ANALYSING PROGRESSIVITY OF PERSONAL INCOME TAXES: A CASE STUDY OF INDIA

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Abstract

This paper suggests two models for isolating empirically the effects of the income inequality and the tax parameters from their combined effect on the progressivity of real world personal income taxes. The inequality in the distribution of income and the graduation in the tax rates are found to significantly influence the progressivity of the tax. It is depicted that in an economy with low or high level of income inequality, income redistribution policies would lead to greater changes in the progressivity of the tax as compared to that in an economy with moderate level of income inequality. In an economy with higher level of graduation in the tax rates, a further increase in the graduation is unlikely to significantly enhance the effective progressivity of the tax. The developing countries cannot rely much on the steep graduation in the tax rates for their economic reforms. During 1961-62 to 1983-84, the effective progressivity of personal income tax in India has substantially declined with a markedly sharp decline during the period 1972-73 to 1983-84. During the latter period, the decline in income inequality as also in the graduation in the tax rates have contributed significantly to the decline in the effective tax progressivity.

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1. Introduction

In the seventies, many countries had very high marginal tax rates at the high income levels. Some of the countries, in the late seventies or in early eighties, initiated the process of reduction in the high marginal tax rates at the high income levels and hike in the low marginal tax rates at the low income levels. As a result, personal income tax schedules in these countries have been substantially changed. These changes may have had substantial impact on the observed or effective progressivity of the tax.[1] Further, the observed progressivity of personal income tax is the net effect of the tax parameters and the economic and social variables, such as the tax rate schedule and the inequality in the distribution of income. It has been shown through simulative exercises that **ceteris paribus** a change in income inequality can affect the progressivity of the tax. For example, Kiefer(1984) shows it with reference to a simple tax function that has a constant liability progression all along the income scale. To what extent a change in the income inequality affects the progressivity of the actual tax system in a country is an empirical question. No attempt has however, been made at delineating the effect of the real world tax schedules and the income inequality from their combined effect on the progressivity of the tax. The objective of this study is to initiate the process of filling this gap. In this study, two models for delineating the effect of the tax rate schedule and the income inequality from their combined effect on the progressivity of the tax are developed. The application of various measures of tax progressivity in studying the trends in

tax progressivity and of the models (developed here) in analysing progressivity of personal income taxes is explained with the data on personal income tax payers in India.

The plan of the study is as follows. A review of earlier studies of tax progressivity is given in Section 2. A discussion on measuring tax progressivity is contained in Section 3. The models for analysing the effect of the tax schedule and the income inequality on observed progressivity of the tax are developed in Section 4. The application of various measures of tax progressivity in studying the trends in tax progressivity, and of the models in analysing progressivity of personal income taxes is illustrated with the data on personal income tax payers in India in Section 5. Finally, the findings are given in Section 6.

2. Review of Earlier Studies

The studies relating to tax progressivity have attempted to compare progressivity of different tax structures or systems across the select countries or, across different States in a country or, to study the trend in progressivity of a tax or tax system over time[2]. Kakwani (1977) studied the trends in tax progressivity in Australia, Canada, the United Kingdom and the United States. He finds that tax progressivity has declined in all the four countries during the period of analysis and that between these countries, there is a substantial variation in the progressivity of the tax. Alchin (1984) also studied the trend in the progressivity of the Australian income taxes. Phares (1980), and Greene and Balkan (1987) compared the progressivity of the tax across the States of USA with respect to their State and local fiscal structures. Formby and Sykes (1984) studied the trends in progressivity of personal income taxes in the selected States of USA. They have shown that almost all the decline, over time, in the tax progressivity in North Carolina can be explained in terms

of inflation, real growth in per capita income and the binary variables representing the tax changes. Gupta (1975), and Gupta and Aggarwal (1982) have looked into the trends in progressivity of the personal income tax in India. Gupta (1975), by using the ratio of the Gini index of pre-tax income to that of the post-tax income of the taxpayers, observed a declining trend in the progressivity of the tax in India during the period 1951-52 to 1964-65. Gupta and Aggarwal (1982), by using Kakwani's measure of tax progressivity - defined as the difference between the concentration index of tax and the Gini index of pre-tax income, observed erratic variations in the tax progressivity during the period 1953-54 to 1975-76. None of these studies, however, attempt to delineate the impact of the tax parameters and the income inequality on observed progressivity of the tax.

3. Measuring Tax Progressivity

There are several measures of tax progression or progressivity which can be classified into three broad categories, namely, local (structural or schedular), global (summary or distributional) and hybrid. A local measure constructs a schedule of tax rate or tax liability or post-tax income along the income scale.[3] A global measure gives rise to a single number and it focuses, in general, on the distributional aspect of the tax in terms of tax liability or pre - and post-tax incomes.[4] A hybrid measure combines the character of both the local and the global measures[5]. It, like the global measures, focuses on the distributional aspect, and gives rise to a schedule of numbers like a local measure. The trend in this schedule of numbers along the low income to the high income groups of taxpayers gives the progressivity of the tax. A local measure reveals the progressivity at different income levels. A global measure gives overall progressivity, that is, the combined impact of the tax structure and the inequality in the distribution of income. In

general, it does not give specific impact at different income levels. A hybrid measure shows each sub-group in relation to the whole population of taxpayers (Baum, 1987). The trends in tax progression can be studied in terms of the measures belonging to either of the above mentioned categories.

In general, the measures invariant to proportional translations[6] of the average tax rates seem more suitable as measures of tax progression and those invariant to proportional translations of post-tax incomes seem more suitable as measures of income redistribution or redistributive effects of the tax.[7] The former measures which are also referred to, as tax scale neutral measures, are found helpful in understanding the redistributive impact of the tax that depends on the tax progressivity and the level of taxation.[8] For given redistributive impact of a tax, there seems to be a trade-off between the progressivity and the level of taxation. Tax progressivity, in terms of global measures, can be estimated by the tax scale invariant measures of progressivity such as, the Kakwanis' measure, defined as the difference between the concentration index of tax and the Gini index of pre-tax income, Suit's measure and the measure proposed by Aggarwal (1991a) defined in terms of the concentration indices of tax and pre-tax income based on the concept of equally distributed equivalent level of income/tax.[9] The concept of equivalent level of income has been developed by Kolm (1969), Atkinson (1970) and Sen (1973). Therefore, hereinafter it is referred to as the KAS concept of inequality and the measures of inequality based on this concept are referred to as the KAS inequality indices. Khetan and Poddar's measures are similar to that of Suit's, and were developed simultaneously. Therefore, hereinafter Suit's measure is referred to as the Khetan-Poddar-Suit's(KPS) measure.

The global measures can be supplemented with the local and the hybrid measures such as the average rate elasticity progression (AREP) proposed by Aggarwal (1980), and the relative tax share progressivity (RTSP) developed by Aggarwal (1991c). The AREP at an income level is defined as the ratio of the proportional change in the average tax rate to the proportional change in income. The RTSP of a group of taxpayers is defined as the ratio of that group's share in total tax yield to that in the total income of all the taxpayers. While the AREP shows progressivity by income classes, the RTSP shows it by income groups. Both the measures, AREP and RTSP, are also neutral to the tax scale. For an insight into the other characteristics of the AREP, see Aggarwal (1980 and 1990c), and those of the RTSP, see Aggarwal (1991c).

4. The Models of Tax Progressivity

The observed or effective progressivity (P) of the personal income taxes can be postulated to depend on the tax rate schedule (TS) and the inequality in the distribution of income (II). These tax - and non-tax parameters may vary over time and across countries, and influence the progressivity of the tax. In this section, two models are developed to delineate the effect of these variables on the progressivity. These models can be used in explaining variation in the effective tax progressivity over time or across countries. The effective progressivity of a tax can be expressed as:

$$P = f(II, TS) \qquad (1)$$

The tax schedule can be represented by the graduation in the statutory tax rates and the tax scale, i.e., the level of taxation.[10] As discussed earlier, tax progressivity is distinguished from the redistributive impact of the tax and is

taken to be independent of the level of taxation. The tax schedule affects the tax progressivity through the graduation in the statutory tax rates. Therefore, it would be appropriate to substitute the variable `tax schedule' by another variable representing the graduation in the statutory tax rates in relationship (1). The graduation in the statutory tax rates can be termed as statutory tax progressivity (STP), defined in terms of statutory tax rates without any reference to the distribution of income. With this change, relationship (1), becomes,

$$P = f(II, STP) \qquad (2)$$

It is noteworthy, that the effective tax progressivity `P' should be nil irrespective of the level of statutory tax progressivity `STP', if income is equally distributed (II=Ø). This seems to suggest that the relationship of II and STP with P is multiplicative.

It is important to note that relationship (2) described here is definitional in nature and not behavioural. Thereby, the variables such as the levels and composition of income and tax evasion are beyond the scope of our formulation of effective tax progressivity.

The process of representing the graduation in the tax structure by a summary measure - statutory tax progressivity (STP), and inequality in the distribution of income by a summary measure (II) results in the omission of some information. This results in inexactness of function (2) which would have been an exact function, otherwise. The following specification of the functional relationship (2), ignoring the error term, seems defendable on the ground of simplicity:

$$P = \alpha\, II^{\beta}\, STP^{\gamma} \qquad (3)$$

where α, β, and τ are parameters to be estimated. Expected signs of α and τ are positive. In other words, a rise in graduation in the statutory tax rates (STP) is expected to enhance the effective progressivity of the tax. That, β can take any sign as the effect of a rise or decline in income inequality (II) on the effective tax progressivity is not unambiguous.

