NBER WORKING PAPER SERIES

THE INEFFECTIVENESS OF EFFECTIVE TAX RATES ON BUSINESS INVESTMENT

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Working Paper No. 1704

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
September 1985

The author would like to give particular thanks to Robert Eisner and Robert Gordon for their extensive criticisms and assistance on a previous draft presented at the 1981 Winter Meeting of the Econometric Society. Helpful comments have also been provided by Craig Hakkio, Fumio Hayashi, Patric Hendershott, Stephen King, Andrew Lyon, Michael Marrese, Robert McDonald, Arlie Sterling, Lawrence Summers, and two anonymous referees. Financial support from the Social Science Research Council, the Hoover Institution, and the National Science Foundation under Grant No. SES-8309073 is gratefully acknowledged. All errors, omissions, and conclusions remain the sole responsibility of the author. The research reported here is part of the NBER's research programs in Economic Fluctuations and Taxation and project in Government Budget. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

NBER Working Paper #1704
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ABSTRACT

In his Fisher-Schultz Lecture, Martin Feldstein examined the effects of non-neutral tax rules on business investment by estimating three econometric models, and he concluded that "the rising rate of inflation has, because of the structure of existing U.S. tax rules, substantially discouraged investment in the past 15 years." In a detailed examination of Feldstein's Effective Tax Rate model and a less extensive review of his other formulations (Neoclassical and Return-Over-Cost models), a number of important and independent criticisms are advanced. Our results from examining all three models suggest strongly that taxes have not adversely affected capital formation during the recent episode of inflation, a conclusion consistent with the relatively robust levels of net investment between 1965 and 1981 actually shown in the newly benchmarked National Income data.

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I. INTRODUCTION

An incorrectly perceived decline in the rate of capital formation during the recent episode of inflation, coupled with the recognition of non-neutralities in the tax system, has renewed interest by both policy-makers and academic economists in the relationships between taxes and investment. Chief among these non-neutralities are the depreciation of fixed assets based on historical purchase costs, first-in, first-out accounting rules, the taxation of nominal capital gains and interest receipts, and the tax deductibility of nominal interest payments. The resulting impact on investment incentives has been investigated intensively and a general conclusion from these theoretical studies is that inflation, by increasing taxes on capital, can have significant adverse effects on capital formation.

Within the context of this broad research program, Martin Feldstein (1982) devoted the Fisher-Schultz Lecture to examining non-neutral tax rules by estimating two new investment models, Effective Tax Rate and Return-Over-Cost, as well as the familiar Neoclassical model. Based on the econometric results from three different models, Feldstein concluded that "the rising rate of inflation has, because of the structure of existing U.S. tax rules, substantially discouraged investment in the past 15 years" (Feldstein, 1982, p. 860).

In this paper, we offer a detailed examination of the Effective Tax Rate model, as well as a less extensive review of the remaining specifications, and challenge the estimates on which Feldstein based his conclusion. Section II presents the original specification of the Effective Tax Rate model, whose key explanatory variable is the net-of-tax real return accruing to those with financial claims on business capital. The original model is reestimated with the newly benchmarked National Income Account data, and continues to support Feldstein's basic conclusion that the net-of-tax real return on capital has had a significant influence on net investment.

In Section III, we argue that the rate of return variable is inconsistent with Feldstein's theory in not allowing for increases in the value of the capital stock relative to the overall rate of inflation. Introducing these net revaluations into the original specification leads to a dramatic reversal: the rate of return variable becomes insignificant and cyclical conditions, as measured by capacity utilization, emerge as important.

To quantify the magnitude of the effect of non-neutral tax rules, Feldstein showed that, if the net-of-tax real return had remained at its 1965 value, then the net investment-output ratio would have been 64% higher than its historical value in 1978. Section IV analyzes this methodology in terms of the original specification and finds that, due almost evenly to data revisions and a correction in the simulation method, the net investment-output ratio would have risen only 16%, a 75% reduction in the previously reported effect. We then examine movements in pretax income, depreciation, and taxes, and discover that the net-of-tax real return, far from being depressed by taxes, would have <u>increased</u> by 27.4% in 1979 if the non-tax components had maintained their 1965 values.

We conclude that the Effective Tax Rate model, when properly specified and evaluated, does not imply that taxes have adversely affected capital formation during the recent inflation episode and, in Section V, we examine briefly the remaining two econometric equations considered by Feldstein. Misspecifications relating to the opportunity cost of funds and lag distributions may bias upward the effect of tax parameters on investment in Feldstein's Neoclassical specification. The Return-Over-Cost model depends crucially on the existence of a standard investment project comprising capital assets purchased in fixed proportions, and evidence is cited that the proportions of equipment to structures or nonresidential capital to the inventory stock will not be constant during an inflationary period. Thus, for a number of independent reasons, we find that the estimates developed in the Fisher-Schultz Lecture do not support Feldstein's conclusion that taxes have exerted a significantly depressing effect on net investment between the mid-1960s and the late 1970s (Section VI).

Before investigating Feldstein's econometric specifications, it is useful to pause and examine the time series for the ratio of net nonresidential fixed investment to output (I^n/Y). The presumed decline in this ratio between 1966 and 1978 has contributed to the belief in a deficient rate of capital formation, possibly caused by the excessive taxation of capital income (e.g., Feldstein, 1982, p. 827). However, the time pattern of I^n/Y, displayed in column 1 of Table 1 and based on the newly benchmarked National Income and Product Account (NIPA) data, contradicts the notion that net investment has been low by historical standards. Data are presented for the years 1953 to 1981, and the period has been divided in 1966, the year in which I^n/Y peaked and inflation, as measured by the overall GNP deflator, began to accelerate. The mean of I^n/Y for the period 1967-1981 is 3.138, 10.2% higher than the mean for 1953-1966 and 4.7% higher than the mean of 2.997 calculated from 1953 to 1981. A casual inspection of the data indicates that net investment, while severely depressed by and recovering slowly from the OPEC shock of 1973-1974, has been very healthy by historical standards.[1]

The NIPA benchmark revisions, undertaken periodically and most recently in December 1980, resulted in significant increases in both the level and growth rate of business plant and equipment expenditures,[2] and consequently in net investment. Previous estimates of I^n/Y are displayed in column 2 of Table 1, and are markedly lower than the most recent figures, though the mean for 1967-1978 continues to exceed the mean for the entire period. The magnitude and timing of the discrepancy resulting from the new and old data are highlighted by the level and percentage differences, displayed in columns 3 and 4, respectively. Persistent discrepancies between the I^n/Y series emerge in 1970, and become more pronounced from 1975 through 1978. Thus, the concern for a "capital shortage", due to the presence of non-neutral tax rules in the inflationary 1970s, may be largely displaced by the benchmark revisions in the NIPA data.

