

Informatization, Public Service Supply, and China's Inbound Tourism Development

Boyang Xu¹ and Daxin Dong^{2*}

¹ School of Economics, Fudan University
Shanghai, 200433 China
[e-mail: xuby21@m.fudan.edu.cn]

² Institute of Western China Economic Research, Southwestern University of Finance and Economics
Chengdu, 611130 China
[e-mail: dongdaxin@swufe.edu.cn]

*Corresponding author: Daxin Dong

*Received March 22, 2022; revised September 10, 2023; accepted November 20, 2023;
published December 31, 2023*

Abstract

This study empirically investigates the impact of informatization on China's inbound tourism development. The analysis utilizes data on the number of inbound tourist arrivals in 30 Chinese provinces from 13 tourist origin countries between 2004 and 2016. The regional informatization level is measured by the internet penetration rate. It is found that informatization in tourist destination provinces has a significant positive impact on inbound tourism. Moreover, the local public service supply plays a moderating role. The positive effect of informatization is stronger in regions with better public services. The study results imply that China can boost its inbound tourism by further improving the level of informatization as well as local public services.

Keywords: China, Inbound tourism, Informatization, Internet penetration rate, Public service supply

1. Introduction

1.1 Research Background

The rapid development of information and communication technology (ICT) has driven the extensive application of mobile phones and broadbands, ushering China into the internet era. Fig. 1 demonstrates the rapid increase in the number of internet users and internet penetration rate in China during 2004—2020. The number of Chinese internet users soared from 94 million in 2004 to 989 million in 2020, an increase of approximately 10.5-fold. During the same period, the internet penetration rate (i.e., the proportion of internet users in the total population) rose from 7.3% to 70.4%, suggesting a significant improvement in network coverage. With the deepening of urbanization and implementation of the “Broadband China” strategy, China’s informatization level will still maintain a sound growth momentum. Informatization is the process through which new ICTs are used as a means for promoting socioeconomic development [1]. The rapid advances and large-scale applications of information technology have markedly reduced information barriers and costs of information acquisition, thus creating access for more people to the benefits brought about by the development of ICT.

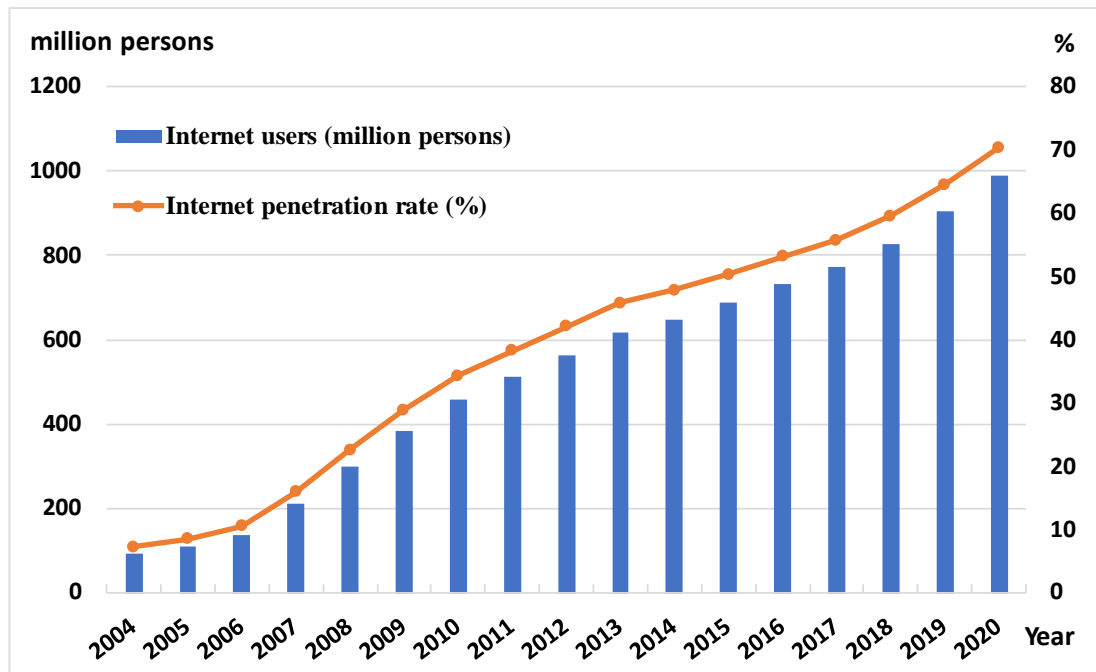


Fig. 1. Number of internet users and internet penetration rate in China (2004—2020). Data source: China Statistical Yearbook.

Additionally, the acceleration of informatization has profoundly changed the way people communicate with each other and acquire information. Therefore, people can eliminate the limitations of geographical distance to learn information conveniently and accurately from different parts of the world. In this way, information quality can be improved, and information barriers can be alleviated to create more possibilities for innovation. During the process of informatization, individual behaviors and business models have also experienced obvious changes [2-4].

Some large high-tech firms have grasped the growing business opportunities and benefited much from the new development of ICTs. These firms established different online platforms, which increasingly shape the ways of data processing (e.g., cloud computing, cloud storage), entertainment (e.g., ByteDance, YouTube), financial transactions (e.g., Alipay, PayPal), goods purchases (e.g., Amazon, eBay, Taobao), information dissemination (e.g., Baidu, Google), and socializing (e.g., Facebook, WeChat). In recent years, one of the most significant hallmarks of informatization was the widespread use of mobile internet and smartphones [5]. A growing number of economic and social activities take place within mobile internet networks.

The tourism sector has been heavily altered by the global informatization process because this industry is largely time-dependent and communication-based [6]. With the help of emerging technologies such as artificial intelligence, cloud computing, the internet of things, and virtual reality, the concept of smart tourism is advocated [7-8]. Utilizing ICTs can reduce costs, increase efficiency, and improve service quality in tourism. There are many animated examples on both the demand and supply sides of tourism. For instance, before deciding whether to visit a place of interest, individuals can investigate the region on the internet and obtain information about tourist attractions and travel routes. Then, after travel plans are made, tourists can book hotel rooms and buy tickets online. ICT systems offer tourists great flexibility, allowing booking or canceling until the last minute. Hotels rely on their ICT systems to manage the routine of booking, check-in, customer recording, room reservations, food and beverage orders, inventory turnover, accounting, and financial reporting quickly and accurately. Based on big data and artificial intelligence, tourism enterprises can examine users' profiles to provide them with customized services. On the internet, private and public tourism organizations frequently use webpages and online multimedia to promote firms and regions by displaying photos and videos. Interactive social media such as instant messaging apps, online forums, microblogs, and multimedia sharing websites are quite popular. Through interactive social media, tourists can share their opinions, feelings, complaints, and suggestions; tourism organizations have the chance to respond and improve their performance in a timely manner.

During travel, tourists usually visit one or more tourist destinations in person and stay there for a period of time. Tourists use local public services to a greater or lesser extent. Thus, tourists' travel experience and satisfaction are inevitably affected by local public services. Public service refers to the activities and services carried out in any governmental capacity for the benefit of the general public [9]. Driven by the promotion of economic construction, China has also made remarkable achievements in the provision of public services. For instance, in recent years, China has built numerous transportation infrastructures. From 2015 to 2019, the total length of highways increased from 4.5773 million kilometers to 5.0125 million kilometers, registering an increase of approximately 9.5%. Meanwhile, China's railway operating mileage increased from 121,000 kilometers to 139,800 kilometers, registering an increase of more than 15%. Although China's environmental pollution problem still exists, the government and society have made great efforts to reduce pollution and improve the ecological environment. From 2015 to 2019, the average annual concentration of fine particulate matter (PM_{2.5}) in China dropped by 21.7%. During the "14th Five-Year Plan" period (i.e., 2021—2025), China intends to vigorously propel the public service level to a new high. The plan covers not only the construction of a modern public service system and the satisfaction of new public service needs in the process of development, but also the equalization of basic public services and the narrowing of the excessive regional gap to realize high-quality social development.

At the same time, China's tourism market has experienced dramatic changes over the past decades, which is marked by a sharp increase in tourist arrivals and tourism earnings. According to the report of the Ministry of Culture and Tourism of the People's Republic of China, domestically, the number of tourists in China rose dramatically from 1,102 million person-times in 2004 to 6,006 million person-times in 2019. The domestic tourism earnings also soared up from 471 billion CNY (approximately 57 billion USD) in 2004 to 5,725 billion CNY (approximately 830 billion USD) in 2019. Inbound tourism in China has also experienced overall growth in recent years. Inbound tourism is defined as the act of traveling to a country by nonresidents for the purpose of tourism [10]. As shown in Fig. 2, during 2004—2019, the number of annual inbound tourist arrivals grew from 109 million person-times to 145 million person-times, with an average year-over-year growth rate of 2%. During the same period, the scale of inbound tourism receipts also increased rapidly, from 26 billion USD in 2004 to 131 billion USD in 2019, with an average annual growth rate of 11%.

