Analysis of Urban Agglomeration Economies Based on Different Employment Structure of China's Deputy Provincial Cities

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Abstract: This text empirically analyzes the influence of employment structure and population density to urban agglomeration economies and productivities of China's 19 deputy provincial cities from 1997 to 2007. Results show: urban agglomeration economies have positive correlation with the resource predominance, logistics facilities, high-tech industrial scale, capital operation, knowledge diffusion and science and technology innovation. Urban expansion goes a way of firstly inhibiting and last stimulating to economic growth. Population density remains lower levels in most of cities.

Keywords: agglomeration economies; employment structure; population density; productivity

1 Introduction

Urban agglomeration economies refer to economic activities on the space productivity and are important power to promote industries and resources clustering. Many scholars have done a lot of studies on urban agglomeration economies. Such as Henderson[1], Carlino[2], Mitra[3] and Nakamura[4]. Zheng[5] discussed the factors that affect agglomeration economies and empirically study urban agglomeration economies or diseconomy in Tokyo. In China, only few quantitative research literatures appear to be referenced. Wang[6] deduced Chinese urban optimal scale by production function method. Jin[7] analyzed industrial agglomeration economies of Tianjin with cost function method. Gao[8] contrastively analyzed the agglomeration economies of Shanghai and Tianjin City. But, above literatures of China have not considered the influence factors of industrial structure to agglomeration economies in modeling process.

In China, different scale or regional urban exist widespread different industrial structure, while urban employment structure is a good substitute for industrial structure. With statistics data of China's 19 deputy provincial cities from 1997 to 2007, this text aim to study the urban productivity difference from the perspective of agglomeration effect, employment structure and urban scale.

The paper is organized as follows: Section 2 sets out in detail the theoretical models. Section 3 presents details on the estimation and analysis of urban agglomeration economies. Finally, Section4 concludes.

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2 Theoretical models

When studying urban agglomeration economies, researchers generally set agglomeration economies function as urban scale or other alternative elements of agglomeration economies. In order to explore economic factors affecting agglomeration economies, Zheng[5] considered the impact of employment index and environmental factors and defined agglomeration economies function as:

$$G(x) = f\left[E_1(x), E_2(x)\cdots, E_m(x)\right] \qquad (1)$$

Here $G(x)$ is an agglomeration economies function and $E_i(x)(i=1,2,\cdots,m)$ is the clustering level of industry i locating in the city x. In order to distinguish the effects of urbanization and localization economy, Shukla[9] set urban agglomeration economic function involving localization economy and urbanization economy effect. In order to study the impact of urban employment structure and urban scale differences on urban agglomeration economies and output, this paper utilize the work of Zheng[5] to define agglomeration economies function as factors of industrial labor employment proportion and urban scale. The basic forms of production function set for:

$$Y_{it} = G(E_{it})K_{it}^{\alpha}L_{it}^{\beta}Z_{it}^{\gamma} \qquad (2)$$

Y_{it}, K_{it} and L_{it} are separately total output, fixed assets stock and labor of city i in year t of urban limitation enterprises. Based on the function form proposed by Shukla[9],

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this text suggest agglomeration economies function as following.

$$G(E_{it}) = AN_{it}^{b_1+b_2 \ln N_{it}} \cdot \exp\left(\sum_{j=1}^{m-1} E_{ijt}^{a_j}\right) \quad (3)$$

Here, N_{it} is the population density of city i in year t; m is number of industrial classification; E_{ijt} is labor employment proportion of the industry j in year t; a_j is the weight of E_{ijt}, indicating the influence of different industries to urban agglomeration economies.

If assuming increasing or decreasing returns to scale is due to agglomeration economies or diseconomy, in order to avoid collinearity problem, when estimate equations (2), production function could be looked as constant returns to scale with capital, labor and other input elements. So equation (3) can be written for:

$$\ln y_{it} = \ln A + b_1 \ln N_{it} + b_2 (\ln N_{it})^2 + \sum_{j=1}^{m-1} a_j E_{ijt} + \alpha \ln k_{it} + \gamma \ln z_{it} \quad (5)$$

Here, $y_{it} = Y_{it} / L_{it}$, $k_{it} = K_{it} / L_{it}$ and $z_{it} = Z_{it} / L_{it}$ respectively indicate per capita output, per capita fixed capital and per capita non-fixed capital.

3 Urban agglomeration economies estimation and analysis

According to the Chinese urban statistical yearbook, urban employment Can be divided into 22 classes: Farming, forestry, animal, husbandry and fishery(FFAHF); Mining and quarrying(MQ); Manufacturing(MA); Production and supply of electricity, gas and water(PSEGW); Construction(CO); Transport, storage, post & telecommunication services(TSPTS); Information transmission, computer services and software(ITCSS); Wholesale and retail(WR); Hotel and catering services(HCS); Finance and insurance(FI); Real estate(RE); Lease and business services(LBS); Scientific research, polytechnic services and geological prospecting(SRPSGP); Residents service and other services(RSOS); Health and social security and social welfare(HSSSW); Education(ED); Water conservancy, environment and public facilities management(WCEPFM); International organization(IO); Cultural, sports and entertainment(CSE); Public administration and social organizations (PASO); Private enterprises and individual(PEI).Because of difficult to estimate the actual employment of PEI, this text dose not investigate the impact of PEI. This paper use urban state-owned enterprises and limitation above enterprises' aggregation data as total enterprise production data of the city. All data are taken from China's Urban Statistical Yearbook and China's industry statistical yearbook. Except the direct data, some data need be calculated.

