AN ANALYSIS OF ECONOMIC IMPACTS OF LOGISTIC ACCESSIBILITY ON MANUFACTURING PRODUCTION: FIRST RESULTS[1]

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ABSTRACT

This paper constructs a manufacturing production function incorporating logistic accessibility to analyze costs of product logistics, which are expected to be more efficient in the future, and a theoretical model to estimate the elasticity of manufacturing output with respect to logistic accessibility. We examine the economic impact of inter-prefectural logistic accessibility on production activity based on the theoretical model and by using time series cross-sectional data for the case of Japan. The result shows that the production function has increasing returns to scale, which positively affects manufacturing production activity when logistic accessibility is taken into account. Also, the estimated elasticities show that the extent of impacts of cost improvements in the transportation of intermediate goods and of finished goods on production activity is confirmed to differ across manufacturing sectors. This enables us to distinguish between manufacturing sectors that are significantly impacted by cost improvements in the inbound transportation of intermediate goods and sectors that are highly impacted by cost improvements in the outbound transportation of finished goods. The empirical analysis supports transportation efficiency strategies and relocation strategies for factories and warehouses in manufacturing sectors from the viewpoint of trends in production base location for input goods as well as trends in market base location for output goods, as seen in the Weber location-production problem.

Keywords: Logistic Accessibility, inbound and outbound shipping costs, the Weber location-production problem, Japan

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1. INTRODUCTION

Real economic activity is not spaceless, and some goods are not ubiquitous. Moreover, transportation costs are charged to ship goods from one place to another. Some studies point out that, alongside the traditional production factors of labor and capital, transportation cost plays an important role in production activity. For example, as the Nobel Economic Prize winner Paul Krugman (2001) remarks:

> We normally model countries as dimensionless points within which factors of production can be instantly and costlessly moved from one activity to another, and even trade among countries is usually given a sort of spaceless representation in which transport costs are zero for all goods that can be traded.

Businesses have continually pursued improvements in logistics, and research on the subject has been conducted. For example, Just in Time (JIT), supply chain management (SCM), Third Party Logistics (3PL), and E-commerce all result from improving logistics efficiency. Most of the research mainly considers logistics activities in intermediate goods transportation and inventory management for raw materials and product components. Compared with shipping networks of finished goods, shipping networks of intermediate goods are complex and have room for improvement. Therefore, single manufacturing companies and small groups of affiliated companies must strive for efficient logistics activities for intermediate goods shipping.

In the case of final goods shipping, there is limited room for improvement in logistics efficiency because final goods transportation is a comparatively simple process. The expansion of product distribution by wholesalers, the spread of regionalized cooperative delivery, and shifts in the price system from c.i.f. price to f.o.b. price, on which improvements are expected for final goods transportation, have faced difficulties because of related business companies, consumer organizations, various institutions and regulations, and business customs. Also, the relocation of companies as one of the strategies to improve efficiency in product distribution is required and can entail long-term efforts if a serious problem is encountered, such as occurred with overseas transfers due to the appreciating yen following the Plaza Accord in 1985. In light of these considerations, it is important to discuss improvements of logistic accessibility separately for intermediate goods transportation costs (i.e., inbound shipping costs) and final goods transportation costs (i.e., outbound shipping costs).

The aim of this research is to estimate empirically the effects of logistic accessibility based on data on inter-regional transportation costs collected by questionnaire surveys conducted in Japan in 1995, 2000, and 2005, and to discuss the economic impacts on production activity of improvements in the cost of inbound shipping (outbound shipping) for intermediate goods (finished goods).

The rest of this paper is structured as follows. Section 2 discusses why this research tries to estimate empirically logistic accessibility elasticities by using pooled data sets. Then, the production function estimated in this paper and the economic impacts of logistic accessibility in manufacturing sectors are discussed. In Section 3, the data set and the analytical framework used in this paper are explained. Section 4 shows the estimated elasticities obtained in panel analysis, and discusses key findings from this empirical study and trends in domestic transportation efficiency. Section 5 concludes this paper with a summary of the empirical results and issues for future research.

2. PRODUCTION FUNCTION AND LOGISTIC ACCESSIBILITY

(1) Earlier Studies

Some studies have tried to estimate the effects of transport improvements by incorporating transport distances or costs instead of social capital stock in traditional production functions. Schürmann et al. (1997) report accessibility indicators that take into account the length of roads and time required for rail transportation as representing the level of real social stock. Maurseth (2001) discusses growth regression analysis with market potential as a control variable which indicates geographical convenience, that is, inter-regional direct distance. Nakazato (2001) applies a growth regression approach to road investment in Japanese prefectures for the period of 1960–1988. Yamaguchi and Maku (2004) analyze the effects of inter-prefectural accessibility by using generalized cost that is based on regular passenger fares. But, these estimations do not exactly reflect the real situation of production activities because of data constraints. Therefore, research which tries to estimate the effect of logistic accessibility for regional economies is needed.

(2) Logistic Accessibility

As Hanson and Giuliano (2004) discuss, the accessibility of a place to other places in an area can be measured using Equation (1).

$$AI_i = \sum_j \frac{O_j}{d_{ij}}, \qquad (1)$$

where AI_i is the accessibility index of zone i, O_j is the number of opportunities available in zone j, and d_{ij} is some measure of the separation between zone i and zone j. Logistic accessibility indexes can also be constructed as synthetic variables with (i) the economic scale of trade partners and (ii) the transportation cost of goods to/from trade partners (see Schürmann et al. (1997)). The population or GDP related to market scale, that is, economic opportunity, is used as the former in the empirical analysis; total transportation cost between zone i and zone j is used as the latter.

In our analysis, we assume that the two types of logistic accessibility affect productivity in manufacturing sectors. $LAII_i$ is the logistic accessibility index taking into account the cost of the inbound transportation of intermediate goods to zone i from zone j, and $LAIO_i$ is the logistic accessibility taking into account the cost of the outbound transportation of final goods from zone i to zone j.

$$LAII_i = \sum_j \frac{q_j}{c_{j,i}} \qquad (2)$$

$$LAIO_i = \sum_j \frac{q_j}{c_{i,j}} \qquad (3)$$

Here, q_j is the gross value of output of trade partners in zone j , and $c_{i,j}$ is the cost of transportation from zone i to zone j .

(3) Production Function with Logistic Accessibility

The production function to be estimated in this paper is Equation (4). We assume liner homogeneity with respect to capital and labor. Equation (4) can be transformed into Equation (5).

$$Y_i = AK_i^{\alpha} L_i^{1-\alpha} \left(\sum_j \frac{q_j}{c_{j,i}}\right)^{\beta_1} \left(\sum_j \frac{q_j}{c_{i,j}}\right)^{\beta_2} = AK_i^{\alpha} L_i^{1-\alpha} LAII_i^{\beta_1} LAIO_i^{\beta_2} \qquad (4)$$

$$\log\left(\frac{Y_i}{L_i}\right) = \log A + \alpha \log\left(\frac{K_i}{L_i}\right) + \beta_1 \log\left(\sum_j \frac{q_j}{c_{j,i}}\right) + \beta_2 \log\left(\sum_j \frac{q_j}{c_{i,j}}\right) \qquad (5)$$

Here, α , β_1 , and β_2 are the respective elasticities of per capita GRP with respect to capital, inbound accessibility, and outbound accessibility.

3. DATA AND ANALYTICAL FRAMEWORK

(1) Data and Source

To measure inter-regional transportation costs, namely, $c_{i,j}$ and $c_{j,i}$, data from a questionnaire survey on cargo flows (Physical Distribution Census[2] by Ministry of Land Infrastructure and Transportation (MILT) of Japan) for 1995, 2000 and 2005 are used. The survey covers 227 “living zones” and 22 manufacturing industries[3] in Japan. Figure 1 shows the 227 living zones in Japan. Data on fixed assets (capital stock) and the number of workers in manufacturing sectors and municipalities are obtained from the Industrial Statistics for each year. Gross regional product (GRP) and gross value of output in manufacturing sectors are obtained from the System of National Accounting (SNA) for each year. Lastly, data on average working time in manufacturing sectors and prefectures are obtained from the Monthly Labor Survey for each year.

