Equity: The Effects of Tax Reform on Progressivity Features of the Tax Structure

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Abstract

The impact of the Tax Reform Act of 1986 (TRA86) on equity is examined using a simulation program and statistical analysis. Specifically, a sample of tax returns was manipulated to calculate taxable income for 1987 and 1988. The results were then compared to determine the degree to which effective and average tax rates changed within discrete income levels. Using both t-tests and z statistics, the results confirm the hypothesis that the degree of progressivity has been affected by TRA86. A graphic analysis illustrates this change at various income levels for both the average and effective tax rates. These findings are significant for tax policy decision purposes.

Introduction

On October 22, 1986, the President signed into law the Tax Reform Act of 1986, enacting the most comprehensive federal tax package in more than four decades. The central focus of this legislation was base-broadening accompanied by a dramatic reduction in marginal tax rates. The Congressional conference reports indicate that the federal revenue raising burden will be shifted from the individual income tax to the corporate income tax. When Reagan assumed office, the maximum individual tax rate was 70 percent; subsequently, in 1981, the President signed into law the Economic Recovery Tax Act, reducing the top rate to 50 percent. The Tax Reform Act of 1986 lowered the individual income tax rate further, to a 33 percent ceiling (i.e., 28 percent with a 5 percent surcharge, eliminating the benefits of the 15 percent bracket and personal and dependency exemptions).

In 1982, 73 percent of the individuals surveyed by the National Opinion Research Center felt that they were overtaxed by the federal income tax system (Keene, p. 371). The Tax Reform Act of 1986 eliminates many tax shelters, limits the deductibility of losses and personal expenses, and places severe restrictions on investment transactions, resulting in the greatest share of income being susceptible to taxation since the mass tax was enacted in 1942 (Deloitte, Haskins, and Sells, p. 1). In addition to base-broadening, the 14-bracket rate structure has been replaced by a structure composed of two brackets and a five percent surcharge. Although the marginal tax rates have been reduced, the tax base is now more broadly defined.

There are three characteristics present in an effective tax system: economic efficiency, equity, and administrative ease. This study, ignoring the effects of recent tax reform on efficiency and ease of administration, examines the impact of the Tax Reform Act of 1986 on equity. Progressivity of the income tax rate structure, which is generally accepted as a method to achieve vertical equity, is perceived as being a desirable attribute of the United States' tax system. Congressional reports stated that the same degree of progressivity would be present under the new law as existed under prior law. This study examines this hypothesis.

Literature Review

Over the years, scholars have addressed the issue of equity in the federal tax system. Current literature tends to investigate the optimal progressivity of the federal income tax (e.g., Sandmo). The U.S. tax system has employed progressive individual tax rates since the institution of the income tax in 1913. A heavy reliance on Adam Smith's concept of the ability to pay has apparently resulted in Congress accepting progressivity as fair:

the subjects of every state ought to contribute towards the support of the Government, as nearly as possible in proportion to their respective abilities... <p. 193, emphasis added

Every major change in the income tax structure has raised concerns about the effects on both horizontal and

vertical equity. Horizontal equity requires equal tax treatment for individuals in equal positions. Vertical equity implies differential treatment among individuals in unequal positions (i.e., individuals with a greater ability should pay more). Regressivity, even proportionality, is considered undesirable (e.g., Bradford). The rich are deemed able to bear more of the burden since they have more disposable income remaining after the purchase of necessities; thus, only a progressive rate structure theoretically provides vertical equity.

However, while Congress maintains that under the Tax Reform Act of 1986 at least the same degree of progressivity exists, these researchers do not concur. Because of the conflicting theories about vertical equity, this research relies on theories of progressivity. The primary issue under investigation is the relationship between tax and income. Ancillary issues are intentionally being ignored.

