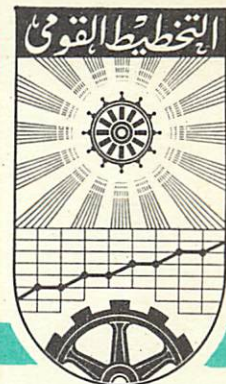


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SOME REMARKS ON CAPITAL-OUTPUT RATIO

By

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Contents

	<u>Page</u>
Introduction	1
I . The concept of capital-output ratio	1
II . The role of capital-output ratio in economic planning.	2
III. International Comparisons of Capital-output ratio ..	3
IV . Limitations of capital-output ratio	6
IIV. Conclusion and Comments	8
Table 1, Comparison of incremental and average over- all Capital Coefficients	10
Table 2, Percentage change in wholesale prices ..	11
Table 3, The relationship between capital and real income for 1913	12
Table 4, Equipment-output relationships, United States, Australia, New Zealand, Canada, Mexico, South Africa and Peru	13
Table 5, Capital-income ratio for 28 countries ..	15
Table 6, Net capital coefficients of the industrial sector	16
Table 7, Over-all net capital coefficients, the United Kingdom and the United States, 1879-1938	17
Table 8, Annual depreciation rates allowed on the ori- ginal cost of plant and equipment , U.S.A. and India..	18

Some Remarks on Capital-Output Ratio

by

Ramzy Zaki

Introduction:

Our object in this paper is to study the capital output ratio, its definition and its importance in economic planning and to examine some of the arguments connected with the international comparisons of the capital-output ratio, especially between underdeveloped and developed countries. Thus the plan of this paper will be as follows:

- I. The concept of capital-output ratio,
- II. The role of capital-output ratio in economic planning,
- III. Comparative study,
- IV. Limitations of capital-output ratio,
- IIV. Conclusions and Comments.

I. The Concept of Capital-output Ratio

The capital-output ratio suffers from a certain amount of vagueness and ambiguity especially on account of the various meanings attached to it by different economists.

Capital-output ratio, as E.D. Domar indicates, is the ratio between capital stock and the output produced by it. This concept may be used with reference to the whole economy, a particular sector, industry or process, and may be accordingly termed as:

1. Over-all capital-output ratio
2. Sector capital-output ratio
3. industry capital-output ratio, or
4. process capital-output ratio.

Another distinction can be made between "gross capital-output ratio" and "net capital-output ratio". The former refers to the relationship between the capital (generally the fixed capital, i.e. land, buildings, machinery, plant) and the gross value of output; the latter refers to the capital and net output which is arrived at by deducting intermediary goods used in the process of production and depreciation from the value of output.

The capital output ratios can be looked at from another angle, viz, whether they describe the existing structure or the changing structure, i. e., whether they are average or marginal. Usually the marginal capital output ratio is higher than the average. (See Table No. 1.).

Determinants of Capital output Ratio:

I. Technological factors:

1. The relationship between capital and labor.
2. Productivity.

II. Nontechnological factors:

1. The depreciation rates allowed on the original cost of plants and equipment.
2. The variation through years of the prices of output and of plant and equipment.
3. The rate of utilization of plant and equipment.

II. The role of Capital output ratio in economic planning:

The capital output ratio is useful and natural concept for the purposes of national economic planning. The use to be made of the capital-output ratio, in economic planning, in its incremental form, can be one of *rough estimation of* the capital needed for a country's development, for a given or desired

rate of growth in national income; the necessary rate of saving can be calculated by multiplication with capital-output ratio. For example, suppose that the target of a plan is to realize 2% increase in the national income P.a. and the capital/output ratio equal to 3. Thus the rate of saving or investment needed for achieving this target should be equal to 6. This relationship between the rate of investment and capital/output ratio is often regarded as the determinant of the rate of economic development ($Y = \frac{S}{K}$). On other words, the rate of economic development, as the Working Party of Problems and Techniques of Planning of the ECAFE indicates, may be analytically considered as being a function of two factors: (a) the rate of capital formation and (b) the capital/output ratio. Accordingly, the development policies may be described as aiming to increase the former and reduce the latter, or do both.

For the purposes of the estimates of capital requirements we are concerned with the incremental rather than the average capital-output ratio.

III. International Comparisons of Capital/output Ratios:

As regards the international comparisons of capital-output ratio, mention should be made of the pioneer works by C. Clark, Leontief, C.M. Palavia and S. A. Abbas.

Clark's data given in (table No. 3) show us the relationships between capital and real income for 14 countries for 1913.

