INPUT OUTPUT MODELLING OF EMPLOYMENT AND PRODUCTIVITY AS BASE OF GROWTH

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India has concertedly endeavored to upgrade the technological base of production from 1956 to the mid 1970's. Thereafter, the process somehow appears to have slowed down resulting in technological stagnation, which extended right upto the late eighties. The nineties were an era of improvement in technology and managerial practices that bore results in the period of globalisation and liberalization. *New technology tends to be more Knowledge and Capital intensive and Labour Displacing.* The movement of the national economy from lower to higher stages of techno centric development requires a transformed production from Material Processing to Knowledge and Information Processing. The modern age Industrial Revolution is manifested as Knowledge Revolution. Hence, highly knowledgeable persons alone can mange new technology. Competencies need to be broadened as production requires greater expertise in terms of knowledge and skills. A shift from general to professional/ technical/ vocational streams of education becomes an essential requirement of this transformation process. Labour displacement processes result in Labour Extension and Augmentation in so far as production capacity of human capital gets increased. As against this, greater capital intensity leads to augmentation of capital, both in quantity and quality through enhancement of capital's productivity. The resultant effect of both these is reduction in costs. The theories of growth, propounded by *Clark and Lewis*, also come into operation at this mature stage in so far as tertiary sector emerges in the center stage of development at the cost of primary and secondary sectors. Tertiary sectors are more human than physical capital intensive. *This process of growth may be designated as, using Barewald's terminology, Factor Transformation Process.*

The factor transformation process through technological improvement may be envisaged to have three different impacts on Employment; (i) Employment less Growth; (ii) Employment Loss Growth; and (iii) Employment Gain Growth. The use of technology of different vintages in developing countries implies the simultaneous operation of Factor Multiplication and Factor Transformation processes of growth. It is, therefore, probable that all three types of employment effect of growth are manifested as the economy moves from lower to higher stages of growth. Within each broad sectoral category, some sub sectors tend to stagnate and even decline, while some others emerge as fast growing /leading /key sectors of development within the given category; growth may carry different employment implications for different sectors.

Some more knowledge and human capital intensive leading/key sectors, may register employment gain, whereas the employment loss of other sectors may swamp this gain. Therefore, the thesis that *Liberalization, Privatization and Globalization has resulted in Employment less growth may be empirically and logical valid in a macro sense.* But the evaluation of the validity of the theses of *Employment Less, Employment Loss* and *Employment Gain* process of growth needs a structural approach. Employment, defined as the

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deployment of labour, undergoes a structural change both in terms of demand and supply as a result of Quantitative and Technological transformation of production; such changes impact upon education and knowledge intensity, embodying skills, quantity, quality, and hence, competencies of human capital. The changes in level and Structure of Knowledge is both demand and supply centric. Then, there are variations between different sectors of the economy and occupations between and within sectors-Primary, Secondary and Tertiary. The structural differences result in differential competency level of human capital in terms of knowledge and skills.

The dominant view of economic and social change assumes that the developed economies are in the midst of a knowledge revolution, driven by the application of new technologies. *It is argued that innovation holds the key to the competitive advantage of countries and the welfare of individuals*. Consequently, in a global economy, the prosperity of a country depends on the skills, knowledge and intellectual capital of those capable of creating and fostering innovations. In this scenario, education becomes central to economic policy because it is through education that knowledge revolution can take place. This exercises direct effect on employment.

