Journal of Public Economics 33 (1987) 173–206. North-Holland

INDIVIDUAL TAXPAYER RESPONSE TO TAX CUTS: 1982–1984

With Implications for the Revenue Maximizing Tax Rate

Lawrence B. LINDSEY*

National Bureau of Economic Research, Cambridge, MA 02138, USA

Received November 1985, revised version received April 1987

This paper measures the response of taxpayers to the U.S. personal rate reductions from 1982 to 1984. A baseline income distribution is created to describe what level and distribution could be expected in the absence of tax changes. Comparison of this baseline with actual tax return data shows that at least one-sixth, and probably one-quarter, of the revenue loss ascribable to the rate reductions was recouped by changes in taxpayer behavior. The data also show that federal income tax revenue would have been maximized at a tax rate of about 35 percent, and total income tax revenue maximized at a total tax rate of about 40 percent.

1. Introduction

The possibility that marginal tax rates and tax revenue may be inversely related is at least as old as the *Wealth of Nations.* Adam Smith (1776, ch. 2, p. 78) argued:

> High taxes, sometimes by diminishing the consumption of the taxed commodities, and sometimes by encouraging smuggling, frequently afford a smaller revenue to government than what might be drawn from more modest taxes.

Most modern economic analyses of taxation have tended to neglect the relationship between rates and revenue and have instead focused on the issue of excess burden. However, the response of the tax base, and therefore of revenue, to changes in tax rates has two important economic implications.

*Assistant Professor of Economics at Harvard University and Faculty Research Fellow at the National Bureau of Economic Research. The research reported here is part of the NBER's program in Taxation and projects in Government Budgets and Taxation and Capital Formation. The author is grateful to NBER for its assistance. Special thanks are also extended to Andrew Mitrusi for outstanding computer work and to Daniel Feenberg, Martin Feldstein, and the members of the NBER Taxation program for their thoughtful comments and suggestions. Of course, any views expressed here are those of the author and not those of NBER or any other organization or individual.

First, if the tax base varies with the level of rates imposed upon it, there exists a tax rate above which revenues start to decrease. Given the usual objective of tax design as minimizing the excess burden of taxation subject to a revenue constraint, tax rates above the revenue maximizing level are irrelevant to consideration. At the point of revenue maximization, the excess burden of collecting an additional dollar approaches infinity, far above any likely shadow price of government revenue. Therefore, the revenue maximizing rate provides an upper bound on the range of socially optimal tax rates.

Second, the response of taxpayers to changes in tax rates has important implications for fiscal policy regardless of the level of rates. The fact that the tax base will be smaller at high rates than at low rates is not a controversial conclusion. This result implies that a given percentage change in tax rates will necessarily produce a smaller percentage change in tax revenue. For example, a 10 percent income tax surcharge will not result in 10 percent more tax revenue even if the macroeconomic implications of the policy change are discounted. Empirical estimation of the magnitude of this effect is therefore necessary for the proper conduct of fiscal policy.

The objective of this paper is to estimate the response of taxpayers to changes in U.S. personal income tax rates and extend the results to predict the likely maximizing rate of personal income taxation. The 1981 Economic Recovery Tax Act provided a 23 percent reduction in tax rates over 3 years and an immediate cut in the top personal rate from 70 percent to 50 percent. The experience from these years provides the data for this investigation.

Section 2 of this paper deals with the methodological issues involved in investigating the behavioral response of taxpayers to changes in tax rates. Section 3 provides data from the period on the size of the tax base and its variation with rates. In section 4, these results are extended to estimate the revenue maximizing top personal income tax rate and the effect of the tax rate reductions on the size of personal income.

2. Methodological issues

The objective of this analysis is to isolate the behavioral response of taxpayers to changes in tax rates. This analysis begins with a simple model of the tax system. A given taxpayer pays tax T_i on taxable income Y_i. The marginal tax rate on this income, t_i, is represented by the derivative of the tax function at the given level of taxable income:

$$T_i = T(Y_i), \tag{1a}$$

$$t_i = T'(Y_i). \tag{1b}$$

The level of taxable income declared by the taxpayer is a function of his endowment and underlying tastes, X_i, and a choice by him of how much of his endowment to convert into taxable income. This underlying endowment can be viewed as the amount of income a taxpayer would earn in the absence of taxes. The choice of how much of one's endowment to convert into income and pay taxes on is dependent upon the share of each additional dollar of taxable income which the taxpayer is allowed to keep, $1-t_i$, which will be called the taxpayer's after-tax share:

$$Y_i = Y(X_i, 1-t_i). \tag{2}$$

The methodological problem is to isolate the tax effect from the effect of a taxpayer's endowment. For this purpose, intertemporal comparisons are not useful. A number of authors, including Minarik (1984) and Simonson (1984a, 1984b) have noted that the share of taxable income reported by high income taxpayers rose with the reduction of the top tax rate from 70 percent in 1981 to 50 percent in 1982. Some take this as an indication of a behavioral response to the lower rates.

But, this need not be the case. The distribution of taxpayer endowments, X_i, may well have changed between the two years in question. For example, interest income reached a record share of personal income in 1982 due to high interest rates. Since the distribution of interest income is skewed toward the top of the distribution, the record amount of interest received alone would raise the share of taxable income reported by upper income taxpayers. Thus, the valuation of taxpayer endowment must be made given the macroeconomic environment of the year the taxable income is reported.

A second methodological issue involves a problem of data limitation. The behavior of individual taxpayers is not observable in the years after the tax cut. Even given a copy of the taxpayer's tax return, the taxpayer's endowment cannot be determined independently of his taxable income. An estimate of a taxpayer's endowment must therefore come from some source which is independent of the calculation of the taxpayer's taxable income for the year in question.

A final point to stress is that the response of taxable income to tax rates is not the same as the response of labor supply or other real economic factors. The response of taxable income includes, but is by no means limited to, these factors. Existing parameters on labor supply response, for example, are not applicable to the problem at hand.

Instead, the response of taxable income to tax rates includes a variety of decisions by the taxpayer, some of which are independently documented. For example, the sensitivity of capital gains realizations to tax rates has been documented by Feldstein and Slemrod (1978), Feldstein, Slemrod and Yitzhaki (1980), the Treasury's Office of Tax Analysis (1986), and Lindsey

(1987), among others. Clotfelter (1983a) discovered a strong relationship between the after-tax price and the use of business travel and entertainment deductions. In a separate piece, Clotfelter (1983b) reported a relationship between tax evasion and tax rates. Numerous authors, including Feldstein and Clotfelter (1976) and Clotfelter and Steuerle (1981), have found a high elasticity of charitable contributions to the after-tax price.

The myriad decisions which affect taxable income coupled with uncertainty regarding actual parameter estimates, and questions about possible interdependence of these various decisions, mean that the overall response of the income tax base to tax rates cannot be determined from the existing literature. The typical model of the effect of tax rates on revenue, such as that by Canto, Joines and Laffer (1981), and the criticisms of that model such as those by Blinder (1981), focus on elasticities of labor supply and saving. They do not include the multitude of non-factor supply decisions, such as those described above, which also determine the actual size of the tax base. Even a study such as Fullerton's (1982), which used a highly sophisticated general equilibrium model based on known parameter values of factor supply elasticity, does not capture the full response of the tax base.

2.1. Baseline income distributions

One method for surmounting these methodological problems is to create a baseline income distribution similar to those used by government technicians to estimate tax revenue in future years. A detailed description of the major revenue estimating model used in the United States, the Treasury Tax Calculator, can be found in Wyscarver (1982). The baseline distributions used by revenue estimators incorporate the projected macroeconomic environment of the year being estimated with taxpayer behavior based on the existing tax regime. In effect, these projections assume that the value of taxpayer endowments will change with the overall economy but that the effects of tax rates changes are nil.

Changes in the relative value of taxpayer endowments are primarily the result of changes in the functional distribution of income in society. This functional distribution, as defined by the National Income and Product Accounts, is part of the forecast of macroeconomic conditions which revenue estimators use. In the case of this study, the macroeconomic conditions and functional distribution of income in the years being studied are known, so the forecast error inherent in revenue projections to future years is eliminated.

Therefore, the baseline revenue estimate is an historic counterfactual which assumes the actual level of taxpayer endowments in a given year, but that taxpayer behavior given those endowments reflects an earlier tax regime. Variations between the counterfactual level of taxable income and the actual

level cannot be attributed to changes in the relative value of endowments due to macroeconomic conditions, but must be associated either with the change in tax regime, or some other change not apparent in the economic data for the period.

If the baseline represents the true underlying distribution of endowments, differences between the baseline and actual distribution of taxable income may be ascribed to changes in after tax shares. Using an asterisk to denote the baseline level of taxable income and the pre-tax cut rate on which the baseline is based:

$$Y_i^* = Y(X_i, 1 - t_i^*), \tag{3}$$

$$Y_i / Y_i^* = F(1 - t_i / 1 - t_i^*). \tag{4}$$

A check on the validity of a model of baseline income distribution is provided in years when there were no significant tax changes. In those years, the baseline and actual distributions of taxable income should be quite close and the two fractions in eq. (4) should both approach unity. The present study examines 1980 and 1981 tax payments predicted by the baseline: two years in which tax changes were relatively insignificant as a prelude to examining later years.

