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Can innovative urban design optimize the business environment? Quasi-natural experimental evidence from China

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ABSTRACT

Improving the business environment (BE) is crucial for sustainable regional development. Innovative city design characterized by innovation driven and knowledge intensive is an important way to shape and optimize urban BE. This study constructs a quasi-natural experiment based on China's Innovative city pilot (ICP) policy. The beneficial contribution of the ICP policy to the improvement of urban BE is empirically examined using asymptotic double-difference models and prefecture-level city panel data from 2004 to 2019. The results find that innovative urban design can effectively improve urban BE, and this policy effect still holds after a multidimensional robustness test. The mechanism test shows that optimizing the allocation of innovation factors is the influence mechanism of ICP policy to optimize urban BE. This mechanism includes four paths: technological innovation effect, government efficiency improvement effect, policy-leading effect, and human capital aggregation effect. Further analysis reveals that this policy effect is more pronounced in central and western regions and regions with higher administrative levels but does not differ significantly depending on the market potential. Furthermore, the ICP policy has a spatial spillover effect, which can improve BE levels in neighboring cities. The findings provide strong evidence for optimizing urban BE and promoting economic transformation and development through regional innovation policies.

1. Introduction

The business environment (BE)[2] is a key component of a country's efforts to reform, innovate, and build an effective market economy. The World Bank first defined BE as "the combination of practices and costs required for firms to comply with policies and regulations in the areas of application opening, production and operation, trading activities, tax payment, exit, and contract enforcement." Previous studies have confirmed the importance of BE for macroeconomic and micro subjects [1,2]. At the level of macroeconomic development, BE is a major development factor and significantly impacts global or regional economic development, per capita income growth, and poverty eradication [3,4]. A good BE can promote economic development by optimizing resource allocation, improving market efficiency, and stimulating investment, promoting social progress [5,6]. At the same time, differences in the BE also explain the differences in productivity across countries [7]. The more those countries with a high ranking in BE, the more

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[2] Business environment, also called doing business or business climate, was first proposed by the World Bank in 2002 in the "Doing Business" project to reflect the ease of doing business in a country or region.

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foreign investment they can attract [8]. At the microsubject level, a country's BE is an external factor for the business success of small and midsize enterprises (SMEs). The BE is the key to SMEs' access to resources, capabilities, and opportunities, affecting activities such as production, operations, financing, investment, and innovation, affecting the direction of entrepreneurial firms [9]. Further focusing on the optimization of the BE, studies have focused on the reform of the BE, emphasizing the need to improve the overall ranking of the BE to create a good external environment for enterprises and promote industrial transformation and upgrading [10,11]. Therefore, building a positive and healthy BE positively impacts innovation and entrepreneurship, enterprise performance, and socioeconomic development.

Major industrial countries worldwide have implemented BE governance policies to promote the private sector strategy. For example, New Zealand has implemented nondiscriminatory tax and loan policies while creating a stable and secure investment and financing environment and establishing a market-oriented resource allocation mechanism. Through the "simplified rules business forum," the Danish allow all kinds of market players to provide the opportunity to reflect the administrative problems and reduce the complexity of the business regulatory system. It is not difficult to find that optimizing the BE has gradually become essential for governments worldwide to enhance international competitiveness. At the same time, cities are also indispensable spatial carriers of market activities as the highland of market factor agglomeration and configuration; thus, cities have become the first object of BE reform, and how to create a sustainable market BE has received attention [12]. In the context of countries worldwide gradually placing innovation drive at the center of development strategy and building innovative countries, constructing innovative cities with dual characteristics of innovation and development has become an important direction of BE reform. Innovative city design focuses on science and technology, independent innovation, and innovation culture, constituting an essential foundation for a country's innovation activities and the construction of an innovative country [13]. On the one hand, innovative city building is a change focusing on urban innovation and development, which is the application of science and technology, knowledge, culture, and other elements to drive urban development, thus improving general urban innovation [14]. In essence, the innovative city embodies the advanced concept of change, and in the application of real-life scenarios, it can prompt the city to improve the level of management services and create a social environment conducive to innovation and entrepreneurship. On the other hand, innovative cities have distinctive attributes of change, reflecting the willingness of local governments to reform and develop. Policy innovations that lead the way in various city areas also offer real possibilities for improving government-business relations [15]. Innovation is the key to transforming old and new city dynamics, improving productivity, investment, and economic competitiveness, and exploring sustainable development [16]; however, little attention has been paid to the reform of the BE from the innovation perspective. In particular, it remains unclear whether local governments can leverage the policy dividends of innovative cities to optimize the urban BE.

China's national innovation city pilot (ICP) policy provides an ideal quasi-natural experiment for this study. First, the effect of China's BE reform is evident. According to the Doing Business 2020 report released by the World Bank, China's BE evaluation was 31st among 190 economies worldwide, a cumulative rise of 65 places from 2013, representing China's highest ranking since the World Bank's Doing Business report began. Furthermore, China has ranked among the top 10 of the Doing Business Governance ranking for two consecutive years. Second, as the world's largest developing country, the Chinese government has recognized the importance of innovation for the country's high-quality development. The ICP is a policy experiment by the Chinese government in recent years to promote the creative transformation of urban economic development and is an important vehicle and potential contributor to cities. The Chinese government started establishing national innovative pilot cities in batches in 2008. Shenzhen City in Guangdong Province was established as the first pilot city and has gone through 6 rounds of pilot city construction approvals, covering 78 cities (districts) in 31 provinces. Against this background, this study adopts the panel data of Chinese cities and devotes itself to systematically demonstrating the policy effects of innovative pilot city policies to optimize the urban BE and its specific mechanisms. The findings of this study provide new ideas for creating an "ease to doing business" environment through regional policies and empirical wisdom for promoting and improving innovative city construction.

This study makes several contributions to the extant literature. First, it expands the research on innovation policy and BE reform. Previous studies have focused more on BE's status quo or "back-end" factors and less on the "front-end" variables that affect BE reform [4,17]. Through the quasi-natural experiment of ICP policy construction, the BE optimization effect of innovation policy-driven urban transformation and development is systematically evaluated for the first time. Second, compared with previous studies that examined BE from the perspectives of transaction costs and informal relationships [18,19], this study introduces the perspective of innovation into BE governance. Integrating innovation theory, signal theory, transaction cost theory, and other theories, it analyses the internal mechanism of ICP policy to enhance BE by optimizing the allocation of innovation factors. This approach enriches the choice path of BE reform to some extent and provides more profound theoretical support for developing and implementing targeted regional innovation and entrepreneurship policies. Third, a quasi-natural experiment is constructed based on a coherent large sample of data from 280 cities for 16 periods. This method provides an insightful discussion on the endogeneity of the impact of ICP policy and discusses the heterogeneity of the effect of ICP policy from some enlightening dimensions. This study also incorporates the spatial spillover effect of ICP policy radiation to drive the optimization of BE in the surrounding areas, which is of practical significance in guiding the flow of innovation factors and promoting regional synergistic development. These approaches are less discussed in existing studies.

The rest of this article is organized as follows. Section 2 presents the literature review. Section 3 develops our main hypothesis. Section 4 describes the research design and data. In Section 5, the empirical results and robustness tests are presented. Section 6 further discusses mechanisms, heterogeneity and spatial spillover effects. Section 7 concludes the paper with a summary of the key findings, implications, and recommendations.

