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**Economic Liberalization and Productivity Growth: A Disaggregated
Analysis of Indian Manufacturing Industries**

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Abstract

The paper studies the impact of Economic Liberalization of the Indian government in the 1990s on the manufacturing productivity. In particular, the paper examines in detail the variations of TFP across manufacturing sector at a more disaggregated level from 1980-97. Further, manufacture productivity growth is decomposed by the framework introduced by Arnold C. Harberger (1991 and 1998). The TFP sunrise/sunset analysis is used to study the structural changes that are occurring in the manufacturing sector due to the economic liberalization policies introduced by the Indian government since 1991. The empirical results show that productivity gains are not evenly distributed across sectors. Some sectors experience very high rates of productivity as they are in the process of adopting new technology and new methods of production particularly after the liberalization.

Key Words: Growth, Productivity, Manufacturing sector, India.

JEL Classification: O3, O4

This work is part of my thesis. The results reported are preliminary and represent work in progress. The contents should not be quoted without permission.

Economic Liberalization and Productivity Growth: A Disaggregated Analysis of Indian Manufacturing Industries

1. Introduction:

A key feature in the overall assessment of the Indian industrialization has been the question of the productivity growth in manufacturing sectors. Recently studies on Total Factor Productivity (TFP) growth for the manufacturing sector have been carried out¹. These studies using different methodologies as also covering different periods emerge with somewhat diverse conclusions. The main conclusion is that, TFP growth rates are either negative or very mildly positive. Further, the observed TFP growth rates are attained during a period of highly restrictive trade regime and perhaps these growth rates could have been better had the regime been less restrictive.

The trade liberalization initiated in June 1991 was a part of the overall reform of the Indian Economy was very different from the piece-meal approach to trade reforms of the 1980s. There is a widely held view, largely due to the studies by Bhagawati and Desai (1970) and Bhagawati and Srinivasan (1975) that the inward looking development strategy based on the policies of import control and domestic licensing have led to considerable inefficiency in the industrial sector. Further studies by Goldar (1986 a, b) and Ahluwalia (1991) have investigated the impact of trade orientation on the productivity for the Indian industry during the 1970s and 1980s. Their studies conclude that the prevailing trade policies did play a role in the observed TFP growth rates for

¹ Refer Goldar (1992), Productivity and Factor Use Efficiency in Indian Industry” and Mookerjee, ed. (1995) “Introduction for an assessment of the studies on TFPG in Indian Industry.

Indian industries. Both these researches were at best a first attempt in investigating the trade policy changes in relation to the productivity growth for the Indian manufacturing sector.

In this paper, we again explore the issue of the effect of trade liberalization on the productivity growth for the Indian manufacturing sector. The focus of this study is to analyze the effect of productivity growth at a more disaggregated industry level. Earlier studies of productivity on Indian manufacturing sector use highly aggregated data to examine the role that productivity has played in economic growth. Although aggregate productivity is a good measure of the overall efficiency of the economy, much relevant information about the distribution of productivity across all sectors of the economy is lost. Thus the aggregate TFP does not reveal the actual effects in the domestic economy.

The TFP growth rates for the sample industries are documented for three different phases of trade reforms. The three different phases of trade reforms are identified as slow trade liberalization period ranging from 1980-85, moderate trade liberalization period from 1986-91 and rapid liberalization period ranging from 1991-97. The cutoff years have been chosen as 1986 and 1991 respectively because for the first time the government announced an export-import policy in 1986 for a period of three years in continuity breaking away from the earlier tradition of yearly announcement. This continuity has been treated as the beginning of attempts at reforming the trade regime. And trade liberalization in June 1991 was unique in every sense. In one step the government eliminated the restrictive and complex system for imports of intermediates and capital goods. The removal of quantitative restrictions on imports has been accompanied by a gradual lowering of tariffs. In addition, the government also liberalized the foreign

exchange regime. Unlike earlier studies, this study uses the growth accounting framework introduced by Harberger (1991) to calculate productivity growth rates and then using the TFP Sunrise/Sunset diagrams introduced by Harberger (1998), the entire scenario for the manufacturing sector is explained.

The remainder of this paper is organized as follows. Section 2 presents the methodology used in this paper. Section 3 explains the details about the sample industries, variables and the database used in the study. Section 4 explains the empirical results. The final section concludes the study.

2. Methodology

Growth Accounting Framework

We use “Two Deflator” growth accounting framework developed by Harberger (1991,1998) in this study. As compared to traditional approaches this method does not require an assumption of a production function or estimation through econometric regression². Though less data intensive compared to the method used by Jorgenson (1987, 1990), we can obtain same level of relevant information³. This method is particularly useful for the developing country studies where the data availability is not very detail or scarce otherwise. “Two Deflator” method starts with zero profit condition:

$$Y = wL + (\rho + \delta)K \quad (1)$$

Y = Output (Value Added)

L = Labor (Man Days)

² See Harberger (1996)

³ See Harberger (1999) on the composition of the “Two Deflator TFP” and the Jorgenson TFP.

$w =$ Wages

$\rho =$ Rate of Return to Capital

$\delta =$ Rate of Depreciation of Capital

The key assumption of the model is that Inputs are compensated their marginal products.

Compensation to the owners of the capital is obtained by subtracting wage bill from the value added. If one assume that the inputs are paid their marginal product, then, an increase in input will lead to an increase in output so that:

$$\Delta Y = w\Delta L + (\rho + \delta)\Delta K + TFP \quad (2)$$

If the increase in output is greater than that which can be accounted for by increase in capital and labor, then the difference or the residual thus obtained is accounted as TFP.

By dividing the equation (2) by output, we can calculate in terms of TFP growth rates,

$\Delta TFP :$

$$\Delta TFP = \frac{TFP}{Y} = \frac{\Delta Y}{Y} - \frac{w\Delta L}{Y} - \frac{(\rho + \delta)\Delta K}{Y} \quad (3)$$

As it is known, traditional method assumes a homogenous of degree one Cobb-Douglas production function. Rearranging the equation (3) we can derive the traditional TFP accounting equation the following way:

$$\Delta TFP = \frac{TFP}{Y} = \frac{\Delta Y}{Y} - \left[\frac{wL}{Y} \right] \frac{\Delta L}{L} - \left[\frac{(\rho + \delta)K}{Y} \right] \frac{\Delta K}{K} = \frac{\Delta Y}{Y} - (\alpha_L) \frac{\Delta L}{L} - (\alpha_K) \frac{\Delta K}{K} \quad (4)$$

Where α_L, α_K are labor and capital share of the value-added respectively.

The “two deflator” method uses the GDP deflator, P_t^* as a deflator for prices and the real wages of the worker, w^* as a deflator for labor. Both output and capital have been deflated using the GDP deflator.

$$Y_{i,t}^* = Y_{i,t} \left[\frac{P_t^*}{P_t} \right] \quad (5)$$

$$K_{i,t}^* = \sum_K \left[K_{i,k,t} \left(\frac{P_t^*}{P_t} \right) \right] \quad (6)$$

Since it is assumed that there are k different types of capital in i different industrial sectors and all capital is measured in “GDP baskets”, one can sum up the capital stocks across different types of capital within an industrial sector and later across industrial sectors to form the aggregate capital stock. A common numeraire between capital and output allows us to formulate the rates of return to capital. Investments are made in the “GDP baskets”. For details about the use of the GDP deflator see Harberger (1996).