The literature on equity provides a rich source of information upon which to build a theoretical underpinning for this study. Joel Slemrod argues that

any choice of tax system almost inescapably involves a judgement about values. Because it is unlikely that in the choice between two tax systems one system will be preferred by all members of society, the gains of some households must be balanced against the losses of others.... Thus, no consensus optimal income tax schedule can ever be expected to emerge... (T)he choice of progressivity is reduced to its fundamental components: facts about the inequality in the distribution of endowment, behavioral response parameters which are subject to econometric investigation, and value judgements (pp. 361-362).

Much research has been conducted in an attempt to determine the optimal degree of progressivity; however, conflicting results have been achieved. In the pioneering effort, Mirrlees chose a tax schedule which maximized social welfare. He determined that the optimal marginal tax rates lie between 0 and 100 percent. Sadka concluded that the top marginal rate should be zero. Slemrod provides a useful argument in considering vertical equity.

Consider an income tax system in which the marginal tax rate applicable to the highest observed income is positive. Now consider a second tax schedule which is identical to the first except that it allows the highest-earning household to pay no taxes on any excess of income it had previously decided not to make the effort to earn, partly because of the tax due on the additional income. When faced with the second tax schedule, this household is certainly better off, works more hours, and pays no less tax than under the first tax schedule. Thus, the highest-earning household is better off under the zero marginal tax rate scheme, and all other households are also at least as well off (they may be strictly better off if the increased tax revenue from the

highest-earning household allows a reduction in tax rates in the lower brackets). A simple explanation is that raising the marginal tax at the top from zero distorts the labor supply decision of the highest earner but raises no revenue (p. 363).

Certainly arguments also exist in support of a proportionate income tax schedule. For instance, Robert Willan calls attention to several morality issues regarding progressivity:

Because of the benefits that middle- and lower-income taxpayers realize, at the expense of higher income taxpayers from the use of progressive rates, it is tempting to rationalize acceptance of the status quo. This is the essence of the socialist morality that there should be a redistribution of income and wealth from the more affluent members of society to the rest of society, which is one of the results of shifting tax burdens to people with greater income or wealth (p. 14).

Agreement as to what constitutes vertical equity is elusive. Musgrave provides an accepted measure of vertical equity: taxpayers with different abilities should pay different amounts of tax in order that they <u>experience equal burdens</u>. So, vertical equity can be measured to the extent that progressivity has been achieved.

Method of Investigation

This study employed various statistical analyses in order to assess the impact of TRA86 on equity. In general, a statistical comparison of gross incomes, taxable incomes, tax liabilities, and tax rates under new and prior law has been made. Specifically, 1982 tax return data were utilized. From the information available on these returns, a computer program was written to simulate 1987 and 1988 tax returns for the taxpayers in the pre-1986 sample. Then, ceteris paribus, tax return information can be aggregated by income level to draw conclusions about the equity of the post-1986 tax system, particularly the progressivity features.

The methodological approach taken was to calculate gross income, taxable income, tax liability, and average (tax/taxable income) and effective (tax/gross income) tax rates for 1987 and 1988. The presence of progressivity was determined by comparing taxes paid by income level. Ignoring inflation, tax return items affected by TRA86, other than those indicated in the "Limitations" section of this paper, were appropriately adjusted. For instance, adjustments were made for the current nondeductible status of IRAs (for most taxpayers), the limitations on employee business expenses, and the reduction in personal consumer interest expense deductions.

Exhibit 1 presents the information on which the hypothesis was derived: changes in the number of income tax

