the present model. Their result (p. 214) that the dividend tax does not affect the cost of capital "whenever the marginal source of funds is the same in two adjacent periods" cannot be confirmed. During Phase II, retained profits are the marginal source of finance in all adjacent "periods", but nevertheless the dividend tax is able to drive a wedge between the marginal product of capital and the market rate of interest. The cited statement is only true in Phase III where retained profits are a potential marginal source of finance *and* dividends are paid.

The possibility of, and preference for, generating equity capital through profit retentions reduces the need for equity injections when the firm is founded and eliminates this need thereafter. It implies an extended period of internal growth during which the cost of capital is higher than the Edwards–Keen and King–Fullerton formulae predict, but it also implies that the firm will eventually reach a stage of maturity where the cost of capital is lower than Harberger assumed.

3. The Harberger Problem

3.1. *Harberger's Own Analysis*

Consider now the Harberger problem more closely. Suppose there are two sectors, X and Y, competing for a given aggregate stock of capital $\bar{K}$:

$$\bar{K} = K_X + K_Y = \text{const.} \tag{18}$$

X is the corporate and Y the non-corporate sector. The two sectors produce the same commodity by using their sector-specific production functions $f_X(\ )$ and $f_Y(\ )$. Aggregate output is

$$Y = f_X(K_X) + f_Y(K_Y)\,.$$

Assume that, before t_1, there was only a non–corporate sector, but at t_1 the corporate sector is "invented". One may think of the corporation as a new form of organizing a firm which increases the efficiency of production and induces the government to impose a dividend tax in order to participate in the rents this form can be expected to generate. Let $f_X(\ )$ be the new production function available to the corporate firm. An efficient allocation of capital to the two sectors which maximizes Y, given $\bar{K}$, is characterized by equality in the marginal products of capital for all points in real time after the corporate firm has been invented ($t > t_1$):

$$f_X'(K_X) = f_Y'(K_Y) \qquad \text{(efficiency)} .$$

The question is whether and when this condition will be violated in the presence of a tax on corporate distributions.

Harberger's (1966) model is based on the implicit assumption that capital invested in the corporate sector satisfies the condition

$$\Theta f_X'(K_X) = r$$

and capital invested in the non–corporate sector the condition

$$f_Y'(K_Y) = r \qquad (19)$$

so that, in a capital market equilibrium,

$$\Theta f_X'(K_X) = f_Y'(K_Y) \qquad \text{(Harberger)} .$$

This means that a constant wedge the size $\tau f_X'$ is being driven between the two marginal products of capital and that there is a permanent welfare loss in terms of a reduced level of output.

