



# Does the perception of smart governance enhance commercial investments? Evidence from Beijing, Shanghai, Guangzhou, and Hangzhou

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## ABSTRACT

This study explores how the perception of specific aspects of smart governance affects the business environment as to attract investment. To this end, we used a survey design and collected data from Beijing, Shanghai, Guangzhou, and Hangzhou. A total of 500 responses from different industries and companies were obtained and then empirically analyzed using ridge regression and intermediary effect models. We found that the perception of smart governance enhances investment due to strong governance and abundant business opportunities. Natural sustainability attracts investment directly because, when cities become smart, they tend to improve their sustainability and attract talent and capital inflows. This external participation has a direct impact on enterprise investment because it creates more business opportunities. An improved social credit system represents the comprehensive progress of the business environment and positively mediates smart governance and investment. This is the first study to combine the key elements of smart governance, the development stage of smart governance, and various dimensions of the business environment to analyze the influence of smart governance perceptions on commercial investments.

## 1. Introduction

China's governance system and capacity have proven its institutional omnicompetence and capabilities. In his speeches, President Xi Jinping emphasizes the modernization of the country's governance system and its capacity because of the importance of smart governance in developing the entire country or urban areas. In China, "first-tier" smart cities are represented by Beijing, Shanghai, Guangzhou, and Hangzhou, whose urban characteristics differ not only compared to each other but also to other cities. In these four cities, smart governance features use diverse paths to attract investment. Therefore, this study analyzes how the specific aspects of smart governance affect all dimensions of the business environment to attract enterprise investment in these four cities.

Beijing, as the capital city, is the center of politics, culture, and science and has international connections. Under the government's leadership, it managed to combine its scientific and political advantages to construct a network government system. In terms of governance, it ranks high in terms of social services (e.g., medical services, pensions, and education) [1].

Shanghai is China's largest city, located in the estuary of the Yangtze River, which is the country's trade, financial, and innovation hub. In Shanghai, the government has relied on the Internet of Things and big data to fine-tune urban management. As a result, it has

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developed people's livelihoods and collected and utilized information to deliver intelligent transportation solutions. Compared to the other three cities, this city's operations are more data-driven and rely on e-government initiatives. Shanghai thus outperformed the other three cities in attracting investment for three consecutive years, from 2018 to 2020.

Guangzhou is a national trade and transportation hub, as well as the south gate of China to the world, all while boasting a rich historical and cultural heritage. Guangzhou is home to a few Internet giants, such as Tencent. Therefore, its governance is bound to focus on enterprises and human needs. In this environment, the direction of reforms is bottom up, the implemented policies have strong human connections, and the city has the strongest environmental sustainability.<sup>1</sup>

Hangzhou is the main city in the Greater Bay area and an important center for e-commerce, with several IP giants and small and medium-sized science and innovation enterprises. Its government and enterprises jointly promote big data and cloud computing, and vie to build the Urban Brain for forming a dual engine for the high-quality development of the digital economy and manufacturing industry. In 2019, Hangzhou experienced a net population growth of 554,000, the highest in China. Because of these characteristics, this city has become very attractive for talent [1].

In Beijing, Shanghai, Guangzhou, and Hangzhou, smart governance has increased the attractiveness for investment and made these vibrant in terms of both their urban settings and economic development. From 2018 to 2020, these four cities were among the top five most attractive for investment in China.<sup>2</sup> However, it is unclear how their specific forms of smart governance contribute to their attractiveness. These cities showed different ways of implementing smart governance and enhancing their attraction. This study thus aims to scrutinize the mechanics of smart governance in each city and their impact on cities' attractiveness for investment. Its main contribution is analyzing how specific aspects of smart governance affect all dimensions of the business environment to attract enterprise investment.

The concept of smart cities has gradually extended from initial information and communications technology (ICT)-based urban solutions to smart governance, sustainability, and adequate urbanization [2]. The most frequently cited definitions of smart cities in extant studies [3] are as follows.

Giffinger et al. [4] emphasize a combination of six core dimensions of smart cities and civic amenities. They propose that a smart city is "a city that performs well in terms of economy, people, governance, mobility, environment, and life, based on an intelligent combination of the endowments and activities of self-determined, independent, and conscious citizens." Caragliu et al. [5] and Bakıcı et al. [6] focus on the concepts of sustainable development and quality of life. Specifically, Caragliu et al. [5] argue that "when investments in human and social capital and traditional (transportation) and modern ICT communication infrastructure drive sustainable economic growth and high quality of life, and through participatory governance wise management of natural resources, such a city is wise," while Bakıcı et al. [6] believe that a smart city is a high-tech intensive advanced city that uses new technologies to connect people, information, and urban elements to create a sustainable, greener city, competitive and innovative business, and improved quality of life.

Harrison et al. [7] and Nam and Pardo [8] emphasize information exchanges, with Harrison et al. [7] arguing that smart cities connect physical, IT, social, and business infrastructure to harness the collective intelligence of a city and Nam and Pardo [8] suggesting that smart cities infuse information into their physical infrastructure to improve convenience, promote mobility, increase efficiency, save energy, improve air and water quality, identify problems and solve them quickly from disasters, collect data to make better decisions, deploy resources effectively, and share data to enable collaboration across entities and domains.

Further, Hajek et al. [3] summarize the commonalities of the smart city concept. Namely, smart cities are based on the abilities of ICT to (1) make resource management more effective (governance), (2) influence human and social capital (people), (3) facilitate transportation (mobility), (4) provide a higher standard of living (livelihood), (5) promote greater prosperity (economy), and, ultimately, (6) enhance sustainability (environment).

The initial goal of smart cities is to achieve urban sustainability with the help of modern technologies [9–11]. However, in practice, smart cities are biased toward technology-centric holistic solutions that fall short of the initial goal of solving urban problems such as environmental pollution, urban congestion, and the inclusive development of vulnerable groups. Almost all smart city initiatives lack the potential to create a sustainable urban future [12]. For example, the daily practice of data-driven governance in Los Angeles revolves around preventing undesired future outcomes (e.g., waste, crime, disaster) rather than creating a better, more sustainable, and connected urban future [13]. The Toronto Waterfront Project in Canada failed to ask fundamental questions at its outset, forcing a retroactive improvisation that allowed the project to lead and propose data governance policies primarily based on the economic interests of companies [14]. Smart cities, such as Shenzhen in China, are technology-centric and have ignored social and environmental issues [15].

The reasons for these developments are as follows. First, the concepts of smart and sustainable cities have been inconsistent. For instance, Bibri and Krogstie [16] suggested that: (1) smart cities focus on modern information and communication technologies and efficient solutions without considering the design aspects of sustainability, (2) smart cities are mainly dedicated to achieving smart goals rather than development goals, and (3) the link between the smart city concept and environmental sustainability is weak. Further, the standardized smart city concept masks the complexity and heterogeneity of cities and proposes solutions that do not fit the existing urban context [17].

Second, there is a significant difference in the emphasis between the smart city assessment framework and the sustainable city

<sup>1</sup> Environmental sustainability is measured using the smart environment index in urban IQ at <http://icity.ikcest.org/content/cityiqi>.

