



# Platform Economy, Supply Chain Resilience, and Firm-Level Innovation:

## An Empirical Analysis of Cross-Border E-Commerce Ecosystems

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**Abstract.** Using China's Comprehensive Cross-Border E-Commerce Pilot Zones (CCBEPZs) as a quasi-natural experiment, this paper draws on panel data from Chinese A-share listed companies (2011–2022) and employs a staggered difference-in-differences (DID) model to examine how CBEC platform ecosystems shape supply chain resilience (SCR) and firm-level innovation. Our findings are threefold. First, CBEC pilot zones significantly improve SCR: supply chain redundancy increases by 2.3 percentage points and the composite SCR index improves by 17.6%. Second, the platform ecosystem raises patent output by 23.1%, operating through transaction cost reduction (31.4% of total effect) and enhanced information access (25.7%). Third, digital transformation positively moderates both effects. Heterogeneity analysis reveals the most pronounced effects among non-SOEs, technology-intensive industries, and inland-region firms.

**Keywords:** platform economy; cross-border e-commerce; supply chain resilience; firm-level innovation; difference-in-differences

## 1 Introduction

The rapid advancement of digital technologies has fundamentally restructured global value chains and trade patterns. Cross-border e-commerce (CBEC)—a paradigmatic application of the digital economy in international trade—has emerged as a powerful driver of corporate internationalization, supply chain resilience, and technological innovation [7][19]. According to data from China's General Administration of Customs, the value of China's CBEC imports and exports rose from CNY 2.1 trillion in 2012 to CNY 16.8 trillion in 2023, representing a compound annual growth rate of approximately 25.9%. In 2023 alone, total CBEC trade volume reached CNY 2.38 trillion (approximately USD 331 billion), a year-on-year increase of 15.6%, driven by a 19.6% surge in exports and a 3.9% rise in imports.

Since the State Council approved the establishment of the first CBEC Comprehensive Pilot Zone (CCBEPZ) in Hangzhou in 2015, the number of such zones has expanded to 165 by end-2022, covering all 31 provinces, autonomous regions, and municipalities [16]. This phased, policy-driven institutional experiment provides an ideal

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quasi-natural experiment for studying how platform ecosystems influence firm-level behavior [13]. The zones function as institutionalized platforms that reduce regulatory uncertainty, streamline customs procedures, and create concentrated hubs of digital trade infrastructure—thereby directly altering the cost structure and information environment facing participating firms.

Yet two critical gaps remain in the existing literature. First, while prior research has examined CBEC's effects on trade efficiency and aggregate export resilience, micro-level evidence on how pilot zones affect firm-level supply chain redundancy and concentration remains scarce. Second, although a positive association between platform participation and innovation has been established [9][18], the distinct mechanisms of information channel effects and transaction cost effects have rarely been jointly identified and tested. Understanding these mechanisms is essential for designing targeted policies that maximize the resilience and innovation benefits of CBEC expansion.

This paper makes three principal contributions. First, we develop an integrated theoretical framework linking platform economics, supply chain resilience theory, and firm-level innovation, synthesizing two-sided market theory [15] with SCR theory [4][5]. Second, we use a staggered DID estimator to address selection bias and unobserved heterogeneity, complemented by the Callaway & Sant'Anna heterogeneity-robust estimator [1]. Third, we identify and empirically test the positive moderating role of digital transformation, providing a basis for differentiated policy implementation. Our findings carry direct implications for policymakers seeking to maximize the "leveling-up" potential of CBEC institutional reform, particularly in underserved inland regions.

## 2 Literature Review and Hypotheses

### 2.1 Platform Economy and CBEC

Platform economics rests on two-sided market theory [15] and network externality theory [11]. By reducing search costs, mitigating information asymmetries, and facilitating co-innovation, platform ecosystems fundamentally alter competitive dynamics [2]. In the CBEC context, the multi-sided nature of these platforms enables efficient buyer-seller matching across national borders, measurably improving export product quality [12]. Drawing on transaction data from a leading Chinese B2B platform, Zhao et al [22] show that sellers' network positions generate differential performance outcomes through implicit social learning, revealing a novel mechanism by which platforms empower firms to acquire global market intelligence.

