

The Structural Changes of Daejeon–Chungnam's Production Linkages Using a Qualitative Regional Input–Output Analysis

대전·충남지역 산업 간 연관관계의 구조적 변화

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I. Introduction

The Korean economy has accomplished rapid economic growth by the government-led sectoral-differential strategic economic policy that is rare in world economic history during half a century. Those government policies towards the economic developments during the high growth period generated a significant spatial inequality as a result of centralized economic strategies, along the lines proposed by Hirschman. However, Korea's future development will require that more attention be paid to problems of regional development; a decentralization strategy, though, requires that careful consideration be given to the particular strengths and competitive advantages that might be enjoyed by the different regions.

Over 10 years ago, the development of local autonomy strategy took effect in Korea. In order to fully develop a decentralizing economic strategy, it is important to analyze the relationships among industries within a region. Even though a great deal of research has been conducted to try to figure out the relationship of industries on the national basis in Korea, little research has been carried out at the regional scale. This paper will focus

on the relationship among industries of the Daejeon-Chungnam region in Korea.¹⁾

This paper proposes to identify the main industries and show how the industries interact with each other within the region. Qualitative Input-Output Analysis (QIOA) will be applied to examine the economic structures by finding out the set of essential relationships between industries in an economy (e.g. Schnable. 1994; Hicoki. 2005; Aroche-Reyes. 2003).

To conduct this analysis, we need to access to input-output tables for the Daejeon-Chungnam region. The Bank of Korea, the agency providing official statistics for the country, compiles only national based input-output tables. Hence, the input-output tables of Daejeon-Chungnam region should be constructed using non-survey methods.

The main object of this study is to identify the structural changes of Daejeon-Chungnam's input-output linkages using a qualitative input-output analysis, particularly, the Minimal Flow Analysis. At first, among all the regional input-output linkages of the productive activities, some important linkages are extracted; the structures constituted by those linkages are identified by a simple theoretical method.

1) Daejeon-Chungnam region is chosen as a case study for a pilot application of Qualitative Input-Output Analysis at the regional level together with the authors' special interests and the availability of the data.

Then we apply the analysis to two time points between 1995 and 2000, namely before and after the 1997 financial crisis in Korea. The intertemporal comparison of the results provides some new insights into the changes in inter-industry linkages that took place in the Daejeon-Chungnam region.

This paper is organized as follows: Section II briefly explains the methodology we use in this research. Section III focuses on the construction of the regional input-output tables of Daejeon-Chungnam. Section IV presents and discusses the main empirical results; the paper concludes with some summary remarks in Section V.

II. Methods

We use Minimal Flow Analysis (MFA) introduced by Schnable (1994, 2001) to identify the structure of Daejeon-Chungnam input-output linkages. MFA is a qualitative input-output analysis (QIOA) that is intended to reveal the underlying structure of an input-output table by classifying which intermediate transactions are regarded as important.

There is a rich body of literature on how to identify underlying fundamental economic structures in input-output tables. They range from the ones using triangularization (Simpson & Tsukui, 1965, among others), to

those associated with the concept of predictability (Jensen et al. 1991), the qualitative input-output analysis (Aroche-Reyes, 1996, 2002) and finally, to applications identifying structural changes such as the study of China's spatial production linkages (Hioki et al. 2005).

The QIOA, of which MFA is a major contributor, is an approach that makes it possible to grasp the fundamental economic structure easily using digraphs derived from the application of graph theory to input-output tables. The reason why we apply MFA in this paper is that an inherent drawback of QIOA associated with transitivity is mitigated in MFA analysis. MFA works with intermediary "layers" composing a transaction matrix. Since the entries of the layer matrices decrease as the stage of layers increase, MFA can avoid over-counting the number of important linkages, although conventional QIOA cannot because it usually works with a direct coefficient matrix which provides only one adjacency matrix.

