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A DISAGGREGATE EQUILIBRIUM MODEL OF THE TAX DISTORTIONS AMONG ASSETS, SECTORS, AND INDUSTRIES*

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This paper encompasses multiple sources of inefficiency into a single general equilibrium model of the U.S. tax system. We measure interasset distortions using disaggregate calculations of user cost, and intersectoral distortions from the differential treatment of the corporate sector, noncorporate sector, and owner-occupied housing. Industries in the model have different uses of assets and degrees of incorporation. Results indicate that distortions between sectors or among industries are much smaller than previously thought. Distortions among assets are larger, but the total of all these welfare costs is still below one percent of income.

1. INTRODUCTION

Practical constraints preclude the elimination of all sources of economic inefficiency introduced by our tax system, and analysts differ as to the relative importance of each. As a consequence, any particular tax reform initiative is likely to address only a few types of inefficiences while ignoring or exacerbating others. In fact, different models have been used to measure different tax distortions, and consistent comparison is difficult. Policymakers are left without comparable estimates of the relative size of different tax distortions, and therefore without clear guidance on the choice among alternative reforms.

The purpose of this paper is to encompass multiple sources of inefficiency into a single general equilibrium model of the U.S. tax system. Starting from disaggregate calculations of user cost in 1984, we incorporate interasset distortions arising from the differential tax treatment of many types of equipment, structures, inventories, and land. Simultaneously, we model the intersectoral distortions arising from the differential treatment of the corporate sector, noncorporate sector, and owner-occupied housing. Because industries differ in their relative use of assets and degree of incorporation, our model also captures interindustry distortions arising from the differential treatment of industries. The model contains only a rudimentary treatment of intertemporal consumption decisions, so this paper

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does not emphasize estimates of intertemporal distortions arising from the differential treatment of consumption in different time periods. Finally, the approach is amenable to the inclusion of financial distortions arising from the differential treatment of debt and equity. The model necessarily deals with many of these financing considerations, but it does not encompass endogenous financial decision making. We therefore compare multiple distortions in the allocation of real capital only.[2]

We use a cost of capital approach in the tradition of Hall and Jorgenson (1967) to measure the incentives to invest in each combination of asset, sector, and industry. These user costs can be reexpressed as "marginal effective tax rates," and so the results of our model can be contrasted with those of previous studies that base incentives on actual taxes paid, or "average effective tax rates."

Our model incorporates effects of taxes on many different kinds of investment decisions, so results necessarily depend on the specification of how these decisions are made. For this reason, we present considerable sensitivity analysis with respect to key substitution elasticities. While numerical magnitudes always depend in part on these parameters, important qualitative results often do not. A further important result of these sensitivity studies is that they provide a clear agenda for future econometric measurement.

Our main finding is that, for a broad range of substitution elasticities, interasset distortions under 1984 law are larger than intersectoral or interindustry distortions. Indeed, the distortion between the corporate sector and the noncorporate business sector, originally emphasized by Harberger (1962, 1966), is almost nonexistent. In sum, these multiple distortions impose an annual welfare cost that is still below one percent of national output.

The next section provides a context for our results by reviewing the previous literature. The remaining sections then proceed to address the simultaneous modeling of interasset, intersectoral, and interindustry distortions; the efficiency gains from removing each of these distortions; and the importance of sensitivity analysis. A brief summary concludes the paper.

2. A REVIEW OF PREVIOUS STUDIES

The issue of intersectoral tax distortions has been studied extensively. Harberger (1962, 1966) used a general equilibrium model to measure the misallocation of real capital between the corporate and noncorporate sectors. He found an efficiency cost from this distortion that was about 0.5 percent of GNP. Today this percentage would represent a $20 billion annual loss.

Shoven and Whalley (1972) and Shoven (1976) 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, 1983). This model

[2] More explicitly, we exclude distortions in financial decisions, saving decisions, the allocation of risk, and the allocation of housing among consumers. We include distortions in other consumption decisions, labor/leisure choices, and the allocation of capital among assets, sectors, and industries.

measures the misallocation of capital among 18 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. 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. A simulation that equalized capital tax rates across industries resulted in a welfare gain that was 0.6 percent of "expanded national income."[3]

Both the Harberger and the FSW models use "average" effective tax rates, measured for existing assets, rather than "marginal" effective tax rates that would apply to incremental uses of capital. Marginal effective tax rates cannot capture every relevant detail of the tax code, but the concept of the tax on a new investment is clearly preferred as a measure of the incentive to invest. Average rates include elements of lump-sum taxes on previous investments. In fact, Feldstein, Dicks-Mireaux, and Poterba (1983) found that total taxes paid were 70 percent of capital income in the corporate sector, prior to the Economic Recovery Tax Act of 1981. This average effective total tax rate is twice the estimate of the marginal effective total tax rate in King and Fullerton (1984) or Fullerton and Henderson (1984).

The purpose of this paper is to integrate the general equilibrium methodology with the marginal effective tax rate methodology. We thus avoid the crude effective tax rate measures of the former, and the fixed rate of return assumption in the latter. We also provide the first comparison of distortions among assets, sectors, and industries.[4] Misallocations among assets were measured in papers by Gravelle (1981) and Auerbach (1983). They calculated the marginal cost of capital for each of about 30 types of equipment and structures, and they found welfare costs in the range of 0.10 to 0.15 percent of GNP. In these papers, the new allocation reflects equilibrium in the market for real capital, but it is not a general equilibrium. The models apply only to corporate capital, not total capital. Each industry uses a different mix of assets in the Auerbach study, but both of these studies employ Cobb-Douglas demands for capital, and neither captures misallocations among sectors.

Hendershott and Hu (1980) examine six categories of assets in the corporate,

[3] See the one-period model of Ballard, Fullerton, Shoven, and Whalley (1985), Chapter 8. Expanded national income includes the value of leisure time, and in the baseline is about 135 percent of national income alone. In a dynamic calculation with a sequence of equilibria, capital tax equalization brought a welfare gain equal to 1.1 percent of the present discounted value of consumption and leisure in the baseline sequence. While the model we develop is capable of examining a sequence of equilibria, the results from capital tax equalization are similar in the one-period and the sequenced models because our simulations do not alter the tradeoff between present and future consumption.

[4] Fullerton and Gordon (1983) amended the FSW model to examine marginal taxes, but the costs of capital were developed from industry-based tax parameters rather than asset-based parameters. Assets were not identified separately. In another refinement of the FSW model, Fullerton and Henderson (1985) measured effective tax rates for different assets. Yet the model in that paper assumes that each industry uses assets in fixed proportions. Thus, while it measures intertemporal and interindustry distortions, it still omits interasset distortions.

noncorporate, and owner-occupied housing sectors.[5] Like Gravelle and Auerbach, Hendershott and Hu model the capital market, not the overall economy, and they assume Cobb-Douglas demands.[6] Finally, the model of Jorgenson and Yun (1986) is an econometrically-estimated general equilibrium model, with corporate, noncorporate, and household sectors that each use a short-lived asset and a long-lived asset. They estimate that the welfare gains from eliminating interasset differences within the corporate and noncorporate business sectors would be about 4 percent of income in the baseline. This is considerably larger than the percentage gain in any of the previous studies. Quite surprisingly, however, Jorgenson and Yun find a welfare loss from eliminating tax differences between the two business sectors.[7]

