How Labor Agglomeration Promotes the Development of New Quality Productivity in China's Regions

Jiaxin Bu*, Xinyi Gao

School of Economics and Finance, Xi'an International Studies University, Xi'an, China

*Email: 2586455158@qq.com

Abstract. Based on provincial-level data from China covering 2010–2022, this study constructs an evaluation framework for regional new-quality productivity across three dimensions: laborers, means of labor, and objects of labor. The entropy-weighted TOPSIS method is employed to measure provincial development levels of new-quality productivity, empirically examining the impact and mechanisms of labor agglomeration on this productivity. The findings reveal that labor agglomeration significantly promotes regional new-quality productivity development, primarily through enhancing regional innovation capacity, facilitating industrial structure upgrading, and accelerating green and low-carbon transformation. Heterogeneity analysis indicates that labor agglomeration exerts a more pronounced effect on new-quality productivity in eastern provinces, provinces with low transportation infrastructure levels, and provinces pursuing economic catch-up.T his study provides valuable empirical evidence and policy insights into the enabling effects and implementation pathways of factor agglomeration on new quality productive forces development.

Keywords: labor agglomeration, new quality productive forces, regional innovation capacity, industrial structure upgrading, green and low-carbon transition

1 Introduction

New-type productive forces, fundamentally characterized by the supply of laborers, means of labor, and objects of labor along with their optimized integration, represent an innovative development within Marx's framework of productive forces. They constitute a new form of productive forces that enhances production efficiency and quality through technological, managerial, and organizational innovations, thereby driving industrial upgrading and high-quality socioeconomic development.

Current literature predominantly focuses on the mutually reinforcing relationship between new-type productive forces and production efficiency. Zhang Pengfei and Li Xinyi (2023) [1] and others found that labor agglomeration significantly boosts labor productivity, aligning with the ultimate outcomes of new-quality productive forces. Concurrently, enhancing labor quality, digitizing labor tools, and promoting the greening of labor objects are key pathways to elevating new-quality productive forces (Zhang

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Lihuan and Zhang Jinchang, 2024) [2]. Therefore, investigating the theoretical mechanisms of new-type productive forces on labor agglomeration is particularly crucial.

2 Literature Review

First, the connotation and measurement of new-quality productivity. Its fundamental essence is summarized as the comprehensive enhancement of the three major elements of productivity and their optimized combination, unfolding around the dimensions of "novelty" and "quality."Ma Rong and Wang Haoxiang (2025) [3] argue that the "novelty" of new-quality productive forces manifests as new content within Marxist productive force theory and a new paradigm for productive forces, while the "quality" primarily lies in shifts in driving forces. Regarding the measurement of new-quality productive forces, most scholars adopt a Marxist economics perspective, constructing a comprehensive evaluation index system based on three dimensions—laborers, objects of labor, and means of production—and employing integrated evaluation methods to measure their development level.(Wang Jue and Wang Rongji (2024) [4], Ren Yuxin, Wu Yan et al. (2024) [5], Liu Kai and Feng Wei (2024) [6])

Second, the connotation and measurement of labor agglomeration. The essence of labor agglomeration lies in the spatial or industrial concentration and optimal allocation of labor factors (Smith, 1981) [7]. In terms of measurement, scholars frequently employ diversified approaches comprehensively characterize labor agglomeration levels across dimensions such as scale, efficiency, matching quality, and dynamic networks.

In summary,① In terms of research methodology, existing studies lack regression analyses of these forces. ② Regarding research content, existing studies primarily focus on measuring the level and value utility of new-type productive forces. There is a lack of research revealing the intrinsic pathways through which labor influences new-type productive forces from a Marxist perspective.

Therefore, this paper makes three main contributions: First, it supplements the literature on the impact of labor factor agglomeration on new-quality productive forces. This paper broadens the scope, providing new evidence for the relationship between labor agglomeration and new-type productive forces. Second, it delves into the important underlying economic mechanisms linking labor agglomeration and new-type productive forces. Labor agglomeration provides robust support for the development of new-type productive forces by fostering technological innovation, driving industrial upgrading, and promoting green and low-carbon transformation.

3 Theoretical Mechanism Analysis

3.1 Direct Effects of Labor Agglomeration on Empowering New Quality Productivity

Knowledge spillover effects refer to the formation of labor pools through regional agglomeration, which facilitates informal exchange of tacit knowledge among enterprises and accelerates innovation (Alfred Marshall, 1890[8]).Zeng Yongming and Zhong

Zikang (2024) [9] constructed a spatial Durbin model and found that during labor agglomeration, workers naturally disseminate tacit knowledge, thereby generating knowledge spillover and diffusion effects for urban innovation. This process enhances urban innovation capacity and technological advancement. Simultaneously, higher spillover levels and lower agglomeration costs generate greater innovation output (Ning Zhong and Si Chunlin, 2003) [10]. This enriches technological diversity—a core condition for green technology spillover effects (Lin Hongying, Yang Xiaohui et al., 2025) [11] —thereby advancing urban green development. Together, these innovations and green initiatives jointly propel the development of new-quality productive forces.Accordingly, Hypothesis 1 is proposed: Labor agglomeration will directly drive the enhancement of new-quality productive forces.