<sup>2</sup> China Index Academy's Investment attractiveness ranking of Chinese cities, [http://zwpg.e-government.gov.cn/art/2021/5/26/art\\_1331\\_6343.html](http://zwpg.e-government.gov.cn/art/2021/5/26/art_1331_6343.html).

assessment framework, as follows:

- (1) Smart city systems emphasize the human and virtual environments over the physical environment, thus lacking environmental indicators [11]. For example, the most popular indicator for smart city identification is “smart digital technology,” while the “ecological sustainability” indicator is less used and only around half of the indicators are related to the needs of residents [18].
- (2) The smart city assessment framework places more emphasis on ICT and “intelligence,” focuses more on social and economic aspects, and is better able to address economic issues than environmental ones. The assessment framework is thus mainly concerned with performance measurement frameworks based on multi-criteria decision-making [3,15,19,20], the challenge of data connectivity [21], the overall performance assessment of smart cities [3,8,22], and the characteristics of the indicator set [23].
- (3) The urban sustainability assessment framework focuses on the dimensions of environmental sustainability. For example, in urban green rating systems, urban heritage indicators mainly refer to physical conservation and less to intangible values; further, indicators mostly belong to the “environmental” dimension and rarely consider the “social” and “economic” dimensions [24].

China clarified at the UN General Assembly in 2022 that it aims to peak CO<sub>2</sub> emissions by 2030 and work towards carbon neutrality by 2060.<sup>3</sup> Reducing energy use is an important goal of smart city governance in China. However, the energy-related indicators in the smart city framework seem rather limited compared with urban sustainability ones. Therefore, sustainability in terms of the environment and energy should be included in the conceptual framework of smart cities.

Smart cities have gone beyond the soft/hard facilities dimension to become a hybrid cyber-physical-social space, namely a mix of the digital, governance, and sociocultural domains [25]. Smart governance is one of the most difficult dimensions to achieve in a smart city; other dimensions include the smart economy, smart transportation, smart living, smart environment, and smart people [26].

The conceptual origin of smart governance is general and effective governance. First, the purpose of governance is to provide public goods and services. According to Lynn et al. [27], general governance refers to legal systems, administrative rules, judicial decisions, and practices related to limiting, prescribing, and enabling the government to produce and provide public goods and services. The Commission on Global Governance [28] suggests that governance is an ongoing process of reconciling conflicting and divergent interests and taking joint action. Second, effective governance, also known as good governance, was originally defined as sound development management [29]. The concept of good governance is considered a key element in achieving sustainable development goals at the national level [30] and has been renamed smart governance in cities [31].

The conceptual development of smart governance has gradually moved from its initial focus on technology to human cooperation. Initially, the definition of smart governance focused on administrative efficiency and instrumental benefits of technology [32]. For example, Backus [33] defines smart governance as ICT-based governance as referring to “the collection of technologies, people, policies, practices, resources, social norms, and information that interact to support urban governance activities.” The concept of smart governance was later broadened and defined as a horizontal decision-making process for developing “better” cities [34]. Smart governance includes effective intra-governmental coordination and adapted policymaking, as well as new internal and external cooperation. The success of smart governance depends on the effectiveness, quality, and rational guidance of state interventions for society as a whole [32].

Smart governance activities focus on the interactions between government and citizens (G2C governance; e.g., providing personalized notifications and services to citizens or informing the government of citizens’ concerns), between government and business (G2B governance; e.g., identifying business partners or providing administrative and legal advice), and between governments (G2G governance, e.g., improving interoperability between government systems or managing government staff-related aspects) [35, 36].

Smart governance is also closely related to enterprise investment. Smart cities offer opportunities for new business models and entrepreneurship. For example, the innovation-oriented internal management of Spanish municipalities, strong collaboration with citizens, and outstanding cooperation with suppliers have improved the efficiency and effectiveness of public values and offered better responses to social challenges [37]. However, governments often lack the capabilities and innovative skills necessary to work with companies and other stakeholders in the ecosystem. They require consulting services to identify and manage specific planning objectives. The demand for technology, networks, telecommunications, and other hardware infrastructure also provides business opportunities [38]. Technologies for future smart cities include the Internet of Things, cloud computing, big data, mobile Internet, autonomous vehicles, and smart grid services [39].

Moreover, enterprise incubation is correlated with smart city development [40]. The development of industry clusters enables innovative companies to enter the market and thrive, thereby taking on business opportunities. Smart cities are entrepreneurs’ cities in a way, where entrepreneurs share knowledge and technology within clusters. Defective perceptions that initiate innovation learning curves (innovation sources) and structures that allow learning curves to propagate through the system (change associations) exist at the individual, organizational, and macro levels of smart cities [41]. Empirical studies show that smart city construction improves urban innovation output [42] and urban innovation performance [43], while also promoting the quantity and quality of urban green innovation [44].

<sup>3</sup> Please see the website of the Central People’s Government at [http://www.gov.cn/zhuanti/20211h2fgzbg/index.htm?zbs\\_baidu\\_bk](http://www.gov.cn/zhuanti/20211h2fgzbg/index.htm?zbs_baidu_bk) for details.

Finally, smart cities reduce investment risk and promote business investment. For example, smart city non-emergency service systems in the United States improve the credit rating of cities, reduce the cost of borrowing and managing government programs, are more transparent to investors, and reduce investment risks [45]. The physical evolution of European cities into smart cities has contributed to an increase in foreign direct investment [46], while smart city construction in China has improved economic and total eco-efficiency [47].

Despite the rich literature on smart cities, there are still some limitations, as follows. First, the above-cited studies focus on the management side to explore the relationship between smart cities and enterprise investment, while disregarding empirical and economic aspects. Further, these studies ignore the effects of smart governance on the business environment and enterprise investment. Second, the existing results are based on the application of a multivariate linear regression model to macro-level and time-series data to estimate the relationship between smart cities and their business environments. As such, there are few studies based on enterprise data that show how smart governance affects the business environment and enterprise investment.

Therefore, our objective is to clarify the relationship between smart governance, the business environment, and urban investment. To this end, the following three research questions were posed: (1) Does smart governance directly enhance business investment? (2) Does smart governance promote an environment favorable to administration, law, and financing? (3) Does the business environment positively mediate smart governance and investments?

This study makes several contributions. First, we establish a conceptual framework that includes smart governance, the business environment, and urban investment. Second, our findings are unique as they indicate that smart governance increases commercial investment through solid governance ability, abundant business opportunities, and an improved business environment. Third, instead of secondhand macro-level data and ordinary least squares regression, we use firsthand enterprise-level data, ridge regression, and an intermediary effect model to analyze how smart governance affects the business environment and enterprise investment.

The remainder of this paper is organized as follows. Section 2 presents the conceptual framework and develops the research hypotheses. Sections 3 and 4 introduce the methodology and the empirical tests, respectively. The results and discussion are presented in Section 5. Finally, Section 6 concludes the paper.

## 2. Conceptual framework and hypotheses development

Smart governance focuses on the vision and actions required to build a smart city. As such, the government uses digital technology and innovative capabilities in organizational processes (including external participation, internal collaboration, decision-making processes, and e-government) to achieve desirable outcomes (including changes in government organization, relative government status, and urban improvement) [31].