[2] Unfortunately, this survey is conducted every five years and is the only source of data on cargo transportation costs between zones in Japan. Also, the survey does not have pre-1995 data on cargo transportation costs.
[3] See Table A1 in the Appendixes for details.

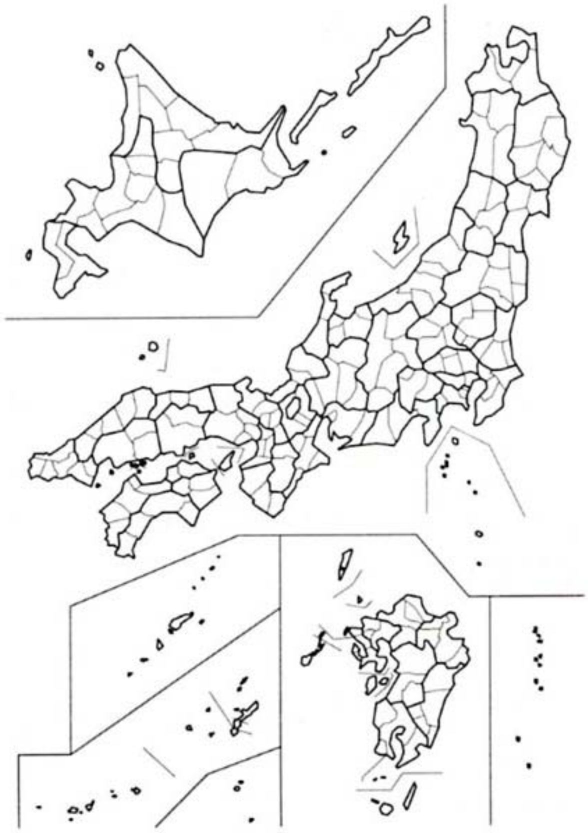

Figure 1- The 227 living zones in Japan

(2) Analytical Framework

We analyze the economic impact of inter-regional logistic accessibility on production activity by using a pooled data set, sometimes called time series cross-sectional data (or longitudinal data), for 1995, 2000, and 2005 for the case of Japan, using the following two types of analytical framework. This paper considers two types of analytical framework because some data (e.g., number of workers and fixed assets) for manufacturing sectors in the living zone categories are not available due to data privacy restrictions. However, the estimation using prefecture categories instead of living zone categories obscures the characteristics of location and transportation mode for the living zones. Therefore, this paper applies the following two types of framework. *Case 1* is the estimation for the overall manufacturing sector, an aggregate of the 22 manufacturing sectors, with data on the 227 living zones for 1995, 2000, and 2005.[4] *Case 2* is the estimation for narrowly defined manufacturing sectors with data on 47 prefectures for 1995, 2000, and 2005.[5] But, because of missing data for transportation costs in the questionnaire survey, the data set is unbalanced panel data. The number of observations in the data set used for estimation is 669 for *Case 1* and 2,649 for *Case 2*.

[4] That is, the data set for *Case 1* contains, in theory, 681 observations (227 living zones * 3 years).
[5] Similarly, the data set for *Case 2* contains, in theory, 3,102 observations (47 prefectures * 22 manufacturing sectors * 3 years).

This study uses models for panel data analysis because this analysis allows for changing models to estimate various assumed 'individual effects'.[6] Despite time-series data constraints on the questionnaire survey, this estimation will give the temporal changes of logistics accessibility and the characteristics of manufacturing sectors by applying panel data analysis. This analysis can avoid a lack of statistical significance by using pooled data, and provide findings valuable for policy discussion.

(3) Panel Data Analysis

There are several types of panel data analytic models: constant coefficients models, fixed effects models, and random effects models. This paper focuses on fixed effects models with the assumption that each manufacturing sector has individual factors. In this section, we examine various types of fixed effects models in relation to the estimated model in this empirical analysis.[7]

First, one type of panel data analytic model estimates the model which has constant coefficients regarding both intercepts and slopes. That is, this type assumes that there are no significant differences between the manufacturing sector's effects and temporal effects. This model is sometimes called the pooled regression model (or constant coefficients model). Model_0_0 in *Case 1* and *Case 2* is based on this model.

Another type of panel data analytic model assumes that intercepts differ according to the manufacturing sectors but slopes are constant. In this type, there are significant differences, or characteristics, of total factor productivity (TFP) among the manufacturing sectors, but there are no significant differences over time. This model is called the fixed effects model, or least squares dummy variable (LSDV) model. In our estimations, 21 (22 minus 1) dummy variables for intercepts are used to indicate particular sectors. Model_0_B in *Case 2* is based on this model.

On the other hand, another type of fixed effects model assumes that intercepts differ according to time but slopes are constant. This model will catch up with the temporal changes of total factor productivity (TFP) by technological innovations and other factors which affect the production system excluding labor and capital. We can account for the time effect over the three years with two (3 minus 1) dummy variables in this study. Model_0_A in *Case 2* is based on this model.

Moreover, we can also estimate the fixed effects model type which has differential intercepts and slopes both of which change according to the manufacturing sector. In this type, we assume that the elasticity for per capita capital (fixed asset) and logistic accessibilities vary with sectors. Model_B_B in *Case 2* is based on this model. Similarly, there is another type of fixed effects model where the slopes and intercepts vary over time as well as sector. This model can estimate not only TFP changes but also elasticity trends over time. Model_A_A in *Case 2* is based on this model.

Combining the models discussed above, fixed effects analysis can also provide a type where both intercepts and slopes might vary according to manufacturing sector and time.

[6] See, for example, Green (2003) and Baltagi (2008) for details.
[7] In this study, we focus on the fixed effects model because of our short time series data. The applications of the variable effects model and other panel analytic models to this data set are targets for future research.

This will be a full baseline model[8] which includes all individual effects as compared to the pooled regression model. If all of these are statistically significant, there will be no reason to adopt the pooled regression. Model_AB_AB in *Case 2* is based on his model.

Finally, we can discuss the changes in logistic accessibility elasticities according to time and manufacturing sector. In this paper, we try to estimate various fixed effects models (or, least squares dummy variable models). The estimation results are shown in Table 1 and Table 2 in the next section. In our analytical frameworks, we find impacts of “individual effects” in intercepts and slopes in estimated functions.

4. ESTIMATION RESULTS AND DISCUSSION

(1) Estimation Results

Tables 1 and 2 summarize the estimated production functions based on the data set that focuses on living zones, *Case 1*, and the data set focusing on manufacturing sectors, *Case 2*, respectively. As we discussed in the previous section, this study attempts to estimate various types of fixed effects panel models which have “individual effects” as intercepts and slopes in order to examine the sectoral differences and temporal changes in logistic accessibility.

In this study, we adapt the log likelihood test for the fixed effects model. We use the pooled regression model as the baseline for our comparison. The likelihood ratio (LR) tests all have the following form:

$$LR = -2\frac{l(res)}{l(unres)} \qquad (6)$$

Here, $l(res)$ denotes the restricted maximum likelihood value (the fixed effects model), and $l(unres)$ denotes the unrestricted maximum likelihood value (the pooled regression model). LR is chi-square distributed with degrees of freedom. For example, the test statistic for Model_0_A in *Case 1* is 66.8, which is significant at the 0.5% level and can be interpreted as the statistical distance between the pooled regression model and the fixed effects model. This likelihood ratio test statistic indicates that the effort to construct the fixed effects model was worthwhile.[9]

[8] See Appendix 2 for the estimated function, for reference.
[9] Overall, the calculated LRs in this empirical study are significant at the 0.5% level with the exception of Model_0_A, Model_A_0 and Model_A_A in *Case 2*.