Specification (3) can be rewritten in the double log linear form as:

$$LP = \alpha_0 + \beta\, LII + \tau\, LSTP \qquad (4)$$

where

$LP = Log(P)$, $LII = Log(II)$,

$LSTP = Log(STP)$ and $\alpha_0 = Log(\alpha)$

The parameters β and τ are interpretable as constant elasticities of P with respect to II and STP respectively. Equation (4) can be modified to allow for variable elasticities with respect to the level of variables II and STP, as:

$$LP = \alpha_0 + \beta_1\, LII + \beta_2\, (1/LII) + \tau_1\, LSTP + \tau_2\, (1/LSTP) \qquad (5)$$

where α_0, β_1, β_2, τ_1 and τ_2 are parameters to be estimated. Equation (5) allows elasticity of P with respect to II to vary with the level of II, and that with respect to STP to vary with the level of STP.[11] This also permits checking, whether the relations of P and II with the tax progressivity are of constant or variable elasticity.

The progressivity (P) can be represented by a global measure of tax progressivity. The statutory tax progressivity (STP) can be represented by a measure based on the variation in marginal tax rates such as the relative mean deviation, coefficient of variation, standard deviation, range of marginal

tax rates and the ratio of the maximum to the minimum marginal tax rate. The latter two measures are sensitive to changes in the minimum and the maximum marginal tax rates.

For a time series analysis of the effective tax progressivity, a simple variant of equation (5) is plausible, if it is assumed that a change in the graduation in the statutory tax rates results in a constant shift in the tax progressivity (P). The simple variant avoids the problem of measuring statutory tax progressivity (STP). It can be expressed as:

$$LP = \alpha_0 + \beta_1 LII + \beta_2 (1/LII) + \sum_{i=1}^{k} \tau_i D_i \qquad (6)$$

where α_0, β_1, β_2, and τ_i $(i=1,2,.....k)$ are parameters to be estimated, k denotes the number of years in which changes in the graduation in the tax rates have been introduced and $D_i(i=1,2.....k)$ denotes the dummy variable for the ith change introduced. All the changes relating to a year are treated as a single change. A dummy variable takes value zero for the years preceding the year of change and takes value unity in the year of change and the subsequent years. If the changes are introduced in many of the years, then estimation of equation (6) becomes infeasible. This problem can be avoided by accounting for only the major changes so that a fewer number of dummy variables are required to capture the effect of changes in the rate schedule, during the given period.

5. Progressivity of Personal Income Tax in India

In this section, applications of various measures of tax progression in studying the trends in tax progressivity, and of the models developed here in analysing the progressivity of personal income taxes are illustrated with the data on personal income tax payers in India.

5.1 Rate Structure of the Personal Income Tax in India

Personal income tax in India, as in many other countries, has seen wide variations in the rate structure. The range of marginal tax rates exclusive as well as inclusive of surcharge in the assessment years 1961-62 to 1991-92 is given in Table 1. Also marginal tax rates by income brackets are presented for the period 1961-62 to 1990-91, in Table 2. From Table 1, it would be observed that during the sixties, there have been very high marginal tax rates at the high income levels and very low marginal rates at the low income levels; during the early seventies, marginal tax rates at the low income as well as at the high income levels were increased, resulting in marginal tax rate rising as high as 97.75 per cent in the years 1972-73 to 1974-75 (Column 4); during the late seventies and the early eighties the marginal tax rates at the low income levels continued to rise, while at the high income levels, the high marginal tax rates followed a sharply declining trend. As a result, in 1983-84 the marginal tax rates at the high income levels were only moderately high but the marginal tax rates at the low income levels were very high - the minimum marginal tax rate was 33.00 per cent (Column 4). Subsequently, the marginal tax rates at the low as well as at the high income levels continued to decline resulting in the minimum and the maximum marginal tax rates as 20.00 and 55.00 per cent respectively in the year 1991-92.

The exemption limit for individual income taxpayers has been substantially raised during the period 1961-62 to 1991-92. The exemption limit in different years is also given in Table 1. It has been raised from Rs. 3,000 in 1961-62 to Rs. 5,000 in 1971-72, to Rs. 8,000 in 1981-82, and to Rs. 22,000 in 1991-92 (column 5).

Besides the increase in the exemption limit, there have been some changes which may have tended to reduce the tax base, over time. In general, the scope of exemptions and deductions has been widened, and the ceilings have been raised over time. For example, the ceiling on the amount of investment in specified assets that qualifies for a graded deduction has been raised from Rs. 10,000 in 1961-62 to Rs. 40,000 in 1983-84; the ceiling on allowable deduction of interest and dividend received from some specified assets has been raised from Rs. 5,000 in 1961-62 to Rs. 9,000 in 1983-84 and subsequently it has been enhanced to Rs. 13,000 with effect from the year 1989-90. The lists of the specified assets have also been enlarged. With effect from the assessment year 1975-76, the system of itemised expense deduction with respect to expenditure incidental to earning salary income has been replaced by a standard deduction based on the salary income. The ceiling on the amount of standard deduction has been raised from Rs. 3,500 in 1975-76 to Rs. 5,000 in 1983-84 and subsequently to Rs. 12,000 with effect from the year 1989-90.

5.2. The Data

The study covers the single major category of personal income tax payers in India - `individuals'. These account for more than 90 per cent of the total number of personal income tax payers and their taxable income.

The data on the statutory marginal tax rates for each of the years under consideration are taken from the annual budgets of the Union Government of India.

The data relating to the personal income taxpayers in India have been obtained from the All India Income Tax Statistics (AIITS) - the only source of data on the income classwise distribution of the taxpayers in India. The data have been

compiled for each of the years from 1961-62 to 1983-84 excepting the years 1970-71 and 1973-74 for which these data were not published. 1983-84 is the last year for which the data comparable with those of the previous years are available.[12] The limitations of these data have been widely discussed in literature (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 which correspond to the income tax returns filed in the current year and a few earlier years. Most of the assessments completed in a year correspond to the current year. Some of these assessments, however, correspond to the returns filed in a few earlier years with a sharply declining proportion of assessments relating to the successive preceding years. The fraction of the total number of assessments completed in a year, covered in AIITS has varied from year to year. Nevertheless, these data can be taken to reasonably reflect the changes in the distribution of income among the taxpayers.

During the period, 1961-62 to 1983-84, the number of income classes by which the data in AIITS are presented has varied from 14 to 20. In order to avoid any distortion, due to variation in the level of disaggregation,[13] in the estimates of relevant variables, the data have been regrouped into a homogenous set of 14 income classes in each of the years.

The analysis that is based on the income classwise distribution of taxpayers is restricted to the period 1961-62 to 1983-84, as the data for the later period are not comparable. However, the analysis that is not based on the income classwise distribution of income is extended beyond 1983-84, wherever found feasible.

5.3. Trends in income inequality and progressivity

The global measures as well as the local and hybrid measures are applied in studying the trends in tax progressivity during the period 1961-62 to 1983-84.

Computation of the measures and analysis of tax progressivity requires estimation of income inequality and tax concentration. These have been estimated as Gini indices based on Lorenz curves and KAS inequality indices. The Gini indices of tax and pre-tax income are estimated, following Aggarwal (1990a) and Kakwani (1980, Chapter 6) on the assumption of linear density functions within the income classes.[14] The lower and the upper values of the estimates were obtained to test for goodness of fit of the linear density functions within the income classes. The estimated values of Gini indices of pre-tax income as well as of the tax 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. The estimates of Gini indices of pre-tax income and tax are denoted by G and C1 respectively. The KAS inequality indices of income and tax are estimated for different values of inequality aversion ranging from 0.50 to 4.00 with an interval of 0.25.[15] The results, however, are reported for only two values, 0.50 and 3.75, of inequality aversion. The KAS inequality indices of pre-tax income for the values of inequality aversion as 0.50 and 3.75 are denoted by A2 and A3 respectively, and those of tax liability for the values of inequality aversion as 0.50 and 3.75 are denoted by C2 and C3 respectively. The estimates of these inequality indices are reported in Table 3 (Columns 2 to 7).

Based on the estimates of inequality indices of income and tax, three measures of the effective tax progressivity (P1, P2 and P3), invariant to tax scale, are obtained as follows:

$$P1 = C1-G \quad (7)$$

$$P2 = C2-A2 \quad (8)$$

$$P3 = C3-A3 \quad (9)$$

P1 is based on the Gini indices, and P2 and P3 are based on the KAS inequality indices of pre-tax income and tax liability. In addition to these measures, another tax scale invariant measure of the effective tax progressivity 'KPS' is estimated. The estimated values of KPS, P1, P2 and P3 are also given in Table 3 (columns 9 to 12).

The statutory tax progressivity has been computed as the ratio of the maximum to the minimum marginal tax rate. It is denoted by STP1. The values of STP1 are reported in Table 3 (column 8).

