1043

97th Congress
1st Session

JOINT COMMITTEE PRINT

MARGINAL TAX RATES, SAVING, AND FEDERAL GOVERNMENT DEFICITS

A STAFF STUDY

PREPARED FOR THE USE OF THE

SUBCOMMITTEE ON MONETARY AND FISCAL POLICY

OF THE

JOINT ECONOMIC COMMITTEE

CONGRESS OF THE UNITED STATES

JULY 9, 1981

Printed for the use of the Joint Economic Committee

U.S. GOVERNMENT PRINTING OFFICE
81-132 O WASHINGTON: 1981

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

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LETTER OF TRANSMITTAL

JULY 6, 1981.

Hon. HENRY S. REUSS,
Chairman, Joint Economic Committee,
Congress of the United States, Washington, D.C.

DEAR MR. CHAIRMAN: I am pleased to transmit herewith a staff study prepared for the Joint Economic Committee entitled "Marginal Tax Rates, Saving, and Federal Government Deficits."

Much of the opposition to the Reagan Program for Economic Recovery rests on the claim that it is based upon "untested economic theories" and on the fear that cuts in personal tax rates will contribute to a widening of budget deficits and thereby add to inflationary pressures.

This study shows that these fears are unfounded. It shows that a 10 percent cut in marginal tax rates will result in a 9.89 percent increase in personal saving. Just as important, the study shows that increases in personal saving will pay for the fiscal 1983 budget deficit. Increases in personal saving will relieve pressure on the Federal Reserve to increase the money supply while at the same time preventing a collision of private and Federal credit demands. This will go a long way toward reducing upward pressures on interest rates.

The results of this study confirm what I have always known: People respond to incentives. Higher taxes on additional income discourage work effort and saving; lower taxes mean more work and more saving. Lower marginal tax rates mean a larger pool of saving, lower inflation and interest rates, more jobs, and faster private sector growth. Tax rate cuts are not only desirable, they are essential to the growth and vitality of the Nation's economy.

Sincerely,

ROGER W. JEPSEN,
Chairman, Subcommittee on Monetary and Fiscal Policy.

FOREWORD

By Senator Roger W. Jepsen

One of the central concerns about supply-side economics is that short-run deficits will result from the significant tax cuts it recommends. In the public's opinion, those deficits are extremely worrisome because deficits can lead to more inflation and higher interest rates. With inflation and interest rates already high, the public's concern about deficits is well placed.

However, there is little mention of the important role of saving in relation to the deficit. If savings are insufficient, deficits must be paid for or financed by printing more money or by displacing some private business ventures. If the personal marginal tax rate cuts now before Congress significantly increase saving such that they offset the short-run deficits, then the short-run deficits are benign. The purpose of this staff study is to measure how cuts in marginal tax rates affect personal saving.

This staff study shows, in no uncertain terms, that the short-run deficits that result from the bipartisan tax package will not, by themselves, cause inflation or interest rates to rise. The study shows that personal marginal tax rate cuts, of the same magnitude as those contemplated by the bipartisan tax cut now before Congress, will significantly raise personal saving. In fact, the response is so strong that the deficit in fiscal year 1983 will be covered, or financed, by the increase in personal saving. Consequently, there is no reason for more money to be printed to cover the deficit.

This is a dramatic finding, but it is one of which we can be most confident. At every step of the study, the authors chose the most constrained and conservative method of determining the relationship between changes in personal marginal tax rates and changes in personal saving.

The findings of this study support a basic linkage in supply-side economics; that is, that saving is responsive to changes in marginal tax rates.

The findings also show that those doomsayers who preach a "go-slow" approach to our mounting economic problems because of inflation and interest rates have not a leg on which to stand. We should no longer fear their counsel nor listen to their judgments. We should start listening to the American people who have been telling Congress what to do since last November.

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MARGINAL TAX RATES, SAVING, AND FEDERAL GOVERNMENT DEFICITS

By Timothy P. Roth and Mark R. Policinski*

I. INTRODUCTION

During the past decade, Americans became less economically secure. Though constant and high unemployment, skyrocketing inflation and high and volatile interest rates have led to a weakening of the financial position of workers and families, the real threat to the security of Americans was the inescapable fact that formal Federal economic policy was unable to correct the country's economic problems. For most Americans, it was their first experience of not having control of their own economic destiny.

It is in this atmosphere that supply-side economics has had its advent or, more accurately, its rebirth; for supply-side economics is nothing more than a modern restatement of neoclassical theory. Today, its most basic economic and political message is that our economic problems are caused by faulty economic policies and that, therefore, we can control our own economic destiny.

While it would seem that such a positive approach would be welcomed by a beleagured country, it must be remembered that supply-side economics calls for a radical change in economic policy. Because it has called into question much of the traditional Keynesian economic theory that has guided this country's economic policy for the past five decades, the evolution of the supply-side movement has been met with a great amount of criticism.

