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TAXATION AND EMPLOYMENT IN GENERAL EQUILIBRIUM: A THEORETICAL AND EMPIRICAL ANALYSIS*

Sutanu Behuria
Department of Economics
Southern Methodist University
Dallas, Texas 75275

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PART I

1. Introduction

In today's economic milieu, the overall level of employment and its sectoral distribution have been a source of constant anxiety to policy makers and political leaders in both the developed and developing countries (LDCs). Policies whose primary objectives have not been the creation of employment opportunities have often foundered in the legislatures on the basis of the argument that they affect the level of employment adversely. On the other hand, strong lobbies have developed in support of policies which promote or maintain employment either at the overall or at the sectoral level. However, this aspect of economic life has been almost completely ignored in the literature on public finance, although there has been a veritable plethora of studies--both theoretical and econometric--regarding the impact of taxation on the supply of work effort by the individual.[1] But, taxes like most economic policies do have important implications for resource allocation at the macro-level. Indeed, Harberger's [1962] now celebrated contribution to the general equilibrium theory of tax incidence illustrated precisely this. And, it was reiterated by a large number of general equilibrium studies on taxation which followed the appearance of his article. However, although a large variety of issues was discussed by them, none considered the issue of unemployment.[2] Therefore, there exists a tremendous need to provide a rigorous theoretical framework in which the impact of various tax policies on employment can be studied and compared. Such a theoretical model must of course be couched in the general equilibrium framework, because what we are interested in is not the immediate effect of any policy, or a purely sectoral impact, but the overall long run impact that a tax policy has on the economy. That is, the

model should be capable of analyzing the impact of any policy after all the linkages have worked themselves out.

The importance of such a model cannot be overemphasized. In fact, employment creation is considered to be so important that there are very few major national policies today which do not consider this to be either a primary or a secondary objective. For example, in the Approach document to the Indian Fifth Five-Year Plan, it was admitted that "purely fiscal devices are unlikely to make a substantial impact on income differentials," and the following were some of the measures which were visualized to effect the transfer of resources to the bottom 30 percent of the population:

> (i) substantial additional opportunities for wage-employment in the non-agricultural sectors,
> (ii) expanded, fuller and more productive self-employment opportunities in agriculture, ... (pp. 3-4)

However, taxes and subsidies remain an integral part of the policy-makers' arsenal in the developing countries. Clearly then, it is imperative that in choosing between various taxes and subsidies, or considering any particular such policy, the policy-maker be able to evaluate the employment impact of these policies. If not, it is possible that on occasion the imposition of many policies would be self-defeating.

This research is a first attempt at providing this much needed theoretical framework. The objective of this study is essentially three-fold. First, we shall develop a model in which it would be possible to analyze the impact of unemployment, both at the sectoral and the economy-wide level. Second, by using this theoretical framework we shall compare some of the more important taxes prevalent in the developing countries, with regard to their employment effects. Lastly, we shall for purposes of highlighting the usefulness of this model, analyze the impact of the corporation income-tax in some detail both at the theoretical and the empirical level.

2. The Methodology

The reason for the neglect of the very real and important issue of unemployment in the literature on public finance has perhaps been the fact that the two-sector paradigm so far used to analyze the general equilibrium impacts of taxation has been ill-equipped to incorporate this phenomenon. Nevertheless, this issue has been discussed often enough in the field of international trade, and we take our inspiration from there. Haberler's [1950] pioneering contribution has led many trade-theorists to relax the assumption of full employment generally made in the standard two-sector models. In a variety of contexts, Johnson [1965], Bhagwati [1968], Lefeber [1971] and Brecher [1974a,b] considered the possibility of generalized unemployment resulting from rigid factor prices. In the context of the theory of development, Harris and Todaro [1970] and Bhagwati and Srinivasan [1974] have considered the somewhat different problem of sector-specific unemployment resulting from the rigidity of the sector-specific real wage. In this contribution, we shall restrict our attention to the more frequently discussed problem of generalized unemployment.

Brecher [1974a], however, has observed that in the case of generalized unemployment, the assumption of constant returns to scale, along with the rigidity of the real wage, results in the Ricardian type of production indeterminacy. Consequently, it is not surprising that public finance theorists have ignored the problem of unemployment in formulating general equilibrium models. A possible answer to this impasse could be the assumption of diminishing returns to scale as made by Batra and Seth [1977]. However, although this may be theoretically interesting to the trade theorist, it is of limited use to the policy maker, at least from the empirical viewpoint. As an alternative, we consider the presence of a specific factor, namely land, being utilized in production in the agricultural

sector or the non-corporate sector. This in itself would be an important contribution. Clearly, any analysis of tax policies can only be of limited usefulness if they ignore a politically, socially and economically dominant group of income earners such as the landowners. Moreover, although the assumption of specificity of land appears to be unduly restrictive, from the empirical standpoint a strong case can be made for such a formulation. Indeed, Shome [1978] has argued that a land specific-factor model is justified even in the United States since the share of land is significant, but only in the non-corporate sector. This argument applies with even greater force when we consider the developing countries.[3] Thus, by introducing a specific factor not only do we circumvent the problem of production indeterminacy, but also add considerably to the realism of our model.

3. The Model

3.1. Assumptions

The model developed below will be based on the following assumptions:

1. The economy can be divided into two sectors, namely the agricultural and the non-agricultural sectors. Alternatively, following Harberger [1962] we could consider a division between the corporate and the non-corporate sectors. In the developing countries there is likely to be a considerable overlap between these two divisions.

2. There are three factors of production in the economy, namely labor, capital and land; the total endowments of which are given. The non-agricultural (corporate) sector uses only labor and capital, whereas the agricultural sector (non-corporate) uses all three sectors. That is, land is specific to the agricultural sector. Such an assumption has previously been empirically justified by Shome [1978] and Ratti and Shome [1977].

3. We assume that capital and land are fully employed, but that labor is in surplus. The unemployment of labor is explained by the presence of wage rigidities. The downward rigidity of wages is assumed to be the result of minimum wage laws or trade unionism. Such arguments have usually been made by the trade theorists mentioned above. A further justification for this assumption is that in developing countries the wage rate, at least in the agricultural sector, may already be at its subsistence minimum. This may lead to unequal wage rates in the two sectors (but this problem is easily tackled). However, for the sake of simplicity, we shall assume that in the absence of taxes no wage differential exists. The justification for assuming full-employment of land and capital, but not of labor, is that in the overpopulated LDCs, the cause of unemployment is not the lack of effective demand in the usual Keynesian sense, but as Rao [1952] argues, structural, in that it is the result of a chronic imbalance between the various factors of production. Moreover, it is usually viewed with greater concern.

4. All other assumptions of the standard two-sector model are retained. Thus, perfect competition, linearly homogeneous and concave production functions, perfect intersectoral mobility of capital and labor are all assumed.

5. We further assume, à la Harberger [1962], that the government spends the proceeds of the tax such that the reduction in the private expenditures of the two goods are exactly counterbalanced. This, together with the assumption of constant marginal propensities to consume each good, makes changes in demand a function of changes in relative prices alone. Again, this assumption is made for the sake of simplicity, and it is noted that the model to be developed below is capable of incorporating different assumptions regarding the government's behavior.

3.2. Notation

The subscript 1 refers to the corporate and the subscript 2 refers to the non-corporate sector. A symbol with an asterisk denotes a percentage change, for example, $X_1^* = dX_1/X_1$.

X_i = output of the ith sector, i = 1,2.

L_i = employment of labor in the ith sector, i = 1,2.

K_i = employment of capital in the ith sector, i = 1,2.

T_i = employment of land in the ith sector, i = 1,2.

r_i = real rental of capital in the ith sector, i = 1,2.

w_i = real wage rate in the ith sector, i = 1,2.

m_i = real rental of land in the ith sector, i = 1,2.

p_i = price of the ith sector's product.

L = total employment of labor.

$\bar{K}$ = total supply of capital which is fully employed.

$\bar{T}$ = total supply of land which is fully employed.

C_{ij} = the proportion of the ith input required to produce one unit of the jth good.

λ_{ij} = the proportion of the ith factor utilized in the production of the jth good, e.g. $\lambda_{K1} = K_1/K$.

θ_{ij} = input i's distributive share in industry j, e.g. $\theta_{K1} = r_1K_1/p_1X_1$.

θ_i = input i's distributive share in national income.

σ_{LK}^1 = the elasticity of factor substitution in the first sector.

σ_{ij}^2 = the partial elasticity of substitution between the ith good and the jth factors in the agricultural sector.

E_1 = the price elasticity of demand for the product of the manufacturing sector.

t_{ij} = a partial tax on i in sector j, i = L,K,T,X.

t_i = a general tax on i, i = L,K,T,X.

a_{ij}, a_i = one minus the tax rate.

3.3. Basic Equations of the Model

In this section we shall set out the basic equations of the model. For illustrative purposes, we shall consider the case of a corporation income tax in discussing the basic features of the model. The approach taken in this formulation is similar to that of Jones [1971], Batra and Casas [1976], and Neary [1978].

