Chapter I

INTRODUCTION

1. Background: A Look Back at Earlier Studies

What sources lead to the growth of output in the long-run? Is the relationship between aggregate output and the sources of its growth essentially a technical one? These are some of the issues that seem to have created enough unrest in the minds of economic theorists since long. In their quest to resolve some of these issues, economists discovered land, labour, capital and also technical change as the proximate sources of growth of real output. However, relative importance which they placed on each of these sources, or group of sources, has varied from time to time.

Early economists believed that growth of real output was primarily a function of growth in quantities of inputs. It does not mean however, that these economists were unfamiliar with the concept of technical change. Adam Smith was quick in noting the importance of this factor.¹ He distinguished both labour saving

and capital saving technological changes. Smith was of the view that these changes occur through the invention and application of improved machinery and division of labour, and increase the per capita income by enabling one man to do the job of many.\(^2\) Technical change was not ignored by Ricardo. He, however, did not believe that these changes could be powerful enough to prevent the operation of law of diminishing returns. Instead, he believed that output growth could proceed only through the growth in capital accumulation, and as latter was sure to cease due to the declining tendency in the rate of profit, increase in real output could not continue indefinitely.\(^3\) Marx

\(^2\) A. Smith, op. cit. p.7.


For Ricardo's views on economic progress and technological change, see:


while noting the importance of technological change as a prime mover in the development of a capitalist economy, ended with similar pessimism about the prospects for future economic growth. Thus, while these economists took cognisance of technological change as an important factor in economic growth they failed to appraise its powerful effect on output growth in the long-run. This is because they believed that such changes occur very gradually, causing only a temporary disturbance in equilibrium.

Neo-classical economists considered technological change as purely an exogeneous factor. They also under-emphasised its role because of their pre-occupation with static equilibrium analysis, involving maximisation

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5 A. Heertje, op. cit., pp.35-36.
of output with optimum resource allocation. They failed to realise that "economic growth is, in many important respects, a learning process, a process where by the human factor acquires new skills, aptitudes, capabilities and aspirations. And a pattern of resource use which may maximise output from a given stock of resources may or may not generate the qualitative changes in the human agent which are most conducive to the growth of output in the subsequent time periods."  

Since the middle of the twentieth century a major change has occurred in economic ideas about the relative importance of increase in factor quantities and technological change in the process of economic growth. Empirical work, mostly for the economy of the United States, has shifted the emphasis from increase in factor quantities as a major source of output growth to technological change. J. Schmookler, F.C. Mills.

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7 Ibid.


S. Valavanis-Vail, 10 J. W. Kendrick, 11 M. Abramovitz, 12
and S. Fabricant 13 are the protagonists of this view. Differences among them are no doubt there, but a broad conclusion emerging from their studies is that during 1869 to about 1955, only a small percentage increase in per capita real output in the United States could be explained as due to the increase in traditionally measured inputs viz. labour, capital and land; the unexplained residual growth being attributed to the contribution of technological change. Solow 14 using the explicit assumption of an aggregate production function wherein technical change was measured as a shift, succeeded in establishing a theoretical base for measurement of sources of growth. Accordingly he showed


that during 1904–1949 about 87½ per cent of the increase in per capita gross real output could be accounted for as the contribution of technological change.

After Solow, 15 many attempts have been made to enrich this theoretical basis empirically and otherwise. Attempt has been to shorten the large residual which had remained unexplained in the earlier studies and inhibited the understanding of the sources of growth in the economy. Solow’s 16 own attempt has been important. He tried to achieve this objective by measuring the part of productivity growth or technical change embodied in capital. Denison made a distinct advance in this area in his 1962 work, 17 further refining and updating it in his subsequent studies. 18 He shortened the size of the


residual by ascribing a part of its growth to factor inputs, especially the labour, by measuring the effect of quality changes embodied in them. According to him, education, the main source of increased labour quality, contributed 23 per cent of the output growth in the United States during 1929–1957, which was more than the contribution of physical capital (15 per cent). The total factor input including quality change is estimated to have contributed 68 per cent of the growth of real income. The residual growth of 32 per cent has been further shortened by identifying and measuring a number of sources like economies of scale, resource allocation, shift of labour from agriculture to industry etc. Denison's final residual which he terms 'advances in knowledge' contributes only 20 per cent of growth. In his latter works he has identified and measured many other sources of growth like irregularities in the pressure of demand, fluctuations in farm output etc.


Others, after Denison, continued the analysis of the sources of growth further, by extending the list of previously identified and measured variables. Much of this effort has been on the lines of allocating more and more growth to traditional factors by developing more comprehensive measures for labour and capital input. Gallop and Jorgenson's study uses the concept of a massive real input. Labour input in their study has been adjusted for changes in sex, age, occupation, education and the type of employment while capital input has been adjusted for six asset classes and three legal forms of organisations. Christenson, Cummings and Jorgenson make similar adjustment for measurement of real capital input.

