

Employment Growth and Industrial Change in Cheongju, 1985-2005: An Analysis Using a Shift-Share Model

Hak-Hoon Kim*

Abstract: The population and employment of Cheongju have increased rapidly since the 1970s. This study examines the industrial employment change of Cheongju City and performs a shift-share analysis for the employment growth. The data used in this study are mainly from the 1985, 2000 and 2005 Census of Population and Housing. This study first explained the population change and industrial structure of Cheongju, then reviewed the development of shift-share models. Location quotients and specialization coefficients resulted from this study revealed the diversifying tendency in the urban industrial structure. Shift-share analysis employing the modified Arcelus model elucidated the favorable industrial mix and the competitiveness of industrial sectors. As a whole, Cheongju has advantageous industrial structure in comparison with that of the nation. All sectors of Cheongju except several services sectors grew faster than those of the nation and showed positive competitive effects. It is suggested to utilize more disaggregated industrial data in more fractured subperiod in order to pinpoint the competitive industries.

Keywords: industrial structure, employment growth, shift-share model, competitiveness, diversification

1. Introduction

1) Purpose of the Study

The growth of a city is affected by the various endogenous and exogenous factors. Among those factors, industrial structure of a city is closely related to the growth of the city. As an exogenous

factor, the change of national economic structure also affects the growth of the city. However, the magnitude of such national economic effect depends on the industrial structure of the city; if a city is specialized in industrial sectors that have not been competitive in a national level, the city will be more affected by the national decline in those sectors. Therefore, examining how the changes in national industrial structure have influenced the

* Professor, Department of Geography Education, Cheongju University

city and which sectors have led the city to growth and decline helps to illuminate the economic factors in urban growth. In order to study the economic factors in the growth of a city, we need to find the industrial sectors that are much related to the growth and decline of a city.

Most research in the topics of urban industrial structure has focused on the specialized urban functions and the differences in the industrial structure among cities. However, the evolution of urban characteristics in North America during the last few decades has already exhibited the diversifying and converging tendency in industrial structure among cities (Marshall, 1989; Kim, 1993). In other words, the differences in the industrial structure among cities tend to diminish and the urban economies become more alike over time as the urban industrial structure become more diversified. Economic restructuring patterns since the 1960s seem to have contributed to reduce the specialization level in urban economic bases.

In relation to such topics as urban industrial structure and its changing characteristics, this study will examine two themes in the case of Cheongju City. The first theme pertains to the changes in the industrial structure of Cheongju City, and the second theme pertains to the application of a modified shift-share model to analyze the sectoral employment growth in Cheongju City.

2) Data and Methodology

This study examines the employment growth and industrial structural changes of Cheongju City, the seat of Choongchungbuk-do provincial government. Cheongju City is a typical case that has experienced rapid growth of the population

since the 1970s, and the industrial structure of the city has been much affected by the economic restructuring of South Korea.

This study first explains the population change and industrial structure of Cheongju using the population census data of South Korea. Then this study reviews the development of shift-share models and applies a shift-share model to analyze the changes in sectoral employment structure of Cheongju City.

The data for this study are mainly from the Census of Population and Housing of Korea compiled in 1985, 2000 and 2005. For the city level like Cheongju, the 2000 and 2005 census compiled the employment data in the system of 21 industrial sectors by the standard industrial classification, while the 1985 census compiled the employment data in the system of 9 industrial sectors. Thus the comparative analysis of industrial structure between 1985 and 2005 adopted the classification by the 9 industrial sectors. There was a shift-share analysis performed by Kim (2004) for Cheongju using the 1985 and 2000 data. However its contribution was limited because the census data with detailed industrial classification for a city such as the 21 sector classification were not available before 2000.

Although the data for the economic activities compiled in the census are based on the 10% sample, those are valuable employment data collected from the residents of the statistical area. On the other hand, the establishment survey that is conducted every year compiles employment data based on the establishment, which cannot fully reflect the residence of the employees and sometimes omit the self-employed farmers and itinerant merchants.

2. Industrial Structure of Cheongju City

1) Population Growth

The population of Cheongju has increased rapidly since the 1970s. Table 1 and Figure 1 shows that its population in 1970 was 143,944, but the population in 2010 became 662,102, that is more than 4 times increase. Though the

administrative area of Cheongju City had been increased until 1990, the population has continued to increase after 1990 when its population reached about 500,000. Also the change of population density since 1970 shows the consistent pattern of population concentration into Cheongju. As is the population increase, the number of household has increased. However the average size of household has decreased steadily as is the national pattern. The average household size of Cheongju was 2.77 in 2010, which is almost same as the nation's that

Table 1. Changes in population and household of Cheongju

Year	1970	1975	1980	1985	1990	1995	2000	2005	2010
Population (A)	143,944	192,734	252,985	350,175	497,429	520,046	586,700	642,805	666,924
Household (B)	26,667	38,743	52,898	83,981	117,378	155,989	179,676	217,941	241,058
A/B	5.40	4.97	4.78	4.17	4.24	3.33	3.27	2.95	2.77
Area (km ²)	84.98	84.98	84.98	114.82	153.55	153.55	153.55	153.55	153.55
Population Density (person/km ²)	1,694	2,268	2,977	3,050	3,240	3,387	3,821	4,186	4,343

Data: Statistics Korea, Census of Population and Housing, each year.

