# CAPITAL REQUIREMENTS
## FOR THE DEVELOPMENT OF SOUTH AND SOUTH-EAST ASIA

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### Problems and the Structure of the Economics

The purpose of this paper is to estimate the capital requirements for certain countries of South and South-East Asia.[1] The problem is in fact very complicated — what is presented in the following pages is an attempt to reach some rough estimates under very simplified assumptions.

Such a study pre-supposes the possibility as well as the fruitfulness of a regional approach and attributes common properties to the region as regards the economic structure. Any region can be dealt with in terms of averages and aggregates only in case the component parts are economically similar units and result in meaningful economic variables. Looked from this angle, the region exhibits common characteristics affecting the, extent as, well as the sequence of economic development, consisting of a large population, a low level of incomes, population pressure in agriculture, disguised unemployment, low productivity, dearth of capital, low savings and a slow rate of economic development.

The problem of capital has naturally been in the forefront of the recent discussions of the under-developed economies which have received considerable emphasis during the last few years. Only a few studies[2] have, however, adopted a quantitative approach and the capital needs, although being emphasized in general terms, their magnitude has seldom been assessed. Estimates of the capital requirements made by the U.N. experts provide a useful starting point. It seems, however, desirable first to look to the existing economic conditions relevant to our purpose, without going into details as we are concerned here with them only as data. It is needless to mention that the major limitation to the quantitative approach for the study of the economic-problems of the under-developed areas remains the non-availability and the degree of the reliability of the existing figures.

### National Income and its Distribution

In our analysis the National Income is to play a significant role. The existing National Income figures and the related totals for the region can, however, be regarded only as tentative and are not sufficiently accurate. The existence of the

non-monetary sphere of the economy, which forms a very large percentage of the total National Income, the difficulty in defining the sectors and the absence of data on some important components of National Income present serious difficulties.

The National Income figures for the countries of the region are not based on the same concept. In spite of the differences the figures are sufficiently reliable indicators as far as our purpose is concerned. The total "National Income" of the region is $ 28081 million and the population is 555.5 million, resulting in a per capita income of $ 50.5, ranging from $ 67 in Ceylon to $ 30 in Indonesia. Agricultural sector contributes from 39% of National Income in Burma to 65% in the Philippines. In the region as a whole, the division of National Income in agricultural and non-agricultural sectors is 47% and 53% respectively.

Information is again lacking on the region's distribution of the National Income between consumption and investment or on the absolute magnitude and the rate of capital formation. However, on the basis of the meagre data available it is possible to draw some broad, general and indirect conclusions. A high average and marginal propensity, to consume ($C/Y$ & $\Delta C/\Delta Y$) is the characteristic of the region.

## Population and Production Trends — Level of Consumption

The total population of the region is 555.5 million, about 28% of the world population.

"The Economic Survey of Asia and the Far-East" 1949, mentions that agriculture employs 60% to 75% of the gainfully employed populations.[3] According to the available data 70% of the population is in the agricultural sector and only 30% in the non-agricultural sector.

The region exhibits a fastly growing population, 1.33%[4] per annum. In case of the increase of population at a compound interest rate (the alternative is the logistic growth) we can project it for any timer period as we get an exponential function.

$$Nt = No \cdot e^{r.t.} \tag{1.1}$$

There is evidence to the effect that the improvement in the standard of living results in lowering the rate of increase of population but it is also possible that on account of the decline in death rate resulting from a higher standard of living the first reaction may be an increase in population rather than a check on its growth. Moreover, the existing standard of living is so ridiculously low that any improvement in it may actually result in a sudden increase in population rather than

its decline. In the present case, we are concerned with the normal planning period which may not be sufficiently long to expect any such reaction. It, therefore, appears reasonable to assume that the present rate of the growth of population will maintain itself for a few years in the near future.

Growth of population is a very important factor making for the demand for capital. Maintenance of the prevalent standard of living is a minimum reasonable target of economic progress. Employment and production in both agricultural and non-agricultural sectors have to expand to sustain the increase in population which will call forth more investments. Such growth of capital will be in the nature of 'widening of capital' as the object is to equip the net addition to the population with the standard capital equipment, K/N, resulting in the prevalent per capita income Y, assuming a constant marginal co-efficient ($\Delta K/\Delta Y$) equal the average capital co-efficient (K/Y).