The use of a baseline income distribution also solves the methodological need for independent sources for the level of taxable income and the estimate of taxpayer endowment. The baseline is constructed from taxpayer behavior in a different year than the year for which taxable income is reported. To maintain this independence, the adjustment of the level of taxpayer endowments to a later year must be made with data from some source other than tax data, such as the National Income and Product Accounts.

Finally, a baseline includes all of the income parameters which determine taxable income. Estimates of the response of taxable income to changes in tax rates are therefore not limited to a few changes in factor supply, but include the whole range of taxpayer adjustments to a new tax regime.

2.2. The National Bureau of Economic Research TAXSIM model

In order to create a baseline income distribution, this study used the National Bureau of Economic Research TAXSIM model.[1] This model, like the Tax Calculator used by the Department of Treasury, combines a large data base of actual tax returns and computerized representations of tax codes for different years. The model is specifically designed to permit calculation of

[1]The economists responsible for the creation of the National Bureau of Economic Research TAXSIM model are Daniel Feenberg, Martin Feldstein, Daniel Frisch, Lawrence Lindsey and Andrew Mitrusi.

baseline income distributions for different years for the purpose of revenue estimation.

The data base used for this study is the 1979 Individual Tax Model File Public Use Sample compiled by the Internal Revenue Service. This file contains roughly 100 data items from the tax returns of a stratified random sample of some 100,000 taxpayers. Due to cost considerations, this study used a one in four random sample from the tax file.

This data base reflects the relationship between taxable income and endowment given 1979 macroeconomic conditions and the tax regime prevailing in that year. That tax regime is the one that was in place prior to the passage of ERTA in 1981, and is sufficiently in advance of the political events which produced the tax cuts that taxpayers can be assumed not to have anticipated the rate reductions. Therefore, a baseline distribution created from this 1979 source and adjusted to reflect the macroeconomic conditions of later years reflects what taxpayer behavior would have been had no tax change been passed.

The creation of baseline distributions for later years involves a process known as 'aging'. TAXSIM raises the value of each income term on each of the tax returns to reflect the rise in the per-tax return level of that type of income in the National Income and Product Accounts between 1979 and the year in question. The sample weights attached to each tax return are then increased to reflect the rise in the number of tax returns between the two years.

This aging technique permits the income distribution in society to change with changes in the functional distribution of income while maintaining the frequency distribution of each individual component of income. It also divides the total growth of each component of income into return-intensive and return-extensive portions. Thus, if a given growth of nominal income is largely due to inflation and not to expanding real economic activity, the number of tax returns would stay constant and the income growth would be reflected in rising incomes on each return. On the other hand, real economic growth tends to expand the number of tax returns, thus spreading the growth in nominal income rather than concentrating it on existing tax returns. A comparison of the actual and predicted levels of each component of income is presented in table 1.

For most of the line items on a tax return, the predicted level for a given year was the 1979 level times the ratio of personal income in the modelled year to personal income in 1979. Specific components of income which may have changed at a different pace than overall personal income were targeted separately. For example, wages and salaries were increased by the ratio of wage and salary income in the modelled year to wage and salary income in 1979. Business income was given similar treatment with the target level provided by non-farm proprietor income. Dividend income was targeted to

the level of dividends paid in the personal income in each year. All of these income items are components of personal income in the National Income and Product Accounts.

Table 1 shows that in the case of wage and salary income and business income, the aggregate level reported on tax returns closely followed the predicted level based on the National Income and Product Accounts. This was not the case for dividend income. In 1980, the NIPA based prediction

Table 1

Actual and predicted levels of income by component.

Component	Year	Predicted	Actual
Wages and salaries	1980	1347.9	1350.0
	1981	1483.3	1486.1
	1982	1559.8	1565.0
	1983	1644.3	1644.6
	1984	1804.6	1818.6
Business income	1980	54.6	54.4
	1981	52.3	53.5
	1982	49.7	50.6
	1983	59.2	60.4
	1984	67.8	69.9
Dividends	1980	39.7	43.6
	1981	46.6	48.2
	1982	49.0	54.0
	1983	51.8	50.4
	1984	57.2	51.3
Interest	1980	102.9	102.0
	1981	135.2	140.6
	1982	155.5	157.0
	1983	158.8	153.8
	1984	168.6	173.8
Capital gains	1980	26.6	28.0
	1981	28.9	30.8
	1982	30.3	34.5
	1983	31.7	46.4
	1984	32.6	n/a
Itemized deductions	1980	219.1	218.0
	1981	256.8	256.5
	1982	288.9	284.5
	1983	286.5	309.6
	1984	326.1	356.4
Number of itemizers	1980	29.52	28.95
	1981	32.58	31.57
	1982	34.18	33.43
	1983	35.72	35.23
	1984	39.03	38.22

Notes: All dollar figures in billions. Number of itemizers in millions.

underestimated actual dividend income by about 8 percent while the NIPA based prediction overestimated dividend income on tax returns by 12 percent in 1984. The NIPA level of personal dividend income includes dividends which accrue to taxpayers via pension funds and similar non-taxed entities. These data suggest that the share of dividends received in non-taxed entities increased over time. This time trend was not taken into account in creating the baseline predictions.

Research shows that the reverse process occurs with respect to interest income. The share of personal interest income as reported by the National Income and Product Accounts which was reported on tax returns was only 27 percent in 1979. By 1984 it had grown to 39 percent. Stated differently, aging interest income from a 1979 base would have led to an underprediction of interest income of over 30 percent by 1984. A key reason for this change was the deregulation of the banking industry, and particularly the emergence of money market mutual funds and the extension of NOW accounts nationwide. As a result, non-institutional personal savings received a sharply higher rate of return.

To model this, the components of household saving in the Federal Reserve Board's Flow of Funds were broken into two groups: market rate and non-market rate accounts. Certificates of deposit, bonds, and money market mutual funds were grouped in the former category while other accounts were placed in the latter category. An average of current 3-month rates, 6-month rates lagged 1-year and 5-year rates lagged 2 years was selected as an estimate of the composite interest rate on the market category. Other funds were assigned an average 3.3 percent rate of return regardless of the year in question. The resulting series closely tracks the actual level of interest reported on tax returns.

It should be noted that this modelling procedure with regard to dividends and interest has the effect of understating the behavioral response of taxpayers to the tax cuts. Retaining a NIPA basis for dividends overstates dividend income, which is concentrated in upper income groups, thus reducing the apparent increase in taxable income for these groups. Similarly, using an alternative measure for interest raises the predicted value of this type of income, also concentrated among upper income taxpayers, thus minimizing the apparent behavioral response.

Capital gains is not a component of income in the National Income and Product Accounts, so no estimate could be derived from that source. Instead, the Federal Reserve Board's Flow of Funds was used to measure tradeable household wealth. Lindsey (1987) found that this wealth, including stocks, real estate, and business equity, has been found to be almost exactly proportional to capital gains realizations after controlling for tax rate changes. On average, 1.2 percent of tradeable household wealth was realized as capital gains for the period 1965–1980. This figure was then applied to tradeable wealth in later years to obtain a predicted value. As a result, the

capital gains estimate was roughly 6 percent below the actual level in the two years before the rate reduction, but well below the target after the rate reduction.

Two further adjustments are made to the data base to reflect changing economic conditions. The sample weight of taxpayers reporting unemployment compensation is adjusted to reflect the unemployment rate in later years. While slow economic growth reduces the number of new entrants to the labor economic force and the growth in the number of tax returns, it also reduces the labor income of existing workers due to temporary unemployment. These workers will file tax returns, but their income is reduced below the level it otherwise would have been. This adjustment for unemployment changes the distribution of particular components of income and thus complements the changes in the income distribution due to changes in the functional distribution which have already been made.

The second adjustment to the data involves increasing the sample weight of taxpayers who itemize their income tax deductions to reflect the higher level of income in the year to which the data is being aged. As the income level of the taxpayers in the original 1979 data base rises in the aging process, the deductions for the state and local taxes, interest payments, charitable contributions and medical payments also rise. If these taxpayers were not originally itemizers, the data base does not contain information on the taxpayer's spending on these activities. TAXSIM adjusts for this by imputing a level of itemized deductions for itemizers and increasing the sample weight of returns with itemized deductions to reflect the increased probability of itemizing for taxpayers at each nominal income level. These adjustments are based on actual tax return data. The data are provided in table 1.

2.3. *Implications of baseline methodology*

It should be noted that this aging procedure has the effect for most types of income of limiting the measured behavioral response of taxpayers to changes in the distribution of income, but not its level. The objective in the aging process follows an approach developed by Deming and Stephen (1940). If we define n_{jk} as the amount of income of type j received by taxpayers in group k in the original 1979 data and m_{jk} as the corresponding amount the taxpayer receives after the extrapolation to a later year, we minimize:

$$\sum_k (m_{jk} - n_{jk})/n_{jk}$$

s.t.

$$\sum_k m_{jk} = m_{j\cdot} \tag{5}$$

The solution of a set of equations such as (5) for each type of income produces a set of extrapolation values which involve an equiproportionate increase for all taxpayers for a given type of income, but different extrapolation values for different types of income.

