International Journal of Multidisciplinary Research and Growth Evaluation.

Research on the Impact of Industrial Synergy Agglomeration on the Technical Complexity of China's Exports

Su Na AN [1*], Li You FU [2]
[1-2] ShangHai DianJi University, China

* Corresponding Author: **Su Na AN**

Article Info

ISSN (Online): 2582-7138
Impact Factor (RSIF): 8.04
Volume: 07
Issue: 03
Received: 13-04-2026
Accepted: 12-05-2026
Published: 11-06-2026
Page No: 923-926

Abstract
China is the world's largest goods trading nation, accounting for a significant proportion of global exports and maintaining a persistent trade surplus. However, China's export trade urgently needs to transition from "quantitative expansion" to "qualitative improvement," with enhancing the technological complexity of exports being a crucial step in boosting its hard power. Industrial agglomeration is not merely a spatial concentration but a comprehensive form of production coordination and promotion. It identifies similar or identical production units within intricate production networks to collaborate, thereby reducing costs and improving quality. As the division of labor in global value chains continues to deepen, manufacturing development relies not only on its own capabilities but increasingly on the integrated growth of manufacturing and producer services. The spatial clustering of these two sectors significantly enhances production efficiency.
Based on provincial panel data from China between 2010 and 2023, this study employs a two-way fixed-effects model to investigate the impact and mechanism of synergistic agglomeration between producer services and manufacturing on the technological complexity of high-tech manufacturing exports. The findings reveal a nonlinear relationship, with synergistic agglomeration between manufacturing and producer services exhibiting a significant promoting effect on export technological complexity.

DOI: https://doi.org/10.54660/.IJMRGE.2026.7.3.923-926

Keywords: Productive services, Export technology complexity, Manufacturing

1. Introduction

With the advancement of the times, China has continuously produced goods that align with contemporary development needs, such as new energy vehicles and lithium batteries, whose export volumes have significantly increased to meet growing consumer demands. Although China holds a certain advantage in export volume, its manufacturing sector still exhibits the characteristic of being "large but not strong," and core technological challenges remain unresolved. China's export trade urgently requires a transition from "quantitative expansion" to "quality enhancement." Increasing the technical complexity of exports is a crucial step toward strengthening hard power and fostering economic development. Therefore, enhancing export technology complexity contributes to improving the competitiveness of exported products.

Industrial agglomeration is not merely a spatial concentration, but rather a comprehensive approach to production coordination and enhancement. It identifies similar or related production units within an intricate network of manufacturing activities, fostering collaboration among them to reduce costs and improve quality. The synergistic clustering of manufacturing and producer services demonstrates how these sectors complement each other and advance collectively.

Export technology complexity reflects the technological content and quality level of a country's export goods, as well as its technological capabilities and production efficiency in manufacturing these products, serving as a key indicator of a nation's position within the international trade division of labor. The concept was first introduced by Michaely (1984), defining this

metric as an indicator of differences in technological content or complexity across products. Subsequently, Hausmann (2005) refined it to develop a more comprehensive measure of export technology complexity that better captures both technological sophistication and production efficiency. Dai Xiang (2015) [3] found through analysis that increased export technology complexity alone did not significantly boost service exports; rather, the interaction between export technology complexity and GDP drove the growth of service exports.

Industrial clustering plays a significant role in fostering corporate innovation, technological advancement, and business model innovation. Research by Yuan Li and Tian Dingxiang (2003) [4] demonstrated that industrial clusters help venture capitalists mitigate investment risks, reduce search costs for investments, and drive technological innovation. The primary benefits of industrial clusters stem from external economies, while regional innovation clusters facilitate knowledge creation. Studies by Liu Jun, Li Lianshui, and Wang Zhong (2010) [9] revealed that industrial clustering significantly enhances regional innovation, encompassing both high-tech and traditional industries. Zhang Xin and Chen Lin (2011) [6] argued that industrial clustering influences regional innovation through technology spillover mechanisms. Cheng Peigang (2006) [7] highlighted that industrial clustering represents a unique locational advantage that attracts foreign investment. Zhu Shaojie (2006) found that agglomeration effects have become a critical factor influencing FDI flows, enabling regions to attract foreign capital through industrial clustering and boost economic growth. Zheng Ruogu (2009) [8] noted that spatial industrial clustering is an economic phenomenon, particularly prominent in China's manufacturing sector, with certain cities demonstrating absolute advantages in this regard, which exacerbates regional development disparities. Liu Jun and Yu Youwei (2010) [5, 9] emphasized the synergistic effects of industrial clustering, noting that upstream-downstream industry clusters achieve greater cost efficiency.

