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The innovation-driven industrial agglomeration for the integrated market of China

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ABSTRACT

From the perspective of investment-driven to innovation-driven for high-quality development, this study discussed an influence mechanism of investment structure optimization on the industrial agglomeration degree and its growth path of balanced regional economics. We put forward assumptions about their relationship with a mediator of the regional innovation capability and a moderator of the market-oriented business environment to solve problems of the regional economic gap to accelerate the construction of a unified national market in China. We used the regional industrial data of 31 provinces in China from 2004 to 2017 to verify these hypotheses. Finally, we found that regional innovation capability completely moderates the relationship between investment structure optimization and industrial agglomeration degree, and the market-oriented business environment adequately moderates the relationship. This result shows that regional innovation capability and market-oriented business environment restrict industrial agglomeration degrees and accelerate the integration of diversified capital. So, improving the investment of human capital and R&D capital is the key to solving the regional economic gap. It has enriched the research of high-quality development and provided necessary enlightenment for the practical application of regional industrial economic growth.

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1. Introduction

China's regional industrial development pattern has gradually evolved into a 'North-South gap' feature (Yang et al., 2021). The research of Huang and Xie (2022) found that the innovation capacity of the southern cities is more vigorous than that of the northern towns, expanding the economic gap. Xiao and Hong (2022) further study the spatial imbalance that causes the gap in China's financial resource allocation efficiency, characterized by a 'ladder' distribution pattern of high in the south and low in the north. Thus, the critical factor for building a unified national market in China

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is to solve the unbalanced regional economics through the innovation-driven high-quality development of industrial agglomeration.

The reason for most research on the regional heterogeneity of industrial agglomeration can be summed up in three aspects. First of all, enterprise investment drives the industrial growth of regional economic development. The various effects of enterprise investments will significantly make the regional industrial agglomeration difference (Carilli et al., 2008; Chen & Vickerman, 2017). So optimizing the investment structure can improve corporate competitiveness and promote their economic system to achieve a new equilibrium, which will help the economic policy-makers to confront an imperfection–market failure dilemma (Gaffard & Quéré, 2006). Secondly, the industry growth of regional economic development is deprived of enterprise innovation when it adapts to regional positioning guidance and matches the resource element endowment. The enterprise games make the regional innovation capability present spatial heterogeneity of industries (Chi & Qian, 2010). As a result, their leading position in science and technology and its radiation effect on industrial economic development differ from north to south China (Zhang et al., 2017). It means that the diversity of industrial layout caused the unbalanced capacity of regional innovation. Thirdly, the market environment determines the resource allocation of investment and innovation from different enterprises. The market-oriented reform process is inconsistent because the government will adjust its policies to local conditions before formulating them. At the same time, there are diverse relationships between the government and enterprises, non-state-owned capital and products, intermediary markets, and the legal environment in different regions. This would result in an uneven distribution of regional resources and inadequate efficiency (Xia & Chen, 2007; Fan et al., 2011). In other words, market-oriented reform can optimize the external conditions of innovation and investment, which is conducive to attracting enterprise investment and promoting regional economic growth. Therefore, investment structure optimization, regional innovation capability, and the market-oriented business environment are essential to promote the high-quality development of industrial agglomeration.

To solve the unbalanced problem of regional economic development, finding the causal mechanism of industrial aggregation differences and establishing a catch-up industrial benchmark for enterprises is necessary. This has become the focus of China's transforming drivers and upgrading industrial structures. However, previous studies are relatively scattered and did not link the internal logic of the influencing factors on industrial agglomeration and clarify their interaction. Based on Schumpeter's innovation theory, this paper discussed the relationship between investment structure optimization, regional innovation capacity, and industrial agglomeration degree.

The main contributions of this study are as follows: (a) It examines the mediating effect of regional innovation capability on the relation between investment structure optimization and industrial agglomeration degree. This result provides an essential inspiration for the research on the high-quality development of innovation-driven industrial agglomeration. (b) It analyses the impact mechanism of investment structure optimization on regional innovation capability and industrial agglomeration

degree. This result enriches the theoretical research results of enterprise optimization and has an essential reference for the research of industrial upgrading path. (c) Combined with the reform to the integrated market of China, this study tests the influence process and change range of investment structure optimization and regional innovation capability on industrial agglomeration degree. The result also verifies that the market-oriented business environment moderates the relationships, thus providing feasible suggestions for optimizing the business environment and corporate strategies to accelerate the construction of China's integrated market.

2. Literature review and research hypothesis

2.1. Investment structure optimization and industrial agglomeration degree

We generally divide the investment structure into state-owned capital and non-state capital investment, and the latter includes private and foreign investments. Optimizing the investment structure should adapt to the changes of a complex environment (Pashko, 2022), which means that it will adjust the proportion of non-state investment in marketization. Therefore, attracting private investment has become the key to transforming and upgrading the economic structure in the face of the current complex economic recovery situation after COVID-19.

