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A TECHNIQUE FOR CALCULATING CAPITAL COEFFICIENTS IN NEWLY INDUSTRIALIZING COUNTRIES, WITH APPLICATION TO THE REPUBLIC OF KOREA

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SEVERAL types of economic study rely on estimates of capital stocks employed in production. Unfortunately, the sophistication of dynamic models and planning techniques is not matched by well-developed sources of capital stock data. One of the most important uses of capital stock matrices is in dynamic economy-wide models embracing many sectors, for example, Evans [13], Taylor et al. [26], Hamilton [14], and Adelman and Robinson [2]. These matrices permit the allocation among supplying industries of total sectoral investments and are therefore essential to a consistent dynamic solution.

This paper presents a method of calculating average sectoral capital coefficients especially suited to newly industrializing countries. It also reports average capital coefficients for twenty-six mining and manufacturing sectors of the Korean economy in 1978. The method of calculation is a modification of the one developed by Kahn and MacEwan [19].

The basic sources of statistics from which the capital coefficients are constructed are the censuses of mining and manufacturing industry carried out by the Economic Planning Board. In Korea these censuses have been conducted every five years and supplemented by surveys in the intervening years. Together they provide annual estimates of book values of fixed capital stocks by sector and by type of asset between 1968 and 1978; see *Report on the Mining and Manufacturing Census (Survey)* [23], hereafter *MMC*. We have used sectoral outputs from the 1978 input-output tables to compute coefficients; the list of sectoral correspondences and sectoral definitions appears in Table I.

The 1978 census records sectoral capital stocks by type of asset at book values. It is necessary to convert these book values into replacement values by taking account of (i) changes in the prices at which stocks are valued, and (ii) the difference between financial depreciation and actual deterioration of capital assets.

Preliminary calculations using the perpetual inventory method produced total coefficients which were well below expected levels and well below those calculated by others for earlier years. It is possible that this is due to serious under-

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TABLE I

SECTORAL CORRESPONDENCES

	1966 *I-O*	1978 *I-O*	1978 *MMC*
1. Coal	5	7	21
2. Other mining	6	8–9	23, 29
3. Processed food	7	10–14	311–312
4. Beverages and tobacco	8–9	15–16	313–314
5. Fiber spinning	10	17	3211
6. Textile fabrics	11	18	3216, 3217, 3219
7. Finished textile products	12	19	3212–3215, 322, 324
8. Lumber and plywood	13	21	3311
9. Wood products and furniture	14	22	3312, 3319, 332
10. Pulp and paper	15	23	341
11. Printing and publishing	16	24	342
12. Leather and leather products	17	20	323
13. Rubber products	18	33	355
14. Basic chemicals	19	25–26	3511
15. Other chemicals	20	28–30	3513, 352
16. Chemical fertilizers	21	27	3512
17. Petroleum and coal products	22–23	31–32	353, 354
18. Nonmetallic mineral products	24	34	36
19. Pig iron and raw steel	25	35	37101, 37102
20. Primary iron and steel products	26	36	37103–37109
21. Nonferrous metal products	27	37	372
22. Fabricated metal products	28	38	381
23. General machinery	29	39	382
24. Electrical machinery	30	40–41	383
25. Transport equipment	31	42	384
26. Miscellaneous manufactures	32	43–44	385, 39

Note: The first column refers to the 1966 *I-O* classification, the second to the 1978 *I-O* classification, and the third to the 1978 *MMC* classification.

estimation of rates of depreciation, or more probably due to understatement of levels of investment in the census. In Table II we present the sectoral total capital coefficients for the Republic of Korea reported in other sources; in the last column are the total coefficients finally computed in this paper.

Below we construct a net-to-gross conversion factor which is applied to book values of 1978 capital stocks which still employs the understated investment series but avoids the aforementioned problem. As will become apparent, we now rely not on the absolute values of investments but on their relative values. In other words, we treat the investment series as indices. The same investment series, for each asset in each sector, occurs as both numerator and denominator in calculating the conversion factor so that the only constraint is that the errors of the figures be consistent. We compute a net-to-gross conversion factor (F) for each asset in each sector and apply this factor to recorded book values (K_b) to arrive at replacement costs (K_r). We ignore stocks of unimproved land, and $K_r = K_b \times F$. This is the method of Kahn and MacEwan [19]. The modification