Employment has always been in the centre stage of both economic analysis and policy ever since the inception of economics as a modern science. Employment and income have both tended to rise in the process of growth. But growth can occur through factor multiplication process or factor transformation process *(Barewald, 1970)*. Factor multiplication involves increase in the quantity of the same factor inputs of the given quality to be transformed into highest output of the same type and quality through the use of the same production function. But the factor transformation process involves a different production function resulting in more and different quality output per unit of factor inputs. New production function generally embodies different technology. Technology affects the nature, direction and magnitude of relationship between employment and income. Development of technology has generally been capital intensive and labour displacing, and hence, labour augmenting. Besides, new technology is often more knowledge and skill intensive. Knowledge and skill requirements are not only greater in magnitude and superior in quality but these are also very different from earlier ones. This makes some occupations and types of knowledge/skills redundant and obsolete, while some new occupations and types of education emerge *(Cf. Prakash, 1977).* Knowledge and skill upgradation is also facilitated by the concurrent and even prior development of education and training in order to *avert the growth lowering supply constraints of human capital (Prakash, 1995, 1996).* Consequently, *new generation manpower is healthier, more, better and differently educated.* Human capital, which is the human resource deployed on productive work, embody different knowledge profiles to match the changing industry-occupation structure as the economy moves from lower to higher stages of growth. Therefore, transformation of both the economy and human resources. Hence, the replacement of the old by new technological transformation of production may involve knowledge, skills, industry and occupational production function through the change in technology may adversely impact employment in the process of growth of income. Factor transformation seems to be the basis of the growth of income in India.

The Indian economy today instills optimism and inspires confidence for the future. Foreign exchange reserves have been bulging, inflation has been slowing down and factor productivity has improved. Intensification of competition and new policy paradigm have reduced labour militancy and made the product quality and consumer care emerge in the

centre stage. Range of consumer choices has been raised significantly. The technology and capital base have been consolidated. The emergence of consumerism makes the country appear more prosperous than ever before. But employment has become an increasing concern. The concept of *'jobless growth'* has emerged as the focus of debate both among analysts and policy makers. We, however, postulate that the *employment income-growth interrelation can not be a homogenous phenomenon across the sectors, over space and through time;* nature and degree of this relationship is bound to vary among sectors. Probably *the nature of employment, specially its knowledge and skills profile, has undergone radical transformation*. A priori reasoning suggests the tertiary activities to have emerged as the dominant generator of job opportunities. The traditional 'bricks and mortar economy' seems to have faded away into background. Conceptual categories, *such as casual and marginal employment,* knowledge, skilled, technical and professional workers have now acquired greater importance in the knowledge economy. The transitional phase is characterised by continuously decreasing craze for government jobs, which have, in any case, been dwindling fast. Emerging competition among the corporates for recruiting technical, medical, engineering, managerial and other professionals even through campus interviews, corporates' rising level of manpower turnover and the resulting concern for the retention of the capable hands, job satisfaction and corporate performance are becoming increasingly important.

INCOME EFFECT ON EMPLOYMENT

The income effect of technological transformation arises from its impact on (i) Factor productivity; and (ii) Knowledge, skills and occupational structure of employment *(Prakash, 1977, 1995, 1996)*. Rise in productivity, induced by technological and knowledge up-gradation of the production base is labour augmenting, since it raises the productive capacity of manpower, reducing overall human capital requirements per unit of output. Growth of output beyond the threshold level of labour displacing effect of factor transformation involves quantitative expansion of employment. The overall ***income effect*** may, therefore, be decomposed into its constituent effects:

- Substitution of capital for labour in production displays ***labour displacement effect*** of technology;

- Labour augmentation effect manifests through productivity growth, that is, more output per unit of labour, where labour coefficient, employment per unit of output, is the reciprocal of productivity; and

- The scale effect of production may still raise employment in the process of growth. As the nature and degree of factor transformation may vary between sectors and even companies within sectors, employment effect of growth of income may also differ between sectors.

All the sectors of the economy do not undergo technological transformation at the same time, technology of different vintages remain operative (*Mathur, 1959).* This makes it difficult to predict employment effect of growth. Whether the impact of growth is employment neutral, employment enhancing, or employment reducing needs investigation. Employment has acquired a sharper edge in the context of globalization and liberalization of Indian economy. For investigating employment-economic growth inter-relations, two complementary models have been developed.