Many studies showed that investment structure optimization has essential theoretical and practical significance for promoting the development of regional industrial agglomeration. Firstly, investment structure optimization is conducive to the mixed reform of private investment for state-owned enterprises (SOEs). Studies found that state-owned capital has excessive investment and relatively low allocation efficiency. If private capital can be introduced and used for the mixed reform of the state-owned capital, it can make SOEs gain more profits and improve the efficiency gap quickly (Tan et al., 2018; Ren & Shao, 2022). That's why the Chinese government actively proposed a mixed ownership economy with diversified capital. However, Wang et al. (2015) worried that non-state-owned shareholders' high return rate should weaken the position advantage of state-owned wealth accumulated by policy convenience and status inertia. Many scholars, like Li et al. (2019), pointed out that the mixed reform needs to strengthen the synergy effect of all kinds of capital and build a symbiotic relationship among investment shareholders to promote the mutual integration and progress of national wealth. Secondly, investment structure optimization is conducive to the internal governance of enterprises. The diversification of investment entities strives to clarify property rights relations, which can alleviate the crowding-out effect of enterprise investment and improve the efficiency of the capital market (Hann et al., 2013; Edmans, 2014). Qi et al. (2023) also found that the 'co-beneficial' cooperation between government–businesses benefits private firms and improves efficiency for the local governments. Thirdly, investment structure optimization is conducive to the economic development of regional industries. Whether enterprise investment can enhance resource allocation efficiency mainly depends on the government's leading position or the market dominance (Shen & Shen, 2016). China's investment structure has changed from a government-dominant pattern to a market-dominant one, and the industrial practice has also transformed into a mixed capital market (Wang,

2014). In short, enterprise investment is an essential source of promoting economic growth, and investment structure optimization determines the conversion rate and the development quality of the regional industrial structure.

So, there is a particular link between the heterogeneity of regional economic development and the difference in enterprise investment structure. The amount of foreign and private capital is the main reason for the regional investment gap, which needs an effective way of investment structure optimization to narrow it (Xu & Tan, 2020). Therefore, the subsequent hypothesis is proposed:

H1: Investment structure optimization can improve industrial agglomeration degree.

2.2. Investment structure optimization and regional innovation capability

Schumpeter proposed a famous innovation theory for researching regional diversity and industrial development. He concluded that technology and innovation are endogenous economic factors, and their differences in regional innovation capabilities induce various formations, imitations, and transformations (Becker et al., 2012). So, the conceptual explanation of regional innovation capability is the comprehensive ability of an organization to transform adequate resources into new outputs through creation, collaboration, imitation, etc. (Li & Cui, 2018; Park et al., 2021).

According to the existing research, the main influencing factors that affect regional innovation capability can be divided into three aspects. First, enterprises obtain a return on innovation scale through investment such as capital, talents, knowledge, and technology, i.e. R&D capital has a double threshold effect on regional innovation capability under the protection of intellectual property rights (Zhou & Shen, 2018). Secondly, the synergistic effect between R&D and knowledge capital leads to intra-regional industrial agglomeration and inter-regional knowledge spillover. That makes regional innovation capacity spatial, complex, and irregular (Tian et al., 2021). Thirdly, the regional innovation capability depends on innovation efficiency, industrial cluster environment, industry-university research connection quality, and other conditions. Significantly, the human capital status also should be considered (Wei et al., 2010; Guastella & Timpano, 2016).

The research of Gao and Wu (2015) shows that various investors, capital relations, and interactions have different impacts on regional innovation capability. The investment structure determines the relations of property rights. In contrast, the enterprise's control and decision-making power define the strategy, such as whether to carry out innovation, direction, sunk cost, etc. Thus, the subsequent hypothesis is proposed:

H2: Investment structure optimization can significantly improve regional innovation capability.

2.3. The mediating effect of regional innovation capability

2.3.1. Regional innovation capability and industrial agglomeration degree

Many studies have shown a significant relationship between regional innovation capability and industrial agglomeration degree. Sher and Yang (2005) proposed that the

higher R&D intensity for more excellent corporate performance and its clustering demonstrates positively moderating power. Further research by Booltink and Saka-Helmhout (2018) found an inverted U-shaped relationship between R&D intensity and corporate performance among non-high-tech SMEs (small and medium-sized enterprises). In a word, the relationship can be explained in two aspects: On the one hand, the regional industrial agglomeration degree difference mainly stems from the varying intensity of technological innovation. Most enterprises improved their regional innovation capability through interactive learning, knowledge diffusion, and information sharing (Xu et al., 2022). And technological innovation has produced a spatial crowding-out effect on industrial agglomeration degree (Capello & Varga, 2013). On the other hand, the industrial agglomeration degree has a significant positive impact on the out achievement of regional innovation (Zhu et al., 2021). This makes regional innovation capability similar in distribution and clustering (Yan et al., 2023). The stronger the regional innovation capability and the more resources it has, the higher the discourse power and cohesion of enterprises. And also, the stronger the ability for them to obtain spatial and monopoly profits by integrating, controlling, and locking the industrial positioning, leading to the greater inclination of regional industrial agglomeration (Yang et al., 2016). Therefore, the following hypothesis is proposed:

H3: Regional innovation capability has a significant positive impact on industrial agglomeration degree.

