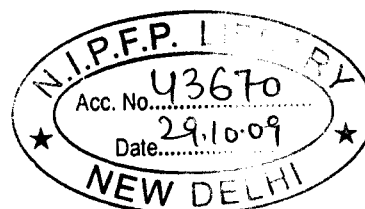


JOINT ESTIMATION OF CORPORATE
TAX FROM MANUFACTURING,
MINING, ELECTRICITY AND SERVICE
SECTORS OF THE INDIAN ECONOMY

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**Joint Estimation of Corporate Tax from Manufacturing, Mining, Electricity, and
Service Sectors of the Indian Economy**

A.L. Nagar, Sanjay Kumar and Rajorshi Sen Gupta

1. Introduction

In an earlier paper, "Estimate of Corporate Tax from the Manufacturing Sector of the Indian Economy", NIPFP, May 2004, we analyzed changes in the corporate tax (CT) paid by the manufacturing sector, during the period 1989-90 to 2002-03, in terms of (a) profits before tax (PBT) - both actual and estimated - in the manufacturing sector; (b) contribution of the manufacturing sector to gross domestic product (GDPMP) and (c) maximum statutory tax rate (TAXRATE). The profits in the manufacturing sector were estimated in terms of (i) interest payments (INTPAID); (ii) a composite index (INFRST) of different infrastructure industries, viz. electricity, coal, cement, petroleum products, etc; (iii) the debt equity ratio (DE) of the manufacturing sector in aggregate; (iv) depreciation expenses (DEPRECIATION) and (v) GDPMP.

We used CMIE data for the analysis. Although, these data are based on selected companies (for whom audited unabridged annual accounts were available) the coverage is fairly comprehensive. They include public and private sector companies, cooperatives and statutory bodies that function as enterprises (both listed and unlisted).

In the present paper we use the CMIE data again to analyze CT accruing from a panel of four sectors (manufacturing, mining, electricity and services) for 14 years (1989-90 to

2002-03). The data on relevant variables (with the data sources) of these sectors are given in the Appendix B. Since the four sectors are simultaneously affected by the general economic conditions prevailing in the country and by changes in government policies, we assume that their functioning is interdependent. It is reasonable to assume that individual sectors do not operate in isolation and independently of each other. Accordingly, we use **Seemingly Unrelated Regressions (SUR)** method of estimating the system of regressions; c.f. Appendix A for the method.

The procedure adopted in this paper is the same as we used for the manufacturing sector; viz., we estimate CT from individual sectors in terms of (i) PBT (i.e., both **actual** and **estimated** profits before tax, and (ii) TAXRATE (i.e., the maximum statutory tax rate). Now PBT has been estimated as follows:

A. For the **Manufacturing Sector**, the explanatory variables are -

- i. INFRST
- ii. SALE
- iii. INTPAID
- iv. DE
- v. DEPRECIATION

B. For the **Mining, Electricity and Services** sector, the explanatory variables are

- i. INFRST
- ii. SALE

iii. INT (Bank rate of interest)

There is some difference in the inclusion of explanatory variables for the manufacturing sector and the other three sectors. This is mainly because data on debt equity ratio, depreciation and interest payment were available only for the manufacturing sector but not for the other sectors. However, instead of INTPAID (interest payments) we have included the bank rate (INT) in the estimation of PBT for the other sectors.

The advantage of estimating CT in terms of estimated profits (rather than actual profits) is that it enables us to examine the effects of changes in certain policy variables on PBT and hence on CT; for example, effects of changes in debt equity ratio, interest payments or the rate of interest, depreciation, etc. in the present case.

In Section 2 we consider joint estimation of PBT from the four sectors (manufacturing, mining, electricity and services) by (i) one-step and (ii) iterative SUR method. A detailed exposition of the SUR method is given in the Appendix A. The joint estimation of CT from 4 sectors in terms of **actual** PBT is presented in Section 3 and in terms of **iteratively estimated** PBT in Section 4.

The actual and estimated PBT are given in Appendix C, along with their graphical representation; and the actual and estimated CT in the two cases (viz., in terms of actual and iteratively estimated PBT) are given in Appendix D and E, respectively.

2. Joint Estimation of Profits Before Tax (PBT) from Four Sectors by SUR Method

To start with, the equations for the different sectors were estimated by one step SUR (seemingly unrelated regressions) method using an estimated variance-covariance matrix (the estimate of this covariance matrix was obtained by applying OLS to each of the four equations). Details of the underlying technique are given in Appendix A of the paper. Then, using the newly estimated covariance matrix (obtained by applying SUR method to this system) we proceed to re-estimate the coefficients, and iterate till the process converges. The effects of iterations are also reported below along with the one-step SUR estimated coefficients. We note that the convergence was achieved in 30 iterations. This exercise leads us to more efficient estimates of the regressions coefficients.

The results of the joint estimation of PBT functions (in loglinear form) for the four sectors according to one-step SUR method and iterative SUR method are presented in the following tables i.e., Table 2.1 to 2.4.

Table 2.1

SUR Estimation of PBT for Manufacturing Sector

Explanatory Variable	One Step SUR Estimation of Coefficients*	Iterated SUR Estimation of Coefficients till Convergence**
\ln (INFRST : MANUF)	0.454528 (2.13)	0.618369 (3.09)
\ln (SALE : MANUF)	1.955633 (7.56)	1.771939 (7.06)
\ln (INTPAID)	-1.037621 (-3.06)	-1.003750 (-3.23)
\ln (DE)	-1.517423 (-6.08)	-1.060740 (-4.39)
\ln (DE PRECIATION)	-0.733805 (-2.42)	-0.621352 (-1.98)
R ²	0.894988	0.868793
Adjusted R ²	0.848315	0.810479
D.W.	1.049418	0.842694

Note: The figures in the brackets under the coefficients are t-values.

* The estimated equation is:

$$(2.1A) \ln(\text{PBT}) = 0.454528 \ln(\text{INFRST}) + 1.955633 \ln(\text{SALE}) - 1.037621 \ln(\text{INTPAID}) \\ - 1.517423 \ln(\text{DE}) - 0.733805 \ln(\text{DEPRECIATION})$$

** The estimated equation is:

$$(2.1B) \ln(\text{PBT}) = 0.618369 \ln(\text{INFRST}) + 1.771939 \ln(\text{SALE}) - 1.003750 \ln(\text{INTPAID}) \\ - 1.060740 \ln(\text{DE}) - 0.621352 \ln(\text{DEPRECIATION})$$

Table 2.2

SUR Estimation of PBT for Mining Sector

Explanatory Variable	One Step SUR Estimation of Coefficients*	Iterated SUR Estimation of Coefficients till Convergence**
\ln (INFRST : MINING)	0.454528 (2.13)	0.618369 (3.09)
\ln (SALE : MINING)	0.770326 (7.74)	0.702026 (7.41)
\ln (INT: MINING)	-0.909941 (-5.59)	-0.935766 (-5.63)
R ²	0.926820	0.924757
Adjusted R ²	0.913514	0.911076
D.W.	1.739530	1.728406

Note: The figures in the brackets under the coefficients are t-values.

* The estimated equation is:

$$(2.2A) \ln (PBT) = 0.454528 \ln (INFRST) + 0.770326 \ln (SALE) - 0.909941 \ln (INT)$$

** The estimated equation is:

$$(2.2B) \ln (PBT) = 0.618369 \ln (INFRST) + 0.702026 \ln (SALE) - 0.935766 \ln (INT)$$

Table 2.3

SUR Estimation of PBT for Electricity Sector

Explanatory Variable	One Step SUR Estimation of Coefficients*	Iterated SUR Estimation of Coefficients till Convergence**
\ln (INFRST : ELEC)	0.454528 (2.13)	0.618369 (3.09)
\ln (SALE : ELEC)	0.759078 (7.94)	0.687871 (7.69)
\ln (INT: ELEC)	-0.762748 (-8.95)	-0.790795 (-9.62)
R ²	0.982124	0.982608
Adjusted R ²	0.978873	0.979445
D.W.	2.137932	2.021362

Note: The figures in the brackets under the coefficients are t-values.

* The estimated equation is:

$$(2.3A) \ln (PBT) = 0.454528 \ln (INFRST) + 0.759078 \ln (SALE) - 0.762748 \ln (INT)$$

** The estimated equation is:

$$(2.3B) \ln (PBT) = 0.618369 \ln (INFRST) + 0.687871 \ln (SALE) - 0.790795 \ln (INT)$$

Table 2.4

SUR Estimation of PBT for Service Sector

Explanatory Variable	One Step SUR Estimation of Coefficients*	Iterated SUR Estimation of Coefficients till Convergence**
ℓ_n (SALE : SER)	0.987820 (18.99)	0.980357 (19.26)
ℓ_n (INT: SER)	-1.173534 (-4.31)	-1.134764 (-4.62)
R ²	0.903873	0.903846
Adjusted R ²	0.895862	0.895834
D.W.	1.198549	1.187701

Note: The figures in the brackets under the coefficients are t-values.

* The estimated equation is:

$$(2.4A) \ell_n (\text{PBT}) = 0.987820 \ell_n (\text{SALE}) - 1.173534 \ell_n (\text{INT})$$

** The estimated equation is:

$$(2.4B) \ell_n (\text{PBT}) = 0.980357 \ell_n (\text{SALE}) - 1.134764 \ell_n (\text{INT})$$

The actual and estimated values of PBT for these 4 sectors are presented in Table C.1 to C.4 in appendix C. They are shown graphically in Figure C.1 to Figure C.4 in the same appendix.

It is interesting to note that the graphs showing one step SUR estimated PBT (i.e., ESTPBT) and iteratively estimated PBT (i.e., ITERESTPBT) almost collapse for all the sectors. (Also, see Tables C.1 to C.4)

From the estimated equations given above we observe the following things.

All the coefficients are significant at 5% level of significance and they have the desired signs. The elasticity of PBT with respect to 'Sales' is highest in case of the manufacturing sector compared to other sectors. A reduction of the bank rate leads to maximum increase in PBT in case of services sector because of the highest "interest-elasticity of PBT" in that sector (in absolute value).

It should be noted that we have not included INFRST for estimating PBT in the service sector, because infrastructure (INFRST) is already accounted for in services.

3. Joint Estimation of Corporate Tax Accruing from the Four Sectors - Using Actual PBT

In this section, we consider joint estimation of CT accruing from the 4 sectors by SUR method. The iteratively estimated regressions using **actual PBT** are given below. The process converged in 31 iterations.

