NBER WORKING PAPER SERIES

INCENTIVE EFFECTS OF TAXES ON INCOME FROM CAPITAL: ALTERNATIVE POLICIES IN THE 1980's

Don Fullerton

Yolanda Kodrzycki Henderson

Working Paper No. 1262

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
January 1984

This paper was written in part while Don Fullerton was a National Fellow at the Hoover Institution, Stanford Univeristy. An earlier version of the paper was presented on September 22, 1983 at the Urban Institute Conference on Reagan's Economic Policy and Long-Term Growth. We are grateful to Dale W. Jorgenson for providing unpublished data and to Michael J. Boskin, Harvey Galper, Charles R. Hulten, Mervyn A. King, Andrew B. Lyon, and conference participants for helpful suggestions. The research reported here is part of the NBER's research program in Taxation. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

NBER Working Paper #1262
January 1984

Incentive Effects of Taxes on Income from Capital: Alternative Policies in the 1980's

ABSTRACT

In this paper, we evaluate existing tax law as of 1980, President Reagan's tax reform initiatives as enacted in the Economic Recovery Tax Act of 1981 (ERTA) and the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA), as well as other proposals that were not enacted. For each law, we measure marginal effective total tax rates for capital in the corporate sector, the noncorporate sector, and the owner-occupied housing sector. These rates include taxation under the corporate income tax, the personal income tax, and property taxes, in order to capture the full distortion of individuals' choices between present and future consumption as well as the distortions in the choice of investment.

Effective tax rates in 1980 were perceived as high in the corporate sector, at least partly because of inflation, and especially when compared to the tax-free treatment of imputed rents from owner-occupied housing. In contrast, we find that (1) the total effective tax rate in the corporate sector was only 35 percent, about half of the rate in some previous estimates; (2) the total effective tax in the noncorporate sector was 36 percent, higher than in the corporate sector; (3) the total effective tax in owner-occupied housing was 19 percent, because of a higher relative property tax rate; and (4) under either 1980 or 1982 law, the marginal effective total tax rate does not rise with inflation in any sector or for the economy as a whole. By 1982 the rate in the corporate sector fell to 30 percent, by more than in other sectors.

Don Fullerton
Hoover Institution
Stanford University
Stanford, California 94305
(415)-497-9694

Yolanda K. Henderson
Department of Economics
Amherst College
Amherst, MA 01002
(413)-542-2106

I. Introduction

A major goal of tax policy in recent years has been to increase saving, investment, and the productivity of American workers. To a great extent, the perceived success of President Reagan's tax program will depend upon its long run effects on total capital formation. Many economists and an increasing number of policymakers, however, are becoming concerned not just with the total amount of capital but with the efficiency of its use.

The amount of capital formation is influenced by the overall rate of taxation of capital income. By imposing a wedge between the gross and net returns to a capital asset, taxes lower the incentives to save and invest. Taxes thus impose an intertemporal distortion, since a given sacrifice of current consumption provides less return in the form of future consumption than would be true in the absence of taxation.

Examination of the effectiveness of the Reagan tax cuts, however, should also focus on their impact on the efficiency of the allocation of capital across assets and industries. If there were no taxes, investors would tend to seek the most productive investments and combine them efficiently. By contrast, the current tax system contains many diverse features that create very high effective rates of tax on some investments and very low rates of tax or even subsidy on others. Investors are attracted to lightly taxed investments at the expense of highly taxed investments, and the otherwise efficient use of capital is disrupted. Tax differentials tend to change the allocation of capital away from its most productive allocation. As a result, the total value of output is reduced. Moreover, these efficiency costs arise even if overall incentives increase the total stock of capital in the long run.

Some of these distortions involve the allocation of financial capital. Corporations receive deductions for interest payments but not for retained earnings or dividends, so they have an artificial incentive to use debt rather than equity finance. Within equity, because of additional personal taxes on dividends, corporations may have an artificial incentive to retain rather than distribute their earnings. Individuals have incentives from the tax system to invest in municipal rather than corporate bonds and to save through pensions rather than regular savings accounts. All of these misallocations bear costs, as do misallocations in terms of who saves and who bears risk.

In this paper, we largely ignore these distortions in the allocation of financial capital, in order to concentrate instead on distortions in the allocation of real capital. We investigate corporate and noncorporate firms' or individuals' decisions regarding the use of various kinds of equipment, structures, inventories, land and rental or owner-occupied housing. Differential tax rates on such assets arise because only equipment receives an investment tax credit, because inventories and land receive no special allowances, and because there is no taxation on the imputed return to owner-occupied housing. Effective tax rates may differ even within one of these categories, as when the same rate of investment tax credit is granted to machines with different useful service lives, or when the same depreciation schedule is assigned to assets that actually wear out at different rates. Because of different taxes in the corporate and noncorporate sectors, further distortions arise in the allocation of real capital between sectors or among the various industries.

In this paper, we evaluate existing tax law as of 1980, President Reagan's tax reform initiatives as enacted in the Economic Recovery Tax Act of 1981 (ERTA) and the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA), as well as other proposals that were not enacted. For each law, we measure marginal effective total tax rates for capital in the corporate sector, the noncorporate sector, and the owner-occupied housing sector. These rates include taxation under the corporate income tax, the personal income tax, and property taxes, in order to capture the full distortion of individuals' choices between present and future consumption as well as the distortions in the choice of investment.[1]

A. General Results about the Taxation of Capital

We obtain four rather surprising results regarding the taxation of capital. First, we find a lower effective tax rate on capital than might have been predicted on the basis of previous studies. The average effective total tax rate in the corporate sector, including all observed taxes on past investment, has been estimated at about 70 percent prior to the Reagan tax cuts.[2] Several studies have indicated that the marginal effective corporate tax rate in 1980, including only corporate taxes on equity-financed marginal investments, was about 33 percent.[3] In

---

[1] This study emphasizes changes in capital cost recovery and in the investment tax credit under ERTA and TEFRA. These laws also lowered marginal personal income tax rates and affected other features of the tax law regarding saving. We do not consider these other effects in this study.

[2] See Feldstein, Dicks-Mireaux and Poterba (1983) and also Feldstein and Summers (1979).

the current study we add personal taxes and property taxes and we assume that the marginal investment is financed by the average mix of equity and debt. Here, the corporate sector has an overall rate of about 35 percent in 1980,[4] but the low taxation of the large owner-occupied housing sector pulls the marginal rate for the economy down to 29 percent. Under 1982 law, these rates are 30 percent for the corporate sector and only 26 percent for all capital income in the economy.

Second, while any given asset would be taxed more in the corporate sector than in the noncorporate sector, the mean rate in the noncorporate sector is higher than the mean rate in the corporate sector. This reversal occurs because the noncorporate sector has more weight on highly taxed assets such as land and structures.

Third, we find a tax rate on owner-occupied housing of 19 percent. This is contrary to the common perception that owner-occupied housing faces zero taxation as a result of exemption of imputed rents. While this feature certainly serves to lower the effective tax rate in this sector, property taxes are levied at a higher rate on housing than on industrial capital. With the lower-than-perceived tax rate on corporate capital and the higher-than-perceived tax rate on housing, our study suggests that the differential between tax rates in the two sectors was less dramatic than some architects of ERTA might have believed.

---

[3] See Gravelle (1982), and Hulten and Robertson (1982), and Fullerton and Henderson (1983).

[4] Our finding for the corporate sector is close to the 37 percent rate found by King and Fullerton (1984). Fullerton (1984) catalogues reasons why average total tax rates may differ from marginal total tax rates.

Fourth, inflation adds to taxes in the corporate sector because of historical cost depreciation, taxation of nominal capital gains, and tax rules for insurance companies, but it subtracts from total taxes because the corporate rate for nominal interest deductions exceeds the personal rate at which nominal interest is taxed. Here, as in King and Fullerton (1984), we find that taxes on corporate equipment and structures increase with inflation. When we add assets that do not receive depreciation allowances, such as corporate land and owner-occupied housing, we find that nominal interest deductions are important. Total taxes in the economy are invariant to inflation, even though disparities in the tax treatments of different assets increase with inflation. The approximate constancy of capital taxation contrasts with the findings of Feldstein and Summers (1979), who found sharp increases in tax rates as a result of inflation.

B. Summary of Tax Rates in the 1980's

We find that the 1981 law, if it had been left in place through 1986, would have greatly reduced the cost-of-capital in all industries except owner-occupied housing. This law would have caused major reductions in intertemporal distortions, thus promoting expansion of the capital stock in the long run. Capital costs for most types of equipment, however, would have been reduced much more than costs for structures, land, or inventories. As a result, the 1981 law would have introduced major interasset distortions which increase with the elasticity of substitution among assets. The 1982 law aborted the transition to lower capital costs. Effects are similar to those of the ultimate 1981 law, but they are smaller. Nevertheless, the reductions in the cost of business capital are still significant. The overall reduction in taxation should help to spur investment in the long run, as intended by the architects of the Reagan program.[5]

Our study also examines tax reforms that have been advanced by others in recent years. The Auerbach-Jorgenson (1980) proposal, because it allows economic depreciation at replacement cost, would result in uniform capital costs across assets. Interasset distortions would be eliminated, and the efficiency gain from this reform could be expected to increase with the assumed substitution elasticity among assets. Corporate firms would still be taxed differently from noncorporate firms, so intersectoral distortions would remain dependent on the intersectoral substitution elasticity.

If the corporate income tax were repealed, corporations would no longer receive investment tax credits, accelerated depreciation allowances, interest deductions, or property tax deductions. As in King and Fullerton (1984), we find that elimination of the corporate tax would reduce taxes in the corporate sector by 2 percentage points under 1980 law, but it would <u>raise</u> effective tax rates and capital costs under 1982 law. Thus the corporate "tax" is really a marginal subsidy, but variations in capital costs remain high. Integration with personal taxes, on the other hand, does not eliminate credits and deductions.

---

[5] Our aim is to measure the long run consequences of tax reform. Changes in monetary policy between 1980 and 1982 might have altered observed interest rates and inflation rates, and therefore might have offset (or reinforced) the impact of the accelerated cost recovery provisions on effective tax rates. We are not concerned with such factors, however, because we do not attempt to measure tax rates in 1982 as opposed to 1980. Rather, we look at the difference between the tax laws, holding all other economic variables constant.

All taxable corporate income would be passed through to the stockholders and would be taxed only at their personal rates. Overall capital costs would fall slightly, but the variation among capital costs would fall dramatically.

C. The Rest of the Paper

Section II discusses each alternative tax regime in more detail. It refers to the Technical Appendix for a discussion of the uses of cost-of-capital data in examining economic efficiency and for a derivation of capital cost formulas for each asset in each sector. These capital costs, or required pre-tax rates of return, are sometimes difficult to interpret by themselves. For this reason, when we report the results of our calculations we always compare this pre-tax return to a fixed real after-tax return. The difference, as a fraction of the pre-tax return, is an effective tax rate measure which includes corporate taxes, personal taxes, and property taxes. Section II includes results for all assets in the corporate sector under each tax regime, and Section III goes on to consider the noncorporate sector and housing. Section IV then investigates the sensitivity of results to alternative assumptions. We measure the effect of inflation by plotting the overall effective tax rate as a function of the inflation rate. Section V is a conclusion.

II. Alternative Tax Regimes

We use cost-of-capital formulas like those in Hall and Jorgenson (1967) to measure the marginal cost of capital for each asset under each tax regime. These formulas are derived in the Technical Appendix, but they can be summarized here. We also introduce notation in the text, in order to discuss the values of the parameters needed to calculate capital costs.

In general, we consider a hypothetical firm that is trying to decide whether or not to buy a particular asset. This asset may be any one of the 38 assets listed in left-hand column of Table 1. These definitions are combinations of more diverse asset types, but they still provide considerable disaggregation. We treat each of these assets as individually homogeneous, in the sense that each has a single tax treatment and economic depreciation rate (δ). The first 20 assets are types of equipment, the next 15 are types of structures, and the last two are inventories and land.[6] Our values for δ are shown in column 1 of Table 1. These rates of depreciation were estimated by Hulten and Wykoff (1981), and their availablity provides the major reason for using this particular set of asset definitions.[7] The estimated depreciation rates range from a low of .015 for housing to a high of .333 for automobiles. Inventories and land do not depreciate (nor are they given depreciation allowances under any tax regime).