TABLE II

TOTAL CAPITAL-OUTPUT COEFFICIENTS FOR THE REPUBLIC OF KOREA

	(1) Adelman 1965	(2) Song 1970	(3) Han 1968	(4) Hamilton 1978
1. Coal	1.057	2.069	0.525	0.962
2. Other mining	0.361	1.550	0.467	0.815
3. Processed food	0.285	0.362	0.258	0.379
4. Beverages and tobacco	0.230	0.270	0.192	0.233
5. Fiber spinning	1.000	1.282	0.751	0.934
6. Textile fabrics	0.364	0.726	0.518	0.656
7. Finished textile products	0.164	0.357	0.255	0.337
8. Lumber and plywood	0.155	0.295	0.211	0.454
9. Wood products and furniture	0.360	0.397	0.283	0.598
10. Pulp and paper	0.389	1.192	0.709	0.464
11. Printing and publishing	0.217	0.593	0.423	0.676
12. Leather products	0.075	0.403	0.287	0.211
13. Rubber products	0.160	0.921	0.629	0.359
14. Basic chemicals	0.922	1.564	1.055	0.926
15. Other chemicals	0.378	0.855	0.234	0.385
16. Chemical fertilizers	1.430	1.816	0.987	1.470
17. Petroleum and coal products	0.406	1.150	0.507	1.150
18. Nonmetallic mineral products	0.908	1.196	0.873	0.811
19. Iron and steel	0.863	1.278	0.672	1.278
20. Steel products	0.446	1.151	0.554	0.932
21. Nonferrous metal products	0.850	1.354	0.756	0.619
22. Fabricated metal products	0.279	0.782	0.535	0.473
23. General machinery	0.507	0.804	0.567	0.614
24. Electrical machinery	0.209	0.338	0.229	0.274
25. Transport equipment	0.335	0.791	0.409	0.475
26. Miscellaneous manufactures	0.204	0.368	0.390	0.367

Sources: (1)=Adelman [1, p. 120]; (2)=Kim Yoon Hyung [21, pp. 88–99]; (3)=Han Kee Chun [15, Table 7.2, pp. 337–43].

introduced here is in the calculation of investment indices for machinery and buildings.

The conversion factor for asset i in sector j is given by

$$F_{ij}{}^{T}=\sum_{t=T-L-1}^{T-1} I_{ij}{}^{t}P_{i}{}^{t}r_{ij}{}^{t}\Big/\sum_{t=T-L}^{T-1} I_{ij}{}^{t}d_{ij}{}^{t}\,,$$

where

$F_{ij}{}^{T}$ = net-to-gross conversion factor for asset i in industry j at the end of year T (T is 1978),

$I_{ij}{}^{t}$ = investment in asset i by industry j in year t,

$P_{ij}{}^{t}$ = price index of asset i in year t,

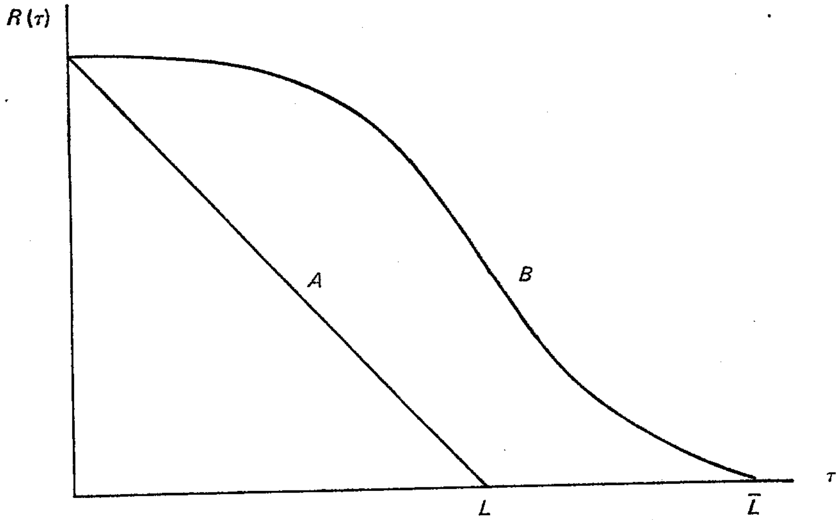
$r_{ij}{}^{t}$ = survival factor indicating proportion of capital good i in industry j installed in year t which is still in service in year T,

$d_{ij}{}^{t}$ = financial depreciation of asset i in industry j installed in year t,

L_{ij} = average life span of asset i in industry j,

$\bar{L}_{ij}$ = vintage of the oldest piece of asset i in industry j.

