INFLATION, ECONOMIC GROWTH, AND CHANGES IN INCOME TAX PROGRESSIVITY

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ABSTRACT

This paper investigates the determinants of changes in income tax progressivity. Time series estimates of D. Suits and N. C. Kakwani's recently proposed summary measures of tax progressivity are presented for a single state, North Carolina, which has had virtually no statutory change in its income tax code. Inflation and real economic growth are shown to be highly significant determinants of the rapidly declining state income tax progressivity.

I. INTRODUCTION

The effects of inflation and real growth on the flow of income tax receipts to taxing authorities has been extensively researched and are well understood.[1] Surprisingly, however, the related effects of inflation and growth on the overall progressivity of an income tax system have not been investigated. Recently, Daniel Suits (1977b) and N. C. Kakwani (1977) developed summary measures that are well suited for analyzing the determinants of tax progression through time. In this paper we use Suits' and Kakwani's summary measures to investigate the effects of inflation and real growth on overall income tax progressivity in a single state, North Carolina. Section II briefly discusses the Suits' and Kakwani measures and establishes the relation among them. Section III presents the empirical measures and analyzes the determinants of changes in progressivity through time. Concluding remarks are summarized in Section IV.

II. THE TAX PROGRESSIVITY INDICES

Suits' index of progressivity was developed to measure differences in the degree of progression and regression in various federal taxes. The Suits measure has been extended by Guthrie (1979) and Kienzle (1980) and has been used by a number of writers to investigate the progressivity and regressivity of specific taxes. [2] Simultaneously and independently of Suits' work, N. C. Kakwani developed a related but distinct measure that has been used to make international comparisons in the degree of tax progression among nations. Both the Suits and Kakwani measures are suitable for use in making cross sectional comparisons and in time series analysis as well. Suits' measure has attracted more attention in the United States, while Kakwani's has dominated discussion abroad.

Both the Suits and Kakwani measures of tax progressivity are closely related to the Lorenz distribution of income and the Gini coefficient (G) of income inequality. Following Formby, Seaks, and Smith (1981) we denote Kakwani's measure as K and Suits' index as S. To explain K and S and their relation to G, we make use of the North Carolina Income tax data shown in Table 1. The cumulative distributions of tax returns and income in columns, 2 and 3 of Table 1 are used to construct the Lorenz curve, I(R), shown in figure 1. The deviation of I(R) from the diagonal line of equality, E(R), reflects Lorenzian income inequality which is measured by area γ. The Gini coefficient, G, of the Lorenz income distribution is:

$$(1) \qquad G = \gamma/.5 = 2\gamma.$$

Figure 1

Kakwani's Approach
Lorenz Curves for North Carolina Income and Taxes - 1977

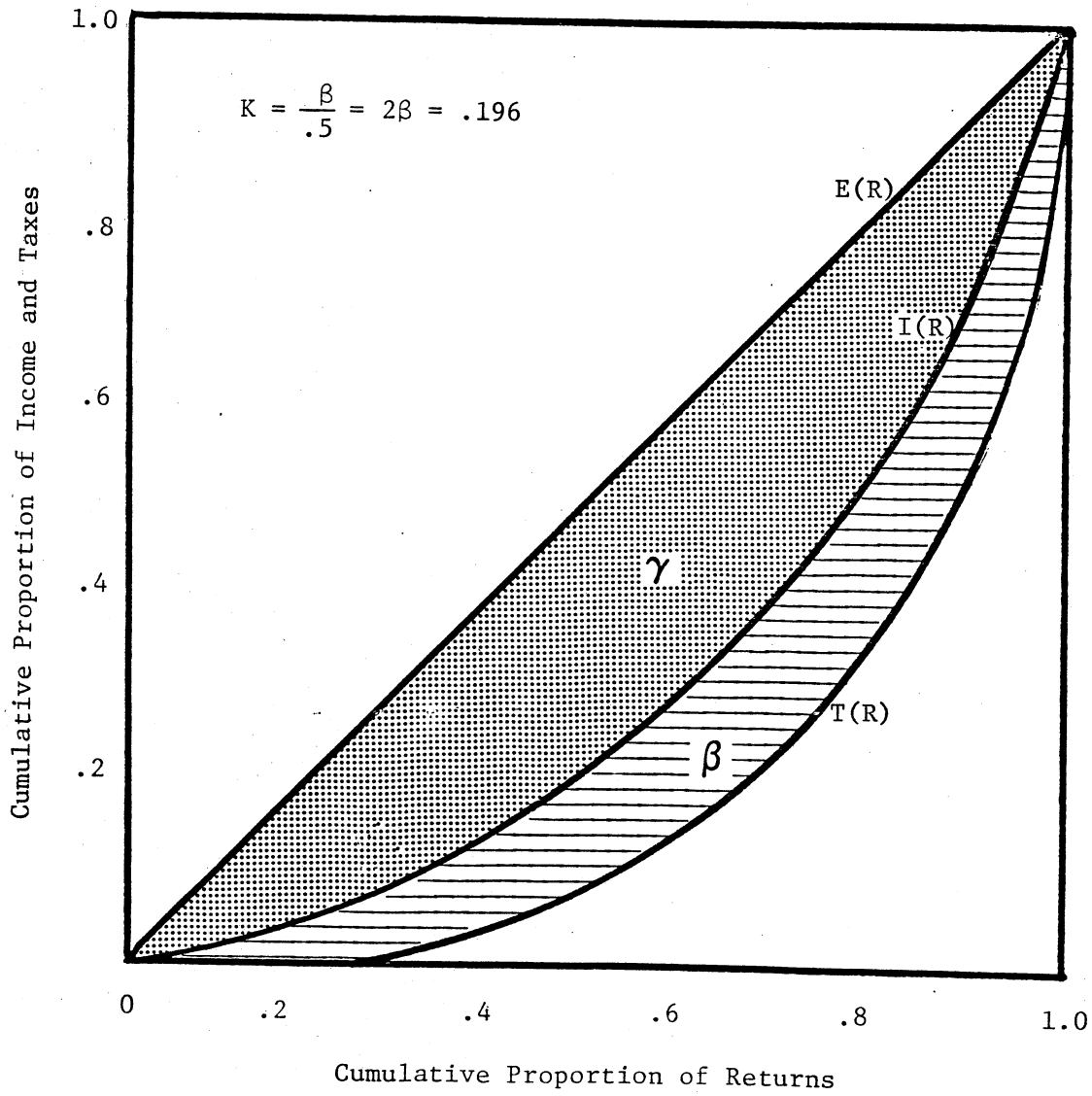


Table 1

ACCUMULATED PROPORTIONS OF NORTH CAROLINA TAX RETURNS, ADJUSTED GROSS INCOME, AND INCOME TAXES - 1977

(1) Income Below	(2) Returns	(3) Proportions Income	(4) Taxes
2,000	.334	.094	.021
4,000	.505	.210	.087
6,000	.666	.360	.203
10,000	.860	.614	.454
15,000	.947	.783	.659
20,000	.974	.853	.756
25,000	.984	.887	.806
50,000	.996	.948	.905
100,000	.999	.980	.963
Max	1.000	1.000	1.000

Source: Statistics of Income, North Carolina Department of Revenue, Various Years.

Kakwani's K is derived by using the data from columns 2 and 4 of Table 1 to construct the Tax-curve, T(R), also shown in figure 1. This curve plots the cumulative proportion of taxes paid relative to the cumulative proportion of tax returns. The deviation of T(R) from E(R) indicates Lorezian inequality of tax payments (tax concentration) which is measured by the area $\beta + \gamma$. The fact that T(R) lies everywhere below I(R) reveals that there is greater tax inequality than income inequality, thereby indicating a progressive tax system. Kakwani's K is directly related to the area β, which is simply the difference between I(R) and T(R), that is,

$$(2) \qquad \beta = \int_0^1 I(R)dR - \int_0^1 T(R)dR.$$

It is clear from (2) that β will be positive when T(R) lies everywhere below I(R) and negative when the reverse is true. a negative net area evidences greater income inequality than tax inequality and therefore indicates a regressive tax. In a fashion analogous to G, Kakwani's index is defined as follows:

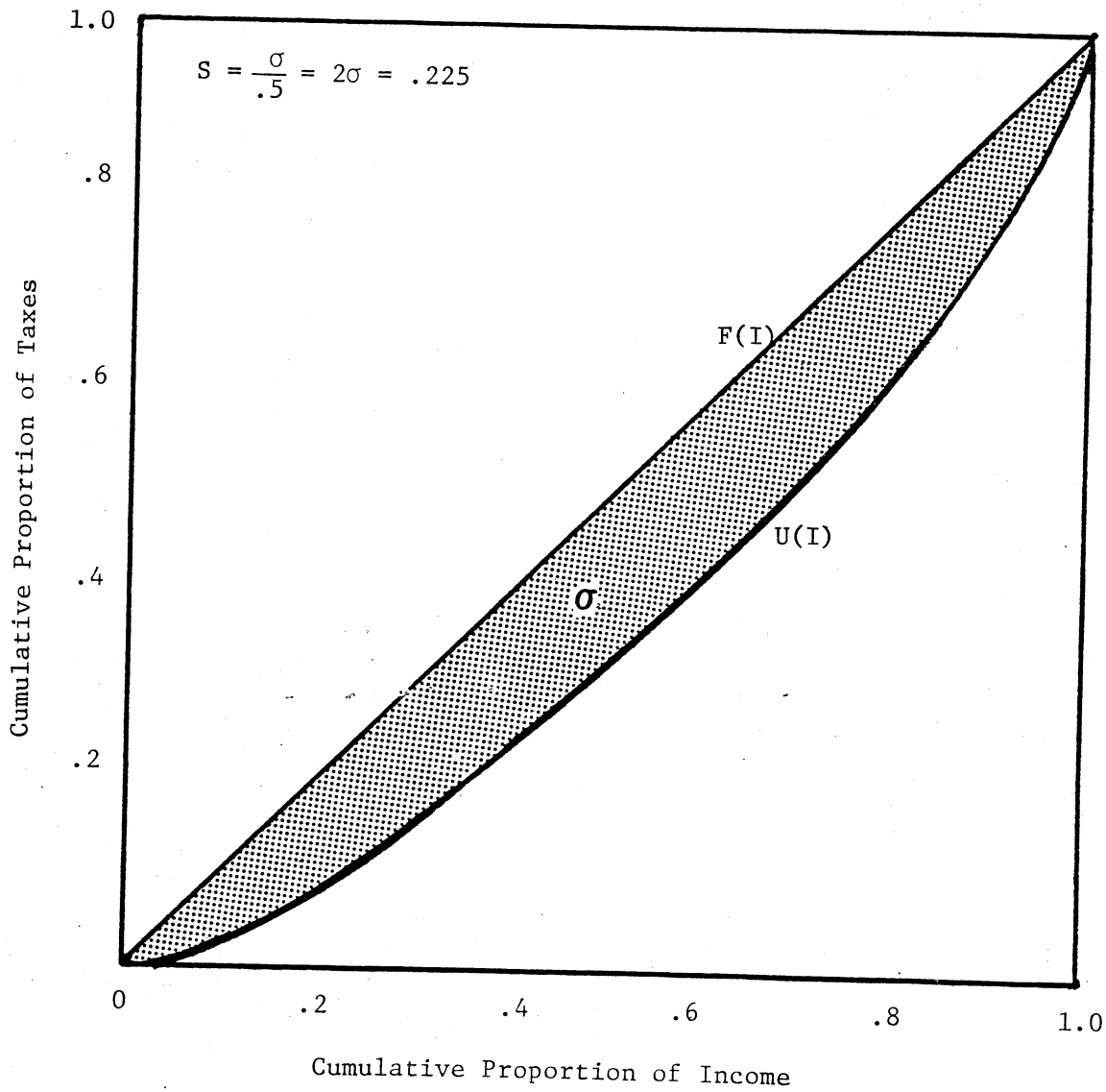
$$(3) \qquad K = \beta/.5 = 2\beta.$$

For the 1977 North Carolina data in Table 1 the values of the G and K are, respectively, .435 and .196.