There is no more dramatic example of the difference between supply-side economics and Keynesian economics than the issue of saving.

In Keynesian theory and policy practice, little importance is placed on saving. It is a residual of the consumption decisions thought to drive individuals and the economy. In fact, this economic theory postulates that government spending has a more powerful effect on the economy than do tax cuts because none of the spending by government is saved, whereas a portion of a tax cut is put into savings.

On the other hand, supply-side economics argues that saving is much more than a residual and that, if an economy is afflicted with stagflation, then the importance of saving grows. To supply-side economists, additional saving affects inflation in two ways: It directs more of the Nation's income to expanding the productive capacity of the economy, thereby increasing the supply of goods in the economy, *and*, increased saving reduces demand in the economy.

*The authors wish to thank Carl R. Backman of the Senate Computer Center for his assistance.

With the election of Ronald Reagan, supply-side economics was moved from a theoretical to a policy debate. Consequently, while theoretical differences between supply-side economists and Keynesians on the issue of saving remain important, they have been overshadowed by a larger political question. This issue centers on the question: Can supply-side policies, specifically across-the-board cuts in individual marginal tax rates, stimulate savings? If for no other reason, this question is crucial because in today's economy interest rates are very high and volatile, and financial markets are particularly sensitive to changes in government policy.

In simplest terms, supply-side economics prescribes an investment boom to cure stagflation. However, among other recommendations, supply-side policies call for substantial tax cuts accompanied by a gradual reduction in the growth rate of the money supply.

In Keynesian analysis, each of these policy options would cause a strain on the credit markets which could temporarily cause real interest rates to rise. A rise in real interest rates—if not compensated for by a reduction in the inflation and uncertainty premiums embedded in interest rates—would have a harmful effect on investment, dampening the very process that supply-side economists postulate will fight high inflation, high unemployment, and slow growth.

In other words, Keynesian analysis posits that the tax cuts and slower money growth would not cause an investment boom but rather an investment bust.

However, supply-side economists argue that marginal tax rate cuts provide an incentive for individuals to increase saving. In turn this increase in saving can at least partially finance the short-run deficit caused by the tax cut, thereby lessening any upward movement in real interest rates caused by a larger deficit. In effect, supply-side economists argue that increased saving would reconcile monetary restraint with tax cuts. Because saving would finance all or part of the deficit, there need be no "crowding out" of private investment in credit markets.

This staff study was undertaken because of the disagreement over the effect of marginal tax rate cuts on saving, and because of the large importance of saving in the present economic debate.

The study seeks to determine the relationship between personal marginal tax rate cuts and changes in the level of personal saving in the American economy. The effects of business tax changes on business saving are not calculated because the business tax cut presently contemplated results in automatic, dollar-for-dollar increases in business saving.

In addition, all "second round" effects of marginal tax rate cuts are not calculated. This would require the use of income, wealth and interest rate forecasts. Such forecasts would take us too far afield. The staff was far more interested in testing one basic tenet of the supply-side approach; namely, the relationship between personal marginal tax rate changes and changes in the level of personal saving.

II. THE EMPIRICAL RESULTS

The aggregate personal saving function is hypothesized to be

$$(1) \qquad SAVING_t = h(MTRJ_t, ATRJ_t, R_t, INT_t),$$

where $MTRJ_t$ and $ATRJ_t$ are the marginal and average tax rates confronting a taxpayer filing a joint return, R_t is the ratio of nonhuman to human income (a proxy for wealth), INT_t is the level of interest rates, and t refers to the current year.

While the microeconomic foundations of equation (1) are discussed in Appendix I, it is useful here to summarize the anticipated results. We expect that, other things equal—

An increase (decrease) in the marginal tax rate will cause personal saving to decrease (increase);

An increase (decrease) in the average tax rate will cause personal saving to decrease (increase);

An increase (decrease) in wealth positions will cause saving to increase (decrease); and

An increase (decrease) in the level of interest rates will cause personal saving to increase (decrease).

An empirical "fit" of equation (1) was sought both to confirm these hypothesized relationships and to estimate the responsiveness of personal saving to changes in each of the independent variables appearing in equation (1). We are interested in knowing the *percent change* in personal saving that will result, other things equal, given a percent change—in either direction—in $MTRJ_t$, $ATRJ_t$, R_t, and INT_t.

With this in mind, equation (1) was estimated in log-log form. The virtue of this approach is that the resulting regression coefficients are the elasticity coefficients; they provide estimates of the percent change in personal saving resulting from a given percent change in $MTRJ_t$, in $ATRJ_t$, in R_t, or in INT_t.

