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Measurement of Urban Potential for Global Consumer Center and Impact Elements

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Abstract

This paper constructs an evaluative system for global consumer centers from four dimensions: consumer level, consumption structure, quality and environment. We first calculate and evaluate the inherent potential of building global consumption centers in 28 tier-1 and tier-2 cities in China by utilizing the entropy method, and then test influential elements by using OLS mixed regression estimation. The research results indicate that the development scale of the service industry and its interaction with tech-innovative capability significantly enhance the construction potential in heterogeneity across regions. Government should construct international consumption centers at eastern developed cities in priority. Fiscal expenditures should mainly support infrastructural work at potential cities in the central, western, and northeastern regions to explore the establishment of regionally distinctive consumption centers.

Keywords

Service Industry, Scientific and Technological Innovation, Government Fiscal Expenditure, International Consumption Center

1. Introduction

Consumption is an important engine driving China's economic growth. Continuously improved spending capacity of Chinese residents cause personalized, diversified, and quality-oriented purchase behaviors. According to Guidance for Cultivating and Building International Consumer Center Cities (referred later as the Guidance) stipulated by the Ministry of Commerce and other 14 authorities in 2019, global consumer center as key function of modernized metropolis lead and drive global consumption for agglomeration of global consumer resources. Guangzhou will cultivate some consumer centers to attract global resources and

upgrade urban consumption within five years. In July 2021, the Chinese State Council approved Shanghai, Beijing, Guangzhou, Tianjin and Chongqing pioneer the construction of global consumer centers as well as capitals of global fashion and trade, and global tourism and consumption destinations. Regions have formulated a series of strategic plans and implementation schemes to construct consumption centers, aiming to boost consumption growth through initiatives flagship store, e-commerce broadcast, and distinctive commercial districts. However, considering the available resources that consumption centers rely on, do all cities have the capability to set up such centers? How to evaluate their construction potential? Based on the panel data of 28 large and medium-sized cities from 2010 to 2019, this paper constructs index to evaluate the construction potential for global consumer centers and examine its impact factors, in order to find out the diverse capacity across regions and put forward political suggestions on the construction path.

2. Literature Review

2.1. Definition and Driving Factors of Global Center City

Edward Glaeser, an American economist, first proposed the concept of consumer city in his studies on the city's function from the perspective of consumption. The Global consumer center is evolved from consumption city. Consumption city have an internal consumption rate of over 50%, emphasizing the endogenous consumption power (Zhao & Zhang, 2009), while global consumer city focus more on external consumption rate, not only emphasizing the continuous growth of local consumption, but also how to attract global tourists to settle in and consume. According to the guideline, global consumer centers are those with good basic conditions, large consumption potential, high level of internationalization, global influence and attraction, which are based on the domestic market and radiate the surrounding areas and open to the world. The global consumer center should have a certain capacity, be able to attract a mass of global famous brands, have complete transportation and information infrastructure, provide preferential taxes and financing policies, and be able to attract global tourists to visit and consume (Wang, 2019). With rich business ecology, perfect supporting service system and diversified consumption patterns, it will drive and radiate the economic development of surrounding cities (Zhong & Li, 2021). It can stimulate consumption potential and upgrade industries by constructing a virtuous cycle of consumption scene → service ecology → consumption power → industrial development.

Clearly, an international consumption center is a city's journey towards internationalization. The city's service capacity determines its ability to accommodate international consumer goods.

2.2. Evaluation of Global Consumer Center

Criterion on construction potential of global consumer center are mostly based

on the evaluation index of global cities, combined with the cities' characteristics. Wang (2019) establish ICCA index from five first-level indicators, including city size and strength, consumer attraction, consuming facilities, consumer service, and consumption realization, and found that eastern cities with good economic foundation have a high score. Provincial capitals have better resource allocation. Zhang (2022) built an evaluation system with 5 first-level indicators and 32 second-level indicators as per the Overall Plan for Cultivating International Consumption Center Cities. Guo (2020) calculates the index measuring possibility of constructing global consumer center by using entropy weight method from capacity, potential and infrastructure dimensions of consumption. However, it is not convincing to reflect the consuming status of clothing and food lines only using store amount of Uniqlo and Haidilao. Zhong and Li (2021) measured the fulcrum effect in 10 major cities by using consumption scale, potential and convenience, but ignore the inducing effect to attract global consumer. Some researcher establish criterion from industrial ,environmental competitiveness and global impact dimensions (He et al., 2019); or from consumption scale, business cost, brand penetration, business format scale and innovative consumption scale aspects (Wei, 2020); or from economic development potential, consumer market potential and urban living environment potential dimensions (Wu, 2021); or from international visibility, city prosperity, business activity, accessibility, consumption comfort and policy guidance aspects.

Scholars use various metrics, mainly concerning the impact of the environment, infrastructure, and consumer scale on consumption, while overlooking the interaction between technology and service capabilities.

2.3. Research on the Influence Factors of Consumption

Research on the relationship between the development of service industry and consumption mainly focuses on four aspects:

First concerns the impact of consumer finance. Most studies believe that moderate development of consumer finance is conducive to consumption (Dong, 2021) by reducing spot transaction costs through innovative financial products and inspiring consumer potential by financial leverage. In the mechanism of promoting residents' consumption by finance, income distribution shows "masking effect" or partial intermediary effect in different periods and regions (Zheng & Li, 2021).