3. A GENERALIZED MODEL

Features of our general equilibrium model not related to the allocation of capital are taken from the Fullerton-Shoven-Whalley model, as described in Ballard, Fullerton, Shoven, and Whalley (1985). On the consumption side, each of 12 income-differentiated households has initial endowments of labor and capital that can be sold for use in production. As indicated in the top part of Figure 1, these households each maximize a nested constant elasticity of substitution (CES) utility function by first making an allocation of resources between present consumption and saving. The elasticity of substitution between present and future consumption is based on an aggregate estimate of 0.4 for the uncompensated savings elasticity with respect to the net rate of return. The model is capable of simulating a sequence of equilibria in which the capital stock increases as a result of saving. The specification of saving behavior does not affect the simulations we perform below, because we hold constant the overall taxation of capital. Also, while the economy in this model is open to balanced international flows of goods and services, it is not open to international capital flows. We therefore look only at a one-period equilibrium, with a fixed capital stock.[8]

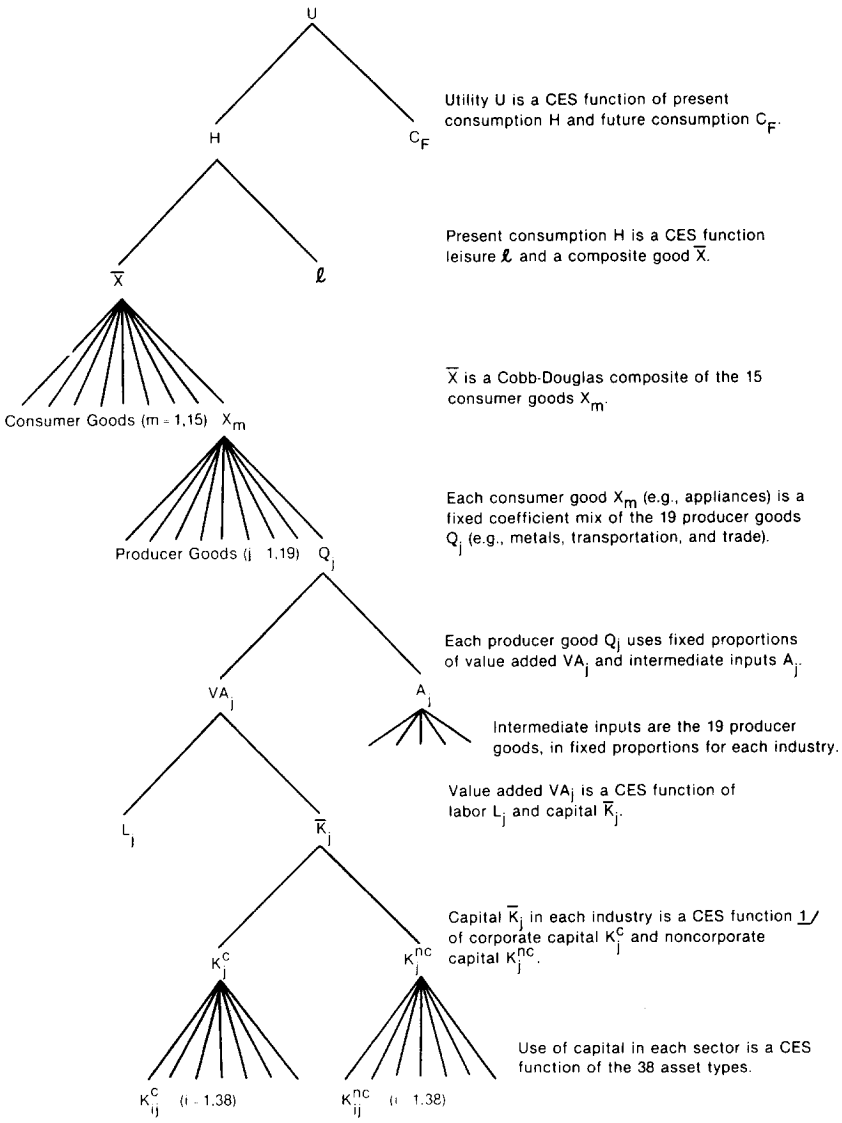
With present resources, as indicated in the next level of Figure 1, a household can choose to buy some of its own labor endowment for leisure. The elasticity of substitution between consumption and leisure is based on an aggregate estimate of 0.15 for the uncompensated labor supply elasticity with respect to the net-of-tax wage. Present consumption expenditures are then divided among 15 consumer goods according to a Cobb-Douglas subutility nest. Each consumer good

[5] This model is updated and expanded in Hendershott (1986).

[6] The measured welfare cost of misallocated assets tends to be smaller when assets are aggregated, as in the Hendershott and Hu study. Mackie (1985) finds that the welfare cost from misallocation between aggregated equipment and aggregated structures is about 40 percent of the welfare cost associated with 30 disaggregated assets.

[7] The reason for this efficiency loss is not explained by the authors.

[8] Capital and labor are assumed to adjust fully within this single period. There are no lags or other costs of adjustment. Our measures tend for this reason to overstate the welfare gains from resource reallocation.



1/ In the housing industry, capital is a CES function of owner-occupied housing and noncorporate rental housing.

FIGURE 1

A DIAGRAMMATIC SUMMARY OF THE MODEL

is a fixed-coefficient combination of outputs of the 18 industries.[9] The model includes the entire spectrum of Federal, state, and local taxes, typically modeled as ad valorem tax rates on purchases of appropriate products or factors.[10]

The structure of production is displayed in the bottom half of Figure 1. Each industry determines its use of factors in a sequence of stages, through a nested CES production function. The first two stages are identical to the FSW model. First, producers have fixed requirements of intermediate inputs and value added per unit of output. Second, they can substitute between labor and capital in a CES value added function. For each industry, the elasticity of substitution between labor and capital is chosen by taking an average of available econometric estimates in the literature. The chosen parameters vary from 0.7 to 1.0 across our 18 industries.

We depart from the FSW model by specifying that a marginal cost of capital formula determines the demand for capital in each of the 18 industries, and by adding third and fourth stages of production. These features are more fully described below, but they can be summarized with reference to Figure 1. In the third production stage for each industry, separate cost of capital expressions are used to determine the division between corporate and noncorporate sectors. In the fourth stage, within each sector of each industry, individual cost of capital calculations are used to determine demand for each of 38 different asset types listed below in Table 1.

The user costs for individual asset types are built up from information on statutory tax rates, credit rates, tax lifetimes, and other statutory specifications. These costs also 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 the corporate sector and the noncorporate sector applies to the overall cost 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.

Another generalization from previous studies is that we are not 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 is a different constant elasticity of substitution (CES) composite of the 38 assets. The elasticity of substitution among assets (ε) may be

[9] Components of the 1973 data set from the FSW model are scaled to 1984 levels for use in our model. The industries include: agriculture, forestry and fisheries; mining; crude petroleum and gas; construction; food and tobacco; textiles, apparel and leather; paper and printing; petroleum refining; chemicals and rubber; lumber, furniture, stone, clay and glass; metals and machinery; transportation, communication and utilities; trade; finance and insurance; real estate; and services.

[10] The model also requires that government run a balanced budget. Therefore, when our simulated leveling of capital taxes raises national income, we must offset the resulting revenue gains by cutting some other tax. We do this by lowering income taxes in a lump-sum manner. Because of the small amount of revenue involved, however, the particular method of maintaining equal yield makes little difference.