Manufacturing

$$(3.1) \ln(\text{CT:MANUF}) = 11.22954 + 0.518907 \ln(\text{PBT: MANUF}) - 2.050794 \ln(\text{TAXRATE:MANUF})$$

(12.00) (14.35) (-10.49)

Mining

$$(3.2) \ln(\text{CT:MINING}) = 22.29146 + 0.777228 \ln(\text{PBT: MINING}) - 6.002040 \ln(\text{TAXRATE:MINING})$$

(3.11) (3.98) (-3.62)

Electricity

$$(3.3) \ln(\text{CT:ELEC}) = 32.54498 + 1.062386 \ln(\text{PBT: ELEC}) - 9.718744 \ln(\text{TAXRATE:ELEC})$$

(2.26) (2.28) (-3.27)

Services

$$(3.4) \ln(\text{CT:SER}) = 9.997519 + 0.657274 \ln(\text{PBT: SER}) - 2.139231 \ln(\text{TAXRATE:SER})$$

(3.81) (12.85) (-3.45)

The quantities within brackets, under the coefficient estimates, are the t-values. All coefficients turn out to be significant at 5% level of significance. The values of R^2 ; \bar{R}^2 and D. W. for each of the above equations are given below:

Equation	R^2	\bar{R}^2	D.W.
(3.1)	0.972014	0.966926	2.579095
(3.2)	0.825649	0.793949	1.138580
(3.3)	0.897787	0.879202	2.265475
(3.4)	0.955711	0.947658	1.884294

The actual and estimated values of CT are shown in Table D.1 to D.4 and they are shown graphically in Figure D.1 to D.4 in Appendix D.

It turns out that for all the sectors, except electricity sector, the "profit elasticity of corporate tax payments" are less than one. Thus, for instance, an increase of 1% in PBT leads

to 0.52% rise in CT paid by the manufacturing sector. The corresponding figures for mining and service sector are 0.78% and 0.66% respectively. On the other hand, in the electricity sector, a 1% increase in PBT leads to a more than proportionate rise in CT paid, which is of the order of 1.06%. Turning to the other variable, viz. maximum statutory tax rate, there is a clear presence of the so called "Laffer Curve" effect in all the sectors under consideration. To substantiate this, we point out that a decrease in the tax rate by 1% would lead to more than proportionate increase in CT collections. The percentage increase in CT are 2.05 for manufacturing sector; 6 for mining sector; 9.72 for electricity sector and 2.14 for the service sector.

4. Joint Estimation of Corporate Tax Accruing from the Four Sectors using Estimated PBT

The iterated SUR estimated regressions are performed using **estimated PBT** (derived from equations:- 2.1B, 2.2B, 2.3B and 2.4B given below Table 2.1 to Table 2.4 in section 2). Here we present only the iteratively estimated SUR coefficients. The SUR estimates obtained in one-step (without iterations) were found to be insignificant for some variables.

The results of this exercise are presented in equations 4.1 to 4.4.

We present the actual and estimated values of CT in Appendix E in Table E.1 to E.4. The graphs are shown in Figure E.1 to E.4 in the same appendix.

ESTIMATION OF SUR MODEL

A.1 SUR Model in Algebraic Form

Seemingly Unrelated Regression (SUR) model may be expressed in algebraic form as

$$(A.1.1) \quad y_{it} = \alpha_i + \beta_{1i} x_{1it} + \dots + \beta_{ki} x_{kit} + u_{it}$$

for $i = 1, \dots, p$ (sectors) and $t=1, \dots, T$ (years); where

y_{it} = the t -th observation on the i -th dependent variable (e.g., CT paid by the i -th sector in year t) and

x_{kit} = the t -th observation on the k -th explanatory variable in the i -th sector (e.g., profits (PBT) and statutory tax rate in the i -th sector in year t).

We specify that the intercept (α_i) and slope coefficients ($\beta_{1i}, \dots, \beta_{ki}$) vary with the sector (i) but remain invariant over time (t). Also, u_{it} is error in the equation. The assumptions of the model are

- (i) the explanatory variables (x 's) are non-stochastic and fixed in repeated samples (thus ruling out the presence of lagged dependent variables among explanatory variables),

- (ii) x_{1it}, \dots, x_{Kit} are mutually linearly independent (i.e., none of them can be expressed as a linear function of others), and
- (iii) the errors (u_{it} 's) in the equation have zero means, constant variances and covariances and they are temporally independent, i.e.,

$$(A.1.2) \quad E u_{it} = 0, \quad V u_{it} = \sigma_{ii}$$

$$\text{Cov}(u_{it}, u_{jt'}) = \sigma_{ij} \quad \text{if} \quad t = t'$$

$$= 0 \quad \text{if} \quad t \neq t'$$

for $i, j = 1, \dots, p$ and $t, t' = 1, \dots, T$.

A.2 SUR Model in Matrix Form

In matrix form (A.1.1) may be expressed as

$$(A.2.1) \quad y_i = X_i \beta_i + u_i$$

for $i = 1, \dots, p$; where

$$(A.2.2) \quad y_i = \begin{pmatrix} y_{i1} \\ \vdots \\ y_{iT} \end{pmatrix}, \quad X_i = \begin{pmatrix} 1 & x_{1i1} & \dots & x_{ki1} \\ \vdots & \vdots & & \vdots \\ 1 & x_{1iT} & & x_{kiT} \end{pmatrix}$$

$$\beta_i = \begin{pmatrix} \alpha_i \\ \beta_{1i} \\ \vdots \\ \beta_{ki} \end{pmatrix}, \quad \text{and} \quad u_i = \begin{pmatrix} u_{i1} \\ \vdots \\ u_{iT} \end{pmatrix}$$

Stacking all equations together, we may write

$$(A.2.3) \quad y = X \beta + u$$

where

$$(A.2.4) \quad y = \begin{pmatrix} y_1 \\ \vdots \\ y_p \end{pmatrix}, X = \begin{pmatrix} X_1 & \cdots & 0 \\ \vdots & & \\ 0 & \cdots & X_p \end{pmatrix}, \beta = \begin{pmatrix} \beta_1 \\ \vdots \\ \beta_p \end{pmatrix} \text{ and } u = \begin{pmatrix} u_1 \\ \vdots \\ u_p \end{pmatrix}$$

We observe that

$$(A.2.5) \quad E u = 0$$

because $E u_i = 0$ for all i . Also, since

$$(A.2.6) \quad E u_i u_j' = \sigma_{ij} I$$

for all $i, j = 1, \dots, p$, where I is $T \times T$ unit matrix; we have

$$(A.2.7) \quad E uu' = \begin{pmatrix} \sigma_{11} I & \cdots & \sigma_{1p} I \\ \vdots & & \\ \sigma_{p1} I & \cdots & \sigma_{pp} I \end{pmatrix}$$

We may briefly express

$$(A.2.8) \quad E uu' = \Sigma \otimes I$$

where

$$(A.2.9) \quad \Sigma = \begin{pmatrix} \sigma_{11} & \cdots & \sigma_{1p} \\ \vdots & & \\ \sigma_{p1} & \cdots & \sigma_{pp} \end{pmatrix}$$

is the matrix of contemporaneous variances and covariances and \otimes indicates Kronecker product of matrices.

A.3. Estimation of the SUR Model

Let us outline the estimation procedure, step-wise, as follows.

Step 1. Obtain the OLS estimator

$$\mathbf{b}_i = (\mathbf{X}_i' \mathbf{X}_i)^{-1} \mathbf{X}_i' \mathbf{y}_i$$

of β_i and

$$\hat{\mathbf{u}}_i = \mathbf{y}_i - \mathbf{x}_i \mathbf{b}_i$$

of u_i in (A.2.1.) for all i .

Step 2. The estimator of σ_{ij} is obtained as

$$\hat{\sigma}_{ij} = \frac{1}{T} \hat{\mathbf{u}}_i' \hat{\mathbf{u}}_j$$

for $i, j = 1, \dots, p$, and construct

$$\hat{\Sigma} = \left(\begin{pmatrix} \hat{\sigma}_{ij} \end{pmatrix} \right)$$

Step 3. Obtain the estimator

$$\hat{\beta} = (X'\hat{\Omega}^{-1}X)^{-1} X'\hat{\Omega}^{-1}y$$

of β in (A.2.3), where $\hat{\Omega}^{-1} = \hat{\Sigma}^{-1} \otimes I$.

Step 4. The estimated asymptotic covariance matrix of $\hat{\beta}$ is $(X'\hat{\Omega}^{-1}X)^{-1}$

where $\hat{\Omega}^{-1}$ is as in Step 3.

DATA ON THE RELEVANT VARIABLES

Table B.1: Manufacturing Sector

Year	SALE in crores of Rs	CT in crores of Rs	PBT in crores of Rs	RATE %	INTPAID in crores of Rupees	DE Ratio	DEPRECI ATION in crores of Rupees	INFR Index
1989-90	178946	2045.3	5702.4	50	8270	1.789	6166	82.15
1990-91	206708.4	2551	6848.8	50	10504	1.916	6774.6	86.03
1991-92	239758.1	3529.2	7934.4	40	13235.2	1.99	8236.4	91.99
1992-93	273708.4	3516.7	7175.6	45	16185.7	1.91	9393.1	94.99
1993-94	314329.7	4055.1	11925.6	45	17874.1	1.526	8909.1	100
1994-95	409090.3	5212	21768.5	45	19492.6	1.236	10846.2	111
1995-96	497705.2	6816.7	27296	40	24502	1.204	13101.2	122.8
1996-97	553616.7	7126.8	19814.2	40	31080.9	1.349	16487.8	127.3
1997-98	585856.9	6466.5	16483.6	40	34011.4	1.477	19654.1	134.5
1998-99	638069	6828.6	12271.7	35	37848.6	1.538	22170.2	138.3
1999-00	757389.5	7463.8	14113.8	35	40554.2	1.425	26206.6	150.9
2000-01	902434.4	7346.5	16609.4	35	44690.5	1.408	29055.6	158.6
2001-02	895831.3	8550.9	17370.2	35	42496.3	1.476	30916.3	163.5
2002-03	965678.6	13438.4	40310.2	35	36365.1	1.323	33461	171.9

