



DO RATE SCHEDULES AFFECT SENSITIVITY
OF PERSONAL INCOME TAX? AN EVIDENCE
FROM A DEVELOPING COUNTRY

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ABSTRACT

This paper estimates sensitivity of the personal income tax at three widely different rate schedules, for a given period, in a developing country, India. Sensitivity of the tax is measured in terms of partial as well as total elasticities of the tax with respect to both the national income and taxable income of the income tax payers. The study suggests that substantial reductions in the high marginal tax rates adopted in some countries, need not necessarily affect the sensitivity of the tax. It shows that large reductions in the high marginal tax rates in India, during mid seventies and early eighties have had no significant impact on the sensitivity of the tax.

**DO RATE SCHEDULES AFFECT SENSITIVITY OF
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In the seventies many countries had very high marginal rates of tax for personal income taxation. The highest marginal tax rate in some of the countries had been as high as greater than 75 per cent. It is well known that in the recent period the high marginal tax rates in some of the countries have been gradually reduced. As the reductions in high marginal tax rates tend to decrease graduation in the tax rates, it might be expected that these would reduce sensitivity of the tax. There is little evidence however about the impact of such reductions, small or large, in the marginal tax rates on the sensitivity of personal income tax. This study aims at fulfilling this gap.

This paper presents a case study of a developing country, India. Contrary to the expectations, the study reveals that the substantial reductions in the high marginal tax rates brought about in the reference period have had no significant impact on the sensitivity of the personal income tax in India.

1. Measure of Sensitivity of the Tax

Sensitivity of a tax can be defined as responsiveness of the tax yield to changes in the tax base or national income. In the current study, elasticity of the tax with respect to national income is taken as the measure of sensitivity of the tax. Among the various measures of sensitivity, the elasticity measure has been favoured.¹

The elasticity of a tax reveals how the tax yield at a constant tax structure grows in response to growth in national income. It is defined as the ratio of proportional change in the tax yield at a constant tax structure to the proportional change in national income.

2. Rate Structure of Personal Income Tax

In India, personal income is taxed at graduated rates by income brackets. During the last two decades, the rate schedule has significantly varied from time to time. At least three sub-periods representing broadly three tax regimes can be identified. First 1971-72 to 1974-75 with the highest marginal tax rates. During this period, the maximum marginal tax rate (inclusive of surcharge) has been as high as 97.5 per cent, and the rate schedule has remained broadly unchanged. Second, 1975-76 to 1976-77 with moderately high tax rates. During this period, the maximum marginal tax rate (inclusive of surcharge) was 77 per cent though the marginal tax rates applicable to low level income ranges were a little higher as compared to the first period. Third, 1977-78 to 1983-84 with lower maximum marginal tax rate and higher minimum marginal tax rate as compared to the first and second periods.

During this period, the maximum marginal tax rate (exclusive of surcharge) was 60 per cent, and the rate inclusive of surcharge has varied from 66 per cent to 72 per cent because of variation in the rate of surcharge. Subsequently, maximum marginal tax rate has been brought down to 50 per cent. During the period 1971-72 to 1983-84, the exemption limit for individuals has been raised from Rs. 5,000 to Rs. 15,000. The exemption limit during the period 1971-72 to 1974-75 has been Rs. 5,000, it has been Rs. 6,000 and Rs. 8,000 respectively during the years 1975-76 and 1976-77 and it has been gradually increased during the period 1977-78 to 1983-84 from Rs. 8,000 in 1977-78 to Rs. 15,000 in 1983-84.

3. Review of Earlier Studies

Studies of income elasticity of personal income tax in India include those of Sahota (1961), Gulati (1962), Cult (1969), Jain (1969). Nambiar and Joshi (1974), Srivastava (1975), Gupta (1975), Rao (1979), Khadye (1981), Gupta and Aggarwal (1982), Bagchi and Rao (1982), Aggarwal (1984), Rao (1987) and Bagchi (1988). Reference period and methodology adopted in estimating elasticity differ among these studies. The estimates of elasticity obtained in these studies are given in Table 1 by methodologies adopted. None of these studies except those by Gupta and Aggarwal (1982), and Rao (1987) attempts estimates of elasticity at different rate schedules. The studies by Gupta and Aggarwal, and Rao do not make the necessary adjustments for varied coverage of the population of taxpayers in different years. Also these studies ignore

the change in distribution of income, over time, within the income classes, and the period covered by these studies do not go beyond 1975-76.

4. Methods of Estimation of Elasticity : A Review

Estimation of elasticity involves capturing/isolating that component of the tax yield which can be considered as automatic growth at a constant tax structure. Historical tax yield comprises the tax yield at a constant tax structure and the effect, on tax yield, of the discretionary changes brought about in the tax structure during the reference period. Various methods of estimating elasticity of a tax have been discussed in literature. These are based on capturing the automatic growth in tax yield at a constant tax structure from the historical tax yield, or estimating the hypothetical tax yield at a constant tax structure, or adjusting the estimate of buoyancy² of the tax.³ All these methods can be said to have a common conceptual basic framework.

In general, tax yield (T) can be said to depend mainly on the tax base (B), index of inequality (II) in the distribution of tax base, and the tax rate structure (R). Further, the tax base can be said to depend on the national income (Y) and the tax structure. Tax structure can affect the tax base mainly in two ways. First through the level of exemptions and deductions. Higher exemptions and deductions tend to reduce the tax base. With a higher exemption limit, lesser number of persons fall in the purview of the tax and a lower proportion of total income of different taxpayers is subject to the marginal rate schedule.