Full-Employment Equations

$$C_{K1}X_1 + C_{K2}X_2 = \bar{K}, \tag{1}$$

$$C_{T2}X_2 = \bar{T}. \tag{2}$$

Competitive Profit Conditions

Under competitive conditions, the input cost per unit of each commodity equals its market price. Also, as a result of our assumption of perfect intersectoral mobility of capital and labor, we get $r_1 a_{K1} = r_2 = r$, and $w_1 = w_2 = w$. We may then write

$$C_{L1}w + C_{K1}r/a_{K1} = p_1, \tag{3}$$

$$C_{L2}w + C_{K2}r + C_{T2}m = p_2. \tag{4}$$

With $a_{K1} < 1$ initially, we have the case of a marginal increase in an already existing tax, whereas with $a_{K1} = 1$, we have the case of an impact tax. In what follows, we shall for the sake of algebraic simplicity consider only impact taxes.[4]

Factor Demand Equations

With quasi-concave and linearly homogeneous production functions, each input-output coefficient is independent of the scale of output, and is a function

solely of input prices. Accordingly, we have

$$C_{i1} = C_{i1}(w,\ r/a_{K1}), \quad i = L,K, \tag{5}$$

and

$$C_{i2} = C_{i2}(w,\ r,\ m), \quad i = L,K,T. \tag{6}$$

Rigidity of Wages

$$w^* = 0. \tag{7}$$

Product Market Equation

Following Harberger, we express the demand function as a function of relative prices alone. This gives

$$X_1^* = E_1(p_1^* - p_2^*), \tag{8}$$

where E_1 is non-positive.

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Since we are interested in relative price movements alone, we can express all other prices in terms of the second commodity's price. That is,

$$p_2^* = 0. \tag{9}$$

The set of equations (1)-(9) completes the description of the model. The set includes twelve equations in twelve endogenous variables (X_j, C_{ij}, w, r, m, p_1 and p_2), and three exogenous variables (a, $\bar{K}$ and $\bar{T}$). Therefore, using this model we can solve for changes in the sectoral distribution of employment, as well as its overall level, consequent to a parametric change in the tax rate.

3.4. Solution of the Model

In order to solve the model, it is necessary to relate changes in the endogenous variables to changes in the corporate income tax rate by differentiating the entire system of equations. Differentiating Equations (1) and (2) first, we obtain

$$\lambda_{K1}X_1^* + \lambda_{K2}X_2^* = -(\lambda_{K1}C_{K1}^* + \lambda_{K2}C_{K2}^*), \tag{10}$$

$$X_2^* = -C_{T2}^*. \tag{11}$$

It may be noted that $\lambda_{i1} + \lambda_{i2} = 1$, $i = K,L,T$.

Differentiating Equations (3) and (4), and using the conditions for cost minimization,[5] we obtain

$$\theta_{L1}w^* + \theta_{K1}r^* = p_1^* + \theta_{K1}a_{K1}^*, \tag{12}$$

$$\theta_{L2}w^* + \theta_{K2}r^* + \theta_{T2}m^* = p_2^*. \tag{13}$$

We note again that $\theta_{Lj} + \theta_{Kj} + \theta_{Tj} = 1$, $j = 1,2$. The reader is reminded that the specificity of land implies that $\theta_{T1} = 0$.

We also need to express the change in each C_{ij} in terms of changes in input prices by totally differentiating Equations (5)-(7). We can then write:

$$C_{L1}^* = -\theta_{K1}\sigma_{LK}^1(w^* - r^* + a_{K1}^*), \tag{14}$$

$$C_{K1}^* = \theta_{L1}\sigma_{LK}^1(w^* - r^* + a_{K1}^*), \tag{15}$$

$$C_{L2}^* = -\theta_{K2}\sigma_{LK}^2(w^* - r^*) - \theta_{T2}\sigma_{LT}^2(w^* - m^*), \tag{16}$$

$$C_{K2}^* = \theta_{L2}\sigma_{LK}^2(w^* - r^*) - \theta_{T2}\sigma_{KT}^2(r^* - m^*), \tag{17}$$

$$C_{T2}^* = \theta_{L2}\sigma_{LT}^2(w^* - m^*) + \theta_{K2}\sigma_{KT}^2(r^* - m^*). \tag{18}$$

Now, using Equations (7)-(9), we can reduce Equations (10)-(19) to a system of four equations in the variables L_1^*, L_2^*, r^* and m^*. The procedure is outlined below. We have

$$L_1^* = X_1^* + C_{L1}^*.$$

Substituting for X_1^* from Equation (8), C_{L1}^* from Equation (14), and using Equations (7) and (9), we get

$$L_1^* = E_1 p_1^* + \theta_{K1}\sigma_{LK}^1(r^* - a_{K1}^*).$$

Substituting further for p_1^* from Equation (12), we obtain

$$L_1^* - \theta_{K1}(E_1 + \sigma_{LK}^1)r^* = -\theta_{K1}(E_1 + \sigma_{LK}^1)a_{K1}^*. \tag{19}$$

The change in employment in the agricultural sector is given by

$$L_2^* = X_2^* + C_{L2}^*.$$

Using Equations (7), (9), (11), (16) and (18), we can rewrite this as

$$L_2^* - \theta_{K2}(\sigma_{LK}^2 - \sigma_{KT}^2)r^* - [\theta_{K2}\sigma_{KT}^2 + (1 - \theta_{K2})\sigma_{LT}^2]m^* = 0. \tag{20}$$

Using the assumption of wage rigidity and the numéraire equation, we can write Equation (13) as

$$\theta_{K2}r^* + \theta_{T2}m^* = 0. \tag{21}$$

Finally, substituting for X_1^*, X_2^*, C_{K1}^* and C_{K2}^* from Equations (8), (11), (15) and (17) in Equation (10), and using Equations (12), (7) and (9), we obtain

$$Ar^* + Bm^* = \lambda_{K1}(E_1\theta_{K1} - \theta_{L1}\sigma_{LK}^1)a_{K1}^*, \tag{22}$$

where

$$A = \lambda_{K1}(E_1\theta_{K1} - \sigma^1_{LK}\theta_{L1}) - \lambda_{K2}\{(1 - \theta_{L2})\sigma^2_{KT} + \theta_{L2}\sigma^2_{LK}\},$$

$$B = \lambda_{K2}\{(1 - \theta_{L2})\sigma^2_{LT} + \theta_{L2}\sigma^2_{KT}\}.$$

We can now rewrite Equations (19)-(22) in matrix form.

$$\begin{bmatrix} 1 & 0 & -\theta_{K1}(E_1+\sigma^1_{LK}) & 0 \\ 0 & 1 & -\theta_{K2}(\sigma^2_{LK}-\sigma^2_{KT}) & -\{\theta_{K2}\sigma^2_{KT}+(1-\theta_{K2})\sigma^2_{LT}\} \\ 0 & 0 & \theta_{K2} & \theta_{T2} \\ 0 & 0 & A & B \end{bmatrix} \begin{bmatrix} L_1^* \\ L_2^* \\ r^* \\ m^* \end{bmatrix} = \begin{bmatrix} -\theta_{K1}(E_1+\sigma^1_{LK}) \\ 0 \\ 0 \\ \lambda_{K1}(E_1\theta_{K1}-\theta_{L1}\sigma^1_{LK}) \end{bmatrix} a^*_{K1}. \tag{23}$$

Denoting the determinants of coefficients in (23) by D, it is readily shown that

$$D = \lambda_{K2}\theta_{K2}\{\theta_{L2}\sigma^2_{LT} + (1 - \theta_{L2})\sigma^2_{KT}\} + \theta_{T2}[\lambda_{K2}\{(1 - \theta_{L2})\sigma^2_{KT} + \theta_{L2}\sigma^2_{LK}\} - \lambda_{K1}(E_1\theta_{K1} - \sigma^1_{LK}\theta_{L1})].$$

If we assume that all partial elasticities of substitution are positive, that is, that all factors are weak substitutes for each other, then D is positive. With three factors, however, it is possible that $\sigma^2_{ij} < 0$, although at most one of the partial elasticities can be negative, if the production function for X_2 is strictly quasi-concave. It is possible to demonstrate that D is positive even when one of these partial elasticities is negative.[6] However, for our purposes no serious loss of generality is involved if we assume that all partial elasticities are non-negative. Accordingly, in what follows we shall make this assumption.

Having determined the sign of D, it is now a simple matter to obtain the expression for the impact of a change in the tax rate on the levels of employment both at the sectoral and the economy-wide level. For example, in the case

of the corporation income-tax L_1^* and L_2^* are immediately derivable from (23). Noting that

$$L^* = \lambda_{L1}L_1^* + \lambda_{L2}L_2^*,$$

the change in the overall level of employment can easily be determined.

