SAVING AND AFTER-TAX RATES OF RETURN

by

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I. Introduction

In recent years, a number of economists have found, or taken for granted, a substantial positive interest elasticity of private saving, and several have concluded that the current taxation of property income has played a major role in depressing saving and investment and therefore economic welfare.[1] Thus, probably the most quoted of these studies, by Michael Boskin (1978), finds that "a variety of functional forms, estimation methods and definitions of the real-after-tax rate of returns invariably lead to the conclusion of a substantial positive interest elasticity of private saving" (p.3). As a consequence he states, "current tax treatment of income from capital significantly retards capital accumulation... Rough estimates of the lost welfare exceed $50 billion per year (a present value of close to $1 trillion!)."[2] The most recent of these

[1] E.g., see Michael J. Boskin, "Taxation, Saving and the Rate of Interest," Journal of Political Economy, April 1978, no. 2, Part 2; Thorvaldur Gylfason, "Interest Rates, Inflation and the Aggregate Consumption Function," Review of Economics and Statistics, May 1981; Charles Steindel, "The Determinants of Private Saving," in Public Policy and Capital Formation, Board of Governors of the Federal Reserve System, 1981 and Lawrence H. Summers, "Capital Taxation and Accumulation in a Life-Cycle Model," American Economic Review, September 1981.

[2] It should be noted that one of what he calls his "astounding" results is a consequence not only of the substantial positive interest elasticity of saving which he finds but also of an estimated elasticity of substitution of .48 between capital and labor, so that he is able to conclude that in reducing the real net rate of return, current taxation not only greatly retards capital accumulation but redistributes a large fraction of income from labor to capital. Boskin makes no mention of the most recent comprehensive survey of the literature on the elasticity of substitution which concludes that the evidence is consistent with an elasticity of unity (Dale W. Jorgenson, "Investment Behavior and the Production Function," Bell Journal of Economics and Management Science, Spring 1972). With an insignificant interest elasticity and an elasticity of substitution near unity, there would be no large redistribution of income.

studies, by Lawrence Summers (1981), uses the Boskin empirical results to check corresponding findings based on assumed values of the relevant parameters in a life-cycle model of aggregate saving behavior. Summers raises the ante in his estimate of the welfare gain associated with the elimination of capital income taxation, claiming it would "exceed $150 billion annually," and noting that this conclusion rests on a high positive interest elasticity of saving (p.533). Summers explains that his even larger interest rate effect than Boskin's reflects his allowance not only for the direct effect of a change in interest rates on saving but also an indirect effect via changed asset valuation.

Since these findings on interest elasticity are inconsistent with earlier studies, have received widespread attention by political activists, and are a basic tenet of Reaganomics, it is important to determine how much confidence can be placed in the underlying analysis. This paper will demonstrate that there is little scientific justification for the recent literature purporting to show a strong positive interest elasticity of saving so that government tax policies predicated on such saving behavior rest on a dubious foundation. The evidence to be presented will indicate that at the present stage of knowledge, we have no sound basis for alleging either a strong positive or negative after-tax rate of return effect on saving and that any undesirable impact (e.g., on income distribution) of the reduction or elimination of capital income taxation can hardly be justified by a supposedly desirable effect on saving and hence general economic welfare. This conclusion is based primarily on a careful empirical investigation of the relationship between real aggregate saving (both household and private) and its basic economic determinants, including real income, initial wealth and real after-tax rates of return. However, it is based also on a brief summary of theoretical considerations and a review of the main studies which have reached contrary conclusions.

The only prior published examination of these recent potentially important findings of a strong positive interest elasticity of private saving has been a brief reference to the Boskin results in a paper by E. Philip Howrey and Saul H. Hymans, which was largely devoted to an analysis of what the authors call "personal cash" or "loanable funds" rather than private saving.[3] These authors report two new results extending Boskin's analysis, indicating first that the elimination of one year, 1934, from the 1934-69 (excluding 1941-45) annual data covered by Boskin reduces the statistical significance of his main interest rate variable and, second, that the additional substitution of an unemployment rate variable lagged two years for the current unemployment rate used by Boskin eliminates the significance of his main interest variable. They also observe that they were unable to reproduce his result using other interest rate variables. However, they do not present these results using other interest variables, and neither in their extension of Boskin's analysis nor in their own analysis do they estimate saving or consumption functions by an instrumental variable or similar technique to obtain consistent estimates of the interest rate coefficients and other parameters in their function in spite of the fact that such estimates provide Boskin with what he considers to be his best results. Moreover, it is not readily apparent how an unemployment rate lagged two years can be justified in a structural equation explaining consumption and saving behavior, other than as a curve-fitting procedure.

In this paper in striking contrast to the Boskin analysis, we show that using the best available proxies for the relevant interest rate variables (real expected after-tax rates of return, estimated both on an *ex ante* and an on *ex post* basis), the estimated interest elasticity of household and

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3 "The Measurement and Determination of Loanable-Funds Saving," *Brookings Papers on Economic Activity* 3, 1978.

private saving is generally found to be either statistically insignificant or significantly negative and only rarely significantly positive, with the result depending on the specific interest rate series, period and consumption function used. Nor is this finding altered when the single equation solution of this saving or consumption function is replaced by an instrumental variable, consistent solution. As a result, there does not seem to be much basis to Boskin's or Summers' strong criticism of the earlier literature which generally concluded that there was no reliable evidence of an important interest rate effect on saving or consumption and that even the direction of this effect was not clear. Thus Boskin's and Summers' concerns over the astronomical welfare loss associated with the U.S. tax treatment of income from saving seem unnecessarily alarmist.

Finally, in this paper we shall attempt to determine the indirect as well as direct effect of a change in after-tax rates of return on saving by estimating the effect of change in after-tax return on asset valuation and the effect of such changes in asset valuation on saving. However, unlike Summers, we shall investigate empirically the relationship of asset valuation to after-tax return rather than rely on *a priori* assumptions.

