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SPATIAL-TEMPORAL ANALYSIS OF REGIONAL DISPARITIES OF INTERNET DEVELOPMENT IN CHINA

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ABSTRACT: This paper attempts to summarize the disparities of Internet development in China spatially-temporally. The major objective is to measure the differences between Eastern, Central and Western China. Methods of map presentation, correlation, Lorenz curve, Gini Coefficient and location quotient analysis are conducted in this study. For convenience, the indicator of regional Internet development is simplified as the number of domain names registered under .CN in each province. The data used are collected from the semi-annual surveys of the *Statistical Survey Report on the Internet Development in China* since 1999. There are several findings: 1) The number of domain names in each province (city) declines gradually from the east to the west. 2) The gap between the highest growth provinces (cities) and the lowest ones is rather large. 3) Although the absolute differences between the eastern, central and western China have been enlarged, the relative differences in each province (city) have remained constant. 4) Provinces (cities) are classified into three types according to location quotient changes, namely, rising type, changeless type and declining type. Compared with industrial and economic growth, Internet sector in the eastern and western China is relatively ascending, while that in the central China is descending. 5) The number of domain names at provincial level is not statistically consistent with GDP.
KEY WORDS: Internet development; regional disparities; China

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1 INTRODUCTION

Both domestic and foreign scholars have conducted many researches on regional economic disparities in China. YANG (1992) used Gini Coeffient to analyze the change of regional income disparities, and LUO (2001) used weighted coefficient of variation to obtain the relative differences curves of three regions in China. FUJITA and HU (2001) analyzed regional disparities in China from the viewpoint of economic globalization and liberalization. There are discussions not only on the provincial level (LU and XUE, 1998), but also on the county level (LI, 1999; LI and QIAO, 2001).

The high-speed growth in economy has made Internet industry in China increase rapidly in recent years. According to the statistics of the China Internet Network Information Center (CNNIC), by June 30, 2004 computer hosts in China exceeded 36.3×10^6 and Internet users and domain names registered under .CN reached 87×10^6 and 382 216 respectively (CNNIC, 2004). Hence Internet regional disparities emerge.

In general, as Web sites clearly form an integral part of social and economic development, their sizes and contents are likely to reflect the distribution of population and the urban geography of the real world (GORMAN, 1998; MITCHELL, 1999). GORMAN found that the correlation between the size of the Web and population was low although that between the Web and GDP was much higher. Various attempts at measuring and interpreting the structure, size, connectivity and disparities of the Internet have been made but its growth and evolution generate a constant need for new measurements and interpretations (BRAY, 1996; PIROLLI *et al*., 1998). Recently, it has been predicted that, despite its apparent arbitrariness, the sizes of Web sites and hyperlinks between them follow known distributions of growth phenomena such as those observed for cities and regions (ALBERT *et al*., 1999; FALOUTSOS *et al*., 1999; HUBERMAN and ADAMIC 1999).

Although the relationships between economy and Internet are well documented, more emphases have been put on economy rather than Internet. In this study the

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regional disparities of Internet development in China are explored through various methods, which help to interpret the economic effects on Internet growth.

2 DATA SOURCES AND METHODS

CNNIC has published the semi-annual surveys of the *Statistical Survey Report on the Internet Development in China* since 1997, which provides quite a few items of Internet development in China such as computer hosts, domain names registered under .CN, Internet users and "WWW" websites. For simplicity, only the domain names in July from 1999 to 2003 are selected in this study.

Because Hong Kong Special Administrative Region, Taiwan Province and Macao Special Administrative Region have their own regional domain names (.HK, .TW and .MO), the domain names registered under .CN do not reflect their regional Internet developments. They are excluded from the province list.

Traditional method such as map presentation is used to reflect the spatial disparities. Lorenz curve analysis is a technique designed to explain the regional disparities through a cumulative frequency plot. Details concerning this method can be obtained from CORE and KING (1970). Gini Coefficient and location quotient analysis have become common techniques in economic research; example of their use includes the identification of economic characteristics in Gansu Province (YUAN *et al*., 1997). All of them are used in this study.

3 RESULTS

3.1 Spatial Distribution of Internet Development in China

The spatial distributions of Internet development in China from 1999 to 2003 were similar. The most typical one in 2001 is shown in Fig. 1.