Upon purchasing the asset, our hypothetical firm receives an investment tax credit at rate k. Discussion of these values is deferred

---

[6] The firm may also earn income on intangible assets such as knowledge acquired through research, or goodwill acquired through advertising. Because we do not have adequate estimates for the stock of these assets in each industry, they are excluded from this study.

[7] For assets 27 through 31, the depreciation rates come from Jorgenson and Sullivan (1981). They use the Hulten-Wykoff methodology to obtain estimates for these additional assets. The rate for housing is an unpublished estimate of Hulten and Wykoff.

Table 1

Tax Parameters for Each Asset

		1.	1980 Law		ACRS	
	Asset	Hulten-Wykoff Depreciation Rate	2. ITC Rate	3. Lifetime	4. ITC Rate	5. Lifetime
1	Furniture and Fixtures	0.110	0.100	8.00	0.100	5.00
2	Fabricated Metal Products	0.092	0.100	10.00	0.100	5.00
3	Engines and Turbines	0.079	0.100	12.48	0.100	5.00
4	Tractors	0.163	0.067	5.00	0.100	5.00
5	Agricultural Machinery	0.097	0.100	8.00	0.100	5.00
6	Construction Machinery	0.172	0.100	7.92	0.100	5.00
7	Mining and Oil Field Machinery	0.165	0.100	7.68	0.100	5.00
8	Metalworking Machinery	0.123	0.100	10.16	0.100	5.00
9	Special Industry Machinery	0.103	0.100	10.16	0.100	5.00
10	General Industrial Equipment	0.123	0.100	9.84	0.100	5.00
11	Office and Computing Machinery	0.273	0.100	7.00	0.100	5.00
12	Service Industry Machinery	0.165	0.100	8.24	0.100	5.00
13	Electrical Machinery	0.118	0.100	9.92	0.100	5.00
14	Trucks, Buses, and Trailers	0.254	0.067	5.00	0.100	5.00
15	Autos	0.333	0.033	3.00	0.060	3.00
16	Aircraft	0.183	0.100	7.00	0.100	5.00
17	Ships and Boats	0.075	0.100	14.40	0.100	5.00
18	Railroad Equipment	0.066	0.100	12.00	0.100	5.00
19	Instruments	0.150	0.100	8.48	0.100	5.00
20	Other Equipment	0.150	0.100	8.16	0.100	5.00
21	Industrial Buildings	0.036	0.0	28.80	0.0	15.00
22	Commercial Buildings	0.025	0.0	47.60	0.0	15.00
23	Religious Buildings	0.019	0.0	48.00	0.0	15.00
24	Educational Buildings	0.019	0.0	48.00	0.0	15.00
25	Hospital Buildings	0.023	0.0	48.00	0.0	15.00
26	Other Nonfarm Buildings	0.045	0.0	30.90	0.0	15.00
27	Railroads	0.018	0.100	24.00	0.100	15.00
28	Telephone and Telegraph	0.033	0.100	21.60	0.100	15.00
29	Electric Light and Power	0.030	0.100	21.60	0.100	15.00
30	Gas Facilities	0.030	0.100	19.20	0.100	10.00
31	Other Public Utilities	0.045	0.100	17.60	0.100	10.00
32	Farm Structures	0.024	0.0	25.00	0.0	15.00
33	Mining, Shafts and Wells	0.056	0.0	6.80	0.0	5.00
34	Other Nonbuilding Facilities	0.029	0.0	28.20	0.0	15.00
35	Residential Structures	0.015	0.0	40.00	0.0	15.00
36	Inventories	0.0	0.0	∞	0.0	∞
37	Business Land	0.0	0.0	∞	0.0	∞
38	Residential Land	0.0	0.0	∞	0.0	∞

to the section for each tax regime, but we always assume that the firm has enough tax liability to make use of the credit.

Out of the return to the asset, the firm must pay a wealth tax (at rate w) on the value of the asset each year. These state and local property tax rates vary among thousands of jurisdictions, so we estimate average rates based on data from the Advisory Commission on Intergovernmental Relations (ACIR), as found in Harriss (1974). These data provide property taxes paid in 1972 on business realty (land and structures), business personalty (equipment and inventories), public utility structures, and household realty (rental and owner-occupied housing). We scale each of these tax amounts upward to 1977, using Commerce Department data on total property taxes in 1977 and 1972; we then divide each 1977 estimate by the corresponding 1977 capital stocks as described below. The resulting rates, applied either to the corporate or noncorporate sector, are .00768 for equipment and inventories, .01126 for business land and structures, .01550 for public utilities, and .01837 for household realty (land and structures).

On its return net of property taxes, the corporation is taxed at the statutory rate u. We use .46 for the federal statutory rate on marginal corporate income, since this top bracket rate applies to the largest firms with essentially all of the corporate capital stock. The weighted-average of the states' top-bracket rates is .0655, including zeros for states without corporate taxes and using personal income to weight the fifty states. The total statutory rate, accounting for deductibility of state taxes at the federal level is then .46 + .0655(1-.46). We use this value, .495, for u.

The noncorporate firm is taxed at the statutory rate τ_{nc}. We use .365 for this parameter, obtained as the weighted average of marginal statutory tax rates on entrepreneurial income of 25,000 individual tax returns in the TAXSIM data file of the National Bureau of Economic Research (NBER).

The after-tax return to this hypothetical firm is expected to grow in nominal terms at the rate of inflation (π), generally set at 7 percent. For most tax schemes, the firm also receives future depreciation allowances that are specified in nominal amounts for a fixed number of years. We calculate the present value of these depreciation allowances (z), and the present value of the nominal after-tax returns, using the nominal after-tax discount rate for the firm. These discount rates are discussed in the Appendix, but they are derived such that the real after-tax return to the average investor is a parameter s, set to 5 percent.

In considering this investment, our hypothetical firm compares the acquisition cost (net of investment tax credits) to the present discounted value of after-tax returns and tax savings from depreciation allowances. In equilibrium, the net outlay would just equal the present value of net returns from the marginal investment. We then use this equality to solve for the gross-of-tax return that the asset must earn in order to cover taxes and still yield the minimum required after-tax return. The required pre-tax return net of depreciation (ρ) is the cost-of-capital for that asset.

Because firms can make certain choices about depreciation lifetimes and schedules, actual capital costs may be affected by those choices.

When accelerated depreciation was first introduced, for example, Vasquez (1974) found that firms were slow to adopt the more advantageous schedules. Because there is no procedure to predict actual choices for untried tax schemes, however, we compare all schemes under the assumption that firms make choices that minimize their taxes. This approach has the further advantage that it allows us to calculate comparable capital costs based only on tax provisions rather than on actual practices. We extend this assumption to firms' choices with respect to inventory accounting. Under all tax regimes we assume that firms minimize their taxes by using only last-in-first-out (LIFO) inventory accounting. This method allows the firm to avoid taxes on purely nominal accounting profits, but it does not avoid taxes on real profits associated with investing in inventories.[8]

Our parameter s, the real return after personal taxes, is defined as a weighted-average of returns to different individuals who finance the marginal investment. In the corporate sector, the asset's purchase is financed by new share issues, retained earnings, and debt, in the proportions c_{ns}, c_{re}, and c_d respectively. King and Fullerton (1984) provide information on these three proportions for each of three different corporate industry groups. When we weight by corporate capital stock, we obtain overall proportions of .0490 for new shares, .6143 for retained earnings, and .3367 for debt.

[8] An equity-financed investment in inventories must yield a return in the form of real corporate profits that is at least as high as the return that could have been earned on an alternative investment. These real corporate profits are taxed at the .495 corporate rate.

Investments financed by new shares earn a return which is paid out in dividends and taxed at rate τ_{ns}. The TAXSIM data file of the NBER provides a tax rate of .475 for marginal dividend income, including state taxes and averaged over 25,000 households. King and Fullerton (1984) provide additional tax rates and weights for dividends received by tax-exempt institutions and insurance companies. When marginal tax rates for these three categories are weighted together, we obtain .356 for τ_{ns}.

Investments that are financed by retained earnings provide owners of equity with accrued nominal capital gains that are taxed at the effective accrued rate τ_{re}. The NBER's TAXSIM file is again used to find the weighted-average statutory rate on marginal capital gains of households, incorporating the 60 percent exclusion on long-term capital gains. This 28 percent rate is further reduced to account for the deferral advantage and the increase of basis at death. Following King and Fullerton (1984), the final 7 percent rate for households is averaged with zero for tax-exempt institutions and .14 for insurance companies to obtain .058 for τ_{re}.

Finally, investments financed by debt earn a return which is paid out as interest and taxed at rate τ_d. The TAXSIM file places the average household's marginal rate at .325, including state taxes, but King and Fullerton (1984) reduce this rate to .284 to account for interest that is paid to banks and received by households in the form of tax-free banking services. Insurance companies' tax rates increase with inflation because of the complex Menge Formula, but the net effect is summarized in the estimate $(.149 + 3.88\pi)$, where π is the rate of inflation.[9] When households, tax-exempts, and insurance companies are weighted together, the overall value for τ_d comes to $(.196 + .595\pi)$. This rate changes as we vary π, but τ_d is .238 in the standard case where inflation is seven percent.

Of marginal investments in the noncorporate sector, a fraction n_d is financed by debt, and n_e is financed by equity of the entrepreneur. Little evidence is available on the complicated financing of noncorporate business in the U.S., but our rough estimates suggest that it is not dissimilar in aggregate to the financing of corporate business, that is, one-third debt.[10]

Finally, for owner-occupied housing, we need a fraction h_d for debt and h_e for equity. New homes are financed with a very large proportion of debt, but we are considering a permanent change in the steady state allocation of capital. The loan to value ratio typically falls as the house ages, and we want total mortgage debt as a fraction of total market value. Unpublished estimates from the Census Bureau suggest that this ratio is again very close to one-third.[11] As a consequence, we use the same fraction for debt financing in all three sectors.

[9] The estimate of the effective tax rate on life insurance companies summarizes a complex set of rules. For a description of this aspect of the tax code and discussion of modeling choices, see King and Fullerton (1984). Revisions in the tax treatment of insurance companies are under discussion in Congress at the time of this writing, but we have not included any new proposals in this paper.

[10] The ratio of noncorporate interest payments to an estimate of the share of noncorporate income attributable to capital, from the July 1982 Survey of Current Business, is almost identical to the ratio of corporate interest payments to corporate income from capital.

[11] We are grateful to Peter Fronczek for providing these numbers.

The weighted-average marginal tax rate for these homeowners is τ_h, estimated at .26 by the TAXSIM model of NBER. Data in Fullerton and Gordon (1983) suggest that 44.8 percent of property taxes are deducted, so the effective homeowners' property tax rate is [1-(.448)(.26)](.01837), which equals .01623.

The required pre-tax returns from each tax scheme are important parameters in that they summarize the cumulative impact of personal taxes, property taxes, and corporate taxes. Because they are numbers like .06 or .08, however, they are sometimes difficult to interpret by themselves. The parameter s represents the real return after all taxes, so the difference (ρ-s) is due solely to taxes. This difference, expressed as a fraction of the pre-tax return, is a measure of the "marginal effective total tax rate" in the terminology of Fullerton (1984). These numbers are presented in the tables below because they are comparable to tax-inclusive ad valorem tax rates such as the 46 percent statutory corporate rate. They are reduced relative to the corporate rate because of investment tax credits and accelerated depreciation allowances, but they are raised relative to the corporate rate because of property taxes and personal taxes.

The rest of this section describes relevant aspects of (A.) the tax law in the United States as it stood in 1980, (B.) the ultimate version of the 1981 tax law (ERTA), if phased reductions had been allowed to continue through 1986, (C.) current tax law as it stands after TEFRA, the 1982 tax law, (D.) an alternative reform suggested by Auerbach and Jorgenson (1980), (E.) the integration of corporate and personal income taxes, and (F.) the elimination of the corporate income tax. For each tax regime, we present marginal effective total tax rates for each asset and for each industry.