The estimates of progression schedules of the personal income tax in India are obtained in terms of the average rate elasticity progression (AREP) and the relative tax share progressivity (RTSP). These are obtained for the tax schedules prevalent during the selected years 1961-62, 1971-72, 1977-78 and 1983-84 covering the period 1961-62 to 1983-84. The tax schedules prevalent during the selected years represent a variety of tax schedules (Table 2). The tax schedules corresponding to the years 1961-62 and 1971-72 represent the tax schedules with very low minimum marginal tax rate and very high maximum marginal tax rate. The tax schedule corresponding to the year 1977-78 represents the tax schedules with moderately low minimum marginal tax rate and moderately high maximum marginal tax rate. The tax schedule corresponding to the year 1983-84 represents the tax schedules

with very high minimum marginal tax rate and moderately high maximum marginal tax rate. The average rate elasticity estimates are obtained also at the tax schedule of the year 1990-91 that represents tax schedules with moderately high minimum and maximum marginal tax rates.

The estimates of average rate elasticity progression are obtained at the middle points of different marginal rate income brackets.[16] In addition to these income levels, the exemption levels in the selected years and some high income levels have also been taken into account. The estimates of the average rate elasticity progression schedule for the selected five assessment years are presented in Table 4. As one would have expected, AREP declines along the income scale excepting some erratic variations at the low income levels in some of the years. The decline in AREP has been sharp along the low and middle income ranges, and only marginal along the high income ranges that basically reveals the fact that, in general, the marginal tax rates rise faster at the low income levels, rise at a low pace at the middle income levels and remain unchanged at the high income levels.

The progressivity schedules in terms of the relative tax share progressivity are computed by deciles of population of taxpayers.[17] For greater details about the top decile, relative tax shares of top 5 per cent and top 1 per cent of the taxpayers are also computed. The estimates of relative tax share progressivity schedules are given in Table 5.

From Table 3, it will be noted that the inequality index of tax liability is greater than that of the pre-tax income in any of the years (columns 2 to 7). This merely reveals the fact that, personal income tax in India is progressive. Inequality in the distribution of pre-tax income as well as in tax liability has markedly declined during the period 1961-62 to 1983-84. The Gini

index of pre-tax income (G) has declined from Ø.47546 to Ø.32181 (column 2) and the concentration index of tax liability (C1) has declined from Ø.86241 to Ø.65592 (column 3). Similarly, for inequality aversion of Ø.5Ø, the KAS inequality index of pre-tax income has declined from Ø.14991 to Ø.ØØ9382 (column 4) and that of tax liability has declined from Ø.66ØØ4 to Ø.36446 (column 5). For inequality aversion of 3.75, the KAS inequality index of pre-tax income has declined from Ø.37395 to Ø.33477 (column 6) and that of tax liability has declined from Ø.89719 to Ø.72984 (column 7).

From Table 3, it will also be noted that the effective progressivity of personal income tax in India, judged by any of the four measures of tax progressivity considered here, has declined during the period 1961-62 to 1983-84 with a markedly sharp decline during the period 1977-78 to 1983-84 (columns 1Ø to 13). During 1961-62 to 1983-84, KPS, P1, P2 and P3 have declined respectively from Ø.59299 to Ø.37628, Ø.38695 to Ø.33411, Ø.51Ø13 to Ø.27Ø64 and from Ø.52324 to Ø.395Ø7. This declining trend can partly be attributed to raising of the marginal tax rates at the low income levels and lowering of the marginal tax rates at the high income levels during the period 1961-62 to 1983-84. These changes in the marginal tax rate schedules are well reflected in the measure of statutory tax progressivity (STP1) defined in terms of statutory marginal tax rates. Consequently, the value of STP1 has declined from 26.66667 in 1961-62 to 2.ØØØØØ in 1983-84 (column 8).

The decline in effective tax progressivity during the period 1961-62 to 1971-72 seems to have been accompanied by significant changes in the average rate elasticity progression (AREP) that has increased at the low and high income levels and decreased at the middle income levels (columns 2 and 3 in Table 4). Also it is accompanied by a decline in the relative tax share progression (RTSP) that has increased at all the deciles of the

taxpayers except the lowest and the top deciles (columns 2 and 3 in Table 5). At both the lowest and the top deciles, the RTSP has marginally declined over time. Consequently, the trend growth rate of tax progressivity along the low income to high income deciles has declined from about 39 per cent in 1961-62 to 32 per cent in 1971-72 implying that the tax has become less progressive. These changes in progressivity of the tax are attributable to the sharp increases in marginal tax rates at the low income levels against relatively small increases at the high income levels. During the reference period, the minimum marginal tax rate has been raised to more than three fold whereas the maximum marginal tax rate applicable to only the high income taxpayers has been raised to less than one and a quarter times (columns 2 and 4 in Table 2).

The decline in effective tax progressivity, during the period 1971-72 to 1977-78, has been small despite the sharp cuts in high marginal tax rates at the high income levels. It has been so because, simultaneously, the marginal tax rates at the low and the middle income levels were also reduced (see columns 7 and 10 in Table 2). The sharp decline in effective tax progressivity, during the period 1977-78 to 1983-84 is accompanied by a substantial increase in the RTSPs at the low income deciles and a decrease in RTSP at the top income decile (columns 4 to 6 in Table 5). The trend growth rate of RTSP along the low income to high income deciles has been approximately 30 and 18 per cent in the years 1977-78 and 1983-84 respectively. Also,the marked decline in effective tax progressivity seems to have been accompanied by an increase in the AREP at the low income levels and by a decrease in the AREP at the middle and the high income levels (columns 3 to 5 in Table 4). The sharp decline in tax progressivity during this period is attributable to increases in the marginal tax rates at the low income levels and decreases in the marginal tax rates at the high income levels (columns 10 to 13 in Table 2).

An implication of the rise in AREP at the low income levels and the decline at the high income levels during the period 1961-62 to 1983-84, seems to be that, over time, the distribution of tax liability has become more unequal (i.e., favourable to the relatively poor) within the groups of low income taxpayers, and less unequal (i.e., favourable to the relatively rich) within the groups of middle and high income taxpayers. This trend, however, seems to have been reversed during the later period i.e., during the period 1983-84 to 1990-91. From Table 4 (columns 5 and 6), it may be noted that during this period the AREP at the high income levels has substantially increased, whereas at the low and middle income levels,it has either decreased or increased moderately.

5.4. Estimation of the Models and Results

Two alternative models of effective tax progressivity have been developed in Section 4. In Model 1 (equation 5), the tax schedule is represented by a measure of statutory tax progressivity (STP1) defined in terms of the statutory marginal tax rates. STP1 is presumed to capture the effect of changes in the graduation in the tax schedule on the effective tax progressivity. In Model 2 (equation 6), effect of the tax rate changes is captured through introduction of the dummy variables corresponding to the years in which the changes in the tax schedule have been introduced during the reference period. From Tables 1 and 2, it will be noted that there have been changes in the exemption limit and/or the marginal tax rates in almost every year. It is not feasible to introduce dummy variables for all the years. Therefore, dummy variables are introduced only for the years in which major changes have been introduced. The years in which the major changes in the tax schedule or the exemption limit were introduced are 1964-65, 1971-72, 1975-76 and 1982-83. The corresponding dummy variables, introduced to capture the effect of these changes on the effective tax progressivity are D64, D71, D75

and D82 respectively. It is assumed that these changes result in constant shifts in the effective tax progressivity. Therefore, a dummy variable is assigned value 'unity' in the year of introduction of the change and in the subsequent years and zero in the years preceding the year of introduction of the change. Accordingly, the dummy variables can be expressed as:

D64 = { Ø for the years 1961-62 to 1963-64
{ 1 for the years 1964-65 to 1983-84

D71 = { Ø for the years 1961-62 to 1970-71
{ 1 for the years 1971-72 to 1983-84

D75 = { Ø for the years 1961-62 to 1974-75
{ 1 for the years 1975-76 to 1983-84

D82 = { Ø for the years 1961-62 to 1981-82
{ 1 for the years 1982-83 and 1983-84

The values of dummy variables D64, D71, D75 and D82 are given in columns 13 to 16 in Table 3.

The major changes in the years 1964-65, 1971-72, 1975-76 and 1982-83 are evident from Table 2 (columns 4 and 5). In the year 1964-65, the marginal tax rates were substantially raised. The minimum marginal tax rate was raised from 3.15 to 6.ØØ per cent, and the maximum marginal tax rate was raised from 87.ØØ to 93.125 per cent. In the year 1971-72, the minimum marginal tax rate was raised from 5.5Ø to 11.ØØ per cent and the exemption limit was raised from Rs. 4,ØØØ to Rs. 5,ØØØ. In the year 1975-76, the minimum marginal tax rate was raised further to 13.2Ø per cent, the process of reduction in the high marginal tax rates at the high income levels has set in and the exemption limit was raised from Rs. 5,ØØØ to Rs. 6,ØØØ. The maximum marginal tax rate was reduced from 97.75 to 77.ØØ per cent. In the year 1982-83, the minimum marginal tax rate was increased from 16.5Ø to 33.ØØ per cent and the exemption limit was raised from Rs. 8,ØØØ to Rs. 15,ØØØ.