In MFA, we begin with the decomposition of a transaction matrix into some layers by using the following relationships:

$$T = A \langle X \rangle \quad (1)$$

In equation (1), A and $\langle X \rangle$ are the input coefficient matrix and a diagonal matrix of

output vector X respectively; T denotes the intermediate transaction matrix. Substituting X by the following equations,

$$X = RY \quad (2)$$

And

$$R = I + A + A^2 + A^3 + \dots \quad (3)$$

Then we obtain equation (4), representing the decomposition of T into several layers T^i ($i=0, 1, 2, \dots$)

$$T = T^0 + T^1 + T^2 + \dots \quad (4)$$

And

$$\begin{aligned} T^0 &= A \langle Y \rangle, T^1 = A \langle AY \rangle \\ T^2 &= A \langle A^2 Y \rangle, \dots \end{aligned} \quad (5)$$

In equations (2) through (5), R , Y and I denotes the Leontief inverse matrix, the vector of final demands and the identity matrix respectively. Note that the superscripts in equation (4) and (5) represent the number of layer, not the exponential power for each matrix. Also, note that the entries should be rounded to integers and the main diagonal entries set to zero.

The next step is to convert each matrix layer T^i ($i=0, 1, 2, \dots$) to a corresponding

adjacency matrix W^i ($i=0, 1, 2, \dots$) using a given filter value F . The filtering is implemented based on the following equation.

$$W_{ij}^k = \begin{cases} 1, & t_{ij}^k \geq F \\ 0, & t_{ij}^k < F \end{cases} \quad (6)$$

where $W^k = (W_{ij}^k)$ and $T_{ij}^k = (t_{ij}^k)$, respectively.

The last step is to obtain a dependence matrix D and a connectivity matrix H from the adjacent matrices. The derivation of each matrix is based on the following equations,

$$D = W(1) + W(2) + W(3) + \dots \quad (7)$$

$$H = D + D' \quad (8)$$

And

$$\begin{aligned} W(i) &= W^{i-1} W(i-1) \text{ for each} \\ i &= 1, 2, 3, \dots (W(0) = I) \end{aligned} \quad (9)$$

Note that the matrix multiplications in (9) and the summation of $W(\cdot)$ in (7) should be done in a Boolean fashion (i.e. $1 + \#1 = 1$). However, the summation in the last equation follows usual algebraic rules. Each entry of the dependency matrix d_{ij} is equal to 1 if and only if there exist direct and indirect flows from sector i to sector j , which, together, sum up to a value greater than or equal to a given filter value F (Schnable).

2001).

Each entry of the connectivity matrix h_{ij} may take one of three possible values (0, 1, 2). If h_{ij} takes the value of 0, sector i and sector j are isolated. If h_{ij} takes the value of 1, there is a unidirectional link between sector i and j . In this case, we can identify the direction of the flow by checking the value of d_{ij} and d_{ji} in D . If h_{ij} takes the value 2, there is a bilateral link between sector i and j , showing that there is a circular relationship in which two sectors are likely to generate both supply and demand impulses with each other.

MFA usually chooses the best filter value using the information maximization principle. When a nearly equal number of differently qualified sectors with $h_{ij} = 0$, $h_{ij} = 1$ or 2 exists, i.e., according to Shannon's theory, the entropy measure applied to these three possible states is maximal.

However, we changed the methods at this point because of a technical reason. MFA procedure is performed for 50 times of 50 equidistant filter levels, where F^1 is zero and F^{50} is the last filter value, which is identified by the value that makes the last bilateral links within H into a unilateral one when it is surpassed.

Using 50 filter values, we can obtain 50

corresponding H matrices, from which we choose the one with the highest entropy (that is, the one with maximum information). The original procedure stated in the above can also be implemented in our research, but it only makes the structure too complicated. The number of linkages contained in the structure becomes so large that it is hard to easily grasp the structure.

As a result, we employ the following method to determine a filter value which is more appropriate for our analysis. First, we calculated the D and H matrix up to 50 equidistant filter levels.