Exhibit 1
CHANGES IN TAX RATES, EXEMPTIONS AND STANDARD DEDUCTION

Filing Status	Number of Tax Rates	Minimum Tax Rate	Maximum Tax Rate	Min. TI Max. Rate	P & D Exemption	ZBA/ Std.Ded.
JOINT						
1982	12	12	50	$85,600	$1,000	$3,400
1986	15	11	50	175,250	1,080	3,670
1987	5	11	38.5	90,000	1,900	3,760
1988	2	15	28	29,750	1,950	5,000
HEAD OF HOUSEHOLD						
1982	12	12	50	60,600	1,000	2,300
1986	15	11	50	116,870	1,080	2,480
1987	5	11	38.5	80,000	1,900	2,540
1988	2	15	28	23,900	1,950	4,400
SINGLE						
1982	12	12	50	41,500	1,000	2,300
1986	15	11	50	88,270	1,080	2,480
1987	5	11	38.5	54,000	1,900	2,540
1988	2	15	28	17,850	1,950	3,000
MARRIED FILING SEPARATELY						
1982	12	12	50	42,800	1,000	1,700
1986	15	11	50	87,625	1,080	1,835
1987	5	11	38.5	45,000	1,900	1,880
1988	2	15	28	14,875	1,950	2,500

brackets and the range of marginal tax rates. Additionally, increased personal and dependency exemptions and standard deductions affected the tax system's progressivity.

The data being used in this study are contained in an Internal Revenue Service sample of individual tax returns made available through an Arthur Young Tax Research Grant at the Paton Accounting Center of the Graduate School of Business Administration at the University of Michigan. The initial data files were acquired from the Statistics of Income Division of the IRS. The files pertinent to this research are the approximately 85,000 returns contained in the 1982 SOI sample. The SAS statistical package was used as the data base management vehicle.

A sample of 32,689 returns was extracted for use in this study. The entire population was considered; however, individual returns having variables that do not lend themselves to correction (e.g., alternative minimum tax, children with unearned income, schedules C or F) were discarded from the sample. The sample of returns was stratified according to income levels, facilitating comparison of progressivity within and across levels of income. Income was defined and stratified using three methods: gross income, taxable income, and income in the marginal tax bracket.

Once the 1987 and 1988 tax return information was recomputed as necessary, the hypothesis that progressivity has been virtually eliminated was examined using four approaches. First, a paired difference t-test was employed. In the analysis of the hypothesis, pairing was a logical step. Pairing assumes that observations (A1, A2, ... AN) and (B1, B2, ... BN) are correlated; appropriately, the differences were calculated: $d1 = A1-B1$. Then, the means of those differences, μ, were estimated. The procedure used was to calculate each $t=d/s$. Rejection of the null hypothesis, Ho: $\mu=0$, then, supports the theory that the degree of progressivity has been reduced by TRA86.

In addition, multiple regression techniques were utilized to analyze the slope of the function:

Tax Liability = f (Income Level),

thus assessing the change in tax rates (average and effective). Third, z tests comparing the slopes of these estimating

equations were utilized to determine if the change in progressivity was significant. A z test was used because this test statistic has a standard normal distribution regardless of the distribution of the population because the same mean is normally distributed given a sufficiently large sample. Finally, estimating equations and scatter diagrams were used to examine each tax year, superimposing the results for comparative purposes.

Results

In this study, statistics for the entire sample, as well as separate statistics for groups of observations in the data set, were computed. Sample estimates of the true parameters were obtained for the variables, including the mean, variance, standard deviation, and range, for 20 income levels (each level representing $10,000 of AGI). The means and standard deviations for these three variables are presented by year and gross income level in Exhibit 2.

T-tests were employed to test the hypotheses that the population mean differences in tax rates were 0. Paired comparisons were made within income levels. The results for income levels, including the probability of a greater absolute value of "t", are presented in Exhibit 3. The results indicate an overwhelming rejection of the null hypothesis that the mean difference in pre- and post-TRA 1986 federal income tax rates is not significantly different from zero for any income level. Comparable results were obtained using marginal tax rates.

Another measurement device utilized in this study was a graphical examination of the difference between effective tax rates before and after TRA86. The visual results of this examination are as conclusive as the aforementioned statistical results. Exhibit 4 presents an overview of the results of graphing the estimating equations derived using regression analysis. The three years examined are superimposed on Tax Rates as a function of Income Level. Again, the results confirm the conclusion that the rates differ within an income level across years and that the progressivity of the U.S. tax structure has been greatly reduced, almost to proportionality. This fact is particularly obvious as income increases (the income tax is nearly regressive).