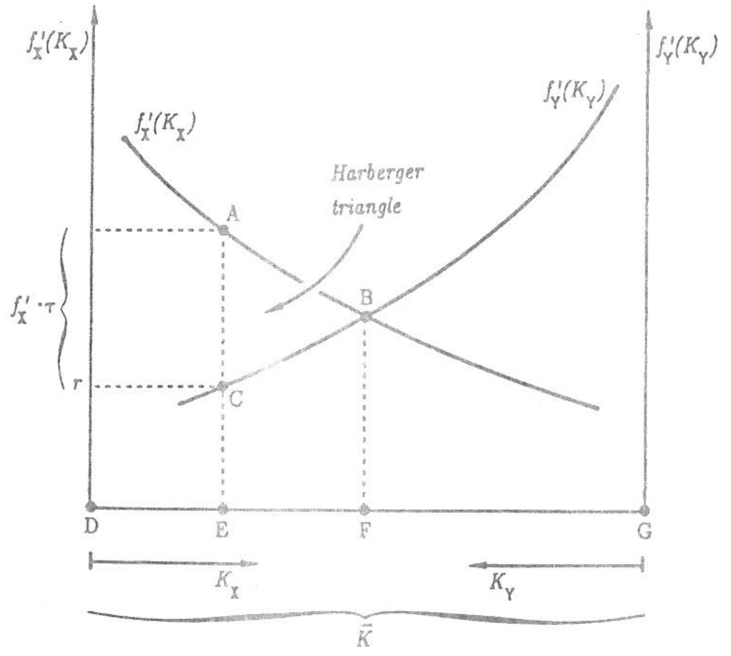

Figure 2: *The Harberger model*

Figure 2 illustrates the Harberger equilibrium. The downward and upward sloping curves are the marginal product curves of the two sectors. The employment of capital in the corporate sector is measured from left to right and in the non–corporate sector from right to left. The distance between the two verticals is the total amount of capital, $\bar{K}$, that is available. The stock of capital is optimally allocated to the two sectors when $K_X = DF$ and $K_Y = FG$, for then aggregate output, the area under the two curves, is maximized. However, the allocation Harberger believed to result from the dividend tax is characterized by $K_X = DE$ and $K_Y = EG$, for this allocation implies that the marginal product of capital in the corporate sector exceeds that in the non–coporate sector by an amount sufficient to compensate for the tax discrimination against corporate investment. Obviously, non–corporate output exceeds its optimum level by the amount CBFE, but this is overcompensated by a comparative output loss of size ABFE in the corporate sector. The net output loss of both sectors together is measured by the

Harberger triangle ABC, and this triangle persists for as long as the dividend tax is levied.

The model set up in the last section is not compatible with this result. To see this, only a few steps are necessary.

3.2. *Another View of the Harberger Problem*

Notice first that the decision problem of the non-corporate firm can be seen as a special case of that model where $\Theta = 1$. The terminology simply has to be changed in an obvious way from a corporate to a non-corporate firm and the constraints $D \geq 0$ and $Q \geq 0$, which, because of (6), (9), and (10), cannot be binding anyway, have to be removed. As revealed by (5) and (8) for the case $\mu_D = 0$, the amount of capital employed by the non-corporate sector will always satisfy (19), and because of (18), the equilibrium level of the market rate of interest is given by

$$r = f_Y'(\bar{K} - K_X) . \tag{20}$$

The decision problem of the corporate firm was formulated for the case of an arbitrarily given time path of the market rate of interest r, but the phase diagram of Figure 1 was analyzed assuming a constant rate of interest. Thus the next step required is to generalize the discussion of this diagram to the case where the market rate of interest is endogenously determined by (20).[8]

When r is endogenous, nearly everything that has been said concerning Phase I and Phase III stays valid. In particular, it will still be true that $q = 1$ in Phase I and $q = \Theta$ in Phase III. Again, Phase Ib cannot exist. On the one hand, $Q > 0$, $D > 0$,

[8]Note that the time path of r is endogenous to the equilibrium, but not to the firm's planning problem. The firm is assumed to be a price taker. It is not assumed that it has market power and thus believes that it can affect the time path of the market rate of interest through its own actions.

and (20) imply that $\dot{K}_X > 0$ and $\dot{r} = -f_Y'' \cdot \dot{K}_X > 0$. On the other hand, (13) and $\dot{r} > 0$ indicate that $\dot{K}_X = \dot{r}/f'' < 0$, a clear contradiction. The only important addition to the previous analysis is that the steady state stock capital, call it now K_{X_2}, that was previously determined by (16), is now implicitly given by

$$f_X'(K_{X_2}) = f_Y'(\bar{K} - K_{X_2}) .$$

There are minor changes with the possible paths during Phase II as defined by (14) and (15). Instead of (17), the slope of a path is now given by

$$dq/K_X = q\,[f_Y'(\bar{K} - K_X) - f_X'(K_X)]/f_X(K_X) .$$

This equation reveals that the paths are more strongly curved than in the case of a constant r, but clearly none of the qualitative properties described in the previous section change. Thus Figure 1 and Propositions 1 and 2 stay perfectly valid. It is only necessary to keep in mind that the market rate of interest can be identified with the marginal product of capital in the non–corporate sector.

