CHAPTER - V

VALUATION OF CAPITAL.

In the third chapter we have analysed labour as one of the important inputs. In this chapter, we discuss the other input — capital. First in Section 'A' we shall discuss the pure theoretical aspect of the problem of valuation of capital. Later in Section 'B', we shall present relative merits of different methods adopted in empirical studies. Section 'C' actually discusses the method adopted in measurement of the capital of the Indian Railways. Apart from the conventional measurement, an attempt is made to measure capital in a way reflecting the post-Keynesian theoretical thinking.

SECTION 'A'

Concepts of Capital:

5.2 Generally two concepts of capital are distinguished viz., financial and physical. The former refers to an enterprise's command over financial resources. It consists of value of all assets in the possession of an enterprise including non-reproducible assets such as land, natural resources, patent rights and trade marks. It also takes into account working capital for payment of wages, purchase of raw-materials and stocks of inventories. On the other hand, physical capital is defined in terms of a factor of production and includes physical assets produced by the economy and which are used for further production.[1] Since our objective is to analyse

1. T.Barna, 'Alternative Methods of Measuring Capital' in The Income and Wealth Series VIII, R.Goldsmith and C.Saunders(Eds), Bowes and Bowes, 1959, p.35.

productivity and technical change, we have made use of the latter concept with some modifications vide Section 'B' of this chapter. But the latter concept itself can be looked at from two angles.

Forward and Backward-looking concepts:

5.3 Hicks distinguishes two concepts of capital — Forward-looking and Backward-looking.[2] The former refers to the discounted future streams of income (in which case the difference between output and capital disappears) while the latter refers to the quantity of labour-time expended in the past to produce it. In fact it is this difference which Keynes recognised as the motivation for investment processes. The concept of marginal efficiency of capital recognises these differences. The forward and backward-looking concepts give the same value in a situation of 'perfect tranquility' and the rate of discount is the rate of interest or return which makes the two equal.[3] In the real world where uncertainty hangs over the future, the expected streams of incomes cannot be calculated reasonably. Hence reliance has to be placed on cost i.e. backward-looking concept, a view supported by Joan Robinson at one time.[4]

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2. J.R.Hicks, 'The Measurement of Capital in Relation to Measurement of other Economic Aggregates' in The Theory of Capital, F.A.Lutz & D.C.Hague (Eds), Macmillan, London, 1961, p.19.
3. J.Robinson, 'Some Problems of Definition and Measurement of Capital', in Collected Economic Papers, Vol.2, Basil Blackwell, Oxford, 1960.
4. Ibid, p.115.

5.4 Joan Robinson observes, 'To treat capital as a quantity of labour-time expended in the past is congenial to the production point of view, for it corresponds to the essential nature of capital regarded as a factor of production.'[4] When an equipment is new, cost approach based on past-labour-time expended in the production of capital goods is justified.

5.5 However, the problem of valuation of capital is extremely difficult even for one moment we accept labour-time as a measure. The concept of capital is closely linked with the concept of round about methods of production (Austrian School) that exists in the economy. Since each stage in this roundabout process has different capital intensity, and change in wage rate affects different stages differently. If all the stages of production have the same capital intensity, the problem is not so serious. In fact, this is at the heart of the Ricardian problem of valuation which finds an echo in Marx's analysis under the caption of 'Transformation of values into prices'.[5]

5.6 Thus a change in distribution whether it comes about by a change either in wage rate or profit rate, per se, changes the value of capital. This is the basis for the turbulent controversy regarding switches, initiated by Sraffa's recent book.[6] Sraffa's book is the strongest criticism of the

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4. Ibid, p.115.
5. P.M.Sweezy, The Theory of Capitalist Development, Monthly Review Press, New York, 1956, pp. 109-112.
6. P.Sraffa, Production of Commodities by Means of Commodities Cambridge University Press, Cambridge, 1963.

neo-classical theory of marginal productivity and hence the violent reaction of Samuelson — vide Surrogate Production Function.[7]

5.7 Though in almost all economic analysis (specially in the theory of growth and development) capital is the crucial variable, yet both conceptually and statistically, the problem of measurement of capital is not adequately solved. This is due to the fact that capital is a composite commodity whose composition does not remain uniform overtime. Further, in a dynamic developing society, techniques of production and therefore, distribution of income change. Consequently, value of capital undergoes change. Moreover, since capital represents an amalgam of heterogeneous types of equipment collected from the past, their life or efficiency does not remain uniform.

Valuation of Capital in Steady Growth and Sraffa System:

5.8 In a steady growth stage (golden age), capital can be precisely measured. In an economy undergoing steady growth with no technical change, it does not matter much in what units we measure capital since prices and distribution of income do not alter. However, for other systems, we have to fall back on Sraffa's 'Standard Commodity'[8] to measure capital. It should be noted that comparison of capital in two steady growth states is extremely difficult. Even Sraffa's standard-commodity is relevant only for one technology. When technology changes, even if the basket

7. J.E.Stiglitz (Ed), The Collected Scientific Papers of Samuelson, Vol. 1, Oxford and IBH, Bombay, 1970, p.325.
8. P. Sraffa, op. cit.

contains the same fixed proportions of consumer goods, yet the ratio of consumer and capital goods is different in the standard commodity. Thus even Sraffa's measure is not completely satisfactory in a dynamic society.

