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SOURCES OF GROWTH OF THE INDIAN ECONOMY*

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SUMMARY. An attempt has been made in the paper to explain the growth of real national income in India since the turn of the century in terms of inputs of two principal factors, labour and capital, using an approach used by Abramovitz, Denison and others. The entire economy and its two major sectors, agriculture and the rest, have been separately studied. It has been found, among other things, that the combined factor inputs explain almost the entire rate of growth of agriculture during the pre-independence period, showing little changes in factor productivity. Since then a third of the growth rate is due to enhanced factor productivity. Coming to the entire economy, for the time horizon up to 1960-61, again a third of the growth rate is due to improvement of factor productivity and the remaining two thirds is attributable to growth in the combined factor input. This and similar other results, for sub-periods as well as under two definitions of capital including and excluding rural land, are of interest, though it is difficult to take them as definitive findings, in view of the various weaknesses of the data base. Of these, the weakest is the information on labour force, taken to measure the labour input.

1. INTRODUCTION

1. Two considerations have prompted me to submit this paper for the present volume. First, Professor Mahalanobis, as the Chairman of the Indian National Income Committee, 1949-54 initiated the regular official estimates of national income in the country. Despite uncertainties of the official estimates due to the inadequacy of observational base, that some conclusions about our post-independence growth can be drawn is entirely due to his foresight, and conviction that having an annual series of nation's output cannot wait till we get satisfactory estimates of all its components. Second, Professor Mahalanobis was surely conscious of the various inadequacies of our macro-constructs of national income, labour force, etc. Yet he courageously used these for purposes of formulation of Indian plans, demonstrating that *a priori* guarantee of perfection of data need not be a condition for their effective use and perhaps hinting that he considered the relevant Indian information good enough for his purpose. We attempt here to explain the rate of growth of Indian national product during the present century in terms of rates of growth of reproducible capital and labour force within the framework of a Denison-Abramovitz model (Denison,

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1962 and 1967; Kendrick, 1961; Abramovitz, 1956; Kuznets, 1964) and hence, have to depend on more uncertain statistics than those used for Indian plans. But we take courage from Professor Mahalanobis' attempts at using macro-economic constructs for policy purposes, and we are more or less convinced that unless such and similar other analytical uses are attempted on the basis of data that are available or can be compiled within a reasonable time (as in the case of our estimate of reproducible capital), it is idle to hope that the data base will improve in future. In view of the uncertainty about the informational content, our conclusions cannot obviously be definitive, but if the scheme of analysis remains valid, it should yield more interesting conclusions once we have confidence about the information that has been fed in.

2. In view of this, we must give some reasons justifying our fool-hardy attempt. First, there is an intrinsic interest in the subject and as such it is worth trying to identify and study the sources of growth. Second, while the estimates for the preindependence period are of dubious value, those for the post-independence period are somewhat more adequate. Third, not enough work of this type has been done for poorer countries. (Bruton, 1967; Correa, 1970; Psacharopoulos, 1969; Voloudakis, 1970; Nadiri, 1972; Mukherjee and Roy, 1967) and the attempt here may at least give a plan of analysis, if not significant positive results. Finally, the model of analysis, if a sound one, brings out certain interrelations among the relevant variables, and it is worthwhile to study the interrelated system even with plausible trial estimates of variables. Such an exercise could help us in evolving a model, which would give sound results when accurate data are fed in, at some future date.

3. For growth of national income during the period, we accept S. Sivasubramonian's series for the period 1900-01 to 1946-47 and the official series for the period 1948-49 to 1960-61. The way the two series have been spliced has been indicated in Notes to Table 1. The conventional explanatory variables, capital and labour inputs going into a year's production, should be measured respectively by the capital used up in the process of production and the man-hours of labour put in. In the absence of the estimates of latter in India, we have used the substitute, labour force. When we consider a fairly long period of time, I think one is permitted to assume that the capital and labour inputs have changed in proportion with the respective stocks. All this shows that in India, available data permit a cruder type of analysis than what is possible in some advanced countries in which better idea of capital and labour inputs can be had. For example, we do not have any historical series on employment measured by man-days or man-hours, which would have given a closer idea of the actual labour input.