Second, level of marginal tax rates may affect evasion and work effort of different persons, which may affect the tax base. Therefore, tax yield model can be written as:

$$T = f (B, II, R) \dots \dots \dots (1)$$

$$B = f (Y, R) \dots \dots \dots (2)$$

In the reduced form, the tax yield can be expressed as:

$$T = f (Y, II, R) \dots \dots \dots (3)$$

The relation (3) can be estimated with different specifications. For this purpose, inequality in the distribution of tax base may be measured in terms of Gini index or any other measure of inequality. However, specifying by a single variable, a tax structure with many marginal tax rates, exemptions, deductions and credits etc., is an uphill task. To overcome this complex problem, a number of techniques have been used in literature which give rise to different methods of estimation of elasticity of a personal income tax.

Various methods of estimation of elasticity of a tax can be classified into the following three broad categories:

- i. Those based on direct estimation of elasticity.
- ii. Those involving estimation of hypothetical series of tax revenue at a constant tax structure.
- iii. Those based on adjustment of estimate of buoyancy of the tax.

Methods based on direct estimation of elasticity of a tax use relation (3) with observed series of tax revenue. However, generally it has been estimated without inclusion of inequality variable. This category of methods includes (a) the methods based on the use of tax rate and base variables persuaded by Wilford (1965), Ray (1966), Legler and Shapiro (1968), Muskin and Lupo (1967), and Srivastava (1975); (b) the method based on the use of dummy variables for the years of major discretionary changes, developed by Singer (1970), Chelliah and Chand (1974) and Washylenko (1975); and (c) the methods based on cross-section of groups of taxpayers by income as proposed by Mishan and Dicks-Mireaux (1958), Blackburn (1967), and Pechman (1973); and by region as advocated by Tanzi (1969) and subsequently applied in various studies including Anderson (1973), Tanzi (1980) and Rao (1987). None of these methods however allow estimation of elasticity at different tax structure/rate schedules, for a given period.

Methods involving estimation of series of hypothetical tax revenue at a constant tax structure use relation (3) with series of hypothetical tax revenue instead of observed revenue and with exclusion of tax rate variable. This however has also been generally estimated without inclusion of inequality variable. Different methods in this category differ with respect to the process of obtaining series of hypothetical tax revenue. Various methods developed for obtaining the hypothetical series include (a) proportional adjustment method developed by Sahota (1961) and Prest (1962), the characteristics of which have been studied in detail subsequently by Chelliah and Chand (1974); and (b) the constant rate-base methods. Various constant rate-base methods have been suggested in literature depending on the degree of disaggregation

of data on the taxpayers. These include those suggested by Auld (1971), Lewis (1962), Pearse (1962) and Wasylenko (1975). The methods used by Lewis and Auld are based on highly aggregated data. The method used by the former is based on the application of a single tax rate in the previous year to the tax base in the current year and that used by the latter is based on the application of a single effective marginal tax rate in the previous year to the change in the tax base in the current year. Methods advocated by Pearse and Wasylenko are based on data grouped by income classes. In estimating hypothetical tax revenue at the tax structure of a reference year, the former emphasises on imposing the distribution of the reference year in all the years in the reference period and the latter emphasises on imposing the ratios of deductions to incomes by income classes in the reference year, in each of the years in the reference period. The method based on highly disaggregative data applies legal tax structure of the reference year to the incomes of each of the taxpayers in each of the years in the reference period. While proportional adjustment method does not permit estimation of series of hypothetical tax revenue (and hence elasticity) at the rate structures of difference years, the constant rate-base methods allow for the same.

The method based on adjustment of estimate of buoyancy was proposed by Choudhry (1979). It derives a 'divisia index' on the basis of historical data on the tax yield. This index is used to adjust buoyancy of the tax to obtain an estimate of elasticity. This method also cannot be used to obtain elasticity at the rate structures of different years, for a given period.

5. Choice of Method of Estimation of Elasticity

For comparing the sensitivity of the personal income tax at the rate schedules of different years we need to obtain estimates of elasticity, for a given period, at the rate schedules of different years. During different reference periods, the elasticity estimates may differ even if the tax structure remains unchanged.⁴

Only the constant rate-base methods allow for estimation of elasticity at the rate schedules of different years in a reference period. Owing to the availability of data, we have chosen to follow the constant rate-base methods based on data grouped by income classes.

The methods based on grouped data generally ignore changes in the distribution of income within the income classes. We have developed a constant rate-base method that accounts for changes in different years in the distribution of income within the income classes. The constant rate-base method developed and applied in the current study is briefly described in the next Section.

6. Constant Rate Base Method as Applied in the Current Study

The constant rate-base approach is modified to account for changes over time in the distribution of income within different income classes. The constant rate-base method developed here assumes that a change in the distribution of income among the taxpayers within an income class

would be reflected in per capita income of that income class. This method involves the following steps in estimating a series of hypothetical tax revenue at a given rate structure:

- i. Obtaining average tax rates and average incomes by income classes in different years,
- ii. Estimation of hypothetical average tax rates by income classes in different years at the rate structure of a reference year,
- iii. Estimation of hypothetical tax revenue by income classes in different years at the rate structure of the reference year, and
- iv. Obtaining the time series of hypothetical tax revenue at the rate structure of the reference year.