If the extrapolation value for a particular type of income equals the aggregate growth in that type of income reported on tax returns, then a comparison of baseline and actual incomes produces:

$$\sum_k Y_{jk} = \sum_k Y^*_{jk}. \tag{6}$$

The effect of eq. (6) is best illustrated in the case of two groups with equal total incomes. If tax rates are cut on group 1, and a behavioral response to tax rate reductions occurs, then $Y_{j1} - Y^*_{j1}$ is greater than 0. That is to say, the actual income reported by group 1 exceeds the baseline income for that group. Eq. (6) requires that $Y^*_{j2} - Y_{j2}$ equals $Y_{j1} - Y^*_{j1}$, so that the total baseline income of the two groups equals their total actual income.

Fig. 1 shows this graphically. The ratio of actual to baseline income for the various taxpayer groups is compared to the ratio of the after-tax shares $(1-t)/(1-t^*)$ for each group, as modelled by eq. (4). If there were no behavioral response to the tax rate change, then the actual and baseline incomes would be equal for all groups. In this case, the data would be arrayed along the horizontal line labelled 'No behavioral response' which represents a ratio of actual to baseline income of unity.

If we assume that the reporting of taxable income is positively related to after-tax share, then any behavioral response to a tax rate reduction would have this horizontal line as a lower bound. A 'True behavioral response' line is therefore drawn as a positive function of the ratio of after-tax shares. This 'True behavioral response' line passes through the point where both the ratio of actual to baseline incomes and the ratio of after-tax shares equals unity. This indicates that a taxpayer who had no change in tax rates – $t_i = t^*_i$ – would have actual income equal to baseline income – $Y_i = Y^*_i$. The 'True behavioral response' line extends down and to the left from this point indicating that taxpayers who had a tax rate increase would have actual income below baseline income.

If a tax change were enacted which raised taxes on some taxpayers and cut tax rates on others so that the behavioral responses to the tax changes exactly offset one another, the 'True behavioral response' line might actually be observed. The tax rate changes of 1982–1984 produced a tax rate reduction, and a net behavioral response which caused actual income to exceed baseline income. As a result, the constraint expressed by eq. (6) means that this true behavioral response will not be observed. Weighted by income, any area above the 'No behavioral response' line must be offset by an equal area below that line.

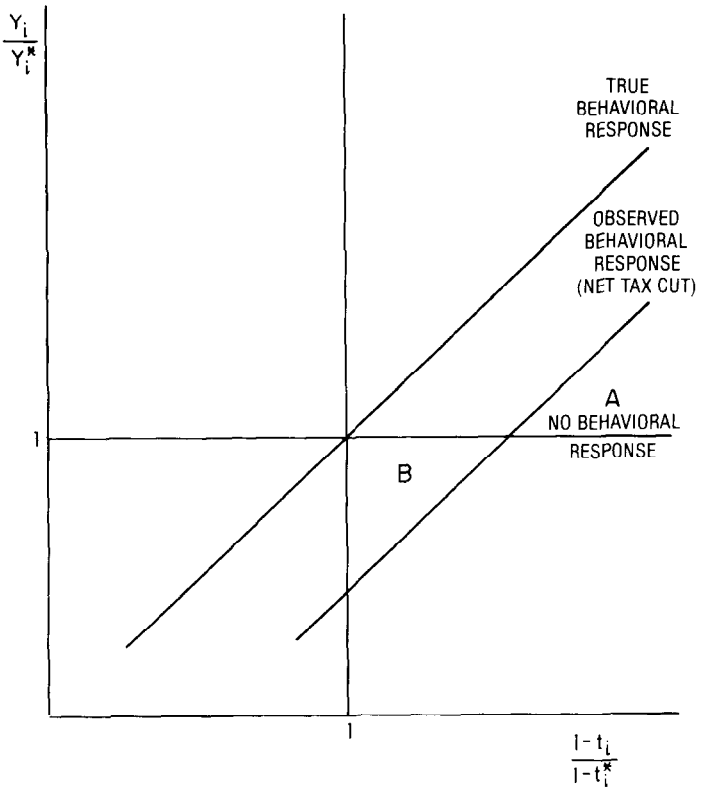

Fig. 1

If we assume that the function F represents the true behavior of taxpayers, then eq. (7) must also hold for each type of income:

$$\sum_k Y_{jk} = \sum_k Y_{jk}^* F((1-t_k)/(1-t_k^*)). \tag{7}$$

If t_k^* is greater than t_k for all k, then eq. (6) will produce a result where the value for baseline income is overstated. The baseline level of income will be increased above its true value so that the area above the 'No behavioral response' line, indicated by A in fig. 1, exactly equals the area below the 'No behavioral response' line indicated by B. Eq. (7) shows that the overstatement of Y^* will be equiproportionate for all taxpayer groups, and a function of the true behavioral response for each group weighted by income.

The logical implications of the overstatement of Y^* become apparent for a taxpayer with no change in tax rates – $t_i = t_i^*$. Although theory implies that $Y_i = Y_i^*$ for such a taxpayer, the overstatement of Y^* will mean that this will

not be the case. The ratio Y_i/Y_i^* will be less than unity for a taxpayer with $(1-t_i)/(1-t_i^*)$ equal to unity. As the income ratio is less than unity for this taxpayer due to the overstatement of Y^*, and the overstatement is proportional to income for all taxpayers, the amount the baseline is overstated can be estimated.

A logarithmic estimation of the observed behavioral response will produce a negative intercept term. The additive inverse of the logarithmic intercept represents the percent overstatement of actual income by the baseline for someone who had no rate reduction. Since the methodology used made this overstatement of income proportional in all income groups, the intercept describes how much lower the baseline or counterfactual level of income should have been given a baseline assumption of no tax rate reductions.

Alternatively, the additive of the intercept measures the proportionate increase in income due to taxpayer response to the rate reductions. This interpretation assumes that the positive behavioral response by taxpayers with a large increase in their after-tax share did not cause a corresponding decline in the incomes received by taxpayers with proportionately smaller rate reductions. Stated differently, this interpretation assumes that the receipt of income is not a zero-sum game and that the aggregate level of income is determined, at least in part, by tax rates.

It is important to note that this interpretation holds for a tax increase as well as a tax cut. If the behavioral response to a tax increase is lower reported income, then the observed behavioral response will be above the true behavioral response. The logarithmic intercept will indicate how much higher the baseline or counterfactual level of income would have been had there been no tax rate increase.

In the data evaluated in this study, the actual tax rate was greater than its baseline value for some groups and lower for other groups. On net, however, the income response to the tax rate changes was positive. The constraint imposed by eq. (6) therefore mandated an equiproportional overstatement of baseline income for all income groups.

3. Rates, revenue, and the tax base 1980–1984

The Economic Recovery Tax Act of 1981 (ERTA) provided for a series of reductions in tax rates over the four-year period 1981–1984. It also reduced the size of the tax base by two statutory provisions: the extension of Individual Retirement Accounts (IRAs) to virtually all working taxpayers, and a partial exclusion of income for married couples where both spouses worked – the two-earner deduction. The effect of these provisions on tax liability is summarized in table 2.

The table presents taxpayers in four different income groups. These groups are defined by the taxpayers reporting Adjusted Gross Income of a particular

Table 2

Tax payments by taxpayer groups, 1980–1984.

Year and estimate	Group 1 '200+'	Group 2 '50–200'	Group 3 '30–50'	Group 4 'under 30'	All taxpayers
1980					
Old law (P)	$19.42	$58.05	$68.06	$101.94	$247.47
New law (P)	19.42	58.05	68.06	101.94	247.47
% Tax cut	0.0%	0.0%	0.0%	0.0%	0.0%
Actual tax	19.46	59.17	69.95	101.76	250.34
% Difference	+0.2%	+1.9%	+2.8%	−0.2%	+1.2%
1981					
Old law (P)	$22.63	$75.11	$85.96	$106.45	$290.15
New law (P)	22.55	74.22	84.12	103.83	284.72
% Tax cut	−0.4%	−1.1%	−2.1%	−2.5%	−1.9%
Actual tax	21.74	72.52	86.59	103.28	284.13
% Difference	−3.6%	−2.3%	+2.9%	−0.5%	−0.2%
1982					
Old law (P)	$25.95	$80.92	$95.64	$108.50	$311.01
New law (P)	22.44	69.79	81.24	93.29	266.76
% Tax cut	−14.5%	−14.8%	−15.1%	−14.0%	−14.2%
Actual tax	26.62	72.36	85.00	93.62	277.60
% Difference	+18.6%	+3.7%	+4.6%	+0.4%	+4.1%
1983					
Old law (P)	$29.01	$93.30	$105.33	$112.69	$340.33
New law (P)	23.52	72.79	80.78	88.81	265.90
% Tax cut	−19.0%	−22.0%	−23.3%	−21.2%	−21.9%
Actual tax	31.73	75.76	82.63	84.06	274.18
% Difference	+34.9%	+4.1%	+2.3%	−5.3%	+3.1%
1984					
Old law (P)	$34.11	$116.00	$117.33	$118.35	$385.79
New law (P)	27.04	85.47	85.22	88.39	286.12
% Tax cut	−20.7%	−26.3%	−27.4%	−25.3%	−25.8%
Actual tax	42.11	92.00	86.43	83.43	303.97
% Difference	+55.7%	+7.6%	+1.4%	−5.6%	+6.2%

Notes: Dollar figures in billions.

size in a particular year according to the *Statistics of Income* for that year. For example, in 1980, the *Statistics of Income* reported 117,250 taxpayers with AGI in excess of $200,000. In order to compare identically situated taxpayers for the baseline prediction, TAXSIM selected the top 117,250 taxpayers ranked by AGI for comparison. Similar rankings were done for each income group in each year. Under this procedure taxpayers placed in an income class in the baseline did not necessarily have AGI in the specified range. The purpose of this analysis is to compare the taxes and incomes of taxpayers situated in identical places in two different income distributions. This approach avoids the problems inherent in other analyses which

compare taxpayers in a given income range even though those taxpayers differ in number and in location in the income distribution.