3.1 Urban agglomeration economies estimation

Because of collinearity problem, while estimating the panel data, many parameters of variables do not statistical significance, even with the transcendental symbols. Combining previous literatures and on the basis of the related industrial employment analysis and model selecting, inspection, comparison and correction, we finally selected 8 industrial's employment as independent variables. Estimation results of equation (5) lie in table1.

Table1. Estimated results based on 19 deputy provincial cities

Dependent variables: logarithm Output (151 effective observations)	Fixed-effect Model	Random-effect Model
Variable	coefficient	coefficient
Intercept		9.513832**
Log(Y/L)	0.116853**	0.111053**
Log(K/L)	0.764262**	0.781534**
Log(N)	-2.720770**	-2.162844**
Log^2 (N)	0.189049**	0.148980*
MQ	11.76500**	4.590784*
PSEGW	-13.32013**	-14.71309**
TSPTS	2.936948**	3.364363**
ITCSS	11.13796**	10.80452**
FI	3.476400**	2.311030
WCEPFM	-0.730655**	-0.733178**
ED	3.849935**	4.976430**
CSE	-18.21822**	-21.45581**
	Fixed Effects	Random Effects
Beijing	11.46964	-0.054730
Chengdu	11.22636	-0.327106
Dalian	11.62897	0.028845
Guangzhou	11.69338	0.095663
Harbin	11.26899	-0.275244
Hangzhou	11.68729	0.087573
Jinan	11.70006	0.101730
Nanjing	11.73446	0.122601
Ningbo	11.86266	0.258858
Qingdao	11.90696	0.295327
Xiamen	11.91178	0.284957
Shanghai	11.58948	0.029235
Shenzhen	11.83490	0.235568
Shenyang	11.24119	-0.220136
Tianjin	11.38465	0.041444
Wuhan	11.45582	-0.142001
Xi'an	11.13159	-0.406016
Changchun	11.78210	0.234171
Chongqing	11.03261	-0.361468

Note: * indicate estimated parameter is in statistical significance at level 0.10 in double tail inspection. * *indicate estimated parameter is in statistical significance at level 0.05 in double tail inspection.

Table1 shows: As a whole, the fixed capital elasticity is about 0.11, while the floating capital elasticity is 0.77. This indicates that changes of floating capital does deeper influence to industrial enterprises' output. Adequate floating capital will stimulate output growth of the

city's limitation above enterprises.

3.2 Analysis on the impact of employment structure to urban agglomeration economies

From Table1, Employment proportion of MQ, TSPTS, ITCSS, FI, and ED have positive influence on urban agglomeration economies. This indicates that urban agglomeration economies' level has positive correlation with resource endowment, perfect degree of logistics facilities, hi-tech industrial scale, capital operating degree and knowledge transmission capacity. Look from the specific parameters, the employment number change of MQ and ITCSS have bigger influence on urban agglomeration economies and productivity comparing with other 4 industries. Resources endowment and high-tech industries have more extensive influence on improving urban productivity, reflecting that Knowledge spillovers plays an important role in improving urban agglomeration economic and productivity. PSEGW, WCEPFM and CSE have negative influence on urban agglomeration economies. Theoretically, PSEGW, WCEPFM and CSE reflect regional living and urban spatial extending levels. They should produce positive effects on urban agglomeration effect. Why the samples of China's deputy provincial cities appear opposite estimated result? This phenomenon probably is due to the lower productivity of these mostly monopoly industries whose monopoly scale expanding hindered other similar industries' development and FDI entering in, which finally causes negative influence to urban agglomeration economies.

3.3 Analysis on impact of urban scale to urban agglomeration economies and productivity

Look from the estimated coefficients and statistics of Log(N) and Log^2 (N) in Table1, it is obvious that population density has significant influence on urban industrial output. Many Classical literatures, such as Nakamura[4], Henderson[10] and Jeffrey[11],generally believed urban agglomeration economies will decrease step by step with the population scale continuously increasing. On these view, the transcendental symbols of b_1 is positive, the transcendental symbols of b_2 is negative. But our estimated results appear just the opposite.

With the formula (3), we maybe simply discuss the impact of population density to urban agglomeration economies. Obviously, if $b_1+2b_2\ln N>0$, $N^{b_1+b_2\ln N}$ will be the increasing function with variable N. Of course, if $b_1+2b_2\ln N<0$, $N^{b_1+b_2\ln N}$ will be the decreasing function with variable N. Based on Table1, it is easy to calculate that the threshold is 1331.29 for the fixed effects model and 1420.61 for the random effects model. Figure1 shows the relation between China's 19 deputy provincial cities' population density and urban agglomerating economies based on fixed effect model.