The implementation of smart governance leads to outcomes that can be divided into three main stages. First-stage outcomes are represented by changes in government organizations, leading to a more efficient and transparent government. In the second stage, the outcomes are changes in government status to offer citizen-centered services and communicate with enterprises, leading to a more stimulating legal and financing environment. The outcomes of the third stage are improvements in the entire city (e.g., economic development, social development, and ecological optimization) for providing a more attractive market setting. These improvements encourage an inflow of talent and investment, as shown in Fig. 1. Fig. 1 also shows how smart governance paves the way for attracting urban investment. Together, all these improvements encourage an inflow of talent and investments.

### 2.1. Positive effects of smart governance on commercial opportunities and governance ability

Smart governance provides opportunities to a large number of business and improves a city’s governance capacity, as well as the investment environment for companies.

#### 2.1.1. Smart governance provides commercial opportunities

All smart governance models offer companies substantial business opportunities. Hybrid governance is primarily used in the initial stages of smart city construction. It is characterized by enhancing the transparency of government work and solving the hardware and

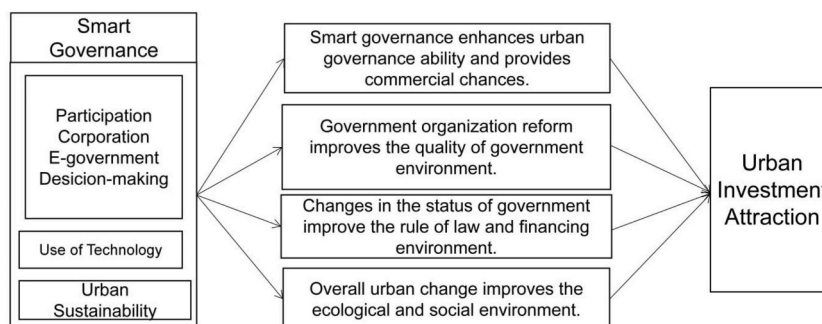


Fig. 1. Path from smart governance to investment.

software problems of smart city construction. Collaborative governance is primarily used in the middle stage of smart city construction. It is characterized by citizens' active participation and system construction, which guarantees and regulates the smooth operation of the city and is related to the decision-making and management of urban public affairs. Network governance is mostly used for smart-city construction in the long term. It is characterized by citizens' joint problem solving and innovation, being mainly applied in the social and environmental fields [48–50]. Most current smart cities in China are in the early stages of construction, and a few cities are in the transition stage from the early to the middle stage. The construction of digital governments, the introduction of smart software and hardware, and the building of digital platforms for urban public affairs in the early and middle stages of smart city construction provide a large number of business opportunities for companies.

### 2.1.2. Smart governance enhances a city's governance ability

Smart cities use big data to solve issues before they become problematic. This process works through knowledge discovery, restructuring, inter-organizational cooperation, and post-evaluation [51]. For example, people conduct collaborative online work through social media platforms such as Sina Weibo, WeChat, and Tencent Cloud. People with access to such media can call for help and rescue during natural disasters or extreme weather events.

Access to big data in a city paves the way for evaluating and managing the dynamics of urban life and increasing investment opportunities for enterprises. For example, delivery platforms such as Meituan and Eleme rely on data from consumer purchases and ordering behavior, while urban residents use traffic apps to plan their work routes and avoid congestion. In this process, they provide business opportunities for AutoNavi Map, Baidu Map, Tencent Map, and other similar enterprises.

ICT and the application of cutting-edge technologies improve the governance capacity of a city and enhance its investment attractiveness. For instance, the Internet of Things provides physical and logical resources for server interconnection and acts as the real brain of intelligent cities. Cloud computing, as another example, provides storage and processing power to cities. As a result, managers and operators have access to all information required for decision-making. Big data analysis techniques help different city management participants make decisions based on recently available information [52].

Therefore, H1 is proposed:

**H1.** Smart governance enhances business investment.

## 2.2. Positive effects of smart governance on the business environment

Changes in government organizations lead to a more efficient and transparent government, while changes in government status that offer citizen-centered services and communicate with enterprises lead to a more stimulating legal and financing environment.

### 2.2.1. Government organization transformation improves the administrative environment

Smart governance improves government systems and makes urban areas more attractive for investment. It also prompts organizational changes within the government, improves the governing system, and boosts enterprise investment. Important drivers of digital transformation in Chinese local governments are technology readiness, organizational efficiency, and public service delivery [53].

Technology maturity is the first driving force of digital government transformation. On the one hand, traditional governments often suffer from poor interdepartmental information, high administrative costs, and low office efficiency, which reduce citizens' trust and are not conducive to maintaining government legitimacy. On the other hand, digital technology use meets the government's need to improve organizational efficiency. Digital technologies provide infrastructure and skills for government departments to implement digital transformation, providing organizations with digital spaces that affect public sector applications, processes, cultures, and structures, as well as the responsibilities and tasks of civil servants. Digital technologies break down the barriers between departments, save costs, enhance communication and coordination within and between organizations, expand citizen engagement, and increase government accountability, all of which contribute to greater operational efficiency and departmental performance.

Public service delivery drives the digital transformation of the government. Specifically, digital transformation facilitates the government's provision of accessible public services. Further, the government shares information and data in many areas with the public through its websites, which allows the public to find the information they need anytime and anywhere. This reflects the openness and transparency of the government by providing quality and accurate services to the public and creating more public value. In addition, digital transformation outside the public sector has led to higher demand from the public, who in turn expect the government to use ICT to provide smarter services.

In summary, social and technological factors drive the organizational transformation of the government, improve the governmental environment, enhance organizational efficiency and public service quality, and facilitate business investment.

### 2.2.2. Changing government status improves the legal environment

Changes in the government–enterprise relationship via smart governance improve the legal and financing environment and make investments in urban areas more attractive. The changing status of the government vis-à-vis citizens and enterprises under smart governance also facilitates the formation of a fair and just legal environment as follows.

First, under the smart governance model, society is jointly responsible for providing public goods and sharing social responsibilities, rather than just relying on the government or the market. As a result, smart cities make trust and the rule of law two main conditions for urban prosperity [54]. Sound central legislation can provide a safe and stable environment for smart cities and

high-quality local regulations can facilitate the development of the digital economy [55].

Second, the government and market complement each other. Government organizations pursue laws, institutions, and ethics more than other organizations or actors and leave technological innovation to enterprises and research institutions. For example, the officials and project managers of the Smart Cambridge project in the UK are keenly aware of laws and regulations and are always mindful of regulatory compliance in decision-making [56].

Third, citizens are the largest object of the government and, at the same time, its main supporters. The government must provide high-quality public policies and services that maximize citizens' interests and satisfaction without harming them. There is also a significant positive correlation between stakeholder management measures such as regulation, cooperation, legalization, and control and the level of citizen participation [57].

Finally, Chinese entrepreneurs rely heavily on trust relationships established through personal networks. The use of digital channels by the government to reach out to enterprises decreases entrepreneurs' dependence on personal networks in favor of government–enterprise relationships. Additionally, the government's use of digital channels improves property rights protection and the quality of the judicial system. Government information disclosure effectively reduces the institutional costs of enterprises through digital channels. However, many factors affect negatively the government's monopoly on information, including the sharing of public administrative information; community-related interests; and information on financial, judicial, and law enforcement operations. Terminating this monopoly increases the public's scrutiny of the government, as well as public trust.