2.3.2. The mediating effect of regional innovation capability

According to Structure, Conduct, and Performance (SCP) theory, the economic growth of regional industry depends on the investment structure of enterprises. Konno and Itoh (2018) proposed that R&D investment can enhance the future profits of enterprises. The research by Audretsch et al. (2008) also shows that regional innovation capability directly or indirectly affects regional industrial growth.

Under the latter-industrial country catching up with advanced technology, whether the market or capital changes technology, regional innovation capability continues to accumulate to dynamically evolve after the technological transformation of 'secondary innovation' and the localization of 'primary innovation'. As a result, they will contribute to later-mover advantages and comparative advantages. Regional innovation capability is a cyclical and spiral process of innovation and re-innovation. Enterprises absorb external knowledge and integrate it with their mastered knowledge, resources, and capabilities to create a new market supply (Roper et al., 2008).

Due to the different strengths of investors, regional innovation capability can be divided into independent innovation ability, imitation innovation ability, and collaborative innovation ability. The later-mover advantage of imitation innovation ability does not stem from the absorption of advanced technology but from the imitation innovation activities, which can save time and cost of enterprise innovation (Wu & Wu, 2018). And collaborative innovation ability is due to innovative enterprises sharing risks and benefits. When capital chooses different innovation abilities, they will result in significant differences in the innovation abilities of heterogeneous enterprises (Li et al., 2014). Therefore, additional capital will consider their innovation abilities,

match similar efficiency industries, and form a differentiated industrial agglomeration pattern. So, we proposed the hypothesis as follows:

H4: Regional innovation capability mediated the relation between investment structure optimization and industrial agglomeration degree.

2.4. The moderating effect of the market-oriented business environment

2.4.1. Market-oriented business environment moderated the relation between investment structure optimization and regional innovation capability

The so-called market-oriented business environment simplifies the administrative examination and approval procedures to reduce costs and grants enterprises more authority to comply with policies, laws, and regulations. A low market-oriented business environment inhibits regional innovation capability for two reasons: On the one hand, low marketization will restrict the flow of factors and divide the market system independently. When trade barriers constrain aspects, regional innovation capability cannot transform into negative entropy, which is difficult to change to a dissipative system. Zhang and Huang (2022) point out that governance quality moderated structural social capital and regional innovation activities positively. And Guo et al. (2020) also believe economic policy uncertainty inhibits enterprise investment and profitability. On the other hand, low marketization can quickly induce rent-seeking and low-efficiency competition. The research of Liu and Wang (2014) shows that the lack of a market system causes a 'paradox of corruption' in China. Rent-seeking behavior wastes entrepreneurial talents, distorts resource allocation (Williams et al., 2016), and has price speculation and adverse demonstration effects, inhibiting enterprise innovation activities. So, optimizing the business environment can eliminate the impact of rent-seeking and promote improving enterprise innovation ability (Xia et al., 2019). It can adjust the constraints of enterprise investment, narrow the capital efficiency gap, promote orderly competition among capital, and release market vitality. So, the following hypothesis is proposed:

H5: A high market-oriented business environment can enhance the relationship between investment structure optimization and regional innovation capability, while a low market-oriented business environment weakens their relationship.

2.4.2. Market-oriented business environment moderated the relation between regional innovation capability and industrial agglomeration degree

As the uncertainty of the external environment usually has potential risks, enterprises must rely on innovation capabilities to enhance their core competitiveness to avoid losing market opportunities. A relatively stable market-oriented business environment can optimize the investment structure and reduce the direct motivation of government shareholding. Kong et al. (2022) found that economic policy uncertainty enhances a firm's investment scale but simultaneously exacerbates the risk, inhibiting investment efficiency. Moreover, enterprises occupying the market by satisfying consumer needs with quality products will minimize additional transaction costs. Similarly, industrial chain integration will form clusters and alliances if enterprises are

connected and integrated into a particular region (Xu et al., 2022). This may significantly promote the improvement of regional industrial agglomeration. On the contrary, enterprises cannot cope with various administrative interventions and sudden changes in an uncertain low-market business environment (Bernatzki, 2022; Zhang & Huang, 2022). That will increase the bureaucratic and rent-seeking costs. From some adverse events, we can see the urgent need of enterprises for a stable and highly market-oriented business environment. Hence, the subsequent hypothesis is proposed:

H6: A high market-oriented business environment weakens regional innovation capability and industrial agglomeration degree, while a low market-oriented business environment strengthens their relationship.

In summary, the relationship between investment structure optimization and industrial agglomeration degree will be mediated by regional innovation capability and moderated by the market-oriented business environment. So, we set up a mixed effect model to explain the impact of investment-driven changes into innovation-driven industrial agglomeration for the integrated market, as shown in Figure 1.