2. Literature review

2.1. Influencing factors of business environment

According to the existing literature, the influencing factors of BE are diversified and can be categorized into three main areas. The first is government and its governance behavior. Political direction and institutional quality affect market operations and firm performance [20,21]. Poor institutional quality can discourage investment and innovation and cause firms to opt out of the market [22]. Therefore, business regulation and supervision have long been important elements of BE reform; however, overly complex regulations may also lead to corruption in business activities [23,24]. High-quality government bureaucracy and implementation of policies and institutions are particularly critical to optimizing regional BE [25]. Reducing transaction costs and administrative burdens through administrative reforms, integrity building, and tax regulation has become a consensus for creating a favorable market environment [26,27]. In the context of digital government, technology-enabled enhancement of government services and administrative efficiency is also an important direction for BE reform [28]. The second area comprises economic development factors, and the macroeconomic level profoundly affects BE optimization. The business activities of market players need to consider inflation, the evolution of interest rates, credit constraints, the availability of financing, and the tendency of residents to save and consume [29]. Innovation and entrepreneurship depend on good public service platforms, infrastructure, sound financial support, and attractive market capacity [30]. Furthermore, labor quality and costs also affect the incentives for enterprises to invest [31]. Therefore, optimizing BE requires multidimensional efforts from infrastructure, financing systems, financial support, trade, etc., to enhance market confidence and create open, accessible, and competitive macroeconomic conditions. The third area is social factors. BE is a complex social system, deeply influenced by people's values, ethics, and lifestyles and the evolution of demographic, cultural, ecological, population, religious, and other conditions [32]. Relevant studies have extensively explored the social characteristics that affect business activities based on the multiple market players and their interactions, such as government, enterprises, the public, and social organizations. Examples include gender structure, informal relationships, social capital, and culture [33–35]. These social factors promote regional economic development by influencing business activities and BE [36].

2.2. Innovative city pilot policy and business environment

The ICP policy is an important development strategy for building an innovative country in China, with significant implications for sustainable development and promoting innovation and entrepreneurship [14]. At the macro level, existing studies mainly assess whether ICP policy can promote urban innovation and ecoefficiency impacts. For example, relevant study has confirmed that innovative city can significantly enhance urban innovation and improve the quality of foreign direct investment [14]. Such policies have the effects of optimizing industrial structure and driving the development of the financial industry [37]. As well as promoting collaborative innovation and knowledge flow between the city's industry, academia, and research institutes [38], innovative city policies can help realize economic growth and high-quality development. Through innovation, it can reduce energy costs and accelerate energy transition [39]. The construction of ICP can significantly increase the level of green innovation and total factor productivity, reduce the emission of industrial pollutants, improve the urban environment, and contribute to the region's sustainable development [40]. At the micro level, ICP policy can stimulate the vitality of market players and promote innovation and entrepreneurial activities in cities. ICP construction can increase the degree of enterprise agglomeration and outward linkage, which can encourage enterprises to invest in innovation and development. A Study has also shown that ICP policy can promote entrepreneurial activity, mediated by intellectual capital and moderated by the ability to raise capital [40]. Overall, different from policy regimes focusing on a single area, such as research and development (R&D) and industry, the experiment of ICP policy contains various aspects such as technological innovation, financial subsidies, tax incentives, and industrial upgrading. As a comprehensive policy experiment, ICP policy can enhance the city's sense of innovation, fulfill the need for information transfer and exchange, reduce risk and uncertainty, and promote entrepreneurial decision-making by market operators. Therefore, with the development of ICP, the government will continue to strengthen the support for innovative activities and further reduce the threshold of entrepreneurship, and these measures will help to create a favorable BE [41]. Unfortunately, no studies directly focus on whether ICP policy optimizes BE.

The literature suggests the potential influences on BE and the significance of ICP policy, contributing a great deal of empirical wisdom to BE reforms and providing important guidance for this study; however, there is still room for improvement. (1) Regarding research content, the above studies cover the main aspects that may affect BE, but most of them take BE as the independent variable and lack direct attention to the "front-end" influencing variables of BE. In particular, it ignores the great potential of innovation policy as a new driving force for high-quality development of the market economy under the framework of innovation-driven development strategy to improve urban BE. (2) From the perspective of research methodology, the intrinsic mechanism and spatial spillover effect of ICP on optimizing BE have not yet been clarified. Innovation factors have the mobility attributes of aggregation and diffusion, and how to make their competitive advantages of BE through innovation policy practices is still a "black box." Furthermore, it is also necessary to consider the spillover effect of ICP policy on BE at the spatial scale.

3. Hypothesis development

3.1. The immediate effect of innovative city pilot policy on urban business environment

Innovation policies have a positive effect on macroeconomic development and promote the management of microenterprises [14,

42]. The survival and development of market players are closely related to policy factors [43]. As the coordinator and facilitator of the market, the government should create favorable innovation policies, reduce the cost of innovation and entrepreneurship, and provide smooth financing channels to promote innovation and entrepreneurship [44,45]. Regional innovation policies help compensate for the resource allocation failure caused by spontaneous market allocation by reducing market risks, facilitating business activities, and enlivening the business atmosphere [46], thus creating a more orderly, efficient, and liberalized BE. At the level of business risks, innovation policies promote technological innovation and market development through innovation compensation, tax incentives, inclusive credit, and government investment [47]. These policies help enterprises enhance the sensitivity of market opportunities and the ability to cope with risks, reduce production and operational risks, and improve the competitiveness of enterprises in the market [48]. Regarding business activities, innovative policies have vigorously promoted infrastructure development, government service reform, enhanced market economy cultivation, and financial support. These favorable policies help to form a good interaction between the government and enterprises, solve the financing constraints faced by entrepreneurs, reduce the transaction costs of the system, and lower the threshold of innovation and entrepreneurship [49]. Regarding the business atmosphere, innovation policies can promote the flow of innovation factors, ease market information asymmetry, and create more market demand [50]. This situation can attract the gathering of technology, talent, capital, and other resources and help promote knowledge exchange and technical cooperation, thus activating innovation and entrepreneurship and creating a more active BE.

The ICP policy is precisely an experimental regional innovation policy for exploring innovation drive in China, and its policy objectives, contents, and tasks are highly compatible with urban BE optimization. In terms of objectives, the Guidelines for Building Innovative Cities issued by the Chinese government emphasize the development of ICP as a core driver of economic and social development by creating a favorable environment for innovation and entrepreneurship.[3] Regarding policy content, ICP policy focuses on infrastructure construction, government reform, innovation, and entrepreneurship. These elements become the assessment requirements of local governments, and under the mechanism of competitive bidding for political performance, localities will be incentivized to invest more resources to improve the BE while competing for the city's honor. At the same time, the ICP policy sets a favorable environment for innovation and entrepreneurship as a general requirement, supporting enterprises to become the main body of innovation, with the top priority being the cultivation of innovative enterprises. It seeks to form a good innovation and entrepreneurship ecology by deepening the reform of the commercial system. The ICP policy also reduces the invisible thresholds of innovation and entrepreneurship, systemic transaction costs, and other tasks, innovating the factor acquisition and application mechanisms. Overall, the ICP policy can improve the quality of urban resource allocation and facilitate the city's shift to a knowledge- and technology-intensive innovative economy. This transition can reduce market risks, improve business efficiency, and create a fair and orderly market environment. In this regard, pilot cities emphasize innovation and BE governance more than nonpilot cities. Therefore, research hypothesis 1 is proposed.

H1. ICP construction may promote urban BE optimization.

3.2. Mechanism analysis

The innovation capacity base is a key factor influencing regional development, and regional business ecosystems differ significantly by regional area innovation pools [51]. According to the "creative destruction" viewpoint of the innovation school, the effective promotion of innovation to economic development cannot be separated from the effective allocation of production factors and conditions [52]. Enhancing the allocation of innovation resource factors has become the policy launching point for optimizing regional BE. The focus of BE reform is shifting from breaking market access barriers to optimizing the allocation of innovation factors; it has become an important idea to broaden enterprises' access to market factors by reducing systemic costs, promoting fair competition, and other ways. According to existing research, ICP can bring into play the advantages of all aspects of the innovation drive, effectively allocate and configure the technology, institutional safeguards, capital, talent, and other resource factors, and help optimize the technological, policy, governmental, and intellectual market environments for market players [38,53].