The second is the influence of circulation industry. Logistics help promote the expansion of residents' consumption as well as quality improvement (Xu, 2020a). Zhu (2021) built a fixed-effect model based on the domestic inter-provincial panel data from 2001 to 2018, and found that modern logistics significantly promoted rural consumers' expenditure in regional heterogeneity. Resident consumption can be expanded in better quality by optimizing supply of products or services, improving circulation efficiency (Yang et al., 2020), and stimulating revenue growth (Sun, 2021). Some scholars examine the impact of cultural indus-

try (Wang & Gu, 2022) and retail formats (Wang, 2021) on consumption.

The third focus on the impact of digital technology. Opening toward the world, technological innovation and digital finance collaborate and promote the development of the tertiary industry (Yan & Feng, 2021; Xu, 2021), which further upgrading household consumption. But this effect is not significant in the western region of China (Yang et al., 2021).

Fourth concerns the role of government fiscal expenditure. Discussion on the two aspects, say total amount and structure of fiscal expenditure by the academic circles have not reached a unanimous conclusion. Some studies show a crowding effect, that is, the increased government fiscal expenditure can drive private consumption expenditure, while the pulling effect differ across regions (Li & Zhong, 2013). some studies found crowding-out effect exists, that is, increasing government fiscal expenditure will restrain household consumer expenditure (Yi & Liu, 2013), this type of relationship changes in different phase and structure. Different fiscal expenditure diversely impact household consumption rate. Government consumption expenditure shows crowding-in effect in the short term, while crowding-out effect in the long term on household consumption. Transfer payment, investment expenditure and service expenditure from government aspect have crowding-in effect on household consumption (Wu & Chao, 2014).

Most studies on consumption are qualitative analysis, some studies establish DSGE model (Zhang, 2020) and SVAR model (Yue et al., 2014) based on time series data, or utilize generalized least square (Zhang et al., 2013), partial least square (Cai & Hu, 2014), intermediary effect model (Yan & Feng, 2021) or dynamic stochastic general equilibrium model (Wu & Chao, 2014) based on panel data. Most existing studies use inter-provincial or national data to examine the impact of specific industries on residential consumption, and few studies have explored international consumption potentials as well as their driving forces across cities.

Invisible, finance, logistics, and technology are the primary aspects of consumer service capability. As technology often permeates all industries, it enables the acquisition of new service capabilities through innovative service models and processes. Connecting data across various stages of service is conducive to obtaining new real-time datasets, which can be leveraged through big data technology to further drive technological innovation and enhance the service experience. Therefore, in research, technology can be considered an exogenous variable in consumer services, and the interaction between technology and consumer services can be explored for its impact on household consumption.

3. Evaluative Measurement for City Potential to Build Global Consumption Center

3.1. Indicators to Evaluate Construction Potential for Global Consumption Centers

Global consumption center city is a world city with strong competitive capacity attracting world consumers. This paper constructs potential index (see **Table 1**)

Table 1. Indexes evaluating construction potential for global consumption centers.

Primary index	Secondary index	Indicator specification	Unit	Data Sources
Power of consumption	Per capita consumption expenditure of urban residents (x1)	Reflecting local per capita consumption level	Yuan	Qianzhan database, local statistical bureau
	Total retail sales of consumer goods(x2)	Reflecting local consumption scale	100 million yuan	State Statistics Bureau
	Urban per capita disposable income(x3)	Reflecting local consumption potential	Yuan	EPS database, local statistical bureau
	Number of foreign tourists received(x4)	Reflecting consumption potential from overseas tourists	Person	EPS database, local statistical bureau
Consumption structure	Proportion of enjoyment consumption accounts for the total (x5)	Reflecting upgrade degree of consumption content	%	EPS database, local statistical bureau
	Volume of online retail transaction (x6)	Reflecting upgrade degree of consumption mode	100 million yuan	Converted using data of Statistics Bureau
Consumption services	Number of star hotels (x7)	Reflecting reception capacity for consumption scenarios	Unit	EPS database, local statistical bureau
	Freight volume of the whole society (x8)	Reflecting social logistics service ability	Ten thousand tons	Qianzhan database, local statistical bureau
	Balance of local and foreign currency loans in financial institutions (x9)	Reflecting social financial support capacity	100 million yuan	Qianzhan database, local statistical bureau
Consumption environment	Per capita GDP growth rate (x10)	Reflecting economic and social development	%	Municipal statistical yearbooks
	Consumer Price Index (x11)	Reflects changes in consumer prices	%	Municipal statistical yearbooks

covering 11 indicators from four dimensions of consumption, say power, structure, service and environment to evaluate the possibilities for constructing international consumer centers in major cities of China, in order to explore the driving factors and feasible channel varies in cities.

Consumption power refers to the quantity of products or services purchased by domestic and foreign tourists and regional residents as well as their satisfaction. It is mainly measured by capita consumption expenditure of urban households, total retail sales of consumer goods, disposable income of urban residents, number of overseas tourists received, number of domestic tourists received, per capita consumption of tourists and other indicators. Among them, the consumption expenditure of urban residents reflects the consumption level of each person at demand-ends, while the total retail sales of consumer goods reflect the scale of regional consumption from at supply-ends. Per capita disposable income

of urban residents reflects local consumption power. The number of foreign tourists received reflects regional consumption potential by attracting overseas tourists, that is, the possibility of a region as a consumption destination for tourism. The larger is the number of overseas tourists received, the greater will the consumption potential be.

