

Capital Output Ratio—Its Uses and Abuses

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The capital/output ratio can be used as a rough guide to the rate of growth that can be attained in an economy with a given rate of investment - and conversely, as an indicator of the savings necessary to attain a given rate of growth. But there is danger in attaching too much importance to it even in this limited context. The ratio holds good only in the long run; it tells us nothing about the investment in "human capital" required to bring about a certain rate of growth; and it hides the truth that in an emergency, a given amount of capital can yield far greater output than past relationships may indicate.

For determining investment priorities, however, the concept is of no use at all and for choosing between two rival technologies, it can only be one of the many criteria that have to be satisfied.

IT has been suggested by Dr Ashok

Mitra that the capital/output ratio is determined principally by the level of wages and the productivity of labour. In a Crusoe-Friday economy, where Crusoe sits and orders and "feeds" Friday, and the latter tills, Crusoe's investment may be identified with the wages (in kind) paid to Friday out of Crusoe's (past) savings. (Investment in the economy would be given by Friday's toil, valued at Friday's wage.) Likewise, the outlay on wages by the entrepreneur could be treated, in the modern setting, as the investment by the entrepreneur; and in a Kalecki-type model of the economy where entrepreneurs are the only savers there being no savings out of wages paid to workers one view of investment would be all outlays necessary to bring about production, total wage payments (including the wages part of the cost of intermediate goods) being the most important constituent of such outlays. In this view of investment, the use of machinery and equipment can be allowed for by adding to total wages paid, the replacement cost of capital consumed in the process of production. Given the capital equipment and employment, output would be determined by labour's dexterity, or labour productivity. Finally, since the depreciation of capital is likely to be of a small magnitude as compared to the outlay on wages, for all practical purposes the capital/output ratio would be given by the level of wages and the productivity of labour. Thus, one way to lower the capital/output ratio would be to lower wage rates.

Mitra's interpretation of the capital/output ratio is based on an "instant" view of capital; given certain fixed assets, production requires the application of labour; and for the economy as a whole, provision of wages in advance of the fruition of

output, may be taken to imply a corresponding saving out of current income, which alone makes possible the act of production.

The merit of Mitra's formulation is that it exposes the danger of identifying a higher capital output ratio with greater capital intensity. Though under certain circumstances these two may well be associated, there is no warrant for the belief that of two processes, the relatively more labour intensive method necessarily has a lower capital/output ratio. The capital/output ratio obtained for the two techniques will be given by the twin factors (a) the output accruing from the two methods of production, and (b) the sum total of savings - in Mitra's formulation, current savings - necessary in the community to produce the requisite amount of output.

While Mitra's formulation helps to remove this popular misconception, it falls into an opposite kind of error through, I believe, an attempt to seek an explanation of the observed "constancy" of the capital/output ratio in countries like the U.S.A. where rapid increases in labour productivity have not brought about any reduction in the capital output ratio in the long run, because of a simultaneous rise in real wage rates. This separate issue we must reserve for another occasion. The inherent weakness in Mitra's formulation of the concept of the capital/output ratio can be seen from the following extreme example.

Let 'X' be the total (replacement) value of capital in an economy and let 'Y' be the value of net output in that economy in a given year such that $X = 3Y$. Further, let the expected life-span of the fixed equipment be assumed to be 30 years, so that capital consumption during the year would be $X/30$. Further, let the total wage payments be taken as $2Y/3$. On Mitra's view, therefore, the Investment involved in producing an output of 'Y' would be given by $2Y/3 + X/30$, or $2Y/3 + Y/10$, or $23Y/30$,

giving a capital/output ratio of 0.77:1. On the other hand, under the simplifying assumptions made above and without entering into an argument as to the definition of capital the capital/output ratio has been defined as 3:1 in the first sentence of this paragraph.

How does this contradiction arise? Even if we accept, for the time being, Mitra's concept of capital and of investment it would be seen that Mitra compares in terms of magnitudes investment during any given period with the total net output in that period, which has been produced by labour in conjunction with the accumulated capital (savings) of the past, and not merely in conjunction with the savings (investment) of the current year. It will be conceded that in a period of depression net investment may well fall to zero or be even negative, but net output will be a positive magnitude. Mitra gets out of this difficulty by a twist of logic whereby wage payments are defined as investment, so that we get a fairly "even" series of the investment/output relationship; in any case, wage payments must be positive for output to be positive. But following Mitra's own logic, we may well derive the following absurd relationship between investment and output.