Table 1- Estimated Production Functions with Logistic Accessibility in *Case 1*

Case 1	Model_0_0			Model_0_A			Model_A_0			Model_A_A		
	Estimator	*t* value		Estimator	*t* value		Estimator	*t* value		Estimator	*t* value	
Constant	1.569	10.590	***	1.474	10.226	***	1.447	9.887	***	1.059	4.404	***
α												
K/L	0.457	22.802	***	0.498	23.766	***						
y1995 * K/L							0.504	14.178	***	0.502	14.178	***
y2000 * K/L							0.532	15.066	***	0.535	14.838	***
y2005 * K/L							0.455	12.468	***	0.467	12.674	***
β1												
LAII	0.093	6.723	***	0.082	6.004	***						
y1995 * LAII							0.131	5.275	***	0.100	3.569	***
y2000 * LAII							0.116	4.866	***	0.119	4.553	***
y2005 * LAII							0.044	2.332	**	0.052	2.717	***
β2												
LAIO	0.015	1.238		0.014	1.174							
y1995 * LAIO							-0.029	-1.209		-0.025	-1.051	
y2000 * LAIO							-0.023	-1.096		-0.024	-1.125	
y2005 * LAIO							0.068	3.641	***	0.076	4.011	***
Dummy Variable												
y1995				0.126	5.632	***				0.911	2.561	**
y2000				0.131	6.257	***				0.325	0.925	
y2005				-						-		
Log Likelihood	-73.371			-106.750			-89.569			-95.477		

(Note) 2000 year constant price. * significant at 10%, ** significant at 5% and *** significant at 1%.

(Please see, Table 2 at the end of this paper)

All in all, the result shows that this production function has increasing returns to scale, which positively affects manufacturing production activity when logistic accessibility is taken into account. The elasticity of per capita GRP with respect to capital (i.e., α) differs across manufacturing sectors and time, and most of these estimators are strongly significant. Also, with the estimated logistic accessibility elasticity, the extent of impacts of cost improvements in the shipping of intermediate goods and of finished goods on production activity is confirmed to differ across manufacturing sectors. The empirical analysis supports efficient transportation strategies and relocation strategies for factories and warehouses in manufacturing sectors from the viewpoint of trends in production base location for input goods as well as trends in market base location for output goods, as seen in the Weber location-production problem.

(2) Findings for Logistic Accessibility Elasticities

The findings from the estimated results for *Case 1* and *Case 2* are as follows:

Case 1: The estimation focusing on living zones.

1. All in all, β1 is larger than β2, and most β1's are significant at the 1% level.

2. β2's for 1995 and 2000 in Model_A_0 and Model_A_A are not significant; therefore, β2 in Model_0_0 and Model_0_A is NOT significant.

3. β1's in Model_A_0 decrease with time. This trend means that improvements in logistic accessibility for intermediate goods have progressed.

4. Two dummy variables as intercepts for time are both significant in Model_0_A.

Case 2: The estimation focusing on manufacturing sectors.

1. As with the result for *Case 1*, all in all, $\beta 1$ is larger than $\beta 2$, and most $\beta 1$'s are highly significant.

2. Dummy variables as intercepts for time are significant in Model_0_AB and Model_B_AB.

3. Except for the parameters of both logistic accessibility indexes for 2000, both parameters $\beta 1$ and $\beta 2$ decrease between 1995 and 2005 in Model_A_B and Model_A_AB. A similar trend is observed for the parameter for inbound shipping, $\beta 1$, of Model_A_0 in *Case 1*.

4. Most parameters for the dummy variables related to the sectors as intercepts are significant and strongly affect the production function relative to time effects, as seen in Model_0_A, Model_0_AB, and Model_A_B with respect to estimators and model fitting.

5. Most parameters of logistic accessibility related to sectors in Model_B_**s are also significant. This means that logistic accessibility elasticity for per capita GRP differs according to sector.

In the next section, we discuss the characteristics of manufacturing sectors and logistic accessibility elasticities in more detail.

(3) Discussion

Let us discuss the implications of the estimated models.

1. All in all, the cost improvements in inbound shipping for intermediate goods, $\beta 1$, strongly drive up regional value added (per capita GDP) as compared with the cost improvements in outbound shipping for final goods based on short-term production structure, and these impacts decrease with time. Some producers have transportation systems for high value added finished goods which need fast outbound shipping; therefore, the impact for per capita GRP becomes smaller. In contrast, many suppliers of intermediate goods must ship their goods and bear the transportation costs because of c.i.f. price.

To discuss the characteristics of manufacturing sectors in terms of logistic accessibility, we summarize the estimators for logistic accessibility based on the results for both Model_B_A and Model_B_AB in *Case 2* (because the estimated elasticities for logistic accessibility vary with the type of model used). Figures 2 and 3 show the logistic accessibility elasticities, both $\beta 1$ and $\beta 2$, of per capita GRP based on the estimation results for Model_B_A and Model_B_AB in *Case 2*[10], respectively.