### 2.2.3. Digital governance tools to improve the financial environment

The digital credit system is conducive to relaxing enterprises' financing constraints and improving their financial environment. As an important digital governance tool, China's digital social credit system contributes to the development of a high credit equilibrium by improving information sharing and implementation by making the fulfillment of commitments a rational choice for all types of social agents [58]. The system includes normative tools to encourage "good" citizenship and social ethics and regulatory tools to restrain "deviant" behaviors and implement social management [59]. As an infrastructure for social quantification, the social credit system plays an important role in social management, constructing differences, and guiding people toward desirable behaviors, as defined by the state [60].

This extensive credit data system, simultaneously supervised by multiple parties, partly resolves the market failures caused by information asymmetry or a lack of hard information in small, medium, and micro enterprises, giving them easier access to private lending. Further, this system helps entrepreneurs surpass the capital requirements required for survival. Smart governance can also prevent managers and shareholders becoming involved in opportunistic practices that increase corporate earnings and improve the overall financial status of the city.

Therefore, H2 is proposed:

**H2.** Smart governance improves the environment of administration, law, and financing.

## 2.3. Overall change in a city improve the ecological and social environment

Improvements in an entire city (e.g., economic development, social development, and ecological optimization) provide a more attractive market setting because they encourage an inflow of talent and investment.

Smart governance promotes sustainable urban development. The causal chain of smart governance and sustainable development is as follows. First, the infrastructure of smart governance influences smart communities and governance structures. Second, smart communities and governance structures act on sustainable development. The specific steps are as follows: (1) technical facilities (infrastructure) facilitate open governance and smart communities; (2) smart communities (people, technology, collaboration) are conducive to open governance; (3) open governance is conducive to urban livability and economic competitiveness; (4) smart communities (people + technology + collaboration) are conducive to an innovation economy; and (5) innovation economy is good for urban efficiency, urban livability, and economic competitiveness [60]. Technological infrastructure is the main driver for the development of EGDI and SDGs, while the development and impact of online services on SDGs is effective [61]. Smart governance at the national level affects social equality more profoundly, while smart governance at the city level is closely related to environmental issues [32].

The economic, natural, and social sustainability of smart cities attract business investment. Smart cities should meet the economic, social, and environmental needs of current and future generations [62]. From an environmental perspective, improving air quality and creating a habitable environment can attract talent. Additionally, many environmental factors provide opportunities for businesses. Examples of these factors include efficient and environmentally friendly transportation, travel services, and improved energy efficiency with a low carbon footprint [52]. A city that endeavors to achieve sustainability is also inherently more eye-pleasing. Social development is another perspective that increases a city's attractiveness. Examples include health and safety, civic participation, and fairness.

Smart governance can agglomerate entrepreneurs and facilitate knowledge diffusion and competition. These opportunities make cities more attractive for business investment. Smart cities require a continuous inflow of investment and capital to sustain their growth, owing to their capital-intensive operations.

Governments promote cluster development through tax incentives, making cities more attractive to entrepreneurs [63]. Entrepreneurs can obtain valuable information, resources, and technology through digital media and face-to-face contact with stakeholders. This information helps entrepreneurs share labor, connect with upstream and downstream markets, and harness knowledge spillovers

from elsewhere. Through these practices, entrepreneurs multiply their innovative opportunities and efficiency in resource allocation. Entrepreneurial agglomeration can form the following virtuous cycle: attracting an inflow of human capital and new entrepreneurs pave the way for bringing greater business vitality, which in turn attracts even more entrepreneurs [64]. We thus hypothesize:

**H3.** The business environment mediates smart governance and investment.

### 3. Materials and methods

We constructed an evaluation system, distributed relevant questionnaires, and estimated the impact of smart governance on business investment through the mediating effect of the business environment by using ridge regression and mediating effect models. All participants provided verbal consent for the use of their data for academic research and publication. All participants were anonymous, and their data were protected. The programs in our research study were approved by the Institutional Review Board of Zhejiang International Studies University. First, we accurately measured the level of digital governance, quality of the business environment, and status of enterprise investment by constructing a scientific evaluation index system (Table 1).

Second, we obtained first-hand data close to practice through questionnaire surveys of enterprises. Namely, questionnaires containing relevant organizational transformation of smart governance (social participation, internal coordination, decision making, smart government), technology use and sustainability, and the business environment were designed and distributed both in online and offline formats. Respondents were asked to indicate their views on doing business and digital governance on a seven-point Likert-type scale. Likert scales are widely applicable and can measure complex multidimensional concepts or attitudes that cannot be measured by other scales with higher reliability than a Likert scale of the same length. However, the disadvantage of the Likert scale is that it cannot describe the difference in attitude structure and can only roughly distinguish the level of attitude between individuals [65].

Finally, we enhanced the explanatory power and credibility of the regression results using a proper model design. In the first step, entropy weight analysis was used to derive the composite score of the digital governance level. In the second step, the impact of the composite score of digital governance on business investment was estimated using ridge regression, with the business environment as a control variable. In the third step, a mediating effect model was used to investigate the effects of different digital governance elements on business investment through the mediating variable, business environment.

#### 3.1. Questionnaire design

The content of the questions is shown in Tables 2 and 3. The investment variable comes from respondents' evaluation of the investment status of the enterprise over the past three years (Table 1). Smart governance perception comes from respondents' evaluations of smart governance (Tables 1 and 2). The perception of the business environment comes from respondents' views of the government, legal, and financial environment (Tables 1 and 3). Respondents' satisfaction was measured using a seven-point Likert scale, where 1 indicated complete disagreement, 5 neutrality, and 7 full agreement with the provided response.

#### 3.2. Sampling procedure

The data used in this study were obtained from a field survey conducted in 2020 and an online survey conducted in January 2021 using the Questionnaire Star website. Respondents used their smartphones to answer questions by scanning QR codes or by using the Questionnaire Star website. Informed consent was obtained from all participants.

##### 3.2.1. Survey background

Owing to the impact of the COVID-19 pandemic, our research could only be conducted online. As such, the sample of respondents was selective. However, when sampling online, we ensured that the sample was as random as possible.

The sample was thus randomly sourced and authentic. With more than 6.2 million registered members, on average, more than 10 million people fill out questionnaires on Questionnaire Star every day. The Questionnaire Star website can reach 300 million users per month and provides accurate questionnaire delivery based on user interest tags and participant classification. Because middle and senior managers have a more thorough understanding of their enterprises' operations, the respondents were restricted to enterprises' middle and senior management. The questionnaire was administered to "middle and senior managers in Beijing, Shanghai, Guangzhou, and Hangzhou."

**Table 1**

Main indicators.