The following notations are used in giving a description of the constant rate-base method developed here:

n = number of years in the reference period

k = number of income classes

N = number of taxpayers

TI = taxable income

ATI = average taxable income

ATL = average tax liability

ATR = average tax rate

ATR* = estimated hypothetical tax rate at the rate structure of a reference year

TR* = estimated hypothetical tax revenue at the rate structure of a reference year.

Scripts i ($=1,2,3,\dots,n$) and j ($=1,2,3,\dots,k$) would be used for i th year and j th income class respectively, e.g., TI_{ij} would denote taxable income of the j th income class in the i th year.

Average tax rate and average taxable income of different income classes can be obtained for each of the years in the reference period, as follows:

$$ATR_{ij} = TR_{ij}/TI_{ij} \dots\dots\dots(4)$$

$$ATI_{ij} = TI_{ij}/N_{ij} \dots\dots\dots(5)$$

If, over time, distribution of taxable income within each income class remains unchanged, then the average tax rates corresponding to a reference year as given by equation (4) can be taken as the average tax rates applicable to the other years at the rate structure of the reference year. However, if distribution of taxable income within an income class does not remain unchanged, then for that income class the average tax rate at the rate structure of the reference year need be estimated by accounting for the change in distribution of taxable income within that income class. For estimating such hypothetical average tax rates, we assume that for fixed income brackets, change in the distribution of taxable income within an income class is appropriately reflected in change⁵ in the average income of the income class. So the average tax rates, at the rate structure of a reference year, applicable to an income class in different years can be estimated by accounting for the change in average taxable income of the income class.

The hypothetical average tax rates can be estimated on the basis of a relationship between the average tax rate and average taxable income at the rate structure of the reference year. For rth year as the reference year, this relationship may be estimated by fitting the following specifications of an average tax rate function:

$$ATR_{rj} = \alpha_1 + \beta_1 ATI_{rj} + \tau_1 (1/ATI_{rj}) \dots \dots \dots (6)$$

$$\text{Log}ATR_{rj} = \alpha_2 + \beta_2 \text{Log}ATI_{rj} + \tau_2 (1/ATI_{rj}) \dots \dots \dots (7)$$

These specifications allow the average tax rate to vary asymptotically with a change in average taxable income. These specifications are thought appropriate as the average tax rate at high income levels is expected to rise with income. It is so, because of lower increase in marginal tax rates with increase in income at high levels of income and because of ceiling on maximum marginal tax rate in general. The choice between these specifications has to depend on the parameter estimates and allied statistics.

Let us denote the estimated values of α_1 , β_1 , τ_1 , α_2 , β_2 and τ_2 at the rate structure of the reference year by α_1^* , β_1^* , τ_1^* , α_2^* , β_2^* and τ_2^* respectively. Now, the estimates of average tax rates in each of the years at the rate structure of the reference year can be obtained by simulating these specifications as follows:

$$ATR^*_{ij} = \alpha_1^* + \beta_1^* ATI_{ij} + \tau_1^* (1/ATI_{ij}) \dots \dots \dots (8)$$

$$\text{Log}ATR^*_{ij} = \alpha_2^* + \beta_2^* \text{Log}ATI_{ij} + \tau_2^* (1/ATI_{ij}) \dots \dots \dots (9)$$

ATR*_{ij} can be obtained with the empirically preferred specification of the average tax rate function.

Tax revenue of an income class, in different years, at the rate structure of the reference year by accounting for the change in distribution of taxable income in the income class can be obtained as:

$$TR^*_{ij} = T_{ij} ATR^*_{ij} \dots \dots \dots (10)$$

Tax revenue of the taxpayers of all the income classes can be obtained as:

$$TR^*_i = \sum_{j=1}^k TR^*_{ij} \dots \dots \dots (11)$$

TR*_i gives the series of hypothetical tax revenue at the rate structure of the reference year.

This process described by equations (6) to (11) can be repeated to obtain series of hypothetical tax revenue at the rate structures of different reference years.

7. The Data, Limitations and Remedy

The only source of data on income classwise distribution of the taxpayers in India is All India Income Tax Statistics (AIITS). The limitations of these data have been widely discussed (see, for example, Gupta and Aggarwal, 1982, Chapter II; and Bagchi and Aggarwal, 1983).

These data are based on the assessments completed in a year. These data for a year can be taken to correspond to a fraction of the total number of taxpayers in that year and these relate to the incomes earned in the previous year.

The fraction of total number of taxpayers, covered in AIITS has not remained unchanged over time. So the time series of hypothetical tax revenue require adjustments. The adjustment multiplier for the i th year ' M_i ' can be taken as the ratio of total number of taxpayers (N^*_i) to those covered in AIITS (N_i) in the i th year (i.e., $M_i = N^*_i/N_i$). For this purpose, the data on the total number of taxpayers in the books of the department at the end of a year are taken from the Report of the Comptroller and Auditor General of India, Direct Taxes (Civil).

8. Reference Period

Reference period is taken from 1966-67 to 1983-84. Prior to 1966-67, the legal definition of taxable income differed significantly from that in the later years, and 1983-84 is the latest year for which comparable data are available. From 1984-85, the data published are return based instead of assessment based, i.e., the published data are based on the information as furnished by the taxpayers instead of information on the taxpayers after their assessments are completed. AIITS was not published for the years 1971-72 and 1973-74. Excluding these two years, our reference period covers 16 years.

