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The Economic Impact of the Korean Port Industry on the National Economy: from the Viewpoint of Macroeconomics

S. H. Moon

Key Word : Port Industry(항만산업), Economic Impact(경제적 영향), Port Input-Output Model(항만투입산출모형), Non-competitive Import Type(비경쟁수입형), Forward Linkage Effect(전방연쇄효과), Backward Linkage Effect(후방연쇄효과), Multiplier Effect(승수효과), Spreading Effect(파급효과), Policy Implication(정책적 의미), Pearson Correlation(피어슨 상관분석)

요 약

경제개발계획이 실시된 이래로 지난 30여년 동안 질적·양적인 면에서 우리나라는 눈부신 경제성장을 거듭하여 왔다. 부존자원이 부족하여 국가경제개발의 방향을 원료의 수입으로 완제품을 수출하는 수출확대정책에 두게됨에 따라 이러한 경제성장은 수출입 물동량의 급속한 증가를 초래하게 되었다. 분단으로 인해 육상수송로가 막혀있는 상태에서 대부분의 수출입화물은 당연히 해상수송에 의지할 수 밖에 없었고, 이에 항만은 이들 물동량을 처리하는 중요한 장소가 되어 왔다. 이러한 관점에서 정부 및 관련기관에서는 항만시설의 확충을 위해 지속적인 투자를 하여왔으나, 결과론적인 면에서 볼 때 항만의 계획 및 개발은 성공적이었다고 할 수 없을 것이다. 왜냐하면 항만수용능력(Port capacity)은 계속 공급부족상태에서 수요에 겨우겨우 부응해가는 수준이었기 때문이다. 이에 대한 이유로는 여러가지가 있을 수 있겠으나 가장 중요한 것으로는 국가경제발전에 있어서 항만의 중요성에 대한 인식의 부족으로 투자우선순위 면에서 항만투자의 시기가 적절치 못했다는 점이다. 다시 말하면, 국가의 기간산업으로서 항만의 중요성을 막연히 여겼을 뿐 계량적으로 그 중요성이 어떻게 나타나는 가에 대한 분석이 지금껏 행해진 적이 없다는 것이다.

이에 본 연구에서는 항만산업이 거시적 관점에서 국가경제에 어떠한 영향을 미치며 각 산업과 어느 정도의 연관관계를 가지고 있는 가를 알아보기 위해 '투입산출모형'을 만들어 분석하였다. 또한 항만에 대한 투자가 국가경제 전반에 걸쳐 얼마만큼의 파급효과를 가져오는 가에 대해서도 분석을 행하였다. 그리고 이러한 항만에 대한 투입산출모형이 장래의 항만계획 및 개발을 위해서 정책수립적인 차원에서 어떠한 의미가 있고 또한 어떻게 이용될 수 있는 지에 대한 분석도 행하였다.

* 正會員, 韓國海洋大學校 海事大學 海事輸送科學科 敎授

1. Introduction

Although the vital importance of the nation's ports to the economies of the cities and regions surrounding them in Korea has long been recognised and demonstrated in various studies, it has never been quantified on a national scale.

The purpose of this paper is to analyse the impact of the Korean port industry and identifies the spreading effects of port investments upon the national economy from the macroeconomic viewpoint. This analysis, the first economic evaluation of the Korean port industry that is national in scope, also details the interactions of the port industry with other industries to which it sells services and from which it purchases goods and services.

This analysis is performed through the creation of an input-output model based on the "1985 Input-Output Table" data used in economic planning and policy. The input-output model constructed for this study, is a powerful economic tool for assessing and analysing the economic impact of the Korean port industry.

In Section 2, an input-output model is selected as a preparatory stage for analysing the impact of the port industry upon the economy and the general analytical methodology is explained. Section 3 quantifies interactions of the port industry with the Korean economy. Section 4 deals with multiplier analysis to measure the impact of the port industry on the economy. Section 5 analyses linkage effects of the port industry. Section 6 is devoted to identifying the spreading effects of port investments upon the nation's economy. Furthermore, in relation to future national economic planning, some policy-making implications of a port input-output model will be drawn in Section 7. Section 8 concludes this paper.

2. Preparations for Analysis

2.1 General Analytical Methodology

The primary source of data utilised in this analysis is the "1985 Input-Output Tables" of Korea which is the most recent to be published by the Bank of Korea in 1988. This table is normally available in a number of forms, in terms of the degree of aggregation and the treatment of imports. There are four kinds of sector tables for this study ; 20×20, 65×65, 161×161, and 402×402 sector tables [1].

To calculate the interactions of port services with the Korean economy, the 65-sector version of the Korean input-output tables was selected and then developed to the appropriate form - the expanded 66-sector. The 66th industry is the port industry. Table 1 shows the 66-industry classification of the 1985 input-output table for the Korean economy. In order to identify the spreading effects of port investments on the national economy, the port investment sector in the 402-sector tables was also selected and put into the exogenous (final demand) sector.

The port industry in this study is defined as the provision of services associated with moving cargo through the port system. Such services and transactions that are generated in conjunction with the direct provision of waterborne services such as cargo documentation, insurance, banking, and warehousing are not considered part of the port industry. Such activities, however, are part of the port industry's impact upon the nation's economy. The input-output matrix provides a flexible tool by which such related activities are quantified.

Several measures are utilised to convey how the port industry interacts with the rest of the economy beyond the employment impact. These

Table 1. 66-Industry Classification of the 1985 Input-Output Table for the Korean Economy

1 Crops	34 Rubber products
2 Livestock breeding, sericulture	35 Ceramics, nonmetallic min. products
3 agriculture services	36 Iron and steel manufacturing
4 Forestry products	37 Primary iron and steel products
5 Fishery products	38 Nonferrous metal ingots
6 Coal mining	39 Fabricated metal products
7 Metallic ores mining	40 Gen. ind. machinery and equipment
8 Nonmetallic mining	41 Electrical equipment and apparatus
9 Meat, dairy, processed fruit products	42 Electronic, communication equipment
10 Processed seafood products	43 Transportation equipment
11 Polished grains	44 Measuring med., opt. instruments
12 Flour and cereal preparations	45 Miscellaneous manufactured products
13 Sugar	46 Electric power services
14 Bread, confectionery products	47 Gas, steam, hot water supply services
15 Other food preparations	48 Water supply
16 Beverages	49 Build. construct. maintenance
17 Tobacco products	50 Public works and other construction
18 Fibre yarn	51 Wholesale and retail trade
19 Fibre fabrics	52 Restaurants and hotels
20 Fabricated textile products	53 Other transport
21 Wear apparels, dress accessories	54 Communications
22 Leather and fur products	55 Finance and insurance
23 Lumber and wood products	56 Real-estate and rental
24 Pulp and paper	57 Business services
25 Printing and publishing	58 Public administration, defence
26 Industrial basic chemicals	59 Educ. services, research institute
27 Chemical fibres	60 Medical, social welfare service
28 Chem. fertilisers, agri. chem.	61 Social services
29 Drugs and cosmetics	62 Other services
30 Other chemical products	63 Office supplies
31 Synthetic resins products	64 Business consumption
32 Petroleum resins products	65 Unclassifiable
33 Coal products	66 Port industry

include analysis of the distribution of the industry's outputs and inputs; analysis of gross product originating (or value-added) by their components; analysis of final demand; and multiplier analysis of both the output and the input sides, as they relate to total sales and value-added.

Given the static nature of the input-output model and the assumption of a homogeneous production function, in estimating the total impact

of the port industry, the measures obtained describe how the port industry fits within an existing economic framework.

The application of the sectoral multiplier in this study should also be amplified. Sectoral multipliers are derived in the traditional fashion by summing the column coefficients of the inverse matrix for the relevant industries. These multipliers quantify the total (direct and indirect) requirements placed on the economy as a result of a change in the level of output of any specified industry's final demand.

Multipliers that are applied to the value-added elements of the relevant industries describe the total change in value-added throughout the economy relative to a unit change in the value-added of a single industry. The same concept is applied to the job multiplier.

Figure 1 illustrates the methodological sequence, which is expressed in various steps, for identifying the impact of the port industry and analysing the spreading effects of port investment on the Korean economy.

2. 2 Model Selections

The input-output model chosen for this analysis is a non-competitive import type, with the distinction between competitive and non-competitive imports in the procedures for calculating imports, stated in producer's prices.

The advantage of the import breakdown by industry lies in the use of input-output tables in the analysis of input requirements. The advantage for indirect allocation of competitive imports in a non-competitive type has been that it produces more stable direct input coefficients when the purchasing rate of imports and domestic goods is varied by the situation of foreign and domestic markets [2].

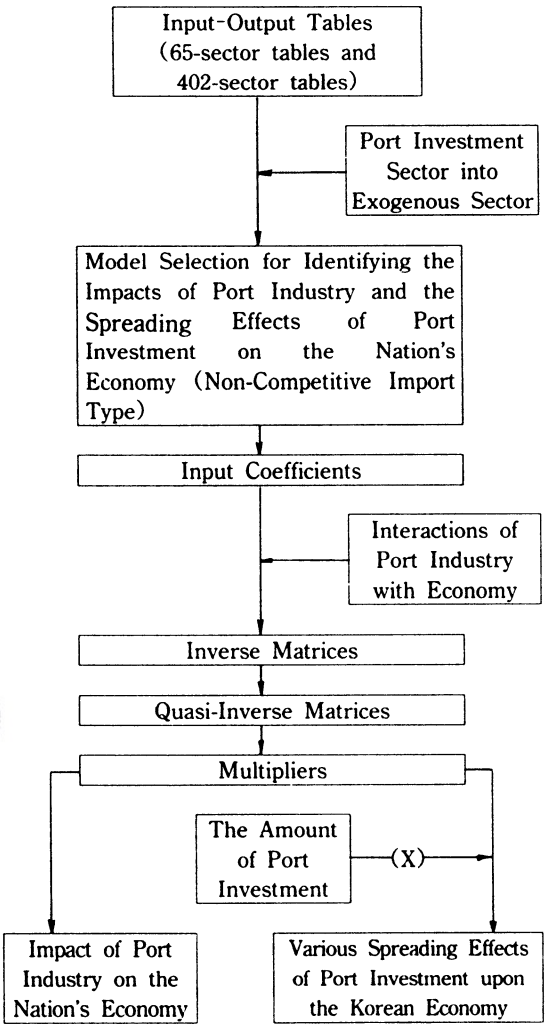

Fig. 1. Flow Chart for Analytical Procedure

Table 2 shows the non-competitive type input-output model for identifying the impact of the port industry and calculating the spreading effects of port investment on the nation's economy. The model consists basically of three phases each concerned with constructing a table from which the multipliers used to measure the chain reactions of port investments are obtained.

