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DOES THE HARBERGER MODEL GREATLY UNDERSTATE THE EXCESS BURDEN OF THE CORPORATE TAX? - ANOTHER MODEL SAYS YES

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ABSTRACT

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. This precludes analysis of within-industry substitution of noncorporate for corporate production in response to the tax. Such within-industry substitution has potentially major implications for both the excess burden and incidence of the corporate tax.

In Gravelle and Kotlikoff (1988) we present a new model of the corporation income tax. The model has two key characteristics. First, corporate and noncorporate firms produce (with identical production functions) each of the model's goods both before and after corporate taxation is imposed, and second, the decision of entrepreneurs to establish unincorporated business is endogenous. Compared with the Harberger model, the new model predicts a very much larger excess burden from corporate income taxation. The incidence of the corporate tax can also differ dramatically in the two models.

Several commentators on our approach suggested that while corporate and noncorporate firms produce goods that are close substitutes, they are not necessarily identical goods. Others questioned the extent to which our results hinged on the endogeneity of entrepreneurship. This paper is a response to those comments. It presents a Harberger-type model (with no entrepreneurs), but one in which each industry/sector contains corporate and noncorporate firms (with identical production functions) which produce goods that are close substitutes in demand. As in our earlier model, 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. For example, using Harberger's original 1957 data and assuming unitary substitution elasticities in production and in inter-sector demand, but substitution elasticities of 30 in intra-sector demand, the excess burden of the corporate income tax in the current model is 107 percent of tax revenue. This figure is quite close to the 123 percent figure reported in Gravelle and Kotlikoff (1988) for the case of unitary substitution elasticities in production and inter-industry demand. Both numbers are considerably larger than the 8 percent excess burden figure that arises in the traditional Harberger model with unitary substitution elasticities.

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I. *Introduction*

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. Empirical applications of the Harberger Model treat all firms producing a particular good (or collection of goods) as identical firms facing the same tax on capital, namely the average tax on capital of firms actually producing the good (collection of goods) in question. This procedure deals with 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.

Unfortunately, the Harberger Model, in its literal form, cannot be used to study the effects of corporate taxation when both corporate and noncorporate firms produce the same goods. As Ebrill and Hartman (1982) point out, in the Harberger Model corporate firms can not compete with noncorporate firms in producing the same good in the presence of the corporate income tax.

In Gravelle and Kotlikoff (1988) we present a new model of the corporation income tax, labeled the Mutual Production Model (MPM), in which entrepreneurship is endogenous and corporate and noncorporate firms produce (with identical production functions) each good both before and after corporate taxation is imposed.[1] Compared with the Harberger model, the MPM predicts a substantially larger excess burden from corporate income taxation.

The incidence of the corporate tax can also differ dramatically in the two models.

Several commentators on the new approach suggested that while corporate and noncorporate firms produce goods that are close substitutes, they are not necessarily identical goods. This paper is a response to those comments. It specifies a Harberger-type model, but one in which each industry/sector contains corporate and noncorporate firms with identical production functions which produce goods that are close substitutes in demand. We label the new model as the Differentiated Product Model (DPM). As in our earlier model, 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. As the substitutability in demand of the noncorporate for the corporate good within each industry increases, the extent of within-industry substitution of noncorporate for corporate capital increases as does the excess burden of the tax per dollar of revenue.

The excess burden from corporate taxation can be quite large in the DPM. For example, using Harberger's original 1957 data and assuming unitary substitution elasticities in production and in inter-sector demand, but substitution elasticities of 30 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 MPM 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 DPM'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 MPM the incidence on capital is 1.41 percent of the tax revenue for production elasticities of .5 and an inter-industry demand elasticity of 1.[3]

The paper begins in the next section, II, with a presentation of 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 compares these predictions with those of the Harberger model and the MPM. Section VI concludes the paper.

II. *The Model*

The DPM 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:

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

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.