5.9 It is on account of these reasons that in recent years Joan Robinson has adopted an almost nihilistic position, believing that the problem is absolutely insoluble in practice. Despite this scepticism Joan Robinson did attempt to provide some type of measure in the economic models she analysed.[9]

Real Capital-Ratio:

5.10 Joan Robinson suggests four methods[10] to measure value of capital viz. in physical units, in terms of productive capacity, in terms of commodities or money of given purchasing power and in past labour-time. All these measures have their own limitations. Horse power is a rough physical measure. The problem of age-composition arises. The measure of productive capacity, with balanced-age composition but with zero rate of investment may be considered. However, this concept loses its utility once we introduce growth. Regarding valuation of capital in labour-time, when techniques and wage rates are different, notional interest rate will be different and hence value of capital changes. Due to these difficulties, Mrs.Robinson

9. J.A.Kregel, The Reconstruction of Political Economy, Macmillan, London, 1973, p.125.
10. Joan Robinson, The Accumulation of Capital, Macmillan, London, 1969, Chapter 11, pp. 118-23.

prefers to measure capital in terms of 'Real Capital-Ratio. It refers to past labour-time spent in the making of equipment divided by the amount of labour currently employed, when the capital outfit is working at normal capacity. Though both the numerator and the denominator in the ratio are expressed in quantities of labour-time, they are not identical. The numerator refers to past labour-time compounded at interest, while the denominator refers to a flow per unit of time of current labour. Thus,

$$\text{Real Capital Ratio} = \frac{\text{Dated Labour-Time}}{\text{Current Wage Bill}}$$

She is not completely satisfied with the concept of Real Capital-Ratio. In another context,[11] she observes, 'In a world where unexpected events occur which alter values, the points of view of the man of deeds, making investment decisions about the future, and the man of words making observations about the past, are irreconcilable and all we can do is botch up some conventional methods of measuring capital that will satisfy neither of them.' Kaldor also seems to hold similar views that since no measurement truly reflects the theoretical concept, the best under the circumstances is to adopt some convention however imperfect it may be.

5.11 We shall now present briefly Kaldor's views on valuation of Capital. He is definitely against measuring capital in money values corrected for prices. 'The fact that due to

11. J.Robinson, 'The Production Function and the Theory of Capital', in Capital and Growth, G.C.Harcourt and N.F.Laing (Eds.), Penguin, 1971.

technical progress, the capital goods produced in any one period are physically non-identical with capital goods produced in previous periods, and therefore cannot simply be added to the latter, even if proportions of the different capital goods serving different end-means remained the same... The measurement of stock of real capital must therefore necessarily be based on some (more or less arbitrary) convention.[12] Thus it is seen that measurement of capital should be based on some convention. He mentions the following conventions: mechanical power, tonnes of steel and total physical weight irrespective of the material with which capital goods are made. We shall now turn our attention to neo-neoclassicals.

Neo-Neoclassicals' concept of Capital:

5.12 The neo-neoclassical economists like Samuelson, Solow treat capital as single physical homogeneous good. They admit that it is not true to say that only one type of capital good exists but such difficulty is there in the case of labour also. In theoretical and empirical analyses, even though labour is heterogeneous, still it is treated as or converted into a homogeneous quantity.[13] Thus there seems to be some justification for not over-emphasising heterogenity. But what about the measuring rod? Can we rely on constant money prices? Kaldor's conventions do not include money prices as mentioned above.

12. N.Kaldor, 'A Model of Economic Growth', in Essays on Economic Growth and Stability, Gerald Duckworth, London, 1960, p.269.
13. R.M.Solow, 'The Production Function and the Theory of Capital', Review of Economic Studies, Vol.23, 1955-56.

A New Measurement :

5.13 We shall now evolve a methodology, where market prices are not excluded in measurement but at the same time the difficulties posed by Joan Robinson and Sraffa are not so serious. To use Joan Roninson's earlier expression, the new measurement is a botch up of the two contending thoughts represented by the two Cambridge Schools adopted to the needs of empirical research.

5.14 We cannot do better than quoting verbatim from Sraffa:-

> "Suppose that, all in all, and including the necessaries for the workers, 280 quarts of wheat and 12 tonnes of iron are used to produce 400 quarts of wheat, while 120 quarts of wheat and 8 tonnes of iron are used to produce 20 tonnes of iron. A year's operations can be tabulated as follows:
>
> 280 qr. of wheat + 12 tonnes of iron —— 400 qr.Wheat
>
> 120 qr. of wheat + 8 tonnes of iron —— 20 tonnes iron.