II. Some Theoretical Considerations

There is, to our knowledge, no satisfactory theoretical model of saving behavior which is based on intertemporal utility maximization subject to a lifetime budget constraint and which incorporates the relevant uncertainties including those of human and non-human wealth and the life span. A large number of two-period and life-cyle certainty models have been developed both at the micro and macro levels, but only a small number of attempts to incorporate uncertainty rigorously have been made in spite of the fact that various types of uncertainty may account for a large proportion of saving. It has been shown in these uncertainty models that the relative importance of "substitution" vs "income" efforts in saving is related to measurable characteristics of households' utility functions, especially the magnitude of the Pratt-Arrow measures of relative risk aversion (the latter having formally the same effect on the interest elasticity of saving as the inverse of the elasticity of substitution between present and future consumption in the certainty case). These uncertainty models are of particular interest in analyzing the effect of changes in after-tax rates of return on saving because risk as well as return may be affected by tax changes.

Several of these uncertainty models have demonstrated under certain simplifying assumptions, including constant relative risk aversion, that if the Pratt-Arrow measure of relative risk aversion is higher than one, saving is negatively affected by an increase in interest rates associated with a change in investment opportunities for a given level of initial wealth and income.[1] In other words, under these circumstances, the "income" effect is greater than the "substitution" effect. Since there is fairly strong evidence that the assumption of constant relative risk aversion is as a first approximation a fairly accurate description of the utility function of a representative household or of the market place, with a Pratt-Arrow measure of relative risk aversion well in excess of one,[2] theory might seem to indicate that abstracting from wealth effects saving is negatively related to changes in real after-tax interest rates, with consumption therefore positively related--a result opposite to that implied by classical economics. However, when taxes are introduced into the analysis, the theoretically expected effect on household saving of changes in real after-tax interest rates associated with changes in personal income taxes will depend not only on the magnitude of relative risk aversion but also, among other things, on the disposition of revenue from changes in taxes (with different effects if changes in taxes are associated with changes in Government expenditures, in Government debt or in Government transfers), on the differential impact of changes in taxes on income from various sources (e.g., property vs. wage income) and on whether households consider as part of their wealth the

[1]E.g., see Robert C. Merton, "Lifetime Portfolio Substitution and Uncertainty," Review of Economics and Statistics, August 1969 which assumes all resources come from non-human capital or wealth; and Etienne Losq, "A Note on Consumption, Human Wealth and Uncertainty," Essays on the Theory of Finance, Ph.D. Dissertation, University of Pennsylvania, 1979, which allows for stochastic wages as well as stochastic returns from non-human wealth. Both of these authors use continuous-time models. See also Emerson Philip Jones, Jr., Intertemporal Financial and Monetary Equilibrium, Ph.D. Dissertation, Massachusetts Institute of Technology, 1980 and David M. Modest, "Uncertainty and Optimal Consumption: Theory and Evidence," Massachusetts Institute of Technology, January 1981, Mimeo.

[2]Irwin Friend and Marshall E. Blume, "The Demand for Risky Assets," American Economic Review, December 1975. Abstracting from human wealth, the Pratt-Arrow measure seems to be about two; allowing for human wealth raises the figure is close to six. (See also Irwin Friend and Joel Hasbrouck, Effect of Inflation on the Profitability and Valuation of U.S. Corporations, Rodney L. White Center for Financial Research Working Paper No. 3-81, 1981, University of Pennsylvania.)

capitalized value of future transfers from the Government. Moreover, a change in personal taxes affects personal disposable income and therefore is likely to affect both personal consumption and saving in the same direction, with the relative impact on these two components of income depending on the magnitude of relative risk aversion and other factors.[1] Thus the results implied by theory depend on a number of assumptions, and these may or may not be warranted. The underlying theory is referred to here mainly to emphasize that there is no theoretical presumption in favor of the classical result.[2]

We have, in referring to these uncertainty models, discussed their implications for the after-tax interest elasticity of household or private saving on the assumption that initial wealth is held constant. However, initial wealth which represents the capitalized value of expected flows on net worth may also be affected by changes in after-tax rates of return on assets,[3] resulting in an indirect interest rate effect on saving (in view of the negative wealth effect on saving).

If the after-tax required rates of return are not affected by a change of tax rates, market values would be increased (decreased) by the ratio of the complement of the effective tax rate after a decrease (increase) in taxes

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[1]If symmetric, uniform percentage personal income taxes (with loss offsets) are introduced into the Merton model, op. cit., it can be shown that with initial wealth held constant, a Pratt-Arrow measure of relative risk aversion well above six would be required for increased taxes to be associated with a higher saving-income ratio. However, with much higher effective taxes on risk-free than on risky assets, the required Pratt-Arrow measure would be very substantially reduced.

[2]Theory does, however, provide a theoretical presumption that saving in specific forms is positively related to relative interest rates.

[3]Income of course could also be affected, though for the major types of tax change usually advocated for stimulating household saving, i.e. a reduction in or the elimination of taxes on property income, other taxes would generally have to be increased so that there would be no overall tax effect on income. It should be noted that with increased taxes on labor income offsetting decreased taxes on property income, there would be no income effect on the desired level of wealth so that a change in the market value of wealth would be expected to be negatively associated with the saving rate.

to the complement of the tax rate before the change. If the before-tax required rate of return is not affected, the market value of such assets would not be altered. A priori the assumption of invariance of the after-tax rate of return seems more plausible than invariance of the before-tax return, but it should be pointed out that for relatively risk-free Treasury bills, the statistical evidence seems to support something intermediate between these two assumptions.[1] More important, in a theoretically rigorous uncertainty model, it is not possible to state with any confidence even the direction of the effect that a decrease in taxes on property income, and the associated change in real interest rates and after-tax real rates of return, would have on the market value of assets and therefore indirectly on savings.[2] The basic reason for this otherwise counter-intuitive results is a larger increase in risk

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[1]Fama ("Short-Term Interest Rates as Predictors of Inflation," American Economic Review, June 1975) suggests a constant real before-tax risk-free rate, but he and others subsequently find (see references in "Stock Returns and Inflation," American Economic Review, September, 1981) this variable to behave as a slow moving random walk. Levi and Makin suggest that inflation depresses the real before-tax rate ("Fisher, Phillips, Friedman and the Measured Impact of Inflation on Interest," Journal of Finance, March, 1979). Since taxes are proportional to nominal interest payments, increased inflation implies a rise in the effective rate of taxation.