Jiang & Zhang [9] analyze panel data from 2012 to 2023 and find that CCBEFZs significantly increase the number of corporate patent applications. However, they uncover an important caveat: tax incentives exhibit a "substitution effect" whereby government subsidies partially crowd out firms' own R&D investment. This counterintuitive finding suggests that simply scaling up fiscal incentives may not sustainably enhance firms' innovation momentum, calling for policy designs that target capability building rather than short-term output subsidies. Han et al [8] further show that CBEC

institutional design—specifically platform governance and rule enforcement mechanisms—plays a critical mediating role in determining the magnitude of these innovation effects.

## 2.2 CBEC, Supply Chain Resilience, and Innovation Mechanisms

Supply chain resilience (SCR) is defined as a supply chain's capacity to anticipate, adapt to, and recover from disruptive events, encompassing redundancy, flexibility, and collaboration [4][14]. Using A-share data from 2010–2022, Dai & Min [7] demonstrate that CBEC pilot zones improve SCR through three pathways: increasing supply chain redundancy, reducing supplier concentration, and enhancing supply chain innovation quality. The authors further show that foreign ownership positively moderates these effects. The COVID-19 pandemic and intensifying geopolitical frictions have dramatically raised the stakes for SCR research, highlighting the urgent need to understand how digital institutions can buffer firms against systemic disruptions [10].

Platform ecosystems influence corporate innovation through two mutually reinforcing pathways [9][18]. The information channel operates because CBEC platforms digitally aggregate all transaction records, providing firms with granular, real-time insights into cross-cultural consumer preferences—an invaluable input for product R&D [12]. The transaction cost channel operates because platforms streamline payment, logistics, and customs clearance, sharply reducing the per-transaction costs of international trade and thereby freeing resources for reinvestment in innovation [3]. Digital transformation amplifies both pathways by deepening firms' capacity to absorb and deploy the information and cost advantages that platforms confer [17].

Based on the above, we propose:

**H1:** CCBEPZs positively affect firm-level SCR, reflected by increased supply chain redundancy and reduced concentration.

**H2:** CBEC pilot zones positively affect firms' technological innovation, mediated by transaction cost reduction and enhanced information access.

**H3:** A firm's digital transformation level positively moderates the CBEC effects on both SCR and innovation.

## 3 Research Design

### 3.1 Data and Variables

The sample covers Chinese A-share listed companies (Shanghai and Shenzhen Stock Exchanges) over 2011–2022. Financial data are from CSMAR; patent data from CNIPA; pilot zone approval schedules from official State Council announcements (five batches: 2015, 2016, 2018, 2019, 2020); digital transformation scores constructed following [20]. We exclude financial/real estate firms, ST/PT firms, and observations with debt-to-asset ratios exceeding unity. Continuous variables are winsorized at the 1st and 99th percentiles. The final balanced panel comprises approximately 3,200 firms and 35,200 firm-year observations.

Supply chain resilience (SCR) is measured along three dimensions following Dai & Min [7]: (i)  $SC\_Redundancy = 1$  minus the coefficient of variation of inventory-to-total-assets; (ii)  $SC\_Concentration$  (HHI) computed from top-five supplier purchase shares; (iii) a composite SCR index. Technological innovation (Innovation) is the natural log of (1 + patent applications). The treatment indicator  $CBEC \times Post$  equals one if the firm's city had been approved as a pilot zone by year  $t$ . Digital transformation is the natural log of digital-technology keyword frequency in annual reports.

### 3.2 Empirical Strategy

The baseline estimating equation is a staggered DID model:

$$Y_{it} = \alpha + \beta(CBEC_{it} \times Post_{it}) + \gamma X_{it} + \mu_i + \lambda_t + \epsilon_{it}$$

where  $Y_{it}$  is the outcome (SCR or Innovation),  $CBEC_{it} \times Post_{it}$  is the treatment indicator,  $X_{it}$  is a vector of firm-level controls,  $\mu_i$  and  $\lambda_t$  are firm and year fixed effects, and  $\epsilon_{it}$  is the idiosyncratic error. Standard errors are clustered at the firm level. H3 is tested by augmenting the model with the triple interaction  $CBEC_{it} \times Post_{it} \times Digital_{it}$ . Validity is assessed via parallel-trend event-study tests, placebo tests, PSM-DID, and the Callaway & Sant'Anna [1] heterogeneity-robust estimator.

## 4 Empirical Results

### 4.1 Descriptive Statistics

Table 1 reports summary statistics for the main variables. The mean  $SC\_Redundancy$  (0.035) and  $SC\_Concentration$  HHI (0.412) are consistent with [7]. The Innovation variable shows substantial cross-firm variation (mean = 1.890; SD = 1.762), indicating heterogeneous innovation capabilities.