The propositions outlined above may warrant the decomposition of overall effect into component parts in order to assess and evaluate the countervailing nature of the positive and negative effects of technological transformation and growth of income on employment. The decomposition model will separate i) *labour displacement effect of growth from productivity augmenting effect; and* ii) *scale effect on employment to determine employment neutrality, enhancing, or displacing nature of growth.*

But the overall employment effect of growth of income comprises of both direct and indirect repercussions, the capturing of which requires an Input- Output model. An Input- Output model has, therefore, been formulated to endogenise employment and growth within the system. Income and employment estimates, derived from this model, have then furnished the data base for prognosticating the decomposition model. Empirical results will furnish estimates of overall, productivity and employment effects of growth of income, facilitating verification of the empirical validity of the theses stated above. The results will also highlight the relative contribution of growth of productivity and employment to the growth of income. The models are outlined below.

DECOMPOSITION MODEL

It is postulated that total output, X equals the product of total employment, N and average productivity, P:

$X = P.\ N$ ……. (1)

where X is GDP at factor cost in 1993-94 prices.

Differencing the equation partially, we get

$\Delta X = \Delta P.N + \Delta N.P + \Delta P.\ \Delta N$ ……. (2)

First term of this equation measures the effect of income growth due to change in productivity, when employment is constant, second term determines employment effect of income growth with constant productivity, and the last term determines the interaction effect of change in employment and productivity in response to the given change in output. Interaction effect may be distributed between employment and productivity effect exactly in proportion to the shares of first and second terms in overall growth.

Division of equation 2 by X yields

$\Delta X/X = (\Delta P/ P + (\Delta N / N) + \{\Delta P/P\}.\ \{\Delta N/N\}$ …….. (3)

Which is also expressed as

$G_x = G_p + G_n + G_p.\ G_n$ …… (4)

where G_x is the rate of growth of income, G_p is the rate of growth of productivity and G_n is the rate of growth of employment.

The model can also be modified as follows in order to estimate the relative shares /contribution of productivity and employment growth in the growth of income.

$\{G_p / G_x\} + \{G_n / G_x\} + \{(Gp. G_n) / G_x\} = 1$ …… (5)

INPUT OUTPUT MODEL

In order to capture both the direct and indirect repercussions of growth of income on employment and productivity, Input Output model has been used to determine output, X:

$X= (I-A)^{-1}f$ …….. (6)

where X is the column vector of gross output, $(I-A)^{-1}$ is Leontief Inverse, and f is final demand. Employment involved in the production of this output may be given by

$\hat{N} = LX$ …….. (7)

where $\hat{N}$ is a column vector of sectoral employment. This will also furnish an idea about the sectoral composition of total employment.

L is a diagonal matrix of employment coefficients, a_{oi} where $a_{oi} = L_{oi} / X_i$, that is, labour required per unit of output, $\sum_i Loi$ is total employment in the economy. Substituting for X from 5 into 6, we get

$\hat{N} = L (I-A)^{-1}.f$ …….. (8)

The gross factor productivity[1], $\hat{P}$ is given by

$\hat{P} = L^{-1} X$ …… (9)

where $\hat{P}$ is sector wise column vector of productivity , $p_j = X_j / L_{oj}$;

Use of solution rather than observed value of X in the above formula is an attempt to (i) consider both direct and indirect requirement of labour for production (ii) direct and indirect requirement of capital. The capital requirements are embodied as a component of final demand which comprises both Gross Fixed Capital Formation (GFCF) and change in stocks (Cf Juan & Febrero) and (iii) requirements of growth, since growth is financed out of surplus. Matrix A discussed above takes this into account; which Sraffa calls " requirements for Self Replacement of economy" at a given level. This surplus feeds the multiplier process through consumption while accelerator is taken care of through change in stock reflecting working capital requirements and fixed capital formation part of final demand.The consumption component of productivity estimates relate to *welfare*. There is another concept of productivity which is used to evaluate the *competitiveness* of a firm or industry in the market given by X_j / L_{oj} , which is the conventional measure of productivity(Cf Juan & Febrero). Thus we can distinguish three different concepts of productivity-productivity for growth; productivity for welfare and productivity for competition;