[2]See Irwin Friend and Joel Hasbrouck, "Comment on Inflation and the Stock Market," American Economic Review, forthcoming March 1982. Under certain assumptions, notably invariance of before-tax interest rates and symmetry of tax effects on property income including capital gains and losses, theory would imply that a reduction in personal tax rates on property income might decrease the market value of assets and hence increase saving if the real before-tax risk-free rate is higher than .019 with the reverse effect if the risk-free rate is below .019 (using reasonable parameter values for the other variables involved). Estimates of the risk-free rate have ranged between .01 and .03. Even assuming invariance of after-tax interest rates, it is not clear in what direction a reduction in tax rates on property income would change the market value of assets. With this interest rate assumption, the expression for the market value of risky assets, equivalent to Eq. 8 in the Friend-Hasbrouck 1982 Comment, becomes

$$(1)\quad dV_m/d\Theta = \frac{K/(1-\Theta)\left[r_f - C\alpha\sigma_m^2(1-\Theta)\right]}{1 - \left[C\alpha\sigma_m^2(1-\Theta)(1+\alpha)\right]\left[r_f + C\alpha\sigma_m^2(1-\Theta)\right]^{-1}}$$

where $K = -E(R)\left[r_f + C\alpha(1-\Theta)\sigma_m^2\right]^{-2} < 0$ and the other symbols are described in the 1982 comment. Substituting reasonable value of the relevant parameters into Equation (1), $dV_m/d\Theta$ can be either positive or negative.

than in after-tax return associated with a reduction in personal taxes.[1]

Thus, combining consol-type and risky assets, the effect of decreased property taxes on saving through a wealth effect seems to be indeterminate on theoretical grounds, though perhaps more likely than not to result in somewhat higher wealth and therefore somewhat lower saving (assuming that the decrease on property taxes is associated with an increase in taxes on labor income).

Since the recent life-cycle model presented by Summers (1981) reached a radically different conclusion, it may be useful to mention briefly some of the reasons for this difference. First, as he points out, certainty is assumed in his model, which among other things "might importantly affect the analysis of tax changes, which alters both the return and risk from savings" (p. 535). Second, as demonstrated by Evans,[2] Summer's results are quite sensitive to plausible differences in assumptions about key parameters in the model--including the elasticity parameter in the utility function, the time preference rate, the value of bequests, the shape of the labor income profile and the introduction of a non-negative wealth constraint. Contrary to Summers, Evans concludes that while it is possible to derive large positive interest elasticities of aggregate saving through such a model, it is also possible to derive either small positive or negative interest elasticities and still obtain plausible saving rates and wealth/income ratios. Incidentally since Summers does not allow for bequests but concludes that such an allowance "would strengthen the conclusions reached here" (p. 537), it might be pointed out that Evans shows that the larger the assumed inheritance, the smaller the interest elasticity of saving.

One last point should be made about Summer's empirical testing of the results implied by his theoretical model. For this purpose he relies on Boskin's estimates of the direct savings elasticity of .4 with respect to after-tax interest rate changes which Summers states implies a "full effect" interest elasticity of saving

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[1] Under the usual assumptions of capital asset pricing theory, while return is decreased by a factor equivalent to the complement of the personal tax rate, assuming complete tax loss offsets, risk is decreased by the square of that factor.

[2] Owen Evans. The Life Cycle Inheritance: Theoretical and Empirical Evidence on the Life Cycle Hypothesis of Savings, Ph.D. Dissertation, University of

of 1.9 when due allowance is made for the empirical response of saving to changes in wealth implicit in Boskin's results and an assumed interest elasticity of wealth of .5 (which Summers says seems "conservative", p. 537). This "full effect" interest elasticity of 1.9 according to Summers is "within the range" implied by his model based on the assumed values of the relevant parameters. We shall comment in the next section on Boskin's estimate of the direct interest rate elasticity of savings. However, we want to emphasize here that Summers appears to neglect the effect of an increase in taxes on property income which clearly affects the numerator of the expression for the value of wealth, i.e., the expected after-tax cash flow, and looks only at the effect on the denominator or the required after-tax rate of return. Moreover, except in a long-run equilibrium sense and even then abstracting from uncertainty, even the denominator would not necessarily be decreased by an increase in property income taxes, as Summers implicitly assumes in his consol example. In any case, the numerator would necessarily be decreased, the denominator would either be unchanged or decreased, and the value of wealth <u>decreased or unchanged</u>, <u>not increased</u>. Consequently, if Summers' consol example were taken at face value, the indirect effect of a decrease in after-tax returns on wealth would be to <u>increase or leave unchanged</u> but <u>not decrease</u> saving.

III. Estimation Results

A large number of regressions relating real per capita consumption to its theoretical determinants, including real per capita permanent and transitory income, initial wealth and expected real after-tax rates of return, are presented in Tables 1-6. Some of these regressions also include additional explanatory variables (such as the unemployment rate, a time trend and the expected rate of inflation) because of their inclusion in other recent studies or because they are of interest for other reasons. In view of the focus of this paper and the substantial measurement problems, the results for a number of different measures of expected real after-tax rates of return are derived. Since there is some controversy as to whether consumption (or saving) should be related to net disposable income or to net private income which combines the household and corporate sectors, both types of regressions have been estimated. Linear and logarithmic and ordinary least squares and two-stage least squares regressions for the 1952-1980 (quarterly and semi-annual) and 1929-1969 (annual) periods are presented.[1] All regressions are adjusted for first-order serial correlation.