Leontief's associate, Robert N. Grosse, showed (table No. 4) the net capital -output ratio (depreciated value of equipment to the value of output) for the United States, Australia, Canada, New Zealand, South Africa, Mexico and Peru. The first five countries will come in the category of the developed countries, the last two are underdeveloped countries in his sense.

Palvia's data gave (table No. 5) the capital-income ratio for 28 countries. He studied the capital-income ratio of the non-agricultural activities and of the whole economy in these countries.

Dr. S. A. Abbas studied the net capital-output ratio of the industrial sector for Australia, Canada, South Africa and New Zealand. He also studied the long-term trends in over-all capital-output ratio of the United States and The United Kingdom during the periods 1879-1938. (Tables 6,7).

What conclusions can be drawn from the above studies with regards to:

- a) The long-term trends in over-all capital-output ratio.
- b) Industrial sector capital-output ratio.
- c) A comparisons of the capital/output ratios of certain industries in the developed and underdeveloped countries.

A) Long-term trends in over-all capital-output ratio:

The over-all capital output ratios of the different countries differ according to the types of activities predominating in their economies. As regards the behaviour of over-all capital-output ratio over long periods, the results of the data given by Dr. Abbas proved that the over-all capital-output ratio is stable over time.

The over-all capital-output ratios of the British economy during 1879-1938 exhibit a high degree of stability, the average capital-output ratio being 2.174. There are only minor deviations from the average, from 1889 to 1924 there was a slight upward movement and from 1932 to 1938 a slight downward movement; on the whole the actual values of the capital output ratios have fluctuated within very narrow limits. In the United States, during 1874-1938 the capital-output ratio was 3.626. The data of the United States also exhibit a fairly stable relationship between

capital and output; wide deviation from the average is observable only during the period 1931-1935. This, however, represents the excess capacity created during the depression period. From 1894-1930, the capital output-ratios remained closely in the neighbourhood of the average and its tendency seems to reappear after 1936.

The other conclusion which has ~~an~~ important bearing in our study consists of the fact that the capital coefficients in railroads affect the over-all capital output ratio. How far the capital coefficient in railroads affects over-all capital-output ratio depends on the share of railroad capital in the total capital.

It is, however, clear that any country which embarks on development has to face the situation of the high capital output ratios in the power and transport sectors.

b) Industrial sector capital-output ratio:

The capital-output ratios of the industrial sector differ from country to country. These coefficients should be influenced by the type of the predominating industries. In a country where the bulk of the industries are capital intensive the sector capital coefficients will obviously be higher than in a country where the bulk of the industries are less capital intensive.

c) A comparison of the capital-output ratios of certain industries in the developed and underdeveloped countries:

An underdeveloped economy is characterised by a large quantity of labour relative to the capital stock and low propensity to save of a given income, while a developed economy has a large capital stock relative to the available labour force and a high propensity to save out of a given income.

Under these conditions, our theoretical expectation would be that in an underdeveloped economy all industries would be using methods of production which are more labour intensive than the methods adopted by the corresponding industries in a developed economy. In other words, the capital coefficient of each industry in an underdeveloped economy will be smaller than the capital coefficient of the corresponding industry in a developed economy.

This theoretical expectation can be tested by comparing the actual empirical capital-output ratios of some industries in an underdeveloped economies with the same ratios of the corresponding industries in a developed economies. This comparison can be taken from the table provided by Leontief's work relating to the industry capital coefficients in different countries.

The following conclusions can be drawn from Table No. 4

1. The capital output ratios of certain industries in underdeveloped countries are higher than the capital output ratios of the corresponding industries in a developed countries.
2. The capital output ratios of certain industries in underdeveloped countries are lower than the capital output ratios of the corresponding industries in a developed countries.
3. The capital output ratio of certain industries are the same in both underdeveloped and developed countries.
4. There are great differences between the capital-output ratios relating to different industries in the developed countries.

IV. Limitations of Capital output ratio:

The capital-output ratio, as Professor C. Kindleberger indicates, is of less value for use in prediction and planning because there are great difficulties that face us when measuring it. The difficulties relate to the following factors: (a) Utilization (b) price changes and (c) rate of depreciation.

(a) Utilization:

The capital coefficient measures the capital used or utilized (K_u) per unit of output. The data generally available for making such estimates relate to the capital existing at a particular time periods. If the capital were to be at its full capacity ($K_e = K_u$), it would make no difference whether we use data relating to (K_e) or to (K_u), but it is rather well-known that industries seldom operate at full capacity. In order to get the real capital coefficient we should collect data on the degree of utilization. But such data are not available for many countries.