9. Choice of Rate Structures

Substantial changes have been brought about in the rate structure of personal income tax during the reference period. As discussed earlier, atleast three sub-periods in the reference period can be identified representing broadly three tax regimes in terms of high and low maximum marginal tax rates. These periods are 1971-72 to 1974-75, 1975-76 to 1977-78 and 1978-79 to 1983-84. We have chosen to estimate sensitivity of the tax by taking 1974-75, 1977-78 and 1983-84 as the reference years. These years correspond to the three tax regimes. These facilitate estimating sensitivity of the tax at widely different rate schedules.

10. Coverage of the Taxpayers

The study covers the single major category of personal income tax payers - 'individuals'. These account for more than 90 per cent of number and taxable income of all the taxpayers.

The exemption limit for individuals has been raised from Rs. 4,000 to Rs. 15,000 during the reference period 1966-67 to 1983-84. The exemption limit during the chosen three reference years 1974-75, 1976-77 and 1983-84 respectively has been Rs. 5,000, Rs. 8,000 and Rs. 15,000. As far as estimation of series of hypothetical tax revenue at the rate structure of 1983-84 is concerned, the taxpayers with taxable income lower than or equal to Rs. 15,000 get excluded from each of the years in the reference period. When the rate structure of 1974-75 or 1976-77 is applied, the choice is either to use uniform cut off point of Rs. 15,000

or estimate additional number of persons and their income who would have been taxable in different years, had the exemption limit not been raised in the succeeding years and exclude the taxpayers in the preceding years with taxable income lower than the exemption limit of the rate structure under consideration. The latter involves interpolation and/or extrapolation of the number of taxpayers and their income that generally is based on not so desirable assumptions about the distribution of income. To avoid the complexities associated with these approximations and with a view to have a uniform group of taxpayers under the rate schedules of all the three reference years, a cut off point of Rs 15,000 has been taken and accordingly only the taxpayers with taxable income greater than Rs. 15,000 have been covered in our analysis with distribution into 12 income classes listed in column 1 in Table 2.

11. Estimates of Average Taxable Income

Average taxable income of each income class is computed for different years in the reference period. In each income class, a substantial variation in average taxable income over time is observed - the variation is specifically marked in the high level income classes. The range of variation in the average taxable income, in the income classes Rs. 15-20 thousand, Rs. 30-40 thousand, Rs. 100-200 thousand, and above Rs. 500 thousand was Rs. 16.83 - 17.83 thousand, Rs. 34.12 - 37.13 thousand, Rs. 123.86 - 133.66 thousand and Rs. 903.03 - 2050.96 thousand respectively (Table 2, column 2). This suggests that the distribution of income within the income classes has not remained unchanged over time. This would have caused substantial variation over time in the average tax rate of an income class even at an unchanged

rate structure. Therefore, we have estimated hypothetical tax rates for each of the income classes in different years at the rate schedule of a reference year by accounting for changes in the distribution within the income classes.

12. Estimates of Hypothetical Average Tax Rates and Tax Revenue

Average tax rate is obtained for each income class for different years in the reference period. As one would have expected, the average tax rate of each income class has shown wide variation over time (Table 2, column 3).

For estimating hypothetical average tax rates at different rate schedules, the relationship between the average tax rate and average income is estimated through the equations 6 and 7 with the cross-section of income classes, separately for each of the reference years 1974-75, 1976-77 and 1983-84. The parameter estimates alongwith allied statistics are given in Table 3.

From Table 3 it would be noted that the parameter estimates of both the specifications of the tax rate function are significant for all the three reference years at 99 per cent level of confidence. As expected, in both the specifications, the variable - inverse of average taxable income is an important variable, dropping it from the specifications leads to substantial reduction in their explanatory powers (Column 6). For example, for the reference year 1974-75, dropping of the inverse variable from equation 6 results in fall in explanatory power of the equation from 0.92 to 0.39 (equations iii & iv, column 6)

and dropping it from equation 7 is followed by fall in explanatory power of the equation from 0.99 to 0.81 (equations i & ii, column 6). So the specifications with the inverse variable are preferable to those without it. Between the equations 6 and 7, the latter gives better fits for each of the three reference years judged in terms of explanatory power of the equations, and the range of deviation of simulated values from the actual values of the average tax rates (columns 6 and 7). For example, for the reference year 1974-75, explanatory power of equation 7 is 0.99 as against 0.92 of equation 6 (equations i and iii, column 6), and the range of deviation of the simulated values from the actual values of the average tax rates is only -9 to 10 per cent for equation 7 as against -24 to 489 per cent for equation 6 (equations i and iii, column 7). This suggests that equation 7 is preferable to equation 6. Therefore, equations i, v, and ix are used for estimating hypothetical average tax rates at the rate schedules of the assessment years 1974-75, 1976-77 and 1983-84 respectively. The ranges of estimates of hypothetical average tax rates by income classes, thus obtained at the rate schedules of the years 1974-75, 1976-77 and 1983-84 are given respectively in columns 1, 2 and 3 in Table 4.

From Table 4 it may be noted that at the rate schedule of each of the three years, hypothetical average tax rate of an income class has shown a substantial variation during the reference period. The ranges of variation in the hypothetical average tax rate for the income classes Rs. 15-20 thousand, Rs. 100-200 thousand, and above Rs. 500 thousand at the rate schedule of 1974-75 are respectively 10.68 - 12.02 per cent, 59.57 - 61.02 per cent and 86.38 - 94.08 per cent (column 1), at the rate schedule of 1976-77 are respectively 10.33 - 11.33 per cent, 48.82

- 50.01 per cent and 73.85 - 82.68 per cent (column 2), and at the rate structure of 1983-84 are respectively 7.02 - 8.03 per cent 45.41 - 46.42 per cent and 59.65 - 61.50 per cent (column 3). This suggests that failure of the earlier researchers to account for this variation in the average tax rate of an income class might have introduced an unknown distortion in their series of estimated hypothetical tax revenue at a constant rate structure and hence in their estimates of elasticity of the tax.