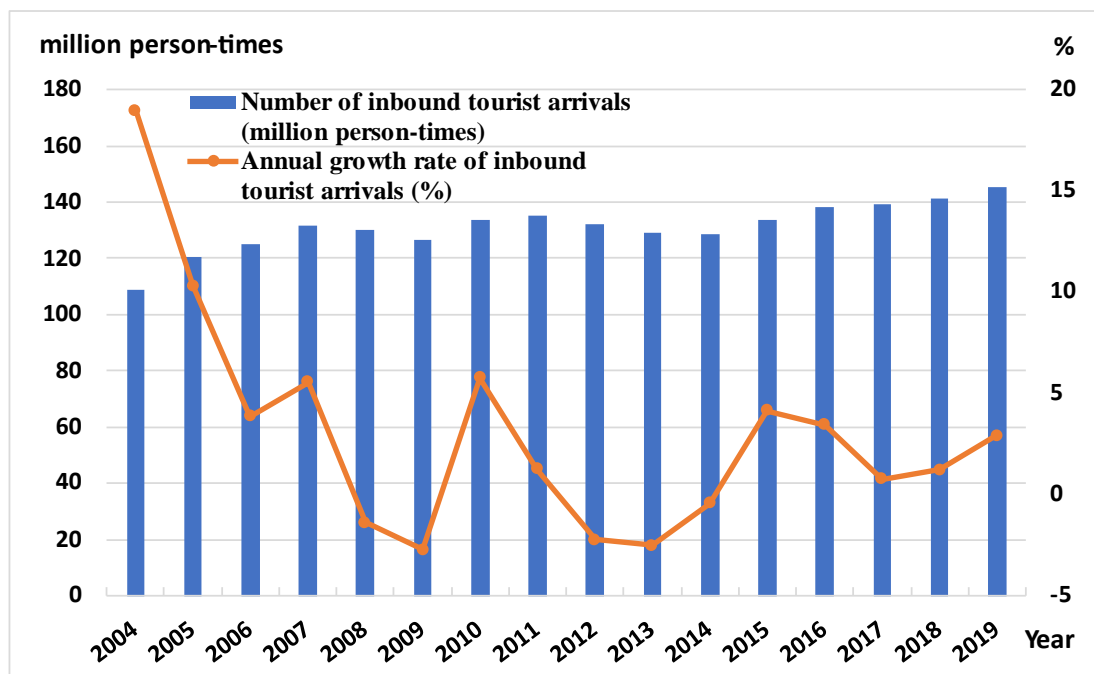


Fig. 2. Number and annual growth rate of inbound tourist arrivals in China (2004—2019). Data source: Yearbook of China Tourism Statistics.

1.2 Research Contributions

Having observed the great development of China's tourism in recent years, it is interesting to understand its determinants. This study empirically analyzes the impact of China's informatization on its inbound tourism industry. Based on the econometric regression method, this study investigates whether and to what extent the improvement of informatization benefits the expansion of inbound tourism in China. Furthermore, this study considers the supply of public services in different districts as a moderator influencing the effect of informatization.

This study makes several contributions to the literature. (1) First, the existing literature usually used country-level data and did not distinguish the different regions within one country. Different from the existing literature, this study uses Chinese province-level data to estimate the impact of informatization, by considering the different economic conditions and resource

endowments in diverse districts. Thus, the study results can be more accurate, which provides novel evidence on the research issue. (2) Second, most of the previous studies examined only the impact of informatization in tourist destinations and omitted the impact of informatization in tourist origin countries. The regression model used in this paper contains the variables measuring the level of informatization in both tourist destination and origin regions. Thus, this study can estimate the influence of informatization more comprehensively and mitigate the potential omitted variable bias in empirical analysis. (3) Third, this paper also evaluates the role of local public services in the relation between informatization and tourism development. Adding the interactive term of public services and informatization level into the empirical model, we explore the moderating effect of public services on the influence of informatization. We provide novel insight into the potential moderator variables in the informatization-tourism nexus.

The rest of this study is organized as follows. Section 2 reviews the literature. The empirical model and data are described in Section 3. Section 4 reports and explains the empirical results. Finally, Section 5 presents further discussions, concludes the study, and mentions the directions of future research.

2. Literature Review

2.1 Impact of Informatization on Tourism Development

In the information era, “tourism informatization” is an important approach that makes good use of contemporary information technology for the comprehensive development and utilization of various tourism resources to accelerate the development of the tourism industry.

With the help of informatization, the time taken by tourists to search a large amount of information has been significantly reduced. By acquiring information more easily and quickly, uncertainties in tourism can be reduced, and the smoothness of the tour can be ensured. Tourists can gain more timely and accurate information about destinations, scenic spots, hotels, traffic, and so on [11]. On that basis, tourists can plan and formulate their journeys more reasonably and economically. Further research [12] suggests that with more information, tourists will be more likely to have more interaction with the destination and determine travel plans more suitable for themselves, which can significantly improve their own utility. At the same time, many service providers are giving potential tourists information, such as the location and prices, through low-cost means, especially the internet [13]. Informatization has also endowed tourists with more assessment rights. On forums or social networks, tourists can introduce and assess scenic areas so that highly rated scenic spots can be made known to more persons. This means that the effect of word of mouth has been pronouncedly enhanced in the information world [14].

To date, the theoretical correlation between informatization and tourism development has been relatively clear, but not many articles have been devoted to examining the empirical correlation between the two. The existing empirical studies have primarily utilized country-level panel data to estimate the average effect of informatization for a group of countries.

Based on the same sample of 40 African countries, Adeola and Evans [15] and Adeola and Evans [16] examined the correlation between informatization level and tourism development. Adeola and Evans [15] showed that internet usage and mobile penetration have nonlinear effects on tourism development. Before reaching a certain informatization level, informatization does not stimulate tourism development. However, after that certain level, informatization significantly boosts international tourist arrivals. Adeola and Evans [16]

incorporated infrastructure conditions into further discussion using a dynamic panel gravity model. The authors provided novel evidence that ICT and infrastructure construction have opened great opportunities for boosting tourism in Africa. Focusing on nine major tourist destination countries, Kumar and Kumar [17] investigated the impact of informatization on international tourist arrivals. Mobile and broadband subscriptions were used as the main explanatory variables. The results showed that the improvement of mobile and broadband subscriptions by each 1% will increase international tourist arrivals by 0.04% and 0.11%, respectively. Several other studies also supported the viewpoint that informatization benefits inbound tourism development based on samples of different country groups, such as Anser et al. [18] for East Asian, Pacific and South Asian countries, Bayrakçı and Özcan [19] for Mediterranean countries, and Milićević et al. [20] for the republics of former Yugoslavia among others [21-25].

It is notable that two previous studies concentrated on China. Shehzad et al. [26] examined the role of ICT and Silk Road infrastructure in tourism development in China. The country-level aggregate data were analyzed. An index of computer, communications and other services, as a percentage of commercial services exports, was used for the proxy variable of ICT. The study suggested that the adoption of ICT promotes tourism development. Zhu et al. [27] used a survey sample of 11,000 rural Chinese residents and reported that ICT adoption increases the probability of tourism participation of rural residents but decreases tourist expenditure.

Although the abovementioned studies have discussed the influence of informatization on tourism, this research topic deserves more analysis. (1) Previous studies have rarely focused on inbound tourism in China. As one of the largest tourism markets in the world, China is still taking actions to improve its degree of international openness and intending to attract more foreign tourists. Under this background, it is important to analyze the factors that may effectively boost China's inbound tourism. Shehzad et al. [26] and Zhu et al. [27] investigated the informatization-tourism nexus in China. However, these two studies were not sufficient to answer our research question. Shehzad et al. [26] chose an index of computers, communications and other services as a share of commercial services exports to reflect ICT. While this variable is linked to changes in the production and export structure of the macroeconomy, it may not describe the informatization level of a country clearly and accurately. In addition, their study used country-level aggregate data for China as a whole and thus did not consider the heterogeneities across different provinces. Zhu et al. [27] analyzed the tourist decisions of rural Chinese residents. Hence, their study did not provide information about the inbound tourism market in China. (2) Previous studies evaluated the impact of informatization in tourist destinations but failed to provide a measure of informatization in tourist origin countries. The improvement of informatization of the country where tourists visit would enhance its publicity, thus making the tourist destination known to more tourists. The informatization of the country where tourists are from can also influence the size of the information-receiving group. The improvement of informatization means that more persons have opportunities to receive more information from potential tourist destinations. In this way, information transmission can form a closed loop, enabling scholars to analyze informatization more comprehensively. Previous studies ignored the impact caused by informatization in tourist origin countries. Consequently, an omitted variable problem might be triggered, thus impairing the reliability of the estimated coefficient. Therefore, an empirical model containing the informatization level in both tourist destination and source regions may provide useful findings. In short, we deem it necessary to study the impact of informatization on China's inbound tourism empirically from other perspectives in an attempt to contribute new evidence to this issue.

2.2 Correlation between Public Service Supply and Tourism Development

Public services mainly refer to the actions of government departments, state-owned enterprises, public organizations, and relevant intermediary institutions to perform their statutory responsibilities, and to help citizens, legal representatives or other organizations handle relevant affairs. Public services help citizens satisfy their needs to survive, live and develop in the world. By different contents and forms, public services can be divided into basic public services, economic public services, security public services, and social public services [28]. Basic public services are basic services provided through the input of public resources and intervention of national power, which can serve the fundamental production, living and development needs of citizens. These services mainly incorporate traffic infrastructures, communication infrastructures, post and telecommunication services, etc. Economic public services can offer various services required by enterprises and individuals to engage in economic development activities, including policy consulting, policy loan, etc. Security public services are security services provided for citizens, such as the police and fire control. Social public services are services to satisfy citizens' needs for social development, such as education, medical care, and environmental protection.

Research [29-30] has suggested that regional public services, such as infrastructure construction and traffic convenience, play a critical role in the development of tourism. Regarding different aspects of public services, previous scholars have conducted a series of investigations.