Consumption structure is used to measure the upgraded degree of urban consumption, that are evaluated from aspects of consumptive objects and modes (Du, 2017), reflected by the proportion of enjoyable consumption in total consumptive expenditure and the ratio of online retail transactions in total social retail sales respectively. Among them, enjoyment-type expenditure consumes for household equipment, supplies and services, medical care, transportation and communications, education, culture, entertainment and services. Optimized consumption structure represents a larger and upgraded regional consumption.

Consumer service refers to consumers' inner feelings about purchased products, content, services and environment, measured from the supply aspect of consumer products and services (Li, 2021). The number of star hotels reflect the reception capabilities for specific consumption scene. The freight volume of the whole society reflect logistical service capacity. The balance of local and foreign currency deposits in financial institutions at the yearend reflects financial service capacity, and the scale of the digital economy reflect the digital service capacity. We suppose that larger loan scale lead to more active economic activities in the city, which is more conducive to funds collection, local consumption and service supply. Diversified channel of purchase induce to consumption decision.

Consumption environment reflect the conditions of stable market prices and orderly economic development in a region. A safe and orderly social environment for industrial mutual assistance, a fresh, clean and sanitary natural environment, and a colorful shopping environment are important guarantees for the construction of an international consumption center. In this paper, the per capita GDP growth rate is used to reflect the economic development situation, and the consumer price index is used to reflect the variation trend of the resident price. If the regional economy develop well, the more stable the consumer price, the more able to attract external tourists and stimulate the current consumption; The greater the fluctuation of consumer prices, the stronger the liquidity constraint on residents' consumption.

3.2. Measurement of the Potential Index of International Consumption Center

3.2.1. Data Sources and Explanation

Considering blocked flow of global personnel and stagnate consumption during 2020 and 2023 for the novel coronavirus (COVID-19) epidemic, this paper selects the balanced panel data of 30 prefecture-level cities in China from 2010 to 2019. For the absent city-level data for online retail transaction before 2015 (except for municipalities directly under the Central government), we use the index decomposition method to estimate weighted by the proportion of urban retail

sales of social consumer goods in the whole country or province. For the missing value, the linear interpolation method is used to estimate based on the data of adjacent years.

3.2.2. Variable Normalization

We then dimensionless process the data utilizing the range standardization method to alleviate role of dimensional differences, and each index is adjusted to the range of [0, 1]. Assume that the original data of index j of city i in the year λ is $x_{\lambda ij}$, the evaluation object corresponded to $x_{\lambda ij}$, the maximum and minimum values of the column j are $x_{\max}$ and $x_{\min}$ respectively, $y_{\lambda ij}$ is the index processed by the range standardization method. The dimensionless treatment formula for the forward index is:

$$y_{\lambda ij} = \frac{x_{\lambda ij} - x_{\min}}{x_{\max} - x_{\min}}, i = 1, 2, \cdots, m;\ j = 1, 2, \cdots, n;\ \lambda = 1, 2, \cdots, h$$

The standardized treatment formula for the negative index is as follows:

$$y_{\lambda ij} = \frac{x_{\max} - x_{\lambda ij}}{x_{\max} - x_{\min}}, i = 1, 2, \cdots, m;\ j = 1, 2, \cdots, n.$$

3.2.3. Calculation of PICC with Index Weighted by Entropy Weight Method

To avoid disturbance from subjective factors, we adopt the objective entropy weight method to determine index weight. The calculation formula is as follows:

$$P_{\lambda ij} = \frac{y^*_{\lambda ij}}{\sum_{\lambda=1}^{h}\sum_{i=1}^{m} y^*_{\lambda ij}}.$$

Among them, $y^*_{\lambda ij} = y_{\lambda ij} + 0.0001$, $P_{\lambda ij}$ represent the proportion of the standardized value of item j's overall shifted indicator in the entire sequence of evaluation years at place i.

The information entropy of item j is:

$$E_j = -k\sum_{\lambda=1}^{h}\sum_{i=1}^{m} P_{\lambda ij} \times \ln P_{\lambda ij}, \text{ in which, } k = \frac{1}{\ln(h \times m)}$$

The entropy weight of item j is:

$$W_j = \frac{1 - E_j}{\sum_{j=1}^{n}(1 - E_j)}$$

We adopt linear weighting method (Wang, 2019) to comprehensively calculate the Potential International Consumption Center (PICC) index for urban international consumer centers, which is displayed per ten thousand scale, the composite index model is:

$$PICC = 10000 \times \sum_{i=1}^{n}\left(W_j \times P_{\lambda ij}\right), i = 1, 2, \cdots, n;\ j = 1, 2, \cdots, m.$$

3.2.4. Index Measurement

Based on above steps, the weights of various indicators in the evaluation system for the potential of global consumer centers are obtained (see **Table 2**).

Table 2. Weights of indicators measuring construction potentials.