The growth rates of sectoral productivity are given by

$$G_p = \Delta \hat{P} . \bar{P}^{-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

where $\Delta \hat{P}$ is the row vector of change in sectoral productivity, G_p is the vector of productivity growth rates, and $\hat{P}^{-1}$ is a diagonal matrix of initial levels of sectoral productivity. Following equation yields the estimate of sectoral employment growth:

$$G_n = \Delta \hat{N} . \bar{N}^{-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

where $\Delta \hat{N}$ is the row vector of change in employment, G_n is the vector of sectoral employment growth rates and $\hat{N}^{-1}$ is the diagonal matrix of sectoral employment levels. Growth rates of sectoral output may be derived analogously:

$$G_x = \Delta \hat{X} . \hat{X}^{-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

where $\Delta \hat{X}$ is the row vector of change in output and $\hat{X}^{-1}$ is the diagonal matrix of initial output. *Since the capital coefficients matrix* B, *corresponding to input coefficients matrices of 1989 and 1994*, is not available, solution values of X determined by relation 5 for these two years have been used to derive the rates of growth of sectoral output.

It is implicitly assumed that the change in output $\Delta \hat{X}$ embodies the effect of change in i) technology, ii) human capital, iii) policy regime, from the base to the terminal year. An attempt has been made to isolate the effect of change in technology from other components of change:

$$X_t = (I - A_{t-1})^{-1} f_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$$

where t refers to the current period. The use of the preceding period's I-O table to estimate X_t *from relation 5 nullifies at least a part, if not the whole, of the change in technology.* Similarly, *the effect of change in final demand may also be worked out:*

$$X_t = (I - A_t)^{-1} f_{t-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

Differential output of 5 and 12 will furnish estimates of differential employment and productivity levels due to the difference of technology. As against this, differential of output of 5 and 13 will reflect the effect of change in final demand, that may manifest the human capital effect on employment.

The above models will be empirically worked out on the basis of Input Output Tables of Indian economy for 1988-89 and 1993-94, the latest available table.

EMPIRICAL RESULTS

Empirical results focus on

Data relating to employment has been the real constraint since sector wise employment is available only for nine highly aggregated sectors, 115X115 IO tables of 1988-89 and 1993-94 have been accordingly aggregated into 9X9 tables. Empirical results related to those aggregative data.

1. Evaluation of the hypotheses pertaining to Employment –Output interrelations. Output elasticity of employment on the one hand, and productivity elasticity of employment on the other have been used as analytical tools both at macro level of the economy, taken as a whole, and micro sectoral level;

2. Prognostication of Decomposition Model through inter-relations of employment, productivity and output;

3. Analysis of the results at sectoral level to deduce inter-sectoral variation; and

4. Empirical prognostication of Input- Output Model.

ANALYSIS OF THE RESULTS

Output has grown at the rate of 30.53% over a period of five years from 1988-89 to 1993-94. These are the two years for which Input-Output tables are available and have been used for the prognostication of the models in this study. Output estimates have been derived from equation 5 (Table 2.2), which indicates that the real GDP at factor cost in 1980-81 prices has, on an average, grown by *6.10%* per annum. Employment, estimated from equation 6 (Table 2.3), indicates a much lower growth of 3.31% during the same period, *yielding an average annual growth rate of 0.662%.* Employment has grown at a rate hardly one tenth of the growth of output. Thus, the growth of *employment has substantially lagged behind the growth of income/ output.* Measely growth of employment suggests its stagnancy, *implying employment neutrality of output growth*.

