International Talent Inflow, Technological Innovation and Export Technological Complexity: an Analysis of Mesomeric Effect Based on Provincial Panel Data

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Abstract: This paper examines the impact of international talent inflow on export technology complexity and Mesomeric effect. The findings indicate that (1) the inflow of international talents, particularly academic students, significantly promotes the complexity of export technology, and this conclusion is robust. (2) The promotion effect of international talent is more pronounced in the eastern region compared to the central and western regions, and it is more significant for capital and technology-intensive export technology complexity compared to labor-intensive export technology. (3) The pathway of "international talent, technological innovation, export technological complexity" is validated, with technological innovation acting as a partial mediator. Therefore, it is recommended to leverage the innovative potential of international talents, foster regional and industry collaboration, enhance export technology complexity, and establish a more open trade pattern.

Keywords: International talent inflow; Export technology complexity; technological innovation Mesomeric effect;

1 Introduction

The inflow of high-level international talents plays a crucial role in driving technological innovation and progress in China. The international talents coming to China for study abroad promote the cross-border flow of knowledge and technological elements, which is vital for advancing the Chinese economy and technological development. This study, from the perspective of studying abroad, focuses on international talents as the research subject and examines their impact on China. Enhancing the complexity of export technology is of significant importance in optimizing product structure, quality, and technological levels. It drives the upgrading of processing trade, promotes high-quality development of foreign trade, cultivates competitive advantages, and breaks economic difficulties and foreign blockades. Currently, research on export technology complexity primarily focuses on index construction and measurement[1,2,3,4]and influencing factors[5,6,7]. Research on international talents primarily centers around innovation [8,9,10], optimization of product structure[11], global value chains[12], and the increase of human capital [13], with less attention given to the influence of international talents on the enhancement of export technology complexity.

The academic contribution of this article mainly lies in exploring the relationship between

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international talent and the complexity of export technology from the perspective of international talent, and revealing the impact mechanism of international talent on the complexity of export technology, opening up some intermediary mechanisms of the relationship between innovation output and export technology complexity.

The rest of the article is organized as follows. Section 2 presents the theoretical framework and hypotheses. Section 3 describes the methodology. Section 4 presents the results, and Section 5 provides the conclusion.

2 Theoretical and Hypotheses

International talent inflow directly enhances export technology complexity by enriching knowledge accumulation, improving labor productivity, and optimizing industrial and export trade structures[14,15]. Their high skills and specialized knowledge contribute to increased technological complexity of exported products. Hypothesis 1: International talent significantly promotes export technology complexity.

International talents mediate the enhancement of export technology complexity through increased technology innovation input and reduced innovation risks. They bring diverse knowledge and inputs, boosting R&D investment and improving complexity [16] .They expand firms' capabilities in searching for new technologies, lower innovation costs, and provide guidance for regional innovation[11]. Thus, Hypothesis 2 suggests that technological innovation mediates the impact of international talents on export tech complexity.

3 Methodology

3.1 Metrological Model Setting

Following Wen Zhonglin et al[17]Mesomeric effect test process and utilizing the SOBEL stepwise Law of Return method, we first establish Model (1) to examine the direct impact of international talent on export technology complexity.

$$LnExpy_{it} = \alpha_0 + \alpha_1 LnSTU_{it} + \sum \alpha_c CV_c + \mu_i + \tau_t + \varepsilon_{it} \quad (1)$$

Secondly, using technological innovation (LnINNO) as the dependent variable, establish a model (2) to examine the impact of international talent on technological innovation

$$LnINNO_{it} = \beta_0 + \beta_1 LnSTU_{it} + \sum \beta_c CV_c + \mu_i + \tau_t + \varepsilon_{it} \quad (2)$$

Finally, international talents and technological innovation are simultaneously included in the model (3) to explore whether technological innovation has a Mesomeric effect in the relationship between international talents and export technological complexity.