A. Tax Law as of 1980

The investment tax credit was introduced in 1962, repealed in 1969, reintroduced in 1971, and raised in 1975. As of 1980, the credit stood at a ten percent rate for all public utility structures and for equipment with tax lifetimes of at least seven years; two-thirds of that for equipment with lifetimes of at least five years; and one-third for equipment with lifetimes of at least three years. Since we treat each of the assets in Table 1 as individually homogeneous, column 2 assigns a ten percent credit to all public utility structures (assets 27-31) and to any type of equipment that has a tax lifetime of at least seven years. Tractors (asset 4) and trucks (asset 14) have five year lives and 6.67 percent credits, while autos (asset 15) have a three year life and 3.33 percent credit.

Our lifetimes for each asset are shown in column 3. The 1962 Guideline lifetimes applied to many diverse assets, and these were aggregated by Jorgenson and Sullivan (1981) to the 35 depreciable asset types shown here. The Asset Depreciation Range (ADR) System, introduced in 1971 and still effective in 1980, allowed firms to use 80 to 120 percent of these Guideline lifetimes for equipment and public utility structures. Because firms minimize their taxes by assumption, they would use the shortest available lifetimes unless that choice had the effect of raising taxes by lowering the investment tax credit. We reduce the Guideline lifetime estimates accordingly. Computers, for example, may be depreciated over 5, 6, or 7 years under 1980 law. Firms would choose 5 years if not for the credit, but they choose 7 years (as shown in column 3 of Table 1) in order to receive the 10 percent credit and minimize taxes.[12]

The 1980 tax scheme, like most others, has separate depreciation rules for different kinds of assets. Double declining balance (DDB) and sum-of-the-years'-digits (SYD) can be used for equipment, public utility property, single-purpose agricultural structures, and residential structures. If we define L as the asset's lifetime for tax purposes, then DDB allows depreciation equal to 2/L of the remaining basis each year. Because of the half-year convention, however, all assets are assumed to have been purchased on July 1. They receive half of the DDB amount, (1/L), in the year of purchase and 2/L of the remaining basis, (1-1/L), in the first full year of ownership. At this point, as shown in Fullerton and Henderson (1983), the firm would minimize taxes by switching to SYD. If there are 3.5 years left (as for a 5 year asset), the firm takes the basis remaining at the time of the switch and divides it over the remaining years according to the fractions obtained by using a denominator of 8.0 and numerators of 3.5, 2.5, 1.5, and 0.5.

For other structures, firms could use 150 percent of declining balance (1.5/L of remaining basis each year), with an optimal switch to

---

[12] Lifetimes for many of the 35 assets are actually averaged over more diverse asset categories. As a result, only some of the assets in one of our categories may need their lifetimes adjusted to receive higher credits. Since the aggregation to 35 assets provides considerable detail, however, it seems appropriate to treat each asset as individually homogeneous. One example of where this treatment may be less appropriate is in mining, shafts and wells. The 6.8 year life here reflects an average of intangible drilling with a zero life and other structures with a longer life.

straight-line after one-third of the life of the asset. The firm must begin straight-line depreciation at the start of a tax year, however, and we assume that they make this choice to take the earliest allowable deductions (to minimize taxes). We also assume that the firm buys only new assets and holds them forever, so that we can abstract from problems with recapture taxes or scrap values.

These depreciation allowances, specified by law over a finite number of years for each asset, are discounted by the firm's nominal after-tax rate of return because allowances are based on historical cost. The present value of allowances per dollar of original basis is the parameter z in equation (A2) of the appendix. Since the entire purchase price was depreciable in 1980, we use 1.0 for the parameter a.[13]

We have now specified enough information to calculate effective tax rates under 1980 law for each asset, and rates for the corporate sector are shown in column 1 of Table 2. Note that the first twenty assets, types of equipment, have rates that vary from a subsidy of 27 percent (for computers) to a tax of 22 percent (for ships and boats). Public utility structures (assets 27-31) also receive investment tax credits, but they have longer depreciation lifetimes and tax rates that are all about 33 percent. Other structures receive no credits, longer lifetimes, and depreciation at only 150 percent of declining balance, so

[13] Fullerton and Henderson (1983) provide more thorough descriptions of depreciation allowances and discounting. In particular, the formulas in that paper indicate that while the depreciation allowances are discrete amounts for each year, we discount them continuously over the course of the year. This procedure recognizes the fact that the basis declines annually, not continuously, and that deductions earlier in the year are worth more than those at the end of the year.

Table 2

Marginal Effective Total Tax Rates on Each Asset in the Corporate Sector

	Asset	1. 1980	2. 1981	3. 1982	4. AJ	5. Integration	6. Repeal
1.	Furniture and Fixtures	-.064	-.578	-.051	.356	-.051	.302
2.	Fabricated Metal Products	.071	-.490	-.058	.356	-.042	.302
3.	Engines and Turbines	.164	-.433	-.064	.356	-.036	.302
4.	Tractors	-.062	-.905	-.029	.356	-.079	.302
5.	Agricultural Machinery	-.068	-.515	-.056	.356	-.045	.302
6.	Construction Machinery	-.056	-.974	-.025	.356	-.083	.302
7.	Mining and Oil Field Machinery	-.092	-.918	-.028	.356	-.080	.302
8.	Metalworking Machinery	.121	-.644	-.046	.356	-.058	.302
9.	Special Industry Machinery	.095	-.544	-.054	.356	-.048	.302
10.	General Industrial Equipment	.099	-.644	-.046	.356	-.058	.302
11.	Office and Computing Machinery	-.268	-2.325	.013	.356	-.140	.302
12.	Service Industry Machinery	-.016	-.918	-.028	.356	-.080	.302
13.	Electrical Machinery	.099	-.619	-.047	.356	-.055	.302
14.	Trucks, Buses, and Trailers	-.041	-1.941	.006	.356	-.128	.302
15.	Autos	.105	-1.040	-.029	.356	-.089	.302
16.	Aircraft	-.215	-1.066	-.021	.356	-.089	.302
17.	Ships and Boats	.220	-.418	-.066	.356	-.034	.302
18.	Railroad Equipment	.120	-.382	-.069	.356	-.030	.302
19.	Instruments	.004	-.812	-.034	.356	-.072	.302
20.	Other Equipment	-.032	-.812	-.034	.356	-.072	.302
21.	Industrial Buildings	.518	.414	.414	.399	.332	.327
22.	Commercial Buildings	.510	.363	.363	.399	.304	.327
23.	Religious Buildings	.477	.332	.332	.399	.288	.327
24.	Educational Buildings	.477	.332	.332	.399	.288	.327
25.	Hospital Buildings	.503	.356	.356	.399	.300	.327
26.	Other Nonfarm Buildings	.562	.450	.450	.399	.353	.327
27.	Railroads	.312	.232	.302	.443	.249	.355
28.	Telephone and Telegraph	.347	.268	.355	.443	.270	.355
29.	Electric Light and Power	.337	.261	.344	.443	.266	.355
30.	Gas Facilities	.315	.176	.267	.443	.214	.355
31.	Other Public Utilities	.336	.189	.300	.443	.225	.355
32.	Farm Structures	.441	.358	.358	.399	.301	.327
33.	Mining, Shafts, and Wells	.358	.283	.283	.399	.237	.327
34.	Other Nonbuilding Facilities	.483	.383	.383	.399	.314	.327
35.	Residential Structures						
36.	Inventories	.356	.356	.356	.356	.329	.302
37.	Business Land	.399	.399	.399	.399	.362	.327
38.	Residential Land						

their tax rates vary from 44 to 56 percent. With inflation, these allowances are sometimes less than economic depreciation at replacement cost. Business land and inventories, which actually receive economic allowances since they do not depreciate, have total effective tax rates of 40 and 36 percent, respectively. These rates include property taxes that differ by asset and personal taxes that do not differ by asset. The wide disparities, from -27 to +56 percent across all assets, indicate the potential for significant misallocation of capital.

The left-hand column of Table 3 shows a marginal effective tax rate for each of eighteen industries by averaging over the asset tax rates in the corporate and noncorporate sectors, weighting by the industry's actual stock of each asset.[14] Column 1 of Table 3 shows the 1980 law, where differences in industry tax rates generally reflect differences in their use of assets. Structure-intensive industries such as crude oil and petroleum refining are weighted towards the high effective tax rates on structures. The low rate on transportation, communications, and utilities reflects the tax credits for public utility structures as well as the low rate for aircraft.

---

[14] For weights, we use Dale Jorgenson's unpublished data on the 1977 stock of each asset used in each industry. See Jorgenson and Sullivan (1981) and Fraumeni and Jorgenson (1980) for more detail. Briefly, they use Commerce Department investment series, a capital flow table, and an RAS scaling routine to estimate an investment matrix for every year. Then they use Hulten-Wykoff depreciation rates and the perpetual inventory method to obtain the capital stock matrix for 1977. For rental and owner-occupied housing, we use estimates for 1977 from the February 1981 Survey of Current Business.

Table 3

Marginal Effective Total Tax Rates in Each Industry

Industry	1. 1980	2. 1981	3. 1982	4. AJ	5. Integration	6. Repeal
1. Agriculture, Forestry and Fisheries	.338	.329	.335	.354	.337	.345
2. Mining	.356	.188	.273	.372	.220	.310
3. Crude Petroleum and Gas	.406	.309	.314	.389	.269	.324
4. Construction	.293	.241	.288	.355	.267	.301
5. Food and Tobacco	.370	.280	.319	.371	.276	.311
6. Textile, Apparel and Leather	.358	.266	.306	.368	.267	.310
7. Paper and Printing	.349	.212	.278	.372	.234	.312
8. Petroleum Refining	.417	.326	.350	.382	.296	.318
9. Chemicals and Rubber	.324	.178	.260	.369	.218	.309
10. Lumber, Furniture, Stone, Clay and Glass	.357	.243	.299	.370	.255	.310
11. Metals and Machinery	.359	.269	.312	.368	.270	.309
12. Transportation Equipment	.380	.318	.340	.369	.299	.310
13. Motor Vehicles	.329	.192	.275	.367	.231	.309
14. Transportation, Communication and Utilities	.275	.116	.248	.406	.192	.333
15. Trade	.352	.313	.330	.360	.306	.310
16. Finance and Insurance	.389	.322	.325	.368	.323	.326
17. Real Estate	.237	.225	.225	.241	.243	.276
18. Services	.297	.115	.210	.361	.183	.287

B. The Economic Recovery Tax Act of 1981

While many provisions of the 1981 Tax Act were to phase-in over several years, the investment tax credit changed immediately to a six percent rate for automobiles and ten percent for all other equipment and public utility property. These credit rates are shown in column 4 of Table 1. Because of our assumption of no carryover problems, both sets of credit rates reflect statutory credits and do not reflect any increase in availability of the credit through the 1981 law's extended carryover and leasing provisions.

Column 5 displays lifetimes of each asset under the Accelerated Cost Recovery System (ACRS), assuming again that each asset is homogeneous. The law assigns a three year life to autos, light trucks, R&D equipment, certain racehorses, and personal property with an ADR midpoint of four years or less. Our level of aggregation shows autos with a three year life, but none of the other assets has an (average) ADR midpoint of four years or less. Thus, all other equipment gets a five year life. Similarly, for public utility structures, we assigned a ten year life to any asset category with an ADR midpoint between 18 and 25 years, as provided in the law. All other structures have a 15 year life, except mining, shafts, and wells which we reduced from a 6.8 to a 5 year life.

Although these shorter lives were effective immediately, depreciation of new equipment was scheduled to accelerate from 150 percent of declining balance to 175 percent of declining balance during a five year phase-in period. After 1985, new equipment was again to be depreciated by double declining balance, again with an optimal switch to sum-of-the-year's-digits.[15] We evaluate only this final set of rules, originally scheduled to begin in 1986. All structures immediately received a 175 percent declining balance rate, replacing both the 150 percent rate for nonresidential property and the 200 percent rate for new residential property. All structures switch at the optimal time from 175 percent declining balance to straight-line, after three-sevenths of the life of the asset.[16]

The 1981 law also provides phased reductions of personal marginal tax rates. While the top marginal rate fell from 70 percent to 50 percent immediately, all other rates are reduced by 23 percent over three years. After 1985, personal rate brackets are scheduled to be indexed for inflation. We wish to compare 1980 with the ultimate (1986) version of ERTA, but we cannot simply reduce personal rates by 23 percent. Inflation after 1980 will erode at least some of these rate cuts by the time indexing starts in 1985. In fact, King and Fullerton (1984) find

[15] An interesting difference, however, is that depreciation of the last half year is moved up. The five year asset in the earlier example receives DDB for 1.5 years as before, but SYD over only 3 remaining years instead of 3.5. Thus, even where the asset's lifetime was not shortened (as for assets 5 and 14), the present value of allowances (z) is still higher under 1981 law.

