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Tax Policy with Dualism in the Labor Market

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Although development economists frequently use dual models to characterize less developed countries, we lack a thorough understanding of tax policy in a dual framework. This paper investigates the incidence of factor and value added taxes in an open Harris-Todaro economy. The magnitudes and signs of incidence elasticities differ from those produced by a unified labor market, as do the ranking of taxes by effect on GNP. In the Harris-Todaro case manufacturing taxes are preferred in contrast to the neoclassical preference of across-the-board taxes. Incidence elasticities and policy rankings of tax/subsidy policies on unemployment and poverty are detailed.

Margaret E. Grosh

Tax Policy with Dualism in the Labor Market[1]

Understanding the effects of taxation is central in economics. Determining who actually pays a tax, and the reallocations that it may entail are the primary focus of tax incidence analysis. It is also a useful framework in which to analyze the effects of a policy on national income and poverty. The place of tax incidence analysis in the public finance economist's toolbox is undisputed. Despite its numerous applications, tax incidence analysis has largely ignored issues specific to developing countries. This paper brings the two fields together.

A model of a developing country with a dual labor market is used to detail the effects of factor and value added taxes on labor allocation, product and factor payments. They are shown to differ in magnitude and frequently in direction from the effects of analogous policies in a neoclassical model. In the neoclassical model the assumption of complete factor price flexibility assures full employment and equalized factor prices across sectors. Hence question about poverty and inequality do not arise. Less developed countries (LDCs) do, however, posses significant inequalities which are captured in the dual economy model. Tax policies are ranked by their effects on national income, employment and poverty. The rankings of taxes by GNP differ from those derived from the neoclassical model.

A brief review of the literature is provided in Section 1. A basic model for the analysis of tax incidence in developing countries is set out in Section 2. Section 3 contains the menu of tax incidence results derived from the model. In Section 4 the policies' implications for national income, unemployment and poverty are detailed. In Section 5 the results from the standard neoclassical model and the paper's dual model are compared. A numerical example is provided in Section 6. Section 7 concludes the paper.

SECTION 1: The Literature

The Harberger version of a two sector general equilibrium model has become a standard tool in tax incidence analysis over the last twenty years. McClure (1975) and Atkinson and Stiglitz (1980) provide excellent summaries of its principal applications and usefulness in relation to partial equilibrium analysis. Barrera (1983) is an exhaustive bibliography on the subject.

The incidence of a tax naturally depends upon the structure of the economy in which it is levied. In order to capture various departures from perfectly competitive neoclassical economies, the Harberger model has been variously modified. In his original (1962) paper Harberger himself considers the case of monopoly in the corporate sector. Other modifications include Dixit and Stiglitz' (1977) treatment of monopolistic competition, Johnson and Mieszkowski's (1970) adaptation to a unionized corporate sector, and Atkinson and Stiglitz' (1980) treatment of a constant wage-price rigidity. In each of these models, the distortion treated is shown to affect the results of the taxes studied to greater or lesser degree.

One shortcoming of the public finance literature on tax incidence becomes apparent to a development economist. Tax incidence has not been studied in a model built specifically to reflect the structure of developing countries. The extent to which their structure differs from that of their more well-to-do neighbors is a topic of considerable debate, whose thorough discussion belongs elsewhere (see especially Taylor (1983)). There is, however, wide recognition that intersectoral differences in product sophistication, choice of technology, and wages, are greater in less developed countries than in developed countries [Meier, (1984)]. If, indeed, structural dualism exists in developing countries then they may be seriously misled by tax policy guidelines derived from neoclassical models. This paper suggests how dualism may affect tax incidence.

In order to proceed, the cause of dualism must be specified. This is difficult for there exists no consensus among development economists as to the root of the phenomenon. The various economic theories of dualism are based on technological differences, labor market imperfections, capital market imperfections, or some combination of these three factors (See any development text for a discussion. Yotopoulos and Nugent (1976) and Meier's (1984) discussions are good.) Indeed, it is probable that in any given economy several distortions may contribute to dualism and further that the distortionary mix differs from country to country. Progress on the topic at hand impels us to choose among dualistic theories and to examine tax incidence within a well-specified structure. Leaving the treatment of taxation and capital market imperfections to subsequent work, we proceed with dual labor markets.

Early seminal work on segmented labor markets concentrated on surplus labor [Lewis, (1954); Ranis and Fei, (1961); and Sen (1965)]. The models assume an initially small capitalist manufacturing sector and large agricultural sectors using primitive and labor intensive techniques. Manufacturing pays a somewhat higher wage than agriculture and so can draw labor away from it. Labor (or laborers) is assumed to be in excess supply in agriculture over a broad range and so the capitalist sector may expand without reducing output in agriculture. This is, of course, contrary to neoclassical notions of production, and more recent work has moved in favor of the neoclassical assumption. Another of the loose ends of the labor surplus literature is that it does not explain why workers stay in agriculture rather than bidding down the wage in manufacturing.

In 1970 Harris and Todaro proposed a model of labor market segmentation based on a fixed wage in modern manufacturing, but which allowed for decreasing agricultural output with the expansion of manufacturing. Urban unemployment is assigned a critical role in balancing the expected wage in manufacturing and the certain agricultural wage. In its original form the Harris-Todaro model was not well supported empirically, but more sophisticated versions [especially Fields, (1975)] have yielded predictions more in line with reality. Further support for its relevance was provided by Todaro (1976b) and (1976a). The model has also received quite a lot of attention in its theoretical aspects.

The early work stresses the non-optimalities resulting from the labor market distortion, and disregarding the financing problem, designs various subsidy packages to reestablish first best [Harris-Todaro, (1970); Bhagwati and Srinivasan, (1974); Basu, (1980); Gang and Gangopadhyay, (forthcoming)]. Consideration of revenue sources is sparse. Corden (1974) treats the matter briefly.

As the Harris-Todaro model became accepted, it was extended. Corden and Findlay (1975) provide a detailed examination of the basic Harris-Todaro model and extend it to the case of capital mobility. Neary (1981) examines the issue of dynamic stability with intersectoral capital mobility. McCool (1982) uses the Harris-Todaro device in the context of a small, open economy and mobile capital. He introduces consideration of revenue sources into the most frequently recommended packages of wage subsidies. However, he examines only profits taxes in the corporate sector and import tariffs. Khan (1980) places the Harris-Todaro model squarely into a Hecksher-Ohlin-Samuelson trade framework. He then concentrates on the issues of the existence and stability of equilibria, and on the standard trade theorems. Imam and Whalley (1985) compare the total factor incomes which accrue with and without the Harris-Todaro distortion.