4. Employment Effect of Different Taxes

In this section we shall analyze the effect of some of the more important taxes on the overall level of employment, and in the next section consider the differential impact on employment of different equal-rate and equal-yield taxes. Such an exercise is useful because by evaluating various tax proposals, it would be possible for the policy maker to choose that tax which has the least adverse (most beneficial) effect on employment, ceteris paribus. No formal theoretical model (known to the author) has yet been developed, which would allow us to examine this question. One of the uses to which the model developed in this study can be put is to analyze this question, as we shall now demonstrate.

In determining the impact of different taxes on employment, all that we need to do is replace the right-hand side of (23) with the appropriate expressions. This is because when we consider different taxes some of the Equations (1)-(9) are modified. The modified equations under different tax regimes, and the overall effect on employment as a result of changes in these taxes are listed below.

Partial Tax on Capital in Sector 1

The relevant expressions in this case have already been discussed. The effect of a change in the overall level of employment due to a change in this tax rate is given by

$$\frac{L^*}{a^*_{K1}} = -\frac{1}{D}\{\lambda_{L1}\theta_{K1}(E_1 + \sigma^1_{LK})[\theta_{K2}B + \lambda_{K2}\theta_{T2}\{(1 - \theta_{L2})\sigma^2_{KT} + \theta_{L2}\sigma^2_{KL}\}]$$
$$- \lambda_{L2}\lambda_{K1}(E_1\theta_{K1} - \theta_{L1}\sigma^1_{LK})\theta_{K2}C\}, \tag{24}$$

where

$$C = \{(1 - \theta_{L2})\sigma^2_{KT} + (1 - \theta_{K2})\sigma^2_{LT} - \theta_{T2}\sigma^2_{KL}\}.$$

Partial Tax on Capital in Sector 2

The following equations are modified as a result of the introduction of a partial tax on K_2:

$$C_{L1}w + C_{K1}r = p_1, \tag{3.1}$$

$$C_{L2}w + C_{K2}r/a_{K2} + C_{T2}m = p_2, \tag{4.1}$$

$$C_{i1} = C_{i1}(w, r), \quad i = L,K, \tag{5.1}$$

$$C_{i2} = C_{i2}(w, r/a_{K2}, m), \quad i = L,K,T. \tag{6.1}$$

The right hand column of the matrix in (23) is now given by the transpose of

$$[0 \quad -\theta_{K2}(\sigma^2_{LK} - \sigma^2_{KT}) \quad \theta_{K2} \quad -\lambda_{K2}\{(1 - \theta_{L2})\sigma^2_{KT} + \theta_{L2}\sigma^2_{KL}\}]a^*_{K2}.$$

The impact on employment of a change in this tax rate is found to be

$$\frac{L^*}{a^*_{K2}} = \frac{1}{D}\{\lambda_{L1}\theta_{K1}(E_1 + \sigma^1_{LK})[\theta_{K2}B + \lambda_{K2}\theta_{T2}\{(1 - \theta_{L2})\sigma^2_{KT} + \theta_{L2}\sigma^2_{KL}\}]$$
$$- \lambda_{K2}\lambda_{K1}(E_1\theta_{K1} - \theta_{L1}\sigma^1_{LK})\theta_{K2}C\}. \tag{25}$$

Note that the effect of a partial tax on capital in this sector is identical in magnitude but opposite in sign to that of a partial tax on capital in sector 1.

Partial Tax on Land

Much has been written regarding the incidence effects of a tax on the rental of land. We now examine the effect of such a tax on the level of employment. The modified equations are

$$C_{L2}w + C_{K2}r + C_{T2}m/a_{T2} = p_2, \tag{4.2}$$

$$C_{i2} = C_{i2}(w, r, m/a_{T2}), \quad i = L,K,T. \tag{5.2}$$

The right hand column of the matrix in (23) is given by the transpose of

$$[0 \quad \{(1 - \theta_{K2})\sigma^2_{LT} + \theta_{K2}\sigma^2_{KT}\} \quad \theta_{T2} \quad B]a^*_{T2}.$$

Solving for L^*_1 and L^*_2, we can determine the overall change in employment as

$$L^*/a^*_{T2} = 0. \tag{26}$$

This is an eminently plausible result, and follows from the specificity of land. Indeed, we find that the only effect of this tax is to raise the rental of land by the amount of the tax.

Partial Tax on X_1

Commodity taxes are usually a favorite with the policy makers in developing countries, perhaps because of their administrative simplicity. The modified equations are

$$C_{L1}w + C_{K1}r = p^1a_{X1}, \tag{3.3}$$

$$C_{L2}w + C_{K2}r + C_{T2}m = p_2, \tag{4.3}$$

$$C_{i1} = C_{i1}(w, r), \quad i = L,K, \tag{5.3}$$

$$C_{i2} = C_{i2}(w, r, m), \quad i = L,K,T. \tag{6.3}$$

In Equation (3.3), the price paid by the consumer p^1 is related to the producer price p_1 by $p_1 = p^1 a_{X1}$.

The transpose of the row vector given below represents the right hand side of the matrix in (23). That is,

$$[-E_1 \quad 0 \quad 0 \quad \lambda_{K1}E_1]a^*_{X1}.$$

We also have

$$\frac{L^*}{a^*_{X1}} = -\frac{1}{D}[\lambda_{L1}E_1\{\lambda_{K1}\theta_{K1}\theta_{T2}(E_1 + \sigma^1_{LK}) + (\theta_{K2}B - \theta_{T2}A)\}$$
$$- \lambda_{L1}E_1\lambda_{K1}\theta_{K2}C]. \tag{27}$$

<u>Partial Tax on X_2</u>

The modified equations in this case are

$$wC_{L1} + rC_{K1} = p_1, \tag{3.4}$$

$$wC_{L2} + rC_{K2} + mC_{T2} = p^2 a_{X2}, \tag{4.4}$$

$$C_{i1} = C_{i1}(w, r), \quad i = L,K, \tag{5.4}$$

$$C_{i2} = C_{i2}(w, r, m), \quad i = L,K,T, \tag{6.4}$$

where p^2 is the consumer price of X_2, and $p^2 = p_2 a_{X2}$.

The right-hand side of the matrix in (23) is given by the transpose of the vector

$$[0 \quad 0 \quad a^*_{X2} \quad 0].$$

Solving the system in (23), we find that the total effect on employment is given by

$$\frac{L^*}{a^*_{X2}} = \frac{1}{D}\,[\lambda_{L1}\theta_{K1}(E_1 + \sigma^1_{LK})B - \lambda_{L2}\lambda_{K1}(E_1\theta_{K1} - \theta_{L1}\sigma^1_{LK})$$
$$\{\theta_{K2}\sigma^2_{KT} + (1 - \theta_{K2})\sigma^2_{LT}\} + \lambda_{K2}\lambda_{L2}\{\theta_{L2}\sigma^2_{KL}\sigma^2_{LT}$$
$$+ \theta_{K2}\sigma^2_{KL}\sigma^2_{KT} + \theta_{T2}\sigma^2_{KT}\sigma^2_{LT}\}]. \tag{28}$$

Equations (24)-(28) give the expressions for the impact of various partial taxes on the overall level of employment. The only partial taxes not considered above are taxes on labor in the two sectors. However, such taxes are of little practical interest, and for the sake of brevity we do not discuss them here.

We turn now to a consideration of some of the more important general taxes, which are in existence in the LDCs. The modified equations for these taxes and the solutions are given below.

General Tax on Capital

$$wC_{L1} + (r/a_K)C_{K1} = p_1, \tag{3.5}$$

$$wC_{L2} + (r/a_K)C_{K2} + mC_{T2} = p_2, \tag{4.5}$$

$$C_{i1} = C_{i1}(w,\ r/a_K), \quad i = L,K, \tag{5.5}$$

$$C_{i2} = C_{i2}(w,\ r/a_K,\ m), \quad i = L,K,T. \tag{6.5}$$

The right-hand side of (23) is given by

$$[-\theta_{K1}(E_1 + \sigma^1_{LK}) \quad -\theta_{K2}(\sigma^2_{LK} - \sigma^2_{KT}) \quad \theta_{K2} \quad A]'.$$

The solution yields

$$L^*/a^*_K = 0. \tag{29}$$

This result is not surprising since no transfer of resources occurs between the sectors. Moreover, since capital is constrained to be fully employed, it follows that the overall level of employment does not change.