The Suits progressivity measure is shown graphically by plotting the cumulative proportion of taxes (Table 1, column 4) and the cumulative proportion of income (Table 1, column 3). This is shown in figure 2. If U(I) coincides with the diagonal line, F(I), a proportional tax is indicated. A progressive tax exists when U(I) falls everywhere below F(I) and, conversely, a regressive tax occurs

Figure 2

Suits' Curve for North Carolina - 1977



when U(I) lies everywhere above F(I). The shaded area σ is instrumental in Suits' measure of progressivity. This area is simply the difference between the total area under F(I) and the area under U(I):

$$(4) \qquad \sigma = \int_0^1 F(I)dI - \int_0^1 U(I)dI = .5 - \int_0^1 U(I)dI.$$

Defined in this manner, progressive taxes yield positive σ values and regressive taxes yield negative σ values. Suits' progressivity index is given by:

$$(5) \qquad S = \sigma/.5 = 2\sigma.$$

For North Carolina in 1977, the area σ is .1125 and the S index is .225.

The progressivity measures K and S are similar in design but, there is, nonetheless, an important difference between them. The essential analytical difference between the measures arises from the fact that Suits integrates with respect to I and Kakwani with respect to R.[3] This difference has recently been investigated by Formby, Seaks and Smith (1981), who find that K and S differ by a weighting factor equal to the slope of the Lorenz curve. Their results reveal that, after manipulation, the measures are:

$$(6) \qquad K = 2 \int_0^1 [I(R) - T(R)]dR$$

$$(7) \qquad S = 2 \int_0^1 [I(R) - T(R)]\, I'(R)dR.$$

The only difference in the two progressivity measures is the term I'(R), the slope of the Lorenz curve. This implicit weighting factor results in different numerical magnitudes of K and S and may result in conflicting implications when time series or cross-section comparisons are made.[4] Further, there is no apparent reason to prefer one of the measures over the other. For this reason, both measures warrant consideration when progressivity is measured and both are used in this paper to analyze changes in income tax progressivity through time, a topic to which we now turn.[5]

III. CHANGES IN PROGRESSIVITY OVERTIME

This section of the paper uses time series analysis to investigate the dynamic factors influencing changes in income tax progressivity within a single state. Unlike the federal income tax system, there have been few legislative and regulatory changes affecting North Carolina's personal income tax. For this reason, changes in North Carolina's tax progressivity should reflect the results of dynamic economic forces through time.

North Carolina tax and income distribution data are available annually for the period 1957-1962 and biennially thereafter. Table 2 shows K and S values for the fourteen years for which data are available. The pattern of North Carolina income tax progressivity is clear. There has been a consistent and dramatic decline. In the two decades since 1957 both K and S have decreased by more than one-half.

The relatively sharp decline in the progressivity measures between 1959 and 1960 deserves special mention. This decrease can be primarily attributed to the adoption in 1960 of a North Carolina law

Table 2

SUITS' AND KAKWANI MEASURES OF NORTH CAROLINA INCOME TAX PROGRESSIVITY 1957-1977

	K	S
1957	.440	.504
1958	.437	.479
1959	.434	.469
1960	.388	.452
1961	.378	.451
1962	.376	.432
1964	.338	.401
1966	.311	.372
1968	.312	.366
1969	.296	.350
1971	.274	.323
1973	.238	.284
1975	.225	.267
1977	.196	.225

Source: Computed from data in Statistics of Taxation, Tax Research Division, North Carolina Department of Revenue (Raleigh, NC, various issues).

implementing mandatory individual income tax withholding. The introduction of withholding resulted in a large increase in the number of returns filed with more than 50 percent of the increase falling in the $0 taxable income bracket. This disproportionate increase in the number of low-income filers substantially increased the measured inequality of the income distribution, γ, between 1959 and 1960. And since the measured inequality of tax payments remained relatively unchanged, the degree of measured tax progression necessarily diminished. Hence, prior to 1960, the calculated K and S numbers are somewhat inflated. Other than a 1968 increase of $300 in the dependent allowance, there have been no other changes in the North Carolina tax laws which would have an apparent broad based effect on progressivity. Therefore, the decline in progressivity from 1960 to 1977 can be analyzed primarily in terms of economic rather than legal considerations.