Exhibit 5 summarizes the estimating equations graphed in the previous exhibit. Exhibit 5 does provide additional information in that actual decreases in the slopes are more apparent. Extremely high F values were obtained (i.e., the lowest was 71.65) and relatively strong coefficients of determination (R^2) were realized, the lowest being .69. The R^2s are presented with the estimating equations in Exhibit 5.

Because distributional effects depend both on the degree of progressivity (i.e., the rate of increase in the ratio of liability to income for increases in income) and on the

level of taxation with respect to the underlying distribution of income, Exhibit 6 is presented. As increasingly higher-income taxpayers are accumulated, disposable income climbs with a slope greater than 1. This phenomenon is particularly noticeable in the top three income levels in which 16 percent of the households have 86 percent of the disposable income and pay 88 percent of the individual income tax. Compare that to the three bottom income groups representing 45 percent of the households, with 1.22 percent of the disposable income and pay .63 percent of the total income tax. The underlying data for this graph are presented in Exhibit 7.

An examination of the actual observations of tax rates at given income levels leads to a conclusion consistent with that drawn from the estimating equations. It is, however, apparent that there were proportionately higher tax rates for upper income taxpayers under old law. Because there was not a comparable reduction of tax rates under TRA86 for lower income taxpayers, the progressivity of the system has obviously been altered. Similarly, clusters of observations at different income levels appear at a single tax rate, suggesting the presence of a modified flat rate tax.

It is evident that the slopes of the regression equations have changed and, to be precise, have decreased, but is there a significant decrease? The final tool used to examine the progressivity features of the current tax system relative to the pre-TRA86 structure was a Z test. For each set of equations presented in Exhibit 5 and depicted graphically in Exhibit 4, a Z test was used to determine the change in the slopes of the tax rates. The results confirm the hypothesis that progressivity has changed, as indicated by the minimum Z value of -14.22. Indeed, the negative sign would indicate a decrease in progressivity. The Z test results are presented in Exhibit 8. Using this information in combination with previous analyses, the conclusion is apparent that progressivity has been diminished.

Limitations

The limitations of this study are numerous; however, the impact on the results is probably negligible. A discussion of the data-imposed limitations is contained in this section. These limitations can be categorized into four topics: absence of break-downs among types of income and expenses on tax returns, lack of availability of 1986 data, difficulty in stratifying taxpayers by income level when income levels may have changed, and complexity of programming tax laws and corresponding changes therein.

It was impossible to determine the nature of the income and expenses from tax return information; so, items such as private activity bond interest income and third home mortgage interest expense deductions could not be determined from 1982 tax return information. Because of the importance of classifying income under TRA86 some