Lead of output over employment growth indicates that Factor Productivity must have grown much faster than employment. Productivity has, in fact, increased at the rate of 26.35 % over the five-year period; it approximates 5.27% per annum growth rate. Output has *grown 1.16 times faster than even productivity and 10 times faster than employment. But productivity has grown 8 times faster than employment.* Thus, employment expansion accounts only for 11 per cent, *while productivity growth explains 79.61 per cent of the growth of income*. The growth rates of employment and output embody *as low an employment elasticity with respect to output as 0.108. Output elasticity of employment is, in fact, practically zero. Employment is almost perfectly inelastic with respect to output.* As against this, *output elasticity of productivity,* that is, *growth of productivity with respect to output is 0.863.* Thus, *productivity elasticity with respect to output is also substantially less than unity*. Therefore, productivity may be dubbed *as output inelastic.* These results lend credence to the hypothesis of *employment neutral growth,* which however, *is not the same as 'Jobless Growth'.*

Jobless Growth would have occurred if the factor productivity increased faster than output. These results furnish no empirical evidence to support the thesis of *Job Displacing Growth*

also. But these results lend credence to the thesis that the technological upgradation and improvement of human capital base of production have promoted the growth of income in India. *Scale effect of output growth on employment has been extremely limited.*

The nature and degree of interrelations among these three variables have been examined by means of rank correlation analysis also. Rank correlation coefficients between the 3 paired rates of growth are listed below:

ρ_{12}	ρ_{13}	ρ_{23}
.164	.382	-0.661

1. Output/income; 2. Employment; 3. Factor Productivity.

Employment neutrality of growth of the Indian economy is reflected by as low a value of rank correlation coefficient as 0.134 between the sectoral rates of growth of i) output, and ii) employment. The coefficient is *not only statistically not significant but its magnitude is also negligible. But the positive sign of the coefficient refutes the thesis that the growth of Indian economy has been employment displacing.* The coefficient of rank correlation between output and productivity *growth is positive but statistically not significant,* t value being only 1.17. However the coefficient of rank correlation between employment and productivity is negative but statistically significant, value of is (t=2.5). These results *imply that with the growth of output productivity grows and employment declines.*

SECTORAL VARIATION

Estimates of growth of sectoral a) Output, b) Employment, c) Productivity are reported below: The results highlight the reduction of employment in 3 sectors, 'Manufacturing', Electricity, Gas & Water, and 'Construction'.

	Agriculture	Mining	Manufacturing	Construction	Electricity, Gas & Water	Transport, Storage & Communication	Trade	Finance, Insurance & Real Estate	Community, Social & Personal Service
Gx	30.86	9.68	36.16	29.29	8.87	29.45	26.79	37.93	59.87
Gn	0.73	6.09	-5.62	-26.66	-6.23	37.91	7.64	28.80	1.10
Gp	29.90	3.38	44.27	76.28	16.11	-6.13	17.78	7.09	58.13

These 3 sectors have recorded negative growth of employment, giving *credence to job displacing growth.* The traditionally labour intensive sectors like Agriculture and Community & Social Services have displayed *near stagnancy in employment, implying that these sectors have registered jobless growth.* Transport, Storage and Communication, and Finance, Insurance and Real Estate are two sectors, which have registered phenomenal growth in employment. But Transport is the only sector where *employment has led the output growth*. For rest of the sectors, output has rather dominated employment growth. Thus, the growth of employment in most of the sectors has lagged behind the output growth. Employment in Mining and Trade has also expanded quite rapidly. But the *growth of employment has lagged behind the growth of output in all sectors except transport, storage and communication.* Naturally, the factor productivity has registered substantial decline in transport sector. But the growth of output of all other 8 sectors has substantially led the growth of employment. Six of 9 sectors have registered dramatic gains in productivity, growth of productivity

ranging from 17.78 per cent for trade to 76.28 per cent for construction. Finance and Mining have registered the improvement in productivity at high to modest rates of 7 to 3 per cent. Mining, Transport, Storage/ Communication and Finance are three sectors in which employment growth dominates the growth of productivity. These three sectors appear to have been under *factor multiplication process of growth.* As against this, productivity growth has almost matched employment growth in agriculture, where both green revolution and traditional technology coexist. This leave five of the nine sectors, where *Factor Transformation* process triggered and sustained the process of growth of output.