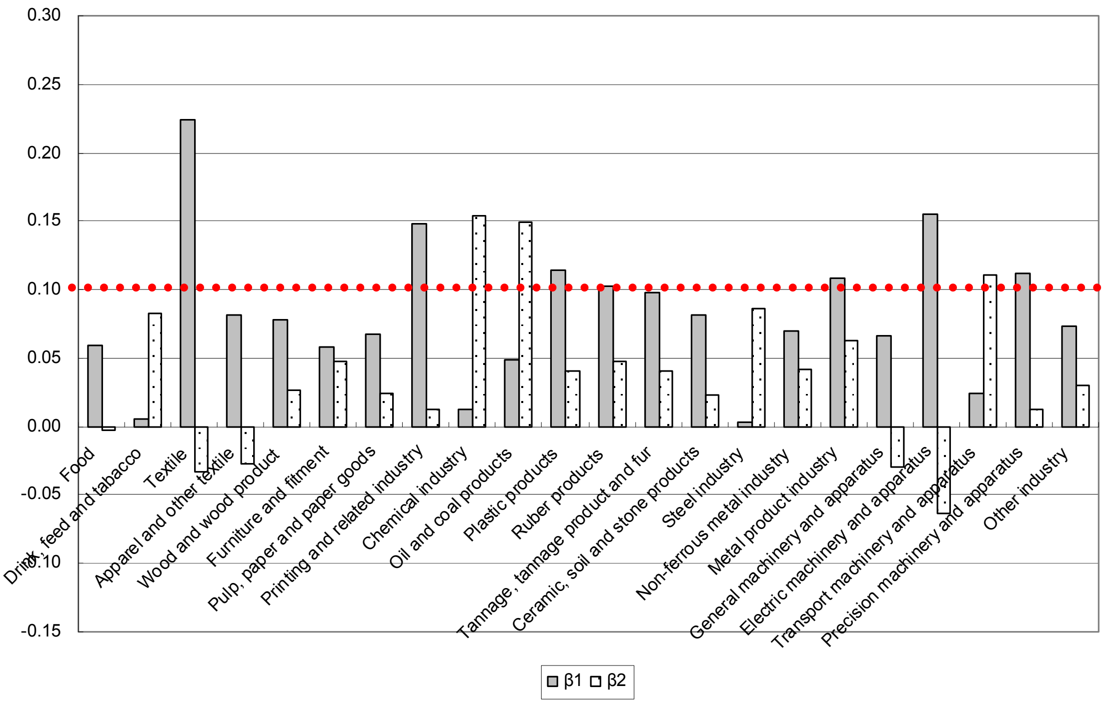

Figure 2- Logistic Accessibility Elasticity of per capita GRP in Model_B_A

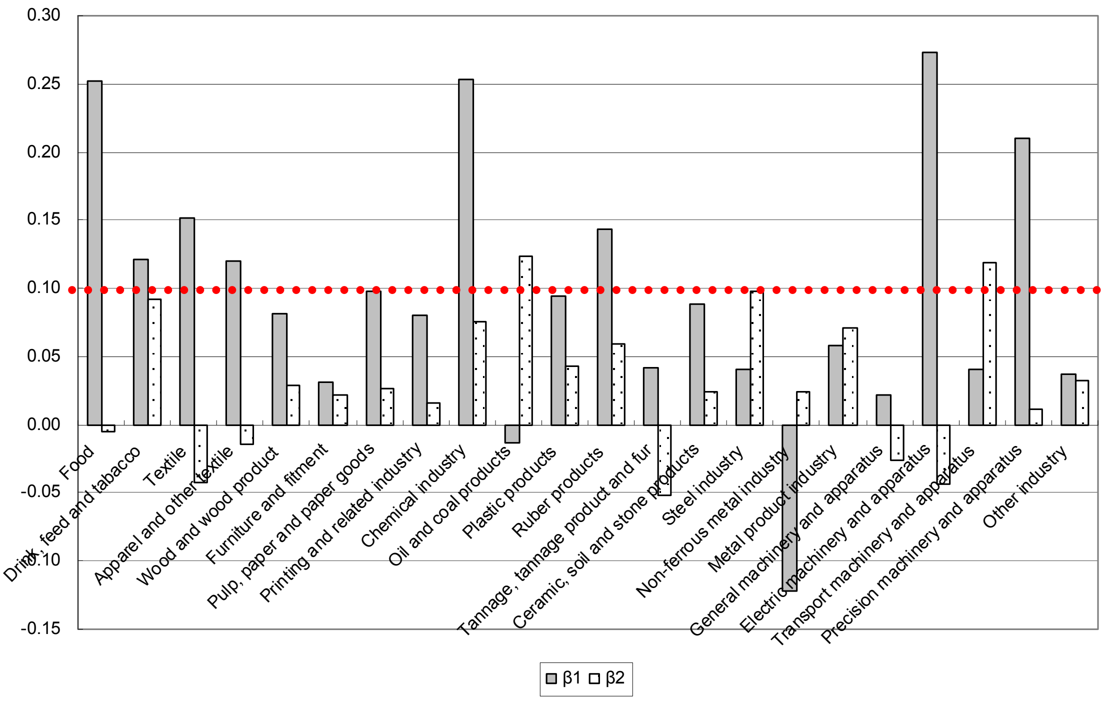

Figure 3- Logistic Accessibility Elasticity of per capita GRP in Model_B_AB

[10] This figure includes the sector whose parameter for logistic accessibility is not significant. See Table 2 for details.

2. The sectors whose estimators for the inbound accessibility elasticity in both models are significant (below the 10% significance level) and are greater than 0.1 are textiles, rubber products, electric machinery and apparatus, and precision machinery and apparatus. For example, since quick responses to changes in the market are needed in these industries, they locate near the market.

3. The sectors whose estimators for the outbound accessibility elasticity in both models are significant (below the 10% significance level) and are greater than 0.1 are oil and coal products, and transport machinery and apparatus. There is room for effective utilization of inland vessels because of varied forms of heavy product transportation. Since producers must absorb transportation costs under c.i.f. price contracts, these industries react sensitively to these costs.

Table 3 shows the ratio of logistics cost to sales in Japanese industries based on the questionnaire survey conducted in 2007 by the Japan Institute of Logistics Systems (JILS). The ratio for the overall industry, including non-manufacturing sectors, and aggregated manufacturing sector is 4.87% and 4.78%, respectively. For reference, the ratio for retailers and wholesalers is 4.84 % and 5.06, respectively. The ratio for sectors with a large parameter for the inbound accessibility elasticity (i.e., $\beta 1$) is relatively low. For example, the ratio for the textile industry is 4.27%. Moreover, the ratio for sectors with a large parameter for the outbound accessibility elasticity (i.e., $\beta 2$) is also relatively low. For instance, the ratio for the transport machinery and apparatus industry is 4.49%. These values are below the ratio for the industry as a whole. A comparison of these values shows that a sector whose ratio of logistics cost to sales is low has a large positive impact on manufacturing productivity.[11]

Table 3- Ratio of Logistics Cost to Sales

Manufacturing Sector	
Food (Keep Refrigerated)	10.38
Ceramic, soil and stone product industry	9.11
Pulp, paper and paper goods	7.34
Steel industry	6.32
Food (Normal Temperature)	6.24
Metal product industry	5.95
Soap, cleanser and paint	5.61
Printing and related industry	4.78
Transport machinery and apparatus industry	4.49
Other Chemical industry	4.32
Textile industry	4.27
Other industry	3.95
Plastic and Ruber product industry	3.95
Logistics machinery and apparatus industry	3.58
Precision machinery and apparatus industry	3.52
General machinery and apparatus industry	3.00
Non-ferrous metal industry	2.07
Electric machinery and apparatus industry	1.73
Medical product industry	0.85

(Source: Japan Institute of Logistics Systems: JILS, the Annual Report of Logistics Cost Research in 2008)

[11] As the production function, Equation (5), implies, the parameters for logistic accessibility also express the transportation cost elasticity, if the level of economic scale does not change.

5. CONCLUSION

This empirical research examines the effects of logistic accessibility improvements on production activity. We use data on inter-regional transportation costs for inbound and outbound shipping obtained from the questionnaire survey for 1995, 2000, and 2005, construct a panel data set, and estimate logistic accessibly elasticities of manufacturing production. Our result shows that the estimated production function has increasing returns to scale, which positively affects production activity when logistic accessibility is taken into account. Also, the extent of impacts of cost improvements in shipping intermediate goods and finished goods on production activity is confirmed to differ across manufacturing sectors. This study faces difficulties because of the short time-series data and constraints found in the questionnaire survey. As for our future research agenda, we plan to estimate long-term effects of changes in logistic accessibility, using other variables which measure the separation between zone i and zone j .

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APPENDIXES

Appendix 1

The following table shows the detailed industrial sectors in this analysis.

Table A1- Industrial Sectors

Sector	Industry
Sector 1	Food
Sector 2	Drink, feed and tabacco
Sector 3	Textile industry
Sector 4	Apparel and other textile
Sector 5	Wood and wood product
Sector 6	Furniture and fitment industry
Sector 7	Pulp, paper and paper goods
Sector 8	Printing and related industry
Sector 9	Chemical industry
Sector 10	Oil and coal product industry
Sector 11	Plastic product industry
Sector 12	Ruber product industry
Sector 13	Tannage, tannage product and fur industry
Sector 14	Ceramic, soil and stone product industry
Sector 15	Steel industry
Sector 16	Non-ferrous metal industry
Sector 17	Metal product industry
Sector 18	General machinery and apparatus industry
Sector 19	Electric machinery and apparatus industry
Sector 20	Transport machinery and apparatus industry
Sector 21	Precision machinery and apparatus industry
Sector 22	Other industry

(Note) The categories are based on the small classification of the System of National Accounts (SNA) for Japan.

Appendix 2

For reference, the equation for the production functions with logistic accessibility in Model_AB_AB in *Case 2*, that is, the full baseline model, can be expressed as:

$$\log y_{i,s,t} = const + \alpha_{s,t} \log k_{i,s,t} + \beta_{1s,t} \log LAII_{i,s,t} + \beta_{2s,t} \log LAIO_{i,s,t} + \sum_{t=1}^{3} const\_Time \bullet d(t)_{i,s} + \sum_{s=1}^{22} const\_Sector \bullet d(s)_{i,t} + \eta_{i,s,t} .$$

Here, $d(t)_{i,s}$ and $d(s)_{i,t}$ are dummy variables which are 1 for the relevant years and sectors, respectively, and are 0 otherwise.