Based upon data covering the 1963–78 period, the logarithmic estimate of equation (1) is:

$$(2) \qquad \begin{aligned} ln SAVING_t = {} & 4.32 - \underset{(7.127)}{0.989}\ ln MTRJ_t - \underset{(0.233)}{0.156}\ ln ATRJ_t \\ & + \underset{(0.943)}{1.464}\ ln R_t + \underset{(16.634)}{2.19}\ ln INT_t \end{aligned}$$

Adjusted $R^2 = 90.381$

$F = 36.24$ for 4 and 11 degrees of freedom

where t refers to the current year and the numbers in parentheses are the F-statistics.

These results are consistent with the hypothesized relationships outlined above. That is, equation (2) indicates that, other things equal, an increase (decrease) in marginal tax rates will cause a decrease

(increase) in personal saving. The same is true of average tax rates. And, finally, an increase (decrease) in either wealth or in interest rates will cause an increase (decrease) in personal saving.

Just as important, equation (2) enables us to estimate the magnitude of the effect on personal saving of given percent changes in $MTRJ_t$, $ATRJ_t$, R_t, or INT_t. We have that, other things equal—

A 10 percent increase (decrease) in marginal tax rates will cause a 9.89 percent decrease (increase) in personal saving;

A 10 percent increase (decrease) in average tax rates will cause a 1.56 percent decrease (increase) in personal saving;

A 10 percent increase (decrease) in wealth will cause a 14.6 percent increase (decrease) in personal saving; and

A 10 percent increase (decrease) in the level of interest rates will cause personal saving to increase (decrease) 21.9 percent.

The statistical results are robust. The adjusted R^2 indicates that more than 90 percent of the variation in personal saving is accounted for by variation in marginal tax rates, average tax rates, wealth, and interest rates. Moreover, the F value of 36.24 for 4 and 11 degrees of freedom means that we can be 99.5 percent confident that there is some relationship between personal saving and the full set of independent variables.

Finally, and perhaps most important, the F-statistics for each of the independent variables—the numbers in parentheses in equation (2)—indicate that—

We can be 98 percent confident that there is some relationship between personal saving and marginal tax rates;

We can be 36 percent confident that there is some relationship between personal saving and average tax rates;

We can be 65 percent confident that there is some relationship between personal saving and wealth; and

We can be 99 percent confident that there is some relationship between personal saving and interest rates.

The relatively low confidence level associated with the relationship between average tax rates and personal saving suggests that reductions in average tax rates are not a reliable means by which to induce additional personal saving. Put another way, the statistical results indicate that the income effect of tax rate changes is considerably less powerful (and less dependable) than is the substitution effect.[1] It follows that the more dependable and efficient way to encourage additional personal saving is to reduce *marginal tax rates*. While reductions in average tax rates can cause personal saving to increase, their effect on personal saving is less powerful and less reliable.

That personal saving is relatively more responsive to changes in marginal than average tax rates should come as no surprise. The erosion of saving and work incentives over the last decade is largely attributable to the double-edged effect of inflation and bracket creep. As inflation accelerated and the anticipation of continuing inflation became more ingrained, anticipatory buying increasingly displaced

[1] Because they change the relative prices of income and leisure and of consumption and saving, marginal tax rate changes generate a substitution effect. Changes in average tax rates, on the other hand, are associated with an income effect; a change in behavior predicated upon a change in real disposable income, holding relative prices constant. See Appendix III.

saving. This, coupled with the fact that inflation drove taxpayers into higher tax brackets, meant that the after-tax reward to *additional* saving and work effort declined.

Changes in the average tax rate—whether in the form of increases in the standard deduction, increases in personal exemptions or tax rebates—do very little to change the after-tax reward to *additional* saving or work effort. It follows that changes in average tax rates do not come to grips with the rudimentary fact that inflation and bracket creep induce changes "at the margin"; that inflation and bracket creep discourage *additional* saving and work effort.

Reductions in marginal tax rates are more efficient and reliable catalysts to additional personal saving precisely because they increase the relative price of consumption and of leisure. In the process, marginal tax rate reductions provide an incentive not only to generate additional income but to change the *disposition* both of additional and of existing income. Taxpayers have an incentive to earn more income, to save more out of each additional dollar of income, and to save more of each dollar of existing income.

All of this is a matter of *a priori* logic. But it is also consistent with a body of economic theory stretching back through the work of J. R. Hicks, Alfred Marshall, William Stanley Jevons, and Adam Smith. It is not new.

The empirical results outlined above support this theory: Changes in relative prices *do* affect economic behavior—and they affect behavior in predictable ways.

The statistical results suggest that reductions in marginal tax rates are a catalyst to a series of predictable supply-side responses. Lower marginal tax rates provide an incentive to work harder, to generate more income, and to save more. Reduced marginal tax rates create a growth environment—an environment in which the future is not held hostage to the present; an environment in which forgoing present consumption in the interest of enhanced *future* consumption makes sense.

