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Urban Competitiveness and the Smart City: An Empirical Analysis in a Developing Country Context

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Abstract

This paper examines whether smart city programs, and information technology in general, contribute to urban competitiveness. Using regression analysis, it investigates the contribution of different metrics of the information economy, network society, online government and digital life to the competitiveness of cities. At a more general level, it seeks to measure the benefits of the application of information technology to the economic competitiveness, livability and environmental sustainability of cities. It concludes with guidance for urban development in developing countries.

Introduction

The rapid progress of urbanization has promoted the development and prosperity of cities and intensified the competition between them. Fundamentally, urban competitiveness is a comparative advantage. It is a city's advantage in attracting resources, developing the local economy, providing services, and protecting its environment, and its ability to maintain this advantage against competition from other cities. Smart city plans are a tool in the arsenal of cities in this competition.

Since the emergence of the smart city concept, smart city programs have been actively implemented all over the world to enhance urban competitiveness and solve the problems of urban development. In 2017, after several decades of rapid urbanization, China's urban population rate reached 58.5 percent. To solve the problems of the growing urban population and to improve urban competitiveness, China like many other nations is actively implementing the construction of smart cities characterized by the Internet of Things, big data, cloud computing and so on. But despite huge investments in infrastructure and the rapid pace of implementation, there is little research on whether smart city investments contribute to urban competitiveness. Urban competitiveness itself has been extensively studied, both in terms of measuring the competitiveness (Boddy & Parkinson, 2004), and explaining the factors that enhance it (Ni, 2013; 2017).

But the impact of smart city programs on urban competitiveness has not attracted as much attention. In an early study, Lonsdale (1999) wrote about the possibility that a city that has the advantage of information resources would be able to extend its economic influence, not only over its own hinterland but over larger regional groupings of cities. Liu and Xie (2014) and others, adopting the perspective of information power theory, hold that the construction of a smart city can be understood as a strategy to enhance the competitiveness of the city. However, as Hao (2001) has argued, with the rapid development of China's economy, the study of China's urban competitiveness would gradually be of profound significance, to enable cities to understand their own competitive opportunities, learn the strengths and advantages of other cities' development, and create evidence-based investment programs and regional cooperation strategies. Therefore, it

is necessary to re-examine urban competitiveness in the context of the smart city, to find if information technologies can give new competitive advantages for the city.

Adding to previous research on urban competitiveness, this paper focuses on the general application of information technology in cities and highlights the developmental role of the information industry. In fact, the information industry and the information economy have become the driving force to enhance the city's competitiveness by influencing and acting on various elements of the city's economic and social development and optimizing resources to enhance urban competitiveness.

This paper first summarizes the previous research on urban competitiveness, and discusses the factors that contribute to it. To provide a framework to study these factors, Castells' theory of the informational city is discussed. Based on an understanding of the mechanisms underlying the smart city's role in improving the competitiveness of the city, the forecast variables are set as information economy, network society, online government and digital life in the construction of smart city. Then, the sources of data for this research are discussed. Next, I conducted a regression analysis aiming to predict the level of urban competitiveness of smart cities based on the factors identified in the literature review. The last part presents conclusions and policy suggestions.

Literature Review

Researchers have studied the competitiveness of cities with the aim of measuring it, as well as identifying the factors that influence it. This section discusses these strands of literature in turn.

Scholars have suggested number of indicators to measure urban competitiveness, such as labor productivity (Porter, 1990), per capita GDP (OECD, 2006) or economic growth (Savitch, 2002). Gordon and Cheshire (1998) measure the competitiveness of cities using income and employment. Rogerson (1999) holds that the factors affecting the urban competitiveness also include the quality of life. Kresl and Singh (1999) divide the factors that determine the competitiveness of cities into two: economic factors and strategic factors. Lambooy (2002) measured urban competitiveness in terms of the city's efficiency in using its own resources.

However, since urban competitiveness is a comprehensive concept, no single indicator is able to adequately measure it. Therefore, scholars have tried to use a broader set of indicators to build city competitiveness indices. One strand of research aims to analyze the interrelationships among the factors affecting urban competitiveness, and to integrate the output and input factors to build indices that measure the competitiveness of cities (Gardiner 2004; Huggins, 2003; Boddy & Parkinson, 2004). Others have proposed to establish quantifiable indicator systems based on various analytical frameworks (Rondinelli, 1998; Lopez-Claros, 2005; Cho, 2007; Shen, 2004). These analyses are limited to cities in the United States; as a result, these indices may not be general and universal, and cannot easily be applied to a developing country context. Ni (2001, 2002) conducted a systematic study on the issue of urban competitiveness with the goal of

identifying a parsimonious set of indicators that still captured all the dimensions of competitiveness. He selected 34 variables sub-divided into three components: “economic competitiveness,” “livability,” and “sustainable development.”