**Table 1.** Descriptive Statistics of Main Variables

Variable	Definition/Measure	N	Mean	SD	Min	Median	Max
<b>Panel A: Dependent Variables</b>							
SC_Redundancy	Supply chain redundancy	35,214	0.035	0.776	-12.595	0.081	1.803
SC_Concentration	Supply chain concentration (HHI)	35,214	0.412	0.231	0.041	0.378	1.000
Innovation	Total patent apps (ln)	35,214	1.890	1.762	0.000	1.792	7.188

Innovation_Inv	Invention patent apps (ln)	35,214	1.247	1.534	0.000	0.693	6.821
<b>Panel B: Key Explanatory Variable &amp; Moderator</b>							
CBEC×Post	Pilot zone × post-policy dummy	35,214	0.538	0.499	0.000	1.000	1.000
Digital	Digital transformation index (ln)	35,214	3.124	1.847	0.000	3.045	8.219
<b>Panel C: Control Variables</b>							
Size	ln(total assets)	35,214	22.341	1.386	18.972	22.218	28.104
Lev	Total liabilities/assets	35,214	0.421	0.204	0.027	0.418	0.963
ROA	Return on assets	35,214	0.043	0.058	-0.214	0.038	0.248
RD_Intensity	R&D/revenue	28,471	0.041	0.052	0.000	0.025	0.412
SOE	State ownership dummy	35,214	0.338	0.473	0.000	0.000	1.000

Notes: Sample period: 2011–2022. Winsorized at 1st/99th percentiles. Sources: CSMAR; CNIPA; State Council announcements.

## 4.2 Baseline Regression Results

Table 2 presents the staggered DID estimates. The CBEC×Post coefficient is positive and significant across all specifications. Pilot zone establishment raises SC\_Redundancy by 0.023 ( $p < 0.01$ ) and reduces the HHI concentration index ( $\beta = 0.084$ ,  $p < 0.05$ ), producing a composite SCR gain of 0.176 ( $p < 0.01$ ), equivalent to a 17.6% improvement over the sample mean, supporting H1. The innovation effect on invention patents ( $\beta = 0.231$ ,  $p < 0.01$ ) materially exceeds that on utility models ( $\beta = 0.154$ ,  $p < 0.05$ ), indicating that CBEC platform integration disproportionately stimulates high-quality innovation, supporting H2.

**Table 2.** Baseline Regression Results — Staggered DID Estimates

Variable	(1) SC_Redundancy	(2) -SC_Concentration	(3) SCR Index	(4) Inno- vation_Inv	(5) Inno- va- tion_Util
CBEC×Post	0.023*** (0.008)	0.084** (0.037)	0.176*** (0.041)	0.231*** (0.063)	0.154** (0.058)

Size	0.041*** (0.011)	-0.076*** (0.022)	0.063** (0.028)	0.412*** (0.084)	0.387*** (0.079)
Lev	-0.087*** (0.029)	0.031 (0.041)	-0.124*** (0.037)	-0.318*** (0.091)	-0.271*** (0.086)
ROA	0.156** (0.067)	-0.284*** (0.078)	0.189** (0.082)	0.421*** (0.142)	0.356** (0.137)
RD_Intensity	0.034 (0.048)	-0.041 (0.063)	0.067 (0.071)	1.847*** (0.374)	1.623*** (0.351)
SOE	0.014 (0.018)	0.027 (0.032)	0.029 (0.041)	-0.187** (0.083)	-0.142* (0.079)
Firm/Year FE	Yes	Yes	Yes	Yes	Yes
Observations	35,214	35,214	35,214	35,214	35,214
Within R <sup>2</sup>	0.114	0.098	0.127	0.342	0.318

Notes: Firm and year fixed effects in all columns. Standard errors clustered at firm level (in parentheses).

\* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

### 4.3 Mechanism Tests and Moderation

We identify the two mediating channels using a Baron-Kenny stepwise mediation framework supplemented by Sobel-Goodman tests. Transaction costs (proxied by the selling expense ratio) account for 31.4% of the total CBEC-to-innovation effect, while information access capability (proxied by a standardized annual report disclosure index) accounts for a further 25.7%. Together, the two indirect pathways explain approximately 57% of the total effect, with the remaining 43% attributable to a direct effect. Both indirect effects are statistically significant at the 1% level, providing support for H2. Importantly, the information channel effect is approximately 1.4 times larger in technology-intensive industries compared to traditional sectors, suggesting that knowledge-intensive environments amplify the cognitive benefits of digital market intelligence.