$$LnExpy_{it} = \gamma_0 + \gamma_1 LnSTU_{it} + \gamma_2 LnINNO_{it} + \sum \gamma_c CV_c + \mu_i + \tau_t + \varepsilon_{it} \quad (3)$$

whrer, $Expy_{it}$ represents the export technology complexity for province i and year t, STU_{it} represents the international talent inflow for provinces and cities in year t, $INNO_{it}$ represents the technological innovation index for province i and year t, CV_C is the set of control variables, μ_I is the individual fixed effect, $\tau_t$is the fixed time effect, and ε_{it} is the random error term. To address the magnitude gap between indicators and the issue of Homoscedasticity and heteroscedasticity, all variables in this study are logarithmized.

3.2 Calculate the complexity of export technology

This article adopts the method of XU&LIU[18] to calculate the complexity of export technology. Firstly, the technological complexity (PRODY it) of export industries in each province is calculated.

$$PRODY_{it} = \sum_i^n \frac{x_{ikt}/X_{it}}{\sum_i^n x_{ikt}/X_{it}} y_{it} \qquad (4)$$

Among them, X_{ikt} represents the export value of industry k in province i during period t, X_{it} represents the total export volume of all industries in province i during period t, x_{ikt}/X_{it} represents the export share of industry k in province i during period t, and y_{it}t represents the per capita GDP of province i during period t.

Secondly, adding it up to the provincial level to obtain the export technology complexity $Expy_{it}$ of province i

$$Expy_{it} = \sum_k^n (x_{ikt}/X_{it}) PRODY_{it} \qquad (5)$$

Among them, $Expy_{it}$represents the complexity of export technology for province and city i in year t.

4 Empirical analysis

4.1 Data

This study uses 2008-2018 provincial Panel data. The dependent variable (Ln Expy) is sourced from China National Research Network, international talent (Ln STU) data is from "Concise Statistics of International Students in China," and technological innovation (Ln PAT) data is from "China Science and Technology Statistical Yearbook." Control variables are sourced from the "China Statistical Yearbook." AS shown in Table 1, Average export technology complexity is 8.760, with a range of 8.020 to 9.278 and a small standard deviation. International talent inflow and export technology complexity show similar levels with a small statistical dispersion.

Table 1 descriptive statistics

variable	Obs.	Mean	Std. dev.	Mini	Max
Ln Expy	341	8.760	0.330	8.020	9.278
Ln STU	341	8.409	0.360	7.807	8.910
Ln Urban	341	3.962	0.261	3.118	4.495
Ln Infra	341	8.825	1.038	4.878	10.138
Ln Scale	341	8.110	0.847	5.659	9.337
Ln RES	341	8.323	0.941	5.687	10.03
Ln FDI	341	-1.515	0.839	-3.065	1.380
Ln Hum	341	7.750	0.328	6.876	8.817

4.2 Benchmark results and Mesomeric effect

Based on Table 2, the benchmark regression results show that international talent inflows have a significant positive impact on export technology complexity. Controlling for other variables in Model (2) does not change this finding. The fixed effects model (Model 3) confirms that a 1% increase in international talent inflows leads to a 0.859 percentage point increase in export technology complexity. These results support Hypothesis 1, demonstrating that international talent inflows enhance human capital, knowledge diversity, innovation efficiency, and the technical complexity of exported products. To address endogeneity, the instrumental variables estimation method is used in Model (4). The instrumental variable, lagged international talent inflows (LnSTU-1), is found to be effective, and the results remain consistent, validating the robustness of the conclusions.

Using the SOBEL method, Model (5) incorporates technological innovation variables into the benchmark model, confirming that both international talent and technological innovation have a significant positive impact on export technology complexity. The Sobel test reveals that technological innovation mediates the impact of international talent on export technological complexity, accounting for 2% of the total effect. Thus, international talent inflows promote technological innovation, optimizing product technology structure and enhancing export technology complexity. This validates Hypothesis 2 and uncovers the critical pathway between international talent and technological innovation.