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21 The Six Asset Classes are:

i. Producers durable equipment,
ii. Consumers durable equipment,
iii. Residential structures,
iv. Non-residential structures,
v. Inventories, and
vi. Land.

The legal forms of organisation are (i) Corporate business, (ii) Non-corporate business, and (iii) Household business.

While these studies seek to narrow the residual by adjusting factor inputs for quality changes, others try to explain its size by making separate estimates of the sources making up the residual. 23

Though most of the empirical studies on the measurement of the sources of growth have been carried-out for developed economies, some break-through has been made in case of developing economies also. Quite in contrast to the developed economies, all these studies conclude that major source of economic growth is the increase in traditional factor inputs; technological change appears to have made relatively a small contribution.

Bruton 24 dealing with sources of growth in 5 Latin American countries estimated that during 1940-64, technical change contributed 25 per cent of the economic growth. 23 Kendrick has estimated the effects of growth in intangible capital stock resulting from investment in health, education and training, research and development etc. in contributing to the growth of the residual. See, J.W. Kendrick, The Formation and Stock of Total Capital, NBER, New York, 1976.

growth in these countries. Gaathan's\textsuperscript{25} study shows that in Israel during 1950-65, total factor quantity and total factor productivity accounted for two-thirds, and one-third of the economic growth respectively. A cross-section study by S. Robinson\textsuperscript{26} for 39 developing countries during 1958-66 revealed that 72 per cent of the measured growth was due to increase in labour and capital inputs. Of the remaining 28 per cent contributed by technical change, he estimated that 16 per cent was due to shift of resources from farm to non-farm activities.

Some other studies which count quality changes as a part of increase in factor quantity, estimate still larger contributions of factor quantity and smaller contribution of technological change. Using such an approach Correa's\textsuperscript{27} study for 9 developing countries


reveals that increase in factor quantity and quality contributed about 50 to 94 per cent of growth of income in these countries. Maddison's²⁸ study relating to 22 developing countries shows that during 1950-65, growth of capital with an average contribution of 55 per cent was the most important source of output growth. Adjusting labour input for quality changes due to increase in levels of health, education and migration of labour from agriculture to industry, he estimates the contribution of labour input to be 35 per cent. Thus, 90 per cent of growth in his study turns out to be the contribution of labour and capital; remaining 10 per cent of being the contribution of technological change. Out of 22 developing countries, Maddison finds that five had negative residual growth due to decline in resource-efficiency.

A few studies on the measurement of sources of growth have been made specifically on India also. Applying basically the same methodology as used by Denison,

Dholakia has estimated that during 1948-49 to 1968-69 total factor productivity in India grew at a rate of 0.92 per cent per annum, the technological change contributing 28.70 per cent of the growth of real output during the period. Bramhananda's study shows that during 1950-51 to 1980-81 total factor productivity in India grew at an average compound rate of 1.16 per cent per annum, technological change contributing 32.86 per cent of the output growth.

The Present Study

While the macro studies for India mentioned above have their own significance, significantly varied growth experiences of regional economies within the large country, make it interesting to carry out such studies at regional or state levels. Such studies, if available for different states would not only throw greater light on the pattern of growth observed for the national economy, but would also enhance our knowledge about the causes of inter-state growth differentials. Since economic decisions to accelerate the pace of growth

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29 B.H. Dholakia; Sources of Economic Growth in India, Goods Companion, Baroda, India, 1974.

30 P.R. Bramhananda, op. cit.
of any state including the decisions to mobilise resources for implementing various programmes (while guided by the broad objectives set at the national level) are taken mostly at the state level, it appears necessary to obtain a greater insight into the pattern of growth in the state economy and the relative contributions made by various sources to its past growth. Present study is a modest attempt in this direction.

The unit selected for the purpose of the study is Uttar Pradesh. U.P. with a population of 11.09 crores and an area of 29.4 lakh sq. km. accounts for 16 per cent of total population and 9 per cent of total area in the country. The population of the state has been increasing at an alarming rate. It has jumped from a rate of 1.8 per cent per annum during 1960-61 to 1970-71 to 2.3 per cent per annum during 1970-71 to 1980-81, which is higher even the national rate of growth of population.\(^3\) While important in terms of population and area, the state is among the most backward in the country. The state economy which largely stagnated

during the First Three Five Year Plans, during the First Three Five Year Plans, 32 started growing gradually thereafter, and, since the mid-seventies it seems to have picked up the momentum of growth. 33 Since 1974-75 growth rate has increased in all the three broad sectors primary, secondary and tertiary compared to the growth rates experienced during the earlier period since 1960. However, with population increasing at an alarming rate and very little prospects of increasing land area to be put into the productive use, reliance is to be placed on increasing use of capital. However, no significant improvement in the economic condition of the masses is likely to occur in the State unless resources are used more


(iv) G.S. Kushwaha, "Rate of Economic Growth in Uttar Pradesh and Reasons for Its Retarded Development", in Economic Backwardness of Uttar Pradesh, op. cit, pp. 51-56.

productively. A quantitative appraisal of the relative contributions made by various sources including total factor productivity or technical change to the growth rate of output in the past could therefore, prove useful for this purpose.

