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Abstract: *Current empirical studies on regional specialization mainly focused on measurement of China's overall regional specialization level, while determinants of industrial geographical distribution, namely the regional specialization pattern, are just paid few attentions. This paper analyzed the regional specialization pattern empirically by employing statistical data of China two-digit industries from 1987 to 2007 through estimating a model which takes comparative advantage and scale economy as driven factors of industrial geographical concentration. Conclusions show that the overall regional specialization of Chinese industries increased between 1987 and 2007, however, it decreased obviously in 1990s. And, scale economy rather than comparative advantage arising from production cost is a long-run factor of China's industrial geographical distribution.*

Key words: *Comparative Advantage; Scale Economy; Regional Specialization*
JEL codes: *R12; R30*

1. Introduction

Since the early of 1990s, studies on regional specialization became more and more deeply in order to discover the evolution and status quo of specialization of a country or region. As regards China's regional specialization, studies mainly focused on this issue from perspectives of regional industry structure convergence, market integration and affect of local protectionism, and recently, researchers have started to pay considerable attention on this topic by employing various measurement methods. In terms of recent literatures, some studies argued that Chinese regional specialization level increased obviously since China implementing the Reform and Opening-up policies(Naughton, 1999; Liang & Xu, 2004; Harrigan & Deng, 2008; Lu, Flegg & Deng, 2011; etc.). However, there are also some evidences indicated that the regional

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specialization level actually decreased in 1990s and there existed a trend of disintegration on Chinese regional market(Young, 2000; Poncet, 2003; Cater & Lohmar, 2002). Based on various measure methods, most of Chinese literatures' conclusions supported the former conclusion, they stated that although overall level is still very low, the historical trend of China's regional specialization ascended after implementing Reform and Opening-up policies(Cai, et al., 2002; Bai, et al., 2004, 2005; Lu & Tao, 2005; Guo & Yao, 2007; Fan, 2007; Lu & Deng, 2010a; etc.).

Nevertheless, there are only few studies which discussed the pattern or driven factors of China's regional specialization ascending. By making use of generalized method of moment(GMM) estimation, Liang and Xu(2004) found that comparative advantage changing arising from technical efficiency improvement, scale economy enhancement and growing economic openness exerted positive effect on the improvement of China's regional specialization between 1988 and 2001. Lu and Deng(2010b) analyzed the interaction of scale economy and manufacturing industrial spatial distribution by estimating Rybczynski Equation Matrix(REM), conclusions supported that factor endowments including labor, capital and natural resources are main factors of China's regional specialization between 1987 and 2007. However, both Liang and Xu(2004) and Lu and Deng(2010b) analyze driven factors of China's regional specialization through an input-output model rather than test correlations of regional specialization and factors directly. While actually, it is possible to achieve the goal through simple OLS estimation since there are not only some coefficients of measuring regional specialization but also some coefficients of measuring Ricardo comparative advantage, factor endowments as well as scale economy. Paluzie, Pons and Tirado(2000) have studied Spanish regional specialization pattern employing this method, which found that scale economy was the key determinant of regional specialization of Spain industries.

Therefore, this paper will focus on the pattern of China's regional specialization using an modified method in terms of that used by Paluzie, Pons and Tirado(2000). The second session will introduce methodology, including coefficients of measuring regional specialization, Ricardo comparative advantage, factor endowments as well as scale economy. The third session will analyze China's regional specialization empirically and answer the question of what determines China's regional specialization in the past decades. And the last one is conclusions and remarks.

2. Methodology

According to trade theories, international specialization can be interpreted by Ricardo comparative advantage, factor endowments and scale economy. In terms of classical and neoclassical trade theories, product cost difference is a main factor to cause trade and international specialization, yet product cost difference basically arose by the differences from labor productivity(Ricardo Model) and factor endowments(Heckscher–Ohlin Model), thus in an open economy, one country will produce those products that it has comparative advantage on labor productivity or those factor-intensive products that it has endowment advantage. Therefore, both Ricardo Model and Heckscher-Ohlin Model interpret international trade and specialization from the perspective of production cost difference.