Table 2. Modified Input-Output Table for Both Identifying Impact of the Port Industry and Calculating the Spreading Effects of Port Investment on the Economy (Non-Competitive Type)

	Intermediate Demand	Port Investment	Final Demand	Import (−)	Total Output
Domestic	$Td_{1,1}$ $Td_{1,2}$ ····· $Td_{1,66}$ $Td_{2,1}$ $Td_{2,2}$ ····· $Td_{2,66}$ ⋮ ⋮ ⋮ $Td_{66,1}$ $Td_{66,2}$ ····· $Td_{66,66}$	Tpd_1 Tpd_2 ⋮ Tpd_{66}	Yd_1 Yd_2 ⋮ Yd_{66}		Xg_1 Xg_1 ⋮ Xg_{66}
Imports	$Tm_{1,1}$ $Tm_{1,2}$ ····· $Tm_{1,66}$ $Tm_{2,1}$ $Tm_{2,2}$ ····· $Tm_{2,66}$ ⋮ ⋮ ⋮ $Tm_{66,1}$ $Tm_{66,2}$ ····· $Tm_{66,66}$	Tpm_1 Tpm_2 ⋮ Tpm_{66}	Ym_1 Ym_2 ⋮ Ym_{66}	M_1 M_2 ⋮ M_{66}	
	V_1 V_2 ····· V_{66}	Vp			V
	Xg_1 Xg_2 ····· Xg_{66}	Xp	F	M	

Based on Table 2, a table of input coefficients was derived by dividing the inputs of each industry by the total output for that industry. Input coefficients for each industry have a significant meaning. It shows the proportion of each input which must be purchased by the industry named at the top of the table from each industry named on the left to produce a unit of output.

Table 3 shows the input coefficients table for identifying the impact of the port industry and calculating the spreading effects of the port industry on the nation's economy.

2.2.1 Model selection for the interactions of the port industry with the nation's economy

The following section concentrates on the derivation of a table for inverse and quasi-inverse matrices. This table provides the basis for obtaining multipliers for computing the total effect of any industry on the economy from the macroeconomic viewpoint - in this particular paper, the port industry.

Table 3. Input Coefficients Table for Both Identifying the Impacts of Port Industry and Calculating the Spreading Effects of Port Industry on the Nation's Economy

	66-sector Industries	Port Investment
Domestic	$a_{d1,1}$ $a_{d1,2}$ ····· $a_{d1,66}$ ⋮ ⋮ $[A_d]$ ⋮ $a_{d66,1}$ $a_{d66,2}$ ····· $a_{d66,66}$	a_{pd1} ⋮ $[A_{pd}]$ a_{pd66}
Import	$a_{m1,1}$ $a_{m1,2}$ ····· $a_{m1,66}$ ⋮ ⋮ $[A_m]$ ⋮ $a_{m66,1}$ $a_{m66,2}$ ····· $a_{m66,66}$	a_{pm1} ⋮ $[A_{pm}]$ a_{pm66}
Value-Added	a_{v1} a_{v2} ··· $[A_v]$ ··· a_{v66}	a_{pv1} $[A_{pv}]$

Note : A_d ; Input Coefficients of Domestic Goods and Services,
A_{pd} ; Domestic Input Coefficients of Port Investment,
A_m ; Input Coefficients of Imported Goods and Services,
A_{pm} ; Imported Input Coefficients of Port Investment,
A_v ; Input Coefficients of Value-Added,
A_{pv} ; Input Coefficients of Value-Added in Port Investment Sector

In a competitive input-output model the transactions among the industries are recorded at producer's prices without distinguishing domestic products from these which are imported. Because a non-competitive model was selected for this analysis, all the inter-industry transactions are divided into domestic products and imports. Equations which serve to make explicit the dependence of interindustry flows on the total outputs of each sector can be arranged separately as follows:

For domestic products transactions,

$$A_d \cdot X_g + Y_d = X_g \quad \cdots\cdots (1)$$

and for imports transactions,

$$A_m \cdot X_g + Y_m = M \quad \cdots\cdots (2)$$

Based on the input coefficients of domestic products in Table 3, the inverse matrix can be calculated. Once the notion of a set of fixed technical coefficients is given, equations for domestic products can be expressed as follows:

$$\begin{aligned}
&a_{d1.1}X_{g1} + a_{d1.2}X_{g1} + \cdots + a_{d1.66}X_{g1} + a_{pd1}X_p + Y_{d1} = X_{g1}\\
&a_{d2.1}X_{g2} + a_{d2.1}X_{g2} + \cdots + a_{d2.66}X_{g2} + a_{pd2}X_p + Y_{d2} = X_{g2}\\
&\quad\vdots \qquad\quad \vdots \qquad\quad \vdots \qquad\quad \vdots \qquad\quad \vdots \qquad\quad \vdots\\
&a_{d66.1}X_{g66} + a_{d66.2}X_{g66} + \cdots + a_{d66.66}X_{g66} + a_{pd66}X_p + Y_{d66} = X_{g66}
\end{aligned} \quad \cdots\cdots (3)$$

For convenience's sake, the equation (3) can be rewritten in terms of matrix and vector notations as follows.

$$\begin{bmatrix} a_{d1.1} \cdots a_{d1.66} & X_{g1} \\ \vdots \quad\quad \vdots & \vdots \\ a_{d66.1} \cdots a_{d66.66} & X_{g66} \end{bmatrix} + \begin{bmatrix} a_{pd1} \cdots 0 & 0 \\ 0 \quad\quad\quad \vdots & \\ \vdots \quad\quad\quad 0 & \\ 0 \; 0 \cdots a_{pd66} & \end{bmatrix} \cdot X_p + \begin{bmatrix} Y_{d1} \\ \vdots \\ Y_{d66} \end{bmatrix} = \begin{bmatrix} X_{g1} \\ \vdots \\ X_{g66} \end{bmatrix}$$

or

$$A_d \cdot X_g + A_{pd} \cdot X_p + Y_d = X_g \quad \cdots\cdots (4)$$

From the equation (4),

$$X_g = (I - A_d)^{-1} \cdot (A_{pd} \cdot X_p + Y_d) \quad \cdots\cdots (5)$$

The expression $(I - A_d)^{-1}$ from the equation (4) is the inverse matrix for this analysis. If the element of this inverse matrix is L_{ij},

$$(I - A_d)^{-1} = L_{ij} \quad \cdots\cdots (6)$$

Elements in this inverse matrix table mean the output of *i* industry that is necessary in order to satisfy a unit worth of final demand for industry *j*'s output. That is, the column sum of each industry indicates the direct and indirect requirements from all industries needed to deliver an additional unit of output of *j* to final demand. This is known as the sectoral multiplier or output multiplier [3].

If A_v is defined as the input coefficient matrix for primary production vectors such as labour, capital, land etc., and V the value-added vector, then the total value-added generated is;

$$V = A_v \cdot X_g \quad \cdots\cdots (7)$$

Sincese $X_g = (I - A_d)^{-1} \cdot (A_{pd} \cdot X_p + Y_d)$ from equation (5), the equation above can be expressd as follows;

$$V = A_v \cdot (I - A_d)^{-1} \cdot (A_{pd} \cdot X_p + Y_d) \quad \cdots\cdots (8)$$

Thus, again, if the quasi-inverse matrix $A_v \cdot (I - A_d)$ is given beforehand, the level of value-added of various types which are generated from the changes in final demand for domestic goods can be easily determined.

The initial value-added effect on the economy is simply the initial unit worth of industry *j* value-added needed to satisfy the additional final demand. The value-added multiplier, therefore, can be calculated as the ratio of the direct and indirect effect to the initial effect.

If E_w is the input coefficients matrix of employees then, E_t, the total employees requirements coefficients for the industries, can be determined as follows;

$$E_t = E_w \cdot (I - A_d)^{-1} \quad \cdots\cdots (9)$$

These total employees requirements coefficients appear to be very small, but that is simply because they represent jobs created per won of new sectoral output (which, as usual, arises because of an additional won's worth of final demand for the sector). The employment multiplier, therefore, is obtained by summing up the elements of each column in the total employees requirements coefficients matrix.

2.2.2 Model selection for identifying the spreading effects of port investment on the national economy

From the equation (5), in case of calculating

the spreading effects of port investment, $Y_d=0$. Therefore,

$$X_g=(I-A_d)^{-1}\cdot A_{pd}\cdot X_p \quad \cdots\cdots (10)$$

The expression $(I-A_d)^{-1}$ is the "inverse matrix" for this analysis. By multiplying this inverse matrix by $A_{pd}\cdot X_p$ (port investment by sector), additional outputs of every sector which are derived from port investment can be calculated. From the equation (4), the expression $(I-A_d)^{-1}\cdot A_{pd}$ means that each element in the matrix portrays the amount of additional output required from the row sector as an indirect result of increasing final demand in port investment by one unit.

Total output which is generated by port investment, X, consists of X_g (indirect output) and X_p (direct input of port investment). That is,

$$X=X_g+X_p$$
$$=(I-A_d)^{-1}\cdot A_{pd}\cdot X_p+X_p \quad \cdots\cdots (11)$$

Similar to the method of deriving the inverse matrix in equation (5), the following equation can be derived by inserting equation (10) into equation (2),

$$A_m\cdot(I-A_d)^{-1}\cdot A_{pd}\cdot X_p+Y_m=M \quad \cdots\cdots (12)$$

In the case of calculating the spreading effects of port investment, $Y_m=0$:

$$A_m\cdot(I-A_d)^{-1}\cdot A_{pd}\cdot X_p=M \quad \cdots\cdots (13)$$

The expression $A_m\cdot(I-A_d)^{-1}$ is called the quasi-inverse matrix of imports. If $A_m\cdot(I-A_d)^{-1}$ is given, the level of intermediate import demand in each industry derived from the port investment for the goods and services of corresponding industries can be calculated.