Variable	Indicator	Data source
Business environment	Political environment (import and export, taxation, ease of business exit, taxation, etc.)	Enterprise questionnaire
	Rule of law environment (quality of justice, investor protection, IPR protection, credit system, etc.)	
	Financing environment (types of financial products, credit guarantees, etc.)	
Smart governance	Organizational processes (internal collaboration, external participation, e-government, decision-making processes), technology use, sustainability	
Corporate investment	Enterprise investment status in the past three years	

**Table 2**  
Sources of the variables for smart governance.

Measuring variables	Specific questions	Based on literature data
1. Organizational Process of Smart Governance (A)	A 1:1 The enterprise is fully involved in the construction of a smart city A 2:2 Process restructuring and inter-sectoral collaboration within the government are very successful A 3:3 Enterprises can fully participate in various decisions of urban construction A 4:4 The digital government services in your city are perfect	Kourtit and Nijkamp [66] Willke [67] Giffinger et al. [4] Odendaal [68] Tapscott and Agnew [69]
2. Technology using of Smart Governance (B)	B1:5 Your city has made full use of big data, the Internet of Things, artificial intelligence, and other digital technologies to carry out the smart governance of the city	Giffinger et al. [4] Tapscott and Agnew [69] Kummitha [63]
3. Sustainability of the Smart City strategy (C)	C1:6 Your city is very focused on the sustainability of the natural environment (natural environment, construction environment, water and waste management, transportation, energy, etc.) C2:7 Your city is very focused on the sustainability of economic development (economic development, culture, education, science and innovation, ICT infrastructure, information technology, etc.)	Ahvenniemi et al. [12] Mohanty et al. [62] Richter et al. [52]

**Table 3**  
Sources of business environment variables.

Measuring variables	Specific questions	Based on the literature
4. Government administration Environment (E)	E 1:8 Taxes are convenient E 2:9 The Forex verification program is very convenient E 3:10 The import and export procedures in the city are very convenient E 4:11 The corporate bankruptcy procedures in the city are very convenient E 5:12 IPR registration and transfer in the city where the business is are very convenient E 6:13 The program for registering enterprises is very convenient E7:14 Registered business costs are too expensive E8:15 Took too long to register business E9:16 The enterprise income tax rate is not too much of a burden for the business E10:17 Corporate VAT levels have no negative impact on the business E11:18 The corporate social security rate has no negative impact on doing business E12:19 The import and export costs and time they take in the city where the enterprise is located have no adverse impact on the business E13:20 The cost of enterprise bankruptcy (including legal opening costs and other expenses incurred) does not negatively affect business E14:21 IPR registration in the city is very cheap E15:22 The export rebate policy in the city where company is located are helpful for doing business E16:23 Document compliance costs of import and export have no adverse impact on doing business	The World Bank [70] The State Council [71] Guangdong-Hong Kong-Macao Greater Bay Area Research Institute [1] Business Environment Evaluation Center of Guomai Research Institute [72] Sanbao et al. [73]
5. Legal Environment (F)	F 1:24 The IPR protection in the city are perfect F 2:25 The quality of judicial procedures in the city is conducive to business operation F 3:26 The degree of protection for investors in the city where the enterprise is located is conducive to business operations F 4:27 The quality of land management is conducive to the enterprise operation F5:28 The city's social credit system (credit investigation environment) is conducive to the economy. F6:29 The government costs of executing the contract (total expenses, taxes, tariffs, and other notarization and registration fees required by law) do not negatively affect the business F7:30 The legal costs of resolving contractual disputes (including opening costs, execution costs, and average attorney fees) do not negatively affect the business F8:31: The export rebate policy in the city where company is located is conducive to business operation	
6. Financing Environment (G)	G 1:32 Financial products offered by banks are very helpful to business operations G 2:33 The line of credit provided by banks in the city where the business is located is conducive to doing business G 3:34 The interest rates for business loans are not too burdensome to the business G 4:35 The credit guarantee institution is conducive to business operations	



Our sample is based the registered members of Questionnaire Star website, whose composition is diverse. Regarding the gender distribution, 48% are female and 52% male. Further, 26.3% are college students, 39.2% general employees, 10.2% managers, 9.7% scientific and technological researchers, 4.2% official officers, 1.8% freelancers, and 8.6% had other jobs. In terms of regional distribution, Guangzhou, Beijing, Shanghai, Zhejiang, the other areas of China account for 14.81%, 10.73%, 7.73%, 6.85%, and 59.88%, respectively. We chose Beijing, Shanghai, Guangzhou, and Hangzhou as the research area, these four cities being in the first echelon of China’s smart cities; the geographical distribution of Questionnaire Star members was also a major reason for our selection.

### 3.2.2. Sampling process

The sampling process consisted of several steps.

First, our first version of the questionnaire, which only contained questions related to the business environment, was distributed on a trial basis in the Hangzhou and Shanghai industrial parks in 2020. A total of 297 valid questionnaires were obtained. Based on respondents’ feedback, we streamlined the number of questions on the business environment, added questions on smart governance, deleted open-ended questions, and retained only selective questions.

Second, in 2021, we conducted a second round of the questionnaire. Due to the pandemic, we could only use online research based on the Questionnaire Star’s website. According to the geographical distribution characteristics of Questionnaire Star registered members (14.81% in Guangzhou, 10.73% in Beijing, 7.73% in Shanghai, and 6.85% in Zhejiang) and according to the development level of Chinese smart cities, we chose Beijing, Shanghai, Guangzhou, and Hangzhou as the research areas.

Third, after automatic and manual screening using the questionnaire star website system, we obtained 500 valid and 409 invalid observations. The invalid ones included responses from grassroots managers, questionnaires with blank responses, questionnaires that did not pass the logical validation of the questionnaire, and multiple submissions from the same IP address. Through the above steps, we ensured the randomness and reliability of the questionnaire.

The questionnaire results showed that 25% of the surveyed companies were located in Beijing, Shanghai, Guangzhou, and Hangzhou. Overall, 37.4% were enterprises operating for less than 10 years, 31.8% enterprises with 11–15 years of experience, and 30.8% enterprises with more than 15 years of experience. The proportion of ownership was 21% for state-owned enterprises, 12.6% for foreign-funded enterprises, and 66.4% for private enterprises. The proportion of employees was 47% for fewer than 200, 28.2% for 200–500, and 25% for more than 500 employees. Senior managers accounted for 42% and middle managers for 58%. According to the “Statistical Classification of Large, Medium, Small, and Micro Enterprises,” issued by the National Bureau of Statistics of China, for example, a medium-sized enterprise in the software service industry has 100–300 employees and a small one 10–100 employees.

### 3.3. Reliability and validity of the questionnaire

Regarding the overall reliability, the reliability alpha index was 0.919 for smart governance. The alpha index was 0.746 for questions regarding the government environment, 0.814 for the legal environment, and 0.845 for the economic environment. Generally, the reliability alpha index should be larger than 0.7 [74]. Therefore, these results indicate a high level of reliability, implying that the research data are sufficiently reliable for this analysis and research.

Regarding structural validity, the Kaiser-Meyer-Olkin (KMO) of smart governance scale was 0.941. The closer the KMO statistic is to 1, the better the effect of validity analysis is. Generally, the effect is better when the KMO statistic is above 0.7 [75]. The Bartlett spherical test extracts three factors from the variables that have a strong correspondence with the organization of smart governance, technology application, and smart governance strategy. Therefore, the scale used for smart governance has satisfactory structural validity.

The KMO of the scale for the business environment was 0.952 and extracted using the Bartlett spherical test for five factors. These five factors correspond closely with the topic of business environment and are: operating costs, legal environment, economic environment, IPR protection, and government environment. Therefore, the scale of the business environment has satisfactory structural validity.

