CORPORATE TAX INCIDENCE AND INEFFICIENCY WHEN CORPORATE AND NONCORPORATE GOODS ARE CLOSE SUBSTITUTES

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An important deficiency in Harberger's [1962] model of corporate income taxation is its inability to consider both corporate and noncorporate production of the same good. Within-industry substitution has potentially major implications for both the excess burden and incidence of the corporate tax.

We analyze this within-industry substitution using a model in which each industry/sector contains corporate and noncorporate firms (with identical production functions) which produce goods that are close substitutes. The scope for considerable within-industry substitution of noncorporate for corporate capital leads to a very much larger excess burden than that in the Harberger model.

I. INTRODUCTION

In 1992, the Treasury Department released a study of corporate tax integration stressing the potential welfare gains of reducing or eliminating the differentials between taxation of capital in the corporate and noncorporate sector. While this study was not accompanied by a specific tax recommendation, such proposals have been made in the past and are likely to be made in the future. For example, the 1984 Treasury proposals for tax reform included a partial dividend deduction, and corporate tax integration was considered by the Carter administration.

Until recently, the standard model used to study the corporate tax was the Harberger [1962] model. An important deficiency in this model is its inability to consider both corporate and noncorporate production of the same good. Empirical applications of the Harberger Model assume all firms producing a particular good (or collection of goods) face the same tax on capital, namely the average tax on capital of firms actually producing the good (collection of goods) in question. This procedure accommodates differential taxation of capital used in the production of different goods (collections of goods). But it totally ignores the differential taxation of capital of corporate and noncorporate firms producing the same good (collection of goods). Hence, the Harberger approach precludes analysis of within-industry substitution of noncorporate for corporate production in response to the corporate income tax. Such within-industry substitution has potentially major implications for both the excess burden and incidence of the corporate tax.

The first rigorous critique of the Harberger model was that of Ebrill and Hartman [1982], who point out that in the Harberger Model corporate firms cannot compete with noncorporate firms in producing the same good in the presence of

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the corporate income tax. The common finesse in empirical work using the Harberger Model is to assume that all firms in a sector are identical and face the average rate of taxation in the industry. Since some corporate firms operate in the "noncorporate sector" and some noncorporate firms operate in the "corporate" sector, the difference between these average tax wedges will typically be smaller than the actual corporate tax wedge. In the extreme case where both industries are equally corporate intensive, the tax wedge would be zero even though a corporate tax exists and corporate firms within an industry face a tax not faced by noncorporate firms. Secondly, this approach does not allow within-industry substitution of capital between corporate and noncorporate firms.

In a numerical application of his model, Harberger [1966] classifies industries into a "noncorporate sector" composed of housing, agriculture and oil and gas that was subject to relatively low taxes and a "corporate sector" composed of the remaining industries that was subject to relatively high taxes. Gravelle and Kotlikoff [1989] show that these two aggregated sectors are characterized by a mix of corporate and noncorporate production, as well as a significant change in shares over time. In the so-called "noncorporate sector," 6 percent of output in 1957 and 20 percent of output in 1982 was produced by corporate firms. (Oil and gas, although classified in the "noncorporate" sector by Harberger, was, and is, primarily corporate; it is, however, subject to low tax burdens because of very generous tax breaks.) Similarly, in the so-called "corporate" sector, 24 percent of output in 1957 and 14 percent of output in 1982 was produced by noncorporate firms.

Two recent responses to this critique of the Harberger model are Gravelle and Kotlikoff [1989] and Fullerton and Henderson [1989]. Fullerton and Henderson simply introduce two capital inputs—corporate capital and noncorporate capital—in the production function of each industry. These capital inputs, along with labor, are substitutable. While this approach introduces some substitutability between corporate and noncorporate capital, it is an ad hoc approach and does not model the separate production in each sector that actually occurs.

The Gravelle and Kotlikoff [1989] model allows separate production in both the corporate and noncorporate sectors of each industry. In this model, denoted the Mutual Production Model (MPM), corporate and noncorporate firms produce identical goods, with the same production function. Agents in this model differ in their entrepreneurial abilities. In equilibrium the more able entrepreneurs compete with the corporations, and the corporate tax induces less able entrepreneurs to enter into production.[1] Compared with the Harberger Model, the Mutual Production Model predicts a substantially larger excess burden from corporate taxation.

This paper specifies a Harberger-type model, but one in which each industry/sector contains corporate and noncorporate firms with identical constant-returns-to-scale production functions. Gravelle and Kotlikoff report that corporate and noncorporate firms co-exist in all two-digit industries and in all three-digit industries for which data are available. Thus corporate and noncorporate firms within an industry are assumed to pro-

1. The Mutual Production Model has two goods each of which are produced with labor, capital, and managerial input (entrepreneurial input in the case of noncorporate firms). Agents differ in their level of entrepreneurial skill. Any agent can choose to become an entrepreneur, a worker, or a corporate manager. Those agents with the most entrepreneurial skill choose, in equilibrium, to become entrepreneurs and establish their own proprietorships. Proprietorships may be quite small. In contrast, corporations must operate at greater than a minimum scale. This minimum scale requirement ensures that the corporate sector will not disappear in the presence of the corporate income tax.

duce goods which are close, but not perfect, substitutes in demand. We label this paper's model the Differentiated Product Model (DPM). When the corporate tax is imposed, capital is released from corporate firms and is absorbed by noncorporate firms many/most/all of which are producing in the same industry sector. This treatment does not dilute the corporate tax wedge, regardless of demand elasticities used. As the substitutability in demand of the noncorporate for the corporate good increases, so does the excess burden of the tax per dollar of revenue. As in Gravelle and Kotlikoff [1989], we illustrate the importance of the modifications by numerical simulation based on the 1957 data used by Shoven [1976]. We compare the results of this model with the Harberger Model as well as the Mutual Production Model.