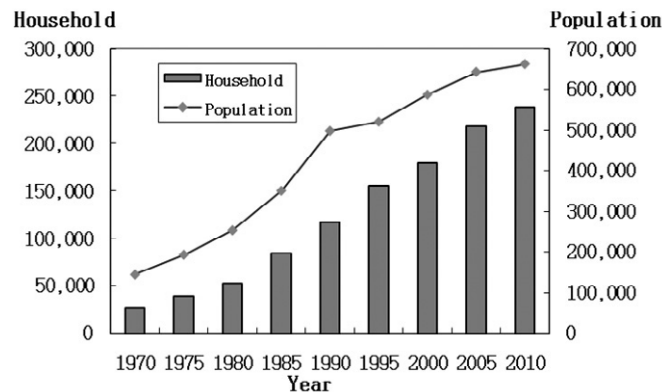


Figure 1. Changes in population and household of Cheongju

was 2.76 in 2010.

The background of such rapid population increase in Cheongju is as follows. (1) Cheongju has been a seat of a provincial government for a long time. (2) The Cheongju Industrial Complex was constructed during the 1970s. (3) Two express highways (Kyungbu expressway opened in 1970 and Joongbu expressway opened in 1987) connect Cheongju to Seoul to the north and to Busan to the south. (4) Four universities in Cheongju City

accommodate about 45,000 students. (5) Ochang Science Industrial Complex and Osong Health Science Complex constructed during the last decade are located in the adjacent Cheongwon County.

2) Industrial Structure

Industrial structure of Cheongju was examined using the 2005 Population and Housing Census.

Table 2. Employment composition of Cheongju, 2005

Industry	Employment	%	LQ
Agriculture & Forestry	8,304	3.42	0.33
Fishing	10	0.00	0.01
Mining	139	0.06	0.54
Manufacturing	61,704	25.43	1.29
Utilities*	947	0.39	0.87
Construction	22,124	9.12	1.22
Trade	34,151	14.08	0.94
Accommodations & Restaurants	18,037	7.43	0.96
Transportation	10,205	4.21	0.91
Telecommunication	2,695	1.11	0.95
Finance and Insurance	8,125	3.35	1.02
Real Estates	5,012	2.07	0.86
Business Services	10,534	4.34	0.75
Public Administration	10,547	4.35	1.13
Education Services	22,600	9.32	1.38
Health & Social Services	10,778	4.44	1.23
Entertainment & Cultural Services	4,412	1.82	0.89
Repair and Personal Services	11,225	4.63	1.05
Household Services	795	0.33	1.22
International & Foreign Institutions	24	0.01	0.21
Unclassified	229	0.09	0.30
Total	242,597	100.00	

* Utilities denote electricity, gas and water supply.

Data: Statistics Korea, 2005 Census of Population and Housing.

Table 3. Cheongju Industrial Complex in manufacturing of Cheongju, 2008

Area	manufacturing establishments	manufacturing employees
Cheongju (A)	2,290	30,445
Cheongju Industrial Complex (B)	278	23,129
Percentage (B/A)	12.1%	76.0%

Data: City of Cheongju, 2009, Statistical Yearbook.

Table 2 shows the employment composition of 20 industrial sectors of Cheongju in 2005, according to the 8th revision of Korea Standard Industrial Classification. The industrial sector that employed the largest number is Manufacturing, which comprises 25.43%. The location quotient (LQ)¹⁾ of manufacturing is 1.29, which implies Cheongju is relatively specialized in manufacturing. Especially, the Cheongju Industrial Complex is very important in manufacturing industry of Cheongju. As seen in Table 3, in 2008 the Cheongju Industrial Complex contained 12.1% of the total manufacturing establishments in Cheongju City, but hired 76% of the total manufacturing employees in Cheongju City. This is because there are large firms employing many workers in the Cheongju Industrial Complex.

The trade sector including wholesale and retail shows the second largest percentage (14.08%). In general, the trade function takes fundamental and largest portion in the service sector of most cities. This is why the LQ of the trade sector of Cheongju is lower than 1. On the other hand, education services sector shows the third largest percentage (9.32%) and the highest LQ (1.38), which implies that the nickname of Cheongju, so-called “educational city” is appropriate. As Cheongju is a provincial seat and the largest city in Choongbuk Province, public administration and health and

social services show high LQs (1.13 and 1.23). Among services sectors, business services sector showed the lowest LQ (0.75), which implies Cheongju is short of business-related professional services.