TABLE 1
COST OF CAPITAL (ρ) AND EFFECTIVE TAX RATE (t)
FOR EACH ASSET UNDER 1984 LAW

	Asset	Corporate Sector ρ	Corporate Sector t	Noncorporate Sector ρ	Noncorporate Sector t
	Equipment				
1	Furniture and fixtures	.041	.019	.037	−.085
2	Fabricated metal products	.041	.025	.038	−.049
3	Engines and turbines	.041	.029	.039	−.025
4	Tractors	.040	.002	.033	−.205
5	Agricultural machinery	.041	.024	.038	−.059
6	Construction machinery	.040	−.001	.033	−.228
7	Mining and oil field machinery	.040	.001	.033	−.209
8	Metalworkihg machinery	.041	.015	.036	−.111
9	Special industry machinery	.041	.022	.037	−.071
10	General industrial equipment	.041	.015	.036	−.111
11	Office and computing machinery	.039	−.036	.026	−.560
12	Service industry machinery	.040	.001	.033	−.209
13	Electrical machinery	.041	.017	.036	−.101
14	Trucks, buses, and trailers	.039	−.029	.027	−.484
15	Autos	.039	−.021	.032	−.267
16	Aircraft	.040	−.005	.032	−.257
17	Ships and boats	.041	.031	.039	−.018
18	Railroad equipment	.041	.033	.040	−.002
19	Instruments	.040	.006	.034	−.172
20	Other equipment	.040	.006	.034	−.172
	Structures				
21	Industrial buildings	.074	.458	.061	.342
22	Commercial buildings	.069	.423	.059	.325
23	Religious buildings	.067	.404	.058	.316
24	Educational buildings	.067	.404	.058	.316
25	Hospital buildings	.069	.419	.059	.323
26	Other nonfarm buildings	.077	.483	.062	.355
27	Farm structures	.069	.420	.059	.324
28	Mining, shafts and wells	.058	.316	.055	.275
29	Other nonbuilding facilities	.071	.437	.060	.332
30	Residential structures	—	—	.065	.386
	Public Utility Structures				
31	Railroads	.061	.339	.055	.273
32	Telephone and telegraph	.064	.370	.055	.273
33	Electric light and power	.063	.364	.055	.273
34	Gas facilities	.057	.297	.053	.243
35	Other public utilities	.058	.314	.052	.237
	Inventories and Land				
36	Inventories	.077	.481	.060	.333
37	Nonresidential land	.081	.504	.064	.371
38	Residential land	—	—	.071	.434

specified exogenously. Capital in each industry is another CES function of composite capital stocks from each sector of that industry. The elasticity of substitution between corporate and noncorporate capital (σ) is also pre-specified. When these elasticities are set to zero, our model reduces approximately to the fixed-

coefficient model in Fullerton and Henderson (1985). When they are unity, the model is similar to those of Gravelle (1981) and Auerbach (1983). This generalization is important because the choices of ε and σ have much bearing on the relative size of different distortions and therefore on the relative attractiveness of alternative reforms.[11]

The following subsection describes our model of the allocation of capital across and within industries. We then review in turn the measurement of user costs, the calculation of tax revenues, and other features of our general equilibrium model.

3.1. *The Use of Capital Assets.* Using a composite cost of capital ($\bar{\rho}_j$), to be discussed below, firms in industry j minimize capital and labor costs per unit of value added. First-order conditions provide demand for labor and capital per unit of value added. In our model, the demand for capital in industry j is actually a demand for composite capital $\bar{K}_j$. In an additional stage, producers use another CES function to decide how much of this capital should be in the corporate sector and how much should be in the noncorporate sector[12]

$$\bar{K}_j = [(\beta_j)^{1/\sigma}(K_j^{nc})^{(\sigma-1)/\sigma} + (1-\beta_j)^{1/\sigma}(K_j^c)^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)}. \tag{1}$$

To use this expression, we need to pre-specify β_j, the weighting parameters for each industry, and σ, the elasticity of substitution between corporate capital (K_j^c) and noncorporate capital (K_j^{nc}).

Using a composite cost of capital in the corporate part of this industry (ρ_j^c) and a composite cost of capital in the noncorporate part of this industry (ρ_j^{nc}), also discussed below, firms minimize capital costs ($K_j^c\rho_j^c + K_j^{nc}\rho_j^{nc}$) per unit of composite capital $\bar{K}_j$. First-order conditions provide demands

$$K_j^c = \frac{(1-\beta_j)(\bar{K}_j\bar{\rho}_j)}{(\rho_j^c)^\sigma[\beta_j(\rho_j^{nc})^{1-\sigma} + (1-\beta_j)(\rho_j^c)^{1-\sigma}]}, \tag{2}$$

and

$$K_j^{nc} = \frac{\beta_j(\bar{K}_j\bar{\rho}_j)}{(\rho_j^{nc})^\sigma[\beta_j(\rho_j^{nc})^{1-\sigma} + (1-\beta_j)(\rho_j^c)^{1-\sigma}]}, \tag{3}$$

[11] We thus show the effects of generalizing from certain simplifying assumptions, but not others. The model still assumes constant returns to scale, perfect competition, no externalities, particular forms of separability in production and consumption, perfect mobility, and no international capital flows. Generalizations in these other directions indicate that results depend fundamentally on the nature of assumptions. Harris (1984), for example, shows that welfare gains from a particular trade policy can be four times larger when a competitive model is generalized to allow imperfect competition. Bhatia (1981) demonstrates considerable sensitivity to assumptions about substitutability between intermediate inputs and primary factors, and Goulder, Shoven, and Whalley (1983) find that some results for a closed economy are reversed when allowance is made for international capital flows.

[12] As discussed further below, little is known about the incorporation decision of firms. The CES functional form is intended only as a representation of capital allocation, and of the possibility that it is responsive to tax differentials. Furthermore, we treat labor as homogeneous in the sense that it can be combined either with corporate or noncorporate capital in each industry. An alternative structure might combine labor and capital in each sector to make separate corporate and noncorporate outputs.

per unit of output. Solving for the Lagrangian multiplier provides the composite cost of capital

$$\bar{\rho}_j = [\beta_j(\rho_j^{nc})^{1-\sigma} + (1-\beta_j)(\rho_j^c)^{1-\sigma}]^{1/(1-\sigma)}. \tag{4}$$

In the last stage, firms in the corporate sector use another CES function to allocate their capital among the 38 assets[13]

$$K_j^c = \left[\sum_{i=1}^{38} (\alpha_{ij}^c)^{1/\varepsilon}(K_{ij}^c)^{(\varepsilon-1)/\varepsilon}\right]^{\varepsilon/(\varepsilon-1)}. \tag{5}$$

Here, we must pre-specify the α_{ij}^c parameters and ε. We use ε as the elasticity of substitution among assets to distinguish it from σ, the elasticity of substitution between corporate and noncorporate capital. The noncorporate sector allocates its capital among the same 38 assets using the same ε. It has an expression identical to (5) except that all c superscripts are replaced by nc superscripts.

Using the individual cost of capital for each of the 38 assets (ρ_i^c), corporate firms minimize capital costs ($\sum_i K_{ij}^c \rho_i^c$) per unit of composite capital K_j^c. First-order conditions provide demands

$$K_{ij}^c = \frac{\alpha_{ij}^c(K_j^c \rho_j^c)}{(\rho_i^c)^\varepsilon[\sum_{i=1}^{38} \alpha_{ij}^c(\rho_i^c)^{1-\varepsilon}]}, \tag{6}$$

per unit of output. Solving for the Lagrangian multiplier from this minimization provides the composite cost of capital

$$\rho_j^c = \left[\sum_{i=1}^{38} \alpha_{ij}^c(\rho_i^c)^{1-\varepsilon}\right]^{1/(1-\varepsilon)}. \tag{7}$$

A similar minimization provides K_{ij}^{nc} and ρ_j^{nc}.