TABLE 1

RATIO OF NET NONRESIDENTIAL FIXED INVESTMENT TO OUTPUT
OLD AND NEWLY REVISED DATA*
(percent)

Year	I^n/Y (New Data) (1)	I^n/Y (Old Data) (2)	Cols. (1)-(2) (3)	Cols. (3)/(2) (4)
1953	2.806	2.700	.106	3.937
1954	2.386	2.300	.086	3.738
1955	2.890	2.800	.090	3.205
1956	3.142	3.100	.042	1.347
1957	2.983	2.900	.083	2.873
1958	1.792	1.700	.092	5.397
1959	2.134	2.000	.134	6.693
1960	2.387	2.200	.187	8.519
1961	2.128	1.900	.228	11.997
1962	2.512	2.300	.212	9.198
1963	2.595	2.300	.295	12.809
1964	3.115	2.900	.215	7.414
1965	4.240	4.000	.240	5.994
1966	4.742	4.500	.242	5.380
1967	4.034	3.800	.234	6.158
1968	3.875	3.700	.175	4.726
1969	4.082	3.800	.282	7.431
1970	3.473	3.100	.373	12.024
1971	2.913	2.500	.413	16.536
1972	3.120	2.800	.320	11.428
1973	4.008	3.400	.608	17.881
1974	3.478	3.100	.378	12.180
1975	1.864	1.400	.464	33.144
1976	1.969	1.500	.469	31.242
1977	2.639	2.000	.639	31.953
1978	3.146	2.500	.646	25.826
1979	3.331	N.A.	N.A.	N.A.
1980	2.647	N.A.	N.A.	N.A.
1981	2.491	N.A.	N.A.	N.A.
Means				
1953-1978	3.017#	2.739	.279	11.501
1953-1966	2.847	2.686	.161	6.321
1967-1978	3.217	2.800	.417	17.544
Coefficients of Variation				
1953-1978	.263	.292	.629	.809
1953-1966	.283	.293	.490	.536
1967-1978	.238	.301	.373	.596

*Definitions and sources for the variables are contained in the Appendix.
#For 1953-1981, the mean value of I^n/Y is 2.997.
N.A., not available.

II. THE EFFECTIVE TAX RATE MODEL AND THE NEWLY BENCHMARKED DATA

In this section, we introduce Feldstein's model relating net investment to tax parameters, and reestimate it with the newly benchmarked data. Following on previous empirical work,[3] Feldstein quantifies the effects of both non-neutral and neutral (e.g., the Federal corporate tax rate) tax rules in the concept of the Effective Tax Rate on capital income, τ_t, defined as follows (definitions and sources for all variables used in this paper are contained in the Appendix),

$$\tau_t = T_t / (Q_t - D_t), \qquad (1)$$

where:

T_t = "corporate income taxes, the property tax, the personal tax on dividends and capital gains, and the personal and corporate taxes on the interest income received by the creditors of the nonfinancial corporations" (Feldstein, Poterba, and Dicks-Mireaux, 1983, p. 137),

Q_t = corporate operating income, before interest payments, capital consumption allowances, and taxes, adjusted for the replacement cost of inventories used in current production and losses on non-interest bearing financial assets,

D_t = the value of depreciation of nonresidential fixed private capital.

Thus, τ_t provides a comprehensive measure of all taxes assessed on an adjusted flow of capital income after it is eventually received bv bondholders and equityholders.[4]

In evaluating the effect of taxation on capital formation, Feldstein posits that net investment is dependent on the net-of-tax real return to capital, defined as the product of $(1-\tau_t)$ and the net pretax return on capital. The net pretax return, R_t, is calculated as the return before taxes, net of depreciation expenses, accruing to those with financial claims on the firm's capital stock,

$$R_t = (Q_t - D_t) / K_t, \tag{2}$$

$$K_t = K_{PE,t} + K_{IN,t} + K_{L,t}, \tag{3}$$

where:

K_t = the replacement value of the firm's total stock of capital at the beginning of period t,

$K_{PE,t}$ = the replacement cost of fixed plant and equipment at the beginning of period t,

$K_{IN,t}$ = the replacement cost of inventories at the begining of period t,

$K_{L,t}$ = the market value of land at the beginning of period t.

The net-of-tax real return, RN_t, is computed by combining (1) and (2),

$$
\begin{aligned}
RN_t &= (1 - \tau_t) * R_t \\
&= \frac{Q_t - D_t - T_t}{Q_t - D_t} * \frac{Q_t - D_t}{K_t} \qquad (4) \\
&= (Q_t - D_t - T_t) / K_t .
\end{aligned}
$$

Thus, RN_t is the yield, adjusted for depreciation and taxes, on a capital investment valued at K_t. It is, however, an average yield that may not accurately reflect marginal returns.[5]

The basic hypothesis examined by Feldstein is the degree to which net investment is affected by RN_t. Using what is now considered the "old" NIPA data, Feldstein estimated the following econometric specification, which we label the Effective Tax Rate (ETR) model,

$$(I^n/Y)_t = b_0 + b_1 \ UCAP_{t-1} + b_2 \ RN_{t-1} + e_t, \qquad (5)$$

where e_t is an orthogonal error. The term $UCAP_{t-1}$ is the Federal Reserve Board's Index of Capacity Utilization for Total Manufacturing, and captures cyclical effects. Both explanatory variables are entered lagged one period to reflect delays in decision making, production, and delivery of capital goods, and to avoid simultaneity (Feldstein, 1982, p. 839).[6] The ETR model was estimated with annual data and a first-order Cochrane-Orcutt correction to remove serial correlation from the residuals. (Estimates without the autocorrelation correction, presented in Chirinko, 1982a, Chapter V, Table III, are not qualitatively different from the results to be discussed in this section.)