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:

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

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:

$$(3) \qquad Q_j = H_i[(1-b_i)L_j^{-\rho_i} + b_iK_j^{-\rho_i}]^{-1/\rho_i} \quad \text{for } i=1,2 \text{ and } j=ci,ni$$

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 1 contains 16 equations from the post-tax equilibrium that we use to calibrate the model. In the post-equilibrium the wage and rental as well as the prices of the corporate goods are measured in units such that they equal 1, 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 1 were it not for the presence of the corporate income tax. Equations (7) give the post-tax equilibrium prices of the noncorporate goods.

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, $\bar{K}$ and $\bar{L}$. 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 2 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 $P_{c2}=P_{n2}=P_2$. The equations in Table 2 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 2 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.

National income, I, is numeraired at $296 billion, the 1957 level of net national income used by Shoven (1976). 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:

$$(32) \qquad \beta_{ci} = \ell_i \left[\frac{(K_{ci}/K_i) + (K_{ni}/K_i)(1-t)^{\sigma_i}}{(K_{ci}/K_i) + (K_{ni}/K_i)(1-t) + \ell_i (K_{ni}/K_i)[(1-t)^{\sigma_i} - (1-t)]} \right] \qquad i = 1,$$

where ℓ_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 (32), 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:

$$(33) \qquad \frac{K_{ci}}{K_i} = \frac{t_i(1-t)}{t(1-t_i)}, \qquad \frac{K_{ni}}{K_i} = \frac{t - t_i}{t(1-t_i)} \qquad i = 1,2$$

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 (33) 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 (34) 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.

$$(34) \qquad \frac{K_1}{K_2} = \frac{\theta_1 \ell_1 (1-t_1)}{\theta_2 \ell_2 (1-t_2)}$$

This ratio together with those calculated in (33) 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.

IV. *Excess Burden*

Table 3 expresses the excess burden in the DPM assuming different elasticities of substitution in production and demand. Excess burden is calculated 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 30. 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 4 compares excess burden in the two models as well as that in the MPM under the assumption of variable entrepreneurs. Our new model (assuming η=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 DPM 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 DPM and MPM 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 DPM and MPM that is 2.6 times the Harberger Model's excess burden. Indeed, setting both the intra-sector and intra-sector elasticities to unity in the DPM produces a model that is quite similar to that of Harberger's with respect to demand elasticities. If we now apply the full corporate - noncorporate tax wedge in this version of the DPM, we find an excess burden in the DPM that is close to 2.6 times the excess burden in the Harberger Model.

To understand these differences note that in the DPM and MPM 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 DPM and MPM 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 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 DPM and MPM than in the Harberger Model involves differences in the DPM and the MPM, on the one hand, and the Harberger Model, on the other, in the source of the inefficiency in conjuncture 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 DPM and MPM model 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 DPM's and MPM'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 DPM and MPM. But one needs to consider these differences in the source of excess burden in light of differences in the within- versus between-sector elasticities of demands for corporate and noncorporate goods. In the DPM the within-sector demand elasticity between corporate and noncorporate output should be set (and is set in Table 4) at a much higher value than the between-sector elasticity. In the MPM 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 10 increases the excess burden as a fraction of tax revenue by a factor of 3. Together with the 2.6 factor arising from differences in effective tax wedges, this factor of 3 suggests an excess burden in the DPM and MPM that could easily exceed that in the Harberger Model by a factor of 7.

The size of the excess burdens in the DPM and MPM raises the question of whether the large shifts in capital underlying these results are plausible? The question can be adduced by comparing actual with predicted changes in the corporate share of output in response to changes in the corporate tax wedge. Gravelle and Kotlikoff (1988) 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 DPM, assuming an within-sector demand elasticity of 10, and the MPM, 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 is suggests, nonetheless, that these models' predictions may well be in the right ballpark.

V. *Tax Incidence*

Equations (26) and (27) give, respectively, the incidence formulae for the DPM and Harberger Model. The formula for the incidence in the DPM 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 DPM 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 DPM 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 the corporate firms in that sector. We know from the Harberger Model that demand factors can drop out of incidence formulae in the case of equal factor shares.