Figure 3 illustrates the intertemporal market equilibrium in a diagram that combines Figures 1 and 2. In the beginning, there is no corporate sector so that the total amount of capital DG is invested by non–corporate firms. Then, at t_1, the corporate sector defined by the new marginal product curve f_X' and the dividend tax factor Θ come into existence. By issuing shares the corporate sector will immediately withdraw the amount of capital DE from the non–corporate sector and bid up the interest rate from HD to CE. The withdrawal is less than is required by efficiency and implies that there is a Harberger triangle of size ABC. However, the welfare loss is only temporary. With the passage of time, the corporate sector will build up equity capital through profit retentions and claim a growing proportion of the economy's available stock of real assets. This improves the allocation of resources to the two sectors and increases aggregate output. The process comes to a halt when the Harberger triangle has vanished, the

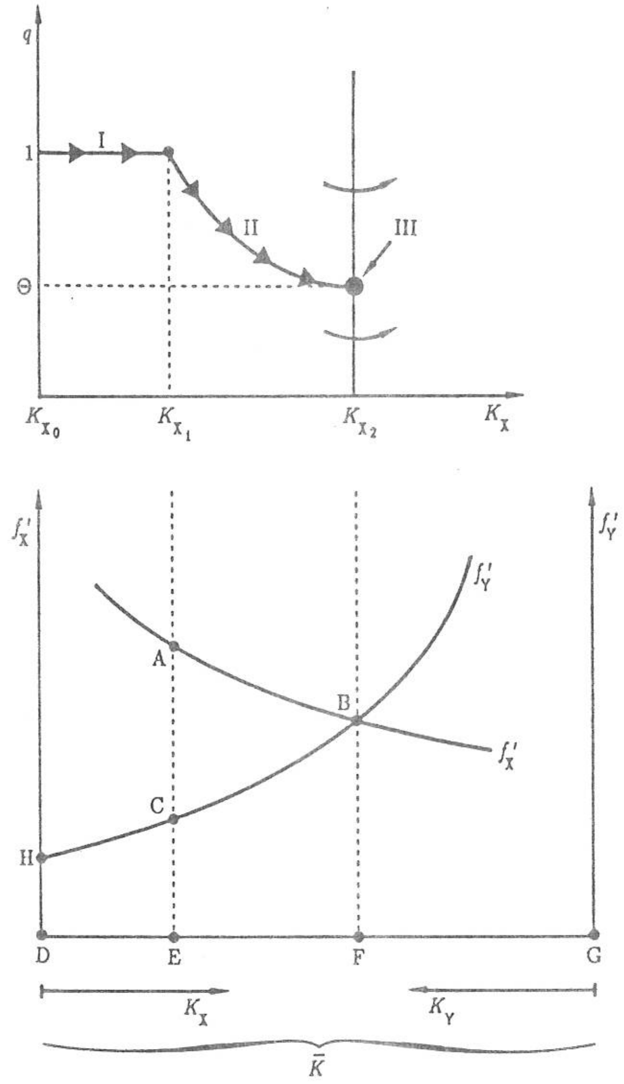

Figure 3: *The vanishing Harberger triangle*

corporate stock of capital has increased to DF, and the non–corporate stock has fallen to FG. The economy is then in an efficient steady state where its output is maximized given the available stock of capital and where the profits are distributed to the household sector. The following proposition summarizes this conclusion.

Proposition 3: *Initially, when the corporate sector is young and reinvests its profits, there is a Harberger triangle. Yet, this triangle gradually vanishes with the passage of time and aggregate output increases. In finite time, the economy reaches a stage of maturity where the corporate sector distributes its earnings and the available stock of capital is being efficiently allocated to the two sectors.*

3.3. *The Correlation between Dividend Taxes and the Distortions they Cause*

There is a final proposition generated by the model which follows directly from the observation that no dividends, and hence no dividend taxes, are paid during the adjustment to the steady state.