The segmentation mechanism proposed by Harris and Todaro is certainly not the only method of specifying dualism in the labor market. It is, perhaps, the most widely used and thoroughly understood by development economists. It will therefore serve well as the specification of dualism in this study of tax incidence in developing countries.

It should be made clear here that the focus of this paper is quite different from that of the main body of tax/subsidy work done in a Harris-Todaro framework. That literature has focused narrowly on the optimal design of policies to cure the system's inherent unemployment.

This paper removes the blinders and deals with the larger issue of general tax incidence. Given that an economy has a Harris-Todaro labor market distortion, what incidence will its various tax options produce? Exploration of the consequences of marginal tax changes in this dual economy should bring us a little closer to understanding the constraints which many developing countries face in their economic policy.

SECTION 2: The Dual Model

The model postulates a small, open economy with two sectors. Each produces its good using an industry specific factor and labor. The two sectors represent the two halves of a dual economy. They have been labeled as urban and rural, industrial and agricultural, or modern and traditional by various authors. In this paper they will be referred to as manufacturing and agricultural, though the terms are not used literally. The manufacturing sector is more capital intensive and usually located in the urban centers. It includes most manufacturing, energy production, communications, government, banking, and the sort of commerce that import-export firms and department stores handle. The agricultural sector is labor intensive, not industrial and predominantly rural. It includes subsistence and some small- to medium-scale commercial agriculture, cottage industries, and the sort of small-scale commerce that is carried on by "Mom and Pop" businesses and street vendors.

Production

Each sector produces according to a constant returns to scale, homothetic production function which is concave in each input. Thus

$$M = F(L_m, K_m) \tag{1}$$

$$A = G(L_a, K_a) \tag{2}$$

where M is manufacturing output, A agricultural product, L labor and K capital. Firms maximize profit so in both sectors the optimal capital to labor ratio is a function of the relative factor prices,[2]

$$K_m/L_m = K_m/L_m(r_m/w_m) \tag{3}$$

$$K_a/L_a = K_a/L_a(r_a/w_a) \tag{4}$$

Technological dualism may be added to the model by assuming the elasticity of factor substitution is lower in manufacturing than in agriculture.

Factor Markets

Capital is sector specific. Many similar models deal with "capital" in manufacturing and "land" in agriculture. Here the term capital will be used in both sectors so that land, improvements on it, and tools are all considered part of agriculture's capital. The joint assumption of sector--specific capital and zero profits implies that the return to capital is an economic rent and may differ between sectors.

The total supply of labor is fixed and its flow between sectors is regulated by a Harris-Todaro migration mechanism. Workers are divided between those working in the modern sector, those working in the traditional sector and the unemployed. Normalizing over the size of the labor force, and denoting unemployment with a U,

$$1 = L_m + L_a + U. \tag{5}$$

Employers hire so that the wage and the value of marginal product are equal, so

$$w_m = P_m F_L \tag{6}$$

$$w_a = P_a G_L . \quad (7)$$

There is an exogenously determined wage in the manufacturing sector. The level at which it is fixed is assumed to be higher than the market-clearing level.[3] Accordingly, the number of jobs in the modern sector is limited. The wage in the traditional sector is flexible, as is the number of jobs there.

Workers may migrate between sectors[4]. An agricultural worker may not seek work in the manufacturing sector before migration. If upon migration s/he does not find employment s/he will remain unemployed. Workers will migrate between sectors until expected wages are equal, at which point equilibrium will be established. The expected wage in the manufacturing sector is the fixed wage times the probability of obtaining employment. This probability is defined as the number of manufacturing jobs divided by the urban labor force[5]. The urban labor force, L_u, is the sum of those actually employed in manufacturing and the unemployed. Denoting the probability of employment with a z,

$$z = L_m / L_u . \quad (8)$$

Because there is full employment in the traditional sector, the expected wage is the actual wage. The labor market equilibrium condition can thus be written as

$$w_a = z w_m . \quad (9)$$

<u>Revenue Exhaustion</u>

The assumptions of perfect competition and constant returns to scale imply that factor payments will exhaust revenues, i.e.,

$$P^w_m M = r_m K_m + w_m L_m \quad (10)$$

$$P^w_a A = r_a K_a + w_a L_a \quad (11)$$

P^H_m and P^H_a are the home prices of the goods. In an untaxed equilibrium they are equal to world prices. Without loss of generality it is assumed that the manufacturing good is imported and that the agricultural good is exported.

This is the whole of the model. The two sectors represent the two sides of a dualistic economy. The introduction of the Harris-Todaro wage mechanism implies that unemployment will exist in equilibrium. World prices have been made exogenous to reflect the small, open nature of most LDCs. The general equilibrium cast of the model facilitates meaningful tax incidence results.

Expression of the system in the percent change ("hat") notation so frequent in the public finance and international trade literature is useful in understanding the flow of changes through the system. The key equations are presented in differential form in Table 1, along with the definition of the elasticities which will recur in the tax incidence results. Following the Harberger tradition, tax incidence elasticities are derived by application of Cramer's rule to the differential form of the model presented in Table 1.

SECTION 3: Tax Incidence Elasticities in the Dual Model

A variety of taxes and subsidies may be introduced into the basic model. They include taxes or subsidies on domestic value added, wages and the return to capital in either sector or in both jointly. The taxes considered are _ad valorem_, so the price of the good in question is multiplied by unity plus the percentage tax rate. Thus for capital in the manufacturing sector, the taxed factor price r_m^* is

$$r_m* = r_m(1 + t_{rm}) \qquad (12)$$

where t_{rm} denotes a tax on the return to capital in manufacturing. Wage taxes are analogous. When a value added tax is levied on domestic production it will drive a wedge between the world price and the home price for the good. This formulation is more general than that used in most of the tax incidence literature in that it requires no normalizations, and that it allows for nonzero initial taxes.[6]

When a tax is imposed, the untaxed price is replaced throughout the system with the taxed price. Firms respond to the net of tax product prices P^N and to the gross factor input prices r* and w*, reflecting their costs and revenues. Consumers respond to gross of tax product prices P^W. Factor owners respond to the net of tax factor prices w and r.