3.2.1. Technological innovation effect

The business process identifies, develops, and utilizes market opportunities [54]. Technological innovation plays a crucial role in creating or discovering market opportunities. According to Solow growth principle, optimizing the allocation of innovation factors can promote technological innovation, introduction, diffusion, and application and improve the enthusiasm and resource efficiency of market technological R&D and transformation [55]. ICP has the factor accumulation and scale effect, and accelerating technological innovation and industrial upgrading using financial tilting and the supply of innovation factors can lead to more market opportunities [56]. On the one hand, through establishing special scientific research funds, protection of R&D, and increased investment in innovation resources, ICP construction contributes to the output and application of regional technological innovation and continuously broadens and optimizes access to factors. It motivates market players to create more market opportunities through R&D and transformation of technological innovation results and improves the performance of urban innovation and entrepreneurship [41]. On the other hand, as the construction of innovative cities progresses, the pilot cities will further improve their innovation protection and service systems. This situation supports the renewal of products and services and technological breakthroughs of enterprises, fundamentally improves enterprises' value creation, and mobilizes more market players to participate in the commercial application of

[3] https://www.most.gov.cn/xxgk/xinxifenlei/fdzdgknr/fgzc/gfxwj/gfxwj2016/201612/t20161213129574.html.

technological innovations [54]. The business opportunities and market demand are constantly emerging. The marketization and commercial application of technological innovations will provide more conditions and opportunities for regional entrepreneurship, further enhancing the market economy's vitality [57].

3.2.2. Government efficiency improvement effect

Overbureaucratization and overcomplexity in the public sector may lead to inefficient allocation of administrative resources, and the ensuing factors, such as higher systemic transaction costs and administrative burdens, may impair the quality of urban BE [27,58]. From the perspective of transaction cost theory, cumbersome administrative procedures cause high institutional transaction costs and have the potential to breed rent seeking and corruption, which affects the innovative and entrepreneurial activities of market players [59]. More and more studies show that streamlining bureaucratic procedures and speeding up the integration of administrative services are crucial to enterprises' healthy production and development [60,61]. An essential element of ICP construction is the reform of decentralization and optimization of services, which provides organizational safeguards for the efficient allocation of innovation factors and strengthens market players' freedom of development and competitiveness. First, through the functional reform and decentralization of management authority, enterprises can have complete autonomy in production, operation, and decision-making and play the "hand of the market" to allocate innovation factors more effectively. Second, simplifying the governmental approval process and accelerating the reform of the commercial system will reduce the administrative constraints and burdens on enterprises caused by red tape. It also helps to improve administrative transparency, healthy government-business relations, and reduce corruption. Finally, optimizing online service platforms and innovative infrastructures improves the flow of information and interaction between market players, provides "one-stop" approval services, strengthens control and accountability, and facilitates business activities and investments. Overall, as the "efficiency dilemma" of government services is solved, it will enhance the government's ability to integrate innovation factors and serve the market, improve the degree of marketization and the efficiency of allocating innovation factors, and provide excellent BE for innovation and entrepreneurship activities [62].

3.2.3. Policy-leading effect

ICP brings together the policy synergies of national and local governments to optimize the allocation of innovation resources and the use of factors, thus creating a good BE. The enhancement of high-quality development of the city not only relies on endogenous economic evolution but also requires the government's exogenous guidance [63]. On the one hand, through scientific innovation development planning, ICP policy guides allocating innovation resources to areas with development advantages. To drive innovation development, the central government has planned the tasks of ICP in economy, science and technology, education, and social development from the top-level design. Governments at all levels have also introduced a system of preferential policies, such as enterprise subsidies, infrastructure improvement, and R&D cooperation among industries, universities, and research institutes, to effectively promote the flow of innovation resources and improve the regional policy environment for innovation and entrepreneurship. On the other hand, ICP policy improves urban innovation resource agglomeration and factor supply capacity and incentivizes and guarantees market innovation and entrepreneurship activities. Favorable policy signals are crucial for market gains in asymmetric information [64]. The ICP has released clear "policy signals" encouraging market players to innovate and startup businesses. These market-friendly policy messages have enhanced the understanding and confidence of entrepreneurs, investors, and startups in the city's BE ecosystem, helped overcome the asymmetry of information leading to innovation and entrepreneurship concerns, and strengthened the ability to cope with risks and bear them [65]. At the same time, the policy implementation promotes the scale concentration of financial, scientific and technological, institutional, and other innovation factors [66], provides additional market opportunities, mitigates the business difficulties caused by the lack of information, financing constraints, etc., and strengthens the willingness and ability of enterprises to innovate and startup businesses.

3.2.4. Human capital aggregation effect

Innovative and entrepreneurial talents are the main body of market activities and one of the most important innovation factors; therefore, human resource factor configuration directly affects the quality of regional BE. A good human resource structure helps the city improve the knowledge stock and quality and promote the flow of knowledge and information [67], thus helping enterprises obtain more market opportunities and improve business performance. As a kind of city brand, the ICP construction process will trigger the innovative talent aggregation mechanism, attracting talents and accelerating talent concentration through various policy and institutional advantages and its innovation potential [68]. The radiation effect formed by talent concentration improves the regional human capital structure, better meets the talent demand of enterprises, and contributes to the spillover of innovative knowledge and the commercialization of innovative technologies; thus, a knowledge-based innovation economy can be built. Innovations are integrated into various market sectors with deepening knowledge and information sharing [38]; they also help reduce the information asymmetry in the business process and enhance enterprises' identification and utilization of market opportunities [69]. In practice, ICP regions continue to improve their talent service and development policies, establish scientific and reasonable talent evaluation and protection systems, and enhance their city reputation to win the "war for talents." Many cities have implemented measures, such as settling talents, subsidizing scientific research, providing innovation platforms, and lowering tax burdens to chase high-end talents and strengthen the city's development advantages [70]. Therefore, ICP policy can promote BE optimization through the talent-gathering path and reattract and self-reinforcement under the cyclic cumulative causal effect to continuously enhance competitive regional development.

In summary, we propose the following research hypothesis.

H2. ICP can optimize urban BE through four potential mechanisms: technological innovation, government effectiveness improvement, policy leading, and human capital aggregation.

4. Methodology and models

4.1. Empirical model

This study's primary objective is to scientifically evaluate the impact of the ICP policy on the urban BE in China. The impact of ICP policy implementation on BE includes not only "the time effect" that naturally occurs with the passage of time or changes in the economic situation but also the so-called "policy treatment effect" caused by policy implementation. To separate these two effects effectively, we use the difference-in-difference (DID) method to compare the effects before and after implementing the ICP policy. DID is a commonly used policy evaluation method in the academic field, which helps alleviate potential endogeneity issues [71]. Taking the ICP policy as a quasi-natural experiment, the pilot cities are treated as the treatment group, while the nonpilot cities serve as the control group. We assume that the preimplementation time trends of the outcome variables in both groups are the same. Therefore, any changes observed after implementing the ICP policy can be attributed to the policy. The specific model is constructed as follows:

$$\mathrm{BE}_{it} = \alpha + \beta ICP_{it} + \gamma X_{it} + \mu_i + \vartheta_t + \varepsilon_{it} \tag{1}$$

In the above equation, i represents the city and t represents the year. The dependent variable BE_{it} reflects the level of the urban BE. The core explanatory variable is ICP_{it}, which indicates whether city i is selected as an ICP in year t. It is obtained by multiplying the city-type dummy variable (*treated*) with the time dummy variable (*time*). β is the coefficient of interest in the study, measuring the net effect of ICP policy implementation on BE. If β is significantly positive, it indicates that the ICP policy effectively contributes to optimizing the BE in the city. Additionally, following existing literature, a series of control variables that may influence urban BE, denoted as X_{it}, are included to mitigate potential estimation biases caused by omitted variables. μ_i and ϑ_t represent city and time fixed effects, respectively, aiming to control for differences between cities and time-related variations. Finally, ε_{it} denotes the random disturbance term.