In case the target is improvement in the standard of living of the existing as well as the additional population, the output has to expand still more, as increase in production is a necessary condition for the better consumption. The possibility of more efficient utilization of the existing capital and better management is not ruled out but in most of the cases the increase in production will result only from the increase in capital. This will be in the nature of 'deepening of capital'.

In increasing the industrial output heavy capital requirements are obvious. The agricultural output, in the context of the prevailing conditions, cannot increase also without heavy capital expenditure. In the days of the abundance of land, mere growth of population was sufficient to increase the agricultural output as labour was the scarce factor and consequently its marginal productivity ($\Delta Y/\Delta N$) was high. In contrast, the growth of population now makes the situation still worse as the marginal productivity of agricultural labour in most of the countries of South and South-East Asia is negative. Increase in agricultural output will only result by making heavy capital expenditures on harnessing the rivers, reclaiming the land, using fertilizers, etc.

It is difficult to estimate the extent to which the production keeping pace with the population growth in the region, but it is highly probable that the events of the last ten years have caused the production per head to deteriorate considerably. The food production is below pre-war level while the population has increased by about 10%; the per capita supplies may be estimated only at 88% of the pre-war level.[5] In the terms of calories consumption the region has a per capita daily consumption of 1,630 as compared to the minimum of 2,400 per day, estimated by the health authorities.

## Analytical Framework

The problem of estimating the capital requirements can be approached in several ways. In the first instance, we have the approach adopted-by the studies of U.N., Singer and DeVries whose great merit consists in its extreme simplicity. At present we shall be concerned only with the logical set-up of these studies and shall postpone the statistical considerations to a later section.

The studies mentioned above have, as their target, the increase in the National Income as the indicator of the general welfare. This increase is divided in the agricultural and the non-agricultural lectors respectively and is affected through transferring the population out of the agricultural sector to the non-farm occupations as well as through the increase in the agricultural yields. The capital requirements in the non-agricultural sector have been calculated on the basis of 'capital required per head' and the resultant output is estimated by using the capital-coefficient. In the Agricultural sector; the increase in the agricultural out-put has been fixed as a target and the capital co-efficient gives the capital requirements.

'Capital required per head' is a useful concept when the problem of development is approached from the employment point of view. It represents the relation between labour-input and capital-input — like the relation between the capital and consumption of fuel or the raw materials. How many persons can be employed by a given investment depends very much on the type of investment, as the investments differ in their capital-labour intensity, *e.g.*, chemicals and textiles. This aspect of the problem is especially significant for the under-developed economies where capital is scarce and the problem of unemployment acute.

Although capital requirements per head differ from industry to industry, it is generally assumed that there is not much difference among various countries as regards the cost of industrial capital per worker in the given industries. In such a case the cost of the industrialization as a ratio of the National Income varies inversely with the per capita National Income. This may be true in so far as it emphasizes the technological limits of the process of substitution between labour and capital in given industries, but sometimes there may exist the possibility of substitution of labour for capital even in the case of the most heavily capitalized industries. In certain units of the ship-building industry of the Netherlands such a possibility has been utilized with much success in the case of certain processes.

Whereas in the case of the under-developed countries, substitution of labour for capital may be suggested as a guiding principle in view of the acute

capital shortage, its actual possibilities are limited on account of the relative prices of the factors, *e.g.*, minimum wage rate in case of labour.

A considerable number of data is available regarding the amount of capital per head in use in different countries as well as the breakdown of this capital in dwellings, railways and shipping, machinery and plants, public utilities and inventories. Colin Clark has plotted these data on a logarithmic diagram in comparison to the data of income per head and found it to lie closely on a parabolic curve.[6] Capital when invested does not, however, result only in employment but also in output. The relation between capital and out-put or the capital co-efficient is, therefore, the other side of the coin. It can be K/Y, the average capital co-efficient or $\Delta K/\Delta Y$ the marginal capital coefficient; while considering the development programmes we are concerned with $\Delta K/\Delta Y$ — how great an increase in production will be caused by one unit of additional investment again depends very much on the type of investment. The industries can be arranged according to the magnitude of the capital co-efficients and according to Leontief, the ratio of the largest capital — coefficient (housing) to the smallest (clothing) is 100 to 1.[7]

The studies made by U.N. and Singer make the use of the 'capital required per head' as well as the capital coefficients. DeVries' study is an improvement on the former as it has attempted to establish relationship between agricultural and non-agricultural development and has also considered the behaviour of consumers which in a detailed analysis is very important for projecting the final demand.