The total import effect which can be generated by port investment, M_t, consists of M (indirect import effect) and M_m (direct import for port investment).

$$M_t=M+M_m$$
$$=A_m\cdot(I-A_d)^{-1}\cdot A_{pd}\cdot X_p+A_{pm}\cdot X_p \cdots (14)$$

Similar to the method of deriving total domestic outputs and imports entailed by port investment, value-added effect, employment effect, and labour effect as follows:

a) Indirect Value-added Effect:
$A_v\cdot(I-A_d)^{-1}\cdot A_{pd}\cdot X_p$

b) Direct and Indirect Value-added Effect:
$A_v\cdot(I-A_d)^{-1}\cdot A_{pd}\cdot X_p+A_{pv}\cdot X_p$

c) Indirect Employment Effect:
$E_w\cdot(I-A_d)^{-1}\cdot A_{pd}\cdot X_p$

d) Direct and Indirect Employment Effect:
$E_w\cdot(I-A_d)^{-1}\cdot A_{pd}\cdot X_p+E_w\cdot X_p$

e) Indirect Labour Effect:
$L_w\cdot(I-A_d)^{-1}\cdot A_{pd}\cdot X_p$

f) Direct and Indirect Labour Effect:
$L_w\cdot(I-A_d)^{-1}\cdot A_{pd}\cdot X_p+L_w\cdot X_p$

where E_w: Input Coefficients of Employees
L_w: Input Coefficients of Workers

3. Interactions with the Korean Economy

Table 4 summarises the basic input-output flows for the port industry sector in 1985.

Table 4. Input-Output Summary of Port Industry Sector (1985)

(unit : million won)

Inputs		Outputs	
I. Intermediate Inputs	85,310	I. Intermediate Sales	220,098
A. Domestic	84,530	II. Final Demand	72,472
B. Imports(Non-competitive)	740	A. Consumption	16,967
II. Gross Value-Added	138,048	a. Private	16,967
A. Employee Compensation	94,098	b. Government	0
B. Operating Surplus	25,533	B. Fixed Capital Formation	6,789
C. Fixed Capital Construction	11,993	a. Private	6,083
D. Indirect Taxes Subsidies	6,424	b. Government	706
		C. Increase in Stocks	2,585
		D. Exports	46,131
		III. Imports	−69,212
III. Total Value of Input	223,358	IV. Total Value of Output	223,358

3. 1 Output (or Production)

In 1985 the Korean port industry grossed a total of 223,358 million won in revenues from the sales of its services. This means that the output of the port industry measured by the services it provided directly to all users - domestic and foreign, private and government - averaged almost 612 million won per day in the base year of this study. In the input-output model these sales of port services were broken down into two categories - intermediate and final sales.

Intermediate sales were port services that were purchased by other industries for the movement of goods destined for further processing by the buyer. They accounted for about 68 per cent of the port industry's direct output in 1985. Final sales of port services - those purchased for movement of cargo to final markets such as consumers - represented 32 per cent of the industry's direct input.

3. 1. 1 Intermediate Port Users

The intermediate sales of the Korean port industry output in 1985 amounted to 220,098 million won. This was the revenue from sales to a large number of users who required the movement of nearly every type of raw material to their factories, processing plants, and refineries.

Table 5 provides a listing of the twenty leading users of the port industry in 1985. Several key industries relied heavily upon port services in the transportation of their inputs. These were mainly heavy industries, such as iron and steel, construction, and nonmetallic mineral, as well as the coal industry. The major consumer of port services in Korea were the other modes in the transport sector, including road and shipping transport. A total of 74,024 million won was paid for such services during 1985.

This is significant in supporting the fact that transport integration, in particular, has been an essential port function. Because ports in Korea have been primarily important as the focal point of the trade and commerce of the country, predictably a large portion of national industries are directly or indirectly attributed to the work

Table 5. Interindustry Sales of the Korean Port Industry (1985)

(unit : million wons)

Purchasing Industry	Amount
Other transport	74,024
Coal products	17,099
Building construction and maintenance	16,646
Iron and steel manufacturing	13,540
Ceramics and nonmetallic mineral products	10,109
Primary iron and steel products	6,981
Public works and other construction	5,987
Electric power services	5,096
Fabricated metal products	5,080
Public administration and defence	5,045
Other food preparations	4,516
Transportation equipment	4,476
Industrial basic chemicals	3,832
Fishery products	3,820
Electronic and communication equipment	3,753
Leather and fur products	3,603
General industrial machinery and equipment	3,145
Nonferrous metal ingots and products	2,485
Crops	2,128
Lumber and wood products	2,014

of the port.

The coal products industry was the second major user of the port industry with 17,099 million won worth of services purchased during 1985. The coal products industry's expenditures were mainly for seaborne transportation and cargo handling services required to bring cool briquettes and dry-stilled coal products to plants throughout Korea. This also supports the fact that a large amount of coal, one of the main seaborne trade volumes, is handled by the port facilities.

None of the above expenditures for port services directly entered into the gross national product (GNP) accounts because the services were not for final deliveries. To avoid double counting of products and services generated in a given year, intermediate sales are excluded from the GNP accounts. They, however, remain traceable as part of the costs incurred in delivering the final product to the actual users. These sales to users in final markets through the various intermediate industries were accounted for in the input-output model through final demand analysis that showed how much of these port services were absorbed in any product or service reaching its final market.

3. 1. 2 Final Demand

Table 6 shows expenditures for port services by final demand sectors. In 1985 the sales of port services throughout the nation to final demand consumers were 72,472 million won.

Table 6. Expenditures for Port Services by Final Demand Sectors

(unit : million won)

Final Buyers	1985	1983
Exports	46,131 (63.7)	28,582 (62.7)
Private consumption expenditures	16,967 (23.4)	8,438 (18.5)
Gross private fixed capital formation	6,083 (8.4)	3,118 (6.8)
Increase in stocks	2,585 (3.6)	4,459 (9.8)
Gross government fixed capital formation	706 (1.0)	997 (2.2)
Government consumption expenditures	0 (0.0)	0 (0.0)

Note : Figures in parentheses indicate the percentage of each final demand sector to the total final demand of each year.

These sales were for services provided to final users of all kinds in channelling cargo to its ultimate destination. Such sales are distinguished from intermediate sales of the port industry and are GNP components. They were broken down in the input-output model into the traditional aggregate categories of consumption (private consumption expenditures and government consumption expenditures), investment (gross private fixed capital formation and gross government fixed capital formation), inventory change (increase in stocks), and exports.

Predictably the largest component of the port industry's final demand category was the export sector, because ports are a central point of economic interchange and the major gateway to foreign trade. A total of 46,131 million won accrued to the port industry in 1985 via this sector. From the viewpoint of the percentage of each final demand sector to the total final demand expenditures for port services, this increased slightly from 62.7 per cent in 1980 to 63.7 per cent in 1985.

The second most important sector among the final demand components was the private consumption expenditures sector which spent 16,967 million won on direct port services in 1985. This was mainly for handling, freight, finance and insurance of imported consumer products and the movement of domestically produced goods headed for final consumer markets by seaborne transport. As in exports, the private consumption expenditures sector was composed of thousands of specific commodities which required cargo handling of all types such as containers, pallets, conventional handling, etc.

In the light of the fact that most expenditure for port services by final demand sectors were taken up by exports and private consumption expenditures, the percentage of the gross government fixed capital formation in the final demand sector of the port industry was only 8.4 per cent. Even though the percentage of the gross government fixed capital formation increased from 6.8 per cent in 1983 to 8.4 per cent in 1985, it still remained very small. This means that port services were more directed towards maximisation of existing facilities, than to investment of new capital in the port industry.

3.2 Inputs

3.2.1 Intermediate Inputs

The total direct purchases of supplies and services (inputs) by the port industry in 1985 amounted to 85,310 million won. Of this amount, 780 million won in goods and services were imported from other nations and 84,530 million won worth of inputs originated in the domestic economy.

In order to provide transportation services to all other industries in the national economy, the port industry must simultaneously be a purchaser of various inputs necessary to make port services available. Such purchases range from business services to fuel, supply services, equipment, maintenance, real estate, and many other goods and services.

Table 7 lists the twenty principal sources of inputs for the nation's port industry in 1985. Domestic business services such as legal and accounting services, technical professional services, advertising, and consulting accounted for the largest block of expenditures by the port industry, amounting to 31,915 million won in the base year of this analysis.

Other key industries which accrued in excess of 3,000 million won in sales to the port industry during 1985 were petroleum products, business consumption, finance and insurance, and gas,

Table 7. Direct Input Requirements of the Korean Port Industry by 20 Leading Supplying Industries (1985)

(unit : million won)

Supplying Industries	Amount
Business services	31,915
Petroleum products	9,871
Business consumption	7,678
Gas, steam, and hot water supply services	4,695
Finance and insurance	3,678
General industrial machinery and equipment	2,914
Transportation equipment	2,791
Social services	2,467
Fabricated textile products	2,463
Lumber and wood products	2,114
Wholesale and retail trade	2,096
Real estate and rental	1,950
Communications	1,899
Medical and social welfare services	1,830
Other transport	1,770
Printing and publishing	1,530
Fabricated metal products	771
Rubber products	467
Building construction and maintenance	386
Other chemical products	346

steam, and hot water supply services.

On the demand side, the indirect use of factors by the port industry is measured as the ratio of intermediate purchases to the total value of output. This ratio in itself, however, is not of great significance, compared to the output multiplier in the following section.

3.2.2 Value Added

Value-added is the difference between the value of goods and services sold and the cost of the material inputs necessary to produce them. It represents the total wages, interest, rent, and profits "added" during each stage of the production and distribution process. It is a more accurate expression of the real economic contribution made by the port industry to the Korean economy than is the gross income represented by the total value of the goods or services sold.

The total value-added by the port industry, as was shown in Table 4, is estimated to be 138,048 million won. Compensation of employees is the major activity in the value-added sector, amounting to 94,098 million won. It accounted for 68 per cent of value-added by the port industry. As in intermediate inputs, however, this value-added in itself is not very significant. It is much more meaningful when it is related to the multiplier analysis. This multiplier analysis is dealt with in the following section.

4. Multiplier Analysis

4.1 Output Multiplier and Total Supplier Impact

The direct suppliers to the port industry rely upon port purchases in indirect ways as well as the direct purchases analysed above. Goods they sell to industries other than the port industry are used for the production of other goods and services that in turn are sold to the port industry. This constitutes a considerable impact area of port activities in the Korean economy.