We use the real annual wages of a “standard worker” to quantify labor inputs in terms of standard labor units. If we assume that there are l different types of workers in i different industrial sectors, the total standard labor units of labor in an industry can be calculated as follows:

$$L_{i,t}^* = \frac{\sum [w_{i,l,t} L_{i,l,t}]}{w_t^*} = \frac{(wageBill)_{i,t}}{w_t^*} \quad (7)$$

The “standard worker” is defined as an unskilled worker who earns two thirds of per-capita GDP. For example, an unskilled worker in a textile factory may contribute one standard labor unit while, an experienced engineer may contribute five standard labor

units, and the general manager of the factory may contribute twenty standard labor units.

For detail explanation of the labor deflator see Harberger (1996).

We allow for different depreciation rates for different types of capital, we can calculate a rate of return for each industrial sector:

$$\rho_{i,t}^* = \frac{Y_{i,t}^* - \sum_1 [w_{i,1,t}^* L_{i,1,t}^*] - \sum_k [\delta_{i,k} K_{i,k,t}^*]}{\sum_k [K_{i,k,t}^*]} \quad (8)$$

The TFP growth rate for each industrial sector can now be calculated as follows:

$$\Delta TFP_{i,t}^* = \frac{Y_{i,t}^* - Y_{i,t-1}^*}{Y_{i,t-1}^*} - \frac{\sum_1 [w_{i,1,t-1}^* (L_{i,1,t}^* - L_{i,1,t-1}^*)]}{Y_{i,t-1}^*} - \frac{\sum_k [(\rho_{i,t-1}^* + \delta_{i,k}) (K_{i,k,t}^* - K_{i,k,t-1}^*)]}{Y_{i,t-1}^*} \quad (9)$$

We can interpret the right hand side of the equation the following way. First term is the growth of output, second and third term can be interpreted as contribution of labor and capital to output respectively.

And the aggregate TFP growth rate for an economy consisting of N industrial sectors can be found out as follows:

$$\Delta TFP_t^* = \sum_{i=1}^N \left[\left(\frac{Y_{i,t}^*}{Y_t^*} \right) \Delta TFP_{i,t}^* \right] \quad (10)$$

Its share of total output weights each industrial sector. The level of aggregation can be the entire economy or certain parts of the economy. Since the ‘‘Two Deflator’’ numeraires are the same at all levels of the economy, aggregation does not pose any problem.

3. Data and Variables

The data of the study is drawn from Annual Survey of Industries (ASI), published by Central Statistical Organization, Ministry of industry, Government of India for the period 1980-81 to 1996-97 and for 70 three-digit industries in the organized sector of the manufacturing industries. The organized segment includes all factories registered under the Factories Act and excludes manufacturing enterprises employing fewer than 10 workers with electricity and those employing fewer than 20 workers without electricity. It may be noted that till 1988-89, the classification of industries followed in ASI was based on the National Industrial Classification, NIC-1970, which was replaced by NIC – 1987 from 1989-90 onwards. Necessary adjustments have been made to make the figures comparable.

The period of the study thus chosen is from 1981 to 1997 and subsequently divided into three sub periods i.e., 1981-1985, 1986-91 and 1991-97 on the basis of the following considerations: the data availability on the variables under study, and to examine the effect of liberalization of the 1990s on the productivity growth of manufacturing industries at three-digit level.

Output

Gross value-added has been used in the present study. It is defined as summation of net value-added and depreciation of capital. GDP deflator (1980-81=100) is used to deflate the output.

Labor Inputs

Labor input into manufacturing is measured by the 'man-days worker' and no skill and quality adjustments are made to arrive at a measure of labor inefficiency units. Data on 'man days workers' and wagebill are extracted from various issues of ASI. Man days represent the total number of mandays worked and not mandays paid for by the factory during the accounting year. It is obtained by summing up the number of persons of specified categories attending in each shift over all the shifts worked on all days. Real wages of a standard worker, w^* is used as a deflator for labor. Details about the labor deflator and standard worker have been discussed in the section on methodology.

Capital Stock estimates

The data in capital stock by two and three digit levels are available in ASI. Fixed capital is used in the present study. GDP deflator (1980-81=100) is used to deflate the capital stock.

4. Empirical Results:

4.a. Sunrise and Sunset Productivity Diagram

Harberger (1998) has proposed an innovative method of visually depicting the distribution of productivity across industries. First of all, industrial sectors are sorted out by TFP growth rates listing the most productive sectors at the top as in Table 1, which lists the TFP growth rates Indian Manufacturing industries between at three different periods of time i.e., 1980-85, 1986-91, 1991-97. For each industry, TFP's contribution to output growth is calculated by multiplying the TFP growth rates with the output of that industry. Just as in equation (10) we sum up across industries, column (C) explains the cumulative contribution of each additional sector. The last two column of the table 1

convert the cumulative output and cumulative distribution of TFP into percentages of cumulative output and of cumulative TFP growth. The Sunrise Productivity diagram⁴ is created by plotting the last two columns of Table 1. Figure 1 shows the plot of TFP growth rates of Indian manufacturing industries between 1980-85. It is noted that column (A) of Table 1, TFP growth rates vary a great deal across sectors from -17.28% to 18.25%. The aggregate TFP growth rate for all manufacturing is 3.40%.

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Table-1
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Figure-1
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The magnitude and distribution of sectoral TFP growth rates determine the shape of the sunrise diagram. The rising slope and the height of the curve are results of the cumulative contributions of the positive TFP growth sectors while the fall in the curve is the result of the cumulative contributions of the negative productive sectors. The last column of the Table 1 shows that the maximum TFP growth is 4.62%. This is the TFP growth rate that could have been achieved if the negative productive sectors were removed from the economy. In the figure 1, this maximum is represented as the peak point in the sunrise diagram. Also it can be noted that sectors that cumulatively produced 78.11% of manufacturing output had positive TFP growth rates.

⁴ It is called Sunset Diagram if the final aggregate TFP growth rate is negative.

Another interesting point to note that with just first 27 sectors, the cumulative TFP growth rate has already reached the final aggregate TFP growth rate of 3.40%. TFP's contribution to output growth of these 27 industries is less than 35% of total manufacturing output, sum up to the TFP's contribution of 100% of the manufacturing sectors. TFP's contributions to output growth of remaining 65% of manufacturing just cancel each other out.

Similar analysis has been done for the period 1986-91 and 1991-97. Plotting the last two columns of Table 2 creates the Sunrise Productivity diagram for the period 1986-91. It is noted that column (A) of Table 2, TFP growth rates vary a great deal across sectors from -18.19% to 25.94%. The aggregate TFP growth rate for all manufacturing is 1.61%. The last column of the Table 2 shows that the maximum TFP growth is 3.68%. This is the TFP growth rate that could have been achieved if the negative productive sectors were removed from the economy. In the figure 2, this maximum is represented as the peak point in the sunrise diagram. Also it can be noted that sectors that cumulatively produced 64.54% of manufacturing output had positive TFP growth rates.