5.15 Nothing has been added by production to the possessions of society as a whole. 400 qr. of wheat and 20 tonne of iron have been used up in the aggregate and the same quantities are produced. But each commodity which initially was distributed between the industries according to their needs, is found at the end of the year to be entirely concentrated in the hands of its producer.....

5.16 There is unique set of exchange values which if adopted by the market restores the original distribution of the products and makes it possible for the process to be repeated; such values spring directly from the methods of production.

In the particular example we have taken, the exchange value required is 10 qr. of wheat for 1 tonne of iron."[14]

5.17 Thus values spring from the methods of production and inter-relations between different industries. In Sraffa's presentation final consumer demand is incorporated in the input side (cf. Leontief's model where inter-industry demand is separated from consumer demand). Though, to the best of our knowledge, Sraffa does not claim, yet in one stride he has erased the difference between shadow prices (dependent upon productive relations) and market prices dependent upon subjective valuation of the consumer.

5.18 This is because Sraffa's pricing at once takes care of inter-industry and final demands. To sum up, concept of value in the Classical School and the consumers' subjective valuation of neo-classicals both find equal significance in Sraffa's pricing system. And what is more significant is the fact that, changes in distribution of income also get reflected in the input side. If share of wages increases the quantum of wage goods in the input side are bound to alter and productive relations get altered and the outcoming prices (the new relative prices) mirror these changes.[14A]

5.19 Sraffa's example quoted above is with respect to a static economy. If we introduce growth, the above example can be amended as (the amendment is ours):

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14. P. Sraffa, op.cit. Ch.I, p.3,

14A. Sraffa in chapter II of his book cited, takes wages out of the productive relations and assigns the role of a co-sharer in surplus.

280 qr. wheat + 12 tonnes iron — 500 qr. wheat.
120 qr. wheat + 8 tonnes iron — 25 tonnes iron.

The exchange ratio which enablesthe advances to be replaced and the profits to be distributed to both industries in production to their advances is 10 qr. of wheat for 1 tonne of iron, and the corresponding rate of profits in each industry is 25%.

5.20 Thus as long as 10 qr. of wheat exchange for 1 tonne of iron the economy grows continuously at 25% and the profit rate is also the same. It is seen that if prices are such that one qr. of wheat is Rs. 100 and one tonne of iron is Rs. 1000 the above exchange is satisfied. If qr. of wheat is costing Rs. 200 and one tonne of iron is costing Rs. 2000, the same exchange rate is maintained and the profit rate is the same in both the activities.

5.21 In sum for an economic analysis, relative prices are more important than individual prices of goods. Price of capital, whatever convention we follow, is not so important for analytical purposes. It is the price of capital vis-a-vis the prices of consumer goods that really matters. Hence in the present analysis we have adopted the method of relative prices as a measurement of capital, apart from adopting the usual method of some form of constant individual prices, not to break off from traditionally accepted methodology.

5.22 Since relative prices depend upon methods of production, once technical change takes place, methods alter and therefore

relative prices alter. Thus variations in relative prices themselves reflect technical change. Therefore capital measured in terms of an index of relative prices partly atleast answers Kaldor's objection of money prices not reflecting technical change. Changes in distribution of income in the ultimate analysis affect the relative prices. Thus measurement of capital in terms of relative prices can be adopted as a convention which is relatively nearer to the theoretical concept though at the moment it might seemingly look most unconventional.

SECTION 'B'

Measures of Capital in Empirical Studies: Replacement Cost:

5.23 Having reviewed the theoretical aspect of valuation of capital, we now consider some of the measures followed in empirical studies. While discussing depreciation in para 2.9 we have indicated some methods. One such method is Replacement Cost. It has two variants — replacement cost new and written-down replacement cost. In the former method, depreciated capital is given an imputed value equal to new identical capital at the current price. If 'X' is the value of a capital equipment bought in 1965, the value in 1972 according to this method is, the current value of a new equipment identical with the one bought in 1965 in its present state as on 1972. According to the latter method if a capital equipment has been in use for some time, its value is, whatever is its market value in that state of depreciation.

Due to technological change an identical capital equipment cannot be obtained in the market. Thus the first method is only conceptual and cannot be used in empirical studies. Since there is no regular market for second hand assets, especially in developing countries, it is impossible to adopt the second method. Moreover, in our present analysis, capital is specific and there is no market at all for second hand equipment. Who would purchase an old engine to determine its value in the market? Therefore we have discarded the above two methods. Our methodology is discussed in detail in Section 'C' of this chapter. We shall now turn to the problem of gross and net capital.

Gross and Net Capital (Problem of Depreciation):

5.24 In the valuation of capital stock, a major question is whether it should be gross or net of depreciation. On a-priori grounds net capital figures appear to be the most useful since they take into account capital consumption occurring in the process of production. However, both in theory and practice, depreciation is not easily amenable for correct measurement for the reasons discussed in para 2.8 and for reasons other than difficulties in measuring depreciation.