3.2 Objectives and Methodology

Main objective of the present study is to measure the contributions of traditional factors viz., land, labour and capital, and also of the technical change in contributing to the economic growth of the State and its broad sectors, i.e., primary secondary and tertiary. It also seeks to assess their relative importance in contributing to the growth of the State economy and its broad sectors.

Towards the fulfilment of the central objective as stated above the present study has also to:

i. measure the economic growth in the State economy during the reference period selected for the study.

ii. obtain the functional break-up of State income among the primary factors land, labour and capital for the reference period.
iii. measure the quantitative and qualitative growth of labour input in the State economy for the reference period.

iv. measure the growth of capital and land inputs in the State for the same period as above.

Quantitative assessment of various sources for the economic growth of the State would be made following total factor productivity method in the neoclassical framework. The methodology assumes that growth rate of real output in the economy is composed of growth rate in total factor quantity and growth rate in total factor productivity. However, the latter can not be measured as such and is obtained as residual after subtracting the rate of growth of total factor quantity from the growth rate of real output. Thus the crux of the method lies in computing a measure of total factor quantity and its rate of growth during the reference period.

The measure of total factor input or total factor quantity usually includes the traditional factors viz:

34. The two terms 'technical change' and 'total factor productivity' are in fact not equivalent to each other. However, in conformity with the usual practice in empirical economic literature, these two would be used interchangeably in the study.
land, labour and capital. However, as these factors are measured in different units and grow at different rates over time, the measurement of aggregate growth of factor inputs is done by using index numbers of these inputs. Series of input indices are combined to obtain the index of total factor input. Percentage share of each factor in the net product is used as weight for aggregating the indices. Use of income share for this purpose assumes that marginal product of each factor is equal to its price, so that a one per cent increase in any input, keeping other inputs constant, results in increasing the total product by the percentage amount earned by that factor.

Growth rates of total factor input obtained from the combined input index when subtracted from the growth rate of real output would yield the rates of change of total factor productivity or technical change. Contributions of different inputs constituting the index of total factor input would be measured as the product of the growth rate of the input and its percentage share in output during the period. Various steps in the methodology are listed below:
1. Estimation of long-term rate of growth of the State economy, on the basis of time series of real income in the state over the reference period, that is twenty years from 1960-61 to 1980-81.

2. Obtaining functional distribution of State income into, labour, capital and land for the study period.

3. Construction of time-series of indices of factor inputs viz., labour, capital and land and estimation of average rate of growth of each during the study period.

4. Derivation of total factor input index as a weighted sum of the three traditional inputs, weights being the percentage shares of these inputs in net domestic product.

5. Estimation of contributions made by total factor input and its different constituents, and of total factor productivity or the technical change to the growth rate of real output.

Relative importance of total factor productivity in effecting the rate of growth of output would be measured in two ways - (i) treating technical progress
as purely disembodied i.e. without making any adjustment in factor inputs for qualitative changes, and (ii) treating it as partly embodied by making adjustment for the quality of labour as affected by increased education and changing sex-composition among workers.

The present study proposes to undertake the sources of growth analysis in broad sectors also. Thus output, input, and total factor input indices would be prepared for three broad sectors viz., primary, secondary and tertiary.

4. Plan of the Study

The Chapter plan of the present study is as follows:

The present introductory chapter dealing with background, objectives and method of study is followed by the exercise in the measurement of economic growth in Uttar Pradesh (Chapter II). The main aspects of this exercise include the concept and methodology of State Income estimation, trends in growth rate of real income during the reference period 1960-61 to 1980-81,
in aggregate and in the broad sectors: primary, secondary and tertiary.

Chapter III on Factor Incomes by Distributive Shares seeks to develop a set of weights for combining indices of factor inputs land, labour and capital. An exercise to prepare these estimates for major sectors of the state economy has also been undertaken. Growth of labour input in Uttar Pradesh is measured in Chapter IV. It attempts to develop an index of the growth of working force in U.P. after making adjustments to account for the definitional changes from Census to Census to make the data comparable. It also attempts to measure the qualitative growth in labour input due to increased education and changing sex-composition of the workforce.

Chapter V attempts the measurement of capital and land input in Uttar Pradesh during 1960-61 to 1980-81. After reviewing the problems in the measurement of real capital, an exercise has been made to build the capital input series for the primary, secondary and tertiary sectors and for the economy as a whole.
The major objective of the present study of measuring contribution of sources of growth is the subject matter of Chapter VI. The series of labour, capital and land prepared in earlier Chapters have been combined to develop the index of total factor input. Absolute and relative contributions of sources of growth have been measured using average growth rates of factor inputs, total factor input and real output. Similar exercise has been carried out for broad sectors also. The last Chapter (VII) summarises the main findings of the study and concludes by pointing out their implications relating to long term growth process and resource-use-efficiency in the State economy.