[16] The optimal switch point for 175 percent of declining balance is calculated as (1.75 - 1.0)/1.75 as shown in Fullerton and Henderson (1983). Rather than specify allowable schedules and let the firm choose, however, the 1981 and 1982 laws provide tables with depreciation amounts for each year. These amounts are calculated for the tables by using the rules described in the text, assuming that firms want the earliest possible deductions. We thus effectively use the tables for the new laws, and we use comparable tax-minimizing choices for the old law. The new law is less flexible, however, because it mandates the earliest possible deductions. If the firm did not expect a steady stream of positive taxable profits, as is assumed in this paper, it might prefer to delay some deductions by using a longer life or by making an early switch to straight-line.

that it would take an annual inflation rate of only about seven percent over those six years to completely negate the 23 percent cut. For this reason, we ignore personal tax changes specified in ERTA. We also abstract from changes related to tax-free "all-savers' certificates" for individuals, charitable deductions for nonitemizers, reductions in the marriage penalty for two-earner families, and other provisions that do not pertain primarily to business income from real capital assets.

Effective tax rates under ERTA are shown for each asset in column 2 of Table 2. Rates for equipment are all negative, while rates for structures range up to 45 percent. Since land and inventories receive no credits or deductions anyway, their effective tax rates are unchanged from 1980. Because the relatively high 1980 rates for these assets remain high while the relatively low 1980 rates for equipment are reduced, it appears that the potential for capital misallocations would be worse under ERTA.

Previous estimates of the marginal effective corporate tax rate under ERTA have consistently been negative for all types of equipment. The implication is that credits and accelerated depreciation deductions outweigh the corporate tax and provide a net subsidy on income from marginal investments in these assets. Yet Table 2 indicates that the marginal effective total tax rates are negative. The implication here is that the subsidy at the corporate level is so large that it completely offsets property taxes and personal taxes, even though personal taxes apply to nominal income.[17]

---

[17] This marginal subsidy can be received by any corporation with sufficient taxable profits against which to take the credits and

Since depreciation schedules were to be the same in 1986 as they were in 1980, we can also see how sensitive tax rates are to lifetimes and credits. When only the lifetime for computers (asset 11) changes from 7 to 5 years, the total effective tax rate changes from a -27 percent to a -233 percent. When only the credit for autos (asset 15) changes from .033 to .06, its effective tax rate changes from a positive 11 percent to a negative 104 percent.[18]

The corresponding industry tax rates are shown in column 2 of Table 3. The fact that all these rates exceed zero reflects weights on structures, inventories and land in all industries. These averaged rates still reflect more variance than they did in 1980.

C. The Tax Equity and Fiscal Responsibility Act of 1982

The scheduled increase for depreciation of equipment was never allowed to take place, since TEFRA effectively repealed the transition to double-declining balance. It retained the investment tax credits and the shorter lives of ACRS, but it left equipment with 150 percent of declining balance and an optimal switch to straight-line. Structures had no transition in the 1981 law, so they are left at 175 percent of

---

deductions. These taxable profits might include a.) the normal return to old investments upon which taxes were deferred, b.) normal returns to taxed investments like land and inventories, c.) unexpected returns, or d.) monopoly profits. The investing firm need not even have its own taxable profits if there is a mechanism for the transfer of tax benefits between firms. The safe harbor leasing provisions of the 1981 Tax Act provided such a mechanism. Still, the large subsidies found in this paper indicate great potential for the marginal investment to receive asymmetric treatment in firms with and without taxable profits.

[18] These rate reductions also incorporate the fact that ERTA moves up the last half year of depreciation.

declining balance with a switch to straight-line. These specifications provide enough information to calculate z, the present value of allowances per dollar of basis. Also, however, TEFRA reduced the basis for depreciation by half of the investment tax credit. As a consequence, we set the depreciable proportion parameter (a) to .95 for equipment and public utility property with a ten percent credit and to .97 for autos with a six percent credit.

Again we abstract from other changes in TEFRA that are not related to the taxation of income from real business assets, including newly introduced excise taxes, medical and casualty loss deductions, and individual minimum tax provisions. Since our hypothetical firm always has sufficient tax liability to use all of its credits and deductions, it is unaffected by TEFRA's restrictions of safe-harbor leasing.

The resulting tax rates for equipment are mostly negative, as shown in column 3 of Table 2. Although they use the ACRS lifetimes of the 1981 law, their overall levels are closer to 1980 law. In fact, for many of the assets (e.g., tractors, some types of machinery, computers, trucks, aircraft, and electric utility property), 1982 tax rates are higher than 1980 rates (for the same expected rate of inflation). For these assets, the tax-raising effect of the basis adjustment outweighs the tax-reducing effect of shortened tax lives. The tendency for tax rates to be higher under 1982 law is stronger when the comparison is made under the assumption of low inflation rates in both periods. When tax rates are computed under the assumption of four percent inflation, for example, more types of equipment show higher tax rates under 1982 law than under 1980 law. Real depreciation allowances (z) are greater at low inflation rates, so the tax-increasing basis adjustment is more important at low inflation rates.

Taxation of structures is the same under the 1982 law as under the 1981 law. Column 3 of Table 3 shows tax rates by industry, reflecting their asset compositions.

D. The Auerbach-Jorgenson Proposal

Next, our study evaluates other investment incentive plans that were not adopted. The Auerbach-Jorgenson (1980) first year capital recovery plan gives the firm one depreciation deduction at the time the asset is purchased, equal to the expected present value of economic depreciation at replacement cost. Since future economic depreciation is discounted at a constant real after-tax discount rate, this proposal effectively indexes depreciation allowances for inflation. It treats all assets symmetrically in the sense that it provides a high first year deduction for equipment with a high δ, a low deduction for structures with a low δ, and no deduction for land and inventories which do not depreciate.

If a.) there is no investment tax credit, b.) Hulten-Wykoff depreciation rates are used to determine economic depreciation, and c.) the firm's real discount rate is used to calculate the first year recovery, then estimates of the marginal effective corporate tax rate are equal to the statutory 49.5 percent rate for all assets. If this depreciation is well measured, then this plan removes all inter-asset distortions in the corporate sector.[19] Similar allowances in the

[19] On the other hand, if actual depreciation differs from Hulten-Wykoff estimates or if the government does not use the firm's discount rate

noncorporate sector can remove interasset distortions there, but intersectoral distortions may remain if the noncorporate sector continues to be taxed at a lower rate. Interindustry distortions remain if some industries are disproportionately incorporated, and intertemporal distortions remain if income from capital is disproportionately taxed.[20]

Column 4 of Table 2 shows the marginal effective total tax rate for each asset under this plan. Although corporate taxes and personal taxes on these assets are uniform, property taxes are imposed at a .8 percent rate on all kinds of equipment, a 1.1 percent rate on nonresidential structures, and a 1.55 percent rate on public utility property. Marginal effective total tax rates vary little, but they are ordered across these assets according to these property tax rates. Industry effective tax rates in column 4 of Table 3 vary even less.

E. Integration of Corporate and Personal Taxes.

Because of the potential for distortions when extra taxes are imposed on the corporate sector, many have suggested integrating the corporate and personal tax systems. Some have suggested partial integration plans such as allowing corporations to deduct dividends, such that this income

---

when it sets the first-year allowances for each asset, then effective tax rates can still vary among assets.

[20] Brown (1981) suggests an investment credit that is proportional to the difference between the acquisition cost of the asset and its first year allowance. This particular choice of asset-dependent credits and first year write-offs results in uniform effective corporate taxes at a rate lower than 49.5 percent. This uniform tax rate can be as high or as low as desired, or even zero, equivalent to immediate expensing of the entire acquisition cost.

is taxed only at the personal level. Here, we evaluate only a full form of integration, and we compare it to current 1982 tax law. Further discussion of many such plans and their effects is provided by McLure (1979).

Our specification of this reform involves retaining investment tax credits and depreciation allowances, just as these features exist in 1982 for the noncorporate sector. We then trace all taxable corporate income through to be taxed only at the level of the individuals who own the corporations. Interest is still taxed at the rate τ_d, but all retained or distributed corporate profits are taxed at τ_{ns}, the full personal rate of corporate stockholders. Intersectoral distortions remain to the extent that these personal tax rates differ from the personal rate of entrepreneurs, and interasset distortions may remain to the extent that credits and depreciation allowances have differential impacts on assets.

Column 5 of Table 2 shows the marginal effective total tax rates on assets in the corporate sector with integration. These rates are very similar to those of the noncorporate sector in 1982. Rates on equipment are reduced from 1982 corporate numbers which vary around zero to numbers which are all negative. Thus, with integration, personal taxes and property taxes are effectively offset by credits and accelerated depreciation deductions for these assets. Rates on structures are reduced from numbers around 38 percent to numbers around 30 percent.

Because industries use these assets in different proportions, industry tax rates still vary in column 5 of Table 3. Some inter-industry distortions thus remain, in contrast to previous models where all industry distortions are based on extra corporate taxes and differential degrees of incorporation. Intertemporal distortions remain as well.

F. Elimination of the Corporate Income Tax

The last set of calculations does not represent a serious or even necessarily desirable policy proposal. Instead, we are merely trying to help evaluate the overall impact of the corporate tax in any of the first four regimes described above. Since personal taxes and property taxes are constant across all of those simulations, any of the first four sets of tax rates (1980, 1981, 1982, AJ) can be compared to those from a world with just the personal and property taxes.

Elimination of the corporate tax, by this definition, involves concomitant elimination of the corporations' investment tax credits (k), depreciation deductions (z), and interest deductions. The IRS undertakes no interactions with corporations, but it continues to collect personal taxes as before on all nominal interest receipts, dividends, capital gains, and noncorporate income. In equations of the appendix, these specifications merely imply that $k = u = z = 0$.

Column 6 of Table 2 exhibits fairly high effective tax rates, differing only to the extent that property taxes differ by asset. Tax rates for equipment are higher than those for any other tax plan except the Auerbach-Jorgenson plan.[21] These findings are consistent with

[21] While the AJ proposal effectively taxes all equity-financed investments at the 49.5 percent statutory rate of the corporation, it still allows deductions for nominal interest payments. It also allows a first-year recovery for depreciation. Repeal of the

previous findings that the corporate tax system amounts to a net subsidy for equipment. Other assets, however, receive no investment tax credits and less accelerated depreciation. Because inflation may reduce the real values of allowances to less than economic depreciation, effective total tax rates on structures under the 1980 law and 1982 law are about 50 and 38 percent, respectively. Under either law, taxes on land and inventories are 40 and 36 percent. The elimination of the corporate tax more than offsets the elimination of nominal interest deductions in these cases, because these rates fall to 33 percent for structures, 33 percent for land, and 30 percent for inventories.

When weighted by the use of assets in each industry, marginal effective total tax rates under repeal are shown in column 6 of Table 3 for each of our 18 industries.

III. The Noncorporate Sector and Housing

The noncorporate entrepreneur is taxed by rules similar to those for the corporation but has a .365 personal tax rate rather than the .495 corporate rate. Effective tax rates therefore vary in a similar manner across the 38 assets, but the overall level is different. For this reason, we do not provide noncorporate rates on all assets under each scheme. Instead, table 4 provides some summary statistics on the

---

corporate tax, on the other hand, would allow no investment tax credits, no interest deductions, and no allowances for depreciation — even economic depreciation. The estimated effective tax rates reflect the fact that the personal tax applies to nominal interest receipts, since they are designed to include all taxes as a fraction of real income from the asset.