3. Model settings, variable descriptions, and data sources

3.1. Econometric model setting and variable interpretation

Based on the above theoretical research, this study takes the analysis of Li (2009) and Xu et al. (2022) about the relationship between capital intensity, innovation, and industrial agglomeration as the reference. And then, we adopt the test method of the moderator and mediator test methods of Baron and Kenny, (1986) and Wen (2004) to construct the following econometric model for the empirical test:

$$\ln IAD = \beta_0 + \beta_1 \ln ISO + \beta_2 \ln RIC + \beta_3 \ln MBE + \beta_4 \ln MBE \times \ln ISO + \beta_5 \ln MBE \times \ln RIA + \beta_6 \ln Controls + \varepsilon \quad (1)$$

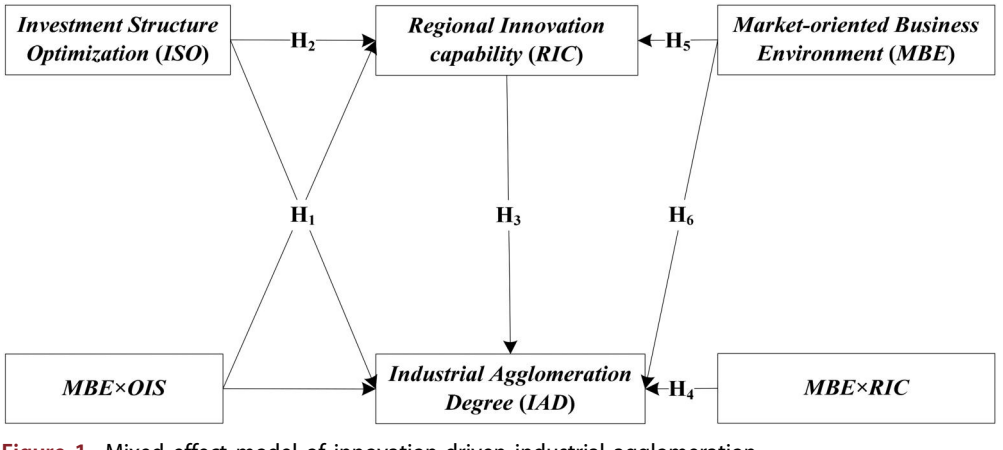

Figure 1. Mixed effect model of innovation-driven industrial agglomeration.
Source: Drawn based on the logical relationship of the literature review.

In equation (1), the dependent variable ln*IAD* reflects the industrial agglomeration degree. The independent variable ln*ISO* reflects investment structure optimization. The mediating variable ln*RIC* reflects regional innovation capability, and the moderating variable, ln*MBE* reflects the market-oriented business environment. ln*MBE*×ln*ISO* represents the interactive term between market-oriented business environment and investment structure optimization. ln*MBE*×ln*RIC* represents the interactive term between market-oriented business environment and regional innovation capability. ln*Controls* represents the variable control group. ε represents the random disturbance term.

3.2. Research variables and data sources

This study used 434 valid sample data from 31 provinces in China from 2004 to 2017 for the empirical test. The calculation method of the main variables is as follows.

i. Industrial agglomeration degree (*IAD*). This study used Herfindahl-Hirschman Index (HHI) test to calculate the numerical estimation of industrial agglomeration degree. The general equation for HHI test is given as follows:

$$HHI = \sum_{i=1}^{n} S_i^2 = \sum_{i=1}^{n} \left(\frac{X_i}{X}\right)^2 \tag{2}$$

In Eq. (2), S_i refers to the proportion of the added value of i industry in regional *GDP*; i refers to the nine significant industries in various provinces; X refers to the industry's added value. And the data is from the China Statistical Yearbook. As a result, the higher the *HHI* value, the greater the industrial agglomeration degree.

ii. Investment structure optimization (*ISO*). We adopted Grey Relation Analysis (*GRA*) to calculate this variable. The process follows: First, all the data on the capital composition of Industrial Enterprises above the Designated Size are dimensionless based on the maximum value. Second, the different sequence of capital is calculated by taking the national capital as the reference sequence. And the two-level maximization and minimization differences are calculated. Third, calculate the correlation coefficient according to Eq. (3),

$$\xi(k) = \frac{\min_i \min_k |y(k) - x_i(k)| + \rho \max_i \max_k |y(k) - x_i(k)|}{|y(k) - x_i(k)| + |y(k) - x_i(k)|} \tag{3}$$

Where ξ is the correlation coefficient; y is the reference sequence of the national capital; x is the comparison sequence of other capital; ρ is the resolution coefficient taken $\rho = 0.5$ according to the convention.