3) Changes in Industrial Structure

In order to find out the changes in industrial structure of Cheongju, employment data by industrial sectors compiled in the Population and Housing Census were compared. Table 4 shows that the changes in employment composition of 9 industrial sectors in Cheongju between 1985 and 2000. The total employment in Cheongju in 1985 was 99,552, and that in 2005 became 242,597, which is about 2.5 times increase. For the same time span, the population of Cheongju increased less than 2 times.

Industrial sectors showing the relatively large increase in employment (increase more than 30,000) are manufacturing, trade, restaurants and accommodations, and public, social, educational and personal services. The percentage of finance, insurance, real estate and business services increased from 4.25 in 1985 to 9.76 in 2005. In addition, the percentage of public, social, educational and personal services increased from 20.69% in 1985 to 24.98% in 2005, whereas

Table 4. Changes in industrial structure of Cheongju, 1985-2005

Industry	Employment			%		LQ	
	1985	2005	Change	1985	2005	1985	2005
Agriculture	7,186	8,314	1,128	7.22	3.43	0.29	0.31
Mining	140	139	-1	0.14	0.06	0.14	0.54
Manufacturing	28,447	61,704	33,257	28.58	25.43	1.22	1.29
Utilities	469	947	478	0.47	0.39	1.72	0.87
Construction	10,348	22,124	11,776	10.39	9.12	1.71	1.22
Trade, Restaurants, & Accommodations	21,672	52,188	30,516	21.77	21.51	0.96	0.94
Transportation & Telecomm.	6,458	12,900	6,442	6.49	5.32	1.39	0.92
FIRE* & Business Services	4,233	23,671	19,438	4.25	9.76	1.13	0.85
Public, Social, Educational, & Personal Services	20,599	60,610	40,011	20.69	24.98	1.56	1.17
Total	99,552	242,597	143,045	100.00	100.00		

* FIRE denotes finance, insurance, and real estate.

Data: Statistics Korea, 1985 and 2005 Census of Population and Housing.

manufacturing sector decreased from 28.58% to 25.43%. Such rapid increase of services sectors reflects the typical “services economy” trend.

In regard of the location quotients, 6 sectors showed LQ higher than 1 in 1985 while 3 sectors showed LQ higher than 1 in 2005. Among those sectors, only manufacturing sector showed the increase in LQ from 1.22 to 1.29. These changes in LQs seem to reflect the diversifying tendency in industrial structure of Cheongju, which indicates that the industrial structure of Cheongju become more similar to that of the nation.

The diversifying tendency can be verified by the coefficient of specialization²⁾. The coefficient of specialization of Cheongju for 1985 was 0.194 and that for 2005 was 0.111. This change indicates the industrial structure of Cheongju became more diversified than before.

3. Shift-Share Models

The shift-share models were formulated to provide a quantitative explanation of regional growth rates in sectoral employment compared to the national growth rates. In order to analyze the relationship between industrial structure and regional growth, many scholars have contributed to the development of the shift-share technique as a sophisticated analytical tool over several decades. After Creamer (1942) initiated the shift-share analysis in order to explain the regional changes in the U.S. manufacturing, Dunn (1960) and others (Perloff, Dunn, Lampard and Muth, 1960) developed the classical shift-share model. Though there has been long-standing criticism of the shift-share analysis (Richardson, 1978a, 1978b), the technique has been popular with urban and

regional planners as well as regional economists and economic geographers. The development of shift-share models was well summarized in Kim (1993: 358-361). The following are the replicated reviews and modifications of the shift-share models summarized by Kim.

1) Classical Shift-Share Model

Given regional employment data by industrial sectors at two points in time, the classical shift-share model decomposes the regional employment change, d , into three components: national growth component, g , industry-mix (or proportional) component, m , and competitive (or differential) component, c .

Letting E_{ij} be employment in industrial sector i of region j in the base year of the analysis, E_{ij}^* be employment in sector i of region j in the terminal year, r_{00} be the change rate in national total employment between the base year and the terminal year, r_{i0} be the change rate in national employment in sector i , and r_{ij} be the change rate in employment in sector i of region j , the traditional shift-share equation may be written as follows:

$$d_{ij} = g_{ij} + m_{ij} + c_{ij}$$

where

$$d_{ij} = E_{ij}^* - E_{ij}$$

$$g_{ij} = E_{ij} r_{00}$$

$$m_{ij} = E_{ij} (r_{i0} - r_{00})$$

$$c_{ij} = E_{ij} (r_{ij} - r_{i0}).$$

In this equation, the national growth effect, g_{ij} , reflects the change in regional employment which would occur when the regional sector grows at the

same rate as the overall national employment. The industry-mix effect, m_{ij} , measures the amount of employment change attributable to the relative importance of the sector in the overall national economy. The competitive effect, c_{ij} , is the difference between the actual change in sectoral employment and the expected change that the region will experience when each regional industrial sector grows at the national rate of the same sector. The sum of the industry-mix and the competitive components, $m_{ij} + c_{ij}$, is called the net shift.