3.2 Mechanistic Effects of Labor Agglomeration Empowering New Quality Productivity

(1) Labor agglomeration enhances the development level of new quality productive forces through industrial structure upgrading.

Labor agglomeration significantly promotes regional industrial structure upgrading (Baldwin, 2003) [12]. Liu Xinzheng (2012) [13] combined theoretical analysis with revealed data to demonstrate that labor agglomeration factors in China can drive regional industrial structure upgrading and exert a significant positive feedback effect on the development of new quality productive forces.Wu Wei and Liu Guoping (2021) [14] By constructing mediation effect models and other methods, the analysis concludes that the development of new-type productive forces carries the weight of industrial structure transformation and upgrading, as well as coordinated urban-rural and regional development.

(2) Labor agglomeration enhances innovation capacity, thereby elevating the development level of new-type productive forces.

Innovation economics emphasizes that innovation capacity is highly dependent on the concentration of highly skilled labor. Meng Caixia (2025) [15] concludes through benchmark regression modeling that high-skilled labor agglomeration significantly boosts green innovation capacity. Meanwhile, Wang Borui and Zhu Zhe (2024) [16] reveal through historical logic analysis that innovation serves as the primary driver of new-quality productive forces.

(3) Labor agglomeration enhances the development level of new-quality productive forces by promoting green and low-carbon transformation.

Labor force concentration in specific spatial areas promotes regional green and low-carbon transformation through multiple pathways.Lu Ming and Feng Hao (2014)[17] revealed through fixed-effects regression that promoting population agglomeration reduces pollutant emissions per unit of industrial value-added, aiding in achieving predetermined emission reduction targets. Green and low-carbon transformation is also an inherent aspect of new-quality productive forces (Wang Jue and Wang Rongji (2024) [4]).

In summary, Hypothesis 2 is proposed: Labor agglomeration enhances the level of new productive forces by promoting industrial structure upgrading, boosting innovation capabilities, and facilitating green and low-carbon transformation.

4 Empirical Design

4.1 Model Specification

This paper constructs the following fixed-effects model:

$$XZS_{it} = \mu + \beta_1 LAG_{it} + \beta_2 X_{it} + b_i + \varepsilon_{it} \quad (1)$$

Where subscripts i and t denote province and year, respectively. The dependent variable isXZS_{it} , representing the level of new-quality productive capacity development in province i during year t. The core explanatory variable isLAG_{it} , indicating the labor agglomeration level across provinces. X denotes provincial-level control variables, and ε represents the random disturbance term following a standard normal distribution.

To examine the mechanism through which labor agglomeration empowers new-quality productivity, this study employs a stepwise regression approach for identification:

$$IDFC_{it} = \mu + \beta_{21} LAG_{it} + \beta_{22} X_{it} + b_{i2} + \varepsilon_{it2} \quad (2)$$

$$INS_{it} = \mu + \beta_{21} LAG_{it} + \beta_{22} X_{it} + b_{i2} + \varepsilon_{it2} \quad (3)$$

$$CAE_{it} = \mu + \beta_{21} LAG_{it} + \beta_{22} X_{it} + b_{i2} + \varepsilon_{it2} \quad (4)$$

Where$IDFC_{it}$ represents innovation capacity,INS_{it} represents industrial structure upgrading,CAE_{it} represents green and low-carbon transformation, and other variables are identical to those in Equation (1).

4.2 Indicator Selection

(1) Dependent Variable: New Quality Productivity

T o better evaluate the development level of new-type productive forces across provinces, this paper constructs a multi-factor evaluation system comprising 18 variables. These variables are selected based on three dimensions—laborers, labor objects, and labor tools—and reference the specific connotations of new-type productive forces. The Entropy Weight-TOPSIS method is employed to comprehensively assess the development level of new-type productive forces.

Results indicate that at the national level, new-type productive showed an upward trajectory. However, this growth exhibits significant regional disparities.

(2) Core Explanatory Variable: Labor Agglomeration

This study employs the concept of locational entropy to measure labor agglomeration across different geographic areas. The specific formula is as follows:

$$LAG_{it} = \frac{{}^{LA_i}/_{\sum_{i=1}^{i} LA_i}}{{}^{Land_i}/_{\sum_{i=1}^{i} Land_i}} \quad (5)$$

WhereLAG_{it} denotes the labor agglomeration index of province i at time t,LA_i represents the year-end labor force size of province i at fixed time t, and$Land_i$ indicates the land area of province i at fixed time t.