Estimates of the models

In estimating equations 5 and 6, four tax scale neutral measures of effective tax progressivity (PI, P2, P3 and KPS) and three measures of income inequality (G, A2 and A3) are used. With the dependent variables P1, P2, P3 and KPS, the sets of measures of exogenous variables taken in equation 5 are (G, STP1), (A2, STP1), (A3, STP1) and (G, STP1) respectively and those taken in equation 6 are (G, D64, D71, D75, D82), (A2, D64, D71, D75, D82), (A3, D64, D71, D75, D82) and (G, D64, D71, D75, D82), respectively. These sets differ only with respect to the measure of income inequality (II). The equations 5 and 6 are estimated by ordinary least squares method. Serial correlation has been identified by Durbin-Watson statistic.[18] An equation with serial correlation has been re-estimated by Cochrane and Orcutt (1949) iterative method that incorporates necessary adjustments for serial correlation. Some of the coefficients in the estimated equations were found statistically insignificant. The equations with insignificant coefficients have been re-estimated by dropping the variables with insignificant coefficients. Dropping of such variables did not give rise to the problem of mis-specification by the Ramseys'(1969) RESET test of mis-specification.[19] Normality of disturbances is tested by the χ^2 - test developed by Jarque and Bera (1980).[20] The parameter estimates of equations 5 and 6 are given in Tables 6 and 7 respectively.

From Tables 6 and 7, it will be noted that the disturbance terms are found to follow the normal distribution by Jarque and Bera test at 90 per cent level of confidence (column 12). The estimated equations with different sets of explanatory variables suggest that Models 1 and 2 explain 62 to 90 and 71 to 88 per cent of the variation in effective tax progressivity respectively.

Regarding the sensitivity of effective tax progressivity to the changes in income inequality, when P1 and P2 are taken as the measures of effective tax progressivity, the elasticity is found to vary with the level of income inequality in both the models. The value of elasticity increases from negative to positive with decline in the level of income inequality (see equations (ii) and (iv) in Table 6, and equations (iii) and (viii) in Table 7). This implies that, at the high levels of income inequality, the elasticity is negative and declines in magnitude with the decline in income inequality and at the low levels of income inequality, the elasticity is positive and rises with the decline in income inequality, as shown in Figure 1. This means that, at the high levels of income inequality, the effective tax progressivity rises with the decline in income inequality, and at the low levels of income inequality, it declines with the decline in income inequality, as shown in Figure 2. Also, it seems to suggest that effective tax progressivity is highly sensitive to the changes in income inequality at the low and high levels of income inequality, whereas, it is almost insensitive at the moderate levels of income inequality. The critical levels of income inequality (G) as given by the equations (i) (in Table 6) and (ii) (in Table 7) are Ø.3656 and Ø.3813 respectively.[21] The critical levels of income inequality (A2) as given by the equations (iv) (in Table 6) and (vii) (in Table 7) are Ø.1202 and Ø.1438 respectively. Around the critical levels of income inequality, effective tax progressivity can be said to be almost insensitive to the changes in income inequality. At the levels of income inequality, sufficiently above (below) the critical levels, the elasticity of the effective tax progressivity can be said to be negative (positive). When P3 is taken as the measure of effective tax progressivity, Model 2 is found to support the finding that the sensitivity of effective tax progressivity depends on the level of income inequality (equation (ix) in Table 7). In this case, the critical value of the relevant index of

income inequality (A3) is found to be Ø.3337. At the levels of income inequality (A3) above (below) Ø.3337, the elasticity of the effective tax progressivity is negative (positive). However, when KPS is used as the measure of effective tax progressivity, the support to the above finding that the elasticity of the effective tax progressivity varies with the level of income inequality is not unambiguous. In the case of Model 1, equation (iii) supports the finding, while equation (ii) does not (Table 6). If the choice is to be made between equations (ii) and (iii), then equation (ii) is preferable to equation (iii) by Akaike's (1973) criterion[22] as well as by Schwart's (1978) criterion[23] of choice between the non-nested models. In the case of Model 2, equation (iv) (in Table 7) seems to indicate that the elasticity of effective tax progressivity depends on the level of income inequality (G) but the dependence is not found statistically significant. In the overall, effective progressivity of the tax may be taken to vary with the level of income inequality, as has been shown in Figures 1 and 2. This means that, in an economy with low or high levels of income inequality, the income redistribution policies would result in greater changes in the effective progressivity of the tax as compared to that in an economy with a moderate level of income inequality. Given that the decline in income inequality during the period 1961-62 to 1983-84 results in cross-over of the critical levels of income inequality, it can be said that the decline in income inequality during the period 1961-62 to 1971-72 would have tended to increase the effective progressivity of the tax and that the decline during the period 1971-72 to 1983-84 would have tended to decrease the effective progressivity of the tax.