Generally, Ricardo comparative advantage can be measured by the difference of output per unit labor which reflects labor productivity(Haaland, et al., 1999), while factor endowment can be measured by labor cost per output(Haaland, et al., 1999; Amiti, 1999; Paluze, et al., 2001). Thus Ricardo comparative advantage coefficient is defined as

$$RC_i = \sqrt{\frac{1}{n}\sum_r \left[\frac{O_{ir}/E_{ir}}{\frac{1}{n}\sum_r (O_{ir}/E_{ir})} - \frac{\sum_i (O_{ir}/E_{ir})}{\frac{1}{n}\sum_r \sum_i (O_{ir}/E_{ir})} \right]^2} \tag{1}$$

where i, r are industry and region prospectively, n is the total number of regions, O is output of an industry, E is employment, and O/E represents the output per unit labor of an industry, namely labor productivity. A larger RC_i implies that industry i reflects a larger interregional labor productivity difference.

Factor endowment coefficient is defined by

$$HO_i = \left| \frac{\sum_r LC_{ir}}{\sum_r O_{ir}} - \frac{\sum_j \sum_i LC_{ir}}{\sum_r \sum_i O_{ir}} \right| \tag{2}$$

where LC represents labor cost and LC/O implies labor cost per output. A higher coefficient implies that an industry has to pay higher labor cost for per unit output comparative with national average. Obviously, this coefficient also involves the core idea of classical and neoclassical trade theories since it doesn't measure the cost of capital and some other factors, and in fact, labor cost is the key factor of production cost in the early stage of industrialization.

New trade theory interprets international trade from the perspective of scale economy effect, it argues scale economy is an important factor of international specialization and intra-industrial trade. Generally, scale economy can be measured by average enterprise scale(Kim, 1995; Amiti, 1999; Paluzie, et al., 2001; etc.), then it is defined as

$$SC_i = \frac{\sum_r E_{ir}}{\sum_r NF_{ir}} \tag{3}$$

where NF is the enterprise total number of a country.

As regards the measurement of regional specialization, there are lots of available methods, such as Location Quotient, Hoover coefficient(Hoover, 1936), Spatial Gini coefficient(Krugman, 1991) and industrial agglomeration coefficient(Ellison and Glaeser, 1994, 1997). Location Quotient indicates the importance of an industry to a region by combining region dimension with industry dimension, it cannot reflect overall localization level of a industry directly. Both Hoover and Spatial Gini coefficient have to sort coefficient firstly, and then measure industrial localization level by employing Lorenz method. While agglomeration coefficient(E-G coefficient) requires specific data of micro enterprises. Actually, Ellison and Glaeser(1994) defined a coefficient of measuring industrial geographical concentration, which they argued it involves the effect of economic interest and it is also easier to calculate than Gini coefficient(Ellison and Claeser, 1994). Considering various method's advantage and data availability, this paper will measure China's industrial regional specialization or industrial geographical concentration taking advantage of the method proposed by Ellison and Glaeser(1994). Setting s_r represents employment share of industry i in region r in national level, and x_r represents employment share of region r in national level, the coefficient is defined as

$$IS_i = \sum_{r=1}^{M} \left(s_r - x_r\right)^2 = \sum_r \left(\frac{E_{ir}}{\sum_r E_{ir}} - \frac{\sum_i E_{ir}}{\sum_r \sum_i E_{ir}} \right)^2 \tag{4}$$

A higher value of coefficient IP_i implies that the concentration level of industry i is higher, further it implies that this industry has a higher regional specialization. In terms of trade theories, regional specialization can be interpreted by the effect of Ricardo comparative advantage, factor endowment and scale economy, thus this relation can be expressed by an implicit function such as $IS_i = F(RC_i, HO_i, SC_i)$. As