Table B.2: Mining Sector

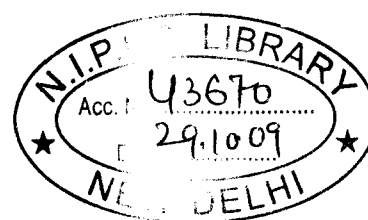
Year	SALE in crores of Rs	CT in crores of Rs	PBT in crores of Rs	RATE %	INT %	INFR Index
1989-90	18196.3	447	2285.9	50	10	82.15
1990-91	20118.4	116.2	2025.7	50	10	86.03
1991-92	18976	51.1	1010.5	40	12	91.99
1992-93	22262	102.3	1503.4	45	12	94.99
1993-94	25479.4	150.6	2876.3	45	12	100
1994-95	30218.2	154.5	2669.6	45	12	111
1995-96	35541.3	523	2614.2	40	12	122.8
1996-97	51076.9	1558	4272.1	40	12	127.3
1997-98	57343.3	1843.6	6659.1	40	10.5	134.5
1998-99	61644.5	2037.5	6462.1	35	8	138.3
1999-00	68784.5	3080.7	6753.9	35	8	150.9
2000-01	76681	4541.5	8985.1	35	7	158.6
2001-02	104322.1	3857.1	11320.8	35	6.5	163.5
2002-03	112401.8	6872.1	19586.5	35	6.25	171.9

Table B. 3: Electricity Sector

Year	SALE in crores of Rs	CT in crores of Rs	PBT in crores of Rs	RATE %	INT %	INFR Index
1989-90	5266.5	2.1	866.8	50	10	82.15
1990-91	8943.1	17.3	1138.4	50	10	86.03
1991-92	11801.8	33.5	1525	40	12	91.99
1992-93	14980.1	54.6	1818.8	45	12	94.99
1993-94	18299.2	56	2140.6	45	12	100
1994-95	23237.6	21.1	2781.6	45	12	111
1995-96	28477.1	171.4	3820.5	40	12	122.8
1996-97	38507.1	240.3	3270.4	40	12	127.3
1997-98	41343.4	1413.9	4440.8	40	10.5	134.5
1998-99	43074.6	1799.9	6242.1	35	8	138.3
1999-00	43846.3	1433.3	7441.9	35	8	150.9
2000-01	49785.7	2026.7	8565.5	35	7	158.6
2001-02	44936.6	1720	9064.6	35	6.5	163.5
2002-03	55086.2	1981.4	9339.1	35	6.25	171.9

Table B.4: Service Sector

Year	SALE in crores of Rs	CT in crores of Rs	PBT in crores of Rs	RATE %	INT %
1989-90	25973.5	515.5	976.2	50	10
1990-91	29567	498.3	902.6	50	10
1991-92	66370.1	1096.8	3756.3	40	12
1992-93	79255.4	1264.2	2788.3	45	12
1993-94	110091	1663.4	4582.3	45	12
1994-95	145077.6	2223.4	10840.3	45	12
1995-96	182211.3	3246	13811.7	40	12
1996-97	213170.9	6024.6	18093.5	40	12
1997-98	230622.8	7004.8	15415.4	40	10.5
1998-99	264115.1	5625.1	13614.4	35	8
1999-00	277088.8	7067.6	22472.7	35	8
2000-01	305811	7925	21504.6	35	7
2001-02	340505.7	11274	31822.6	35	6.5
2002-03	357050.2	12547.6	34840.6	35	6.25



SOURCES OF THE DATA:

* SALE (i.e. income from sales for different sectors) : Different issues of **Corporate Sector** published by CMIE.

* CT (i.e. Corporate Tax paid) : Different issues of **Corporate Sector** published by CMIE

COVERAGE OF THE SECTOR(S)

- Manufacturing Sector includes Food & Beverages; Textiles; Chemicals; Non Metallic Mineral Products ; Metal & Metal Products; Machinery; Transport & Equipment ; Miscellaneous Manufacturing & Diversified.

- Services Sector includes “Financial Services” & “Other services”

- Finally, ownership includes both Government & Private - Indian or Foreign or Cooperatives.

* PBT (i.e. Profit Before Tax) : Different issues of **Corporate Sector** published by CMIE

* RATE (i.e. Maximum Statutory Tax Rate) : <http://incometaxdelhi.nic.in/taxsys/refund.htm>

* INT (i.e. Bank Rate) : **Money and Banking** , published by CMIE in Dec’2003.

* INFRST (i.e. Infrastructure Index) : A Composite Index of different Infrastructure industries , viz. electricity; coal; cement; petroleum products, etc. is available from 1981-82 till 2001-02 , in **Handbook of Statistics on Indian Economy(‘02-‘03)** , published by RBI. The provisional data for the year 2002-03 were collected from **Annual Report (‘02-’03)**, pp. 276

- The issue of change of base period:

The observations for 1989-90 till 1992-93 were computed by using the following method:

$$\text{INFRST}(t)^{93-94} = \frac{\text{INFRST}(t)^{81-82} \times \text{INFRST}(93-94)^{93-94}}{\text{INFRST}(93-94)^{81-82}}, \text{ for } t = 1989-90, \dots, 1992-93$$

where $\text{INFRST}(t)^{93-94}$ & $\text{INFRST}(t)^{81-82}$ denote index at time t with 93-94 prices & 81-82 prices

respectively . Also we note that $\text{INFRST}(93-94)^{93-94}$ is 100.

* DEPRECIATION data were obtained (1990-91 to 2001-02) from different issues of **Industry Financial Aggregates and Ratios** , published by CMIE. The data for 1989-90 & 2002-03 were however calculated as follows:

DEPRECIATION(t)= PBDIT(t)-INTPAID(t)-PBT(t), where t= ‘89-‘90 & ‘02-’03. Here PBDIT(t) denotes Profit Before Depreciation, Interest & Tax paid at time t , the data for which were taken from **Corporate Sector published by CMIE.**

* INTPAID (Interest Paid) : Data were obtained from different issues of **Corporate Sector**, published by CMIE

* DE : The Debt-Equity Ratio of the Manufacturing Sector (in aggregate)are available from 1989-90 till 2002-03 in various issues of **Corporate Sector** , a CMIE publication.

ACTUAL AND ESTIMATED VALUES OF PROFIT BEFORE TAX (PBT)

Table C.1 : Manufacturing Sector

Year	Actual PBT	EST PBT *	ITERESTPBT**
1989-90	5702.4	8190.55	8636.95
1990-91	6848.8	7277.21	7916.03
1991-92	7934.4	6453.11	7239.4
1992-93	7175.6	6653.55	7344.22
1993-94	11925.6	11770.35	11498.97
1994-95	21768.5	22507.05	19846.02
1995-96	27296	24706.45	21731.94
1996-97	19814.2	17177.06	16239.97
1997-98	16483.6	13726.49	13819.05
1998-99	12271.7	12657.11	13058.92
1999-00	14113.8	17022.26	17028.14
2000-01	16609.4	20936.9	20640.18
2001-02	17370.2	19611.19	19984.88
2002-03	40310.2	30428.63	29438.9

All figures are in Crores of Rupees

*The estimated equation (2.1A) is

$$\begin{aligned} \ln(\text{PBT:MANUF}) = & 0.454528 \ln(\text{INFRST:MANUF}) + 1.955633 \ln(\text{SALE:MANUF}) \\ & - 1.037621 \ln(\text{INTPAID}) - 1.517423 \ln(\text{DE}) - 0.733805 \ln(\text{DEPRECIATION}) \end{aligned}$$

** The estimated equation (2.1B) is

$$\begin{aligned} \ln(\text{PBT:MANUF}) = & 0.618369 \ln(\text{INFRST:MANUF}) + 1.771939 \ln(\text{SALE:MANUF}) \\ & - 1.003750 \ln(\text{INTPAID}) - 1.060740 \ln(\text{DE}) - 0.621352 \ln(\text{DEPRECIATION}) \end{aligned}$$

Table C.2 : Mining Sector

Year	Actual PBT	EST PBT *	ITERESTPBT**
1989-90	2285.9	1745.33	1732.95
1990-91	2025.7	1925.67	1913.36
1991-92	1010.5	1607.67	1613.86
1992-93	1503.4	1844.85	1841.52
1993-94	2876.3	2095.4	2089.95
1994-95	2669.6	2505.72	2512.86
1995-96	2614.2	2972.73	2997.56
1996-97	4272.1	3995.58	3953.63
1997-98	6659.1	5057.37	5027.13
1998-99	6462.1	6935.62	6940.13
1999-00	6753.9	7851.66	7910.38
2000-01	8985.1	9860.8	9976.15
2001-02	11320.8	13557.77	13523.99
2002-03	19586.5	15224.17	15249.02

All figures are in Crores of Rupees

*The estimated equation (2.2A) is

$$\begin{aligned} \ell_n (\text{PBT:MINING}) = & 0.454528 \ell_n (\text{INFRST:MINING}) + 0.770326 \ell_n (\text{SALE:MINING}) \\ & - 0.909941 \ell_n (\text{INT:MINING}) \end{aligned}$$

** The Estimated equation (2.2B) is

$$\begin{aligned} \ell_n (\text{PBT:MINING}) = & 0.618369 \ell_n (\text{INFRST:MINING}) + 0.702026 \ell_n (\text{SALE:MINING}) \\ & - 0.935766 \ell_n (\text{INT:MINING}) \end{aligned}$$

Table C.3 : Electricity Sector

Year	Actual PBT	EST PBT *	ITERESTPBT**
1989-90	866.8	855.89	897.57
1990-91	1138.4	1306.45	1329.37
1991-92	1525	1446.63	1451.71
1992-93	1818.8	1759.17	1744.77
1993-94	2140.6	2096.19	2066.95
1994-95	2781.6	2635.07	2598.54
1995-96	3820.5	3219.33	3181.29
1996-97	3270.4	4114.75	4003.23
1997-98	4440.8	4930.22	4833.66
1998-99	6242.1	6338.24	6271.99
1999-00	7441.9	6683.97	6700.79
2000-01	8565.5	8336.26	8381.12
2001-02	9064.6	8274.55	8439.4
2002-03	9339.1	10180.31	10329.36

All figures are in Crores of Rupees

*The estimated equation (2.3A) is

$$\begin{aligned} \ln(\text{PBT:ELEC}) = & 0.454528 \ln(\text{INFRST:ELEC}) \\ & + 0.759078 \ln(\text{SALE:ELEC}) - 0.762748 \ln(\text{INT:ELEC}) \end{aligned}$$