Table 2- Estimated Production Functions with Logistic Accessibility in *Case 2*

Case 2	Model_0_0			Model_0_A			Model_0_B			Model_0_AB		
	Estimator	*t* value		Estimator	*t* value		Estimator	*t* value		Estimator	*t* value	
Constant	1.608	11.541	***	1.616	11.596	***	1.752	11.510	***	1.806	11.805	***
α												
K/L	0.516	50.486	***	0.516	48.895	***	0.427	34.075	***	0.415	30.944	***
y1995 * K/L												
y2000 * K/L												
y2005 * K/L												
Sector 1 * K/L												
Sector 2 * K/L												
Sector 3 * K/L												
Sector 4 * K/L												
Sector 5 * K/L												
Sector 6 * K/L												
Sector 7 * K/L												
Sector 8 * K/L												
Sector 9 * K/L												
Sector 10 * K/L												
Sector 11 * K/L												
Sector 12 * K/L												
Sector 13 * K/L												
Sector 14 * K/L												
Sector 15 * K/L												
Sector 16 * K/L												
Sector 17 * K/L												
Sector 18 * K/L												
Sector 19 * K/L												
Sector 20 * K/L												
Sector 21 * K/L												
Sector 22 * K/L												
β1												
LAII	0.075	8.083	***	0.075	8.094	***	0.085	9.621	***	0.086	9.796	***
y1995 * LAII												
y2000 * LAII												
y2005 * LAII												
Sector 1 * LAII												
Sector 2 * LAII												
Sector 3 * LAII												
Sector 4 * LAII												
Sector 5 * LAII												
Sector 6 * LAII												
Sector 7 * LAII												
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Sector 17 * LAII												
Sector 18 * LAII												
Sector 19 * LAII												
Sector 20 * LAII												
Sector 21 * LAII												
Sector 22 * LAII												
β2												
LAIO	0.017	2.306	**	0.017	2.327	**	0.034	5.466	***	0.036	5.704	***
y1995 * LAIO												
y2000 * LAIO												
y2005 * LAIO												
Sector 1 * LAIO												
Sector 2 * LAIO												
Sector 3 * LAIO												
Sector 4 * LAIO												
Sector 5 * LAIO												
Sector 6 * LAIO												
Sector 7 * LAIO												
Sector 8 * LAIO												
Sector 9 * LAIO												
Sector 10 * LAIO												
Sector 11 * LAIO												
Sector 12 * LAIO												
Sector 13 * LAIO												
Sector 14 * LAIO												
Sector 15 * LAIO												
Sector 16 * LAIO												
Sector 17 * LAIO												
Sector 18 * LAIO												
Sector 19 * LAIO												
Sector 20 * LAIO												
Sector 21 * LAIO												
Sector 22 * LAIO												
Dummy Variable												
y1995				-0.002	-0.101					-0.046	-2.796	***
y2000				-0.043	-2.260	**				-0.065	-4.115	***
y2005				-						-		
Sector 1							-0.347	-7.780	***	-0.348	-7.824	***
Sector 2							0.369	7.719	***	0.382	7.956	***
Sector 3							-0.355	-7.745	***	-0.353	-7.715	***
Sector 4							-0.371	-8.103	***	-0.380	-8.299	***
Sector 5							-0.334	-7.335	***	-0.334	-7.363	***
Sector 6							-0.150	-3.163	***	-0.151	-3.191	***
Sector 7							-0.249	-5.249	***	-0.238	-5.024	***
Sector 8							0.011	0.249		0.017	0.367	
Sector 9							0.398	8.208	***	0.413	8.455	***
Sector 10							-0.208	-3.539	***	-0.185	-3.102	***
Sector 11							-0.208	-4.667	***	-0.206	-4.621	***
Sector 12							-0.078	-1.670	*	-0.077	-1.662	*
Sector 13							-0.027	-0.453		-0.033	-0.549	
Sector 14							-0.142	-3.099	***	-0.137	-2.995	***
Sector 15							-0.268	-5.502	***	-0.256	-5.244	***
Sector 16							-0.161	-3.272	***	-0.150	-3.042	***
Sector 17							-0.296	-6.609	***	-0.295	-6.598	***
Sector 18							0.033	0.731		0.035	0.776	
Sector 19							0.269	5.956	***	0.272	6.044	***
Sector 20							-0.058	-1.261		-0.053	-1.148	
Sector 21							0.121	2.565	**	0.123	2.624	***
Sector 22							-			-		
Log Likelihood	2592.6			2598.3			1683.2			1678.9		

(Note) 2000 year constant price. * significant at 10%, ** significant at 5% and *** significant at 1%.

Table 2- Estimated Production Functions with Logistic Accessibility in *Case 2* (continued)

Case 2	Model_A_0			Model_A_A			Model_A_B			Model_A_AB		
	Estimator	*t* value		Estimator	*t* value		Estimator	*t* value		Estimator	*t* value	
Constant	1.583	11.305	***	1.744	7.932	***	1.760	11.514	***	2.006	9.697	***
α												
K/L												
y1995 * K/L	0.482	29.371	***	0.480	28.956	***	0.386	22.812	***	0.381	22.306	***
y2000 * K/L	0.542	28.308	***	0.542	28.228	***	0.434	22.683	***	0.433	22.559	***
y2005 * K/L	0.537	27.122	***	0.536	27.007	***	0.437	22.733	***	0.434	22.522	***
Sector 1 * K/L												
Sector 2 * K/L												
Sector 3 * K/L												
Sector 4 * K/L												
Sector 5 * K/L												
Sector 6 * K/L												
Sector 7 * K/L												
Sector 8 * K/L												
Sector 9 * K/L												
Sector 10 * K/L												
Sector 11 * K/L												
Sector 12 * K/L												
Sector 13 * K/L												
Sector 14 * K/L												
Sector 15 * K/L												
Sector 16 * K/L												
Sector 17 * K/L												
Sector 18 * K/L												
Sector 19 * K/L												
Sector 20 * K/L												
Sector 21 * K/L												
Sector 22 * K/L												
β1												
LAII												
y1995 * LAII	0.085	5.978	***	0.094	5.384	***	0.098	7.820	***	0.115	7.507	***
y2000 * LAII	0.063	4.370	***	0.065	3.697	***	0.066	5.211	***	0.067	4.462	***
y2005 * LAII	0.077	6.059	***	0.070	4.945	***	0.088	7.831	***	0.079	6.333	***
Sector 1 * LAII												
Sector 2 * LAII												
Sector 3 * LAII												
Sector 4 * LAII												
Sector 5 * LAII												
Sector 6 * LAII												
Sector 7 * LAII												
Sector 8 * LAII												
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Sector 11 * LAII												
Sector 12 * LAII												
Sector 13 * LAII												
Sector 14 * LAII												
Sector 15 * LAII												
Sector 16 * LAII												
Sector 17 * LAII												
Sector 18 * LAII												
Sector 19 * LAII												
Sector 20 * LAII												
Sector 21 * LAII												
Sector 22 * LAII												
β2												
LAIO												
y1995 * LAIO	0.020	1.583		0.022	1.722	*	0.033	3.027	***	0.036	3.326	***
y2000 * LAIO	0.020	1.482		0.020	1.487		0.048	4.246	***	0.048	4.234	***
y2005 * LAIO	0.010	0.901		0.008	0.708		0.029	3.022	***	0.026	2.657	***
Sector 1 * LAIO												
Sector 2 * LAIO												
Sector 3 * LAIO												
Sector 4 * LAIO												
Sector 5 * LAIO												
Sector 6 * LAIO												
Sector 7 * LAIO												
Sector 8 * LAIO												
Sector 9 * LAIO												
Sector 10 * LAIO												
Sector 11 * LAIO												
Sector 12 * LAIO												
Sector 13 * LAIO												
Sector 14 * LAIO												
Sector 15 * LAIO												
Sector 16 * LAIO												
Sector 17 * LAIO												
Sector 18 * LAIO												
Sector 19 * LAIO												
Sector 20 * LAIO												
Sector 21 * LAIO												
Sector 22 * LAIO												
Dummy Variable												
y1995				-0.355	-1.041					-0.594	-2.088	**
y2000				-0.191	-0.570					-0.264	-0.950	
y2005				-						-		
Sector 1							-0.344	-7.751	***	-0.342	-7.707	***
Sector 2							0.378	7.887	***	0.381	7.949	***
Sector 3							-0.357	-7.807	***	-0.355	-7.770	***
Sector 4							-0.380	-8.289	***	-0.378	-8.261	***
Sector 5							-0.338	-7.452	***	-0.336	-7.414	***
Sector 6							-0.152	-3.221	***	-0.151	-3.210	***
Sector 7							-0.242	-5.108	***	-0.239	-5.046	***
Sector 8							0.017	0.372		0.021	0.466	
Sector 9							0.412	8.437	***	0.417	8.539	***
Sector 10							-0.184	-3.097	***	-0.174	-2.914	***
Sector 11							-0.204	-4.577	***	-0.201	-4.502	***
Sector 12							-0.074	-1.603		-0.071	-1.528	
Sector 13							-0.038	-0.635		-0.031	-0.506	
Sector 14							-0.140	-3.064	***	-0.141	-3.079	***
Sector 15							-0.254	-5.203	***	-0.251	-5.136	***
Sector 16							-0.153	-3.095	***	-0.148	-2.989	***
Sector 17							-0.294	-6.580	***	-0.293	-6.559	***
Sector 18							0.037	0.829		0.039	0.871	
Sector 19							0.272	6.050	***	0.275	6.106	***
Sector 20							-0.049	-1.058		-0.046	-1.008	
Sector 21							0.125	2.661	***	0.128	2.737	***
Sector 22							-			-		
Log Likelihood	2626.4			2626.2			1706.0			1703.2		