Our simulations indicate that the excess burden from corporate taxation can be quite large in the Differential Product Model. For example, using Harberger's original 1957 data and assuming unitary substitution elasticities in production and in inter-sector demand, but substitution elasticities of thirty in intra-sector demand, the excess burden of the corporate income tax is 102 percent of tax revenue. This figure is quite close to the 123 percent figure in the Mutual Production Model for the case of unitary substitution elasticities in production and inter-industry demand.[2] Both numbers are considerably larger than the 8 percent excess burden figure that arises in the traditional Harberger Model with unitary substitution elasticities.

The Differentiated Product Model's predicted incidence from the corporate tax is similar to that of the Harberger Model. To illustrate, if elasticities of substitution in industry 1 and 2 are .5, the inter-sector demand elasticity is 1, and the within-sector elasticity is 10, 88 percent of the tax falls on capital. The incidence on capital in the Harberger Model is 82 percent of the tax for production elasticities of .5 and a demand elasticity of 1. In contrast, in the Mutual Production Model the incidence on capital is 141 percent of the tax revenue for production elasticities of .5 and an inter-industry demand elasticity of 1.[3]

The next section, II, presents the model. Section III briefly describes the data used to calibrate the model. Sections IV and V present, respectively, the model's predictions for the excess burden and the incidence of the corporate tax and compare these predictions with those of the Harberger Model and the Mutual Production Model. Section VI concludes the paper.

II. THE MODEL

The Differentiated Production Model has two industries, 1 and 2. In each industry there is a corporate and a noncorporate good. The four goods are denoted C_1, N_1, C_2, N_2, where C_1 and N_1 (C_2 and N_2) are the corporate and noncorporate goods, respectively, in industry 1 (2). While C_1 and N_1 (C_2 and N_2) are not identical goods, they are closer substitutes than, for example, C_1 and C_2, and, hence, are classified as in the same industry. Our notion of closer substitutes is made precise by reference to the model's utility function:

2. The large excess burden in the Mutual Production Model reflects, to some extent, our assumptions concerning the supply elasticity of entrepreneurs. But even if we assume a zero supply elasticity of entrepreneurs, the Mutual Production Model's excess burden is still over nine times larger than that of the Harberger Model for the Cobb-Douglas case.

3. In the Mutual Production Model corporate and noncorporate goods within each industry are perfect substitutes. Hence, the effective intra-industry elasticity of substitution in demand between noncorporate and corporate goods is infinite.

$$(1) \quad U = \Big[a \big(d_1 C_1^{1-1/\eta} + (-d_1) N_1^{(1-1/\eta)}\big)^{(1-1/\varphi)/(1-1/\eta)} + (1-a) \big(d_2 C_2^{(1-1/\eta)} + (1-d_2) N_2^{(1-1/\eta)}\big)^{(1-1/\varphi)/(1-1/\eta)} \Big]^{-1/(1-1/\varphi)}.$$

In equation (1) η is the within-industry elasticity of substitution, while φ is the key determinant of the between-industry elasticity of substitution. The terms a, d_1, and d_2 are share parameters.

While this formulation reflects the structure of output in that it allows for both corporate and noncorporate firms in each industry, it does not confront the question of why corporate products are different from noncorporate products. The most reasonable characterization of this difference has to do with size. Corporate firms tend to be large, often tapping a national equity market for funds, while noncorporate firms tend to be small. Output of large firms might be characterized by reliability, and small firms by adaptability and responsiveness to local preferences. For example, a fast-food chain's menu is relatively unchanged from location to location and from day to day; it offers reliability and certainty. A local restaurant can vary its offerings to suit local tastes and can alter menu and prices more easily. Large retailers may offer a wider range of goods; smaller stores may offer more personal attention. Even goods that are relatively homogeneous, such as crude oil and agricultural products, can be differentiated to consumers if exchange is carried out through contracts with different attributes (e.g., reliability vs. flexibility). Since these goods are close substitutes, however, we would expect the within-sector substitution elasticity to be much larger than the between-sector substitution elasticity.

As is traditional in static models of this kind, workers, capitalists, and the government are assumed to have the same preferences, given by (1). Hence, economy-wide demands for the three goods result from maximizing (1) subject to the economy-wide budget constraint:

$$(2) \quad P_{c1}C_1 + P_{n1}N_1 + P_{c2}C_2 + P_{n2}N_2 = I.$$

The left-hand side of equation (2) is total expenditure on the four goods, while the right-hand side, I, stands for national income, which is taken as the model's numeraire.

Production of each good is governed by a CES production function. The production functions for C_1 and N_1 are identical, and the production functions for C_2 and N_2 are identical. The production functions are expressed as:

$$(3) \quad Q_j = H_i[(1-b_i)L_j^{-\rho_i} + b_i K_j^{-\rho_i}]^{-1/\rho_i}$$

$$\text{for } i=1,2 \text{ and } j=ci, ni.$$

In (3) the terms L_j and K_j refer to labor and capital used in production of good j.

Factor markets are competitive. Hence, the marginal revenue products of labor equal the wage, W, and the net of tax marginal revenue products of capital equal the rental on capital, R. In order to close the model, we add to the first-order conditions for utility and profit maximization and equation (2) the conditions that factor demands equal factor supplies.