III. CONCLUSION

The issue of saving has become a crucial question in the present economic debate which centers on large tax cuts. There is concern that significant personal marginal tax rate cuts will increase the deficit, and that larger deficits will lead to higher inflation. In turn, it is feared that higher inflation and expectations of continuing, still higher inflation will drive up already high interest rates.

The results of this staff study—that personal saving responds strongly to changes in personal marginal tax rates—suggest that, other things equal, this fear is unfounded. The personal marginal tax rate cuts contemplated in the bipartisan tax package now before Congress will not be inflationary. In order to understand the validity of this conclusion, we must understand the relationship between deficits, inflation and interest rates.

Contrary to public opinion, deficits, in and of themselves, are not inflationary. When the Government runs a deficit, it turns to the credit market for funds to finance that deficit. Assuming a relatively fixed supply of loanable funds in the economy, this additional governmental demand on the credit market will preempt some of the credit demands of private business. Consequently, we have "crowding-out"; some private sector initiatives will be displaced because of the intrustion of the Federal Government in the credit markets. In addition, there will be upward pressure on real interest rates due to the increased demand for loanable funds. However, none of these actions are intrinsically inflationary.

In an effort to prevent both "crowding-out" and short-term increases in real interest rates, the Federal Reserve might increase the money supply. Because output is relatively constant in the short-run, this increase in the money supply would raise the price level. The increase in the money supply will lower real interest rates, but because inflation is worsened by the money supply increase, the inflation premium built into interest rates will rise. The net effect is that the nominal rate of interest will rise.

The importance of saving is that it can "short-circuit" the inflationary process that surrounds deficits. If tax cuts generate sufficient saving to offset a significant portion of the resulting deficits, then the deleterious effects on credit markets are greatly lessened if not eliminated.

This is so because, if tax cuts significantly stimulate saving relative to the deficit, there is little or no reason for the Federal Reserve to monetize the debt. It follows that both real and nominal interest rates will not rise because of the tax cut. Real interest rates will not rise because added demands on the credit market are offset by an additional supply of savings. Nominal interest rates will not rise because there is no increase in the inflation premium built into interest rates.

The empirical results outlined in Section II indicate that marginal tax rate cuts *will* substantially increase personal saving. The following table shows that, assuming nothing else happens—assuming, in other words, that marginal tax rate cuts do *not* increase work effort, incomes, or wealth positions—increases in personal saving would finance a substantial portion of the Federal deficits contemplated under the Bipartisan Tax Package.

	Fiscal 1981	Fiscal 1982	Fiscal 1983	Fiscal 1984
Increase in personal saving due to marginal tax rate cuts (billions)[1]	[2] 0	$6.525	$11.09	$12.20
Federal deficit (billions)[3]	−$51.25	−$21.15	−$11.05	$4.65
Percent of Federal deficit financed by increases in personal saving	0	30.85	100.4	[4] NA

[1] Personal marginal rate cuts are 5 percent beginning Oct. 1, 1981, 10 percent beginning July 1, 1982, and 10 percent beginning July 1, 1983.
[2] No personal marginal tax rate cuts during fiscal 1981.
[3] Budget under Bipartisan Tax Package, June 4, 1981.
[4] Budget surplus of $4.65 billion in fiscal 1984.

It is important to emphasize that the increases in personal saving cited above are based solely upon the substitution effect; that is, these estimates reflect only the change in saving attributable to a change in the relative prices of saving and consumption. In other words, the only effect of marginal tax rate cuts of which explicit account is taken is an increase in the after-tax rate of return to additional saving or, equivalently, an increase in the relative price of consumption. In doing this, we focus exclusively on the relative price effect of personal tax rate cuts.

The study takes no account of the indirect, or second order, effects of marginal tax rate cuts. These effects accrue as a result of the changes in income and wealth induced by the substitution of saving and investment for consumption. In other words, the second-order effects flow from the expansion of income and wealth induced by the additional work effort, saving and investment that result from marginal tax rate cuts.

Finally, the method of estimating the marginal and average tax rates deliberately underestimates the actual tax rates confronting America's taxpayers. Had our method of determining tax rates reflected the distribution of taxpayer incomes, it would have yielded higher estimates of prevailing tax rates. This, in turn, would have shown saving to be even more responsive to changes in marginal and average tax rates.

Though the saving estimates provided in this study are quite large, they are, by design, *underestimates* of the effect of personal tax rate cuts on saving.

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Appendix I.—THE MICROECONOMIC FOUNDATIONS OF THE MODEL

Econometric estimation of the effects of marginal and average tax rate changes can proceed in a number of ways. Perhaps the most straightforward is to focus on the microeconomic foundations of the saving-consumption decision.