Hypothetical tax revenue in different income classes of the taxpayers, with taxable income exceeding Rs. 15,000 in each of the years in the reference period, at the rate schedules of each of the three years 1974-75, 1976-77 and and 1983-84 is obtained by using the hypothetical average tax rates in equation 10. Hypothetical tax revenue in a year, at the rate schedule of a year, is obtained by adding the hypothetical tax revenue in different income classes. This gives a time series of hypothetical tax revenue at each of the three rate schedules.

Hypothetical tax revenue as well as taxable income of different years is not comparable over time because of variation in coverage of the taxpayers in different years. These series need be corrected. This is done by multiplying the revenue and taxable income in a year by the adjustment multiplier which is the ratio of total number of taxpayers in a year to the number of taxpayers covered in our data set. The adjustment multipliers of individuals computed for different years are presented in Table 5 (column 3). The corrected series of taxable income and of hypothetical tax revenue are given in Table 6 along with gross domestic product (GDP) at factor cost and current prices (with one year

lag) and Gini index of taxable income of taxpayers. Gini index of taxable income of individuals is estimated based on the distribution of taxpayers into the same set of 14 income classes in each year in the reference period. The 14 income classes comprise 12 income classes as listed in Table 2, and the other two income classes as nil to Rs. 10,000, and Rs. 10,000 to Rs. 15,000. Gini indices are estimated by accounting for inequality within the income classes. This has been done, following Aggarwal (1990) and Kakwani (1980, Chapter 6), on the assumption of linear density functions within the income classes.⁶ Lower and upper values of the estimates were obtained to test for goodness of fit of the linear density functions. The estimated values of Gini index were found to lie between their lower and upper values implying that the assumption of linear density functions within the income classes is not unrealistic. Estimated values of Gini index (G) are given in column 7 in Table 6.

13. Estimates of Sensitivity of the Tax

Estimates of sensitivity of the tax are obtained by estimating the following two specifications of the tax function (3) with exclusion of tax rate variable. The estimates are obtained with the time series of hypothetical tax revenue at the rate schedules of 1974-75, 1977-78 and 1983-84.

$$\text{Log TR}_i^{**} = \alpha_3 + \beta_3 \text{Log GDP}_{i-1} + \tau_3 \text{Log G}_i \dots\dots\dots(12)$$

$$\text{Log TR}_i^{**} = \alpha_4 + \beta_4 \text{Log GDP}_{i-1} \dots\dots\dots(13)$$

Where TR_{i}^{**} = corrected hypothetical tax revenue in the i th year at the rate schedule of a given year. Estimates of β_3 and β_4 give sensitivity of the tax in terms of partial and total elasticities of the tax with respect to GDP.

Both the equations 12 and 13 are estimated by Ordinary Least Squares method. In case of problem of serial correlation, an equation has been re-estimated by Cochrane-Orcutt iterative method that adjusts for serial correlation. All the parameter estimates of equations 12 and 13 along with allied statistics are given in Table 7. It would be noted from Table 7 that there is little variation among the estimates of sensitivity of the tax at the three rate schedules with respect to GDP. This is so in terms of partial elasticity of the tax that is around 1.48 {equations (i) to (iii)}, as well as in terms of total elasticity of the tax that is around 1.18 {equations (iv) to (vi)}, with respect to GDP. This invariance of the sensitivity of the tax with respect to the three widely different rate schedules suggests that the major reductions in the high marginal tax rates in India, during the period 1974-75 to 1982-83 have not affected, to any significant extent, the sensitivity of the personal income tax.

The above finding is also corroborated in terms of sensitivity of the tax with reference to the tax base, i.e., taxable income. Equations 12 and 13 are re-estimated by replacing GDP_{i-1} by taxable income of the i th year. The parameter estimates thus obtained are presented in Table 8. The estimates of sensitivity of the tax with reference to taxable income also reveal that there is little variation in the sensitivity of the tax at the three rate schedules. Partial and total elasticities of

the tax with reference to taxable income are found around 1.05 {equations (i) to (iii)} and 0.95 {equations (iv) to (vi)} respectively at the three rate schedules considered in the study.

14. Conclusions

The study suggests that substantial reductions in the high marginal tax rates on personal income prevalent in some countries need not necessarily affect the sensitivity of personal income tax. It shows that large reductions in the high marginal tax rates in India, during mid seventies and early eighties have had no significant impact on the sensitivity of the tax.