4.2. Variable selection

4.2.1. Dependent variable

The China City BE Evaluation Index System measures the BE of Chinese cities. The data for this index system is derived from the "Evaluation of China City BE" research project conducted by the Economic Research Institute of the "Management World magazine" in China. This index system is constructed based on ecosystem theory and encompasses seven dimensions: proximity index, integrity index, government concern, government services, corporate tax burden, government integrity, and government transparency. Furthermore, the system provides a comprehensive evaluation standard for the BE at the city level in China, demonstrating reliability and feasibility. Meanwhile, some specific indicators were selected regarding the indicators of the World Bank's Doing Business Program survey and related study [32] (Table A1 in Appendix). Multiple channels, including the collection of public data, survey data, and web data, were integrated to measure and collect data. Finally, the utility value method was employed to calculate the BE Index scores for Chinese cities.[4]

4.2.2. Explanatory variable

This study establishes a Quasi-natural experiment based on the ICP policy as a policy shock. The policy treatment effect of the ICP policy is represented by the interaction term of the treatment group (*treated*) and the period (*time*) as two dummy variables. Virtual variables are set based on the list of innovative cities published on the Chinese Ministry of Science and Technology website from 2008 to 2018. ICP cities are assigned a value of 1, while non-ICP cities are assigned a value of 0. The year in which a pilot city is approved and subsequent years are assigned a value of 1, while other years are assigned a value of 0. As ICP cities were established in batches, variations exist in the setting of the time dummy variable for different ICP cities.

4.2.3. Control variables

In selecting control variables, we focus on variables that significantly impact urban BE but have not been included in the BE evaluation index system. Drawing from previous relevant studies, we incorporate more variables on city characteristics that may affect the BE to minimize the potential interference of omitted variables on the research findings.

(1) Economic development (gross domestic product (GDP)): A city's real GDP is divided by its total population to get the real GDP per capita; we then take the logarithm. Areas with advanced economies tend to pay more attention to BE governance, better market management services, infrastructure, institutional safeguards, etc., and higher market entry and freedom for enterprises with more business opportunities [72].

[4] The specific calculation procedure and equations can be obtained from the corresponding author.

(2) Industrial structure (*Ind*): The ratio of tertiary industry output value to secondary industry reflects the differences in resource endowment, input factors, and other conditions at the city level. Different industrial structures in cities imply different BE ecological statuses and paths to high-quality development [73].
(3) Financial development level (*Fin*): This variable is the ratio of the balance of deposits in financial institutions to GDP at the end of the year. A sound financial system provides markets with a stable funding source and can promote business confidence and certainty to introduce innovations or remain resilient in dynamic markets [74].
(4) Internet penetration rate (*Inter*): This variable is the ratio of the number of households with Internet access to the total number of households at the end of the year. The Internet can contribute to a fairer and more sustainable BE by reducing the risk of information asymmetry and the cost of doing business for firms and facilitating the synergy of knowledge and innovation in the marketplace [75].
(5) Education Level (*Edu*): Total urban education expenditures are logarithmic to characterize the region's intellectual capital stock. According to the evaluation criteria for indicators developed by the International Finance Organization, the higher the education level in the region, the richer the resources available to the city regarding innovation factors, and the better the market environment for investment and doing business.
(6) Population density (*Pop*): This variable represents the ratio of the total population of a city to the size of its administrative area. Generally, the denser the city's population, the stronger the government's public service provision and the easier it is to generate a "population dividend." At the same time, the city will attract more and more enterprises, talent, and knowledge [76].

4.3. Sample and data sources

Following the principles of systematicity, scientificity, comparability, and data availability, this study takes 280 prefecture-level cities in China from 2004 to 2019 as the research sample. The primary data mainly come from the China Urban Statistical Yearbook, China Urban and Rural Construction Statistical Yearbook, and annual statistical bulletins of each city; the rest of the data come from online databases and are manually searched and organized from web pages. The data for BE's selected measurement indicators come from the EPS Global Statistics Database,[5] the China Judgments Online database,[6] and the Tian Yan Cha database.[7] Data on the number of policy releases for the mechanism analysis are collected from the official websites of prefecture-level city governments and the Peking University Law Information Database.[8]

To enhance the representativeness of the sample data, samples belonging to district or county-level cities, those affected by administrative division adjustments, and those with significant data gaps are excluded. For a few missing values and abnormal values in the data, the relevant city statistical yearbooks and statistical bulletins were manually organized. If they could not be verified, the abnormal values were processed as missing values, and linear interpolation was utilized. Following these procedures, a balanced panel dataset for 2004 to 2019 is obtained, consisting of 280 cities, with 72 cities in the experimental group and 208 cities in the control group. The number of observations before and after the policy implementation is 541 and 3,939, respectively. Table 1 presents the basic statistical characteristics of the main variables.

5. Results

5.1. Benchmark regression

The Hausman test of ICP policy on BE shows the p-value 0.000, indicating that the fixed-effects model is superior to the random effects model; therefore, the fixed-effects model is chosen for subsequent regression analyses. Table 2 reports the benchmark regression results. In column (1), no regional characteristic variables are introduced, and there are no controls for time and city fixed effects. The estimated coefficient for the ICP policy is 6.944, significant at the 1% level. In column (2), city and year fixed effects are controlled, but regional characteristic variables are not included. Similarly, the estimated coefficient for the ICP policy remains significantly positive. Columns (3) and (4) introduce regional characteristic variables, building upon the first and second columns. Even after fully controlling for city and year fixed effects and considering control variables, the ICP policy remains significantly positive at the 1% level. These results indicate that implementing the ICP policy significantly affects optimizing the urban BE. Thus, the research hypothesis H1 is validated.

5.2. Parallel trend test

The parallel trends assumption is the primary assumption for applying the time-varying DID method. This assumption states that in the absence of the ICP policy shock, the preimplementation levels of the BE in the pilot and nonpilot areas exhibit the same trend. If the pilot and nonpilot cities do not have consistent temporal trends, differential endogeneity may arise, resulting from systematic biases in the sample; therefore, a common event study approach [77] is employed to examine the suitability of this study's DID model [78]. A

[5] https://www.epsnet.com.cn/index.html#/.
[6] https://wenshu.court.gov.cn/.
[7] https://www.tianyancha.com/.
[8] https://www.pkulaw.com/law?cahannel=SEM-topad.

Table 1
Descriptive statistics.

Variables	Symbol	Total (N = 280)		The experimental group (N = 72)		The control group (N = 208)	
		Mean	Std.	Mean	Std.	Mean	Std.
Business environment	BE	13.08	5.533	19.182	10.227	12.023	3.829
Innovative city pilot	ICP	0.121	0.326	1.000	0.000	0.000	0.000
Economic development	GDP	10.27	0.791	10.678	0.662	10.218	0.791
Industrial structure	Ind	1.360	0.679	1.161	0.504	1.387	0.696
Financial development	Fin	0.859	0.538	0.977	0.653	0.842	0.518
Internet penetration rate	Inter	0.158	0.178	0.232	0.209	0.148	0.171
Education level	Edu	12.54	1.058	13.374	0.840	12.425	1.033
Population density	Pop	4.358	3.285	4.788	3.225	4.299	3.289

Table 2
The impact of ICP policy on BE.

	(1)	(2)	(3)	(4)
	BE	BE	BE	BE
ICP	6.944***	2.521***	5.689***	2.509***
	(0.232)	(0.282)	(0.232)	(0.281)
Control variables	NO	NO	YES	YES
City fixed effects	NO	YES	NO	YES
Year fixed effects	NO	YES	NO	YES
Observations	4480	4480	4480	4480
R^2	0.167	0.834	0.240	0.835

Notes: The brackets represent robust standard errors. ***, **, and * denote 1%, 5%, and 10% significance levels, respectively. The control variables added are GDP, Ind, Fin, Inter, Edu, and Pop.

dynamic model is established as follows:

$$BE_{it} = \alpha + \sum_{k=-4}^{12} \beta_k ICP_k + \gamma X_{it} + \mu_i + \vartheta_t + \varepsilon_{it} \quad (2)$$

ICP_k represents a virtual variable with the same meaning as Equation (1). If k is a negative number, it indicates k years before the policy implementation; if k is a positive number, it indicates k years after the policy implementation. The estimated coefficient β is interesting as it measures the differences between the treatment and control groups at different points. If the coefficient β is not statistically significant when k is negative, it implies the parallel trends assumption holds. Conversely, if the coefficient β is statistically significant, the application of the DID method may not be appropriate.