Proposition 4: *The dividend tax distorts the intersectoral allocation of resources when it is* ***not*** *paid and it is neutral when it* ***is*** *paid.*

The payment of dividend taxes signals that the firm is in a stage of maturity where the new view of corporate taxation holds and where the dividend tax no longer affects the investment decisions. The burden of the tax is capitalized in share prices, and there is no way for the corporate sector to reduce this burden by changing its investment policy. By way of contrast, corporations which do not pay dividend taxes signal that they are in need of equity capital and have not yet reached the stage of maturity and efficiency. The point is simply that dividend taxes create distortions *before* they are paid. The threat of dividend taxes that will have to be paid in the future makes shareholders reluctant to inject more than a nucleus of equity capital into their firms. However, when these taxes are actually paid, the process of reinvesting profits must have generated enough equity to compensate for this threat and to eliminate the Harberger triangle. In any given period of time, there is a negative correlation between the size of the tax burden and the magnitude of the Harberger triangle.

4. Extensions and Qualifications

The previous discussion referred only to a single tax and to the case of founding the corporate sector as a whole. It was also based on an extreme version of the trapped equity view. This section comments on possible extensions, generalizations, and qualifications.

4.1. *Disturbances with an Existing Corporate Sector*

One obvious extension is to think of an initial steady state equilibrium with an existing corporate sector that is disturbed by new and unforeseen inventions which shift this sector's marginal product curve upward. This case can be captured with the formal approach derived above by changing the initial condition of problem (4) from $K_0 = 0$ to $K_0 > 0$. This would not affect the time paths depicted in Figures 1 and 3 but would simply imply that the economy starts at a later stage on these paths. Suppose, the new marginal product curve after the invention is the one illustrated in Figure 3 and the old curve intersected the marginal product curve of the non–corporate sector to the left of point C. In this case, the corporate sector issues new shares at the time the invention occurs and jumps immediately to point C. After this, there is again the finite period of internal growth ending with the stage of maturity, B, where dividends are paid. And once again the dividend tax retards the adjustment process towards an efficient equilibrium, but does not prevent this equilibrium from being eventually reached.

Instead of the initial equilibrium being located to the left of point C in Figure 3, it might also have been to the right of this point. In this case, the corporate sector will not react to the inventions by issuing new shares but will merely stop paying dividends to its shareholders, entering a period of internal growth which eventually leads to the stage of efficiency and maturity.

4.2. *Escapes from the Equity Trap*

Another extension would be to relax the constraint that dividends are the only way of distributing cash to shareholders. This constraint is certainly not realistic as most countries allow for a tax–exempt return of original capital. If such return were permitted to replace or precede dividend payments, the firm's optimal growth path would be strongly affected. However, the typical provision – one that definitely applies in the United States, for example – is that a return of capital cannot occur before current profits and all accumulated reserves have been paid out. Formally, the possibility of returning the original capital *after* distributing the reserves and profits implies that the constraint $Q \geq 0$ of problem (4) is removed for $K \leq K_1$ and maintained for $K > K_1$ where K_1 is the original capital (see Figures 1 and 3). As this means that a flow constraint is removed for values of the state variable (K) where it is not binding $(q \geq 1)$, and retained where it is $(q < 1)$, the firm's optimal growth path and all of the conclusions based on it would remain unaffected.

Cash payments to shareholders that would undermine both Harberger's results and those derived in this paper are profit financed share repurchases and acquitisions. Share purchases by corporations that are financed out of past and present profits largely avoid the double taxation of dividends and indicate a loophole in the classical and partial imputation systems of capital income taxation. Most countries have effectively closed this loophole by declaring share repurchases illegal. However, in the United States the situation is ambiguous. On the one hand, Section 302 of the Internal Revenue Code prohibits firms to repurchase shares in lieu of dividend payments. On the other hand, share purchases by corporations have recently increased dramatically, constituting a large fraction of corporate cash distributions. A very extensive record of this phenomenon is provided by Shoven (1986).[9] He showed that, since 1984, the volume of corporate share purchases, predominantly acquisitions, exceeded ordinary dividend payments, yet he also found that the share purchases did not simply replace the dividends but reflected a leverage phenomenon. Quite remarkably, the time path of dividends was unaffected by the rising repurchase volume and debt rather than profits seemed to have been the source of the additional cash that shareholders received.[10] Whether and to what extent the recent increase in corporate share purchases can be seen

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[9] Cf. also Poterba (1987, p. 471) and Bagwell/Shoven (1988).