Secondly, we choose the filter level in which we can find the most important structure of Daejeon–Chungnam economy. In this paper, we call the linkages found with this filter value ($n=10$ or 30) the "most important linkages."

Thirdly, we choose another new filter value whose sectors are 20 or 60. These linkages are referred to as "secondary important linkages" in this analysis.

By comparing the digraph of the most important and secondary important linkages at different time points, we can identify any structural changes that might have taken place in Daejeon–Chungnam's fundamental industry linkages.²⁾

2) The concept of structural change used in this paper is to investigate any possible shifts in the structure of industries before and after the 1997 financial crisis in Korea with the values of F determined by the theory of entropy maximum information. To avoid extreme complexity, however, the values of F are selected somewhat arbitrarily in order to

III. Data: Constructing Daejeon-Chungnam's Regional I-O tables

1. Methods

Since there are no regional I-O tables in Korea, it is necessary to construct a set of tables for the region. The two main alternative methods for making regional input-output tables are either through survey techniques or non-survey techniques. The cost of constructing survey-based regional input-output tables may well involve considerable expenditures of both time and money. Although national-level tables have become an accepted part of the data collection and assembly processes associated with national income and product accounts, the same has not been true at the regional level. The existence of sets of input-output tables at the national level has provided the basis for the development of non-survey regional input-output tables.

In the most common situations, the existence of national tables has been complemented by very limited information at the regional level. These data usually constitute Gross Regional Domestic Product (GRDP), industry statistics supplemented by

data available in the Korea Statistics web-site (provide by the Korea Statistics Office). From these data, we are usually able to construct a vector of total output for a set of industries in the region. The next steps involve the use of some modifying techniques to transform the national table to a regional one.

Following Hewings (1985), these techniques involve the estimation of various quotients or ratios, many of which have been applied in other contexts to the regional analysis literature. In operating with the non-survey techniques, an assumption is usually made to the effect that:

$$a_{ij}(r) = a_{ij}(n) \quad (10)$$

Namely, the technology used in comparable industrial sectors is the same at the national (n) and regional (r) levels. This assumption thus precludes possible differences in technology, and possible variations in product mix. However, in the absence of any information about many of these characteristics at the regional level, one is left with very few options but to adopt a very conservative strategy, namely, a minimum of speculation is applied to the modification process.

As a result, the strong assumption needs

maintain the similar numbers of industries of both most important and second important in 1995, 2000 for consistency.

to be adopted that the distributions of many of these characteristics concerning firms are similar both at the national and regional levels. The various non-survey techniques seek to modify the national technical coefficients to produce a set of regional requirements coefficients:

$$r_{ij} = a_{ij}^{(n)} q_j \quad (11)$$

where q_j is a quotient or ratio of some kind; this quotient may be applied uniformly across all entries in a row or down a column or it may be developed as q_{ij} and applied separately to each individual coefficient. The choice of technique must be rooted in theory; in the development of the basic economic model, similar problems arose in the estimation of the proportion of activity that was basic as opposed to non basic when survey data were not available. In this case, a popular non survey technique that has been used is the location quotient.

Equation (12) shows the formula for the estimation of the location quotient for industry i in region r :

$$l_{q_i} = [X_i(r) / \sum_i X_i(r)] / [X_i(n) / \sum_i X_i(n)] \quad (12)$$

The above equation enables us to compare the proportionate share of industry i in the region with the share of industry i in the nation. The data used for the X_i usually constitute

either employment or output figures.

Once the quotient has been obtained, it is applied in the following fashion:

$$r_{ij} = \begin{cases} a_{ij}^{(n)} & \text{if } l_{q_i} \geq 1 \\ a_{ij}^{(n)} l_{q_i} & \text{if } l_{q_i} < 1 \end{cases} \quad (13)$$

The reason why we adopt this application may be stated in terms of the expectation that any industry i , will be able to supply the demands placed upon it by all other industries in the region.