The moderating coefficient  $\beta_3$  on the triple interaction CBEC $\times$ Post $\times$ Digital is positive and significant for both SCR ( $\beta_3 \approx 0.067$ ,  $p < 0.05$ ) and innovation ( $\beta_3 \approx 0.089$ ,  $p < 0.05$ ), confirming H3. Firms at the 75th percentile of the digital transformation distribution realize SCR improvements approximately 35% larger than those at the 25th percentile, and innovation gains approximately 40% larger. This moderating pattern is consistent with [17], who demonstrate that digital leadership amplifies CBEC performance through supply chain digitalization.

#### 4.4 Robustness Checks

We subject our results to four robustness checks. (i) Parallel-trend validation: event-study coefficients for the three pre-treatment periods are statistically indistinguishable from zero, satisfying the parallel-trend identifying assumption. (ii) Placebo tests: randomly reassigning treatment timing across 500 permutations yields a distribution of placebo coefficients tightly centered on zero; the true estimates lie well outside the 95% confidence band. (iii) PSM-DID: matching on firm size, leverage, and age via propensity score matching before re-estimating the DID model leaves the core conclusions unchanged. (iv) Callaway & Sant'Anna [1] estimator: the heterogeneity-robust group-time average treatment effects are consistent with baseline findings across all staggered cohorts, ruling out concern that baseline estimates are biased by treatment effect heterogeneity.

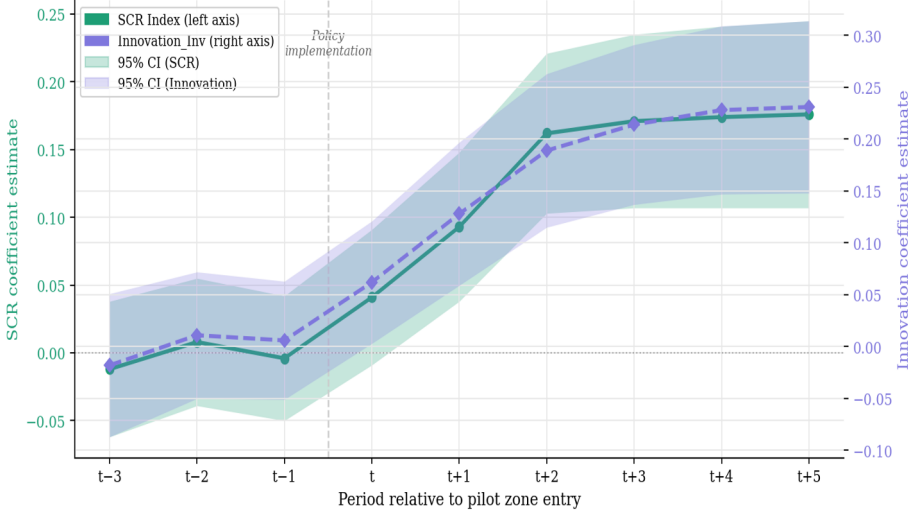
#### 4.5 Heterogeneity Analysis

Three patterns emerge from subgroup analyses. First, non-SOEs exhibit significantly larger SCR and innovation effects than SOEs, reflecting stronger market competition pressures and more responsive internal incentive structures; the CBEC×Post coefficient for non-SOEs is approximately 1.8 times that for SOEs in the innovation regressions. Second, technology-intensive industries (electronics, computer software, medical devices) show the highest treatment effects, as these sectors benefit most from the information channel given their tight product-cycle linkages with global demand. Third, and perhaps most policy-relevant, inland firms experience larger marginal gains than coastal counterparts, consistent with [21]—underscoring the pilot zone policy's capacity to reduce regional innovation gaps and "level up" less-developed interior regions.