Some tax combinations are equivalent to each other. The effect of an across-the-board (national) tax is the sum of the effect of taxes in the individual sectors when the tax rates are the same. A subsidy may be regarded as a negative tax, so the derivations hold for subsidies as well as taxes.

It is assumed that the revenue raised from the taxes is redistributed to consumers in a lump sum transfer (If a subsidy is used then revenue to finance it is raised through a lump sum tax). This assumption is clearly unrealistic but allows us to concentrate on one change in the system at a time. To calculate the effect of multiple instruments the elasticities for a variable with respect to each tax are summed. The number of possible permutations is quite large and will not be dealt with here.

The basic method of deriving the incidence results is the same for all of the taxes. A tax is inserted into the system, and the elasticity of the system's variables with respect to the policy is ascertained using Cramer's Rule. The elasticities are presented in Table 2. A graphical explanation of the principle qualitative results follows.

A Value Added Tax in Manufacturing

An intuitive understanding of these results can be achieved through use of a diagram developed by Corden and Findlay (1975). The length of the horizontal axis in Figure 1 represents the size of the total labor force, with the agricultural sector's origin on the left and the manufacturing sector's origin on the right. Wages are measured on the vertical axis. MM' and AA' are the value of marginal product (demand) curves for labor in the manufacturing and agricultural sectors, respectively. The fixed wage in the manufacturing sector is w_m. At that wage firms are willing to employ L_m workers. HH' is a rectangular hyperbola drawn through manufacturing's value of marginal product curve at the fixed wage. Using the property that the area of all rectangles drawn from points on the rectangular hyperbola to the axes will be equal, we can determine agricultural labor and wages. Consider point R, the intersection of the rectangular hyperbola and agriculture's demand curve for labor. Drawing lines from it to the labor and wage axes we have, respectively, the agricultural labor force and the agricultural wage. The area of the rectangles $O_m w_a R L_a$ and $O_m w_m Q L_m$ are equal. The former is given by $w_a L_u$ and the later by $w_m L_m$. Thus $w_a = w_m L_m / L_u$ which is the equilibrium condition for the labor market given in equation 9.

Now let us consider the effect of a domestic value added tax on manufactures. This is formulated so that in equilibrium $P^{w}_{m} = P^{w}_{m}(1+t_m)$.

Consumers are free to purchase on the world market, whose price is invariant to the tax, so the domestic price must fall enough to entirely offset the tax. With a lower domestic price, the value of labor's marginal product in manufacturing will decrease, as shown by a move to mm'. A new rectangular hyperbola is drawn through the new point q. The quantity of labor employed in the manufacturing sector clearly declines, that employed in agriculture increases, and the agricultural wage falls. The effect on unemployment is uncertain. Production of the manufacturing good decreases as the amount of the variable factor employed decreases. Similarly, agricultural production rises. The rent on manufacturing capital falls because the price of its product and the amount of labor with which it is combined falls. The rent on agricultural capital rises as its product's price is constant and the amount of labor with which it is combined increases.

A Value Added Tax in Agriculture

The value added tax is now levied on domestic production of agriculture, so $P^W_a = P^H_a(1+t_a)$. Again the producer price, P^H_a, must fall enough to offset the tax because consumers are still free to purchase at world price. The graphical analysis (see Figure 2) is simpler in this case. Starting from the same initial situation as previously, the tax lowers the price of the agricultural good, and thus the value of labor's marginal product falls to aa'. The amount of labor used in agriculture, and its wage fall. Manufacturing employment and its wage are unchanged. The manufacturing wage seems more appealing in contrast to the lowered agricultural wage, so there is migration and unemployment increases. The return to agricultural capital falls because the value of the output it produces and its complement of labor fall. The return to manufacturing capital is unchanged because both the price of its product and the amount of labor with which it is combined are unchanged.

A National Value Added Tax

The effect of a national value added tax is the same as that of taxes in the individual sectors applied at a uniform rate. Both demand for labor curves shift down. This will always decrease the labor used and output in manufacturing. As a result of the lower product price and smaller complement of labor the return to manufacturing capital will fall as well. As the demand for labor has fallen, the agricultural wage will fall unambigously. The amount of labor employed in agriculture and the sector's output and return to capital may either increase or decrease as shown in the contrast between panels a and b of figure 3.

In determining whether agriculture's labor force expands or contracts the manufacturing technology plays an important role. If the elasticity of substitution between capital and labor is less than the share of capital then a national value added tax will cause a decline in agricultural production. With few factor substitution opportunities, manufacturing employment falls only a little in response to the tax. The agricultural wage has also been lowered. The combination lowers the expected urban wage less than the agricultural wage so migration occurs. Agricultural employment and output fall while unemployment rises. The rent on manufacturing capital is driven down by the fall in product price and in complementary labor use. The rent on agricultural capital is uncertain due to the uncertainty of the size of its corresponding labor use.

Taxes on Labor

A tax on labor lowers the value of marginal product curve in the same manner as a value added tax on the product. Indeed, the elasticities computed for changes in a tax on labor are identical in all cases to those computed for changes in value added taxes save those for the returns to capital. This is not surprising when we realize that the initial demand curve for labor is

$$P^{w} MP_{L} = w. \qquad (13)$$

Taxing the commodity modifies the demand for labor to be

$$P^{H} MP_{L} = w \qquad (14)$$

where $P^{w} = P^{H}(1+t)$. Taxing the wage modifies the curve to

$$P^{w} MP_{L} = w(1+t) \qquad (15)$$

or

$$(P^{w}/(1+t))\ MP_{L} = w,$$

but by substitution

$$P^{H} MP_{L} = w \qquad (16)$$

This equivalency, of course, only holds so long as capital is immobile, and the tax rates on the wage and the value added are the same. A value added tax applied at the same rate as a wage tax will, however, provide greater revenue as it captures some of the return to capital.