For the real estate industry alone, we have an owner-occupied sector instead of a corporate sector. The β_j weight in (1) still applies to noncorporate (rental) capital with composite price ρ_j^{nc}, but the $(1-\beta_j)$ weight applies to owner-occupied housing with a price ρ^h. The α_{ij} weights in equation (5) are then positive only for residential structures ($i = 30$) and land ($i = 38$).

Having described the behavior of producers, we turn next to the steps needed to obtain parameter values for equations (1) through (7). No study to our knowledge has ever estimated σ, the elasticity of substitution between corporate and noncorporate sectors, or ε, the elasticity of substitution among 38 assets. Using a CES production function, Sato (1967) found a 1.72 elasticity of substitution between equipment and structures. Using a translog function, Berndt and Christensen (1973) found Allen partial elasticities of substitution between equip-

[13] Actually, this is an allocation over the assets that the firm uses in the baseline data. Firms cannot substitute into assets that were not used in the baseline (where initial $K_{ij}^c = 0$). Also, land is one of the 38 assets in equation (5). Any given industry might use more or less land in a new equilibrium, even if land were in fixed total supply. Moreover, the total use of land in the three productive sectors of this model may increase at the expense of vacant or unused land. Finally, we include inventories in equation (5), because some capital must be allocated to stocks of inputs and/or stocks of output in order to provide the final product or service.

ment and structures in the range of 4.4 to 8.4 during their sample period 1929–1969. According to Mackie (1985), these elasticities imply about twice the substitutability of the Cobb-Douglas form.[14] None of these estimates is directly applicable here, however, because our model requires an elasticity of substitution among different kinds of equipment and different kinds of structures.

Because estimates of these parameters are not available, we provide results for alternative specifications. To calibrate the model, we start with the pre-specified σ and ε, as well as data on K_{ij}^{c} and K_{ij}^{nc}, each sector's observed allocation of capital among assets in each industry.[15] As specified below, we also measure the capital costs ρ_i^c, ρ_i^{nc}, and ρ^h that apply to each asset and sector. We then solve backwards for the α_{ij}^c that must have pertained if corporate producers did in fact demand K_{ij}^c according to (6), while facing ρ_i^c from the 1984 law. Combination of equations (6) for ($i = 1, \ldots, 38$) imply that

$$\alpha_{ij}^c = \frac{K_{ij}^c(\rho_i^c)^\varepsilon}{\sum_{i=1}^{38} K_{ij}^c(\rho_i^c)^\varepsilon}, \tag{8}$$

and similarly for the noncorporate sector. This done, we can calculate actual 1984 composite capital K_j^c and similarly K_j^{nc} from (5) and composite prices ρ_j^c and ρ_j^{nc} from (7). Finally, the same strategy is applied in finding β_j as the weighting parameters that must have pertained if industries did in fact demand those composites K_j^c and K_j^{nc} via demand equations (2) and (3)

$$\beta_j = \frac{K_j^{nc}(\rho_j^{nc})^\sigma}{K_j^{nc}(\rho_j^{nc})^\sigma + K_j^c(\rho_j^c)^\sigma}, \tag{9}$$

for each industry ($j = 1, \ldots, 18$).

At this point, it is useful and convenient to review the operation of the model. First, before any equilibrium calculations, we use K_{ij} data for 1984, individual ρ for 1984, and prespecified substitution elasticities to derive α_{ij} and β_j values from equations (8) and (9). We are then prepared for calculating an equilibrium under any tax regime. At each iteration in the search for an equilibrium, we have a new trial value for the real after-tax rate of return s. This s is used to obtain ρ_i^{nc} and ρ_i^c for each asset, as described below. These individual prices can then be used in (7) to obtain ρ_j^c and similarly ρ_j^{nc}, and these composite prices are used in (4) to get the overall composite price $\bar{\rho}_j$ for each industry. This overall price of capital is

[14] Mackie also updated the Berndt and Christensen data and found an even higher elasticity. Finally, the Jorgenson-Yun model includes a translog estimate of this substitution elasticity, but the value is not reported in their paper.

[15] From the July 1985 *Survey of Current Business* we obtain 1981 data for corporate equipment, corporate structures, noncorporate equipment, and noncorporate structures, as well as the total depreciable capital stocks in each of our 18 industries. For each of these 22 capital stock figures, we project to 1984 by using an econometric estimate of the relationship between economic growth and capital formation. This information is then used to update a 4 × 18 matrix of asset uses by industry, using an RAS procedure on an unpublished 1977 matrix from Dale Jorgenson. Finally, we obtain the finer capital allocation by using proportions for all 20 types of equipment and 15 types of structures from the Jorgenson data. These data also form the basis for our 1984 values of land and inventories in each industry.

used to calculate the demand for composite capital $\bar{K}_j$. At this point, we have enough information to calculate K_j^c and K_j^{nc} from (2) and (3). Finally, individual asset demands K_{ij}^c and K_{ij}^{nc} are obtained from (6). Since each sector has 18 industries and 38 assets, capital can be allocated to any of $2 \times 18 \times 38$ locations (although some of these uses are zero). We add the capital demanded in all of these 1,368 possible locations and compare the total demand to the total fixed supply for that period. This comparison tells the algorithm whether to raise or lower the rate of return s, or whether in fact an equilibrium has been found.

When we find an equilibrium under 1984 law, the allocation of capital exactly replicates the observed allocation in the baseline data set. This result is ensured by our construction of the α_{ij} and β_j weighting parameters, but it provides a valuable check on the computational procedures of the model.

3.2. *The Calculation of Marginal Products.* The measurement of investment incentives is taken from Fullerton (1987). That paper derives user costs of capital under the assumption that the perfectly competitive firm considers a new investment in a world with no uncertainty, that it has sufficient tax liability to take associated credits and deductions, and that the firm does not resell the asset. Unlike the measures of Hendershott and Hu (1980), Gravelle (1981), and Auerbach (1983), our measures include both personal and corporate taxes. The costs of capital used by corporations (ρ_i^c), noncorporate businesses (ρ_i^{nc}) and owner-occupied housing (ρ_i^h) are

$$\rho_i^c = \frac{r^c - \pi + \delta_i}{(1-u)}(1 - k_i - uz_i) + w_i - \delta_i, \tag{10}$$

$$\rho_i^{nc} = \frac{r^{nc} - \pi + \delta_i}{(1-\tau_{nc})}(1 - k_i - \tau_{nc} z_i) + w_i - \delta_i, \tag{11}$$

$$\rho^h = r^h - \pi + (1 - \lambda\tau_h)w_h, \tag{12}$$

for ($i = 1, \ldots, 38$). The appropriately-superscripted r is the discount rate for each sector, shown below to depend upon personal taxes. In these formulas, π is the expected inflation rate (assumed equal across sectors), u is the statutory corporate income tax rate, τ_{nc} is the noncorporate entrepreneur's marginal tax rate, τ_h is the homeowner's personal marginal tax rate, and λ is the fraction of property taxes that is deducted by the homeowner. For asset-specific parameters, δ_i is the economic depreciation rate, k_i is the investment tax credit rate, z_i is the present value of depreciation allowances per dollar of investment, and w_i is the property tax rate. Parameter values are described in the Appendix.

