INTRODUCTION.

The 'Magnificient Dynamics'[1] or classical economists, their theories of distribution, growth and ultimate stagnation were neatly built at a time when their society had just received the impact of Industrial Revolution. The classicals were aware of the significance of technical change but felt it can not successfully insulate profits from the withering effects of wage after rising rents are paid.[2] No wonder, they were skeptical whether the quick growth of aggregate output would last for ever. Thus the progress of 'Wealth of Nations' and the limitations of technical change with respect to diminishing returns were at the core of classical thinking.[3]

0.2 To Marx, technical change is growth of organic composition of capital. During capital accumulation, organic composition of capital rises leading to a decline of rate of profit.[4] He starts from his basic equation of

$$C+V+S = O$$

where C is constant capital i.e. sum of fixed capital and raw materials, V the variable capital i.e. the wage bill and S is the surplus and O is the output.

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1. W.J.Baumol, Economic Dynamics, Macmillion, New York, 1959, p.13.
2. Ibid., p.19.
3. P.A.Samuelson, Economics, Mc Graw-Hill, Kogakusha, New Delhi, 1973, p.737.
4. P.M.Sweezy, The Theory of Capitalist Development, Monthly Review Press, New York, 1956, pp.67-68.

The following ratios are derived from the above equation. $r = S/C+V$ (rate of profit), $q = C/C+V$ (organic composition of capital) and $S' = S/V$ (rate of exploitation). Mathematically it can be derived that $r=S'(1-q)$. Therefore as 'q' increases 'r' declines and to offset this tendency, S' (rate of exploitation) is raised leading to class conflict. Thus Marx uses technical change to substantiate his main thesis of class-conflict and the inherent contradictions of capitalist system.

The classicals including Marx failed to appreciate the real significance and potentialities of technical change. In fact they underestimated its potentialities.

0.3 To neo-classicals, growth was not the main interest and therefore they had very little to say about technical change. Value and distribution remained their major concerns as they had been of the old political economy of classicals, but they were no longer treated as incidental to the great question of growth of wealth but as central in themselves[5]. While the economy was growing there may be no need to wonder at the cause. It is not surprising that the greatest interest in economic growth should come at the initial stage of Industrial Revolution and again at initial stage of economic maturity[6]. The economist should not only be concerned

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5. R.D.Collison Black (Ed), Jevons the Theory of Political Economy, Penguin Books, England, 1970, p.9.

6. J.A.Kregel, The Theory of Economic Growth, Macmillan, London, 1972, p.9.

with methods of attaining growth of output but should pay proper attention to who receives the benefit and whether this distribution is conducive to continuous change and not a once-over change[7]. It is debatable whether a certain distribution of income is the cause of growth or merely an effect of it[8].

0.4 To post-Keynesians, which include neo-neoclassicals, growth has become the central of their models and therefore a study of technical change and distribution of income have assumed crucial importance.

0.5 The present analysis is concerned with one of the important variables in sources of economic growth — technical change leading to higher productivity in the context of growth of Indian Railways during the time span 1951-72. Despite the great importance of distribution in macro-analysis, the present micro-study is limited to one specific aspect of growth — technical change and productivity.

Ever since Solow's path-breaking article[9] on technical change, a number of follow-up studies have been published. The post-war period witnessed an upsurge of interest in the study of growth, productivity and technical change.

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7. J.A.Kregel, Rate of Profit,Distribution and Growth, Macmillan, London, 1971, p.1.

8. P.A.Samuelson, op.cit., p.759.

9. R.M.Solow, "Technical Change and the Aggregate Production Function", Review of Economics and Statistics, Vol.39,1957.

Technical Change and Production Function:

0.6 Studies of technical change are closely related with the concept of production function. The production function is generally that of Cobb-Douglas form following the neo-classical tradition or it is of the Robinsonian variety — her present nihilism regarding capital measurement apart.

A distinction is sometimes made between production function and production shifts. The former deals with existing known techniques (movement on the same production function) while the latter is concerned with changes in the existing techniques (shift in production function) due to inventions. For a developing economy, the distinction between production function and shifts is immaterial, since a shift is from one known technique to another which has been already adopted by advanced economies. However, the present analysis avoids the fine distinction between the production function and shifts.[10]

New Strands of thinking:

0.7 While analysing the present problem, the following importa questions emerged and they deserve further careful examination.

(1) Is measurement of capital in relative prices more appropri than the traditional individual prices? Can we use capita consumer price ratio indexes for adjustment of capital series? Since all sectors of the economy are inter-relate is there a tendency for the relative market prices to remain fairly stable? If so, is the historic value of capital a better reflection of true valuation? This thinking is provoked by Sraffa's input-output model - see paras 5.14 to 5.20.