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Table-2
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Figure-2
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Another interesting point to note that with just first 16 sectors, the cumulative TFP growth rate has already reached the final aggregate TFP growth rate of 1.61%. TFP's contribution to output growth of these 16 industries is less than 12% of total

manufacturing output, sum up to the TFP's contribution of 100% of the manufacturing sectors. TFP's contributions to output growth of remaining 88% of manufacturing just cancel each other out.

Also, Plotting the last two columns of Table 3 creates the Sunrise Productivity diagram for the period 1991-97. It is noted that column (A) of Table 3, TFP growth rates vary a great deal across sectors from -16.34% to 28.77%. The aggregate TFP growth rate for all manufacturing is 2.94%. The last column of the Table 3 shows that the maximum TFP growth is 4.42%. This is the TFP growth rate that could have been achieved if the negative productive sectors were removed from the economy.

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Table-3
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Figure-3
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. In the figure 3, this maximum is represented as the peak point in the sunrise diagram. Also it can be noted that sectors that cumulatively produced 57% of manufacturing output had positive TFP growth rates. Another interesting point to note that with just first 12 sectors, the cumulative TFP growth rate has already reached the final aggregate TFP growth rate of 2.94%. TFP's contribution to output growth of these 12 industries is approximately 14% of total manufacturing output, sum up to the TFP's contribution of 100% of the manufacturing sectors. TFP's contributions to output growth of remaining 86% of manufacturing just cancel each other out.

Sources of growth using the two deflator approach:

As has been explained earlier the data are organized into sub-periods of six and seven years, particularly on the basis of the pre and post liberalization. We have used the price numeraire as the GDP deflator and standard worker is defined as one earning in each year, a w^* equal to 2/3 of that year's per capita GDP. The labor contribution can be

defined as $\frac{w^* \Delta L^*}{y^*}$ and the capital contribution as $\frac{(\rho + \delta) \Delta K^*}{y^*}$. To reduce the amount of

noise in this calculation, it is typically made for six or seven periods. The TFP figures represented in the Table 4 are percentage rates of GDP growth attributable to TFP. It is worth mentioning here that labor contribution to growth of output has improved quite significantly as the economy entered from pre liberalization to moderately liberalization phase and finally to the post liberalization phase.

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Table-4 (a, b, c)
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Conclusion

This study employs the growth account technique introduced by Harberger (1991). The analysis has shown that productivity gains are not evenly distributed across all industries. Some industries experience very high rates of productivity growth as they are in the process of adopting new technology, and new methods of production at the onset of

economic liberalization. At the same time some industries experience sluggish/negative productivity growth as they still use inefficient methods of production. As we have mentioned earlier, to draw a line between the post and pre reform TFP, the entire time period has been divided into three sub periods. The sunrise/sunset diagrams explain that larger number of industries were productive in the pre liberalization period as compared to the post liberalization period. The pre liberalization 'sluggish growth' or 'negative growth' of TFPG in most of the industries is mainly attributable to the restrictive trade policies though several other growth constraining factors might be playing some roles. Though, there exists very few quantitative evidence in support of this argument, we would like to take up this issue in our future exercise.

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Appendix-1

Table-1. TFP Growth Rates for Indian Manufacturing Industries, 1981-85

Sector Code	Sec. TFP Gr. Rate	Sec. Output (Million Rs. 1981=100)	TFP's contrib. To Output Growth (Million Rs 1981=100)	Cum. TFP's Contrib to Output Growth (Million Rs 1981=100)	Cum. Output (Million Rs 1981=100)	Cum. Output (% of Total Output)	Cum. TFP's Contrib To Output Growth (% of total Output)
	(A)	(B)	(A)*(B)	{C}	(D)	(D)/Total	{C}/Total
202	18.25	1441.93	263.16	263.16	1441.93	0.20	0.04
324	17.73	34508.52	6120.05	6383.20	35950.45	5.07	0.90
206	15.20	38569.26	5862.94	12246.14	74519.72	10.50	1.73
205	14.96	4575.35	684.65	12930.80	79095.06	11.15	1.82
222	11.67	3002.52	350.54	13281.33	82097.58	11.57	1.87
201	9.31	6762.57	629.41	13910.74	88860.16	12.52	1.96
357	9.27	15122.12	1401.12	15311.86	103982.28	14.66	2.16
203	8.22	1511.04	124.20	15436.06	105493.32	14.87	2.18
364	8.20	16776.19	1375.85	16811.92	122269.50	17.23	2.37
300	7.53	20979.76	1579.84	18391.76	143249.26	20.19	2.59
342	7.32	3666.38	268.34	18660.10	146915.65	20.71	2.63
220	6.38	3836.07	244.66	18904.76	150751.72	21.25	2.66
359	6.25	4573.71	285.93	19190.68	155325.43	21.89	2.70
207	6.09	3619.68	220.60	19411.28	158945.11	22.40	2.74
208	6.06	1298.49	78.72	19490.00	160243.60	22.59	2.75
214	6.05	2335.94	141.33	19631.33	162579.54	22.92	2.77
211	5.88	6019.18	354.07	19985.40	168598.72	23.76	2.82
200	5.85	410.82	24.04	20009.44	169009.54	23.82	2.82
204	5.79	14308.60	828.16	20837.60	183318.14	25.84	2.94
321	5.64	7005.62	395.11	21232.71	190323.76	26.83	2.99
226	5.30	7713.66	409.06	21641.77	198037.42	27.91	3.05
318	5.17	3049.20	157.76	21799.53	201086.62	28.34	3.07
352	4.69	23574.40	1104.75	22904.28	224661.02	31.67	3.23
291	4.40	3648.38	160.69	23064.97	228309.41	32.18	3.25
350	4.04	10127.48	409.13	23474.10	238436.89	33.61	3.31
355	4.01	5169.17	207.23	23681.34	243606.06	34.34	3.34
216	3.90	1577.59	61.54	23742.88	245183.64	34.56	3.35
360	3.60	46190.08	1662.31	25405.18	291373.73	41.07	3.58
292	3.59	214.60	7.71	25412.89	291588.32	41.10	3.58
354	3.59	11615.78	416.69	25829.58	303204.10	42.74	3.64
330	3.57	116750.37	4165.81	29995.39	419954.47	59.19	4.23
316	3.25	21175.97	688.10	30683.50	441130.44	62.18	4.32
303	2.71	10294.54	279.09	30962.59	451424.98	63.63	4.36
312	2.33	13199.62	307.57	31270.15	464624.60	65.49	4.41
290	2.28	4729.29	107.90	31378.05	469353.89	66.15	4.42
329	2.28	9479.49	216.15	31594.20	478833.38	67.49	4.45
310	2.01	38820.31	780.48	32374.68	517653.69	72.96	4.56
341	1.81	4902.65	88.78	32463.46	522556.34	73.65	4.58