The equivalence does not hold for the elasticities of returns to capital. This accords with McClure's result (1975) that the effect of an equal rate tax on both factors of production will be identical to that of a tax on the product, and with the differential form of equations 10 and 11 in which the change in the product's price is the weighted sum of changes in the factor prices, with the weights being the share of each factor in revenue.

Taxes on Capital

Because capital is immobile, taxing it can only decrease the rent it accrues. It will not change its allocation, nor the productivity and thus employment and wages of labor, nor the quantity nor composition of the economy's output. None of the variables in the system change except for the net return to capital itself.

An Aside on Capital Mobility vs. Immobility

It is the "putty-clay" assumption that prompts the specification of immobile capital. Before investment, capital is malleable (like putty). It may be used in either sector. Once it has been invested in plant and equipment its form is fixed and immutable (like fired clay). Plant and equipment are specialized by use so capital is sector specific. This is not an inappropriate conceptualization of capital in a model which abstracts from growth and investment.

If we think of investment as occurring discretely as exogenous changes in the static system outlined above, then while still abstracting from the determination of the amount of investment, we can draw some conclusions about its composition.[7]

First let us consider how an exogenous change in capital endowments affects the system. If K_m increases, it will increase the productivity of labor in manufacturing and shift up the value marginal product curve (see

Figure 4). The effect is analogous to a subsidy on labor. Employment in manufacturing increases, agricultural employment falls and unemployment may increase or decrease.

Capital will be invested where the rate of return is highest. Thus a policy which changes the relative rates of return for the two sectors will change the sectoral balance of new investment. This can be incorporated into the mathematical analysis as exogenous changes in the marginal product of labor, ie. F_L or G_L increases. An intuitive understanding can be gained by shifting the labor demand curves in the diagrams.

If the "putty-clay" assumption is replaced by a "putty-putty" concept, then the economy's initial capital endowment is completely mobile, and will migrate between sectors until the rates of return are equalized. Bearing in mind that there is no new investment, capital mobility implies a complete lack of specialization in equipment. In this economy agricultural capital is mostly land with some simple implements. Manufacturing capital is mostly factories. The putty-clay presumption may exaggerate the system's rigidity, but the putty-putty assumption certainly exaggerates its flexibility.

If capital mobility is allowed in this model the movement of capital will affect that of labor. Both the magnitude and the direction of many of the tax incidence elasticities differ from the sector-specific case. A detailed comparison would lengthen this paper beyond the reader's tolerance and so is left to future work. For a brief treatment of policy in a capital mobile case see section 3 of Corden and Findlay (1975).

SECTION 4: Taxes and GNP, Unemployment and Poverty: The Dual Model

Tax incidence is primarily used to determine who actually bears the burden of a tax. In this model we can also quantify the extra cost to society of the levy, that is the change in gross of tax national income. Another common motivation for incidence analysis is a (frequently vague) concern for distributional issues. This is made explicit here through consideration of unemployment and poverty's response to tax policy.

Gross National Product

The gross national product is the value of production at world prices. That is

$$GNP(t) = P^{w}_{m} M(t) + P^{w}_{a} A(t) \qquad (17)$$

Differentiating with respect to the tax and multiplying by t/GNP yields

$$\varepsilon_{GNP,t} = \theta_{m} \varepsilon_{m,t} + \theta_{a} \varepsilon_{a,t} \qquad (18)$$

where θ_m and θ_a are the share of manufactures and agriculture in GNP. Using this formula it is possible to quantify the loss in national income from each tax. The elasticities are given in Table 3.

The capital taxes are nondistortionary in this fixed capital economy and cause no change in national income. The expressions for the elasticity of national income with respect to the labor and value added taxes are negative. Thus even in the second best case of a Harris-Todaro economy taxes introduce costly distortions. It is particularly noteworthy that even national taxes produce a loss of income, because in the neoclassical model they are nondistortionary.

If we assume that the production functions are Cobb-Douglas and thus that factor shares are constant, it is possible to rank tax policies by effect on GNP. Subtracting $\varepsilon_{GNP,i}$ from $\varepsilon_{GNP,j}$, where i and j are the taxes to be compared, will show which tax is the most distortionary at a given rate. To develop a clear policy ranking the less distortionary tax must raise more revenue. Comparison of the revenue raising abilities of the two taxes is made through comparison of their bases' share in national income.

The comparison of value added and wage taxes in the same sector is quite simple. They have identical elasticities, so the tax which raises the most revenue is preferred. The value added tax has as its base the income of the sector, that is both labor and capital income, so applied at a given rate, a value added tax will always raise more revenue than the wage tax in the same sector. Hence it is always preferred. The value added tax in manufacturing is preferred to the wage tax in manufacturing, the value added tax in agriculture is preferred to the wage tax in agriculture, and the national value added tax is preferred to the national wage tax.

Because wage and value added taxes in the same sector have identical elasticities, the ranking between sectoral value added taxes and sectoral wage taxes will be the same. Subtracting the elasticity of GNP with respect to a manufacturing tax from the same elasticity for an agricultural tax shows that the sign of the difference depends on the inequality in 19.

$$\frac{S_m\ f_L\ g_K}{S_a\ g_L\ f_K} \ \gtrless\ \frac{\theta_a}{\theta_m} \qquad (19)$$

If the less than (greater than) sign holds then an agricultural policy will have a greater (lesser) effect on national income than a similar manufacturing policy.

Manufacturing technology is frequently stylized to have a lower elasticity of factor substitution than agriculture. By the classification of enterprises into the two sectors (which the reader will recall is not literal, but based on capital intensity) we would expect the share of labor to be less in manufacturing than in agriculture, and that the share of capital would be greater in manufacturing than in agriculture. Thus each of the three ratios on the left hand side of expression 19 is likely to be less than unity. It is not unusual, though certainly not universal, to find that the share of agriculture is smaller in income (though not in employment) than the share of manufacturing. If that is the case, then the right hand side of 19 is also less than unity. In the rest of this section it will be assumed both that $\theta_m > \theta_a$ and that the less than sign in 19 holds. The first assumption implies that a manufacturing tax raises more revenue than the analogous agricultural tax and the second assumption implies that the former is less distortionary than the latter. These assumptions allow us to rank manufacturing taxes above agricultural taxes. If the assumptions are false then this ranking and those developed below are ambiguous. Fortunately each of the parameters in 19 is readily estimated, so that a planner may verify the applicability for his/her economy of the tax ranking which follow.