Because changes in marginal and average tax rates have an impact on both the labor-leisure and the saving-consumption choice, it is convenient to conceive of the taxpayer's decision process as involving two stages.

At stage one the taxpayer determines the quantity of labor willingly supplied. This decision, in turn, has an impact upon the income flow that accrues to the taxpayer during a given time period. At stage two the taxpayer decides upon the optimal flow of saving, given the stage one solution.

The stage one problem is complicated by the fact that the quantity of labor supplied (and therefore the amount of income generated) is dependent upon a number of variables.

In general, anything that affects the income-leisure substitution rate has basic relevance. It follows, therefore, that the prevailing wage rate is important. In a world of zero taxes, the wage rate *is* the price of leisure: An hour of labor forgone (or leisure taken) involves forgoing the current wage. But this is not a world of zero taxes. In a world of positive and progressive income taxes, the labor-leisure choice is also affected by the prevailing tax structure; by the marginal and average tax rates confronting the taxpayer. And, finally, the labor-leisure choice is affected by the taxpayer's wealth position. Put another way, the present value of his anticipated human and nonhuman income influences the taxpayer's decision to supply current labor and therefore to generate current income.[1]

The solution of the stage two problem depends partly upon the solution of the stage one problem. That is, the optimal saving flow will, at any cross section of time, be partly dependent upon current disposable income.[2] In addition, the saving decision is affected by the household's wealth position and by the level of prevailing interest rates.

The Labor-Leisure Choice

On the assumption that he derives satisfaction from income and leisure, we can write

$$U=f(y_d,L) \tag{1}$$

as the taxpayer's utility or preference function.[3] Here, U denotes utility or satisfaction, y_d denotes disposable income, or income after Federal income taxes, and L denotes leisure.

The presumption is that the taxpayer seeks to maximize utility subject to an appropriately defined constraint. The specification of the constraint is a relatively straightforward matter in a competitive world in which there are no income taxes. In this rarefied state of affairs, the individual seeks to maximize utility subject to a market determined wage rate. Equation (1) is therefore maximized subject to

$$w=\overline{w}, \tag{2}$$

where $\overline{w}$ is the fixed, market-determined wage rate.

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[1] Human and nonhuman income are defined below. For a discussion of the role of wealth in the income-leisure and consumption-saving decision, see Boris P. Pesek and Thomas R. Saving, *Money, Wealth and Economic Theory* (New York: Macmillan, 1967), esp. pp. 382–389.

[2] The inclusion of current disposable income as an independent variable in the saving function has a long tradition. See, for example, Albert Ando and Franco Modigliani, "The Life Cycle Hypothesis of Saving: Aggregate Implications and Tests," *American Economic Review*, Volume 53, March 1963, pp. 55–84.

[3] The usual properties are imputed to the utility function. In particular, the taxpayer is assumed rational and the indifference curves to which equation (1) gives rise are assumed to be convex. See, for example, John R. Hicks, *Value and Capital* (Oxford: Clarendon, 1946), esp. Chapter 1.

The decision problem outlined by equations (1) and (2) is illustrated in Figure I:[4]

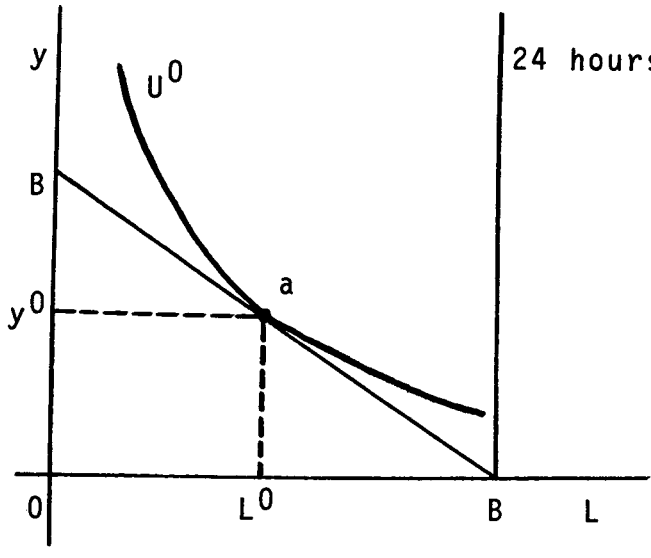

Figure I

The slope of constraint BB is given by the fixed wage rate, while the slope of the indifference curve, U^0 is given by the ratio of the marginal utility of leisure over the marginal utility of income. The utility maximizing solution is given by point a, the point at which the rate at which income and leisure are willingly substituted is equal to the rate at which they can be substituted in the market (the latter determined by the wage rate). At equilibrium, L^0 units of leisure would be taken and income would equal y^0.