While the sources of the data used are shown in the notes to the tables, it should be noted here that the consumption as well as some of the other variables for the quarterly and semi-annual post-war regressions are taken from the data base of the MPS economic model in which consumption is defined as expenditures on non-durable goods and services plus an imputed service flow from the stock of durables.[2] Income is adjusted to reflect the latter, as well.

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[1] Although we shall refer to analyses over the longer period as being from 1929 to 1969, the period spanned by the Christensen-Jorgenson data, it should be noted that many of our regressions actually start subsequent to 1929. The data for the first few years were often consumed in smoothing the real return variables.

[2] A number of these regressions were recomputed (but not shown) using the national accounts definition of consumption (personal consumption expenditures), without any significant change in the interest rate coefficients.

For the annual 1929-1969 regressions, consumption and many of the other series were taken from the Christensen-Jorgenson data used by Boskin.[1]

Tables 1 and 2, based on linear, quarterly, post-war regressions, indicate that for given levels of disposable income and initial wealth the two measures of expected after-tax real rate of return used either exhibited a significant positive effect on consumption or no significant effect. Significant positive effects were more common for the private sector than for the personal or household sector regressions, for the ordinary least squares than for the two-stage least squares regressions and for one of the two measures of expected after-tax rates used. However, in no case was there a clearly significant negative after-tax return effect on consumption.

Overall the results of Tables 1 and 2 seem quite plausible. The correlations are fairly high, the Durbin-Watson measures not too unsatisfactory, and the income and wealth coefficients appear reasonable. The assumed linearity of the relationship is consistent with theory,[2] except for the interest rate variable which will be treated somewhat differently in some subsequent regressions. It would be preferable to have permanent and transitory after-tax labor income substituted for permanent and transitory after-tax private or personal income, but the data were not available. For given levels of initial wealth and after-tax rates of return, the income coefficients could be considered as roughly reflecting the effect of changes in after-tax labor income on consumption. Similarly, the after-tax rate of return coefficients reflect the effect of changes in after-tax rates of return when total after-tax income as well as initial wealth are held constant. Thus, these return coefficients can be

[1] Laurits Christensen and Dale Jorgenson, "U.S. Income, Savings and Wealth, 1929-1969," Review of Income and Wealth, December 1973.

[2] E.g,, Merton shows that the entire HARA family of utility functions, which includes the special case of constant proportional risk aversion, implies consumption functions which are linear in wealth and income ("Optimum Consumption and Portfolio Rules in a Continuous Time Model," Journal of Economic Theory, December 1971).

considered as measuring the effect of a change in property taxes on consumption if the total of taxes is not changed. It should be noted, however, that neither here nor in subsequent regressions does the empirical analysis permit us to distinguish between the effect on saving of a change in property taxes from other developments affecting the expected after-tax real rate of return on assets.

In the initial tables, the two expected after-tax real rates of return used were estimated as the difference between the average annual yield on municipal issues and each of two measures of the expected annual inflation rate. The first of these estimates of expected inflation was derived from a quarterly autoregressive forecasting model, the second from a T-bill forecast where the expected real return each quarter was considered to be the average actual real return over the year preceding the forecast.[1]

Though both of these two measures of the expected after-tax real rates of return exhibited more evidence of a positive than a negative effect on real consumption (and therefore evidence of a negative effect on saving), they are both subject to substantial measurement error, especially with respect to the estimation of the expected rate of inflation. It is fortunate therefore that it is possible to derive independent estimates of the expected rate of inflation from the Livingston survey data.[2] From these *ex ante* data, a third measure of the expected after-tax real rate of return is obtained, again using the municipal yields to estimate expected after-tax nominal returns. The regressions in Tables 1 and 2 are recomputed in Tables 3 and 4, except that the *ex ante* measure of expected after-tax real return is now used, and the regressions are estimated on a semi-annual rather than quarterly basis for

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[1] See notes to Table 1 for further details.

[2] See notes to Table 3 for details.

reasons of data availability.

The results of Tables 3 and 4 are generally in agreement with those in the first two tables. The income coefficients are generally of the same order of magnitude, while the wealth coefficients are somewhat lower than in the preceding tables (and in the two-stage regression estimates, they are never statistically significant). The correlation coefficients are somewhat improved, while the Durbin-Watson statistics are not quite as good. More importantly for our purposes, the ex ante real after-tax return again evidences either a statistically positive or insignificant effect on real consumption.[1]

Thus, none of the regressions in Tables 1-4 employing three different measures of expected real after-tax returns provides any support for Boskin's finding of a negative return effect on consumption, implying instead either a positive or no effect on consumption. However, in addition to his use of a different return series, his regressions differ from ours in that they are mainly logarithmic in form, with one exception are fitted annually to the 1929-1969 period rather than quarterly and semi-annually over 1953-1980, and are based on Christensen-Jorgenson data rather than the MPS and national accounts data we used.[2] His real after-tax rate of return estimates were derived by his application of a smoothing and forward projection process to Christensen-Jorgenson nominal after-tax rate of return and price data, a subjective procedure which could not be replicated.[3]

To determine whether it is the differences in the mathematical forms used, in the time periods, in the basic sources of data or in Boskin's processing

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[1] It should be noted that the coefficients of expected inflation in all estimations were found to be sensitive to the estimation period and the inclusion of the expected return variable, in the absence of which the coefficient was generally close to zero.

[2] His analysis is confined to private saving alone.