Sector Code	Sec. TFP Gr. Rate	Sec. Output (Million Rs. 1981=100)	TFP's contrib. To Output Growth (Million Rs 1981=100)	Cum. TFP's Contrib to Output Growth (Million Rs 1981=100)	Cum. Output (Million Rs 1981=100)	Cum. Output (% of Total Output)	Cum. TFP's Contrib To Output Growth (% of total Output)
	(A)	(B)	(A)*(B)	{C}	(D)	(D)/Total	{C}/Total
362	1.41	6518.88	91.89	32555.35	529075.22	74.57	4.59
340	1.12	9563.01	107.44	32662.79	538638.23	75.92	4.60
314	0.91	15568.38	141.13	32803.92	554206.60	78.11	4.62
334	-0.08	1712.16	-1.39	32802.53	555918.77	78.35	4.62
209	-0.39	614.18	-2.39	32800.13	556532.94	78.44	4.62
343	-1.16	9795.83	-114.02	32686.11	566328.77	79.82	4.61
224	-1.51	1974.70	-29.86	32656.25	568303.47	80.10	4.60
219	-1.72	4829.01	-83.23	32573.02	573132.48	80.78	4.59
332	-1.88	2738.49	-51.62	32521.40	575870.97	81.17	4.58
210	-2.21	5692.31	-126.02	32395.38	581563.28	81.97	4.57
302	-2.38	6486.86	-154.45	32240.93	588050.14	82.88	4.54
326	-2.99	1912.56	-57.19	32183.74	589962.70	83.15	4.54
363	-3.33	9599.40	-319.62	31864.12	599562.09	84.51	4.49
365	-3.98	7758.16	-308.44	31555.67	607320.25	85.60	4.45
345	-4.20	2738.24	-115.04	31440.63	610058.50	85.99	4.43
339	-4.35	1542.26	-67.10	31373.53	611600.76	86.20	4.42
349	-5.53	2439.99	-135.02	31238.51	614040.75	86.55	4.40
320	-5.67	10467.46	-593.87	30644.64	624508.20	88.02	4.32
356	-5.98	20594.38	-1232.02	29412.62	645102.58	90.93	4.15
313	-6.44	35706.88	-2298.19	27114.43	680809.47	95.96	3.82
351	-7.05	7459.36	-525.96	26588.48	688268.83	97.01	3.75
223	-8.19	754.82	-61.80	26526.67	689023.65	97.12	3.74
217	-9.81	1285.83	-126.20	26400.48	690309.48	97.30	3.72
358	-11.76	1899.27	-223.30	26177.17	692208.75	97.56	3.69
361	-11.82	11878.85	-1404.31	24772.86	704087.60	99.24	3.49
323	-12.26	4095.02	-502.11	24270.75	708182.63	99.82	3.42
228	-15.70	822.29	-129.11	24141.64	709004.91	99.93	3.40
325	-17.28	482.64	-83.39	24058.25	709487.56	100.00	3.40
Total		709487.56	24058.248			100	3.4026864

Contd. of Table 1.