By combining the direct and indirect impact of the port industry a more accurate perspective is obtained of the overall interface of each industry with port activities. This indirect impact can be measured by using the sectoral output multiplier from the input-output model. Table 8 presents values of output multipliers by industry calculated from the input-output model.

Table 8. Output Multipliers by Industry

Rank	Name of Sector	Multiplier	Rank	Name of Sector	Multiplier
1	Unclassifiable	4.739019	25	Fibre yarns	2.010689
2	Office supplies	2.931264	26	Elec. equip. and apparatus	1.971102
3	Meat, dairy & processed fruit	2.871887	27	Water supply	1.955221
4	Business consumption	2.817797	28	Ceramics & nonmetal. mine prod.	1.953124
5	Primary iron and steel products	2.611866	29	Industrial basic chemicals	1.951639
6	Fabricated textile products	2.399091	30	Coal products	1.923109
7	Livestock breeding and sericulture	2.359230	31	Rubber products	1.920230
8	Iron and steel manufacturing	2.322284	⋮	⋮	⋮
9	Social services	2.301595	⋮	⋮	⋮
10	Polished grains	2.301389	44	Coal mining	1.692914
11	Fibre fabrics	2.290949	45	Agricultural services	1.691171
12	Wearing apparels and dress	2.174861	46	Lumber and wood products	1.686884
13	Fabricated metal products	2.174861	47	Port industry	1.678869
14	Printing and publishing	2.166976	48	Public admin. & defence	1.671316
15	Bread, confectinoery & noodles	2.162151	49	Restaurants and hotels	1.631304
16	Gas, steam & hot water supply	2.145008	50	Primary nonferrous metal man.	1.621470
17	Miscellaneous manu. products	2.136454	51	Other transport	1.594525
18	Building const. & maintenance	2.122084	52	Non-metallic mining	1.583430
19	Processed seafood products	2.081445	53	Other services	1.558728
20	Synthetic resins and products	2.057249	54	Sugar	1.550700
21	Transporation equipment	2.057249	55	Finance and insurance	1.512289
22	Gen. ind. machineray and equip.	2.056649	⋮	⋮	⋮
23	Pulp and papers	2.044169	⋮	⋮	⋮
24	Public works and other cons.	2.031554	66	Petroleum products	1.112917

The output multiplier for the port industry is 1.68 which ranks 47th in the country's industry. This means that a one unit increase in the output of the port industry entails an increase in the aggregate output of the national economy of 1.68 units.

Application of this multiplier shows that an additional 151,883 million of indirect output was required through the economy to sustain the direct level of port industry sales of 223,358 million won in 1985. Thus the total economic impact of the port industry, as measured by its direct and indirect sales impact, came to 375,241 million won for the base year. This means that the industry's impact on the economy averaged about 1,028 million won per day for that year.

The ranking suppliers to the port industry, in terms of both direct and indirect requirements, closely paralleled the port industry's leading direct suppliers in 1985. Table 9 details the direct and indirect sales of the port industry's twenty leading supplying industries.

The port industry's impact upon the rest of the economy runs across a broad front of producers of goods and services. The purchasing power of the Korean port industry, with its ripple effect extending to many other industries, is of vital importance to many suppliers throughout the nation.

The petroleum products industry, which sold 2. 31 per cent of its total output in 1985 to the port industry, directly and indirectly, is among those industries which rely upon ports to purchase a significant share of their outputs.

Others include the business services industry which sold 1.48 per cent of its 1985 output to the

Table 9. The Direct and Indirect Requirement of the Korean Port Industry by 20 Leading Supplying Industries (1985)
(unit : million won)

Supplying Industries	Amount
Business services	33,610
Petroleum products	14,626
Business consumption	11,253
Electric power services	7,023
Finance and insurance	6,053
Printing and publishing	5,856
Wholesale and retail trade	5,737
Real estate and rental	4,816
Communications	3,756
Pulp and paper	3,517
General industrial machinery and equipment	3,511
Transportation equipment	3,473
Other services	3,042
Fabricated textile products	2,857
Social services	2,820
Lumber and wood products	2,687
Beverages	2,671
Other transport	2,605
Restaurants and hotels	2,523
Crops	2,168

port industry, and the communications industry which sold 1.41 per cent of its output. These percentages include the indirect effect, i.e. the impact generated by the sales of each of these industries to various other suppliers of the port industry to enable them to produce such supplies in the first place.

4. 2 Value-added Multiplier

The value-added multiplier generated in the Korean economy by the port industry in 1985 was 1.463392 and places it in 49th place in the table of Korean industries. This means that a one unit increase in the value-added of the port industry entails an increase in the aggregate value-added of the national economy of 1.463392 units (See Table 10).

In terms of ranking, the value-added multiplier is slightly lower than that of the output multiplier. This means that the port industry has more influence on industries which involve relatively low value-added.

In view of the total value-added effect (the direct and indirect value-added effect), the Korean port industry is ranked in 12th position with a coefficient of 0.904460. This figure indicates that for the port industry to deliver a unit of output to final demand, national industries have to create both directly and indirectly 0.904 460 units of value-added (See Table 10).

In 1985, the port industry generated a total of 202,261 million won in direct and indirect value-added. Gross value-added within the port industry itself came to 138,048 million won while the total value-added generated in other industries was 64,213 million won. This impact was based on a value-added multiplier of 1.463392 derived in the input-output model.

The service industries were the major value-added beneficiaries from port activities. Significantly, eight of the leading ten industries are service oriented underscoring the importance of the port industry. Business services were the most strongly affected in 1985 with 19,037 million won in value-added generated by port purchases. Electric power services, finance and insurance services, wholesale and retail trade, and real estate and rentals services also showed strong value-added impact. Table 11 lists the twenty leading Korean industries on which port purchases made the strongest value-added impact.

Table 10. Total Value-added Effects and Multipliers by Industry

NO. OF SECTOR	DIRECT EFFECT	TOTAL EFFECT	RANK	INDIRECT EFFECT	MULTI-PLIER	RANK	NO. OF SECTOR	DIRECT EFFECT	TOTAL EFFECT	RANK	INDIRECT EFFECT	MULTI-PLIER	RANK
1	0.799528	0.942935	4.	0.143407	1.179364	60.	34	0.320465	0.611726	44.	0.291260	1.908867	37.
2	0.213366	0.770432	27.	0.557065	3.610839	6.	35	0.332694	0.718181	33.	0.385487	2.158684	23.
3	0.597799	0.901246	13.	0.303446	1.507606	45.	36	0.127880	0.485345	58.	0.357465	3.795310	5.
4	0.857616	0.942238	5.	0.084622	1.098671	62.	37	0.185172	0.574486	51.	0.389313	3.102436	8.
5	0.583516	0.765276	28.	0.181760	1.311492	55.	38	0.200581	0.438803	64.	0.238222	2.187659	20.
6	0.587293	0.872458	16.	0.285166	1.485560	47.	39	0.300899	0.650445	40.	0.349547	2.161677	22.
7	0.533358	0.847409	21.	0.314051	1.588819	43.	40	0.313391	0.660438	37.	0.347047	2.107394	29.
8	0.652031	0.868489	18.	0.216458	1.331975	53.	41	0.311023	0.637371	42.	0.326348	2.049272	30.
9	0.137193	0.792981	24.	0.655788	5.780041	2.	42	0.262787	0.528011	54.	0.265224	2.009277	33.
10	0.231673	0.749296	31.	0.517624	3.234289	7.	43	0.299752	0.654653	39.	0.354901	2.183979	21.
11	0.030354	0.935940	6.	0.905586	30.834095	1.	44	0.319604	0.632043	43.	0.312439	1.977579	34.
12	0.122142	0.202536	66.	0.080394	1.658199	39.	45	0.322223	0.690671	34.	0.368448	2.143455	25.
13	0.315321	0.503750	56.	0.188429	1.597578	41.	46	0.621680	0.738764	32.	0.117084	1.188334	58.
14	0.268672	0.665522	35.	0.396850	2.477079	14.	47	0.108598	0.463449	61.	0.354850	4.267547	4.
15	0.206417	0.592586	47.	0.386170	2.870828	9.	48	0.421475	0.850437	20.	0.428963	2.017766	32.
16	0.538051	0.855765	19.	0.317713	1.590490	42.	49	0.389043	0.794055	23.	0.405012	2.041045	31.
17	0.805927	0.956593	1.	0.150665	1.186947	59.	50	0.412821	0.788844	25.	0.376022	1.910860	36.
18	0.167862	0.467553	60.	0.299691	2.785336	10.	51	0.687543	0.912333	10.	0.224790	1.326947	54.
19	0.251415	0.603495	45.	0.352080	2.400392	16.	52	0.600308	0.899406	14.	0.299098	1.498240	46.
20	0.249451	0.646565	41.	0.397114	2.591954	12.	53	0.461787	0.662481	36.	0.200694	1.434602	50.
21	0.219685	0.589553	48.	0.369868	2.683628	11.	54	0.846018	0.925714	7.	0.079696	1.094201	63.
22	0.226213	0.484657	59.	0.258444	2.142478	26.	55	0.680638	0.923767	9.	0.243129	1.357207	52.
23	0.204655	0.459372	62.	0.254716	2.244613	19.	56	0.768423	0.954422	3.	0.185998	1.242052	56.
24	0.249104	0.601149	46.	0.352046	2.413248	15.	57	0.566463	0.908967	11.	0.342504	1.604637	40.
25	0.360691	0.764186	29.	0.403494	2.118670	27.	58	0.528676	0.774067	26.	0.245391	1.464160	48.
26	0.199564	0.495747	57.	0.296184	2.484158	13.	59	0.869954	0.956305	2.	0.086351	1.099259	61.
27	0.189685	0.439247	63.	0.249562	2.315664	17.	60	0.564003	0.887961	15.	0.323958	1.574390	44.
28	0.242488	0.522677	55.	0.280188	2.155471	24.	61	0.449087	0.872158	17.	0.423071	1.942070	35.
29	0.419238	0.755748	30.	0.336510	1.802671	38.	62	0.654192	0.924592	8.	0.270400	1.413334	51.
30	0.262182	0.553781	53.	0.291599	2.112202	28.	63	0.000001	0.658522	38.	0.658521	0.000002	65.
31	0.257148	0.585661	49.	0.328513	2.277528	18.	64	0.000001	0.805597	22.	0.805596	0.000003	64.
32	0.173095	0.207026	65.	0.033931	1.196025	57.	65	-1.109547	0.582746	50.	1.692293	-0.525211	66.
33	0.110318	0.560757	52.	0.450439	5.083083	3.	66	0.618057	0.904460	12.	0.286403	1.463392	49.