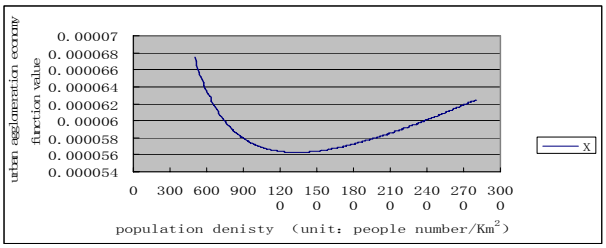

Figure1. Population density influence on agglomerating function

In 2007, there are 11 deputy provincial urban whose population density are below 1450 people, such as Beijing, Dalian, Harbin, Hangzhou, Nanjing, Jinan, Ningbo, Xiamen, Tianjin, Chongqing and Changchun. At the same time, the population density of 8 cities, such as Chengdu, Guangzhou, Qingdao, Shenzhen, Shanghai, Shenyang, Wuhan and Xian, are above 1450 people. With the estimated threshold of population density, we can judge: The population density of the first 11 cities are lower, the increase of population density will lead to decrease urban agglomeration economies level before urban population density surpasses the threshold value. Along with the further expansion of the urban scale, population density will bring to promote urban economic growth if the population density surpasses the threshold value. Though some scholars doubt or demur about the stimulating effect of population density to urban productivity, such as Moomaw[12].At least from the conclusion of this paper's empirical analysis, if not consider problems of agglomeration diseconomy which company with urban expansion, such as resources crowded, environment problem, and crime problem, etc, only from the consideration of improving productivities, China's regional urban scale expansion goes a way of initial restraining and then continuously stimulating to regional economic growth.

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3.4 Estimating and comparing of urban agglomeration economies

According to Table1, we measure the urban agglomeration economies' level in 1998-2007. From the Figure2, cities whose urban agglomeration economies' level were above 10.0 in 2007 are Beijing, Guangzhou, Nanjing, Jinan, Hangzhou, Ningbo, Qingdao, Xiamen, Shenzhen, Shanghai and Shenyang. While urban agglomeration economies' levels of Harbin, Changchun, Dalian, Tianjin, Chongqing, Chengdu, Wuhan and Xi'an have not reached 10.0. Especially, as the northeast old industrial base, Harbin's urban agglomeration economies' level is only 6.46 and Nanjing is 179.57% of Harbin's. This phenomenon is also factually reflects the realistic difference productivities of two cities. Eastern cities' industries develop more rapidly and obtain more significant urban agglomeration effects. Midwest cities are comparatively small scale and obviously lag in industrial development among most cities.

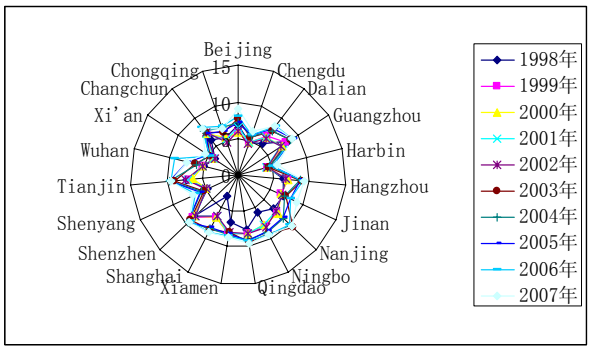

Figure2. Radar diagram: 19 cities' urban agglomeration level

Looking from the cities' actual relative employment, there are numerous employees in eastern deputy provincial cities who work in logistics, financial and cultural and social services industries. The third industry of above cities has a good development momentum. Manufacturing and urban productivity have been the leading level, utilization efficiency of capital is also relative to the top. The Midwest deputy provincial cities' industrialization is relatively slower, employment of Midwest cities is relatively larger in PSEGW, WCEPFM and CSE but smaller in TSPTS, ITCSS, FI, and ED, restricts the improvement of urban agglomeration economies effects. Especially, due to the western regions' shortage of capital accumulation, industrial foundation is poor, the productivities of labor and capital are very low. In order to promote regional urban agglomeration economies and raise productivity level, Western cities should continue to increase investment, improve the development of infrastructure, develop high-tech industries and regional advantage industries, accelerate urbanization, attracts FDI and the high quality human capital to enter in.

4 Conclusions

Urban agglomeration economies of China's major cities have positive correlation with cities' resources endowment, logistics facilities, high-tech industries, knowledge diffusion and technical innovation. Most cities' population density are still lower, if not enough corresponding population in urban areas, only land expansion doesn't mean enlargement of the urban scale. Only from consideration of productivity, China regional urban expansion would firstly restrain and then stimulate to regional economic growth. Thus, the voices of cities' scale excessiveness will further dispute in future.

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