(26)

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

(27)

$$-\frac{\hat{R}}{\hat{\tau}} = \frac{[(1-\beta_2)+(\beta_2-\beta_1)\theta_1]\sigma_1 K_1 + (\beta_2-\beta_1)\theta_2(\sigma_1-\phi)K_1 + \beta_1\theta_1 K_2[(\sigma_1-\phi)\beta_1 - (\sigma_2-\phi)\beta_2 - (\sigma_1-\sigma_2)]}{[(1-\beta_2)+(\beta_2-\beta_1)\theta_1][\sigma_1 K_1+\sigma_2 K_2] + (\beta_2-\beta_1)[\theta_2(\sigma_1-\phi)K_1 - \theta_1(\sigma_2-\phi)K_2]}$$

Turning to the incidence of the corporate tax in the DPM, Table 5 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 6 compares incidence in the DPM with incidence in the Harberger Model and the MPM. The incidence in the DPM is quite similar to that of the Harberger Model, but may differ considerably from that in the MPM. This is not surprising given the fairly similar structures of the DPM and Harberger Models and the somewhat different structure of the MPM.

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 (1988) in which corporate and noncorporate firms within the same industry produce identical goods.[8] In both models the presence of corporate and noncorporate goods in the same industry (where industry is defined in this paper 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 (1988) 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.

As a consequence of ignoring within-sector substitution and using a much too small tax wedge, the Harberger Model may well understate the excess burden of the corporate tax by a factor in excess of ten.

Table 1

Post-Tax Equilibrium Equations used to Calibrate the Model

(4) $R = 1$ (5) $W = 1$ (6) $P_{ci} = 1$ $(i=1,2)$

(7) $$P_{ni} = \left[(1-\beta_{ci}) + \beta_{ci}(1-t)^{\rho_i/(1+\rho_i)} \right]^{(1+\rho_i)/\rho_i} \qquad (i=1,2)$$

(8) $$K_{c1} + K_{c2} + K_{n1} + K_{n2} = \bar{K}$$

(9) $$L_{c1} + L_{c2} + L_{n1} + L_{n2} = \bar{L}$$

(10) $$\frac{K_{ci}}{L_{ci}} = \frac{\beta_{ci}\,(1-t)}{(1-\beta_{ci})} \qquad (i=1,2)$$

(11) $$\frac{K_{ni}}{L_{ni}} = \frac{\beta_{ci}\,(1-t)^{\rho_i/(1+\rho_i)}}{1-\beta_{ci}} \qquad (i=1,2)$$

(12) $$C_i = \frac{K_{ci}}{(1-t)\beta_{ci}} \qquad (i=1,2)$$

(13) $$N_i = \frac{K_{ni}(1-t)^{-\rho_i/(1+\rho_i)}\; P_{ni}^{-1/(1+\rho_i)}}{\beta_{ci}} \qquad (i=1,2)$$

(14) $$C_1 + P_{n1}N_1 + C_2 + P_{n2}N_2 = I$$

(15) $$\frac{C_i}{N_i} = \left(\frac{d_i}{1-d_i}\right)^{\eta} P_{ni}^{\eta} \qquad (i=1,2)$$

(16) $$\frac{C_1}{C_2} = \left(\frac{a}{1-a}\right)^{\phi} \left(\frac{d_1}{d_2}\right)^{(1/\eta-1)(1-\phi)} \left(\frac{1 + \left[\frac{d_1}{1-d_1}\right]^{\eta} P_{n1}^{(1-\eta)}}{1 + \left[\frac{d_2}{1-d_2}\right]^{\eta} P_{n2}^{(1-\eta)}} \right)^{\frac{(\eta-\phi)}{1-\eta}}$$

Table 2

Equations of No-Tax Equilibrium

$$K_{c1} + K_{c2} + K_{n1} + K_{n2} = \bar{K} \tag{17}$$

$$L_{c1} + L_{c2} + L_{n1} + L_{n2} = \bar{L} \tag{18}$$

$$P_i = \left((1-\beta_{ci}) W^{\rho_i/(1+\rho_i)} + \beta_{ci}[R(1-t)]^{\rho_i/(1+\rho_i)} \right)^{(1+\rho_i)/\rho_i} \qquad (i=1,2) \tag{19}$$