First, the level of basic public services directly affects residents' quality of life and tourists' travel experience, which is an important index to measure the local tourist destination's attraction. In the field of infrastructure, Ahmed and Anwar [31] for Pakistan, Jovanovi and Ili [32] for Southeast Europe, Lubov et al. [33] for Russia, and Seetanah et al. [34] for Mauritius obtained similar conclusions that infrastructure construction (e.g., transportation, communication, and energy infrastructure) positively boosts the tourism industry.

Second, in terms of economic public services, there was little literature that explored the relationship between tourism development and economic public services. For sightseeing visitors, economic services in the destination country have no direct effect on their tourism decision-making behavior. For business travelers, the improvement of economic public services ameliorates the business environment and possibly exerts a positive effect on their willingness to visit. Thus, the degree of influence probably depends on the proportion of business travelers.

Third, security public services are also very important. Terrorism has been revived over the last two decades, thus posing a serious threat to security public services. Relevant violent cases continue to pop up [35]. Security is a basic need of mankind and plays an important role in tourists' destination selection. Therefore, when the national security of the tourist destination is not guaranteed, tourism demand will largely decline. Terrorism can reduce tourism demand in many countries, such as those discussed by Ahmed and Anwar [31] and Raza and Jawaid [36] for Pakistan, Bonham et al. [37] and Goodrich [38] for the US, Enders and Sandler [39] for the UK, and Neumayer and Plümper [40] from a global perspective. All the above studies suggest that the public security service level plays an important role in the development of tourism.

Fourth, tourism can benefit from the improvement of the social public service level. Because of the weak link between tourism and other segments, such as education and medical care, environmental protection has gained much attention in recent years and has been chosen to illustrate the correlation between tourism and the social public service level. Dong et al. [41] found that the concentration of particulate matter with a diameter of 10 micrometers or less

(PM10) significantly decreases the number of international visitor arrivals in China. Furthermore, Deng et al. [42] reported that the negative influence has a spillover effect, which means that the deterioration of air quality not only reduces inbound tourism in local areas but also exerts a negative impact on adjacent areas. Therefore, aiming at improving environmental quality, the enhancement of social public services should encourage the development of tourism.

By discussing the correlation between public services and tourism, we can infer that the public service level can, to some extent, influence the scale of local tourism demand. Although tourists cannot truly experience the local public services before visiting the tourist destination in person, the influence can be realized through the transmission of information. In the internet era, information transmission has been greatly facilitated. Information about the changes in the local public service level can be delivered to potential tourists through the internet, thus reflecting the moderating role of the public service level in the link between informatization and tourism.

3. Empirical Model and Data

3.1 Model

This study builds a linear regression model to evaluate the impact of informatization on tourism. The model is expressed by Equation (1):

$$\begin{aligned} \ln(\text{Tourist}_{ijt}) = & \alpha \ln(\text{Tourist}_{ij(t-1)}) + \beta_1 \text{Internet}^{ori}_{it} + \beta_2 \text{Internet}^{dest}_{jt} \\ & + X_{ijt}'\theta + u_{ij} + v_t + \varepsilon_{ijt} \end{aligned} \quad (1)$$

In the equation, the symbol \ln denotes the natural logarithm. The subscripts i , j , and t of variable names provide the indexes of the tourist origin countries, tourist destination provinces, and years, respectively. $\ln(\text{Tourist}_{ijt})$ is the dependent variable in the regression analysis, which is the logarithmic value of the number of inbound tourist arrivals in China's tourist destination province j from tourist origin country i in year t . $\ln(\text{Tourist}_{ij(t-1)})$ is the lagged one-period term of the explained variable $\ln(\text{Tourist}_{ijt})$. $\text{Internet}^{ori}_{it}$ and $\text{Internet}^{dest}_{jt}$ are the internet penetration rates in country i and province j , respectively, as proxies of informatization level. X_{ijt} is a vector containing a set of variables measuring the characteristics of country i and province j . u_{ij} is the section-fixed effect for each country-province pair. v_t is the time-fixed effect. ε_{ijt} is the error term. The explained variable and its lagged term are log-transformed to address the scaling problem. α , β_1 , β_2 , and θ are coefficients that will be estimated using regression methods. The influences of independent variables on the dependent variable are reflected by the values and statistical significance levels of these coefficients. We are particularly interested in β_1 and β_2 . They respectively measure the impacts of foreign and domestic informatization on inbound tourism in China.

It is notable that in Equation (1), the lagged one-period term $\ln(\text{Tourist}_{ij(t-1)})$ is included as an explanatory variable. We use such a dynamic panel data model to capture the inertia of tourist groups. Because the lagged term of the explained variable is contained on the right-hand side of the regression equation, the explanatory variable may be correlated with the error term. Thus, the ordinary least squares (OLS) method cannot provide consistent estimation of the coefficients because of the endogeneity issue. In this paper, we adopt the system general method of moments (system-GMM), derived by Arellano and Bover [43] and Blundell and Bond [44], to estimate the dynamic panel data model. Furthermore, we add the section- and time-fixed effect terms u_{ij} and v_t into the model to control the discrepancy of

different regions and years.

3.2 Selection of Variables

$\ln(Tourist_{ijt})$ denotes the logarithmic value of the number of inbound tourists after adding 1 to it. The number of tourists can be used to describe the development status of inbound tourism. Tourism demand research usually adopts the number of tourists, tourism income, spending of tourists, and length of time spent by tourists as proxy variables of tourism demand. Since the number of tourists can efficiently provide information on the appeal, traffic convenience, and tourism infrastructure of a tourist spot, the number of tourists is most frequently used to describe the scale of tourism demand [45].

$Internet^{ori}_{it}$ denotes the internet penetration rate of country i where tourists are from. The internet penetration rate is the proportion (%) of internet users in the total population. $Internet^{ori}_{it}$ is used to describe the informatization level of the tourist source country. The development of the tourist origin country's informatization can open residents' eyes to the world, thus helping tourists learn more tourist information, gain more options and acquire more information about potential tourist destinations. With the deepening of informatization, information asymmetry has been alleviated. Tourists can finish planning and booking online by themselves. The convenience of tourism has been significantly improved. Tourists can thus better make personalized choices in accordance with their own needs and better control the time and tempo of their travels.

$Internet^{dest}_{jt}$ denotes the internet penetration rate of province j where the tourist destination is located. It is used to depict the level of informatization of the tourist destination province. Under the background that local informatization is improving, local voices and news will be spread externally through the internet. In this way, information such as local tourism resources, infrastructure, and public services can be delivered to potential tourists more authentically and punctually. Benefiting from informatization, potential tourists can learn more about tourist destinations through the internet. Therefore, tourists' uncertainties about tourist spots can be mitigated, and the appeal of tourist destinations can be significantly strengthened.

The set of control variables X_{ijt} contains the following variables: $FiveA_{jt}$, $\ln(Investment_{jt})$, $Tertiary_{jt}$, $\ln(Carrier_{it})$, $\ln(GDPpc_{it})$, $TradeRatio_{ijt}$, and $\ln(Distance_{ij})$.

$FiveA_{jt}$ is the number of national AAAAA-rated tourist attractions in province j , used to represent the endowment of local tourism resources. The larger the number of 5A level tourist attractions is, the stronger the attraction of local tourism.

$\ln(Investment_{jt})$ is the logarithmic value of the total investment in fixed capital in province j , reflecting the amount of construction or renewal of fixed capital in monetary form. Infrastructure construction and renewal play a critical role in tourism development [29]. Benefiting from better infrastructure conditions, tourists can arrive at the destination faster and more conveniently, and the attraction of the destination to tourists is significantly improved.

$Tertiary_{jt}$ is the share of tertiary industry within the economy of province j . This variable is measured by the proportion of employees in the tertiary industry, directly reflecting the differences in employment structure across different regions and representing the different dependent forces of provincial economic development. For areas with a higher proportion of employees in the tertiary industry, the service industry may be more developed and is capable of providing better tourism services for tourists.

$\ln(\text{Carrier}_{it})$ is the logarithmic value of the number of registered carrier departures in origin country i , reflecting the convenience of air transport in the origin country. The higher the air transport volume is, the more developed the local aviation industry. Then, it would be more convenient for tourists to arrive at their destinations through airlines. For cross-border travel, international tourists often come from the origin country through long-distance flights. Therefore, aviation convenience plays a critical role in tourists' journeys.

$\ln(\text{GDPpc}_{it})$ denotes the average income status and economic level of tourists from origin country i , measured by the logarithmic value of GDP per capita. Alegre and Pou [46] investigated the positive impact of income condition on travel intention. With the increase in income level, citizens' willingness and frequency of travel have significantly improved.

TradeRatio_{ijt} refers to the trade dependence of the origin country on the destination province, measured by the ratio of import and export trade volume between country i and province j to the GDP of origin country i . Bilateral trade causes the two sides to have closer ties in the economic field. The higher the trade dependence is, the more potential business tourists there are.

$\ln(\text{Distance}_{ij})$ refers to the logarithmic value of the geographical distance between the capital of the origin country and the destination provincial capital. The specific distance is calculated by the authors based on longitude and latitude data. According to distance decay theory, there is a negative correlation between distance and tourism demand [47]. Thus, we expect that geographical distance negatively influences tourism demand.

In this study, we also examine the moderating effect of public service supply. Five variables, the waste water disposal ability ($\text{WaterDisposal}_{jt}$), quantity of buses (Bus_{jt}), crime rate (CrimeRate_{jt}), PM2.5 concentration density (PM2.5_{jt}), and environmental protection expenditure (Environment_{jt}), are selected to measure the different aspects of public services in destination j . We expect a positive moderating effect of public services. The details of these variables will be discussed later.