Table 2- Estimated Production Functions with Logistic Accessibility in *Case 2* (continued)

Case 2	Model_B_0			Model_B_A			Model_B_B			Model_B_AB		
	Estimator	*t* value		Estimator	*t* value		Estimator	*t* value		Estimator	*t* value	
Constant	1.695	10.919	***	1.753	11.196	***	2.487	2.734	***	2.382	2.625	***
α												
K/L												
y1995 * K/L												
y2000 * K/L												
y2005 * K/L												
Sector 1 * K/L	0.599	5.145	***	0.577	4.943	***	0.469	3.792	***	0.440	3.550	***
Sector 2 * K/L	0.583	12.002	***	0.570	11.710	***	0.583	12.265	***	0.568	11.930	***
Sector 3 * K/L	0.164	3.170	***	0.146	2.812	***	0.126	2.368	**	0.106	1.988	**
Sector 4 * K/L	0.614	12.181	***	0.592	11.621	***	0.616	12.483	***	0.591	11.841	***
Sector 5 * K/L	0.446	7.499	***	0.422	6.997	***	0.455	7.229	***	0.422	6.605	***
Sector 6 * K/L	0.469	8.701	***	0.446	8.172	***	0.410	7.214	***	0.384	6.693	***
Sector 7 * K/L	0.481	10.504	***	0.472	10.289	***	0.503	9.947	***	0.489	9.673	***
Sector 8 * K/L	0.338	4.406	***	0.301	3.874	***	0.299	3.880	***	0.253	3.244	***
Sector 9 * K/L	0.367	5.178	***	0.367	5.189	***	0.463	6.331	***	0.462	6.325	***
Sector 10 * K/L	0.216	5.038	***	0.215	5.008	***	0.202	4.783	***	0.200	4.742	***
Sector 11 * K/L	0.299	4.013	***	0.287	3.857	***	0.281	3.550	***	0.263	3.320	***
Sector 12 * K/L	0.327	5.168	***	0.320	5.048	***	0.338	5.425	***	0.329	5.279	***
Sector 13 * K/L	0.364	7.595	***	0.358	7.452	***	0.340	7.181	***	0.333	7.026	***
Sector 14 * K/L	0.479	8.675	***	0.454	8.127	***	0.488	8.024	***	0.459	7.485	***
Sector 15 * K/L	0.471	11.725	***	0.474	11.819	***	0.490	12.111	***	0.493	12.229	***
Sector 16 * K/L	0.430	11.387	***	0.428	11.346	***	0.301	6.541	***	0.292	6.340	***
Sector 17 * K/L	0.243	2.856	***	0.218	2.543	**	0.222	2.602	***	0.188	2.188	**
Sector 18 * K/L	0.716	6.803	***	0.691	6.559	***	0.659	5.957	***	0.631	5.699	***
Sector 19 * K/L	0.571	8.231	***	0.558	8.016	***	0.685	9.113	***	0.660	8.760	***
Sector 20 * K/L	0.381	6.135	***	0.382	6.156	***	0.418	5.786	***	0.421	5.846	***
Sector 21 * K/L	0.446	7.378	***	0.437	7.224	***	0.570	8.489	***	0.562	8.382	***
Sector 22 * K/L	0.511	6.606	***	0.486	6.237	***	0.514	6.783	***	0.484	6.333	***
β1												
LAII												
y1995 * LAII												
y2000 * LAII												
y2005 * LAII												
Sector 1 * LAII	0.054	1.066		0.059	1.171		0.243	2.855	***	0.252	2.965	***
Sector 2 * LAII	0.002	0.074		0.005	0.148		0.110	2.374	**	0.122	2.621	***
Sector 3 * LAII	0.224	7.149	***	0.224	7.165	***	0.149	3.298	***	0.152	3.367	***
Sector 4 * LAII	0.078	2.010	**	0.081	2.093	**	0.114	2.266	**	0.120	2.398	**
Sector 5 * LAII	0.078	3.111	***	0.078	3.138	***	0.084	2.874	***	0.082	2.821	***
Sector 6 * LAII	0.050	1.757	*	0.058	2.028	**	0.022	0.763		0.032	1.071	
Sector 7 * LAII	0.073	2.483	**	0.068	2.299	**	0.109	2.276	**	0.098	2.063	**
Sector 8 * LAII	0.137	4.060	***	0.148	4.373	***	0.073	1.632		0.080	1.808	*
Sector 9 * LAII	0.014	0.339		0.012	0.294		0.259	3.614	***	0.254	3.548	***
Sector 10 * LAII	0.048	1.679	*	0.049	1.709	*	-0.014	-0.387		-0.013	-0.370	
Sector 11 * LAII	0.113	3.072	***	0.114	3.095	***	0.097	2.139	**	0.095	2.084	**
Sector 12 * LAII	0.101	3.463	***	0.103	3.525	***	0.142	3.742	***	0.144	3.801	***
Sector 13 * LAII	0.098	3.625	***	0.098	3.662	***	0.039	1.300		0.042	1.404	
Sector 14 * LAII	0.076	3.417	***	0.081	3.630	***	0.082	2.886	***	0.088	3.097	***
Sector 15 * LAII	0.000	-0.010		0.003	0.097		0.036	0.987		0.041	1.130	
Sector 16 * LAII	0.074	2.511	**	0.070	2.358	**	-0.107	-2.235	**	-0.122	-2.534	**
Sector 17 * LAII	0.106	2.890	***	0.108	2.958	***	0.061	1.163		0.058	1.101	
Sector 18 * LAII	0.064	1.446		0.066	1.502		0.019	0.347		0.022	0.411	
Sector 19 * LAII	0.155	3.078	***	0.155	3.075	***	0.283	4.624	***	0.274	4.485	***
Sector 20 * LAII	0.024	0.722		0.024	0.722		0.039	1.089		0.040	1.119	
Sector 21 * LAII	0.112	3.952	***	0.112	3.953	***	0.208	5.610	***	0.211	5.688	***
Sector 22 * LAII	0.070	2.024	**	0.073	2.127	**	0.023	0.375		0.037	0.600	
β2												
LAIO												
y1995 * LAIO												
y2000 * LAIO												
y2005 * LAIO												
Sector 1 * LAIO	-0.003	-0.084		-0.003	-0.084		-0.005	-0.130		-0.005	-0.128	
Sector 2 * LAIO	0.082	3.287	***	0.083	3.334	***	0.090	3.686	***	0.092	3.776	***
Sector 3 * LAIO	-0.037	-1.167		-0.033	-1.042		-0.047	-1.480		-0.042	-1.340	
Sector 4 * LAIO	-0.029	-0.841		-0.027	-0.804		-0.017	-0.478		-0.014	-0.402	
Sector 5 * LAIO	0.021	0.749		0.026	0.951		0.025	0.853		0.029	1.002	
Sector 6 * LAIO	0.050	1.777	*	0.048	1.709	*	0.023	0.797		0.022	0.752	
Sector 7 * LAIO	0.016	0.485		0.024	0.711		0.018	0.550		0.026	0.792	
Sector 8 * LAIO	0.013	0.597		0.013	0.587		0.016	0.778		0.016	0.782	
Sector 9 * LAIO	0.153	3.752	***	0.153	3.772	***	0.074	1.686	*	0.076	1.722	*
Sector 10 * LAIO	0.151	5.100	***	0.149	5.063	***	0.125	4.137	***	0.123	4.090	***
Sector 11 * LAIO	0.039	1.326		0.041	1.388		0.041	1.417		0.043	1.506	
Sector 12 * LAIO	0.049	1.780	*	0.048	1.762	*	0.060	2.162	**	0.059	2.153	**
Sector 13 * LAIO	0.041	1.353		0.040	1.341		-0.055	-1.464		-0.051	-1.367	
Sector 14 * LAIO	0.021	0.911		0.023	1.005		0.022	0.978		0.025	1.086	
Sector 15 * LAIO	0.092	3.249	***	0.086	3.049	***	0.103	3.658	***	0.098	3.454	***
Sector 16 * LAIO	0.038	1.270		0.042	1.407		0.020	0.686		0.024	0.813	
Sector 17 * LAIO	0.059	1.972	**	0.063	2.112	**	0.065	2.200	**	0.071	2.397	**
Sector 18 * LAIO	-0.034	-1.058		-0.029	-0.925		-0.031	-0.991		-0.026	-0.843	
Sector 19 * LAIO	-0.066	-1.420		-0.063	-1.349		-0.046	-1.000		-0.044	-0.952	
Sector 20 * LAIO	0.112	3.873	***	0.111	3.826	***	0.119	4.069	***	0.119	4.053	***
Sector 21 * LAIO	0.010	0.439		0.012	0.519		0.010	0.417		0.012	0.507	
Sector 22 * LAIO	0.027	0.853		0.030	0.948		0.030	0.969		0.033	1.065	
Dummy Variable												
y1995				-0.041	-2.405	**				-0.049	-2.878	***
y2000				-0.057	-3.610	***				-0.061	-3.923	***
y2005				-						-		
Sector 1							-3.588	-2.603	***	-3.453	-2.511	**
Sector 2							-2.986	-2.614	***	-2.992	-2.627	***
Sector 3							0.988	0.818		1.113	0.923	
Sector 4							-1.646	-1.359		-1.545	-1.279	
Sector 5							-1.034	-0.922		-0.752	-0.670	
Sector 6							0.496	0.481		0.645	0.627	
Sector 7							-1.650	-1.264		-1.370	-1.051	
Sector 8							0.575	0.514		0.851	0.761	
Sector 9							-4.708	-3.549	***	-4.480	-3.383	***
Sector 10							0.940	0.849		1.119	1.012	
Sector 11							-0.419	-0.373		-0.164	-0.146	
Sector 12							-1.811	-1.626		-1.643	-1.478	
Sector 13							1.890	1.673	*	1.955	1.735	*
Sector 14							-0.990	-0.888		-0.826	-0.742	
Sector 15							-1.851	-1.737	*	-1.717	-1.615	
Sector 16							3.910	2.884	***	4.320	3.184	***
Sector 17							0.085	0.071		0.385	0.324	
Sector 18							0.346	0.283		0.507	0.414	
Sector 19							-4.281	-3.168	***	-3.863	-2.857	***
Sector 20							-1.454	-1.257		-1.339	-1.160	
Sector 21							-3.167	-2.866	***	-3.057	-2.772	***
Sector 22							-			-		
Log Likelihood	1811.3			1811.1			1648.7			1645.9		