Primary index	Secondary index	Weight (W_j)
Power of Consumption (0.3671)	Per capita consumption expenditure of urban residents (x1)	0.0436
	Total retail sales of consumer goods (x2)	0.0768
	Urban Per Capita Disposable Income (x3)	0.0419
	Number of foreign tourists received (x4)	0.2021
Consumption Structure (0.2894)	Proportion of enjoyment consumption accounts for the total (x5)	0.0035
	Volume of online retail transaction (x6)	0.2859
Consumption Services (0.3146)	Number of star hotels (x7)	0.1133
	Freight volume of the whole society (x8)	0.1028
	Balance of local and foreign currency loans in financial institutions (x9)	0.0985
Consumption Environment (0.0318)	Per capita GDP growth rate (x10)	0.0045
	Consumer Price Index (x11)	0.0273

3.3. Evaluation of Potential to Formulating Global Consumer Centers

We divided the 30 prefecture-level cities into four regions by the northeast, central, eastern and western and measure its' PICC index (see Appendix 1). During 2010 and 2019, the average index increased from 19.88 to 52.57 (see Figure 1), increased by 11.41 percent annually, showing a rising consumption level. The eastern region grew at the fastest speed by 11.81 percent. The western, central and northeastern regions increased by 10.44%, 12.01% and 7.91% respectively, which indicate that China's supply-side structural reform, political measures to boost domestic demand and accelerate domestic and international circulation in recent years have been effective.

Comparing PICC mean value across regions, we find that the construction potential varies from large to small in order of East, West, Northeast, and central regions during 2010 and 2014, and East, West, Central, and Northeast regions during 2015 and 2019. The eastern region, home to first-tier and new first-tier cities, has a relatively high level of economic development, plenty of job opportunities, excellent business environment, and developed service sector, attracting

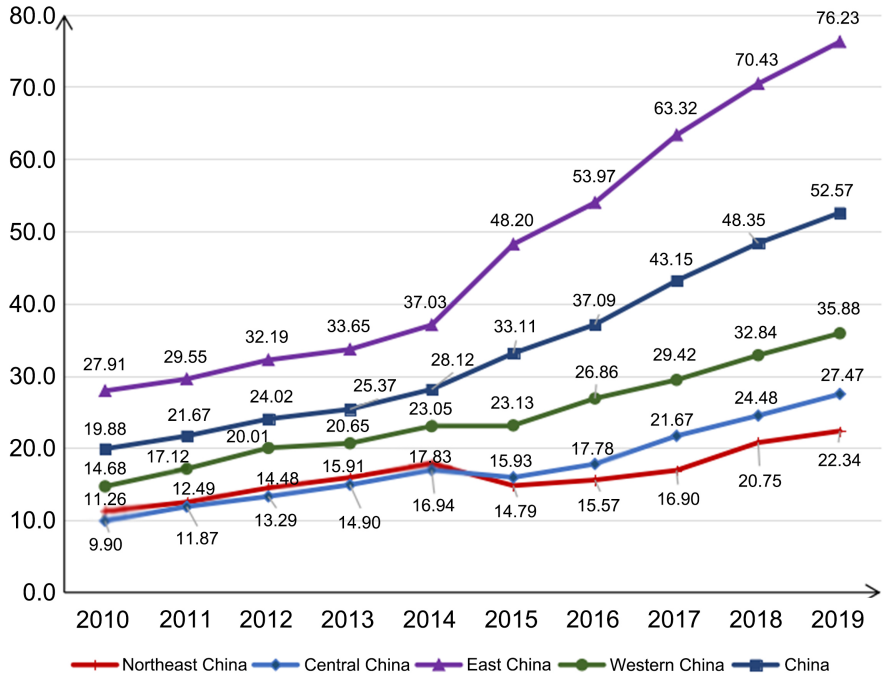

Figure 1. Comparison of PICC mean values across regions from 2010 to 2019.

mass of human being and capital, which is conducive to ameliorative consumption. Thanks to the rapid development of the digital economy, the Western Corridor and the Chengdu-Chongqing economic circle, the western region has enriched scene for consumers, enhanced supply of global brands, increased job creation in the service sector, and continuous improvement in residents' income and consumption quality. Since 2014, the consumption potential of Northeast China has declined sharply, and the business mode supported by resource-dependent heavy industry has encountered a bottleneck, which backward its economic development and loss population seriously.

In terms of annual indicators, cities with PICC index above the mean increased from 7 in the year of 2010 (Beijing, Shanghai, Suzhou, Hangzhou, Guangzhou, Shenzhen and Chongqing) to 10 in the year of 2019 (Nanjing, Ningbo and Chengdu were added), among which 2 cities were in the western region and the rest were in the east. Considering IPCC index, Shanghai is above 200, Beijing, Shenzhen and Guangzhou is above 100, showing greater construction potential for global consumer center than other cities. 12 cities have small construction potential with PICC index of less than 30, with (see **Table 3**). From above we think the eastern regions are qualified to built global consumer centers, the western region, as Chongqing and Chengdu has great development potential, and the central and northeastern regions have to rely on other city to create opportunities. The PICC index of Harbin, Changchun, Lanzhou, Haikou, Taiyuan, Guiyang, Shijiazhuang, Hefei, Nanchang and other cities is less than half of the average value, manifesting their little construction potential and needs to leverage other core cities for development.

Table 3. Construction potential index for global consumer centers by cities in 2019.