3.3 Data

This study employs a sample of 30 provinces in Mainland China except Tibet. Tibet is not analyzed because of the unavailability of data. International visitor arrival data at the province level are available for 13 tourist origin countries: Australia, Canada, France, Germany, Japan, South Korea, Malaysia, Philippines, Russia, Singapore, Thailand, the UK, and the US. The sample period covered 13 years, between 2004 and 2016.

The data on inbound tourist arrivals, five-A-rated tourist attractions, proportion of tertiary industry, total investment in fixed capital, trade dependence, waste water disposal ability, quantity of buses, and environmental protection expenditure are obtained from the database of EPS China Data, available at <https://www.epsnet.com.cn/>. The PM2.5 data in different provinces are derived from the Chinese Research Data Services Platform (CNRDS), accessed at <https://www.cnrds.com>. The crime rate in different provinces is obtained from the Procuratorial Yearbook of China. The data on the internet penetration rate, GDP per capita, and registered carrier departures in the tourist origin country are derived from the World Bank's World Development Indicators (WDI) database. The internet penetration rate in the destination province is collected from the China Statistical Yearbook. The distance between the capital of the origin country and the destination provincial capital is calculated by longitude and latitude data. **Table 1** reports the definition and summary statistics of the variables applied in the empirical analysis.

Table 1. Summary statistics

Variable	Definition	Obs	Mean	SD	Min	Max
$\text{Ln}(\text{Tourist}_{ijt})$	Logarithmic value of the number of inbound tourist arrivals (person-times)	5070	9.967	1.873	0	14.354
$\text{Internet}^{\text{ori}}_{it}$	Internet penetration rate (%) in tourist origin country	5070	63.236	23.588	4.858	94.776
$\text{Internet}^{\text{dest}}_{jt}$	Internet penetration rate (%) in tourist destination province	5070	30.509	19.769	2.2	77.8
FiveA_{jt}	Number of 5A-rated tourist attractions	5070	3.805	3.02	0	22
$\text{Ln}(\text{Investment}_{jt})$	Logarithmic value of the amount of total investment in fixed capitals (100-million CNY)	5070	8.502	1.012	5.572	10.421
Tertiary_{jt}	Proportion of tertiary industry (%) in economy	5070	41.123	8.511	28.6	80.232
$\text{Ln}(\text{Carrier}_{it})$	Logarithmic value of the number of registered carrier departures	5070	13.205	1.166	10.937	16.128
$\text{Ln}(\text{GDPpc}_{it})$	Logarithmic value of GDP per capita (in constant 2010 USD)	5070	10.025	1.006	7.473	10.928
TradeRatio_{ijt}	Ratio of bilateral trade volume to GDP	5070	0.004	0.01	0	0.106
$\text{Ln}(\text{Distance}_{ij})$	Logarithmic value of the geographical distance (km)	5070	8.502	0.703	6.329	9.504

4. Results

This section first reports and explains the results of the main regression. Then, a set of robustness tests is conducted. Following that, the role of the public service level in tourism development is examined.

4.1 Main Results

Considering the lagged term in the model's explanatory variables and the potential issue of endogeneity, this paper uses the system-GMM for estimation of the aforesaid regression Equation (1). The main regression results are presented in column (1) of **Table 2**. The coefficients are estimated using the two-step method. The AR (1) statistic rejects the null hypothesis, while the AR (2) statistic does not reject the null hypothesis, indicating that the issue of second-order series correlation does not exist in the model. The Hansen statistic does not reject the null hypothesis, indicating that the issue of overidentification of instrumental variables does not exist, and thus, the validity of instrumental variables is guaranteed.

The estimated coefficient of $\text{Ln}(\text{Tourist}_{ij(t-1)})$ is positive and statistically significant, showing a significant correlation between the number of inbound tourists in the last period and the number of tourists in the current period. The coefficient of $\text{Internet}^{\text{dest}}_{jt}$ is positive and statistically significant. This indicates that the improvement in the informatization level represented by internet penetration in the destination provinces has pronouncedly boosted the growth of inbound tourism. Nevertheless, a finding that deviates from the theoretical expectation is the statistically insignificant coefficient of $\text{Internet}^{\text{ori}}_{it}$. This implies that, on average, there is no significant influence of the improvement of internet penetration in the tourist origin country on the development of inbound tourism in China.

Table 2. Impact of informatization on China's inbound tourism and robustness check

Variable	Robustness Check			
	(1) System-GMM (two-step)	(2) System-GMM (one-step)	(3) Difference- GMM (two-step)	(4) System-GMM (two-step)
Ln(Tourist _{ijt-1})	0.5994*** (0.0446)	0.5976*** (0.0446)	0.4866*** (0.0422)	0.8623*** (0.0198)
Internet ^{ori} _{it}	-0.0027 (0.0020)	-0.0026 (0.0019)	0.0011 (0.0016)	
Internet ^{dest} _{jt}	0.0079*** (0.0030)	0.0080*** (0.0030)	0.0070** (0.0029)	
Mobile ^{ori} _{it}				0.0003 (0.0002)
Mobile ^{dest} _{jt}				0.0014*** (0.0005)
FiveA _{jt}	0.0182* (0.0093)	0.0185** (0.0093)	-0.0043 (0.0080)	-0.0029 (0.0040)
Ln(Investment _{jt})	0.4555*** (0.0779)	0.4581*** (0.0781)	-0.1401** (0.0652)	0.1632*** (0.0286)
Tertiary _{jt}	0.0126** (0.0052)	0.0129** (0.0052)	-0.0405*** (0.0050)	0.0068*** (0.0017)
Ln(Carrier _{it})	0.2286*** (0.0424)	0.2281*** (0.0423)	-0.0657 (0.0530)	0.0359** (0.0173)
Ln(GDPpC _{it})	0.3003*** (0.0632)	0.3037*** (0.0634)	0.7495** (0.2939)	0.1016*** (0.0217)
TradeRatio _{ijt}	5.1367* (2.6708)	5.0863* (2.6717)	5.4279 (4.0919)	0.3715 (1.0643)
Ln(Distance _{ij})	-0.5251*** (0.0833)	-0.5311*** (0.0836)	0.0000 (0.0000)	-0.1541*** (0.0307)
Section-fixed effect	yes	yes	yes	yes
Year-fixed effect	yes	yes	yes	yes
P value of AR(1) statistic	0	0	0	0
P value of AR(2) statistic	0.336	0.318	0.836	0.205
P value of Hansen test statistic	0.285	0.285	0.171	0.281
Number of observations	5070	5070	4680	5070

Note: The values in parentheses denote standard errors. *, **, *** represent the significance levels of 10%, 5%, and 1%, respectively.

In column (1), the local informatization level of tourist destination ($Internet^{dest}_{jt}$) has an estimated coefficient of 0.0079, which is significant at the significance level of 1%. This coefficient means that an improvement in the internet penetration rate of the tourist destination by one percentage point will lead to an increase of 0.79% in inbound tourist arrivals. During this study's sample period 2004—2016, the annual average number of inbound tourists in China reached 129 million. The regression coefficient suggests that an increase in the internet penetration rate of the destination province by one percentage point will bring about an increase of 1.02 (=129×0.79%) million inbound tourists in China, which can propel the rapid development of the inbound tourism market.

Contradictory to expectations, the estimated coefficient of the internet penetration rate of the tourist origin country ($Internet^{ori}_{it}$) is not statistically significant. This means that, on average, with the promotion of the tourist origin country's informatization, the demand of foreign tourists to travel to China has not significantly changed. This finding can be explained from the perspective of tourist preference. Although the informatization of the tourist origin country can help potential tourists obtain more tourism information and convenience, the information and convenience are not merely from China. Tourists can choose the tourist destination in light of their own preferences. Although the informatization of the origin country has encouraged more tourists to travel internationally, tourists' specific preferences might make them travel to places other than China. Therefore, the increasing internet penetration rate might not necessarily increase the inbound travel demand in China. It is worth noting that although the estimated average effect of $Internet^{ori}_{it}$ in **Table 2** is not statistically significant, informatization in tourist source countries is not completely irrelevant to inbound tourism in China. In Section 4.3, we will report the finding that informatization in tourist source countries exerts a positive effect if the destinations have a high level of public services.

The coefficient of the control variables generally coincides with expectations. The coefficient of the number of 5A-rated tourist attractions ($FiveA_{jt}$) is positive, which suggests a positive correlation between the number of 5A tourist attractions and the number of inbound tourists. The growing number of 5A tourist attractions means that local tourism resources are expanding, thus strengthening the demand for inbound tourism. The coefficient of the total investment in fixed capital ($Ln(Investment_{jt})$) is also positive and remains significant at the significance level of 1%. This implies a reliance of tourism development on the construction and updating of fixed assets. The coefficient of the tertiary industry share in the aggregate economy ($Tertiary_{jt}$) is positive, which manifests an important position of the tertiary industry in the development of tourism. An increase in the percentage of the tertiary industry can mirror the abundance of supporting facilities for local tourism, which can further drive the demand for inbound tourism. The coefficient of the registered carrier departures ($Ln(Carrier_{it})$) remains significant at the significance level of 1%, which means that traffic convenience is essential to the growth of tourism demand. At the same time, the GDP per capita ($Ln(GDPpc_{it})$) of the tourist origin country is significant at the 1% significance level, suggesting that residents' income level is a crucial determinant of the willingness to travel. An increase in income can significantly strengthen residents' travel willingness. The degree of trade dependence ($TradeRatio_{ijt}$) and tourism demand are positively correlated, meaning that trade-related business tourists account for a certain proportion of inbound tourists. Finally, the coefficient of geographical distance ($Ln(Distance_{ij})$) remains significantly negative, which suggests that travel distance significantly inhibits the growth of tourism demand and that tourism demand constantly weakens with the increase in geographical distance.