To compute the rate of discount for each sector, we first assume that individuals hold debt and equity issued by all three sectors, and that they arbitrage away any differences in net rates of return. If i is the nominal interest rate and τ_d is the debtholders' personal marginal rate, then the net real return to holding debt is

$$s = i(1 - \tau_d) - \pi. \tag{13}$$

We start with an assumption that $s = .04$ in the benchmark, and we calculate i for all sectors from equation (13) as $(s + \pi)/(1 - \tau_d)$.

The computation of discount rates then involves examining separately each sector and each source of finance (debt, retained earnings, and new share issues). We assume that the financing decision is exogenous, and that debt-equity ratios are the same for all industries and sectors (see the Appendix). An investment financed by debt must earn the net-of-corporate-tax interest rate: $r = i(1 - u)$. For an investment financed by retained earnings, the resulting share appreciation is taxed at the accrued personal capital gains rate τ_{re}, and the individual's nominal net return must match $i(1 - \tau_d)$ because of the arbitrage assumption. Thus the nominal net-of-corporate-tax return r must be such that $r(1 - \tau_{re}) = i(1 - \tau_d)$. The requisite discount rate for retained earnings is thus $r = i(1 - \tau_d)/(1 - \tau_{re})$. For an investment financed by new shares, each dollar of after-corporate-tax return could be distributed as a dollar of dividends that would be taxed at the personal rate τ_{ns}. Thus new shares must earn an r such that $r(1 - \tau_{ns}) = i(1 - \tau_d)$. The corporation's single discount rate is a weighted average of these three discount rates

$$r^c = c_d[i(1 - u)] + c_{re}\left[\frac{i(1 - \tau_d)}{(1 - \tau_{re})}\right] + c_{ns}\left[\frac{i(1 - \tau_d)}{(1 - \tau_{ns})}\right], \tag{14}$$

where c_d, c_{re}, and c_{ns} are proportions of investment financed by debt, retained earnings, and new shares, respectively.

In the noncorporate sector, recall that τ_{nc} represents the marginal tax rate of entrepreneurs. Then the noncorporate firm's debt costs $i(1 - \tau_{nc})$, and its equity must earn $i(1 - \tau_d)$ after taxes, because of individual arbitrage. Its overall discount rate is thus

$$r^{nc} = n_d[i(1 - \tau_{nc})] + n_e[i(1 - \tau_d)], \tag{15}$$

where n_d and n_e represent the shares financed by debt and equity, respectively. For homeowners, τ_h is the marginal tax rate, and a similar logic provides the discount rate

$$r^h = h_d[i(1 - \tau_h)] + h_e[i(1 - \tau_d)]. \tag{16}$$

The parameters h_d and h_e are the respective debt and equity shares. Once s and π are specified, the model calculates i from (13), the discount rates from (14) through (16), and the ρ from (10) through (12). The effective tax rate (t) for any asset is $(\rho - s)/\rho$.[16]

[16] If individuals earn the same rate of return net of all taxes from debt and equity, then the firm must earn a higher marginal product on a project financed by equity than on the same project financed by debt. In a perfect certainty context, this can be justified only if for some reason firms must use a given mix of finance. Here, we do not model the role of uncertainty or institutional restrictions that influence financing choices. We take these choices to be exogenous. An alternative assumption would be that firms arbitrage between debt and equity, such that individuals then earn different after-tax rates of return. Firm arbitrage is explored in Fullerton and Henderson (1984).

A final modeling issue concerns the calculation of revenues from capital taxation. The FSW model computes tax revenues in each industry by adding up the payments of corporate, personal, and property taxes. These tax payments are divided by income from capital in that industry to obtain an average tax rate that is also used to measure capital allocation incentives at the margin. Our model, by constrast, starts with an explicitly marginal approach to investment. Since the benchmark is also assumed to be an equilibrium, we use the cost of capital to measure tax revenue in each industry ($j = 1, \ldots, 18$)

$$T_j = \sum_{i=1}^{38} [(\rho_{ij}^c - s)K_{ij}^c + (\rho_{ij}^{nc} - s)K_{ij}^{nc} + (\rho^h - s)K^h]. \tag{17}$$

Here, ρ_{ij} is the before-tax rate of return (or user cost) and K_{ij} is the dollar value of the stock of asset i used in industry j. As before, the superscripts c, nc, and h refer to the corporate, noncorporate, and owner-occupied housing sectors, respectively. The parameter s remains the after-tax rate of return, assumed equal for all uses of capital. The value of T calculated in (17) is not a more accurate measure of revenues than exists in the FSW model, but it is consistent with our modeling of marginal investment incentives with no lump-sum taxes on capital.

4. THE IMPORTANCE OF DIFFERENT DISTORTIONS

4.1. *Disparities in the Cost of Capital.* Table 1 presents the costs of capital (ρ) and effective tax rates (t) under 1984 law for each asset in each sector. A glance at the column for the corporate sector reveals the nature of interasset distortions. Effective rates for equipment are near zero, ranging from $-.036$ (for office and computing machinery) to $+.033$ (for railroad equipment). Effective taxation of structures is much higher, since these do not qualify for the investment tax credit and since depreciation allowances are less generous. These rates lie between .316 and .483. Tax rates for public utility property are generally somewhat lower than those for other structures, since they do receive an investment tax credit. Finally, tax rates for inventories and land are above 48 percent. These assets do not receive special tax incentives (other than the subsidy to corporate debt, which is common to all assets). The noncorporate business sector exhibits similar interasset variations.

Intersectoral tax differences may be observed by comparing entries across any row of Table 1. For each asset, the effective tax rate (and the user cost) are higher in the corporate sector than in the noncorporate sector. The tax rate differentials are between 4 and 52 percentage points.

The intersectoral and interasset distortions can also be observed in Table 2, which aggregates and summarizes the data for the corporate, noncorporate business, and owner-occupied housing sectors. The overall tax rate in the noncorporate sector, 34.7 percent, is only 2.5 percentage points below that in the corporate sector. This aggregate difference is less than might be expected from Table 1. The reason for this relatively small difference is that the noncorporate

sector tends to use a higher proportion of high-taxed assets, such as land.[17] Table 2 does point to a larger gap, however, between the taxation of business capital and the taxation of household capital. As a result of local property taxes, owner-occupied housing is shown to be taxed at a 23.2 percent rate. However, this is still 11.5 points below the rate in the noncorporate business sector and 14 points below the rate in the corporate sector.

Overall, relative to our assumed 4 percent net-of-all-tax return, the 6 percent economy-wide cost of capital implies a 33.1 percent total effective tax rate. The standard deviation in the cost of capital is 1.2 points, weighted by the amount of capital of each type in each sector.

4.2. *General Equilibrium Analysis of Tax Equalization.* Harberger's model had only two sectors, and his noncorporate sector included owner-occupied housing. Our model does not have the same aggregation, so we offer several simulations for comparison. We first examine the misallocation of capital between the corporate and noncorporate business sectors. We then add owner-occupied housing as a third sector to measure total intersectoral distortions. Next, we isolate interasset distortions by themselves. Each of these simulations partially removes differences among industries. When we eliminate all intersectoral differences and interasset differences, the calculations necessarily also eliminate industry differences, since these were based totally on different compositions of assets and sectors.