**The estimated equation (2.3B) is

$$\begin{aligned} \ln(\text{PBT:ELEC}) = & 0.618369 \ln(\text{INFRST:ELEC}) \\ & + 0.687871 \ln(\text{SALE:ELEC}) - 0.790795 \ln(\text{INT:ELEC}) \end{aligned}$$

Table C.4 : Service Sector

Year	Actual PBT	EST PBT*	ITERESTPBT**
1989-90	976.2	1538.96	1559.74
1990-91	902.6	1749.12	1771.02
1991-92	3756.3	3138.95	3181.55
1992-93	2788.3	3740.27	3786.01
1993-94	4582.3	5174.73	5225.17
1994-95	10840.3	6796.36	6848.49
1995-96	13811.7	8512.27	8563
1996-97	18093.5	9939.58	9987.11
1997-98	15415.4	12565.56	12553.07
1998-99	13614.4	19767.37	19520.86
1999-00	22472.7	20726.27	20460.47
2000-01	21504.6	26723.23	26225
2001-02	31822.6	32416.17	31695.09
2002-03	34840.6	35571.71	34715.31

All figures are in Crores of Rupees

*The estimated equation (2.4A) is

$$\ell_n (\text{PBT:SER}) = 0.987820 \ell_n (\text{SALE :SER}) - 1.173534 \ell_n (\text{INT:SER})$$

*The estimated equation (2.4B) is

$$\ell_n (\text{PBT:SER}) = 0.980357 \ell_n (\text{SALE :SER}) - 1.134764 \ell_n (\text{INT:SER})$$

Figure C. 1
 Graphs showing Actual, Estimated & Iteratively Estimated PBT for the Manufacturing Sector

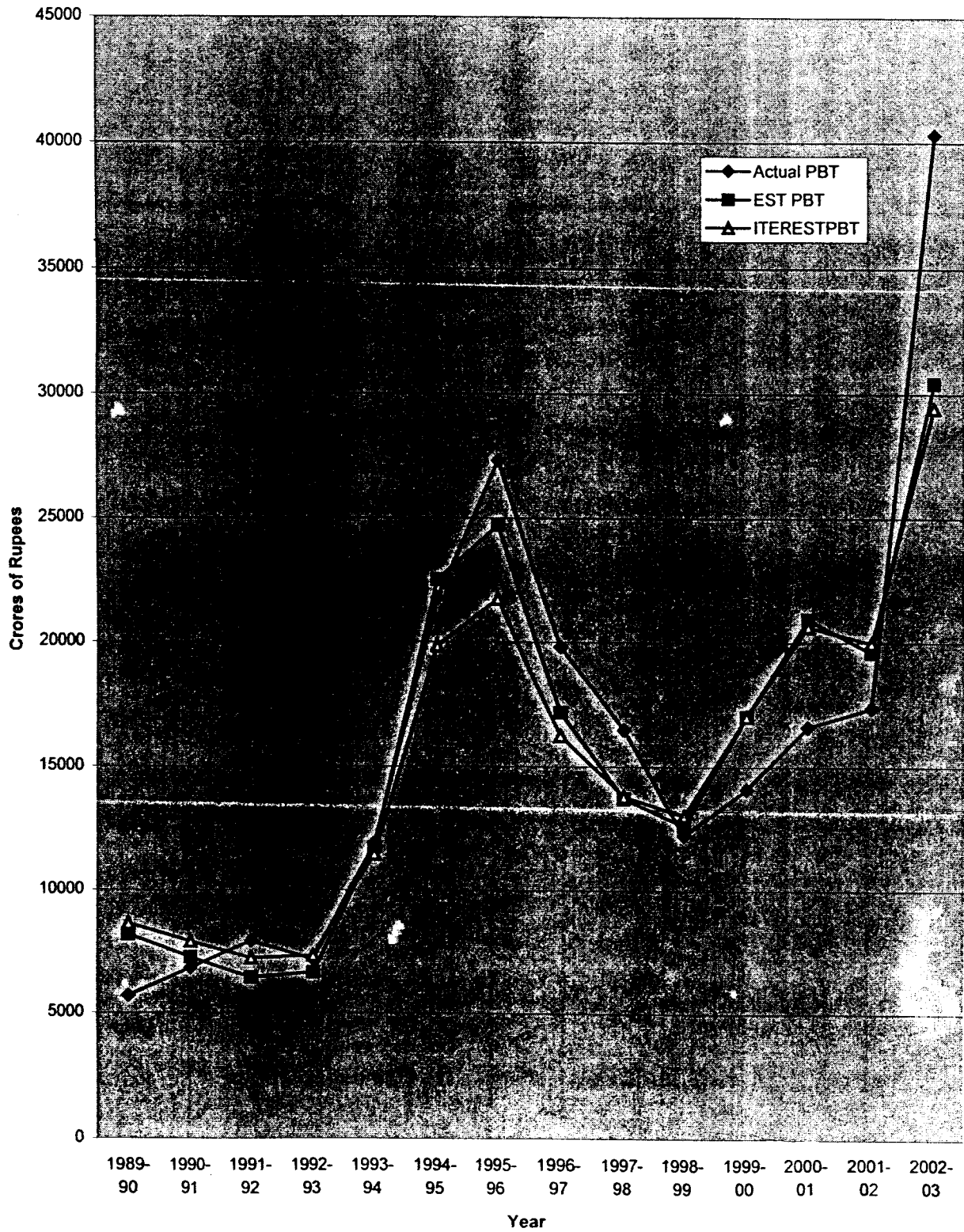


Figure C. 2
 Graphs showing Actual, Estimated & Iteratively Estimated PBT for the Mining Sector

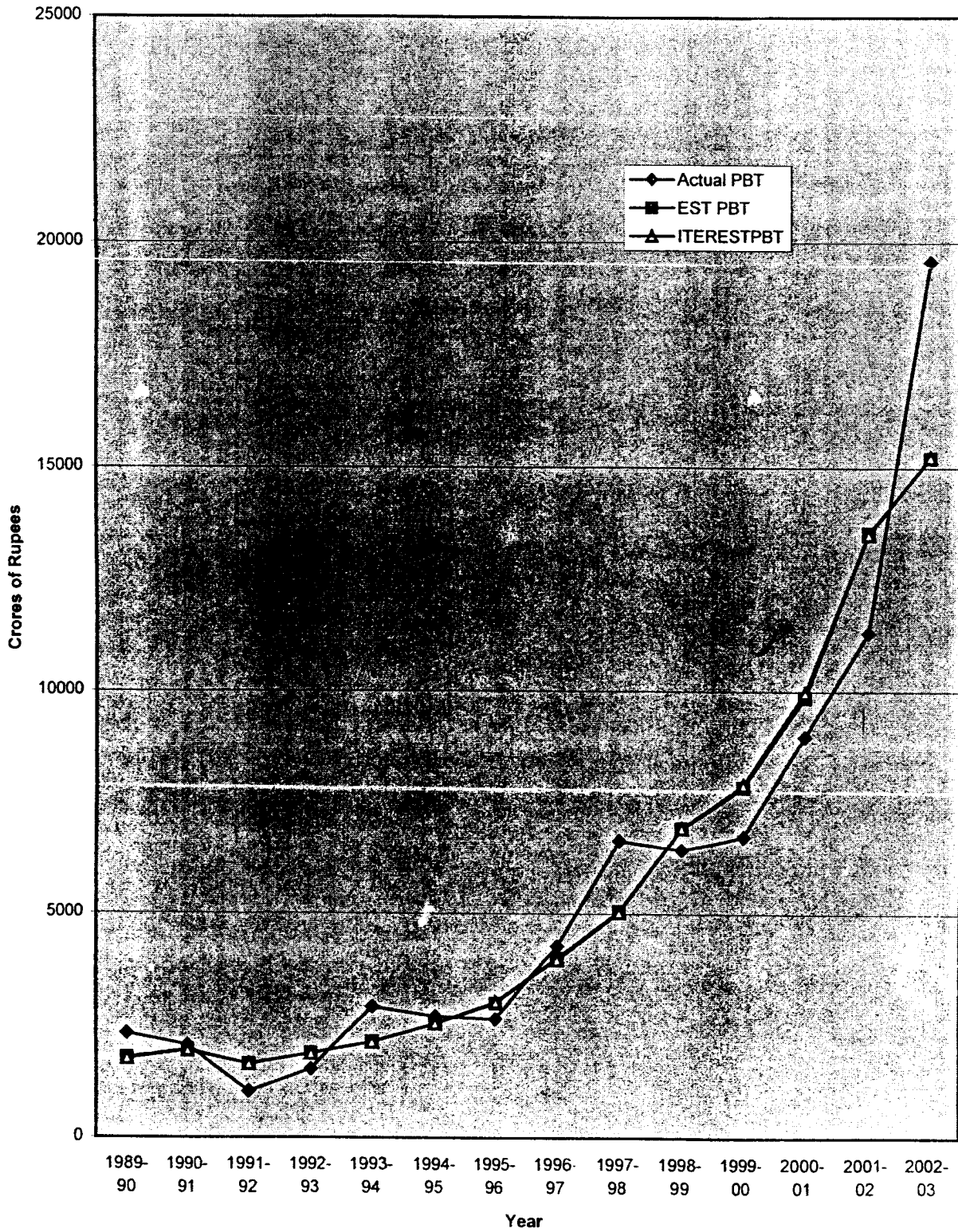


Figure C. 3
 Graphs showing Actual, Estimated & Iteratively Estimated PBT for the Electricity Sector