Estimates of the ETR model with the old and newly benchmarked data are displayed in columns 1 and 2 of Table 2, respectively.[7] Despite the significant revisions in $(I^n/Y)_t$ discussed in Section I, the regression relationship is robust with respect to the new data (the components of RN_{t-1} also incorporate the benchmark revisions). For both equations, the coefficients for the constant and $UCAP_{t-1}$ are insignificant, while the coefficient on RN_{t-1} is significant at the 1% level. The $\bar{R}^2$ is slightly lower and the estimated autocorrelation coefficient, ρ, is doubled when (5) is estimated with the newly benchmarked data. The "price" elasticity for net investment, ε, relating RN_{t-1} to $(I^n/Y)_t$, is decreased slightly from .609 with the old data to .575 with the new data. In sum, reestimating the ETR model with the newly benchmarked data has little impact on Feldstein's conclusion of a significant role for the net-of-tax rate of return on net investment. However, the specification and interpretation of the original ETR model is subject to a number of criticisms that are pursued in the following two sections.

TABLE 2

ESTIMATED EQUATIONS

THE ORIGINAL AND MODIFIED EFFECTIVE TAX RATE MODELS*

Dependent Variable = $(I^n/Y)_t$

Variable or Statistic	Original Old Data (1)	Original New Data (2)	Modified New Data (3)	Modified New Data (4)
Constant	-2.091	-.611	-2.908	-1.555
	(1.756)	(1.709)	(2.245)	(1.932)
$UCAP_{t-1}$	.038	.023	.065	.054
	(.023)	(.022)	(.028)	(.023)
RN_{t-1}	.437	.439	---	---
	(.087)	(.094)	---	---
$RNNR^{\#}_{t-1}$	---	---	.130	---
	---	---	(.091)	---
$RNNR^{@}_{t-1}$	---	---	---	.018
	---	---	---	(.006)
ρ	.250	.466	.398	.644
	(.198)	(.173)	(.180)	(.150)
$\bar{R}^2$	.766	.725	.504	.607
σ	.391	.405	.543	.483
Durbin-Watson	1.959	2.052	1.698	2.006
Res. Sum Sq.	3.209	3.764	6.782	5.371
Mean of Dep. Var.	2.758	3.048	3.048	3.048
Mean of "Price" Var.	3.841	3.995	4.046	6.379
"Price" Elasticity, ε	.609	.575	.173	.038
Observations	24	26	26	26
F^+	---	2.71	.59	1.04

*Estimates in column 1 are for the period 1955-1978 and in columns 2-4 for the period 1955-1980. Definitions and sources for the variables are contained in the Appendix. Standard errors in parentheses.

#Net revaluations in $RNNR_{t-1}$ are based on the price of new plant and equipment.

@Net revaluations in $RNNR_{t-1}$ are based on Standard & Poor's composite stock price index.

+F statistic for the Chow test; breakpoint between 1966 and 1967.

III. NET REVALUATIONS OF THE CAPITAL STOCK

The key variable in the Effective Tax Rate model, RN_t, is defined as the income flow, net of taxes and depreciation, accruing to bondholders and equityholders relative to their capital investment at the beginning of the period (see (4)). In general, however, this measure is inconsistent with Feldstein's model in not allowing for capital gains on the initial investment relative to the overall rate of inflation.[8] Consideration of these net revaluations of capital leads to a modified definition of the net-of-tax real return,

$$RNNR_t = RN_t + NR_t \tag{6}$$

$$NR_t = \sum_{j \epsilon J} (\dot{q}/q)_{j,t} \, (K_{j,t} \,/\, K_t) - (\dot{p}/p)_t \tag{7}$$

where: $RNNR_t$ = net-of-tax real return with net revaluations of capital,

NR_t = net revaluations of capital,

$(\dot{q}/q)_{j,t}$ = the percentage change in the value of the jth type of capital,

$(\dot{p}/p)_t$ = the overall rate of inflation,

J = plant and equipment (PE), inventories (IN), or land (L).

Under the <u>assumption</u> that changes in the value of capital have been matched by inflation, the original and modified definitions of the rate of return will be equal.

Changes in the value of existing (tangible) capital - plant, equipment, inventories, land - can be measured by changes in the value of new capital, calculated from published price deflators.[9] While price series for plant and equipment can be readily obtained, no suitable sources exist for the prices of land and inventories.[10] These latter deficiencies arise because transactions in land occur infrequently and the NIPA inventory price index applies to the end of the period and is heavily influenced by changes in the composition of inventory stocks. Rather than utilizing poor proxies, we have decided to omit changes in the prices of inventories and land from NR_t,

$$NR_t = .65 * ((\dot{q}/q)_{PE,t} - (\dot{p}/p)_t), \tag{8}$$

where .65 is the share of plant and equipment in the firm's total tangible capital stock (Feldstein, et. al., 1983, p. 134, fn. 13). The overall rate of inflation is calculated from the implicit price deflator for GNP.