The research on urban competitiveness in China started late. Han (2011) and others selected indicators such as economy, scientific and technological innovation, and social environment to study the factors influencing urban competitiveness. Ni (2013) used quantitative methods to calculate a competitiveness index for 500 cities and used dynamic clustering and stepwise regression analysis to analyze and study the seven factors influencing cities’ competitiveness. Liu (2013), drawing on Ni's (2013) analysis, divided the factors affecting urban competitiveness into 12 items (talent, capital, science and technology, industrial structure, infrastructure, location, environment, culture, system, government, enterprise, and degree of openness).

Despite these previous studies, research on the relationship between the “smart city” and urban competitiveness is still in the exploratory stage, as evidenced by the multiplicity of indices and explanatory factors. Therefore, this paper investigates the factors that improve the competitiveness of the city and gives targeted suggestions, which are of both academic and practical value. The next two sections present our theoretical framework and hypotheses.

Theory

Economists have attempted to explain economic growth and development from a number of theoretical perspectives including classical economic growth theory (Adam Smith, David Ricardo), neoclassical economic growth theory (Cass, 1965; Koopmans, 1963; Solow, 1956; Swan, 1956) and the new economic growth theory (Romer, 1986). However, all three approaches view the role of technology and technological change somewhat differently. Classical economic growth theory only pays attention to the influence of labor and production efficiency on economic growth and did not have a role for information technology. Neoclassical economic growth theory proposed technological progress as an exogenous variable explaining economic growth. The New Economic Growth Theory explains that technological progress promotes the sustained economic growth in reality. It is also the first one to theoretically justify the application of information technology to promote economic growth.

But economic competitiveness is only one part of urban competitiveness. The focus of the paper is on examining the role of smart city implementation on urban competitiveness, defined more broadly to also include quality of life and sustainable development. As demonstrated in the literature review, urban competitiveness is a multidimensional concept and therefore no single index can measure it. Measuring it as economic competitiveness alone is insufficient. Cities succeed also by making themselves attractive destinations for people and businesses to relocate; therefore, the quality of life in cities is also a dimension of competitiveness (Rogerson, 2005). Also, the long-term success of cities is dependent on how well they protect and sustain the local environment (Liu, 2013, Ni, 2013). An added dimension of competitiveness is therefore

sustainable development.

A more appropriate framework to analyze the impacts of smart city programs on urban competitiveness is Manuel Castells' theory of the informational city. Manuel Castells launched a study on the dynamic space of information and network society in the 1980s. In the book "The Informational City," he proposed that technological change, by increasing productivity, can influence the relationship between factors of production and change the developmental mode of the city (Castells, 1989). Information technology is substitutive of resources through increased efficiency, and specific technologies also have coordination functions to structure and systemize disorganized components. Castells called the new economic phenomenon that had emerged worldwide as the information economy. The basic organizational form of this new economic system is the network. The operational mechanism is the interaction between various related elements such as data and information processing technologies. The combination of technology and organization makes innovation more common, changing the economic structure and enabling the city to enter a new stage of economic development. With the emergence of new industrial spaces and new divisions of labor, regional and urban development have also undergone major changes. For example, the innovation of transportation and communication technology will eliminate the spatial limitations on enterprises and residents and change the resulting aggregation scale and spatial distribution of urban elements.

According to Castells, the impact of information technologies is not limited to the economic sphere. He also proposed that information technologies led to a more interconnected social and political sphere that may be called the network society. In the network society, people's social activities are no longer restricted to their local communities. But at the same time, information networks also allow individuals to interact with their local communities in singularly new ways, as a result of which new social mechanisms may emerge. He pointed out that in the network society, the areas where creativity is maximized and diffused are effectively more competitive. It thus becomes necessary to investigate social life and standards of living, as part of urban competitiveness.

On the basis of the above theory, we put forward the following hypotheses.