discussed previously, factor endowment coefficient(HO_i) is constructed based on labor cost, thus it essentially involves the comparative advantage idea of classical and neoclassical trade theories. Therefore, if econometrical model involves both Ricardo comparative advantage coefficient and factor endowment coefficient, it could cause multicollinearity problems. Actually, experimental estimation of a model which involves three independent variables exactly proved that there existed serious multicollinearity and estimation coefficients of other independent variables also were affected dramatically. Thus following model involves comparative advantage presented by Ricardo comparative advantage coefficient expressed by function (1) or factor endowment coefficient expressed by function (2). Yet it will use a Log model in order to reduce heteroscedasticity effectively,

$$LnIS_i = \rho + \alpha LnCa_i + \beta LnScale_i + u_i \quad (5)$$

where Ca_i represents comparative advantage of industry i which can be expressed by RC_i or HO_i, $Scale_i$ represents scale economy and it is expressed by coefficient SC_i, ρ is the overall effect of other factors which are not involved in model.

3. Data and Empirical Analysis

Considering data availability especially the availability of labor cost data, this paper picked 1987, 1993, 1997, 2001, 2003 and 2007 as the analysis objects, and industries covered 26 two-digit classified industries including both mining and manufacturing of 31 regions in mainland China. Output will be expressed by value-added value since total value of output in some years is unavailable, labor cost is expressed by total labor compensation provided by official dataset. Specifically, industry value-added, employment and enterprise number are from corresponding year's "China Industry Economy Statistical Yearbook" edited by National Statistics Bureau, and labor compensation is from "China Labor Statistical Yearbook" edited by National Statistics Bureau and Ministry of Human Resources and Social Security. Classification of industry in 1987 is based on a different standard, but it will not affect estimation in a section data model. Moreover, because labor compensation data by region and tow-digit industry was absence before 2000, but there is average labor compensation of mining and manufacturing, thus labor compensation of every two-digit industry before 2000 is defined by the value of average labor compensation of mining and manufacturing timing employment of every two-digit industry.

Industrial geographical concentration which is measured by function (4) is listed

in Table-1. Ccoefficient mean shows that overall trend of industrial concentration increased from 0.0198 in 1987 to 0.0425 in 2007, while it also indicated there exactly exited an obvious descending in 1990s, this result is as same as that of Young(2000), Poncet(2003), Cater & Lohmar(2002), etc.. Comparative 2007 with 1993, geographic concentration of most of industries rose dramatically except four industries such as Beverage Manufacture(C15) as well as Smelting and Pressing of Non-Ferrous Metals(C32).