Unfortunately, the world is not so simple as equations (1) and (2) suggest. While for present purposes the specification of utility function (1) is satisfactory, the wage constraint is clearly inadequate. Explicit account must be taken of the fact that the taxpayer's decision environment is complicated by a progressive income tax system.

A progressive income tax system means that the constraint confronting the taxpayer can no longer embody only the wage rate. The income-leisure substitution rate is complicated by the fact that the government taxes some portion of each additional dollar earned. Moreover, in a progressive income tax system, the tax rate increases as the absolute level of income rises: As the absolute level of income rises, the marginal tax rate rises, lowering the price of leisure.

Given the operation of a progressive income tax system, constraint (2) must be modified. In this environment, the taxpayer seeks to maximize (1) subject to the constraint that:

(3)
$$g(\bar{w}, \pi_1, y_T{}^2) + h(\bar{w}, \pi_2, y_T{}^3) + k(\bar{w}, \pi_3, y_T > y_T{}^3) = y_d$$

where $\bar{w}$ is the market determined wage rate, and the π_j, $j=1, 2, 3$ denote the marginal tax rates ($\pi_1 < \pi_2 < \pi_3$).

[4] "Income", y, appears on the vertical axis rather than disposable income, y_d, because we are momentarily assuming the absence of taxes in general, and of income taxes in particular. For ease of exposition we ignore the impact of nonhuman income on Figure I and subsequent, related graphs. Had we incorporated nonhuman income, the constraint line BB would have a positive intercept on the 24 hour axis.

π_1 obtains for taxable incomes up to and including y_T^2; π_2 obtains for taxable incomes greater than y_T^2 but not in excess of y_T^3, and π_3 applies to taxable incomes in excess of y_T^3.

Imposing constraint (3) on Figure I yields Figure II:

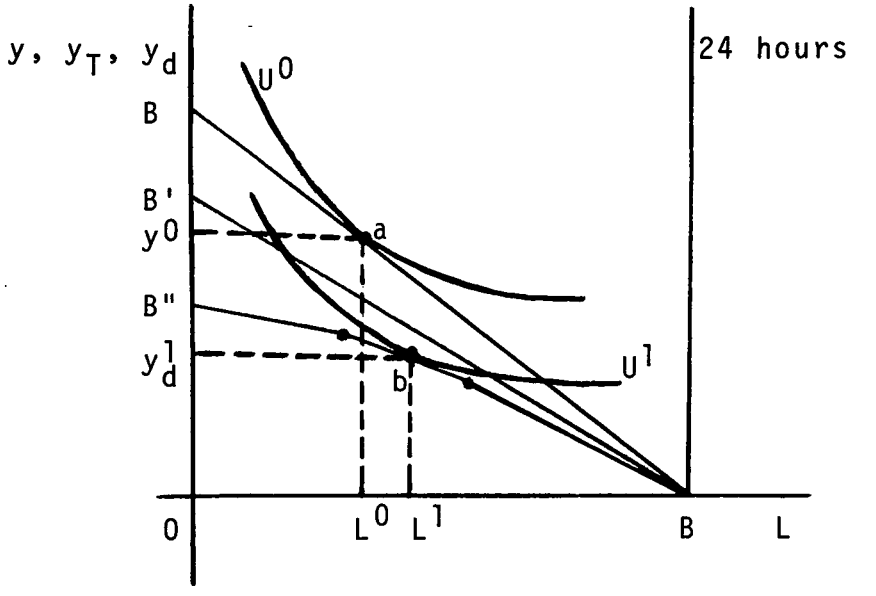

Figure II

Constraints *BB*, *BB'* and *BB''* reflect the same fixed nominal wage, but *BB'* and *BB''* incorporate the essential features of the progressive income tax structure. Constraint *BB'* yields, for any level of nominal income, the associated level of *taxable* income.[5] *BB''* shows, for a given level of taxable income, the associated disposable income, given the prevailing tax rate structure.

Point *a* is the optimal income-leisure solution (y^0, L^0) in the *absence* of taxes. Point *b* yields the optimal solution ($y^1{}_d$, L^1), given the progressive income tax system. While this need not always be the case, the effect of the shift from constraint *BB* to *BB''* is an increase in leisure ($L^1 > L^0$), and a reduction in disposable income ($y^1{}_d < y^0$).

The logic of the income-leisure model outlined in equations (1) and (3) enables us to write

$$NDINC_t = f(MTRJ_t, ATRJ_t, w_t), \tag{4}$$

where $NDINC_t$ is aggregate nominal disposable income, $MTRJ_t$ and $ATRJ_t$ are the marginal and average tax rates confronting taxpayers filing joint returns, w_t is the wage rate, and t denotes the current time period.[6]

[5] In constructing constraint *BB'* we have assumed that adjustments to income and itemized deductions increase as the absolute level of nominal income rises. We assume, in other words, that the share of taxable income in nominal income falls as nominal income rises.