4. I do not see any harm in using capital and labour as the two basic inputs; I cannot think of any other input that can be put in the same category. In other words, a Cobb-Douglas type of production function formulation seems to be a reasonable starting point, provided we take it to imply that we have some knowledge of the output (as measured by us) when we have some knowledge of the two dependent variables.

5. There is a tendency to think about other explanatory variables. For example, why not take consumption of fertilizers in India for explaining agricultural growth ? Or, should not one reckon some significant current inputs, say, production of coal, or of electricity as causative factors in the non-agriculture sector ? These may explain the growth here better than the basic causative factors. However, logically, I am not inclined to use components of output which have been used to measure growth as explanatory factors in the system. The overall explanation of growth has to be in terms of some identifiable and measurable entities that are different from current output which is being explained. The use of capital stock and labour force is justified on this count. Even when we think in terms of annual capital and labour services put in, while their returns must add up to national income, the services considered are factor services and are distinct from the collection of goods and services comprising national income as produced.

6. In identifying sources of growth for the poorer countries, I think it is important to reckon the structural changes in the economy as an explicit explanatory variable. Pre-independence growth of India in the present century was largely mediated through the expansion of the non-agriculture sector, the agriculture only showing a very small rise. Thus, for a study of sources of growth, it is important to distinguish at least agriculture and non-agriculture sectors, and also observe the interaction between the two sectors. Sizably larger rate of growth in the non-agriculture sector in India is largely due to the use of relatively modern technology in many activities included in the sector, the growth of the share of non-agriculture sector in NNP giving a crude measure of the use of improved technology. Secondly, study by sectors, keeping an eye on intersectoral relations, can take care of the produced inputs as factors explaining growth, provided we are prepared to go into details. Thus, we can use production of fertilizer as a factor explaining agricultural growth since this is not an output of agriculture. It is agreed that here we avoid only a logical rather than a practical difficulty. No attempt however has been made in this paper to follow up the idea just outlined.

7. It is perhaps also useful to take account of natural factors like rainfall in a predominantly agricultural country. It is a free gift of nature, and is not normally included as an explanatory variable. While land and irrigation works enter under capital, and fertilizer production through sectoring, rainfall, temprature, etc., are completely missed. I think it is important to include these when they have large influence on the output. We have not, however, taken up the problem here.

8. All other conceivable explanatory variables can perhaps be covered under qualitative improvements of capital and labour inputs. Technological changes are mostly embodied in capital, and improvement of educational and health standards in labour. Organizational improvements in production, on the other hand, involve an interaction of capital and labour. Most of these can be included conceptually provided wider definitions of capital and labour are used. In practice, however, tremendous statistical difficulties are to be encountered, even in advanced countries, to cover such items and to use comprehensive measures of capital and labour in this sense. Indian data do not permit even an exploration of this field.

2. ESTIMATES AND FINDINGS

9. In sum, all we have succeeded in doing in this paper is to obtain a series of capital stock and a series of labour force for the period 1900-01 to 1960-61 split up into two sub-periods, 1900-01 to 1946-47 and 1946-47 to 1960-61, the pre-independence and the post-independence periods. The year 1946-47 is used as the cut-off point simply because Sivasubramonian's series ended in the year. The series of capital stock and labour force have been split up by agriculture and non-agriculture sectors. We are thus able to explain the growth of the agriculture and non-agriculture sectors separately in terms of our inputs. In addition the global growth can also be explained in the same manner. We have used two concepts of capital in our study, reproducible tangible wealth (RTW) and RTW plus land. Since land is a very important capital asset in agricultural production, we thought that it will be desirable to use capital inclusive of land in one variant of our analysis.