Table I contains sixteen equations from the post-tax equilibrium that we use to calibrate the model. In the post-tax equilibrium the wage and rental as well as the prices of the corporate goods are measured in units such that they equal one; hence, equations (4)–(6). Since the noncorporate production functions are identical to the corporate production functions, the prices of the noncorporate goods would also equal one were it not for the presence of the corporate income tax. Equations (7) give the post-tax equilibrium prices of the noncorporate goods.

TABLE I
Post-Tax Equilibrium Equations used to Calibrate the Model

(4)	$R = 1$	$(i = 1,2)$
(5)	$W = 1$	$(i = 1,2)$
(6)	$P_{ci} = 1$	$(i = 1,2)$
(7)	$P_{ni} = \left[(1-\beta_{ci}) + \beta_{ci}(1-t)^{\rho_i/(1+\rho_i)}\right]^{(1+\rho_i)/\rho_i}$	$(i = 1,2)$
(8)	$K_{c1} + K_{c2} + K_{n1} + K_{n2} = \overline{K}$	
(9)	$L_{c1} + L_{c2} + L_{n1} + L_{n2} = \overline{L}$	
(10)	$(K_{ci}/L_{ci}) = [\beta_{ci}(1-t)]/[(1-\beta_{ci})]$	$(i = 1,2)$
(11)	$(K_{ni}/L_{ni}) = [\beta_{ci}(1-t)\rho_i/(1+\rho_i)]/[1-\beta_{ci}]$	$(i = 1,2)$
(12)	$C_i = [K_{ci}]/[(1-t)\beta_{ci}]$	$(i = 1,2)$
(13)	$N_i = [K_{ni}(1-t)^{-\rho_i/(1+\rho_i)} p_{ni}^{-1/(1+\rho_i)}]/[\beta_{ci}]$	$(i = 1,2)$
(14)	$C_1 + P_{n1}N_1 + C_2 + P_{n2}N_2 = I$	
(15)	$(C_i/N_i) = [(d_i)/(1-d_i)]^{\eta} P_{ni}^{\eta}$	
(16)	$(C_1/C_2) = [a/(1-a)]^{\varphi} (d_1/d_2)^{(1/\eta-1)(1-\varphi)}$ $\left[1 + \{[d_1/(1-d_1)]^{\eta} P_{n1}^{(1-\eta)}\}/\{1 + [d_2/(1-d_2)]^{\eta} P_{n2}^{(1-\eta)}\}\right]^{(\eta-\varphi)/(1-\eta)}$	

The terms β_{c1} and β_{c2} are the respective capital income shares in the production of C_1 and C_2.[4] Equations (8) and (9) are general equilibrium conditions requiring, respectively, that total capital and labor demanded equal the total supplies of capital and labor, $\overline{K}$ and $\overline{L}$. Equations (10) through (13) reflect profit maximization by producers. Equation (14) is simply a rewrite of the budget constraint (2). Finally, equations (15) and (16) are combinations of the first-order conditions for utility maximization.

Table II lists the equations of the no-tax equilibrium with which we compare the post-tax equilibrium. Note that in the no-tax equilibrium $P_{c1} = P_{n1} = P_1$ and $P_{c2} = P_{n2} = P_2$.

4. The capital income shares are related to the parameters of the production function through the formula $\beta_{ci} = b_i^{1/(1+\rho_i)} (H_i(1-t))^{-\rho i/(1+\rho i)}$ for $i=1,2$.

TABLE II
Equations of No-Tax Equilibrium

(17)	$K_{c1} + K_{c2} + K_{n1} + K_{n2} = \overline{K}$	
(18)	$L_{c1} + L_{c2} + L_{n1} + L_{n2} = \overline{L}$	
(19)	$P_i = \left[(1-\beta_{ci})w^{\rho_i/(1+\rho_i)} + \beta_{ci}(R(1-t))^{\rho_i/(1+\rho_i)}\right]^{(1+\rho_i)/\rho_i}$	$(i = 1,2)$
(20)	$(K_{ci}/L_{ci}) = (K_{ni}/L_{ni}) = (\beta_{ci}/1-\beta_{ci})(1-t)^{\rho_i/(1+\rho_i)}(R/W)^{-1/(1+\rho_i)}$	$(i = 1,2)$
(21)	$C_i = [K_{ci}/\beta_{ci}](1-t)^{-\rho_i/(1+\rho_i)}(R/P_i)^{-1/(1+\rho_i)}$	$(i = 1,2)$
(22)	$N_i = [K_{ni}/\beta_{ci}](1-t)^{-\rho_i/(1+\rho_i)}(R/P_i)^{-\rho_i/(1+\rho_i)}$	$(i = 1,2)$
(23)	$P_1(C_1 + N_1) + P_2(C_2 + N_2) = I$	
(24)	$(C_i/N_i) = (d_i/1-d_i)^{\eta}$	$(i = 1,2)$
(25)	$(C_1/C_2) = (a/1-a)^{\varphi}(d_1/d_2)^{(1/\eta-1)(1-\varphi)}\left[\{1+[d_1/(1-d_1)]^{\eta}\}/\{1+[d_2/(1-d_2)]^{\eta}\}\right]^{(\eta-\varphi)/(1-\eta)}(P_2/P_1)^{\varphi}$	

The equations in Table II represent sixteen equations in the sixteen unknowns: K_{c1}, K_{c2}, K_{n1}, K_{n2}, L_{c1}, L_{c2}, L_{n1}, L_{n2}, P_1, P_2, C_1, C_2, N_1, N_2, R, and W.