Research on the impact of industrial synergy and agglomeration on export technology complexity remains limited among scholars. Liu Hongduo (2016) [10] found that greater industrial agglomeration in a region has a more positive effect on export technology complexity. Xu Ziyan, Yao Zhanqi, and Xia Jiechang (2021) [11] demonstrated that industrial synergy and agglomeration enhances export technology complexity through regional innovation, recommending that cities promote synergistic agglomeration between service and manufacturing sectors. Liu Chi and Lu Tingting (2023) [12], by analyzing provincial-level data and constructing a model, revealed that synergistic agglomeration between producer services and manufacturing boosts technological innovation, thereby elevating export technology complexity.

According to existing literature, an increasing number of authors have focused on the technological complexity and industrial agglomeration of China's exports. However, there are few studies directly examining the impact of industrial collaborative agglomeration on the technological complexity of manufacturing exports, with most research concentrating on a single aspect. This paper investigates the effect of industrial collaborative agglomeration on the technological complexity of manufacturing exports.

Based on this, we utilize provincial-level panel data from China covering the period 2010‑2023 to explore the influence of collaborative agglomeration between producer services and manufacturing on the technological complexity of high-tech manufacturing exports.

2. Method

To examine the impact of the digital economy on China's service exports, this paper adopts the research methodology proposed by Ma Zhaoliang *et al*. and constructs the following panel data fixed-effects model:

ln(export-tech)

$$\alpha 0+ \alpha 1\text{colocation}+ \alpha 2\text{Xit}+ \mu \text{ i}+ \gamma \text{ t}+ \varepsilon \text{ it}$$

Here, ln(export-tech) denotes the logarithm of export technology complexity, while colocation refers to industrial synergy agglomeration.

2.1. Selection of Variables

2.1.1. Explanatory Variable: Industrial Synergy Agglomeration

After reviewing extensive literature, we adopted the index developed by Chen Jianjun, with the specific calculation formula as follows:

$$CO = \left[1 - \frac{|LQZ - LQS|}{|LQZ + LQS|}\right] + [LQZ + LQS]$$

$$LQZ = \frac{(E_{zi} / E_i)}{(E_z / E)}$$

$$LQS = \frac{(E_{si} / E_i)}{(E_s / E_i)}$$

CO represents the level of synergistic clustering between producer services and manufacturing; a higher value indicates stronger synergy. LQZ reflects the clustering intensity of manufacturing in a region, while LQS measures that of producer services.

The data were obtained or calculated from indicators such as producer services in the China Labor Statistical Yearbook covering the period 2010‑2023. The employment figures for high-tech manufacturing were sourced from the China High-Tech Statistical Yearbook for the same period. The level of collaborative agglomeration was derived accordingly.

2.1.2. Dependent Variable: Export Technology Complexity

Measurement of Export Technology Complexity: Drawing on the methodology proposed by Hausmann *et al*. (2007) [2], the following formula is used to calculate manufacturing export technology complexity:

$$ETC_i = \sum_p \left[\frac{\left(\frac{x_{ip} - e_{ip}}{X_p - E_p}\right)}{\sum_p \left(\frac{x_{ip} - e_{ip}}{X_p - E_p}\right)} Y_j \right]$$

$$ETC_p = \sum_i \left[\frac{x_i - e_i}{X - E} ETC_i \right]$$

Here, i and p represent the product and province respectively, while ETCi denotes the export technical complexity of product i.