[3] Boskin states that he also used a number of bond series to estimate the nominal after-tax rate of return, but does not present or discuss these results.

of these data which account for the differences between his results and ours, we first present in Table 5 selected quarterly regressions for the postwar period previously shown in Tables 1-4, but now following Boskin generally substituting log for linear forms. The new log results are consistent with the linear results, with the after-tax return coefficients again pointing either to significantly positive or insignificantly positive effects on consumption. The correlation coefficients and Durbin-Watson statistics are satisfactory and the regression coefficients seem sensible. The sum of the permanent income and wealth coefficients is quite close to its expected value of one for the ordinary least squares estimations and not significantly different from one in the two-stage least squares estimations (ranging from 1.020 to 1.124). In contrast, in Boskin's preferred equation (Eq. 5), the elasticities of consumption with respect to income and wealth add to 1.59, an implausible result.[1]

Table 6 presents annual regressions for the 1929-69 period, excluding the World War II years, which are similar to the quarterly, postwar regressions in the earlier tables except that the Christensen-Jorgenson data are used (in addition to the MPS-national accounts data) and expected after-tax real rates of return are derived from the Christensen-Jorgenson after-tax nominal returns (as well as from the autoregressive forecasting model used earlier in conjunction with municipal bond yields). The after-tax real return based on the Christensen-Jorgenson data is significantly negatively related to consumption while the corresponding coefficient for the autoregressive-model-based return is significantly positive. The multiple correlations and Durbin-Watson statistics are

[1]Boskin presents one ordinary least-squares annual regression for the postwar period through 1969 but even here the sum of the income and wealth elasticities is 1.35.

reasonably satisfactory and the sum of the income and wealth elasticities again does not differ markedly from the expected value of one. If the World War II years are included but a dummy variable added to distinguish between the war and nonwar years, the correlation coefficients and Durbin-Watson statistics are further improved and the Christensen-Jorgensen-based after-tax real return coefficients are very much smaller in absolute size and no longer significant though they remain negative. The use of the Christensen-Jorgensen after-tax nominal rate of return as the basis for estimating expected after-tax real return does seem to lead to somewhat more negative real return effects of consumption than all the other estimates of real return, but apparently the particular processing of the data by Boskin contributed to the statistically significant negative effects.

One other attempt was made to estimate the effect on consumption of changes in after-tax return on assets by substituting the theoretically more satisfactory after-tax labor income (only available from the Christensen-Jorgenson data) for after-tax private income and substituting after-tax property income for after-tax return, thus avoiding the theoretically unsatisfactory use of a linear term in return. A linear regression, based on the Christensen-Jorgenson real per capita annual data for the 1929-69 period, related consumption to after-tax labor income, after-tax capital income, initial wealth and unemployment (this latter variable simply because it was used by Boskin). Changes in property income for given levels of initial wealth presumably reflect changes in after-tax real returns (though not necessarily in expected after-tax real returns). If an increase in after-tax real returns (say as a result of lower capital income taxes, offset by higher labor income taxes) decreased consumption, then the capital income coefficients would be expected to be lower than the labor income coefficients. In fact, they are slightly though insignificantly higher, again providing no evidence of a significant negative effect of after-tax real returns on consumption.[1]

While the empirical analysis does not provide any strong support for a direct effect of changes in expected after-tax real interest rates (or rates of return) on consumption or savings, as maintained by Boskin and Summers,[2]

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[1]The estimated equation is

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\begin{aligned}
CONP_t = & -.298 + .557\, YLAB_t + .116\, YLAB_{t-1} \\
& \;(-5.0)\quad (7.2)\qquad\quad (1.6) \\
& + .589\, YCAP_t + .206\, YCAP_{t-1} + .047\, W_t \\
& \quad (5.5)\qquad\quad (1.8)\qquad\quad (5.9) \\
& + .013\, UN_t \\
& \quad (7.5) \\
& - .051\, WW2DUM_t \;;\; R^2C = .787,\; DW = 1.67 \\
& \;(-2.1)
\end{aligned}
$$

CONP is consumption; YLAB, labor income; YCAP, capital income; W , wealth; UN, unemployment rate; WW2DUM, dummy variable for the World War II years. Consumption, income and wealth are from the Christensen-Jorgenson data and are on a real per capita basis.

[2]We have not discussed two other recent papers which also conclude that there was a signficant negative relation between quarterly consumption and real interest rates. The first, by Steindel (1981), assumes the values of the income and wealth coefficients and does not provide satisfactory extrapolations for consumption beyond the 1955-72 estimation period. The second, by Gylfason (1981) which finds a significant negative relation for the period 1952-78, also finds that when the years 1965-78, the period of most variation in interest and inflation rates, are analyzed separately, this relation disappears. Tests for serial correlation suggest that the results for this period are more reliable than those for 1952-65. Moreoever, the adaptive expectations model used, where expected inflation is determined by inflation of the current and one previous quarter, is questionable as a basis for inferring the relevant long-run interest rate.

we have yet to analyze the possible indirect effect via wealth. Table 7 presents several annual regressions both for the 1948-80 and 1930-69 periods, relating the change in the log of real wealth (adjusted for saving) to changes in the different measures of expected after-tax real rates of return previously used.[1] There is no strong evidence in any of these regressions of an after-tax interest rate effect on wealth. For the postwar period, one of the return measures does suggest a positive effect of after-tax return on wealth, and by implication consumption, but this is not confirmed by either of the other measures. However, this analysis of indirect effects of changes in return on saving yields less satisfactory results than that of direct effects, probably at least in part as a reflection of substantial measurement error in the estimation of wealth.

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[1]Real capital income after taxes was introduced as an additional explanatory variable but the results seem questionable since the capital income coefficient was negative as against the theoretically expected positive coefficient. If all assets were consols, the expected income coefficients would be expected to be one. The questionable income coefficients may reflect measurement error and it should be noted that the wealth variables used do not completely reflect current market values.