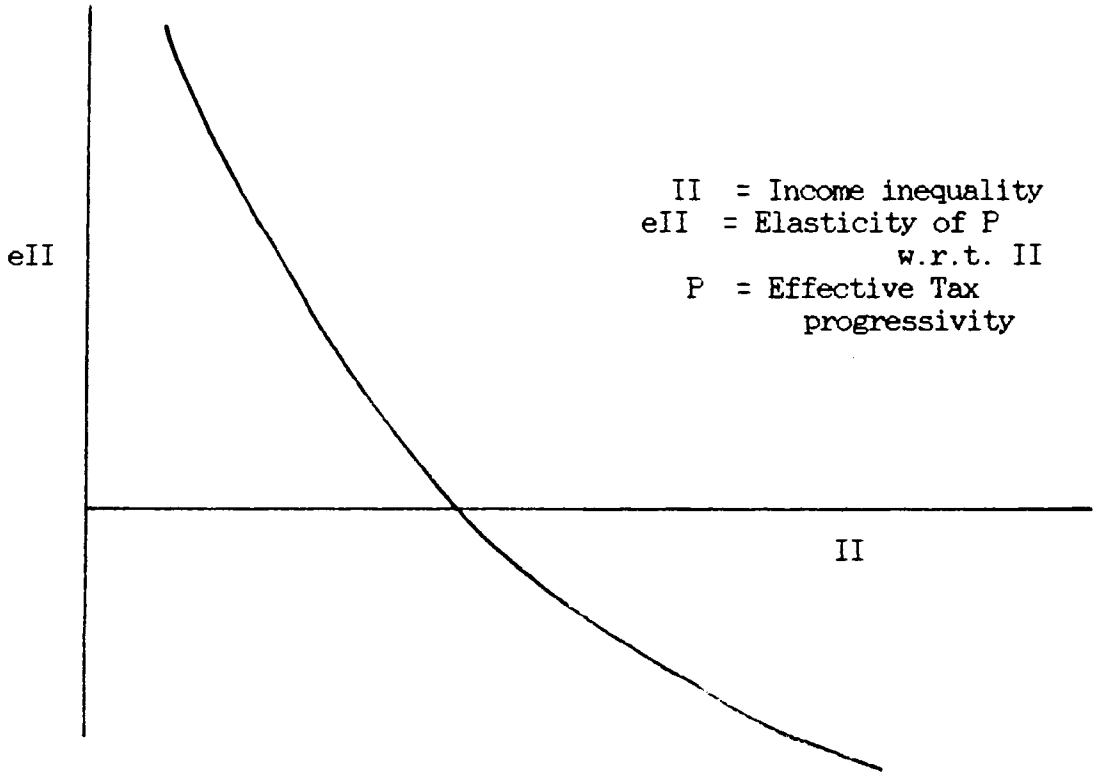

Figure 1

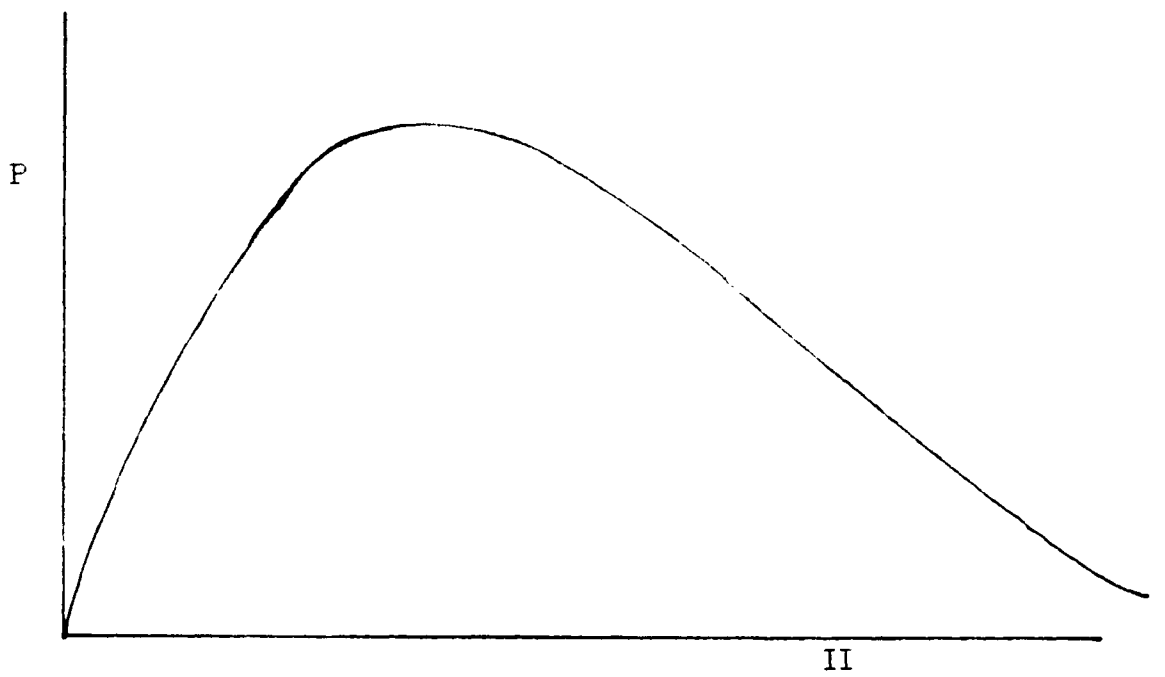

Figure 2

Regarding the sensitivity of effective progressivity of the tax to the changes in statutory tax progressivity, the two models are found to give complementary information. Model 1 seems to reveal that the elasticity of the effective tax progressivity with respect to the statutory tax progressivity (STP1) is positive and declines with the rise in the level of STP1. The exception to this rule is found only when KPS is taken as the measure of effective tax progressivity, wherein the elasticity is not found to vary with the level of STP1 (columns 7 and 8 in Table 6). In the overall, the elasticity can be taken to be positive and declining with the rise in the level of STP1, as shown in Figure 3. This suggests that, for a given level of income inequality, the effective tax progressivity rises at a declining rate with the rise in statutory tax progressivity, as shown in Figure 4. In other words, for a given level of income inequality, higher the statutory tax progressivity lower would be the effect of a change in it on the effective tax progressivity. This means that, in an economy with high level of graduation in the tax rates, a further increase in the graduation in the tax schedule, with a view to enhance effective progressivity of the tax may not be of much significance. Also, the above analysis suggests that the substantial decline in the statutory tax progressivity during the period 1961-62 to 1983-84 would have tended to decrease effective progressivity of the personal income tax in India.

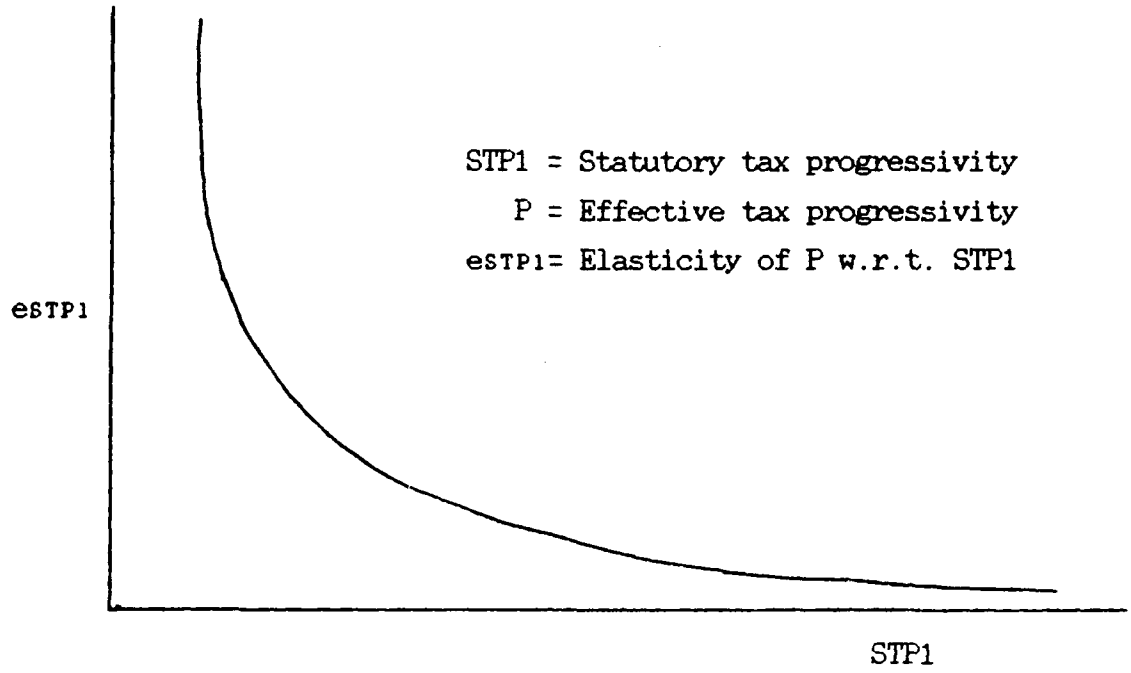

Figure 3

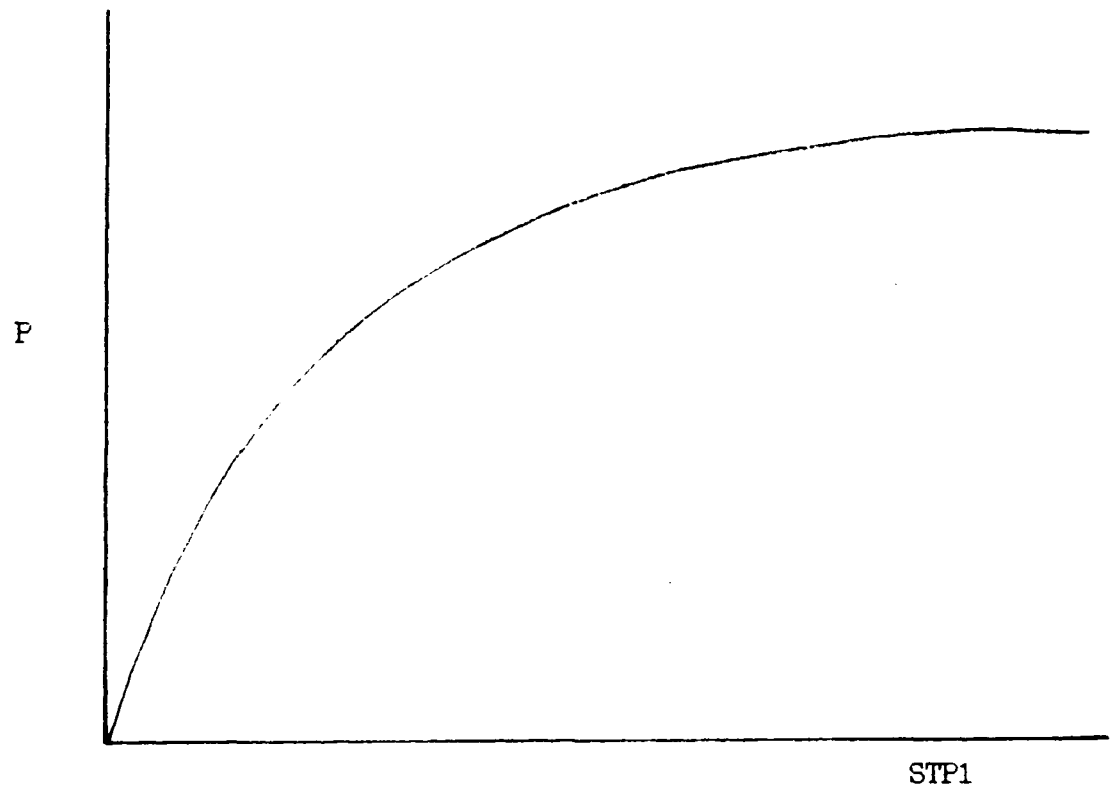

Figure 4

Model 2 reveals that the dummy variables (D71 and D75) representing the tax changes introduced in the years 1971-72 and 1975-76 are statistically insignificant (equations (i), (iii), (vi) and (viii), columns 8 and 9 in Table 7). More so, when the relevant equations are re-estimated by dropping the insignificant dummy variables (D71 and D75), the explanatory power of the estimated equations is found to have increased or remained unchanged (equations (i) & (ii), (iii) & (iv), (vi) & (vii) and (viii) & (ix), columns 8,9 and 11 in Table 7). This implies that raising the minimum marginal tax rate and the exemption limit in the years 1971-72 and 1975-76 did not significantly affect the effective progressivity of the tax. The negative sign and the significance of the coefficients of the dummy variables D64 and D82 (equations (ii), (iv), (vii) and (ix), columns 7 and 10 in Table 7) imply that the substantial hike in the marginal tax rates at the low income levels and only a small increase in the marginal tax rate at the high income levels in 1964-65, and the substantial increase in the minimum marginal tax rate and the exemption limit in 1982-83 have tended to reduce the effective progressivity of the tax. The impact of the change in the latter year seems to be higher than that of the change in the former year. This corroborates our finding based on Model 1 that the changes in the tax schedule during the period of analysis have tended to reduce the effective progressivity of the tax over time.

A policy imperative of these findings seems to be that, the economies with already a high degree of graduation in the tax schedules and moderate or lower level of income inequality cannot rely much on further increases in the statutory tax progressivity for their economic reforms. This is more relevant to the developing countries which generally place greater emphasis on reduction in economic inequality that tends to dampen the

effective progressivity of the tax, more so, an increase in statutory tax progressivity, when it is already high does not help much in enhancing the effective progressivity of the tax.