In each year, the first row is the tax liability predicted by TAXSIM under pre-ERTA tax law for the given class of taxpayers. The second row is TAXSIM's prediction for that group of taxpayers under ERTA. The percentage difference between these two numbers is TAXSIM's measure of the percent tax cut under the ERTA legislation. The fourth row is the actual amount of taxes paid by the taxpayer group. This is then contrasted with the predicted level of taxes in row 2, and the percent difference is reported in the fifth row.

This final row represents the percent difference in taxes paid by the group not ascribable to changes in the legislation, or to changes in taxpayer endowments caused by changes in the aggregate level or functional distribution of income in the particular year. This paper terms this final row, marked '% Difference', as the 'revenue response'. This response may be attributed either to the rate reductions or to some unobserved phenomenon not indicated in either the level or functional distribution of income.

3.1. The revenue response 1980–1984

3.1.1. 1980

The Economic Recovery Tax Act was not passed until 1981. Thus, the 'old law' and 'new law' estimates of revenue presented in table 1 are identical. The data are presented to show the predictive ability of the TAXSIM model. A comparison of the actual taxes paid and the predictive level shows an underestimate by TAXSIM of 1.2 percent. By contrast, a study by the Congressional Budget Office (1983) of the forecasting ability of the Treasury Tax Calculator shows an average error due to 'technical' factors of 1.4 percent for the 3 years preceding the passage of ERTA. Neither Treasury nor CBO has presented data on the average error by income group. TAXSIM missed the tax liability of particular groups by amounts ranging from 0.2 percent to 2.8 percent.

3.1.2. 1981

ERTA was passed in the summer of 1981. The law provided for rate reductions of 1.25 percent for the year for taxpayers using the regular tax computation techniques. In addition, the top tax rate on capital gains income was reduced to 20 percent for all assets sold after 8 June, 1981. The net effect of these changes is shown as the percent tax cut on line 3. The legislated tax reduction at the top of the income distribution was less than average because alternative tax computations such as the minimum tax were unaffected and the tax reduction was limited to unearned income for taxpayers filing under the maximum tax provisions. On the other hand, taxpayers in lower income

groups are the primary beneficiaries of the tax credits in the code including the earned income credit and the residential energy credit. The 1.25 percent tax reduction was applied before credits were considered, so the average reduction in taxes after credits would exceed 1.25 percent.

TAXSIM overestimated the tax revenue in this year by 0.2 percent. The overestimate was greatest at the top of the income distribution. One cause of the overestimation was a data limitation. We have no data on what fraction of capital gains were realized after the top capital gains was reduced in mid-year. We therefore computed tax for these upper income taxpayers assuming no rate reduction on capital gains, thus overestimating the tax liability of upper income taxpayers.

The year 1981 also contained the possibility of a behavioral response to the tax rate reductions. Overall, the 1.25 percent reduction was relatively negligible, raising the after-tax share for someone in the 30 percent bracket from 70 cents to 70.375 cents or a bit more than one-half of 1 percent. However, taxpayers were aware that marginal rates would be substantially lower in 1982, and had an incentive to postpone income and accelerate deductions from income. This effect would be greatest for taxpayers in the top income bracket of 70 percent, who could anticipate a reduction to 50 percent in the next tax year. This may provide a further explanation for why taxes paid by upper income groups were over-predicted for 1981.

By contrast, the Treasury model's prediction of revenue in 1981 was high by 1.4 percent in its 1978 and 1979 estimates, and high by 1.8 percent in its 1980 estimate of 1981 revenue after controlling for the effect of macro-economic conditions and tax law changes. Again, the TAXSIM model is well within the predictive range of the model used to determine fiscal policy at the Department of Treasury as measured by the Congressional Budget Office (1983).

3.1.3. 1982

The Economic Recovery Tax Act provided for tax rates in 1982 to be 10 percent lower than before the tax cut was passed. In addition, the top tax rate was constrained to being no more than 50 percent. The 1982 provisions also extended the Individual Retirement Account provisions to nearly all taxpayers with labor income. Taxpayers could contribute up to $2,000 of labor income to an IRA and reduce their Adjusted Gross Income by that amount. In addition, married couples with both spouses working were allowed to reduce their AGI by 5 percent of the earnings of the lower earning spouse.

These changes make comparison of taxpayers in the same AGI groups in different years tricky. Taxpayers with identical gross earnings in 1981 and 1982 could have AGIs with as much as a $7,000 difference between the two years. This paper avoids this analytic problem by matching identically situated taxpayers under a consistent definition of AGI.

The data show that these tax changes resulted in a roughly proportional tax reduction for all taxpayer groups of about 14 percent. Middle class taxpayers saw a particularly large tax reduction due to the IRA and two-earner deduction provisions. However, these latter provisions provided comparatively little marginal tax rate relief, providing instead a substantial infra-marginal tax reduction.

A comparison of the level of revenues predicted by TAXSIM and the actual level of tax revenue shows that actual revenue was substantially above the predicted level. In the aggregate, roughly $11 billion more was collected than predicted. As the total tax reduction in 1982 was about $44 billion, one-quarter of the expected tax reduction was recouped due to a revenue response. More to the point, the rate reduction portion of the tax cut of 1982 was roughly $32 billion. In this case, about one-third of the cost of the rate reduction was recouped.

The Treasury model again predicted a non-behavioral revenue estimate very similar to TAXSIM's. In the three annual forecasts prior to 1982, the Treasury underestimated actual 1982 revenues by 1.7 percent, 4.6 percent, and 5.1 percent, respectively, after controlling for macroeconomic conditions and tax law changes, according to the Congressional Budget Office (1983). The average 3.8 percent underestimate amounts to $10.55 billion, almost exactly the $10.84 billion underestimate of actual revenue in the TAXSIM estimate. Again, the counterfactual revenue estimates by TAXSIM prove to be extremely close to those made by the Department of Treasury.

Roughly 40 percent of the extra $11 billion of tax revenue collected could be found in the top taxpayer group, representing the top 170,000 taxpayers. These taxpayers paid taxes under the new law of $26.6 billion. By contrast, the TAXSIM prediction of the taxes owed by the top 170,000 in 1982 was only $22.4 billion under the new law and $26.0 billion under the old tax law. These findings imply that these taxpayers actually paid more revenue under the new tax regime than we would expect to have collected from them under the old higher set of tax rates. For this group, the reduction in the top rate from 70 percent to 50 percent was costless to the government.

This top taxpayer group is probably both more tax conscious and more able to control taxable income than other income groups. Some taxable items such as capital gains are purely discretionary. Similarly, compensation packages for both high income employees and for self-employed taxpayers may be largely discretionary in the level of taxable compensation received.

Although the revenue response was greatest in the top income group, it was not negligible in other groups. In the second taxpayer group, representing the next 4.34 million taxpayers that year, tax revenues were $2.5 billion more than expected. This amounted to a revenue response equal to 23 percent of the tax reduction legislated for these taxpayers. In the third taxpayer group, an extra $3.7 billion was collected, or 26 percent of the legislated tax reduction.

In viewing this data, it is important to keep two factors in mind. First, as fig. 1 demonstrated, the baseline income and tax numbers overpredict what actually would have occurred in the absence of the tax rate reductions. The revenue response to the rate reductions, the percent difference, is therefore greater for all income groups than the amount shown.

Second, given the errors normal to simulation work in years when no tax rate changes occurred, it may be possible that the changes for these latter two groups represent technical error rather than a true taxpayer response. The magnitude of these changes, excluding the factor mentioned above, is only about 1.5 times the maximum errors in years when no tax changes, or only minor tax changes, occurred.

Technical error is not a very plausible explanation for the 18.6 percent difference in taxes for the top taxpayer group, however. This difference is five times the maximum difference for any other group in any other year. The strong likelihood exists that this difference, which is not explicable by changes in the number of taxpayers in the group, or by the level or functional distribution of income, represents a clear response of taxpayers to lower tax rates.

3.1.4. 1983

The 1981 tax bill legislated further rate reductions for 1983, bringing tax rates 19 percent below their pre-tax cut level. The top rate was again constrained to be no more than 50 percent. Furthermore, the two-earner deduction was increased from 5 percent of the lower earning spouse's wages in 1982 to 10 percent in 1983.

The net effect of these legislative changes was a slightly more progressive tax reduction for 1983 than that legislated for 1982. At the top, the marginal rate of 50 percent was not lowered further. However, even top bracket taxpayers saw a further tax reduction as inframarginal rates were cut still further. Throughout the income distribution the lower rates of 1983 partially offset the value of the reductions of 1982 as the tax reduction value of IRA contributions and the two-earner deduction were reduced by the lower rates. On net, 1983 rules produced a 22 percent tax reduction relative to those prevailing before the tax cut.