III. CALIBRATION OF THE MODEL

To solve the equations in Table II for the no-tax equilibrium and to compare the results with the observed post-tax equilibrium, we need to specify values for β_{c1}, β_{c2}, σ_1, σ_2, t, d_1, d_2, η, a, φ, K, and L, where $\sigma_i = 1/(1+\rho_i)$ (i=1,2,) is the elasticity of substitution in production in industry i. We consider values of σ_1, and σ_2 of .5, .75, 1, and 2. For the within-industry elasticity of substitution, η, we use values ranging from .5 to 30. For the inter-industry elasticity of substitution, φ, we use values of .5 and 1. The numeraire is national income and is set at $296 billion, the 1957 level of net national income used by Shoven [1976]. Using expenditure as the numeraire (rather than the wage as in the Harberger Model) simplifies the interpretation of incidence. The value of t used is .45, which is the average corporate tax rate for 1957 according to data reported in the *The Economic Report of the President, 1987.*[5]

Shoven's [1976] study also reports capital income shares in the "noncorporate" sector (our industry 1) and the "corporate" sector (our industry 2) of .60 and .20, respectively. To obtain values for β_{c1} and β_{c2} we use the following post-tax relationships:

$$(26)\quad \beta_{ci} = M_i[(K_{ci}/K_i) + (K_{ni}/K_i)(1-t)^{\sigma_i}]/[(K_{ci}/K_i) + (K_{ni}/K_i)(1-t) + M_i(K_{ni}/K_i)[(1-t)^{\sigma_i} - (1-t)]$$

$$\text{for } i = 1,2$$

where M_i is the capital income share in industry i, and K_i is total capital in industry i.[6] Given values of the ratios of capital stocks in equation (26), one can compute values of β_{ci}. To solve for these capital ratios in the 1957 post-tax U.S. economy we use the following relationships:

$$(27)\quad (K_{ci}/K_i) = [t_i(1-t)]/[t(1-t_i)],$$

$$(K_{ni}/K_i) = [t - t_i]/[t(1-t_i)]$$

$$\text{for } i = 1,2$$

where t_i is the average corporate tax rate reported in 1957 in sector i. The specific values, which are determined from Rosenberg's [1969] data, are $t_1 = .014$ and $t_2 = .340$. Equation (27) simply exploits the idea that if the tax is levied only on corporate firms and one observes the average tax rate t_i in sector i, where the average is computed using total sector i capital, one can infer the corporate share of the sector's capital, i.e., the share of the capital that is subject to the tax t.

The calibration of $\bar{K}$ proceeds by first noting that the ratio K_1/K_2 can be computed from (28) given a value for $\theta_1 = (1-\theta_2)$, sector 1's share of total national product. From Shoven's data this value is .15.

$$(28)\quad (K_1/K_2) = [\theta_1 M_1(1-t_1)]/[\theta_2 M_2(1-t_2)].$$

This ratio together with those calculated in (27) fix the post-tax ratios $K_{n1}/\bar{K}$, $K_{n2}/\bar{K}$, $K_{c1}/\bar{K}$, and $K_{c2}/\bar{K}$. These four ratios together with the values of β_{c1}, β_{c2}, t, and I and the assumed substitution elasticities can be used to determine K in the following manner: First, prices for the two noncorporate goods can be determined from equation (7) and then substituted into each sector's version of equation (13). This version of (13) plus (12) express output in terms of capital and other known parameters. These expressions for output are then substituted into equation (14) yielding one equation in the four capital inputs. By substituting into this expression the calculated post-tax ratios of each capital input to $\bar{K}$ we can solve for the value of $\bar{K}$. Given the value for $\bar{K}$, the capital ratios are used to solve for the levels of K_{n1}, K_{n2}, K_{c1}, and K_{c2}. Given these values, each sector's version of (10) and (11) is used to solve for L_{n1}, L_{n2}, L_{c1}, and L_{c2}, and hence, $\bar{L}$, and each sector's version of (12) and (13) can be used to solve for C_1, C_2, N_1, and N_2. Given the output ratios, each sector's version of (15) is used to solve for d_1 and d_2, and equation (16) is used to solve for a.

5. The revenue base for measuring this tax rate is corporate profits plus interest.

6. Equation (26) incorporates the following relationship between corporate and noncorporate capital income shares:

$$\beta_{ni} = \beta_{ci}((1-t)/P_{ni})^{\rho i/(1+\rho i)}.$$

IV. EXCESS BURDEN

Table III expresses the excess burden in the Differentiated Product Model assuming different elasticities of substitution in production and demand. We calculate excess burden as the amount of additional income needed in the post-tax equilibrium to regain the no-tax equilibrium level of utility.[7] The last entry in the first row may be of most interest. This case corresponds to the standard assumption of Cobb-Douglas technologies as well as the Harberger benchmark of a unitary inter-industry demand elasticity. However, the case also involves a very high within-industry elasticity of substitution—a value of thirty. The excess burden in this case exceeds the revenue. The excess burden remains substantial even for smaller values of the within-industry elasticity. For example, it is 19 percent of the tax revenue in the case that all substitution elasticities are unity.

While the excess burden figures are highly sensitive to the within-industry substitution elasticity, they are rather insensitive to production or inter-industry substitution elasticities. In the case that the within-industry substitution elasticity equals 10, the excess burden ranges from 39 to 58 percent of tax revenue for combinations of the production elasticities ranging from .5 to 2 and for values of the inter-industry substitution elasticity of .5 and 1.

These excess burden figures are quite large when compared with those from the Harberger Model. Table IV compares excess burden in the two models as well as that in the Mutual Production Model under the assumption of variable entrepreneurs. Our new model with a very high intrasectoral substitution elasticity ($\eta = 30$) and our earlier model both predict very substantial excess burdens—excess burdens equal to or somewhat larger than the amount of taxes collected.