10. Economists like Professor Kaldor do not make a distinction between production function and shifts. They treat movement along a production function as similar to shifts from one production function to another. See N.Kaldor, Essays on Economic Growth and Stability, Gerald Duckworth, London, 1960, p.265.

(2) In developing economies where capital is frequently used beyond its technical life, does the rise in inter-industry purchases, especially fuel and maintenance (Machine-wages), reflect depreciation? Can this data be used to compute depreciation on an approved scientific basis? - see para 2.10.

(3) Can technical change be measured using the Robinsonian production function? We have evolved such a tentative methodology in the last chapter - see paras 6.14 and 6.15.

(4) Is the concept of real-wage cost (W_c), money wage deflated by output prices, a better tool of analysis of productive relations? We have used this concept extensively - see paras 3.20 and 3.21.

Synopsis of Chapters:

0.8 The first chapter, as usual, is an historical perspective. It has been written briefly to come to analytical chapters quickly. But it is a necessary chapter for an easy understanding of the later crucial chapters.

0.9 The second chapter deals with output and we have adopted the gross value added concept. Since labour and capital are deemed as inputs, the sales value output is not logically correct. We have presented a detailed discussion of different methods of measurement. An attempt has been made to aggregate physical output of goods and passenger traffic.

0.10 The third and fifth chapters deal with the two inputs — Labour and Capital which are heterogeneous in character and problems of aggregation occur in both. Different categories of labour are converted into a homogeneous quantity using wages as weights. Labour productivity is correlated with real

wages and real wage cost. We have also analysed the pattern of growth of different classes of employees and their money and real wages.

0.11 Measurement of capital is the main unresolved problem in capital theory. In fact, the present 'Two Cambridges' controversy, between the giants on either side of Atlantic, resolves around valuation of capital. One set of economists is very skeptical whether capital can ever be measured even conceptually. Sraffa's inimitable book 'Production of Commodities by Means of Commodities'[11] raises very serious doubts about the futility of measuring capital. The old Ricardian problem of value, as reflected in Wicksell effects and switching and reswitching controversy, makes the problem of measurement of capital hopelessly difficult. Therefore, certain amount of departure from pure theory has become inevitable. The chapter on capital is timidly bold. An attempt is made in presenting a new measurement based on relative prices of capital and consumer goods. A suggestion is thrown that unadjusted book value of capital is more in consonance with theoretical formulations. However, the traditional empirically accepted method of measurement based on constant prices is not discarded to protect the thesis from the charge of too much academic radicalism.

0.12 The fourth chapter is with reference to evaluation of levels of under-utilisation of capital of different types.

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11. P.Sraffa, Production of Commodities by Means of Commodities, Cambridge University Press, Cambridge, 1960.

We have estimated the capacity utilisation ratios of four important types of capital assets viz. track, locomotives, wagons and passenger vehicles. This chapter has an unique difficulty of finding a solution for different levels of utilisation of various types of capital in the same enterprise. The problem of reconciliation is solved by taking into account that type of capital which can first attain full utilisation when efficiencies improve.

0.13 The last chapter (sixth) is on productivity and technical change, where mutual relationships between labour, capital and output are studied. The cause, nature, measurement and description of technical change are attempted in this chapter. A new method of measurement of technical change based on Robinsonian production function is attempted. The logic of the new method is examined but calculations are avoided for reasons explained in the chapter.

0.14 Postal consultations were held with a number of transport economists in different parts of the world. At relevant places references are indicated.

SOURCES OF DATA

All the data relate to financial year from 1st April to 31st March. The main source of data is the official statistics published annually by the Railway Board, viz. 'Report by the Railway Board on Indian Railways - Vol.II'. From 1960 onwards, this publication has been named as 'Supplement to the Report by the Railway Board on Indian Railways -- Statistical Statements'. Hereafter, they are referred to as 'Supplements'. All statistics pertaining to output, rolling stock, track, labour, wages, profits, income, expenditure, etc. are collected from the Supplements.

Track statistics of capacity are computed from 'General Managers' Annual Reports', which are published by the respective Zonal Railways and records of the Railway Board. Capital figures, in financial terms, are taken from 'Appropriation Accounts of Railways in India, Part II, Annexure - G' for various years. To determine the share of inter-industry purchases, the annual Railway Budgets are made use of. Some information is collected from Railway Board's other annual publications like 'The Review of Performance of the Indian Government Railways', 'Indian Railways'.

Apart from the above mentioned publications, some data are collected from various articles and books. We have to fall back on interview-method to collect some information which is not published in the official publications. At the relevant places, the sources of data are mentioned. The methods adopted to adjust the data are discussed in the relevant chapters.