10. Table 1 below gives the estimates of income, labour force and capital used in our study. The way the estimates are derived and the source material used are given in the Notes attached to the table. The estimates are given at decade intervals commencing from 1900-01, with the exception of the year 1946-47 which has to

TABLE 1. BASIC DATA USED IN THE ANALYSIS

	year	national income at 1960-61 prices Rs. crores			labour force in million			capital stock at 1960-61 prices : Rs. crores					
								exclusive of land			inclusive of land		
		A	nA	T	A	nA	T	A	nA	T	A	nA	T
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1.	1900-01	3151	1599	4750	80.0	31.4	111.4	5394	3173	8567	21621	4290	25911
2.	1910-11	3632	2207	5839	91.2	20.2	111.4	6102	4147	10249	24458	5268	29726
3.	1920-21	3341	2393	5734	89.9	28.0	117.9	6211	5723	11934	24898	6937	31835
4.	1930-31	3694	3451	7145	90.5	30.1	120.6	6371	8310	14681	25538	9756	35294
5.	1940-41	3825	4093	7918	96.5	34.3	130.8	6500	11943	18443	26056	13851	39907
6.	1946-47	3996	4470	8466	100.1	36.8	136.9	6581	14493	21074	26542	16875	43417
7.	1950-51	4532	4710	9242	102.5	34.8	140.9	6725	16390	23115	26956	19088	46044
8.	1960-61	6161	7133	13294	140.9	47.5	188.4	7690	24470	32160	30825	27881	58706

geometric rates of growth per year

9.	1900-01 to 1960-61	1.12	2.52	1.73	0.94	0.72	0.88	0.53	3.46	2.23	0.59	3.17	1.37
10.	1900-01 to 1946-47	0.52	2.25	1.26	0.49	0.34	0.45	0.35	3.36	1.98	0.45	3.02	1.13
11.	1946-47 to 1960-61	3.14	3.39	3.27	2.47	1.84	2.31	1.12	3.81	3.06	1.07	3.65	2.18

Notes on *Table* 1 : *Upper Panel* : *Cols.* (2)-(4) : *Lines* 1-6 : Sivasubramonian's estimates at 1938-39 prices by industrial origin for pre-independence area of the country (taken from his Ph.D. thesis, National Income in India, 1900-01 to 1946-47), were converted into percentage shares and his aggregates were adjusted for the Indian Union area by multiplying his per capita figures by the population of the Indian Union. The actual figures in the table are obtained by redistributing

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Indian Union aggregates by Sivasubramonian's percentage shares and then raising the figures to 1960-61 price base generally with the aid of national income deflators available for post indepen-dence period. Thus, for the period up to 1946-47, the growth rate of national income is identical with that in Sivasubramonian's thesis. There is, however, one exception in line 6, where Siva-subramonian's income aggregate is distributed between agriculture and non-agriculture by using Mukherjee's estimates of shares given in the *National Income of India : Trends and Structure*, p. 13, because Sivasubramonian's agricultural share for this year appeared unduly low.

Lines 7-8 : Estimates are based on the conventional national income series at 1948-49 prices for the years, but the aggregate for 1960-61 adjusted to the revised estimate for 1960-61, with corresponding changes in the other figures. The procedure naturally brings all the figures to 1960-61 price base, and the most important comparison relating to the aggregate net output over the sixty year period makes use of the generally acceptable current estimates. This state-ment, however, does not hold true for the agriculture (A), non-agriculture (nA) breakdowns for the two years. The procedure is unavoidable in the absence of revised estimates for 1950-51. Acceptance of 1960-61 revised series for sectoral breakdown would have given unrealistic sectoral rates of growth for the recent period when used in conjunction with the accepted 1946-47 break-downs. The figures used result in rates of growth of A and nA which compare well with those based on conventional series for 1948-49 to 1960-61.

Cols. (5)-(9) : *Lines* 1-8 : The figures are taken from B. R. Kalra, Census of India 1961 : Final Population Table, Appendix : A note on working force estimate, 1901-61.