If each of the shift-share components is summed over all sectors, the resulted sign of each component may indicate the direction of regional change compared to the national change. A positive industry-mix effect indicates that the region has a favorable growth mix of industries on balance (Plane, 1988: 267), and a positive competitive effect indicates that the region competes well on the whole (Herzog and Olson, 1977: 443).

There are two sources leading to the imperfection of this classical shift-share model: the weights on the base year and the interwoven effects between industry-mix and competitive components (Herzog and Olson, 1977: 443-444). Since growth rates of all components in this model are weighted by base year employment levels, changes in regional industrial structure over the study period cannot be reflected. Also, the industry-mix and competitive effects are interdependent because of technical linkages among supplying sectors and induced multiplier effects on service sectors (MacKay, 1968). Other problems of this model can be the inaccuracy of the model in the projection application and the

sensitivity of the model to the degree of industrial disaggregation.

2) Esteban-Marquillas Model

In an effort to solve the problem of interwoven effects of the competitive component, Esteban-Marquillas (1972) attempted to modify the classical shift-share model by introducing the concept of homothetic employment, E^{\wedge}_{ij} , and separating the competitive effect, c_{ij} , into a pure competitive effect, c'_{ij} , and an allocation effect, a_{ij} . Letting E_{0j} be total employment in region j in the base year, and E_{i0} and E_{00} each be national employment in sector i and national total employment in the base year, Esteban-Marquillas' model can be specified as follows:

$$d_{ij} = g_{ij} + m_{ij} + c'_{ij} + a_{ij}$$

$$\begin{aligned} \text{where } E^{\wedge}_{ij} &= E_{0j}(E_{i0}/E_{00}) \\ c'_{ij} &= E^{\wedge}_{ij}(r_{ij} - r_{i0}) \\ a_{ij} &= (E_{ij} - E^{\wedge}_{ij})(r_{ij} - r_{i0}). \end{aligned}$$

Homothetic employment, E^{\wedge}_{ij} , is defined as "the employment that sector i of region j would have if the structure of the employment in such a region were equal to the national structure" (Esteban-Marquillas, 1972: 251). However, Herzog and Olson (1977) found that this refinement created another weighting problem. Since homothetic employment also refers to the base year, the allocation effect comprising the specialization component, $(E_{ij} - E^{\wedge}_{ij})$, and the competitive advantage component, $(r_{ij} - r_{i0})$, does not give a reliable sign of change when the regional employment structure changes between the base

year and the terminal year.

3) Arcelus Model

In another effort to resolve the entangled effects in the competitive component, Arcelus (1984) further extended the shift-share model by subdividing the traditional competitive effect, c_{ij} , into the regional growth effect, Rg_{ij} , and the regional industry-mix effect, Rm_{ij} . Employing the homothetic employment concept of the Esteban-Marquillas model, he formulated the following model:

$$d_{ij} = g_{ij} + m_{ij} + Rg_{ij} + Rm_{ij}$$

$$\begin{aligned} \text{where } Rg_{ij} &= E^{\wedge}_{ij}(r_{0j} - r_{00}) + (E_{ij} - E^{\wedge}_{ij})(r_{0j} - r_{00}) \\ Rm_{ij} &= E^{\wedge}_{ij}[(r_{ij} - r_{0j}) - (r_{i0} - r_{00})] + \\ &\quad (E_{ij} - E^{\wedge}_{ij})[(r_{ij} - r_{0j}) - (r_{i0} - r_{00})]. \end{aligned}$$

In this model, the regional growth effect, Rg_{ij} , which is the difference in total growth rates between region j and the nation, attempts to capture the component of the regional employment change in sector i which is attributable to the total growth of region j . The regional industry-mix effect, Rm_{ij} , which is the difference in sector i 's competitiveness between region j and the nation, attempts to measure that component of the regional employment change which is attributable to the regional industry mix. In other words, the regional industry-mix effect explains whether sector i enjoys a competitive advantage in region j (Arcelus, 1984: 6).

4) Other Shift-Share Models

Berzeg (1978) formulated a stochastic linear model based on analysis of variance (ANOVA) so as to statistically test predictive hypotheses on the shift-share identity. His model can be specified as follows:

$$r_{ij} = \alpha + \beta_i + \varepsilon_{ij}$$

where α is an estimate of the national growth rate, r_{00} , and β_i is an estimate of the industry-mix rate, $(r_{i0} - r_{00})$. The competitive rate, $(r_{ij} - r_{i0})$, is estimated by a random error term, ε_{ij} . As seen in the specification of the equation, growth rates instead of employment numbers are estimated in this model. This linear model can be transformed so as to estimate Arcelus' extension model (Knudsen and Barff, 1991: 427).