The actual tax paid in 1983 was $8.3 billion higher than predicted by TAXSIM. Virtually this entire revenue response could be found in the top taxpayer group. This group, numbering nearly 200,000 taxpayers in 1983, paid $31.7 billion in tax instead of the predicted $23.5 billion. TAXSIM predicted that under the old set of tax rules, these taxpayers would have paid $29.0 billion in tax. As in 1982, it appears that these top bracket taxpayers paid more taxes under the new lower rates than was predicted they would pay under the higher set of tax rates of the old law.

Also, as in 1982, other taxpayer groups saw much more modest changes in their tax liability relative to prediction. It is useful to remember that for most

types of income, the constraints imposed in the baseline prediction mean that a behavioral response for top taxpayer groups will cause lower taxpayer groups to have a negative behavioral response. This is evident in the 1983 data where taxes paid by the bottom taxpayer group are lower than predicted. The revenue response for the middle two groups is probably also understated.

There is also substantial evidence that the 1983 TAXSIM revenue estimate is in line with Treasury calculations. The 1983 Budget of the United States estimated that the individual income tax provisions of ERTA would cost $82.3 billion in 1983. This compares with TAXSIM's estimate of $74.4 billion. The Treasury estimate is high in part because of excessive optimism about the state of the economy. Personal income was predicted to be $51 billion or 1.8 percent higher than it actually was that year. Although CBO estimates of the Treasury model's margin of error ended in 1982, it is reasonable to conclude from this budget data that the revenue response relative to the Treasury model's estimate was roughly as great as, or perhaps greater than, the response relative to the TAXSIM model.

3.1.5. 1984

The tax cut of 1984 involved a reduction in tax rates to 23 percent below their pre-cut levels from 19 percent in 1983. The IRA and two-earner deductions were continued at their 1983 levels. The third row in table 2 again shows the scheduled percent tax cut for all groups. The scheduled reductions averaged about 26 percent, with middle income groups again receiving the largest tax rate reduction.

A comparison of the predicted level of revenues with the actual taxes paid shows that about $17.8 billion more was collected than predicted by TAXSIM. Again, nearly all of this revenue response could be found in the top taxpayer group. These taxpayers actually paid $42.1 billion in taxes compared with the $27 billion predicted by TAXSIM. As in 1982 and 1983, the actual taxes paid by these taxpayers was more than TAXSIM predicted would have been paid under the old tax law.

The revenue response was also apparent in the second taxpayer group. Here, about $6.5 billion more was collected than predicted by the baseline. This amounted to about 21 percent of the tax cut scheduled for this group. Other taxpayer groups paid less than expected on net, with the most likely explanation being the constraints imposed by the baseline methodology.

In summary, the data regarding the revenue response indicate that about one-sixth of the total cost of ERTA over the period 1982–1984 was recouped. Due to the constraints imposed by the baseline methodology, this is likely to be an underestimate of the actual taxpayer response and it does not include any feedbacks from macroeconomic effects of tax reductions. If these factors

are considered, the net revenue cost of the 1981 bill to the Treasury was probably far less than predicted.

The data also show that the revenue collected from the top taxpayer groups was higher than the predicted level even given the old set of higher rates and more stringent definition of the tax base. This was true for each year after the reduction in the top rate to 50 percent. This strongly implies that the revenue maximizing top marginal tax rate is below the 70 percent level which existed under earlier law.

3.2. Tax rates and the tax base

The preceding section described the level of revenue expected and actually received from different taxpayer groups, This section explores that revenue relationship more closely by comparing changes in the size of the tax base – taxable income and the marginal tax rates imposed on the base. Table 3 shows the level of taxable income and the average marginal tax rates faced by taxpayers for a more detailed set of taxpayer groups.

Taxable income is the base on which the income tax is levied. It includes all forms of income, less adjustments for items such as Individual Retirement Accounts and the two-earner deduction and less the amount itemized deductions exceed the zero bracket amount. Taxable income is also exclusive of personal exemptions which depend on the number of people in the tax filing household.

The definition of taxable income changed over the period as provisions of the tax code changed. The primary cause of these changes was the increase in the two-earner deduction for married couples where both worked from 5 percent in 1982 to 10 percent in 1983 and 1984. In all cases, the baseline level of taxable income and the actual level of taxable income to which it is compared are based on the same definition. Furthermore, as noted above, the taxable income levels for any taxpayer group in any year are for identical numbers of taxpayers, identically situated in both the predicted and actual income distributions.

Two federal tax rates are also presented for each taxpayer group. The baseline rate represents the pre-tax cut tax rate which prevailed when the baseline income distribution was created. This rate tends to decline slightly over time within each taxpayer group because the group represents a relatively poorer set of taxpayers in later years than earlier years, and under a constant tax regime would have a correspondingly lower marginal tax rate. The new law tax rates represent the rates actually faced by the taxpayer group in the year specified. These rates also show a downward trend as a result of the statutory tax cuts taking place over the period.

It is interesting to note that in some cases the actual tax rate faced by a group is higher than the baseline rate. This is the result of 'bracket creep'

Table 3

Differential response of taxable income to rate cuts.

Taxpayer group and	year	Taxable income			Federal tax rate	
		Predicted	Actual	% change	Baseline	New law
1a	1982	10.79	14.89	+38.0	60.0	48.0
over	1983	12.59	19.73	+56.7	59.3	48.7
1000	1984	15.88	31.44	+98.0	59.1	48.4
1b	1982	8.38	11.04	+31.8	58.0	47.7
500–	1983	9.88	13.71	+38.8	58.5	49.4
1000	1984	11.01	17.52	+59.1	57.7	48.9
1c	1982	28.18	31.96	+13.4	55.2	48.6
200–	1983	31.34	36.60	+16.8	55.0	49.2
500	1984	37.15	45.31	+22.0	54.7	48.2
2a	1982	57.18	58.94	+3.1	50.8	48.2
100–	1983	61.99	63.72	+2.8	50.2	46.2
200	1984	74.23	78.87	+6.3	49.5	43.7
2b	1982	45.97	46.72	+1.6	46.1	45.5
75–	1983	54.18	54.35	+0.3	45.4	42.0
100	1984	67.04	68.58	+2.3	44.1	39.2
2c	1982	137.90	141.40	+2.5	39.3	39.9
50–	1983	163.40	166.10	+1.7	38.4	36.4
75	1984	210.70	216.60	+2.8	36.6	34.2
3a	1982	161.90	166.00	+2.5	32.6	34.4
40–	1983	180.30	181.30	+0.5	31.6	31.5
50	1984	210.00	211.70	+0.8	30.5	29.8
3b	1982	265.40	273.40	+3.0	28.1	29.2
30–	1983	284.90	288.40	+1.2	27.7	26.9
40	1984	304.40	306.30	+0.6	26.8	25.8
4a	1982	165.10	169.70	+2.8	24.9	26.3
25–	1983	162.50	163.10	+0.3	24.4	23.8
30	1984	172.00	168.20	−2.2	23.8	23.1
4b	1982	160.80	160.10	−0.4	23.0	24.4
20–	1983	168.90	161.10	−4.6	22.7	22.2
25	1984	170.60	161.60	−5.3	22.2	21.6
4c	1982	148.40	147.50	−0.6	20.5	21.4
15–	1983	158.50	151.00	−4.7	20.3	20.4
20	1984	170.50	161.90	−5.1	20.0	19.2
4d	1982	267.20	251.70	−5.8	11.9	12.1
under	1983	27.190	245.70	−9.6	11.9	11.4
15	1984	270.80	246.50	−9.0	11.2	10.8

overwhelming the effect of the statutory tax rate reductions. The rise in nominal income over the period caused taxpayers to enter higher tax brackets than the one they were in when their baseline behavior was observed in 1979. This effect is most pronounced in 1982, the first year of the tax cuts, and less pronounced in later years as the successive tax rate reductions compensated for more of the bracket creep of the period.

In all cases, the tax rate for each household represents a weighted average of the taxpayer's marginal rate on earned income and unearned income. Under old law, these differed due to two provisions: the earned income credit, available to low income taxpayers, and the maximum tax on earned income, which was available to upper income taxpayers.[2] Under the new law, the earned income credit was retained but the maximum tax was abolished. The weight assigned to the earned income rate was the share of wage, salary, and business or professional income in Adjusted Gross Income. The unearned rate was assigned the residual. Thus, the baseline tax rate for the top income groups was well below the statutory maximum rate of 70 percent, but above the 50 percent rate applying to some taxpayers' earned income.

For the sake of more complete analysis, an alternative set of tax rates was also computed for each taxpayer. This alternative set of rates included the effect of the Social Security Tax paid by the employee and state income taxes as well as the effect of the two-earner deduction provision for married couples under ERTA. In this alternative, the tax rate under old law was defined as

$$t_o = f_o + er_o + s_o(1 - df_o). \tag{8}$$

The federal tax rate in 1979, f_o, was the same as defined in table 3. The fraction of income represented by wages earned by someone under the social security tax ceiling wage is represented by e, and the social security tax rate prevailing in 1979 by r_o. The wages of husbands and wives were separated for computing effective social security taxes. Wage income for each spouse was computed from actual tax return data on this division by income class. A random number was assigned to each jointly filed tax return to determine the allocation of wages on that particular return based on the tax return data. A taxpayer with wages over the social security tax ceiling was modelled as being unaffected by the social security tax at the margin. The taxpayer's state tax rate was defined by s_o and is computed for each taxpayer given his state of residence by the TAXSIM state tax rate calculator.[3] The effect of this state tax is reduced by the deductibility of state taxes from federal taxable income for taxpayers who itemize their returns. Thus, defining d as the probability of a taxpayer in a given class itemizing, this deductibility effect can be computed.