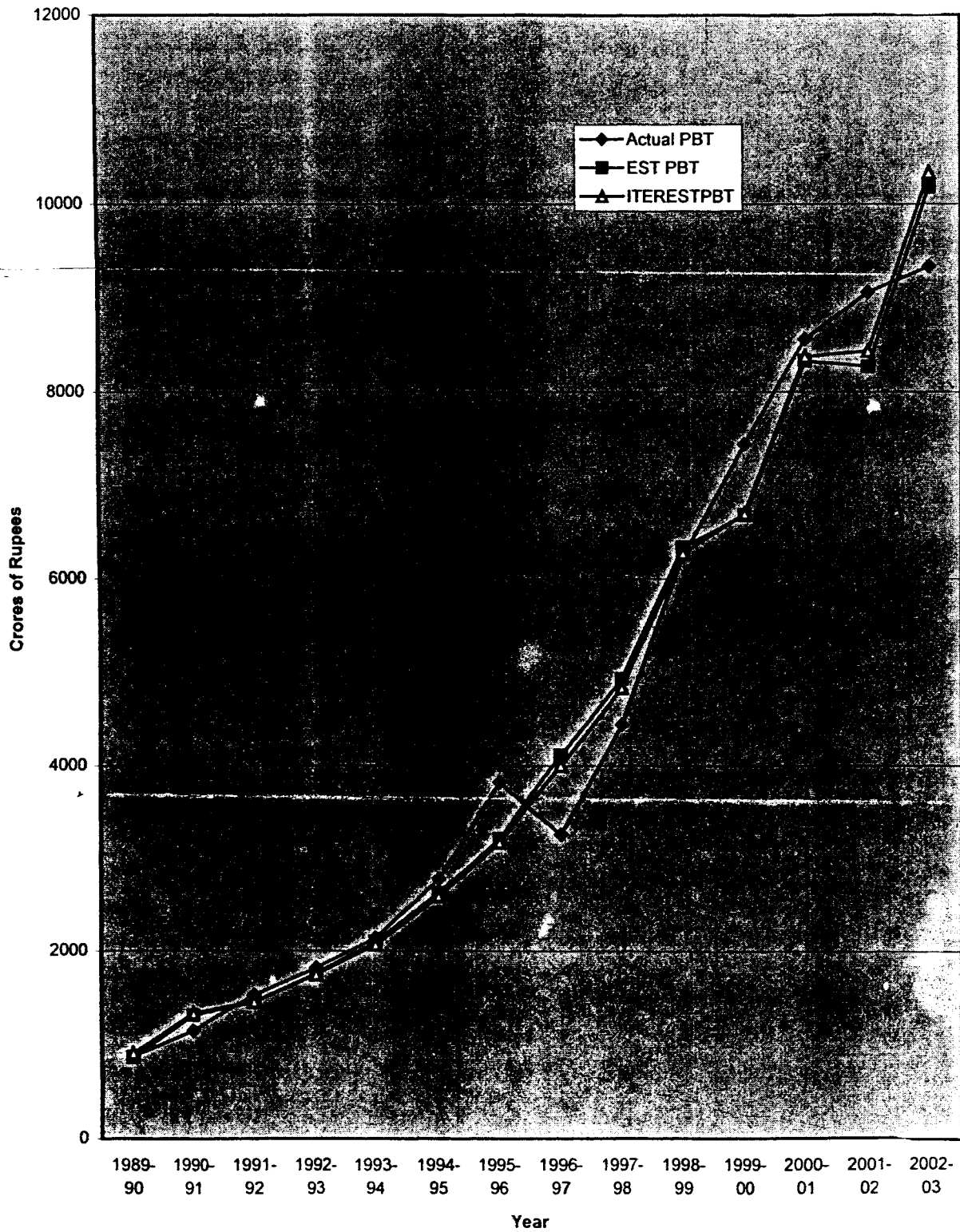
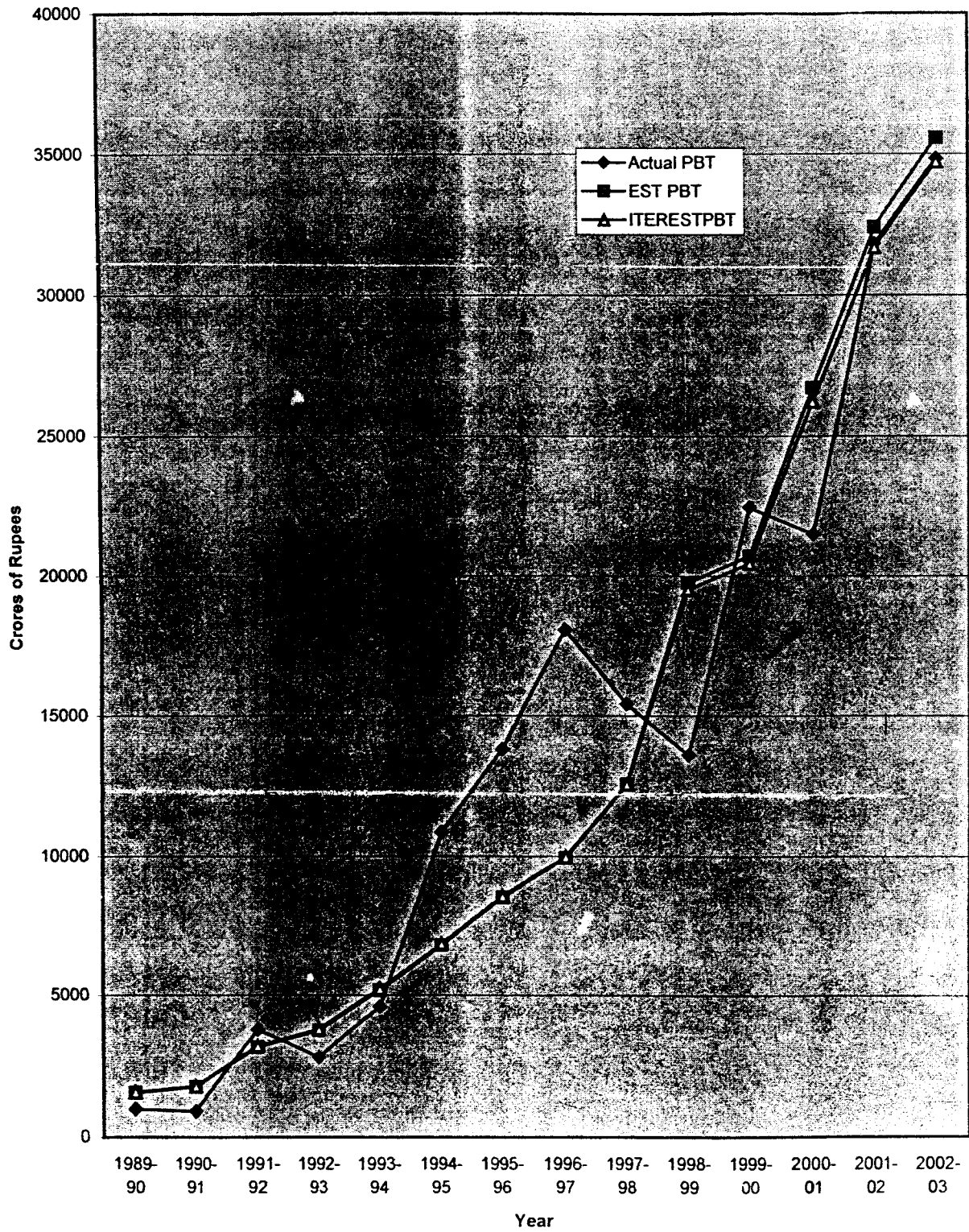


Figure C. 4
 Graphs showing Actual, Estimated & Iteratively Estimated PBT for the Service Sector



**ACTUAL AND ESTIMATED CORPORATE TAX(CT) CORRESPONDING TO
ACTUAL PBT**

Table D.1: Manufacturing Sector

Year	ACT CT	EST CT *using Actual PBT with Iteration
1989-90	2045.3	2196.52
1990-91	2551	2415.56
1991-92	3529.2	4120.19
1992-93	3516.7	3071.57
1993-94	4055.1	3998
1994-95	5212	5463.34
1995-96	6816.7	7822.67
1996-97	7126.8	6624.66
1997-98	6466.5	6021.3
1998-99	6828.6	6793.96
1999-00	7463.8	7305.35
2000-01	7346.5	7949.37
2001-02	8550.9	8136.29
2002-03	13438.4	12593.42

All figures are in Crores of Rupees

*The estimated equation (3.1) is

$$\ell_n(\text{CT:MANUF}) = 11.22954 + 0.518907 \ell_n(\text{PBT:MANUF}) - 2.050794 \ell_n(\text{TAXRATE:MANUF})$$

Table D.2: Mining Sector

Year	ACT CT	EST CT * using Actual PBT With Iteration
1989-90	447	124.32
1990-91	116.2	113.17
1991-92	51.1	251.56
1992-93	102.3	168.94
1993-94	150.6	279.71
1994-95	154.5	263.96
1995-96	523	526.6
1996-97	1558	771.38
1997-98	1843.6	1089.17
1998-99	2037.5	2371.53
1999-00	3080.7	2454.35
2000-01	4541.5	3064
2001-02	3857.1	3666.8
2002-03	6872.1	5614.73

All figures are in Crores of Rupees

*The estimated equation (3.2) is

$$\ell_n(\text{CT:MINING}) = 22.29146 + 0.777228 \ell_n(\text{PBT:MINING}) - 6.002040 \ell_n(\text{TAXRATE:MINING})$$

Table D.3: Electricity Sector

Year	ACT CT	EST CT * using Actual PBT with Iteration
1989-90	2.1	5.54
1990-91	17.3	7.4
1991-92	33.5	88.3
1992-93	54.6	33.89
1993-94	56	40.3
1994-95	21.1	53.23
1995-96	171.4	234.25
1996-97	240.3	198.59
1997-98	1413.9	274.86
1998-99	1799.9	1444.81
1999-00	1433.3	1741.51
2000-01	2026.7	2022.11
2001-02	1720	2147.51
2002-03	1981.4	2216.66

All figures are in Crores of Rupees

*The estimated equation (3.3) is

$$\ln(\text{CT:ELEC}) = 32.54498 + 1.062386 \ln(\text{PBT:ELEC}) - 9.718744 \ln(\text{TAX RATE:ELEC})$$

Table D.4: Service Sector

Year	ACT CT	EST CT * using Actual PBT with Iteration
1989-90	515.5	470.24
1990-91	498.3	446.63
1991-92	1096.8	1837.76
1992-93	1264.2	1174.35
1993-94	1663.4	1627.79
1994-95	2223.4	2866.76
1995-96	3246	4324.82
1996-97	6024.6	5164.76
1997-98	7004.8	4648.63
1998-99	5625.1	5700.58
1999-00	7067.6	7924.63
2000-01	7925	7698.56
2001-02	11274	9960.48
2002-03	12547.6	10571.68

All figures are in Crores of Rupees

*The estimated equation (3.4) is

$$\ell_n (CT:SER) = 9.997519 + 0.657274 \ell_n(PBT:SER) - 2.139231 \ell_n(TAX RATE:SER)$$

Figure D.1
Graphs showing Actual & Estimated CT (corresponding to actual PBT) paid by the Manufacturing Sector