(b) Price changes:

To measure the real capital-output ratio we should eliminate the influence of price fluctuations of output and capital. But the problem of estimating such fluctuations is more difficult. This is due to the lack of relevant statistics.

(c) Depreciation allowances:

Depreciation allowances differ from industry to industry, from country to country (See table No. 8) and from time to time. Moreover, there is no fixed scientific basis for calculating depreciation for a given capital asset.

"The capital-output ratio, however, is analytically useful in calling attention to the importance of capital in economic growth and handy for many rough computations. But in its present rudimentary stage it is hardly a planning device. "Kindleberger"

Conclusions and Comments:

[IV- Conclusions and Comments:

We can summarize our conclusions and comments as follows:

1. In spite of the constant and growing references to the capital-output ratio in current economic analysis, it still suffers from a certain amount of vagueness on account of the different meaning, attached to it by different economists.
2. The capital output ratio differ from industry to industry, from sector to sector and from country to country.
3. The capital-output ratio, in its marginal form, can be used as a rough estimation of the capital needed for achieving a given rate of growth.
4. The capital-output ratios are stable over time
5. The over all capital output ratio differ from country to country according to the types of activities predominating in their economics.
6. There is not much difference between the capital-output ratios of given industries in the developed countries and in the underdeveloped ones.
7. A country which embarks on development has to face the situation of the high capital-output ratios, especially in the power and transport sector.
8. It is very difficult to use the capital-output ratio in the international comparisons because this ratio is affected by several nontechnological factors, data of which are not available for most of the countries.

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- (5) S.A. Abbas; Capital Requirements for the Development of South and South-East Assia, Printed in the Netherlands, 1956.
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TABLE (1)
 COMPARISON OF INCREMENTAL AND AVERAGE OVER-ALL CAPITAL COEFFICIENTS.

Industry	INCREMENTAL	AVERAGE	
		Undepre- ciated	Depre- caited.
	(1)	(2)	(3)
(1) Leather	.20	.20	.09
(2) Edible fats and oils, n.e.c., and Other food products.	.23	.25	.13
(3) Smelting and refining of nonferrous metals, and Aluminum products.	.60	.41	.15
(4) Silk and rayon products	.70	.48	.29
(5) Cotton yarn and cloth	.82	.72	.33
(6) Blast furnaces, Steel works and rolling mills, Iron and steel foundry products, Firearms.	1.61	.74	.39
(7) Construction .	.08	.12	.06
(8) Nonferrous metal mining	1.07	2.32	
(9) Transoceanic transportation	2.58	1.02	.52

SOURCE: Leontief and others, . P. 209.

TABLE (2)

Percentage Change in Wholesale Prices.

Country	Years	All Commodity	Products metals and Metal.	Textiles	Finished Goods.
India	1920-39	- 46	- 37	- 67	..
	1928-39	- 35	..	..	..
	1939-46	+ 165	..	..	+ 129
	1939-47	+ 212	..	..	+ 188
Maxico	1928-39	+ 13	..	..	..
	1939-46	+ 129	..	..	..
	1939-47	+ 142	..	..	..
Peru	1928-39	+ 11	..	..	..
	1939-46	+ 122	..	..	..
	1939-47	+ 200	..	..	..
U.S.A.	1920-39	- 50	- 36	- 57	..
	1928-39	- 20	..	..	- 16
	1939-40	+ 57	+ 22	+ 68	+ 44
	1939-47	+ 97	+ 54	+104	+ 81
Australia	1920-39	- 32	- 23	- 58	..
	1928-39	- 8	..	..	..
	1939-47	+ 50	..	..	..
Canada	1920-39	- 51	..	..	..
	1928-39	- 21	..	..	- 20
	1939-46	+ 43	..	..	+ 30
	1939-47	+ 71	..	..	+ 55
New Zealand	1920-39	- 30	+ 34	- 59	..
	1928-39	+ 7	..	..	..
	1939-48	+ 48	+ 72	+111	..
	1939-47	+ 53	+ 68	+113	..
South Africa	1920-39	- 54	- 59	- 58	..
	1928-39	+ 15	..	..	..
	1939-46	+ 59	+ 61	+ 83	..
	1939-47	+ 67	+ 76	+117	..

SOURCE: The Review of Economics and Statistics, August 1954, P. 318.

TABLE (3)

The Relation Between Capital and Real Income for 1913.