If the industry's representation in the region is greater than that observed in the national data (i.e. the location quotient is greater than one), then there is a high probability that the industry will be able to meet all local demands.

However, if the reverse is true, then in all likelihood, only a portion of the local demands will be able to be supplied from the local industry (the remaining demands will have to be imported). The share of the total demands supplied locally is thus reduced in accordance with the size of the location quotient.

If $l_{q_i} = 0.83$, then only 83% of the local demands for the output of industry i will be supplied within the region.

If the industry is not present in the region, then all coefficients in that row would be zero. Note that no matter how

<Table 1> Daejon-Chungnam Input-Output Tables (billion, won)

In 1995	Agri	Mining	Manu- facture	SOC	Service	Total inter- mediate Demand	Final demand	Total Demand
Agriculture	179	0	1,137	11	98	1,424	2,664	4,088
Mining	0	0	187	85	2	274	-40	234
Manufacture	726	18	5,485	2,635	1,647	10,511	10,924	21,435
SOC	14	8	346	205	660	1,234	8,486	9,719
Service	283	32	2,048	1,342	3,692	7,398	13,232	20,629
Total Intermediate Input	1,202	59	9,203	4,278	6,098	20,840	35,266	56,106
VA	2,681	160	6,671	4,086	12,542	26,141	-	-
Imports	205	15	5,562	1,355	1,988	9,125	-	-
Total Input	4,088 (7.3)	234 (0.4)	21,435 (38.2)	9,719 (17.3)	20,629 (36.8)	56,106 (100.0)	-	-

In 2000	Agri	Mining	Manu- facture	SOC	Service	Total Inter- mediate Demand	Final Demand	Total Demand
Agriculture	208	0	2,044	19	142	2,414	2,591	5,005
Mining	0	0	142	47	2	191	9	200
Manufacture	1,037	23	15,584	2,798	2,839	22,281	28,936	51,217
SOC	19	8	842	397	762	2,028	9,326	11,354
Service	335	29	3,965	1,223	5,287	10,840	20,446	31,285
Total Intermediate Input	1,600	60	22,577	4,484	9,032	37,753	-	-
VA	3,125	127	13,939	5,034	18,459	40,682	-	-
Import	281	13	14,701	1,836	3,795	20,626	-	-
Total Input	5,005 (5.1)	200 (0.2)	51,217 (51.7)	11,354 (11.5)	31,285 (31.6)	99,061 (100.0)	-	-

<Table 2> The Change in Production Inducement Multipliers

Sectors	Industries	In 1995			In 2000		
		Production Inducement Multipliers	Backward Linkage	Forward Linkage	Production Inducement Multipliers	Backward Linkage	Forward Linkage
1	Agri	1.50	0.95	1.23	1.55	0.94	1.16
2	Min	1.40	0.88	0.79	1.45	0.89	0.71
3	FBT	1.94	1.22	1.33	1.97	1.20	1.18
4	Tex	1.70	1.08	0.85	1.70	1.04	0.79
5	Wood	1.70	1.08	1.36	1.80	1.10	1.33
6	Print	1.79	1.13	0.73	1.88	1.15	0.66
7	Petro	1.14	0.72	1.06	1.11	0.68	1.33
8	Chemi	1.78	1.13	2.01	1.88	1.15	2.19
9	Nonmetal	1.80	1.14	0.99	1.80	1.10	0.86
10	P metal	1.62	1.02	1.29	1.69	1.04	1.38
11	Fab metal	1.66	1.05	0.83	1.72	1.05	0.89
12	Gen mach	1.63	1.03	0.96	1.82	1.11	1.05
13	Electro	1.50	0.95	0.92	1.50	0.92	1.06
14	Pre inst	1.69	1.07	0.71	1.75	1.07	0.72
15	Motor	1.53	0.97	0.72	2.20	1.35	1.03
16	Ship	1.51	0.96	0.64	1.61	0.98	0.62
17	Furni	1.68	1.06	0.67	1.74	1.06	0.68
18	Electric	1.51	0.95	1.19	1.43	0.87	1.19
19	Construc	1.73	1.10	0.86	1.69	1.03	0.75
20	Sale	1.42	0.90	1.07	1.38	0.85	0.96
21	Eat Hotels	1.56	0.99	0.85	1.83	1.12	1.05
22	Trp	1.34	0.85	0.96	1.38	0.85	0.83
23	Com	1.22	0.77	0.86	1.48	0.90	0.92
24	Fi In	1.35	0.85	1.09	1.31	0.80	1.10
25	Re Bs	1.44	0.91	1.89	1.33	0.82	1.55
26	Pub	1.47	0.93	0.63	1.37	0.83	0.61
27	Edu	1.25	0.79	0.88	1.27	0.78	0.84
28	Med	1.59	1.01	0.68	1.68	1.03	0.66
29	Soc	1.59	1.01	0.69	1.65	1.01	0.69
30	Others	2.36	1.49	1.28	2.14	1.31	1.22