4.2 Robustness Check for the Main Result

To further verify our main regression result, we conduct robustness checks by changing the estimation method and the selection of proxy variable for informatization.

In column (2) of **Table 2**, the one-step approach is adopted for estimation. To prevent the potential downward bias in the two-step estimation from resulting in unreliability of the approximately asymptotic distribution of the two-step GMM estimator, hereby the one-step GMM is adopted to verify the conclusions obtained in column (1). The coefficient of the internet penetration rate of the origin country ($Internet^{ori}_{it}$) presented in column (2) is close to that reported in column (1) and remains statistically insignificant. The coefficient of the

internet penetration rate of the destination province ($Internet^{dest}_{jt}$) is 0.0080, which is very similar to 0.0079 reported in column (1) and remains significant at the significance level of 1%. Meanwhile, the values and significance levels of the coefficients of all control variables have not been largely changed. The results thus obtained are consistent with those in column (1). This verifies the reliability of the main research findings in this paper.

In addition, we employ the difference-GMM to verify the regression results. Compared with system-GMM, difference-GMM only uses the endogenous lagged variables as instruments and takes the first difference to remove the section-fixed effect. The result of difference-GMM is often used for examining the validity of system-GMM. Column (3) in **Table 2** shows this robustness check result. The coefficient of the internet penetration rate of the destination province ($Internet^{dest}_{jt}$) is 0.0070, remaining statistically significant at the 5% level, which is not much different from the main regression. Meanwhile, the coefficient of the internet penetration rate of the origin country ($Internet^{ori}_{it}$) remains insignificant. Therefore, the aforementioned conclusions are further verified. The result shows that the conclusion we obtained previously is robust to using different estimation methods.

Moreover, we change the measurement of informatization level to test whether our results are sensitive to the specific variable selection method. Here, the number of mobile subscriptions ($Mobile^{ori}_{it}$ and $Mobile^{dest}_{jt}$) is adopted as the proxy of informatization level. The popularity of mobile internet helps citizens gather the latest information conveniently and in a timely manner by means of smartphones or other mobile devices. An increasing amount of information is received and dispatched on mobile devices. Thus, we consider that the number of mobile subscriptions could appropriately illustrate the informatization level of different regions. Column (4) of **Table 2** reports the estimated coefficients if the internet penetration rate is replaced by the number of mobile subscriptions. The coefficient of the informatization level of the tourist origin country ($Mobile^{ori}_{it}$) remains statistically insignificant, and the coefficient of informatization of the destination province ($Mobile^{dest}_{jt}$) remains significant at the 1% level. The results we obtain here are consistent with the main regression results, which show that our findings are robust to using different proxy variables for informatization level.

4.3 The Role of Public Service Supply

Previous research [29-30] has suggested that the development of the public service level, including regional infrastructure construction, traffic convenience, environmental protection and so on, is critical to the development of tourism. In real life, even if some places are blessed with beautiful scenery and enjoy a good reputation among tourists, they might still be rarely visited because of traffic restrictions and the backwardness of infrastructure construction. This can also explain why the number of tourists and tourism revenue have not experienced significant growth in some good tourist destinations. In contrast, places with a favorable industrial base and complete infrastructure construction will benefit from their tourism convenience, which allows tourists to visit comfortably and in a way that is time-saving. This can largely increase the appeal of tourist destinations and fuel the development of local tourism. Hence, this paper hypothesizes about the moderating role of the public service level in the promoting effect of informatization. With the constant improvement of the tourist destination's public service level, the increase in the informatization degree can not only help potential tourists experience the completeness of public services but also shape good word of mouth for local tourism. The interplay between informatization and public services can contribute to the flourishing of tourism.

By different contents and forms, public services can be divided into basic public services, economic public services, security public services, and social public services [28]. These diverse categories describe different aspects of public services. Because of the weak correlation between the economic public service indexes and tourism development, this study does not investigate the effect of economic public services. Research efforts are taken to focus on the impact of the interplay between indexes in the other three public service categories and informatization.

In a bid to comprehensively observe the impact caused by the public service supply, this paper introduces relevant indicators in basic public services, security public services and social public services, and multiplies them with the internet penetration rate of the tourist origin country and the destination province, respectively. In this way, we are able to examine whether the public service supply can moderate the impact of informatization.

In terms of basic public services, we consider that the waste water disposal ability can well describe the local residents' basic life guarantee and infrastructure bearing capacity, and the number of buses can measure the development of local public transportation. Hereby, the waste water disposal ability ($WaterDisposal_{jt}$) and the number of buses (Bus_{jt}) are chosen as proxy variables of basic public services. To exclude the impact caused by the population scale, the aforementioned indexes are divided by the size of the local population. Regarding security public services, the number of prosecutions per 10,000 residents is adopted as the proxy variable of crime rate ($CrimeRate_{jt}$) to describe the security status of the tourist destination province. Regarding social public services, factors related to education and medical care are not much linked with the development of tourism. The major social public services that are significantly correlated with tourism are related to environmental protection. The PM2.5 concentration can directly measure the local air pollution status, and the governmental expenditure on environmental protection can denote the local authorities' emphasis on environmental protection, which is also closely related to the ecological environment. The annual average PM2.5 concentration ($PM2.5_{jt}$) and the per capita environmental protection expenditure provided by the government ($Environment_{jt}$) are used to indicate the social public service level. The lower the PM2.5 concentration is and the higher the environmental protection expenditure per capita is, the more emphasis is placed on environmental protection, and the higher the social public service level is.

Table 3 reports the novel estimation results after the interactive term of the internet penetration rate in the tourist origin country and the public service level in the tourist destination province is added into the regression equation. The regression model is formulated by Equation (2):

$$\begin{aligned} \ln(Tourist_{ijt}) = & \alpha \ln(Tourist_{ij(t-1)}) + \beta_1 Internet^{ori}_{it} + \beta_2 Internet^{dest}_{jt} \\ & + \beta_3 Internet^{ori}_{it} \times PublicService_{jt} + \beta_4 PublicService_{jt} + X_{ijt}'\theta + u_{ij} + v_t + \varepsilon_{ijt} \end{aligned} \quad (2)$$

Compared to Equation (1), Equation (2) contains two additional terms: $Internet^{ori}_{it} \times PublicService_{jt}$ and $PublicService_{jt}$. The variable $PublicService_{jt}$ denotes the public service level in tourist destination province j in year t . In the regression analysis, the diverse dimensions of public services are represented by five different variables: waste water disposal ability ($WaterDisposal_{jt}$), number of buses (Bus_{jt}), crime rate ($CrimeRate_{jt}$), PM2.5 concentration ($PM2.5_{jt}$), and governmental environmental protection expenditure ($Environment_{jt}$). The coefficient β_4 associated with $PublicService_{jt}$ measures whether public services in the tourist destination province have a direct influence on inbound tourism. The coefficient β_3 of $Internet^{ori}_{it} \times PublicService_{jt}$ is of interest. It captures the moderating effect of public services on the relation between informatization in the tourist

origin country and inbound tourism. Other symbols and variables used in Equation (2) are identical to those in Equation (1). Detailed explanations of those symbols and variables have been provided previously when we introduced Equation (1) in Section 3.1.

Table 3. Result about the interaction between the informatization level in tourist origin countries and the public services in destination provinces

Variable	(1)	(2)	(3)	(4)	(5)
$\ln(\text{Tourist}_{ij(t-1)})$	0.7494*** (0.0246)	0.8768*** (0.0187)	0.7602*** (0.0261)	0.6102*** (0.0372)	0.8222*** (0.0245)
$\text{Internet}^{\text{ori}}_{it}$	-0.0039 (0.0028)	-0.0030 (0.0018)	0.0040* (0.0024)	0.0045 (0.0032)	-0.0022 (0.0016)
$\text{Internet}^{\text{ori}}_{it} \times \text{WaterDisposal}_{jt}$	2.9707* (1.6804)				
$\text{WaterDisposal}_{jt}$	-159.6900 (121.6153)				
$\text{Internet}^{\text{ori}}_{it} \times \text{Bus}_{jt}$		0.0007*** (0.0003)			
Bus_{jt}		-0.0113 (0.0137)			
$\text{Internet}^{\text{ori}}_{it} \times \text{CrimeRate}_{jt}$			-0.0004* (0.0002)		
CrimeRate_{jt}			0.0234 (0.0158)		
$\text{Internet}^{\text{ori}}_{it} \times \text{PM2.5}_{jt}$				-0.0001* (0.0001)	
PM2.5_{jt}				0.0077 (0.0049)	
$\text{Internet}^{\text{ori}}_{it} \times \text{Environment}_{jt}$					0.0849* (0.0449)
Environment_{jt}					-4.2214 (3.5838)
Control variables	yes	yes	yes	yes	yes
P value of AR(1) statistic	0	0	0	0	0
P value of AR(2) statistic	0.255	0.254	0.269	0.363	0.760
P value of Hansen test statistic	0.180	0.204	0.112	0.208	0.522
Number of observations	5070	5070	5070	5070	2730

Note: The values in parentheses denote standard errors. *, **, *** represent the significance levels of 10%, 5%, and 1%, respectively.