Value of gross output
— input of materials (including depreciation)
net output

all factor payments (including wages and remuneration to other factors necessary to bring about production)

Investment

Hence, investment net output and capital/output ratio is always unity.

Mitra does not state this explicitly; but his thesis, whereby outlay - investment by a twist of his own logic, is obviously not intended to give a definitional equation of the economic system. This approach to

Ashok Mitra: A note on the Capital/Output Ratio, The Economic Weekly, Annual Number, January 1956, Page 109.

the concept of capital/outlay ratio has, on the other hand, some special uses; but the usefulness of this concept arises mostly from disproving a series of popularly accepted notions and beliefs, and not as a valid concept in itself.

At this stage, it may be useful to ask as to what really the capital/output ratio really connotes. There can be two ways in which the problem can be examined; from the strictly theoretical point of view, starting with a definition of capital and from the operational or measurement point of view. We will here adopt the latter method by reason of its greater simplicity,

Difficulties of Measuring Aggregate Capital

The value of existing stock or fixed capital and equipment—i.e. of durable replaceable capital—can be taken either as the gross (Investment) value of existing capital less accumulated capital consumption, or as the replacement value of existing assets and equipment.** There may be differences in the value of physical assets as measured in the two ways noted above, arising out of changes in the price level. But even if an adjustment for price changes were to be made, in measuring the total value of the existing stock of physical assets, two difficulties would arise: the difficulty of relative price changes, and of a change in weights, in the valuation of total output; and more significantly, the lower valuation of existing physical assets in the event of a rise in real wage rates.

The first of the above two difficulties, i.e. a change in relative weights, is essentially a problem of measurement, and reflects the inadequacy of usual procedures of index number construction for deriving any "constant price" series. But the problem of lower valuation of capital in a period of rising real wage rates (or vice-versa) remains. (Indeed, this is one of the lessons which

emerge from Mitra's analysis of the capital/output ratio.) Since durable assets have a long life, in a period of inflation the money value of existing physical assets tends to be understated. This can, of course, be corrected by allowing for price changes. But in a period of rising labour productivity (and rising real wage rates), the real value of existing physical assets—produced at a lower level of real wages—would get understated.

It is thus conceptually difficult to define, and operationally difficult to measure capital in the aggregate sense; and hence, correspondingly, to derive the average capital/output ratio. Furthermore, for purposes of projections or for planning, the average capital/output ratio has not much significance, especially because of distortions in past relationships arising from valuation difficulties noted earlier. An alternative formulation, which avoids the above difficulties is the marginal capital/output ratio, which relates the additions to output accruing from additional investments made from year to year.

Marginal Ratio

A number of different formulations are possible in respect of the marginal capital/output ratio. To begin with, in deriving the capital/output ratio, capital may be taken to connote not only fixed investments but also working capital required for production." It is obvious that in computing the capital/output ratio, the requirements of working capital cannot be assumed away; but correspondingly, violent fluctuations in inventory holdings cannot also be included in computing the capital/output ratio, which has some significance only as an indicator of a long-term relationship. The remedy for this lies in taking the marginal capital/output ratio over a number of years, so that all cyclical and random fluctuations (in inventories as well as in output) may be evened out.

From the measurement point of view, it is easier to take marginal savings as giving the numerator, and output increases as the denominator. This procedure saves a number of awkward difficulties connected with

This pertains not only to the derivation of the marginal capital/output ratio but also the average capital/output ratio; but in the latter instance, the importance or fluctuations in inventories—which depend to a considerable extent on speculative considerations—is minimised.

the valuation of capital or its quantitative measurement, and allows for bad investments or investments abandoned before completion, as well as preliminary expenses on exploration, etc. But even this procedure does not allow for a number of difficulties inherent in any analysis of the marginal capital/output ratio.

Time Lag between Investment and Return

The first difficulty is connected with the roundaboutness of the process of production, and though apparently simple, makes for difficulties in interpreting the capital/output ratio. With varying lengths of the 'gestation' period of investment, the danger of simultaneous association of investment and output is manifest; what is not so obvious is that under conditions of competition allowing for a certain degree of "lumpiness" of capital—the capital/output ratio, adjusted for the discounted value of output over the expected period of life of capital, should be equal for all investments. In computing the capital/output ratio, therefore, should allowance be made for the lag between investment and the accrual of output? If no allowance is made for this lag, investments maturing quickly would appear advantageous over investments which may, in the long run, be better. On the other hand, no computation of the capital/output ratio, after allowing for such lags, would have any meaning. Not only would the concept be vague, but the measurement of the capital/output ratio would be nearly impossible.