Table 11. Direct and Indirect Value-Added Impact of the Korean Port Industry in the Twenty Leading Supplying Industries (1985)

(unit : million won)

Supplying Industry	Value-Added
Business services	19,037
Electric power services	4,360
Finance and insurance	4,124
Wholesale and retail trade	3,940
Real estate and rentals	3,699
Communications	3,180
Petroleum products	2,518
Printing and publishing	2,112
Other services	1,990
Other transport	1,756
Crops	1,733
Restaurants and hotels	1,514
Beverages	1,437
Social services	1,265
Medical and social welfare services	1,120
Gen. industrial machinery & equipment	1,099
Transportation equipment	1,035
Pulp and paper	876
Fabricated textile products	713
Lumber and wood products	550

4. 3. Employment Multiplier

Table 12 lists the employment multipliers by industry and shows that the employment multiplier of the port industry is 1.286436. This figure represents, for ten million won's worth of final demand for the port industry, a total of 1. 286436 jobs created in all industries throughout the national economy.

Based on this multiplier, the input-output model shows that in 1985 28,760 jobs throughout Korea were directly and indirectly attributable to operations within the port industry. Of these, as a result of the movement of cargo and vessels,

Table 12. Employment Multipliers by Industry
—per 10 Million Won Output—

NO	NAME OF SECTOR	MULTIPLIERS	RANK
1	CROPS	0.325382	57.
2	LIVESTOCK BREEDING & SERICULTURE	0.624467	42.
3	AGRICULTURAL SERVICES	0.828013	23.
4	FORESTRY PRODUCTS	0.745183	30.
5	FISHERY PRODUCTS	0.755251	28.
6	COAL MINING	1.234193	7.
7	METALLIC ORES MINING	1.000798	12.
8	NONMETALLIC MINING	1.261309	6.
9	MEAT, DAIRY & PROCESSED FRUIT PRODUCTS	0.816023	25.
10	PROCESSED SEAFOOD PRODUCTS	0.824661	24.
11	POLISHED GRAINS	0.378116	56.
12	FLOUR & CEREAL PREPARATIONS	0.175262	63.
13	SUGAR	0.234100	62.
14	BREAD, CONFECTIONERY, AND NOODLES	0.692482	35.
15	OTHER FOOD PREPARATIONS	0.464597	49.
16	BEVERAGES	0.378531	55.
17	TOBACCO PRODUCTS	0.172782	64.
18	FIBRE YARNS	0.558859	45.
19	FIBRE FABRICS	0.951169	15.
20	FABRICATED TEXTILE PRODUCTS	1.077350	9.
21	WEARING APPARELS & DRESS ACCESSORIES	1.341036	4.
22	LEATHER AND FUR PRODUCTS	0.744803	31.
23	LUMBER AND WOOD PRODUCTS	0.753125	29.
24	PULP AND PAPER	0.629275	41.
25	PRINTING AND PUBLISHING	0.886301	17.
26	INDUSTRIAL BASIC CHEMICALS	0.292298	61.
27	CHEMICAL FIBRES	0.301904	59.
28	CHEMICAL FERTILISERS	0.299986	60.
29	DRUGS AND COSMETICS	0.547642	46.
30	OTHER CHEMICAL PRODUCTS	0.505879	48.
31	SYNTHETIC RESINS & PRODUCTS	0.566252	44.
32	PETROLEUM PRODUCTS	0.035688	66.
33	COAL PRODUCTS	0.718282	33.
34	RUBBER PRODUCTS	0.984171	14.
35	CERAMICS & NONMETALLIC MINE PRODUCTS	0.727863	32.
36	IRON AND STEEL MANUFACTURING	0.384199	54.
37	PRIMARY IRON AND STEEL PRODUCTS	0.429033	50.
38	PRIMARY NONFERROUS METAL MANUFACTURING	0.407475	52.
39	FABRICATED METAL PRODUCTS	0.669708	36.
40	GENERAL INDUSTRIAL MACHINERY&EQUIPMENT	0.656250	38.
41	ELECTRICAL EQUIPMENT AND APPARATUS	0.644466	40.
42	ELECTRONIC & COMMUNICATION EQUIPMENT	0.654117	39.
43	TRANSPORTATION EQUIPMENT	0.620012	43.
44	MEASURING MEDICAL&OPTICAL INSTRUMENTS	0.839968	22.
45	MISCELLANEOUS MANUFACTURING PRODUCTS	1.134517	8.
46	ELECTRIC POWER SERVICES	0.166836	65.
47	GAS, STEAM & HOT WATER SUPPLY	0.415969	51.
48	WATER SUPPLY	0.518893	47.
49	BUILDING CONSTRUCTION & MAINTENANCE	0.869734	20.
50	PUBLIC WORKS & OTHER CONSTRUCTION	0.879180	19.
51	WHOLE SALE AND RETAIL TRADE	0.815745	26.
52	RESTAURANTS AND HOTELS	2.121029	1.
53	OTHER TRANSPORT	0.662747	37.
54	COMMUNICATIONS	0.406917	53.
55	FINANCE AND INSURANCE	0.847116	21.
56	REAL ESTATE AND RENTALS	0.315978	58.
57	BUSINESS SERVICES	0.710992	34.
58	PUBLIC ADMINISTRATION & DEFENCE	0.985662	13.
59	EDUCATION SERVICE & RESEARCH INSTITUTES	1.059228	10.
60	MEDICAL & SOCIAL WELFARE SERVICES	0.880639	18.
61	SOCIAL SERVICES	1.633775	2.
62	OTHER SERVICES	1.027518	11.
63	OFFICE SUPPLIES	0.803001	27.
64	BUSINESS CONSUMPTION	0.887663	16.
65	UNCLASSIFIABLE	1.616056	3.
66	PORT INDUSTRY	1.286436	5.

23,237 were employed directly in port operations and an additional 5,523 jobs were created in various industries supplying the ports. For the most part, these jobs occur within industries providing maritime services.

In terms of the size of employment multiplier, the port industry ranks fifth. Comparing the rankings of the port industry in terms of both output and value - added, this is a considerably better result for the port industry. With the discussion of the effect - particularly in terms of employment - of port investment on the nation's economy reserved for a later section, this is very interesting point in relation to the future creation of new jobs, even though figures created do not seem to be enormous. This point will be further substantiated by the comparative analysis undertaken between port investment and other major industries and discussed in Section 2.

5. Linkage Analysis

Originally introduced by Hirschman (1958), the concept of linkages has attracted attention as a means of identifying key sectors both in the analysis and planning of industrial development. The basic argument is that interdependencies among productive activities are the essential features of modern production and that the direction and level of such interdependencies indicate each sector's potential capacity to stimulate other sectors. Activities having the highest linkages are considered key sectors because by concentrating resources on them it should be possible to stimulate a more rapid growth of production, income and employment than with alternative allocations of resources [4].

In the framework of an input-output model, production by a particular sector has two kinds of economic effects on other sectors in the economy. If sector j increases its output, this means there will be increased demands from sector j (as a purchaser) on the sectors whose products are used as inputs in production in j. This is the direction of causation in the usual demand-side model. The term backward linkage is used to indicate this kind of interconnection of a particular sector to those sectors from which it purchases inputs. On the other hand, increased output in sector j also means additional amounts of product j that are available to be used as inputs to other sectors for their won production. That is, there will be increased supplies from sector j (as a seller) for the sectors which use the good j in their production. The term forward linkage is used to indicate this kind of interconnection of a particular sector to those sectors to which it sells its output [5].

Many authors have proposed various kinds of linkage measures to quantify such backward and forward linkages among the sectors of an economy [6]. A useful and comprehensive measure of the backward linkage effect (BLE) of sector j - the amount by which sector j procuction depends upon inputs - is given as follows :

$$BLE = \frac{1}{n} \sum_{i} L_{ij} \Big/ \frac{1}{n^2} \sum_{j} \sum_{i} L_{ij} \quad (i, j = 1, \cdots\cdots n) \qquad \cdots\cdots (15)$$

where, ΣL_{ij} is the sum of the column elements and is interpreted as the total increase in the output from the whole system of industries needed to cope with an increase in the final demand for the product of industry j by one unit. Similarly, forward linkage effect (FLE) of sector i is defined as follows:

$$FLE = \frac{1}{n} \sum_{i} L_{ij} \Big/ \frac{1}{n^2} \sum_{j} \sum_{i} L_{ij} \quad (i, j = 1, \cdots\cdots n) \qquad \cdots\cdots (16)$$

where ΣL_{ij} is taken as the increase in output in industry i needed to cope with a unit increase in the final demand of all the industries.

Given a shortage of information, the linkage mechanism might stimulate the economic activity of others and have a sort of multiplier effect on growth. Industries with high linkages thus generate externalities which merit government intervention. If the backward linkage of sector i is larger than that of sector j, one might conclude that a unit worth of expansion of sector i output would be more beneficial to the economy than would an equal expansion in sector j's output, in terms of the productive activity throughout the economy that would generated by it.

Similarly, if the forward linkage of sector m is larger than that of sector n, it could be said that a unit worth of expansion of the output of sector m is more beneficial to the economy than a similar expansion in the output of sector n, from the viewpoint of the overall productive activity that it would support.

It is therefore of interest to ascertain the extent to which the Korean port industry exhibits Hirschmanian linkages. Table 13 presents interindustry domestic linkage effects for 66-sectors of the Korean economy. Within the economy, the port industry does not display very strong linkages of either sort. Backward linkages in the port industry rank in 47th position among industries, while forward linkages rank 57th. When compared with the service-oriented industries, however, the Korean port industry has substantially more backward linkages, but slightly smaller forward linkages.

6. Spreading Effects of Port Investment on the Economy

6.1 The Effect of Port Investment on the Economy

6.1.1 Output(or Production) Effect

In 1985 the total output generated in Korea by port investment was 358,734 million won with a total output multiplier of 1.971869. This amount was comprised of direct input within the industry itself of 181,926 million won, and 176,808 million won of other industries' input induced by port investment(see Table 14).

The distribution of the ten leading supplying industries which benefited most from capital investment in the ports in 1985 is presented in Table 15. As the Table indicates, the majority of the effects are concentrated on industries providing maritime services, including other modes of the transport industry.