One reason that the excess burden in the Differentiated Product Model is so much greater than in the Harberger Model involves the size of the distortionary tax rates used in the three analyses. Although the results for the three models rely on the same tax data, including the same tax revenue, the effective distortionary wedges in the Differentiated Product Model and Mutual Production Model are both 82 percent compared to only 50 percent in the Harberger Model. Since excess burden rises roughly with the square of the tax rate, the difference in effective distortionary taxes can, by itself, account for an excess burden in the Differentiated Product and Mutual Production Models that is 2.6 times the Harberger Model's excess burden. Indeed, setting both the intra-sector and inter-sector elasticities to unity in the Differentiated Product Model produces a model that is quite similar to Harberger's with respect to demand elasticities. If we now apply the full corporate-noncorporate tax wedge in this version of the Differentiated Product Model, we find an excess burden in the Differentiated Product Model that is close to 2.6 times the excess burden in the Harberger Model.

To understand these differences note that in the Differentiated Product and Mutual Production Models the economy-wide average corporate tax rate, calculated as total corporate revenues divided by total corporate income, is .45. In terms of the model's tax variable τ, this value of .45 for t corresponds to a tax wedge of .82, where $.82 = .45/(1-.45)$. With such a large distortionary tax, the considerable size of the distortions in the Differentiated Product Model and the Mutual Production Model is not surprising. In contrast, in the Harberger-Shoven analysis the distortionary corporate tax is the difference between the average corporate tax rates in the two sectors. But this average tax in each sector is computed based on total sector capital

7. Recall that in the post-tax equilibrium, tax revenues are returned to the consumers in a lump sum.

TABLE III
The Excess Burden of the Corporate Income Tax

Elasticity of Substitution in Production		Excess Burden Divided by Tax Revenue				
"Corporate"	"Noncorporate"	$\eta = 1$, $\varphi = 1$	$\eta = 10$, $\varphi = .5$	$\eta = 10$, $\varphi = 1$	$\eta = 20$, $\varphi = 1$	$\eta = 30$, $\varphi = 1$
1	1	.19	.46	.47	.87	1.09
2	2	.33	.57	.58	.92	1.11
.75	.75	.16	.43	.44	.86	1.09
.50	.50	.12	.41	.41	.85	1.09
1	2	.21	.46	.47	.82	1.02
1	.75	.19	.46	.47	.88	1.11
1	.50	.18	.46	.47	.90	1.13
2	1	.30	.55	.57	.95	1.16
.75	1	.16	.43	.44	.85	1.07
.50	1	.13	.40	.41	.82	1.05
2	.50	.28	.54	.56	.97	1.19
.50	2	.14	.39	.40	.76	.97

income, not simply the corporate income in the sector. By averaging over noncorporate as well as corporate capital to determine the tax rates in each sector, Harberger and Shoven dilute the effective distortionary corporate tax. Since $t_1 = .014$ and $t_2 = .340$, the effective distortionary tax wedge in the Harberger-Shoven procedure is only .50, which corresponds to $[(.340 - .014)/[(1-.340)(1-.014)]$.

The second reason that the excess burden is so much larger in the Differentiated Product and Mutual Production Models than in the Harberger Model involves differences among these models in the source of the inefficiency in conjunction with differences in within-sector and between-sector demand elasticities. To understand this point, first note that the approximation formula for excess burden is the same in all three models, namely $.5\tau^2 \partial K_c/\partial \tau$, where K_c stands for total corporate capital and τ is the comparative tax wedge. But the change in corporate capital in the Differentiated Product and Mutual Production Models is due, in large part or entirely (e.g., in the case of a perfectly symmetric model), to within-sector substitution of noncorporate capital as well as other factors for corporate capital. In contrast, in the Harberger Model $\partial K_c/\partial \tau$ is negative only because of between-sector substitution of capital away from corporate capital.

The fact that the Differentiated Product Model's and Mutual Production Model's primary source of inefficiency is within-sector rather than between-sector reallocation of capital does not, by itself, suggest that excess burden is larger in the Differentiated Product and Mutual Production Models. But one needs to consider these differences in the source of excess burden in light of differences in the within- versus

TABLE IV
A Comparision of Excess Burden in the Differentiated Product Model, the Harberger Model, and the Mmutual Production Model

Elasticity of Substitution in Production		Excess Burden Divided by Tax Revenue		
"Corporate"	"Noncorporate"	DPM (η = 30 φ = 1)	Harberger Model (φ = 1)	MPM (φ = 1)
1	1	1.09	.08	1.23
2	2	1.11	.13	1.22
.75	.75	1.09	.07	1.26
.50	.50	1.09	.05	1.30
1	2	1.02	.10	1.00
1	.75	1.11	.08	1.30
1	.50	1.13	.07	1.38
2	1	1.16	.10	1.40
.75	1	1.07	.07	1.18
.50	1	1.05	.06	1.13
2	.50	1.19	.13	1.51
.50	2	.97	.06	.85

between-sector elasticities of demands for corporate and noncorporate goods. In the Differentiated Product Model, the within-sector demand elasticity between corporate and noncorporate output should be set (and is set in Table IV) at a much higher value than the between-sector elasticity. In the Mutual Production Model the within-sector elasticity is, indeed, infinite. In contrast, in all three models the between-sector demand elasticity between corporate and noncorporate goods is assumed to be small, typically unity or less. To appreciate how this difference in demand elasticities may affect the reduction in corporate capital and, thus, excess burden, consider how excess burden in the Harberger Model changes as the between-sector demand elasticity increases. Assuming unitary elasticities of substitution in production, raising the demand elasticity in the Harberger Model from unity to ten increases the excess burden as a fraction of tax revenue by a factor of three. Together with the 2.6 factor arising from differences in effective tax wedges, this factor of three suggests an excess burden in the Differentiated Product Model and Mutual Production Model that could easily exceed that in the Harberger Model by a factor of seven.