The stochastic properties of these ANOVA-based models make it possible to test hypotheses for prediction and policy formulation. In spite of this advantage, the limitations of the ANOVA-based models are mainly due to the operational difficulties (Knudsen and Barff, 1991: 430). The stochastic shift-share models require system closure for the data set; if a study is concerned with a region of a nation, then all regions of the nation must be included in the data set.

Barff and Knight (1988) developed a dynamic shift-share approach in order to solve the problem of weights of the classical shift-share model. Since the classical static approach uses employment structure of the base year to calculate changes over to the terminal year, it cannot explain continuous changes in regional total employment and industrial mix over the time period. This problem

was eliminated by using the annual employment data which enable to adjust the shift-share components annually for changes in industrial structure (Barff and Knight, 1988). Since annual employment data based on the establishment survey are now available, the task of calculating annual shift-share components has become easier. However the problem of such establishment-based data is that they cannot fully reflect the residence of the employees.

Rigby and Anderson (1993) extended the shift-share model by adopting output effect and labor productivity effect. Since significant increase of labor productivity may lead to decrease in employment level, Rigby and Anderson separated output and productivity effects on employment level.

4. Shift-Share Analysis of Employment Growth

In order to examine the effects of the national economic structure on changes in employment structure of Cheongju and the sectoral competitiveness of Cheongju, this study employed a shift-share model modified from the Arcelus model. Other shift-share models than the Arcelus model were not appropriate for this study since the ANOVA-based model requires system closure for the data set and the dynamic shift-share model requires annual employment data. However Arcelus' original model was specified using the homothetic employment terms that create additional problem of weights as seen in the Esteban-Marquillas model. Thus this study adopted

a shift-share model that eliminated the homothetic employment terms from Arcelus' model. The model is as follows:

$$d_{ij} = g_{ij} + m_{ij} + Rg_{ij} + Rm_{ij}$$

where $Rg_{ij} = E_{ij}(r_{0j} - r_{00})$

$$Rm_{ij} = E_{ij}[(r_{ij} - r_{0j}) - (r_{i0} - r_{00})]$$

This model does not include the misleading homothetic employment terms, so the utility of this model is enhanced by simpler calculation and easier interpretation of the terms: regional growth effect (Rg_{ij}) and regional industry-mix effect (Rm_{ij}).

The data set consists of employment data of 9 industrial sectors for Cheongju and the nation compiled from the 1985 and 2005 Census of Population and Housing. Additionally, the data set composed of employment data of 21 industrial

sectors for Cheongju and the nation compiled from the 2000 and 2005 Census of Population and Housing was analyzed in order to explain more specific employment growth effects. For the 1985 Census, the city-level employment data are available only in the industrial classification system of 9 sectors.

Table 5 shows changes in sectoral employment of the nation and Cheongju from 1985 to 2005. The total employment of Cheongju increased with the change rate of 1.437 which is much higher than 0.288 of the national change. Also the employment of Cheongju in all industrial sectors except utilities sector increased with the rates higher than those of the nation. Industrial sectors of Cheongju showing higher change rates than 1.437 are FIRE & business services and public, social, educational, & personal services. Especially, FIRE & business services shows the highest change rate, 4.592, that is much

Table 5. Changes in sectoral employment of nation and Cheongju, 1985-2005

Industry	Nation			Cheongju		
	1985	2005	Change Rate	1985	2005	Change Rate
Agriculture	3,733,000	2,100,297	-0.437	7,186	8,314	0.157
Mining	155,000	20,402	-0.868	140	139	-0.007
Manufacturing	3,504,000	3,804,029	0.086	28,447	61,704	1.169
Utilities	41,000	86,539	1.111	469	947	1.019
Construction	911,000	1,442,733	0.584	10,348	22,124	1.138
Trade, Restaurants, & Accommodations	3,377,000	4,389,690	0.300	21,672	52,188	1.408
Transportation & Telecomm	701,000	1,116,780	0.593	6,458	12,900	0.998
FIRE* & Business Services	563,000	2,216,527	2.937	4,233	23,671	4.592
Public, Social, Educational, & Personal Services	1,984,000	4,100,373	1.067	20,599	60,610	1.942
Total	14,969,000	19,277,370	0.288	99,552	242,597	1.437

* FIRE denotes finance, insurance, and real estate.

Data: Statistics Korea, 1985 and 2005 Census of Population and Housing.

higher than 2.937 of the same sector of the nation.