City	PICC index	Rank	City	PICC index	Rank	City	PICC index	Rank
Shanghai	225.10	1	Wuhan	50.68	11	Shenyang	25.85	21
Pecking	186.16	2	Tianjin	40.29	12	Hefei	25.17	22
Shenzhen	141.89	3	Xiamen	38.74	13	Shijiazhuang	19.92	23
Guangzhou	132.26	4	Qingdao	33.67	14	Haerbin	18.68	24
Hangzhou	82.66	5	Fuzhou	33.40	15	Guiyang	18.56	25
Chongqing	65.60	6	Changsha	32.87	16	Nanchang	16.57	26
Ningbo	61.83	7	Xian	30.75	17	Changchun	15.56	27
Suzhou	54.83	8	Jinan	30.52	18	Taiyuan	12.71	28
Chendu	54.51	9	Dalian	29.28	19	Lanzhou	9.98	29
Nanjing	53.01	10	Zhenzhou	26.81	20	Haikou	9.15	30

4. Research on Factors Driving the Construction of Global Consumer Center

We believe that the global consumer center is evolved from urban service industry at a certain stage. One side, producer services act as intermediate goods for manufacturing, conducive to integration of two industries and enriching qualified digital outputs through producing servitization. On the other hand, innovative financial products, optimized logistics routes and digital business mode are also beneficial for stimulating current consumer demand, enhancing user experience and attracting global consumers (see **Figure 2**).

The application of new generation of information technology organically integrate online and offline consumption mode, and greatly attract urban consumption. Consumers adopt various ways such as "online ordering and offline distribution", "store experience and online consumption" by drainage cross channels and scenes, enjoying an integrated service experience. With the rapid development of e-commerce, consumers change their purchase structure more efficiently. The emergence of online court and e-commerce insurance has made credit a crucial connecting foundation, which is conductive to shape integrity culture and purified business environment, and attract global brands and made consumers "purchase with confidence and convenience".

Integrated development of science and technology and service industry foster the emergence of online medical care, online education, digital content, smart business travel and other consumption formats. Remote consumption drive talents, capital and technology flocking toward smart cities, which is beneficial to expand production capacity and upgrade industrial structure by enlarging urban consumer scale, and finally empower local and overall consumption by increasing residents' income.

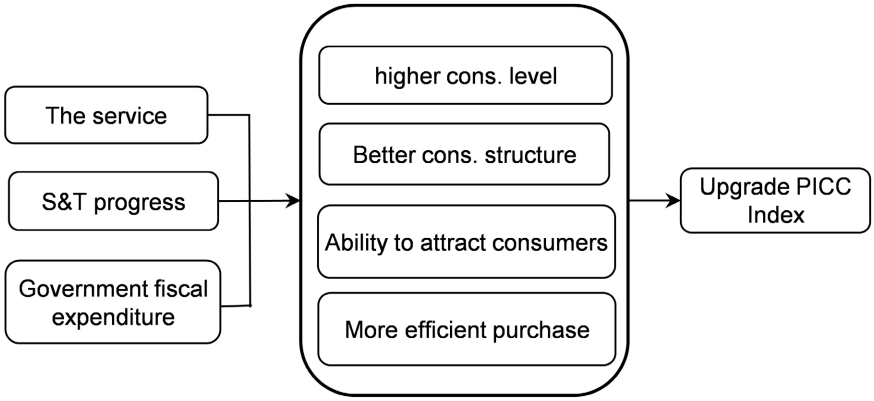

Figure 2. Factors impacting PICC index.

Based on Keynesian economic theory, under insufficient effective social demand, increasing government fiscal expenditure can stimulate consumption growth from three perspectives: Firstly, through multiplier effect, it can drive national economic growth, expand aggregate demand, increase job supply and social employment level, thereby raising residents' income and improve their consumption. Secondly, by increasing expenditure on basic healthcare, basic education and other general public services, it can reduce residents' precautionary savings motives and stimulate current consumption (Cai & Hu, 2014). Thirdly, by increasing spending on social infra structure such as parks and squares, it effectively enhances the consumption environment and reduces consumption constraints through the purchase of public goods and the creation of public consumption space (Ran & Li, 2017).

In summary, the development of the service industry, scientific and technological progress, and increased government fiscal expenditure contribute to enhancing urban consumption convergence, diversifying consumption scenarios and patterns, improving residents' purchasing efficiency, attracting the gathering of global brands, and consequently driving cities transform into global consumption hubs. Based on this, the research hypothesis is proposed: the development of service industry, scientific and technological progress, and government fiscal expenditure are crucial factors driving cities the establishment of global consumption centers. The integrated development of science, technology and service will further enhance the potential of constructing global consumption centers.

5. Empirical Test on the Driving Forces of PICC

5.1. Variable Selection and Data Sources

We use international consumption center potential index ($picc_{it}$) previously measured as explained variables, and select servicing development scale (ser_{it}), technical innovation level (pat_{it}), government spending (gov_{it}), the interaction of services and technology innovation ($ser^{*}pat_{it}$) as explanatory variables. Servicing development scale (ser_{it}) is reflected by ratio of the added value of servicing in

the GDP; The level of technological innovation (pat_{it}) is reflected by per capita number of granted patents; Government expenditure (gov_{it}) is reflected by general public budget expenditure. The interaction between services and technological innovation ($ser^{*}pat_{it}$) reflects their synergistic impact.