The size of the excess burdens in the Differentiated Product and Mutual Production Models raises the question of whether the large shifts in capital underlying these results are plausible. Unfortunately, there is little to guide us on the intra-sector substitution elasticity other than a general expectation that similar goods would be easily substitutable. With very high elasticities, the shifts in capital between the corporate and noncorporate sectors can become very large. Initially, the primarily noncorporate sector contains 0.8 percent of the capital stock in its corporate firms and 43.4 percent in its noncorporate firms, while the primarily corporate sector contains 35.2 percent of the capital stock in its corporate firms and 20.6 percent in its noncorporate firms. In the unitary elasticity case, including a unitary intra-sector elasticity, these shares become 1.0, 33.5, 49.4, and 16.0 respectively when the excess corporate tax is removed. When the intra-sectoral elasticity is raised to ten, the shares become 15.5, 19.1, 58.9, and 6.5 respectively. When the intra-sectoral elasticity rises to thirty, the shares become 34.5, 0.0, 64.7, and 0.7.

Some insight can be gained by comparing actual with predicted changes in the corporate share of output in response to changes in the corporate tax wedge. Gravelle and Kotlikoff [1989] report that between 1957 and 1982 the corporate share of output increased from 6 to 20 percent in the "noncorporate" sector and from 76 to 86 percent in the "corporate" sector. During this period the corporate tax wedge declined by about 23 percent. Both the Differentiated Product Model, assuming an within-sector demand elasticity of ten, and the Mutual Production Model, assuming fixed entrepreneurs, predict changes in corporate output shares in response to a 23 percent change in the corporate tax wedge that are roughly similar to those actually observed. Obviously this is a rather crude test of the two models, but it suggests, nonetheless, that these models' predictions may well be in the right ballpark.

V. TAX INCIDENCE

Turning to the incidence of the corporate tax in the Differentiated Product Model, Table V reports the share of the tax falling on capital. As one would expect, in the case of Cobb-Douglas production functions 100 percent of the tax incidence falls on capital. The values of the incidence on capital reported in the table range from 60 percent to 145 percent. The highest values occur when the production substitution elasticity in the corporate sector is large. Higher values of the production substitution elasticity in the noncorporate sector serve to lower somewhat the share of the tax falling on capital.

Table VI compares incidence in the Differentiated Product Model with incidence in the Harberger Model and the Mutual Production Model. The incidence in the Differentiated Product Model is quite similar to that of the Harberger Model, but may differ considerably from that in the Mutual Production Model. This is not surprising given the fairly similar structures of the Differentiated Product and Harberger Models and the somewhat different structure of the Mutual Production Model.

Further insight into the reasons for these incidence results can be gained by deriving an incidence formula (as Harberger [1962] did) by differentiating a model beginning from a no-tax equilibrium. Equations (29), (30), and (31) give, respectively, the incidence formulae for the Differentiated Product Model, the Harberger Model, and the Mutual Production Model. The formula for the incidence in the Differentiated Product Model is derived in the Appendix. In the case of the Harberger Model, industry 1 is the "corporate" industry. Note that the formula for incidence in the Differentiated Product Model reduces to the Harberger formula in the case that $K_{c2} = K_{n1} = 0$, i.e, in the case that sector 1 is totally corporate and sector 2 is totally noncorporate. Note also that the within-industry demand elasticity, η, plays no role in the formula for tax incidence in the Differentiated Product Model in the case of small tax changes. This is not entirely surprising since, in the no-tax equilibrium, the factor shares of noncorporate firms within each sector are identical to those of

TABLE V
The Incidence on Capital of the Corporate Income Tax

Elasticity of Substitution in Production		Share of Tax Burden Falling on Capital		
"Corporate"	"Noncorporate"	$\eta = .5 \quad \varphi = .5$	$\eta = 1 \quad \varphi = 1$	$\eta = 10 \quad \varphi = .5$
1	1	1.09	1.00	1.07
2	2	1.24	1.21	1.23
.75	.75	1.02	.91	.99
.50	.50	.93	.78	.88
1	2	.93	.88	.92
1	.75	1.14	1.04	1.11
1	.50	1.19	1.08	1.17
2	1	1.37	1.31	1.36
.75	1	.97	.87	.94
.50	1	.81	.70	.78
2	.50	1.45	1.37	1.43
.50	2	.67	.60	.65

TABLE VI
A Comparision of Incidence in the Differentiated Product Model, the Harberger Model, and the Mutual Production Model

Elasticity of Substitution in Production		Incidence on Capital		
		DPM	Harberger Model	MPM
"Corporate"	"Noncorporate"	($\eta = 30 \quad \varphi = 1$)	($\varphi = 1$)	($\varphi = 1$)
1	1	1.00	1.00	1.00
2	2	1.21	1.12	1.03
.75	.75	.91	.93	1.10
.50	.50	.78	.82	1.41
1	2	.88	.87	.63
1	.75	1.04	1.04	1.20
1	.50	1.08	1.08	1.47
2	1	1.31	1.22	1.29
.75	1	.87	.89	.88
.50	1	.70	.73	.71
2	.50	1.37	1.27	1.57
.50	2	.60	.61	.27

the corporate firms in that sector. We know from the Harberger Model that demand factors can drop out of incidence formulae (for small changes) in the case of equal factor shares.