EXHIBIT 2
RESULTS OF ANALYSES OF TAX RATES:
MEANS AND STANDARD DEVIATIONS

ADJUSTED GROSS INCOME LEVEL:		EFFECTIVE TAX RATE 1982	1987	1988	AVERAGE TAX RATE 1982	1987	1988
1	MEAN	.0286	.0159	.0142	.0741	.0504	.0513
	S.D.	.0337	.0238	.0236	.0675	.0595	.0711
2	MEAN	.0912	.0655	.0621	.1517	.1263	.1364
	S.D.	.0409	.0325	.0344	.0343	.0325	.0431
3	MEAN	.1245	.0904	.0884	.1832	.1451	.1515
	S.D.	.0420	.0300	.0277	.0307	.0165	.0139
4	MEAN	.1396	.1015	.1008	.2031	.1515	.1550
	S.D.	.0416	.0296	.0263	.0318	.0200	.0160
5	MEAN	.1548	.1178	.1146	.2260	.1663	.1638
	S.D.	.0473	.0339	.0292	.0382	.0256	.0210
6	MEAN	.1764	.1376	.1352	.2541	.1881	.1855
	S.D.	.0504	.0355	.0352	.0377	.0251	.0259
7	MEAN	.1848	.1563	.1520	.2720	.2103	.2046
	S.D.	.0634	.0403	.0389	.0514	.0280	.0295
8	MEAN	.2002	.1724	.1631	.2890	.2286	.2165
	S.D.	.0752	.0454	.0416	.0670	.0287	.0289
9	MEAN	.1976	.1820	.1754	.2959	.2409	.2310
	S.D.	.0874	.0490	.0505	.0758	.0312	.036
10	MEAN	.2191	.1962	.2000	.3209	.2566	.2586
	S.D.	.0850	.0416	.0475	.0731	.0235	.0334
11	MEAN	.2436	.2076	.2144	.3447	.2703	.2771
	S.D.	.0892	.0464	.0470	.0747	.0246	.0280
12	MEAN	.2728	.2270	.2282	.3789	.2904	.2903
	S.D.	.0878	.0501	.0442	.0602	.0305	.0267
13	MEAN	.2735	.2437	.2380	.3792	.3068	.2981
	S.D.	.1065	.0510	.0425	.0971	.0231	.0168
14	MEAN	.2783	.2545	.2441	.3944	.3183	.3035
	S.D.	.1043	.0456	.0370	.0916	.0232	.0184
15	MEAN	.3005	.2633	.2461	.4082	.3247	.3021
	S.D.	.1066	.0529	.0414	.0878	.0291	.0211
16	MEAN	.3057	.2720	.2468	.4138	.3315	.2996
	S.D.	.1111	.0520	.0412	.0944	.0319	.0268
17	MEAN	.3120	.2882	.2452	.4211	.3462	.2935
	S.D.	.1246	.0583	.0435	.1160	.0327	.0326
18	MEAN	.3473	.3085	.2455	.4579	.3645	.2884
	S.D.	.1118	.0490	.0344	.0870	.0182	.0112
19	MEAN	.3479	.3174	.2463	.4589	.3713	.2856
	S.D.	.1224	.0471	.0326	.1042	.0149	.0113
20	MEAN	.3708	.3220	.2429	.4779	.3784	.2830
	S.D.	.1148	.0526	.0364	.0822	.0040	.0016

EXHIBIT 3

RESULTS OF t-TEST:
DIFFERENCES IN TAX RATES ANALYZED
USING 1987 ADJUSTED GROSS INCOME LEVEL

1987
ADJUSTED GROSS
INCOME LEVEL   AVERAGE TAX RATE

	Mean Difference	1982-87 t* score	Mean Difference	1982-88 t* score
1.	0.02371	39.29	0.02287	30.19
2.	0.02539	57.53	0.01529	25.07
3.	0.03817	110.59	0.03171	76.88
4.	0.05159	110.22	0.04808	95.43
5.	0.05971	73.86	0.06220	75.91
6.	0.06594	105.79	0.06861	106.17
7.	0.06171	42.42	0.06737	44.86
8.	0.06046	22.33	0.07251	25.95
9.	0.05504	14.58	0.06490	16.50
10.	0.06428	16.33	0.06225	15.00
11.	0.07442	33.47	0.06766	30.27
12.	0.08854	37.70	0.08856	36.78
13.	0.07244	13.94	0.08114	15.53
14.	0.07607	14.79	0.09084	17.60
15.	0.08344	25.85	0.10607	32.05
16.	0.08228	19.97	0.11423	27.25
17.	0.07496	27.12	0.12767	45.49
18.	0.09345	45.03	0.16954	80.73
19.	0.08762	21.70	0.17335	42.98
20.	0.09944	65.54	0.19485	127.74

* All t-values are significant at .0001.