Finally, the average value of the correlation coefficient represents investment structure optimization, which means the diversification of capital correlation degree. The

results show that the smaller the Grey Relation Analysis, the greater the investment structure optimization.

iii. Regional innovation capability (*RIC*). The evaluation results are from the annual regional innovation capability report by the Chinese Academy of Science and Technology for Development.
iv. Market-oriented business environment (*MBE*). Professor Fan (2011) took this data from China's provincial marketization index report. It also takes the overlapping data of 2008 and 2009 as the base. It divides the subsequent years' data to obtain two groups of weight coefficient matrices to calculate the average, supplemented by a trend analysis method for correction.
v. Control variables. Many factors affect industrial agglomeration driven by investment and innovation. According to the research results of Wang et al. (2015) and Zhou & Shen, (2018), the following variables are used as control variables in this paper: regional scientific research capital investment (ln*rd*), human capital investment (ln*edu*), the labour force (ln*lab*), enterprise asset size (ln*cap*), profit level (ln*pro*), and proportion of fiscal revenue in GDP (ln*fin*). And then, the following processing equation is made to ensure the data reliability of the above variables and avoid multicollinearity problems.

$$\ln rd = \ln \frac{(1-\delta)R_{t-1} + \frac{I_{t-\xi}}{P_{t-\xi}}}{GDP} \tag{4}$$

In Eq. (4), ln*rd* represents the scientific research capital investment weighed by the R&D capital stock of 10000 yuan output value. $R_{t\text{-}1}$ represents the previous year's R&D capital stock estimated using the (Chen & Zhu, 2016) perpetual inventory method (PIM). Other variables are ξ reflects the lag period; Current R&D expenditure I; R&D expenditure price index p; depreciation rate δ, which is taken as 20.6% based on the research of Sun and Jiang, (2018).

$$\ln edu = \ln \frac{es_i \times hp_i}{\sum_{i=1}^{n} hp_i} \tag{5}$$

In Eq. (5), ln*edu* refers to regional human capital measured by average years of education. *hp* refers to the number of educated people. *es* refers to a stage of education, and non-formal education is set as 1, primary school 6, junior high school 9, high school or technical secondary school 12, college and above 15, respectively.

In addition, ln*cap* and ln*pro* are expressed by the average value of dividing the asset scale and total profit of industrial enterprises above the designated size by the number of their organizations in the current year. The relevant data for these variables are from China Statistical Yearbook and China Science and Technology Statistical Yearbook.

4. Empirical results and discussion

4.1. Descriptive statistics

Table 1 presents descriptive statistics of the essential variables in this paper. We can see that investment structure optimization is negatively significantly correlated with industrial agglomeration degree and regional innovation capability, with coefficients of $r = -0.376^{***}$ and $r = -0.537^{***}$, respectively. On the other hand, regional innovation capability has significantly positively correlated with industrial agglomeration degree ($r = 0.604^{***}$). Meanwhile, the market-oriented business environment significantly positively impacts industrial agglomeration degree and regional innovation capability, with coefficients of $r = 0.285^{**}$ and $r = 0.590^{***}$, respectively. It also considerably negatively affects investment structure optimization ($r = -0.348^{***}$), indicating that the market-oriented business environment positively influences the relationship between investment structure optimization and industrial agglomeration degree.

The above empirical test has not controlled the other factors. Forward if we added control variables, centralized the primary variables, subtracted the mean value of each sample, and interacted with the product of the terms. And then, the variance expansion factor was also used to test each model. The results show that the *VIF* mean value fluctuates in the range of $2.16 \sim 3.51$, and every value of the single variable is not greater than 10. Therefore, we can determine that there is no severe multicollinearity.

4.2. The mediating effect of regional innovation capability

To test whether regional innovation capability can mediate the relationship between investment structure optimization and industrial agglomeration degree, we analyze it from two aspects: the mediating effect test and its impact path.

i. We test the mediating effect test of regional innovation capability using the causality regression method to verify whether the coefficient is significant. The results are shown in Table 2. In model 4, with a significant negative correlation ($\beta = -0.283^{*}$), investment structure optimization significantly impacts industrial agglomeration degree. Therefore, we can see that hypothesis H1 is true. In models 2 and 5, the former is significantly negatively correlated ($\beta = -1.304^{**}$), and the latter is positively correlated ($\beta = 0.156^{***}$). Therefore, the impact of investment structure optimization and regional innovation capability on industrial agglomeration degree is significant. On the other hand, we can

Table 1. Descriptive statistics of essential variables.

Variables	Mean	Std.	ln*OIS*	ln*IAD*	ln*RIC*
ln*OIS*	4.554	0.068			
ln*IAD*	4.158	0.107	−0.376***		
ln*RIC*	3.303	0.334	−0.537***	0.604***	
ln*MBE*	1.948	0.584	−0.348***	0.285***	0.590***

Note: ***, **, * represent significance levels of 1%, 5%, and 10%, respectively.
Source: author's manual production.

Table 2. Regression results of the mediating effect of regional innovation capability.