Fig. 1.



Note that the investment series I_{ij} may be actual investments or simply an index of investments. The capital-output coefficients are calculated from

$$k_{ij}{}^T = K_{ij}{}^T / Y_j{}^T u_j ,$$

where

$k_{ij}{}^T$ = the capital coefficient for the ith capital good in industry j at the beginning of year T,

$K_{ij}{}^T$ = replacement cost of the ith capital in industry j,

$Y_j{}^T$ = gross output of industry j in year T,

u_j = reciprocal of the level of capacity utilization in industry j.

We next describe the sources and application of the data.

Survival factors. The survival factor r is the percentage of the relevant capital good installed in year t still in service in year T and its particular form is taken from Evans [13, p. 167]. It is derived from a survival function $R(\tau)$ in which τ is the number of years since the capital good was installed and which for discrete time has the form

$$R(\tau) = 1 - \frac{1}{\sqrt{2\pi L}} \sum_{t=0}^{\tau-1} \exp\{-(t-L)^2/2L\}.$$

This function is based on a probability distribution around the average life L, as in Figure 1.

The cutoff point $\bar{L}$ is taken to be two standard deviations $(2\sqrt{L})$ from the average life L. A survival function with this shape reflects the fact that new assets do not, as a rule, deteriorate as rapidly as old assets.

Depreciation rates. The financial depreciation function $d_{ij}{}^t$ is assumed to be a straight line (curve B in Figure 1) for want of accurate data on financial depreciation rates in Korea. Curve B can be written $R(\tau) = 1 - \tau/L$. The complexity and obscurity of depreciation rules in Korea have led to the assumption that depreciation is of straight-line form. This assumption is also applied in the International Management Institute study cited below, and is made in the model of the Korean economy built by Adelman and Robinson [2, p. 207]. To make some allowance for the favorable provisions of the tax laws we have assumed that the depreciable life of buildings and structures is twenty-five years while that of the other assets remains equal to assumed life spans (see below).

Capacity utilization. We assume that for the year 1978 there is full capacity utilization in all sectors. According to official figures, manufacturing industry operated above capacity in 1978 at a level of 111.1 taking the 1976 capacity level as 100. This was the highest level in the 1974–80 period [4, 1981, Table 100]. This was the case in nearly all industry groups. See also the industrial production indices which reveal that all indicators were rising in 1978 to their peak in 1979.

Life spans. The estimated life span for each asset is assumed to apply equally in all sectors. They are taken from International Management Institute [18, p. A-5–159].

Asset	Average Serviceable Life (Years)
Buildings and structures	50
Machinery and equipment	10
Vehicles and delivery equipment	5

These correspond closely to the average service lives of buildings, machinery, and vehicles for Japan reported in OECD [24, Tables 2–5].

Investment series. The basic source here is the collection of mining and manufacturing censuses and surveys for the years 1968–78 (census years were 1968, 1973, and 1978). Investment by sector is only available from 1968 so that it was necessary to attempt to estimate the replacement cost of the stock of each asset in each sector which existed in 1968 and which still survived in 1978. Clearly this is unnecessary in the case of vehicles in which category the oldest surviving asset in 1978 was bought in 1968 ($L+2\sqrt{L}=9.5$).

It is here that the technique described below is particularly suited to newly industrializing countries in which the gathering of industrial statistics does not go back very far. One method would be to construct an estimate of the investment series for each sector prior to 1968. This was the preferred method in the case of machinery and equipment where the pre-1968 tail of the investment series accounts for a very small proportion of the 1978 stocks as a consequence of the rapidity of deterioration of machines after ten years (the average life span). It was decided to apply a common tail to each sector, one derived from figures for aggregate investment in machinery and equipment—the "machinery and equipment" component of gross domestic capital formation from *KSY* [22, 1967 and 1979] and *ESY* [4, 1967].