Corporate and Noncorporate Business Sectors. When we remove distortions between the two business sectors, we preserve the differences among assets within each sector.[18] Specifically, for each of the 36 nonresidential assets listed in Table 1, we equalize the tax treatment across the two sectors by assigning to that asset the average cost of capital for corporate and noncorporate uses.

This simulation eliminates intersectoral differences for each asset, but it does not equalize the two weighted-average user costs because the two sectors use different mixes of assets. The first column of Table 2 shows that the costs of capital start at .064 in the corporate sector and .061 in the noncorporate sector. This simulation is not shown in Table 2, but the new weighted average user costs are .057 for the corporate sector and .064 for the noncorporate sector.[19]

[17] At high rates of inflation, Henderson (1985) shows that the corporate sector rate may actually fall significantly below the noncorporate sector rate, because the subsidy to corporate debt finance rises with inflation. On the other hand, if the calculation assumes that firms use the observed FIFO-LIFO mix, rather than the cost-minimizing mix, then the corporate rate rises significantly above the noncorporate rate at high inflation.

[18] These adjustments do not correspond to a particular manipulation of statutory tax parameters in equations (10)–(12). Instead, we change ρ directly in a conceptual experiment similar to Harberger's original removal of the surtax in the corporate sector.

[19] These differences reflect the relatively high use of high-taxed assets in the noncorporate sector. While our standard simulations define sectoral differences asset by asset, we have performed alternative simulations that define sectoral differences by the weighted average costs of capital in each sector. For example, the alternative version of this case would lower all the costs of capital in the corporate sector and raise all costs of capital in the noncorporate sector so that they averaged .0625 in both sectors. However, this alternative does not necessarily give any one asset the same user cost in the two sectors. The alternative definition of sectoral differences yields some differences in the numerical simulation results, but it does not change our qualitative findings.

TABLE 2
CAPITAL COSTS (ρ) AND TAX RATES (t) FOR AGGREGATE ASSETS IN EACH SECTOR

	1984 Law		Equal sector tax rates		Equal asset tax rates	
	ρ	t	ρ	t	ρ	t
Corporate sector						
Equipment	.040	.010	.037	−.083	.067	.399
Nonresidential structures	.069	.423	.063	.366		
Public utility structures	.061	.348	.057	.297		
Inventories	.077	.481	.067	.402		
Land	.081	.504	.070	.432		
Total	.064	.372	.057	.295		
Noncorporate business sector						
Equipment	.034	−.181	.036	−.102	.054	.252
Nonresidential structures	.059	.322	.063	.362		
Public utility structures	.055	.267	.057	.299		
Inventories	.060	.334	.067	.402		
Nonresidential land	.064	.371	.070	.432		
Residential structures	.065	.386	.057	.302	.070	.425
Residential land	.071	.434	.060	.330		
Total	.061	.347	.064	.378	.057	.295
Owner-occupied housing	.052	.232	.058	.312	.054	.265
Average overall cost of capital	.060		.060		.060	
Standard deviation	.012		.010		.007	
Average overall tax rate	.331		.331		.331	

In order to concentrate on the allocation of capital across sectors in our simulations, and to compare our results with the previous literature, we adopt the common assumption that asset demands are Cobb-Douglas ($\varepsilon = 1$).[20] The efficiency gain in this case should be related to the value of σ, which measures the responsiveness of intersectoral capital allocation to differentials in user cost. If firms readily change their corporate status in response to changes in tax differentials, then σ is high and intersectoral distortions may be high. On the other hand, it may be that the corporate-noncorporate allocation is influenced heavily by other factors. For example, Ebrill and Hartman (1983) posit that firms tend to incorporate when they reach a size that requires them to have access to national financial markets. If this is the case, then σ may be small and sector tax equalization may result in little welfare gain.

In the case where both ε and σ are one, removal of this intersectoral distortion provides a welfare gain that is .007 percent of expanded national income. There is no configuration of elasticity parameters that can make this welfare effect anything other than tiny in comparison to the .5 percent of national income found by

[20] Our production functions are defined in terms of net output, so we use the cost of capital net of depreciation. As a consequence, these results are not strictly comparable to those from other models with production of gross output and capital costs gross of depreciation. For a given pair of σ and ε, the use of net production implies greater sensitivity of capital allocation.

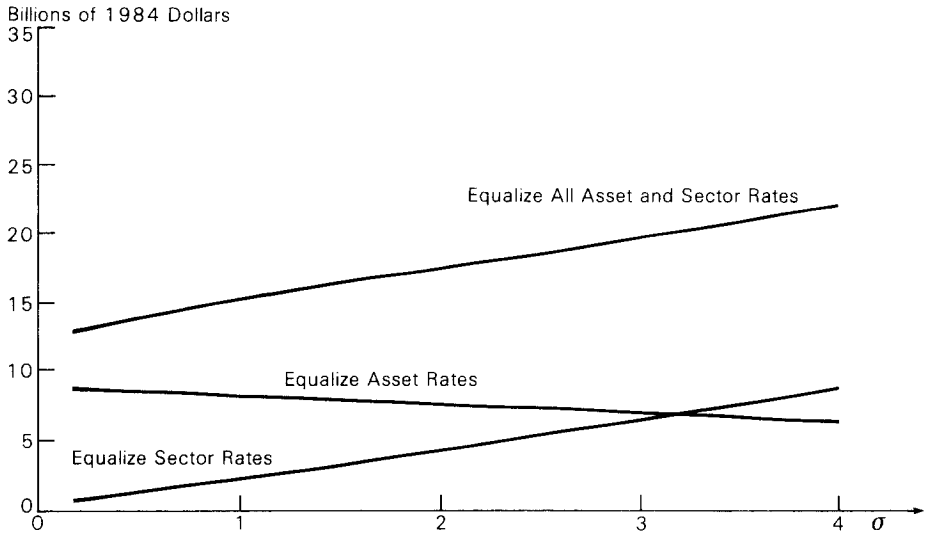


FIGURE 2

EFFICIENCY GAINS FROM ASSET AND SECTOR EQUALIZATION AS σ VARIES ($\varepsilon = 1$)

Harberger. The reason, of course, is that marginal effective tax rates are very similar in the two sectors, where Harberger's average effective tax rates differed more substantially. Two key elements account for the small size of the surtax in the corporate sector. First, debt-financed corporate investments receive a subsidy from the fact that the tax rate at which corporations deduct interest payments is substantially above the marginal rate of the average interest recipient. See the Appendix parameters and Fullerton (1987). Second, personal income taxes on corporate dividends affect investment only for the small fraction financed by new shares. This result is consistent with the "new view" of King (1977), Auerbach (1979), and Bradford (1981). To simulate the "old view" that dividend taxes are important for investment incentives, we later raise the fraction of new investment financed by new shares.

Business and Housing Sectors. The Harberger analysis can be extended to distortions between the business sector and the owner-occupied housing sector. In this model, we can eliminate all of these intersectoral distortions. As indicated in the middle two columns of Table 2, we equalize the tax cost of any given asset wherever it is used. Here, however, we provide more sensitivity analysis.

Intersectoral distortions are expected to vary with the sectoral substitution elasticity. Figure 2 shows the welfare gains from sector tax equalization as σ varies from 0.2 to 4.0, with ε held constant at 1. The gains range from \$0.8 to \$8.4 billion (1984 dollars). As a proportion of expanded national income,[21] these annual gains are between 0.02 and 0.18 percent.

These welfare gains are still fairly small because they do not address a major

[21] Expanded national income includes the value of leisure time, and in the baseline is about 135 percent of national income.