(3) Instrumental Variables

Following existing literature on labor agglomeration and new-type productive forces, this study selects innovation capacity (IDFC), industrial structure upgrading (INS), and green low-carbon transition (CAE) as instrumental variables.

(4) Control Variables

This study controls for the following provincial-level characteristic variables: industrialization level (IDL), urbanization level (URL), government intervention level (GOV), environmental regulation intensity (ENQ), number of legal entities (NLP), and marketization level (MAL). Additionally, to reduce computational heteroskedasticity, the number of legal entities is log-transformed.

4.3 Data Sources

This study selected 30 provinces (autonomous regions and municipalities) in China as samples from 2010 to 2022. Data sources include the National Bureau of Statistics, CEIC China Statistical Database, China Environmental Statistical Yearbook, etc. Missing data for certain years in individual provinces were imputed using linear interpolation.

5 Results Analysis

5.1 Benchmark Regression Results

Table 1 presents the benchmark regression results for new-type productive forces.

Table 1. Direct Effects Analysis

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
LAG	*0.430***	*0.429***	*0.278****	*0.259****	*0.108***	*0.130****	*0.117***
	(0.0318)	*(0.0321)*	*(0.0153)*	*(0.0145)*	*(0.0185)*	*(0.0267)*	*(0.0268)*
IDL		*0.0489****	*-0.0910****	*-0.261****	*0.518***	*0.162****	*0.131***
		(0.0102)	*(0.0113)*	*(0.0188)*	*(0.0373)*	*(0.0398)*	*(0.0414)*
URL			*0.252****	*0.206****	*0.0810****	*0.169****	*0.0561**
			(0.0220)	*(0.0223)*	*(0.0178)*	*(0.0316)*	*(0.0325)*

GOV				*-0.344****	*-0.332****	*-0.0238*	*0.0758*
				(0.0291)	*(0.0183)*	*(0.0667)*	*(0.0683)*
ENQ					*0.939****	*2.129****	*2.020****
					(0.0444)	*(0.307)*	*(0.304)*
lnFRSL						*0.0555****	*0.0475*****
						(0.00990)	*(0.0102)*
MAL							*0.0149*****
							(0.00159)
Constant	*0.304****	*0.258****	*0.260****	*0.517****	*-0.114****	*-0.603****	*-0.547****
	(0.00207)	*(0.00985)*	*(0.0110)*	*(0.0207)*	*(0.0403)*	*(0.168)*	*(0.165)*
Time Fixed Effect	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
N	390	390	390	390	390	390	360
R^2	0.1791	0.1854	0.2237	0.3587	0.5105	0.5908	0.6089

Note: *, **, *** denote significance levels of 10%, 5%, and 1% respectively; the same applies to the table below.

This study employs the least squares method to regress the panel data, with results shown in the table. As a series of control variables are progressively incorporated,.the core explanatory variables (LAG) are all statistically significant at the 1% level and exhibit positive values. This indicates that labor agglomeration can directly drive the development of new-type productive forces, serving as an effective pathway to enhance regional new-type productive force development, thereby validating Hypothesis 1.

5.2 Robustness Tests

To mitigate the contingency of regression results, this study conducted robustness tests using three methods: indicator substitution, outlier treatment, and special region sampling. The coefficients of core explanatory variables were all statistically significant at the 1% level. The findings (not shown) indicate robust and reliable conclusions.

5.3 Heterogeneity Analysis

This paper conducts heterogeneity analysis across three dimensions: geographic location characteristics, transportation infrastructure development, and economic development levels. Table 2 reports the results of the heterogeneity analysis.