Manufacturing TFP Sunrise Diagram-1980-85

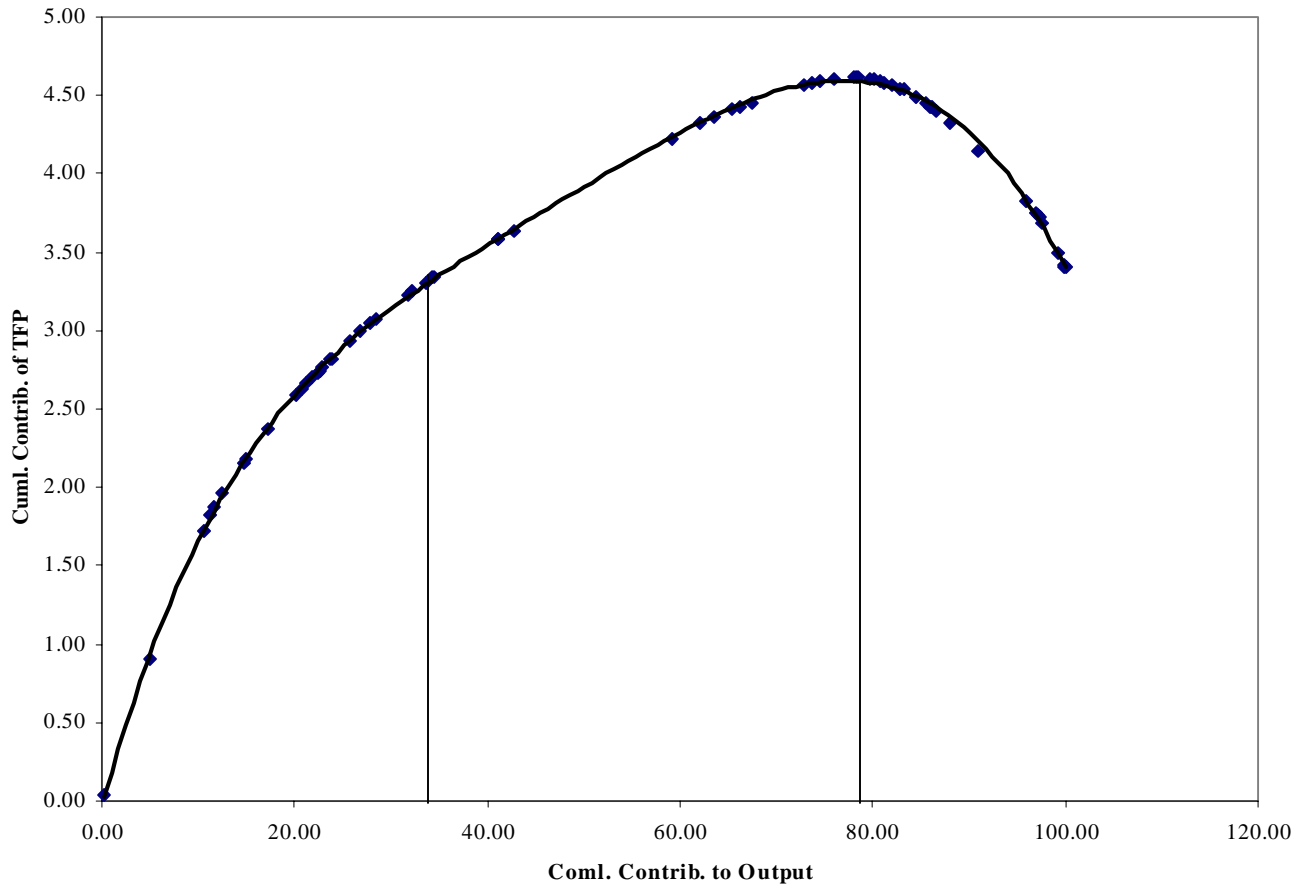


Figure-1

Table-2. TFP Growth Rates for Indian Manufacturing Industries, 1986-91

Sector Code	Sec. TFP Gr. Rate	Sec. Output (Million Rs. 1981=100)	TFP's contrib.To Output Growth (Million Rs 1981=100)	Cum. TFP's Contrib to OutputGrowth (Million Rs 1981=100)	Cum. Output (Million Rs 1981=100)	Cum. Output (% of Total Output)	Cum. TFP's Contrib To Output Growth (% of total Output)
	(A)	(B)	(A)*(B)	{C}	(D)	(D)/Total	{C}/Total
292	25.94	1470.23	381.34	381.34	1470.23	0.16	0.04
201	23.11	14914.69	3446.39	3827.73	16384.92	1.74	0.41
228	22.06	1416.30	312.46	4140.19	17801.22	1.89	0.44
208	18.89	1842.76	348.12	4488.31	19643.98	2.09	0.48
345	17.59	2360.00	415.04	4903.36	22003.99	2.34	0.52
342	15.84	4543.89	719.59	5622.94	26547.88	2.82	0.60
339	15.79	2278.60	359.75	5982.70	28826.48	3.06	0.64
200	14.40	571.10	82.22	6064.92	29397.58	3.12	0.64
290	12.99	6577.55	854.37	6919.29	35975.13	3.82	0.73
325	11.44	579.90	66.35	6985.63	36555.04	3.88	0.74
217	11.14	1833.67	204.36	7189.99	38388.71	4.08	0.76
323	10.49	4660.01	488.66	7678.65	43048.71	4.57	0.82
310	9.12	44704.15	4076.88	11755.54	87752.87	9.32	1.25
223	7.99	1360.20	108.67	11864.21	89113.07	9.46	1.26
361	7.10	18033.75	1280.09	13144.30	107146.81	11.38	1.40
291	6.95	5700.22	396.40	13540.69	112847.04	11.98	1.44
330	6.83	142854.99	9761.22	23301.92	255702.02	27.15	2.47
209	6.44	1404.52	90.40	23392.32	257106.55	27.30	2.48
360	6.41	56561.28	3623.49	27015.81	313667.83	33.31	2.87
343	5.98	10370.94	620.07	27635.87	324038.77	34.41	2.93
350	5.93	13371.36	793.03	28428.90	337410.13	35.83	3.02
326	5.75	2914.87	167.48	28596.38	340325.00	36.14	3.04
320	5.64	13033.96	735.42	29331.81	353358.96	37.52	3.11
226	5.56	12994.24	722.90	30054.70	366353.20	38.90	3.19
356	5.38	27365.10	1471.15	31525.86	393718.31	41.81	3.35
362	5.06	7252.64	367.04	31892.90	400970.95	42.58	3.39
211	4.03	12786.62	515.84	32408.74	413757.57	43.94	3.44
203	3.96	1903.95	75.45	32484.19	415661.52	44.14	3.45
351	3.57	8310.21	296.88	32781.07	423971.73	45.02	3.48
205	2.74	5772.51	158.31	32939.39	429744.24	45.63	3.50
224	2.69	3222.36	86.66	33026.05	432966.60	45.98	3.51
349	1.67	3135.53	52.32	33078.36	436102.13	46.31	3.51
363	1.53	8594.98	131.73	33210.10	444697.11	47.22	3.53
359	1.44	5752.97	82.97	33293.07	450450.07	47.83	3.54
329	1.17	10242.63	119.90	33412.97	460692.70	48.92	3.55
204	1.11	18996.56	211.04	33624.01	479689.26	50.94	3.57

Sector Code	Sec. TFP Gr. Rate	Sec. Output (Million Rs. 1981=100)	TFP's contrib.To Output Growth (Million Rs 1981=100)	Cum. TFP's Contrib to OutputGrowth (Million Rs 1981=100)	Cum. Output (Million Rs 1981=100)	Cum. Output (% of Total Output)	Cum. TFP's Contrib To Output Growth (% of total Output)
	(A)	(B)	(A)*(B)	{C}	(D)	(D)/Total	{C}/Total
314	1.09	44759.09	489.91	34113.92	524448.36	55.69	3.62
324	0.85	47073.10	401.71	34515.63	571521.45	60.69	3.67
207	0.53	3694.34	19.72	34535.35	575215.79	61.08	3.67
303	0.35	20007.70	69.76	34605.11	595223.49	63.21	3.67
357	0.21	12597.41	26.41	34631.52	607820.90	64.54	3.68
332	-0.16	5854.20	-9.47	34622.05	613675.10	65.17	3.68
316	-0.70	17497.82	-122.45	34499.60	631172.92	67.02	3.66
321	-0.79	9182.72	-72.53	34427.06	640355.63	68.00	3.66
352	-1.07	21850.26	-234.84	34192.22	662205.90	70.32	3.63
220	-1.08	6419.41	-69.48	34122.74	668625.31	71.00	3.62
313	-1.23	40025.30	-490.91	33631.83	708650.61	75.25	3.57
354	-1.52	13750.42	-209.16	33422.67	722401.03	76.71	3.55
206	-1.55	53513.78	-830.37	32592.31	775914.81	82.39	3.46
334	-1.74	1672.87	-29.17	32563.14	777587.68	82.57	3.46
341	-2.27	9254.70	-210.11	32353.02	786842.38	83.55	3.44
358	-2.53	1881.17	-47.52	32305.50	788723.56	83.75	3.43
216	-3.45	1374.28	-47.36	32258.14	790097.83	83.90	3.43
312	-4.23	13632.91	-576.13	31682.01	803730.74	85.35	3.36
202	-5.14	1594.84	-81.97	31600.04	805325.58	85.52	3.36
340	-5.90	12978.38	-766.09	30833.96	818303.97	86.89	3.27
222	-5.91	4657.84	-275.49	30558.47	822961.81	87.39	3.24
355	-6.46	7676.31	-495.87	30062.59	830638.12	88.20	3.19
219	-7.22	5874.64	-423.92	29638.68	836512.76	88.83	3.15
364	-8.34	18284.93	-1525.28	28113.40	854797.68	90.77	2.99
318	-9.78	3480.46	-340.36	27773.04	858278.14	91.14	2.95
365	-10.65	22330.30	-2377.82	25395.22	880608.44	93.51	2.70
210	-10.76	7185.34	-773.17	24622.05	887793.78	94.27	2.61
302	-16.79	10965.50	-1840.61	22781.45	898759.28	95.44	2.42
300	-17.80	40631.06	-7231.71	15549.73	939390.34	99.75	1.65
214	-18.19	2332.23	-424.21	15125.52	941722.57	100.00	1.61
Total		941722.57	15125.52			100	1.61