During the period 1961-62 to 1983-84, the effective progressivity of personal income tax in India has substantially declined with a markedly sharp decline during the period 1972-73 to 1983-84. During the period 1961-62 to 1971-72, the declining trend in income inequality would have tended to increase the effective progressivity and the declining trend in the statutory tax progressivity would have tended to decrease it. The effect of the declining trend in the statutory tax progressivity seems to have dominated the effect of the decline in income inequality, resulting in a declining trend in the effective progressivity of the tax. During the period, 1972-73 to 1983-84, the decline in income inequality as also in the graduation in the tax rates have contributed significantly to the decline in effective progressivity of the tax. The increases in the minimum marginal tax rate and the exemption limit in the years 1971-72 and 1975-76, however, are not found to have had any significant impact on the effective tax progressivity.

8.6. Conclusions

The study presents two models for isolating empirically the effect of the income inequality and the tax schedules from their combined impact on the effective progressivity of personal income taxes.

The two models are found to be complementary. The application of these models is illustrated with the data on personal income tax payers in India. The trends in income inequality are found to significantly influence the effective progressivity of the tax. For a given tax structure, the

effective tax progressivity seems to be more sensitive to a change in the income inequality in an economy with a low or high level of income inequality as compared to that in an economy with a moderate level of income inequality. For a given distribution of income, the sensitivity of effective tax progressivity is found to decline with the rise in the level of graduation in the tax schedules or statutory tax progressivity. In an economy with a high level of graduation in the tax schedule, a further increase in the graduation is unlikely to significantly enhance the effective progressivity of the tax. It seems that the countries with a high degree of graduation in the tax schedules and a moderate or low level of income inequality, cannot rely much on further increases in the graduation in the tax schedules, for their economic reforms. This is more relevant for the developing countries which generally place greater emphasis on the reduction in economic inequality that tends to dampen the effective progressivity. More so, an increase in graduation at the high levels of graduation in the tax schedule does not help much in enhancing the effective progressivity of the tax.

During the period 1961-62 to 1983-84, the effective progressivity of personal income tax in India has substantially declined with a markedly sharp decline during the period 1972-73 to 1983-84. During the latter period, the decline in income inequality as also in the graduation in the tax rates have contributed significantly to the decline in effective progressivity of the tax. The increases in the minimum marginal tax rate and the exemption limit in the years 1971-72 and 1975-76, however, are not found to have had any significant impact on the effective tax progressivity.

TABLE 1

Range of Marginal Tax Rates Applicable to Individual Taxpayers in the Years 1961-62 to 1991-92

Assessment years	Exclusive of surcharge (Per cent)	Surcharge on income tax (Per cent)	Inclusive of surcharge (Per cent)	Exemption limit (Rs.thousand)
(1)	(2)	(3)	(4)	(5)
1961-62	3.00 - 70.00	5.0 - 20.0[1]	3.150 - 84.000	3
1962-63 & 1963-64	3.00 - 72.50	5.0 - 20.0[1]	3.150 - 87.000	3
1964-65	6.00 - 75.00	0.0 - 24.167[2]	6.000 - 93.125	3
1965-66	5.00 - 65.00	10.0 - 35.0[3]	5.500 - 89.375	3
1966-67 to 1968-69	5.00 - 65.00	10.0 - 35.0[3]	5.500 - 89.375	4
1969-70 & 1970-71	5.00 - 75.00	10.0	5.500 - 82.500	4
1971-72	10.00 - 85.00	10.0	11.000 - 93.500	5
1972-73 to 1974-75	10.00 - 85.00	10.0 or 15.0[4]	11.000 - 97.750	5
1975-76	12.00 - 70.00	10.0	13.200 - 77.000	6
1976-77	17.00 - 70.00	10.0	18.170 - 77.000	8
1977-78	15.00 - 60.00	10.0	16.500 - 66.000	8
1978-79 & 1979-80	15.00 - 60.00	15.0	17.250 - 69.000	8[5]
1980-81	15.00 - 60.00	20.0	18.000 - 72.000	8[5]
1981-82	15.00 - 60.00	10.0	16.500 - 66.000	8[6]
1982-83 & 1983-84	30.00 - 60.00	10.0	33.000 - 66.000	15
1984-85	25.00 - 60.00	12.5	28.125 - 67.500	15
1985-86	20.00 - 55.00	12.5	22.500 - 61.875	15
1986-87 & 1987-88	25.00 - 50.00	Nil	25.000 - 50.000	18
1988-89 & 1989-90	25.00 - 50.00	5.0[7]	25.000 - 52.500	18
1990-91	20.00 - 50.00	8.0[8]	20.000 - 54.000	18
1991-92 & 1992-93	20.00 - 50.00	12.0[8]	20.000 - 56.000	22

Notes:
1. 5 per cent on tax on income upto Rs. 7,500 and 20 per cent on tax on income exceeding Rs. 7,500.
2. Nil, 12.5., 15, 17.5 and 24.167 per cent respectively on tax on the income ranges 0-10, 10-25, 25-75, 75-100 and above 100 thousand rupees.
3. 10, 30 and 35 per cent respectively on tax on the income ranges 0-15, 15-50 and above 50 thousand rupees. These rates are inclusive of 10 per cent special surcharge.
4. Surcharge on total tax is 15 per cent if taxable income exceeds Rs. 15,000 and 10 per cent otherwise.
5. If income does not exceed Rs. 10,000, it is treated as exempt.
6. If income does not exceed Rs. 12,000, it is treated as exempt.
7. Applicable only if the taxable income exceeds Rs. 50,000 and otherwise `nil'.
8. Applicable only if the taxable income exceeds Rs. 75,000 and otherwise `nil'.

Source: Budget of Union Government of India, for different years.

TABLE 2

Marginal Tax Rates Applicable to Individual Taxpayers in the Assessment Years 1961-62 to 1990-91

(Per cent)

Taxable income (Rs. thousand)	Assessment year(s)															
	1961-62	1962-63 & 1963-64	1964-65	1965-66 to 1968-69	1969-70 & 1970-71	1971-72 to 1974-75	1975-76	1976-77	1977-78	1978-79 to 1981-82	1982-83	1983-84	1984-85	1985-86	1986-87 to 1989-90	1990-91
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
0 - 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]
3 - 4	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]
4 - 5	3.0	3.0	0.0	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]
5 - 6	7.0	7.0	10.0	10.0	10.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]
6 - 7.5	7.0	7.0	10.0	10.0	10.0	10.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]
7.5 - 9	10.0	10.0	15.0	10.0	10.0	10.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]
9 - 10	10.0	10.0	15.0	10.0	10.0	10.0	12.0	17.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]
10 - 12.5	12.0	12.0	15.0	15.0	15.0	17.0	15.0	17.0	15.0	15.0	0.0	0.0	0.0	0.0	0.0	[illegible]
12.5 - 15	15.0	15.0	20.0	15.0	15.0	17.0	15.0	17.0	15.0	15.0	0.0	0.0	0.0	0.0	0.0	[illegible]
15 - 17.5	20.0	20.0	20.0	20.0	20.0	23.0	20.0	50.0	18.0	16.0	50.0	30.0	25.0	50.0	0.0	[illegible]
17.5 - 18	20.0	23.0	20.0	20.0	20.0	23.0	20.0	20.0	16.0	16.0	50.0	30.0	25.0	20.0	0.0	[illegible]
18.0 - 20	60.0	23.0	20.0	20.0	20.0	23.0	20.0	20.0	16.0	16.0	50.0	30.0	25.0	20.0	25.0	[illegible]
20 - 25	20.0	33.0	35.0	50.0	50.0	30.0	50.0	50.0	25.0	25.0	50.0	30.0	50.0	25.0	25.0	[illegible]
25 - 30	33.0	43.0	40.0	40.0	40.0	40.0	40.0	40.0	30.0	30.0	34.0	34.0	35.0	50.0	30.0	[illegible]
30 - 40	43.0	47.0	55.0	50.0	50.0	50.0	50.0	50.0	40.0	40.0	50.0	50.0	50.0	35.0	50.0	[illegible]
40 - 50	47.0	57.0	55.0	50.0	50.0	50.0	50.0	50.0	40.0	40.0	50.0	50.0	50.0	50.0	30.0	[illegible]
50 - 60	57.0	65.0	70.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	45.0	40.0	[illegible]
60 - 70	65.0	70.0	70.0	50.0	50.0	70.0	50.0	50.0	50.0	50.0	50.0	50.0	52.5	52.5	45.0	[illegible]
70 - 80	70.0	72.5	75.0	65.0	65.0	70.0	70.0	70.0	55.0	55.0	55.0	55.0	55.0	50.0	40.0	[illegible]
80 - 85	70.0	72.5	75.0	65.0	65.0	75.0	70.0	70.0	55.0	55.0	55.0	55.0	55.0	50.0	40.0	[illegible]
85 - 100	70.0	72.5	75.0	65.0	65.0	75.0	70.0	70.0	55.0	55.0	55.0	57.5	57.5	50.0	40.0	[illegible]
100 - 200	70.0	72.5	75.0	65.0	70.0	60.0	70.0	70.0	60.0	50.0	50.0	30.0	50.0	55.0	30.0	[illegible]
200 - 250	70.0	72.5	75.0	65.0	70.0	85.0	70.0	70.0	50.0	60.0	50.0	60.0	50.0	55.0	30.0	[illegible]
250 - 300	70.0	72.5	75.0	65.0	75.0	85.0	70.0	70.0	60.0	50.0	60.0	60.0	60.0	55.0	60.0	[illegible]
300 - 400	70.0	72.5	75.0	65.0	75.0	60.0	70.0	70.0	60.0	60.0	60.0	60.0	60.0	55.0	50.0	[illegible]
400 - 500	70.0	72.5	75.0	65.0	75.0	85.0	70.0	70.0	60.0	60.0	60.0	60.0	60.0	55.0	60.0	[illegible]
Above 500	70.0	72.5	75.0	65.0	75.0	85.0	70.0	70.0	50.0	60.0	60.0	60.0	60.0	55.0	60.0	[illegible]

Note: The marginal tax rates presented here do not include surcharge or special surcharge if any. These, however include surtax prevalent in the years 1961-62 to 1964-65, that was applicable to high income taxpayers.