General Sales Tax

A general sales (commodity) tax imposed at the same rate on both sectors results in the following modified equations:

$$wC_{L1} + rC_{K1} = p^1 a_X, \tag{3.6}$$

$$wC_{L2} + rC_{K2} + mC_{T2} = p^2 a_X, \tag{4.6}$$

$$C_{i1} = C_{i1}(w, r), \quad i = L,K, \tag{5.6}$$

$$C_{i2} = C_{i2}(w, r, m), \quad i = L,K,T. \tag{6.6}$$

The right-hand side of (23) is given by

$$[-E_1 a_X^* \quad 0 \quad a_X^* \quad \lambda_{K1} E_1 a_X^*]'.$$

$$\frac{L^*}{a_X^*} = \frac{1}{D}\,[\lambda_{L1}\{\theta_{K1}(E_1 + \sigma_{LK}^1)(B - \lambda_{K1}E_1\theta_{T2}) - E_1(\theta_{K2}B - \theta_{T2}A)\}$$
$$+ \lambda_{L2}\{\theta_{K2}\sigma_{LK}^2 B + \lambda_{K1}\theta_{L1}\sigma_{LK}^1[\theta_{K2}\sigma_{KT}^2 + (1 - \theta_{K2})\sigma_{LT}^2]$$
$$- \lambda_{K1}E_1[\theta_{K2}(\theta_K - \theta_T)\sigma_{KT}^2 + \theta_{K1}(1 - \theta_{K2})\sigma_{LT}^2 + \theta_{K2}\theta_{T2}\sigma_{LK}^2]\}]. \tag{30}$$

General Income Tax

The modified equations in this case are

$$w/a_L\, C_{L1} + r/a_K\, C_{K1} = p_1, \tag{3.7}$$

$$w/a_L\, C_{L2} + r/a_K\, C_{K2} + m/a_T\, C_{T2} = p_2, \tag{4.7}$$

$$C_{i1} = C_{i1}(w/a_L,\ r/a_K), \quad i = L,K, \tag{5.7}$$

$$C_{i2} = C_{i2}(w/a_L,\ r/a_K,\ m/a_T), \quad i = L,K,T. \tag{6.7}$$

We note, however, that because of the equality of tax rates on all income sources, we have

$$a_K^* = a_L^* = a_T^*.$$

Also, since the C_{ij} functions are homogeneous of degree zero, the effect on employment in this case is identical to that of a general sales tax. This follows immediately from the fact that the right-hand side of (23) is identical to that which would obtain with a general sales tax.

This completes the analysis of general taxes. The only general tax not considered by us is a tax on labor because of its limited interest. The reader is reminded that a partial tax on land is identical to a general tax because of the specificity of this factor.

5. A Comparison of Different Taxes

In this section we shall attempt to compare the various taxes discussed above with a view to analyzing their differential impact on employment. We shall divide the analysis into two parts. In the first part we shall consider equal-rate taxes, and in the second part we shall compare equal-yield taxes since revenue generation is an important objective of taxation. Finally, we shall conclude by making some general observations regarding these taxes.

5.1. Equal-Rate Taxes

A Tax on Capital versus a Commodity Tax in Sector 1

The policy maker in LDCs is often faced with the choice of imposing a tax on capital or a sales tax in the manufacturing sector. If it is assumed that

the effect of such taxes on the overall level of employment is an important criterion in choosing between these two taxes, then the following theoretical proposition would aid in the decision-making process.

Proposition 1.

(i) If $\sigma^1_{LK} \gtreqqless |E_1|$, and $(1 - \theta_{L2})\sigma^2_{KT} + (1 - \theta_{K2})\sigma^2_{LT} \gtreqqless \theta_{T2}\sigma^2_{KL}$ (with one of the inequalities holding strictly), then a tax on capital increases (decreases) employment more (less), when compared to a sales tax. This is a sufficient but not a necessary condition.

(ii) If the production functions in the agricultural sector are of the Leontief type, then a tax on capital is preferable to a sales tax. However, if in addition $\sigma^1_{LK} = 0$, then the two taxes are identical from the employment perspective.

(iii) If $E_1 = 0$, and $(1 - \theta_{L2})\sigma^2_{KT} + (1 - \theta_{K2})\sigma^2_{LT} < \theta_{T2}\sigma^2_{KL}$, then a sales tax is to be preferred.

The above proposition is immediate from the fact that

$$\left(\frac{L^*}{a^*_{K1}} - \frac{L^*}{a^*_{X1}}\right)_{a^*_{K1}=a^*_{X1}} = -\frac{1}{D}\,[\lambda_{L2}\lambda_{K1}\theta_{K2}(E_1 + \sigma^1_{LK})C - \lambda_{L1}\lambda_{K2}\theta_{L1}E_1\{\theta_{K2}\theta_{L2}\sigma^2_{LT} + (1 - \theta_{L2})^2\sigma^2_{KT} + \theta_{T2}\theta_{L2}\sigma^2_{LK}\} - \lambda_{L1}\lambda_{K1}\theta_{T2}E_1\sigma^1_{LK}]. \tag{31}$$

A Tax on Capital versus a Commodity Tax in Sector 2

Although the agricultural sector is by and large exempt from taxation in the LDCs, subsidies in this sector are very important. The argument below is easily modified to analyze, for example, a subsidy on fertilizer use or on the price of the product. For the sake of continuity we shall analyze the case of

taxes, but the reader can easily modify the proposition by reversing the conditions for the taxes, in order to analyze subsidies.

Proposition 2.

(i) Proposition 1(i) applies.

(ii) If the production function in the agricultural sector is of the Leontief type, then the differential impact on employment of the two taxes is zero.

(iii) For a sales tax to be preferred either $|E_1| > \sigma^1_{LK}$ or $(1 - \theta_{L2})\sigma^2_{KT} + (1 - \theta_{K2})\sigma^2_{LT} < \theta_{T2}\sigma^2_{KL}$, but not both. This is only a necessary condition.

The above proposition is derivable from the fact that

$$\left(\frac{L^*}{a^*_{K2}} - \frac{L^*}{a^*_{X2}}\right)_{a^*_{K2}=a^*_{X2}} = -\frac{1}{D}\,[\lambda_{L1}\lambda_{K2}(E_1 + \sigma^1_{LK})\theta_{L2}C - \lambda_{K1}\lambda_{L2}(E_1\theta_{K1} - \theta_{L1}\sigma^1_{LK})$$
$$\{\theta_{K2}\theta_{L2}\sigma^2_{KT} + (1 - \theta_{K2})^2\sigma^2_{LT} + \theta_{K2}\theta_{T2}\sigma^2_{LK}\}$$
$$+ \lambda_{K2}\lambda_{L2}\{\theta_{L2}\sigma^2_{KL}\sigma^2_{LT} + \theta_{K2}\sigma^2_{KL}\sigma^2_{KT} + \theta_{T2}\sigma^2_{KT}\sigma^2_{LT}\}]. \quad (32)$$

The theoretical propositions regarding the employment effects of sales taxes and capital-income taxes are easily explained. For example, in Proposition 1(i), we find that a large elasticity of factor substitution favors a tax on capital, whereas a large elasticity of demand favors a commodity tax. This is a result of the substitution effects, and is applicable to the impact in the first sector. In the agricultural sector, the differential impact of a tax on capital is always favorable. However, the smaller the elasticity of substitution between capital and labor, given that $\sigma^1_{LK} > |E_1|$, the less will capital be substituted for labor, as a result of the movement of capital from the taxed to the untaxed sector.

Again, in Proposition 1(ii), we see that since with Leontief type production functions, no factor substitution is possible, the only effect is through

the impact on demand. Consequently, we find that a tax on capital has no effect on employment, whereas a commodity tax reduces employment unambiguously.

Tax on Land versus Capital in Sector 2

The following proposition is available:

Proposition 3.

(i) If $\sigma^1_{LK} \geq |E_1|$, and $(1 - \theta_{L2})\sigma^2_{KT} + (1 - \theta_{K2})\sigma^2_{LT} \geq \theta_{T2}\sigma^2_{KL}$ (with one of the inequalities holding strictly), then a tax on land is preferable to a tax on capital. This is a sufficient condition.

(ii) Proposition 2(ii) applies.

(iii) If $\sigma^1_{LK} \leq |E_1|$, and $(1 - \theta_{L2})\sigma^2_{KT} + (1 - \theta_{K2})\sigma^2_{LT} \leq \theta_{T2}\sigma^2_{KL}$ (with one of the inequalities holding strictly), then a tax on capital is preferable.

These results are directly explicable by the fact that the employment effect of a tax on land is zero. Consequently, we have

$$\left(\frac{L^*}{a^*_{K2}} - \frac{L^*}{a^*_{T2}}\right)_{a^*_{K2}=a^*_{T2}} = \frac{L^*}{a^*_{K2}}, \tag{33}$$

the expression for which is given in Equation (25). It therefore follows that the conditions which lead to a tax on capital increasing (decreasing) the level of employment are identical to the conditions which lead to a preference for a tax on capital (land).

A Tax on Land versus a Sales Tax in Sector 2

Noting again that

$$\left(\frac{L^*}{a^*_{X2}} - \frac{L^*}{a^*_{T2}}\right)_{a^*_{X2}=a^*_{T2}} = \frac{L^*}{a^*_{X2}}, \tag{34}$$

which implies that the differential impact of the two taxes is dependent on whether employment increases or decreases as a result of the commodity tax, the following proposition is immediate.