5.25 Through depreciation, allowance is made for the age, wear and tear and obsolescence. Generally, as machines become older, their value declines due to two reasons — rise in the cost of maintenance and fall in the expected future life of the machine. But 'value declines faster than the productive efficiency and it

is even believed that for important classes of assets, the decline in productive efficiency in the course of effective life is negligible.' [15] On another occasion Barna remarks that in most of the capital intensive industries, the efficiency of equipment tends to increase rather than decrease with life. 'In the wider field it is obsolescence rather than wear-and-tear which is the dominant cause of mortality — homicide to make room for a new favourite, rather than natural death'. [16] Leontief also seems to prefer gross ratios since they resemble more closely to the incremental ratios. His comments on the use of depreciated and undepreciated capital coefficients are worth noting; 'Recent information indicates that the undepreciated coefficients correspond much more closely to the incremental coefficients than do the depreciated ones. Use of the depreciated coefficients implies that the capital stocks decrease inefficiency in exact relation to the depreciation charge. Most available information indicates that this is not a reliable assumption. Use of the undepreciated coefficients implies that capital stocks have a constant efficiency from the time of purchase until the time they are fully written off, when their usefulness is assumed to be zero. Both methods are dependent upon accounting procedures, both fail to take account of technological change and both present an index number problem for the reduction of

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15. T. Barna, 'Replacement Costs of Fixed Assets in British Manufacturing Industry in 1955', Journal of Royal Statistical Society, Series 'A', 1957, p.7 and 'Alternative Methods of Measuring Capital in The Income and Wealth Series VIII, op.cit. p.46.

16. T. Barna, 'On Measuring Capital' in 'The Theory of Capital' op.cit., p.95.

stock of capital accumulated overtime'.[17] Domar[18] also favours the use of gross ratios for a different reason. When net investment and net capital stock figures are considered, one loses sight of gross investment as a major vehicle of technical progress. Hence in his opinion, gross capital is more meaningful with some small unknown deductions than the traditional depreciation to account for the decrease in efficiency of capital. Depreciation policy is mainly governed by taxation laws and the valume of business in various years and is arbitrary and does not precisely reveal deterioration of capital stock. Depreciation methods are mere conventions used to adjust balance-sheets and do not have any foundation in economic calculus.[19]

5.26 There is another reason to prefer gross capital figures specially in developing economies. In these nations, an asset is often used at approximately constant levels of output far beyond its technical life until it is discarded or sold for scrap.[20] Consequently, maintenance charges, fuel consumption, etc. go up. The object of maintenance expenditure is to keep capital more or less intact. Thus, changes in inter-industry purchases, partly at least, reflect depreciation

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17. W.W.Leontief, Estimates of the Capital Stock of the American Industries 1947, Harvard Economic Research Project, Cambridge-Mass., 1953, pp.21-22.
18. E.D.Domar, 'The Capital Output Ratios in the U.S.: Its variation and Stability', in the Theory of Capital, op.cit. p.99.
19. F.A.Lutz, 'The Essentials of Capital Theory', op.cit.
20. G.Rosen, Industrial Change in India, Asia Publishing House, Bombay, 1959, p.42.

charges. This suggests that to a certain extent there can be some measurement of depreciation in developing countries by a scrutiny of interindustry purchases. However we have not attempted such measurement.

In view of the gross ratios being more appropriate, though an acceptable novel method of measurement of depreciation could be evolved, we have used only gross capital figures.

5.27 From the above discussion, it is obvious that the problem of capital valuation is not solved satisfactorily either in theory or in empiricism. However, this does not mean that one should not attempt to measure capital until perfect solutions are found to all the conceptual and practical problems. Attempts have to be made, to find out solutions, however, imperfect they may be, by considering some conventions. Some of these conventions are discussed in para 5.11 above.

SECTION 'C'

We start with a brief description of the statistical methods adopted by others for measurement of Capital in railways.

5.28 Roy Choudhury[21] made an attempt to measure capital of the Indian Railways in constant rupees by deflating the gross book value capital with a composite index of prices. The composite index was computed by taking four important assets forming the bulk of the Railway capital expenditure viz. iron and steel manufacturers, cement, timber, bricks and tiles and average wage per railway employee. However, she has not discussed

21. Uma Datta Roy Choudhury, 'A Possible Production Function for Indian Railway System', Indian Economic Review, Vol.4, No.2, (New Series), October, 1971.

the details of calculation of the composite index. So her methodology is not helpful to us.

The Indian Railway authorities also value their capital-at-charge in a similar way in their annual publication.[22] It is inferred from the interviews with the officers at the Railway Board that they give equal weightage to the important inputs such as cement, steel, average wage per employee. Constructing such an index without proper justification for weights is also not useful for researchers. To develop a suitable methodology (see para 5.32 below), it is first necessary to scrutinise the various types of assets of the Indian Railways.