	Regional innovation capability		Industrial agglomeration degree			
	(1)ln*RIC*	(2)ln*RIC*	(3)ln*IAD*	(4)ln*IAD*	(5)ln*IAD*	(6)ln*IAD*
ln*OIS*		−1.304***		−0.283*		−0.099
		(−2.75)		(−2.05)		(−0.97)
ln*RIC*					0.156***	0.141***
					(7.24)	(5.32)
ln*rd*	0.228***	0.184***	0.089***	0.079***	0.053***	0.054***
	(14.64)	(8.73)	(8.98)	(7.49)	(4.55)	(4.56)
ln*edu*	0.486***	0.489***	0.149***	0.150***	0.074	0.081*
	(5.30)	(5.62)	(3.40)	(3.49)	(1.85)	(2.03)
ln*lab*	0.001	−0.023*	−0.037***	−0.043***	−0.038***	−0.039***
	(0.13)	(−2.22)	(−7.88)	(−8.60)	(−8.37)	(−8.05)
ln*cap*	−0.280***	−0.300***	−0.048***	−0.053***	−0.005	−0.011
	(−16.86)	(−19.81)	(−5.17)	(−5.70)	(−0.44)	(−0.86)
ln*pro*	0.019	0.024*	0.026***	0.027***	0.023***	0.023***
	(1.62)	(2.10)	(3.19)	(3.28)	(3.15)	(3.17)
ln*fin*	0.348***	0.319***	−0.028	−0.034	−0.082***	−0.079***
	(10.01)	(10.02)	(−1.43)	(−1.78)	(−4.31)	(−4.10)
_cons	1.996***	2.315***	3.624***	3.693***	3.313***	3.367***
	(8.41)	(8.67)	(30.09)	(29.77)	(30.05)	(27.49)
VIF	2.22	2.16	2.22	2.16	2.93	3.02
adj. R^2	0.749	0.798	0.433	0.454	0.491	0.492
F	251.359	315.036	60.709	60.384	88.061	80.266

Note: ***, **, * represent significance levels of 1%, 5%, and 10%, respectively.
Source: author's manual production.

see that H2 and H3 are valid. the regression of whether investment structure optimization and regional innovation capability significantly impact industrial agglomeration degree. In model 6, regional innovation capability significantly affects the industrial agglomeration degree ($\beta = 0.141^{***}$), but investment structure optimization does not considered the same way. The above results prove that regional innovation capability significantly and completely mediates the relation between investment structure optimization and industrial agglomeration degree. This means that the impact of investment structure optimization on industrial agglomeration degree depends on the mediating effect of regional innovation capability. Therefore, H4 is assumed to be true.

ii. We test the path impact of regional innovation capability promoting industrial agglomeration. In model 1 of Table 2, the labor force change does not significantly impact regional innovation capability. However, after adding the variable of an investment structure optimization, reducing the labor force can significantly improve regional innovation capability. Furthermore, increasing human capital and scientific research capital can significantly improve regional innovation capability and industrial agglomeration degree with the progress of the education level of the labor force. Therefore, this should be the preferred strategy for China to cope with the current downward trend of 'demographic dividend' .

iii. Enterprise assets significantly negatively impact regional innovation capability and industrial agglomeration degree. This shows two possible paths for enterprise growth with the continuous increase of investments. On the one hand, the independent innovation ability of enterprises increases, and the competition in

the market intensifies. With the increasing coordination cost of collaborative innovation among enterprises, regional innovation capability will become the core competitiveness to deepen the protection of intellectual property rights. Thus, it would inhibit regional innovation capability. On the other hand, the growth of enterprises moves towards diversification and internationalization. As Penrose said, it will also increase industrial specialization. Therefore, the industrial division of labor is finer, and the layout is more comprehensive, leading to the decline of industrial agglomeration degree.

iv. Enterprise profit also has a significant positive impact on industrial agglomeration degree. This indicates that enterprises intend to promote industrial agglomeration development under the condition of profit. But at this time, enterprises cannot effectively improve their innovation ability. Making a short-term profit with scientific and technological innovation is generally difficult for them. They hope to make a long-term plan. If it is profitable in the short term, why does it have to pay a significant opportunity cost to seek to improve its innovation ability? Therefore, enterprises are slack in their innovation ability when going through the down-flow stage. But in the counter-flow stage, they will go backward without innovation.

4.3. The moderating effect of the market-oriented business environment

4.3.1. The moderating effect test before the mediating effect

Based on the verified intermediary effect of regional innovation capability, we further examine whether hypotheses H5 and H6 are valid. First, we test the moderating effect before the mediated variable to verify whether the market-oriented business environment moderates the relationship between investment structure optimization and regional innovation capability. Then, we test the moderating effect after the mediating effect has been verified to determine whether there is a 'moderated mediating effect'. Finally, we further test whether the market-oriented business environment has a mediated moderating effect based on hypotheses H4 and H5. That is, whether the interaction between the market-oriented business environment and the optimization of investment structure affects the industrial agglomeration degree through regional innovation capability. The empirical results are shown in Table 3.