How much error is likely to be introduced into the calculation of machinery stocks as a result of choosing a particular year (here 1968) to splice the industry-specific body with the common tail? In the following example the errors are

TABLE III

INVESTMENT AND PRICE INDICES FOR MACHINERY

	J	P	r
1977		1.040	1.00
1976		1.085	0.99
1975		1.163	0.98
1974		1.400	0.96
1973		1.669	0.93
1972		1.713	0.87
1971		1.897	0.79
1970		2.009	0.69
1969		2.294	0.57
1968	(100.0)	2.349	0.44
1967	65.0	2.637	0.32
1966	59.7	2.879	0.22
1965	23.4	3.371	0.14
1964	17.3	3.890	0.09
1963	14.9	4.866	0.05
1962	10.8	5.311	0.04
1961	7.3	5.384	0.03
1960	5.5	5.538	0.02

exaggerated to indicate the maximum likely deviation. Suppose that the common tail underestimates actual pre-1968 investment in industry *j* because of (i) the deviation of the actual pre-1968 investment profile from the hypothesized profile, and (ii) the choice of splicing year, which has an uncharacteristically low value. Assume that the real level of undeteriorated (accumulated) investment is an evenly-distributed 100 both before 1968 and since 1968. Because of the shape of the survival function, after deterioration the pre-1968 part of total investment will stand at only one-ninth of the level of post-1968 investments. If the actual undeteriorated tail in fact represents one-third rather than one-half of total undeteriorated investments (representing perhaps an upper limit for Korean development) then only $1/2 \times 1/9 = 1/18 = 5.5$ per cent of the error will be carried through to final deteriorated stocks.

The common tail appears in Table III along with the price index and deterioration function for machinery and equipment. We now have for each sector an index of investment in machinery and equipment for 1960–77 and can apply the formula for the conversion factor.

In the case of buildings and structures, use of the method described above would not give results of acceptable accuracy because of the importance of the pre-1968 tail for this asset. The assumption of a uniform or common pre-1968 investment index would be spurious because of (i) the fact of bunching in investments in construction, and (ii) the related inaccuracy due to the choice of 1968 (or any particular year) as the date for splicing the common with the sector-specific indices.

Instead, we use a method which adds investments in the 1969–77 period to the *stock* of buildings in 1968 in each sector. These sectoral stocks are given as book values in the 1968 *Mining and Manufacturing Census* (but see later). The apparent problem raised here is the variable age distribution of 1968 stocks of buildings since this will influence the proportion of 1968 stocks that survives into 1978.

However, this difficulty is avoided by reference to the fact that nearly all of the buildings existing in 1968 were built subsequent to 1953—87 per cent of real value in fact, and 67 per cent subsequent to 1962 (see Table IV). Observe that, using our survival function, assets with an average life span of fifty years do not deteriorate at all for the first twenty-five years. As a result, the stocks of buildings in 1968 do not deteriorate significantly in the years to 1978, and we assume that they do not deteriorate at all. We can thus treat the stock of 1968 buildings as if it were a block of *investments* in that year.

Note that the above method for buildings could not be used for machinery and equipment because the shorter life span of machines requires that we know the age-distribution of 1968 stocks. Different age-distributions would leave different proportions of 1968 stocks intact in 1978, whereas we have argued that in the case of buildings the age-distribution is given by the newness of building investment. The key assumptions of this method, therefore, are (1) that we can estimate the replacement cost of building stocks in 1968, and (2) that industrial development has been so recent that the great bulk of buildings existing in 1978 are less than twenty-five years old.

How do we estimate the replacement value of 1968 stocks of buildings? There are two possibilities: (1) Adjust the sectoral book-values of stocks given in the 1968 *MMC* by applying a crude net-to-gross conversion factor. This would of necessity be an economy-wide conversion factor using aggregate data on investments and prices. These indices appear in Table IV. The computed conversion factor would be applied to each sectoral book value to get replacement value. (2) Apply actual capital-output coefficients for buildings in 1968 from another source. Coefficients for 1970 have been prepared by Kim Yoon Hyung [21, pp. 88–99] and these are based on the coefficients derived by Song Byung-Nak [25]. We assume that the 1970 coefficient values do not deviate markedly from 1968 values. The second method has been used here.