NOTES

- 1 According to Auld (1971, p. 515), ".....The elasticity measure, since it incorporates the average tax rate, is a better method of measuring the sensitivity of different tax schedules".
- 2 Buoyancy of a tax is defined as the ratio of proportional change in the historical tax yield to the proportional change in national income.
- 3 There is another approach to calculating elasticity that gives, year by year, point elasticity. This method of calculating elasticity assumes equiproportionate growth in incomes of all the persons and that the income growth does not affect their marginal tax rates. For an exposure to this method of calculating elasticity, see Fries, Hutton and Lambert (1982), and Hutton and Lambert (1980).
- 4 The level of inequality in the distribution of income may differ between different periods. This may result in different estimates of elasticity for different periods even if the tax structure remains unchanged. Hutton (1980) has shown that elasticity depends on the level of inequality in the distribution of income.
- 5 The type of change in the distribution of taxable income within an income class that would not be affecting the average taxable income of the income class is unlikely to have any significant impact on average tax rate of the income class, at an unchanged tax structure.
- 6 Suppose there are n taxpayers that are grouped into k income classes, $(x_0 \text{ to } x_1), (x_1 \text{ to } x_2), \dots, (x_{k-1}, x_k)$. Let n_i and y_i denote number and income of taxpayers in the i th income class. Further, let f_i and p_i denote proportions of number of taxpayers in and upto the i th income class respectively. The formula used for computation of Gini index, based on the assumption of a separate linear density function within each income class which exactly fits the data points, is:

$$G = GL + \frac{1}{\mu} \sum_{i=1}^k f_i^2 \mu_i G_i$$

where

$$GL = 1 - \frac{\sum_{i=1}^k f_i (q_i + q_{i-1})}{\mu}$$

$$f_i = n_i/n$$

$$\mu_i = y_i/n_i$$

$$\mu = y/n$$

$$y = \sum_{i=1}^k y_i$$

$$q_i = \frac{1}{\mu} \sum_{j=1}^i f_j \mu_j, \quad i=1,2,\dots,k$$

$$G_i = (2/15) (x_i/\mu_i) (9\delta_{i-1} - 9\delta_i^2), \quad i=1,2,\dots,k-1$$

$$G_k = (\mu_k - x_{k-1})/(\mu_k + x_{k-1})$$

$$x_i = x_i - x_{i-1}$$

$$\delta_i = (\mu_i - x_{i-1})/x_i$$

GL gives an estimate of income inequality (G) based on the assumption that inequality of income within each income class is zero.

The test of goodness of fit of the linear density functions within the income classes is conducted on the basis of the following inequality:

$$GL < G < GL + \bar{D}$$

Where \bar{D} , for the last income class as open ended class is given as

$$\bar{D} = \frac{1}{\mu} \left\{ \sum_{i=1}^{k-1} f_i^2 (x_i) \delta_i (1-\delta_i) + f_k^2 (\mu_k - x_{k-1}) \right\}$$

The estimate of G satisfying the above inequality would mean that the fit is satisfactory. For an exposition to the above formulae see, for example, Aggarwal (1990), Gastwirth (1972), and Kakwani (1976).

Table 1

Results of Earlier Studies on Income Elasticity
of the Personal Income Tax in India

Methodological category/study	Reference Period	Estimate of elasticity	Remarks
1	2	3	4
A. Estimates Based on Proportional Adjustment Method			
Sahota (1961)	1951-52 to 1957-58	0.56	
Cutt (1969)	1955-56 to 1960-61 1960-61 to 1964-65	0.50 0.65	Based on data for first and last years of the reference period.
Rao (1979)	1960-61 to 1973-74	0.76	
Khadey (1981)	1960-61 to 1974-75 1960-61 to 1978-79	0.77 0.88	
Gupta & Aggarwal (1982)	1961-62 to 1975-76	0.93	
Bagchi & Rao (1982)	1965-66 to 1979-80	1.08	With three sets of estimated revenue effects of discretionary changes ¹
Aggarwal (1984)	1970-71 to 1981-82	0.86 to 1.04	---do--- ²
Bagchi (1988)	1965-66 to 1973-74 1973-74 to 1984-85	0.99 0.62	
B. Estimates based on Inclusion of Tax Rate Variable in Elasticity Equation			
Srivastava (1975)	1961-62 to 1972-73	1.00	Progressive rate structure is represented by an estimated initial rate and an incremental factor.
C. Estimates based on Constant Rate-Base Method			
Gulati (1962)	1949-50 to 1958-59	2.70	At the rate structure of 1958-59. Based on data corresponding to first and last years of the reference period.
Gupta (1975) ³	1951-52 to 1964-65	0.63	At the rate structure of 1954-55 with exemption limit at Rs. 4200 and Rs. 3000 respectively.
Gupta & Aggarwal (1982) ⁴	1954-55 to 1964-65 1965-66 to 1975-76	0.53 0.56	At the rate structure of 1972-73.
	1954-55 to 1964-65 1965-66 to 1975-76	0.63 0.58	At the rate structure of 1974-75.
Rao (1987) ⁵	1953-54 to 1974-75	0.91	At the rate structure of 1961-62.
		0.92	At the rate structure of 1974-75.
D. Estimates based on Cross-Section Data			
Rao (1987)	1961-62 1966-67 1971-72 1974-75	1.33 1.35 1.51 1.36	

Notes:

- Budget estimates of revenue effects of discretionary changes made in different years ignore the revenue effects of some of the discretionary changes on the optimism that the effect would be compensated for by better tax compliance. In the absence of any evidence in favour of such an optimism, Bagchi and Rao have accounted for also the revenue effects of such discretionary changes and obtained three alternative sets of estimates of the revenue effects.
- Aggarwal used three alternative sets of revenue effects. First, as per the budget estimates; second, accounts for also the revenue effects of the change made outside the budget, third, accounts for also the revenue effects ignored on the optimism of better tax compliance, but only to the extent of 50 per cent of such revenue effect.
- Elasticity estimates by Gupta (1975) are with respect to assessed income, whereas by others are with respect to GDP at factor cost (at current prices).
- Covers the categories of taxpayers: Individuals, Hindu Undivided Families, Unregistered Firms, and Associations of Other Persons.
- Covers only Individuals and Hindu undivided families