Since government expenditures on port investment create a demand in new construction, the ripple effect of such spending is strongly reflected in the demand for construction materials such as cement, metals and other supplies. Business services, wholesalers and retailers were also major beneficiaries.

The ceramics and nonmetallic mine products industry was the largest single investement category by industry in 1985, amounting to 55,304 million won. These expenditures covered the costs of clay and cement products for the construction of port facilities. The second leading category of port investment was in other modes of the transport sector. Port investment caused a total of 29,042 million won worth of output in other transport modes.

Table 13. Interindustry Linkages of Korean Economy in 1985

A	B	R	F	R	A	B	R	F	R
1	0.691049	60.	1.879175	7.	34	1.001570	31.	0.649942	50.
2	1.230548	7.	1.054093	19.	35	1.017953	29.	1.140732	17.
3	0.882096	45.	0.582285	56.	36	1.211277	8.	1.710222	8.
4	0.647181	62.	0.734142	43.	37	1.362320	5.	1.409815	11.
5	0.783413	57.	0.790296	35.	38	0.845741	50.	0.900161	26.
6	0.883005	44.	0.881779	29.	39	1.134383	13.	0.925465	24.
7	0.935531	38.	0.560251	71.	40	1.072725	22.	1.036321	20.
8	0.825899	52.	0.714381	44.	41	1.028105	26.	0.819189	32.
9	1.497944	3.	0.764814	14	42	0.905550	42.	0.792453	33.
10	1.106855	19.	0.568036	58.	43	1.073038	21.	0.790593	34.
11	1.200379	10.	0.745857	41.	44	0.954039	35.	0.618335	53.
12	0.610838	65.	0.677885	47.	45	1.114350	17.	0.774801	37.
13	0.808828	54.	0.639985	52.	46	0.723919	59.	2.111840	5.
14	1.127753	15.	0.669527	48.	47	1.118812	16.	0.564830	60.
15	0.956108	34.	1.488089	10.	48	1.019821	27.	0.688479	46.
16	0.911617	40.	0.971417	22.	49	1.106873	18.	0.892985	27.
17	0.666035	61.	0.538427	63.	50	1.059636	24.	0.536567	64.
18	1.048753	25.	1.332339	13.	51	1.059636	24.	0.366496	2.
19	1.194933	11.	1.065962	18.	52	0.850870	49.	0.888985	28.
20	1.251339	6.	0.700761	45.	53	0.831686	51.	1.301778	14.
21	1.157058	12.	0.547424	62.	54	0.619068	64.	0.923735	25.
22	0.939485	37.	0.754747	40.	55	0.788793	55.	2.212782	4.
23	0.878959	46.	0.825289	31.	56	0.743022	58.	1.170701	15.
24	1.066216	23.	1.898475	6.	57	0.926835	39.	1.348712	12.
25	1.130270	14.	0.872126	30.	58	0.871739	48.	0.521589	66.
26	1.018727	28.	2.353470	3.	59	0.643876	63.	0.565632	59.
27	0.897046	43.	1.159853	16.	60	0.909705	41.	0.565632	59.
28	0.975609	33.	0.763157	39.	61	1.200486	9.	0.610999	54.
29	0.943489	36.	0.743249	42.	62	0.813015	53.	0.661234	49.
30	0.981859	32.	0.941979	23.	63	1.528914	2.	0.641113	51.
31	1.985658	20.	1.004508	21.	64	1.469732	4.	1.638734	9.
32	0.580485	66.	3.076261	1.	65	2.471819	1.	0.528304	65.
33	1.003072	30.	0.781356	36.	66	0.875679	47.	0.581698	57.

Note : A ; Number of Sector, B ; Value of Backward Linkage Effect, R ; Rank, F ; Value of Forward Linkage Effect

Table 14. Summary of Various Effects of Port Investment

(unit : million won, *persons)

Port Investment (A) (181,926)		Output Effect	Value-added Effect	Imports Effect	Labour Effect	Employee Effect
Total Amount Induced (B)		358,734	152,241	29,685	*29,603	*26,565
Total Multiplier (B/A)		1.971869	0.836827	0.163173	0.162721	0.146023
Own Sector	Induced Amount (C)	181,926	85,673	537	*21,000	*20,000
	Multiplier	1.000000	0.470922	0.002952	0.115432	0.109935
Other Sectors	Induced Amount (D)	176,808	66,568	29,148	*8,603	*6,565
	Multiplier	0.971869	0.365905	0.160221	0.047290	0.036088
C/B (%)		50.7	56.3	1.8	70.9	75.3
D/B (%)		49.3	43.7	98.2	29.1	24.7
D/C (%)		97.2	77.7	5,527.9	41.0	32.8

Table 15. The Direct and Indirect Outputs Created by Port Investment by the Ten Leading Industries : Actual Value and Ratio to Corresponding Port Investment (unit : million won)

Industries	Amount	Multiplier
1. Ceramics & Nonmetallic Mine Products	55,304(30,246)	0.303992
2. Other Transport	29,042(16,030)	0.159636
3. Petroleum Products	23,503(16,415)	0.129190
4. Primary Iron and Steel Products	23,137(13,491)	0.127178
5. Nonmetallic Mining	18,628(10,783)	0.102393
6. Business Services	18,592(10,193)	0.102195
7. Whole sale and Retail Trade	11,851(7,842)	0.065142
8. Finance and Insurance	9,988(6,461)	0.054901
9. Business Consumption	9,377(6,010)	0.051543
10. Iron and Steel Manufacturing	8,591(8,620)	0.047223

Note: Figures in parenthesis indicate the indirect outputs generated by port investment.

6. 1. 2 Value-Added Effect

Port investment in Korea is important in producing value-added such as compensation of employees and operating surplus. In 1985, port investment created a total of 152,241 million won of value-added. Gross value-added within its own industry amounted to 85,673 million won while the total value-added generated in other industries was 66,568 million won.

Table 16 lists the ten leading industries ranked by the amount of value-added generated by port investment.

Table 16. Value-Added Created by Port Investment by the Ten Leading Industries : Actual Value and Ratio to Corresponding Port Investment (unit : million won)

Industries	Amount	Multiplier
1. Cer. & Non-metallic Mine Prod.	17,994	0.098909
2. Other Transport	8,618	0.047370
3. Business Services	7,634	0.041964
4. Non-metallic Mining	6,813	0.037450
5. Primary Iron and Steel Products	5,540	0.330453
6. Whole Sale and Retail Trade	3,657	0.020104
7. Finance and Insurance	3,258	0.017909
8. Business Consumption	2,712	0.014909
9. Fabricated Metal Products	1,619	0.008952
10. Lumber and Wood Products	1,585	0.008713

As this Table indicates, the majority of the value-added is received by industries in the maritime service sector. The service industries were the major beneficiaries of value-added from port investment. The ceramics and non-metallic mine products industry showed the most indirect value-added effect, amounting to 17,994 million won. Transportation services that were not part of the port industry, were strongly affected in 1985 with, 8,618 million won in value-added generated indirectly by port investment.

6. 1. 3 Import Effect

The import effect of port investment means the amount of additional imports required from the row sector as an indirect result of increasing investment in port construction. It can be calculated by multiplying quasi-inverse matrix of imports by port investment by sector.

Total imports created by port investment in 1985 were 29,685 million won with a multiplier of 0.1632. This amount consisted of the direct imports of 537 million won (generated by own industry) and the indirect imports of 29,148 million won (induced by other industries). This implies that port investment by itself has little

import effect on the national economy. Rather, throuth the ripple effect of port investment, it influences other industries to purchase imports. In other words, port investment has a high backward linkage effect.

Indirect imports generated by port investment by the ten leading industries are shown in Table 17. The non-metallic mining industry such as building stone, and gravel, and limestone for construction were the most strongly affected in 1985, amounting to 12,850 million won. Significantly, most leading industries affected by port investment were construction oriented underscoring the importance of port investment as a major commercial hub.

Table 17. Imports Created by Port Investment by the Ten Leading Industries: Actual Value and Ratio to Corresponding Port Investment
(unit : million won)

Industries	Amount	Multiplier
1. Non-metallic Mining	12,850	0.070643
2. Coal Mining	2,301	0.012646
3. Forestry Products	1,542	0.008477
4. Primary Iron and Steel Products	1,404	0.007718
5. Petroleum Products	1,293	0.007105
6. Iron and Steel Manufacturing	1,102	0.006056
7. Other Transport	1,042	0.005729
8. Industrial Basic Chemicals	1,028	0.005650
9. Metallic Ores Mining	957	0.005260
10. Gen. Ind. Machinery & Equip.	759	0.004173

6. 1. 4 Employment Effect

Government spending in ports also affects civilian employment. The input-output model showed that 26,565 jobs throughout Korea were directly and indirectly attributable to port operations in 1985. Of these, 20,000 were employed directly in port construction and an additional 6,565 jobs were generated in various industries supplying the ports (see Table 14). These figures, of course, do not include direct employment in port operations(port workers).

These figures do not appear substantial. The impact of port investment on employment, however, is of great significance and is discussed in a later section. Table 18 shows the indirect employment effect in the ten supplying industries most affected by port investment.

Table 18. Employees Created by Port Investment by the Leading Industries: Actual Value and Ratio to Corresponding Port Investment
(unit : persons)

Industries	Amount	Multiplier
1. Non-metallic Mining	1,179	0.006478
2. Creamics&Non-metallic Mine Products	1,080	0.005935
3. Other Transport	813	0.004467
4. Whole Sale and Retail Trade	511	0.002810
5. Finance and Insurance	419	0.002305
6. Business Services	398	0.002185
7. Restaurants and Hotels	260	0.001431
8. Lumber and Wood Products	209	0.001152
9. Primary Iron and Steel Products	171	0.000942
10. Fabricated Metal Products	137	0.000753

6. 2 A Comparative Analysis Between Port Investment and Other Major Industries

In this section, a comparative analysis of spreading effects between port investment and other major industries is effected. In selecting other major industries, the similar proportion of investment to GNP was considered.

Output, value-added, import, labour, and employment multipliers of selected industries were calculated by using the input-output model developed in this paper.

The calculation of these multipliers for each industry is similar to the method of deriving multipliers of port investment; after selecting the industry which has a similar proportion of investment to GNP from the 402-version table

that industry was put into the exogenous sector. These multipliers appear in Table 19.