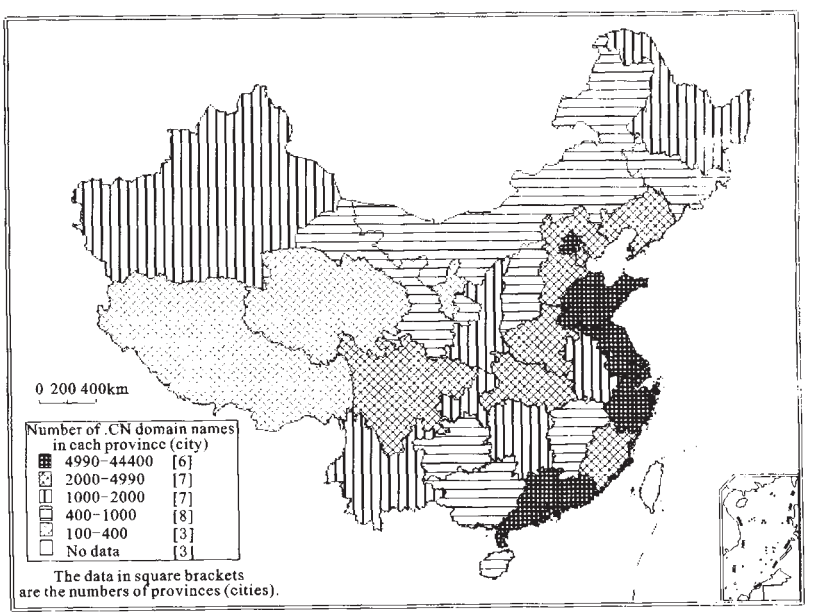

Fig.1 Distribution of .CN domain names in each province (city)

The characteristics of the spatial distribution of the number of .CN domain names in China are described as follows:

(1) As shown in Fig. 1, .CN domain names decline gradually from the east to the west. The number of more developed provinces (cities) is more or less equal to that of less developed ones. Yet the differences between them are sharp. For example, .CN domain names in Beijing is 442 times as many as those in Qinghai Province, accounting for 35.33% and 0.08% of the whole national domain names respectively. Meanwhile, domain names in more developed provinces (cities) (mainly in the eastern China) are 147 times as many as those in low developed ones (mainly in the western China). These extreme data increase the discrete degree, which discloses the fact that disparities of Internet development between the eastern and the western China are very sharp.

(2) All developed provinces (cities) are mainly located along costal lines in the eastern China, including Shandong, Shanghai, Jiangsu, Zhejiang, Guangdong and Beijing. These provinces (cities) account for only 19% of China′s total, but with 73% of the whole national domain names.

(3) Provinces (cities) in the central China including Liaoning, Hebei, Tianjin, Henan, Hubei and Sichuan are formed as moderately developed area. These provinces take 23% of China′s total, but occupy 15% of the whole national domain names.

(4) Less developed provinces are concentrated in the western China. These provinces occupy 58% of China′s total, but with only 12% of the whole national domain names. The features of less developed provinces vary from one area to another. The development in Northeast China is lower than average except Liaoning Province. And the development in Southwest China falls behind except Sichuan Province. Northwest China is the lowest developed area in the whole country. For example, Qinghai Province and Ningxia Hui Autonomous Region are ones of the lowest development provinces, in which the numbers of the domain names are only 105 and 342 respectively. Besides, Jiangxi Province, Guangxi Zhuang Autonomous Region and Guizhou Province are less developed than their neighboring provinces. An example is that the numbers of the domain names in the provinces like Fujian and Zhejiang provinces are above 1200, but that in Jiangxi Province only 514.

(5) The correlation coefficient of GDP and the number of .CN domain names is 0.6 (Fig. 2), which shows that the relationship between them is not very close. The number of .CN domain names in most provinces (cities) is directing proportional with GDP, meaning that when GDP increases the number of the domain names increases too. The tendency line, indicating average number of .CN domain names corresponding to GDP, can be used to measure Internet development in each province (city). Taking Beijing for an example, its position is above the line, which shows that by comparison with its GDP the Internet development is better than average. On the contrary, Jiangxi Province is below the line, meaning that the Internet development in it is less than average.