The net-of-tax real returns with and without the addition of net revaluations of the stock of plant and equipment, and the level and percentage differences between these two series are displayed in Table 3, columns 1 through 4, respectively. The introduction of net revaluations reduces the dispersion of the means of the rate of return series in the sub-sample periods and only slightly affects the coefficients of variation. The largest positive percentage increases in NR_t relative to RN_t occur in 1956-1957 and 1974-1975, which are also the years that witnessed the largest inflation rates in the first and second parts of the sample. Given the non-neutral tax rules that are reflected in τ_t, displayed in column 5, it is not surprising that the effective

TABLE 3

NET-OF-TAX REAL RETURN VARIABLES
WITH AND WITHOUT NET REVALUATIONS,
AND THE EFFECTIVE TAX RATE ON CAPITAL INCOME*

Year	$RNNR_t$ (1)	RN_t (2)	NR_t (3)	Cols. (3)/(2) (4)	τ_t (5)
1953	3.064	2.884	.180	6.229	.747
1954	3.138	3.413	-.276	-8.076	.681
1955	4.423	4.567	-.144	-3.150	.654
1956	5.758	3.295	2.464	74.776	.711
1957	4.340	2.982	1.358	45.548	.716
1958	1.500	2.703	-1.203	-44.502	.703
1959	3.498	3.842	-.344	-8.944	.660
1960	2.696	3.484	-.788	-22.607	.665
1961	2.631	3.675	-1.044	-28.418	.650
1962	4.023	4.772	-.749	-15.689	.599
1963	4.782	5.220	-.438	-8.388	.589
1964	5.718	6.093	-.375	-6.158	.552
1965	6.254	6.822	-.628	-9.119	.535
1966	6.446	6.630	-.184	-2.769	.549
1967	6.235	5.985	.250	4.178	.550
1968	5.011	5.174	-.163	-3.151	.611
1969	3.749	4.034	-.285	-7.071	.661
1970	2.948	2.989	-.041	-1.384	.695
1971	3.846	3.598	.247	6.875	.654
1972	4.035	4.169	-.134	-3.207	.621
1973	2.357	3.586	-1.229	-34.262	.668
1974	2.873	1.285	1.587	123.519	.847
1975	6.147	2.703	3.445	127.452	.703
1976	3.035	3.279	-.244	-7.444	.662
1977	3.377	3.611	-.234	-6.484	.646
1978	3.520	3.158	.362	11.465	.681
1979	2.849	2.754	.095	3.465	.694
Means					
1953-1979	4.009	3.954	.055#	6.766	.656
1953-1966	4.162	4.317	-.155	-2.233	.644
1967-1979	3.845	3.563	.281	16.458	.669
Coefficients of Variation					
1953-1979	.340	.336	19.152	6.040	.103
1953-1966	.361	.326	6.280	13.338	.106
1967-1979	.322	.326	4.023	3.014	.101

*Definitions and sources for the variables are contained in the Appendix.
#For 1953-1981, the mean value of NR_t is .037.

tax rate was also very high in these years. Thus, net revaluations will tend to mitigate the impact of effective tax rates in the ETR model.

In order to test the importance of net revaluations, the original ETR model is modified by replacing RN_{t-1} with $RNNR_{t-1}$. Estimates based on the original and modified models are presented in columns 2 and 3 of Table 2, respectively, and offer a striking reversal of the influence of the capacity and rate of return variables on net investment. The coefficient (and the implied elasticity) on the adjusted rate of return falls by 70%, and is no longer statistically different from zero, even at the 10% level.[11] However, cyclical factors, represented by $UCAP_{t-1}$, become statistically significant at the 5% level.

As a further test of the modified ETR model, we measure changes in the value of existing capital by changes in financial capital, calculated from Standard & Poor's composite stock price index (SP).[12] The resulting parameter estimates allow for an assessment of the robustness of our econometric evidence, and are presented in column 4 of Table 2. The $\bar{R}^2$ of .607 is bracketed by the $\bar{R}^2$ statistics from the previous regressions and, unlike these results, both $UCAP_{t-1}$ and $RNNR_{t-1}$ prove statistically significant. However, the elasticity for $RNNR_{t-1}$ is only .038, indicating a quantitatively unimportant role for the rate of return variable.

Additional support for including net revaluations is obtained when the original and both modified ETR models are tested for structural stability. Following Feldstein, we split the sample between 1966 and 1967 and, at the 10% level, the appropriate F statistic (shown in Table 2) indicates that the original ETR model is unstable.[13] However, the null hypothesis of structural stability can not be rejected with the modified ETR model using either measure of the value of existing capital.[14]

In sum, the econometric results discussed in this section indicate a significant misspecification in the original ETR model, and a dramatic reversal in the roles of price and output variables on net investment. While the modified ETR model may be just another "false model" (to use Feldstein's terminology), it is the model consistent with the theoretical ideas presented in the Fisher-Schultz Lecture.

IV. THE IMPACT OF TAXES, THE GROSS PRETAX RETURN, AND DEPRECIATION ON THE RATE OF RETURN AND NET INVESTMENT

The analyses of the ETR model developed in Sections II and III have focused on the statistical significance of coefficients. While appropriately large t-statistics are necessary in order to ascribe explanatory power to independent variables, further information can be obtained by calculating the magnitude of the effects implied by the estimated coefficients. Feldstein assesses the implications of the ETR model by using the estimated equation, including the residual e_t, to compute the net investment-output ratio under an alternative path of RN_t. From 1965 onward, the net-of-tax real return is set equal to its value in 1965, the year in which RN_t reaches a peak for the sample period.[15] Given the one-period lag in the model, this alternative path will lead to differences between the simulated and actual paths of the dependent variable beginning in 1967, and the scenario attempts to quantify the impact of the effective tax rate, boosted by the interaction of inflation and non-neutral tax rules, on capital formation. Feldstein concluded that, if RN_t had been maintained at its 1965 level, $(I^n/Y)_t$ would have been 64% higher than actually realized in 1978. Parallel calculations, based on the newly benchmarked data and the corresponding parameter estimates (column 2 of Table 2), reveal that the magnitude is lowered to 46% in 1978 but rises to a substantial 68% in 1980.