The analytical framework of the above studies can, however, best be described by the nature of the production function adopted implicitly or explicitly. In their logical set-up these studies do not differ much and are the numerical versions of the Harrod-Domar Models:

(1) Rigid Production Function — Use of Harrod-Domar models faithfully follow:—

The formulae

$$D = Sp - r \qquad \text{(Singer)} \qquad (2.1)$$

and

$$a = d.r / n.p. \qquad \text{(DeVries)} \qquad (2.2)$$

$$G_w \cdot C_r = S \qquad \text{(Harrod)} \qquad (2.3)$$

and

$$I = I_0 \cdot e^{a\alpha} \qquad \text{(Domar)} \qquad (2.4)$$

Explanation of symbols:

In (2.1) D = the rate of Economic development, S = the rate of net saving, P = the productivity of new investment per unit of capital and r = the rate of annual increase of population.

In (2.2) P = the percentage of income derived from agriculture, d = the percentage available for new investment, r = rate of agricultural investment in the total, investment, c = capital co-efficient and a = the annual increase.

In (2.3) $G_w$ = warranted rate of growth, $G_r$ = requirements for new capital divided by the increment of output to sustain which this new capital is required and S = the fraction of income saved.

In (2.4) I = the rate of investment per year, a = Potential social average investment productivity, $\propto$ = marginal propensity to save.

Domar-Harrod models can be used for estimating the capital requirements, because these models establish the relationship between capital and rate of growth. The problem in Harrod-Domar models is by what rate the income must grow in case of a given capital output ratio and the rate of saving. We can invert the problem and ask, given the capital-output ratio and the intended rate of development to what extent the capital must grow and given the rate of savings what is the gap which should be filled by capital imports in case the intended development has to be carried out.

Domar's[8] subject is the study of the relation between capital accumulation and employment. Domar discards the approach from the point of view of labour force and productivity as presenting a theoretically incomplete picture and, on the contrary, shifts the emphasis from the income creating effect of investment to the capacity creating effect. This analysis concluded that with the growth of capital, stock employment is not a function of level of National Income, as assumed by Keynes but of the rate of growth of National Income.

The equilibrium rate of growth is given by $\propto$a in:

$$I = I_0 e^{\alpha\propto} \tag{2.5}$$

So long it remains constant, the maintenance of Full Employment requires investment to grow at a constant compound rate.

Criticism has been levelled against Domar that he has considered only the "Full Capacity growth" and has neglected the "Full Employment growth" or alternatively has assumed that the full capacity use of capital will assure the full employment of labour also, which in most cases may not be justified.[9]

This raises the issue of the assumptions made by Domar regarding the treatment of the other factors of production although explicitly only capital has been mentioned.

In Domar's model the problem of obtaining growth arises because of the growing capacity which follows from factor 'supply increases and from the technological changes.

This involves the consideration of the production function assumed by Domar, which is:

$$U = K/C \tag{2.6}$$

with a given capital co-efficient U is the function of K; what happens to labour is not specifically mentioned but the assumption is that labour supply is not a bottleneck and sufficient labour is forthcoming for all levels of output. Therefore in Domar's model the rate growth is the rate necessary to attain the capacity level which results from the growth in both factor supplies.

When only one input co-efficient is being used there might be enough justification for taking capital rather than labour alone but for more general and more practical purposes the labour should be given an explicit place. An explicit production function offers much by way of clarity and a better and more general treatment of the growth is possible by using a production function which takes into consideration both labour and capital and not capital alone.