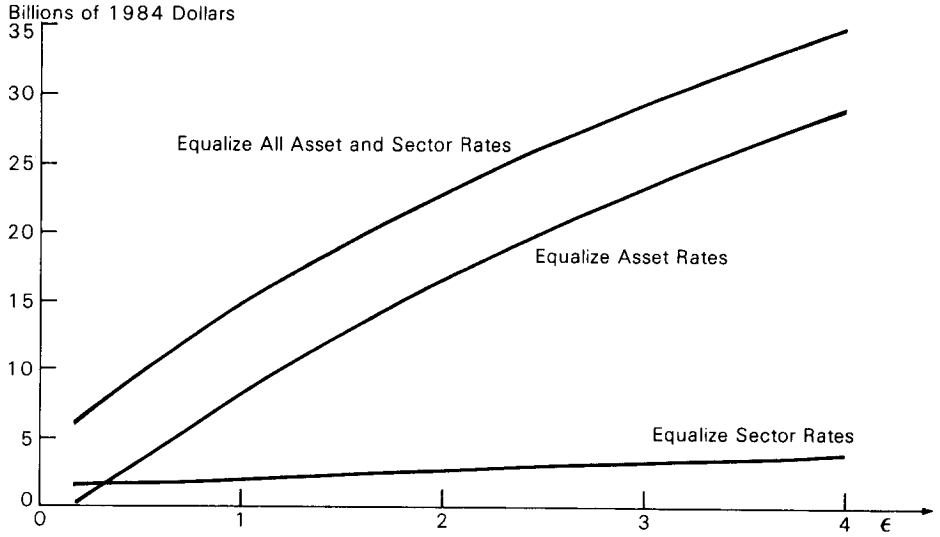


FIGURE 3

EFFICIENCY GAINS FROM ASSET AND SECTOR EQUALIZATION AS ε VARIES ($\sigma = 1$)

source of the economy-wide disparities in the taxation of income from capital. As shown in Table 2, equalization of sector tax rates would lower the standard deviation of user costs only from 1.2 percentage points to 1.0 point.

Relative Treatment of Assets. To isolate interasset distortions, we perform an experiment where we preserve sectoral differences in the cost of capital but equalize the cost of capital for assets within each sector. Operationally, we first assign all assets in the corporate sector a capital cost of .064, the average for that sector. Then nonresidential assets in the noncorporate sector are all assigned the cost of capital that reflects the current weighted average difference between the noncorporate and corporate sectors. Residential assets in the noncorporate sector receive a similar adjustment relative to owner-occupied housing.[22] Finally, the resulting capital costs are all scaled to reproduce the original 6 percent economy-wide cost of capital. The last two columns of Table 2 show these capital costs for the general equilibrium calculations. For sensitivity analysis in these simulations, we vary ε, the asset substitution parameter, from 0.2 to 4.0 while holding σ, the sector substitution parameter, at one. As indicated in Figure 3, the gains range from \$0.4 to \$28.5 billion (1984 dollars), or from 0.01 to 0.62 percent of expanded national income.[23]

[22] An alternative concept of asset equalization would assign the same cost of capital to all assets in the noncorporate sector. In that case, however, we found that the cost of noncorporate residential assets would be reduced significantly toward the cost of owner-occupied housing, effectively introducing unintended intersectoral equalization. Because our reported calculations retain some disparities in the cost of capital for different assets, the welfare gains from asset equalization could be biased downward.

[23] When $\varepsilon = 1$, our parameters are similar to those in Gravelle (1981) and Auerbach (1983). Welfare gains, however, are 0.18 percent of expanded national income, somewhat larger than those authors found for asset equalization within the corporate sector alone.

Comparisons. Efficiency gains from asset tax equalization are generally larger than those from sector tax equalization in our model. Some intuition for this result is provided in Table 2, where the weighted standard deviation of capital costs is 0.7 percent for asset equalization, compared to 1.0 percent for sector tax equalization. The simulations confirm that for a wide range of substitution elasticities in our model, unequal taxation of assets contributes more to tax distortions than does unequal taxation of sectors.

This finding is reversed only if the elasticity of asset substitution is very low, or if the elasticity of sector substitution is very high. When $\sigma = 1$, Figure 3 shows that the elasticity of asset substitution must be below 0.4 for the gains from eliminating sectoral differences to be higher than the gains from eliminating asset differences. Yet previously-cited econometric studies indicate a high elasticity of substitution between equipment and structures.

As shown in Figure 2, where $\varepsilon = 1$, disparities in asset tax rates create more distortion in this model than disparities in sector tax rates unless σ is at least 3.0. If ε is actually higher than 1, the threshold value of σ would be even greater. The possibility that capital moves readily across sectors in response to tax differentials is a matter on which there is little evidence, but the hypothesis of Ebrill and Hartman at least suggests that there may be important factors apart from taxation that influence this decision.

Also, different production nesting structures could affect the results. If there were particular cross-price elasticities and a constraint on the taxation of one asset such as housing, for example, Feldstein (1985) points out that second-best considerations may require nonuniform taxation of other assets. In our model, however, all corporate assets in one nest are equal substitutes for all noncorporate assets or housing in other nests. We have no evidence on cross-price elasticities and no reason to believe that corporations would change their asset mix in response to a change in the relative prices of noncorporate assets.

Figures 2 and 3 also show the efficiency gains from removing all differentials in tax rates among all uses of capital. In these simulations, the cost of capital is set to .060 for all assets and all sectors. It is therefore equal for all industries as well. Thus the standard deviation of ρ is zero. The corresponding tax rate is 33.1 percent. Under the cases shown, the highest potential gain from comprehensive capital tax equalization is \$34.4 billion, in the simulation where $\varepsilon = 4$ and $\sigma = 1$. This is 0.74 percent of expanded national income. Since the welfare gains from tax equalization vary substantially with assumptions about elasticities, our results indicate the importance of econometric evidence on σ and ε. Such evidence, however, is not likely to reverse our results on the ranking of interasset and intersectoral distortions.

An issue that does affect our results significantly is the importance of dividend taxes. In the logic of Section 3.2 above, personal taxes on dividends do not affect the rate of return to an investment financed by retained earnings, because they affect equally the later increase in dividends in the numerator and the currently foregone dividends in the denominator. Personal taxes on dividends necessarily affect incentives only for the fraction of corporate investment financed by new

shares. Because new shares are used to finance only 5 percent of investment, however, dividend taxes play a small role as in the "new view" of King (1977), Auerbach (1979), and Bradford (1981). Auerbach (1984) found evidence in support of the "new view," while Poterba and Summers (1983) rejected it. In our model, the "old view" can be represented by the idea that marginal finance is different from existing finance.

If retained earnings are exhausted, then the equity portion of marginal corporate investment must (in the extreme) all be financed through new share issues. The results for capital costs are dramatic. Under 1984 law, the cost of capital in the corporate sector becomes .093, about 50 percent higher than in the noncorporate sector. Welfare gains from eliminating all differentials in taxes are two to three times higher than under the "new view." The distortions caused by asset differences account for only about half the total, even in the strong case where $\varepsilon = 4$. This sensitivity of results further emphasizes the importance of econometric measurement, not just of elasticity parameters, but of how dividend taxes affect marginal investment.