1987
ADJUSTED GROSS
INCOME LEVEL   EFFECTIVE TAX RATE

	Mean Difference	1982-87 t* score	Mean Difference	1982-88 t* score
1	0.01263	60.20	0.01431	60.73
2	0.02563	84.62	0.02906	89.44
3	0.03410	95.02	0.03606	92.55
4	0.03806	73.55	0.03884	70.69
5	0.03701	41.17	0.04018	43.84
6	0.03877	51.67	0.04118	52.93
7	0.02854	17.52	0.03281	19.58
8.	0.02778	10.58	0.03711	13.69
9	0.01558	3.92	0.02217	5.44
10	0.02280	5.36	0.01905	4.34
11	0.03601	15.82	0.02923	12.70
12	0.04578	15.81	0.04456	14.78
13	0.02988	5.76	0.03558	6.77
14	0.02381	4.34	0.03423	6.11
15	0.03715	10.53	0.05438	14.88
16	0.03371	7.48	0.05896	12.72
17	0.02382	8.44	0.06673	23.35
18	0.03881	15.84	0.10180	40.59
19	0.03047	6.80	0.10159	22.40
20	0.04884	27.25	0.12797	68.33

* All t-values are significant at .0001.

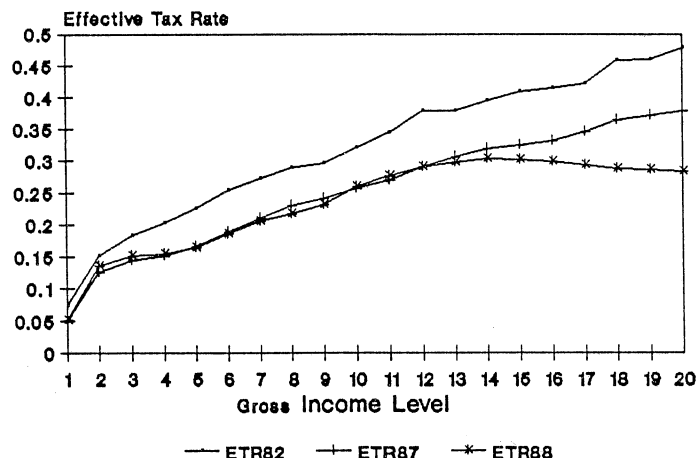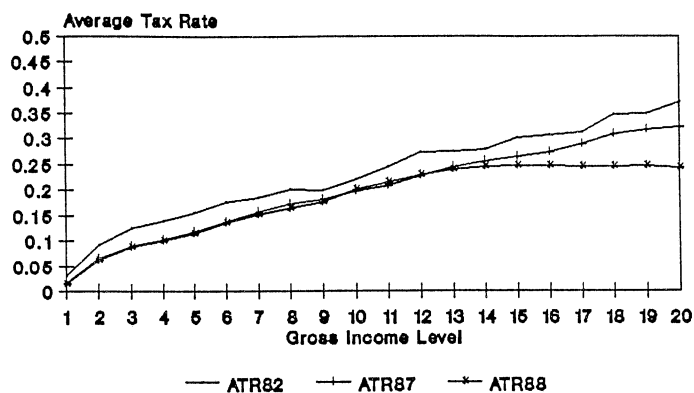## Exhibit 4
Superimposed Graphs of Estimating Equations

Average Tax Rate — ATR82, ATR87, ATR88 vs Gross Income Level

Effective Tax Rate — ETR82, ETR87, ETR88 vs Gross Income Level

Exhibit 5
ESTIMATING EQUATIONS

Model:	Year	Intercept	Slope	R^2
ETR = f(GIL)	1982	.0511	.0165	.69
	1987	.0284	.0155	.86
	1988	.0377	.0120	.79
ATR = f(GIL)	1982	.1001	.0200	.79
	1987	.0744	.0162	.88
	1988	.0927	.0116	.70
ETR = f(TIL)	1982	-.0472	.0260	.80
	1987	-.0179	.0314	.91
	1988	-.0072	.0286	.88
ATR = f(TIL)	1982	.0359	.0302	.90
	1987	.0055	.0234	.91
	1988	.0589	.0231	.84
ETR = f(MTB)	1987	-.0335	.0208	.73
	1988	-.0219	.0175	.78
ATR = f(MTB)	1987	.0046	.0224	.78
	1988	.0275	.0178	.77