Country	Capital coefficient	Country	Capital coefficient
Argentina	5.85	Italy	4.36
Sweden	5.65	United States	4.33
Australia	5.53	Canada	4.32
Hungary	5.05	Britain	3.72
France	4.82	Japan	3.57
Belgium	4.66	Spain	3.52
Germany	4.45	Austria	3.50

SOURCE: Leontief and others, op. cit., P. 213

TABLE (4)

Equipment-Output Relationships, United States, Australia,
New Zealand, Canada, Mexico, South Africa, and Peru.

Industry	<u>Depreciated Value of Equipment</u> <u>Value of Output</u>						
	United States 1939	Australia 1939-40	New Zealand 1939-40	Canada 1939	Mexico 1940	South Africa 1938-39	Peru 1939
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Food processing and tobacco.							
(a) Fishing	.57	.43	-	.65	-	-	-
(b) Flour and grist mill products.	.07	.13	.12	-	.15	-	-
(c) Canning and preserving	.12	.11	.08	-	.14	-	-
(d) Bread and bakery products.	.14	.18	.19	-	.06	-	-
(e) Sugar refining	.24	.21	-	.30	.47	-	-
(f) Alcoholic beverage	.13	.32	.16	.30	.20	-	.45
(g) Nonalcoholic beverages	.13	.20	.34	-	.20	-	-
(h) Tobacco manufactures	.03	.09	.09	-	.10	-	-
(i) Manufactured dairy products.	.10	.10	.07	.20	.06	-	-
(i) Slaughtering and meat packing.	.06	.07	.07	.08	.03	-	-
(2) Machinery							
(a) Agricultural machinery	.20	.27	-	.39	-	-	-
(b) Automobiles	.16	.13	.14	-	.04	-	-
(c) Transportation equipment, n.e.c.	.58	.41	-	-	-	-	-
(d) Machinery, n.e.c.	.22	.22	-	.27	.20	-	-
(e) Electrical equipment, n.e.c.	.09	.12	-	-	-	-	-
(3) Iron and steel smelting and refining.	.35	.29	-	.80	.33	-	-
(4) Rubber products	.16	.16	-	.34	.11	-	-
(5) Nonmetallic mineral manufactures.	.43	.38	.45	.64	.26	.37	-

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(6) Chemicals	.21	.23	.22	.22	.08	.22	-
(7) Lumber and timber products	.32	.18	.25	.28	-	-	-
(8) Wood pulp, paper, and paper products.	.26	.38	-	-	.23	-	-
(9) Printing and publishing	.26	.22	.33	-	-	.32	-
(10) Textiles and leather							
(a) Cotton yarn and cloth	.31	.25	-	.36	.24	-	.37
(b) Woolen and worsted manufactures	.32	.22	.36	.32	.17	-	.26
(c) Silk and rayon products	.22	.35	-	-	.11	-	.26
(d) Clothing	.02	.08	.09	.03	.10	-	-
(e) Leather	.15	.09	.11	.08	-	-	-
(f) Leather shoes	.06	.10	.09	-	.06	-	.07
(11) Shipbuilding	.16	-	-	-	-	.04	-
(12) Construction	.02	-	.02	-	-	.03	-
(13) Automotive repair and services.	.23	-	-	-	.19	-	-
(14) Fuel and power							
(a) Coke and manufactured solid fuel	1.17	1.22	-	-	.18	-	-
(b) Manufactured gas	2.24	1.48	2.20	1.69	-	-	-
(c) Electric public utilities.	2.99	2.11	2.31	-	3.81	-	-
(d) Petroleum refining	.12	-	-	.14	-	-	-
(15) Steam railroad transportation. ⁴	5.79	6.87	6.28	7.38	-	-	-

SOURCE: Leontief and others, P. 214.

TABLE (5)
Capital-Income Ratio for 28 countries

Country	Non-agricultural activity	Whole economy
Egypt	2.82	3.34
Kenya	4.70	4.22
North Rhodesia	4.77	4.51
South Africa	3.85	3.87
Canada	3.60	3.66
Dominican Republic	3.00	3.42
Mexico	3.56	3.65
Porto Rico	2.94	3.21
United States	3.29	3.35
Argentina	3.34	3.50
Chile	3.40	3.51
Colombia	3.70	3.84
Paraguay	3.52	3.68
Peru	3.23	3.48
China	3.22	3.72
India	3.29	3.62
Japan	3.65	3.72
Philippines	2.80	3.56
Turkey	2.86	3.43
Bulgaria	3.42	3.71
Denmark	3.69	3.72
Finland	3.72	3.80
France	3.78	3.80
Greece	3.33	3.61
Iceland	3.42	3.64
Italy	3.47	3.67
Netherlands	3.52	3.57
United Kingdom	3.70	3.72

SOURCE: Dr. S.A. Abbas Capital Requirements for the Development of South and South-East Asia. P. 87.