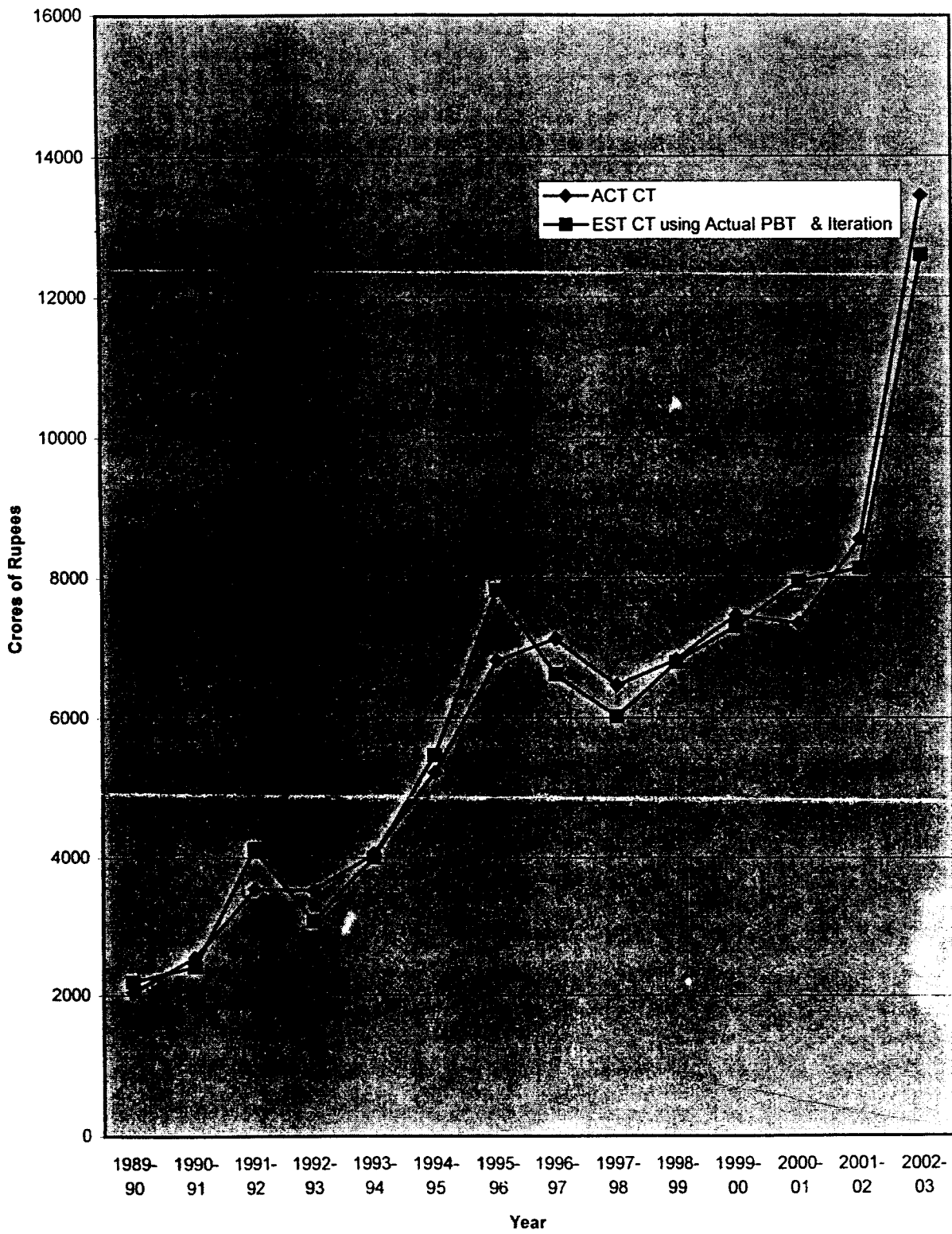


Figure D.2
 Graphs showing Actual & Estimated CT (corresponding to Actual PBT) paid by the
 Mining Sector

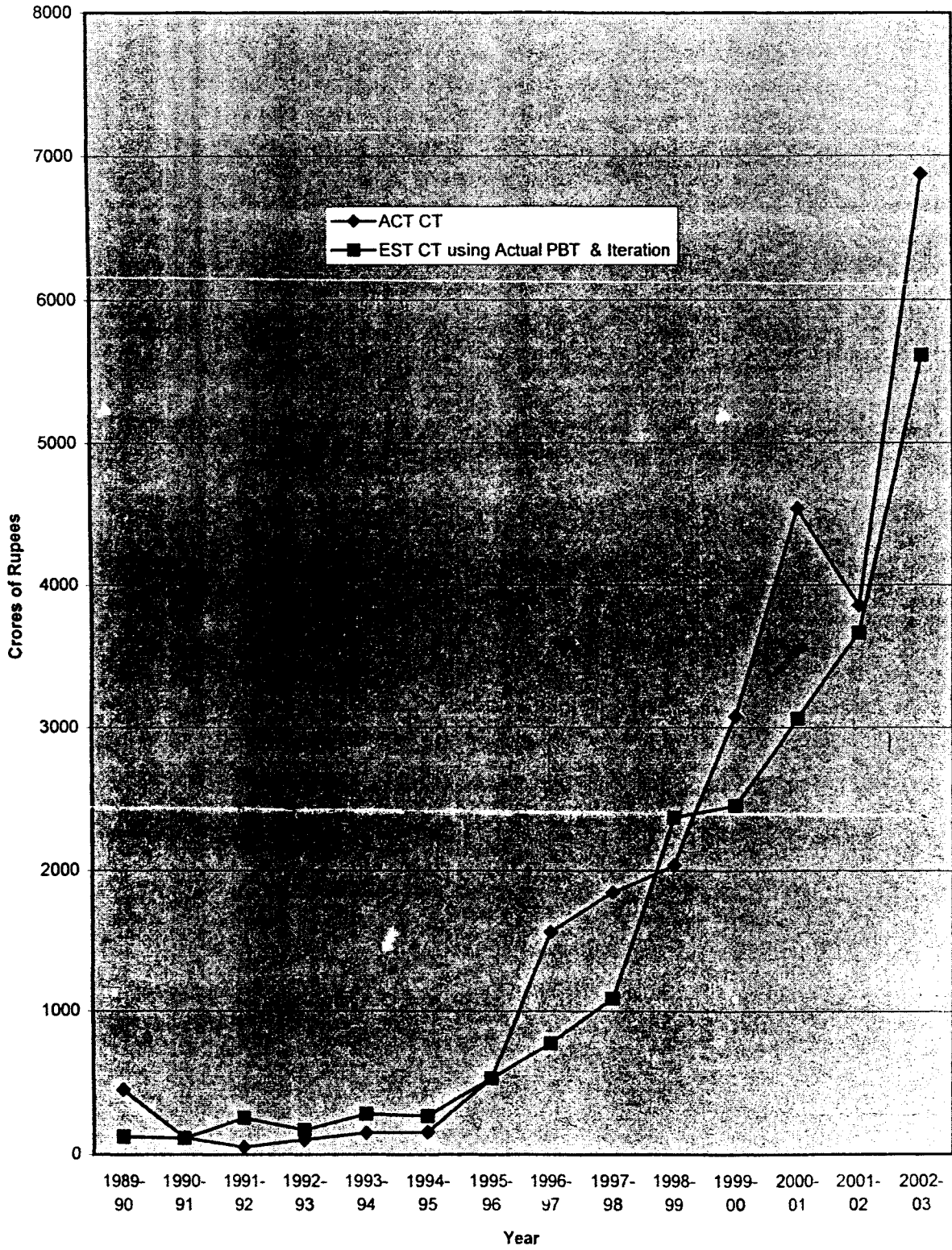


Figure D.3
 Graphs showing Actual & Estimated CT (corresponding to Actual PBT) paid by the
 Electricity Sector

