MEASURING THE SENSITIVITY OF THE FEDERAL INCOME TAX
FROM CROSS-SECTION DATA

[Adapted from a paper by Vito Tanzi]

The analysis of the sensitivity of the individual income tax to changes in national income has been a subject that has attracted considerable attention for many years. For a time this attention was directed toward the contribution that this sensitivity made to stabilization. Lately, however, it has been considered more relevant to find out to what extent that tax interferes with the growth of the economy. Its elasticity, which had been considered a "blessing," has come to be regarded as a "drag."

Many studies have analyzed the sensitivity of the yield of the Federal individual income tax in the United States. Although they have differed in many aspects and in their degree of sophistication, the majority of them has attempted to measure that sensitivity by means of time-series approaches—that is, by observing the reaction of the yield of the tax to actual or simulated changes in some aggregate estimate of income over a relatively short historical period.

Two studies have attempted to determine the elasticity of the Federal income tax for large changes in aggregate income by using cross-section data. Basically, these studies have estimated the sensitivity of the Federal income tax for a specific year by regressing tax liability against adjusted gross income using data by income classes. The assumption implied in this approach is that the parameters thus obtained are a good approximation to what one would obtain if, instead of using cross-section data, he used time-series data ranging over the same income range.

The objective of this paper is, first, to suggest a different approach to the measurement of the sensitivity of the individual income tax and, then, to apply it to the Federal income tax of the United States. The approach, which is also based on cross-
section data, may be particularly useful for cases in which data on the relevant variables are not available for a relatively long period of time because of frequent changes in tax legislation.

**Description of Method and Data**

To analyze statistically the relationship between changes in income tax revenues and changes in income, one must have either an actual or a simulated time series of the relevant variables. This series is generally available for only a few years and for modest changes in income so that the effect of large variations cannot be analyzed. This is the main reason why cross-section approaches are important. The method suggested in the present study is based on the hypothesis that one can simulate a time series of the Federal income tax yield and adjusted gross income from data for the same variables at the State level.

Per capita adjusted gross income ranged in 1963 (the year chosen for study) from 899 dollars for Mississippi to 2614 dollars for Connecticut. Since each state was subjected to the same prevailing Federal income tax legislation, the substantial range of per capita income covered by the states provides a way to analyze the sensitivity of the individual income tax of the United States over an equivalent range. More specifically it will be assumed that the relationship between per capita income tax and per capita adjusted gross income for the fifty states in 1963 is equivalent to that which one would obtain if he had available historical data for the United States for a period of fifty years during which the nominal tax structure remained unchanged but per capita adjusted gross income increased from 899 dollars in the first year to 2614 dollars in the last, covering the income range of the fifty states. Thus, each state is assumed to be equivalent to an observation for the United States at a specific time and thus at a given level of income.

Let $T_i$ stand for Federal individual income tax revenue that the Federal government has collected from each individual in a given state. Let $Y_i$ stand for per capita adjusted gross income. And, let $i =$
1 ... 50 stand for the index of the state. Using these data we can find an estimate for the relationship

\[ T_i = f(Y_i) \]

between tax revenue (T) and adjusted gross income (Y).

**Statistical Results**

In its most common definition, the built-in flexibility of tax revenue with respect to adjusted gross income is given by the expression \( \Delta T / \Delta Y \). This can be estimated from the slope of an equation of the type

\[ T = a + bY \]

The estimated regression equation obtained by the application of the method to 1963 data is

\[ T = -88.6879 + 0.17620 Y \]

\[ (10.1759) \quad (0.00552) \]

\[ R^2 = .954 \]

where parentheses contain standard errors. This equation gives the value 0.1762 as a direct estimate of the flexibility.

In equation (2) above the form of the relationship has been assumed to be linear. A priori, however, in view of the progressivity of the income tax, one might expect that relationship to be nonlinear. The exponential form

\[ T = AY^b \]

might be preferable. In logarithmic form the function appears as a straight line with log \( A \) as the vertical intercept and \( b \) as the slope of the straight line which has also the nice quality of being the elasticity of \( T \) with respect to \( Y \).

The equation thus obtained is

\[ \ln T = -4.799 + 1.363 \ln Y \]

\[ (0.256) \quad (0.034) \]

\[ R^2 = .970 \]

The fit is improved somewhat by the use of logarithms. Equation (5) indicates that the elasticity of the tax with respect to adjusted gross income is slightly over 1.36.

The equations given above were obtained from the data of all the fifty states. One could argue, however, that the states with the lowest income have characteristics which make the relation between tax and income in them different from the relation that prevails in the rest of the United States economy. In other
words, one could maintain that, for example, the per capita tax revenue in Mississippi is probably different from the per capita tax revenue that the United States economy would have if its per capita income were the same as that of Mississippi. Observing the scatter diagram, it seems that there may be some justification in eliminating the five states with the lowest per capita income. Thus, using only forty-five observations, the relationships were estimated again. The equations obtained are:

(6) \[ T = -104.819 + 0.184 Y \]
\[ (12.366) (0.006) \]
\[ R^2 = .948 \]

(7) \[ \ln T = -5.202 + 1.416 \ln Y \]
\[ (0.329) (0.044) \]
\[ R^2 = .960 \]

The major change brought about by the elimination of the five poorest states is the increase in the elasticity of the tax from 1.36 to about 1.42.

**Conclusions**

The method followed above has provided estimates for elasticity and flexibility for which the standard errors are extremely small. In all cases the fit was excellent. What remains to be seen now is the closeness of these results to those obtained in some other studies. The estimated equation obtained by Mishan and Dicks-Mireaux was:

(8) \[ \ln T = -5.752 + 1.425 \ln Y \]

which should be compared with equation (7) above. It is remarkable that results as close as these could have been obtained from two methods as diverse as those followed and by the use of completely different data. This similarity of results certainly strengthens the credibility of this estimate of elasticity. [Several other studies also have estimated the elasticity of the Federal income tax to be about 1.4.]

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