[6] The methods employed in determining the marginal and average tax rates confronting taxpayers are discussed in Appendix II.

Equation (4) is, however, incomplete. As noted above, the taxpayer's wealth position affects his labor-leisure choice. On this logic, (4) may be rewritten as

$$(4') \qquad NDINC_t = g(MTRJ_t, ATRJ_t, w_t, R_t)$$

where R_t denotes the ratio of nonhuman to human income, our proxy for wealth.[7]

As the model is structured, the aggregate income function (equation (4')) emerges from the solution by individual taxpayers of the constrained maximization problem given by equations (1) and (3).

The Saving-Consumption Choice

Equation (4') represents the aggregate solution to the income-leisure or stage one problem. The solution to the stage two or saving-consumption problem is partly dependent upon the stage one solution.

In the decision environment contemplated, aggregate personal saving during the current time period is dependent upon the current level of nominal disposable income, $NDINC_t$, and the current level of interest rates:

$$(5) \qquad SAVING_t = f(NDINC_t, INT_t),$$

where INT_t denotes the current level of interest rates.

Substituting (4') into (5) we have that

$$(5') \qquad SAVING_t = g(MTRJ_t, ATRJ_t, w_t, R_t, INT_t),$$

so that saving is understood to be a function of marginal and average tax rates, the wage rate, wealth, and the level of interest rates, all defined for the current time period.

Equation (5') can, however, be simplified. As it happens, the wage rate, w_t, and wealth, R_t, are highly correlated. Indeed, with a simple correlation coefficient of 0.924 linking w_t and R_t, the employment of both as "independent" regressors in the saving function would assure a high degree of multicollinearity, jeopardizing the integrity of the individual regression coefficients. With this in mind we drop the wage rate from equation (5') so that the saving function emerges as [8]

$$(5'') \qquad SAVING_t = h(MTRJ_t, ATRJ_t, R_t, INT_t).$$

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[7] The taxpayer's wealth position derives from his stock of human and nonhuman capital. The stock of human capital—knowledge, skills, and talents—generates the flow of services which, when rented, yields a flow of human income. The stock of nonhuman capital—physical and financial assets—yields a flow of services which produces a flow of nonhuman income.

Because the stock of human capital is not separable from the owner of it, the discount rate used to convert the stream of human income into present value terms exceeds the discount rate applicable to nonhuman income. It follows that any redistribution of income away from human and toward nonhuman income increases wealth.

It is in this sense that the ratio of nonhuman to human income is a proxy for wealth: An increase in the ratio is equivalent to an increase in wealth; a decrease in the ratio is equivalent to decrease in wealth. See for example, Boris P. Pesek and Thomas R. Saving, *Money, Wealth and Economic Theory* (New York: Macmillan, 1967), esp. Chapter 10. See also G. S. Laumas, "Discount Rate and Wealth," *Journal of Political Economy*, February 1981, pp. 196–8.

[8] Given equation (5), the substitution of $MTRJ_t$, $ATRJ_t$ and R_t for $NDINC_t$ in (5'') is admissible as a matter of *a priori* logic. Moreover, when the relation $NDINC_t = h(MTRJ_t, ATRJ_t, R_t)$ was subjected to empirical test the following results emerged: With an adjusted R^2 of 0.8996 the model accounts for almost 90 percent of the variation in $NDINC_t$, while the F value of 45.80 for 3 and 12 degrees of freedom assures us that we can be 99.5 percent confident that there is some relationship between $MTRJ_t$, $ATRJ_t$, R_t and $NDINC_t$.

Appendix II. THE MARGINAL AND AVERAGE TAX RATE VARIABLES

The logic behind the calculation of the tax rates follows from the fact that, in affecting his income-leisure and saving-consumption choices, the taxpayer confronts a discontinuous, quasi-concave constraint (see Appendix I). Because of the progressive income tax system, the taxpayer's decision environment is such that, as the absolute level of income rises, the price of leisure and of consumption falls. It is the resulting change in relative prices that is the catalyst to changed economic behavior.

While they applied their analytical apparatus to a somewhat different problem, in calculating the marginal and average tax rates, we have adopted the basic approach of Buchanan and Gabor.[1] The latter focused upon the specification of the income constraint confronting a consumer whose problem is to maximize utility subject to a quasi-convex income constraint; a constraint enbodying a declining block rate schedule. Their interest centered, in other words, on a decision environment in which monopolistic quantity discounts obtain. In such an environment, the relative price of the good subject to the discount falls as its consumption rises. (An obvious example is the declining block rate schedule frequently employed by electric utilities.)