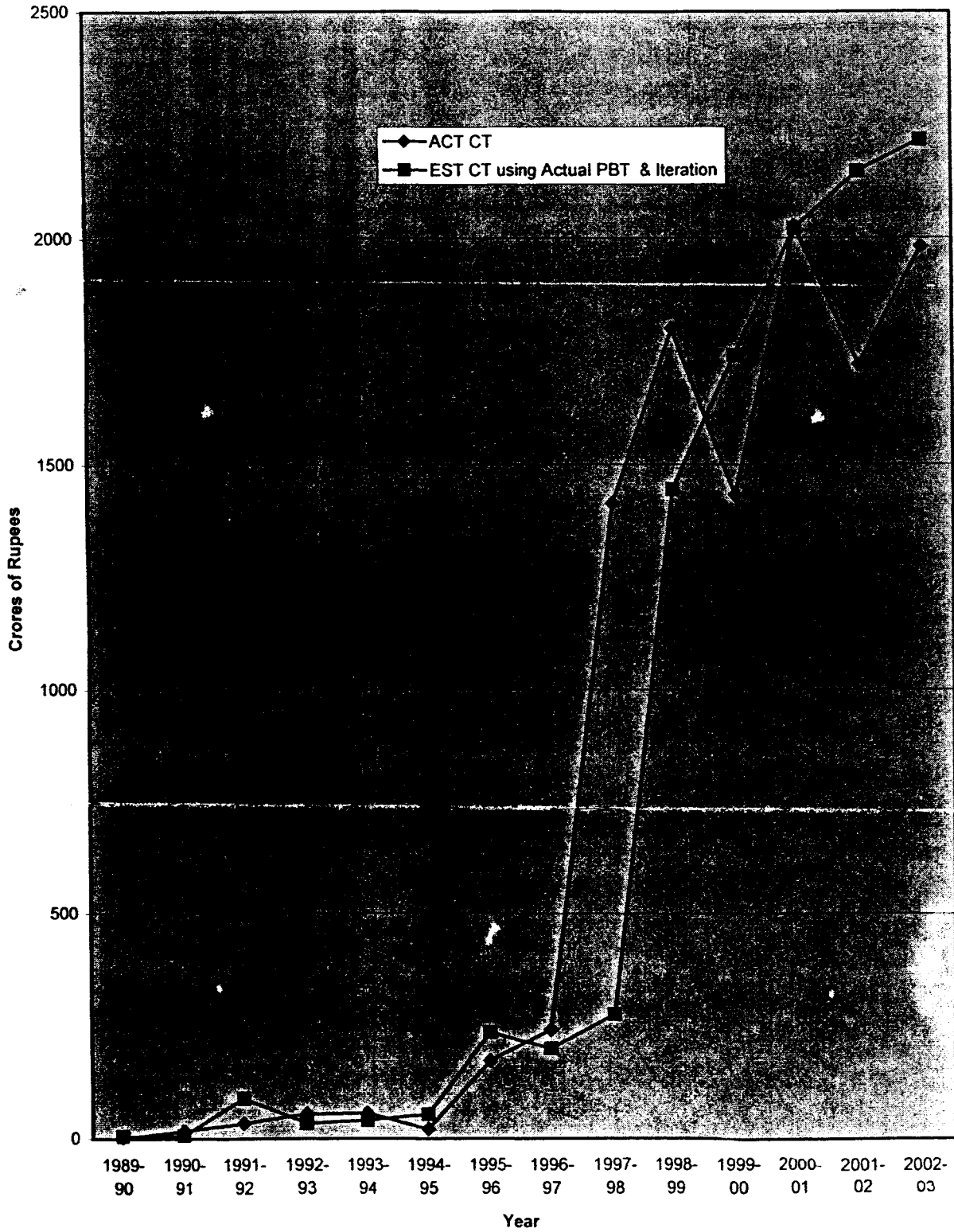
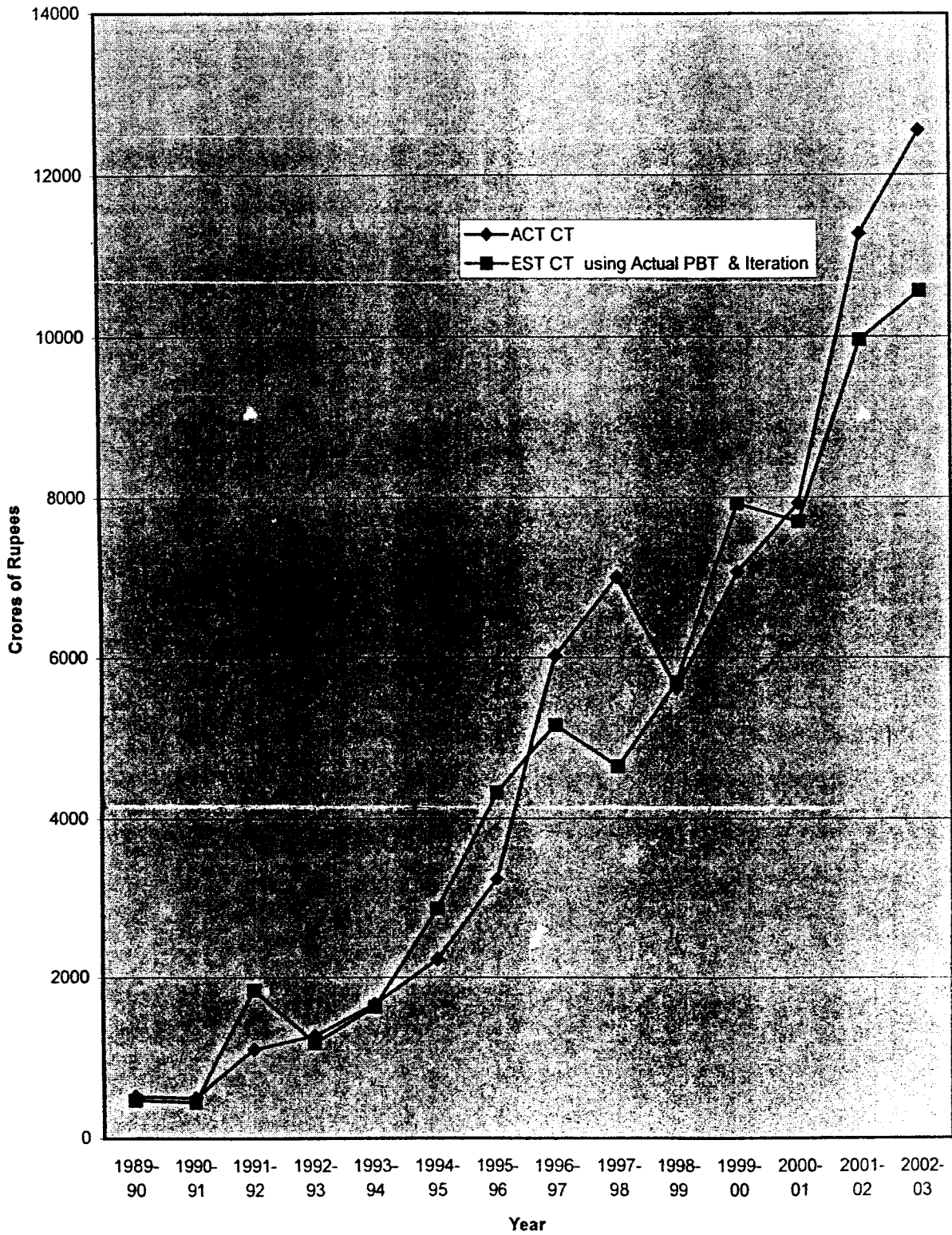


Figure D.4
 Graphs showing Actual & Estimated CT (corresponding to Actual PBT) paid by the
 Service Sector



**ACTUAL AND ESTIMATED CORPORATE TAX (CT) CORRESPONDING TO
ITERATIVELY ESTIMATED PBT**

Table E.1 :Manufacturing Sector

Year	ACT CT	EST CT* using ITERESTPBT & Iteration
1989-90	2045.3	2697.22
1990-91	2551	2537.69
1991-92	3529.2	3467.33
1992-93	3516.7	2873.97
1993-94	4055.1	3932.62
1994-95	5212	5760.65
1995-96	6816.7	7480.46
1996-97	7126.8	6101.46
1997-98	6466.5	5449.97
1998-99	6828.6	6554.95
1999-00	7463.8	7892.09
2000-01	7346.5	9028.84
2001-02	8550.9	8827.36
2002-03	13438.4	11574.41

All figures are in Crores of Rupees

*The estimated equation (4.1) is

$$\ln(\text{CT:MANUF}) = 8.127780 + 0.699489 \ln(\text{ITERESTPBT:MANUF}) - 1.678885 \ln(\text{TAXRATE:MANUF})$$

Table E .2 :Mining Sector

Year	ACT CT	EST CT* using ITERESTPBT & Iteration
1989-90	447	93.66
1990-91	116.2	108.09
1991-92	51.1	191.87
1992-93	102.3	150.63
1993-94	150.6	180.9
1994-95	154.5	236.17
1995-96	523	469.96
1996-97	1558	701.47
1997-98	1843.6	993
1998-99	2037.5	2586.51
1999-00	3080.7	3125.63
2000-01	4541.5	4372.5
2001-02	3857.1	6790.75
2002-03	6872.1	8078.9

All figures are in Crores of Rupees

*The estimated equation (4.2) is

$$\ln(\text{CT:MINING}) = 8.127780 + 1.446840 \ln(\text{ITERESTPBT:MINING}) - 3.675343 \ln(\text{TAXRATE:MINING})$$

Table E .3:Electricity Sector

Year	ACT CT	EST CT* using ITERESTPBT & Iteration
1989-90	2.1	5.07
1990-91	17.3	10.74
1991-92	33.5	38.63
1992-93	54.6	30.52
1993-94	56	42.18
1994-95	21.1	65.31
1995-96	171.4	172.85
1996-97	240.3	268.11
1997-98	1413.9	384.31
1998-99	1799.9	1229.43
1999-00	1433.3	1394.95
2000-01	2026.7	2138.8
2001-02	1720	2167.3
2002-03	1981.4	3188.2

All figures are in Crores of Rupees

*The estimated equation (4.3) is

$$\ln(\text{CT:ELEC}) = 8.127780 + 1.910036 \ln(\text{ITERESTPBT:ELEC}) - 4.982506 \ln(\text{TAXRATE:ELEC})$$

Table E.4 :Service Sector

Year	ACT CT	EST CT* using ITERESTPBT & Iteration
1989-90	515.5	509.88
1990-91	498.3	564.73
1991-92	1096.8	1412.13
1992-93	1264.2	1283.96
1993-94	1663.4	1663.76
1994-95	2223.4	2068.21
1995-96	3246	3131.28
1996-97	6024.6	3543.73
1997-98	7004.8	4259.3
1998-99	5625.1	7930.46
1999-00	7067.6	8236.06
2000-01	7925	10055.99
2001-02	11274	11711.19
2002-03	12547.6	12600.71

All figures are in Crores of Rupees

*The estimated equation (4.4) is

$$\ln(\text{CT:MINING}) = 8.127780 + 0.804316 \ln(\text{ITERESTPBT:SER}) - 1.995682 \ln(\text{TAXRATE:SER})$$

Figure E.1
 Graphs showing Actual; Estimated & Iteratively Estimated CT(corresponding to ITERESTPBT)
 paid by the Manufacturing Sector