IV. Concluding Remarks

The empirical evidence analyzed in this paper and in earlier studies provides little support for the belief that higher after-tax rates ofreturn on assets stimulate saving. Based on this evidence, a redistribution of taxes from capital to labor income is fully as likely to decrease as to raise the propensity to save. It should be noted, however, that the analysis of after-tax rate of return effects both in this paper and in the other studies referred to are incomplete since they do not cover the effects on saving of the redistribution of after-tax income among different economic groups,[1] or the effects on investment and hence realized saving of shifting the incidence of taxes from capital to labor income.[2] Moreover, the types of regressions estimated in all of these studies may have only limited usefulness in indicating the response of saving to a permanent change in the taxation of capital and labor income. Nevertheless, the essential point remains that any strong conclusion about the interest elasticity of saving or the effect on saving of a shift in incidence of taxation from capital to labor income is without a scientific basis.

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[1] Permanent income theory would of course imply that a permanent redistribution of after-tax income among different economic groups as a result of tax changes would not affect the propensity to save.

[2] Abstracting from uncertainty, at least in the long run realized saving and investment might be expected to rise.

Table 1

Consumption Regressions, Quarterly, OLS, 1952 - 1980

Equation	Constant	$YPERM_t$	YTR_t	W_t	UN_t	$TIME_t$	$ERR1_t$	$ERR2_t$	$EDP1_t$	$EDP2_t$	R^2C	DW	ρ
1.	.225 (1.1)	.712 (15.2)	.084 (2.9)	.022 (3.6)			.145 (2.7)				.711	1.46	.995
2.	-.202 (-2.0)	.772 (23.2)	.106 (3.6)	.025 (4.3)	.011 (3.6)		1.470 (3.6)		1.351 (3.3)		.952	1.59	.961
3.	.378 (2.0)	.531 (7.3)	.096 (3.5)	.018 (3.1)	.003 (.9)	.006 (3.5)	.906 (2.2)		.811 (2.0)		.910	1.65	.983
4.	.263 (1.3)	.691 (14.2)	.092 (3.1)	.025 (3.8)				-.023 (-.1)			.744	1.33	.994
5.	-.182 (-1.8)	.754 (21.9)	.118 (4.0)	.028 (4.5)	.013 (4.1)			1.288 (2.9)		1.398 (3.4)	.952	1.50	.959
6.	.493 (2.5)	.474 (6.3)	.107 (3.9)	.020 (3.4)	.004 (1.2)	.007 (3.9)		.570 (1.3)		.763 (1.8)			
7.	-.122 (-1.4)	.873 (28.0)	.159 (3.9)	.022 (3.9)			.089 (1.8)				.958	1.57	.958
8.	-.099 (-1.1)	.854 (24.6)	.151 (3.6)	.023 (4.0)	-.001 (-.3)		.653 (1.6)		.564 (1.4)		.958	1.56	.958
9.	.356 (1.8)	.633 (6.9)	.155 (3.8)	.018 (3.0)	-.004 (-1.3)	.005 (2.5)	.424 (1.0)		.350 (.9)		.923	1.64	.979
10.	-.099 (-1.2)	.854 (27.6)	.171 (4.2)	.024 (4.3)				-.203 (-1.5)			.962	1.47	.953
11.	-.078 (-.9)	.831 (23.6)	.171 (4.1)	.026 (4.5)	.001 (.5)			.390 (.9)		.608 (1.5)	.961	1.48	.954
12.	.469 (2.3)	.566 (6.1)	.175 (4.4)	.020 (3.4)	-.002 (.9)	.006 (3.0)		.082 (.2)		.346 (.9)	.919	1.58	.981

NOTE: In regr. in top half, YPERM and YTR refer to net private income; in bottom half, to disposable personal income.

Table 2

Consumption Regressions, Quarterly, 2SLS, 1952 - 1980

Equation	Constant	$YPERM_t$	YTR_t	W_t	UN_t	$TIME_t$	$ERR1_t$	$ERR2_t$	$EDP1_t$	$EDP2_t$	DW	ρ
1.	-.324	.850	.195	.021			.205				1.70	.955
	(-1.8)	(13.5)	(2.8)	(1.1)			(2.0)					
2.	-.969	.783	.129	.045	.015		1.441		1.285		1.59	.997
	(-1.5)	(10.0)	(1.9)	(2.5)	(2.6)		(1.3)		(1.2)			
3.	-.858	.677	.128	.038	.011	.004	1.150		1.034		1.63	.998
	(-1.2)	(4.8)	(2.0)	(2.0)	(1.4)	(1.0)	(1.0)		(.9)			
4.	-.368	.883	.145	.016				.831			1.71	.959
	(-1.8)	(13.3)	(1.7)	(.9)				(2.0)				
5.	-.824	.790	.132	.044	.015			2.086		1.672	1.68	.995
	(-1.5)	(9.7)	(1.9)	(2.4)	(2.1)			(1.5)		(1.4)		
6.	-.653	.657	.132	.036	.010	.005		1.375		1.177	1.67	.996
	(-1.0)	(4.2)	(2.0)	(1.9)	(1.3)	(1.1)		(.9)		(.9)		
7.	-.274	.905	.340	.022			.049				1.93	.960
	(-1.5)	(14.8)	(2.9)	(1.3)			(.5)					
8.	-.723	.886	.324	.034	.002		1.120		1.058		1.91	.996
	(-1.2)	(10.3)	(3.0)	(2.0)	(.3)		(1.0)		(.9)			
9.	-.768	.781	.332	.027		.003	.959		.920		1.96	.998
	(-1.0)	(4.8)	(3.1)	(1.5)		(.8)	(.8)		(.8)			
10.	-.267	.879	.315	.028	.000			-.065			1.81	.958
	(-1.6)	(15.3)	(3.0)	(1.9)	(0.0)			(-.2)				
11.	-.895	.852	.334	.040	.006			.809		1.045	1.78	.997
	(-1.3)	(9.7)	(3.0)	(2.4)	(.9)			(.5)		(.8)		
12.	-.658	.715	.344	.033	.004	.004		.384		.748	1.80	.997
	(-1.0)	(4.1)	(3.1)	(1.8)	(.6)	(1.0)		(.3)		(.6)		