Table 2- Estimated Production Functions with Logistic Accessibility in *Case 2* (continued)

Case 2	**Model_AB**			**Model_AB_A**			**Model_AB_B**			**Model_AB_AB**		
	Estimator	*t* value		Estimator	*t* value		Estimator	*t* value		Estimator	*t* value	
Constant	1.709	10.951	***	1.846	8.664	***	2.399	2.649	***	2.485	2.718	***
α												
K/L												
y1995 * K/L	0.471	6.035	***	0.466	5.953	***	0.469	6.134	***	0.464	6.058	***
y2000 * K/L	0.528	6.635	***	0.525	6.580	***	0.526	6.744	***	0.523	6.695	***
y2005 * K/L	0.544	6.745	***	0.538	6.662	***	0.550	6.956	***	0.545	6.880	***
Sector 1 * K/L	0.095	0.684		0.099	0.711		-0.037	-0.253		-0.033	-0.226	
Sector 2 * K/L	0.041	0.447		0.047	0.511		0.037	0.407		0.042	0.465	
Sector 3 * K/L	-0.361	-3.883	***	-0.361	-3.873	***	-0.399	-4.317	***	-0.399	-4.308	***
Sector 4 * K/L	0.118	1.281		0.111	1.205		0.120	1.333		0.114	1.262	
Sector 5 * K/L	-0.069	-0.710		-0.067	-0.685		-0.060	-0.607		-0.059	-0.603	
Sector 6 * K/L	-0.047	-0.501		-0.057	-0.602		-0.107	-1.127		-0.115	-1.209	
Sector 7 * K/L	-0.049	-0.544		-0.042	-0.467		-0.031	-0.333		-0.026	-0.278	
Sector 8 * K/L	-0.221	-2.021	**	-0.223	-2.047	**	-0.269	-2.486	**	-0.272	-2.518	**
Sector 9 * K/L	-0.152	-1.439		-0.143	-1.355		-0.061	-0.574		-0.053	-0.496	
Sector 10 * K/L	-0.304	-3.400	***	-0.298	-3.320	***	-0.322	-3.668	***	-0.316	-3.599	***
Sector 11 * K/L	-0.226	-2.103	**	-0.224	-2.089	**	-0.249	-2.278	**	-0.247	-2.258	**
Sector 12 * K/L	-0.186	-1.862	*	-0.180	-1.795	*	-0.177	-1.805	*	-0.172	-1.750	*
Sector 13 * K/L	-0.132	-1.447		-0.141	-1.538		-0.158	-1.762	*	-0.166	-1.848	*
Sector 14 * K/L	-0.059	-0.618		-0.047	-0.487		-0.055	-0.569		-0.044	-0.455	
Sector 15 * K/L	-0.043	-0.487		-0.038	-0.432		-0.024	-0.279		-0.020	-0.232	
Sector 16 * K/L	-0.090	-1.042		-0.085	-0.973		-0.229	-2.572	**	-0.223	-2.493	**
Sector 17 * K/L	-0.276	-2.406	**	-0.263	-2.291	**	-0.301	-2.654	***	-0.290	-2.548	**
Sector 18 * K/L	0.187	1.438		0.195	1.495		0.130	0.976		0.137	1.023	
Sector 19 * K/L	0.049	0.472		0.055	0.529		0.156	1.467		0.163	1.527	
Sector 20 * K/L	-0.129	-1.288		-0.124	-1.242		-0.093	-0.880		-0.086	-0.813	
Sector 21 * K/L	-0.071	-0.716		-0.070	-0.707		0.055	0.538		0.055	0.545	
Sector 22 * K/L	-			-			-			-		
β1												
LAII												
y1995 * LAII	0.083	2.333	**	0.097	2.626	***	0.046	0.736		0.060	0.945	
y2000 * LAII	0.055	1.564		0.052	1.436		0.013	0.205		0.010	0.158	
y2005 * LAII	0.073	2.044	**	0.068	1.885	*	0.034	0.534		0.031	0.487	
Sector 1 * LAII	-0.020	-0.335		-0.019	-0.324		0.209	1.988	**	0.207	1.971	**
Sector 2 * LAII	-0.066	-1.416		-0.067	-1.437		0.094	1.214		0.092	1.184	
Sector 3 * LAII	0.152	3.350	***	0.154	3.390	***	0.122	1.591		0.123	1.602	
Sector 4 * LAII	0.005	0.096		0.006	0.116		0.086	1.073		0.087	1.086	
Sector 5 * LAII	0.005	0.122		0.005	0.130		0.053	0.777		0.052	0.752	
Sector 6 * LAII	-0.019	-0.436		-0.017	-0.393		-0.006	-0.086		-0.006	-0.081	
Sector 7 * LAII	-0.001	-0.029		-0.001	-0.029		0.072	0.923		0.070	0.886	
Sector 8 * LAII	0.081	1.718	*	0.082	1.756	*	0.054	0.708		0.053	0.692	
Sector 9 * LAII	-0.051	-0.997		-0.050	-0.963		0.222	2.346	**	0.224	2.366	**
Sector 10 * LAII	-0.020	-0.454		-0.021	-0.481		-0.051	-0.711		-0.055	-0.762	
Sector 11 * LAII	0.038	0.776		0.039	0.788		0.059	0.762		0.059	0.761	
Sector 12 * LAII	0.030	0.684		0.030	0.674		0.108	1.490		0.106	1.452	
Sector 13 * LAII	0.026	0.614		0.025	0.571		0.005	0.078		0.003	0.044	
Sector 14 * LAII	0.008	0.190		0.006	0.146		0.053	0.771		0.050	0.728	