Proposition 4.

(i) A sufficient condition for a tax on land to be preferable is that $\sigma^1_{LK} \geq |E_1|$.

(ii) Proposition 2(ii) applies.

(iii) A necessary condition for a commodity tax to be preferred is $\sigma^1_{LK} < |E_1|$.

Propositions 3 and 4 are easily explained. For example, in Proposition 3, as a result of the tax on capital in this sector, capital moves to sector 1. Also, since the relative price of the manufactured goods fall, demand increases in this sector. Thus, a low elasticity of demand, and a high elasticity of factor substitution in this sector adversely effects the level of employment. In the agricultural sector, there is a tendency to substitute land and labor for capital. A small elasticity of substitution between capital and labor in this sector adversely effects the level of employment in this sector. Proposition 4 is explicable by a similar argument.

Tax on Capital in Sector 1 versus Sector 2

Proposition 5.

(i) Proposition 1(i) applies.

(ii) Proposition 2(ii) applies.

(iii) If $|E_1| \leq \sigma^1_{LK}$ and $\theta_{T2}\sigma^2_{KL} \leq (1 - \theta_{L2})\sigma^2_{KT} + (1 - \theta_{K2})\sigma^2_{LT}$ (with one of the inequalities holding strictly), a tax on the non-corporate sector is preferable.

These results are immediate once we note that

$$\left(\frac{L^*}{a^*_{K1}} = -\frac{L^*}{a^*_{K2}}\right)_{a^*_{K1}=a^*_{K2}} . \tag{35}$$

Tax on Capital in Sector 1 and Land in Sector 2

The capitalists in the manufacturing sector and the landlords in the agricultural sector are both powerful lobbies in the developing countries. In choosing between taxing one of these two groups, the employment effects can be compared by using the theoretical structure developed here.

Proposition 6.

(i) Proposition 1(i) applies.

(ii) Proposition 2(ii) applies.

(iii) Proposition 5(iii) applies.

The above proposition follows from the fact that a choice between these two taxes is dependent on whether a tax on capital in sector 1 increases or decreases employment. This is because the tax on land has no effect on employment. Therefore,

$$\left(\frac{L^*}{a^*_{K1}} - \frac{L^*}{a^*_{T2}}\right)_{a^*_{K1}=a^*_{T2}} = \frac{L^*}{a^*_{K1}} . \tag{36}$$

General Tax on Capital versus Land

Proposition 7.

From the employment perspective these two taxes are identical.

This follows from the result that neither of these taxes have any effect on employment.

General Sales Tax versus Capital Tax

We first note that these results would apply equally well if we interchanged sales with income, and capital with land. This is because a general sales tax is identical to a general income tax, if the tax rate is equal on all factor incomes. Also, as noted previously, the overall employment effect of a general capital tax and a land tax are both zero.

Proposition 8.

(i) With $\sigma^1_{LK} \geqq |E_1|$ and $\theta_K \geqq \theta_T$, a tax on capital is preferable. These are sufficient conditions.

(ii) A necessary condition for a sales tax to be preferred is that $\sigma^1_{LK} < |E_1|$ or $\theta_K < \theta_T$.

(iii) With Leontief type production functions in sector 2, and $\sigma^1_{LK} \geqq |E_1|$, a tax on capital is preferable.

These results are also in the expected direction. As has been mentioned before, a large elasticity of factor substitution in the corporate sector tends to reduce employment when a sales tax is imposed. We also note that in this case

$$\left(\frac{L^*}{a^*_X} - \frac{L^*}{a^*_K}\right)_{a^*_X = a^*_K} = \frac{L^*}{a^*_X}, \tag{37}$$

where the solution for L^*/a^*_X is given in Equation (30).

This completes the discussion of the relative impacts of some of the more important taxes on the overall level of employment. We have not exhausted the possibilities, but the discussion above indicates the procedure for any such analysis. We now turn our attention to a comparison of equal-yield taxes.

5.2. Equal-Yield Taxes

It may be of greater interest to evaluate the employment effects of equal-yield taxes rather than equal-rate taxes since revenue generation is often the major objective of tax policy. Although the differential impact of equal-yield and equal-rate taxes are usually different in magnitude, the choice of one tax versus another is often conditional on the relative size of the same elasticities. Accordingly, I shall derive the conditions for equal-yield taxes, and in comparing different taxes (where possible), refer to the relevant propositions discussed in the context of equal-rate taxes.

A Tax on Capital versus a Commodity Tax in Sector 1

$$\text{Capital tax yield} = \text{gross income} - \text{net income}$$
$$= (r/a_{K1})K_1 - rK_1.$$

$$\text{Commodity tax yield} = (p_1/a_{X1})X_1 - p_1X_1.$$

The equal-yield condition is

$$(r/a_{K1})K_1 - rK_1 = (p_1/a_{X1})X_1 - p_1X_1.$$

Differentiating and noting that initially the tax is zero, we get

$$a^*_{X1} = \theta_{K1}a^*_{K1}.$$

This yields

$$\left(\frac{L^*}{a^*_{K1}} - \frac{L^*}{a^*_{X1}}\right)_{a^*_{X1}=\theta_{K1}a^*_{K1}} = -\frac{1}{D}\left[\lambda_{L2}\lambda_{K1}\theta_{K2}\theta_{L1}\sigma^1_{LK}C - \lambda_{L1}\lambda_{K1}\theta_{K1}\theta_{T2}\sigma^1_{LK}E_1\right]. \quad (38)$$

Proposition 9.

(i) If $(1 - \theta_{L2})\sigma^2_{KT} + (1 - \theta_{K2})\sigma^2_{LT} > \theta_{T2}\sigma^2_{KL}$, a tax on capital is preferable. This is a sufficient condition.

(ii) If Leontief production functions prevail in sector 1 then the differential impact is zero.

(iii) If Leontief production functions prevail only in the agricultural sector then a tax on capital is preferable.

The conditions for a tax on capital to be preferred are weaker in the case of equal-yield taxes. This is because equal-yield taxation implies that capital has to be taxed at a higher rate so that those conditions which implied that employment increased consequent to an imposition of a tax on capital need now be weaker. Indeed, we note that the relative magnitudes of the elasticities of factor substitution, and that of demand in the manufacturing sector, are no longer critical.

A Tax on Capital versus a Commodity Tax in Sector 2

The condition for equal-yield in this case implies that

$$a^*_{X2} = \theta_{K2} a^*_{K2}.$$

Proposition 10.

(i) A tax on capital is preferable, if $|E_1| \geqq \sigma^1_{LK}$, and $\sigma^2_{KT} \geqq \sigma^2_{LK}$. This is a sufficient condition.

(ii) Proposition 2(ii) applies.

(iii) If $\sigma^2_{KL} = \sigma^2_{KT} = 0$, and $\sigma^1_{LK} > |E_1|$, then a commodity tax is preferable.

These results follow from the fact that we now have

$$\left(\frac{L^*}{a^*_{K2}} - \frac{L^*}{a^*_{X2}}\right)_{a^*_{K2}=\theta_{K2}a^*_{X2}} = \frac{1}{D}\,[\lambda_{K2}\lambda_{L1}\theta_{L1}\theta_{T2}(E_1 + \sigma^1_{LK})\{(1 - \theta_{L2})\sigma^2_{KT} + \theta_{L2}\sigma^2_{KL}\} - \lambda_{K1}\lambda_{L2}\theta_{K2}\theta_{T2}(E_1\theta_{K1} - \theta_{L1}\sigma^1_{LK})(\sigma^2_{KT} - \sigma^2_{LK}) - \lambda_{K2}\lambda_{L2}\{\theta_{L2}\sigma^2_{KL}\sigma^2_{LT} + \theta_{K2}\sigma^2_{KL}\sigma^2_{KT} + \theta_{T2}\sigma^2_{KT}\sigma^2_{LT}\}]. \tag{39}$$

It is interesting to observe that the conditions on the demand and factor substitution elasticities in the manufacturing sector are reversed when we consider equal-rate and equal-yield taxes. However, note that with $\sigma^1_{LK} \geq |E_1|$, a tax on capital in this sector leads to a decline in employment in sector 1. Therefore, a higher rate of tax on capital vis-à-vis a sales tax leads to a reversal of this elasticity condition.

The differential impact of any tax when compared to a tax on land does not change when we consider equal-yield or equal-rate taxes. This is because of the invariance of the level of employment to a tax on land. Accordingly, Propositions 3, 4 and 6 continue to hold.

Tax on Capital in Sector 1 and 2

The equal-yield condition is given by

$$a^*_{K2} = (K_1/K_2)a^*_{K1}.$$

Noting that

$$\left(\frac{L^*}{a^*_{K1}} - \frac{L^*}{a^*_{K2}}\right)_{a^*_{K2}=(K_1/K_2)a^*_{K1}} = \tfrac{1}{2}\,\frac{(K_1 + K_2)}{K_2}\left(\frac{L^*}{a^*_{K1}} - \frac{L^*}{a^*_{K2}}\right)_{a^*_{K1}=a^*_{K2}}, \tag{40}$$

it follows that Proposition 5 is valid for an equal-yield comparison.