We use urbanization level (urb_{it}), urban openness degree (tra_{it}), the infrastructure construction level (inf_{it}) and urban population (pop_{it}) as control variables. The urbanization level (urb_{it}) is reflected by the urbanization rate. Urban openness degree (tra_{it}) is reflected by the total volume of imports and exports in the current year; The infrastructure construction level (inf_{it}) is reflected by the number of users connecting Internet broadband. Urban population (pop_{it}) is reflected by population density. The variable description is shown in Table 4.

This article focuses on 28 prefecture-level cities with the characteristics of provincial capital, direct-administered municipalities (excluding Xinjiang, Tibet and Inner Mongolia), having prominent tourism and cultural resources as the research object. The time series covers 2010 to 2019, with missing values filled using the mean imputation method. Logarithmic transformation or range standardization are applied to certain indicators.

Descriptive statistical analysis (see Table 5) indicates that service industry scale (*SER*) exhibits a large range (0.3634), with a standard deviation (0.0786) smaller than the range, indicating a concentrated data distribution and relatively small differences between data, without significant outliers. The standard deviation of PICC index (0.8377) is greater than the range (4.1301), indicating a dispersed data distribution and significant regional disparities.

Table 4. Variables definition and economic implication.

Variable	Name of variable	Code	Definition of variable	Data source
Explained variable	International Consumer Center Potential Index	*PICC*	As measured	-
Explanatory variables	Service industry scale (%)	*SER*	Share of value added of service industry	As measured
	Technological innovation level (piece)	*PAT*	The Number of Granted Patents	Local statistics
	Government expenditure level (100 million yuan)	*GOV*	General public budget expenditure	Local statistics
	Synergy of service and technological innovation	*SER*PAT*	Interaction between service industry scale and technological innovation	As measured
Control variables	Urbanization Level (%)	*URB*	Urbanization rate of permanent resident population	Local statistics
	City openness (US $100 million)	*TRA*	Total imports and exports of goods	Local statistics
	Infrastructure construction level (ten thousand households)	*INF*	Number of fixed Internet broadband access users	EPS database
	Population status (people/km^2)	*POP*	Density of Population	EPS database

Table 5. Descriptive statistical analysis.

Variable	Observed value	Mean value	Standard Deviation	Min. value	Max. value
PICC	280	3.1619	0.8377	1.2910	5.4211
SER	280	−0.2741	0.0786	−0.4407	−0.0773
GOV	280	6.8839	0.8569	4.3765	9.0324
PAT	280	9.5919	1.2224	5.1623	12.0212
URB	280	4.2619	0.1882	3.7145	4.6123
INF	280	5.4985	0.7182	3.6652	7.3563
POP	280	8.2594	0.6568	7.0312	9.6275
TRA	280	5.9450	1.4976	2.3662	8.5924

5.2. Model Specification

We employ a static panel regression model as follows:

$$PICC_{it} = \alpha + \beta_1 SER_{it} + \beta_2 PAT_{it} + \beta_3 GOV_{it} + \beta_4 SER * PAT_{it} + \gamma CONTROL_{it} + \mu_i + \varepsilon_{it}$$

Wherein, $PICC_{it}$ refers to the construction potential of international consumption centers at city i in year t. $SER*PAT_{it}$ represents the interaction between the service industry and technological innovation at city i in year t. $CONTROL_{it}$ represent control variables, including urbanization level (URB_{it}), degree of urban openness (TRA_{it}), infrastructure development level (INF_{it}), and demographic factors (POP_{it}). μ_i represents unobservable regional effects. ε_{it} is random error term.

5.3. Unit Root Test

To examine the validity of the model, we conduct Variance Inflation Factor (*VIF*) test and find that the *VIF* values of all independent variables are within the range of 0 to 10, indicating the absence of multi-collinearity among the data. Then we perform LLC test. The results (see **Table 6**) indicate that there are no unit root issues, and no spurious regression problem exists.

5.4. Result of Model Estimation

First, we use OLS mixed regression estimation to test the individual effect, getting the probability of F statistic of 0.0000, which indicates that the fixed effect model is superior to the mixed OLS model. Then we use the LM statistic method to test the time effect, getting the P value of 0.0000, which indicate that the random effect model over match the mixed regression model. Then, we use Hausman test, getting the P value of 0.0000, that is, the fixed effect model over match the random effect model, so the fixed effect model is used for estimation.

Table 6. Results of LLC unit root test.

Variables	Total samples		The eastern		The middle		The western		The northeastern	
	t	P	t	P	t	P	t	P	t	P
PICC	−7.3377	0.0000	−3.0362	0.0012	−4.2318	0.0000	−2.7134	0.0033	−3.6394	0.0001
SER	−4.7082	0.0000	−5.4199	0.0000	−1.9976	0.0229	−1.3832	0.0833	−10.8534	0.0000
GOV	−10.1680	0.0000	−3.5787	0.0002	−5.0970	0.0000	−3.9621	0.0000	−2.2373	0.0126
PAT	−12.9745	0.0000	−8.8343	0.0000	−16.7027	0.0000	−3.3342	0.0004	−3.1944	0.0007
*SER*PAT*	−7.8908	0.0000	−7.0394	0.0000	−9.0692	0.0000	−10.0298	0.0000	−1.7816	0.0374
URB	19.6709	0.0000	−8.5526	0.0000	−4.8734	0.0000	−1.8515	0.0321	−2.3111	0.0104
INF	21.1320	0.0000	−6.4032	0.0000	−11.4580	0.0000	−4.5988	0.0000	−3.0578	0.0011
POP	11.6638	0.0000	12.4728	0.0000	−1.7933	0.0360	−2.8294	0.0023	−3.7508	0.0001
TRA	7.5349	0.0000	−3.6060	0.0000	−3.7585	0.0001	−4.0843	0.0000	−3.2908	0.0005