Table 4

Summary Statistics

	1. 1980	2. 1981	3. 1982	4. AJ	5. Integration	6. Repeal
Corporate Tax Rates						
Equipment	.054	-.721	-.040	.356	-.064	.302
Structures	.496	.377	.377	.399	.308	.328
Public Utilities	.332	.240	.326	.443	.253	.355
Inventories	.356	.356	.356	.356	.329	.302
Land	.399	.399	.399	.399	.362	.328
Overall	.345	.236	.300	.388	.252	.321
Noncorporate Tax Rates						
Equipment	-.020	-.311	-.056	.328	-.079	-.124
Structures	.388	.293	.293	.358	.304	.327
Public Utilities	.245	.184	.241	.389	.256	.287
Residential Structures	.395	.334	.334	.409	.350	.381
Inventories	.328	.328	.328	.329	.329	.331
Land	.358	.358	.358	.358	.363	.372
Residential Land	.409	.409	.409	.409	.420	.441
Overall	.358	.321	.327	.371	.335	.351
Owner-Occupied Housing Tax Rates	.186	.186	.186	.186	.206	.242
Overall Cost of Capital	.070	.066	.068	.072	.068	.072
Standard Deviation	.017	.020	.017	.014	.009	.019
Overall Tax Rate	.288	.247	.264	.305	.263	.305

overall levels of tax for the twenty kinds of equipment averaged together, the nine types of business structures averaged together, and the five public utility structures averaged together, as well as for land and inventories.

Under the 1980 law, shown in column 1, we obtain the surprising result that the 35.8 percent overall tax rate in the noncorporate sector exceeds the 34.5 percent rate in the corporate sector. A noncorporate firm would not reduce its taxes by incorporating, however, because on any one activity, the corporate rate exceeds the noncorporate rate. In the corporate and noncorporate sectors, respectively, equipment is taxed at rates of +5 and -2 percent, structures are taxed at rates of 50 and 39 percent, while land is taxed at rates of 40 and 36 percent. The explanation of the overall tax rates is that noncorporate firms use much more of the highly taxed structures and land.

Still, the difference between the two sectors is not great. The fact that the corporate statutory rate exceeds the entrepeneur's rate implies higher taxes on some assets but higher interest deductions and subsidies on other assets. Additional personal taxes on corporate income are very small. The 5.8 percent capital gains rate applies to the large share of finance through retained earnings, and the 35.6 percent dividends rate applies only to the tiny share of financing through new issues.

The overall rate in the noncorporate sector includes 39 and 40 percent effective tax rates, respectively, on structures and land in rental housing. By contrast, the effective tax on structures or land in owner-occupied housing is only 18.6 percent. This rate represents only state and local property taxes, reduced to the degree that they are deducted from personal taxes. The rate is further reduced to the degree that mortgage interest is deducted at a rate greater than the rate at which interest receipts are taxed.

When averaged over the entire economy, the marginal effective total tax rate in 1980 was 28.8 percent, reflecting an after-tax return of .05 and a pre-tax return of .070. Though we have not yet measured misallocations associated with variations of this cum-tax cost-of-capital across assets and sectors, the weighted standard deviation of .017 indicates potential for excess burden.

The second and third columns of Table 4 indicate that the Economic Recovery Tax Act would have reduced corporate taxes dramatically but that the Tax Equity and Fiscal Responsibility Act removed about half of that tax cut. Equipment in either sector would have been heavily subsidized under ERTA but is now only slightly subsidized. The tax cuts for public utility structures were almost completely removed, while the tax cuts for structures were not touched by TEFRA. In contrast, neither law provided any changes for taxes on inventories, land, or owner-occupied housing.

Because the largest tax cuts in ERTA applied to equipment, the assets with the lowest existing tax rates, the standard deviation among capital costs would have increased from .017 to .020 at the same time that the average capital cost would have fallen from .070 to .066. TEFRA removed tax cuts for equipment in particular, so the standard deviation returns to .017 while the overall pre-tax returns climbs half-way back, to .068.

The Auerbach-Jorgenson plan, in column 4, would leave inventories and land unchanged, raise slightly the 1982 tax on structures and raise significantly the 1982 rate on equipment. There remain interasset differences due to the property tax, and intersectoral differences due to the unintegrated corporate tax system and the exclusion of imputed net rents. Relative to 1982, effective tax rates rise by 9 percentage points in the corporate sector, 4 points in the noncorporate sector, and 4 points overall. The cost-of-capital rises to .072, but its weighted standard deviation falls to .014.

Integration of corporate and personal taxes, the way we have defined it, does not remove interasset distortions attributable to investment tax credits and differential allowances. It does remove almost all differences between the corporate and noncorporate sectors, however. These differences turn out to be important, because the standard deviation of capital costs falls to .009. Each individual asset would be taxed at the same rate in either of the two sectors, but the noncorporate sector includes highly taxed rental housing and therefore averages to a higher overall tax rate.[22]

Asset tax differences in the corporate sector would be greatly reduced by repeal of the corporate tax, as shown in column 6 of table 4. Asset differences remain in the noncorporate sector, as do intersectoral differences. Elimination of corporate subsidies raises the corporate

[22] Tax rates for noncorporate business and housing are slightly changed from column 3 to column 5, even though "integration" does not affect tax rules applicable to those sectors. We use the *ceteris paribus* assumption that the weighted-average after-tax return to capital is constant across tax schemes, however. The higher personal taxation of corporate income necessitates a higher interest rate to maintain that fixed after-tax return, and the higher market interest rate affects discounting in the noncorporate and housing sectors.

rate from 30 percent in 1982 to 32.1 percent.[23] It raises the overall tax rate to 30.5 percent, capital costs to .072, and the standard deviation to .019.

IV. Sensitivity Analysis

A. Inflation

The sensitivity of tax rates to inflation is among the most significant findings of our study. Under 1982 law we find that inflation has far from uniform impact on the taxation of different assets: it raises some tax rates and lowers others. These differing impacts result in interasset distortions that become quite sizeable at some levels of inflation. Specifically, we find that double-digit inflation is associated with sharply higher dispersion in the cost-of-capital than is inflation in the zero to five percent range. Although we cannot measure the associated efficiency losses without performing general equilibrium simulations, these results are indicative of potential misallocations of captial at high rates of inflation.[24]

---

[23] Corporations may not actually experience this subsidy because the size of their earnings puts a limit on use of deductions and credits. The assymetric treatment of taxes and subsidies is accentuated when the tax law allows marginal subsidies as is currently true for equipment.

[24] As we discuss below, there is also some uncertainty about the robustness of these results on dispersion when we vary modeling assumptions. The pattern that some tax rates rise with inflation and others fall seems to be general, however. Finally, although we do not present inflation sensitivity results for 1980 law in this paper, they are similar to those for 1982 law (under a given set of modeling assumptions).

There are four influences of inflation that our model captures. First, even though tax lives are sharply reduced under the accelerated cost recovery system, the basis for depreciation is still original cost rather than replacement cost. As a consequence, with higher rates of inflation, the present discounted value of depreciation allowances falls, and the cost-of-capital rises.

Second, equity holders are taxed on nominal rather than real capital gains, and debt holders are taxed on nominal rather than real interest receipts. A constant rate of tax on nominal income thus results in a rising real burden as inflation increases. The magnitude of this effect depends on the hypothesized increase in taxable income for each additional point of inflation. As described in the Technical Appendix, our model assumes that the real after-tax rate of return is constant, when we look at different rates of inflation. As a result, taxable income rises by more than point for point with inflation.

A third reason that the cost-of-capital rises with inflation lies in the taxation of insurance companies. The Menge Formula determines the deductibility of reserves in such a way that inflation raises the insurance company's rate of tax as well as its taxable income (see King and Fullerton, 1984, Chapter 6). After accounting for the proportion of debt that is held by insurance companies, we find that each point of inflation adds about 0.6 points to τ_d, the tax rate on interest income.

Offsetting the first three influences of inflation is the deductibility of nominal interest payments. In the corporate sector, firms deduct interest payments from taxable income at their 49.5 percent rate, while interest recipients include it at the rate

$\tau_d = .196 + .595\pi$. As we vary inflation from zero to fifteen percent in our sensitivity analysis, the tax rate for interest recipients rises from .196 to .285, which indicates a subsidy per dollar of interest ($u-\tau_d$) that diminishes with inflation. Thus, as inflation increases the nominal interest which receives the subsidy ($u-\tau_d$), it also reduces the rate of subsidy.

Because the marginal tax rate of noncorporate entrepreneurs is .365, there is also a subsidy on the use of debt in that sector. In our third sector for homeowners, marginal tax rates average 26 percent. Each dollar of interest is thus subsidized at rates of inflation below 10.8 percent (where τ_d reaches .26) and taxed at rates of inflation above 10.8 percent.

The list of influences of inflation explicitly excludes any bracket creep for individuals. Since we look at the long-run impact of current law, we assume the indexing provisions currently scheduled to begin in 1985. In the absence of this measure, inflation would have a greater tendency to push tax rates upward. We also exclude FIFO inventory accounting when we look at only the tax-minimizing firm. If FIFO were required in some way, inflation would increase taxes for this reason as well.

We use two figures to display the net effects of the four included influences of inflation under 1982 law. Figure 1 plots selected tax rates as a function of inflation, and figure 2 plots the weighted standard deviation of capital costs across all assets and sectors as a function of inflation. One striking fact in figure 1 is the relative constancy of aggregated marginal tax rates on capital. The economy-wide