A comparison of equal-yield general taxes yield the same conditions as equal-rate taxes. Again, this is due to the fact that a general tax on capital and land have no effect on employment. It follows therefore that Propositions 7 and 8 continue to hold.

6. Conclusion

In Section 5 we compared a large number of taxes with regard to their effect on employment. In the majority of cases, we found that equal-yield and equal-rate taxes gave rise to similar conditions. This study does not claim to have made an exhaustive comparison of all taxes, but suggests a methodology whereby a comparison between two or more taxes can be carried out.

From an empirical standpoint, we find that most of the results hinge on the magnitudes of the elasticity of demand and factor substitution in the manufacturing sector, and the magnitudes of the partial elasticities of substitution between the factors in the agricultural sector. In practice, it is not unreasonable to assume that Cobb-Douglas production functions prevail in both the sectors.[7] Also, the elasticity of demand in the manufacturing sector is likely to be less than unity.[8] In the Appendix, we demonstrate that with Cobb-Douglas production functions, all cross-partial elasticities are positive and equal to one. With these empirical values of the elasticities in mind the following conclusions can be derived:

(i) A tax on capital in any sector is preferable to an equal-rate sales tax in that sector from the employment perspective.

(ii) A tax on land is preferable to a tax on capital, and by implication to a sales tax in the agricultural sector.

(iii) A tax on capital in the manufacturing sector is preferable to a tax on capital in the agricultural sector.

(iv) A tax on capital in the manufacturing sector is preferable to a tax on land in the agricultural sector.

With the availability of more empirical data, many additional such conclusions can be derived. Moreover, results in the tradition of Mieszkowski's [1967] analysis of tax incidence are also derivable in the context of our model. For example, it is easy to demonstrate that equal-rate taxes on factors imposed in the same sector are equivalent to a commodity tax in that sector.

The results mentioned above are meant only to indicate the usefulness of our theoretical model, and in no way exhaust the possibility of its applicability. However, our study provides a methodology to evaluate the employment effect of various taxes before choosing between them. We need hardly stress the usefulness of such an exercise, especially when employment creation is considered to be of paramount importance in the formulation of national policies.

PART II

1. Introduction

In the first part of the paper we compared the overall impact on employment of various equal-rate and equal-yield taxes. We now go on to a detailed analysis of the employment effect of a particular tax, namely the corporation income-tax, both at the sectoral and at the economy wide level.

We shall discuss this question in the context of two different frameworks. In the first case, we shall assume that the country is "small," that is, the relative output prices are fixed. Such an assumption may be valid for small open economies such as Taiwan. Alternatively, we shall postulate that the commodity prices are variable, that is, using the model developed in the first part of the paper analyze the employment question is some detail. This latter analysis is likely to be of greater validity in the context of relatively closed, labor surplus economies such as India. Finally, using the theoretical results from the latter model, we shall obtain numerical estimates for the impact on employment, by utilizing recent empirical data for India.

The discussion to be presented below is likely to be of interest for two reasons. First, proponents of the corporation income tax argue, usually by reference to partial equilibrium analysis, that such a tax creates a tendency towards the adoption of lower capital-intensive techniques, and hence aids the objective of promoting total employment in the economy. Our analysis will reveal that in the general equilibrium context, especially with output prices variable, no such unambiguous statement regarding changes in total employment, can be made. Indeed, we shall demonstrate that the impact on employment is crucially dependent on the relative magnitude of various elasticities. Second, we shall show that

the model developed in this study is capable of yielding numerical estimates of the impact on employment with the use of relatively limited empirical data.

2. The Case of Fixed Output Prices

When the country in question is a small open economy, it is usual to assume that it faces exogenously given world prices. In that case, the model is described by Equations (1) - (7), presented in the earlier part of the paper. Of course, it is to be noted that the small country assumption implies that $p_1^* = p_2^* = 0$.

Following the procedure described in Section 3.4 of Part I, we can rewrite the equations of change in matrix form as shown below.

$$\begin{bmatrix} \lambda_{K1} & 0 & H_1 & H_2 \\ 0 & 1 & -\theta_{K2}(\sigma_{LK}^2-\sigma_{KT}^2) & H_3 \\ 0 & 0 & \theta_{K2} & \theta_{T2} \\ 0 & 0 & \theta_{K1} & 0 \end{bmatrix} \begin{bmatrix} L_1^* \\ L_2^* \\ r^* \\ m^* \end{bmatrix} = \begin{bmatrix} -\lambda_{K1}\sigma_{LK}^1 \\ 0 \\ 0 \\ \theta_{K1} \end{bmatrix} a_{K1}^*, \qquad (41)$$

where,

$$H_1 = -\{\lambda_{K1}\sigma_{LK}^1 + \lambda_{K2}(1-\theta_{L2})\sigma_{KT}^2 + \lambda_{K2}\theta_{L2}\sigma_{LK}^2\},$$

$$H_2 = \lambda_{K2}\{(1-\theta_{L2})\sigma_{KT}^2 + \theta_{L2}\sigma_{LT}^2\},$$

and

$$H_3 = -\{(1-\theta_{K2})\sigma_{LT}^2 + \theta_{K2}\sigma_{KT}^2\}.$$

The solution of the system in equation (41) gives

$$L_1^*/a_{K1}^* = -\frac{1}{D_1}[\lambda_{K2}\theta_{K1}\{(1-\theta_{L2})^2\sigma_{KT}^2 + \theta_{T2}\theta_{L2}\sigma_{LK}^2 + \theta_{K2}\theta_{L2}\sigma_{LT}^2\}], \qquad (42)$$

and

$$L_2^*/a_{K2}^* = \frac{1}{D_1}\left[\lambda_{K1}\theta_{K1}\theta_{K2}\{(1-\theta_{K2})\sigma_{LT}^2 + (1-\theta_{L2})\sigma_{KT}^2 - \theta_{T2}\sigma_{LK}^2\}\right] . \qquad (43)$$

where,

$$D_1 = -\lambda_{K1}\theta_{K1}\theta_{T2} < 0 .$$

Equations (42) and (43) reveal that whereas a corporation income-tax leads to an unambiguous decline in employment in the corporate sector, the impact on employment in the non-corporate sector is dependent on the relative magnitudes of the partial elasticities of factor substitution in the non-corporate sector. In particular, employment in the non-corporate sector increases if

$$(1-\theta_{K2})\sigma_{LT}^2 + (1-\theta_{L2})\sigma_{KT}^2 > \theta_{T2}\sigma_{LK}^2 .$$

These results are easily explained. At constant commodity prices, there is no "output (demand) effect," and at the sectoral level the entire impact is due to the "factor substitution effect."[9] In the corporate sector, capital tends to move out, consequently employment declines. In the non-corporate sector there is an inflow of capital, therefore employment tends to increase. However, because there is no constraint on the employment of labor there is a tendency to substitute capital for labor, given that the employment of land in this sector is fixed. Therefore, the change in employment is ambiruous, and is dependent on the magnitude of the various partial elasticities.

It is also interesting to note that with fixed output prices, the capital-labor ratio in the corporate sector does not change. However, the change in the capital labor ratio in the non-corporate sector, and the economy-wide level is ambiguous. This is an important result because statements regarding the employment effect of taxes are often based on results regarding the capital-labor ratios. Our general equilibrium analysis indicates that statements such as these which are

based on partial equilibrium studies could lead to misleading conclusions. A result similar to ours has been derived by Neary [1978], who has studied the impact of capital subsidies on employment in the context of variable labor supplies.

When we consider the overall impact on employment, the "factor intensity effect" is important in addition to the "factor substitution" effect. We can derive the following proposition:

Proposition 1.

(i) If the non-corporate sector is the relatively capital intensive sector, and $(1-\theta_{L2})\sigma^2_{KT} + (1-\theta_{T2})\sigma^2_{KL}$ is greater than $\theta_{K2}\sigma^2_{LT}$, then overall employment declines. This is a sufficient condition.

(ii) If the corporate sector is the relatively capital intensive sector, and $(1-\theta_{L2})\sigma^2_{KT} + (1-\theta_{T2})\sigma^2_{KL}$ is less than $\theta_{K2}\sigma^2_{LT}$, then overall employment increases. This is a sufficient condition.

(iii) If the production function in the non-corporate sector is of the Leontief variety, then there is no change in employment either at the sectoral or at the overall level.