While the simulation procedure can be criticized for the instability of parameters and endogeneity of the explanatory variables,[16] the fundamental problem is that Feldstein's results mirror the influence of both higher effective tax rates and lower net pretax returns. For 1965 onward, Feldstein has defined the alternative net-of-tax real return as $RN'_t = (1 - \tau_{1965}) * R_{1965}$. If we are concerned with the effect of taxes on net investment over this period, then the alternative rate of return should be defined by holding only τ_t at its 1965 value $(RN''_t = (1 - \tau_{1965}) * R_t)$. Simulations based on the newly benchmarked data for RN'_t and RN''_t are displayed in the first two rows of Table 4, and generate vastly different results. When both R_t and τ_t are held constant, the original ETR model implies that $(I^n/Y)_t$ would have been 43% higher on average than actual values for the period 1967-1980, compared to a 17% average difference when only τ_t is held fixed.[17] Thus, an appropriate simulation of Feldstein's <u>original</u> ETR model with the newly revised data lowers substantially the estimated impact of effective tax rates on net investment during the recent episode of inflation.

The interpretation of the above simulations is unclear because the rise in τ_t can be due to increased taxes (T_t) in the numerator or lower pretax operating income (Q_t) or higher depreciation (D_t) in the denominator. These considerations indicate that it will be useful to decompose RN_t into the following three components,

$$RN_t = (Q/K)_t - (D/K)_t - (T/K)_t, \qquad (9)$$

TABLE 4

DIFFERENCES BETWEEN CONDITIONAL AND ACTUAL VALUES OF $(I^n/Y)_t$

MEAN AND END OF PERIOD VALUES*

Conditional Variable	Mean (1967-1980) Level Diff. (1)	Mean (1967-1980) Perc. Diff. (2)	1980 Level Diff. (3)	1980 Perc. Diff. (4)
Original ETR Model				
$RN'_t = (1-\tau_{1965}) * R_{1965}$	1.360	42.72	1.812	68.43
$RN''_t = (1-\tau_{1965}) * R_t$	.548	17.22	.628	23.72
$UCAP'_t = UCAP_{1965}$	.142	4.46	.090	3.40
Modified ETR Model				
$RNNR'_t = RN'_t + NR_t$	.289	9.06	.442	16.69
$RNNR''_t = RN''_t + NR_t$	.162	5.09	.186	7.01
$UCAP'_t = UCAP_{1965}$	.403	12.65	.255	9.65

*Conditional values of $(I^n/Y)_t$ are based on alternative paths of the explanatory variables that are defined in the Table and indicated by primes. For each simulation, the other explanatory variable takes on historical values. The calculations in rows 1-3 are based on the coefficients in column 2 of Table 2 and in rows 4-6 on the coefficients in column 3 of Table 2. Columns 1 and 3 contain the level differences between the conditional and actual values of $(I^n/Y)_t$; columns 2 and 4 contain the comparable percentage differences.

where (9) is equivalent to (4).[18] Calculations based on (9) for 1965 and 1979 are presented in Table 5, and provide a striking challenge to the popular notion that the fall in RN_t has been caused by higher taxes. From 1965 to 1979, RN_t declined from 7.08 to 2.74 a -61.3% change relative to its 1965 value. However, as indicated in the third row, the change in the gross pretax return of -72.3%, holding $(D/K)_t$ and $(T/K)_t$ at their 1965 values, was greater than the overall decrease in RN_t. Depreciation alone contributed to a further decline of 16.4% and taxes, far from contributing to a decline in the rate of return, would have lead to a 27.4% increase in RN_t if the other components had maintained their 1965 values.

This latter calculation may be misleading because of the positive relationship between pretax income and tax payments. In order to adjust for the lower level of economic activity in 1979, we assume that each one point drop in $(Q/K)_t$ lowers $(T/K)_t$ by the effective tax rates on dividends and real retained earnings and on corporate income assessed by Federal, State, and Local governments (the average for 1965-1979 of these tax rates is .4431). If we use the above assumptions to adjust $(T/K)_{1979}$ upward for falling pretax income and if $(Q/K)_t$ and $(D/K)_t$ had remained at their 1965 levels, then the net-of-tax real return would have been 6.75 in 1979, a 4.65% decline that is much smaller than the actual 61.3% drop. Thus neither appropriate simulations with Feldstein's original ETR model nor a careful examination of his data reveal that taxes have exerted a significantly depressing effect on net investment.

TABLE 5

DECOMPOSING THE NET-OF-TAX REAL RETURN ON CAPITAL (RN_t)*

	$(Q/K)_t$ (1)	$(D/K)_t$ (2)	$(T/K)_t$ (3)	RN_t (4)
Return by Year#				
1965 (%)	+23.58	-8.35	-8.15	+7.08
1979 (%)	+18.46	-9.51	-6.21	+2.74
Change in Return Attributable to Each Component				
% change	-72.32	-16.38	+27.40	-61.30
% of total change	-117.98	-26.72	+44.70	-100.00

*The net-of-tax real return on capital is computed according to equation (9): $RN_t = (Q/K)_t - (D/K)_t - (T/K)_t$ (the inclusion of net revaluations would change the results trivially). The figures in row (3) are computed as the sum of the 1979 value of the variable in a given column plus the 1965 values of the remaining components, divided by the 1965 total value, less 1, times 100. Definitions and sources for the variables are contained in the Appendix.

#The capital stocks are valued at 525.3 and 2091.0 billions of current dollars for 1965 and 1979, respectively.