Another difficulty, a relatively minor one, is that in an expanding economy, the capital/output ratio must always be rising. This, again, follows from the 'lag' between investment and the accruing output, so that in a period of expanding investment, the capital/output ratio will always tend to rise.

But the major difficulty in the measurement of the capital/output ratio—whether the average or the marginal concept—be under considera-

Frequently, a capital/output-capacity ratio is recommended as a meaningful measure, in order to determine investment priorities. This can only relate to physical output capacity, and has some relevance in the limited context of planning the investment programme (with alternative types of equipment) in a single industry. But obviously, the concept has no further use either for the economy as a whole, or even for comparing sectoral capital/output ratios (which, as we will see later, mean very little themselves

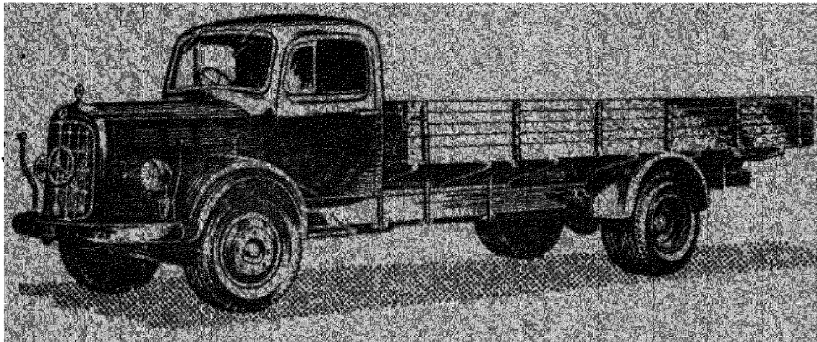
One may recall Keynes' treatment of all Government expenditure as investment, for the purpose of his multiplier analysis. That was useful for a given type of analysis; and obviously, it was not intended to imply that all Government outlay was to be treated as 'investment' in every context.

There have been attempts to link the gross value of output with gross investment (cf., for instance, The Economic Bulletin for Asia and the Far East, November 1955, p 26), but the precise significance of this relationship is not very clear.

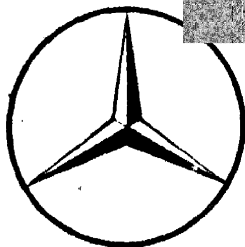
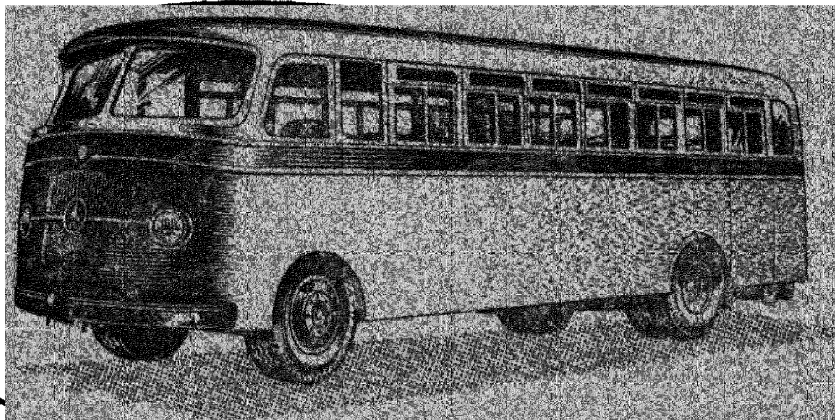
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tion—is that the cost of investment in 'training' etc, is seldom or never treated as part of investment for reasons of conceptual and of measurement difficulties. With increasing complexity of the process of production, labour has to acquire technical skill and technical knowledge; and the need to allow for the cost of training etc. as an overhead investment cost is admitted almost universally. But in practice such allowance is seldom made, if only because not all expenditure on education can (or should) be regarded as investment; and by the same token, expenditure on health, and indeed, even on nutritive foods, can well be regarded as "investment". (The danger of logical hair-splitting is that strictly in theory there can be no limit to the extent of such "splitting" of hairs until they are reduced to "electrons" or "protons".)