Hypotheses

Information economy. An information economy is an information activity-oriented and self-driven economy in which the use of information technologies is fully integrated into economic and social activities. Castells demonstrated that, compared with the industrial society, the economic sphere in an information society will be characterized by informatization, networking and globalization. Only by transforming from an industrial economy with high resource consumption and high pollution to an information economy based on the application of innovative core technologies can the problems of resource shortage and sustainable utilization be solved while promoting economic development. Therefore, the following hypothesis is put forward:

H1: Progress toward an information economy will be positively correlated with urban competitiveness.

Network Society Index. Castells pointed out that the information technology revolution has driven the formation of a new social model—the network society. The network society is characterized by globalization of economic behavior, networking of organizational forms, flexible work practices and increasing specialization of professions. With the implementation of a network society, a new economy characterized by informatization, networking and globalization will also emerge, making full use of the productive potential of the mature industrial economy. The network society will also build a new social relationship over time and space, making it possible for information to flow around the globe in a timely manner. People no longer need to be crowded into a narrow urban space, but can use information technology to participate in production and life whenever and wherever. In this way, a second hypothesis is put forward:

H2: The development of network society is positively correlated with urban competitiveness.

Online government. Since smart city is a complex system, which emphasizes integration and cooperation between government, enterprises and society (Lambooy, 2002), the vigorous development of e-government and the application of various information technology tools to aid decision-making will help cities realize the full potential of informatization, thus enhancing urban development. In particular, information technology in China has two unique developmental characteristics: a large installed base due to the large population and rising adoption rates; a push towards the delivery of electronic services through e-government programs and informatization initiatives. In the past ten years, informatization in China has proceeded apace with the government playing a prominent role. The government has not only issued a series of policies to point the way for the development of emerging industries but has also promoted strategic cooperation among enterprises. McKinsey reports that half of China's top 50 start-ups have partnered with the large home-grown technology companies, known collectively under the acronym BAT (Baidu, Alibaba, Tencent). The realization of e-government also makes it possible for the country to obtain real-time data on the development status of various fields of the national economy, improving macroeconomic coordination. Also, e-government helps establish an international business platform and encourages economic activity by facilitating the process of obtaining permits and licenses. Therefore:

H3: The improvement of online government services is positively correlated with urban competitiveness.

Digital life. Digital life is a way of life based on the Internet and a series of digital technology applications, which can quickly and conveniently enhance the quality of people's lives and work. Castells believes that the popularization of the Internet will completely change the way people work and live and promote the networking of production tools and the digitization of life styles. In actual city development, digitization and sustainability lay foundation for the construction of

the smart city. Technology providers, data providers and city leaders use digital technology to improve living conditions and reduce costs. This leads to a fourth hypothesis:

H4: The development of digital life is positively correlated with urban competitiveness.

Other control variables. Chenery's (1982) theory of industrialization points out that GDP per capita is a very effective and practical indicator for the kinds of consumption, business activities and corresponding economic opportunities available in the city. Per capita GDP is included as one of the variables in the measurement of Information Economy, one of our independent variables. But in addition, we collected data on the public budget expenditure as an indicator of the level of general prosperity of the local economy, and the value added of the tertiary industry as an indicator of the regional industrial structure. In addition, we include disposable personal income in the city as an indicator of the people's quality of life. By including these controls, the regression analysis will be able to exclude impacts on urban competitiveness unrelated to information technology.

Data

Data on the independent and dependent variables are collected for each city for the latest available year, 2017. The sample includes 294 prefecture-level cities in China (prefecture-level cities are the second-level local administrative regions, intermediate between provinces and counties).

Dependent Variable: Urban competitiveness index. Through the literature review above, it can be seen that urban competitiveness is a comprehensive concept that covers all aspects of social and economic life. Therefore, operationalization of urban competitiveness cannot be based on any single variable but needs to use a multidimensional index. For example, the "bowstring model" put forward by Ni (2013) can better reflect various aspects of urban competitiveness. His indexing system is relatively comprehensive and persuasive. The urban competitiveness put forward by him not only focuses on the current state of the city, but also emphasizes the sustainability of urban development and growth potential. Ni's method divides urban competitiveness into *economic competitiveness* (EC), *livability competitiveness* (LC), and *sustainable development competitiveness* (SDC). The indicator system selected is listed in Table 1.

The secondary indices in the urban competitiveness index are intended to measure different aspects of the competitiveness of cities. In this paper, we use the EC index, the LC index, and the SDC index as alternative dependent variables. Data on Ni's urban competitiveness index for the 292 cities in our database are available from the China Urban Competitiveness Report (2017). To ensure the reliability of the data, we carried out reliability test on the data. The reliability analysis module of SPSS shows that the reliability coefficient Alpha value of the indices in the Table 1 is 0.893, a satisfactory level.