Fig. 1 presents the estimated coefficients, denoted as β, of the annual BE indicators at a 95% confidence interval. As shown, before the policy intervention, the coefficients of the policy regression were not statistically significant, with estimates fluctuating around zero and failing to pass the 5% significance level. This outcome suggests that the experimental and control groups exhibit consistent trends in BE changes; however, following the implementation of the ICP policy, the differences in BE between the experimental and control group cities become increasingly pronounced. Therefore, the changes in BE are not solely attributed to time effects but instead driven by the ICP policy, indicating that the research design satisfies the parallel trends assumption. Additionally, the variation in the interaction term coefficients after policy implementation indicates that the policy effects of the ICP policy exhibit a certain lag, becoming significantly different only after the Chinese government's widespread replication and promotion of the ICP policy.

5.3. Robustness test

5.3.1. Propensity score matching–difference-in-difference

Although the DID method can isolate the net effect of the ICP policy on BE, it cannot effectively address estimation errors and potential endogeneity issues caused by self-selection bias. Propensity score matching (PSM) is a powerful procedure to mitigate bias [79,80]; therefore, we employ the PSM method to match the experimental and control groups on control variables. The pilot policy in China does not strictly adhere to the assumptions of a natural experiment, as the selection of pilot areas is more a result of bargaining between the central and local governments [17,81]. Cross-sectional PSM and period-by-period PSM have some limitations, such as the "self-matching problem" in cross-sectional PSM and the inconsistency of matched objects before and after the policy in period-by-period PSM; therefore, we employ a panel data transformation approach and a period-by-period matching method for PSM–DID. The matching results indicate that both methods effectively reduce sample selection bias, satisfying the conditions for conducting PSM–DID. The estimation results of the two PSM–DID models are presented in Table A2. Columns (1) and (2) show that regardless of the matching method employed, the coefficient of the time-varying DID variable for the ICP policy is significantly positive at the 1% level, consistent with the benchmark regression results. Therefore, the impact of the ICP policy on urban BE remains significant, even after adequately considering sample selection bias, and the results of PSM–DID further strengthen the robustness of the

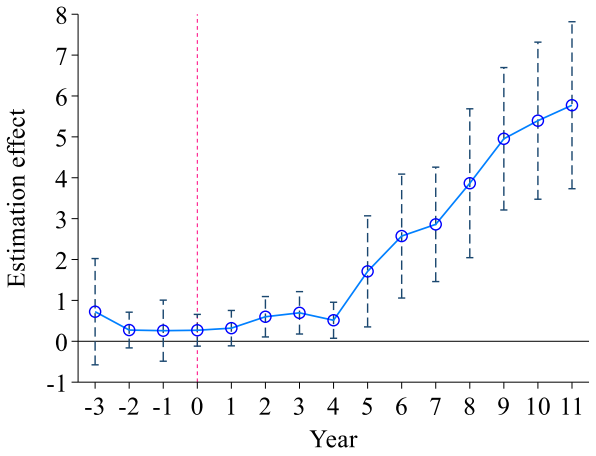

Fig. 1. Parallel trend test.

benchmark regression.

5.3.2. Placebo test

We randomly selected a virtual experimental group and a control group for placebo testing to mitigate the potential influence of unobservable city characteristics on the trend changes of both groups. Following the approach of previous study [78], we randomly selected 72 pilot cities from a pool of 280 cities as the "pseudo-policy" treatment group, while the remaining cities were designated nonpilot cities. This approach allowed us to construct a placebo test with a policy dummy variable and generate a "pseudo-policy" dataset. This process was repeated 1000 times. Fig. 2 displays the kernel density of the estimated coefficients of the randomly generated experimental groups along with the corresponding p-values. The x-axis represents the policy estimation coefficients from 1000 randomly generated samples. The solid line represents the kernel density distribution of the coefficients for the pseudo-policy's impact on BE, while the hollow circles represent the corresponding p-values. As shown, the mean of the pseudo-policy regression coefficients is close to 0, roughly following a normal distribution but deviating significantly from the actual regression coefficient values. Additionally, most p-values are greater than 0.1, indicating a lack of statistical significance at the 90% confidence interval. Based on these findings, we can infer that the influence of omitted variables on the estimation results is minimal, and the true estimation coefficients are unlikely to be obtained by chance. Therefore, the estimation results of the benchmark regression are robust.

5.3.3. Instrument variables estimation

Although this study employs the two-way fixed-effects time-varying DID method, it cannot eliminate endogeneity issues arising from sample selection bias and omitted variables. Therefore, following the approach of related study [82], the quantity of the Temple of Confucius[9] (*Temple*) in cities is used as an instrumental variable, and a two-stage least squares (2SLS) regression is conducted.[10] In terms of relevance, Confucian culture has been the orthodox culture in China since the Han Dynasty; it has profound implications for various aspects of politics, society, and the economy. Regions where Confucianism flourishes tend to be more prosperous in terms of socioeconomic development. Additionally, related research confirms that Confucianism has a guiding and enlightening role in developing the Chinese market economy. Regarding exclusivity, no evidence suggests a direct correlation between the number of Temples and the dependent variable of urban BE. Table 3 presents the estimation results of the instrumental variable approach. The coefficient of the first-stage instrumental variable is significantly positive, indicating that cities with more Temples are more likely to be selected for the ICP program. Moreover, the *K-P Lagrange multiplier (LM) statistic* is 33.71 with a p-value of 0.000, and the *K-P Wald F statistic* is 38.94, indicating the absence of weak instrument bias and instrument irrelevance; thus, the selection of the instrumental variable in this study is reliable. The results of the second-stage regression demonstrate that when using the quantity of Confucius Temples as the instrumental variable, the coefficient of the ICP policy remains significantly positive, supporting the robustness of the benchmark regression results.

5.3.4. Adjustment samples

Some cities in the research sample have a better political power or economic development level foundation, such as provincial capitals, municipalities directly under the central government, and planned cities. These cities have higher levels of economic development, relatively well-developed markets, and more active innovation and entrepreneurship, and they have advantages in BE reform that are incomparable to other cities. Furthermore, city characteristics may affect the ICP strategy as a regional innovation

[9] The number of Confucian Temples was compiled from *A Study of Confucian Temples in the World* (Kong, 2011).

[10] The first stage is the regression of the explanatory variables on the instrumental variables to obtain the fitted values of the explanatory variables. The second stage is the result of regression of the fitted values of the explanatory variables on the explanatory variable.

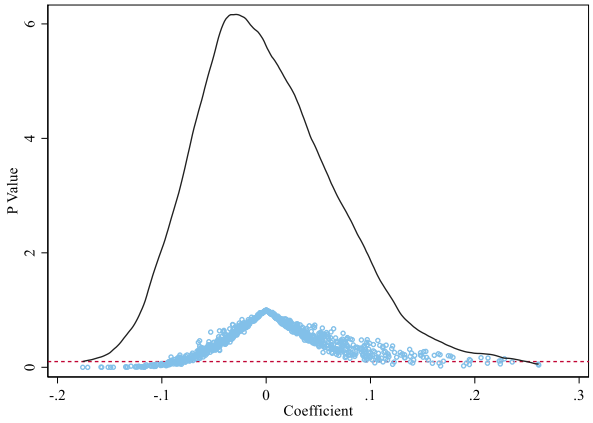

Fig. 2. Placebo test.

Table 3
The results of instrumental variables estimation.

	(1)	(2)
	First stage	Second stage
ICP		8.316***
		(1.950)
Temple	0.004***	
	(0.000)	
Kleibergen–Paap rk LM statistic	33.71	
	[0.000]	
Kleibergen–Paap Wald rk F statistic	38.94	
Cragg–Donald Wald F statistic	52.09	
Hansen J statistic	0.000	
Control variables	YES	YES
City fixed effects	YES	YES
Year fixed effects	YES	YES
Observations	4480	4480

Notes: The brackets represent robust standard errors. ***, **, and * denote 1%, 5%, and 10% significance levels, respectively. The control variables added are GDP, Ind, Fin, Inter, Edu, and Pop.

policy with evident regional characteristics. To avoid the interference of the differences in city scale and other characteristics on the research conclusions, we exclude these samples for the robustness test to make the experimental group more comparable with the control group photo. Based on the new sample data, the results are reported in columns (3) and (4) of Table A2. The results show that the regression coefficients for ICP policy remain significantly positive, consistent with the results of the benchmark regression.