Classification of Assets:

5.29 The main source of data for capital figures is Block Accounts,[23] an annual publication of the Railway Board. The capital expenditure figures are reported as on 31st March of each year under eleven headings (with details of sources of finance, commercial and strategic sections, manufacturing units and zone-wise) viz. Preliminary Expenses, Land, Structural Engineering Works, Equipment, Rolling Stock, General Charges, Collieries, Miscellaneous, Suspense, Purchase of Railway Lines and Investment in the shares of commercial concerns.

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22. A Review of Performance of Indian Railways, Ministry of Railways, Government of India, New Delhi.
23. Block Accounts, Balance Sheets and Profit & Loss Accounts of Indian Government Railways - Appropriation Accounts of Railways in India, Part II, Annexure 'G', Ministry of Railways, Government of India, New Delhi.

Table 6.1

GROSS FIXED CAPITAL STOCK AND INCREMENTAL CAPITAL
(BOOK COST)

(Rs.Crores)

Years	CAPITAL STOCK				INCREMENTAL CAPITAL			
	Structural Engineering Works	Equipment	Rolling Stock	Total	Structural Engineering Works	Equipment	Rolling Stock	Total
	1	2	3	4	5	6	7	8
1951-52	429 (65)	32.8 (5)	195 (30)	657 (100)	-	-	-	-
-53	440	34.4	201	675	11.0	1.61	6.01	18.6
-54	457	36.6	219	713	16.9	2.19	17.6	36.7
-55	467	40.1	247	774	30.6	3.47	28.0	62.1
-56	515 (60)	44.1 (5)	298 (35)	857 (100)	27.4 (33)	4.04 (5)	50.8 (62)	82.2 (100)
-57	557	48.4	371	976	42.2	4.29	72.9	119.4
-58	630	55.4	439	1124	73.2	6.97	68.1	148.3
-59	721	6100	494	1276	90.6	5.63	54.9	151.1
-60	808	67.5	532	1408	87.4	6.39	38.6	132.4
-61	907 (58)	72.5 (5)	582 (37)	1562 (100)	98.8 (64)	4.96 (4)	49.7 (32)	153.3 (100)
-62	1004	80.0	652	1736	96.9	7.58	70.0	174.5
-63	1135	86.0	741	1962	131	5.98	89.3	226.3
-64	1289	93.1	837	2219	154	7.03	95.1	256.1
-65	1473	103	954	2530	184	9.88	118	311.9
-66	1600 (58)	114 (4)	1060 (38)	2774 (100)	127 (51)	16.7 (7)	106 (42)	249.7 (100)
-67	1708	125	1125	2958	109	11.6	64.6	185.2
-68	1789	135	1189	3113	80.4	9.77	64.4	154.6
-69	1864	141	1255	3260	75.2	6.18	65.6	147.0
-70	1931	152	1317	3400	66.9	10.4	62.7	140.0
-71	2007	162	1368	3537	75.9	10.4	50.3	136.6
-72	2087 (56)	181 (5)	1439 (39)	3709 (100)	82.2 (48)	19.1 (11)	71.0 (41)	172.3 (100)

Source: Block Accounts, Part II, Annexure 'G'

Notes : 1. Totals do not tally due to rounding off.
2. Figurres in parentneses represent percentages.

5.30 We have excluded capital employed in the manufacturing units for reasons discussed in para 2.13. In calculating the capital stock, we took into account only the major types of fixed capital viz. Structural Engineering Works, Equipment and Rolling Stock. Had we included other assets, the problem would have become intractable. In fact some economists[24] due to difficulties of measurement take only rolling stock while measuring capital. It is fortunate that the present study could take into account three types of capital accounting for about 85% of the total capital. The details are given in Appendix Table 5-A. The reasons for omission of other types of capital are discussed in Appendix-B.

Adjusted Book Value Capital Series:

5.31 Thus after excluding the other types of capital, mentioned in the Appendix-B, we took into account the value of three major types of fixed capital assets, gross of depreciation.[25] The relevant figures are given in Table 5.1.

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24. In some of the transportation studies, capital invested in rolling stock alone is considered in terms of constant prices or in physical units due to difficulties involved in the measurement of capital. In the words of Barger, "In any comprehensive sense the latter (capital) is difficult to measure and we shall be content ourselves by noticing some changes in the amount and capacity of movable equipment employed." See H.Barger, The Transportation Industries 1889-1946, NBER, New York, 1951, p.98 and also D.L.Munby, 'The Productivity of British Railways', Bulletin of the Oxford University Institute of Economics and Statistics, Vol. 24, No.1, Feb. 1962.
25. In a similar way Kaplan evaluated gross fixed capital only. See N.Kaplan, 'The Growth of Output and Inputs in Soviet Transport and Communications', American Economic Review, Vol.57, No.5, Dec. 1967.