Contd. Of Table-2

Manufacturing TFP Sunrise Diagram 1986-91

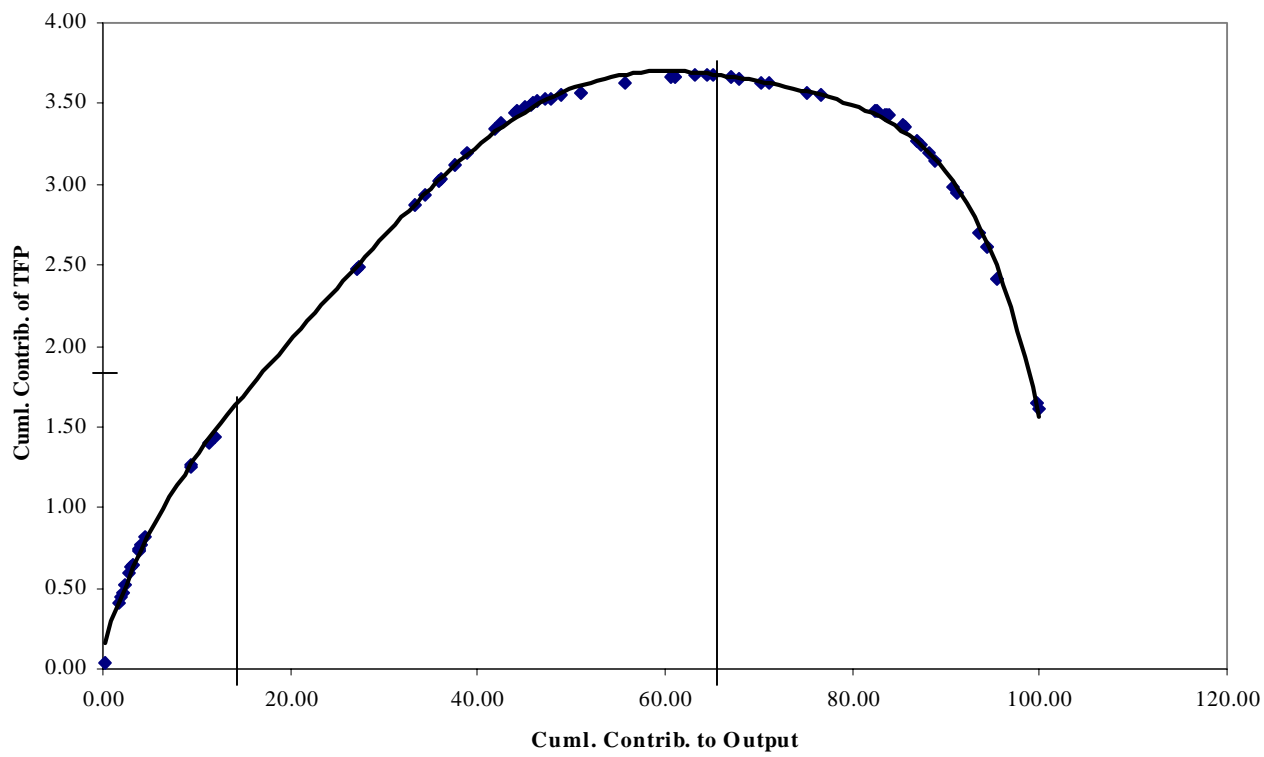


Figure-2

Table-3. TFP Growth Rates for Indian Manufacturing Industries, 1991-97

Sector Code	Sec. TFP Gr. Rate	Sec. Output (Million Rs. 1981=100)	TFP's contrib.To Output Growth (Million Rs 1981=100)	Cum. TFP's Contrib to Output Growth (Million Rs 1981=100)	Cum. Output (Million Rs 1981=100)	Cum. Output (% of Total Output)	Cum. TFP's Contrib To Output Growth (% of total Output)
	(A)	(B)	(A)*(B)	{C}	(D)	(D)/Total	{C}/Total
200	28.77	2259.42	650.11	14688.70	2259.42	0.15	1.01
313	24.22	53778.37	13025.47	27714.18	56037.79	3.84	1.90
351	22.08	11461.59	2531.14	30245.32	67499.39	4.63	2.07
332	17.26	6716.46	1159.05	31404.37	74215.85	5.09	2.15
214	17.07	2401.86	410.03	31814.40	76617.71	5.25	2.18
202	15.70	2382.36	374.01	32188.40	79000.07	5.41	2.21
292	13.27	5409.01	718.03	32906.43	84409.08	5.79	2.26
318	11.33	6480.35	734.05	33640.48	90889.43	6.23	2.31
207	10.44	3276.36	342.09	33982.57	94165.80	6.45	2.33
204	10.41	28888.29	3006.89	36989.46	123054.09	8.43	2.54
206	9.16	79918.90	7321.16	44310.63	202972.99	13.91	3.04
223	8.34	2123.61	177.04	44487.66	205096.60	14.06	3.05
362	8.20	10518.71	862.96	45350.62	215615.30	14.78	3.11
364	7.75	7308.03	566.63	45917.25	222923.33	15.28	3.15
358	7.20	1791.56	129.07	46046.32	224714.89	15.40	3.16
323	6.88	5556.72	382.51	46428.83	230271.61	15.78	3.18
354	6.81	20103.76	1369.57	47798.40	250375.37	17.16	3.28
205	6.36	8611.82	547.76	48346.15	258987.19	17.75	3.31
349	6.21	6787.39	421.75	48767.91	265774.58	18.22	3.34
359	6.11	13319.74	814.12	49582.02	279094.32	19.13	3.40
203	6.07	6702.47	406.57	49988.59	285796.79	19.59	3.43
209	5.87	3011.34	176.77	50165.37	288808.13	19.79	3.44
320	5.84	19549.49	1141.41	51306.78	308357.62	21.13	3.52
334	5.81	1817.68	105.63	51412.41	310175.31	21.26	3.52
201	5.60	18279.59	1024.01	52436.41	328454.90	22.51	3.59
350	5.48	20784.60	1138.16	53574.57	349239.50	23.94	3.67
343	5.18	13247.53	686.14	54260.71	362487.03	24.84	3.72
312	4.75	10893.66	517.49	54778.20	373380.69	25.59	3.75
208	4.59	2323.54	106.70	54884.89	375704.23	25.75	3.76
352	4.24	30789.04	1306.11	56191.00	406493.27	27.86	3.85
360	3.47	82214.64	2851.65	59042.65	488707.90	33.50	4.05
226	3.42	16962.55	579.83	59622.48	505670.46	34.66	4.09
340	3.24	17115.75	555.16	60177.64	522786.21	35.83	4.12
329	3.02	15155.24	458.30	60635.94	537941.45	36.87	4.16