In order to rank the national taxes with the single- sector taxes the difference in tax rate necessary to achieve the same revenue must be considered. Let us suppose first that the contribution of the two sectors to GNP is just equal. In this circumstance a national tax at one half the rate of the single-sector tax will raise equal revenue. Now, suppose that manufacturing predominates in GNP. The single-sector tax will raise greater revenue than the national tax at half the rate. Comparing the elasticities of GNP with respect to the manufacturing tax and the national tax at half the rate shows that the relative loss in GNP depends again upon the inequality in 19. Assuming as before that the less than sign holds, and that the share of manufacturing is greater than the share of agriculture, then a manufacturing tax induces a smaller loss in GNP while raising greater revenue. Thus it may be ranked above the national tax unambiguously.

If agriculture is taxed, less revenue will be raised than with a national tax of half the rate. Comparison of the elasticities of GNP with respect to an agricultural tax and a national tax at half the rate shows that the agricultural tax will induce a greater loss of GNP. Thus the national tax is preferred to the manufacturing tax on the grounds of revenue and of effect on GNP.

For the rest of the policy comparisons we need to break away from the symmetric cases discussed. Comparing the effects of a value added tax in one sector with a wage tax in the other sector: The same condition, 19, determines the relative magnitude of the distortion induced, but the revenue effects now hinge upon the size of one sector's share in income relative to the size of the other sector's labor income. Because it is unlikely that a single sector's labor income be larger than the combined labor and capital income of the other sector, the value added tax will generally be expected to raise more revenue. In comparing a manufacturing value added tax with the agricultural wage tax that enables us to rank the former above the latter (as long as 19 holds with a less than sign). In comparing the agricultural value added tax with the manufacturing wage tax, the manufacturing tax will produce fewer distortions when applied at the same rate but is likely to raise less revenue. Thus the ranking is indeterminate.

Using the same reasoning we compare a national value added tax and single-sector wage tax. The distortion from a manufacturing wage tax is less than the distortion from a national value added tax of the same rate, but the former raises less revenue so the ranking is ambiguous. The distortion from an agricultural wage tax is more than the distortion from a national value added tax of the same rate, and the former raises less revenue so a national value added tax is preferred to an agricultural wage tax.

The last set of comparisons ranks sectoral value added taxes with the national wage tax. If the share of manufactures is greater than (less than) the share of labor in GNP then the manufacturing value added tax is less distortionary and more (less) lucrative, hence it will be preferred (no ranking is possible). If the share of labor is greater than (less than) the share of agriculture in GNP, then the national wage tax is less distortionary and more (less) lucrative than the agricultural value added tax, and is therefore preferred (no ranking is possible).

The following rules of thumb for tax policies effects on GNP apply for a dual LDC (with 19 holding with a less than sign and a larger manufacturing than agricultural share in income): 1) Taxes on the return to capital are nondistortionary. 2) Value added taxes are preferred to wage taxes in the same sector ($t_m > t_{wm}$, $t_a > t_{wa}$, $t > t_w$). 3) For either value added or wage taxes, a tax on manufacturing is preferred to a national tax, which is in turn preferred to a tax on agriculture ($t_m > t > t_a$, and

$t_{wm} \succ t_m \succ t_{wa}$). 4) Both the manufacturing and the national value added taxes are preferred to an agricultural wage tax ($t_m \succ t_{wa}$, $t \succ t_{wa}$). 5) The other four tax pairs cannot be ranked without ambiguity ($t_a \gtrless t_{wm}$, $t \gtrless t_{wm}$, $t_m \gtrless t_w$, $t_w \gtrless t_a$).

Unemployment

The main concern of most of the Harris-Todaro literature has been the treatment of unemployment. As the subject has been treated at much length elsewhere[8] we will touch on it only briefly here.

The responses of unemployment to a value-added or wage tax in manufacturing depends on the sign of

$$\frac{g_K}{S_a} \gtrless \frac{L_a}{L_m} \frac{U}{L_u} . \qquad (20)$$

We know that g_K is less than unity, but S_a may fall between zero and infinity. Thus the left hand side of the expression may vary from zero to infinity. The right hand side is composed of two ratios. The first is generally greater than unity and the second always less than unity. Thus no easy presumption can be made about the direction of the inequality, though the value of each term should be easily obtainable for an individual economy.

Note that the elasticity of factor substitution in agriculture is key. If the technology is linear, then S_a approaches infinity and the left hand side of 20 approaches zero. In this case $\epsilon_{U,t_m} = \epsilon_{U,t_{wm}} < 0$, implying that a wage or value-added tax on the manufacturing sector lowers unemployment. The logic is simple. The tax in manufacturing lowers its employment and its expected wage. With a linear agricultural technology, the value of marginal product of labor in agriculture is constant. The constant agricultural wage is thus relatively more attractive than the decreased manufacturing wage, so the unemployed will reverse migrate until unemployment has fallen enough to reestablish the equilibrium condition.

With a Leontief technology in agriculture, the elasticity of factor substitution is equal to zero. The left hand side of 20 approaches infinity and unemployment increases with a tax in manufacturing. None of the labor released from manufacturing will be absorbed into agriculture, even with a precipitous decline in its wage, thus unemployment must increase.

Moving next to the effects of taxation in the rural sector we recall that $\epsilon_{u,t_{wa}} > 0$. An agricultural tax will lower the demand for labor in agriculture but will leave the demand for labor in manufacturing unaltered, thus increasing the number of unemployed. The elasticity of substitution and thus the slope of the demand for labor curve will affect the magnitude but not the direction of the change in this case.

Taxation of both sectors simultaneously produces uncertainty as to the change in unemployment. The necessary and sufficient condition for ϵ_{u,t_m} to be positive is also the sufficient condition for $\epsilon_{u,t}$ to be positive. It is not necessary, however, because there is an additional positive term in the second elasticity due to the tax in agriculture, lowering employment there. Thus if unemployment increases with a tax in manufacturing, it will increase even more with an across the board tax of the same rate.