The tax rate under new law, t_n, is provided by eq. (9):

$$t_n = f_n + er_n + s_n(1 - df_n) - gw(1 - f_n). \tag{9}$$

[2]For a more complete description of the effect of these provisions on effective marginal tax rates, see Lindsey (1981, 1983).

[3]Daniel Feenberg is the economist responsible for the creation of the TAXSIM state tax rate calculator.

In this case, f_n represents the federal tax rate under new law for the year being modelled. The effect of social security taxes is the same, except that the new social security tax rates, r_n, prevailing in each year are used and the effect of these on the margin, e, is based on the set of social security tax ceilings prevailing in each year. State taxes are computed in the same way, but updated to reflect the new state and federal tax rates. Finally, the effect of the two-earner deduction is modelled by the last term. The proportion of total income represented by the lower earning spouse's wages, conditional on those wages being below the $30,000 ceiling for deductibility, is represented by w. The amount of exclusion, 5 percent in 1982 and 10 percent in 1983 and 1984, is represented by g. This deduction is then valued at the marginal federal rate. The distribution of income between the spouses was determined by the same process as described above for determining social security taxes.

The set of tax rates obtained by this procedure is presented in table 4. The data show that the more comprehensive set of tax rates shows a less progressive tax system than the federal rates taken alone. The data also show that the effect of rising social security tax rates, higher state income tax rates, and bracket creep at the federal level overwhelmed the statutory tax rate reductions in the federal income tax for most taxpayer groups. Taxpayers with incomes below $50,000 faced higher rates in 1984 than did identically situated taxpayers in the baseline year of 1979. It should be noted, however, that in the absence of the tax cuts mandated by ERTA, the actual rates faced by these groups would have been even higher.

The net effect of all these tax rate calculations is to produce a marginal tax rate which assumes marginal equiproportionate increases in all forms of income received by the taxpayer. Implicit in this choice of tax rates is the assumption of no prior judgement regarding the response of different types of income to changes in marginal tax rates. Ex ante judgements regarding the elasticity of particular components of income with respect to tax rates would imply a different weighting scheme for the effective marginal tax rates.

3.3. Estimating the effect of tax rates on taxable income

The basic model used to estimate the effect of tax rates on taxable income was given by eq. (4) and illustrated in fig. 1:

$$Y_i/Y_i^* = F(1-t_i/1-t_i^*). \tag{4}$$

The theory described in the section does not provide any particular specification of the functional form for this analysis. In light of this, three sets of specifications are considered. First, consider the assumption that all taxpayers respond identically to equiproportionate increases in the share of income they can take home at the margin. In this case, a constant elasticity

Table 4

Combined federal, state, and social security tax rates.

Taxpayer group	Year	Total tax rate	
		Baseline	New law
1a	1982	62.0	50.4
over	1983	61.3	51.2
1000	1984	61.1	51.2
1b	1982	60.0	50.2
500–	1983	60.6	52.0
1000	1984	59.9	51.7
1c	1982	57.8	51.4
200–	1983	57.5	52.1
500	1984	57.2	51.2
2a	1982	53.8	51.4
100–	1983	53.3	49.6
200	1984	52.6	47.3
2b	1982	49.8	49.1
75–	1983	49.0	45.9
100	1984	47.9	43.5
2c	1982	43.5	43.9
50–	1983	42.8	40.9
75	1984	41.1	39.1
3a	1982	37.4	39.8
40–	1983	36.6	38.4
50	1984	36.0	38.2
3b	1982	35.4	38.0
30–	1983	35.0	36.1
40	1984	33.9	35.2
4a	1982	32.5	35.4
25–	1983	31.9	33.0
30	1984	31.1	32.6
4b	1982	30.8	33.5
20–	1983	30.2	31.5
25	1984	29.4	31.3
4c	1982	27.9	30.2
15–	1983	27.4	29.5
20	1984	26.8	28.5
4d	1982	17.9	19.7
under	1983	17.5	19.2
15	1984	16.6	18.7

model of taxpayer behavior, as shown by eq. (10), is implied:

$$Y_i/Y_i^* = (1 - t_i/1 - t_i^*)^{\beta}. \tag{10}$$

A logarithmic regression specification was chosen:

$$\ln(Y_i/Y_i^*) = \alpha + \beta \ln(1 - t_i/1 - t_i^*) + \varepsilon_i. \tag{11}$$

The interpretation of the intercept, α, is the proportionate increase in personal income caused by the response of taxpayers to lower tax rates. The coefficient, β, provides the percent change in the tax base for every 1 percent change in the share of marginal income the taxpayer is allowed to keep. It therefore represents the elasticity of taxable income with respect to the after-tax share.

However, the data described in table 3 suggest that the response of taxpayers to changes in their after-tax shares may rise with income. Two possibilities are considered: that the elasticity rises with natural log of income, and that the elasticity rises in direct proportion with income. A behavioral specification of the logarithmic assumption is given by eq. (12):

$$Y_i/Y_i^* = (1 - t_i/1 - t_i^*)^{\beta + \gamma \ln Y^*}. \tag{12}$$

The regression, again done in logs in order to calculate an elasticity, is

$$\ln(Y_i/Y_i^*) = \alpha + \beta \ln(1 - t_i/1 - t_i^*) + \gamma \ln Y^* \ln(1 - t_i/1 - t_i^*) + \varepsilon_i. \tag{13}$$

In this specification the intercept term has the same interpretation as above, but the elasticity of the tax base with respect to the after-tax share varies with income.

Finally, the possibility that the elasticity varies directly with income is considered. Behaviorally, the difference between this assumption and the logarithmic assumption involves whether taxpayer responsiveness rises with equal changes or equal proportional changes in income. The logarithmic assumption would imply that the change in the elasticity is the same between incomes of $20,000 and $40,000 as between incomes of $200,000 and $400,000. The alternative assumption is that the change in elasticity is 10 times as great between the latter two income levels as between the former two levels.

The equations describing the direct variation with income are presented below:

$$Y_i/Y_i^* = (1 - t_i/1 - t_i^*)^{\beta + \gamma Y^*}. \tag{14}$$

The regression, again done in logs in order to calculate an elasticity, is

$$\ln(Y_i/Y_i^*) = \alpha + \beta \ln(1-t_i/1-t_i^*) + \gamma Y^* \ln(1-t_i/1-t_i^*) + \varepsilon_i. \quad (15)$$

In each case the regressions were performed using the data presented above. The lowest income group presented on the earlier tables was broken into three groups: below \$5,000, \$5,000–\$10,000 and \$10,000–\$15,000, thus providing a total of 14 observations for each year of data. The data were segmented into a number of sets in order to examine the robustness of the results.

The results from the constant elasticity specification are presented in table 5. Table 6 presents the data from the regressions where the elasticity varies with the natural log of income, and table 7 presents the results where the elasticity varies directly with income. Each set of regressions uses the data from 1982, 1983, and 1984 separately from the three-year period 1982–1984 and from the five-year period 1980–1984. In each of the latter two cases regressions are run with and without dummy variables for the various years.

The various specifications show that the assumption that tax rates have an important effect on taxable income is robust. Under the constant elasticity specification the elasticity of taxable income to after-tax share ranges from 1.05 to 2.75 with most of the data suggesting an elasticity of between 1.6 and 1.8. In each case the elasticity with respect to the total tax rate is below the elasticity with respect to the federal rate alone. This is as expected. As total rates are higher than federal rates, a given percentage point change in the federal rate will cause a larger percent change in the marginal take home share after all taxes are included than after federal taxes alone are included.

The specification where elasticity varies with the log of income also shows a substantial elasticity for most levels of income. The results imply a positive elasticity of taxable income with respect to after-tax share in all cases for all income levels over \$17,350. In most of the regressions a positive elasticity is implied for all income levels over \$10,000. Thus, a positive elasticity is implied for the vast majority of the tax base. The average elasticity implied for taxpayers with incomes of \$50,000 is 0.728. This figure rises to 1.023 for taxpayers with incomes of \$100,000, 1.413 for taxpayers with incomes of \$250,000, and 2.003 for taxpayers with incomes of \$1,000,000.

The specification where elasticities vary directly with income suggests positive elasticities in excess of unity for all taxpayer groups. Again, an elasticity which rises with income is indicated, with elasticities roughly 1.5 for taxpayers earning between \$50,000 and \$200,000 and an elasticity of 1.9 for a taxpayer with income of \$1,000,000.

In each specification the R^2 term is roughly between 0.75 and 0.90, indicating that between three-quarters and nine-tenths of the variation in the data is explained by the regression. The R^2 terms are highest in the case

Table 5
Regression results: Constant elasticity specification.