We choose the three steps of the Hierarchical Multiple Regression (HMR) method to detect the moderated effect. First, we test the impact of investment structure optimization on regional innovation capability. As shown in model 2, they have a significant negative correlation ($\beta = -1.304^{**}$). Secondly, we investigate the impact of investment structure optimization with the market-oriented business environment on regional innovation capability. As shown in model 7, they are significantly correlated, and the coefficients are $\beta = -1.317^{***}$ and $\beta = -0.060^{***}$, respectively. Thirdly, we added investment structure optimization, market-oriented business environment, and their interaction terms to the equation, and the result is shown in model 8. The interaction term coefficient is significantly negative ($\beta = -2.672^{***}$). Therefore, the market-oriented business environment moderated the relationship between investment structure optimization and regional innovation capability. This means that the higher

Table 3. Test results of the moderating effect of the market-oriented business environment.

	Regional innovation capability		Industrial agglomeration degree				
	(7)ln*RIC*	(8)ln*RIC*	(9)ln*IAD*	(10)ln*IAD*	(11)ln*IAD*	(12)ln*IAD*	(13)ln*IAD*
ln*OIS*	−1.317***	−0.372	−0.293*	−0.126	−0.067	−0.068	−0.029
	(−2.79)	(−1.65)	(−2.14)	(−1.18)	(−0.72)	(−0.75)	(−0.39)
ln*RIC*				0.127***	0.087***		0.106***
				(4.76)	(3.04)		(4.07)
ln*MBE*	−0.060***	0.061*	−0.046***	−0.038***	−0.007	−0.017	−0.024
	(−3.12)	(2.03)	(−3.31)	(−2.82)	(−0.45)	(−1.07)	(−1.56)
ln*MBE*		−2.672***				−0.636***	−0.352
×ln*OIS*		(−5.59)				(−3.71)	(−1.96)
ln*MBE*					0.088***		
×ln*RIC*					(2.65)		
Controls	Y	Y	Y	Y	Y	Y	Y
_cons	2.165***	1.819***	3.577***	3.302***	3.247***	3.495***	3.301***
	(8.35)	(8.62)	(27.13)	(24.66)	(24.82)	(27.28)	(26.38)
VIF	2.33	2.70	2.33	3.16	2.33	2.70	3.51
adj. R^2	0.802	0.833	0.478	0.508	0.514	0.494	0.511
F	293.179	233.750	63.782	74.491	72.376	67.503	76.516

Note: ***, **, * represent significance levels of 1%, 5%, and 10%, respectively. The control variables are consistent with Table 2.
Source: author's manual production.

the market-oriented business environment, the smaller the negative impact of investment structure optimization on regional innovation capability. Therefore, a market-oriented business environment plays a role in strengthening the relationship between the two variables, which supports hypothesis H5.

4.3.2. The regression test of moderated mediating effect

According to Wen's research method, we use four steps to test moderated mediating effect. The regression test of investment structure optimization and market-oriented business environment on industrial agglomeration degree. The result is shown in model 9 that investment structure optimization significantly negatively impacts industrial agglomeration degree ($\beta = -0.293^{**}$). The regression of regional innovation capability to investment structure optimization and market-oriented business environment, as shown in model 7, investment structure optimization has a significant negative impact on regional innovation capability ($\beta = -1.317^{*}$). The regression of industrial agglomeration degree on investment structure optimization, market-oriented business environment, and regional innovation capability. In model 10, regional innovation capability significantly impacts industrial agglomeration degree ($\beta = 0.127^{***}$). The impact regression of investment structure optimization on industrial agglomeration degree, adding variables of the market-oriented business environment, regional innovation capability, and their interactive terms, as shown in model 11. We can see that the interactive terms positively impact industrial agglomeration degree ($\beta = 0.088^{***}$).

Therefore, regional innovation capability is a moderated mediator, and market-oriented business environment is a moderating variable in the relationship between regional innovation capability and industrial agglomeration degree. The higher the market-oriented business environment is, the more significant the positive impact of the regional innovation capability on the industrial agglomeration degree. Market-oriented business environment plays a role in strengthening the relationship between the two variables; that is, hypothesis H6 also passed the test.

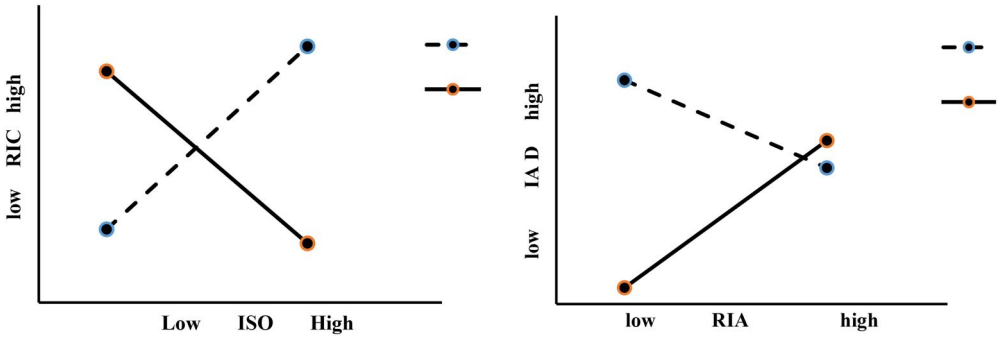

Figure 2. Moderating effect of the market-oriented business environment.
Source: Author's own.