For the nation, industrial sectors showing change rates higher than 0.288, that is the national average, are all service sectors, and agriculture, mining, and manufacturing sectors show change rates lower than the national average. For the nation, agriculture and mining sectors lost employment, while agriculture sector of Cheongju gained employment and mining sector of Cheongju lost only one person. These changes in Cheongju are mainly due to the expansions of the administrative boundary of Cheongju in 1987 and 1990, which embraced the population in countryside of Cheongwon County.

Table 6 summarizes the results of shift-share analysis of employment growth between 1985 and 2005 in Cheongju. The total employment change between 1985 and 2005 was 143,045 and the

change can be divided into three components: national growth effect, industry-mix effect, and competitive effect. The national growth effect (g_{ij}) can be explained as follows. The national growth rate (0.288) between 1985 and 2005 induced the employment growth in each sectors with the same rate, and the total growth effect resulted in the employment increase of 28,653.

In regard of the industry-mix effect (m_{ij}), agriculture, mining, and manufacturing sectors showed negative effects, because the growth rates of those sectors of the nation were lower (or slower) than the national average growth rate (0.288). However, since all other sectors showed positive effects, which means that the growth rates of those sectors of the nation were higher (or faster) than the national average, the total industry-mix effect resulted in 21,814. This means that as a

Table 6. Shift-share analysis of employment growth in Cheongju, 1985-2005

Industry	Change (d)*	National growth effect (g)	Industry-mix effect (m)	Competitive effect			Net shift ($m+c$)
				Total (c)	Rg^{**}	Rm^{***}	
Agriculture	1,128	2,068	-5,211	4,271	8,257	-3,986	-940
Mining	-1	40	-162	121	161	-40	-41
Manufacturing	33,257	8,188	-5,752	30,821	32,688	-1,866	25,069
Utilities	478	135	386	-43	539	-582	343
Construction	11,776	2,978	3,062	5,736	11,891	-6,154	8,798
Trade, Restaurants, & Accommodations	30,516	6,238	261	24,017	24,903	-886	24,278
Transportation & Telecomm.	6,442	1,859	1,972	2,612	7,421	-4,809	4,583
FIRE & Business Services	19,438	1,218	11,214	7,006	4,864	2,142	18,220
Public, Social, Educational, & Personal Services	40,011	5,929	16,045	18,038	23,670	-5,632	34,082
Total	143,045	28,653	21,814	92,578	114,392	-21,814	114,392

* $d = g + m + c$

** Rg = regional growth effect

*** Rm = regional industry-mix effect)

whole Cheongju has advantageous industrial structure in comparison with the industrial structure of the nation.

For the competitive effect (c_{ij}), only utilities sector showed negative effect because its growth rate in Cheongju (1.019) was lower than that of the nation (1.111). Since all other sectors of Cheongju grew faster than those of the nation, they were competitive enough to result in the total employment increase of 92,578. Most competitive sector in terms of the effect is manufacturing which showed the competitive effect of 30,821.

The competitive effect can be divided into two components: regional growth effect and regional industry-mix effect. The regional growth effect (Rg_{ij}) reflects the difference in total growth rates between Cheongju (1.437) and the nation (0.288), and the employments of all sectors in Cheongju increase with the same rate (1.149). This regional growth effect resulted in 114,392.

The regional industry-mix effect (Rm_{ij}) reflects the difference in competitiveness of each sector between Cheongju and the nation. After removing the national sectoral competitiveness from the sectoral competitiveness of Cheongju, only one sector (finance, insurance, real estate, and business services) showed purely positive effect (2,142). The total regional industry-mix effect ended with -21,814. Thus the fact that the competitive effect showed positive number (92,578) is mainly due to the total employment of Cheongju growing faster than the national total employment.

The net shift is the sum of industry-mix effect and competitive effect, and reflects the advantageous position in industrial structure of a region in comparison with that of a nation. Though agriculture and mining showed negative

effects in the net shift, all other sectors displayed positive net shifts. Especially public, social, educational, and personal services sector shows highest effect of the net shift (34,082).

In order to explain the shift-share effects in more disaggregated industrial sectors and more recent subperiod, this study analyzed employment data of 21 industrial sectors for Cheongju and the nation compiled from the 2000 and 2005 Census of Population and Housing using the same shift-share model as specified before. Table 7 shows the results of shift-share analysis of employment growth between 2000 and 2005 in Cheongju.

As seen in Table 7, the total employment change between 2000 and 2005 was 26,518 and the change is attributed to the national growth effect of 9,615, the industry-mix effect of 2,764, and the competitive effect of 14,139. The competitive effect is entirely attributable to the regional growth effect (Rg) that is 16,903, since the regional industry-mix effect (Rm) shows negative number. This high regional growth effect in the competitive component reflects the difference in the total growth rates between Cheongju (0.123) and the nation (0.044), which is 0.079.