Data used	Intercept	Elasticity	R^2
1982 only Federal rates	0.03 (0.013)	1.143 (0.129)	0.867
1982 only Total rates	0.018 (0.012)	1.053 (0.121)	0.864
1983 only Federal rates	−0.064 (0.017)	1.992 (0.188)	0.903
1983 only Total rates	−0.023 (0.018)	1.709 (0.192)	0.864
1984 only Federal rates	−0.089 (0.029)	2.750 (0.306)	0.871
1984 only Total rates	−0.014 (0.029)	2.285 (0.312)	0.817
1982, 1983 and 1984 Federal rates	−0.038 (0.015)	1.837 (0.158)	0.773
1982, 1983 and 1984 Total rates	−0.002 (0.014)	1.624 (0.145)	0.758
1982, 1983 and 1984 Federal rates Annual dummies	[a]	1.845 (0.161)	0.778
1982, 1983 and 1984 Total rates Annual dummies	[a]	1.625 (0.147)	0.764
1980–1984 Federal rates	−0.019 (0.009)	1.699 (0.122)	0.739
1980–1984 Total rates	0.002 (0.009)	1.570 (0.115)	0.734
1980–1984 Federal rates Annual dummies	[a]	1.801 (0.133)	0.757
1980–1984 Total rates Annual dummies	[a]	1.583 (0.122)	0.740

[a]Intercepts vary with year. See text for details.
Note: Standard errors in parentheses.

where the elasticity varies with the log of income and lowest when the elasticity is invariant to income. This strongly implies either that higher income taxpayers are more sensitive to after-tax shares than are lower income taxpayers, or that high income taxpayers have income which is more subject to taxpayer discretion than do other taxpayers.

The data also shows that regressions involving federal tax rates alone have higher R^2 values than regressions involving total tax rates. At first this may seem puzzling given an assumption of taxpayer rationality. But, there are a

Table 6

Regression results: Elasticity varies with log of income.

Data used	Intercept	Elasticity	R^2
1982 only Federal rates	−0.000 (0.012)	−1.72 + 0.211 ln Y (1.68) (0.124)	0.895
1982 only Total rates	0.007 (0.014)	−1.11 + 0.164 ln Y (1.41) (0.107)	0.888
1983 only Federal rates	−0.048 (0.016)	−2.84 + 0.354 ln Y (1.89) (0.138)	0.940
1983 only Total rates	−0.036 (0.015)	−2.58 + 0.328 ln Y (1.56) (0.119)	0.923
1984 only Federal rates	−0.051 (0.016)	−7.37 + 0.755 ln Y (1.68) (0.124)	0.970
1984 only Total rates	−0.047 (0.018)	−6.25 + 0.671 ln Y (1.68) (0.132)	0.946
1982, 1983 and 1984 Federal rates	−0.029 (0.014)	−3.58 + 0.402 ln Y (1.65) (0.122)	0.822
1982, 1983 and 1984 Total rates	−0.019 (0.014)	−2.56 + 0.322 ln Y (1.37) (0.105)	0.805
1982, 1983 and 1984 Federal rates Annual dummies	[a]	−3.92 + 0.426 ln Y (1.77) (0.328)	0.828
1982, 1983 and 1984 Total rates Annual dummies	[a]	−2.65 + 0.328 ln Y (1.40) (0.106)	0.812
1980–1984 Federal rates	−0.013 (0.008)	−3.82 + 0.410 ln Y (1.40) (0.104)	0.788
1980–1984 Total rates	−0.007 (0.009)	−2.17 + 0.285 ln Y (1.12) (0.085)	0.772
1980–1984 Federal rates Annual dummies	[a]	−3.87 + 0.419 ln Y (1.50) (0.11)	0.808
1980–1984 Total rates Annual dummies	[a]	−2.56 + 0.318 ln Y (1.16) (0.089)	0.784

[a]Intercepts vary with year. See text for details.
Note: Standard errors in parentheses.

number of explanations for this. First and foremost is that the within-group variation in tax rates is greater for the total tax rate measure than for the federal rate alone. Not only do taxpayers within any group face different state tax rates, they also face different social security tax rates depending on the sources of their income and their demographic characteristics.

An alternative explanation is that both taxpayers and tax advisers are more familiar with the implications of the federal tax code than with state law and the social security tax implications of taxpayer behavior. Reasons for

Table 7

Regression results: Elasticity varies directly with income.

Data used	Intercept	Elasticity	R^2
1982 only Federal rates	−0.003 (0.013)	0.970 + 1.62 Z (0.230) (1.79)	0.876
1982 only Total rates	0.016 (0.013)	0.864 + 1.93 Z (0.206) (1.71)	0.878
1983 only Federal rates	−0.055 (0.017)	1.556 + 4.24 Z (0.305) (2.43)	0.924
1983 only Total rates	−0.024 (0.015)	1.219 + 5.64 Z (0.268) (2.44)	0.912
1984 only Federal rates	−0.064 (0.022)	1.680 + 12.9 Z (0.358) (3.47)	0.943
1984 only Total rates	−0.019 (0.019	1.260 + 15.3 Z (0.310) (3.56)	0.932
1982, 1983 and 1984 Federal rates	−0.033 (0.015)	1.491 + 3.55 Z (0.261) (2.16)	0.787
1982, 1983 and 1984 Total rates	−0.004 (0.014)	1.260 + 4.26 Z (0.220) (2.08)	0.781
1982, 1983 and 1984 Federal rates Annual dummies	[a]	1.496 + 3.52 Z (0.273) (2.26)	0.792
1982, 1983 and 1984 Total rates Annual dummies	[a]	1.250 + 4.39 Z (0.230) (2.13)	0.788
1980–1984 Federal rates	−0.016 (0.009)	1.359 + 3.56 Z (0.209) (1.79)	0.753
1980–1984 Total rates	−0.001 (0.008)	1.230 + 3.93 Z (0.180) (1.70)	0.754
1980–1984 Federal rates Annual dummies	[a]	1.482 + 3.19 Z (0.227) (1.86)	0.768
1980–1984 Total rates Annual dummies	[a]	1.230 + 4.11 Z (0.190) (1.74)	0.761

[a]Intercepts vary with year. See text for details.
Notes: Standard errors in parentheses.
$Z = Y/10{,}000{,}000$.

this include a cognitive focus on the primary tax – the federal income tax, the existence of a national market in tax shelters which ignores state rates in its operation, and the fact that the social security tax rate overestimates the net effect of this tax by the present value of additional social security benefits earned at the margin.

The data also show that taxpayers were more sensitive to tax rate changes at the end of this period than at the beginning. An explanation of this is the

natural delay involved in rearranging portfolios and in renegotiating compensation arrangements. Still, the rising sensitivity over the period does not bode well for the hypothesis that the revenue response we observe is a temporary phenomenon.

4. Interpreting the results

The preceding section presented the results of three specifications of the response of taxable income to changes in after-tax shares. The elasticities indicated by the results of these regressions can be used to estimate the revenue maximizing tax rate and the intercept parameters can be used to estimate the extra income which resulted from the tax cuts.

4.1. The revenue maximizing tax rate

Analysis of the implication of the elasticity of taxable income with respect to after-tax shares for the revenue maximizing tax rate depends on the form of the tax rate schedule. Consider first a proportional income tax levied at rate t. If we define the elasticity coefficient from the regressions as η, the tax revenue from the proportional tax is a function of a taxpayer's endowment, X_i, and the prevailing tax rate, t, is given by:

$$T_i = tY_i = tX_i(1-t)^{\eta}. \tag{16}$$

The revenue maximizing tax rate in this case occurs when the tax rate is set at $1/(1+\eta)$.

Table 8 presents the values of the revenue maximizing rate indicated by the regression results. The data imply that the elasticity of taxable income with respect to the after-tax share varied with the income level of the taxpayer. As a result, table 8 shows the revenue maximizing tax rate at various income levels. Three values are shown for each revenue maximizing tax rate: maximum, average, and minimum. The maximum value corresponds to the smallest elasticity found in any of the regression specifications while the minimum value corresponds to the greatest elasticity value. The average value is computed by selecting the rate corresponding to the mean elasticity implied by the various regressions.

In a variable elasticity model with higher elasticities at higher levels of income, the revenue maximizing calculus depends on the distribution of income. A revenue maximizing government would calculate a tax rate where the revenue lost on higher income, more elastic, taxpayers is just offset by increased revenue on lower income, less elastic, taxpayers. As there is more revenue to be lost on each high income taxpayer than can be gained from each low income taxpayer, the revenue maximizing rate will be lower, for any

Table 8
Estimated ranges for revenue maximizing top marginal tax rate.

Income	Specification	Federal tax rate			Total tax rate		
		Max.	Av.	Min.	Max	Av.	Min.
1,000,000	Constant	46.7	34.9	26.7	48.7	38.0	30.4
	Log of income	45.4	33.3	24.6	46.4	34.1	24.9
	Income	46.9	34.5	25.2	48.6	36.3	26.4
250,000	Constant	46.7	34.9	26.7	48.7	38.0	30.4
	Log of income	52.3	41.4	33.2	51.9	40.9	32.7
	Income	49.7	39.2	33.3	52.3	42.8	37.9
100,000	Constant	46.7	34.9	26.7	48.7	38.0	30.4
	Log of income	58.2	49.4	42.9	56.2	46.9	40.4
	Income	50.4	40.3	35.6	53.1	44.5	41.4
50,000	Constant	46.7	34.9	26.7	48.7	38.0	30.4
	Log of income	63.6	57.9	50.3	60.0	52.7	49.8
	Income	50.6	40.7	36.4	53.4	45.1	42.8

given elasticity, than that implied by eq. (16). On the other hand, the results show that a variable elasticity model will predict a lower elasticity than a constant elasticity model.