## Douglas Production Function

This logically brings us to Douglas Production Function which considers both the factors labour and capital and envisages the substitution between them. The function is as under:

$$U = C \cdot A^{\propto} \cdot K^{B} \tag{2.7}$$

where U is the quantity of product, A the quantity of labour and K the quantity of capital where C, $\propto$ and B are constants, $\propto$ is the elasticity of production with respect to labour and B is the elasticity of production with respect to capital. In case of homogeneity or the constant returns to scale.

$$\propto + B = 1$$

This production function can be used, for estimating capital requirements as U is known as "target"; with the given population in the initial period and its rate of growth it is possible to have a projection of N for any time period.

Therefore with known exponents $\propto$ and B and given U and N we can find the value of k.

This production function again does not consider all the variables, the noticeable absence being that of circulating capital. There is also the serious criticism of the high degree of multicollinearity. But in spite of these limitations this function is of much help on account of the fact that it takes into consideration the three most important variables and being relatively simple is easy to handle. Prof. Palvia has used it for his planning model for India.

## Leontief's Input — Output Analysis

Leontief's 'Dynamic' model is another alternative and much can be said in favour of its merits as regards long term projections but as it can be hardly of any

direct use in the problem with which we are concerned at the moment we can leave it only by mentioning it.

In the preceding section we have discussed spine of the theoretical aspects of the various approaches for the estimation of the capital requirements. In the present section we will be concerned mainly with the statistical considerations.

## Statistical Considerations

As has already been observed the studies by U.N., DeVries and Singer follow the same logical set-up. These studies, however, reach different conclusions as regards the estimates of capital requirements for the under-developed areas. These divergent figures Are the result of the differences in the targets set and different assumptions; some of which have been discussed in the first section of the present paper.

Assumptions in the Nature of Data

| | Assumption made | U.N. | Singer | DeVries | Present Study |
|---|---|---|---|---|---|
| 1. | Ratio of agricultural incomes to the total incomes (initial period) | 1:4.5 | 1:2.5 | Actual | 1:2.13 |
| 2. | Ratio of working population to the total population (initial period) | 1:2.5 | 1:2.5 | ” | 1:2.5 |
| 3. | Ratio of agricultural population to the total population | N.C. | 7:10 | N.C. | 7:10 |
| 4. | Rate of growth of population per year | 1.31% | 1.25% | 1.25% | 1.33% |
| 5. | Rate of savings as a percentage of National Income | 4.8% | 6% | 3% to 8% | 5% |

Pitfalls in this field can he avoided by making a careful selection of the data for the initial period. More serious difficulties, however, arises as regards the capital co-efficients and the selection of the figures for the amount of capital required per head for increasing employment. The above-mentioned studies have adopted the following figures:

Co-efficients

| Nature of co-efficient | U.N. | Singer | DeVries |
|---|---|---|---|
| Capital of co-efficient | | | |
| (*a*) Agriculture | 4 | 4 | 4 |
| (*b*) Industries | 16 | 6 | 4 |
| (*c*) Others | – | 4 | – |
| Capital required per head in | | | |
| (*a*) Agriculture | – | – | … |
| (*b*) Industries | $ 1000 | $ 1600 | … |
| (*c*) Others | – | * 800 | … |

The estimates of U.N. and Singer for the "capital required per head" in the industries are $1,000 (Rs. 4,750) and $ 600 (Rs. 7,600) per head. How far these estimates are realistic can be judged to some extent by the comparison with the figures, of the industrial capital per head in India which is as follows:

(Rupees)

| Year | 1946 | 1947 | 1948 | 1949 | 1950 |
|---|---|---|---|---|---|
| Capital | 2,425 | 2,470 | 2,829 | 3,024 | 3,765 |

It is, however, obvious that the figures in the above table refer to the existing capital per head (K/N) whereas figures given by U N. and Singer refer to (ΔK/ΔN). The figures given by Singer are rather high as compared to the existing capital per head (K/N). In view of the trend of increase in the capital per head from 1946 to 1950 it will not be unrealistic to take a figure higher than that of 1950 while considering the development programme. It is doubtful whether it would be possible to provide the increase in working population with a capital per bead (ΔK/ΔN) much above the level of (K/N); the idea of Singer, however, is to take a higher (ΔK/ΔN) so that the process of "deepening of capital" goes on simultaneously with the "widening of capital".