Table 4 reports the results after adding the interactive term of the internet penetration rate and public service level in the tourist destination province. The regression model is formulated by Equation (3):

$$\ln(\text{Tourist}_{ijt}) = \alpha \ln(\text{Tourist}_{ij(t-1)}) + \beta_1 \text{Internet}^{\text{ori}}_{it} + \beta_2 \text{Internet}^{\text{dest}}_{jt} + \beta_3 \text{Internet}^{\text{dest}}_{jt} \times \text{PublicService}_{jt} + \beta_4 \text{PublicService}_{jt} + X_{ijt}'\theta + u_{ij} + v_t + \varepsilon_{ijt} \quad (3)$$

Compared to Equation (1), Equation (3) adds two terms: $\text{Internet}^{\text{dest}}_{jt} \times \text{PublicService}_{jt}$ and $\text{PublicService}_{jt}$. The coefficient β_4 of $\text{PublicService}_{jt}$ measures the direct influence of public services in the tourist destination province on inbound tourism. The coefficient β_3 of $\text{Internet}^{\text{dest}}_{jt} \times \text{PublicService}_{jt}$ measures the moderating effect of public services on the relation between informatization in the tourist destination province and inbound tourism. Other symbols and variables used in Equation (3) are the same as those in Equation (1).

Table 4. Results about the interaction between the informatization level and public services in destination provinces

Variable	(1)	(2)	(3)	(4)	(5)
$\ln(\text{Tourist}_{ijt(t-1)})$	0.8572*** (0.0183)	0.8856*** (0.0166)	0.6416*** (0.0423)	0.6065*** (0.0353)	0.7138*** (0.0304)
$\text{Internet}^{\text{dest}}_{jt}$	0.0036** (0.0015)	0.0043** (0.0017)	0.0170*** (0.0037)	0.0152*** (0.0030)	0.0082** (0.0038)
$\text{Internet}^{\text{dest}}_{jt} \times \text{WaterDisposal}_{jt}$	1.5260*** (0.5062)				
$\text{WaterDisposal}_{jt}$	-30.3047 (39.8242)				
$\text{Internet}^{\text{dest}}_{jt} \times \text{Bus}_{jt}$		0.0006*** (0.0001)			
Bus_{jt}		0.0076 (0.0083)			
$\text{Internet}^{\text{dest}}_{jt} \times \text{CrimeRate}_{jt}$			-0.0005*** (0.0001)		
CrimeRate_{jt}			-0.0035 (0.0078)		
$\text{Internet}^{\text{dest}}_{jt} \times \text{PM2.5}$				-0.0001* (0.0000)	
PM2.5				0.0035 (0.0024)	
$\text{Internet}^{\text{dest}}_{jt} \times \text{Environment}_{jt}$					0.0885* (0.0486)
Environment_{jt}					-3.8876 (2.5078)
Control variables	yes	yes	yes	yes	yes
P value of AR(1) statistic	0	0	0	0	0
P value of AR(2) statistic	0.245	0.282	0.322	0.401	0.712
P value of Hansen test statistic	0.182	0.208	0.187	0.131	0.317
Number of observations	5070	5070	5070	5070	2730

Note: The values in parentheses denote standard errors. *, **, *** represent the significance levels of 10%, 5%, and 1%, respectively.

The results presented in **Table 3** show that, after the interaction term between various public service variables and the internet penetration rate of the tourist origin country is introduced, the coefficient of informatization in the tourist origin country ($\text{Internet}^{\text{ori}}_{it}$) is still statistically insignificant, similar to that reported in **Table 2**. At the same time, the coefficient of each single public service index itself ($\text{WaterDisposal}_{jt}$, Bus_{jt} , CrimeRate_{jt} , PM2.5_{jt} , Environment_{jt}) is not significant, either. This means that when the informatization level is extremely low, improving the public service supply level alone cannot effectively strengthen inbound tourism demand. However, the coefficients of the interaction terms between the informatization of the tourist origin country and destination province's waste water disposal ability, number of buses, and environmental protection expenditure are significantly positive; the coefficients of the interaction terms with the crime rate and PM2.5 concentration are significantly negative. This finding means that the promoting role of informatization in inbound tourism essentially relies on the level of public services relevant to public infrastructure, social security, and environmental protection, and that there is a

significant interplay between informatization and public service provision. As the public service level of the destination province improves, the advancement of the tourist origin country's informatization will also drive the demand for inbound tourism more markedly. A place that attempts to benefit from the informatization progress should constantly improve the public service level, thus equipping tourists with better tourism support services. This strategy can help it stand out from competition with other places and speed up its tourism development.

After adding the interaction between public services and the informatization level of the destination province, **Table 4** shows the estimation results. Similar to **Table 3**, the coefficients of the interaction terms between the internet penetration rate and the waste water disposal ability, number of buses, and environmental protection expenditure are significantly positive, and the coefficients of the interaction terms with the crime rate and PM2.5 concentration are significantly negative. The results show that the promoting effect of the destination province's informatization on inbound tourism development is highly dependent on the public service level. With the improvement of the public service level, the promoting effect of informatization could be stronger.

After the interaction item is introduced, the coefficient of the internet penetration rate in the destination province ($Internet^{dest}_{jt}$) remains positive and statistically significant. This finding suggests that the improvement of informatization and enhancement of public awareness of tourist destinations are indeed useful ways to fuel inbound tourism demand and boost tourism development. However, the coefficient of each single public service index itself ($WaterDisposal_{jt}$, Bus_{jt} , $CrimeRate_{jt}$, $PM2.5_{jt}$, $Environment_{jt}$) is statistically insignificant, which means that when the informatization level is extremely low, improvement of the public service level alone can hardly stimulate tourism demand effectively.

5. Discussion, Conclusions, and Limitations

5.1 Discussion

The empirical analysis in this study provides an important policy implication: the improvement of informatization can substantially boost the development of inbound tourism in China. According to the results reported in **Table 2**, a one-percentage-point additional increase in the internet penetration rate in China will bring an approximately 0.79% additional increase in the number of inbound tourist arrivals. Over time, the cumulative benefits would be quite large. **Fig. 3** shows this point quantitatively. The solid blue curve in the figure presents the actual number of inbound tourist arrivals in China during 2004—2019. The dashed orange curve gives the estimated number after an imagined 0.79-percentage-point extra increase in the annual growth rate of inbound tourist arrivals since 2004. In 2019, the number in the dashed orange curve would be approximately 164 million person-times, while the actual number was approximately 145 million person-times. Obviously, the expansion of 19 million person-times tourists would generate great economic benefits for tourism-relevant industries.

During the past few decades, China has invested much in ICT infrastructure. Informatization-oriented hardware and software have been greatly developed all over the country. Currently, people's daily lives and economic activities are deeply affected by informatization. As our research shows empirically, the process of informatization also generates considerable impacts on inbound tourism in China. Tourists can utilize ICTs to conveniently obtain tourist information, make tourist plans, purchase tourism products, and obtain better travel experiences. Companies in the tourism sector can apply ICTs to expand markets, improve efficiency, and make profits. The tourism-relevant public sectors are also

able to apply information technologies to provide better management and public services. We expect that in the future, informatization will persistently provide abundant opportunities for inbound tourism on both the demand and supply sides of the market. Accordingly, the government should provide further facilitating conditions in support of informatization; tourism organizations and tourists should more actively take advantage of emerging technologies.

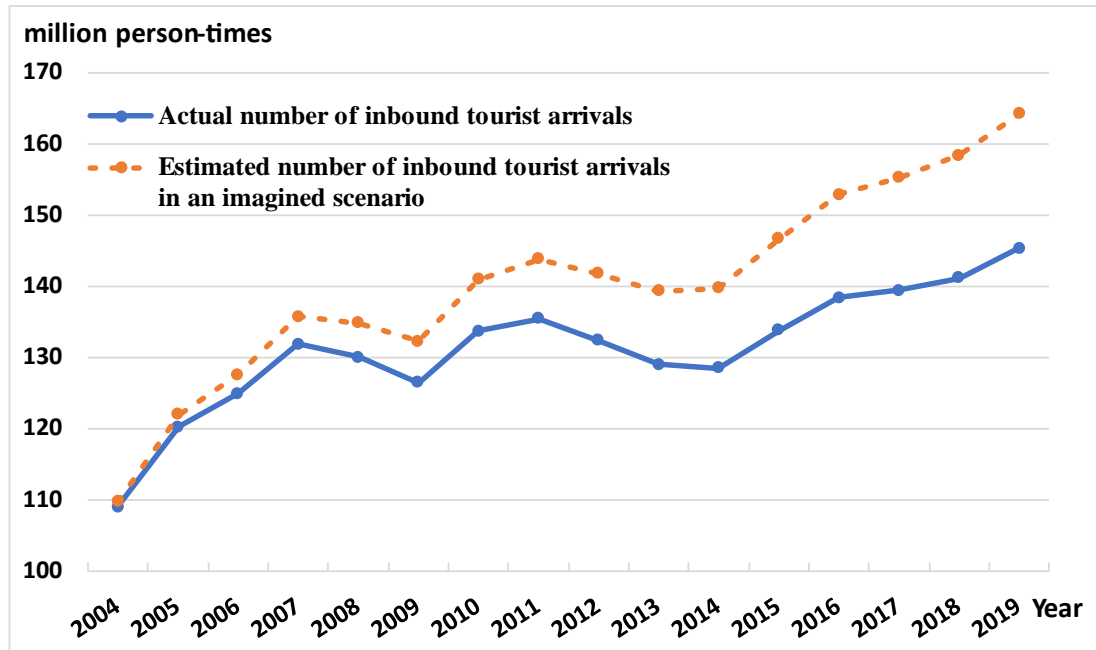


Fig. 3. Actual number of inbound tourist arrivals versus the estimated number after an imagined 0.79-percentage-point increase in the annual growth rate of inbound tourist arrivals (2004—2019). Data source: Yearbook of China Tourism Statistics and authors' own calculation.