Cols. (8)-(13) : *Lines* 1-8 : Figures are based on my paper 'An exercise in the estimation of the growth of tangible wealth in India since 1900', *Indian Economic Journal*, 19, No. 2, October-December, 1972, pp. 222-243. The estimates in the paper relate to reproducible capital stock and land and the estimates at 1948-49 prices are available by decades starting from 1900-01. These figures are converted to 1960-61 prices using an investment cost deflator based on capital forma-tion estimates at current and at constant prices. The land values were given separately by urban and rural areas in the paper. The breakdown of the RTW by agriculture and non-agriculture sectors for 1950-51 was on the basis of detailed calculation for March 1950 by Mukherjee and Sastry in 'An estimate of tangible wealth of India', *Income and Wealth Series* VIII, Bowes & Bowes, London, 1959. These were carried forward to 1960-61 using the capital stock estimates for March 1961 given in 'Estimates of tangible wealth of India', *Reserve Bank of India Bulletin*, January 1963, pp. 8-19 and estimates of capital formation prepared in the CSO and given in R. N. Lal's 'Capital formation in India, 1950-51 to 1965-66', 7th Indian Conference on Research in National Income and Wealth, 1970, (mimeo). The agricultural RTW was then carried over to the other years, by and large, in relation to rural land value. Cols. (8)-(10) present figures of RTW only while the remaining columns give figures of RTW plus land.

Lower panel : The estimates are all annual geometric rates of growth computed from the end points.

be introduced for the choice of the two sub-periods of our analysis. The lower panel of the table gives the annual geometric rates of growth of the variables considered for the two periods as well as the combined period. Contributions of factor inputs worked out from this table are given in Table 2, the procedure of computation being indicated in Notes on Table 2.

11. From Table 1 we see that the overall rate of growth of real national income was 1.73 per cent per year during the 60 year period covered. The rate of growth was considerably higher for the post-independence sub-period, and consequently was modest during the pre-independence period. Secondly, in all the periods, the agri-cultural growth lagged behind that of the non-agricultural sector, though the two

TABLE 2.   ALLOCATION OF THE SOURCES OF GROWTH OF REAL NATIONAL INCOME

					explanation of the sources of growth : annual growth rates				
sector	period	labour input	capital input		comb. factor input		increase in output per unit of input		national income per capita
			excl. land	incl. land	excl. land	incl. land	excl. land	incl. land	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
agriculture	1900-01 to 1946-47	0.40	0.06	0.08	0.46	0.48	0.06	0.04	0.52
	1946-47 to 1960-61	2.02	0.21	0.19	2.23	2.21	0.01	0.03	3.14
	1900-01 to 1960-61	0.77	0.10	0.11	0.87	0.88	0.25	0.26	1.12
non-agriculture	1900-01 to 1946-47	0.25	0.88	0.79	1.13	1.04	1.13	1.22	2.26
	1946-47 to 1960-61	1.36	0.99	0.95	2.35	2.31	1.04	1.08	3.39
	1900-01 to 1960-61	0.53	0.90	0.82	1.43	1.35	1.09	1.17	2.52
Indian economy	1900-01 to 1946-47	0.36	0.41	0.23	0.77	0.59	0.49	0.67	1.26
	1946-47 to 1960-61	1.80	0.67	0.48	2.47	2.28	0.80	0.97	3.27
	1900-01 to 1960-61	0.70	0.46	0.28	1.16	0.98	0.57	0.75	1.73

Notes :   The shares of income from assets in national income were respectively 18.3 per cent in agriculture and 26.7 per cent for non-agriculture in 1950-51 according to estimates by Narayanan and Roy (The movements in distributive shares in India, 1948-49 to 1957-58, *Papers on National Income and Allied Topics*, **III**, 1965, pp. 75-114. These figures were adopted for 1900-01 and 1946-47. The weighted combination for the national economy for this percentage, however, was 20.7 in 1900-01 and 22.2 in 1946-47, against 22.4 for 1950-51. For all periods, the rates of growth in Table 1 were multiplied by the base period factor shares, giving the figures in this table.

are close for the post-independence period. Labour force grew at the rate of 0.88 per cent per year for the 60 year period. Its growth for the post-independence period was very fast, and this is probably partly due to definitional reasons. Further in all the periods, agricultural labour force moved more rapidly than the non-agricultural labour force. Coming to RTW, we see that its growth during the 60 year period was 2.23 per cent per year or slightly above that of real income. But during the period, the rate of growth of agricultural capital was lower than that of agricultural income while that of non-agricultural capital was larger than that of non-agricultural income. The same pattern persists for the two sub-periods, though in the post-independence period, the growth of income was somewhat faster than that of RTW. The inclusion of land, reduces the rate of growth of capital for the non-agricultural sectors to some extent and substantially for the national economy. On the other hand, the rates of growth of agricultural capital are not substantially altered by the inclusion of land.