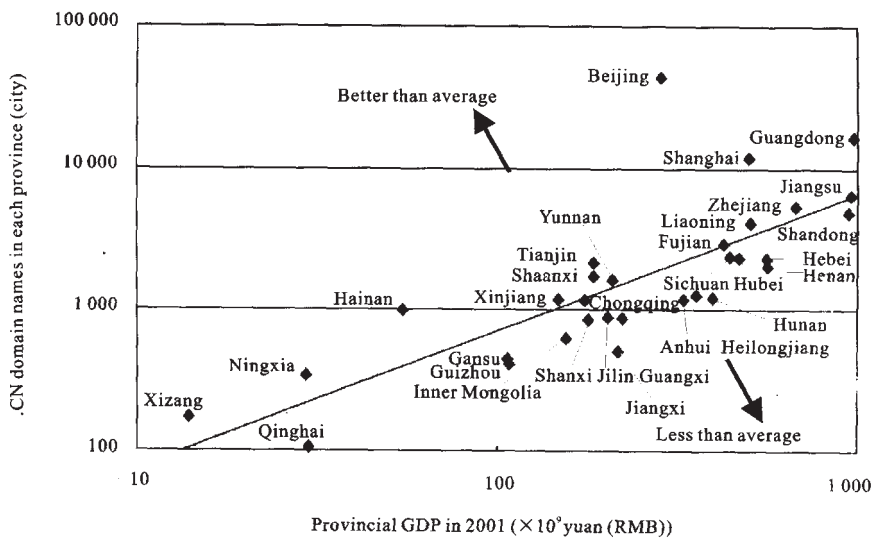

Fig. 2 GDP and the number of .CN domain names at provincial level

3.2 Temporal Analysis of Internet Development in China

A variety of methods are available for temporal analysis. Lorenz curve, Gini Coefficient and location quotient analysis are common techniques in economic research. Traditionally population is often associated with regional economy but cannot be applied to measure the Internet development, because it is absurd to calculate domain names per capita. A domain name has the feature of sharing, meaning that it can be used by a lot of people (ZHANG, 2001). To measure the regional disparities of Internet development we put forward a way of using average number of .CN domain names per province (city).

(1) It can be seen from Fig. 3 that the average number of .CN domain names per province (city) in the eastern, central and western China has increased greatly from 1999 to 2003①. The average number of .CN domain names per province (city) in the eastern China is above the whole country′s average, while the average numbers in the central and western China are below it.

Since 2001 the average number per province (city) in

① The average number′s drop in 2002 is that .EDU domain names are excluded from .CN domain names.

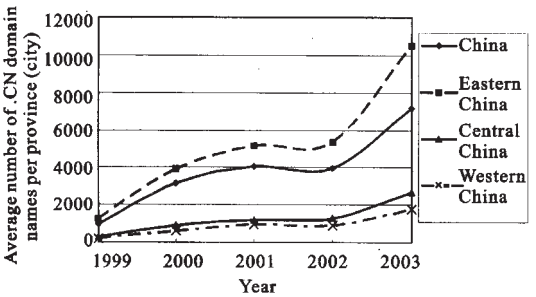

Fig. 3 Average number of .CN domain names per province (city) in the eastern, central and western China from 1999 to 2003

the eastern China has accelerated, with the absolute differences to the whole country′s average enlarging from 1111.14 in 1999 to 3371.43 in 2003. At the same time, the increases in the central and western China are small and their absolute differences to the eastern China expand from 932.23 and 1053.66 in 1999 to 7863 and 8761.22 in 2003 respectively. Disparities among these three regions are widening, which corresponds to the forecast of economic disparities between eastern and western China (WEI, 1997), the effect of later comer (WANG, 1993) and the Matthew effect (LIU, 2001).

(2) Lorenz curve and Gini Coefficient analysis are usually used to identify the typical regional disparity features. As seen from Fig. 4, the Internet development in China is uneven. For example, the position of (28, 0.48) at Lorenz curve (Fig. 4a) indicates that in 2003 the .CN domain names in 28 provinces (cities) were about half of those in the whole country, but those in 3 provinces (cities) of Beijing, Guangdong and Shanghai another half.