Admittedly, the existence of ICT infrastructure does not mean that the tourism sector will necessarily make full use of ICT infrastructure. Previous literature has found that the acceptance and use of ICTs in tourism is largely influenced by subjective factors in terms of user psychology, attitude, and cognition. Ali et al. [48] and Wagaw and Mulugeta [49] pointed out that perceived usefulness and subjective norms affected the behavioral intentions to use ICTs in the tourism sector. The government and technology providers need to spend time conveying information and convincing potential users that the deep integration of ICT and tourism is a wise choice.

While we are optimistic that informatization can boost tourism, we should not lose sight of the potential risks of using information technology. There are plenty of human interactions in the tourism industry. Personal information is frequently and widely disseminated. A critical risk of the integration of ICT and tourism is that personal privacy information may be insecure [5]. To avoid the exposure of privacy, effective technical and institutional measures need to be adopted. In the technical aspect, previous studies have done inspiring research in many daily life applications, such as archive management, digital libraries, e-commerce websites, online financial transactions, and personalized information retrieval [50-55]. Researchers have proposed a series of effective and low-cost technical methods to avoid user privacy leakage [56-59]. These privacy-protecting methods should be widely used in the tourism industry. In

the institutional aspect, legislation aimed at privacy protection should be strengthened, and illegal acts of leaking user privacy must be punished [60].

Furthermore, this study shows that local public service provision can enhance the impact of informatization. The positive effect of informatization in tourist destinations is stronger in regions with better local public services. Although, on average, informatization in tourist origin countries has no statistically significant effect, the effect becomes significantly positive when tourist destinations provide sufficiently high levels of public services. The moderating effect of public services found in this study implies that China can better utilize the benefits of informatization progress by providing better public services such as public transportation, social security, and environmental protection.

5.2 Conclusions

In summary, this study analyzes the impact of informatization on the number of inbound tourists visiting China. The empirical analysis utilizes the aggregate level data of tourists from 13 origin countries who visited 30 provinces in Mainland China during the period 2004—2016. A dynamic panel regression model is estimated to quantify the effect of informatization. It is found that the level of informatization in destination provinces has a significant positive impact. Moreover, the local public service supply plays a moderating role such that the impact of informatization is stronger in regions with better public services. Overall, the study shows that improving the informatization level in China is an effective way to boost its inbound tourism.

5.3 Limitations

This research has several limitations. Further research can extend our study in several aspects. First, this study did not distinguish different tourists according to their purposes of travel (e.g., sightseeing, business, visiting relatives). However, tourists with different travel purposes may respond to informatization unequally, because their dependence on the availability of public information differs. In the future, researchers can explore how informatization influences tourists with different travel purposes, and thus, we are able to better understand how informatization alters the market structure of China's inbound tourism. Second, this study focused on inbound tourism and did not analyze the impact of informatization on domestic tourism in China. We expect that domestic tourists are also influenced by the informatization level because they also demand information for travel planning. Future studies can employ our analysis framework to investigate domestic tourism.

References

- [1] E. M. Rogers, "Informatization, globalization, and privatization in the new Millenium," *Asian Journal of Communication*, vol. 10, no. 2, pp. 71-92, 2000. [Article \(CrossRef Link\)](#)
- [2] L. Bruni, and L. Stanca, "Income Aspirations, Television and Happiness: Evidence from the World Values Survey," *Kyklos*, vol. 59, no. 2, pp. 209-225, 2006. [Article \(CrossRef Link\)](#)
- [3] W. Hyll, and L. Schneider, "The causal effect of watching TV on material aspirations: Evidence from the 'valley of the innocent'," *Journal of Economic Behavior & Organization*, vol. 86, pp. 37-51, 2013. [Article \(CrossRef Link\)](#)
- [4] K. Hughes, and G. Moscardo, "ICT and the future of tourist management," *Journal of Tourism Futures*, vol. 5, no. 3, pp. 228-240, 2019. [Article \(CrossRef Link\)](#)
- [5] S. Gössling, "Tourism, technology and ICT: a critical review of affordances and concessions," *Journal of Sustainable Tourism*, vol. 29, no. 5, pp. 733-750, 2021. [Article \(CrossRef Link\)](#)

- [6] G. E. Bayram, "Impact of information technology on tourism," in *The Emerald Handbook of ICT in Tourism and Hospitality*, Emerald Publishing Limited, Bingley, 2020, pp. 243-257. [Article \(CrossRef Link\)](#)
- [7] F. Femenia-Serra, B. Neuhofer, and J. A. Ivars-Baidal, "Towards a conceptualisation of smart tourists and their role within the smart destination scenario," *Service Industries Journal*, vol. 39, no. 2, pp. 109-133, 2019. [Article \(CrossRef Link\)](#)
- [8] Y. Li, C. Hu, C. Huang, and L. Duan, "The concept of smart tourism in the context of tourism information services," *Tourism Management*, vol. 58, pp. 293-300, 2017. [Article \(CrossRef Link\)](#)
- [9] A. K. Shittu, "Public service and service delivery," in *Global Encyclopedia of Public Administration, Public Policy, and Governance*, Springer, Cham., 2020, pp. 1-8. [Article \(CrossRef Link\)](#)
- [10] S. Singh, "Inbound tourism," in *Encyclopedia of Tourism*, Springer, Cham, 2021, pp. 1-2. [Article \(CrossRef Link\)](#)
- [11] D. Buhalis, and R. Law, "Progress in information technology and tourism management: 20 years on and 10 years after the Internet—The state of eTourism research," *Tourism Management*, vol. 29, no. 4, pp. 609-623, 2008. [Article \(CrossRef Link\)](#)
- [12] S. Kotiloglu, T. Lappas, K. Pelechrinis, and P. P. Repoussis, "Personalized multi-period tour recommendations," *Tourism Management*, vol. 62, pp. 76-88, 2017. [Article \(CrossRef Link\)](#)
- [13] D. Buhalis, "Strategic use of information technologies in the tourism industry," *Tourism Management*, vol. 19, no. 5, pp. 409-421, 1998. [Article \(CrossRef Link\)](#)
- [14] B. D. Gelb, and S. Sundaram, "Adapting to 'word of mouse'," *Business Horizons*, vol. 45, no. 4, pp. 21-25, 2002. [Article \(CrossRef Link\)](#)
- [15] O. Adeola, and O. Evans, "Digital tourism: mobile phones, internet and tourism in Africa," *Tourism Recreation Research*, vol. 44, no. 2, pp. 190-202, 2019. [Article \(CrossRef Link\)](#)
- [16] O. Adeola, and O. Evans, "ICT, infrastructure, and tourism development in Africa," *Tourism Economics*, vol. 26, no. 1, pp. 97-114, 2020. [Article \(CrossRef Link\)](#)
- [17] N. Kumar, and R. R. Kumar, "Relationship between ICT and international tourism demand: A study of major tourist destinations," *Tourism Economics*, vol. 26, no. 6, pp. 908-925, 2019. [Article \(CrossRef Link\)](#)
- [18] M. K. Anser, B. N. Adeleye, M. I. Tabash, and A. K. Tiwari, "Services trade-ICT-tourism nexus in selected Asian countries: new evidence from panel data techniques," *Current Issues in Tourism*, vol. 25, no. 15, pp. 2388-2403, 2022. [Article \(CrossRef Link\)](#)
- [19] S. Bayrakçı, and C. C. Özcan, "Chapter 9. Relationship Between ICT and Tourism: The Case of Mediterranean Countries," *ICT as Innovator Between Tourism and Culture*, IGI Global, 2022. [Article \(CrossRef Link\)](#)
- [20] S. Milićević, and J. Petrović, and N. Đorđević, "ICT as a factor of destination competitiveness: The case of the republics of former Yugoslavia," *Management & Marketing. Challenges for the Knowledge Society*, vol. 15, no. 3, pp. 381-392, 2020. [Article \(CrossRef Link\)](#)
- [21] U. Al-Mulali, S. A. Solarin, A. E. Andargoli, and H. F. Gholipour, "Digital adoption and its impact on tourism arrivals and receipts," *Anatolia*, vol. 32, no. 2, pp. 337-339, 2021. [Article \(CrossRef Link\)](#)
- [22] S. A. Choudhary, M. A. Khan, A. Z. Sheikh, et al., "Role of information and communication technologies on the war against terrorism and on the development of tourism: Evidence from a panel of 28 countries," *Technology in Society*, vol. 62, pp. 101296, 2020. [Article \(CrossRef Link\)](#)
- [23] H. F. Gholipour, A. E. Andargoli, A. Andargoli, and B. Foroughi, "Capital investment in telecommunications infrastructure and tourist arrivals in developing countries: Does the public-private sectors relationship matter?," *Tourism Economics*, vol. 28, no. 7, pp. 1805-1822, 2021. [Article \(CrossRef Link\)](#)
- [24] C. Lee, M. Chen, W. Wu, and W. Xing, "The impacts of ICTs on tourism development: International evidence based on a panel quantile approach," *Information Technology & Tourism*, vol. 23, pp. 509-547, 2021. [Article \(CrossRef Link\)](#)