Table 2

Range of Average Incomes and Average Tax Rates
of Individual Taxpayers By Income Classes
(1966-67 to 1983-84)

Income Class (Rs. thousand)	Range of average taxable income (Rs. thousand)	Range of average tax rates (per cent)
(1)	(2)	(3)
15-20	16.83- 17.87	6.92 - 12.72
20-25	21.89- 22.37	11.64 - 16.74
25-30	27.01- 27.50	15.62 - 20.47
30-40	34.12- 37.73	22.07 - 26.77
40-50	44.01- 45.43	25.36 - 34.57
50-70	57.42- 58.78	32.23 - 42.42
70-100	81.27- 82.76	39.30 - 51.28
100-200	123.86- 133.66	49.28 - 65.04
200-300	234.65- 244.45	52.52 - 74.81
300-400	337.21- 347.10	49.06 - 75.79
400-500	436.00- 461.54	50.54 - 80.15
above500	903.03-2050.96	63.49 - 87.64
All		13.23 - 19.58

Table 3

Estimates of Parameters of the Equation of Average Tax Rate at the Rate Schedule of Different Assessment Years

Equation No.	Dependent variable	Constant term	Average taxable income	Log of average taxable income	Inverse of average income	R ²	Range of deviation of estimated values from actuals (per cent)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	
At the Rate Schedule of Assessment Year 1974-75							
1.	LogATR	3.93808 (26.01)		0.08140 (3.19)	-30.13025 (15.86)	0.99	(-9,10)
2.	LogATR	1.72481 (5.70)		0.43468 (6.84)		0.81	(-39,39)
3.	ATR	83.74535 (15.17)	0.01349 (2.34)		-1171.43282 (8.01)	0.92	(-24,439)
4.	ATR	39.20909 (5.50)	0.03691 (2.76)			0.39	(-70,56)
At the Rate Schedule of Assessment Year 1976-77							
5.	LogATR	3.52603 (12.96)		0.11821 (2.57)	-25.71404 (7.58)	0.98	(-15,8)
6.	LogATR	1.62040 (6.05)		0.42456 (7.52)		0.84	(-36,34)
7.	ATR	53.57994 (12.09)	0.01980 (3.13)		-865.13003 (6.11)	0.90	(-17,187)
8.	ATR	31.27379 (5.78)	0.04053 (3.53)			0.52	(-66,61)
At the Rate Schedule of Assessment Year 1983-84							
9.	LogATR	4.04867 (18.83)		0.01151 (0.32)	-35.71960 (13.30)	0.99	(-12,13)
10.	LogATR	1.40934 (3.94)		0.43447 (5.78)		0.75	(-51,44)
11.	ATR	47.94967 (21.87)	0.01322 (4.46)		-791.01408 (11.23)	0.96	(-14,260)
12.	ATR	27.32915 (6.00)	0.03081 (3.30)			0.48	(-76,55)

1. Average tax rate (ATR) equations fitted are of the form:

$$\text{LogATR} = \alpha_0 + \alpha_1 \text{Log AAI} + \alpha_2 (1/\text{AAI})$$

$$\text{ATR} = \alpha_0 + \alpha_1 \text{AAI} + \alpha_2 (1/\text{AAI})$$

Where AAI denotes average assessed income of an income class.

- Estimates are based on cross-section of income classes for the relevant assessment year.
- Estimates correspond to the taxpayers with taxable income greater than Rs. 15,000.

Table 4

Range of Estimated Hypothetical Average Tax Rates of Individual Taxpayers at a Constant Tax Schedule during 1966-67 to 1983-84 by Income Classes

Income Class	At the rate schedule of the year		
(Rs. thousand)	1974-75 (percent)	1976-77 (percent)	1983-84 (percent)
(1)	(2)	(3)	(4)
15-20	10.68 - 12.02	10.30 - 11.33	7.02 - 8.03
20-25	16.66 - 17.19	15.12 - 15.55	11.62 - 12.03
25-30	22.00 - 22.47	19.37 - 19.75	15.87 - 16.25
30-40	28.29 - 31.03	24.28 - 26.41	20.96 - 23.19
40-50	35.21 - 36.07	29.64 - 30.30	26.59 - 26.88
50-70	42.23 - 42.82	35.06 - 35.52	32.24 - 32.72
70-100	50.67 - 51.08	41.66 - 41.94	38.85 - 39.17
100-200	59.57 - 61.02	48.82 - 50.01	45.41 - 46.42
200-300	70.38 - 70.98	58.07 - 58.61	52.42 - 52.76
300-400	75.38 - 75.75	62.67 - 63.02	55.13 - 55.32
400-500	78.55 - 79.21	65.73 - 66.39	56.66 - 56.93
above500	86.38 - 94.08	73.85 - 82.65	59.65 - 61.50

Table 5

Adjustment Multipliers of Individuals to Correct for Varied Coverage of the Taxpayers in Different Years

Year	Total No. of taxpayers (thousand)	Taxpayers covered in AIITS (thousand)	Adjustment multipliers for Individuals (2)/(3)
(1)	(2)	(3)	(4)
1966-67	2234	1586	1.409208
1967-68	2214	1510	1.466258
1968-69	2146	1753	1.224515
1969-70	2366	1793	1.319778
1971-72	2569	1967	1.306296
1972-73	2692	1966	1.369066
1974-75	2885	2119	1.361128
1975-76	2981	2131	1.399013
1976-77	2877	2139	1.344958
1977-78	3038	2228	1.363668
1978-79	3052	1667	1.831141
1979-80	3160	1549	2.040309
1980-81	3489	1237	2.821003
1981-82	3521	1200	2.934072
1982-83	3612	1055	3.423878
1983-84	3638	886	4.103614

Note: The decline in the number of taxpayers covered in AIITS during the period 1977-78 to 1983-84 is attributable to the departmental policy to allocate relatively lesser resources for compilation of income tax statistics.