V. ADDITIONAL ECONOMETRIC EVIDENCE

Apart from the ETR model, Feldstein presented econometric evidence from two other models reaffirming a significant relationship between taxes and investment and, in the following two sub-sections, we show that these estimates are also subject to a number of reservations

A. Neoclassical Model

The neoclassical theory of investment, as developed by Jorgenson (1963) and Hall and Jorgenson (1971), relates the desired capital stock to the level of output and the user cost of capital, the latter combining in a nonlinear fashion the opportunity cost of funds, the depreciation rate, and various tax parameters. Unlike in the ETR model, the impact of taxes on investment is assessed at the margin (cf., fns. 4, 5). Movements in output or the user cost are translated into net investment through the same distributed lag coefficients, reflecting adjustment costs brought about by delays in planning and delivery. Using estimates from this model, Feldstein concluded that higher taxes and financing costs, resulting from inflation and raising the user cost, have weakened the incentive to invest since the mid-1960s.[19]

The relationship between net investment and the user cost is overstated in this model for three reasons. First, since Feldstein used a single lag distribution, the lag coefficients represent an amalgam of output and user cost effects. If output has the stronger influence on investment, then the single lag distribution will overstate the potency of the user cost, hence taxes. Second, the opportunity cost of funds is taken as a weighted average of the costs of debt and equity, the latter equal to an earnings-stock price ratio adjusted for the difference between book and economic profits. The presence of an earnings-price ratio in the user cost variable may involve a misspecification, for a decline in this ratio may well reflect an increase in expected future earnings relative to current earnings rather than a decline in the cost of funds. Insofar as buoyant equity markets and surging investment are both positively associated with the state of the business cycle, a significant but spurious inverse relationship between investment and the user cost will exist. Econometric verification of the importance of these two biases has been presented in Chirinko and Eisner (1982, 1983): when an equation for equipment expenditures (taken from the Data Resources Inc. model) based essentially on the neoclassical model was reestimated with separate lag distributions and the earnings-price ratio removed from the opportunity cost of funds, the estimated response of equipment investment to changes in tax credits and depreciation allowances fell, relative to previous estimates, by approximately 80%![20]

Third, the nominal cost of equity is defined as the sum of an adjusted earnings-price ratio and capital gains. The latter term is equated to the overall rate of inflation which, however, may overstate capital gains on equity. From 1965 to 1981, the compound annual growth rate in Standard & Poor's composite stock price index was only 2.33%, compared to 5.98% in the GNP deflator. The languid increase in capital gains relative to the overall inflation rate may have counterbalanced the rise in the adjusted earnings-price ratio, resulting in a moderately increasing or stable real cost of equity and a stable or possibly declining real cost of funds. By assuming that capital gains have matched the inflation rate, Feldstein overestimated the rise in the cost of capital services since the mid-1960s, and hence the adverse effects on investment in the Neoclassical model.

B. Return-Over-Cost Model

The third model analyzed by Feldstein quantifies investment incentives by contrasting the internal rate of return a firm can afford to pay on a standard investment project with the cost of funds (i.e., the return-over-cost). In an inflationary environment, the internal return is decreased by historical cost depreciation and increased by the tax deductability of nominal interest payments, and Feldstein's calculations indicate that the return firms can afford to pay has not been greatly affected by inflation. However, the cost of funds has risen substantially, thus reducing the spread between the return on and cost of an investment project. (The criticism advanced above concerning the calculation of the real cost of equity applies with equal force to the cost of funds used in the Return-Over-Cost model.) Positive and significant regression coefficients on the return-over-cost variable, with the components entered either as one term or separately, led Feldstein to conclude that non-neutral tax rules have had an adverse effect on investment.

However, the Return-Over-Cost model is suspect as a useful tool for analyzing non-neutral tax rules. A key maintained assumption of the model is that there exists a standard investment project comprising capital assets purchased in fixed proportions. At a theoretical level, such an assumption is unwarranted in the presence of non-neutral tax rules that may favor a particular type of capital.[21] Empirically, the ratio of the constant dollar stocks of equipment to structures has risen from .77 in 1950 to 1.33 in 1980.

Even if the equipment-structures mix is neutral with respect to inflation, the standard investment project assumption is inappropriate in the presence of an inventory stock of materials used in the production process. The user cost of the inventory stock depends on the inventory accounting rule and turnover rate and, with first-in, first-out accounting, increases in the rate of inflation, ceteris paribus, raise the effective price of inventories and induce a substitution toward more plant and equipment (Chirinko, 1982b).[22] In a world with more than one capital asset owned by firms, the Return-Over-Cost model would not appear to be useful in assessing the relationship between taxes and investment in new plant and equipment.

Lastly, the Return-Over-Cost model is no longer stable over time when estimated with the newly benchmarked data. Following Feldstein, we split the sample between 1966 and 1967, and the F statistic for stability of the coefficients over the two sub-samples is 8.76, significant at the 1% level.

VI. SUMMARY AND CONCLUSIONS

This paper has examined the evidence from three econometric models presented by Martin Feldstein in his Fisher-Schultz Lecture, and particular attention has been given to the Effective Tax Rate model. In Section II, the original specification proved very robust to reestimation with the newly benchmarked data, and Feldstein's basic conclusion concerning the importance of the net-of-tax real return remained essentially unchanged. It has been argued in Section III that the rate of return has been misspecified by not incorporating the net revaluations of the capital stock. Including net revaluations in the rate of return led to a dramatic reversal of the roles of "prices" and output in the estimated model, as the net-of-tax real return lost its statistical significance to the capacity utilization variable. In Section IV, the magnitude of the effect of taxes on net investment in the original model was examined. Due almost evenly to data revisions and a correction in the simulation method, we found that, if the effective tax rate had been held at its 1965 value, the net investment-output ratio would have risen only 16% in 1978 relative to its historical value, a 75% reduction in the previously reported effect. An examination of the components of RN_t led to the surprising conclusion that, ceteris paribus, changes in taxes have significantly <u>raised</u> the net-of-tax real return to capital. The results generated in this paper suggest strongly that the Effective Tax Rate model, when properly specified and evaluated, does not imply that taxes have adversely affected business capital formation during the recent episode of inflation,[23] a conclusion consistent with the relatively robust levels of net investment between 1965 and 1981 actually shown in the benchmarked National Income data.