Of these three types of capital, the share of equipment is about 5%. Thus the bulk of the fixed capital consists of Rolling Stock (locomotives, passenger carriages and wagons) and Structural Engineering Works (consisting of track, buildings, tele-communications, etc.)

5.32 We have followed Perpetual Inventory Method to calculate gross fixed capital which was pioneered by Goldsmith in the United States.[26] It refers to the estimation of capital as the accumulated capital expenditure incurred in the past and expressed in constant prices of a base year. The procedure followed in calculating the gross fixed capital at original cost is briefly described below. For the period 1951-72, a series of annual increase in fixed capital has been computed by taking the difference between the total capital stock in the two consecutive years. The difference between the stock of capital at the beginning of t_1 and t_0 periods is the additional or marginal capital in t_0 period. Thus capital stock at the beginning of 1951-52 and the annual increments in the total stock of capital during 1951-72 are calculated. To use these series, it is necessary to convert them into market prices of a base year which in our analysis is 1951-52.

Adjustment of Base Year Capital Figures:

5.33 The value of capital which we have taken into account for the year 1951-52 is the book cost. Since the Railways have been in operation from 1853, the capital stock in 1951 includes

26. For details, see T.Barna, 'On Measuring Capital', op.cit., p.77.

capital assets that have been built up over a number of decades. Therefore, the yearly capital accumulation prior to 1951 should be corrected for price changes. For practical reasons (due to non-availability of data and multiplicity of government and non-government Railway Companies) we cannot go as far back as 1853. However, we have capital-at-charge figures from 1938 onwards of Government Railways.

Capital-at-charge is an accountancy concept which does not tally with productive capital as used in economic analysis. For want of data, we have taken capital-at-charge figures from 1938 to 1950 as rough approximations to productive capital. This we have done after[8] scrutiny of figures connected with capital-at-charge and productive capital from 1951 onwards. We are convinced that capital-at-charge can be used as a rough measure of productive capital.

On examination of the capital-at-charge figures from 1938-51, we find that there is negligible change in capital stock during the period. This lends belief to the assumption that productive capital has not grown since 1938 to any considerable extent. Hence, we have taken 1938 capital figures at 1951 prices and took the adjusted figure as base year capital. For these adjustments, British capital price indices have been used, since the bulk of capital during pre-Independence period was of British origin.

5.34 In measuring value of capital at constant prices of 1951-52 the following two types of deflators are used.

1. Machinery transport equipment prices index.
2. Relative prices index derived by dividing the capital price index by consumer price index.

In all empirical studies, the convention is to measure capital at constant prices of a base year by deflating the book value of capital by a composite index of relevant capital goods prices. Price series pertaining to the capital assets are not available. The data relevant to the proportion of capital expenditure on various components of assets are also not available. In the Railway Budgets, prices of rolling stock alone are published which refer to different types and quality of capital goods. Due to these reasons, we could not construct a composite index and hence we used the general transport machinery price index.

5.35 There is a wide divergence between the advancement of theoretical concepts and the concepts developed in empirical studies. The refined sophisticated theoretical concepts are not sufficiently reflected in empirical analysis. It is well-known that the micro-price theory is being replaced by a macro-price theory where it is the relative prices that are more important for resource allocation rather than the individual prices. If the prices of all the individual goods and services are proportionately increased, the economy is not disturbed at all. That is why for allocation purposes we have to adopt the relative shadow prices and not the absolute prices. In the absence of shadow prices, relative market prices are better than individual prices. In the present study to get the empirical

Table 5.2

GROSS FIXED CAPITAL AT BOOK COST AND CONSTANT PRICES

(Rs. Crores)

Years	Capital at Book Cost	Capital at constant prices		Index Numbers of		
		Deflated by Machinery Transport equipment Prices.	Deflated by Relative Prices.	Col. 1	Col. 2	Col. 3.
	(1)	(2)	(3)	(4)	(5)	(6)
1951-52	657	1662	551	100.0	100.0	100.0
-53	675	1679	568	102.8	101.0	103.0
-54	713	1712	602	108.5	103.0	109.2
-55	774	1769	656	117.8	106.4	119.1
-56	857	1844	725	130.4	110.9	131.5
-57	976	1951	835	148.6	117.4	151.6
-58	1124	2081	975	171.0	125.2	176.9
-59	1274	2210	1122	194.2	132.9	203.6
-60	1408	2320	1253	214.2	139.6	227.4
-61	1562	2442	1398	237.8	147.0	253.7
-62	1736	2577	1563	264.2	155.1	283.6
-63	1962	2747	1778	298.6	165.3	322.7
-64	2219	2930	2019	337.7	176.3	366.4
-65	2530	3147	2346	385.0	189.3	425.7
-66	2774	3310	2611	422.2	199.2	473.9
-67	2958	3420	2813	450.2	205.8	510.5
-68	3113	3509	2994	473.9	211.2	543.4
-69	3260	3592	3163	496.2	216.1	574.0
-70	3400	3668	3320	517.5	220.8	602.4
-71	3537	3736	3469	538.4	224.8	629.5
-72	3709	3816	3649	564.4	229.6	662.2

Source: Block Accounts, Part II, Annexure 'G'

Notes : (i) Capital figures for 1951-52 shown in Cols. 2 & 3 have been adjusted for price changes since 1938.