much larger than one the location quotient might be, the national technical coefficient serves as an upper bound³⁾.

2. Results

The regional input-output tables of Daejeon-Chungnam are shown in <Table 1>. When we evaluate the relative importance of Daejeon-Chungnam's industries, we find that the sectors of Agriculture, Forestry and Fishing diminished between 1995 and 2000 from 7.3% to 5.1%, but the manufacturing sector increased from 38.2% to 51.7% during the same period. We think the geographical advantage of Daejeon-Chungnam, which is adjacent to the metropolitan area of Seoul-Gyeonggi, is revealed as a very important factor. Because of banning the construction of new factories in metropolitan Seoul-Gyeonggi, many new industries (for example the electronic, automobile, petroleum and chemical industries) were launched in the northern part of Daejeon-Chungnam.

Although the service industry also became larger and its growth rate was over 50% from 1996 to 2000 (overwhelming the average growth rate of all industry), the overall gain was smaller.⁴⁾

Now we can use the input-output tables of Daejeon-Chungnam in order to examine the effects of related industries. Related industries are those in which one industry's development is induced by another industry. The linkages of related industries are composed of both forward effects and backward effects. A forward effect is the 'ripple effect' of a new industry causing development of additional industries using the materials which are produced by the new industry. A backward effect arises when the development of one industry causes the development of another industry that supplies materials.

In general, the supply of capital in a developing country is in shortage. Making equal investments in all industries is almost impossible. Strategic policy to bring economic development often focuses on specific industries and then invests intensively creating strong effects on related industries where the in-country resources utilization factor is most promising.

<Table 2> shows the changes in production inducement multipliers measuring average backward and forward linkage effects, respectively.

3) If the location quotient of a certain industry (l_i) is greater than one, then the region is more specialized in the industry than the national as a whole, and thus it becomes an outgoing industry, vice versa.

4) In spite of over 50% growth rate of service sector from 20,629 to 31,285, the relative weight has reduced from 36.8% to 31.6%.

During the period of our analysis, overall backward and forward linkages have increased considerably, showing that the degree of intermediation has been strengthened (perhaps a common phenomenon observed in most growing regions) from average related industries' effect of 1.58 in 1995 to 1.64 in 2000.

When we examine the effects of related industries, the highest backward linkages are found in Motor Vehicles (1.35), and FBT (1.20), Print (1.15), Chemicals (1.15), Nonmetallic Mineral Products (1.10) in 2000.