We now have sectoral investment series for 1968–77 and, applying the price series, deterioration and depreciation functions, we can calculate our conversion factors for buildings and structures. Our final conversion factor is given by

$$\overset{1978}{F} = \sum_{1968}^{1977} I^t P^t \Big/ \sum_{1968}^{1977} I^t d^t ,$$

remembering that $r^t = 1$ for all relevant years. Although we have chosen the second method for calculating investments in 1968, as a matter of interest the calculation of 1968 investment from book values of stocks in 1968 would use the formula:

$$\overset{1968}{I} = \overset{1968}{K_B} \times \overset{1968}{F} ,$$

$$= \overset{1968}{K_B} \times \left(\sum_{1913}^{1967} J^t P^t r^t \Big/ \sum_{1913}^{1967} J^t d^t \right) ,$$

TABLE IV

INDICES OF BUILDING INVESTMENT AND PRICES, 1913–68

	Index of Investment (Cur. Price) (*J*)	Price Index (*P*)	Survival Factor (*r*)
1968	414,363	1,000,000,000	1.00
	268,215	885,841,000	1.00
	209,185	871,224,000	1.00
1965	148,706	803,027,000	1.00
	79,365	666,134,000	1.00
	78,767	560,388,000	1.00
	57,853	551,123,000	1.00
	39,225	548,341,000	1.00
1960	28,723	505,588,000	1.00
	30,126	475,710,000	1.00
	25,554	499,846,000	1.00
	25,328	499,267,000	1.00
	15,821	431,066,000	1.00
1955	14,146	379,760,000	1.00
	5,908	270,495,000	1.00
	3,712	140,205,000	1.00
	2,341	83,923,000	1.00
	930	48,448,000	1.00
1950	125	9,809,000	1.00
	133	7,393,053	1.00
	69.1	4,374,296	1.00
	32.2	2,757,796	1.00
	16.4	1,185,595	1.00
1945	8.80	42,728	1.00
	4.49	2,972	1.00
	3.83	2,714	1.00
	3.13	1,724	1.00
	2.30	1,643	1.00

	Index of Investment (Cur. Price) (*J*)	Price Index (*P*)	Survival Factor (*r*)
1940	1.54	1,393	1.00
	1.23	1,305	0.99
	0.939	1,113	0.99
	0.788	931	0.99
	0.601	799	0.99
1935	0.500	752	0.99
	0.340	682	0.99
	0.326	672	0.99
	0.256	605	0.98
	0.208	610	0.97
1930	0.231	758	0.96
	0.269	869	0.95
	0.262	900	0.93
	0.249	918	0.91
	0.247	981	0.89
1925	0.221	1,082	0.86
	0.206	1,020	0.82
	0.192	947	0.78
	0.183	960	0.74
	0.162	965	0.69
1920	0.192	1,284	0.64
	0.188	1,238	0.59
	0.118	988	0.53
	0.070	724	0.47
	0.049	521	0.41
1915	0.045	446	0.36
	0.024	475	0.31
1913	0.023	503	0.26

Sources: The current price index of investment in buildings and structures, *J*, is made up of proxies from various sources: The 1913–40 period is measured by "gross output of manufacturing industry" and is from Hong [16, Table B.1]. The difficult war years have been represented as follows: 1941–42, "employment in manufacturing industry"×"wage index" from Hong [16, Table B.12] and Chosen-unhaeng [12, Table 6]; 1943–45, "total loans by banks, etc." from [12, Table 6]. The period 1946–53 is represented by an index of production of major commodities×wholesale price index for the relevant years taken from, respectively, Kim and Roemer [20] and *PSS* [9, 1970, p. 162]. The years 1954–68 are represented by the "non-residential buildings" and "other construction and works" components of gross domestic capital formation from *KSY* [22, 1967 and 1979]. The price index, *P*, is from Han [15, Appendix B], "glass, clay, and stone products."

TABLE V

PRICE INDICES OF CAPITAL GOODS, 1968–78

	Buildings & Structures	Machinery & Equipment	Vehicles & Ships
1978	1.000	1.000	1.000
1977	1.067	1.040	1.026
1976	1.172	1.085	1.067
1975	1.248	1.163	1.126
1974	1.498	1.400	1.367
1973	2.087	1.669	1.586
1972	2.355	1.713	1.584
1971	2.563	1.897	1.849
1970	2.600	2.009	1.986
1969	2.993	2.294	1.986
1968	3.136	2.349	1.986

where $\overset{1968}{K_B}$ is the book value of stocks in 1968 and J^t is an index of total investments in buildings over the period. In fact $\overset{1968}{F} = 1.7503$.

Price indices. For each type of asset, price indices are taken from *KSY* [22, 1967 and 1979], and *PSS* [9, 1977 and 1970]. In the case of buildings and structures, the pre-1968 price index appears, with sources, in Table IV. Price indices for the 1968–78 period appear in Table V.

The net-to-gross conversion factors for the three types of asset in the mining and manufacturing sectors appear in Table VI.