As Feldstein states in his Lecture, evidence from any one model is unlikely to be definitive because it may be subject to a number of biases affecting the results in unknown ways. Thus Feldstein also analyzed the Return-Over-Cost and Neoclassical models; our review of these two specifications generated supporting evidence for the conclusion of a limited role for tax incentives (Section V). We have clearly not exhausted all plausible models of the investment process nor all possible variations of the specifications under review. In particular, little attention has been given to the explicit modeling of expectations and additional dynamic elements influencing the capital formation process. Models have been developed that are well-suited for examining these factors, and their implications for tax policy have been summarized elsewhere (Chirinko, 1983). *Based on the current study*, we conclude that fiscal policies aimed at stimulating capital formation are likely to succeed only insofar as they have a salutary effect on the level of capacity utilization. The direct impact of tax policy on net investment appears to be negligible.

APPENDIX

Data Sources and Glossary

Sources

CEA - Council of Economic Advisers (1981).

FELD - Feldstein (1982).

FPDM - Feldstein, Poterba, Dicks-Mireaux (1983)

SCB - U.S. Department of Commerce: 1952-1976 (1981b), 1977-1980 (1981a).

Variables

D - current dollar depreciation of nonresidential fixed private capital; SCB, Table (T) 5.2, Line (L) 8

I^n - constant dollar net nonresidential fixed investment; SCB, T 5.3, L 9

$(I^n/Y)_{OLD}$ - ratio of net investment to output, old NIPA data; FELD, T1, Column (C) 1, p. 20

K - the replacement value of the firm's total stock of capital; FPDM, pp. 134-135

NR - net revaluations of K; equation (8)

p - implicit deflator for gross national product; SCB, T 7.1, L 1

q - implicit deflator for gross nonresidential fixed investment; SCB, T 7.1, L 8

Q - current dollar operating income, before capital consumption allowances and taxes, adjusted for the replacement cost of inventories used in current production and losses on non-interest bearing financial assets; FPDM, T 3, C 1 Plus D

R - net pretax return on K; FPDM, T 2, C 4, and equation (2)

RN - net-of-tax real return on K; equation (4)

RN′ - alternative path of RN; see Table 4

RN" - alternative path of RN; see Table 4

RNNR - net-of-tax real return on K with net revaluations; equation (6)

RNNR′ - alternative path of RNNR; see Table 4

RNNR" - alternative path of RNNR; see Table 4

SP - Standard & Poor′s composite stock price index; CEA, T B-90, C 7

T - current dollar total taxes assessed on an adjusted flow of capital income after it is eventually received by bondholders and equityholders

τ - effective tax rate on capital income; FPDM, T 3, C 9, and equation (1)

UCAP - Federal Reserve Board Index of Total Manufacturing Capacity; CEA, T B-43, C 1

UCAP′ - alternative path of UCAP; see Table 4

Y - constant dollar Gross National Product; SCB, T 1.2, L 1

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FOOTNOTES

1. Two caveats associated with this conclusion should be noted. First, it has been argued that the reported net investment and GNP figures should be reduced by the amount of direct pollution abatement expenditures, which do not affect output as recorded in the National Income Accounts (Summers, 1981, pp. 71-73). When this adjustment is made to the I^n/Y series, capital formation in recent years continues to be strong by historical standards: the mean for the period 1953-1979 of 2.8 is exceeded or equaled by the mean for 1967-1979 of 2.9 and by the values for 1978 and 1979 of 2.8 and 3.0, respectively. Second, alternative breakpoints in the sample may lead to different assessments of the strength of net investment. The 1966-1967 split was chosen because it was the one used by Feldstein in his empirical work and, as mentioned in the text, I^n/Y peaked and inflation began to accelerate in the mid-1960s.

2. During the postwar period, benchmark revisions have been undertaken in 1947, 1951, 1954, 1965, 1976, and 1980. The purpose of these benchmarks is to allow for the "incorporation of newly available and revised source data" (e.g., input-output tables), "the reconsideration and improvement of definitions, classifications, and estimating procedures, the introduction of new series" (e.g., the economic measure of capital consumption in the 1976 benchmark), "and the redesign of tables to make them more convenient and informative" (U.S. Department of Commerce, 1980, p. 1). In the 1980 benchmark, significant revisions occurred in expenditures on producers durable equipment, now based solely on commodity flows but previously calculated as an average of commodity flows and responses from the Bureau of Economic Analysis' Plant and Equipment

Survey. An increasing amount of equipment leasing by non-producing firms and a decrease in the number of respondents to the Survey partly explain the growing discrepency between the commodity flow and survey methods. Expanded coverage and the use of recently released input-output tables also contributed to the higher estimates of producers durable equipment. The level of nonresidential structures was increased by the inclusion of hotels and motels from the residential structure category, although this transfer did not appreciably alter the growth rate.

3. The concept of the Effective Tax Rate on capital income was initially presented in Feldstein and Summers (1979), extended to include state and local taxes in Feldstein and Poterba (1980), and recalculated with the newly benchmarked data in Feldstein, Poterba, and Dicks-Mireaux (1983). Cf., fn. 4.

4. In contrast to the marginal effective tax rates that have been calculated by some researchers (e.g., King and Fullerton, 1984), τ_t is an average effective tax rate. While no definitive definition of "the" marginal or average effective tax rate exists (Fullerton, 1984), it is interesting to note that the correlation coefficient between the marginal and average effective corporate tax rates of Hulten and Robertson (1984) is .89 for the period 1952-1980 or 1952-1982. Cf., fn. 5 for a further discussion of average and marginal concepts.

5. See Gravelle (1980), Feldstein and Summers (1980), Sullivan (1981, Chapter IV), and Feldstein, Poterba, and Dicks-Mireaux (1983, p. 143, fn. 38). Fullerton (1984) provides an excellent discussion of various definitions of and differences in average and marginal effective tax rates and, by extension, average and marginal net returns. Neither concept would appear to be dominant in the analysis of capital formation.