Table 3

Consumption Regressions, Semiannual, OLS, 1953 - 1980

Equation	Constant	$YPERM_t$	YTR_t	W_t	UN_t	$TIME_t$	$ERR3_t$	$EDP3_t$	R^2C	DW	ρ
1.	.209 (.8)	.772 (13.3)	.144 (2.8)	.007 (.9)			1.083 (2.3)		.738	1.15	.993
2.	-.282 (-2.3)	.854 (19.6)	.123 (2.5)	.009 (1.2)	.015 (3.8)		1.724 (2.7)	.797 (1.1)	.972	1.58	.910
3.	.444 (2.1)	.545 (6.8)	.139 (3.3)	.003 (.5)	.003 (.6)	.016 (4.1)	.769 (1.3)	-.085 (-.1)	.930	1.39	.978
4.	-.137 (-1.3)	.908 (25.1)	.303 (4.2)	.013 (2.1)			.632 (1.7)		.971	1.30	.934
5.	-.164 (-1.4)	.913 (20.6)	.294 (3.9)	.014 (2.1)	.003 (1.0)		.463 (.8)	-.250 (-.4)	.970	1.34	.935
6.	.325 (1.5)	.670 (6.7)	.299 (4.3)	.009 (1.4)	-.002 (-.5)	.012 (2.7)	.144 (.3)	-.504 (-.8)	.945	1.37	.972

Table 4

Consumption Regressions, Semiannual, 2SLS, 1953 - 1980

Equation	Constant	$YPERM_t$	YTR_t	W_t	UN_t	$TIME_t$	$ERR3_t$	$EDP3_t$	DW	ρ
1.	.781 (1.6)	.838 (9.9)	.260 (2.9)	-.002 (-.2)			1.970 (2.3)		1.57	.996
2.	-.355 (-2.4)	.863 (13.0)	.160 (2.0)	.012 (.8)	.015 (3.0)		2.555 (2.8)	.788 (.8)	1.87	.920
3.	.082 (.3)	.694 (5.2)	.162 (2.5)	.005 (.4)	.008 (1.2)	.009 (1.3)	1.687 (1.8)	.382 (.4)	1.66	.959
4.	-.173 (-1.1)	.953 (17.5)	.508 (4.0)	.005 (.4)			1.275 (1.9)		1.57	.941
5.	-.173 (-1.1)	.922 (14.1)	.516 (3.5)	.011 (.8)	.005 (.1)		1.616 (1.7)	.426 (.4)	1.60	.934
6.	-.022 (0.)	.848 (5.5)	.501 (3.6)	.008 (.6)	-.001 (-.2)	.004 (.5)	1.372 (1.4)	.335 (.3)	1.58	.943

Table 5

Logarithmic Consumption Regressions

Equ.	Constant	$LYPERM_t$	$LYTR_t$	LW_t	LUN_t	$ERR1_t$	$ERR2_t$	$ERR3_t$	$EDP1_t$	$EDP2_t$	$EDP3_t$	R^2C	DW	ρ
1.	-.421	.905	.148	.123	.018	.406			.373			.971	1.68	.944
	(-7.6)	(24.5)	(4.1)	(4.2)	(3.7)	(3.2)			(2.9)					
2.	-.429	.888	.162	.132	.021		.351			.384		.972	1.63	.940
	(-7.7)	(23.6)	(4.4)	(4.4)	(4.1)		(2.5)			(3.0)				
3.	-.756	.905	.176	.219	.026	.518			.464				1.78	.993
	(-2.4)	(9.8)	(1.9)	(2.2)	(2.5)	(1.5)			(1.3)					
4.	-.672	.880	.182	.217	.022		.873			.710			1.84	.953
	(-3.4)	(9.8)	(1.7)	(2.1)	(1.8)		(1.7)			(1.6)				
5.	-.343	.971	.158	.057	.025			.532			.320	.982	1.65	.886
	(-4.8)	(20.1)	(2.8)	(1.6)	(4.4)			(2.8)			(1.4)			
6.	-.055	.977	.217	.043	.021			.730			.041		2.01	.998
	(-.2)	(9.7)	(2.3)	(.6)	(2.5)			(2.4)			(.1)			

Equation	Description
1	quarterly, OLS
2	quarterly, OLS
3	quarterly, 2SLS
4	quarterly, 2SLS
5	semianual, OLS
6	semianual, 2SLS

Table 6

Logarithmic Consumption Regressions, Annual, OLS, 1932 - 1969

Equation	Constant	LY_t	LY_{t-1}	LW_t	LUN_t	ERR1	ERR4	EDP1	R^2C	DW	ρ
1.	-.509	.426	.146	.309	.012	1.390		1.426	.983	1.81	.727
	(-4.9)	(8.9)	(3.9)	(5.7)	(1.3)	(3.1)		(3.2)			
2.	-.678	.415	.145	.410	.005		-.377	.016	.924	1.63	.905
	(-4.9)	(8.6)	(4.7)	(7.8)	(.5)		(-2.9)	(1.0)			
3.	-.400	.487	.174	.249	.009	.895		.925	.985	1.64	.742
	(-4.1)	(10.6)	(4.7)	(4.8)	(1.2)	(2.2)		(2.2)			
4.	-.187	.443	.146	.246	.003		-.295	.007	.891	1.71	.965
	(-1.0)	(10.0)	(5.2)	(4.3)	(.4)		(-2.7)	(.5)			

Equations 1 and 2 employ total private income as the income variable; 3 and 4 employ personal income.

Table 7

The Interest Elasticity of Wealth, Annual, OLS.