These results follow from the fact that

$$L^*/a^*_{K1} = -\frac{1}{D_1}\left[\theta_{K1}\lambda_{K2}\lambda_{L1}\{(1-\theta_{L2})^2\sigma^2_{KT} + \theta_{T2}\theta_{L2}\sigma^2_{LK} + \theta_{K2}\theta_{L2}\sigma^2_{LT}\}\right.$$

$$\left. - \theta_{K1}\lambda_{K1}\lambda_{L2}\{(1-\theta_{K2})\theta_{K2}\sigma^2_{LT} + (1-\theta_{L2})\theta_{K2}\sigma^2_{KT} - \theta_{K2}\theta_{T2}\sigma^2_{LK}\}\right] . \quad (44)$$

There are two clearly opposing effects. However, it is easy to demonstrate that the terms in the first braces are greater (less) than those in the second if $(1-\theta_{L2})\sigma^2_{KT} + (1-\theta_{T2})\sigma^2_{KL}$ is greater (less) than $\theta_{K2}\sigma^2_{LT}$. Also, we know that the non-corporate sector is relatively capital intensive implies that $\lambda_{K2}\lambda_{L1}$, is greater than $\lambda_{K1}\lambda_{L2}$, and vice-versa. With Leontief production functions in the

non-corporate sector, the factor substitution effect vanishes, and since there is no demand effect with output prices given, the level of employment is unaffected.

The model developed here is quite general. For example, it is capable of analyzing the case when land is specific to the non-corporate sector, and capital to the corporate sector. Such a situation may not be unrealistic in some of the developing countries. In order to analyze this case, all we need to do is set $\lambda_{K2} = \theta_{K2} = \sigma^2_{KT} = \sigma^2_{KL} = 0$. As expected, we find that under this specification the impact on employment both at the sectoral and the economy-wide level is zero. This result follows from the specificity of capital.

3. The Case of Variable Prices

In this section we generalize the model to take account of variable output prices. Consequently, we can now take account of the "demand effect." The model and the method of solution to this problem have already been discussed in Part I of the paper. Accordingly, in this section we limit our discussion to the results.

Solving the system of equation in (22), we have

$$L_1^*/a_{K1}^* = -\frac{1}{D_2}\left[\lambda_{K2}\theta_{K1}(E_1+\sigma^1_{LK})\{(1-\theta_{L2})^2\sigma^2_{KT}+\theta_{L2}\theta_{K2}\sigma^2_{LT}+\theta_{T2}\theta_{L2}\sigma^2_{LK}\}\right], \quad (45)$$

and

$$L_2^*/a_{K2}^* = \frac{1}{D_2}\left[\lambda_{K1}\theta_{K2}(E_1\theta_{K1}-\theta_{L1}\sigma^1_{LK})\{(1-\theta_{L2})\sigma^2_{KT}+(1-\theta_{K2})\sigma^2_{LT}-\theta_{T2}\sigma^2_{KL}\}\right], \quad (46)$$

where

$$D_2 = \lambda_{K2}\{(1-\theta_{L2})^2\sigma^2_{KT}+\theta_{K2}\theta_{L2}\sigma^2_{LT}+\theta_{T2}\theta_{L2}\sigma^2_{LK}\} - \lambda_{K1}\theta_{T2}(E_1\theta_{K1}-\theta_{L1}\sigma^1_{LK}) > 0 .$$

The demand effect is immediately discernible by noting that in the numerator of Equations (45) and (46), we have terms identical to the expressions in Equations

(42) and (43). Therefore, we should expect more stringent conditions while determining the direction of change in employment. For example, we now find that the direction of change in employment in the taxed sector is dependent on the relative magnitudes of the elasticity of substitution between the factors, and the elasticity of demand for the product of this sector. In particular, employment in this sector declines (increases) if the absolute value of E_1 is greater (less) than the magnitude of the elasticity of factor substitution. The condition for employment to increase in the non-corporate sector, however, remains identical to the "small country" case, only the magnitude of the impact changes.

The intuitive explanation for these results is quite simple. When product prices are variable, the relative price of the corporate sector product rises due to the imposition of a tax. Therefore, demand declines, and consequently, employment declines. However, because of the rise in price, production expands, leading to an increase in employment. It follows, therefore, that the impact on employment is dependent on the relative magnitudes of the elasticity of factor substitution and the elasticity of demand. A large elasticity of factor substitution promotes employment creation, while a large elasticity of demand adversely affects the level of employment in this sector.

When we consider the overall impact on employment, the following proposition is available:

<u>Proposition 2</u>.

(i) If $\sigma^1_{LK} \geq |E_1|$ and $(1-\theta_{L2})\sigma^2_{KT} + (1-\theta_{K2})\sigma^2_{LT} > \theta_{T2}\sigma^2_{KL}$ (with one of the inequalities holding strictly), then a corporation income-tax has a positive effect on employment.

(ii) A necessary condition for employment to decline as a result of the tax is that the non-corporate sector be relatively capital intensive.

(iii) If the production function of the non-corporate sector is of the Leontief variety then the tax has no effect on the level of employment.

These results follow from the fact that

$$L^*/a^*_{K1} = -\frac{1}{D_2}\,[\lambda_{L1}\lambda_{K2}\theta_{K1}(E_1+\sigma^1_{LK})\{(1-\theta_{L2})^2\sigma^2_{KT} + \theta_{L2}\theta_{K2}\sigma^2_{LT} + \theta_{T2}\theta_{L2}\sigma^2_{LK}\}$$

$$- \lambda_{L2}\lambda_{K1}(E_1\theta_{K1} - \theta_{Lk}\sigma^1_{LK})\{(1-\theta_{L2})\theta_{K2}\sigma^2_{KT} + (1-\theta_{K2})\theta_{K2}\sigma^2_{LT} - \theta_{K2}\theta_{T2}\sigma^2_{LK}\}]. \quad (47)$$

These results indicate that statements based on the impact of taxes on the capital-labor ratios, and derived from partial equilibrium studies could lead to erroneous policy prescriptions. The model developed in this paper demonstrates that the general equilibrium impact of taxes could be quite different from the partial equilibrium prediction. In particular, the study reveals that the employment impact of the corporation income-tax is crucially dependent on the demand and factor substitution elasticities. Some results are also conditional on the relative factor intensities of the two sectors. In order to further stress the usefulness of this model, we shall now present numerical estimates of the impact of the corporation income-tax by using recent Indian data.

4. The Empirical Study

In this section we shall present empirical estimates of the effect on employment. The theoretical model on the basis of which these results will be obtained is one in which we consider the output prices to be variable. This appears to be the appropriate assumption for a country like India, although the model with output prices given, can be used in different contexts.

The employment effect of the Indian corporation income tax is analyzed for the financial year 1971-72. The economy is divided into two sectors, namely, the corporate sector and non-corporate sector.[10] This division is done by including in the corporate sector those sectors in which the tax to capital income ratio is 15 per cent or more. If this ratio is less than 15 per cent we include it in the non-corporate sector. In order to calculate this ratio, we determine the ratio corporation income tax paid to income accruing to capital in each sector.[11] These data are presented in Table I.[12] The following sectors are included in the corporate sector: (i) manufacturing, construction, electricity, gas, and water supply, (ii) transport, storage and communication, trade, hotels and restaurants, (iii) banking, insurance, real estate, ownership of dwellings, business services, public administration, defense and other services. The non-corporate sector includes: (iv) agriculture, forestry and logging, fishing, mining and quarrying.

The reader is reminded that the use of the terms "Corporate and "Non-corporate" sectors may not be very appropriate. For example, Harberger [1974] argues that a better classification is perhaps into "Heavy-Tax" and "Light-Tax" sectors. Be that as it may, our division is commensurate with previous general equilibrium studies, and in the context of our analysis this issue does not appear to be very serious.

In Table II we present the shares of capital, labor and land in Net Domestic Product divided between the corporate and non-corporate sectors.

From the values in Table II, we obtain the elements λ_{ij} and θ_{ij}, and these are presented in Table III. We obtain two sets of values (a) and (b) depending on the assumption regarding the shares of the various factors in non-corporate income. We illustrate below the method utilized in obtaining the values of λ_{ij} and θ_{ij}:

TABLE I

(1971-72 Data for India)†

(All figures are in lakhs of Rupees)

	Sector	(1) Contribution to Net Domestic Product	(2) Capital income assessed	(3) Corporation income tax	(4) Ratio(3):(2) [Tax: Capital Income]	(5) Labor Income	(6) Land Income
(i)	Manufacturing, construction, gas, electricity, and water supply	752,200	90,654.78	41,959.06	0.46	661,545.22	-
(ii)	Transport, storage and communication, trade, hotels, restaurants,	564,100	140,280.48	27,851.66	0.19	423,819.52	-
(iii)	Banking, insurance, real estate, ownership of dwellings and business services, public administration, defense and other services	561,200	27,140.67	11,885.40	0.20	534,059.33	-
(iv)	Agriculture, forestry and logging, fishing, mining and quarrying	1,810,400	(a)271,560 (b)452,600	2,245.56	0.08 0.05	995,720 905,200	543,120 452,600

†The value (a) or (b) appears in Sector (iv) according to the assumption (a) or (b) made in Footnote 12.