Though the total regional industry-mix effect (Rm) resulted in negative effect, such sectors as agriculture, manufacturing, business services, health and social services show high positive regional industry-mix effects. These sectors are considered to be purely competitive because their regional industry-mix effects were calculated by subtracting the national sectoral competitiveness from the sectoral competitiveness of Cheongju.

The net shifts of such sectors as agriculture, manufacturing, construction, business services, education services, health and social services are

Table 7. Shift-share analysis of employment growth in Cheongju, 2000-2005

Industry	Change (<i>d</i>) ^a	National growth effect (<i>g</i>)	Industry- mix effect (<i>m</i>)	Competitive effect			Net shift (<i>m+c</i>)
				Total (<i>c</i>)	<i>Rg</i>	<i>Rm</i>	
Agriculture & Forestry	1,485	303	-1,165	2,346	533	1,813	1,182
Fishing	-44	2	-13	-33	4	-37	-46
Mining	-55	9	-45	-19	15	-34	-64
Manufacturing	5,152	2,516	-4,231	6,867	4,424	2,443	2,636
Utilities	107	37	-13	83	66	17	70
Construction	2,784	861	452	1,472	1,513	-41	1,923
Trade	1,799	1,440	-1,473	1,833	2,531	-698	359
Accommodations & Restaurants	524	779	705	-960	1,370	-2,330	-255
Transportation	227	444	-360	143	781	-637	-217
Telecommunication	129	114	-97	112	201	-89	15
Finance and Insurance	-873	400	-1,074	-199	704	-903	-1,273
Real Estates	1,067	176	1,361	-470	309	-778	891
Business Services	3,847	298	2,322	1,228	523	705	3,549
Public Administration	783	434	246	102	764	-662	349
Education Services	2,103	912	2,423	-1,232	1,603	-2,836	1,191
Health & Social Services	5,295	244	3,122	1,929	429	1,501	5,051
Entertainment & Cultural Services	790	161	468	161	283	-122	629
Repair and Personal Services	1,072	452	322	298	794	-496	620
Household Services	75	32	-223	266	56	209	43
International & Foreign Institutions	23	0	0	23	0	23	23
Unclassified	228	0	39	189	0	189	228
Total	26,518	9,615	2,764	14,139	16,903	-2,764	16,903

relatively high. In agriculture, the employment of Cheongju increased from 6,819 to 8,304 between 2000 and 2005, while the national employment declined. Also in manufacturing, the employment of Cheongju increased from 56,552 to 61,704 between 2000 and 2005, while the national employment decreased. Thus agriculture and manufacturing sectors are considered to be competitive in spite of the negative industry-mix effects. Contrarily, business services and health &

social services shows highly positive effects in all shift-share components, and construction sector show positive effects in all shift-share components except the regional industry-mix effect.

Education services sector shows high positive effect in the net shift, but negative effect in the regional industry-mix component. This is because, while the employment of that sector grew from 20,497 to 22,600 between 2000 and 2005, its growth rate (0.103) was lower than that of the

nation (0.163). Though the location quotient (LQ) of the education services sector was highest (1.38) among all sectors of Cheongju in 2005 as seen in Table 2, the LQ of that sector was higher (1.56) in 2000. This implies that the position of Cheongju as an “educational city” was weakened.

Finance and insurance sector shows negative net shift and its employment decreased from 8,998 to 8,125 between 2000 and 2005, while finance, insurance, real estate, and business services showed highly positive effects in all shift-share components between 1985 and 2005. Even the national employment of finance and insurance sector decreased between 2000 and 2005, which resulted in the negative industry-mix effect.

By way of the breakdown of industrial sectors in detail and shorter time span of the study, the shift-share analysis can show different patterns of the employment growth effects. Therefore, more disaggregated industrial classification and more fractured subperiod are encouraged for a shift-share analysis.

5. Conclusions

In regard of the change of the urban industrial structure, this study examined the industrial employment change of Cheongju City and performed the shift-share analysis for the employment growth. The data used in this study are mainly from the 1985, 2000 and 2005 Population and Housing Census. Since these data are based on the residence, not the establishment, they are useful to analyze the industrial structure of a city that reflects its residents’ characteristics.

The population of Cheongju has increased rapidly since the 1970s. The reasons of such population increase are the construction of Cheongju Industrial Complex, the opening of Kyungbu and Joongbu expressways, four universities in Cheongju City, and the construction of Ochang Science Industrial Complex and Osong Health Science Complex during the last decade.

The industrial sector that employed the largest number is manufacturing, which comprises 25.43% in 2005, and the Cheongju Industrial Complex hired 76.0% of the total manufacturing employment in Cheongju. The analysis of location quotient (LQ) revealed that the education services sector of Cheongju shows the highest LQ, which implies that the nickname of Cheongju, so-called “educational city,” is appropriate.