[10] See Sinn (1987, ch. 6) for a formal analysis of the advantages of profit and debt financed acquisitions.

as a use for profits from marginal investment projects that eliminates Harberger type distortions remains to be seen.

4.3. *Other Taxes*

Further modifications would involve a richer set of taxes. It would be space consuming, but easy, to introduce personal income taxes on dividends and interest income, personal capital gains taxes, and a corporate tax on retained and distributed profits. This extension could change the nature of the steady state, as there could be a persistent Harberger triangle resulting from a difference between the combined marginal corporate and capital gains tax burden on retained profits on the one hand and the shareholders' marginal personal tax burden on interest income on the other. However, under the classical system of capital income taxation, the basic adjustment pattern described, including the initial share issues, the phase of internal growth, and the shrinking Harberger triangle, would still show up. Moreover, the steady state size of the triangle would continue to be smaller than Harberger believed it to be.[11] The driving force behind the results of this paper is a comparatively high tax burden on corporate dividends which exceeds both the burden on personal interest income and that on retained profits. Because of an unmitigated double taxation of distributed profits and a limited taxation of accrued capital gains this force is fully operative in real tax systems of the classical type which are, for example, employed in the United States, Switzerland, and Australia. The present model should have some relevance for these economies although it assumes that the dividend tax is the only tax in the economy.

[11]A discussion of the steady state properties of the present model in the presence of richer tax structures can be found in Sinn (1987, ch. 6).

5. Conclusion

In one sense, the results of this paper confirm Harberger, in another they contradict him. It is certainly true that the high tax burden on corporate dividends creates efficiency losses as Harberger claimed. This burden is an obstacle to the foundation of firms and prevents capital from being used in the corporate sector although it could usefully be employed there. After a corporation has been founded with a nucleus of external equity capital, there is a phase of internal growth where retentions are the only marginal source of finance. During this phase, the intersectoral distortions are higher than those the cost of capital formulae used by holders of the new view of corporate taxation predict. It is not correct to weight the influence of dividend taxes with the proportion of investment financed by new share issues and it is not true that dividend taxes are neutral when firms generate their equity capital through profit retentions. There is a Harberger triangle when all profits are retained in consecutive periods and no shares are issued.

On the other hand, dividend taxes will not create permanent distortions in the allocation of capital but merely retard the speed with which an efficient allocation is reached. One lesson of the model is that the intersectoral distortions which Harberger claimed to result from the dividend tax are transitory phenomena that may have been important in early stages of the development of the corporate sector, but vanish when the economy matures.

In a mature economy, corporations distribute dividends to their shareholders. Firms that distribute dividends can always generate more equity capital by stopping the distributions. These firms are therefore in the situation which the new view of corporate taxation concentrates on. Their marginal cost of equity capital is the market rate of interest and they follow the same investment rules as their non-corporate competitors.

A stage of full maturity is conceivable for a world with one representative firm, and in some real economies it may have been reached to a high degree of approximation. In general, however, account must be taken of the facts that there are always new entrants into the corporate sector and that new investment opportunities show up for existing firms. These facts imply a continuing incentive to issue new shares. The model developed has immediate implications for this case. One such implication is that the size of the dividend tax rate will have a negative impact on the entrants' starting stocks of equity and the incumbents' share issues after inventions. The tax will therefore adversely affect corporate investment. Perhaps this is the explanation for the empirical result of Poterba and Summers that was cited in the introduction.

