impacts of FDI and cross-border e-commerce on regional export dynamics, we use an empirical approach to decompose the core dataset into subsamples of three specific regions. Table 6 details the analytical findings from this region-focused study.

The positive effect of FDI on export trade is most significant in the eastern region, with a regression coefficient of 0.278, which is significant at the 1% level. This shows that the eastern region, with its mature foreign investment attraction ability, perfect infrastructure, and high integration with the international market, enables foreign investment to promote export trade more effectively. In contrast, the FDI coefficients in the central and western regions are 0.179 and 0.161, respectively, with slightly lower significance, indicating that foreign investment has a limited effect. This may be related to the relatively weak infrastructure, low degree of marketization, and low efficiency of resource allocation in the central and western regions [24].

The impact of CE on export trade is also most significant in the eastern region, with a regression coefficient of 0.397, which is significant at the 5% level. This highlights the leading position of the eastern region in the construction of digital infrastructure and the development of cross-border e-commerce platforms, enabling cross-border e-commerce to promote export growth more efficiently. The CE coefficients of the central and western regions are 0.365 and 0.325, respectively, with lower significance, reflecting that these regions still have specific gaps in developing e-commerce ecosystems, logistics networks, and digital economies.

Regarding control variables, the coefficient of labor resources (Lab) in the eastern region is 0.815, which is significantly higher than that in the central region (0.742) and the western region (0.688), indicating that the higher-quality labor force in the eastern region contributes more to export growth. The marginal effect of technological input (Tec) in the eastern region is the strongest, with a

coefficient of 0.389, while that in the central and western regions is 0.276 and 0.259, respectively. This may be related to the eastern region's higher technological R&D investment and industrial chain upgrading capabilities [25]. Knowledge capital (Kn) and education level (Ed) positively affect all three regions. However, the coefficient in the eastern region is more significant, indicating that the role of human capital accumulation and education level in promoting exports is more evident in the east. The GDP coefficients of all regions are positive, and the coefficient of the eastern region (0.512) is significantly higher than that of the central region (0.429) and the western region (0.395). This shows that the larger the regional economic volume, the stronger the export capacity [26]. With its economic advantages, the eastern region has further strengthened the growth momentum of export trade.

Table 6. Results of regional heterogeneity analysis

Variable and model	Model (8)	Model (9)	Model (10)
ln(FDI)	0.278***	0.179***	0.161***
	(4.328)	(4.586)	(4.179)
ln(EC)	0.397**	0.365**	0.352**
	(2.167)	(2.187)	(2.019)
ln(Lab)	0.815*	0.742*	0.688*
	(2.364)	(1.953)	(1.812)
ln(Tec)	0.389*	0.276*	0.259*
	(1.726)	(1.821)	(1.697)
ln(kn)	0.117*	0.086	0.073
	(1.869)	(1.487)	(1.295)
ln(Ed)	0.145**	0.108**	0.092*
	(2.361)	(2.027)	(1.841)
ln(GDP)	0.512***	0.429**	0.395**
	(3.125)	(2.874)	(2.716)
constant	-1.507	-1.547*	-1.701
	(-1.259)	(-1.624)	(-1.213)
F-statistical value	79.977***	74.728***	75.363***
Province-fixed effect	Yes	Yes	Yes
Year-fixed effect	Yes	Yes	Yes
R^2	0.412	0.389	0.345
Area	Eastern area	Central area	Western area

Note:*10% significance level; **5% significance level; **1% significance level; Standard error shown in parentheses

5. Conclusions and Policy Recommendations

5.1. Conclusions

Based on the perspective of regional heterogeneity, this study explores the impact mechanism and regional differences of foreign direct investment (FDI) and cross-border e-commerce transaction volume (CE) on China's export trade. By adopting the fully modified least squares method (FMOLS), dynamic least squares method (DOLS), and regional grouping regression analysis, this study draws the following main conclusions:

The empirical results show that FDI has a significant positive promoting effect on export trade, which is most evident in eastern China. With its high economic openness, superior infrastructure conditions, and close ties with the international market, the eastern region can more effectively attract foreign investment and convert it into export momentum. In contrast, the promotion effect of FDI in

the central and western regions is weak, indicating that there is still room for improvement in the efficiency of foreign investment utilization and resource allocation in the central and western regions.

The study found that the promotion effect of cross-border e-commerce transaction volume on export trade is significant, especially in the eastern region. The perfect logistics network, developed e-commerce platform, and high-level digital infrastructure in the eastern region strongly support the development of cross-border e-commerce. Although the central and western regions also benefit from the development of cross-border e-commerce, their digital economic foundation is relatively weak, resulting in a weakened role of cross-border e-commerce in export growth.

Labor resources (Lab), technology input (Tec), knowledge capital (Kn), education level (Ed), and regional gross domestic product (GDP) all have a significant positive impact on export trade. However, their effects vary significantly in different regions. The eastern region's high-quality labor force and higher education level have significantly enhanced export competitiveness. In contrast, the central and western regions still have much room for improvement in labor quality and education input. The marginal utility of technology input and knowledge capital is higher in the eastern region, indicating the leading advantage of the eastern region in technological innovation and industrial upgrading. The GDP of each region has a significant positive correlation with export trade, but the total economic volume of the eastern region has the most significant driving effect on exports.

Regional heterogeneity analysis shows that the role of FDI and CE in promoting export trade in the eastern region is significantly higher than in the central and western regions. This difference stems from the gap between regions in terms of economic development level, infrastructure construction, technological innovation capabilities, and the degree of development of the digital economy. Therefore, policy formulation should take differentiated measures based on regional characteristics.

5.2. Policy recommendations

Based on the insights of this study, we propose several policy recommendations and practical solutions to further leverage the role of foreign direct investment (FDI) and cross-border e-commerce transactions (CE) in promoting export trade while narrowing regional gaps and achieving coordinated regional development. First, the eastern region should leverage its advantages in economic openness, infrastructure, and technological innovation to attract more foreign investment and boost cross-border e-commerce. Efforts should focus on industrial upgrading by prioritizing high-tech and high-value-added industries, shifting from traditional to high-end manufacturing and services. Additionally, fostering the high-end development of cross-border e-commerce platforms, encouraging vertical business models, and supporting enterprises to deliver high-quality products will enhance global competitiveness.

The central region should capitalize on its location advantages by improving infrastructure, optimizing the investment environment, and enhancing resource allocation efficiency. Key measures include accelerating the development of logistics networks, particularly in cross-border e-commerce pilot zones, to reduce costs and improve efficiency. Simplifying administrative procedures and offering tax incentives will also attract foreign and cross-border enterprises, driving regional economic growth.

As a relatively underdeveloped region, the western region requires increased policy support to unlock its potential and promote export growth. Special funds should be established to assist cross-border e-commerce and foreign-funded enterprises in overcoming financial and technical challenges. Investment in digital infrastructure, such as 5G networks and e-commerce platforms, is essential to narrow regional gaps. Additionally, leveraging the region's unique resources to integrate foreign investment and cross-border e-commerce with local industries (e.g., agriculture and cultural products) can create strong regional brands and foster economic development.

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