Table 2 regression test results

	(1) OLS	(2) OLS	(3) FE	(4) IV	(5) Ln PAT	(6) Ln EXPY
Ln STU	0.911^{***} (0.008)	0.859^{***} (0.014)	0.859^{***} (0.014)	0.814^{***} (0.018)	1.076*** (0.114)	0.841^{***} (0.016)
Ln STU-1						
Ln PAT						0.017^{**} (0.007)
CV	NO	YES	YES	YES	YES	YES
Sobel						0.018^{**} 0.008）
_cons	1.170^{***} (0.066)	1.354^{**} (0.552)	1.586^{***} (0.566)	0.596^{***} (0.225)	-20.76*** (4.481)	1.928^{***} (0.582)
N	341	341	341	310	341	341
R^2			0.993	0.886	0.906	0.994

4.3 Heterogeneity analysis

Table 3 shows regional heterogeneity in the impact of international talent on export technology complexity in China. The eastern region has the strongest effect due to its economic development and quality education, attracting more international talents. The central and western regions have weaker effects due to limited innovation factors and industrial agglomeration[19].

Industry heterogeneity is observed in the impact of international talent on export technology complexity in China. Capital-intensive industries [1] show the highest impact, followed by technology-intensive industries, and labor-intensive industries have the lowest impact. This suggests that industries relying on innovation and technology allocation benefit more from international talent inflows[20].

Educational programs have a significant positive impact on export technology complexity by increasing advanced human capital, reducing innovation costs and risks, and improving product technology structure.

Table 3 Heterogeneity analysis

	(1) Easte	(2) West	(3) Middle	(4) Capital	(5) Labour	(6) Technology
Ln STU	0.973^{***} (0.034)	0.759^{***} (0.018)	0.972^{***} (0.020)	1.109^{***} (0.126)	0.80^{***} (0.120)	0.99^{***} (0.103)
CV	YES	YES	YES	YES	YES	YES
_cons	0.980 (0.938)	-0.507 (0.764)	-1.238 (1.625)	-0.055 (4.938)	-7.198 (4.714)	7.358^{*} (4.072)
N	132	121	88	341	341	341
R^2	0.996	0.997	0.998	0.571	0.658	0.782

4.4 Robustness testing

We conducted multiple robustness tests to confirm our research findings' reliability. Results using alternative measures of human capital, such as per capita research and education funding, were consistent with the main regression, supporting the positive impact of international talent inflows on export technology complexity. Excluding samples from central government municipalities and considering the financial crisis's impact on 2009 data still showed a significant positive effect of international talent inflows. These tests validate the robustness and reliability of our conclusions.

5 Conclusion

Using panel data from 31 provinces and cities in China from 2008 to 2018, this study examines the impact of international talent inflow on export technology complexity. The findings reveal a significant positive effect, particularly for academic and international students, supporting the robustness of the conclusion. The eastern region experiences a stronger promotion effect

[1] Labor-intensive: food manufacturing and tobacco processing industry, textile industry, clothing, leather, down and related products industry, wood processing and furniture manufacturing industry.
Capital intensive: paper printing and stationery manufacturing industry, petroleum processing, coking and nuclear fuel processing industry, non-metallic mineral products industry, metal smelting and rolling metal products industry
Technology intensive: general and specialized equipment manufacturing in the chemical industry, transportation equipment manufacturing, electrical, mechanical and equipment manufacturing, communication, computer and other electronic equipment manufacturing, instrument and cultural office machinery manufacturing Other manufacturing industries.

compared to the central and western regions, and capital and technology-intensive export technology complexity is more affected than labor-intensive exports. The results validate the "international talent - technological innovation - export technological complexity" pathway, with technological innovation serving as a partial Mesomeric effect. To optimize export product technological structure and enhance complexity, China should increase educational openness, strengthen international talent education, and optimize resource allocation for innovation.

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