Capital stocks and their valuation. Book values of capital stocks by industry for the three asset groups "buildings and structures," "machinery and equipment," and "vehicles and ships" are from the 1978 *MMC*. These are recorded in purchasers' prices so it was necessary to convert to producers' prices to conform to the valuation of outputs in the input-output tables from which we take values of sectoral outputs. (The *I-O* tables do not give alternative values of outputs in purchasers' prices.) In the I-O tables over several years, the proportion of private fixed capital formation due to "wholesale and retail trade" and "transportation and storage" has hovered around a fairly stable 6 per cent. We assume that the trade and transport margins for building and construction are negligible so that the whole of these costs are applied to machinery. Applying the weight of machinery in total capital stock (0.6609) to this 6 per cent we get factors for converting our capital stocks of buildings and machinery from purchasers' prices to producers' prices of, respectively, 1.0 and 0.9092.

Reclassification of assets. Once we have the conversion factors for each of the three assets in each of the manufacturing industries we can calculate the replacement value of capital stocks and thus the capital-output coefficients. However, our crude data do not divide stocks of machinery between nonelectrical and electrical machinery, and, more importantly, do not distinguish imported machinery (including transport equipment) from the domestically produced article. This is of the utmost importance in the case of Korea. As far as I am aware there are no figures which indicate or approximate the value of machinery imports by destination for 1978 or thereabouts.

TABLE VI
NET-TO-GROSS CONVERSION FACTORS

	Buildings & Structures	Machinery & Equipment	Vehicles & Ships
1. Coal	2.7353	1.9414	2.2358
2. Other mining	3.2757	1.9299	2.0857
3. Processed food	2.5080	1.8608	2.2533
4. Beverages and tobacco	2.3586	1.9370	2.1470
5. Fiber spinning	2.2380	1.8626	2.5568
6. Textile fabrics	2.1937	1.8524	1.9727
7. Finished textile products	2.3478	1.9576	2.0924
8. Lumber and plywood	2.4997	2.7899	2.0855
9. Wood products and furniture	3.3212	1.8501	1.7940
10. Pulp and paper	2.7153	1.8249	2.0455
11. Printing and publishing	2.4252	2.0235	2.3909
12. Leather products	1.8800	1.5108	1.7389
13. Rubber products	2.2257	1.8163	1.7078
14. Basic chemicals	2.1832	1.8102	1.8921
15. Other chemicals	1.9303	1.8142	1.9947
16. Chemical fertilizers	2.1727	2.7299	1.9924
17. Petroleum and coal products	3.1835	2.2896	1.9845
18. Nonmetallic mineral products	2.3961	1.8761	1.7505
19. Iron and steel	2.1142	1.5516	1.8861
20. Steel products	2.0522	1.6956	2.2021
21. Nonferrous metal products	2.5263	1.9939	2.1569
22. Fabricated metal products	2.0718	1.6699	1.8820
23. General machinery	1.7280	1.3724	1.7351
24. Electrical machinery	1.5768	1.5918	2.1502
25. Transport equipment	2.1815	1.5437	2.0302
26. Miscellaneous manufactures	2.2304	1.6032	1.6962

As a rough approximation, we distribute the sum of stocks of machinery and equipment and vehicles in each industry between the domestic categories (nonelectrical machinery, electrical machinery, and transport equipment) and imported machinery (imports undifferentiated) in the same proportions as those which were applied in Adelman's 1965 coefficient matrix [1, Table 1, p. 120]. We could make some adjustment to these proportions, however, on the basis of the trade figures which indicate the composition of imports by sectoral origin. Table VII shows the proportions of total investments in machinery and transport equipment which have been imported, for the period 1955–80. Clearly there has been a substantial increase in import content of machinery stocks. We can estimate the extent of this increase by taking a weighted average of import coefficients over the eighteen years prior to 1978, eighteen being the age of the oldest vintage of machinery still in use in the base year with our chosen survival assumption for machinery. The weights are the survival factors. Data were not available prior to 1955 so we had to be content with the eleven years prior to 1966. This would not have an appreciable effect on the results. The averages are for 1978 0.787 and for 1966 0.445.