Table 19. Comparison of Multipliers of Selected Industries

	Output	Value-added	Import	Labour	Employment
1. Auqiculture	1.552372 (21)	0.904317 (3)	0.095683 (19)	0.176122 (4)	0.111519 (5)
2. Limestone, ceramic & refractory minerals	1.889548 (14)	0.799800 (8)	0.200200 (14)	0.119456 (11)	0.104243 (9)
3. Canned or preserved fruits & vegetables	2.164975 (5)	0.868243 (5)	0.131756 (17)	0.228700 (2)	0.110332 (8)
4. Polished barley	2.332056 (2)	0.936818 (1)	0.063156 (21)	0.271727 (1)	0.040196 (20)
5. Other fibre yarn and thread	2.384485 (1)	0.628796 (16)	0.371204 (6)	0.115888 (12)	0.101609 (10)
6. Silk fabrics	1.968963 (11)	0.512377 (20)	0.487623 (2)	0.091528 (17)	0.82196 (15)
7. Fibre bleaching and dyeing	1.715981 (17)	0.624736 (17)	0.375264 (5)	0.159649 (6)	0.149103 (2)
8. Cordage, rope, and fishing nets	2.218110 (4)	0.588883 (18)	0.411117 (4)	0.110377 (13)	0.98948 (12)
9. Other wood products	2.132833 (6)	0.646852 (14)	0.353148 (8)	0.142933 (8)	0.110401 (7)
10. Soap and synthetic detergents	1.907922 (13)	0.555585 (19)	0.444415 (3)	0.063721 (20)	0.046052 (19)
11. Agricultural chemicals	1.677819 (18)	0.481354 (21)	0.518646 (1)	0.48621 (21)	0.036149 (21)
12. Pottery china and earthen ware	1.797502 (16)	0.706173 (9)	0.293827 (13)	0.150486 (7)	0.138114 (4)
13. Metal working and processing machinery	1.979025 (9)	0.638868 (15)	0.361132 (7)	0.091115 (18)	0.075592 (27)
14. Railroad vehicles	2.004108 (8)	0.702787 (10)	0.297213 (12)	0.071613 (19)	0.059211 (18)
15. Other transportation equipment	2.261979 (3)	0.676839 (13)	0.323161 (9)	0.093307 (16)	0.077225 (16)
16. Measuring & medical instruments	2.016887 (7)	0.690983 (12)	0.309017 (10)	0.107051 (14)	0.091474 (13)
17. Transport related services	1.863098 (15)	0.894908 (4)	0.105092 (19)	0.129643 (9)	0.110608 (6)
18. Warehousing	1.628351 (19)	0.920198 (2)	0.079802 (20)	0.121340 (10)	0.101443 (11)
19. Sanitary services	1.580191 (20)	0.866031 (6)	0.133969 (16)	0.210181 (3)	0.202848 (1)
20. Photographic and optical instruments	1.925160 (12)	0.699160 (11)	0.300840 (11)	0.097902 (15)	0.083410 (14)
21. Port investment	1.971869 (10)	0.836827 (7)	0.163173 (15)	0.162721 (5)	0.146023 (3)

Note: 1. Figures in parenthesis indicate the ranking.

2. In terms of the proportion of investment to GNP, selected industries were similar to the port investment.

This Table of multipliers provides a large volume of information with respect to output, value-added, import, labour, and employment characteristics of selected industries and port investment; this is the first time this information has been available in respect of the Korean economy.

6.2.1 Output Multipliers

The total output multiplier for selected industries indicates the direct and indirect industrial support requirements from all industries for each unit increase in investments of any selected industry. Table 19 displays the size of output multipliers which reflects the ranking.

Higher output multipliers simply mean stronger linkages among industries. In the rankings of output multipliers, the port sector was in 10th position among industries having a similar proportion of investment to GNP. This means that port investment has a relatively high linkage effect which is an indication of its importance.

6.2.2 Value-Added Multipliers

Table 19 also provides the total value-added multipliers for selected industries and the port sector. In general, the size of value-added multipliers was high in primary and tertiary industries.

In terms of the ranking, the multiplier of port investment was in 7th position among selected industries. This means that, by considering the port investment sector as one of secondary industry, the value-added effect of port investment is very high. This is further evidence of the contribution made by port investment to the nation's value-added.

6.2.3 Import Multipliers

Total import multipliers for selected industries measure the direct and indirect industrial import requirements from all industries for the investment of any selected industry in the exogenous sector. The import multiplier of port investment was 0.163173 and was ranked 15th among selected industries. This means that imports induced by port investment are relatively small compared to other selected industries.

6.2.4 Labour and Employment Multipliers

The labour and employment multipliers are also presented in Table 19. It is noticeable that the labour and employment multiplier of port investment achieve a higher ranking among selected industries, 5th and 3rd place respectively. This draws attention to the importance of port investment as one of the leading measures of creating new jobs. Traditionally in Korea particular emphasis has been given to creating new jobs to accommodate the increasing population. This result of high employment multiplier in port investment, therefore, can be applied to the macro-economic development planning in Korea as one of alternatives in deciding investment priority.

7. Policy Implications of the Port Input-Output Model

Value-added multipliers derived in previous sections provide some degree of prediction in so far as they can be used to determine the absolute and relative impact of the expansion of output in each sector in the economy. The multipliers indicate which sector would be likely to have greater relative impact than others upon the total value-added and/or output of the economy. Expansion in those sectors with the highest multipliers should be encouraged, assuming that

these are consistent with other economic and development objectives.

This section is concerned with the implications of the port input-output model in policy-making from the macroeconomic viewpoint. Investment decisions in relation to the port industry are dependent upon senior decision-makers' recognition of the importance of port investments. From the viewpoint of senior national planners, every industry has its own importance in the dynamic economic development of countries such as Korea. Therefore, they balance investments amongst industries. However, sometimes they prefer to invest in industries which have a substantial effect in terms of income, employment, balance of payments, and production.

To give them more incentive to invest in the port industry rather than others, it is important for investors to realize the significance of the Korean port industry in relation to national development objectives. The multipliers calculated in the previous sections were measured in terms of unweighed increases in output which were obviously not the most relevant indices for policy formulation. Rather, for policy purposes the multipliers should be related to Korean economic development objectives, such as income, self-sufficiency, balance of payments, national budget, and employment.

The way in which long-term economic development aims have created acute short-term problems suggests some likely policy weighting. The singled-minded pursuit of rapid industrialisation, for example, resulted in a capital-intensive form of development throughout the 1970s. Unfortunately the employment position also suffered from an extremely rapid population increase and in urban areas was further aggravated by a substantial rural influx.

The introduction of the industrialisation strategy of import-substitution in the 1970s has implied a continual dependence for foreign exchange on the earnings of exports facing stagnating international demand [7]. Although exports have increased vigorously, the balance of payments has deteriorated as a result of sharp oil price increase and the need for imports to fuel rapid economic development. Consequently, it is certain that the shortage of foreign exchange has restrained Korea's effort for economic development.

This experience suggests that the long-term priority of industrialisation should be reconciled with pressing short-term needs to increase income, employment, and foreign exchange earnings while economising in the use of capital. Traditionally, the Korean government has objectives and strategies within the economic development plan, which are displayed by placing a particular emphasis on the increase in income, the creation of employment opportunities, the improvement of the balance of payments, and the economisation of the use of capital [8].

By adopting simple linear functions, these four objectives may be incorporated into the short-run analysis. If the concern, for example, is with income creation, then by multiplying the industry output multipliers with coefficients of value-added per unit of output, the relevant income multipliers are derived. In a similar fashion, it is possible to use as policy weights the ratio of employment per unit of output, incremental capital-output ratios, and net foreign exchange used per unit of output (see Appendix for data and sources).

The results provide estimates of the income and employment created, and the capital and foreign exchange used, per unit of final demand in each industry. The correlations between them indicate the degree of compatibility between different policy objectives. These are shown in Table 20.

Table 20. Pearson Correlations Coefficients between Industry by Policy Objective

Policy Objective	Maximise Income	Maximise Employment	Minimise Capital	Minimise For. Exchange
Max. Income	1.0000 (66) P= *			
Max. Employment	.3639 (66) P=.001	1.0000 (66) P= *		
Min. Capital	.0405 (66) P=.373	.0052 (66) P=.484	1.0000 (66) P= *	
Min. F. Exchange	−.2664 (66) P=.015	−.4443 (66) P=.000	−.0982 (66) P=.216	1.0000 (66) P= *

Note: 1. (Coefficient/(Cases)/1-Tailed Significance)
2. "*" is printed if a coefficient cannot be computed.

Source: See Data Appendix.

From Table 20, it is evident that there are important inter-industry policy conflicts. Most noticeable is the extent to which industries minimising the negative effect on the balance of payments perform poorly when judged by other criteria.

This results in a negative relationship between the objective of minimising the use of foreign exchange and the objectives of maximising income and employment(e.g. the Pearson correlations are −0.2664 and −0.4443 respectively).

In a similar fashion, industries which allow a maximum return in employment and income after all multiplier repercussions have been accounted for tend to be heavy users of capital. Thus while there appears to be some degree of policy compatibility between maximising employment and income (correlation=0.3649), these objectives are inconsistent with the aims of minimising capital used and minimising the negative effect on the foreign balance.

The port industry which is characterised as a labour-intensive foreign exchange earner appears to be attractive in a situation characterised by foreign balance and capital constraints. The above results permit a quantitative assessment of the policy implications of the port industry compared with other industries. In order to gauge their relative impact on the Korean economy, industries were ranked by each policy weighting. The top fifteen rankings are displayed in Table 21.

The port industry is compared with the other sectors of the Korean economy on the basis of an output multiplier of 1.68. Table 21 shows that the port industry performs best when the objective of maximising employment created and maximising income are pursued, but performs rather poorly when the objective is minimising the use of capital. The port industry's relative impact on foreign exchange is also rather low (i.e. ranked only 22nd by this policy objective).