$$\frac{K_{ci}}{L_{ci}} = \frac{K_{ni}}{L_{ni}} = \frac{\beta_{ci}}{1-\beta_{ci}} (1-t)^{\rho_i/(1+\rho_i)} \left(\frac{R}{W}\right)^{-1/(1+\rho_i)} \qquad (i=1,2) \tag{20}$$

$$C_i = \frac{K_{ci}\ (1-t)^{-\rho_i/(1+\rho_i)} \left(\frac{R}{P_i}\right)^{-1/(1+\rho_i)}}{\beta_{ci}} \qquad (i=1,2) \tag{21}$$

$$N_i = \frac{K_{ni}\ (1-t)^{-\rho_i/(1+\rho_i)} \left(\frac{R}{P_i}\right)^{-1/(1+\rho_i)}}{\beta_{ci}} \qquad (i=1,2) \tag{22}$$

$$P_1(C_1 + N_1) + P_2(C_2 + N_2) = I \tag{23}$$

$$\frac{C_i}{N_i} = \left(\frac{d_i}{1-d_i}\right)^{\eta} \qquad (1=1,2) \tag{24}$$

$$\frac{C_1}{C_2} = \left(\frac{a}{1-a}\right)^{\phi} \left(\frac{d_1}{d_2}\right)^{(1/\eta-1)(1-\phi)} \left(\frac{1 + \left[\frac{d_1}{1-d_1}\right]^{\eta}}{1 + \left[\frac{d_2}{1-d_2}\right]^{\eta}} \right)^{\frac{(\eta-\phi)}{1-\eta}} \left(\frac{P_2}{P_1}\right)^{\phi} \tag{25}$$

Table 3

The Excess Burden of the Corporate Income Tax

Elasticity of Substitution in Production		Excess Burden Divided by Tax Revenue				
"Corporate"	"Noncorporate"	η=1,ϕ=1	η=10,ϕ=.5	η=10,ϕ=1	η=20,ϕ=1	η=30,ϕ=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

Table 4

A Comparision of Excess Burden in the DPM, the Harberger Model, and the MPM

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

Table 5

The Incidence on Capital of the Corporate Income Tax

Elasticity of Substitution in Production		Share of Tax Burden Falling on Capital		
"Corporate"	"Noncorporate"	$\eta=.5\ \phi=.5$	$\eta=1\ \phi=1$	$\eta=10\ \phi=.5$
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 6

A Comparision of Incidence in the DPM, the Harberger Model, and the MPM

Elasticity of Substitution in Production		Incidence on Capital		
"Corporate"	"Noncorporate"	DPM (η=30 ϕ=1)	Harberger Model (ϕ=1)	MPM (ϕ=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

Appendix I

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

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

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

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

Equation (3) and the profit maximization conditions imply:

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

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

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

where β_i is the capital income share. In equations (a4) and (a5) the term $\hat{r}$ refers to the percentage change in the tax wedge and is set to zero in the case of the noncorporate prices. Differentiation of equations (8) and (9) yields:

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

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

Differentiation of equation (23) yields:

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

Equations (a1) through (a8) provide 18 equations in the 18^ variables.

Notes

1 The MPM 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.

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

3 In the MPM 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.

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.

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

6 Equation (38) incorporates the following relationship between corporate and noncorporate capital income shares: $\beta_{ni}=\beta_{ci}[(1-t)/P_{ni}]^{\rho i/(1+\rho i)}$.

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

8 While the two models predict similar excess burdens, the MPM with a rather inelastic supply of entrepreneurs seems a better model of corporate taxation. In contrast to the MPM, the DPM does not permit corporate and noncorporate firms to produce the same good. For example, in modeling the agricultural sector the DPM requires that one view corporate corn as a different good from noncorporate corn. It is true that using an extremely high within-sector demand elastic brings one quite close to a model in which corporate and noncorporate corn are identical goods. But if this elasticity is set too high the DPM's predicted swings in the corporate share of output in response to changes in the corporate tax wedge are implausible. The notion of assuming less than perfect substitutability among corporate and noncorporate goods seems particularly strained when the goods in question are intermediate inputs. Another reason to favor the MPM over the DPM is its endogenous treatment of proprietorships and its ability to explain the size distribution of noncorporate firms.

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