Source: For column (2) Report of the Comptroller and Auditor General of India for different years, and for column (3) All India Income Tax Statistics for different years.

Table 6

Estimates of Taxable Income, Hypothetical Tax Revenue at given
Rate Schedules, National Income and Gini Index of
Taxable income

Assessment year	Taxable assessed Income (Rs. crore)	Hypothetical Tax Revenue at the rate schedule of			Gross domestic product at factor cost, at current prices (Rs. crore)	Gini Index of taxable income
		1974-75 (Rs. crore)	1976-77 (Rs. crore)	1983-84 (Rs. crore)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1966-67	835.00	260.54	222.72	191.02	22030.00	0.44396
1967-68	916.27	291.83	249.41	213.69	25480.00	0.44502
1968-69	998.71	301.38	257.88	221.27	29870.00	0.42570
1969-70	1136.55	342.28	292.94	251.32	30548.00	0.42126
1971-72	1475.14	442.45	378.95	324.37	36736.00	0.41102
1972-73	1159.32	359.09	310.14	258.43	39274.00	0.39636
1974-75	1347.32	380.76	329.11	275.60	53826.00	0.37320
1975-76	1579.71	424.65	366.15	310.33	63342.00	0.35411
1976-77	2012.28	574.07	493.68	419.60	66630.00	0.36065
1977-78	2277.15	629.78	543.95	457.49	71665.00	0.33123
1978-79	3090.79	839.64	724.77	611.66	80931.00	0.31610
1979-80	3416.41	942.90	814.08	685.39	87214.00	0.30840
1980-81	4260.41	1214.09	1042.87	889.27	95358.00	0.32260
1981-82	4482.10	1273.55	1098.26	925.81	113548.00	0.31246
1982-83	5836.87	1526.79	1316.71	1119.08	130770.00	0.29120
1983-84	7233.83	2053.18	1764.67	1503.27	145961.00	0.32181

- Note:**
1. Gross domestic product (GDP) shown against the *i*th assessment year corresponds to the (*i*-1)th financial year, i.e., column 6 gives one year lagged values of GDP.
 2. Gini index of taxable income of individuals is estimated based on the distribution of taxpayers into the same set of 14 income classes in each year. The 14 income classes comprise 12 income classes as listed in Table 2, and the other two income classes as nil to Rs. 10,000, and Rs. 10,000 to Rs. 15,000.

Table 7

Estimates of Sensitivity of the Tax at Different Rate schedules
with respect to GDP

Equation No.	Dependent variable tax at the rate Schedule of assessment year	Constant term	Coefficient of log of		\bar{R}^2	DW Statistic
			Gross domestic product (GDP)	Gini index (G)		
i.**	1974-75	-8.0772 (3.86)	1.4327 (6.42)	1.7345 (2.11)	0.95	1.94
ii.**	1976-77	-8.1852 (3.98)	1.4752 (6.50)	1.7448 (2.10)	0.95	1.93
iii.**	1983-84	-8.4749 (3.91)	1.4900 (6.23)	1.7835 (2.03)	0.95	1.98
iv.**	1974-75	-6.6092 (2.77)	1.1823 (5.56)		0.93	1.83
v.**	1976-77	-6.7529 (2.90)	1.1318 (5.68)		0.94	1.83
vi.*	1983-84	-6.8213 (2.38)	1.1722 (4.64)		0.94	1.48

Notes: * Equation is estimated by Cochrane-Orcutt iterative method that adjusts for first order serial correlation.

** Equation is estimated by Cochrane-Orcutt iterative method that adjusts for second order serial correlation.

1. Figures in parenthesis show t-statistic.

2. All the parameter estimates are significant at 99 per cent level of confidence.

Table 8

Estimates of Sensitivity of the Tax at Different Rate Schedules with respect to Taxable Income

Equation No.	Dependent variable tax at the rate Taxable of assessment year	Constant term	Coefficient of Log of		\bar{R}^2	DW Statistic
			Taxable Income (AI)	Gini index (G)		
i.	1974-75	-1.0454 (11.91)	1.0522 (43.57)	0.5871 (5.00)	0.99	1.94
ii.	1976-77	-1.1938 (13.30)	1.0446 (42.27)	0.5318 (4.43)	0.99	2.03
iii.	1983-84	-1.3845 (17.86)	1.0630 (49.81)	0.6441 (6.21)	0.99	1.72
iv.*	1974-75	-0.8675 (4.46)	0.9505 (37.99)		0.99	1.84
v.*	1976-77	-1.0188 (5.99)	0.9506 (43.32)		0.99	1.84
vi.*	1983-84	-1.2315 (5.17)	0.9567 (31.38)		0.99	1.87

- Notes:**
- * Equation is estimated by Cochrane-Orcutt iterative method that adjusts for first order serial correlation.
 - 1. Figures in parenthesis give t-statistic.
 - 2. All the elasticity estimates are significant at 99 per cent level of confidence.

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