Table 21. Industries within the First Fifteen Rankings by Policy Objectives

Rank	Maximise Income	Maximise Employment	Minimise Capital	Minimise For. Exchange
1	No. 17	No. 52	No. 50	No. 65
2	No. 59	No. 61	No. 49	No. 21
3	No. 56	No. 65	No. 35	No. 45
4	No. 1	No. 21	No. 8	No. 19
5	No. 4	Port Industry	No. 40	No. 34
6	No. 11	No. 8	No. 23	No. 7
7	No. 54	No. 6	No. 41	No. 20
8	No. 62	No. 45	No. 37	No. 42
9	No. 55	No. 20	No. 43	No. 39
10	No. 51	No. 59	No. 36	No. 18
11	No. 57	No. 62	No. 38	No. 55
12	Port Industry	No. 7	No. 57	No. 54
13	No. 3	No. 58	No. 44	No. 51
14	No. 52	No. 34	No. 7	No. 27
15	No. 60	No. 19	No. 39	No. 22
			Port industry's rank=45	Port industry's rank=22

Source : See Appendix.

These results, of course, cannot give direct answers to problems in relation to the current port development planning process. However, it is possible to draw some implications from the present port input-output model; it can remind the decision-makers that the investment in the port industry becomes an even more attractive policy option when the objective is to maximise employment created or maximise income.

Viewed from the macroeconomic viewpoint, the port industry might be considered by decision-makers as one of the alternatives in selecting sectors which are the most desirable contribution to national objectives. In particular, in the case that capital allocation is in a situation of intense competition, the maximisation of income and employment is important for the Korean economy at the national level. With limited capital at their disposal, it is expected that national planners adapt the development strategy drawn up at the macro level from the input-output model to a specific sector. They can introduce a kind of efficiency criterion in the shape of the contribution individual sectors make to development objectives; in order to attain certain income, employment most effectively, investment priority can be given to the port industry.

8. Conclusion

This paper has empirically analysed the economic impacts of the port industry upon the nation's economy. This was achieved by developing an input-output model showing, in quantifiable terms, how the port industry is economically linked with every other sector of the national economy.

Using the input-output model, the analysis revealed that port industry operations in the base year of this study were responsible directly and indirectly for gross sales within the economy of 375, 241 million won and the creation of a 202,261 million won contribution to gross national product (GNP), and 28,760 jobs.

The analysis also shows that the chain reactions initiated by the multiple purchases for port operations give the port industry a multiplier effect of 1.68. This means that each unit worth of sales by the port industry produces 1.68 units in sales throughout the economy.

In view of the employment multipliers by industry, the ranking of the port industry was the 5th amongst all industries, with an employment multiplier of 1.29. This figure means that ten million won worth of sales by the port industry creates 1.29 jobs in all industries.

Comparing the ranking of output multiplier of the port industry, this higher ranking of the port industry in the employment multiplier implies that the port industry has a great influence upon industries which have a high employment rate. This result of the port industry can be applied to the macro national economic planning and development in the future as one of the key sectors.

This paper has also utilised the input-output model to identify the structural characteristics of port investments. The analysis was basically designed to describe the spreading effects of port investment in the Korean economy.

The input-output model adopted has provided the empirical results of port investments for the Korean economy. The large volume of results obtained has allowed a highly selective discussion of the input-output tables and multipliers. This discussion has been cast in explanatory terms; its potential contribution to the understanding of the port investments is considerable, especially in terms of jobs and value-added.

In particular, comparing the results of other major industries which have a similar proportion of investment to GNP, port investment is significant in terms of new job creation. The contributions of port investment in the 66-sector model to the Korean economy in terms of output, value-added, import, labour, and employment have been summarised.

Finally, certain policy implications of the present port input-output model were drawn by carrying out correlation analysis between industries by policy objectives with the help of 'SPSS-X'. The fact that the port industry performs best when the objectives of maximising employment and income are pursued, implies that investment in the port industry becomes an even more attractive policy option when these objectives are pursued. This result can provide some criteria to aid investment decision-makers from the macroeconomic viewpoint.

Abstract

The Korean central government has not appreciated the full extent of the impact of seaports on the national economy. As a consequence port investment has not been given sufficient priority and capacity has failed to keep pace with demand. The principal reason for this failure is the fact that the linkages (or relationships) of the port transport industry with other sectors have not been quantified and fully appreciated.

To overcome this dificiency this paper developed a port input-output model to determine the economic impact of the port industry on the national economy. This impact study was conducted by analysing the impact of the Korean port industry upon the national economy from the macroeconomic viewpoint, and identifying the spreading effects of port investments upon the nation's economy.

The analysis of the economic impact of the port industry suggests that its contribution to the Korean economy is substantial. What the model shows is, in quantifiable terms, there are the strong economic linkages between the port industry and the other sectors of the national economy. The contribution of the port industry to the Korean economy was summarised in the Conclusion section.

Notes and References

1. Bank of Korea, *1985 Input-Output Tables, Vol. I and II*, (Seoul, Korea: 1988).
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Appendix. The Data and Sources for Table 20

	Value-added Ratio(a)	Labour-Output Ratio(b)	I. C. O .R (c)	Export Coefficient(d)	Import Coefficient(e)	(d)−(e)
1	0.942935	32.5382	0.015402	0.035120	0.057065	−0.021945
2	0.770432	62.4467	0.054756	0.055635	0.229568	−0.173933
3	0.901246	82.8013	0.020792	0.038057	0.098754	−0.060697
4	0.942238	74.5183	0.097025	0.144549	0.057762	0.086787
5	0.765276	75.5251	0.002297	0.290823	0.234724	0.056099
6	0.872458	123.4193	0.116481	0.202837	0.127542	0.075295
7	0.847409	100.0798	0.288540	0.442164	0.152591	0.289573
8	0.868489	126.1309	0.619341	0.248542	0.131511	0.117031
9	0.792981	81.6023	0.017478	0.053777	0.207019	−0.153242
10	0.749296	82.4661	0.001902	0.311663	0.250704	0.060959
11	0.935940	37.8116	0.013328	0.018370	0.064060	−0.045690
12	0.202536	17.5262	0.033494	0.065142	0.797464	−0.732322
13	0.503750	23.4100	0.026922	0.169278	0.496250	−0.326972
14	0.665522	69.2482	0.034226	0.066363	0.334478	−0.268115
15	0.592586	46.4597	0.034908	0.086760	0.407414	−0.320654
16	0.855765	37.8531	0.061519	0.096843	0.144236	−0.047393
17	0.956593	17.2782	0.003961	0.010669	0.043407	−0.032738
18	0.467553	55.8859	0.019606	0.746376	0.532446	0.213930
19	0.603495	95.1169	0.014318	0.752962	0.396506	0.356456
20	0.646565	107.7350	0.038423	0.608776	0.353435	0.255341
21	0.589553	134.1036	0.001786	0.812507	0.410447	0.402060
22	0.484657	74.4803	0.017474	0.682224	0.515343	0.166881
23	0.459372	75.3125	0.531918	0.213783	0.540629	−0.326846
24	0.601149	62.9275	0.165250	0.328455	0.398851	−0.070396
25	0.764286	88.6301	0.151912	0.150934	0.235814	−0.084880
26	0.495747	29.2298	0.135088	0.543842	0.504253	0.039589
27	0.439247	30.1904	0.022528	0.729438	0.560753	0.168685
28	0.522677	29.9986	0.017837	0.257211	0.477323	−0.220112
29	0.755748	54.7642	0.006855	0.029451	0.244252	−0.214801
30	0.553781	50.5879	0.275352	0.321439	0.446219	−0.124780
31	0.585661	56.6252	0.196789	0.393800	0.414339	−0.020539
32	0.207026	3.5688	0.170938	0.413556	0.792974	−0.379418
33	0.560757	71.8282	0.120399	0.204542	0.439243	−0.234701
34	0.611726	98.4171	0.049412	0.721445	0.388275	0.333170
35	0.718181	72.7863	0.649375	0.188319	0.281819	−0.093500
36	0.485345	38.4199	0.371279	0.630933	0.514655	0.116278
37	0.574486	42.9033	0.400757	0.545687	0.425514	0.120173
38	0.438803	40.7475	0.362101	0.480258	0.561197	−0.080939
39	0.650445	66.9708	0.281694	0.564385	0.349555	0.214830
40	0.660438	65.6250	0.573701	0.227253	0.339562	−0.112309
41	0.637371	64.4466	0.409508	0.336064	0.362629	−0.026565
42	0.528011	65.4117	0.159175	0.690767	0.471989	0.218778
43	0.654653	62.0012	0.378354	0.459780	0.345347	0.114433
44	0.632043	83.9968	0.297157	0.441767	0.367957	0.073810
45	0.690671	113.4517	0.068384	0.669485	0.309329	0.360156
46	0.738764	16.6936	0.165176	0.296858	0.261236	0.035622
47	0.463449	41.5959	0.095819	0.292717	0.536551	−0.243834
48	0.850437	51.8893	0.095477	0.179310	0.149562	0.029748
49	0.794055	86.9734	0.880245	0.021924	0.205945	−0.184021
50	0.788844	87.9180	0.940759	0.029184	0.211157	−0.181973
51	0.912333	81.5745	0.175425	0.256594	0.087667	0.168927
52	0.899406	212.1029	0.067876	0.256753	0.100594	0.156159
53	0.662481	66.2747	0.090233	0.188383	0.337519	−0.149136
54	0.925714	40.6917	0.143605	0.251186	0.074286	0.176900
55	0.923767	84.7116	0.212808	0.261152	0.076233	0.184919
56	0.954422	31.5978	0.122151	0.080431	0.045578	0.034853
57	0.908967	71.0992	0.340756	0.196265	0.091033	0.105232
58	0.774067	98.5662	0.000000	0.002866	0.225933	−0.223067
59	0.956305	105.9228	0.005889	0.009351	0.043695	−0.034344
60	0.887961	88.0639	0.012789	0.020982	0.112039	−0.091057
61	0.872158	163.3775	0.083890	0.102917	0.127842	−0.024925
62	0.924592	102.7518	0.029499	0.050940	0.075408	−0.024468
63	0.658522	80.3001	0.199720	0.262817	0.341479	−0.078662
64	0.805597	88.7663	0.184936	0.249747	0.194403	0.055344
65	0.582746	161.6056	0.010021	0.836459	0.417254	0.419205
66	0.904460	128.6436	0.030225	0.200000	0.095540	0.104460

Note: (a) Value-added divided by total output. See Table 10.
(b) Numbers employed per billion won output. See Table 12.
(c) Incremental capital-output ratios. Source: The Bank of Korea, *1985 Input-Output Tables*(II), (Seoul, Korea: 1988).
(d) Exports divided by total output. Source: as (c).
(e) Intermediate imports divided by total output. Source: as (c).