5.3.5. Excluding the impact of other policies

Estimating the impact of ICP city establishment on BE will inevitably be influenced by other policies, which may result in an overestimation or underestimation of the estimated effect of the ICP policy. This study searched for other relevant policies introduced during the sample period and found that, in addition to implementing the ICP policy, the Chinese government also implemented other pilot policies to shift new momentum in economic development. For example, the Intellectual Property Demonstration City policy (*IP*) was implemented in 2012, and the National Smart City Pilot policy (*SC*) was implemented in 2013. To some extent, implementing these two innovation incentive policies has contributed to optimizing the environment for urban innovation and entrepreneurship. Therefore, we must exclude these two policies. Columns (5) and (6) in Table A2 present the regression results after including dummy variables for these two types of policies to obtain the net effect of the ICP policy. The results show that even after controlling for these two policies that enhance cities' innovative development capacity, the ICP policy's coefficient on BE remains significantly positive. This result demonstrates the robustness of the conclusions from the benchmark regression.

6. Further analysis

6.1. Mechanism analysis

Based on the findings from the benchmark regression, it is evident that the ICP policy significantly affects optimizing BE; however, we must determine the mechanisms through which this effect is transmitted. The previous theoretical analysis section identified four

mechanisms through which the ICP policy may affect the optimization of urban BE: technological innovation effect, government efficiency improvement effect, policy-leading effect, and human capital aggregation effect. Therefore, drawing on relevant study [83], we examine the mechanisms through which the ICP policy influences urban BE by setting the following econometric model:

$$M_{it} = \alpha + \beta \mathrm{ICP}_{it} + \gamma X_{it} + \mu_i + \vartheta_t + \varepsilon_{it} \tag{3}$$

$$\mathrm{BE}_{it} = \alpha_1 + \rho_1 ICP_{it} + \rho_2 \mathrm{M}_{it} + \gamma X_{it} + \mu_i + \vartheta_t + \varepsilon_{it} \tag{4}$$

where M_{it} represents an action variable's mechanism; the other variables are consistent with the previous section. If both the coefficient β and ρ_2 of equations (3) and (4) are significant, the mechanism of action is valid. Specifically, the following mechanism variables are selected. (1) Technological innovation (*Tech*) is synthesized by converting the number of government science and technology inputs and patent applications. (2) Governmental efficiency enhancement (*Gov*) is the ratio of government financial expenditures to GDP. (3) Policy leading (*Policy*) is the number of innovation and entrepreneurship policies issued by the government. The relevant data comes from the official website of each prefecture-level city government and "The Peking University Law Information Database." (4) Human capital aggregation (*Intell*) is the ratio of the sum of employees engaged in scientific research, technical services, information services, and software industry to the total number of employees in the city.

Table 4 presents the results of the policy effect mechanism analysis. Columns (1), (3), (5), and (7) display the results with the inclusion of the mechanism variables mentioned in Equation (3). The coefficients of the ICP policy corresponding to the four mechanism variables are significantly positive at the 1% level. This result indicates that implementing the ICP policy can significantly promote technological innovation, enhance governmental efficiency and policy leading, and boost human capital aggregation in urban areas. Columns (2), (4), (6), and (8) display the results when the equations include the mechanism variables. The coefficients of the ICP policy and the four mechanism variables are all significantly positive. Therefore, the technological innovation effect, government efficiency improvement effect, policy-leading effect, and human capital aggregation effect are the four channels through which the ICP policy optimizes urban BE. The research hypothesis H2 is confirmed.

6.2. Heterogeneity analysis

The previous section analyzed the average effect of the ICP policy on BE; however, the analysis based on the overall sample may mask the differences between regions. In particular, significant differences exist in development potential, resource endowment, and institutional arrangements among the model regions, resulting in very different BE levels across cities. For this reason, this paper further tests whether ICP policy has a heterogeneous effect on BE.

6.2.1. Heterogeneity of market potential

From the perspective of New Economic Geography, regions with higher market potential are more likely to attract the inflow of labor and resource factors due to increasing returns to scale and transportation costs [77]. Under equal conditions, regions with larger market potential are more likely to stimulate innovation and entrepreneurship. These differences may, to some extent, impact the effectiveness of the ICP policy in optimizing urban BE; therefore, we adopt a grouped regression approach to identify this heterogeneity effect. Specifically, following the method proposed by Harris [79], the market potential of each city is calculated. Based on this, a dummy variable for market potential (*Potential*) is set, assigning a value of 1 to cities with a market potential above the mean and 0 to the remaining cities. Columns (1) and (2) in Table 5 report the estimation results. The regression coefficients for both groups are significantly positive, but the difference in coefficients between the groups is not significant. This outcome suggests that the impact of

Table 4
The results of the mechanism analysis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Tech	BE	Gov	BE	Policy	BE	Intell	BE
ICP	0.845***	1.274***	0.880***	2.468***	7.011***	1.689***	0.414***	2.287***
	(0.062)	(0.250)	(0.127)	(0.288)	(0.513)	(0.281)	(0.060)	(0.282)
Tech		1.462***						
		(0.220)						
Gov				0.047**				
				(0.022)				
Policy						0.117***		
						(0.020)		
Intell								0.537***
								(0.077)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
City fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4480	4480	4480	4480	4480	4480	4480	4480
R^2	0.738	0.859	0.876	0.835	0.670	0.843	0.820	0.839

Notes: The brackets represent robust standard errors. ***, **, and * denote 1%, 5%, and 10% significance levels, respectively. The control variables added are GDP, Ind, Fin, Inter, Edu, and Pop.

Table 5
The results of the heterogeneity test.

	(1)	(2)	(3)	(4)	(5)	(6)
	Low Potential	High Potential	Central and western	Eastern	Low Admin	High Admin
ICP	2.102***	2.367***	2.689***	1.889***	2.423***	2.991***
	(0.220)	(0.428)	(0.391)	(0.423)	(0.322)	(0.435)
SUEST	0.1162		0.0532*		0.0001***	
Control variables						
City fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Observations	2384	2096	3072	1408	3888	592
R^2	0.838	0.839	0.832	0.849	0.836	0.843

Notes: The brackets represent robust standard errors. ***, **, and * denote 1%, 5%, and 10% significance levels, respectively. The control variables added are GDP, Ind, Fin, Inter, Edu, and Pop.

the ICP policy on urban BE does not vary due to differences in market potential.

6.2.2. Heterogeneity of urban location

Due to geographical disparities and policy preferences, cities in eastern China have significantly higher economic development than cities in the central and western regions [81]. As a result, the effectiveness of the ICP policy may also vary across regions. Eastern cities benefit from their coastal location and convenient transportation, which have become increasingly advantageous since the reform and opening-up period began. In contrast, cities in the central and western regions are located inland and have relatively backward socioeconomic foundations and market mechanisms; therefore, the sample is divided into eastern cities and central–western cities to examine regional heterogeneity. The relevant estimation results are presented in columns (3) and (4) of Table 5. The ICP policy positively affects both eastern and central–western cities' BE, but the effect is more significant in the latter. The SUEST test statistic is significant at the 10% level, supporting the difference between the two data groups.

6.2.3. Heterogeneity of administrative power

In the development process of Chinese cities, the allocation of administrative resources is an essential factor that cannot be ignored. Different administrative levels result in varying degrees of ease in resource allocation for cities, with higher administrative-level cities having advantages in resource agglomeration. Therefore, it is necessary to consider the heterogeneity of the effects of the ICP policy caused by differences in administrative levels. Cities with higher economic management authority, such as provincial capitals, municipalities directly under the central government, planned single cities, and economic special zones, are categorized as high administrative-level cities. In contrast, the remaining cities are categorized as low administrative-level cities. The regression results are reported in columns (5) and (6) of Table 5, indicating that in cities with higher administrative levels, the estimated coefficients of the ICP policy variable are larger, and the difference in coefficients between the groups is significant at the 1% level. This finding reflects the vertical differences in the effects of ICP policy implementation on urban BE.