The stepwise regression results of Model 1 - 3 show that service industry (SER), government expenditure (GOV), scientific and technological innovation (PAT) drive the construction of global consumer center. The fit goodness of 0.8795 indicates a strong explanatory power for model 4. The coefficients of service industry development (SER) and government fiscal expenditure (GOV) are 0.0836 and 0.6835, which are significant at 5% level and 1% level respectively. When all explanatory variables are considered, the regression coefficient of scientific and technological innovation (PAT) becomes insignificant, while the coefficient of SER*PAT is significantly positive, which confirms the hypothesis: Service industry development and government fiscal expenditure are important forces driving the construction of global consumer center. Limited by the weak innovative capability, promoting the integration of scientific and technological innovation and service industry is conducive to enhancing the potential of building global consumer center.

Results of all regression models show that the coefficient of infrastructure construction (INF) is always significantly positive, indicating that the more perfect infrastructure construction, the stronger the agglomeration ability of global consumer brands, the more conducive to attracting overseas consumers.

5.5. Regional Heterogeneity Regression

To investigate the regional heterogeneity of factors influencing the PICC as mentions above, the selected 28 prefecture-level cities was divided into four sub-sample groups: East, Central, West and northeast. Individual effect, time effect and Hausman test were conducted for each subgroup. Eventually, a fixed effects model was chosen to estimate regressions for each of the four sub-sample groups, and the results are presented in Table 7.

The results in Table 7 show that, of the first, the impact of servicing development scale on urban IPCC index exhibits notable regional heterogeneity. In the

eastern region, the scale of servicing development has a significantly positive impact on urban PICC. However, for the central, western, and northeastern regions, this effect is not obviously manifested, which might because the service industry in these regions are in smaller size, making limited and insignificant economic effects and having a constrained influence on enhancing urban PICC. The eastern region develops service industry earlier, leveraging its talent, location, and economic advantages to attract necessary production factors and resources. Expanded service industrial scale in eastern regions generates positive external economic effects by qualifying, increasing and optimizing local consumption. This, in turn, enhances the attractiveness of eastern cities both domestically and internationally, leading to rising urban PICC.

Second, the effect of government fiscal expenditure on enhancing the PICC does not exhibit regional heterogeneity. This indicates that government intervention contributes to urban development as global consumption centers across all regions.

Third, the role of S&T innovation in increasing the IPCC index is not significant in any of the four regions. This is primarily due to the relative weak innovative capability in China.

Table 7. Estimate results by region.

	The eastern	The middle	The western	The northeastern
SER	0.2114***	0.0164	−0.0232	0.0088
	3.71	0.43	−0.73	0.17
GOV	0.6040***	0.1925*	0.5993***	0.4977**
	7.98	1.87	4.01	3.64
PAT	0.0465	0.1259	0.0442	0.0770
	1.03	1.61	0.44	−1.03
*SER*PAT*	0.7552**	0.0087	0.0346	0.0270
	3.36	0.49	1.88	0.61
URB	0.1440	−1.0525	0.6853	0.5814
	0.46	−1.04	0.87	0.74
INFRA	−0.0242	0.2000***	0.1370	0.4610**
	−0.55	4.35	1.48	3.35
POP	0.0709	0.0519	−0.2086**	0.0066
	1.12	0.50	−2.97	0.15
TRADE	0.0085	0.0716	−0.1625**	0.2844**
	0.08	1.06	−2.84	3.36
cons	2.3782*	0.5289	1.7608	−6.7824**
	1.69	1.20	0.51	−1.95
R-sq	0.8790	0.9629	0.9412	0.8926
F	115.30	90.88	73.99	29.08
p > *F*	0.0000	0.0000	0.0000	0.0000

t statistics in parentheses, *$p < 0.01$, **$p < 0.05$, ***$p < 0.001$.

Finally, the combined influence of service industry and S&T progress on the PICC exhibits evident regional heterogeneity. In the eastern region, this influence is significantly positive, while it is not significant in other regions that might caused by the lower servicing level and weak innovative abilities in these regions, which hinder the formation of substantial external effects.

5.6. Robustness Test

To ensure the reliability of the estimation results, we conducted a robustness test by replacing the core explanatory variables. The location entropy of servicing was used to reflect the servicing scale developed in regions. The formula for calculating the location entropy of servicing is as follows:

$$Lq_i = \frac{q_{i1}/q_i}{q_1/q}$$

where Lq_i represents the location entropy of servicing in city i, L_i represents the added value of serving in city i, q_i represents regional total output value of city i; q_1 represents added value of national servicing, q represents the national Gross Domestic Product (GDP). Per capita government fiscal expenditure ($GOV1$) is calculated by general publicfiscal budget expenditure divided by the

Table 8. Robust regression results.