Source: 1. All-India Income Tax Statistics, 1971-72, Directorate of Inspection (Research, Statistics, and Publication), Mayur Bhawan, New-Delhi.

2. India: Book of Economic Information, 1973 and 1974, Government of India, Ministry of Finance, Department of Economic Affairs.

TABLE II

(India, 1971-72)†

(All Figures are in lakhs of Ruppes)

Sector	Net Domestic Product		Capital Income	Labor Income	Land Income
Corporate	1,877,500		258,075.93	1,619,424.07	-
Non-Corporate	1,810,400	(a)	271,560	995,720	543,120
		(b)	452,600	905,200	452,600

†These figures are post tax incomes.

TABLE III

(Values of elements)

	λ_{L1}	λ_{L2}	λ_{K1}	λ_{K2}	θ_{L1}	θ_{L2}	θ_{K1}	θ_{K2}	θ_{T2}
(a)	0.62	0.38	0.49	0.51	0.86	0.55	0.14	0.15	0.30
(b)	0.64	0.36	0.36	0.64	0.86	0.50	0.14	0.25	0.25

$\lambda_{L1} = L_1/L$ is obtained by dividing the labor income in the corporate sector, by total labor income (in both sectors). Similarly, $\theta_{L1} = wL_1/p_1X_1$ is calculated by dividing the share of labor income in the corporate sector by the contribution of the corporate sector to Net Domestic Product.

Now, all that we require are the parameter values of the various elasticities in order to calculate the change in employment. Sidhu [1974] in a study of production functions in Indian agriculture with specific reference to Punjab, concluded that the Cobb-Douglas specification is an appropriate fit. In the Appendix, we demonstrate that this implies that the various cross partial elasticities of substitution are all equal to unity. Nayar and Kanbur [1976] in a study of the manufacturing sector in India, also concluded that the hypothesis of a Cobb-Douglas production function for this sector could not be rejected. Indeed, the conclusion arrived at by Nayar and Kanbur, is further supported by the work of Zarembka [1970], who suggests that for most manufacturing industries the CES production function degenerates to the Cobb-Douglas case. This implies that the elasticity of factor substitution in the corporate sector is negative and equal to unity.

An estimate of E_1 is more difficult to obtain. However, following a line of argument similar to that of Harberger [1962], we can assume that the elasticity of substitution between the two products is equal to unity. This implies a value of -0.49 for E_1.[13]

These parameter values and those of the elements are now plugged into the expressions for the changes in employment given in Equations (45) - (47). The results are presented in Table IV. Noting that a^*_{K1} is negative, we find that employment increases in both the sectors as a result of the tax. It is also found that the increase in employment in the corporate sector is less than that

TABLE IV

Summary of Results

Specification	L_1^*	L_2^*	L^*
Assumption (a), Footnote 12	$-0.05a_{K1}^*$	$-0.20a_{K1}^*$	$-0.10a_{K1}^*$
Assumption (b), Footnote 12	$-0.06a_{K1}^*$	$-0.21a_{K1}^*$	$-0.11a_{K1}^*$

in the non-corporate sector. The results did not appear to be particularly sensitive to minor changes in the distributive share of the factors in the non-corporate sector.

5. Conclusion

The prevalent impression regarding the employment effect of the corporation income tax is that it has a beneficial impact on employment because it reduces the capital-labor ratio. This impression is based on partial equilibrium analysis. Our study has revealed that in a general equilibrium setting, no unambiguous statement can be made regarding the effect on taxation on the overall capital-labor ratio, and hence on employment. Indeed, depending on the magnitudes of various elasticities, it is possible that employment may decline.

However, the formulation of the model allows us to obtain empirical estimates with the use of limited data. For purposes of illustration, we use 1971-72 Indian data, and find that the corporation income tax on India had a beneficial effect on employment, both at the sectoral and the economy-wide level.

This study, therefore, demonstrates the need and the usefulness of analyzing the impact on employment of various tax policies before implementation. It also demonstrates that such an analysis must be based on a general equilibrium framework, as partial equilibrium models can often lead to misleading conclusions.

The model developed above is quite general, and is capable of analyzing a wide variety of questions under different assumptions. For example, as we have demonstrated we can analyze the case of specific factors in both sectors, or the "small country" case quite easily. Some of the other questions which can be analyzed by using this model are the effect of trade unionism on employment and the distribution of income, the effect of taxation on industrial location in

the presence of unemployment, and so on. Moreover, it is possible to generate reasonable empirical estimates of the impact of various policies on the objectives of these policies, by plugging in reliable empirical data into the theoretical solutions.

APPENDIX

Consider a Cobb-Douglas production function

$$X_2 = A\ L_2^{\alpha} K_2^{\beta} T_2^{\gamma}\ , \tag{A.1}$$

where X is output, L labor, K capital, and T land, and A, α, β, γ are constants. Substituting for the optimal values of K and T in (A.1), we get

$$X_2 = A \cdot \beta^{\beta} \cdot \gamma^{\gamma}\ \alpha^{(\beta+\gamma)}\ w^{(\alpha+\gamma)}\ r^{-\beta}\ m^{-\gamma}\ L_2^{(\alpha+\beta+\gamma)}\ .$$

Since, $(\alpha+\beta+\gamma) = 1$, we can write

$$L_2/X_2 = C_{L2} = Z\ w^{-(\beta+\gamma)}\ r^{\beta}\ m^{\gamma}\ , \tag{A.2}$$

where

$$Z = [A\ \beta^{\beta}\ \gamma^{\gamma}\ \alpha^{(\beta+\gamma)}]^{-1}\ .$$

Totally differentiating (A.2), we get

$$C_{L2}^{*} = -\ (\beta+\gamma)\ w^{*} + \beta\ r^{*} + \gamma\ m^{*}\ . \tag{A.3}$$

However, Allen [1968] has shown that a linear homogeneous production function can be written as

$$C_{L2}^{*} = \theta_{L2}\sigma_{LL}^{2}\ w^{*} + \theta_{K2}\sigma_{LK}^{2} r^{*} + \theta_{T2}\sigma_{LT}^{2} m^{*}. \tag{A.4}$$

Noting that θ_{L2}, θ_{K2} and θ_{T2} are equal to α, β and γ, respectively, we can conclude that

$$\sigma_{LK}^{2} = \sigma_{LT}^{2} = 1\ .$$

Similarly, it can be shown that

$$\sigma_{KT}^{2} = 1.$$

FOOTNOTES

1. The analysis of the leisure-income choice in the presence of taxation at the individual level is discussed by Musgrave [1959]. Much of the literature is surveyed by the Organization for Economic Cooperation and Development [1975]. Boskin [1976] has critically reviewed some of the empirical studies on the impact of taxes on hours of work.

2. See for example, Mieszkowski [1967], McLure [1970], McLure and Thirsk [1975a,b], Batra [1975], Ballantyne and Eris [1975], among others.

3. Dholakia [1976] has calculated the shares of the various factors in agricultural and non-agricultural income in India. His analysis reveals that during the period 1948-49 to 1968-69, the average share of land in the agricultural sector was 29 percent, while its share in the manufacturing sector was only 3 percent. Indeed, we find that the share of capital in the agricultural sector during the same period was 15 percent.

4. For a methodology of incorporating preexisting taxes into the analysis see Ballantyne and Eris [1975].

5. To solve the model we use the minimum cost conditions whereby the average of the changes in the C_{ij} coefficients weighted by the respective distributive shares is zero. Geometrically, this implies that the slope of the isoquant equals the slope of the factor cost line.

6. See Batra and Casas [1976] for such a demonstration.

7. See Sidhu [1974] for a study of production functions in the agricultural sector, and Nayar and Kanbur [1976] for such a study in the manufacturing sector in India. Both studies indicate that our assumption is not unrealistic.

8. See Shome [1978] for a justification of this statement.

9. These effects have been enumerated by Mieszkowski [1967] in the context of an analysis of tax incidence.

10. This division into the four broad sectors is in the tradition of Shome [1978].

11. The use of sector-wise rather than industry-wise data is defended on the grounds of the paucity of data. Harberger [1966] and Shome [1978] have used this approach earlier.

12. Source: All-India Income-Tax Statistics, 1971-72, Directorate of Inspection (Research, Statistics, and Publication), Mayur Bhawan, New Delhi. However, this source does not permit us to derive the income accruing to capital and land. Dholakia's [1976] study reveals that the average share of land in the agricultural sector was 29 percent, and that of capital was 15 per cent. These figures relate to the period 1948-49 to 1968-69. It is likely that in recent years the share of capital in agriculture income has increased, and those of the other two factors has decreased. Accordingly, we consider the following two ranges: (a) share of land 30 per cent, share of capital 15 per cent, and share of labor 55 per cent, and (b) share of land 25 per cent, share of capital 25 per cent, and share of labor 50 per cent.

13. The formula utilized in deriving the value of this elasticity was

$$E_1 = Vp_2X_2/(p_1X_1 + p_2X_2),$$

where V is the elasticity of product substitution.

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