Had the growth process been purely *factor multiplication* process, *employment growth alone would have accounted for output growth. Employment would have expanded at the same rate as output growth rather than lagging behind it.* Obviously, the growth process has been based on *factor transformation process in some sectors*. Had the growth process been factor transformation process, productivity growth alone would have accounted for output growth. But *actual results embody a mixture of growth of both employment and productivity in all but one sector. Probably the high level of aggregation has shadowed a part of factor transformation process*. Besides, the coexistence of vintages of technology also explain this facet. Factor transformation process is associated with advances in technology and/or improvement in quality of factor inputs like human resources' capability, managerial techniques and organizational decision-making. These parameters are reflected in the growth of productivity. All the above inferences are well supported by estimated elasticity. The sectoral employment elasticity given below indicates a significant positive elasticity in Transport, Storage and communication. This sector is also plagued with low productivity growth.

SECTORS/Elasticity with respect to output	**Employment Elasticity with respect to output**	**Productivity Elasticity with respect to output**
Agriculture	0.024	0.969
Mining	0.63	0.349
Manufacturing	-0.155	1.224
Construction	-0.910	2.60
Electricity, Gas & Water	-0.702	1.82
Transport, Storage & Communication	1.29	-0.208
Trade	0.285	0.664
Finance, Insurance & Real Estate	0.759	0.187
Community, Social & Personal services	0.018	0.971
Aggregate	0.108	0.863

IMPOUNDING TECHNOLOGY AND HUMAN CAPITAL EFFECTS ON PRODUCTIVITY

The traditional theory explained growth in terms of growth of labour and capital but studies by Abramowitz, Kendrick , Dennison and Solow found a big residual in the growth of economy of the US. Technological change was hypothesized to be the primary mover of economic growth. Technological transformation is reflected by the changes in input output coefficients (S. Prakash, 1976). Within limits , technology explains partly the changes in productivity. Productivity is greatly affected also by techniques of organization, administration and management, which relate to human resource capability.(For details see, Prakash S, 1976, Layard and Saigal ,1966)

Productivity is basically a function of technology, managerial techniques and the operational organizational efficiency/performance. Last two factors reflect the human capital capability. *Technological and Human capital effects on productivity are assumed to be additive*. This facilitates the *decomposition of productivity growth into technology and human capital effects.* Pure Technology Effect, the leading factor of *Factor Transformation,* and Human Capital Effect may then relate to Change in Productivity as follows:

$$\Delta P = \Delta T + \Delta H \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (15)$$

where Δ T reflects the contribution of technological advances and Δ (HC) manifests Human Capital effect on the change in productivity. Relation 14 then gives:

$$\Delta H = \Delta P - \Delta T \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (16)$$

where

$$\Delta T = L_t(I-A_t^{)-1}-L_{t-1}\ (I-A_{t-1})^{-1} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(17)$$

The change in productivity has been deduced from the results yielded by the application of equations 5, 6 and 8 to 1988-89 and 1993-94 I-O tables. Technology effect on productivity has then been deduced from relation 16. Substitution of these values of ΔP and ΔT in relation 15 furnishes the estimate of ΔH.

The table below gives the sectoral variation in the changes in productivity comprising of technology effect and human capital effect:

	Productivity Differential	Productivity differential due to tech. change	Percentage of technology effect in Total	Productivity differential due to human factors	Percentage of human capital effect in total
Agriculture	407190.38	155238.62	38.12	251951.77	61.88
Mining	27276.11	19338.82	70.90	7937.29	29.10
Manufacturing	190181.42	125162.48	65.81	65018.93	34.19
Construction	373628.36	80269.54	21.48	293358.82	78.52
Electricity	173412.74	89603.85	51.67	83808.89	48.32
Transport	-15003.26	-4990.77	-33.27	-10012.48	-66.73
Trade	280419.26	125363.60	44.71	155055.66	55.29
Finance	26531.35	25459.28	95.96	1072.07	4.04
Community, Social & Personal services	46060.83	7387.95	16.04	38672.88	83.96