Source: Budget of Union Government of India, for different years.

Estimates of Income Inequality, Tax Concentration and Tax Progressivity

Year	G1	C1	A2	C2	A3	C3	STP1	KPS	P1 (3-2)	P2 (5-4)	P3 (7-6)	D64	D71	D75	D82
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1961-62	0.47546	0.96241	0.14991	0.66004	0.37395	0.89719	26.66667	0.59299	0.38695	0.51013	0.52324	0	0	0	0
1962-63	0.46004	0.85615	0.14181	0.64481	0.36314	0.89951	27.61999	0.58896	0.39611	0.50300	0.52737	0	0	0	0
1963-64	0.44954	0.85435	0.13384	0.64373	0.34086	0.88242	27.61999	0.59743	0.40481	0.50989	0.54156	0	0	0	0
1964-65	0.44570	0.81366	0.12912	0.60930	0.32661	0.85007	15.52000	0.57234	0.36796	0.48016	0.52346	1	0	0	0
1965-66	0.43710	0.82414	0.12536	0.59737	0.31117	0.83218	16.25000	0.56432	0.38704	0.47201	0.52101	1	0	0	0
1966-67	0.44396	0.82119	0.13781	0.58203	0.34529	0.83673	16.25000	0.53385	0.37723	0.44422	0.49144	1	0	0	0
1967-68	0.44502	0.82314	0.14319	0.58251	0.35829	0.84335	16.25000	0.52642	0.37812	0.43932	0.48506	1	0	0	0
1968-69	0.42570	0.80632	0.13305	0.55217	0.35895	0.84892	16.25000	0.50827	0.38062	0.41912	0.48997	1	0	0	0
1969-70	0.42126	0.80169	0.13141	0.54324	0.36055	0.84705	15.00000	0.50229	0.38034	0.41103	0.48650	1	0	0	0
1971-72	0.41102	0.76957	0.13144	0.52768	0.37395	0.84193	8.50000	0.49163	0.37855	0.39624	0.46798	1	1	0	0
1972-73	0.39636	0.80314	0.12343	0.55420	0.32701	0.83617	8.88636	0.52323	0.40678	0.43077	0.50916	1	1	0	0
1974-75	0.37320	0.77501	0.10964	0.51229	0.32088	0.81119	8.88636	0.50801	0.40181	0.40265	0.49031	1	1	0	0
1975-76	0.35411	0.77482	0.10092	0.50242	0.31498	0.83941	5.83333	0.50838	0.42071	0.40150	0.52443	1	1	1	0
1976-77	0.36065	0.74621	0.11027	0.47275	0.34659	0.84815	4.11760	0.46025	0.38556	0.36248	0.50156	1	1	1	0
1977-78	0.33123	0.74881	0.09898	0.46425	0.31703	0.86340	4.00000	0.48490	0.41758	0.38527	0.54637	1	1	1	0
1978-79	0.31610	0.67988	0.09145	0.39758	0.30541	0.79956	4.00000	0.41684	0.36378	0.30613	0.48515	1	1	1	0
1979-80	0.30640	0.66285	0.09072	0.39848	0.28869	0.76604	4.00000	0.41793	0.37445	0.30776	0.47735	1	1	1	0
1980-81	0.32260	0.66770	0.09552	0.37566	0.31059	0.72507	4.00000	0.38604	0.34510	0.28014	0.41448	1	1	1	0
1981-82	0.31246	0.67974	0.09415	0.39956	0.30095	0.75493	4.00000	0.41300	0.36728	0.30541	0.45398	1	1	1	0
1982-83	0.29120	0.58639	0.07533	0.30833	0.28587	0.64536	2.00000	0.34834	0.29519	0.23300	0.35949	1	1	1	1
1983-84	0.32181	0.65592	0.09382	0.36446	0.33477	0.72984	2.00000	0.37628	0.33411	0.27864	0.39507	1	1	1	1

Notes:
1. All these estimates are based on distribution of taxpayers into the same set of 14 income classes in each of the years.
2. G and C1 are respectively Gini index of assessed income and tax liability, and these estimates account for inequality within income classes.
3. A2 and C2 are respectively Atkinsons indices for assessed Income and tax liability for inequality aversion of 0.50.
4. A3 and C3 are respectively Atkinsons indices for assessed income and tax liability for inequality aversion of 3.75.
5. STP1 is gradnation in the tax rates interpretable as tax progression defined without refereace to distribution of income. It is defined as the ratio of maximum to minimum marginal tax rate.
6. KPS = Khetan-Poddar-Suits measure of tax progressivity.

TABLE 4

Estimates of Average Rate Elasticity Progression Schedules of Individual Taxpayers (1961-62 to 1990-91)

Taxable income level (Rs. thousand)	Assessment year				
	1961-62	1971-72	1977-78	1983-84	1990-91
(1)	(2)	(3)	(4)	(5)	(6)
5.0	3.2812	-	-	-	-
8.0	1.3918	1.7333	-	-	-
12.0	1.1200	1.1429	1.6000	-	-
15.0	1.3218	1.2963	1.3095	-	-
18.0	0.8364	1.0980	1.1824	4.0000	-
22.5	1.0158	1.1643	1.1478	1.8000	4.2955
27.5	1.3651	1.2310	1.2200	1.3469	2.2292
35.0	0.9823	0.9837	0.8474	0.8474	1.0783
45.0	0.8525	0.7597	0.7302	0.7302	1.3571*
55.0	0.8578	0.6663	0.6847	0.7230	0.8617
65.0	0.7050	0.6214	0.5974	0.6231	0.6456
75.0	0.6696	0.5348	0.5174	0.5245	0.4894
90.0	0.3543	0.3607	0.3481	0.3442	0.4482
150.0	0.1720	0.2071	0.1803	0.1734	0.2349
250.0	0.1102	0.1555	0.1150	0.1110	0.1451
350.0	0.0616	0.0854	0.0641	0.0620	0.0800
600.0	0.0354	0.0483	0.0368	0.0356	0.0454
1000.0	0.0173	0.0234	0.0180	0.0174	0.0220

Notes: * For the assessment year 1990-91, surcharge at the rate of 8 per cent is leviable on total income if taxable income exceeds Rs. 50,000. This results in higher degree of progression at the income level of Rs. 45,000. Without inclusion of surcharge it should have been 0.9232. It is noteworthy, however that inclusion of uniform surcharge at all income levels does not affect average rate elasticity progression.

Source: Budget of Union Government of India for different years.

TABLE 5

Relative Tax Share Progressivity Schedules of Individual Taxpayers in Selected Years (1961-62 to 1983-84)

Percentage of taxpayers	Relative tax share progressivity (RTSP) in the year				
	1961-62	1971-72	1977-78	1980-81	1983-84
(1)	(2)	(3)	(4)	(5)	(6)
First 10 per cent	0.093	0.091	0.167	0.431	0.412
Second 10 per cent	0.069	0.186	0.186	0.359	0.392
Third 10 per cent	0.069	0.190	0.188	0.359	0.370
Fourth 10 per cent	0.081	0.190	0.188	0.359	0.353
Fifth 10 per cent	0.163	0.315	0.447	0.359	0.353
Sixth 10 per cent	0.163	0.381	0.450	0.540	0.399
Seventh 10 per cent	0.250	0.479	0.450	0.610	0.623
Eighth 10 per cent	0.345	0.535	0.677	0.724	0.786
Ninth 10 per cent	0.547	0.718	0.833	0.975	1.086
Top 10 per cent	2.238	2.139	2.262	1.995	1.964
Top 5 per cent	2.797	2.616	2.738	2.306	2.208
Top 1 per cent	3.957	3.508	3.820	2.900	2.699

NOTES

1. A change in progressivity of the tax may affect work effort, tax avoidance/evasion, income inequality, sensitivity and redistributive impact of the tax. Alingham (1972) has analysed the disincentive effect of progressive income taxation on labour supply. He shows that under some conditions, a small increase in tax progressivity holding tax revenue constant reduces work effort that results in an increase in consumption of leisure. Marchon (1979) extends Alinghams' model to allow the use of taxpayers' time for tax avoidance activities. He also shows that under some conditions, a small increase in tax progressivity, holding tax revenue constant, reduces work effort. In his model, a decrease in work effort does not increase consumption of leisure. Instead, it induces an increase in taxpayers' time and money devoted to the tax avoidance activities. See Alingham (1979) for a comment on Marchans' model. For a lively discussion on tax progressivity or tax schedules and the sensitivity of tax yield see, for example, Aggarwal (1990b and 1991a), and Hutton and Lambert (1979 and 1982).