Persistent inflation and real economic growth are two obvious factors that can be expected to systematically act on the progressivity of tax system. Both factors result in rising incomes which shifts taxpayers into higher tax brackets, the familiar "bracket-creep". The extent of this effect will vary with different tax systems. In North Carolina the top bracket rate of 7 percent is reached at a taxable income of only $10,000. This relatively low level of taxable income has been exceeded by large numbers of taxpayers as incomes have responded to inflation and real economic growth. In fact, the percent of all North Carolina tax filers with taxable income exceeding $10,000 has increased over five fold from 1.7

in 1960 to 9.5 in 1975. This characteristic of the rate structure has therefore contributed to the redistribution of more taxpayers over fewer rate brackets and hence to the decline in progressivity over time.

This paper does not purport to offer a comprehensive theory of the determinants of the progressivity of state income taxes. Nevertheless, the results of regressing the K and S progressivity measures on inflation and real income variables are quite striking. The following equations were estimated:

$$(8) \qquad \hat{K} = .62 - .0012P - .1917Y - .0490D$$
$$(4.68) \quad (6.17) \quad (6.05)$$
$$RY^2 = .99 \qquad n = 14 \qquad DW = 1.72$$

$$(9) \qquad \hat{S} = .69 - .0015P - .2118Y - .0281D$$
$$(5.55) \quad (5.68) \quad (3.05)$$
$$R^2 = .99 \qquad n = 14 \qquad DW = 1.71$$

The numbers in parentheses are the absolute value of the t-ratios and,

K = the Kakwani measure of progressivity
S = the Suits measure of progressivity
P = the implicit GNP price deflator,
Y = per capita income in North Carolina expressed in 1972 dollars (a proxy for real growth),
D = a binary variable to allow for the effects of the withholding tax law change in 1960 (D = 0 for 1957-59 and D = 1 for 1960-75).

Equations (8) and (9) reveal that all estimated coefficients have the expected negative signs. A glance at the t-ratios shows that all estimated coefficients are statistically significant at the usual 5 percent level. Note, moreover, the great explanatory power of the estimated equations as indicated by the extremely high R^2 values. Thus, changes in inflation and real economic growth go a long way in

explaining changes in observed tax progressivity as measured by either S or K. In fact, the similarity of equations (8) and (9) is even more apparent when comparisons of mean elasticities are made. The mean elasticity of K and S with respect to the inflation variable is calculated to be approximately .31, and .33 respectively, i.e., a one percent increase in the GNP implicit price deflator is expected to result a decrease in progressivity of slightly more than .30 percent. The mean elasticity of the K and S with respect to the real income variables of Equations (8) and (9) is .38 and .37 respectively. Hence, the proportionate response of the tax progressivity measures to a change in per capita real income is expected to be virtually the same. Overall, the results of the regression analysis is clearly consistent with the hypothesis that inflation and real economic growth have contributed significantly to the decline in the overall progressivity of the North Carolina tax system during the period 1957-1977.

IV. CONCLUSION

Application of the Suits and Kakwani Tax Progressivity measures to the North Carolina income tax system reveals that progressivity over the period 1957-1977 has declined by more than one-half. Regression analysis shows that changing progressivity is almost totally explained by inflation and growth in per capita real income.

FOOTNOTES

[1]See, for example, Aaron (1976) and Von Furstenberg (1975).

[2]For applications see Suits (1977a), Clotfelter (1979) and Calmus (1981).

[3]Technically, $R = R(x)$ is a probability distribution function generated by the existing distribution of incomes x. I(R) is also a probability distribution function and is related to R and x as follows:

$$I(x) = \frac{1}{E(x)} \int_0^X t \, dR(t),$$

Where E denotes expected value. On this point, see Kakwani (1977).

[4]Formby, Seaks, and Smith (1981, p. 1018) show that for the U. S. personal income tax system K and S moved in opposite directions in three out of fourteen years between 1962 and 1976.

[5] It is well known that there are differences in the Lorenz distributions of income across states, see, for example, Conlisk (1967) and Formby and Seaks (1978). Such differences in combination with equations (6) and (7) suggests that K and S will diverge.

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