Equation	Constant	ΔERR1	ΔERR2	ΔERR3	R^2C	DW
1.	.010 (1.1)	.205 (.8)			.022	2.12
2.	.009 (.9)		.686 (1.5)		.076	2.13
3.	.010 (1.1)			-.369 (-.7)	.017	2.17
4.	.003 (.9)	-.005 (-.1)			.000	1.81

Dependent variables is the first difference of the logarithm of wealth, corrected for additions over the period. See table notes.

Equations 1-3 are from 1952-1979; equation 4 is from 1932-1969.

Notes to Table 1

The dependent variable in all estimations is real per capita consumption in thousands of 1972 dollars at a seasonally adjusted annual rate. This variable is taken from the database of the MPS economic model and is equal to expenditures on nondurables plus an imputed service flow from the stock of durables.

Other Variables

YPERM	Real per capita permanent income (thousands of 1972 dollars) estimated as an 8-quarter moving average of either disposable personal income or private income. The former is from the MPS model and reflects an imputed income on consumer durables. The latter is equal to the former plus retained corporate profits net of IVA and capital consumption adjustment. Equations 1-6 employ the private income variable; 7-12 employ the personal income variable.
YTR	Transitory income estimated as actual income less YPERM.
W	Real per capita household wealth in thousands of 1972 dollars. Beginning of period value from MPS model, which is in turn interpolated from Federal Reserve Board replacement-value asset and liability statistics.
UN	Unemployment rate, in percent.
TIME	Linear time trend, initialized to 1 in 1947 I and incremented by 1 each quarter thereafter.
EDP1	Expected annual inflation based on a quarterly autoregressive forecasting model. To obtain a forecast at time t, contemporaneous inflation was regressed against six lagged quarters of inflation. This regression was estimated over the 10 years preceding the forecast, and was then simulated forward to obtain a projection of long-run inflation.

ERR1	Proxy for expected real return. Computed as (average yield on municipal bonds, S&P) - EDP1.
EDP2	Expected annual inflation based on a T-bill forecast. The expected real return on 3-month treasury bills was estimated as the average actual real return over the year preceding the forecast. EDP2 was then estimated as (current yield) - (expected real return).
ERR2	Proxy for expected real return. Computed as (average yield on municipal bonds) - EDP2

All estimations are quarterly from 1952 II to 1980 IV, and employ a first-order autocorrelation correction. R^2C is corrected for degrees of freedom; DW is the Durbin-Watson statistic; ρ is the autocorrelation coefficient; t-statistics are in parentheses.

In equations 1-6, the income variables YPERM and YTR refer to net private income; in equations 7-12, YPERM and YTR refer to disposable personal income.

Notes to Table 2

All variables are as defined in Table 1. In equations 1-6, the income variables YPERM and YTR refer to net private income; in equations 7-12 they refer to disposable personal income. The estimations in Table 2 are two-stage least squares regressions with a first-order autocorrelation correction. The instrumental variables used are:

- (i) Real per capita non-interest, non-transfer-payment government expenditures.
- (ii) Monetary base, per capita, deflated by GNP deflator.
- (iii) Federal Reserve discount rate.
- (iv) Real per capita exports.
- (v) Linear time trend.

In addition, since a first-order autocorrelation correction was being estimated, lagged values of all independent variables were included in the instrumental variable set.

Notes to Table 3

Unless noted below, all variables are as defined in Table 1. YPERM is estimated over the current and three preceding 6-month intervals. In equations 1-3, YPERM and YTR refer to net private income; in equations 4-6, they refer to disposable personal income. All estimations are semiannual, from 1953 to 1980.

EDP3 — Expected annual inflation, from Livingston survey data. For each respondent, a forecast of the forward inflation rate was estimated as

(forecast of CPI 12 months ahead)/(forecast of CPI 6 months ahead) - 1.

These values were tabulated over all respondents, outliers were discarded, and the average rates were annualized. Livingston forecasts are made in December and June. The June forecast was assumed to reflect expectations for the first half of the year; the December forecasts for the second half.

ERR3 — Proxy for expected real return. Computed as (average yield on municipal bonds) - EDP3.

Notes to Table 4

All variables are as defined for Table 3. In equations 1-3, YPERM and YTR refer to net private income; in equations 4-6 they refer to disposable personal income. Estimations are two-stage least squares regressions and employ a first-order autocorrelation correction. The instrumental variables used are described in notes to Table 2. All estimations are quarterly from 1952 II to 1980 IV, and employ a first-order autocorrelation correction.

Notes to Table 5

The dependent variable in all equations is the logarithm of real per capita consumption. Estimations are from 1952-1980. LYPERM and LYTR are the logarithm of (respectively) permanent and transitory real per capita private income; LW is the log of initial wealth; LUN is the log of the unemployment rate. Other variables, including the instrumental variables where relevant, are described in the notes to earlier tables.
Equations 1-4 are quarterly, with 1 and 2 estimated by OLS, and with 3 and 4 estimated by 2SLS. Equations 5 and 6 are semiannual, with 5 estimated by OLS and 6 estimated by 2SLS.

Notes to Table 6

The dependent variable in all equations is the logarithm of real per capita consumption. All estimations are from 1932-1969 with 1941-1945 excluded. LY is the logarithm of real per capita private income in equations 1 and 2, and real per capita personal income in equations 3 and 4. LW and LUN are the logarithms of initial wealth and unemployment. ERR1 and EDP1 are described in the notes to Table 1. ERR4 is a smoothed, lagged average of the real rate of return to capital from Christensen and Jorgenson.
Weights of 3/6, 2/6 and 1/6 were given to the returns from the three prior years.

Notes to Table 7

The dependent variable in all regressions is the first difference of the logarithm of wealth corrected for intraperiod savings. In regressions 1-3 the wealth variable used is real assets owned by households from Federal Reserve Board data, and the period is 1952-1979. In regression 4, the wealth and income variables used are from Christensen-Jorgenson and the estimation is over 1932-1969. ERR1, ERR2 and ERR3 are end-of-year values for the expected real return proxies described in the notes to Tables 1 and 3. "Δ" is "first difference".