$$(29)\quad -(\hat{R}/\hat{\tau}) = \{[(1-\beta_2)+(\beta_2-\beta_1)\theta_1][\sigma_1 K_{c1}+\sigma_2 K_{c2}]+(\beta_2-\beta_1)[\theta_2(\sigma_1-\varphi)K_{c1}-\theta_1(\sigma_2-\varphi)K_{c2}]-[\beta_2\theta_2 K_{n1}-\beta_1\theta_1 K_{n2}][(\sigma_1-\varphi)\beta_1-(\sigma_2-\varphi)\beta_2-(\sigma_1-\sigma_2)]\}/\{[(1-\beta_2)+(\beta_2-\beta_1)\theta_1][\sigma_1 K_1+\sigma_2 K_2]+(\beta_2-\beta_1)[\theta_2(\sigma_1-\varphi)K_1-\theta_1(\sigma_2-\varphi)K_2]\}$$

$$(30)\quad -(\hat{R}/\hat{\tau}) = \{[(1-\beta_2)+(\beta_2-\beta_1)\theta_1]\sigma_1 K_1+(\beta_2-\beta_1)\theta_2(\sigma_1-\varphi)K_1+\beta_1\theta_1 K_2[(\sigma_1-\varphi)\beta_1-(\sigma_2-\varphi)\beta_2-(\sigma_1-\sigma_2)]\}/\{[(1-\beta_2)+(\beta_2-\beta_1)\theta_1][\sigma_1 K_1+\sigma_2 K_2]+(\beta_2-\beta_1)[\theta_2(\sigma_1-\varphi)K_1-\theta_1(\sigma_2-\varphi)K_2]\}$$

$$(31)\quad -(\hat{R}/\hat{\tau}) = \{[(1-\beta_2)+(\beta_2-\beta_1)\theta_1](\sigma_1 K_{c1}+\sigma_2 K_{c2})+(\beta_2-\beta_1)[\theta_2(\sigma_1-\varphi)K_1-\theta_1(\sigma_2-\varphi)K_2]/\{[(1-\beta_2)+(\beta_2-\beta_1)\theta_1][\sigma_1 K_1+\sigma_2 K_2]+(\beta_2-\beta_1)[\theta_2(\sigma_1-\varphi)K_1-\theta_1(\sigma_2-\varphi)K_2]\}$$

While all three models produce the same result when all elasticities are equal (the tax is borne by capital), the results can vary dramatically when factor substitution elasticities differ between the two industries. To explore this point, consider the case where the factor shares are identical in each sector and the factor substitution elasticity in sector 1 is zero. In the Harberger model, in order for sector 2, not subject to the corporate tax, to maintain its capital labor ratio (and absorb these inputs in the fixed ratio released by sector 1) the wage/return ratio must remain fixed. Both the wage rate and the rate of return therefore fall by the same percentage and capital will bear a share of tax equal to its share of income. When the reverse occurs—the factor substitution elasticity in sector 2 is zero—the wage rate must fall proportionally with the change in the tax-inclusive price of capital. That is, the percentage change in the wage rate is equal to the sum of the percentage change in the rate of return plus the change in the tax rate. In this case, capital bears more than 100 percent of the tax.

The Differentiated Product Model simply modifies these relationships. When the factor substitution elasticity in sector 1 is zero, there are both corporate and noncorporate firms in sector 2 to absorb capital and labor. In this case, the percentage change in the wage rate is equal to the percentage change in the rate of return plus the change in tax multiplied by the ratio of corporate sector 2 capital to total sector 2 capital. The incidence of the tax on capital is larger than in the Harberger Model. Similarly, if the factor substitution elasticity is zero in sector 2, the percentage change in the wage rate is equal to the percentage change in the rate of return plus the change in tax rate multiplied by the ratio of corporate sector 1 capital to total sector 1 capital. As compared with the Harberger Model, the incidence tends to move closer to one in both cases. (These comparisons do not necessarily hold when capital shares are not equal; when the "noncorporate" sector is more capital intensive, the incidence tends to rise in the Differentiated Product Model relative to the Harberger model).

The Mutual Production Model, however, has a very different structure. In this model, there are three factors of production: managers, workers, and capital. The noncorporate sector inputs are the noncorporate entrepreneur, workers, and capital. Managers, workers and the marginal entrepreneur earn the wage rate, inframarginal entrepreneurs have effectively larger inputs and earn rents. Prices in this model are identical for corporate and noncorporate firms and are set by corporate characteristics. When capital shares are identical, relative prices between the two sectors do not change. If sector 1 has a factor substitution elasticity of zero, there is no movement of inputs or outputs in this sector. In that case, the rate of return falls as if there were simply a factor tax on sector 2—by the amount of the tax. If the corporate share of capital in sector 2 is very small, the effect on the rate of return is also very small. Similarly, if the factor substitution in sector 2 is zero, it is as if the factor tax were imposed solely on sector 1; in this case if the corporate output is large, the effect on rate of return can be very large. In both cases, although capital does not migrate between industries, it is shifted between corporate and noncorporate firms. Since corporate firms use labor more intensively than noncorporate firms, the wage rate falls and rents rise. (Indeed, even when 100 percent of the tax falls on capital, there is a fall in the wage rate and a rise in entrepreneurial rents.)

VI. SUMMARY AND CONCLUSION

This paper contains a Harberger-type model of corporate income taxation, but one that admits corporate and noncorporate production of goods that, while not identical, are close substitutes in demand. The model's predictions concerning the corporate tax's excess burden are quite similar to those in Gravelle and Kotlikoff [1989] in which corporate and noncorporate firms within the same industry produce identical goods. In both models the presence of corporate and noncorporate goods in the same industry (where industry is defined by a collection of goods that are close substitutes in demand and are produced with the same technology) means that an important response to the corporate income tax will be within-industry substitution of noncorporate for corporate capital. The high demand elasticity between corporate and noncorporate goods in the same industry translates into considerable scope for capital to flow out of corporate into noncorporate production. Since the excess burden of the corporate tax is proportional to the change in corporate capital, this increased substitutability of capital implies a much greater excess burden than in the Harberger Model.