On the other hand, the highest forward linkages are in Chemicals (2.19), Real Estate and Business Service (1.55), Agriculture

<Table 3> The Structure of Related Industries of National Economy

In 1995	Degree of Importance	(F: million)	The relations among Industries (refer to Appendix 1)
Unilateral Linkage	Most important	F>= 180 (N=32)	3→26 8→4, 19, 28 9, 11, 12→19 25→20, 29 10→12, 19 21→26
	Secondary important	F>= 132 (N=58)	1→20, 26 3→20 5→19 7→22 8→13, 15 10→11, 13, 15 19→29 21→20 23→20
Bilateral Linkage	Most important	F>= 88 (N=12)	1↔3 19↔13, 20, 24, 25 24↔25
	Secondary important	F>= 72 (N=20)	3↔19, 25 19↔22 20↔25
In 2000	Degree of Importance	(F: million)	The relations among Industries (refer to Appendix 1)
Unilateral Linkage	Most important	F>= 294 (N=30)	1→3, 21 3→21 7→22 8→4, 13, 28 9, 10, 11→19 20→13 25→20,29
	Secondary important	F>= 196 (N=58)	10→12, 13, 15 8→15 7→22 3→21, 26 1→21 12, 20→19 21→26 23→20 25→13, 28 27→13
Bilateral Linkage	Most important	F>= 161 (N=10)	24↔25 19↔13, 20, 24, 25
	Secondary important	F>= 105 (N=20)	1↔3↔20↔21↔25↔3

Note: F = the value of filter used in order to get the result, N = the number of sectors appeared in result.

(1.16), FBT(1.18), Wood (1.33), Petroleum (1.33), Primary Metal Products (1.38) in 2000.

If we compare the linkage effects associated with related industries between 1995 and 2000, the sectors of Chemicals, Electronics, Motor Vehicles, Eating and Lodging show greater values in 2000.

IV. Empirical Results

To provide a comparison between the whole national economy and Daejeon–Chungnam region, we examine the case of the national economy firstly. In <Table 3>, we provide the underlying structure of the industries in Korea. In case of unilateral linkages⁵⁾, we clearly recognize the existence of the 'food–backbone', which is the chain connection of "Agriculture → Food → Eating and Hotel industries" in 2000, but it was not clear in 1995. The sector of Construction was a very important industry in terms of backward linkage, while the sector of Chemical Products was a very important industry in terms of forward linkage both in 1995 and in 2000. Also the sector of Wholesale and Retail Trade gained the importance both in 1995 and in 2000.

In case of bilateral linkages, the

relationship between Agriculture and Food · Beverages · Tobacco was the most important in 1995 as it was in the Daejeon–Chungnam region; but it was not in 2000. The role of Construction was most important both in 1995 and in 2000 just like Daejeon–Chungnam. Also, the relationship of "Finance and Insurance ↔ Real Estate and Business Service" may be developing as important industries. We can also find the chain connections of "Agriculture ↔ Food and Beverages ↔ Wholesale and Retail Trade ↔ Eating Hotels" as second important industries in 2000.⁶⁾

There were important changes in the structure of industries in Korea before and after "the financial crisis in 1997". In short, before the crisis, the products of Agriculture and Food and Beverage industries were primarily purchased by the Public Administration and Defense sector (in 1995), but after the crisis the sector of Eating and Hotels grew rapidly due to the high growth of the leisure industry that could be traced to the increased disposable income of the general public.

Now, we move on to find the underlying structure of the Daejeon–Chungnam industries in <Table 4>. In case of unilateral

5) The unilateral linkage is estimated using equation (7), while the bilateral linkage is done by equation (8), respectively.

6) The unilateral linkage measure is independently estimated from the bilateral linkage measure with different critical values so that there may have both linkages at a certain time according to the specified industries.