## 4. Empirical tests

### 4.1. Dependent variable of the ridge regression

The dependent variable is investment (variable 1 in Table 4). The data come from respondents’ evaluation of the investment status

**Table 4**  
Summary of weight results calculated by the entropy method.

Item	Mean	Standard deviation	Information entropy value	Information utility value	Weight coefficient, w%
Decision process	5.136	1.399	0.9934	0.0066	21.75
Internal collaboration	5.262	1.295	0.9946	0.0054	17.78
External participation	5.356	1.279	0.995	0.005	16.34
E-government	5.602	1.194	0.9959	0.0041	13.46
Technology application	5.794	1.122	0.9966	0.0034	11.05
Environmental sustainability	5.818	1.084	0.997	0.003	10.04
Economic sustainability	5.83	1.06	0.9971	0.0029	9.59

of the enterprise over the past three years.

#### 4.2. Independent variable of the ridge regression

The independent variables are the total score of smart governance obtained from entropy weight analysis and the seven elements of smart governance (variables 2–8 in Table 4).

We performed entropy weight analysis on the seven elements of smart government to obtain a total score for the level of smart governance. Entropy is a unit of measurement. A higher entropy means more chaotic data with less information content and smaller utility values and weights [76]. Entropy weight analysis relies only on discrete items of the data, which reduces the degree of information loss and makes weights more objective.

Table 4 shows that the decision process has the highest weight (0.22) in evaluating smart governance, followed by internal collaboration, and external participation (0.17). These estimations are followed by e-government and technology (0.12), environmental sustainability, and economic sustainability (0.10). Multiplying the corresponding items and their weights yields the total scores for smart governance.

#### 4.3. Control variables for the ridge regression

First, the correlation between the variables may indicate confounding factors. Where R is the correlation coefficient between two variables. The correlation of the coefficients is high if  $|R| \geq 0.8$ , moderate if  $0.5 \leq |R| < 0.8$ , and low if  $0.3 \leq |R| < 0.5$ . Coefficients are uncorrelated if  $|R| < 0.3$ .

Second, stepwise regression analysis with the automated removal of insignificant values of x is commonly used in exploratory studies. As such, multiple stepwise regression was required to avoid missing variables. The variables used for the study were determined using correlation and exploratory analyses.

Third, we found that the correlation coefficients between corporate investment and some indicators of government environment (E1–E16 in Table 3), legal environment (F4, F6, F7, and F8 in Table 3), and financial environment (G2 and G3 in Table 3) are below 0.3 and the above indicators are not significant in the stepwise regression. Therefore, the control variables do not include the above indicators. The control variables related to the business environment are variables 9–18 in Table 4. In addition, Table 5 presents the descriptive statistics.

#### 4.4. Ridge regression model

We then applied ridge regression to study the overall impact of smart governance on the attractiveness of urban areas to investments. Ridge regression is a modified least-squares method used to determine the most negligible effect at the expense of abandoning the unbiasedness of the least-squares data [77] and can better tolerate collinear ill-conditioned data than ordinary linear least squares regressions [78]. The ridge regression estimates the coefficients by introducing a K-unit array, which causes data loss. However, it offers a reasonable estimation of the regression model.

The first stage combines ridge plots to find the best K values. The value of K is the minimum value for which the normalized regression coefficients of each independent variable tend to be stable. A smaller K decreases the deviation. A value of zero for K makes it an ordinary least squares regression. In the second stage, regression modeling is performed after determining the value of K. A value of K below 1 is usually recommended [76]. The normalized regression coefficient on the independent variable tends to stabilize at 0.99 for K. Therefore, the value for K is assigned as 0.99 to conduct ridge regression (Table 6). Equation (1) represents the ridge regression model:

**Table 5**  
Descriptive statistics of the variables.

		Min.	Max.	Mean	Std. dev.
Dependent variable	1 Investment	2.00	7.00	5.3680	1.21306
Independent variables	2 Internal collaboration	1.00	7.00	5.2620	1.29488
	3 External participation	1.00	7.00	5.3560	1.27927
	4 Decision-making process	1.00	7.00	5.1360	1.39908
	5 E-government	1.00	7.00	5.6020	1.19434
	6 Digital technologies	1.00	7.00	5.7940	1.12164
	7 Economic sustainability	1.00	7.00	5.8300	1.05988
	8 Environmental sustainability	1.00	7.00	5.8180	1.08408
Control variables	9 Judicial quality	1.00	7.00	5.4340	1.18679
	10 Investor protection	1.00	7.00	5.4440	1.15825
	11 Intellectual property protection	1.00	7.00	5.1820	1.39167
	12 Intellectual property transfer	1.00	7.00	4.9900	1.30434
	13 Credit investigation system	1.00	7.00	5.6080	1.08475
	14 Financial goods	2.00	7.00	5.3760	1.20230
	15 Credit guarantee	1.00	7.00	5.1640	1.30864

$$\text{investment} = \eta \times \text{smartgov} + \varphi \times \text{Control} + v \tag{1}$$

where investment represents the company’s investment, smartgov is the total score of smart governance based on entropy weight analysis, and Control is a set of control variables. The total sample size is 500 and the sample size for each city is 125.

#### 4.5. Mediation effect model

Ridge regression can only determine factors with significant influence. As such, the model of mediation effects will explain the impact of smart governance on investment.

An intermediary effect model extends the influence relationship. The intermediary variable, M (business environment), is effective in determining whether the independent variable, X (smart governance), affects the dependent variable, Y (investment). Equation (2) shows the mediation effect model:

$$\begin{aligned}
 Y &= C * X + \epsilon_1 \\
 M &= a * X + \epsilon_2 \\
 Y &= C' * X + b * M + \epsilon_3
 \end{aligned}
 \tag{2}$$

where C represents the regression coefficient of the seven smart governance elements (external participation, internal coordination, decision-making process, e-government, technology application, economic sustainability, and environmental sustainability), a denotes the regression coefficient of smart governance on business environment elements, b signifies the regression coefficient of the business environment on investment, a \* b is the intermediary effect, and C' represents the direct influence of X on Y (with mediator variable M in the model). ε is the stochastic term.

### 5. Results and discussion

This section presents the results of ridge regression and mediation effect model, and then discusses whether these results support the hypotheses and why.

#### 5.1. The direct influence of smart governance on investments in the ridge regression

Table 6 presents the ridge regression results. In general, smart governance has a positive and significant impact on investment. Similarly, smart governance in Shanghai, Guangzhou, and Hangzhou was found to have a significant impact on investments. This finding supports H1. Further, Beijing’s governance impact is insignificant, suggesting a possible complete intermediary effect of its business environment on smart governance. The results of the mediation effect model about Beijing in Appendix show that a complete intermediary effect exists.

Smart governance promotes urban governance. The degree of a smart city is significantly associated with the resilience of that city, which is influenced by all dimensions of smart cities [78]. Over the past few years, smart cities have shown higher COVID-19 readiness and lower COVID-19 mortality [79], thus providing evidence that smart governance has improved urban governance capacity.