6.3. Spatial spillover effect

The innovation effect of the ICP policy may spread to neighboring nonpilot regions on a spatial scale; thus, the following model was constructed to test this policy effect:

$$BE_{it} = \beta_0 + \rho WBE_{it} + \beta_1 ICP_{it} + \delta W\mathrm{ICP}_{it} + \gamma X_{it} + \mu_i + \vartheta_t + \varepsilon_{it} \tag{5}$$

where W is the spatial weight matrix, ρ, and δ are the spatially lagged coefficients to be estimated for the explanatory and core explanatory variables. The definitions of the other parameters are consistent with Equation (1).

Based on the spatial matrix of economic distance, the global Moran's I values of BE from 2004 to 2019 are positive and pass the significance test, indicating that BE among prefecture-level cities has significant positive spatial aggregation characteristics[11]. Therefore, it is reasonable and necessary to choose a spatial econometric model to test the spatial homogeneity assumption to assess ICP policy effects, which may lead to the problem of biased estimation results. The robust LM test, Wald test, likelihood-ratio (LR) test, Hausman test, and other tests were successively conducted to verify the fitting effect of different panel spatial models. The results in Table 6 show that the key indicators of the intereconometric model tests are all significantly positive. Therefore, compared with the spatial autoregressive model (SAR) and spatial error model (SEM), the two-way fixed-effects spatial Durbin model (SDM) was chosen to have a better fitting effect and capture the spatial correlation characteristics of the dependent and independent variables.

Table 7 presents the estimation results of the spatial econometric model. The results show that the coefficient of the ICP policy is still significantly positive after considering the spatial spillover effect, which further proves the reliability of the benchmark regression

[11] Due to space limitations, the results of spatial correlation tests, such as Moran's I and its scatterplot for BE at the prefecture level cities, are not shown. The authors will provide them on request.

Table 6
Spatial econometric model testing.

Type of test	Statistic	Conclusion
LM test	1613.44***	Reject
	631.74***	Reject
Wald test	17.58**	Reject
	24.00***	Reject
LR test	17.58**	Reject
	23.93***	Reject
Hausman test	322.88***	Reject

Notes: The brackets represent robust standard errors. ***, **, and * denote 1%, 5%, and 10% significance levels, respectively. The control variables added are GDP, Ind, Fin, Inter, Edu, and Pop.

Table 7
Spatial Durbin model regression results.

Variables	W1		W2		W3	
	BE	BE	BE	BE	BE	BE
ICP	2.442***	2.416***	2.445***	2.380***	2.442***	2.416***
	(0.342)	(0.340)	(0.348)	(0.336)	(0.342)	(0.340)
rho	0.133***	0.130***	0.141***	0.133***	0.133***	0.130***
	(0.030)	(0.031)	(0.033)	(0.033)	(0.030)	(0.031)
σ^2	5.019***	4.9874***	5.012***	4.959***	5.019***	4.987***
	(1.793)	(1.781)	(1.797)	(1.778)	(1.793)	(1.781)
Control variables	NO	YES	NO	YES	NO	YES
City fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Observations	4480	4480	4480	4480	4480	4480
R^2	0.217	0.154	0.208	0.164	0.217	0.154

Notes: The brackets represent robust standard errors. ***, **, and * denote 1%, 5%, and 10% significance levels, respectively. The control variables added are GDP, Ind, Fin, Inter, Edu, and Pop. W1 = Economic distance matrix; W2 = Economic geographic weight matrix; W3 = Economic geographic nesting matrix.

results. The spatial spillover effect is significantly positive at the 1% level, indicating a significant spatial spillover effect of ICP policy on the level of urban BE. Furthermore, we confirm the robustness of the findings using the economic distance weight matrix and the economic geography nested matrix. Regardless of the spatial matrix, the effect of ICP construction on the city BE level is significantly positive, producing a strong demonstration effect on neighboring cities.

7. Conclusion and recommendation

7.1. Discussion

Innovation drives labor productivity and is a policy launching point for optimizing BE. Against the backdrop of countries worldwide competing to build innovative countries, looking at BE from the perspective of innovation is particularly necessary. The focus of BE reform in China is shifting from breaking down market access barriers to facilitating the flow of innovation factors and broadening private enterprises' access to scarce factors such as talent, capital, and technology through institutional innovation. Previous studies have focused more on the overall impact of general business regulations and informal relationships, etc. [25,34], on BE or business operations and have lacked discussions on the impact of specific innovation policy practices on the government's efforts to reform business regulations and optimize BE. Compared with the "back-end" effects of BE, we focus on the "front-end" factors and introduce the innovation perspective to conduct theoretical analysis and empirical testing, which has specific theoretical and practical significance.

(1) ICP policy has a positive impact on urban BE. The results of the benchmark regression indicate that ICP cities have more significant BE improvement than nonpilot cities. This finding remains solid after a multidimensional robustness test and endogeneity treatment. Previously, more studies have focused on exploring the impact of general national policy regimes on BE [20,84]. Innovation-driven policies help improve the market economic environment, especially for regions and countries such as Western Europe, North America, Japan, and Korea [24,85]. Innovative city design is committed to an innovation-driven intensive economic growth model, which creates a favorable environment for enterprises to carry out innovative and entrepreneurial activities [41]. Based on the DID methodology, we confirm the positive impact of the ICP policy in China on improving urban BE performance, even if this policy effect is not immediate. This outcome supports and extends the relationship between innovation policy and BE.

(2) Effective allocation innovation factor is ICP policy's influence mechanism to optimize BE. The results of the mechanism test indicate that ICP policy can enhance the BE level of cities through the technological innovation effect, government efficiency improvement effect, policy-leading effect, and human capital aggregation effect. The primary goal of ICP policy is to create a more suitable technological, governmental, market, and financial environment for the market through the aggregation and allocation of innovative resources. This approach is conducive to optimizing market regulation and service level, lowering the access threshold, enabling market players to enter the market equally according to the law, stimulating market vitality, and reducing the distortion of economic activities [32]. An indepth study of the internal mechanism of ICP policy shows that technological progress, institutional norms, governmental efficiency, and information flow mechanisms shape a better BE [27, 86], effectively integrating the fragmented knowledge of innovation policies affecting BE.

(3) The effects of ICP policy to optimize BE are heterogeneous. First, the positive effects of the ICP policy do not differ significantly depending on the market potential gap between cities. Cities with higher market potential have a strong attraction and synergize with the positive effects of the ICP policy to attract more innovation factors. At the same time, the ICP policy can also help cities with lower market potential to utilize their comparative advantage over latecomers and fully develop potential innovation resources and space. This situation implies that implementing innovation-driven policies can help break through the bottleneck of development potential inherent in regional development. Second, the policy effect of ICP policy affecting BE is somewhat more significant in the central and western regions than in the eastern regions with better location conditions, which is similar to the findings of existing studies [32,41]. This result may be because the eastern region is affected by the siphoning effect, the development of the BE level is relatively high, and the economic significance of the ICP policy is relatively weak. The central and western regions, however, do not have an innovation advantage, and with the series of incentives brought by the ICP policy, the marginal benefit of the innovation drive is more pronounced. This finding indicates that implementing the ICP policy is conducive to narrowing the development gap between regions and promoting synergistic development between regions. Finally, the impact of ICP policy on BE varies according to the administrative level of cities. Cities with high administrative levels, such as provincial capitals and special economic zones, have more financial strength, better infrastructure, and public services and are more flexible in responding to market demand [87,88]. These cities can build better innovation ecosystems and gather richer innovation resources; therefore, BE reforms should focus on regional differences and explore the decentralization of economic management authority on a "first pilot" basis.

(4) The ICP policy can lead to the enhancement of BE in neighboring areas. Spatial measurement results show that ICP policy has positive spatial spillover effects on the optimization of BE in geographically proximate and economically connected cities, and this effect is deepening. As a typical embodiment of China's "experimental governance" model, the policy pilot mechanism is essential to China's economic takeoff since the reform and opening up to a highly complex and uncertain situation [89]. It differs from the traditional hierarchical top-down model of policy implementation, where power is transferred, and regulation operates from the top down. Through the diffusion of policies through competition, learning and imitation, and the process of small-scale pilots, large-scale pilots, and experimental extension, pilots can promote inter-regional synergistic development by "leading by example." Relevant studies have also noted the impact of ICP policy in promoting spatial spillovers of innovation factors, such as knowledge, capital, and technology [38,90], because the specialized agglomeration pattern of innovative cities further strengthens the synergistic development of cities. Furthermore, the formation of innovation networks in terms of technological innovation and infrastructure construction makes cities closer to each other, which is more conducive to the flow and allocation of innovation factors and radiates and drives the transformation and development of the region.