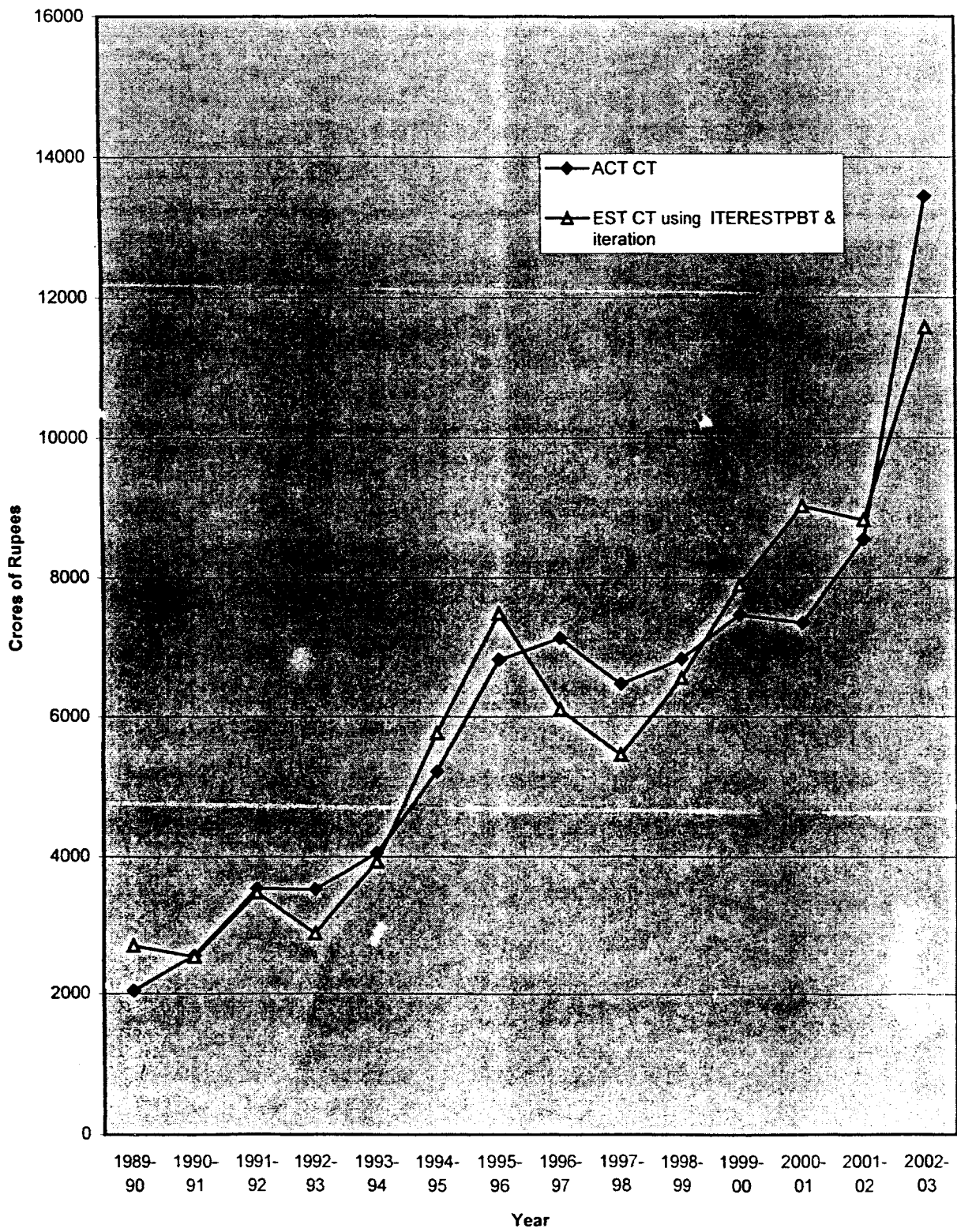


Figure E. 2
 Graphs showing Actual; Estimated & Iteratively Estimated CT (corresponding to ITERESTPBT)
 paid by the Mining Sector

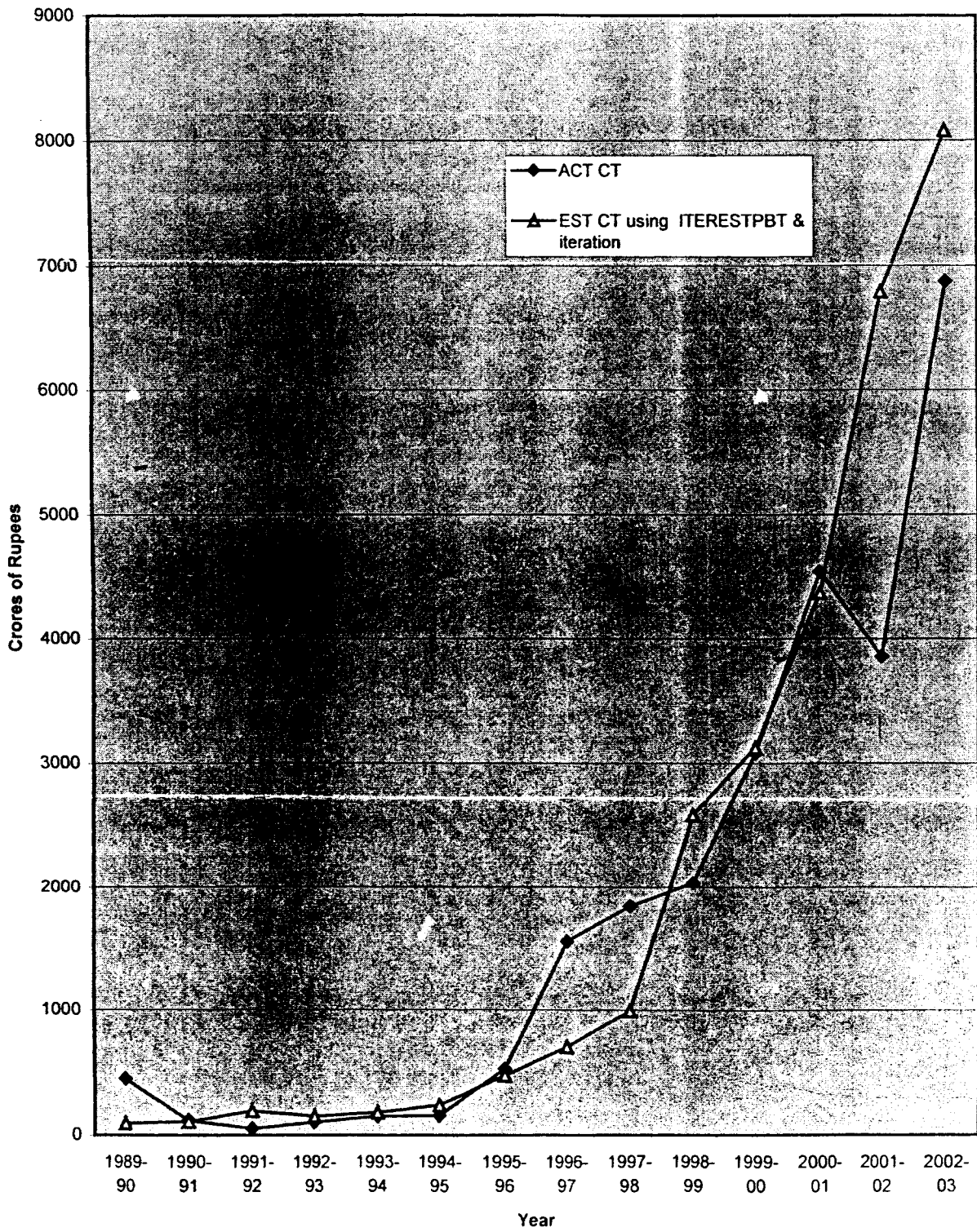


Figure E.3
 Graphs showing Actual; Estimated & Iteratively Estimated CT (corresponding to ITERESTPBT)
 paid by the Electricity Sector

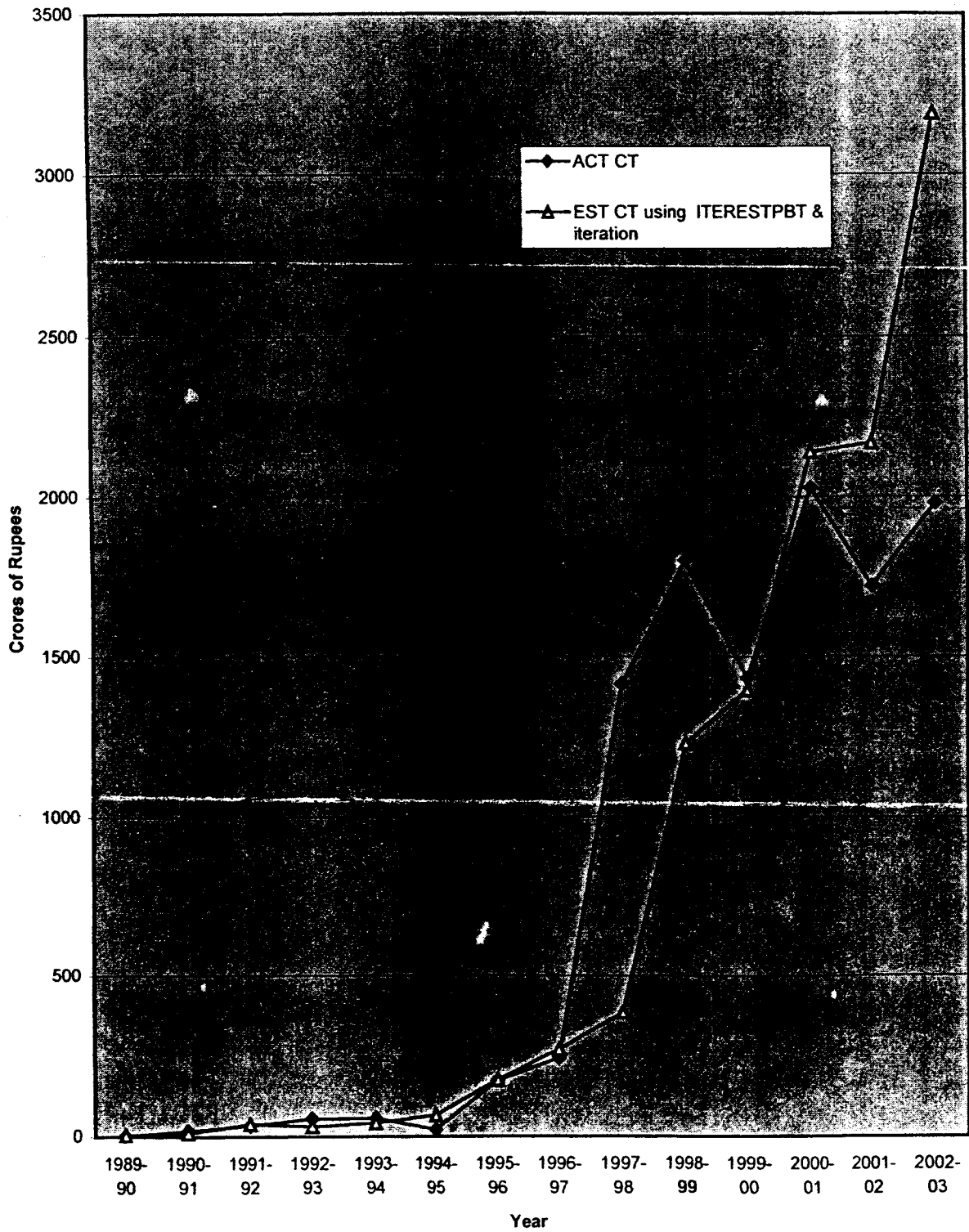


Figure E.4
 Graphs showing Actual; Estimated & Iteratively Estimated CT (corresponding to ITERESTPBT)
 paid by the Service Sector