Sector 15 * LAII	-0.064	-1.388		-0.063	-1.382		0.012	0.164		0.010	0.144	
Sector 16 * LAII	-0.009	-0.193		-0.009	-0.207		-0.164	-2.076	**	-0.163	-2.072	**
Sector 17 * LAII	0.032	0.656		0.030	0.613		0.026	0.315		0.023	0.281	
Sector 18 * LAII	-0.012	-0.215		-0.014	-0.253		-0.016	-0.192		-0.019	-0.231	
Sector 19 * LAII	0.078	1.293		0.077	1.280		0.240	2.752	***	0.240	2.749	***
Sector 20 * LAII	-0.048	-1.011		-0.046	-0.977		0.007	0.097		0.008	0.112	
Sector 21 * LAII	0.042	0.974		0.044	1.006		0.180	2.484	**	0.180	2.486	**
Sector 22 * LAII	-			-			-			-		
β2												
LAIO												
y1995 * LAIO	0.024	0.738		0.028	0.850		0.025	0.780		0.029	0.888	
y2000 * LAIO	0.034	1.058		0.034	1.073		0.040	1.267		0.040	1.270	
y2005 * LAIO	0.013	0.407		0.013	0.391		0.013	0.424		0.013	0.417	
Sector 1 * LAIO	-0.028	-0.567		-0.030	-0.604		-0.032	-0.668		-0.034	-0.701	
Sector 2 * LAIO	0.065	1.628		0.064	1.605		0.073	1.859	*	0.072	1.835	*
Sector 3 * LAIO	-0.057	-1.267		-0.059	-1.315		-0.067	-1.515		-0.069	-1.566	
Sector 4 * LAIO	-0.056	-1.220		-0.055	-1.201		-0.045	-0.968		-0.044	-0.941	
Sector 5 * LAIO	-0.002	-0.050		-0.003	-0.075		0.002	0.049		0.000	0.004	
Sector 6 * LAIO	0.024	0.575		0.025	0.602		-0.003	-0.077		-0.002	-0.039	
Sector 7 * LAIO	0.001	0.031		-0.001	-0.017		0.002	0.049		0.000	0.000	
Sector 8 * LAIO	-0.011	-0.302		-0.012	-0.320		-0.010	-0.269		-0.011	-0.284	
Sector 9 * LAIO	0.125	2.425	**	0.120	2.332	**	0.048	0.883		0.043	0.794	
Sector 10 * LAIO	0.126	2.922	***	0.125	2.900	***	0.094	2.185	**	0.093	2.154	**
Sector 11 * LAIO	0.022	0.525		0.022	0.504		0.024	0.560		0.023	0.537	
Sector 12 * LAIO	0.024	0.589		0.023	0.554		0.033	0.798		0.031	0.760	
Sector 13 * LAIO	0.011	0.252		0.015	0.354		-0.089	-1.849	*	-0.083	-1.719	*
Sector 14 * LAIO	0.002	0.049		0.000	-0.011		0.002	0.058		0.000	0.001	
Sector 15 * LAIO	0.060	1.431		0.059	1.388		0.068	1.634		0.067	1.593	
Sector 16 * LAIO	0.028	0.642		0.027	0.614		0.009	0.213		0.008	0.190	
Sector 17 * LAIO	0.039	0.910		0.037	0.867		0.045	1.045		0.043	1.002	
Sector 18 * LAIO	-0.049	-1.088		-0.049	-1.092		-0.047	-1.069		-0.047	-1.079	
Sector 19 * LAIO	-0.082	-1.454		-0.083	-1.474		-0.063	-1.144		-0.064	-1.161	
Sector 20 * LAIO	0.088	2.058	**	0.085	1.983	**	0.092	2.166	**	0.090	2.118	**
Sector 21 * LAIO	-0.014	-0.357		-0.016	-0.397		-0.017	-0.456		-0.019	-0.495	
Sector 22 * LAIO	-			-			-			-		
Dummy Variable												
y1995				-0.424	-1.442					-0.383	-1.315	
y2000				-0.070	-0.253					-0.020	-0.073	
y2005				-						-		
Sector 1							-3.474	-2.532	**	-3.435	-2.502	**
Sector 2							-3.129	-2.751	***	-3.102	-2.727	***
Sector 3							0.940	0.781		0.963	0.800	
Sector 4							-1.675	-1.390		-1.686	-1.398	
Sector 5							-1.033	-0.922		-0.969	-0.863	
Sector 6							0.545	0.531		0.556	0.541	
Sector 7							-1.537	-1.181		-1.471	-1.130	
Sector 8							0.753	0.676		0.812	0.728	
Sector 9							-4.430	-3.354	***	-4.430	-3.354	***
Sector 10							1.310	1.186		1.371	1.241	
Sector 11							-0.262	-0.234		-0.254	-0.227	
Sector 12							-1.669	-1.505		-1.619	-1.459	
Sector 13							2.060	1.831	*	2.044	1.816	*
Sector 14							-0.877	-0.790		-0.851	-0.766	
Sector 15							-1.724	-1.624		-1.688	-1.590	
Sector 16							4.291	3.170	***	4.264	3.150	***
Sector 17							0.205	0.173		0.224	0.189	
Sector 18							0.389	0.319		0.422	0.346	
Sector 19							-4.060	-3.008	***	-4.078	-3.021	***
Sector 20							-1.332	-1.155		-1.360	-1.179	
Sector 21							-3.107	-2.824	***	-3.086	-2.803	***
Sector 22							-			-		
Log Likelihood	1833.6			1832.9			1665.0			1664.5		