TECHNICAL NOTE

THE MODEL AND THE ESTIMATION

1. Derivation of the Rental Cost of Capital

Following Jorgenson (1963), Auerbach (1983), Nakamura and Nakamura (1982), Hulten (1984), Gupta and Gupta (1985), and others, taxes on company income are assumed to affect investment by altering the notions regarding the rental cost of capital, 'c', which is the minimum expected net rate of return. The notions about the level of 'c' depend upon factors such as equipment prices, debt-equity ratio, dividend pay-out ratio, profitability as well as various tax provisions. Since the focus of this study is to quantify the impact of some of the tax provisions, it is necessary to depict in detail exactly how these tax provisions affect the rental cost of capital. Let us denote the various elements of the rental cost by the following symbols:

q=equipment price,
Y=gross cash flow,
A=proportion of dividends D in Y,
B=proportion of debt in total capital,
d=real rate of depreciation,
r=shareholders' net discount rate,
i=rate of interest, and
υ=rate of inflation.

Besides these, the tax elements considered are:

u=corporate income tax rate (including surcharges),
v=average rate of personal income tax on dividend incomes,
d'=rate of tax depreciation,

k=rate of investment allowance/development rebate, and,

a=proportion of k to be retained in order to claim the investment allowance.

The condition for the cost effectiveness of any investment item priced at q would be

$$(1-B)\,q=R-TC-TP \qquad (1)$$

where
$$R=c\int e^{-(r+d)t}\,dt-Bqi\int e^{(r+p)t}dt,$$
$$TC=[R-qd'\int e^{-(r+d'+p)t}.dt-qk]u,$$
$$TP=[R-TC-akq]Av$$

R represents the minimum total expected profits which are net of the present value of the interest payments for given proportion of debt. TC represents the total tax liability due to corporation taxes along with the depreciation allowance and investment allowance. And TP represents the tax liability due to personal income taxation for given dividend pay-out ratio (long-run). Solving (1) for the rental cost, c,

$$c=q(r+d)\left\{\frac{1-B}{(1-u)(1-Av)}-\frac{zu}{(1-u)}+\frac{Bi}{(r+p)}\right\} \qquad (2)$$

where $z=[d'/(d'+r+p)]$.

2. The Investment Model

Briefly, the investment function is derived as follows: Following the celebrated study of Jorgenson (1963), as well as various other studies such as Eisner (1963), Anderson (1964), Eisner and Nadiri (1968), Coen (1969), Auerbach (1983), first gross fixed investment I_t is defined as the change in the capital stock K_t,

$$I_t=K_t-(I-d)K_{t-1} \qquad (3)$$

where d is the rate or depreciation. On the rate of investment,

$$I_t/K_{t-1}=K_t/K_{t-1}-(I-d) \qquad (4)$$

Second, following the neoclassical approach it is assumed that companies first arrive at the level of capital stock 'K^*_t' required for meeting the expected demand for the output. Because of various delays, such as due to placement of orders for the equipment, installation. phasing and so on, it takes some time to realise the planned change in the capital stock. And these capital stock growth plans are also prone to revisions, depending upon the revised expectations with regard to the output demand. The adjustment of actual change in the capital stock to its desired change is assumed to be such that,

$$K_t/K_{t-1}=(K_t^*/K_{t-1})^g$$

where $$o<g\leqslant 1. \tag{5}$$

Third, assuming output level Q_t is guided by a CES type of production function, and that the objective of the companies is maximisation of profits over time, the first order condition that the marginal productivity of capital equals the ratio of the rental cost of capital and the price of the output, yields a behavioural function for the determination of the desired stock of capital as

$$K_t^*=A^s\,(p/c)^s{}_t\;Q^*{}_t \tag{6}$$

where p denotes price per unit of output Q, c denotes the rental cost per unit of capital, and s denotes the elasticity of substitution between capital and labour.

Substituting (6) in (5), the rate of change in the capital stock is obtained as

$$K_t/K_{t-1}=A^{gs}\,(p/c)^{gs}\,Q^{*g}\;K^{-g}{}_{t-1} \tag{7}$$

The parameters s and g denote the elasticity of substitution and the lag parameter respectively.

3. The Dividend Behaviour Model

Following the literature on corporate dividend behaviour, the most plausible and empirically convenient hypothesis regarding the dividends appears to be that the long-run or 'desired' dividends, D^* are determined by

$$D^*=A_o\,Y(1-u')\,x^s1 \tag{8}$$

where x represents the relative opportunity tax cost of paying one rupee of net dividends in terms of net retentions and u' is the effective rate of tax on corporate income (before dividend payments). In other words, if P_d denotes the 'tax price' of D, and P_r the tax price of retentions, $x=P_r/P_d$. For example, under the current tax system $P_r=1/(1-u')$ and $P_d=1/1-u')(1-v)$ so that $x=(1-v')$.

To quantify impact of the investment allowance reserve condition, a component needs to be added for x, so that the D^* function would be

$$D^* = A_o\, Y(1-u')\,(1-v)^{s_1} \left(\frac{1-u}{1-u^e}\right)^{s_2} \tag{9}$$

where u^e is the likely effective corporation income tax rate in the absence of investment allowance provision. This takes care of the extra cost of dividend payments. The response coefficient for the 'cost' due to investment allowance is assumed to be not necessarily equivalent to that of $(1-v)$ because the nature of the obligation to retain profits is different.

The actual dividends, D, after taking into account the partial adjustment process, are determined as

$$D_t=A_o\, Y^1{}_t(1-u')^1\,(1-v)^{ls_1}\left(\frac{1-u}{1-u^e}\right)^{ls_2} D_{t-1}^{e-1} \tag{10}$$

where $o<1<1$

4. The Debt Equity Model

With regard to B, the gearing ratio, a simple hypothesis is that the long-run marginal rate of substitution between debt and equity is a function of their relative costs. Thus the debt-equity ratio

$$\left[\frac{B}{1-B_t}\right]=A_1\left[\frac{1-i/(r+p)}{(1-u)\,(1-Av)}\right]^{ms_3}\left[\frac{B}{1-B_{t-1}}\right]^{1-m} \tag{11}$$

Equations (10) and (11) indicate how investment allowance and other tax provisions affect A and B, which can be plugged into equation (7) to compute the rental cost of capital c.