2. See, for example, Alchin (1984), Formby and Sykes (1984), Greene and Balkan (1987), Gupta (1975), Gupta and Aggarwal (1982), Kakwani (1977 and 1980), and Phares (1980).

3. For a brief discussion on the local measures of tax progression see, for example, Aggarwal (1980 and 1990c), Lambert (1989, Chapters 7 and 8), and Podder (1990).

4. For an extensive discussion on the global measures of tax progression see, for example, Kiefer (1984) and Pfahler (1987). Also see, Aggarwal (1991b) for a recently developed new global measure of the effective progressivity of the tax.
5. For an exposure to the hybrid measures of tax progressivity see Aggarwal (1991c) and Baum (1987).

6. A proportional translation of the average tax rates a(y) is defined as (1+c).a(y), where c is a constant fraction. For c>0 (c<0), it is called positive (negative) proportional translation.

7. See, for example, Aggarwal (1990c and 1991b), Kakwani (1977 and 1980) and Pfahler (1987).

8. It has been argued that the tax-scale invariant measures of tax progressivity are preferable to the others as these add to the understanding that the redistributive impact of a tax can be varied through a change in either or both the tax level and the tax progressivity (see Kakwani, 1977 and 1980). However, welfare implications of the tax-scale invariant

measures of tax progressivity are not unambiguous (see Liu, 1984 and 1985:Formby, Smith and Thistle, 1987). Formby, Smith and Thistle (1990) show that valid welfare inferences based on a tax-scale invariant or the other global measures of tax progressivity can be drawn only in the case of comparison of equi-revenue tax structures. They have demonstrated that the tax level plays a critical role in the welfare analysis of taxes as it affects disposable income of the taxpayers.

9. For a review of the limitations of a measure of inequality based on the concept of Lorenz curves and for the merits of the same, based on the concept of equally distributed equivalent level of income, see Kiefer (1985).

10. For a discussion on representing a tax rate schedule by its constitutes, namely, the graduation in the tax schedule or the statutory tax progression and the level of taxation , see Aggarwal (1990a).

11. Let e_1 and e_2 denote elasticities of P with respect to II and STP respectively. From equation (5), we get:

$$e_1 = \beta_1 - \beta_2 \ (1/LII^2)$$
$$e_2 = \tau_1 - \tau_2 \ (1/LSTP^2)$$

For $\beta_1>0$, $\beta_2>0$ (<0) would mean that e_1 rises (declines) with the rise in LII or II. Similarly, for $\tau_1>0$, $\tau_2>0$ (<0) would mean that e_2 rises (declines) with the rise in LSTP or STP.

12. From the year 1984-85, the data are published on the basis of income as reported by the taxpayers instead of income as assessed by the income tax officers.

13. Variation in the level of disaggregation over time can cause distortion in the measures of skewness (see, for example, Atkinson (1980)).

14. The formulae used for computing Gini indices by accounting for changes in the distribution of income within the income classes can be explained as follows. Suppose there are n taxpayers that are grouped into k income classes, (x_0 to x_1),(x_1 to x_2),..., (x_{k-1},x_k). Let n_i and y_i denote the number and income of taxpayers in the ith income class. Further, let f_i and p_i denote proportions of the number of taxpayers in and upto the ith 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 point, is:

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

where

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

$$f_i = n_i/n$$

$$\mu_i = y_i/n_i$$

$$\mu = y/n$$

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

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

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

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

$$\Delta X_i = X_i - X_{i-1}$$

$$\delta_i = (\mu_i - X_{i-1})/\Delta X_i$$

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

$$\bar{D} = \frac{1}{\mu} \{ \sum_{i=1}^{k-1} f_i^2 (\Delta X_i) \delta_i (1-\delta_i) + f_k^2 (\mu_k - X_{k-1}) \}$$

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 (1990a or 1990b), Gastwirth (1972), and Kakwani (1976).

15. The formula adopted for computing the KAS inequality index ($A\epsilon$) for constant inequality aversion (ϵ), based on an additively separable, homogenous, symmetric, increasing and concave social welfare function is:

$$A\epsilon = 1 - \{ \sum_{i=1}^{n} (\mu_i/\mu)^{1-\epsilon} f_i \}^{1/(1-\epsilon)}$$

where

μ_i = mean income of the ith income class (i=1,2,....n)

μ = mean income of all the taxpayers

f_i = proportion of taxpayers in the ith income class

ϵ = inequality aversion parameter.

There is no hard and fast rule for assigning a value to ϵ. It is assigned on the basis of value judgement of a society's aversion towards income inequality.

16. Average rate elasticity progression (AREP) at an income level is computed as the ratio of the proportional change in the average tax rate to the proportional change in income (between the income level under consideration and the subsequent income level). For computing AREP at the last income level of Rs. 1,000,000 at which the maximum marginal tax rate is applicable, the subsequent income level taken is Rs. 2,000,000.

17. Relative tax share progressivity of a group of taxpayers is computed as the ratio of that group's share of the total tax yield to its share of the total income of all the taxpayers.

18. The statistical tables on the critical values of Durbin-Watson statistic given by Durbin and Watson (1951) assume the existence of a constant term and non-existence of lagged values of the dependent variable in the regression equation. These tables are applicable for a sample size of 15 to 100 and for the number of regressors (exclusive of the constant term) upto five, and when there are no missing observations in the time series data. In the absence of constant term in the regression equation, the statistical tables on Durbin-Watson test created by Farebrother (1980) can be used. In the case of time series with missing observations, the statistics developed by Savin and White (1978) to test for auto-correlation can be used. Savin and White (1977) has created the statistical tables for Durbin-Watson test for auto-correlation for the sample size of 6 to 200 and for the number of regressors upto 20. The

appropriate statistics and statistical tables have been used to test for the presence of serial correlation in the time series under consideration.

19. Ramsey's (1969) RESET test of mis-specification is based on an extended regression of estimated residual terms e_t $(=Y_t-\hat{Y}_t)$ obtained from the OLS, on the exogeneous variables with $\hat{Y}_t^2$, $\hat{Y}_t^3$,.....$\hat{Y}_t^P$ specified as additional variables, where Y_t and $\hat{Y}_t$ denote observed and estimated values of the dependent variable in the tth year. The test statistics reported in the current study relate to the simple case, where only the square of estimated values (i.e., $\hat{Y}_t^2$) are included in the extended regression.

20. The Langrange multiplier (LM) version of the statistic for Jarque and Bera's test of normality of regression residuals is given by:

$$\chi_n^2(2) = n\{\mu_3^2 / (6\mu_2^3) + (1/24)(\mu_4/\mu_2^2 - 3)^2\} + n\{3\mu_1^2 / (2\mu_2) - \mu_3.\mu_1 / \mu_2^2\}$$

$$\text{Where } \mu_j = \sum_{t=1}^{n} e_t^j / n \qquad j=1,2,3$$

Where e_t is the disturbance in the t^{th} year. The above defined statistic follows Chi-square with 2 degrees of freedom. When an intercept term is included in the regression, $\mu_1 = 0$, i.e., the second term on the right hand side of χ^2 will be zero. For a discussion on this test, see Jarque and Bera (1980), and Bera and Jarque (1981).

21. The critical values of income inequality are obtained by taking the elasticity of tax progressivity with respect to income inequality as zero (i.e., for e_1 in note 6, critical value of Π = exponent of square root of (β_2/β_1).

22. Following Akaike (1973), the Akaike Information Criterion (AIC) statistic for the choice between two models (say M1: $Y=\alpha+\beta X_1+\tau X_2$, and M2: $Y=\delta+\tau X_1+\Gamma X_3$) is computed as:

$$AIC = LL_1 - LL_2 - (K_1-K_2)$$

Where LL_1 and LL_2 are maximum log-likelihood values of the models M_1 and M_2 respectively. K_1 and K_2 are the number of regressors in the models M_1 and M_2 respectively.

If AIC > 0, model M_1 is preferred to M_2, otherwise model M2 is preferred to M_1. For a lucid discussion of this and other selection criteria see Amemiya (1980), and Judge et. al. (1985), Chapter 21.

23. Following Schwarz (1978), the Schwarz Bayesian Information Criterion (SBIC) statistic for the choice between the two models (say M1 and M2) is computed as:

$$SBIC = LL_1 - LL_2 - (\emptyset.5)\,(K_1-K_2)\,\log(n)$$

Where LL_1 and LL_2 are maximum log-likelihood values of the models M_1 and M_2 respectively. K_1 and K_2 are number of regressors in the models M_1 and M_2 respectively.

If SBIC $>$ $\emptyset$, model M_1 is preferred to M_2, otherwise model M2 is preferred to M_1. For a lucid discussion of this and other selection criteria see Amemiya (198$\emptyset$), and Judge et. al. (1985), Chapter 21.

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