AN EXPERIMENT WITH INCREMENTAL CAPITAL-OUTPUT RATIO

by

Ranadev BANERJI

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In a recently published article S. J. Patel has shown that for groups of developing countries ranked according to their rates of growth of real gross domestic product, there exists an inverse relationship between the rates of growth and the ICOR [1]. The purpose of this note is, strictly speaking, two fold: First, we shift the focus of attention from group behaviour to individual cases and study if an inverse relationship can be said to hold true in the case of a particular country going through the process of economic development. A similar study has been made by Prof. Leibenstein in a stimulating article published two years earlier [2]. Our analysis differ from his in respect to the choice of the countries and to some extent in the use of methodology. Our sample consists only of the developing countries. The results obtained are however similar. Secondly, we wish to examine on the basis of the existing data whether the developing countries exibit the related phenomenon of a falling overall marginal capital-output ratio over time. This hypothesis of a declining ICOR as a country becomes

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[1] S.J. Patel: A note on the incremental capital output ratio etc., Kyklos, Vol. XXI (1968).

[2] H. Leibenstein: Incremental capital-output ratios and growth rates in the short run: The Review of Economics and Statistics, Vol. XLVIII, Feb. 1966.

more developed economically has very often been discussed in the literature of economic growth [3]. We, however, do not propose to go over in detail into all the arguments that underline this hypothesis.

A set of countries (all belonging to the developing category) for which sufficient and reliable data were available were chosen. Both our sample size and the number of observations are rather small [4]. But that does not prevent us from obtaining some meaningful conclusions, as we shall see. For each of the countries the yearly relative rates of growth of real gross domestic product and the corresponding gross ICOR were calculated for a number of years. The ICOR were calculated by dividing gross capital formation (= gross Investment) by changes in gross domestic real product on a year to year basis. For economy of space the results of the calculations for some of the countries are shown in table 1. For the remaining countries the results are very similar.

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[3] See, for example, H. Leibenstein: Economic Backwardness and Economic Growth (1957); S. Kuznets: Six lectures on Economic Growth (1959); C. Clark: The Conditions of Economic Progress (1957).

[4] Samples include twenty developing countries and observations cover mostly ten years, 1955-65.

Table 1.

Annual Rates of Growth of Real Output and ICOR

Country	1955 - 56		56 - 57		57 - 58		58 - 59		59 - 60		60 - 61		61 - 62		62 - 63		63 - 64	
	y	k	y	k	y	k	y	k	y	k	y	k	y	k	y	k	y	k
China (Taiwan)	4	3.7	7	2.3	6	2.9	7	2.9	7	3.1	8	3.2	6	4.0	6	3.9	-	-
Ecuador	3	4.6	5	3.0	2	6.4	5	3.0	6	2.6	2	6.6	4	3.4	4	4.5	5	3.2
Guatemala	9	2.0	5	3.16	4	3.6	5	2.7	3	3.8	4	3.0	2	4.3	12	0.9	5	2.7
Israel	9	3.44	8	3.8	7	4.2	12	2.7	8	3.8	9	3.6	11	3.1	10	3.0	12	2.9
Phillip.	3	2.6	4	2.4	5	1.7	6	1.3	3	2.8	4	2.3	2	3.2	5	2.0	3	3.4
Venezuela	10	2.7	11	2.5	1	18.0	7	3.3	1	12.0	1	8.5	6	2.3	4	3.4	7	2.1

Note: $y = \Delta Y | Y$ Y = Gross domestic product (at constant prices)

$k = \Delta K | \Delta Y$ K = Capital stock

The growth rates are to be interpreted as percentages.

Source: Derived from the data in United Nations, Statistical Year Book, 1966, and Year Book of National Accounts Statistics, 1965.

An interesting feature that strikes immediately when one examines the behaviour of y and k over time is the fact that both seem to behave in a random fashion. The random character of the variables are reflected in their year to year fluctuations which do not exibit any regular pattern. One factor responsible for such random behaviour, among numerous others, may be the variations in the weather conditions which have profound influence on agricultural output which forms the bulk of the gross domestic product of the developing countries.

The nature of the relationship between y and k is not made very obvious from a visual study of the results presented. To see it more clearly two methods are useful. One would be to take the average rates of growth of real GDP and corresponding average ICOR over two periods of time and compare them. The results for some of the countries are presented in the table below.

Table 2.

Average Relative Rate of Growth and Average ICOR

Country	1955 - 59		1959 - 64	
	y	k	y	k
China (Taiwan)	6.0	2.9	6.75	3.5
Colombia	3.5	6.8	4.25	4.9
Ecuador	3.75	4.2	4.0	4.0
Israel	9.0	3.5	10.0	3.3
Phillip.	4.5	2.0	3.4	2.7
Venezuela	7.25	6.7	3.8	5.7

An examination of the table makes clear the negative correlation between y and k. High growth rates are associated usually with low ICOR and vice versa. To examine it more rigorously, the coefficients of correlation were calculated for all the countries under consideration [5]. This is our second method. The results for twelve countries are presented here (see table 3). To test the significance of the coefficients, the resulting t-values were also calculated. We test the basic hypothesis of no relationship between y and k (the "Null Hypothesis") at 5°|o level of significance. At this level for almost all the countries the Null hypothesis is rejected and we infer a significant negative correlation. Irrespective of its magnitude, the sign of the correlation coefficient for all the countries is negative.

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[5] Calculations are based on the data of table 1.

Table 3.

Simple Correlation Coefficients (between y and k)

and the t-values for Selected Countries.

Country	China (Taiwan)	Chile	Colombo	Ecuador	Guatemala	Korea (Republ.)
Correlation Coefficient = r	- 0.51	-0.77	- 0.83	- 0.95	- 0.97	- 0.85
t-values	1.45	2.95	3.64	7.45	9.77	3.95

Country	Israel	Phillipines	Rhodesia and Nayasiland	Zambia	Thailand
Correlation Coefficient = r	- 0.97	- 0.98	- 0.77	- 0.72	- 0.55
t-values	9.77	12.06	2.95	2.54	1.61

Country	Venezuela
Correlation Coefficient = r	- 0.77
t-values	2.95

The conclusions that emerge are:

1.) It is not evident when one examines Table 1, that the overal marginal productivity of capital rises over time. But on the average (see Table 2), this tendency may be said to hold true in case of most of the countries. One, in fact, needs to have data ranging over a period of more than 25 to 30 years to examine such phenomenon. Only in such cases the calculated capital-output ratios will reflect the lagged effect on output of heavy investments (such as in infrastructure) that were undertaken decades earlier.

2.) Inspite of this limitation, one can at least expect on the basis of the available evidence of negative correlation, that if a country experiences increasing rates of growth over time, it will find its overall marginal productivity of capital rising gradually.

As to the theoretical reasonings behind such inverse relationship Dr. Patel in his note has already given some hints. and Prof. Leibenstein has discussed it elaborately in his article mentioned earlier. Our findings lend further support to their empirical verifications.