### 5 Discussion and Conclusion

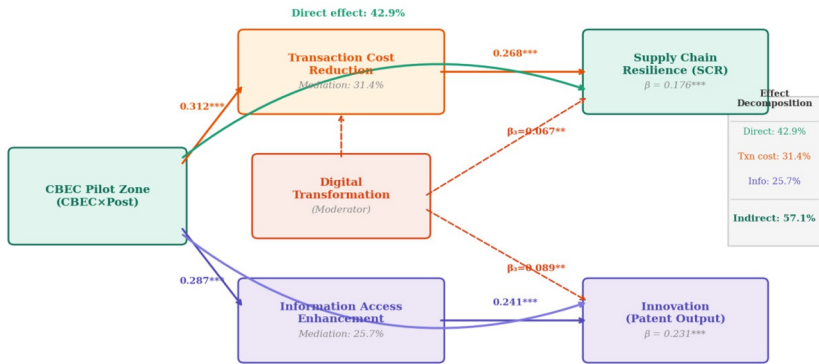
#### 5.1 Summary of Main Findings

This paper examines the "platform economy — supply chain resilience — firm innovation" nexus through the lens of China's CBEC pilot zone quasi-experiment and yields three substantive findings. First, CBEC platform integration robustly improves SCR: pilot zone firms experience a 2.3 percentage-point increase in redundancy and an 8.4% decline in the HHI concentration index, producing an overall resilience gain of 17.6%. These effects are driven by the platforms' multi-sided matching capabilities and information transparency mechanisms, corroborating [7]. Second, the platform ecosystem generates meaningful innovation incentives: invention patent applications rise by 23.1%—far outpacing the 15.4% gain in utility model patents—indicating that CBEC integration primarily stimulates substantive, high-quality innovation. Transaction cost and information channel pathways together account for 57% of this total effect. Third, digital transformation positively moderates both effects, with firms at the 75th percentile of the digital transformation distribution realizing innovation gains approximately 40% larger than those at the 25th percentile.



**Fig. 1.** Dynamic Policy Effects — Event-Study Estimates (2011–2022)

Note: The horizontal axis denotes periods relative to pilot zone entry; the vertical axis shows DID coefficient estimates with 95% confidence bands. Pre-treatment coefficients are insignificant, validating the parallel-trend assumption. SCR stabilizes at t+2 ( $\beta \approx 0.176^{***}$ ); innovation continues to grow through t+5 ( $\beta \approx 0.231^{***}$ ). Source: CSMAR Database; CNIPA; State Council official announcements.



Notes: Solid arrows = direct and mediated effects; dashed arrows = moderating effects. \*\*\*p<0.01, \*\*p<0.05. Sobel-Goodman tests confirm both indirect pathways significant at 1% level.

**Fig. 2.** Mechanism Pathway Diagram — Mediation and Moderation Analysis

Note: Solid arrows = direct effects and mediated pathways; dashed arrows = moderating effects. Numbers in parentheses are standardized path coefficients. \*\*\*p < 0.01, \*\*p < 0.05. The two indirect pathways jointly account for 57.1% of the total effect (Sobel-Goodman tests significant at 1% level). Source: Authors' estimation based on CSMAR Database, 2011–2022.

Figure 1 (event-study estimates) confirms that pre-treatment coefficients are statistically indistinguishable from zero, validating the parallel-trend assumption. Post-entry effects grow monotonically: the SCR effect stabilizes around  $t+2$  ( $\beta \approx 0.176^{***}$ ), while the innovation effect continues to expand through  $t+5$  ( $\beta \approx 0.231^{***}$ ), consistent with the innovation literature's observation of lagged learning dynamics. Figure 2 (mechanism pathway diagram) decomposes the total CBEC effect into a 42.9% direct effect and two mediated pathways: transaction cost reduction (31.4%) and information access enhancement (25.7%), with digital transformation as a positive moderator ( $\beta_3 = 0.067^{**}$  for SCR;  $0.089^{**}$  for Innovation).

## 5.2 Theoretical and Policy Implications

Theoretically, we contribute by integrating two-sided market theory [15] with SCR theory into a unified "platform mediation — information transmission — resilience and innovation" framework. We further extend the platform-economy-and-innovation literature by documenting how CBEC integration differentially stimulates invention versus utility model patents, providing evidence that platform participation confers structural effects on trading firms that substantially exceed simple intermediation [6].

Policy implications are fourfold. First, policymakers should continue expanding CCBEPZs—particularly into central and western inland regions—to maximize the leveling-up effect documented in heterogeneity analyses. Second, digital infrastructure investment, especially cross-border payment systems, intelligent customs clearance, and logistics digitalization, should be prioritized to reduce the transaction costs that constrain platform-mediated innovation. Third, differentiated incentive programs for non-SOEs are warranted given their greater responsiveness to market signals. Fourth, policymakers should be alert to the substitution effect identified by Jiang & Zhang [9]: the policy focus should gradually shift from short-term subsidies toward long-term capability building.