Productivity in manufacturing, mining and in the generation and distribution of electricity improved substantially during the post-reform period but employment growth in these sectors was low. The productivity growth in 4 sectors, namely Mining, Manufacturing, Electricity, Gas & Water and Finance, Insurance & Real Estate sectors has been dominated by *technology effect*. The productivity growth in *finance is almost totally accounted by technology effect*, the share of human capital effect being hardly 4 per cent of the total. The Information Technology Revolution has brought about radical transformation in

technological base of tertiary activities including Finance, Insurance and Real estate. *The technology effect on productivity growth of mining is 2.4 times greater than the human capital effect*, while it is *almost twice as large* as *human capital effect for manufacturing*. It is pertinent to note that mining has been brought in Public Sector under 1956 policy resolution and its later day modification. Public Sector has been the abode of disguised unemployment as a result of which the wage rates and marginal productivity have remained in dissonance. However, with the emphasis on privatization and technological up gradation, technology has now emerged as the dominant factor. But for Electricity & Gas sector, the share of two effects is *almost balanced*, technology effect being only 1.07 times the human capital effect. Though it is also under the focus of privatization and technological up gradation. Thus, *productivity growth of 44 per cent of all the sectors of* the Indian economy has been accounted largely by the technological up gradation of the production base, while the human capital base of these sectors seems to have lagged behind.

As against this, productivity growth of 56 per cent of the total sectors is *accounted mainly by the upgradation of human capital base of production.* Agriculture, Construction, Trade, Community, Social & Personal services. The domination of productivity growth by human capital effect on productivity is not surprising. Several studies have shown investment in education and hence human capital to be the major force behind Green Revolution in India. (Chaudhary D.P., Prakash S (1995).Though Construction is labour intensive, during the last two decades, technological upgradadtion has taken place in mega projects like barrages , bridges , flyovers and more land intensive multistoried buildings. This has led to the upgradation of knowledge and skill base of human resources associated with the sector. With the growth of industry and agriculture trading has emerged as the fast growing sectors and there is a consistent movement from traditional ways of trading to se commerce, and retail trading and merchandising where augmented human resource capabilities have been in the centre stage. The emerging trend is towards employment of more qualified and professionally trained personnel being employed in Community, Social & Personal services sector. But one of these sectors, namely transport, *registered decline in productivity and the negative human capital effect is twice as large as the negative technology effect on productivity.* This leaves the *technology and human capital dominated sectors exactly equal in number.* Community & Social Service and Construction are two sectors the productivity growth of which has been *dominated largely by human capital effect, it being 5.23 and 3.7 times greater than the technology effect*. Impact of human capital on productivity in *trade and agriculture has been 1.24 and 1.62 times greater than the technology effect*. Estimate of human capital effect on the *productivity growth of agriculture is in consonance with the findings relating to the role of education in green revolution* (For example, See Prakash, 1995, Chaudhary, D.P., 1969).

MAIN FINDINGS OF THE STUDY

The input output model of production seems to have performed well in so far as the output and employment estimates, furnished by the model, are extremely close to the actual figures. The results yielded by *the model of decomposition of growth* of output *highlight the employment neutrality of growth*. But there is no evidence *to support the thesis of either the i) jobless, or ii) job displacing growth.* Both output elasticity of employment and correlation coefficient between output and employment growth support the thesis of employment neutrality of growth. *Domination of the growth of output by productivity suggests the growth of Indian economy being factor transformation rather than factor multiplication based. Results also lend credence to the thesis that productivity and employment growth are inversely related.*

As expected, *the model results support inter sectoral variation in interrelations between employment, productivity and output growth. Growth of output is employment dominated in mining, transport and finance, whereas output growth of agriculture, manufacturing, construction, electricity, trade and social services is productivity dominated.*

The decomposition of productivity growth into technology and human capital effects highlight that i) *human capital explains the major share of productivity growth of 4 sectors; ii) technology accounts for the major proportion of productivity growth of another 4 sectors;* and iii) transport is the only *sector showing negative change in productivity, which is accounted both by negative technology and negative human capital effects.* The sector seems to have grown through factor multiplication process, where disguising unemployment might have led to the negative growth of productivity.