4.3. *The Importance of Capital Tax Disparities.* One surprising result of these simulations is that equalization of capital tax rates does not seem to generate a very large increase in economic welfare. Harberger's simple two-sector model considered only a subset of distortions in capital taxation, and it generated a welfare gain of .5 percent of GNP. Our study includes more distortions and more capital allocation decisions, and it indicates that the welfare cost of all capital misallocations is unlikely to exceed even this low percentage.

The major explanation for this contrast is that the average effective tax rates used by Harberger varied more between the sectors than do the marginal effective tax rates used here. Similarly, the average rates used in the Fullerton-Shoven-Whalley model vary more among the 18 industries than do the marginal rates used here.[24] Fullerton (1984) describes many differences between these two types of measures, noting elements of lump sum taxes in the average effective rates that would not affect incentives at the margin. The Harberger or FSW calculations may therefore overstate the welfare gain from equalizing rates.

Direct comparison of the different models does not isolate the effect of using marginal instead of average rates, because of other differences between the models. We need to compare marginal and average rates within a single model. We cannot substitute average effective tax rates into our model, because rates for the 18 industries are built up from rates by asset and sector. Instead, we can substitute marginal effective tax rates from our model into the 18 industry rates of the FSW model. When that model starts with marginal effective tax rates for 18 industries, the welfare gains from equalizing tax rates is only one-fifth of the

[24] The industry tax rates in the marginal rate model range from .274 for services to .429 for transportation equipment. In the average rate model, they range from .315 for petroleum refining to .776 for food and tobacco, apart from an outlier rate of .959 for transportation equipment.

gain from equalizing average effective rates.[25] This simulation confirms that the potentially larger efficiency gains from capital tax equalization in our more comprehensive model do not materialize because of our simultaneous introduction of marginal tax rate measures.

There are other possible reasons that our welfare effects may seem small. In particular, we have omitted some distortions in the taxation of capital. First, we have omitted intangible capital such as advertising goodwill and R&D knowledge. Investments in these assets are expensed, so their inclusion might create additional differentials in taxation across assets. Second, the heavier taxation of income from equity-financed capital may cause firms to use more leverage than is socially desirable. Our use of fixed debt/equity ratios precludes the measurement of distortions in financial decisions. Third, we assume perfect certainty and thus omit distortions in the allocation of risk-bearing. Finally, of course, this paper abstracts from intertemporal distortions caused by the overall taxation of capital. Estimates of the welfare cost of this distortion vary widely,[26] but they typically exceed the welfare costs of interasset and intersectoral distortions measured here. However, Section 2 points out that our 33 percent overall marginal effective tax rate is substantially lower than the average effective tax rates used elsewhere, especially the 70 percent average effective tax rate of Feldstein, Dicks-Mireaux, and Poterba (1983). This lower overall tax rate could generate lower intertemporal welfare effects, depending on intertemporal substitution elasticities.

Other considerations might reduce still further the distortions contained in our paper. It has been hypothesized, by Bosworth (1985) for example, that structures and equipment are financed by different mixes of debt and equity. Because structures are better collateral for loans, it may be relatively easier to use debt to finance construction of structures than to finance purchases of equipment. If so, then the effective tax rates for corporate equipment and structures might be more similar than they appear in our study.[27] Evidence in Auerbach (1985), however, does not support the hypothesis that corporate firms with high use of structures tend to be more highly leveraged, all else equal. Furthermore, Gravelle (1985)

[25] According to the simulation cited in Section 2, equalization of average tax rates in the FSW model results in an annual welfare gain of $10.9 billion (1973 dollars). We use the FSW model with its average tax rates as the baseline, and we simulate the effects of introducing the rates from our marginal model (scaled up so that their average is equal to that of the average rates). With this simulation, the efficiency gain is $8.9 billion (1973 dollars). Thus about four-fifths of the welfare cost in the FSW model is associated with the use of average rather than marginal rates.

[26] The welfare cost of intertemporal distortions has been placed at around 3 percent of national income by Boskin (1978) and Feldstein (1978) and at 5 to 12 percent of income by Summers (1981). In the model of Auerbach, Kotlikoff, and Skinner (1983), intercohort redistributions imply that long run steady state welfare rises by 6 percent if capital taxes are replaced by a consumption tax but falls by 4 percent if replaced by a wage tax. In the infinite-life model of Jorgenson and Yun (1986), the replacement of capital taxes provides potential gains that are about 8 percent of income in the baseline. Even Fullerton, Shoven, and Whalley (1983) find that removing capital taxes raises incomes by 1.0 to 2.5 percent.

[27] If debt finance reduced the effective tax on structures far below that on equipment, then interasset distortions may remain large.

found that the use of debt in the rental housing market is similar to what is observed for corporate capital in general.

5. CONCLUSION

The model in this paper builds upon previous ones by further disaggregation of assets, sectors, and industries, by the use of marginal effective tax rates, and by the calculation of full general equilibrium responses to counterfactual simulations. The model is used here to investigate the importance of tax distortions in the allocation of real capital among assets, sectors, and industries. We find that distortions between the corporate sector and the noncorporate sector are much smaller than those in the average effective tax rate model of Harberger. Distortions among industries are considerably smaller than those in the average effective tax rate model of Fullerton, Shoven, and Whalley. In contrast, distortions among assets tend to dominate these other misallocations.

The combined cost of distortions in the allocation of real capital is tens of billions of dollars annually, but this is still less than one percent of national income. We offer a number of interpretations. First, one might conclude that tax policy can be altered to reduce this deadweight loss still further. Indeed, the Tax Reform Act of 1986 repeals the investment tax credit and removes many elements of the interasset distortions found in this paper. It may exacerbate intersectoral distortions, but these were found to be small. The net effect is positive in a model similar to this one, as confirmed by simulations in Fullerton, Henderson, and Mackie (1987). Second, one might conclude that efficiency effects are unimportant, especially with this recent reduction of interasset distortions, and that research should now proceed to other areas. Third, one might conclude that the standard competitive framework determines the nature of the results and that larger effects might be found in an entirely different type of model. Finally, one might conclude that the study of tax distortions should proceed to other areas. Additional welfare costs might arise from distortions in savings decisions, the allocation of risk-bearing, portfolio choices, or financial decisions of firms.

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APPENDIX

As discussed in Fullerton (1987), the parameters for calculation of capital costs are: $u = .495$ to account for both federal and state corporate taxes; $k = .10$ for equipment and public utility property, except $k = .06$ for automobiles; $\tau_h = .300$, $\tau_{nc} = .245$, $\tau_d = .231$, $\tau_{ns} = .292$, and $\lambda = .7$. These personal rates account for federal and state taxes, and for the fraction of investment income received through banks, insurance companies, and tax-exempt institutions. Rates of economic depreciation (δ) are from Hulten and Wykoff (1981). To calculate z, we use the sector's nominal discount rate and the most accelerated options available

under current law. Tax minimizing behavior also precludes the use of FIFO inventory accounting. Rates of property tax (w) range from .00768 for equipment and inventories to .01837 for residential land and structures. We derive $i = .104$, using the above value of τ_d and the assumptions $s = .04$ and $\pi = .04$. For discount rates by sector, we use financing weights given by $c_d = .337$, $c_{re} = .614$, and $c_{ns} = .049$. These weights are derived from the debt, retained earnings and new shares that are used to finance existing investment, and they are assumed to apply to marginal investment. Also, $n_d = .337$, $n_e = .663$, $h_d = .337$, and $h_e = .663$. The similarity of debt/equity ratios in the three sectors is explained in Fullerton and Henderson (1984), while no source provides market value of outstanding debt and equity on specific assets.

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