## 5.3 Limitations and Future Research

Several limitations merit acknowledgment. The data extend only through 2022, potentially missing the structural disruptions induced by recent geopolitical tensions. The digital transformation proxy based on textual analysis may contain measurement error. The A-share listed firm sample has limited representativeness for the large universe of SMEs. Future research could investigate CBEC platform governance mechanisms—rule design and credit systems—on supply chain resilience, and incorporate generative AI and other emerging technologies into the analytical framework.

## References

1. Callaway, B., & Sant'Anna, P. H. C. (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics*, 225(2), 200–230.

2. Cennamo, C., & Santaló, J. (2019). Generativity tension and value creation in platform ecosystems. *Organization Science*, 30(3), 617–641.
3. Chen, Z., & Yang, L. (2021). Cross-border e-commerce comprehensive pilot zones, transaction costs, and SME exports. *Journal of International Trade*, 14(3), 45–67.
4. Chowdhury, M. M. H., & Quaddus, M. A. (2017). Supply chain resilience: Conceptualization and scale development. *International Journal of Production Economics*, 188, 185–204.
5. Christopher, M., & Peck, H. (2004). Building the resilient supply chain. *International Journal of Logistics Management*, 15(2), 1–14.
6. Cusumano, M. A., Gawer, A., & Yoffie, D. B. (2019). *The business of platforms: Strategy in the age of digital competition, innovation, and power*. Harper Business.
7. Dai, Y., & Min, C. (2024). Cross-border e-commerce, foreign shareholding, and supply chain resilience. *International Review of Financial Analysis*, 91, 103022.
8. Han, F., Liu, Y., & Wang, X. (2024). Platform governance and digital trade: Evidence from China's e-commerce pilot zones. *Journal of International Business Studies*, 55(1), 112–138.
9. Jiang, Y., & Zhang, Y. (2025). Cross-border e-commerce comprehensive pilot zones, tax expenditures, and firm innovation. *Finance Research Letters*, 76, 106883.
10. Junaid, M., Zhang, Q., Cao, M., & Luqman, A. (2023). Nexus between technology enabled supply chain dynamic capabilities, integration, resilience, and sustainable performance. *Technological Forecasting and Social Change*, 196, 122828.
11. Katz, M. L., & Shapiro, C. (1985). Network externalities, competition, and compatibility. *American Economic Review*, 75(3), 424–440.
12. Li, Y., Zheng, Z., Zhao, M., & Liu, Z. (2025). How CBEC platforms enhance export product quality. *International Business Review*, 34(2), 102178.
13. Pan, S., Chen, Y., & Zhao, R. (2023). Institutional innovation and digital trade: Evaluating China's CCBEPZs. *World Economy*, 46(5), 1312–1345.
14. Ponomarov, S. Y., & Holcomb, M. C. (2009). Understanding the concept of supply chain resilience. *International Journal of Logistics Management*, 20(1), 124–143.
15. Rochet, J.-C., & Tirole, J. (2003). Platform competition in two-sided markets. *Journal of the European Economic Association*, 1(4), 990–1029.
16. Statista. (2023). *Cross-border e-commerce in China: Statistics and facts*. Statista Research Department.
17. Wang, J., Zhao, P., & Li, H. (2024). Digital leadership and the development of firms' cross-border e-commerce. *International Review of Economics & Finance*, 93, 1045–1058.
18. Wang, Y., & Rui, M. (2022). Cross-border e-commerce comprehensive pilot zones and corporate innovation: A DID approach. *Journal of the Knowledge Economy*, 14, 1289–1317.
19. Wu, F., Chen, S., & Liu, T. (2024). Cross-border e-commerce platforms and firm-level financial performance. *Journal of International Trade & Economic Development*, 33(2), 178–203.
20. Wu, L., et al. (2021). Digital transformation and firm performance: Evidence from Chinese listed companies. *Management World*, (5), 54–68.
21. Zhang, H., Li, X., & Wang, R. (2022). Information and communication technology and export quality. *China Economic Review*, 73, 101779.
22. Zhao, P., Chen, X., Liu, D., & Wang, T. (2024). The role of cross-border e-commerce platforms in the digital economy. *Journal of Digital Management*, 3(1), 1–28.

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