An important qualification to this calculation must be stressed. This interpretation of the regression results for computing a revenue maximizing rate assumes a proportional income tax. It should be noted that a progressive tax would imply a lower revenue maximizing top marginal rate. The rate which maximizes revenue in the proportional case does so because all income, including inframarginal income, is taxed at that rate. Revenue maximization occurs when the marginal increase in tax revenue on inframarginal income due to a higher rate just offsets the marginal decrease in income from the higher rate. If inframarginal income is taxed at lower rates, revenue maximization would require a broader tax base and hence a lower tax rate.

Given the usual objective of income tax progressivity, the figures shown in table 8 represent upper bounds on the revenue maximizing rate. Lower rates on lower income taxpayers also mean that there are fewer low elasticity taxpayers on whom revenue can be gained to offset the revenue lost on high elasticity taxpayers at the top of the income distribution. This means that the revenue maximizing rate must be set at the rate appropriate to an income level which is higher than that suggested above, implying a still lower rate. Given the U.S. income distribution, and a desire to have lower rates on taxpayers with incomes below $50,000, a revenue maximizing rate should be set somewhere between the rate implied at a $250,000 income and that implied at a $1,000,000 income.

Given the data shown in table 8, this means that a top federal tax rate in the vicinity of 35 percent, and a total tax rate of about 40 percent, will produce the most revenue from income taxation. A more progressive tax system than that indicated by our current total tax burden would suggest revenue maximizing rates below these levels. Interestingly, the Tax Reform Act of 1986 mandates an effectively proportional tax for top bracket taxpayers, with both the average and marginal tax rates set at 28 percent, but with lower income taxpayers facing a marginal rate of 33 percent. This is consistent with the revenue maximizing objectives described above.

An important caveat must be added to these results. As noted in the Introduction to this paper, the revenue maximizing tax rate is not the socially optimal tax rate. Rather, it provides an upper bound on the optimal tax rate. In all likelihood there is an excess burden to the tax rate not captured by the response of the tax base. In this event, the socially optimal maximum tax rate is below the level suggested here.

4.2. Baseline bias and growth in personal income

Section 2 noted that the baseline income distribution was likely to be biased upward as it includes the behavioral feedback from the tax rate reductions. As the expected value of the ratio of actual to baseline taxable income for someone with no change in tax rates is zero, any deviation provides a measure of the amount of upward bias in the baseline. The regression results generally confirm the existence of this upward bias. The intercept term in the regressions represents the percent overstatement by the baseline when the intercept is negative, and the percent understatement by the baseline when the intercept is positive.

When 1982 data are run alone, no statistically significant intercept term emerges. The average value of all six intercepts implies an understatement by the baseline of 0.8 percent. On the other hand, 1983 data run alone produce four statistically significant intercepts out of six. The average value of these is −5.1 percent, while the average value of all six intercepts is −4.2 percent. The 1984 data show a similar result, with four statistically significant intercepts having an average value of −6.2 percent and all six intercepts averaging −4.7 percent.

When the data from 1982–1984 are run together without annual dummy variables, three of the six intercepts are significant with an average value of −3.3 percent, while all six intercepts average −2.1 percent. The addition of annual dummy variables, none of which is statistically significant, produces averages of −1.9 percent for 1982, −3.6 percent for 1983 and −0.8 percent for 1984.

The regressions involving all of the data from 1980 to 1984 have one statistically significant intercept of −1.9 percent and an average value of

−0.8 percent. The inclusion of annual dummy variables shows an average intercept of zero for 1980, an average value of +0.3 percent for 1981, and values of −1.7 percent, −3.5 percent, and −0.5 percent for 1982, 1983, and 1984, respectively.

The finding of a zero value for the intercept in 1980 confirms that the baseline replicated the actual result in a year where there was no tax change. The small positive value in 1981 implies an understatement of the true economic situation by the baseline. This would confirm the expectation, discussed in section 2, that taxpayers would delay income in 1981 until 1982 to take advantage of the known lower set of tax rates that year.

These findings do not support the contention that tax cuts by themselves produce any great surge in economic performance. However, they do suggest that some extra personal income is attributable to the behavioral effects of tax rate reductions. The fact that the intercept terms do not show substantially greater values in 1984 than in earlier years suggests that the tax cuts cause a sustained rise in the level of personal income, but only a temporary rise in the growth rate of that income. In effect, the extra factors of production which are bid into service by higher after-tax compensation to produce that income remain in place, but the finite amount of productive factors in society limits the total growth in output.

It is important to add that the finding of a negative intercept implies that the revenue response described earlier in the paper is an understatement of the true additional amount of revenue obtained from the rate reductions. If, as this data indicates, personal income is about 2 percent higher than it otherwise would have been, the income elasticity of the tax system would convert this into about 3 percent more revenue, or about $9 billion extra revenue each year. In the aggregate, therefore, about one-quarter of the non-behavioral cost of the tax bill was recaptured by the revenue response. In terms of the revenue loss from the rate reductions alone, the revenue response amounted to about one-third of the prospective cost.

4.3. Limitations on the data

The regressions described in this section implicitly ascribe all of the deviation between actual and baseline taxable income to the effect of rate reductions. It is important to recall that the baseline includes most, but not all, of the economic factors which might affect the distribution of income in a particular year. For example, although the baseline controls for the changes in the functional distribution of income in society, it does not control for possible changes in the distribution of individual components of income.

These changes may, on net, bias the baseline in either direction. For example, it is generally accepted that the deregulation of the banking industry and the advent of money market mutual funds extended market

rates of interest to a broader range of society and therefore made the distribution of interest income more equal. This would have the effect of having the baseline overstate the interest income at the top of the income distribution and therefore understate the behavioral response to the tax rate reductions. On the other hand, the rise in unemployment over the period may have had distributional consequences not captured by increasing the sample weights of tax returns reporting unemployment compensation.

Thus, the observation that all of the measured change in the distribution of taxable income is ascribed to changes in tax rates does not imply whether the actual behavioral response was greater than or less than that described in the present paper. The result hinges on whether the changes measured here were greater than or less than those that actually occurred.

References

Blinder, Alans S., 1981, Thoughts on the Laffer curve, in: Laurence H. Meyer, ed., The supply side effects of economic policy (Center for the Study of American Business, St. Louis).

Canto, Victor A., Douglas H. Joines and Arthur B. Laffer, 1981, Tax rates, factor employment and market production, The supply side effects of economic policy (Center for the Study of American Business, St. Louis).

Clotfelter, Charles T., 1983a, Tax-induced distortions and the business–pleasure borderline, The American Economic Review 73, 1053–1065.

Clotfelter, Charles T., 1983b, Tax evasion and tax rates: An analysis of individual returns, Review of Economic and Statistics 65, 363–373.

Clotfelter, Charles T. and Eugene Steuerle, 1981, Charitable contributions, in: Henry J. Aaron and Joseph A. Pechman, eds., How taxes affect economic behavior (The Brookings Institution, Washington, D.C.) 403–446.

Congressional Budget Office, 1983, Forecasting individual income tax revenues: A technical analysis (U.S. Government Printing Office, Washington, D.C.).

Deming, W. Edward and F.F. Stephen, 1940, On a least squares adjustment of a sampled frequency table when the expected marginal totals are known, Annals of Mathematical Statistics 11, 427–444.

Feldstein, Martin and Charles Clotfelter, 1976, Tax incentives for charitable contributions in the United States, Journal of Public Economics 5, 1–26.

Feldstein, Martin and Joel Slemrod, 1978, The lock-in effect of the capital gains tax: Some time series analysis, Tax Notes, Aug. 7.

Feldstein, Martin, Joel Slemrod and Shlomo Yitzhaki, 1980, The effects of taxation on the selling of corporate stock and the realization of capital gains: Reply, The Quarterly Journal of Economics 94, 777–791.

Fullerton, Don, 1982, On the possibility of an inverse relationship between tax rates and government revenues, Journal of Public Economics 19, 3–22.

Lindsey, Lawrence B., 1981, Is the maximum tax on earned income effective?, National Tax Journal 34, 249–255.

Lindsey, Lawrence B., 1983, Alternatives to the maximum tax on earned income, in: Martin Feldstein, ed., Behavioral simulation methods in tax policy analysis (University of Chicago Press, Chicago) 83–102.

Lindsey, Lawrence B., 1987, Capital gains rates, realizations, and revenues, in: Martin Feldstein, ed., Taxes and capital formation (University of Chicago Press, Chicago).

Minarik, Joseph, 1984, The tax shares boomlet, Tax Notes, June 11.

Office of Management and Budget, 1983, Budget of the United States: Fiscal year 1983 (U.S. Government Printing Office, Washington, D.C.).

Simonson, Kenneth, 1984a, Supply side tax changes: Do they soak the rich or sock it to the poor?, Tax Notes, June 11, p. 684.
Simonson, Kenneth, 1984b, A closer look at the 1981–82 tax changes, Tax Notes, Sept. 24, p. 1293.
Smith, Adam, 1776, The wealth of nations (J.M. Dent and Sons, Ltd., London).
Sunley, Emil, 1974, The maximum tax on earned income, National Tax Journal, Dec., 543–552.
U.S. Department of Treasury, Office of Tax Analysis, 1986, Report to Congress on the capital gains tax reductions of 1978 (U.S. Government Printing Office, Washington, D.C.).
Wyscarver, Roy A., 1982, The Treasury individual income tax simulation model (Office of Tax Analysis, Secretary of the Treasury, Washington, D.C.).