Data source: The conceptual definition of high-tech manufacturing is based on the "China High-Tech Industry Statistical Yearbook," selecting five major industries−

"aerospace,""communications,""computing,""pharmaceuticals," and "medical care" −as high-tech manufacturing sectors. Export technology complexity was then calculated accordingly.

2.1.3. controlled variable

In addition to the core explanatory variables, this study also includes control variables such as economic development level (GDP), trade index (trade), foreign direct investment level (FDI), and transportation infrastructure measures (infrastructure).

2.2. Literature search

The author conducted a search for information sources in the form of research journals that discuss this problem.

3. Data evaluation

The author evaluates the contents of the research journal obtained so that the research data to be discussed can be in accordance with what is desired.

4. Data analysis and interpretation

The author analyzes the research data obtained so that it can then be summarized and rewritten in the resulting article.

The data analysis technique used by the author is the content analysis technique where the author will analyze the results of research that has been carried out based on suitability with the topic discussed and the time of implementation of the research.

5. Empirical Analysis

5.1. Basic Regression

This table conducts a regression analysis between export technology complexity and industrial synergy agglomeration. The first column shows that industrial agglomeration has a significantly positive impact on export technology complexity; the significance level increases markedly when control variables are included, with each one-unit increase in industrial synergy agglomeration raising export technology complexity by 0.679 units. Infrastructure also exhibits a significant positive effect.

Table 1: Basic Regression Results

	(1)	(2)	(3)	(4)
colocation	0.357**	0.590***	0.679**	0.679***
	(0.145)	(0.138)	(0.256)	(0.240)
rd		9.005	4.069	-0.500
		(6.079)	(12.559)	(10.763)
fin		0.157***	0.185	-1.003***
		(0.056)	(0.114)	(0.266)
fdi		-4.982***	-4.656***	-0.621
		(1.057)	(1.127)	(1.337)
ti		0.052***	0.054**	0.034**
		(0.008)	(0.021)	(0.014)
open		-1.644***	-1.723***	-0.998**
		(0.178)	(0.347)	(0.425)
_cons	7.554***	5.395***	4.948***	16.082***
	(0.471)	(0.571)	(0.953)	(2.594)
Time Effect	YES	NO	NO	YES
Regional Effect	YES	NO	YES	YES
N	420	420	420	420

5.2. Qualitative Testing

The impact of industrial collaborative clustering on export technology complexity varies across regions. In areas with high levels of collaborative economy, this impact exhibits a significant positive correlation, primarily due to well-developed infrastructure in advanced regions that enables enterprises to leverage digital technologies and equipment to enhance both import/export volumes and service quality, fostering a "positive feedback loop." Consequently, the effect of industrial collaborative clustering on export technology complexity demonstrates heterogeneity.

Table 2: Qualitative Testing Results

	(1)	(2)	(3)
	East	Middle	West
colocation	0.725**	-0.294	1.025***
	(0.306)	(0.483)	(0.304)
rd	24.539*	63.443	-21.378
	(11.530)	(38.109)	(23.501)
fin	-1.386***	-1.894***	-0.508
	(0.356)	(0.472)	(0.597)
fdi	-1.088	-7.784*	-3.322
	(1.426)	(4.042)	(6.668)
ti	0.003	0.048	0.017
	(0.019)	(0.038)	(0.013)
open	-0.315	-6.276**	-5.183***
	(0.448)	(2.484)	(0.715)

_cons	19.653***	26.448***	11.414*
	(3.052)	(4.666)	(5.841)
N	168	126	126
r2	0.775	0.797	0.730

6. Conclusion

Based on provincial panel data from China covering the period 2010‑2023, this study employs a two-way fixed-effects model to investigate the impact and mechanism of synergistic agglomeration between producer services and manufacturing on the technological complexity of high-tech manufacturing exports. Transportation infrastructure, foreign direct investment, economic development level, and trade index were selected as control variables for empirical analysis. Targeted recommendations are proposed based on the empirical findings to enhance China's export technological complexity and improve its international competitiveness. The study reveals that synergistic agglomeration between manufacturing and producer services significantly promotes export technological complexity.