- [25] S. Lee, S. Joo, J. Park, and Y. Nam, "ICT infrastructure, OTT market growth, economic freedom, and international tourism: A cross-country empirical study," *Sustainability*, vol. 14, no. 19, pp. 12236, 2022. [Article \(CrossRef Link\)](#)
- [26] K. Shehzad, X. Liu, A. Rauf, M. Arif, S. Mazhar, N. Sohail, and W. Amin, "Revolutionising tourism development in China: an effective role of ICT and Western Silk Road project," *Asia Pacific Journal of Tourism Research*, vol. 24, no. 9, pp. 965-977, 2019. [Article \(CrossRef Link\)](#)
- [27] Z. Zhu, W. Ma, and C. Leng, "ICT adoption and tourism consumption among rural residents in China," *Tourism Economics*, vol. 28, no. 6, pp. 1669-1675, 2021. [Article \(CrossRef Link\)](#)
- [28] Y. Xuan, and Y. Yu, "Public Expenditure Structure, Public Service and Residents' Happiness," *Studies in Labor Economics (in Chinese)*, no. 5, pp. 96-119, 2016.
- [29] J. Balaguer, and M. Cantavella-Jordá, "Tourism as a long-run economic growth factor: the Spanish case," *Applied Economics*, vol. 34, no. 7, pp. 877-884, 2002. [Article \(CrossRef Link\)](#)
- [30] J. Brida, and M. Pulina, "A literature review on the tourism-led-growth hypothesis," *CRENoS Working Papers 2010/17*, Centre for North South Economic Research, University of Cagliari and University of Sassari, 2010.
- [31] M. Ahmed, and A. Anwar, "The Nexus between Terrorism, Infrastructure and Tourism Industry in Pakistan," *International Journal of Economics and Empirical Research*, vol. 4, pp. 25-31, 2016.
- [32] S. Jovanovi, and I. Ili, "Infrastructure as Important Determinant of Tourism Development in The Countries of Southeast Europe," *EcoForum*, vol. 5, no. 1, pp. 288-294, 2016.
- [33] M. Lubov, M. Vladimír, H. Natalya, L. Elena, and B. Elena, "Ensuring the Development of Tourism in the Regions of the Russian Federation, with Account of the Tourism Infrastructure Factors," *Indian Journal of Science and Technology*, vol. 9, no.5, pp. 1-13, 2016. [Article \(CrossRef Link\)](#)
- [34] B. Seetanah, T. D. Juwaheer, M. J. Lamport, S. Rojid, R. V. Sannasee, and A. U. Subadar, "Does infrastructure matter in tourism development?," *University of Mauritius Research Journal*, vo. 17, pp. 89-108, 2011. [Article \(CrossRef Link\)](#)
- [35] C. Lanouar, and M. Goaid, Tourism, "terrorism and political violence in Tunisia: Evidence from Markov-switching models," *Tourism Management*, vol. 70, pp. 404-418, 2019. [Article \(CrossRef Link\)](#)
- [36] S. A. Raza, and S. T. Jawaid, "Terrorism and tourism: A conjunction and ramification in Pakistan," *Economic Modelling*, vol. 33, pp. 65-70, 2013. [Article \(CrossRef Link\)](#)
- [37] C. Bonham, C. Edmonds, and J. Mak, "The Impact of 9/11 and Other Terrible Global Events on Tourism in the United States and Hawaii," *Journal of Travel Research*, vol. 45, no. 1, pp. 99-110, 2006. [Article \(CrossRef Link\)](#)
- [38] J. N. Goodrich, "September 11, 2001 attack on America: a record of the immediate impacts and reactions in the USA travel and tourism industry," *Tourism Management*, vol. 23, no. 6, pp. 573-580, 2002. [Article \(CrossRef Link\)](#)
- [39] W. Enders, and T. Sandler, "Causality between transnational terrorism and tourism: The case of Spain," *Terrorism*, vol. 14, no. 1, pp. 49-58, 1991. [Article \(CrossRef Link\)](#)
- [40] E. Neumayer, and T. Plümper, "Spatial spill-overs from terrorism on tourism: Western victims in Islamic destination countries," *Public Choice*, vol. 169, no. 3, pp. 195-206, 2016. [Article \(CrossRef Link\)](#)
- [41] D. Dong, X. Xu, and Y. F. Wong, "Estimating the Impact of Air Pollution on Inbound Tourism in China: An Analysis Based on Regression Discontinuity Design," *Sustainability*, vol. 11, no. 6, pp. 1682, 2019. [Article \(CrossRef Link\)](#)
- [42] T. Deng, X. Li, and M. Ma, "Evaluating impact of air pollution on China's inbound tourism industry: a spatial econometric approach," *Asia Pacific Journal of Tourism Research*, vol. 22, no. 7, pp. 771-780, 2017. [Article \(CrossRef Link\)](#)
- [43] M. Arellano, and O. Bover, "Another look at the instrumental variable estimation of error-components models," *Journal of Econometrics*, vol. 68, no. 1, pp. 29-51, 1995. [Article \(CrossRef Link\)](#)
- [44] R. Blundell, and S. Bond, "Initial conditions and moment restrictions in dynamic panel data models," *Journal of Econometrics*, vol. 87, no. 1, pp. 115-143, 1998. [Article \(CrossRef Link\)](#)

- [45] H. Song, G. Li, S. F. Witt, and B. Fei, "Tourism Demand Modelling and Forecasting: How Should Demand Be Measured?" *Tourism Economics*, vol. 16, no. 1, pp. 63-81, 2010. [Article \(CrossRef Link\)](#)
- [46] J. Alegre, and L. Pou, "Micro-Economic Determinants of the Probability of Tourism Consumption," *Tourism Economics*, vol. 10, no. 2, pp. 125-144, 2004. [Article \(CrossRef Link\)](#)
- [47] W. B. Bull, *Geomorphic Responses to Climatic Change*, Oxford University Press, 1991.
- [48] M. B. Ali, R. Tuhin, M. A. Alim, M. Rokonuzzaman, S. M. Rahman, and M. Nuruzzaman, "Acceptance and use of ICT in tourism: the modified UTAUT model," *Journal of Tourism Futures*, 2022. [Article \(CrossRef Link\)](#)
- [49] M. Wagaw, and F. Mulugeta, "Integration of ICT and tourism for improved promotion of tourist attractions in Ethiopia," *Applied Informatics*, vol. 5, pp. 6, 2018. [Article \(CrossRef Link\)](#)
- [50] Q. A. Arain, Z. Deng, I. Memon, S. Arain, F. K. Shaikh, A. Zubedi, M. A. Unar, A. Ashraf, and R. Shaikh, "Privacy Preserving Dynamic Pseudonym-Based Multiple Mix-Zones Authentication Protocol over Road Networks," *Wireless Personal Communications*, vol. 95, pp. 505-521, 2017. [Article \(CrossRef Link\)](#)
- [51] J. Su, L. He, R. Ren, and Q. Liu, "Reliable blockchain-based ring signature protocol for online financial transactions," *KSII Transactions on Internet and Information Systems*, vol. 17, no. 8, pp. 2083-2100, 2023. [Article \(CrossRef Link\)](#)
- [52] Z. Wu, J. Xie, X. Lian, and J. Pan, "A privacy protection approach for XML-based archives management in a cloud environment," *The Electronic Library*, vol. 37, no. 6, pp. 970-983, 2019. [Article \(CrossRef Link\)](#)
- [53] Z. Wu, R. Li, Z. Zhou, J. Guo, J. Jiang, and X. Su, "A user sensitive subject protection approach for book search service," *Journal of the Association for Information Science and Technology*, vol. 71, pp. 183-195, 2020. [Article \(CrossRef Link\)](#)
- [54] Z. Wu, S. Shen, H. Zhou, H. Li, C. Lu, and D. Zou, "An effective approach for the protection of user commodity viewing privacy in e-commerce website," *Knowledge-Based Systems*, vol. 220, pp. 106952, 2021. [Article \(CrossRef Link\)](#)
- [55] Z. Wu, S. Shen, C. Lu, H. Li, and X. Su, "How to protect reader lending privacy under a cloud environment: a technical method," *Library Hi Tech*, vol. 40, no. 6, pp. 1746-1765, 2022. [Article \(CrossRef Link\)](#)
- [56] J. Curzon, A. Almehmadi, and K. El-Khatib, "A survey of privacy enhancing technologies for smart cities," *Pervasive and Mobile Computing*, vol. 55, pp. 76-95, 2019. [Article \(CrossRef Link\)](#)
- [57] N. Kaaniche, M. Laurent, and S. Belguith, "Privacy enhancing technologies for solving the privacy-personalization paradox: Taxonomy and survey," *Journal of Network and Computer Applications*, vol. 171, pp. 102807, 2020. [Article \(CrossRef Link\)](#)
- [58] Z. Wu, C. Lu, Y. Zhao, J. Xie, D. Zou, and X. Su, "The Protection of User Preference Privacy in Personalized Information Retrieval: Challenges and Overviews," *Libri*, vol. 71, no. 3, pp. 227-237, 2021. [Article \(CrossRef Link\)](#)
- [59] Z. Wu, S. Shen, H. Li, H. Zhou, and D. Zou, "A comprehensive study to the protection of digital library readers' privacy under an untrusted network environment," *Library Hi Tech*, vol. 40, no. 6, pp. 1930-1953, 2022. [Article \(CrossRef Link\)](#)
- [60] M. W. Kim, I. H. Kim, J. Kim, J. H. Oh, J. Chang, and S. Park, "A study on the protection of biometric information against facial recognition technology," *KSII Transactions on Internet and Information Systems*, vol. 17, no. 8, pp. 2124-2139, 2023. [Article \(CrossRef Link\)](#)



Boyang Xu received his Master's degree in economics from Southwestern University of Finance and Economics and his Bachelor's degree in economics from Sichuan University. He is a Ph.D. Candidate at Fudan University, China. His current research interests focus on environmental economics and climate economics.



Daxin Dong, Ph.D., is an associate professor at the Institute of Western China Economic Research, Southwestern University of Finance and Economics, China. His research interests include industrial economics and economic policy analysis.