**Table 6**  
Ridge regression results.

		Overall	Beijing	Shanghai	Guangzhou	Hangzhou
Smart governance	Comprehensive score	0.109** (5.916)	0.007 (0.178)	0.092** (2.805)	0.15** (3.99)	0.138** (3.824)
Legal environment	Judicial quality	0.044* (2.375)	0.075* (2.014)	0.09* (2.487)	0.108** (2.881)	Y
	Intellectual property transfer	0.044* (2.301)	0.121** (2.988)	Y	Y	Y
	Intellectual property protection	0.036* (1.982)	0.123** (3.135)	Y	Y	Y
Financial environment	Investor protection	Y	Y	Y	Y	Y
	Credit investigation system	0.063** (3.346)	Y	Y	0.103** (2.781)	Y
	Financial products	Y	Y	0.082* (2.25)	Y	Y
Government environment	Credit guarantee	Y	Y	Y	Y	0.084* (2.336)
	Export tax rebate	0.04* (2.094)	0.092* (2.344)	Y	Y	Y
	Income tax level	Y	0.079* (2.049)	Y	Y	Y
	Value-added tax level	Y	Y	Y	0.075* (2.042)	Y
	R <sup>2</sup>	0.218	0.245	0.308	0.291	0.313
	Adjusted R <sup>2</sup>	0.195	0.148	0.219	0.200	0.226
	F	F (14,485) = 9.651, p = 0.000	F (14,110) = 2.544, p = 0.003	F (14,110) = 3.489, p = 0.000	F (14,110) = 3.219, p = 0.000	F (14,110) = 3.587, p = 0.000

Note: \*p < 0.05, \*\*p < 0.01; the standardized coefficient in the model, t statistics between parentheses, and Y is controlled but not significant.

For example, Beijing’s 12345 hotline service system enhanced the city’s governance capacity and made it more conducive to business investment. This hotline service is an effective new initiative for political participation to alleviate urban public problems such as non-emergency services being provided as public services, such as market regulation, social work, and ecological and environmental protection, and has had a dampening effect on urban public problems [80]. Similar to the 3-1-1 in the United States and Canada, 1-2-0 in South Korea, and 1-1-5 in Germany, the 12345-hotline service is an easily accessible intelligent system for citizens to contact the government and report infrastructure and urban service problems. Relying on artificial intelligence technology, the system collects millions of data points corresponding to problems and their resolution processes. These data provide a comprehensive picture of urban problems and the potential to improve urban governance.

Smart governance can supply many commercial opportunities. The operation and maintenance of smart city services are now becoming more important than building urban infrastructure [81]. The way companies maintain smart city services is becoming diversified, and companies are actively establishing cooperative systems to maintain smart city technologies. For example, basic support systems for smart city development in Shanghai are information infrastructure, information technology and industrial development, and cyber security systems [82]. ICT-driven development emphasizes technological innovation and integrated applications implemented mainly by companies.

The Shanghai government has initiated the creation of a citizen cloud on its service platform, which adopts the B2G2C model to connect third-party developers to the public through the government. The platform is managed by the Shanghai Municipal Economic and Information Commission, and operations and maintenance work are outsourced to a company in which other third-party developers participate.

However, public participation in the smart governance in Beijing and Shanghai is still insufficient and there is room for improvement. It is necessary for Shanghai to build a government-led participation mechanism with other stakeholders, such as academic institutions, enterprises, and citizens [82]. Beijing’s 12345 system also lags behind by 3–5 days in suppressing urban public problems and has no positive effect on urban problems in engineering and construction management and market regulation. As Mello Rose et al. [83] argue, “citizenship and politics” are less important than the “service users and entrepreneurs” concept of smart cities. However, the actual participation of “citizen-centered” social civil society organizations has not been realized in terms of both strategic direction and practical implementation.

## 5.2. The mediation effect model

### 5.2.1. The influence of natural sustainability on investment

Table 7 shows that investment is positively influenced by external participation, decision process, digital technology application,

**Table 7**  
The mediation effect model.

	Model 1	Model 2	Model 3a	Model 3b	Model 3c	Model 3d
	Investment	Investment	Credit investigation system	Export tax rebate	IPR protection	IPR transfer
External participation	0.142** (2.708)	0.133* (2.536)	-0.034 (-0.733)	0.157** (3.057)	0.124* (2.224)	0.079 (1.386)
Internal collaboration	0.021 (0.414)	-0.017 (-0.330)	0.138** (3.03)	-0.018 (-0.353)	0.195** (3.597)	0.120* (2.138)
Decision process	0.095* (2.125)	0.064 (1.422)	0.087* (2.191)	0.055 (1.267)	0.201** (4.25)	0.111* (2.283)
E-government	-0.053 (-0.942)	-0.067 (-1.219)	0.013 (0.264)	0.029 (0.526)	0.008 (0.133)	0.134* (2.203)
Technology application	0.133* (2.358)	0.114* (-2.03)	0.142** (2.846)	0.150** (2.721)	-0.042 (-0.696)	-0.05 (-0.812)
Environment sustainability	0.194** (-3.44)	0.151** (2.664)	0.122* (2.448)	0.194** (3.512)	0.244** (4.085)	0.131* (2.138)
Economic sustainability	0.114 (1.953)	0.077 (1.338)	0.134** (2.586)	0.105 (1.842)	0.138* (2.232)	0.103 (1.613)
Credit investigation system		0.153** (2.843)				
Export tax rebate		0.018 (0.378)				
IPR protection		0.035 (0.763)				
IPR transfer		0.089* (2.01)				
Sample size	500	500	500	500	500	500
R <sup>2</sup>	0.213	0.246	0.226	0.232	0.33	0.191
Adjusted R <sup>2</sup>	0.202	0.229	0.215	0.221	0.32	0.179
F value	F (7,492) = 19.065, p = 0.000	F (11,488) = 14.480, p = 0.000	F (7,492) = 20.548, p = 0.000	F (7,492) = 21.262, p = 0.000	F (7,492) = 34.567, p = 0.000	F (7,492) = 16.562, p = 0.000

Note: \*p < 0.05 \*\*p < 0.01; t-values are shown between in parentheses. Each city’s results of mediation effect model are in the appendix, and the results support H1, H2, and H3.

and environmental sustainability in model 1, and Fig. 2 shows that external participation and natural sustainability directly improves investment. These findings also support H1.

Table 7 and Fig. 2 show that, among the seven smart governance factors, natural sustainability has the most influential and direct effect on business investment. The reason may be that smart cities promote sustainability to some extent, which in turn attracts talent and capital clusters. There is coordination between the two subsystems of urban intelligence and sustainability in China, and their degree of coordination is on the rise [84]. Smart city construction reduces carbon emission intensity [85], PM2.5 emissions [86], and haze pollution [87,88] and promotes the quantity and quality of green innovation in cities [44,89].

For example, Guangzhou’s smart city vision is to build a “beautiful and livable flower city and a dynamic global city.” Its judicial system maintains a sustainable ecological balance to bring in more enterprise investment. This achievement identifies Guangzhou as a city with historical and cultural attractions, strategically positioning itself as the center of socialism with Chinese characteristics. It is the culmination of the vision to convert the city to become not only a pleasant place to live and enjoy life, but also dynamic on a global scale while preserving its culture and history.

5.2.2. The influence of external participation on investment

From Table 7 and Fig. 2, external participation has a direct impact on business investment and is the second most influential factor. The reason may be that the greater is the space for the participation of non-government actors, the more governance power and business opportunities regarding the provision of public goods, services, and public value are available.