The procedure for ranking taxes by their effects on unemployment is analogous to that for ranking by effect on GNP. In this case the inequality

$$\frac{S_m L_m g_K}{S_a L_a f_K} \lessgtr 1 \qquad (21)$$

occurs in the differences in elasticities. As before we assume that the elasticity of factor substitution is smaller in manufacturing than in agriculture, and that the share of capital is larger in manufacturing than in agriculture. Appealing to "stylized facts", the percent of the work force in manufacturing is smaller than that in agriculture. Thus each of the ratios in 21 is less than unity and the less than sign can be expected to hold. Coupled with the assumption that $\theta_m > \theta_a$, subtraction of elasticities and consideration of revenues yields the same ranking of tax policies by effect on unemployment as was derived by effect on gross national product.

It should be noted that the discussion of unemployment has concentrated on U, the number of workers unemployed. Because we normalized the labor variables so that their total was unity, U is also the economy-wide unemployment rate (the percent of all workers unemployed). This should be carefully distinguished from the rate of urban unemployment, 1-z, which is increased by all of the policies discussed.

Poverty

The alleviation of poverty is of the highest priority in most developing countries. The framework developed in this paper makes it easy to quantify the effects of tax policy on poverty.

Let us assume that a satisfactorily measurable poverty line, Π, exists such that before the introduction of any tax/subsidy policies those employed in manufacturing have incomes greater than the poverty level, and those in agriculture or unemployed fall below the poverty line. Thus $w^\circ_m > \Pi > w^\circ_a > 0$, where the ° notation refers to the pre-tax wages. The concept of poverty entails several notions, three will be examined here. Individual consideration will be given to the number of those whose incomes fall below the poverty line, the amount by which their incomes fall short, and the dispersion of income among the poor as measured by the Gini coefficient. Each of these measures have intuitive appeal. They may be combined in the Sen poverty index which has great axiomatic appeal [Sen, (1976)].

Only those employed in the manufacturing sector are above the poverty line. Thus we define the headcount measure of poverty as

$$H = 1 - L_m. \tag{22}$$

Income shortfall shall be measured by the average percent shortfall of the poverty line so

$$I = \frac{L_a(\Pi - w_a) + U\Pi}{(L_a + U)\Pi}. \tag{23}$$

The Lorenz curve for the poor is as shown in figure 5. The Gini coefficient is the ratio of the area of the triangle ABD to that of ABC. In our notation this is most simply expressed as

$$G_p = \frac{U}{L_a + U}. \tag{24}$$

The Sen index is

$$Sen = H[I + (1-I)G_p]. \tag{25}$$

Manufacturing Taxes and Poverty

We know from section 3 that a tax on either the product or labor in the manufacturing sector decreases the number employed there. They are the only workers above the poverty line, so the headcount measure of poverty increases. The exact quantity is given in Table 3.

The change in the average income shortfall is more complex. The agricultural wage falls, which tends to increase the shortfall. The proportion of unemployed workers to agricultural workers is, however, uncertain. The lower is S_a, the elasticity of factor substitution in agriculture, the more likely is unemployment to rise and thus the income shortfall to increase. If the elasticity is great, however, then the shortfall may decline.

The change in the Gini coefficient depends upon the difference between $\varepsilon_{u,tm}$ and $\varepsilon_{La,tm}$. The sign of dG_p/dtm depends upon

$$\frac{g_K}{S_a} \gtrless \frac{U}{L_M}\left(1 + \frac{L_a}{L_u}\right) \qquad (26)$$

which is very similar to the crucial term in expression 20. The role of factor substitutability in agricultural technology is analogous here to is role in determining the response of unemployment.

The expression for the change in the Sen poverty index is quite complex and is of determinate sign only if $S_a \lesssim g_K$, as is the case for two of its component parts. If this condition holds then a tax in manufacturing increases poverty. Conversely a subsidy there would decrease poverty.

Agricultural Taxes and Poverty

A tax on agricultural value added or labor will leave the number of manufacturing workers, and thus the number of poor unchanged. Both the agricultural wage and the number who receive it decline, while unemployment increases. Thus the average income shortfall increases unambiguously.

With the increase in unemployment the proportion of the poor with zero income increases and raises the Gini coefficient. Two of the three aspects of poverty are exacerbated by levies on agricultural value added or labor, causing the Sen index to worsen.

National Taxes and Poverty

Taxing both sectors evenly will lower the numbers employed in manufacturing and thus raise the headcount of the poor. The wage in agriculture falls, but the numbers employed there and the number of unemployed may either increase or decrease. The effect on the average income shortfall is thus indeterminate. Inspection of the precise expression reveals that if the substitutability of capital and labor in manufacturing is low, then a national value added or labor tax will increase income shortfall. If it is high then it lowers urban employment enough to induce reverse migration. This will decrease unemployment and increase agricultural employment. With the lower agricultural wage, however, the effect on the income shortfall is still likely to be indeterminate.

The change in the Gini coefficient is similarly dependent on the manufacturing technology. If S_m is small then the dispersion of income below the poverty level increases. If S_m is large enough so that unemployment is reduced, then the taxed income distribution among the poor would Lorenz dominate the pre-tax distribution and the Gini coefficient would fall.

The effect of a general wage or commodity tax on the Sen poverty measure depends on the elasticity of substitution in manufacturing. If it is low then all three components of poverty worsen. If it is high, the headcount of the poor will increase but the average income shortfall, the Gini coefficient and the Sen index may decrease.

The ranking of taxes by effect on poverty is much more difficult than ranking by effect on GNP or unemployment. For the headcount measure of poverty agricultural taxes are preferred to all national and manufacturing taxes ($t_a \succ t$, $t_{wa} \succ t_w$, $t_a \succ t_m$, $t_{wa} \succ t_{wm}$, $t_{wa} \succ t$, $t_{wa} \succ t_m$, $t_a \succ t_w$, $t_a \succ t_{wm}$). A national tax, however, cannot be clearly ranked with the manufacturing tax. The national tax is less distortionary, but if we continue to assume that $\theta_m > \theta_a$, then a national tax at half the rate will raise less revenue that the manufacturing tax ($t' \prec t_m$, $t_w' \prec t_m$). Value added taxes are still preferred to their wage counterparts ($t_{wm} \succ t_{wm}$, $t_w \succ t_{wa}$, $t \succ t_w$).