Sector Code	Sec. TFP Gr. Rate	Sec. Output (Million Rs. 1981=100)	TFP's contrib.To Output Growth (Million Rs 1981=100)	Cum. TFP's Contrib to Output Growth (Million Rs 1981=100)	Cum. Output (Million Rs 1981=100)	Cum. Output (% of Total Output)	Cum. TFP's Contrib To Output Growth (% of total Output)
	(A)	(B)	(A)*(B)	{C}	(D)	(D)/Total	{C}/Total
357	2.63	14960.80	393.81	61029.76	552902.25	37.90	4.18
326	1.92	8079.25	154.73	61184.49	560981.50	38.45	4.19
356	1.81	41536.80	753.56	61938.05	602518.30	41.30	4.25
291	1.64	11356.98	186.29	62124.35	613875.28	42.08	4.26
365	1.38	55820.85	773.00	62897.34	669696.13	45.90	4.31
341	1.10	15345.13	168.95	63066.29	685041.26	46.95	4.32
314	1.00	117718.20	1178.45	64244.74	802759.46	55.02	4.40
217	0.76	4153.85	31.52	64276.26	806913.31	55.31	4.41
361	0.63	26017.27	165.12	64441.38	832930.57	57.09	4.42
324	-0.25	70540.58	-177.86	64263.51	903471.16	61.92	4.40
330	-0.39	203679.85	-802.48	63461.03	1107151.01	75.88	4.35
321	-0.51	14411.28	-73.36	63387.67	1121562.29	76.87	4.34
219	-0.69	8669.99	-59.63	63328.04	1130232.28	77.47	4.34
355	-0.77	11993.85	-92.27	63235.77	1142226.13	78.29	4.33
211	-1.27	32090.78	-408.39	62827.38	1174316.91	80.49	4.31
339	-2.15	2899.65	-62.23	62765.14	1177216.57	80.69	4.30
363	-2.16	7451.40	-161.14	62604.00	1184667.97	81.20	4.29
290	-2.57	8382.13	-215.10	62388.90	1193050.10	81.77	4.28
345	-2.82	2353.17	-66.36	62322.54	1195403.27	81.93	4.27
300	-2.95	82371.62	-2427.29	59895.26	1277774.89	87.58	4.11
224	-3.10	6304.57	-195.59	59699.67	1284079.46	88.01	4.09
222	-3.50	7742.09	-271.12	59428.54	1291821.55	88.54	4.07
220	-3.82	10461.70	-399.53	59029.02	1302283.25	89.26	4.05
342	-4.06	5678.56	-230.37	58798.65	1307961.81	89.65	4.03
228	-4.45	2004.61	-89.18	58709.47	1309966.41	89.79	4.02
310	-5.01	37669.58	-1888.56	56820.91	1347635.99	92.37	3.89
303	-6.45	32922.13	-2122.26	54698.65	1380558.11	94.62	3.75
325	-7.05	421.61	-29.72	54668.94	1380979.72	94.65	3.75
216	-8.57	444.59	-38.12	54630.82	1381424.31	94.68	3.74
210	-9.55	9614.99	-917.79	53713.03	1391039.30	95.34	3.68
316	-12.30	8416.32	-1035.09	52677.93	1399455.62	95.92	3.61
302	-16.34	59544.20	-9729.24	42948.70	1458999.81	100.00	2.94
Total		1458999.81					

Contd. Of Table-3

Manufacturing TFP Sunrise Diagram 1991-97

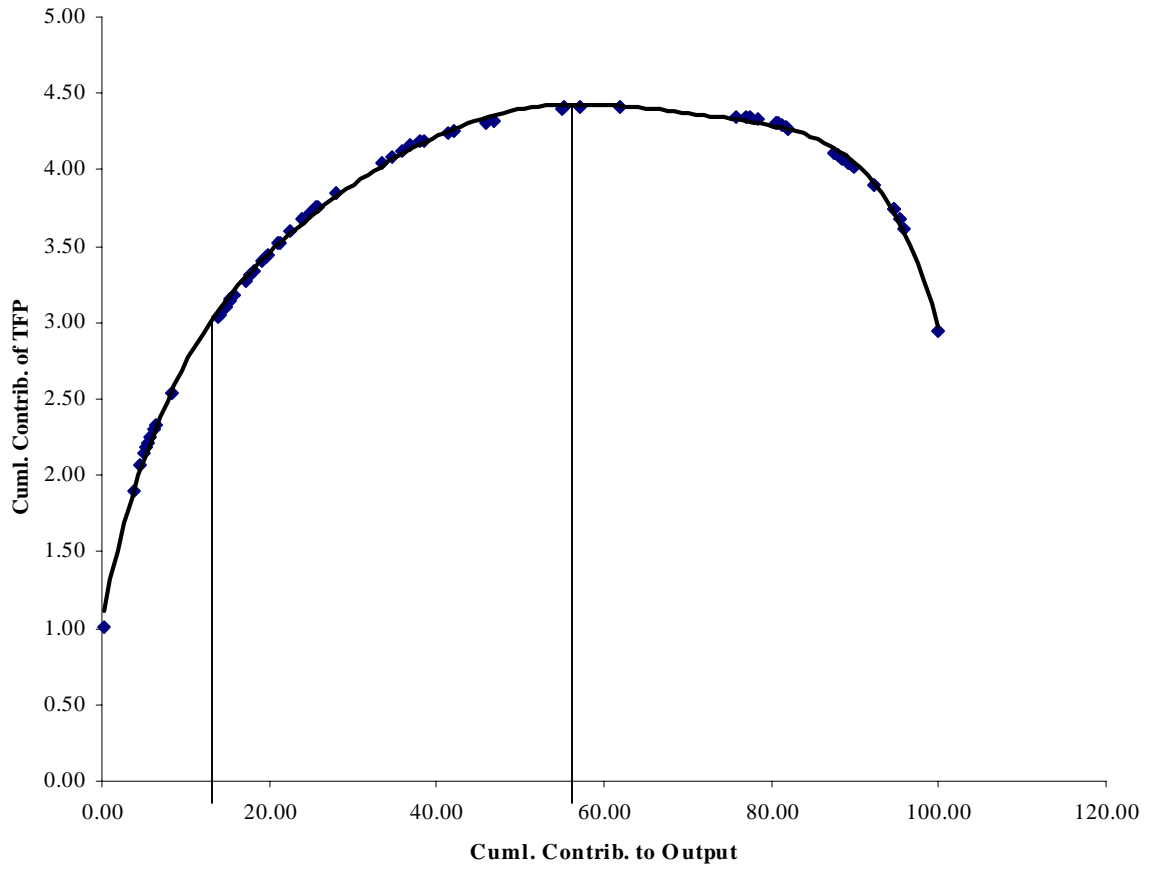


Figure-3

Table-4(a)**1981-86 Sources of Growth**

Sector Code/Name	Labor Cont.	Capital Cont.	TFP Contr.	Gr. GDP
20-Manufacture of Food Products	0.82	5.51	4.99	11.33
21-Manufacture of other Food Products	-0.27	7.59	0.34	7.67
22-Manuf of Beverages, Tobacco, etc.	0.56	12.80	0.34	13.70
24-Wool, Silk and Man made Fibres Textiles	-1.00	9.94	-3.79	5.15
26-Other Textiles	-0.72	8.55	3.04	10.87
28-Paper and products	0.13	6.78	1.64	8.56
29-Leather & products of leather	0.72	9.13	3.43	13.28
30-Basic Chem & products (except Petroleum and Coal)	0.81	11.40	1.04	13.25
31-Rubber, Plastic, Petroleum & Coal products, Processing of Nuclear Fuels	1.96	10.71	3.38	16.05
32-Manufacture of Non-Metalic Mineral Products	-0.21	10.94	-5.05	5.69
33-Basic Metal & Alloys industries	-0.50	6.10	2.51	8.12
34-Metal Products and Parts, Except Machinery and Equipment	-1.19	4.72	-1.59	1.94
35-Machinery & Equipments other than Transport Equipments	0.27	9.93	-1.30	8.90
36-Electrical Machinery & equipments	0.79	14.85	-6.20	9.44

Table-4(b)