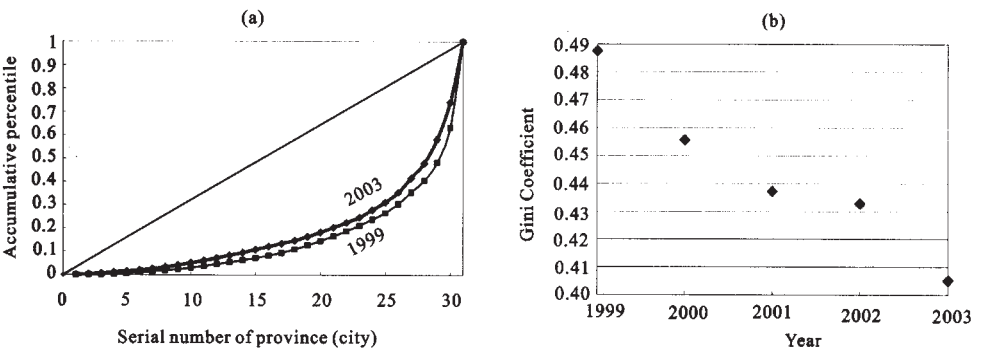

Fig. 4 Lorenz curves (a) and Gini Coefficients (b) from 1999 to 2003

Lorenz curves are close to the diagonal gradually from 1999 to 2003, meaning that disparities are becoming small. But the change is not big. It can be seen from Fig. 4b that the decrease in Gini Coefficients is only 17% from 1999 to 2003, which shows that disparities, in the main, remain constant in the period.

(3) Lorenz curve and Gini Coefficient only reflect disparities at country level and local quotient analysis is an effective technique to obtain disparities at provincial level. A local quotient matrix (Table 1) representing the difference among averages in each province (city) from 1999 to 2003 is constructed to reflect the variation of temporal observations.

In Table 1, provinces (cities) in which local quotients are above 1 are more developed areas and those in which local quotients are below 1 are less developed areas. It can be seen that in 2003 Internet development in seven provinces (cities) of Beijing, Shanghai, Jiangsu, Zhejiang, Shandong, Liaoning and Guangdong were better than average, most of which were located along the coastal area in the eastern China. They were about one-fifth of the whole provinces (cities).

All provinces (cities) are classified into three types according to location quotient changes, namely, rising type, changeless type and declining type (Fig. 5). Provinces (cities) of rising type, which include 17 provinces (cities) accounting for 54.8% of the whole provinces (cities), are located in the northeastern China, northwestern China and eastern China. It is due to the favorable policy of Chinese government to develop the undeveloped area, which helps the Internet growth in the western China, and the previous strong economic strength along the coastal area in the eastern China. Provinces (cities) of changeless and declining types accounting for 29.1% and 16.1% of the whole provinces (cities) respectively are mainly congregated in the central China. This shows that Internet development in this region stagnates. One of the reasons is the lack of investment for a long time. Besides, the disappearing monopolization status of some provinces (cities) such as Beijing, whose location quotient fell from 11.737 in 1999 to 7.997 in 2003, also contributes to the stagnation.