Legend: ETR = Effective Tax Rate; ATR = Average Tax Rate; GIL = Gross Income Level; TIL = Taxable Income Level; MTB = Marginal Tax Bracket.
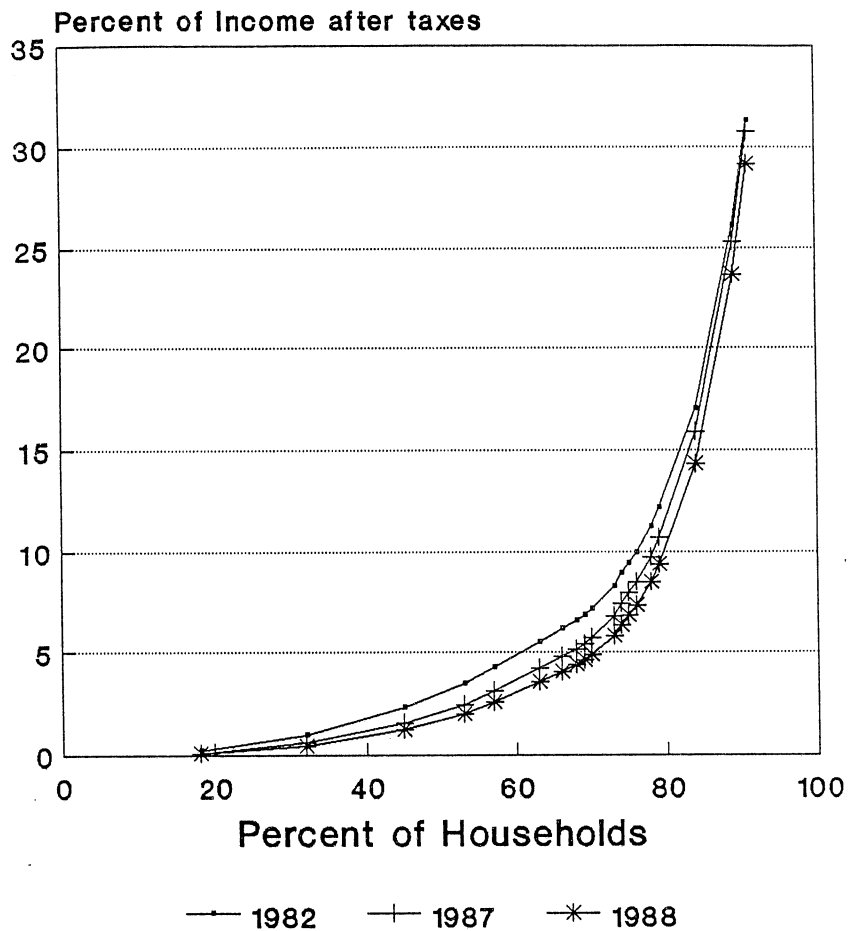
EXHIBIT 6

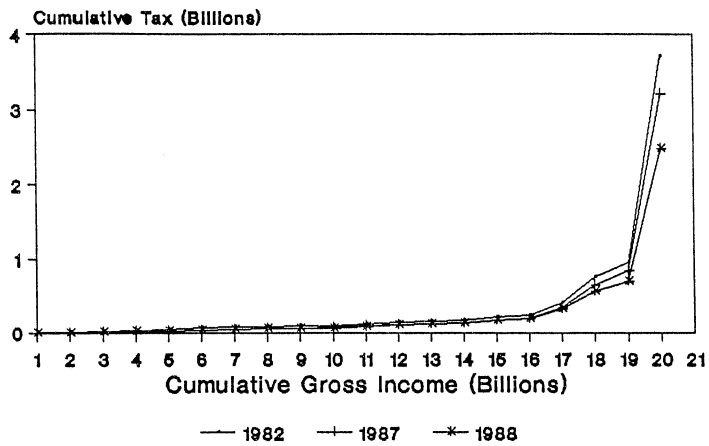**Percent of Income after taxes**

Percent of Households

—— 1982   —+— 1987   —*— 1988

EXHIBIT 7

Cumulative Tax (Billions)