Use of the Concept

Where does all this lead us? We are still a long way from a satisfactory definition of the capital/output ratio, and we seem to be receding from the position where any sensible use can be made of this much boosted concept. And since all workable definitions appear to fail us, we may enquire whether, and to what extent, the concept of the capital/output ratio can be of use for policy making.

The concept of capital/output ratio was suddenly "discovered" after Harrod's exposition of his model of the growth of an economy; and the first use of the concept was to give the rate of growth that can be attained in an economy with a given rate of investment. Leontief extended this use by treating capital as an "input", in his input-output analysis, for deriving the structural relationship in any economy between output of different kinds. There have, of late, been some attempts to treat the capital/output ratio as a criterion for determining investment priorities. Finally, it is recommended as a criterion for the choice of different technologies for deriving a given output, as Mitra has done, for instance.

That the capital/output ratio can be used as a rough guide to the rate of growth that, can be attained in an economy with a given rate of investment -and conversely, as an indicator of the savings necessary to attain a given rate of growth few will deny. But as already observed earlier, there is danger in attaching too much importance to the capital/output ratio even in this limited context. The capital/output ratio holds

good (as a constant) only in the long run; it tells us nothing about the investment in "human capital" required to bring about a certain rate of growth; and it hides the truth that in an emergency, a given amount of capital can yield far greater output than past relationships between investment and output may indicate. Factories can be worked on a second or third shift if necessary; the use of capital can be rationalised; and the same equipment can give significantly different outputs with different types of labour. Ashok Mitra's concept of "dexterity" as a factor in the capital output ratio thus reappears as an incontrovertible factor in the equation.

How to measure the capital/output ratio even for the limited purpose indicated earlier? My own preference is to treat output increases as a function of the rate of saving. This has its limitations, as we have seen, but making allowances for cyclical variations, the above measure of the capital/output ratio would have the twin advantages of measurability and of practical significance in the context of changing prices and labour productivity. No adjustments are necessary for a comparison of the rate of savings with the rate of growth of the economy.

Investment Priorities

The use of the capital/output ratio as a criterion for determining investment priorities is, however, to put it mildly, not very correct. For the economy as a whole, the output accruing directly from any investment is quite unconnected with the total increase in output in the economy resulting from the investment; for a private investor, what is relevant is the discounted net return (profit) on his investment, for the entire period of life of the investment. This is so obvious that the point need not detain us any further.

Where a choice is necessary between two rival technologies, the capital/output ratio can be only one of many criteria, for the choice of the best alternative. The choice of technology for promoting development, however, is a subject by itself, and quite a few readers of the Economic Weekly are at present exercised by the manifold aspects of this problem. Without, delving any deeper into this subject, therefore, It may be well to sum up our conclusions on the notion of the capital/output ratio.

The function of capital is to raise

labour productivity. But capital I only one of several elements—though undoubtedly a very important element—in raising labour productivity. There is use in abstracting capital from the other factors only as an analytical exercise; in planning for development, the capital/output ratio (as obtaining in the past) tells merely of the physical asset formation necessary for obtaining a given output; the concomitant expenditures on education, training, etc. which are equally necessary to obtain the given output are not indicated. This is generally recognised, but, frequently forgotten when making ready comparisons. It may well be that in a given situation, expenditure for raising the level of technical skill, as well as expenditures that will "increase general awareness, initiative and enterprise — howsoever these may be fostered — may be of greater benefit in raising the level of output in an economy, than the introduction of isolated pockets of highly mechanised industrial units. The fact that a few foreign investments have, in no country, raised the general level of industrial development, is proof of this.

The capital/output ratio is a useless concept in the determination of investment priorities; and hence, of little use in actual planning. Ashok Mitra's concept of the capital/output ratio is perhaps more useful in this connection than capital/output ratio as it is generally understood; but Mitra's concept is not an appropriate concept of the capital/output ratio either for a private investor or for the economy as a whole.

For practical purposes, a rough measure of the capital/output ratio is best derived from the savings coefficient. It is easy to calculate the statistical relationship between the rate of savings and the growth of national income the former adjusted for external borrowing. Like many other simple correlations in statistics, the relationship may not give a correct structural equation of the economic system, but is good enough for prediction.

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