If the explanation is correct, it follows that dividend taxation impedes investment not only at the point in time where new shares are issued, but also in the period of internal growth that follows and, in fact, the distortion will be larger, the longer this period. A corollary of this result is that the overall distortion in the economy will be larger, the larger the proportion of investment that is financed with retained profits rather than with newly issued shares. This corollary is contrary to what the weighted average formulations of the cost of capital predict.

Harberger's empirical estimates of the intersectoral distortions created by the existing capital income taxes are strongly affected by these considerations. Unlike Poterba and Summers, Harberger and many of his followers did not focus on statutory tax rates but based their welfare estimates on "effective tax rates" defined as a sector's ratio of total capital income tax liability and total volume of capital income per unit of time. With a classical system of capital income taxation, where the overall tax burden on dividends exceeds that on retained profits, this means that the measured welfare loss will be higher, the higher the proportion of profits paid out as dividends, for the higher this proportion, the higher is the measured value of the effective tax rate.

If the spirit of the model presented in this paper is correct, this method of estimating the welfare loss stands the truth on its head. Given the tax law, a high effective tax rate for the corporate sector signals, among other things, that many corporations are mature and pay dividends; and a low effective tax rate – one that approximates the tax rate of the non–corporate sector – signals that many corporations are in the transitory period of rapid internal growth. A high tax rate therefore signals small, and a low tax rate large, intersectoral distortions or, to put it another way, the true intersectoral distortions are smaller, the larger the distortions that Harberger estimated. The Harberger triangle has not vanished, what has vanished is the idea that the triangle and the visible tax burden take the stage together.

Appendix

By studying the functional form of the Phase–II paths, this appendix

i) *proves that the ordinate is an asymptote for all possible paths and*

ii) *derives a sufficient condition for Phase II to start with a capital stock lower than that which follows from Harberger's formula or, equivalently, a sufficient condition for the cost of capital associated with new share issues to be higher than Harberger's formula implies.*

The proofs apply to the general model of section 2 where r is endogenous. The constant value of r assumed in section 1 is a special case of this.

The Functional Form of the Phase–II Path

Let $q(K_X)$ be a function that describes the Phase–II path in (q,K_X) space (see Figures 1 and 3) and let β_i denote the production elasticity of capital employed in sector i, assuming that this elasticity is bounded away from unity:

$$\text{(A1)} \qquad \beta_i(K_i) \equiv f_i'(K_i)K_i/f_i(K_i); \quad i = X,\ Y; \ \beta < \bar{\beta} < 1 .$$

From (15), the time derivative of q is

$$\dot{q} = q'(K_X)\dot{K}_X = q'(K_X)f_X(K_X) .$$

Inserting this into (14) and using (20) to explain r endogenously, one obtains

(A2)
$$\frac{q'(K_X)}{q(K_X)} = \frac{f_Y'(\bar{K}-K_X)}{f_X(K_X)} - \frac{f_X'(K_X)}{f_X(K_X)}$$

or, upon logarithmic integration,

(A3)
$$q(K_X) = \frac{\Phi(K_X)}{f_X(K_X)} \cdot c$$

where c is a strictly positive constant and

(A4)
$$\Phi(K_X) \equiv \exp \int_0^{K_X} \frac{f_Y'(\bar{K}-u)}{f_X(u)} du \,.$$

Notice that, as $f_Y'(\bar{K}-u) < \infty$ for $u < \bar{K}$, the integral in (A4) is finite for all $K_X < \bar{K}$ if $\int_0^{K_X} 1/f_X(u)\, du < \infty$ for $K_X \geq 0$. As $1/f_X(u) \to \infty$ for $u \to 0$, this condition is non-trivial. It results from the assumption that β is bounded away from unity as K approaches zero. With $\bar{\beta}$ as the upper bound on β, a positive constant δ exists such that $f_X(u) > u^{\bar{\beta}}/\delta$ for all u below some arbitrarily small constant ε, $\varepsilon > 0$. It follows that

$$\int_0^{\varepsilon} 1/f_X(u) du < \int_0^{\varepsilon} \delta u^{-\bar{\beta}} du = \left[\frac{\delta}{1-\bar{\beta}}\, u^{1-\bar{\beta}}\right]_{u=0}^{u=\varepsilon} = \frac{\delta}{1-\bar{\beta}}\, \varepsilon^{1-\bar{\beta}} < \infty$$

which clearly implies that $\int_0^{K_X} 1/f_X(u)\, du < \infty$ for all $K_X \geq 0$.