Table 1 Location quotient in each province (city) from 1999 to 2003

Year	Beijing	Shanghai	Tianjin	Chongqing	Hebei	Shanxi	Qinghai	Inner Mongolia
1999	11.373	2.395	0.552	0.263	0.580	0.144	0.011	0.140
2000	11.951	2.675	0.504	0.305	0.510	0.203	0.017	0.139
2001	10.937	2.941	0.532	0.290	0.576	0.207	0.026	0.154
2002	9.731	3.301	0.540	0.302	0.647	0.214	0.033	0.162
2003	7.997	3.210	0.569	0.395	0.677	0.186	0.040	0.240
Year	Liaoning	Jilin	Heilongjiang	Jiangsu	Zhejiang	Anhui	Ningxia	Fujian
1999	0.851	0.203	0.250	1.579	1.208	0.231	0.017	0.750
2000	0.748	0.209	0.281	1.334	1.285	0.232	0.065	0.765
2001	1.041	0.213	0.315	1.623	1.333	0.300	0.084	0.740
2002	0.920	0.231	0.344	1.681	1.444	0.357	0.082	0.772
2003	1.015	0.403	0.374	1.992	1.906	0.406	0.111	0.988
Year	Jiangxi	Shandong	Henan	Hubei	Hunan	Guangdong	Xinjiang	Guangxi
1999	0.140	0.140	0.831	0.645	0.281	4.639	0.077	0.356
2000	0.121	0.121	0.619	0.542	0.284	4.334	0.216	0.246
2001	0.127	0.127	0.504	0.572	0.310	4.443	0.295	0.222
2002	0.144	0.144	0.536	0.586	0.328	4.998	0.277	0.247
2003	0.240	0.240	0.513	0.636	0.350	4.882	0.339	0.308
Year	Hainan	Sichuan	Guizhou	Yunnan	Xizang	Shaanxi	Gansu	
1999	0.325	0.650	0.080	0.270	0.007	0.460	0.127	
2000	0.554	0.479	0.075	0.432	0.025	0.392	0.101	
2001	0.244	0.602	0.102	0.409	0.042	0.431	0.111	
2002	0.205	0.585	0.092	0.357	0.038	0.425	0.128	
2003	0.139	0.686	0.134	0.303	0.074	0.388	0.144	

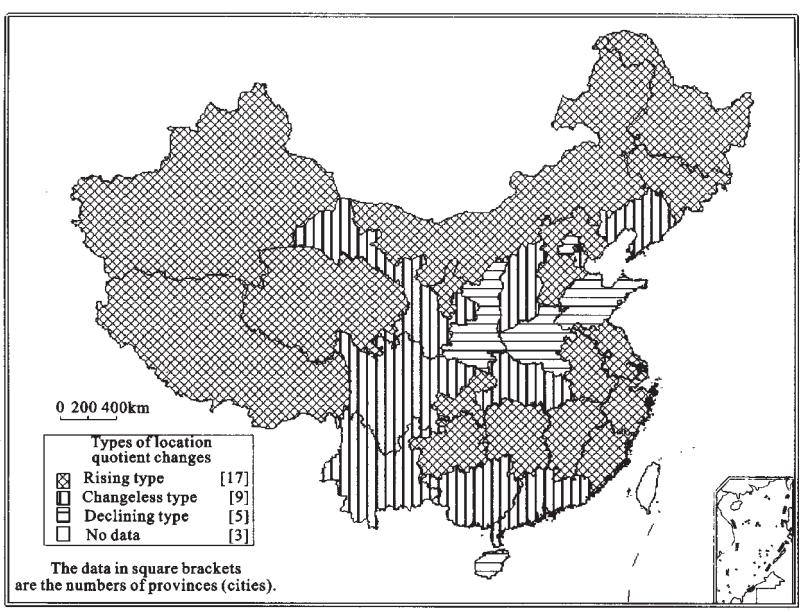

Fig. 5 Distribution of location quotient changes from 1999 to 2003

4 CONCLUSIONS

The purpose of this study is to provide further insight into the Internet development in China. Spatial distribution is obtained through map presentation. Lorenz curve and Gini Coefficient are then calculated for the changes of .CN domain names at country level. Finally, three types are classified according to changes of location quotient in order to identify Internet growth in each province temporally.

The conclusions can be drawn from the results of this analysis as follows:

(1) Spatially .CN domain names in each province gradually decline from the east to the west and the gap

between two opposing extremes is rather large.

(2) Although the pure differences among the eastern, central and western China are enlarged, the relative differences in each province (city) remain constant. The Internet in the eastern and western China is growing, contrast to the stagnation in the central China.

(3) The number of .CN domain names in each province is not statistically consistent with GDP, meaning that the Internet development has its own features.

(4) The Internet differences between the eastern and western China show the necessity of the policy of developing the undeveloped area by Chinese government. But the Internet development in the central China has fallen behind, to which should be paid more attention by scholars and the government.

A variety of possibilities for future research exits regarding the association of Internet development and economic growth. Although we did illustrate the plausibility of the hypothesis that the economy is all the more important in explaining the Internet distribution spatially-temporally, the role of it remains to be fully investigated. Due to the limited amount of the Internet data available, the study needs to be undertaken using a longer time. In addition, analysis of the Internet development will provide further insight into the significance of economic policy by the government.

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