Table 1 Urban competitiveness index system (Ni, 2013)

Primary indexes	Secondary indexes	Tertiary indexes
1. Urban economic competitiveness	1.1 Economic density	1.1.1 GDP per square kilometer of land
	1.2 Economic growth	1.2.1 Average GDP growth for five consecutive years
2. Urban livable competitiveness	2.1 Enterprise Ontology	2.1.1 Number of large companies
		2.1.2 Enterprise growth index
		2.1.3 Enterprise operation index
	2.2 Local Elements	2.2.1 Proportion of college population
		2.2.2 Number of patents
		2.2.3 Deposit balance per capita
	2.3 Local Demand	2.3.1 GDP
		2.3.2 Total retail sales of consumer goods
		2.3.3 Total sales of wholesale and retail goods
	2.4 Institutional Environment	2.4.1 Degree of convenience in setting up enterprises
		2.4.2 Tax of enterprises
		2.4.3 Rate of Non-Performing Loan
	2.5 Subject Contact	2.5.1 Total urban freight volume
		2.5.2 Total urban passenger transport
		2.5.3 Number of international travelers
	2.6 Infrastructure	2.6.1 Highway transportation convenience
		2.6.2 Railway transportation convenience
		2.6.3 Air transportation convenience
		2.6.4 Sea transportation convenience
3. Urban sustainable development competitiveness	3.1 Population quality	3.1.1 Per capita life expectancy,
		3.1.2 Proportion of college students or above
	3.2 Social environment	3.2.1 Number of doctors per10000
		3.2.2 Number of primary schools per 1000
		3.2.3 Number of criminal cases per 10000
	3.3Ecological environment	3.3.1 Air quality
		3.3.2 Comfort meteorology index
		3.3.3 Greenery coverage
	3.4 Living environment	3.4.1 Ratio of house price to income
		3.4.2 Number of restaurants and shopping places per 10000
	3.5 Municipal facilities	3.5.1 Road area per capita
		3.5.2 Density of drainage pipe
		3.5.3 Water supply pervasion

Independent variables:

The independent variables address the four explanations identified above: *information economy index, network society index, digital life index and online government index,* with their components as shown in Table 2. Data for all 292 cities are available from the Information Society Development Report (2017).

Table 2 Information society evaluation index system

Primary indexes	Secondary indexes		Tertiary index	
Name	Name	Weight	Name	Weight
1. Information economy index	1.1 Economic Development Index	1/4	1.1.1 Per capita GDP index	1
	1.2 Human resources index	1/4	1.2.1 Adult literacy index	1/3
			1.2.2 Educational investment index	1/3
			1.2.3 College student index	1/3
	1.3 Industrial structure index	1/4	1.3.1 Output structure index	1/2
			1.3.2 Employment structure index	1/2
	1.4 Development mode index	1/4	1.4.1 R&D investment index	1/3
			1.4.2 Innovation index	1/3
			1.4.3 Energy efficiency index	1/3
2. Network society index	2.1 Capacity to pay index	1/2	2.1.1 Broadband subscriptions index	1/2
			2.1.2 Mobile cellular tariffs index	1/2
	2.2 Social development index	1/2	2.2.1 Life expectancy index	1/3
			2.2.2 Urbanization index	1/3
			2.2.3 Air quality index	1/3
3. Online government index				
4. Digital life index	4.1 Number of subscriptions	1/3		
	4.2 Number of computers	1/3		
	4.3 Number of internet users	1/3		

Analysis

As a first step to analyzing the data, averages and standard deviations of all the variables were calculated and reported in Table 3.

Table 3: Range, Means and Standard Deviations of Variables

		N	Minimum	Maximum	Mean	SD
Economic competitiveness	(0-1)	291	0.02	1	0.096	0.09
Livable competitiveness	(0-1)	291	0.04	0.90	0.42	0.18
Sustainable development competitiveness	(0-1)	291	0.03	0.99	0.33	0.16
Information economy	(0-1)	291	0.21	0.78	0.36	0.10
Network society	(0-1)	291	0.25	0.86	0.43	0.12
Online government	(0-1)	291	0.18	0.93	0.56	0.13
Digital life	(0-1)	291	0.20	1.0	0.53	0.17
Per capita GDP	(thou.yuan)	291	12.36	190.00	58.16	41098
Household deposit balance	(bill. yuan)	291	22	2801	209.4	265
Tertiary industry added value	(bill. yuan)	291	8	2256.9	139.3	243
Public budget expenditure	(bill. yuan)	291	1.5	754.7	48.9	74.2
Disposable personal income	(yuan)	291	11085	58988	27569	8658

Note: SD, standard deviation.