Figure 1: The Effects of Inflation on the Taxation of Capital

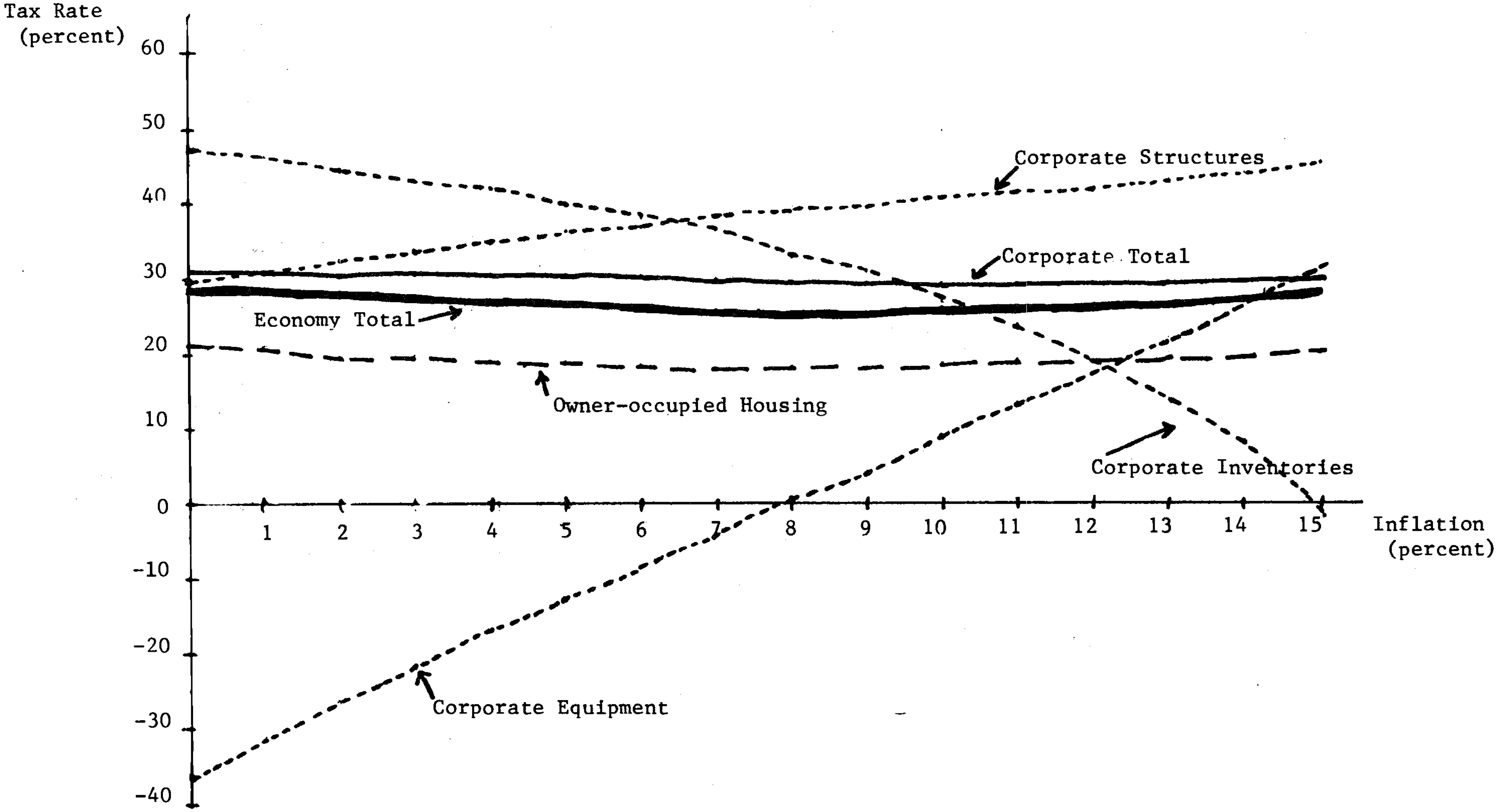
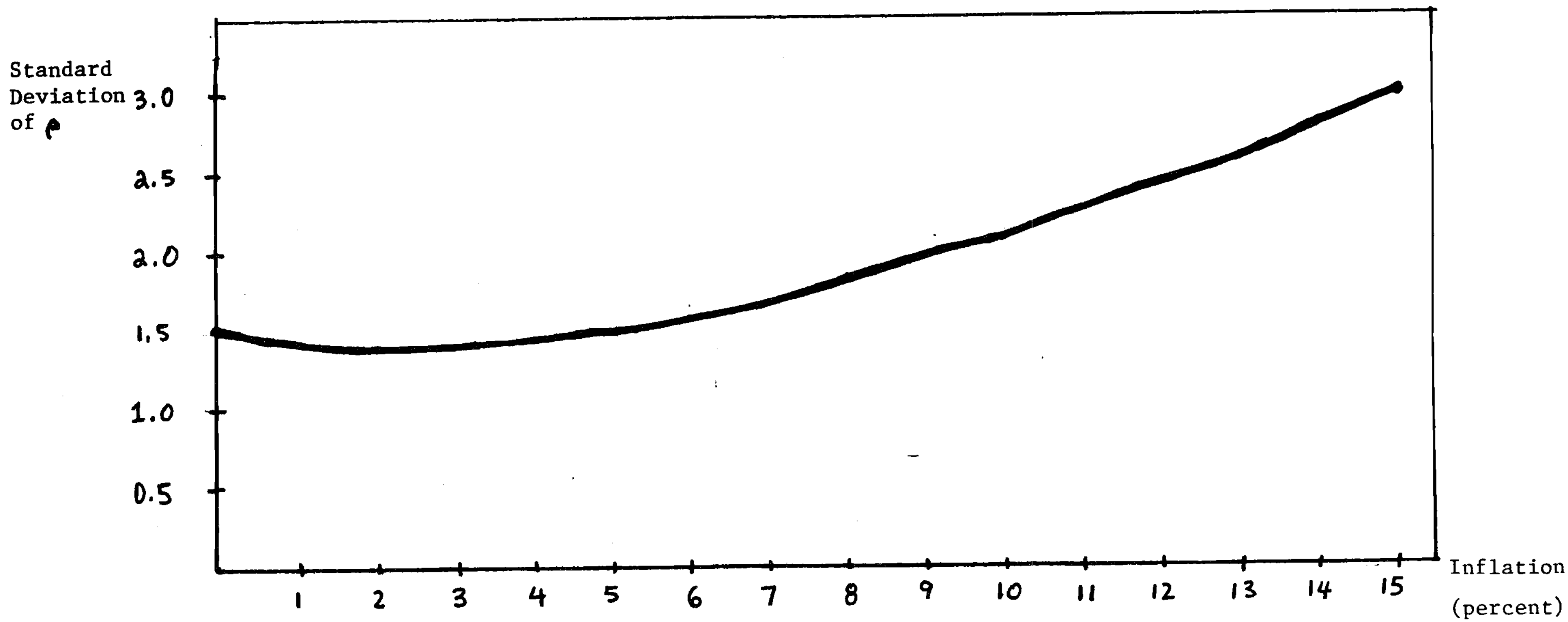


Figure 2: The Effect of Inflation on the Variation in the Cost of Capital



tax rate is .282 at zero inflation, reaches a low of .262 at about ten percent inflation, then rises back to .270 at 15 percent inflation. The corporate rate is even more constant, staying between 29.5 and 30.5 percent!

This remarkable stability of mean tax rates, however, masks underlying differences in the effect of inflation on the taxation of various individual assets. Figure 1 provides a glimpse at this diversity, since it includes a plot of the tax rates in the corporate sector for the aggregate of the twenty types of equipment, for the nine types of structures, and for inventories. The effective tax rate on equipment rises monotonically from -.359 at zero inflation to +.312 at 15 percent inflation. In the cost of equipment, then, the erosion of depreciation allowances is more important than the net addition to nominal interest deductions. Inflation also reduces the real value of depreciation on structures and raises the effective tax rate on that asset. Because of the relatively long tax lives for structures, however, a given inflation-induced increase in the discount rate has less impact on the present value of allowances than it does in the case of equipment. For assets that do not depreciate, such as inventories in figure 1, inflation adds to the nominal interest which is deducted at a rate greater than the rate at which it is subsequently taxed. This subsidizing effect of further inflation eventually offsets the tax on this asset. Finally, figure 1 indicates that the tax rate on owner-occupied housing is a U-shaped function of inflation. Initial inflation increases the nominal interest subsidy since τ_h is greater than τ_d, but subsequent inflation raises the latter rate for interest receipts above the former rate for interest deductions. Inflation then adds to the net tax in housing. Because this sector comprises a third of the total capital stock, the rate for the economy also exhibits a slight U-shaped pattern.

Figure 2 summarizes information about the effect of inflation on the spread in the cost-of-capital among assets and sectors. The standard deviation of ρ is about 1.5 percentage points when inflation is 5 percent and under. At 10 percent inflation it is one-fourth greater, and at 15 percent it is fully twice as great. In section D below, we explore the sensitivity of these results to specifications of the model.

To summarize, high inflation seems to add more to interasset and intersectoral distortions than it adds to intertemporal distortions via overall capital costs. Because of offsetting effects from the taxation of interest and historical cost depreciation, a rise in inflation does not affect the overall tax rates on capital. A rise in inflation does, on the other hand, discourage investment in depreciable assets, thereby affecting efficiency in the use of capital.

B. Debt Finance

As the previous section on inflation points out, investments financed by debt are subsidized because firms that deduct interest payments are in a higher marginal tax bracket than the individuals who include interest receipts. Because the debt-to-capital ratio is about one-third in each of our three sectors, this subsidy can have a major impact on the cost of capital. This hypothesis is confirmed in our analysis of the 1982 law assuming all equity finance. These results employ the standard seven percent inflation rate and are reported in column 2 of table 5. Without debt, the overall tax rate in the economy would rise from 26 to 38 percent. The largest increase, from 30 to 64 percent, would occur in the corporate sector for two reasons. First, the differential between the statutory corporate rate and the personal tax rate on interest is a large 26 percentage points. Second, in the absence of debt, a larger fraction of the corporate capital stock would be taxed at the high rate for dividends. Under the assumption of no debt finance, the combination of the investment tax credit and depreciation allowances for equipment (in both the corporate and noncorporate sectors) would no longer be sufficient to offset other features of the income tax system, and these assets would face positive rates of tax.

Column 3 of table 5 presents, for contrast, marginal tax rates under the assumption of 100 percent debt finance at the margin. We find that the subsidies to investment in the corporate sector and in noncorporate equipment are sizeable, and that investment in other depreciable assets in the noncorporate sector faces very low rates of taxation.

C. Property Taxation

In column 4 of table 5 we show estimates of current law tax rates in the absence of the property tax. These may be useful for two purposes. First, the results highlight the relatively large importance of the property tax in measuring the cost-of-capital. This point is especially striking in light of the fact that many published measures of marginal tax rates on capital do not include taxes on wealth. Second, the estimates provide an alternative assessment of the tax system, under the view that property taxes are exactly offset at the margin by additional

Table 5

Sensitivity Analysis for 1982 Law

	1. Standard Parameters	2. No Debt	3. All Debt	4. No Property Tax	5. Alternative Model
Corporate Tax Rates					
Equipment	-.040	.483	-2.082	-.385	.169
Structures	.377	.668	- .464	.203	.424
Public Utilities	.326	.640	- .561	.001	.372
Inventories	.356	.677	- .890	.238	.474
Land	.399	.694	- .665	.238	.493
Overall	.300	.640	- .847	.097	.398
Noncorporate Tax Rates					
Equipment	-.056	.107	- .528	-.249	-.042
Structures	.293	.378	.082	.169	.308
Public Utilities	.241	.329	.026	.021	.257
Residential Structures	.334	.408	.155	.131	.349
Inventories	.328	.418	.088	.255	.340
Land	.358	.439	.144	.255	.370
Residential Land	.409	.478	.237	.255	.422
Overall	.327	.410	.116	.192	.341
Owner-Occupied Housing Tax Rates	.186	.179	.203	-.021	.231
Overall Cost of Capital	.068	.080	.049	.055	.075
Standard Deviation	.017	.018	.017	.015	.012
Overall Tax Rate	.264	.376	- .025	.087	.329

local public services. If taxpayers are sufficiently mobile and have sufficient choice among jurisdictions, then local property taxes are merely voluntary payments for local services and thus do not distort the marginal investment decision. We apply this Tiebout hypothesis to both residential and nonresidential capital.

For homeowners, whose implicit rents and capital gains go untaxed, the property tax is the only source of taxation. Without the property tax, the effective tax rate on owner-occupied housing drops from +18.6 percent to -2.1 percent. The remaining subsidy is due to the fact that mortgage payments are deducted by owner-occupants at a rate slightly higher than the rate at which they are included by holders of mortgage debt.

Nonresidential property taxes were estimated to be a lower fraction of the value of capital than were residential property taxes: rates ranged from 0.77 percent for equipment to 1.55 percent on public utilities, as opposed to 1.84 percent for housing. As a result, elimination of the property tax has a somewhat smaller effect in non-housing sectors. Still, the impact is large enough to produce a drop in the overall tax rate in the economy from 26 to 9 percent. In addition, without differential property tax rates, the standard deviation in the cost-of-capital would fall from 0.17 to .015.

D. Assumptions about Arbitrage

Our standard model assumes that arbitrage takes place at the firm level: firms in all sectors compare the return to debt with the return on real capital, and they use the after-tax interest rate as the required after-tax return on all investments. The rate of return, net of personal taxes, averages .05 in the economy, but differences in the taxation of equity capital across the three sectors precludes the possibility of the same return, net of personal taxes, to all forms of investment. As described in the Appendix, an alternative model assumes arbitrage at the personal level. An investment in any sector would then earn a common return of .05, net of all taxes. In column 5 of table 5, we present the tax rates under this alternative model, using a universal net return of .05. All provisions of the tax law and all other assumptions are identical to those used in our standard estimates for 1982 law, which appears in column 1.

The most important message from this exercise is that the set of rates of return or rates of taxation is not invariant to model assumptions. We cannot find "the" 1982 marginal tax rates. Tax rates under the alternative model are somewhat higher than under the standard model: 33 percent as opposed to 26 percent for the economy as a whole.[25] The previously reported subsidy of corporate equipment becomes a tax of 17 percent. It is encouraging, however, that the ranking of tax rates for different assets and sectors is invariant to the choice of assumption about arbitrage. Equipment still faces the lowest tax rates, for example, and corporate inventories and land the highest.

Two other differences in results are worth mentioning briefly. First, in the alternative model, elimination of the corporate income tax results in a 2-point cut in the rate of taxation in the corporate sector

[25] At other rates of inflation, however, the alternative model implies tax rates that are less than those in the standard model.

(as opposed to a 2-point increase). Second, the variability in the overall cost-of-capital as a result of inflation is much less than in our standard model.

E. Assumptions about the Rate of Return

In another set of experiments, we use the standard model and vary s, the mean net-of-tax return. These results do not appear in the table. The overall tax rate falls from 36 percent at s=.02 to 25 percent at s=.06, which in part reflects the division of the tax wedge by a larger value of ρ. This result again underscores the fact that the measurement of tax rates is not unique. The sensitivity of the tax rate to the assumed after-tax rate of return appears to be especially large in the case of a subsidy: the tax rate on corporate equipment varies between -128 percent at s=.02 to -.3 percent at s=.06.