(ii) The relevant price indexes are given in Table 5.3.

Table 5.3.

MACHINERY TRANSPORT EQUIPMENT, CONSUMER AND RELATIVE PRICES INDEX NUMBERS (1951-52=100)

Years	Machinery Transport Equipment Price Indexes	All India Consumer Price Indexes	Relative Price Indexes
	(1)	(2)	(3)
1951-52	100.0	100.0	100.0
-53	112.6	100.0	112.6
-54	110.4	101.9	108.3
-55	109.0	95.2	114.5
-56	109.7	92.3	188.9
-57	111.4	102.9	108.3
-58	114.5	107.7	106.3
-59	117.0	113.5	103.0
-60	119.9	118.2	101.4
-61	126.0	119.2	105.7
-62	128.9	122.1	105.5
-63	132.8	125.9	105.4
-64	139.9	131.7	106.3
-65	144.1	151.0	95.4
-66	153.0	162.5	94.2
-67	168.7	183.7	91.8
-68	174.6	204.7	85.3
-69	177.5	203.9	87.1
-70	184.5	206.7	89.3
-71	200.0	217.3	92.0
-72	214.9	224.0	96.0

Sources: (1) Consumer Price Indexes are taken from Currency & Finance, R.B.I., Bombay.

(2) Machinery Transport Equipment Price Indexes are supplied on request by the Economic Adviser, Ministry of Industrial Production, Government of India, New Delhi.

(3) Relative Prices are derived by dividing col. 1 by Col. 2.

analysis as nearly as possible to the theoretical concepts, we have taken the relative price index as a deflator for capital measurement. We know that this is rather unusual, but as a humble pioneering effort, we have adopted this not ignoring the usual conventional methodology of using individual prices.

5.36 Table 5.2 presents two types of capital series in constant prices along with capital at book cost. Capital deflated with machinery transport equipment prices index stands at 230 (base 1951-52), an increase of 130%. Index of capital measured in relative prices is 662 as against book value of 564 in 1971-72. The following are the compound annual growth rates.

Book cost	10.3%
Capital in constant prices deflated by transport machinery prices.	4.9%
Capital deflated by relative prices.	11.2%

Growth of capital during the Second and Third Five Year Plan periods was high since the rate of investment was stepped up steeply to replace the worn-out capital and to meet the increasing traffic demand.

Since the movements in consumer price index and capital goods price index are almost uniform - vide Table 5.3, there is not much difference between the capital figures at book cost and at constant prices (deflated by relative prices).

Table 5.4

CAPITAL SERIES CORRECTED FOR UNDER-UTILISATION

(Rs.Crores)

Years	Corrected Capital Series at Constant Prices		Indices of	
			Col.1	Col2
	1	2	3	4
1951-52	1155	383	100.0	100.0
-56	1282	504	111.0	131.6
-61	1539	881	133.2	230.0
- 66	1986	1576	172.0	409.2
-72	2297	2197	198.9	573.6

Source: Computed from Tables 5.2 and 4.5.

Notes : 1.Col. 1 refers to capital deflated by Machinery Transport Equipment Prices.

2.Col.2 refers to capital deflated by Relative Prices.

3.Cols. 1 and 2 are calculated by correcting the capital figures in columns 2 and 3 of Table 5.2 with capacity under-utilisation vide Table 4.5.

Thus in our analysis it does not matter much whether we consider capital at book cost or in terms of relative prices. We shall now present capital series corrected for under-utilisation of capacity.

Under-utilisation of Capital — Corrected Capital Series:

5.37 In para 4.24 the overall capacity utilisation of capital of the Railways was discussed. The under-utilisation of capacity during the 21-year period varied between 30% and 40%. Since our objective is to measure technical change, the capital employed to produce the services has to be corrected for under-utilisation of capacity.

5.38 The corrected capital series are given in Table 5.4. Since the data for estimating under-tuilisation of capital is available only for certain points of time we have only 5 observations to cover 21 years. Capital deflated by machinery transport price index has grown by about 100%. The corrected capital in terms of relative prices has grown by about 474%. Such wide divergence in the two series is understandable since the methodology is different. In the next and final chapter, we shall discuss productivity and technical change.