Average returns are a deficient measure because they are not directly related to the marginal decisions at the core of economic theory. However, quantifying the marginal return on capital can be achieved only by considering selected features of the tax code and by relying on a number of maintained assumptions -- competitive market structure, uniformly positive cash flows, and the maximization of a particular objective function. Studies using average returns are best viewed as complementary to work on marginal returns where, in the former, potentially restrictive assumptions are relaxed at the expense of a direct link to the neoclassical model of capital accumulation.

6. It should be noted that (5) is not an investment schedule, but rather a supply curve for funds allocated to nonresidential fixed investment, conditional on the aggregate amount of saving (Feldstein, 1982, p. 836).

7. The results presented in column 1 are comparable to those reported in equation (3.2) (Feldstein, 1982, p. 840), and differ slightly due to scaling of the variables, less precision in the data, and possibly the convergence criterion for the estimate of the autocorrelation coefficient.

8. As with the net-of-tax real return, it is the expected rates of capital gains and inflation that are the relevant variables, which, following the reasoning implicit in Feldstein's study, we proxy by lagged realizations. While superior proxies may be available, their implementation would require significant departures from Feldstein's framework, and hence have not been utilized.

9. With a rise in the price of investment goods, equityholders enjoy a capital gain on existing capital but, due to higher priced inputs, suffer an increase in operating costs. Insofar as the price of output fails to rise pari passu, the latter effect may lead to lower operating income, Q_t, and is captured by Feldstein's RN_t.

10. It has been argued that the published price index for plant and equipment, which is calculated based on production costs, may suffer from a systematic upward bias, leading to a similar bias in NR_t. In the presence of quality changes in new capital goods not proportional to the added cost of production, the published series may overstate price increases (or understate decreases) relative to an index based on the value to capital goods users (Gordon, 1979). While the methodology underlying the construction of price series may be open to debate, systematic bias in the aggregate investment deflator is not apparent over a long time horizon. For the period 1953-1981, the ratio $(q/p)_t$, scaled to unity in 1953, reaches a peak in 1957 (1.050), generally falls for the ensuing 17 years, and bottoms-out in 1973 (.942). The ratio rises sharply between 1973 and 1975. From 1975-1981, the series exhibits a damped oscillatory pattern and, in 1981, equals its 1953 value. While the time series of $(q/p)_t$ may exhibit some serial correlation, casual inspection of the data do not reveal a systematic bias that will affect the results presented in this paper. Further evidence in support of our measure of NR_t is that, when summed over the sample period, net revaluations are zero (Table 3).

11. Since the elasticity is the product of an estimated coefficient and the inverse of the mean of $(I^n/Y)_t$, both of which are stochastic and non-independent, we do not know the distribution of ε. Logarithmic regressions of the original and modified ETR models generated estimated ε's that are slightly smaller than, but not significantly different from, those reported in Table 2. The confidence intervals for these estimated ε's are similar to those of the estimated b_2's discussed in the text.

12. In this case, $NR_t = (\dot{SP}/SP)_t - (\dot{p}/p)_t$.

13. The discussion in Feldstein (1982) suggests that the 1966-1967 breakpoint was chosen simply to halve the sample. In addition, 1966 is the year in which $(I^n/Y)_t$ peaked and inflation, as measured by the overall GNP deflator, began to accelerate.

14. As noted by Toyoda (1974), the Chow test's significance levels are increased when the regression standard errors from the sub-samples are unequal. The percentage differences between the regression standard errors from the sub-samples are only 6.97%, 10.94%, and 12.22% for the original and modified models, respectively, and thus have a trivial effect on the critical region (Toyoda, 1974, Table I; Schmidt and Sickle, (1977).

15. Rather than a decline in profitability, the observed fall in RN_t could be due to a change in the mix of tangible to non-tangible capital. For example, proportionate declines in the stock of research and development and the flow of capital income, leaving "true" profitability unaffected, would nonetheless result in a decline in RN_t as measured in this study. However, the correlation coefficient between RN_t and a rate of return including the stocks of research and development and goodwill is .97 (this statistic is based on series whose cyclical components have been removed).

16. The issue of unstable parameters, due to changes in policy or non-policy factors, has been discussed in Eisner (1969), Lucas (1976), and Sargent (1981). Of further concern is the feedback from the counterfactual path of RN_t to greater investment, a larger capital stock, and ultimately a lower RN_t. This scenario suggests that the reported results from any of these simulations are biased upward, though the magnitude of the bias is likely to be small because of net investment's negligible impact on the capital stock.

17. The coefficient on capacity utilization is significant only in the modified ETR model, and holding $UCAP_t$ to its 1965 value would have resulted in 13% more investment on average between 1967-1980. Simulation results with the insignificant variables are presented in Table 4, rows 3-5, and the response of net investment is small.

18. This decomposition suggests that we may wish to relax the constraint implicit in (5) that forces each component of the rate of return to affect net investment through the same coefficient. The theoretical justification for such a decomposition follows from interpreting the estimated coefficient as an amalgam of expectation and

delivery lag parameters, which may vary systematically among components of RN_t (Eisner, 1969; Nerlove, 1972). Estimates of this more general model reveal that the constraint is barely rejected for the original ETR model and easily rejected for the modified ETR model (all tests are based on a 5% significance level). In addition, only the coefficients of $(Q/K)_{t-1}$ and $(T/K)_{t-1}$ are statistically different from zero.

19. Chirinko and King (1984) show that, in an inflationary environment, the presumed rise in the user cost and the bias in favor of shorter-lived assets occur only under a limited set of circumstances.

20. A comment has been offered by Sinai and Eckstein (1983).

21. See Auerbach (1979), Abel (1981), and fn. 19.

22. This conclusion rests on the substitutability of materials for capital in production. See Humphrey and Moroney (1975) and Morrison and Berndt (1981) for supporting evidence.

23. Fair (1981) also fails to discover a significant rate of return effect on net investment in an alternative investment equation.