4.3.3. The regression test of the mediated moderating effect

Further tests are as follows: The regression of industrial agglomeration degree by investment structure optimization, market-oriented business environment, and their interactive terms of the latter two variables. In model 12, the interactive term coefficient is significantly negative ($\beta = -0.636^{***}$). The regression of regional innovation capability by investment structure optimization, market-oriented business environment, and their interactive terms of the latter two variables. In model 8, the interactive times are significantly negative ($\beta = -2.672^{***}$). The regression of industrial agglomeration degree by regional innovation capability, investment structure optimization, market-oriented business environment, and their interactive terms of the latter two variables. In model 13, regional innovation capability positively impacts industrial agglomeration degree ($\beta = 0.106^{**}$), but their interactive items are insignificant. We can see that the market-oriented business environment is a mediated moderator variable. A market-oriented business environment first affects regional innovation capability, then involves industrial agglomeration degree through regional innovation capability.

The market-oriented business environment significantly modifies the relationship among investment structure optimization, regional innovation capability, and industrial agglomeration degree. To see the moderating effect vividly, Figure 2 shows that whether the market-oriented business environment is high or low, it significantly impacts investment structure optimization and the relation between regional innovation capability and industrial agglomeration degree. The difference is that the slope in the high market-oriented business environment is more significant than that in the low one. As a result, the former strengthens the negative impact, but the latter enhances the positive effect. That is to say, under the highly market-oriented business environment, the enhancement effect of the moderator has to be improved.

5. Conclusion and recommendations

5.1. Conclusions

This study used the provincial data for empirical analysis to find some interesting conclusions about innovation-driven industrial agglomeration for the integrated national market of China. (i) Investment structure optimization has a significant

positive impact on industrial agglomeration degree. Diversified capital can learn from each other's advantages and complement their inferiority for corporate performance. Optimizing investment structure attracts diversified capital to participate in mixed reform and stimulate private capital's effectiveness, which can improve the factors' efficiency to solve the insufficient and unbalanced development of regional economics. (ii) Regional innovation capability plays a mediating effect on the relationship between investment structure optimization and industrial agglomeration degree. This path will help to exert social capital's coordination and integration ability, break down the capital monopoly barrier, and realize the change in industrial economic structure. And it will affect the regional industries' spatial layout and business type distribution to optimize the industrial agglomeration degree. (iii) The market-oriented business environment significantly moderates the relationship between mediating links. This is conducive to breaking the market monopoly, reducing disorderly involution behavior, and improving innovation capability. At the same time, the guiding role of optimizing the business environment has also strengthened the impact of regional innovation capability on industrial agglomeration. It makes intellectual property rights and price mechanisms more important and encourages enterprises to pay more attention to the integrated development model of the whole industrial chain.

5.2. Policy implications

According to the above conclusions, we suggest that the government should first focus on creating a first-class business environment to improve the quality of the investment structure. Establishing a practical business environment evaluation system will attract more private capital to participate in reforming the mixed enterprise system. And we should also take the benign competition of enterprises as the core and build a clear property rights relation. The high business environment can provide enterprises with a fair and effective competitive market mechanism.

Secondly, the regional organization should focus on the efficient cooperation of Government-Industry-University-Research to promote the improvement of regional innovation capability. Local government should actively set up a regional collaborative innovation platform for every regional organization's collaboration to open up information exchange channels. We should also improve the protection system for intellectual property rights and create an intellectual property trading market mechanism to attract knowledge, technology, and talent-free flow on this platform. The industrial agglomeration effect generated by regional alliances and clusters will be boosted by collective creation for regional economics.

Thirdly, enterprises should start with compliance and innovation to improve a systematic internal control system. They should pay attention to compliance issues, predict enterprise behavior's inertia and uncertainty factors, and avoid potential risks in the high market-oriented business environment. As a result, enterprises gain their competitive advantage mainly depending on the quality of products and services and customer choice. Therefore, they should focus on combining the internal control system with compliance ability and reengineering the internal control process to improve innovation capability to face the changing business environment.

5.3. Limitations and future guidelines

Finally, we want to talk about the limitations of our research study. Our study regarded human capital as an incremental factor in regional innovation capability, but the trend of negative population growth and regional attractiveness are not discussed. Especially for the unified national market of China, whether the regional industrial agglomeration can smoothly move to the path of high-quality development will play an essential role in transforming and upgrading the regional economic structure. Moreover, due to the different economic recovery situations in other regions caused by the current COVID-19 epidemic and global inflation, our research has avoided the impact of this factor when selecting data. Still, it may also cause some uncertainty in the future.

In addition, human capital and R&D capital investment significantly positively impact regional innovation capability and industrial agglomeration degree. Entering the new era of a knowledge economy, China may face a unique labor force reduction and demographic dividend receding situation. This brings the knowledge value embodied in human and scientific research capital into play. That will not only drive technological progress but also release the efficiency dividend. Therefore, knowledge capital will become an essential direction of industrial transformation and upgrading in the future.

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