Cumulative Gross Income (Billions)

—— 1982   —+— 1987   —*— 1988

Exhibit 8
RESULTS OF Z STATISTIC

GIL = Independent Variable

Dep.Var.	R=E(slope)	Std. Dev.	Dep.Var.	R=E(slope)	Std.Dev.	Z(R-L)
ETR82	0.01647167	0.00006154	ETR87	0.01547197	0.00003394	- 14.22
ETR87	0.01547197	0.00003394	ETR88	0.01203739	0.00003423	- 71.25
ETR82	0.01647167	0.00006154	ETR88	0.01203739	0.00003423	- 62.97

GIL = Independent Variable

ATR82	0.01996977	0.00005731	ATR87	0.01622231	0.00003362	- 56.40
ATR87	0.01622231	0.00003362	ATR88	0.01161887	0.00004232	- 85.17
ATR82	0.01996977	0.00005731	ATR88	0.01161887	0.00004232	-117.22

MTB82 = Independent Variable

ETR82	0.02597898	0.00007252	ETR87	0.02078852	0.00007032	- 51.38
ETR87	0.02078852	0.00007032	ETR88	0.01752745	0.00005113	- 37.51
ETR82	0.02597898	0.00007252	ETR88	0.01752745	0.00005113	- 95.25

MTB82 = Independent Variable

ATR82	0.03135495	0.00005578	ATR87	0.02237455	0.00006605	-103.88
ATR87	0.02237455	0.00006605	ATR88	0.01782970	0.00005446	- 53.09
ATR82	0.03135495	0.00005578	ATR88	0.01782970	0.00005446	-173.50

inaccuracies are inherent; however, precautions were taken to eliminate many of these errors. For example, all income from Schedule E was assumed to be passive.

Ideally, this study would compare 1986 to 1987 and 1988 rather than using 1982 returns which have undergone additional reform; however, the rate structures are comparable. If anything, using 1982 information is more conservative when measuring changes in progressivity (see Exhibit 2).

Some taxpayers changed taxable income level groups under new law; therefore, they would either skew their original income level groups or they would not be compared to individuals in their original groups, thus distorting the statistical results. Instead, taxpayers were assigned to groups based on calculations of their 1987 and 1988 incomes.

Distortion of returns with the following characteristics was problematic: schedules C or F, dependents with unearned income, and irregular filing status. These returns were completely eliminated from the sample.

Additional problems which apparently had little impact on this particular research include: utilization of constant dollars, changes in alimony rules were ignored, assumption of no behavioral changes, and insufficient data to determine the alternative minimum tax.

Conclusions

The primary examination in this study was whether vertical equity was lost with enactment of TRA86. This study demonstrates that although many deductions were eliminated and loopholes closed, progressivity has been sacrificed. The results of each of the statistical analytical methods employed in this study indicate the same result: the current U.S. tax system is less progressive than the pre-TRA '86 structure and, indeed, is nearly proportionate (i.e., flat). On average, the progressivity factor (i.e., the slope of the tax rate variable) has declined 7 percent for 1987 and 21 percent for 1988. In fact, both the effective and average tax rates actually decrease at upper income levels.

These findings are significant for tax policy decision purposes. This study makes no attempt to determine the optimum degree of progressivity. It has merely shown that there is significantly less progressivity in our present tax system than there was prior to 1987. If vertical equity is held to be a desirable attribute, then a return to more steeply graduated tax rates at upper income levels would seem to be indicated. The enactment of the Revenue Act of 1987 may require further examination of these issues due to the imposition of an increase in the top marginal tax rate. Further research is needed to assess the impact of this and likely future increases.

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