<Table 4> The Structure of Related Industries of Daejeon-Chungnam Region

In 1995	Degree of Importance	(F: million)	The relations among Industries (refer to Appendix 1)
Unilateral Linkage	Most important	F>= 155 (N=30)	3→26 8→4 5, 8, 9, 10, 11, 12, 13, 24→19 25→20, 21
	Secondary important	F>= 95 (N=56)	1→26, 29 2→19 3→29 8→1, 28 19→20, 21, 26, 29 21→26, 29 22→19
Bilateral Linkage	Most important	F>= 55 (N=10)	1↔3 19↔1, 20, 21, 25
	Secondary important	F>= 40 (N=18)	3↔8, 19, 20 19↔1, 3, 8, 20, 21, 25
In 2000	Degree of Importance	(F: million)	The relations among Industries (refer to Appendix 1)
Unilateral Linkage	Most important	F>= 200 (N=30)	1, 3→21 9, 10, 11, 12→19 7→8, 22 8→15, 28 21→26
	Secondary important	F>= 120 (N=60)	8→1, 4, 13 10→12, 15 12→15 13→15 18→8 21→27, 29 25→20, 26, 29 27→13
Bilateral Linkage	Most important	F>= 85 (N=10)	1↔3, 19↔8, 13, 20, 25
	Secondary important	F>= 65 (N=22)	1↔8 3↔8 8↔21 19↔1, 3, 21

Note: F= the value of filter used in order to get the result, N= the number of sectors appeared in result.

linkages, the patterns of development between Agriculture, Food, Beverages and Tobacco, and Eating places and Hotels show usual relations, but they are weaker than national level. The Construction sector is more important in Daejeon-Chungnam than in the national economy. It is related to nonmetallic, primary metal products,

fabricated metal products, general machinery and equipment. In addition, the Motor industry turns out to be the most important sector along with the Chemical industry in 2000, but there was no signal in 1995. This may have resulted from the rapid growth of the Motor industry in the northern part of Chungnam region.

In case of bilateral linkages, the relationships between Agriculture (Agr) and Food · Beverages · Tobacco (FBT), and between Construction and Construction Material industries showed the most importance. The bilateral linkages between Chemicals and Allied products, and Related industries were in second place. Specifically, Chemical Products played a role as an important material in Agriculture, Food and Beverages, Eating and Hotels in 2000. As a result, the fact that the sector of Construction had a strong relationship with Agriculture, Food and Beverage, Eating and Hotels has been changed in 2000. That is, it rather has a strong relationship with Chemicals and Allied Products due to the rapid technological advancement in construction materials. Of specific note is a weak link between Agriculture, Food and Eating, hotels in the region of Daejeon–Chungnam in 1995. However, the relationships of those sectors were strengthened in 2000. We might conclude that one of the reasons is the so–called Engel's law of consumption.⁷⁾

V. Conclusion

The motivation of this paper is to explore how the dependencies among the major

industries of Daejeon–Chungnam have changed between before and after 'the financial crisis' of 1997 and what differences there are between the national and the regional economy. For this purpose, we estimated some linkage measures and structural changes in the regional input–output model using Minimal Flow Analysis. Our analysis reveals that the structure of major industry relations of Daejeon–Chungnam in 1995 is significantly different from that in 2000.

First, when we compare the ratios of input and output linkages between 1995 and 2000 in the Daejeon–Chungnam region, we find that Agriculture, and Eating and Hotel were better oriented toward 'consumption of final demand' in 2000 rather than in 1995. Also, the Wholesale and Retail Trade was strengthened toward increasing 'consumption'.

Second, we can find the backbone of the Daejeon–Chungnam industries by analyzing the linkage effects among related industries. In case of unilateral linkages, the sectors of Agriculture; Food, Beverages and Tobacco; and Eating, Drinking Places and Hotels are turned out to be important industries from the perspectives of development patterns. Construction has also been an important industry. While the Motor industry was the most important industry along with the

7) That is, the income elasticity is less than 1. For more details, see Schnable (1994).

Chemical industry in 2000, but there was no important signal in 1995. This result was originated from the rapid growth of the Motor industry in the northern Chungnam region.

In case of bilateral linkage, the relationship between 'Agriculture and Food, Beverages, Tobacco', 'Construction and Related Construction materials' showed the most importance. Chemicals and related industries were in second place. Specifically, Chemical Products played a role as an important material in Agriculture and Food and Beverages sectors.