Variable	Regression Coefficient
LQ	0.5068***
	(8.30)
*GOV*1	0.3288***
	(4.35)
*PAT*1	0.0142
	(0.49)
*LQ*PAT*1	0.0429***
	(3.92)
URB	−0.1613
	(−0.77)
INFRA	0.0283
	(0.96)
POP	0.0027
	(0.08)
TRADE	−0.0948**
	(−3.28)
cons	1.1768
	(1.12)
R-sq	0.8875
F	240.63
$p > F$	(0.0000)

t statistics in parentheses, *$p < 0.01$, **$p < 0.05$, ***$p < 0.001$.

Table 9. Estimation results of sample regression.

	Model-1	Model-2	Model-3	Model-4
SER	0.3313*** (9.41)			0.0836** (3.13)
GOV		0.8288*** (22.64)		0.6835*** (12.69)
PAT			0.4136*** (11.01)	0.0451 (1.28)
*SER*PAT*				0.0580*** (4.07)
URB	0.3796 (1.12)	−0.0186 (−0.08)	1.1646*** (3.82)	0.0580 (0.25)
INF	0.2569*** (6.25)	0.0792** (2.74)	0.2181*** (5.45)	0.0690** (2.44)
POP	−0.0293 (−0.60)	0.0233 (0.71)	0.0459 (0.97)	−0.0200 (−0.60)
TRA	0.1208** (2.82)	−0.0793** (−2.61)	0.0381 (0.90)	−0.0635* (−2.16)
CONS	0.8115 (0.52)	−2.6210** (−2.90)	−3.6062** (−2.76)	−1.6445* (−1.72)
R-sq	0.6996	0.8673	0.7261	0.8795
F	115.03	322.87	130.99	222.71
p > *F*	0.0000	0.0000	0.0000	0.0000

Note: *t* statistic in parentheses. "*" represents p value of less than 0.01, "**" represents p value of less than 0.05. "***" represents p value of less than 0.001.

total population with urban household registration. Number of per capita authorized patents (*PAT*1) is calculated by ratio of authorized patents' number to the population of urban household registration and used to reflect tech-innovative capability. Unit root tests passed after replacing core explanatory variables.

The regression results after replacing the core explanatory variables are shown in Table 8. Compared to Table 9, we found that the significance of the regression coefficients of the core explanatory variables or control variable remain unchanged or largely consistent, indicating the research results are highly robust.

6. Research Conclusions and Political Suggestion

6.1. Research Conclusion

This study first constructs a comprehensive evaluation system for the construction potential of urban international consumption centers from four dimensions: consumption level, structure, quality and environment. The entropy method is used to calculate the PICC Index for major cities. Based on the obtained

index, the potential for constructing international consumption centers is briefly analyzed for major provincial capitals and direct-administered municipalities in China.

Secondly, it explores the impact of the service industry, scientific and technological innovation, and government fiscal expenditure on the potential of urban global consumption centers. Using panel data from 28 first- and second-tier cities in China from 2010 to 2019, empirical tests are conducted to examine the effects of service industry development, scientific and technological innovation, and government fiscal expenditure on the potential of urban international consumption centers.

Several conclusions are drawn as followings:

The development scale of the service industry has a significant positive impact on the constructing potential of urban international consumption center. The larger the scale of the service industry in a city, the greater its potential to become a global consumption center.

The impact of service industry development scale on cities' PICC varies significantly across regions. In regions with high levels of service industry development, or where service industry's scale reaches a certain threshold, it's influence on urban PICC becomes significant.

Government fiscal expenditure has a significant positive impact on urban PICC, and this impact is consistent across regions.

The combined impact of the service industry and technological innovation on PICC is significantly positive, and shows regional heterogeneity. As the service industry and S&T innovation develop further, their contribution to enhancing PICC increases.

Due to the ample developing room for China's overall S&T innovation, Its impact on urban PICC is not very pronounced.

6.2. Political Suggestion

Taking into account the aforementioned research conclusions, this paper provides the following insights:

It's necessary to develop service industry and stimulate technological innovation driving the construction of urban international consumption centers. As China's economy enters a new phase of development, it is crucial to give full attention to the roles of the service industry and S&T innovation in boosting urban consumption attractiveness aggregation capabilities. Leveraging these two "swords" of the service industry and technological innovation, cities can effectively evolve towards global or regional consumption hubs, stimulate domestic demand and promote economic growth.

Policy-maker should support centrally the development of service industry and S&T innovation in developed eastern regions. This includes enhancing the consumption environment, which in turn, will stimulate both local and surrounding regions' consumption levels and drive the establishment of global

consumption centers in major developed cities in the eastern regions. Additionally, support should be extended to infrastructure development in the central, western and northeastern areas. This involves improving the consumption environment, enhancing purchase convenience and creating consumption scenarios that are tailored to the local cultural characteristics. By doing so, the consumption aggregation capabilities can be elevated, facilitating the development of regional consumption centers with rich cultural features in the relatively developed cities of the central, western and northeastern regions.

Government fiscal expenditure should primarily favor cities with significant development potential in the central, western and northeastern regions. This targeted approach will encourage these areas to establish a batch of distinctive regional consumption centers through a combination of government fiscal intervention and local development exploration.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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