Table-1. **Industrial Geographical Concentration: 1987-2007**

Code	Industries	1987	1993	1997	2001	2003	2007	2007Rank
B06	Coal Mining and Washing	0.0304	0.0346	0.0326	0.0433	0.0476	0.0629	7
B07	Petroleum and Natural Gas Extraction	0.0905	0.0878	0.0601	0.0659	0.0552	0.0767	3
B08	Mining and Processing of Ferrous Metal Ores	0.0419	0.0450	0.0464	0.0599	0.0587	0.0636	6
B09	Mining and Processing of Non-Ferrous Metal Ores	NA	0.0376	0.0350	0.0372	0.0382	0.0523	11
B10	Mining and Processing of Nonmetal Ores	0.0077	0.0083	0.0083	NA	NA	0.0140	19
C13	Food Processing from Agricultural Products	0.0053	0.0096	0.0097	0.0169	0.0313	0.0433	13
C14	Food Manufacture	NA	0.0222	0.0213	0.0377	0.0348	0.0459	12
C15	Beverage Manufacture	NA	0.0090	0.0059	0.0076	0.0089	0.0078	23
C16	Tobacco Manufacture	NA	0.0294	0.0306	0.0341	0.0355	0.0416	14
C17	Textile Manufacture	0.0081	0.0112	0.0130	0.0166	0.0218	0.0318	15
C18	Manufacture of Textile Apparel, Footware and Caps	NA	0.0272	0.0341	NA	NA	0.0533	9
C22	Paper and Paper Products Manufacture	0.0044	0.0040	0.0035	0.0095	0.0115	0.0160	18
C25	Processing of Petroleum, Coking, Processing of Nuclear Fuel	0.0424	0.0221	0.0259	0.0370	0.0586	0.0710	5
C26	Raw Chemical Materials and Chemical Products Manufacture	0.0038	0.0061	0.0048	0.0059	0.0057	0.0078	24
C27	Medicine Manufacture	0.0037	0.0038	0.0050	0.0058	0.0052	0.0054	26
C28	Manufacture of Chemical Fibers	0.0296	0.0195	0.0299	0.0258	0.0408	0.0524	10
C31	Manufacture of Non-Metallic Mineral Products	0.0034	0.0028	0.0029	0.0026	0.0035	0.0067	25
C32	Smelting and Pressing of Ferrous Metals	0.0272	0.0267	0.0248	0.0286	0.0274	0.0283	16
C33	Smelting and Pressing of Non-Ferrous Metals	NA	0.0252	0.0185	0.0231	0.0217	0.0127	21
C34	Manufacture of Metal Products	0.0034	0.0491	0.0070	0.0252	0.0379	0.0556	8
C35	Manufacture of General Purpose Machinery	0.0045	0.0075	0.0129	0.0147	0.0175	0.0234	17
C36	Manufacture of Special Purpose Machinery	NA	0.2082	0.0083	0.0111	0.0066	0.0082	22
C37	Manufacture of Transport Equipment	0.0305	0.0128	0.0156	0.0172	0.0146	0.0137	20
C39	Electrical Machinery and Equipment Manufacture	0.0305	0.0079	0.0113	0.0326	0.0613	0.0893	2
C40	Manufacture of Communication Equipment, Computers and Other Electronic Equipment	0.0202	0.0345	0.0402	0.1049	0.1370	0.1488	1
C41	Manufacture of Measuring Instruments and Machinery or Cultural Activity and Office Work	0.0134	0.0139	0.0179	0.0284	0.0686	0.0733	4
	Mean	0.0198	0.0295	0.0202	0.0266	0.0354	0.0425	

Source: Authors' calculation.

As regards specific industries, generally, geographical concentration of mining

industries is higher than that of manufacturing industries since geographical distribution of mining industries depend on natural resources distribution, for example, coefficient mean of mining industries(B06-B10) was 0.0539 in 2007, while the mean of manufacturing industries was just 0.0398. Moreover, some technology-intensive industries are mainly locating in regions which have corresponding advantages. Geographical concentration coefficients of Manufacture of Communication Equipment, Computers and Other Electronic Equipment(C40), Electrical Machinery and Equipment Manufacture(C39) and Manufacture of Measuring Instruments and Machinery or Cultural Activity and Office Work(C41) ranked the top3 in all manufacturing industries, they are mainly locating in coastal developed regions, for example, according to Location Quotient in 2007, top3 regions of C39 are Beijing, Guangdong and Shanghai, and top3 regions of C41 are Guangdong, Beijing, Jiangsu, all of these regions have considerable advantages on technology and innovation capabilities.

Table-2 shows OLS estimation results of comparative advantage, scale economy and industrial geographical concentration. In terms of model I, it is evident that comparative advantage which are reflected by labor cost per output difference just passed significance test in 1987 and 1993, while scale economy passed significance test with a high level in all years. According to estimation of model II, Ricardo comparative advantage is just significant in partial years, but effect of scale economy was affected seriously in this model. Therefore, to some extent, scale economy is a significant long-run factor of China's industrial geographical distribution in terms of the results of model I, while there were no evidences proved that comparative advantage arising from labor cost and labor productivity differences is a long-run factor of industrial geographical distribution. Moreover, effect of other factors which is reflected by constant in OLS model cannot be ignored actually. According to New Economic Geography(NEG) or Spatial Economy theories, factors such as geographical location, market potential as well as historical accidents are also important factors of industrial geographical distribution. Estimation results indicated that other factors are very significant, although their specific effect cannot be defined in our model, elasticity of these kind of factors increased obviously in 2000s which probably implies they played increasing role on China's industrial geographical distribution in recent years. Anyway, empirical results showed that scale economy rather than classical and neoclassical comparative advantages is a long-run factor of China's industrial geographical distribution to a certain extent.