Ranking of taxes by their effect on the Gini coefficient among the poor reverts to the pattern described for rank by GNP and unemployment. In this case, however, it must be assumed that $f_K > S_m$ in order to establish the rankings between manufacturing and national taxes.

The responses of the income shortfall and the Sen composite measure are so complex that simple assumptions such as used in the other cases do not produce neat rankings. General rules of thumb are not forthcoming.

SECTION 5: A Comparison: Neoclassical vs. Dual Tax Incidence

One of the important reasons to examine tax incidence in a dual economy is that it differs from that of a neoclassical economy. This section contrasts the results from the two cases.

The neoclassical model used follows the dual model presented in section 2, except that the urban wage w_m is flexible. Unemployment is zero

(=0), and so the probability of employment in the urban sector is unity (=1). Incidence elasticities are derived in the same manner.

Figure 6 provides some insight into how taxes work in the neoclassical economy without presenting the calculus. As previously, the length of the horizontal axis denotes the size of the total labor force with the origin for manufacturing on the right and that for agriculture on the left. The wage is on the vertical axis. In the neoclassical case, the wage is flexible in both sectors, and so the allocation of labor and the national wage are determined by the intersection of the two demand curves for labor MM' and AA', at point B. A tax on either the product or the wage in manufacturing will shift the sector's demand for labor down to mm'. Now the demand curves intersect at b. The wage has fallen and labor has moved to agriculture.

Tables 4 and 5 contrast the qualitative results from the two models. Capital taxes, of course, act in identical manners in the two models due to the specific factors assumption. Taxes in the manufacturing sector on either the product or labor produce the same qualitative effects in the two models. Taxes in agriculture, however, show differences. Because of the fixed manufacturing wage in the dual model, a tax in agriculture will not promote the reallocation of labor to manufacturing that it does in the neoclassical model. Manufacturing output and the return to manufacturing capital are therefore unchanged in the dual model, but increase in the neoclassical model. Because agricultural taxes prompt different changes in the two models, across-the-board taxes also act differently. In the neoclassical model, they produce no change in sectoral allocations, but merely decrease factor prices in relation to product prices.

An important implication of the disparate behavior of sectoral allocations is that the ordering of taxes by effect on GNP differ in the two models.[9] In the neoclassical model, as in the dual model, capital is sector specific and its taxation will have no effect on national income. Here national wage and value-added taxes can also claim the distinction of being non-distortionary and causing no loss in national income. These policies are followed in desirability by single-sector wage or value-added taxes which do cause a loss in national income. The loss is the same for equal rate taxes in the two sectors. Thus the policy recommendations from the neoclassical model are: 1) Taxes on capital in one or both uses, the national wage, and the national value added taxes are nondistortionary. 2) Value added taxes are preferred to wage taxes in the same sectors ($t_m \succ t_{wm}$, $t_a \succ t_{wa}$), and 3) For either value added or wage taxes, a manufacturing tax is preferred to a wage tax ($t_m \succ t_a$, $t_{wm} \succ t_{wa}$).

The difference in the rankings of taxes with respect to national income in the neoclassical model and the dual model indicates that prescriptions for LDC's based on neoclassical models of tax incidence are misleading, at best.

Even in the cases in which the qualitative results agree in the two models, the magnitudes of the elasticities are unequal. Table 6 contains the signs of the differences in absolute value of the elasticities derived from the two models. Those for the dual model are subtracted for those from the neoclassical model.

For a tax in manufacturing, its employment, output and the return to the sector's capital is more affected in the dual model than in the neoclassical model. The wage rigidity exaggerates the change in employment i the dual case compared to that in the neoclassical case, where a fall in the wage may help absorb the shock to the system. The sign of the differences in elasticities for agricultural employment, output and return to capital are indeterminate. The change in agricultural and manufacturing employment in the neoclassical model are of equal magnitude but opposite direction. In the dual model, however, the change in unemployment comes in to play. Where it is uncertain, the absolute value of the differences in the two model's elasticities cannot be determined.

For taxes in agriculture the use of labor in manufacturing does not change in the dual model, so the elasticities for manufacturing variables in the neoclassical model are larger than in the dual model. The same uncertainties as before prevail as to the relative size of the elasticities for agricultural variables.

For national value added taxes there are no reallocations of labor in the neoclassical model, hence the elasticities for labor and output are smaller in absolute value than those in the dual model. The elasticity on the returns to capital in the neoclassical model are negative unity, the corresponding dual elasticity for the manufacturing sector is greater in absolute value, and uncertain in the agricultural sector.

For a national wage tax, the only non-zero elasticity is for wages, thus for the comparisons we can make, the dual model's elasticities will always be larger in absolute value.

These comparisons show that the effects of taxes on sectoral allocations, output, and factor payments do differ in significant ways between the neoclassical model suitable for developed countries, and the dual model appropriate for less developed countries. Rankings of policies by their impact on GNP differ between the models. The need for the dual model is further supported by its ability to deal with unemployment and poverty, problems of real concern which are not addressable in the neo-classical model presented here.

SECTION 6: An Example

The preceding sections have derived the formulae with which to calculate the effects of taxes on sectoral allocations, unemployment, national income, and poverty. The derivations are quite useful in understanding the workings of the system and in deriving policy rankings. The formulae derived are also valuable in that they may be applied to data for individual countries to determine the magnitudes of the effects which can be expected in the specific cases.

In this section we provide a rough estimate of tax incidence in Kenya based on the formulae derived above. It is, of course, only one example and as such cannot provide us with information on the range of the elasticities across countries. Nor is Kenya necessarily "representative" or median. It was chosen for the example in part because its data are more complete than many countries' and in part because it is in a sense the birthplace of the Harris-Todaro literature.[10]

Data for the sectoral allocation of labor, the share of agriculture in gross domestic product, the level of GDP, and the size of the labor force were taken from Kurian (1982). The value of w_m was assigned the value for "wages in non-agriculture" from International Labor Office (1984). From these numbers the agricultural wage and the factor shares in output were derived. The elasticities of factor substitution in the production functions were postulated such that $S_A > S_M$, to accord with the technological theory of dualism. A poverty level was specified arbitrarily half way between the manufacturing and agricultural wages. The parameter values employed in the example are presented in Table 7. The data used here are very rough and it is certainly to be hoped that more careful analysis be conducted before actual policy recommendations be made. It should further be born in mind that these are local estimates only. Large changes in taxes may induce changes in f_L, f_K, g_L, and g_K, upon which the incidence estimates are based.