The calculation of marginal and average tax rates proceeds as follows: Aggregate taxable income of those taxpayers filing *taxable* returns is divided by the number of taxable returns.[2] This yields, for each year over the period 1963 to 1978, the average taxpayer's taxable income.

On the assumption that he filed a joint return, the marginal tax rate confronting the taxpayer during any year was determined by appeal to that year's tax rate schedule. The marginal tax rate for any year was taken to be the marginal rate associated with the tax bracket into which the average taxpayer's taxable income fell.

The average tax rate in any year is understood to be the base tax for the bracket into which the average taxpayer's taxable income falls divided by the lower bound of the income bracket.

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[1] See James M. Buchanan, "The Theory of Monopolistic Quantity Discounts," *Review of Economic Studies*, Volume 20, 1952–53. See also A. Gabor, "A Note on Block Tariffs," *Review of Economic Studies*, Volume 23, 1955–56.

[2] The data source was the Office of the Secretary of the Treasury, Office of Tax Analysis.

Appendix III. THE INCOME AND SUBSTITUTION EFFECTS OF TAX RATE CHANGES

As the model outlined in Appendix I is structured, marginal and average tax rate changes have qualitatively different effects. In particular, marginal tax rate changes alter the relative prices of income and leisure. In more formal language, marginal tax rate changes produce a substitution effect. This substitution effect is to be distinguished from the income effect induced by changes in average tax rates.

The effects of marginal and average tax rate changes can be illustrated graphically.

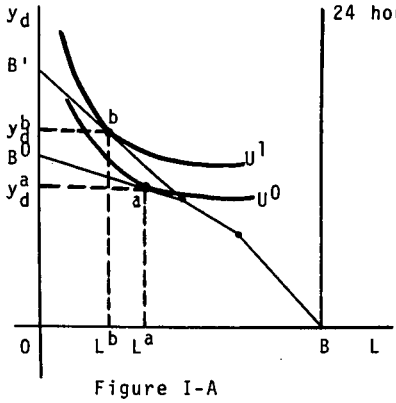

Figure I-A

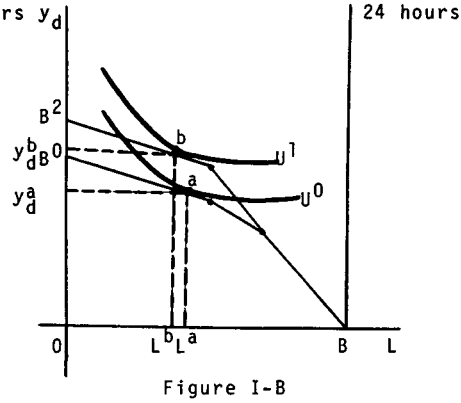

Figure I-B

Figures 1–A and 1–B are variants of Figure II drawn in Appendix I.

Figure 1–A contemplates an initial situation, summarized by point *a*. At point *a*, the taxpayer has affected his labor-leisure choice based upon his preference structure (summarized by the indifference map of which indifference curves U^0 and U^1 are a part), and the constraint BB^0. BB^0, in turn, reflects the fixed, market determined wage rate and the prevailing progressive income tax structure. At point *a*, the relevant marginal tax rate is π_3, where $\pi_3 > \pi_2 > \pi_1$, as in Figure II, Appendix I.

Suppose now that the marginal tax rate is reduced so that the new constraint emerges as BB'. In this event, the new utility maximizing solution is at point *b*. In effect, the reduction in the marginal tax rate increases the relative price of leisure. This, in turn, is a catalyst to a "substitution effect"; the substitution of work effort (and therefore income) for leisure: Whereas the initial situation involved L^a units of leisure and a level of nominal disposable income equal to $y^a{}_d$, the new equilibrium involves both a lower level of leisure, L^b, and a higher level of nominal disposable income, $y^b{}_d$.

The substitution effect associated with a marginal tax rate reduction can be contrasted with the income effect associated with an average tax rate reduction.

Figure 1–B contemplates the same initial situation (summarized by point *a*) as does Figure 1–A. Now, however, the *average* or intramarginal tax rate, π_2, is reduced. The result is the emergence of the new constraint line BB^2.

Given his now-changed decision environment, the taxpayer's new utility maximizing solution lies at point *b*.

The movement from point *a* to point *b* in Figure 1–B reflects a pure income effect; a change in behavior predicated upon a change in real income rather than upon a change in the relative prices of income and leisure.[1]

[1] We are assured that the movement from *a* to *b* in Figure 1–B is a pure income effect because the slopes of the constraint lines BB^0 and BB^2 are the same at points *a* and *b*. This is the same thing as saying that the price of leisure is the same at point *a* as it is at point *b*.

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