A P P E N D I X

(Chapter-V)

APPENDIX TABLE 5-A
GROSS CAPITAL STOCK
(AT BOOK COST)

(Rs.Crores)

Years	Preli-minary Expen-ses	Land	Struct-ural Engg. Works	Equip-ment	Rolling Stock	General Charges	Misce-llaneous	Purcha-se of Mly.	Invest-ment in Shares	Total
	1	2	3	4	5	6	7	8	9	10
1951-52	3.90	16.1	429	32.8	195	36.5	25.7	62.6	2.21	804
	(0.5)	(2.0)	(53.4)	(4.1)	(24.3)	(4.5)	(3.2)	(7.8)	(0.3)	(100)
-53	3.94	16.4	440	34.4	201	37.0	25.8	62.9	3.07	825
-54	3.93	17.1	457	36.6	219	37.6	25.8	26.9	3.60	864
-55	4.19	17.4	487	40.1	247	38.9	10.6	69.1	4.12	918
-56	4.24	18.1	515	44.1	298	39.8	10.7	69.1	5.04	1004
-57	4.20	19.2	557	48.4	371	41.4	9.08	71.3	5.33	1128
-58	4.27	20.2	630	55.4	439	44.3	9.08	72.2	6.60	1281
-59	4.33	21.6	721	61.0	494	48.2	9.09	71.9	7.44	1443
-60	4.38	23.1	808	67.5	532	53.1	9.10	71.9	8.82	1578
-61	4.44	26.0	907	72.5	582	58.1	9.10	71.9	10.1	1741
-62	4.56	27.9	1004	80.0	652	65.4	10.2	71.9	12.0	1928
-63	4.27	31.0	1138	86.0	741	74.4	4.68	73.4	13.0	2153
-64	4.48	33.9	1289	93.1	837	85.3	4.67	73.2	13.7	2434
-65	4.82	27.8	1473	103	954	104	4.68	85.0	15.5	2732
-66	4.84	41.6	1600	114	1060	110	5.76	73.2	17.8	3027
-67	5.41	46.2	1708	125	1125	120	5.75	71.2	19.7	3226
-68	5.56	49.1	1789	135	1189	129	5.78	70.0	21.0	3393
-69	6.00	51.5	1864	141	1255	138	5.16	70.8	22.6	3554
-70	6.14	54.6	1931	152	1317	145	5.21	69.4	24.5	3705
-71	6.35	56.6	2007	162	1368	153	5.22	69.4	26.9	3855
-72	6.35	58.8	2089	181	1439	159	5.24	69.4	31.3	4069
	(0.2)	(1.5)	(51.7)	(4.5)	(35.6)	(3.9)	(0.1)	(1.8)	(0.8)	(100)

Source: Block Accounts, Part II, Annexure 'G'
Note : Figures in parentheses represent percentages.

APPENDIX - B

CLASSIFICATION OF CAPITAL EXPENDITURE.

Preliminary expenditure: This item includes the initial expenditure on surveys, location, preparation of plans and estimates on a proposed project. Though from an accountant's point of view, they may be classified under capital expenditure but they are not technically related to the output. Even if they are excluded, the results will not be distorted as they form a negligible proportion (less than 1%) in the total expenditure.

Land: It refers to all expenses pertaining to the acquisition of land including compensation paid to the occupiers for their houses or other properties situated on the land, damages paid, wage bill of the personnel deputed to value the property, etc. Land occupies relatively a small proportion in the capital structure. Besides, land is a non-reproducible type of capital and bulk of the land in the possession of the Railways was acquired at nominal price. Hence, its exclusion or inclusion will not make much difference.

General Charges and Miscellaneous: These include expenditure pertaining to the acquisition and construction with extensions and betterments to railway property which are not immediately assignable to the proper head of account. When they are assignable at a later date, the expenditure is transferred to the appropriate account. Thus, over a period of time, its relative share will be small and hence their exclusion will not vitiate the results.

Collieries: Upto March 1954, certain coal collieries were in the possession of the Railways. With effect from April 1954, they were transferred to the Ministry of Production, Government of India. Apart from this, like the capital employed in the Manufacturing Units, capital invested in collieries is not directly related to the output of the Railways. Hence, we have excluded capital stock of collieries.

Suspense: It is purely a book entry. All temporary entries of miscellaneous expenses which are yet to be settled are recorded under this heading. Sooner or later, these are transferred to the relevant account. Hence, capital expenditure under this head should not be considered.

Investment in Shares: It refers to the purchase of shares of commercial concerns by the Railways with a view to assist and control the operations of these concerns. Strictly, such expenditure should not be included in the productive capital.

Working Capital: Notwithstanding the fact, though working capital plays an important role in any enterprise, we have excluded it from the present study. Its exclusion is justifiable on the ground that growth of output is less influenced by it than the relation of technological factors on fixed capital to output.[1] The amount of working capital depends not on the technique of production but on various other factors. Besides, it is difficult to arrive at a suitable price index to correct for changes in prices since working capital has a peculiar composition.

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[1] Rosen also excluded working capital on the same ground. See G.Rosen, op.cit. p.43 and A.Banarjee, 'Productivity, Growth and Factor Substitution in Indian Manufacturing', Indian Economic Review, Vol. 6, No.1 (New Series), April, 1971.