The study of sensitivity to s reveals a couple of pitfalls in judging relative tax rates for different assets. In a result reminiscent of the earlier inflation sensitivities, relative tax rates change as s changes. For example, while the tax rate for corporate land is 2 percentage points higher than the tax rate for corporate structures at our standard value for s, it is 45 percentage points lower when s is .02. Another case illustrates dramatically the sensitivity of the dispersion of asset tax rates to the choice of s. When s is .04, we find that all corporate equipment depreciated over five years is taxed at exactly the same rate, even though economic depreciation still varies among these assets. This anomalous result occurs because the corporate discount rate associated with an s of .04 happens to produce an equality between (1-u) and (1-k-uaz). Equations of the Appendix indicate that δ no longer enters in the determination of ρ under this condition.

V. Conclusion

This paper has examined the marginal effective total tax rates on capital as they have changed in the early 1980's. It has also looked at these rates under alternative reforms and under alternative rates of inflation. Our study covers many diverse assets and industries, as well as aggregates for the corporate, noncorporate, and owner-occupied housing sectors and the economy as a whole.

The tax law of 1982 results in a lower overall effective tax rate on capital than existed under 1980 law. It thus provides a larger incentive to invest in real capital. At 26 percent, this overall tax rate is also significantly lower than would be predicted by previous studies that looked at average rather than marginal tax rates or that emphasized equity finance at the margin.

An equally important aspect of recent tax changes is that they have not, on the whole, reduced tax differentials among different assets and industries. Our measure of the weighted deviation in the costs-of-capital across the economy remains unchanged from 1980 law. In other words, there has been no apparent improvement in the efficiency with which capital is allocated across its various uses, despite the fall in overall tax rates. We also find that the corporate tax system makes significant contributions to tax rate differences, even though it makes negative contributions to the overall tax on marginal investments under our standard set of parameters. Additional inflation also contributes to tax rate disparities without adding to the overall tax burden. There is a lower weighted deviation, however, for reforms such as the Auerbach-Jorgenson first year capital recovery plan and integration of personal and corporate taxes.

TECHNICAL APPENDIX

Part A of this appendix describes potential uses of the tax rates of this paper in examing intertemporal, intersectoral, and interasset features of tax reforms in the 1980's. Part B describes the exact computation of the tax rates presented in this paper.

A. The Use of Tax Rates to Measure Efficiency Gains and Losses

It is easiest to explain the applicability of our study in the context of previous efforts to measure the effects of tax distortions. In particular, we follow the tradition of Harberger (1962,1966), who used an analytical general equilibrium model to measure the misallocation of real capital between the corporate and noncorporate sectors. He found that the cost in efficiency from this distortion amounts to about a half of one percent of GNP. This cost is a small fraction of a number as large as gross national product, but it amounts to between ten and twenty percent of the revenue obtained from the additional tax on the corporate sector.

Shoven and Whalley (1972) showed how to incorporate taxes in a computational general equilibrium model with more consumer groups and production sectors, and this method is used in the larger more recent general equilibrium model of Fullerton, Shoven and Whalley (FSW, 1978, 1983). This model measures the misallocation of capital among eighteen industries, where tax differences arise because corporations make up a larger fraction of firms in some industries, and because corporations use different combinations of interest, dividends, and retained earnings. The model also measures the misallocation of resources over time that are due to extra taxes on saving for future consumption.

Tax rates in the FSW model are measured by the total of observed corporate taxes, property taxes, and personal taxes as a fraction of capital income in each industry. These tax rates can be revised to capture the effects of each alternative tax scheme, but rates are then held constant as the model calculates a new (counterfactual) allocation of capital among industries. For this reason, the model does not capture firms' efforts to affect their taxes by changing their mix of assets or by changing their corporate status.

Another problem is that these "average" effective tax rates, measured for existing assets, are applied to marginal uses of capital. Fullerton and Henderson (1983) amend the FSW model to measure "marginal" effective tax rates explicitly for each asset, using the cost-of-capital approach of Hall and Jorgenson (1967). A further advantage of these marginal rates is that they can easily reflect changes in investment tax credits and depreciation allowances such as those introduced with the Accelerated Cost Recovery System (ACRS) in 1981. Yet the model in that paper assumes that each industry uses the different assets in fixed proportions. Thus, while it measures intertemporal and interindustry distortions, it still omits interasset distortions.

Misallocations among assets are measured in papers by Hendershott and Hu (1980) and Gravelle (1981, 1982). They calculate the marginal cost-of-capital in the corporate sector for each asset, and they assume Cobb-Douglas demands. By changing the cost-of-capital to reflect a new tax law, or even to remove all asset distortions, they can simulate the new economy-wide demand for each asset and measure the gain or loss in total output. The new allocation reflects equilibrium in the market for real capital but it is not a general equilibrium. Their models apply only to corporate capital, not total capital. They do not capture industry misallocations, and they do not capture intertemporal misallocation associated with the overall taxation of income from capital.

In this paper we compute tax rates that could be used in a more general model that incorporates all of these decisions simultaneously. When efficiency costs from all of these misallocations are combined, they can add to substantially more than a half percent of GNP.

First, in such a model, a marginal effective total tax rate (including corporate, personal, and property taxes) affects individual choices between present and future consumption. Saving for future consumption affects the total available supply of capital in subsequent periods. Second, in any one period, a marginal cost-of-capital formula is used to determine the demand for capital in each of the eighteen industries. Third, within each industry, separate cost-of-capital expressions are used to determine the division between corporate and noncorporate sectors. Fourth, within each sector of each industry, individual cost-of-capital calculations are used to determine demand for each of the different asset types.

We could simulate the change in any tax parameter such as a statutory rate, credit rate, or depreciation lifetime, and we could calculate new user costs for each asset in the general equilibrium model that we envisage. These user costs depend endogenously on the real after-tax rate of return determined in equilibrium. A composite of those costs applies to each sector of a given industry, and an additional composite of corporate and noncorporate costs applies to the overall use of capital for that industry. Each industry has a different mix of assets in each sector, as well as a different mix of sectors, all determined endogenously. When the total use of capital equals the total available supply, we have equilibrium in the capital market; when other markets clear as well, we have a general equilibrium.

In a generalized model, we would not be limited to a unitary elasticity of substitution among assets, as implied by the Cobb-Douglas functional form. Instead, capital in the corporate sector or in the noncorporate sector of each industry would be a different Constant Elasticity of Substitution (CES) composite of the 38 assets. The elasticity of substitution among assets (ε) may be specified exogenously. Capital in each industry would be another CES function of composite capital stocks from each sector of that industry. The elasticity of substitution between corporate and noncorporate capital (σ) would also be pre-specified. When these elasticities are set to zero, the generalized model would reduce to the one in Fullerton and Henderson (1983). When they are unity, the model would be very similar to that of Gravelle (1981,1982). This generalization is important because the choices for ε and σ have much bearing on the relative attractiveness of alternative proposals.

B. Measurement of the Cost of Capital and Effective Tax Rates

We start with a cost of capital formula like that developed by Hall and Jorgenson (1967). The underlying premise behind this formula is that the profit maximizing firm will undertake a marginal investment project if it earns a return net of tax such that the present value of cash flows is at least equal to the initial outlay. Under competitive equilibrium conditions the two will be exactly equal.

Consider a marginal investment with an acquisition cost q, a rental price c, and wealth tax rate of w per dollar of asset. The rental price is the amount for which the asset could be rented if the owner covers maintenance, depreciation, and taxes. If the statutory marginal corporate income tax rate is u, and if the property tax is deductible, then the rental net of property taxes and corporate taxes is $(1-u)(c-wq)$. This return is treated as certain, and it grows in nominal terms at the rate of inflation, π. Further assume that the quantity of capital embodied in the investment declines at the economic depreciation rate δ. As a consequence, the net-of-tax rental receipts from the investment at time t will equal $(1-u)(c-wq)e^{(\pi-\delta)t}$. To derive the present value of such a stream, these nominal cash flows would be discounted at the nominal after-tax rate, r.

Capital cost recovery provisions affect the equilibrium rental rate in two ways. First, an investment tax credit at rate k lowers the acquisition cost of the asset from q to $(1-k)q$. Second, the firm receives a reduction in taxes as a result of depreciation allowances. Let a denote the fraction of purchase price that is eligible for depreciation allowances. The present value of this deduction per dollar of basis will be denoted by z, so the total tax reduction is uazq. The particular value for z will reflect the discount rate, the tax lifetime for the asset, the depreciation schedule, and whether allowances are based on historical or replacement cost. With the inclusion of all these features of the tax code, the equilibrium condition is expressed as:

$$(1 - k)q = \int_0^\infty (1 - u)(c - wq)e^{(\pi - \delta)t}e^{-rt}dt + uazq \qquad \text{(A1)}$$

From this expression we can solve for the rental rate c/q as a function of the tax parameters as well as r, δ, and π. Finally, since c/q is gross of depreciation, we subtract δ to obtain the corporation's real rate of return net of depreciation:

$$\rho^c = \frac{c}{q} - \delta = \frac{r - \pi + \delta}{1 - u}(1 - k - uaz) + w - \delta \tag{A2}$$

This crucial expression is used to find the cost to the corporate firm of employing any of the 38 assets. The discount rate, inflation rate, and corporate tax rate do not vary by asset, but parameters such as δ, k, a, z, and w are asset-specific. None of these parameters is specific to any industry.

In the noncorporate sector, we assume that the firm must earn at least its own discount rate r in nominal terms, after taxes at rate τ_{nc}, on any alternative investment. The noncorporate firm may use any of the 38 assets, and each has an equilibrium condition analogous to equation (A1) above.

$$\rho^{nc} = \frac{r - \pi + \delta}{1 - \tau_{nc}}[1 - k - \tau_{nc}az] + w - \delta \tag{A3}$$

Corporate and noncorporate parameters are identical for depreciation rates (δ), investment tax credits (k), property taxes (w), basis adjustment (a), and depreciation schedules. Discount rates differ, however, so the present value of depreciation for any one asset (z) depends on the sector.

A final cost-of-capital forumla applies to owner-occupied housing. This asset earns a rental rate c, minus property taxes, of which λ are deducted from the personal income tax at rate τ_h. The return $c - (1-\lambda\tau_h)wq$ is not subject to income tax, but the investor receives no credits or depreciation allowances. The return grows in nominal terms at rate π, depreciates at its own rate δ and is discounted at the individual's nominal after-tax rate r. Logic similar to that of (A1) and (A2) implies the equilibrium condition:

$$q = \int_0^{\infty} [c - (1 - \lambda\tau_h)wq]e^{(\pi - \delta)t}e^{-rt}dt \qquad \text{(A4)}$$

and the required rate of return:

$$\rho^h = \frac{c}{q} - \delta = r - \pi + (1 - \lambda\tau_h)w \qquad \text{(A5)}$$

The deductibility of mortgage interest is captured in the fact that these flows are discounted by an after-tax rate of return.

1. Arbitrage at the Firm Level

Next we outline two possible models for the choice of discount rates. In one model, as in Bradford and Fullerton (1981), we assume that the firm arbitrages between debt and real capital. Instead of making this investment, the firm can always use the marginal dollar of funds to retire a dollar of debt, an action which would earn the after-tax interest rate for the firm. Therefore, each alternative asset must yield the after-tax interest rate. If i is the nominal market interest rate, then the discount rate in the corporate sector is i(1-u), in the noncorporate sector it is $i(1-\tau_{nc})$, and in owner-occupied housing it is $i(1-\tau_h)$. In any one sector, the discount rate does not depend upon the actual sources of finance.