1986-91 Sources of Growth	Labor Cont.	Capital Cont.	TFP Contr.	Gr. GDP
Sector Code/Name				
20-Manufacture of Food Products	0.96	4.48	4.40	9.84
21-Manufacture of other Food Products	-1.17	13.31	-4.14	8.00
22-Manuf of Beverages, Tobacco, etc.	1.35	7.44	5.06	13.86
24-Wool, Silk and Man made Fibres Textiles	2.98	7.96	5.82	16.77
26-Other Textiles	3.60	23.32	-10.65	16.28
28-Paper and products	-3.13	6.05	-0.07	2.85
29-Leather & products of leather	6.77	10.51	15.29	32.57
30-Basic Chem & products (except Petroleum and Coal)	1.50	14.97	-1.20	15.27
31-Rubber, Plastic, Petroleum & Coal products, Processing of Nuclear Fuels	-2.49	-2.16	-3.76	-8.41
32-Manufacture of Non-Metalic Mineral Products	-0.96	1.76	5.62	6.41
33-Basic Metal & Alloys industries	-1.51	8.47	4.99	11.95
34-Metal Products and Parts, Except Machinery and Equipment	1.57	9.74	0.90	12.21
35-Machinery & Equipments other than Transport Equipments	-0.05	3.03	1.46	4.44
36-Electrical Machinery & equipments	-1.18	9.59	-2.28	6.12

Table-4©**1991-97 Sources of Growth**

Sector Code/Name	Labor Cont.	Capital Cont.	TFP Contr.	Gr. GDP
20-Manufacture of Food Products	3.83	6.54	6.70	17.07
21-Manufacture of other Food Products	3.38	14.39	0.20	17.97
22-Manuf of Beverages, Tobacco, etc.	2.09	9.90	-0.62	11.37
24-Wool, Silk and Man made Fibres Textiles	7.60	8.17	9.12	24.89
26-Other Textiles	5.98	13.64	3.63	23.24
28-Paper and products	2.88	4.06	7.42	14.37
29-Leather & products of leather	1.90	6.97	4.12	12.98
30-Basic Chem & products (except Petroleum and Coal)	3.84	-0.27	7.29	10.86
31-Rubber, Plastic, Petroleum & Coal products, Processing of Nuclear Fuels	2.48	13.20	22.63	38.30
32-Manufacture of Non-Metalic Mineral Products	0.94	7.55	1.68	10.17
33-Basic Metal & Alloys industries	3.63	16.34	-1.44	18.54
34-Metal Products and Parts, Except Machinery and Equipment	3.68	7.78	2.49	13.95
35-Machinery & Equipments other than Transport Equipments	3.30	4.47	4.15	11.92
36-Electrical Machinery & equipments	1.76	11.25	-1.34	11.68

Appendix-2:

Industry

Code Three Digit Industries

Description

20 Manufacture of Food Products

- 200 Slaughtering, preparation and preservation of meat
- 201 Manufacture of dairy products
- 202 Canning and preservation of fruits and vegetables
- 203 Processing, canning and preservation of fish, crustacea and similar foods
- 204 Grain milling
- 205 Manufacture of bakery products
- 206 Manufacturing and refining of sugar etc
- 207 Production of indigenous sugar from sugarcane palm juice etc
- 208 Production of common salt
- 209 Manufacture of cocoa products and sugar confectionary

21 Manufacture of other Food Products

- 210 Manufacture of hydrogenated oils and vanaspati ghee etc.
- 211 Manufacture of vegetable oils and fats other than hydrogenated
- 213 Processing and blending of tea including manufacturing of instant tea
- 214 Coffee curing, roasting, grinding and blending etc.
- 215 Processing of edible nuts
- 216 Manufacture of ice
- 217 Manufacture of prepared animal and bird feed
- 219 Manufacture of food products n.e.c

22 Manufacture of Beverages, Tobacco and related products

- 220 Distilling, rectifying and blending of spirits, etyle alcohol production from fermented materials
- 221 Manufacture of wine
- 222 Manufacture of malt liquors and malt
- 223 Production of country liquor
- 224 Manufacture of soft drink and syrup
- 225 Tobacco stemming and preparation of raw leaf tobacco
- 226 Manufacture of bidi
- 227 Manufacture of cigars, cigarette, cheroots and cigarette tobacco
- 228 Manufacture of snuff, chewing tabacco etc.
- 229 Manufacture of pan masala and chewing lime

29 Manufacture of Leather and products of leather, fur and leather substitutes

- 290 Tann, curring, fin of leather
- 291 Leather ft. wear
- 292 Wearing apprl of leather & sub leather
- 293 Consumer goods of leather &sub lthr
- 299 Leather & fur n.e.c

30 Manufacture of Basic Chemicals and Chemicals Products (except products of Petroleum and Coal)

- 300 Ind org & inorg chm
- 301 Fert & pest
- 302+306 Plastic, synth rub & man fibr
- 303 Paints, varnishes, & related products
- 304 Drugs & pharma
- 305 Perfume, cosmetics, lotions etc.
- 307 Matches

31 Manufacture of Rubber, Plastic, Petroleum & Coal products, Processing of Nuclear Fuels

- 310 Tyres & tubes
- 311 Rubber & plastic, ftw wear
- 312 Rubber products n.e.c
- 313 Plastic prdct. n.e.c
- 314 Refined petroleum prdcts.
- 315 Liquified petroleum gas
- 316 Refined petroleum prdcts. N.e.c
- 318 Coke oven products.
- 319 Other coal &tar products

32 Manufacture of Non-Metallic Mineral Products

- 320 Refractory prdcts. & clay prdcts
- 321 Glass & glass products
- 323 Ceramic ware
- 324 Cement, lime and plaster
- 325 Mica products
- 326 Stone dressing &crushing etc.
- 327 Asbestos cement and others
- 329 Miscellaneous non-metallic products n.e.c

33 Basic Metal & Alloys industries

- 330 Iron & steel in primary or self-finished forms
- 331 Semi finished iron & steel prdcts
- 332 Ferro alloys
- 333 Cpoopr mfg
- 334 Brass mfg
- 335 Aluminium mfg
- 336 Zinc mfg
- 338+339 Metal scrap & non ferr metals

34 Metal Products and Parts, Except Machinery and Equipment

- 340 Fabricated structural metal products
- 341 Fabricated metal products n.ec
- 342 Furniture & fixtures of metals
- 343 Hand tools, weights & measures etc.
- 344 Finished or semifinished metal prdct.
- 345 Coating of metals
- 349 Metal products n.e.c

35 Machinery & Equipments other than Transport Equipments

- 350 Agrl mach, equipment & parts
- 351 Mach/equip used by const & minning indst
- 352 Prime movers, boilers, etc.
- 353 Food & textile machinery
- 354 Mach. Other than food/textiles
- 355 Refrg, aircon, & accessories
- 356 General purpose non-elect mach
- 357 Machine tools parts & accessories
- 358 Office/computers, accounting mach etc
- 359 Spl porpose equip & components

36 Electrical Machinery & equipments

- 360 Electrical indust machinery
- 361 Insulated wires & cables
- 362 Accumulators, primary cells and batteries
- 363 Electric lamps
- 364 Electric fans & electro-thermic domestic appl.
- 365 Appratus for radio broadcasting, TV transmission etc
- 366 Microphones, amplifiers, audio/video tapes etc.
- 369 X-ray apparatus, X-ray tubes & parts and elect equip n.e.c