The choice of the capital co-efficient presents the other serious problem.

We may use any of the methods mentioned above but in estimating the capital requirements for the expansion of economy we have to know the relationship between the expansion of capacity or output and purchases of the capital goods. The basic problem, therefore, is the determination of the capital coefficients. The co-efficients are not intended to describe the existing capital structure of the industries but the requirements for expansion, hence we are concerned with the marginal capital coefficients.

Determination of capital co-efficients requires the collection of many data which in case of most of the countries are very scanty. In United States very comprehensive data have been, collected.[10] The co-efficients calculated are based on the data on the expansion of the industrial capacity which took place during World War II and the Korean War period. The relevant questions regarding the capital co-efficients are relating to their stability with respect to scale, time and region.

The problem of scale is not in respect to the expansion capacity but the size of the new plant. In cases where the economies of scale are probable the question of the size of plant becomes relevant. In such cases the capital co-efficient for too large or too small plant are inappropriate.

The change of capital co-efficient over time is another important problem. In most cases introduction of new-production processes may mean a drastic change in the capital co-efficient. The capital co-efficients in the economy, as a whole, have not exhibited any great change over time. According to Hansen, however, the capital co-efficient has declined since 1909-18 as shown in the following table:

| Year | (K/Y)[11] |
|---|---|
| 1889-98 | 3.0 |
| 1899-08 | 3.1 |
| 1909-18 | 3.3 |
| 1919-28 | 2.9 |
| 1950- | 2.5 |

The decline in the capital co-efficient in the United States is attributed to the increase of services in the composition of demand.

Evidence of the regional variations within a country are scarce but capital co-efficients, especially the marginal capital coefficients, vary in different parts of the world. According to the U. N. document[12] the capital co-efficient in non-agricultural activity range from 2.82 in Egypt to 4.77 in South Africa. The difference is not so pronounced as regards the whole economy.

The comparison of data as regards the capital co-efficients in India and U.S.A. exhibits considerable differences.

| | | INDIA | U.S.A. I | U.S.A. II[13] |
|---|---|---|---|---|
| | | 1948 | 1939 | 1947 |
| Wheat Flour | … | 3.73 | .194 | – |
| Biscuit Making | … | 1.31 | .301 | .3344 |
| Fruit and Vegetable Processing | … | 2.78 | .299 | .3084 |
| Sugar | … | 2.17 | .334 | .6063 |
| Vegetable Oils | … | 7.18 | .285 | – |
| Tanning | … | 2.29 | – | .1359 |
| Glass and Glassware | … | 2.46 | – | .8715 |
| Plywood and Tea Chests | … | 2.97 | – | .2407 |
| Paper and Board | … | 2.99 | .605 | – |
| Cotton Textile | … | .194 | .825 | .3417 |
| Woollen Textile | … | 1.43 | .412 | – |
| Jute Textile | … | 1.56 | – | .3411 |
| Iron and Steel | … | 2.05 | 1.798 | – |
| Electric Lamp | … | 4.08 | – | .3580 |
| Electric Fan | … | 2.33 | .222 | – |
| General Electric Goods | … | 2.21 | – | .3083 |

The above table shows wide divergences between the capital co-efficients for India and United States. The figures for the United States are in terms of the

capacity unit and the figures for India are in terms of output unit. The capital co-efficients for the United States are, therefore, capital — capacity rates rather than capital output ratios. Any industry seldom operates continuously at the maximum short run capacity. There might be several reasons for it, *e.g.*, market conditions, differences in shift for repairs or even the maintenance of a 'normal' spare capacity. This is, however, insufficient to explain the wide divergences as shown above.

Such a wide disagreement in the figures is on account of the fact that the figures for the United States are related to gross capacity while the figures for India are related to the net production.

The figures for the capital — coefficients for the non-agricultural sectors taken by Singer and DeVries are 4 and 6 respectively. The figure for the 29 industries included in the Fifth Census of Indian Manufactures 1950 works out at 2.16 which is very near to 2.1 adopted for the Latin American countries in the ECLA Report.[14]

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(14) ECLA Beport E/CNP 292, p. 3.