12. Cols. (3)-(5) in Table 2, give the products of rates of growth of the factor inputs and the base period factor shares, and cols. (6) and (7), the combined factor inputs under the two definitions of capital. Cols. (8) and (9) are obtained by deducting

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the part of the growth of income explained by combined factor inputs from the growth rate of per capita income shown in col. (10), thus showing the contribution of the changes in factor productivity. We observe that combined factor input explains almost the entire rate of growth of agriculture during the pre-independence period, showing little change in factor productivity. In the post-independence period on the other hand, roughly two thirds of the growth is explained by the combined inputs, the residual one-thirds representing the growth in factor productivity. During the 60 year period, the contribution of productivity growth is somewhat smaller, being a little more than 20 per cent.

13. In the non-agricultural sector, the contribution of factor productivity is much larger, 30 to 50 per cent. However, the post-independence period shows a modest contribution of 30 per cent, while as much as 50 per cent is contributed by factor productivity in the pre-independence period. This shows that the rapid growth of capital stock in recent times, has not been accompanied by an upsurge of capital productivity. This is partly due, of course, to the emphasis on social overheads, in the Indian plan outlays. Also, it is interesting to note that the growth of factor productivity remained dimensionally the same for all the sub-periods considered, and the larger share in pre-independence period was due to the lower rate of growth of income during the period. But despite this, the figures suggest no striking improve- ment in factor efficiency in the recent past and the Indian growth during the post- independence period appears to have depended primarily on larger factor inputs and only incidentally on improvement in factor efficiency. Coming to the entire economy, and when we consider RTW only, factor productivity contributed about one-third in the entire period of 60 years, its pre-independence contribution being about 40 per cent and post-independence about 25 per cent. When we include land, the contribution for the whole period rises above 40 per cent, the figures for pre-independence and post independence periods being respectively, about 50 and 30 per cent.

3. CONCLUDING OBSERVATIONS

14. While we have presented our findings in the last section, we should again draw attention to what we have already observed in the second paragraph. The findings depend on the accuracy of the estimates of the three main series used in the paper. Of these, that of national income perhaps is the most reliable, being based on a vey detailed study undertaken by its author. In so far as the series for capital stock is concerned, this has been obtained by using a perpetual inventory method using the recent estimates by myself and N. S. R. Sastry and by the Reserve Bank of India. But the series of capital formation used (Roy, 1963) was rather inadequate and had to be adjusted. The only good point is that the series checks well with the independent estimates given by Giffen (1903) for 1903, Shirras (1924) for 1922, and Doane (1933) for 1929. This, however, supports only the aggregate. The breakdown of the aggregate between agriculture and non-agriculture is arbitrary, as the Notes following Table (2) indicate. The labour force estimates can be taken to be plausible for the comparison

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between 1900-01 and 1960-61, estimates at both the end points having used similar definitions. The figures for 1946-47, however, are underestimated in comparison with estimates at the two extreme points because of differences in definitions of labour force used in the 1941 and 1951 Censuses. Thus the real growth rate of labour force between 1900-01 and 1946-47 is under-estimated while that between 1946-47 and 1960-61 is overestimated. Subject to all these limitations, our findings do not appear to be entirely implausible, and probably suggest that more useful results can be obtained provided estimates of capital stock and labour force are put on a firmer footing. In any case, we use these historical series for other purposes as well, and the exercise we have undertaken here can at least be regarded as a reasonable method of checking one aspect of the internal consistency of time series of income, wealth and labour force.

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