A proportion c_{ns} of corporate investment is financed by new shares sold to individuals with tax rate τ_{ns}. These investments earn i(1-u) after corporate taxes, and this return is paid as dividends to the owners who receive $i(1-u)(1-\tau_{ns})$ after all taxes. A proportion c_{re} is financed by retained earnings, and the return i(1-u) is retained by the corporation. Individual owners are taxed at τ_{re}, the effective accrued rate on capital gains, and they receive $i(1-u)(1-\tau_{re})$ after taxes. A final proportion c_d is financed by debt sold to individuals with tax rate τ_d. The firm pays interest at rate i and the individual receives $i(1-\tau_d)$ after taxes. When these different individuals are aggregated, however, the average real net-of-tax return in the corporate sector is defined as:

$$s^c \equiv c_d[i(1-\tau_d)] + c_{re}[i(1-u)(1-\tau_{re})] + c_{ns}[i(1-u)(1-\tau_{ns})] - \pi \qquad \text{(A6)}$$

When we compare the pre-tax return ρ^c to this average value of s^c, we implicitly assume that the marginal investment is financed by the average proportions of debt, retained earnings, and new shares.

In the noncorporate sector, a fraction n_d of investment is financed through the market for debt. The noncorporate firm pays the same interest rate i, it deducts interest at rate τ_{nc}, and the interest recipient earns $i(1-\tau_d)$ after taxes. The remaining share n_e is financed by equity of the entrepreneur, who earns $i(1-\tau_{nc})$ after taxes. The average real net return in the noncorporate sector is

$$s^{nc} \equiv n_d[i(1 - \tau_d)] + n_e[i(1 - \tau_{nc})] - \pi \ . \tag{A7}$$

Owner-occupants finance a fraction h_d through debt, pay the market interest rate i, and deduct interest payments at their statutory rate τ_h. The equity-financed share h_e must therefore earn $i(1-\tau_h)$, and the average real net return is

$$s^h \equiv h_d[i(1 - \tau_d)] + h_e[i(1 - \tau_h)] - \pi \ . \tag{A8}$$

The average real net return for the economy is

$$s \equiv \frac{K^c s^c + K^{nc} s^{nc} + K^h s^h}{K^c + K^{nc} + K^h} \ , \tag{A9}$$

where K refers to the stock of capital in each sector.

All calculations could proceed by setting the single market interest rate i. In the corporate sector, for example, the discount rate would be i(1-u), the pre-tax return would be given by (A2), and the after-tax return would be given by (A6). Instead, we wish to use the *ceteris paribus* assumption that the average real net return s is constant across alternative tax regimes and different inflation rates. For this reason, we set s at .05 in each case and then calculate the interest rate compatible with above equations. We substitute (A6)-(A8) into (A9) and solve for i as a function of s, π, tax rates, finance shares, and capital stocks. Under 1982 law with 7 percent inflation, for example, i is .181. Because nominal income is subject to tax, inflation adds more than proportionately to nominal interest in order to maintain the fixed real after-tax return s. This relationship between π and i is not based on empirical observations but is a necessary consequence of the *ceteris paribus* assumption on s.

2. Arbitrage at the Individual Level

The assumption of arbitrage at the firm level precludes the possibility of arbitrage at the personal level. Individuals receive $i(1-\tau_d)$ if they purchase debt, $i(1-u)(1-\tau_{ns})$ if they purchase new shares, $i(1-\tau_{nc})$ if they invest in a noncorporate firm, or $i(1-\tau_h)$ if they invest in housing. In an alternative model, we could assume that individuals would adjust their portfolios until all these returns were equal to the real net return from holding debt, s, redefined as

$i(1-\tau_d) - \pi$. The corporation's discount rate for debt is still $i(1-u)$, but a new share issue would have to earn a return after corporate taxes such that dividends could be taxed at rate τ_{ns} and still provide $i(1-\tau_d)$ to the saver. The discount rate for new shares thus equals $i(1-\tau_d)/(1-\tau_{ns})$. By a similar logic, the discount rate for retained earnings finance is $i(1-\tau_d)/(1-\tau_{re})$. A weighted-average discount rate for the corporation may be defined as:

$$c_d[i(1 - u)] + c_{ns}[i\left(\frac{1 - \tau_d}{1 - \tau_{ns}}\right)] + c_{re}[i\left(\frac{1 - \tau_d}{1 - \tau_{re}}\right)] \tag{A10}$$

We can set s at .05, calculate i as $(s+\pi)/(1-\tau_d)$, and use (A10) for corporate discounting.

By analogy, the entrepreneur's cost of deductible debt finance is $i(1-\tau_{nc})$. The equity-financed investment must earn enough that the entrepreneur as an individual can pay taxes at rate τ_{nc} and still match the return to holding debt, $i(1-\tau_d)$. The weighted discount rate in the noncorporate sector is thus:

$$n_d[i(1 - \tau_{nc})] + n_e[i(1 - \tau_d)] \tag{A11}$$

By further analogy, the weighted discount rate in housing is

$$h_d[i(1 - \tau_h)] + h_e[i(1 - \tau_d)] \tag{A12}$$

This second model has the advantage of a single after-tax return, but this time the assumption of arbitrage at the <u>personal</u> level precludes the possibility of arbitrage at the <u>firm</u> level. The corporation's marginal investment earns a certain return after taxes given by (A10), an amount which exceeds i(1-u). The firm thus forgoes the opportunity to make pure profits by issuing one more unit of debt and undertaking one more unit of investment.

It would be possible to reconcile these alternative models by introducing a risk premium on equity and a portfolio choice model for individuals. Instead, for this perfect certainty model, we choose reconciliation through market segmentation. Firms arbitrage between debt and real capital, as in the first model, and equilibrium is established as in Miller (1977). Because some individuals hold only debt and others hold only equity, there is no arbitrage at the personal level. Thus we use the first model for primary calculations in this paper, but we test the sensitivity of these results by providing calculations based on the second model.

A final note regards the presentation of each tax law in our tables. The relevant information is embodied in various values of ρ, the gross-of-tax returns, but we sometimes find it easier to interpret effective tax rates. Since the various values of s represent the returns net of all taxes, the differences ρ-s represent the combination of corporate taxes, property taxes, and personal taxes. If this difference is expressed as a fraction of ρ, we have a marginal effective total tax rate. These effective tax rates can be measured for each corporate asset by using $(\rho^c-s^c)/\rho^c$, for each noncorporate asset by using $(\rho^{nc}-s^{nc})/\rho^{nc}$, or for owner-occupied housing by using $(\rho^h-s^h)/\rho^h$. For notational simplicity, we suppressed the index for assets (i=1...38) in all expressions above. If we use ρ_i^c to denote ρ^c for asset i, and use K_{ij}^c to denote the stock of that asset in the corporate part of industry j, then the effective tax rate for the corporate part of industry j may be defined as:

$$t_j^c \equiv \frac{\Sigma_i K_{ij}^c (\rho_i^c - s^c)}{\Sigma_i K_{ij}^c \rho_i^c} \tag{A13}$$

We calculate similar tax rates for the noncorporate sector, replacing all c superscripts with nc superscripts. An overall rate for that industry is defined as the sum of the numerators from t_j^c and t_j^{nc} divided by the sum of the denominators. (The housing industry combines rental and owner-occupied housing instead of corporate and noncorporate sectors.) An overall rate for the economy is similarly defined as the sum of the numerators from all industry tax rates divided by the sum of the denominators.

REFERENCES

Auerbach, Alan J. and Dale W. Jorgenson (1980). "Inflation-Proof Depreciation of Assets," Harvard Business Review LVIII, pp. 113-118.

Bradford, David F. and Don Fullerton (1981). "Pitfalls in the Construction and Use of Effective Tax Rates," in Charles R. Hulten (ed.), Depreciation, Inflation, and the Taxation of Income from Capital, Washington, DC: The Urban Institute Press.

Brown, E. Cary (1981). "The 'Net' Versus the 'Gross' Investment Tax Credit," in Charles R. Hulten (ed.), Depreciation, Inflation, and the Taxation of Income From Capital, Washington, D.C.: The Urban Institute Press.

Feldstein, Martin and Lawrence Summers (1979), "Inflation and the Taxation of Capital Income in the Corporate Sector," National Tax Journal, XXXII, pp.445-470.

Feldstein, Martin, Louis Dicks-Mireaux and James Poterba (1983). "The Effective Tax Rate and the Pretax Rate of Return," Journal of Public Economics XXI, pp.129-158.

Fraumeni, Barbara M. and Dale W. Jorgenson (1980). "The Role of Capital in U.S. Economic Growth, 1948-1976," in George von Furstenberg (ed.), Capital, Efficiency and Growth, Cambridge, MA: Ballinger.

Fullerton, Don (1984). "Which Effective Tax Rate?," National Tax Journal, March.

Fullerton, Don and Roger H. Gordon (1983). "A Reexamination of Tax Distortions in General Equilibrium Models," in Martin Feldstein (ed.), Behavioral Simulation Methods in Tax Policy Analysis, Chicago: University of Chicago Press.

Fullerton, Don and Yolanda K. Henderson (1983). "Long Run Effects of the Accelerated Cost Recovery System," revised version of NBER Working Paper No. 828, Cambridge, MA: National Bureau of Economic Research.

Fullerton, Don, John B. Shoven, and John Whalley (1978). "General Equilibrium Analysis of U.S. Taxation Policy," 1978 Compendium of Tax Research, Washington, DC: Office of Tax Analysis, U.S. Treasury Department.

Fullerton, Don, John B. Shoven, and John Whalley (1983). "Replacing the U.S. Income Tax with a Progressive Consumption Tax: A Sequenced General Equilibrium Approach," Journal of Public Economics XX-1 (February), pp. 3-23.

Gravelle, Jane G. (1981). "The Social Cost of Nonneutral Taxation: Estimates for Non-Residential Capital," in Charles R. Hulten (ed.), Depreciation, Inflation and the Taxation of Income from Capital, Washington, D.C.: The Urban Institute Press.

Gravelle, Jane G. (1982). "Effects of the 1981 Depreciation Revisions on the Taxation of Income from Business Capital," National Tax Journal XXXV (March), pp. 1-20.

Hall, Robert and Dale Jorgenson (1967). "Tax Policy and Investment

Behavior," American Economic Review LVII (June), pp. 391-414.

Harberger, Arnold C. (1962). "The Incidence of the Corporation Income Tax," Journal of Political Economy LXX-3 (June), pp.215-240.

Harberger, Arnold C. (1966). "Efficiency Effects of Taxes on Income from Capital," in M. Krzyzaniak (ed.), Effects of Corporation Income Tax, Detroit: Wayne State University Press.

Harriss, C. L. (1974). Property Taxation in Government Finance, Research Publication No. 31, Washington D.C.: The Tax Foundation.

Hendershott, Patric H. and Sheng-Cheng Hu (1980). "Government-Induced Biases in the Allocation of the Stock of Fixed Capital in the United States," in George von Furstenberg (ed.), Capital, Efficiency and Growth, Cambridge, MA: Ballinger, pp. 323-360.

Hulten, Charles R. and James W. Robertson (1982). "Corporate Tax Policy and Economic Growth: An Analysis of the 1981 and 1982 Tax Acts," discussion paper, Washington, D.C.: The Urban Institute.

Hulten, Charles R., and Frank C. Wykoff (1981). "The Measurement of Economic Depreciation," in Charles R. Hulten (ed.), Depreciation, Inflation and Taxation of Income from Capital Washington, D.C.: The Urban Institute Press.

Jorgenson, Dale W., and Martin A. Sullivan (1981). "Inflation and Capital Recovery in the United States," in Charles R. Hulten (ed.), Depreciation, Inflation and the Taxation of Income from Capital Washington, D.C.: The Urban Institute Press.

King, Mervyn A. and Don Fullerton (eds.) (1984). The Taxation of Income from Capital: A Comparative Study of the U.S., U.K., Sweden, and West Germany, Chicago: The University of Chicago Press (forthcoming).

McLure, Charles E., Jr. (1979). Must Corporate Income be Taxed Twice?, Washington, D.C.: The Brookings Institution.

Miller, Merton (1977). "Debt and Taxes." Journal of Finance XXXII-2 (May), pp. 261-275.

Shoven, John B. and John Whalley (1972). "A General Equilibrium Calculation of the Effects of Differential Taxation of Income from Capital in the U.S.," Journal of Public Economics VIII-1 (August), pp. 1-18.

Stiglitz, Joseph E. (1973). "Taxation, Corporate Financial Policy, and the Cost of Capital," Journal of Public Economics, II, pp. 1-34.

Vasquez, Thomas (1974). "The Effects of the Asset Depreciation Range System on Depreciation Practices," OTA Paper No.1, Washington D.C.: U.S. Treasury Department.