Table 2. Heterogeneity Regression Analysis

	Grouped by Region			By Transportation Infrastructure		By Economic Development Level	
	Eastern Region	Central	Western	High Infrastructure	Low Infrastructure	High Economy	Low economic
LAG	0.102***	-2.035***	6.92e-05	0.154***	3.602***	0.0667***	1.371***
	(0.0164)	(0.657)	(0.263)	(0.0250)	(0.134)	(0.0321)	(0.455)
IDL	-0.583***	-0.0932	-0.00183	-0.618***	0.278***	-0.875***	0.184***
	(0.0939)	(0.238)	(0.0807)	(0.144)	(0.0393)	(0.238)	(0.0445)
URL	0.118**	-0.123**	0.105**	0.211***	0.227***	0.540***	-0.0628***
	(0.0560)	(0.0549)	(0.0439)	(0.0604)	(0.0299)	(0.0356)	(0.0210)
GOV	-0.677***	-0.290**	0.0155	0.186***	0.214***	-0.779***	-0.0287
	(0.0730)	(0.146)	(0.0485)	(0.0653)	(0.0362)	(0.125)	(0.0488)
ENQ	1.672***	5.703**	1.575**	1.664***	2.694***	2.485***	1.685***
	(0.0611)	(2.349)	(0.705)	(0.300)	(0.738)	(0.397)	(0.565)
lnFRSL	0.0364***	0.0509**	0.0178***	0.0611***	0.0469***	0.0845***	0.0128***
	(0.00247)	(0.0214)	(0.00617)	(0.0139)	(0.00404)	(0.00904)	(0.00430)
MAL	0.0280***	0.00959*	0.00162	0.0126***	-0.00591**	-0.00301	-0.00297
	(0.00458)	(0.00514)	(0.00193)	(0.00439)	(0.00260)	(0.00448)	(0.00204)
Constant	0.234***	-0.196	-0.00777	-0.152	-0.701***	-0.0687	-0.00573
	(0.0684)	(0.467)	(0.120)	(0.144)	(0.0709)	(0.284)	(0.0523)

N	*145*	*72*	*132*	*181*	*192*	*181*	*180*
Time Fixed Effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R^2	*0.7344*	*0.6842*	*0.2578*	*0.6687*	*0.8535*	*0.7293*	*0.3193*

1. Analysis of Geographic Location Characteristics

Labor concentration in eastern regions has a significant positive impact on the development level of new-type productive forces; central regions exhibit a significant negative impact; while western regions show no significant effect.

2. Analysis by Transportation Infrastructure

In provinces with low transportation infrastructure levels, labor agglomeration significantly promotes new-type productive forces more than in provinces with high transportation infrastructure levels.

3. Heterogeneity Analysis Across Different Levels of Economic Development

Labor agglomeration in economic catch-up provinces enhances new quality productive forces to a greater extent and with higher significance than in leading development provinces.

5.4 Mechanism Regression

Table 3. Mechanism Regression Results

	LNDC	***INS***	***CAE***
LAG	*0.274***	*0.352***	*4.030***
	(0.000747)	*(0.000222)*	*(0.539)*
IDL	*1.686***	*0.119***	*56.28*
	(0.258)	*(0.0355)*	*(225.0)*
URL	*0.118*	*-0.0294***	*557.8***
	(0.254)	*(0.0130)*	*(112.0)*
GOV	*-0.0700*	*-0.00616*	*-572.5***
	(0.340)	*(0.0441)*	*(175.1)*
ENQ	*-39.42***	*0.161*	*44,564***
	(9.177)	*(0.138)*	*(11,155)*
lnFRSL	*0.999***	*-0.0283***	*307.6***
	(0.0691)	*(0.00437)*	*(29.97)*
MAL	*0.224***	*-0.0179***	*-113.9***
	(0.0238)	*(0.00334)*	*(19.24)*
Constant	*-6.186***	*0.590***	*-2,965***
	(0.930)	*(0.0823)*	*(365.9)*
Time Fixed Effect	*Yes*	*Yes*	*Yes*
N	*360*	*360*	*360*
R^2	*0.9009*	*0.7785*	*0.4153*

According to the results of the mechanism regression (Table 3), labor agglomeration exerts a significant positive impact on innovation capacity, industrial structure upgrad-

ing, and green low-carbon transformation. This indicates that labor agglomeration effectively promotes regional innovation capacity enhancement, drives industrial structure optimization, accelerates green low-carbon transformation, and consequently fosters the development of new productive forces.

6 Conclusions and Policy Recommendations

This study systematically examines the impact and mechanism of labor agglomeration on new quality productive forces using data from 30 provinces (autonomous regions and municipalities) in China. Empirical findings reveal: (1) Labor agglomeration directly drives the development of new quality productive forces; (2) Labor agglomeration indirectly promotes new quality productive forces by enhancing innovation capacity, facilitating industrial structure upgrading, and accelerating green and low-carbon transformation; (3) The effectiveness of labor agglomeration in promoting new quality productive forces varies across regions.

Based on these findings, the paper offers the following policy proposals: Deepen labor market reforms to achieve free labor mobility. Utilize digital technologies to establish labor supply-demand platforms across regions, guiding labor toward high-efficiency areas and emerging industries through digital information platforms in response to market signals. Encourage enterprises, universities, and research institutions to jointly establish technology innovation centers, promoting collaborative innovation among industry, academia, research, and application. For traditional labor-intensive industries, transform and reshape them through technological penetration and model innovation, enabling traditional industries to locally transition into components of "new-quality productive forces." Integrate green and low-carbon transformation into corporate evaluation systems to incentivize energy conservation and carbon reduction, while providing "carbon emission reduction subsidies" to guide enterprises in adopting low-carbon technologies. Tailor guidance policies to each region's specific development level and geographical location.

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