i) The Limiting Value of q

It is obvious from (A3) and (A4) that $q(K_X) \to \infty$ for $K_X \to 0$ if it is recalled that, by assumption, $f_X(K_X) \to 0$ for $K_X \to 0$ and realizes that $\Phi(K_X) \to 1$ for $K_X \to 0$.

ii) The Stock of Original Capital

Let

(A5) $$q^{H}(K_X) \equiv f_X'(K_X)\Theta/f_Y'(\bar{K}-K_X)$$

be the value of q implicit in the Harberger approach and let K^H be the size of the corporate stock of capital where $q^H = 1$; i.e., the size Harberger believed to result from dividend taxation. The goal is to find sufficient conditions for

(A6) $$K^H > K_{X_1}$$

or, equivalently, for

(A7) $$q(K^H) < q^H(K^H)\,.$$

As K_{X_2} is defined by $f_X'(K_{X_2}) = f_Y'(\bar{K}-K_{X_2})$ and as $q(K_{X_2}) = \Theta$, it follows from (A5) that $q^H(K_{X_2}) = q(K_{X_2}) = \Theta$. A sufficient condition for (A7) and hence (A6) to hold is therefore

$$\frac{\partial \ln\ q(K_X)}{\partial K_X} > \frac{\partial \ln\ q^H(K_X)}{\partial K_X} \quad \text{for} \quad K^H \leq K_X < K_{X_2}\,.$$

Using (A2) and (A5), this inequality can be transformed to

$$\frac{f_Y'}{f_X} - \frac{f_X'}{f_X} > \frac{f_X''}{f_X'} + \frac{f_Y''}{f_Y'}$$

or, after a few manipulations and using (A1), to

(A8) $$\left(-\frac{f_X''}{f_X'}K_X - \frac{f_Y''}{f_Y'}K_Y\frac{K_X}{K_Y}\right)\frac{1}{\beta_X} > \frac{f_X' - f_Y'}{f_X'}\,.$$

To interpret condition (A8), it is useful to hypothesize that the pure profit or rent which the concave functions f_X and f_Y imply are the returns from a hidden second factor of production. Let $\sigma_i(K_i)$, $i = X, Y$, denote the Hicksian substitution elasticity between capital and the hidden factor in sector i assuming that the production functions are linearly homogenous. It is a standard result that (A8) can then be written as:

$$\text{(A9)} \qquad \left(\frac{1-\beta_X}{\sigma_X} + \frac{1-\beta_Y}{\sigma_Y}\frac{K_X}{K_Y}\right)\frac{1}{\beta_X} > \frac{f_X' - f_Y'}{f_X'} .$$

Note that, by the definition of K^H,

$$\frac{f_X' - f_Y'}{f_X'} \leq \tau \text{ for } K^H \leq K_X < K_{X_2} .$$

This implies that it is sufficient for (A9) and hence for (A6) to hold if

$$\text{(A10)} \qquad \left(\frac{1-\beta_X}{\sigma_X} + \frac{1-\beta_Y}{\sigma_Y}\frac{K_X}{K_Y}\right) > \beta_X\tau .$$

This condition captures the case of a constant rate of interest in the limiting case of a small corporate sector where $K_X/K_Y \to 0$. With a Cobb-Douglas technology ($\sigma_X = 1$) the condition would then require that the implicit current tax burden on the normal return to equity does not eliminate the pure corporate rent ($\tau\beta_X < 1-\beta_X$). With $\sigma_X < 1$ and/or a "large" corporate sector ($K_X/K_Y > 0$), (A10) would be satisfied even under weaker conditions.

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