As a further preliminary to regression analysis, correlations between the variables were calculated. The results are reported in Table 4, below.

Table 4: Pearson's correlations between variables

	EC	LC	SDC	IE	NS	OG	DL	HDB	TIAV	PBE
LC	.550**									
SDC	.734**	.805**								
Information economy	.791**	.755**	.842**							
Network society	.654**	.778**	.754**	.881**						
Online government	.579**	.550**	.619**	.631**	.574**					
Digital life	.606**	.725**	.771**	.817**	.859**	.548**				
Household deposit balance	.715**	.388**	.660**	.590**	.399**	.434**	.445**			
Tertiary industry added value	.856**	.486**	.728**	.717**	.542**	.528**	.521**	.875**		
Public budget expenditure	.792**	.396**	.648**	.626**	.439**	.468**	.427**	.878**	.957**	
Disposable personal income	.628**	.710**	.686**	.805**	.768**	.517**	.694**	.391**	.553**	.514**

**. Correlation is significant at the 0.01 level (2-tailed).

As shown in Table 3, high correlations were observed among some economic variables, namely the tertiary industry added value, public budget expenditure, and household deposit balance. To

avoid multicollinearity, it was decided to retain only one of these variables in the regression analysis. Because the tertiary industry marks the level of economic development of a country, it is one of the important indicators to measure the degree of economic development. It was decided to retain tertiary industry added value among these three. From Table 4 we can also see the correlation of the three competitiveness indices (EC, LC, SDC). It is noteworthy that the correlation between EC and LC is only 0.550. So our initial consideration is reasonable, there is justification to treat these three indices separately, as alternative dependent variables.

We started with a model including all the variables (with the exceptions discussed above). The results are reported in Table 5 below.

Table 5: Regression analysis for alternative dependent variable

	EC			LC			SDC		
	R-sq		0.833	R-sq		0.660	R-sq		0.775
	Sig.		< 0,0001	Sig.		< 0,0001	Sig.		< 0,0001
	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.
(Constant)		-4.464	0.000		-3.980	0.000		-3.358	0.01
Information economy	0.259	3.392	0.001	0.095	0.836	0.404	0.371	4.044	0.000
Network society	0.156	0.821	0.041	0.425	4.276	0.000	0.084	1.044	0.297
Online government	0.026	0.712	0.001	0.016	0.301	0.763	0.037	0.859	0.391
Digital life	0.027	.516	0.607	0.135	1.772	0.178	0.244	3.968	0.000
Tertiary industry value	0.666	17.269	0.000	0.014	0.247	0.805	0.276	6.082	0.000
Personal income	0.012	0.265	0.791	0.195	2.976	0.003	-0.032	-0.534	0.707

With these results, the hypotheses may be revisited. Our first hypothesis, on the impact of the information economy, was supported for Economic Competitiveness and Sustainable Development Competitiveness. This result may be considered in the context of China's transformation from an industrial economy with high resource consumption and high pollution to an information economy dominated by the application of new technologies. The intensification of the information economy is contributing to the economic competitiveness of cities, and moreover, doing so sustainably. However, the information economy index, focusing on macro-economic variables, is not contributing significantly to the livability of cities.

Turning to the second hypothesis, the regression results show that the development of network

society can promote urban economic competitiveness and livability competitiveness. However, it does not contribute to sustainable development. This makes sense, since the network society index also includes items (such as increasing broadband penetration and mobile phone use), that indicate a more resource intensive lifestyle.

For the third hypothesis, the regression results show that the development of online government can promote urban economic competitiveness. However, the results also show that online government did not have an impact on the livability of cities or sustainable economic development. As the administrator and participant in the economy, the level of management and service of the government has a direct impact on the development of the economy. Effective use of e-government can achieve better utilization of macro-data in a relatively short period of time, ensure the real-time availability and reliability of data, and lead to better decision-making. However, the results also indicate that the way Chinese e-government is currently used is not impacting urban livability or sustainable economic development. There is scope to reorient e-government services in a way that has better results in these areas.