TABLE (6)

Net Capital Coefficients of the Industrial Sector .

	Australia	Canada	Union of South Africa	New Zealand
1914	1.27	-	-	-
1915	1.80	-	-	-
1916	1.69	-	1.51	-
1917	1.79	1.82	1.41	-
1918	2.00	1.98	1.35	-
1918-1919	2.01	2.15	1.34	1.73
1919-1920	2.06	2.40	1.51	1.36
1920-1921	1.62	2.34	1.40	1.41
1921-1922	1.40	2.01	1.36	1.42
1922-1923	1.43	1.94	1.29	1.42
1923-1924	1.55	2.24	1.04	1.45
1924-1925	1.59	2.22	1.19	1.77
1925-1926	1.52	2.00	1.23	1.86
1926-1927	1.54	1.89	1.08	1.95
1927-1928	1.54	1.80	1.15	1.98
1928-1929	1.68	1.69	1.08	2.06
1929-1930	1.54	1.79	1.14	2.28
1930-1931	1.84	1.69	N.A.	2.73
1931-1932	1.89	1.88	N.A.	2.81
1923-1933	1.73	1.99	.95	2.60
1933-1934	1.66	1.71	.95	2.46
1934-1935	1.55	1.61	.95	2.26
1935-1936	1.46	1.56	.89	1.98
1963-1937	1.46	1.54	.87	1.89
1937-1938	1.38	1.51	.90	1.97
1938-1939	1.43	1.40	.89	1.83
1939-1940	1.48	1.34	.82	1.72
1940-1941	1.31	1.27	.81	1.63
1941-1942	1.22	-	.82	1.50
1942-1943	1.21	-	.93	1.46
1943-1944	1.17	-	.91	1.44
1944-1945	1.27	-	.95	1.45
1945-1946	1.28	-	.97	1.42
1946-1947	1.23	-	1.03	1.47
1947-1948	1.29	-	1.18	1.47
1948-1949	1.29	-	1.25	-
1949-1950	1.32	-	-	-

SOURCE: Dr. S.A. Abbas op. cit., P. 93.

TABLE (7)

Over-all Net Capital Coefficients, the United Kingdom and
the United States, 1879-1938.

	The United Kingdom		The United States	
	Capital Coefficient	3 year moving averages	Capital Coefficient	3 year moving averages
1879	2.08	2.10	2.98	2.99
1884	2.12	2.05	3.01	3.07
1889	1.96	2.00	3.21	3.27
1894	1.93	2.01	3.59	3.55
1899	2.16	2.12	3.85	3.66
1904	2.27	2.25	3.55	3.64
1909	2.31	2.29	3.51	3.57
1914	-	-	3.66	3.62
1919	-	-	3.70	3.69
1920	-	-	3.72	3.81
1921	-	-	4.00	3.82
1922	-	-	3.75	3.69
1923	-	-	3.32	3.47
1924	2.40	2.40	3.35	3.34
1925	2.43	2.41	3.34	3.31
1926	2.41	2.36	3.24	3.30
1927	2.25	2.32	3.31	3.30
1928	2.29	2.26	3.36	3.30
1929	2.23	2.25	3.22	3.39
1930	2.24	2.24	3.59	3.67
1931	2.24	2.24	4.20	4.31
1932	2.24	2.20	5.15	4.79
1933	2.12	2.15	4.98	4.83
1934	2.08	2.08	4.37	4.46
1935	2.03	2.04	4.04	3.98
1936	2.00	2.02	3.54	3.64
1937	2.02	2.02	3.34	3.46
1938	2.05	2.04	3.51	3.42

SOURCE: Dr. S.A. Abbas; op. cit., P. 90.

TABLE (8)

Annual Depreciation Rates Allowed on the Original
Cost of Plant and Equipment, U.S. and India.

Industry .	"equipment."	Percentage of Original Value .	
		United States	India
Cool-mining		7½ to 10	10
Cotton mills		3½ to 10	5 to 7½
Foundry		7½ to 10	7½
Paper and pulp mills		8 to 10	7½
Furnaces and ovens		7½	7½
Glass manufacturing		8	10
Steel plants		12	7½
Moter trucks		10 to 66⅔	15

SOURCE: The Review of Economic and Statistics, August
1954., P. 313.