Nevertheless, there are some limitations in this paper: The single regional input-output model is good to investigate the interactions between industries in a specific region such as Daejeon-Chungnam in Korea, but not appropriate to apply to a relatively small region because a small region must have related economic transactions with many regions. In this sense, we need to employ a multi-regional input-output model. Thus, the future applications of qualitative input-output analysis should be made to a multi-regional input-output model which includes more than two regions. If the multi-regional input-output tables of Korean economy are completed in the future, we can utilize the same methods of examination and explore the way in which interregional trade may influence the structure of related industries and

functioning of a single regional economy.

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[Appendix] Classification of Industries

Sectors	Abb.	Full Name
1	Agr	Agriculture, Forestry, and Fisheries
2	Min	Mining and Quarrying
3	FBT	Food, Beverages and Tobacco
4	Tex	Textile products and Leather Products
5	Wood	Wood and Paper Products
6	Print	Printing, Publishing and Reproduction of Recorded Media
7	Petro	Petroleum and Coal Products
8	Chem	Chemicals and Allied Products
9	Nonmetal	Nonmetallic Mineral Products
10	P metal	Primary Metal Products
11	Fab metal	Fabricated Metal Products
12	Gen mach	General Machinery and Equipment
13	Electro	Electronic and Other Electric Equipment
14	Pre inst	Precision Instruments
15	Motor	Motor Vehicles, Trailer
16	Ship	Ship Building and Other Transportation Equipment
17	Furni	Furniture and Other Manufacturing Products
18	Electric	Electric, Gas, And Water Services
19	Constru	Construction
20	sale	Wholesale and Retail Trade
21	Eat Hotels	Eating and Drinking Places, and Hotels and Other Lodging Places
22	Trp	Transportation and Warehousing
23	Com	Communications and Broadcasting
24	Fi In	Finance and Insurance
25	Re Bs	Real Estate and Business Service
26	Pub	Public Administration and Defense
27	Edu	Educational and Research Services
28	Med	Medical And Health Services, and Social Security
29	Soc	Social and Other Services
30	others	Others

ABSTRACTS

대전·충남지역 산업 간 연관관계의 구조적 변화

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※ 주요단어: 산업연관관계, 투입산출분석

본 연구는 Schnable (1994, 2001)에 의해 도입된 최소흐름분석(MFA)기법을 대전·충남 지역경제에 적용하여 외환위기 전후로 산업구조의 질적인 변화가 어떻게 나타나고 있는가를 분석한 것이다. 이를 위해 미국의 경제학자 휴잉스가 제안한 간접적인 방법을 사용하여 1995년과 2000년 대전·충남 지역산업연관표를 작성·이용하였다. 투입산출모형의 질적인 측면을 강조하는 최소흐름분석기법은 투입산출표에서 중간거래액의 상대적 중요성을 분류할 수 있다는 전제에서 출발하고 있으므로 정확한 지역산업연관표의 작성이 요구된다.

본 연구의 주요 결과를 보면 일방적(한 방향)인 연관관계의 경우 농림수산물, 음식료품 그리고 음식숙박업으로 이어지는 선진국형 기본 산업구조가 전국에 비해서는 약하지만 대전·충남 지역에서 확연히 정착되어 가고 있음을 알 수 있었다. 또한 상호 연관관계의 경우 농림수산물과 음식료품 간, 건설과 화학·전기전자 제품 간의 연관성이 대전·충남 지역경제에서 매우 중요한 것으로 나타났다. 본 연구의 의의는 최소흐름분석기법을 대전·충남 지역경제에 최초로 적용하여 각 산업 간 주요 연관관계를 분석함으로써 국가균형발전 및 지역발전을 추구하는 정부와 지방자치단체에게 중요한 정책적 시사점을 줄 수 있다는 데 있다.

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