The second reason for the higher excess burden involves the size of the tax wedge. In the model developed here, as well as in that of Gravelle-Kotlikoff [1989], the incentive to move capital from corporate to noncorporate production depends on the full difference between corporate and noncorporate capital taxation. The size of this tax wedge is much larger than the size of the tax wedge entering the Harberger Model, because the Harberger analysis compares average taxes across two sectors both of which have corporate as well as noncorporate firms. If the two sectors were equally corporate-intensive, the Harberger analysis would suggest a zero corporate tax wedge when, in fact, there might be a very substantial tax wedge within each industry between corporate and noncorporate firms in that industry.

These results should be viewed in perspective. We have followed Harberger and Shoven in using average effective tax rates rather than marginal tax rates and in ignoring personal taxes. (Gravelle's [1987] estimates of total (corporate plus personal) marginal tax wedge would, however, actually raise our estimates of excess burden.[8]) The model remains highly aggregated and further disaggregation would alter the estimates. We also do not deal with issues of financial equilibria (debt and dividend pay-out choices).[9]

While both the Mutual Production and Differentiated Product Models permit the coexistence of corporate and noncorporate firms in the same industry, it is not clear which model is better. There may be no single explanation for the co-existence of corporate and noncorporate firms. Elements of both the Mutual Production and the Differentiated Product Models may appear in different degrees in different industries. Indeed, a new direction for modeling the tax may be to introduce product differentiation of varying degrees within the framework of the Mutual Production Model, at least for some industries. The important finding of this analysis, however, is that either method of modeling the tax suggests that the Harberger Model substantially understates the excess burden of the corporate income tax.

8. Personal taxes on corporate source income are levied at a lower rate than the noncorporate tax because of the beneficial treatment of capital gains, where taxes can be deferred and even forgiven if stock is passed on at death. Indeed, where no dividends are paid and funds are retained indefinitely in the firm, higher tax rate individuals could have actually had a lower tax rate in the corporate form than in the noncorporate form, providing in the extreme an alternative explanation for the co-existence of corporate and noncorporate firms. In such a model, the corporate tax is simply a tax shelter which reduces the progressivity of the individual income tax. Although these clientele models have been discussed in the literature, they have never been seriously considered since individuals have never exhibited the portfolio specialization these models require (the average marginal tax rates for holders of corporate equity and holders of noncorporate equity are, in fact, quite close) and since most corporate capital is held in large firms which tend to pay substantial dividends. Such models are completely untenable under current law where the corporate tax rate exceeds the top individual tax rate.

9. Excess burdens of corporate tax will be smaller when the new view of dividends is assumed. In the new view, personal taxes on dividends are capitalized into the value of assets and have no effect at the margin. Similarly, excess burdens will be smaller if the marginal debt-equity ratio is greater than the average. On the other hand, if dividends and capital gains and debt and equity are imperfect substitutes, there will be an additional excess burden associated with these choices. For further discussion of these issues, see the U.S. Department of Treasury [1992] integration report.

APPENDIX I

From the first-order conditions for utility maximization we derive the following relations, where the symbol ^ denotes percentage change:

(a1) $\hat{C}_1 - \hat{N}_1 = \eta\ (\hat{P}_{n1} - \hat{P}_{c1})$

(a2) $\hat{C}_2 - \hat{N}_2 = \eta\ (\hat{P}_{n2} - \hat{P}_{c2})$

(a3) $\hat{C}_1 - \hat{C}_2 = (\eta - \varphi)[(K_{n1}/K_1)(\hat{P}_{n1} - \hat{P}_{c1}) - (K_{n2}/K_2)(\hat{P}_{n2} - \hat{P}_{c2})] - \varphi(\hat{P}_{c1} - \hat{P}_{c2})$

Equation (3) and the profit maximization conditions imply:

(a3) $\hat{C}_j = (1-\beta_i)\hat{L}_j + \beta_i K_j^{\wedge}$ for $i = 1,2$ and $j = ci, ni$

(a4) $\hat{P}_j = (1-\beta_i)\hat{W} + \beta_1(\hat{R} + \hat{\tau})$ for $i = 1,2$ and $j = ci, ni$

(a5) $\hat{K}_j - \hat{L}_j = -\sigma_i(\hat{R} + \hat{\rho} - \hat{W})$ for $i = 1,2$ and $j = ci, ni$

(a6) $(K_{c1}/\bar{K})\hat{K}_{c1} + (K_{c2}/\bar{K})\hat{K}_{c2} + (K_{n1}/\bar{K})\hat{K}_{n1} + (K_{n2}/\bar{K})\hat{K}_{n2} = 0$

(a7) $(L_{c1}/\bar{L})\hat{L}_{c1} + (L_{c2}/\bar{L})\hat{L}_{c2} + (L_{n1}/\bar{L})\hat{L}_{n1} + (L_{n2}/\bar{L})\hat{L}_{n2} = 0$

Differentiation of equation (23) yields:

(a8) $\hat{P}_{c1}\theta_1(K_{c1}/K_1) + \hat{P}_{n1}\theta_1(K_{n1}/K_1) + \hat{P}_{c2}\theta_2(K_{c2}/K_2) + \hat{P}_{n2}\theta_2(K_{c2}/K_2) = 0.$

Equations (a1) through (a8) provide eighteen equations in the eighteen ^ variables.

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