TABLE VII
IMPORT CONTENT OF MACHINERY INVESTMENT

	Investments in Machinery (Billion Won)	Proportion Imported
1955	3.40	0.482
1956	6.01	0.356
1957	6.94	0.306
1958	6.72	0.273
1959	7.00	0.299
1960	8.51	0.306
1961	12.03	0.458
1962	17.25	0.526
1963	26.33	0.571
1964	27.96	0.637
1965	39.61	0.503
1966	95.56	0.489
1967	126.37	0.670
1968	180.75	0.817
1969	222.16	0.813
1970	233.53	0.799
1971	308.48	0.827
1972	374.38	0.812
1973	560.93	0.820
1974	890.78	1.004
1975	1,381.89	0.669
1976	1,411.83	0.818
1977	1,908.37	0.737
1978	3,081.98	0.777
1979	3,948.07	0.751
1980	3,783.87	0.878

Sources: Total investment in machinery is the sum of the "machinery and other equipment" and "transport equipment" components of gross domestic capital formation from *ESY* [4, 1981, Table 153] and *NIK* [8, Table 6]. Imports of "machinery and transport equipment" from *ESY* [4, 1981, Tables 124 and 130] [4, 1970, Tables 142 and 147] [4, 1967, Tables 149 and 156] [4, 1960, Table 117].

In fact, on the basis of Adelman's coefficients and 1966 outputs the total stock of imported machinery forms 0.737 of the total stocks of machinery in 1966—very close to the 1978 figure calculated from the trade figures. Hong [16, Table 7.3, p. 154] suggests on the basis of I-O tables for the years 1960–73 that the import content of inputs of machinery was, apart from 1960, around 70 per cent. The high figure in Adelman is due to two facts: (1) her coefficients refer to manufacturing industry only in which imported machinery has played a proportionately greater role, and (2) Adelman's method of compiling the figures emphasized the most modern factories which were more import-dependent. In the end, then, we made no adjustment to Adelman's 1965 distribution between imported and domestically-produced machines in our calculations for 1978.

TABLE VIII

CAPITAL-OUTPUT COEFFICIENTS: KOREA, 1978

Sector	1	2[a]	3[a]	4	5	6	7[a]	8	9	10	11[a]	12[a]
General machinery (23)	0.0167	0.2562	0.1234	0.0368	0.0129	0.0884	0.0512	0.0258	0.0060	0.0133	0.0425	0.0004
Elect. machinery (24)	0.0773	0.0369	0.0190	0.0153	0.0020	0.0051	0.0112	0.0123	0.0102	0.0190	0.0042	0.0380
Transp. equip. (25)	0.0463	0.0854	0.0029	0.0078	0.0034	0.0047	0.0022	0.0252	0.0102	0.0052	0	0.0051
Building	0.6695	0.3349	0.1886	0.1063	0.2552	0.2286	0.1531	0.1386	0.2989	0.1760	0.2552	0.1147
Imports	0.1526	0.1012	0.0449	0.0665	0.6600	0.3290	0.1195	0.2516	0.2724	0.2507	0.3742	0.0531
Totals	0.9624	0.8146	0.3788	0.2327	0.9335	0.6558	0.3372	0.4535	0.5977	0.4642	0.6761	0.2113

Sector	13	14[a]	15[a]	16[a]	17[b]	18	19[b]	20	21	22	23	24	25[a]	26[a]
General machinery (23)	0.0358	0.0663	0.0338	0.0065	0.0049	0.0573	0.0517	0.1679	0.0318	0.0746	0.1084	0.0240	0.0334	0.0192
Elect. machinery (24)	0.0165	0.0280	0.0223	0.0013	0	0.0365	0.2444	0.0149	0.1337	0.0153	0.0100	0.0187	0.0087	0.0375
Transp. equip. (25)	0.0041	0.0103	0.0041	0.0366	0.0805	0.0035	0.0357	0.0056	0.0029	0.0012	0.0052	0.0014	0.0123	0.0061
Building	0.1016	0.2420	0.1419	0.1628	0.4502	0.3044	0.3380	0.2320	0.2121	0.1717	0.2698	0.0973	0.1940	0.1823
Imports	0.2010	0.5792	0.1829	1.2628	0.6145	0.4094	0.6082	0.5113	0.2388	0.2097	0.2210	0.1321	0.2261	0.1218
Totals	0.3590	0.9258	0.3850	1.4700	1.1501	0.8111	1.2780	0.9317	0.6193	0.4725	0.6144	0.2735	0.4745	0.3669

[a] Where there are large differences in sectoral gross outputs between the *I-O* tables and the *MMC*, due to differences in classification and the base for compiling figures (the census excludes some establishments), the census has been taken as the divisor for calculating coefficients. This ensures that capital stock and gross output figures refer to the same set of establishments.