Industrial sectors showing the relatively large increase in employment from 1985 to 2005 are manufacturing, trade, restaurants and accommodations, and public, social, educational and personal services. Finance, insurance, real estate, and business services showed the highest growth rate in both Cheongju and the nation.

The location quotients and the coefficients of specialization resulted from this study revealed the converging tendency toward the national average of the urban industrial structure by diversification, as mentioned by Marshall (1989: 134). The result indicates the industrial structure of Cheongju became more diversified than before. This phenomenon seems to be due to the spread of service economy in the postindustrial society.

The effects of the national economic structure on changes in employment structure of Cheongju and the sectoral competitiveness of Cheongju were examined by employing a shift-share model

modified from the Arcelus model. The Shift-share model elucidated the pure competitiveness of each industrial sector by subdividing the competitive effect into the regional growth effect and regional industry-mix effect. As a whole, Cheongju has advantageous industrial structure in comparison with that of the nation. All sectors of Cheongju except the utilities sector grew faster than those of the nation and showed positive competitive effects. The industrial sector showing the highest effect in the competitive component was manufacturing, which indicates that the manufacturing sector is still important for the employment growth of Cheongju.

The shift-share analysis employing more disaggregated industrial sectors and more recent subperiod showed different patterns of industrial growth components. Such sectors as agriculture, manufacturing, business services, health and social services show high positive regional industry-mix effects. Education services sector shows high positive effect in the net shift, but its growth rate is lower than that of the nation. This implies that the position of Cheongju as an “educational city” was recently weakened.

From this study, it is concluded that the shift-share analysis is useful to find out the competitive industry for the regional development, and it is suggested to utilize more disaggregated industrial data in more fractured subperiod in order to pinpoint the competitive or declining industries.

Notes

- 1) The location quotient (LQ) is a criterion that shows the specialization level of each industry by comparing the region’s industrial composition with the national industrial composition. The location quotient of *i* industry of a region (R), LQ_i , as follows:

$$LQ_i = \frac{\frac{R_i}{R}}{\frac{R_i}{R}} = \frac{\frac{\text{Regional employment in } i \text{ industry}}{\text{Regional total employment}}}{\frac{\text{National employment in } i \text{ industry}}{\text{National total employment}}}$$

- 2) The coefficient of specialization for a region (or a city), S_i , can be formulated as follows:

$$S_i = 10^{-2} (\sum_{i=1}^n |R_i - N_i|)$$

where R_i is the percentage which industrial sector *i* makes up in the total employment of a region and N_i is the percentage which industrial sector *i* makes up in the total employment of a nation (Florence et al., 1943; Marshall, 1975; Hoover and Giarratani, 1984: 262-263). Here, a coefficient of zero indicates perfect diversification and a coefficient of 1 (or 100 %) indicates perfect specialization.

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Correspondence: Hak-Hoon Kim, Department of Geography Education, Cheongju University, Cheongju, 360-764, Tel: +82-43-229-8598, e-mail: hkim@cju.ac.kr
 교신: 김학훈, 360-764, 충북 청주시 상당구 내덕동 36, 청주대학교 지리교육과, 전화: 043-229-8598, 이메일: hkim@cju.ac.kr

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청주의 고용 성장과 산업 변화, 1985–2005: 변이할당모형에 의한 분석

김학훈*

요약: 청주시는 1970년대부터 인구와 고용이 급성장하였다. 본 연구는 청주시의 산업별 고용변화를 조사하고 고용성장에 대한 변이할당 분석을 시행하였다. 본 연구에서 사용한 자료는 주로 1985년, 2000년, 2005년의 인구 및 주택 총조사에서 얻은 청주시의 산업별 고용자료이다. 본 연구는 먼저 청주의 인구 변화와 산업구조를 설명하고, 그 다음은 변이할당모형의 발달을 검토하였다. 본 연구에서 얻은 청주의 산업별 입지계수와 특화계수의 변화를 통해서 도시산업구조의 다양화 추세를 알 수 있었다. 본 연구에 적용한 변이할당모형은 Arcelus의 모형을 수정하여 사용하였으며, 분석 결과를 통해서 산업 부문별 경쟁력을 파악할 수 있었다. 청주는 국가 전체와 비교하면 대체로 유리한 산업구조를 가지고 있다. 일부 서비스 부문을 제외한 모든 산업 부문에서 국가보다 빨리 성장하여 양(+)의 경쟁효과를 보였다. 변이할당분석에서 세분된 산업분류와 짧게 나누어진 분석기간을 사용하면 경쟁력 있는 산업을 더 정확하게 찾을 수 있다.

주요어: 산업구조, 고용성장, 변이할당분석, 경쟁력, 다양화

* 청주대학교 사범대학 지리교육과 교수