7. Policy Proposal

This study demonstrates the positive role of synergistic clustering between producer services and high-tech manufacturing in enhancing export technology complexity. To promote high-quality development of the national manufacturing sector and strengthen international competitiveness, the following policy recommendations are proposed:

First, strengthen top-level design and institutional safeguards, enhancing strategic guidance and coordinated planning at the national level. Create an ecosystem conducive to collaborative development by establishing a robust institutional framework that facilitates free flow of resources, knowledge sharing, and industrial integration. Second, implement innovation-driven strategies supported by talent development, refining a technology innovation system centered on enterprises. Encourage growth of high-tech manufacturing companies, establish exemplary models, and foster an innovation culture characterized by risk-taking and open collaboration. Deepen industry-academia-research-application synergy and talent cultivation mechanisms by fostering close partnerships between universities, research institutions, and industrial clusters, creating talent development programs and R&D initiatives aligned with industrial needs. Promote customized talent training and targeted technological innovation to ensure talent supply and patent output meet industrial demands. Additionally, adopt more flexible talent recruitment policies with tailored support for high-end professionals in key sectors, building a global hub for talent excellence. Finally, optimize regional distribution and industrial cluster ecosystems through differentiated development strategies, elevating the modernization level and integration depth of industrial clusters.

References

1. Hausmann R, Rodrik D. Economic development as self-discovery. Journal of Development Economics. 2003;72(2):603–633.
2. Hausmann R, Hwang J, Rodrik D. What you export matters. Journal of Economic Growth. 2007;12(1):1–25.
3. Dai X, Zhang Y. International comparison and evolution mechanisms of service export complexity in China. Nanjing Social Sciences. 2015;(05):25–32, 47. doi:10.15937/j.cnki.issn1001-8263.2015.05.004.
4. Yuan L, Tian D. Regional innovation and industrial agglomeration. Hunan Economy. 2003;(04):28–29.
5. Liu J, Li L, Wang Z. The impact of industrial clustering on regional innovation capacity and its industry-specific variations. Scientific Research Management. 2010;31(06):191–198. doi:10.19571/j.cnki.1000-2995.2010.06.025.
6. Zhang X, Chen L. Industrial clustering, knowledge spillover and regional innovation performance: an empirical study based on the pharmaceutical manufacturing industry. Science and Technology Management Research. 2011;31(19):69–72.
7. Cheng P. Location advantages of industrial clusters and transnational investment. China Market. 2006;(Z2):6.
8. Zheng R. Industrial clustering, growth drivers, and regional disparities: An empirical analysis of China's manufacturing sector since WTO accession. Economic Management. 2009;31(12):14–22. doi:10.19616/j.cnki.bmj.2009.12.005.
9. Liu J, Yu Y. The rational distribution of industrial clusters across regions and strategies for promoting it. Economic System Reform. 2010;(02):112–117.
10. Liu H. The impact of industrial agglomeration on export technology complexity: An empirical analysis from the perspective of transformation in foreign trade development models. Journal of the Graduate School of the Chinese Academy of Social Sciences. 2016;(04):39–47.
11. Xu Z, Yao Z, Xia J. The impact of collaborative clustering on export technology complexity: A study based on regional innovation mediation effects. Economic Horizons. 2021;(09):43–52. doi:10.16528/j.cnki.22-1054/f.202109043.
12. Liu C, Lu T. The impact of industrial synergy and agglomeration on export technology complexity: A case study of high-tech manufacturing and producer services. Journal of Central South University for Nationalities (Humanities and Social Sciences Edition). 2023;43(03):137–146, 187. doi:10.19898/j.cnki.42-1704/c.20221125.05.

How to Cite This Article

Su Na AN, Li You FU. Research on the impact of industrial synergy agglomeration on the technical complexity of China's exports. International Journal of Multidisciplinary Research and Growth Evaluation. 2026;7(3):923–926. doi:10.54660/.IJMRGE.2026.7.3.923-926