Finally, we examined a hypothesis related to the development of digital life industry. It was positively related to the sustainable competitiveness. This indicates that digital technology has played a positive role in improving the competitiveness of cities in sustainable development.

A few further implications of these results may be noted. Firstly, the information economy index was not significant for urban livable competitiveness. This agrees with the observation that the current stage of development of the Chinese economy has resulted in great strains placed on the urban environment due to pollution and environmental degradation. Economic development, often associated with higher information economy deployment is also associated with issues of livability of cities in some parts of the country. In the course of fast growth, resources are wasted, environmental pollution is getting worse, and water resources are scarce. These problems are difficult to overcome in the short term and must be resolved step by step through long-term efforts and correct policy guidance. In the short term, the results indicate that the rise of the information economy is not making China's cities more livable.

Second, the digital life index was significant only for sustainable competitiveness. There is no doubt that digital technology has great potential in promoting the goal of sustainable development. But the construction of digital life in China is still in the initial stages. The key question is whether the government can effectively use the power of technology to create a more comfortable life for the public. We have reason to believe that with the use of digital technology in daily life, people will have more happiness by stimulating the sustained power of the digital economy in the future. The research in this area needs further improvement.

Discussion

In this paper, a theoretical framework from Castells' theory of the informational city was applied

to analyze the relationship between urban competitiveness and the smart city. The analysis uses existing government databases as secondary sources and applies quantitative analysis to explore how various elements of the smart city contribute to city competitiveness. The research results are as follows:

The four independent variables are all positively correlated with the three urban competitiveness scores. According to this result, we conclude that smart city programs are conducive to improving overall urban competitiveness. Smart city programs and city competitiveness are mutually enhancing and supportive; urban development will be more promising due to the promotion of information technology in the construction of a smart city.

Information economy, network society and online government all contribute to improve the urban economic competitiveness. From the macro perspective, the information economy promotes the transformation and upgrading of industrial infrastructure, optimizes the efficiency of resource allocation, enables the production possibility frontier to expand outward and accelerates economic growth. Meanwhile, the network society enables companies or individuals from everywhere to be closely connected in information sharing, resource sharing and intelligence sharing, which provides trade opportunities for enterprises and enables efficient economic development. Therefore, if local government wants to improve the urban economic competitiveness, in addition to vigorously developing the information economy industry and the network society, government can also strengthen e-government. For instance, in view of the current chaos in city financial management and the emergence of corruption in society, e-government can fully exert its supervisory role through the development of application software, plugging financial management loopholes and preventing corruption.

Developing the network society is the key to enhancing the urban livable competitiveness. Network society is mainly manifest in two respects, namely, the availability of information services and the comprehensiveness of social development. By ensuring that residents can get information at low cost, the network society will improve residents' access to information products and services and enable the vast majority of citizen to fully enjoy the civilized life of the modern city, which also improves the urban livable competitiveness.

Information economy and digital life are the main driving forces to improve the sustainable development competitiveness. The core concepts of information economy and digital life is abandoning the traditional economic growth mode and realizing the sustainable development of the city through the low-carbon economy and lifestyle. For example, the new round of the digital revolution driven by technologies such as cloud computing, big data and the Internet of Things has made it possible to solve the dilemma of energy consumption. Moreover, an increasing number of enterprises are using digital technology at work, and their management and energy efficiency have been greatly improved.

Economic competitiveness that relies on the tertiary industrial sector can have a positive impact

on sustainable development. Therefore, in order to balance economic growth and environment protection, it is crucial to transform the traditional industrial development and adopt the tertiary-industry-oriented eco-economic model.

In this paper, we define a new competitiveness system that reflects economic growth, social well-being and sustainable development. A complex mechanism connects the comprehensive development of smart cities and overall competitiveness. For different types of cities, different strategies and countermeasures should be adopted to enhance urban competitiveness. For cities which try to climb to the top of the world, it is necessary to strengthen the power of technological innovation, global connections and international brands in the information economy fields. For the fast-growing emerging metropolitan cities, improving the business and living environment are an imperative. But it is also necessary to ensure that residents can get information at low cost. For the more backward cities, government should start from the foundation: improve access to basic communication facilities; create employment opportunities by developing local industries; use e-commerce to sell agricultural products to various places, help people shake off poverty and improve people's living standards from multiple measures. It should be noted that economic vitality, urban livability and sustainable development are the three components of urban competitiveness, and different competitive advantages are mutually reinforcing. It is necessary for a city to move toward a future of coordinated development of economy, society and environment.

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