Notes:

1. Entire Output is attributed to labour implying as if it were the only factor used in production. Besides, primary factor labour, capital is an important factor of production. The grossness arises from two factors (i) Total output is attributed to labour and (ii) gross rather than net output is used as denominator. Net productivity may be estimated by working out the ratio of factors used in production and net output i.e value added which is given by V_j / l_j where $l_j = a_{oj} \times \Sigma a_{ij}$ and V_j is the value added per unit of output.
2. Marshall, in a different context describes the experience of mining industry in 1870's in similar terms. See *Principles of Economics*

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AGGREGATION OF INPUT OUTPUT TRANSACTION MATRIX- 1988-89 Table 1

INPUT COEFFICIENT MATRIX **TABLE 1**

AGRICULTURE	0.197097	0.000003	0.063134	0.042662	0.000696	0.319560	0.000000	0.0000000	0.057295
MINING	0.295974	0.004960	0.11917	0.058455	0.162385	0.016375	0.000000	0.0000000	0.079531
MANUFACTURING	0.067997	0.124789	0.34532	0.320677	0.037528	0.221650	0.033905	0.0086995	0.085647
Construction	0.011899	0.003151	0.00093	0.003417	0.024884	0.021049	0.007413	0.0769823	0.004374
Electricity, Gas & water	0.018447	0.037589	0.34532	0.007383	0.254556	0.040143	0.021169	0.0847894	0.015572
Transport, Storage, Communication	0.010303	0.013658	0.04139	0.049187	0.073885	0.046096	0.113960	0.0192441	0.013316
Trade	0.033551	0.017467	0.06308	0.063984	0.041164	0.030268	0.003866	0.0010808	0.024031
Finance, Insurance & Real Estate	0.008046	0.013616	0.02596	0.021785	0.027461	0.030789	0.025177	0.0351868	0.023312
Community, Social & Personal service	0.010632	0.015273	0.04139	0.050937	0.076990	0.050829	0.119170	0.0282575	0.016216

AGGREGATION OF INPUT OUTPUT TRANSACTION MATRIX- 1993-94 Table2

INPUT COEFFICIENT MATRIX- 93-94 **TABLE 2.**

Agriculture,Hunting etc	0.25071	0.0000	0.06251956	0.0245669	0.00134	0.041139	0.00294015	0	0.0464807
Mining & quarrying	0.25071	0.0046	0.052600955	0.0492702	0.078262	0	0.00151717	0	0.0016174
Manufacturing	0.08487	0.0349	0.311790157	0.3346345	0.015905	0.0072203	0.01323626	0.0064579	0.1144201
Construction	0.00773	0.0031	0.004535204	0.0078684	0.004312	0.0017972	0.0005732	0.0002808	0.0042667
Electricity, gas & water	0.01665	0.0129	0.035029613	0.0154745	0.096618	0.0130537	0.00165057	0.0116753	0.0516931
Transport, storage & Comm	0.03869	0.0143	0.063433256	0	0.035943	0.0055294	0.00744101	0.0049456	0.0414725
Trade	0.17350	0.0041	0.135855887	0.0170539	0.014917	0.0252997	0.01297929	0.0226283	0.0131954
Finance, Insurance, real esta	0.00970	0.0048	0.024164664	0	0.007797	0.0024027	0.00030043	0.002149	0.0531963
Community, Social & perso	0.00275	0.0044	0.026923232	0.0171258	0.003484	0.0095597	0.0001329	0.0085502	0.0382368
Labour Coefficient	5.6534E-07	1.19972E-06	1.297E-06	1.158E-06	8E-07	4.355E-06	3.2256E-07	1.915E-06	7.981E-06
Gross Value of Output	26143431	9110437	49313991	10594200	12111670	7141259	13920024	7984346	13692013