7.2. Conclusions and policy recommendations

We built a quasi-natural experiment with implementing the ICP policy. We empirically evaluated the direct impacts, role-channeling impact mechanisms, heterogeneous impacts, and spatial spillover effects of the ICP policy on urban BE in China using balanced panel data from 280 cities from 2004 to 2019. The following are the key conclusions. (1) As a regional innovation strategy, ICP policy effectively optimizes urban BE. Robustness tests like the PSM–DID test, placebo test, instrumental variable regression, adjustment samples, and exclusion of the effects of other policies in the same period all corroborate this conclusion. (2) The mechanism test demonstrates that ICP policy primarily optimizes urban BE through four potential channels: technological innovation effect, government efficiency improvement effect, policy-leading effect, and human capital aggregation effect. (3) The effects of ICP policy show heterogeneity and their effects on urban BE are more significant in cities with high administrative levels and the central and western regions but do not vary depending on the city's significant difference depending on the high or low market potential. In addition, (4) The ICP policy optimizes city BE with positive and significant spatial spillover effects, which can lead to the synergistic development of adjacent neighboring cities. (5) ICP policy has a "stacking effect" with innovation policies such as smart city pilot policies and intellectual property pilot cities.

Based on the above findings, the following policy implications are proposed.

First, the implementation support of the ICP policy should be strengthened to promote urban innovation and transformation. Full play should be given to the top-down political impetus of the central government and the bottom-up learning and innovation role of local governments. Furthermore, ICP pilot regions should be encouraged to conduct early and pilot implementation, explore and replicate relevant mature experiences, and expand the areas and scope of the pilot program. In this process, monitoring and evaluation feedback mechanisms and safeguards should be developed to ensure the quality of policy implementation and proliferation. It is also necessary to focus on the coordination and progress of ICP policy with other policies, optimize the policy mix, and reduce the conflict of policy tools and objectives and the waste of resources caused by them. Moreover, it is necessary to develop monitoring and evaluation

feedback mechanisms and safeguards to ensure the quality of policy implementation and diffusion.

Second, attention should be paid to the multiple channels of the diversified mechanisms through which ICP policy can exert its effects. BE reform should combine the "two hands" of government institutional design and market allocation of resources and combine and optimize the multidimensional paths that promote the full flow of innovation factors. Furthermore, the financial expenditures for constructing urban business platforms, protecting intellectual property rights, introducing scientific and technological talents, and refining and implementing policies and systems that facilitate innovation and entrepreneurship must be strengthened. At the same time, the government's administrative efficiency and service quality should be improved, administrative burdens should be reduced, and a "close" and "cleaning" relationship between the government and business must be established. The government should also utilize the technology diffusion effect of the market to improve the flow of intellectual factors and innovation performance within and outside the city.

Furthermore, the government should adopt a strategy of insisting on differentiation, refining, and replanning innovation policies according to local conditions. ICP policy and BE reforms should be promoted scientifically by considering the geographic location, resource endowment, socioeconomic and other conditions of different regions and scientifically promoting ICP policy according to local conditions. It is necessary to give full play to the advantages of the scale and agglomeration effects of high-administrative-level cities and developed eastern cities. Additionally, low-administrative-level cities and cities in central and western China can also take advantage of the policy dividend to break through the limitations of market potential and realize "Catch up from behind." Therefore, it is necessary to relax the approval conditions for ICP pilot projects in less developed regions and appropriately increase the number of ICPs in these regions.

Finally, the spatial spillover dividend of ICP policy benefits should be fully utilized. Improvements should be made in the mechanism of regional innovation synergy and the overall level of urban agglomeration, and inter-regional exchanges and cooperation in BE reform and economic development should be systematically strengthened to optimize the general regional BE. It is necessary to strengthen the radiation-driven effect of the pilot regions on the surrounding areas and encourage inter-regional cooperation, exchange, and benchmarking competition. Promoting the flow of factors and resource sharing among innovative regions can help form a synergistic and coordinated pattern of sustainable development and improve overall regional resource allocation efficiency.

7.3. Limitations and directions for future study

As with any empirical study, this research has some limitations that deserve further exploration.

First, this study's primary data sources are prefecture-level city statistical yearbooks and public survey data. The official data are considered convincing since the study covers an extensive range of prefecture-level cities in China; however, a potential drawback is the lack of empirical evidence at the firm level or data on entrepreneurs' intuitive perceptions. In addition to subjects such as government and financial institutions, social capital plays a vital role in BE governance [35]. Therefore, in subsequent studies, more detailed surveys can be considered to analyze the impact of social organizations and entrepreneurial characteristics and accurately measure innovation policies' actual impact on urban BE based on public feedback. Furthermore, in November 2018, the Chinese government identified the first list of innovative counties (cities) to be built. The relationship between ICP policy and BE can be analyzed in depth using more microcounty-level data.

Second, this paper only focuses on the impact of China's ICP policy on BE. Policy insights may not be generalizable due to the lack of comparisons with more types of economies. Through the evidence of policy experiments at the city level in China, we confirm that the innovation policies implemented in China, a developing country, help to optimize urban BE; however, it is unclear whether this policy effect can be revealed in other less developed countries or mature economies. Therefore, future research can focus on and compare more types of economies, especially data related to innovation-driven policies and innovative urban design in mature economies.

Finally, causal mechanisms need to be further discussed. Due to data access constraints, we did not further control for factors such as individual characteristics of prefecture-level city officials, labor costs, cultural level, and ecological environment; however, in the context of the accelerated development of the digital economy, the sustainable development goals, etc., these factors are also critical for a sustainable market economy [91]. Therefore, these factors should be fully considered in future research.

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Additional information

No additional information is available for this paper.

CRediT authorship contribution statement

Tao Yang: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation. **Yuliang Ying:** Writing – original draft. **Hongchun Zhang:** Supervision, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Table A1
China BE evaluation indicator system

Secondary indicators	Tertiary indicators	Calculation instructions
Public services	Natural gas supply	Total gas supply
	Medical care	Total number of medical beds
	Water supply	Water consumption for production and operation
	Electricity supply	Industrial electricity consumption
Human resources	Human resources reserve	Year-end unit employees
	Education level	Number of students in school
	Wage level	Total wages of employees on duty
Market environment	Economic development	Real GDP per capita
	Enterprise organizations	Number of industrial enterprises above designated size
	Imports and exports	Amount of foreign capital utilized during the year
Innovation environment	Innovation inputs	Science expenditures
	Innovation outputs	Number of patents granted for inventions
Financial services	Practitioner size	Financial practitioners
	Financing services	Overall scale of financing
Rule of law environment	Social security	Number of criminal cases per 10,000 persons
	Judicial services	Number of law firms
	Openness of judicial information	Index of openness of judicial information
Government environment	Government expenditure	General budget expenditure
	Public governance	Number of employees in the water, environment, and utilities management industry

Notes: The data are mainly obtained from the China City Database and the China Urban and Rural Construction Database in the EPS global statistics/analysis platform and manually searched and organized on the website.

Table A2
The results of the robustness test

	(1)	(2)	(3)	(4)	(5)	(6)
	BE	BE	BE	BE	BE	BE
ICP	2.506***	2.476***	2.842***	2.665***	2.435***	2.550***
	(0.287)	(0.356)	(0.335)	(0.341)	(0.292)	(0.287)
IP					0.224	
					(0.202)	
SC						−0.365***
						(0.133)
Control variables	YES	YES	NO	YES	YES	YES
City fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Observations	4379	4263	3904	3904	4480	4480
R^2	0.822	0.823	0.833	0.836	0.835	0.835

Notes: The brackets represent robust standard errors. ***, **, and * denote 1%, 5%, and 10% significance levels, respectively. The control variables added are GDP, Ind, Fin, Inter, Edu, and Pop.

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