[b] In the cases of these two industries there are irreconcilable differences in classification between the *I-O* tables and the *MMC*. Instead we have used the coefficients in Song, the totals of which appear in Table II.

Summary. In summary, the procedure for calculating 1978 capital coefficients is as follows:
1. find net-to-gross conversion factors for each asset in each industry using investment and price series, financial depreciation, and deterioration functions;
2. calculate capital stocks by applying conversion factors to book values;
3. convert capital stocks into producers' prices;
4. reallocate capital stocks to imported capital goods and domestic capital goods (nonelectrical and electrical machinery, and transport equipment);
5. calculate capital coefficients using total outputs; and
6. validate the results against the investment figures in the base years.

The final capital-output coefficients appear in Table VIII and for convenient comparison the totals for each sector appear in Table II.[1]

[1] It may be of some interest to compare the sectoral capital-output ratios of different countries, although such an exercise is vitiated by the inadequacy of the figures. Nevertheless, in Appendix Table A we present some capital-output coefficients by sector for five countries including those for Korea calculated here.

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APPENDIX TABLE A

CAPITAL-OUTPUT COEFFICIENTS FOR SOME OTHER COUNTRIES

	Korea (1978)	Australia (1971/72)	U.S.A. (1958)	Brazil (1959)	Pakistan (1962/63)
1. Coal	0.962	1.278[a]	0.690	1.44	—
2. Other mining	0.815	1.107[b]			—
3. Processed food	0.379	0.197	0.294[c]	0.61	—
4. Bevs. & tobacco	0.233	0.394	0.132[d]	0.61	—
5. Fiber spinning	0.934	0.327	0.394	0.76	—
6. Textile fabrics	0.656	0.215			—
7. Fin. text. prod.	0.337	0.174	0.142	0.54	—
8. Lumber & plywood	0.454	0.303	0.409	0.80	0.455
9. Wood prod./furn.	0.598	0.171			
10. Pulp & paper	0.464	0.555	0.707	0.99	0.665
11. Print. & publ.	0.676	0.330	0.496	0.79	
12. Leather prod.	0.211	0.152	0.167	0.70	0.273
13. Rubber prod.	0.359	0.392	0.447	1.19	0.850
14. Basic chemicals	0.926	0.877	0.718		0.802
15. Other chemicals	0.385	0.269	—	0.78	
16. Chem. fertilizer	1.470	0.787	—		5.878
17. Pet. & coal prod.	1.150	0.397	0.664[e]		1.217
18. Nonmet. min. prod.	0.811	0.547	0.844	0.83	1.810
19. Iron & steel	1.278	0.574	1.011		
20. Steel prod.	0.932	0.284	—	0.91	0.538
21. Nonferr. metal prod.	0.619	0.724	0.438		
22. Fab. metal prod.	0.473	0.407	0.416[f]		0.465
23. General machinery	0.614	0.304	—	0.80	0.838
24. Elect. machinery	0.274	0.253	0.274	0.77	
25. Transp. equip.	0.475	0.295	0.233[g]	1.01	1.861
26. Misc. manuf.	0.367	—	—	—	—

Sources: Australia: Hourigan [17, Table 4.1]; Brooks and Lawson [10, Appendix 1]. U.S.A.: Carter [11, Tables C6 and D2]. Brazil: Taylor et al. [26, Tables 8.1 and 8.6]. Pakistan: Kahn and MacEwan [19, Table II-B] (these figures are for West Pakistan and refer to large-scale manufacturing only).

Notes: 1. The coefficients for Korea and the U.S.A. are adjusted for the level of capacity utilization; the others are not.

2. It should be observed that since highly disaggregated sectoral breakdowns for all countries are not available, and since different systems of sectoral classification have been employed, the sectors correspond only roughly across countries. Even if the classification schemes were precisely the same in each country, comparison of capital-output ratios would still not be a good indication of relative "capital intensities" because of the different compositions of outputs of the various products produced within each sector. In addition to these problems of aggregation, there is the further problem of differing techniques of calculation. For instance, some methods make allowance for excess capacity while others do not. For a review of the techniques see Ward [27].

[a] Includes petroleum extraction.
[b] Excludes petroleum extraction.
[c] Includes beverages.
[d] Tobacco only.
[e] Petroleum refining only.
[f] Includes primary iron and steel products.
[g] Motor vehicles only.