Table-2. **OLS Estimation Results of Factor Endowment, Scale Economy and Industrial Geographical Concentration**

Model	Independent Variables	Year	Constant		Comparative Advantage	Scale Economy	Adjusted-R^2	F-value	Regions	Industries
			ρ	Elasticity						
I	HO, SC	1987	-2.0017*** (0.000)	0.1351	0.4009* (0.067)	0.4395*** (0.004)	0.420	7.519	29	19
		1993	-1.4908*** (0.005)	0.2252	0.5940** (0.021)	0.2858** (0.020)	0.340	7.562	30	26
		1997	-2.4919*** (0.000)	0.0828	-0.0144 (0.896)	0.4687*** (0.001)	0.252	5.215	31	26
		2001	-2.2749*** (0.000)	0.1028	-0.0285 (0.789)	0.5173*** (0.002)	0.133	2.770	31	24
		2003	-1.6904*** (0.009)	0.1844	0.2351 (0.143)	0.3333** (0.018)	0.112	2.452	31	24
		2007	-1.4197* (0.053)	0.2418	0.1414 (0.465)	0.4289** (0.011)	0.095	2.315	31	26
II	RC, SC	1987	-2.5922*** (0.000)	0.0749	1.2203** (0.010)	0.279 (0.116)	0.538	11.48	29	19
		1993	-2.3222*** (0.000)	0.0981	0.1189 (0.754)	0.4598*** (0.001)	0.176	3.672	30	26
		1997	-2.9464*** (0.000)	0.0525	0.9078 (0.198)	0.2349 (0.282)	0.299	6.322	31	26
		2001	-3.2009*** (0.000)	0.0407	1.0825** (0.036)	0.1718 (0.294)	0.270	5.259	31	24
		2003	-2.7291*** (0.000)	0.0653	0.5300 (0.106)	0.2539 (0.205	0.076	1.944	31	24
		2007	-2.6189*** (0.000)	0.0729	0.7433** (0.026)	0.2561 (0.152)	0.166	3.488	31	26

Notes: data in parenthesis is possibility value(P-value); *,** and *** imply statically significant under significance of 10%、5% and 1%; Elasticity of constant is calculated through natural anti-logarithm, exp(ρ).

4. Conclusions and Remarks

Current studies on China's regional specialization mainly focus on theoretical analysis and measurement of regional specialization. In sum, these studies stated that China's overall regional specialization level has been enhancing after implementing Reform and Opening-up policies. However, just few studies discussed determinants of China's regional specialization. According to classical, neoclassical as well as New trade theories, Ricardo comparative advantage, factors endowments and scale economy are main driven factors of regional specialization and industrial geographical distribution. Following these ideas, this paper empirically analyzed correlations of comparative advantages which are reflected by labor productivity and labor cost differences, scale economy which is expressed by average employment scale, and industrial geographical concentration which is measured by a coefficient proposed by Ellison and Glaeser(1994). Findings show that, on long terms, China's industrial geographical concentration increased obviously from 1987 to 2007, but it suffered a descending in 1990s. Furthermore, this paper estimated a OLS model which focus on correlation of comparative advantages and industrial geographical concentration, findings indicated that, to a certain extent, scale economy rather than classical and neoclassical comparative advantages is a long-run factor of China's industrial geographical distribution.

However, this paper just defined scale economy as significant factor of China's regional specialization, while according to New Economic Geography or Spatial Economy theories, spatial factors such as geographical location, market potential as well as historical accidents are also important factors of industrial geographical distribution, whose combined effect is just involved in constant of the estimation model. And moreover, factor endowment difference only embodied that arising from labor cost which essentially, as the same as labor productivity difference, reflects the differences of production cost in different regions. While in fact, capital and natural resources endowment have been proved that they are significant factors of industrial geographical distribution as well(Lu & Deng, 2010b). Governmental actions also can affect industrial geographical distribution, especially in China, preferential policies embodies significant regional effects(Démurger et al., 2002). Therefore, further studies are supposed to consider the effect of spatial factors and governmental policies on China's regional specialization.

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