China’s smart city construction is in the primary stage. In the early stage of smart city construction, the government acts as a ruler, providing public goods and services, while there is little room for non-governmental actors to participate in the process. Second, in the early and middle stages of smart city construction, the government acts as the principal, setting the goals and vision and assuming full responsibility for the project. The government then contracts the project to a nongovernmental agency, while setting the rules and overseeing the process. NGOs are involved as implementers.

Taking Hangzhou as an example, the full participation of the private sector in the City Brain project has led to some governance power transfer to the private sector and many business opportunities [90]. Hangzhou’s public service platform has gradually moved from Alipay’s service to the government-led Zhejiang Municipal Office, which offers a public service platform. The two platforms adopt the G2B2C and B2G2C modes, respectively. Governments and enterprises have also played leading roles in the development of an intelligent city service system. Hangzhou’s municipal government adopts a collaborative governance mechanism of “government guidance + market leadership,” including hierarchical governance during the incubation period, network governance during the growth period, and market governance during the takeoff period to facilitate the growth of new enterprises [91]. This is meant to promote the growth of new enterprises, reduce the operating costs of enterprises, and make the city more attractive for investment [92].

The above findings are consistent with those of Snow et al. [93], Siokas et al. [94], and Lee et al. [95]. Snow et al. [93] argue that a smart city can be understood as a community in which citizens, business firms, knowledge institutions, and municipalities collaborate with each other to achieve system integration and efficiency, citizen engagement, and an ever-increasing quality of life. Siokas et al. [94] show that by building strategic partnerships, municipalities are better able to design and implement smart city strategies that meet the needs of their communities. Public and private organizations play key roles in supporting smart strategies.

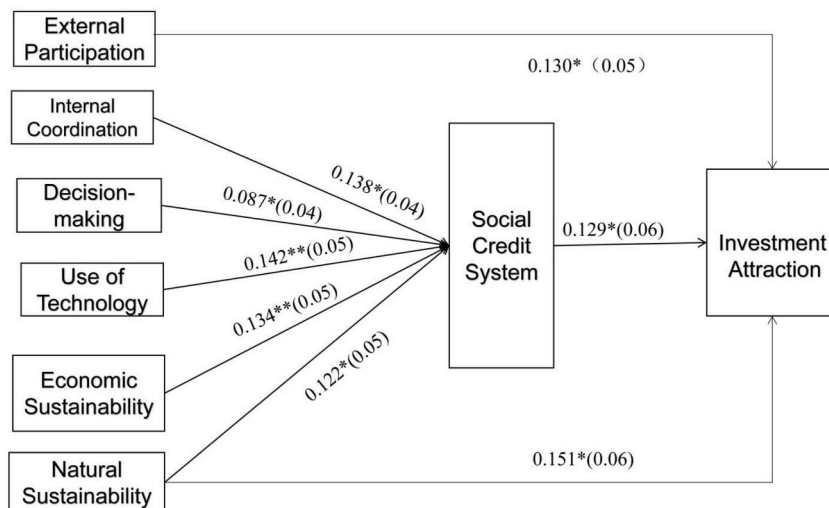


Fig. 2. Theoretical model results. Note: \*p < 0.05, \*\*p < 0.01, with a non-standardized coefficient in the model and standard errors between parentheses.

### 5.2.3. The mediating effect of the social credit system between smart governance and investment

Table 7 and Fig. 2 show that internal collaboration, decision-making processes, digital technology, and economic sustainability promote business investment through the fully mediating role of social credit systems. Natural sustainability promotes business investment through the partial mediating role of the social credit system. These results support H3.

The social credit system is an intersection of legal, financial, market, and regulatory environments. The original concept of credit in Europe and the United States was strongly moralizing and educational and was later reduced to a financial concept. The original narrow concept of credit in China, which focuses on financial aspects, has been expanded to a broader understanding of social behavior and moral ideals [96]. In practice, China's digital credit system focuses on financial and commercial activities rather than political activities [97].

The improvement of the social credit system represents an overall progress in the legal, financial, market, and regulatory environment. China wants to improve its social credit system as soon as possible to avoid the middle-income trap and catch up with high-income countries. However, the process of building a credit system through the bottom-up approach of a modern market economy takes very long. That is why China has adopted a state-led top-down credit system building process [96].

The credit system in China differs significantly from those in Europe and the United States. The U.S. and German governments focus on providing an environment in which trust among business actors can develop from the bottom up, while the Chinese government intervenes in a top-down manner to build trust in the business sector through its centralized information infrastructure and extended legal enforcement function of the credit system [96]. Specifically, the state's influence in the Chinese credit system is significantly stronger than in the United States and Germany; the Chinese government extends the legal enforcement function of the credit system to ex-post enforcement rather than only ex-ante approval, the information infrastructure in the Chinese credit system exhibits a higher degree of centralization, and private platforms in China show significantly higher levels of disclosure than their counterparts in the United States and Germany [96].

Digital credit systems narrow the treatment gap between firms and reduce transaction costs. Both state- and non-state-owned enterprises are required to comply more strictly with business regulations and better manage the relationships and company information with supply chain partners to build economic trust [96]. China's previously rather opaque business environment required a large amount of company information to reduce transaction costs. By contrast, centralized public databases and new technologies can help improve transparency at a relatively low cost. More progress has been made in promoting credit systems among firms than among civil servants or the general public [98].

Digital credit systems have hitherto worked well. The ethical dimension of financial credit scoring in China has spread to non-financial areas, and the institutionalization of such ethical standards is seen as an effective solution to various social problems that have long plagued China's economic development and social justice since the reform era [87,88]. Social credit systems change resident behavior and public social credit systems have a greater impact on resident behavior than commercial social credit systems [99]. Further, social credit systems work together with relational networks to promote a new stratified order driven by social consistency norms that reduce social mobility by designating some individuals as high risk, thus affecting their occupational achievement [100].

## 6. Conclusions

Based on a survey of enterprises, this study used ridge regression and intermediary effect models to analyze how smart governance perception influences the business environment and investment. The results are as follows. First, the perception of smart governance enhances investment because of the strong governance ability and abundant business opportunities. Second, natural sustainability attracts investment directly because smart cities improve sustainability and attract talent and capital inflows. Third, external participation has a direct impact on enterprise investment because greater participation space in smart governance means higher governance rights and business opportunities. Finally, the social credit system positively mediates most elements of smart governance and investment. The reason is that, being the intersection of the legal, financial, market, and regulatory environments, an improved social credit system represents the comprehensive progress of the business environment.

The above findings have insightful policy implications for other smart cities. For instance, the municipal authority should improve city governance ability and accelerate the governance transition to network governance. Moreover, smart city assessment should include environmental and economic sustainability. Further, great efforts should be made toward encouraging citizen participation and eliminating the technological and institutional barriers of citizen participation. Finally, there is a need to accelerate constructing the social credit system with new technologies.

However, our study is limited to a simple conceptual framework of smart governance and investment and focuses on four typical smart cities in China in 2021. Future research should further explore the deeper connection between different types of smart governance (corporate, market, multilevel, network governance) and the development of smart cities, as well as expand the survey period and scope to produce more reliable, generalizable, and relevant findings.

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## Author contribution statement

Jinghua Yin: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools, and data; Wrote the paper. Haiying Song: Conceived and designed the experiments; Analyzed and interpreted the data; Critically revised its important intellectual content.

## Data availability statement

Data will be made available on request.

## 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 A. Supplementary data

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