The calculations of tax incidence for Kenya (see Table 7) show some interesting points. Taxes on manufacturing product or labor yield very similar results in the two models. The results for the agricultural and national sales and wage taxes differ more markedly.

In this example dual model unemployment decreases with a manufacturing tax, but increases with national or agricultural taxes. The manufacturing tax also has the lowest excess burden of the possible choices. The number of poor increases with manufacturing or national sales or labor taxes. Income shortfall increases with all of the non-capital taxes. The Gini coefficient for income distribution among the poor decreases with a manufacturing tax but rises in the other cases. The ordering of desirability of taxes with regard to their effect on poverty in this example is manufacturing first, national second, and agriculture third with the value added tax preferred to the same sector wage tax.

SECTION 7: Concluding Remarks

A model for the analysis of tax incidence in dualistic developing countries has been presented. The labor market is segmented by a fixed manufacturing wage and the workers' maximization of expected wages. Capital is sector-specific. Use of a mechanism whose implications have been thoroughly studied in other contexts has enabled us to concentrate attention on the incidence of marginal tax changes.

Using the dual model, the effects of national and sectoral taxes on value added, wages, and the return to capital are described and formulae for their precise expression derived. These are then used as building blocks to develop the rankings of tax policy instruments by effect on GNP, unemployment and poverty. Generally, manufacturing taxes are preferred to national taxes which are preferred to agricultural taxes.

The menu of incidence elasticities derived from the dual model differs substantially from that resultant from a neoclassical model. Changes in the sectoral allocations of labor, product and the return to capital differ in magnitude. The signs of many of the dual elasticities are indeterminate where they are known in the neoclassical model. The dual model allows for the integral consideration of unemployment and poverty. The ordering of taxes by effect on national income differs in the two models. We must, therefore, conclude that reliance upon traditional (neoclassical) wisdom in the formulation of tax policy will seriously mislead LDCs.

The introduction of a single simple dual structure produced significant changes in the effects of tax policies and their rankings. Before ending this essay let us spend a moment considering elaborations on this model which bear consideration. Perhaps its greatest over-simplification is the assumption of sector-specific capital. This drives the results of nondistortionary capital taxes and strongly influences the other elasticities as well. The basic dichotomy between land and manufacturing capital is, however, somewhat appealing.

An interesting way of maintaining a degree of specialization without introducing the rigidity of complete capital immobility would be to consider the endowment of land fixed, but to let the quantity of manufacturing capital vary according to the rate of return. Fixing the rate of return in manufacturing at the world rate would simulate the experience of capital influx or capital flight, unquestionably important issue is less developed countries. While maintaining the simplicity of the static model, this formulation brings growth considerations within the model's reach. A more complex formulation would use a three factor production function in agriculture with land fixed and capital equipment mobile between sectors and internationally. This would permit modernization to occur by transforming agriculture rather than by abandoning it.

Another shortcoming of the model as presented here is that there is no trade balance constraint. This implicit assumption of unlimited foreign exchange certainly mimics many countries' actions during the 1970's, but is less plausible now. The other extreme of the spectrum is to assume a closed economy with endogenous prices. The complexity of the income effects with changes in employment rates is such that if done precisely the case is untractable.

The lack of a government budget balance constraint is not important. It was dispensed with here by the assumption of lump sum transfers. If it is desired to avoid this, then because income shares are known, it is easy to calculate at what level one tax would have to be levied in order to support a given level of subsidization of some variable, or to decrease another tax by a given amount.

This essay has studied only one extremely simple version of a segmented labor market and its implication for tax policy. The divergence of results from it and the neoclassical model suggests the sensitivity of tax policy to the economy's structure. Further study is needed to encompass the modifications suggested above, to investigate other labor market segmentations, and to branch into other causes of dualism entirely. The importance of understanding fiscal alternatives in developing countries is too great to ignore these issues.

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2. The product price does not affect the capital to labor ratio when the production functions are homothetic.

3. The wage may be set as a result of institutional forces such as labor unions, a sectoral minimum wage, or highly paid civil servants. An efficiency wage due to turnover [Stiglitz, (1974)], nutrition [Leibenstein, (1957)], or employee incentive [Garner, (forthcoming)] will give a higher than market-clearing sectoral wage. Better enforcement of minimum wage, fringe benefit and worker safety regulations in the urban sector would also account for the wage differential.

4. Migration here refers to the movement from one sector to another. It frequently implies a geographic move as well, but not necessarily.

5. This implies complete job turnover in each period, and completely random selection of employees. These assumptions are clearly unrealistic. They do not, however, alter the qualitative results of the model, but merely exaggerate the likelihood of employment. For a treatment of the relaxation of these assumptions see Fields, (1975).

6. For simplicity's sake zero initial taxes are assumed. The formulae for the elasticities derived are applicable to cases with nonzero initial taxes. Their values may change, however, because they are evaluated at different points for the cases of zero and nonzero initial taxes. Where the paper refers to an imposition of a tax, it could as well mean an increase in the rate of a pre-established tax.

7. Foreign aid is an example of such an investment. The amount is largely determined from outside the LDC economy, but it is to be hoped that it is invested where the return is highest.

8. See especially Bhagwati-Srinivasan (1974) and (1973) for the design of optimal wage subsidies, and the first essay of this dissertation for a discussion of the effects of marginal wage subsidy changes.

9. These comparisons are again based on the assumption of Cobb-Douglas production functions.

10. Michael Todaro did the first published work while at the Institute for Development Studies of the University of Nairobi in 1969.

Table 1

Key Equations

Production

$$\hat{M} = f_L \hat{L}_m \qquad \hat{A} = g_L \hat{L}_a$$

Factor Substitution

$$\hat{L}_m = S_m(\hat{r}_m{*} - \hat{w}_m{*}) \qquad \hat{L}_a = S_a(\hat{r}_a{*} - \hat{w}_a{*})$$

Price relations

$$\hat{P}^M{}_m = f_L \hat{w}_m{*} + f_K \hat{r}_m{*} \qquad \hat{P}^M{}_a = g_L \hat{w}_a{*} + g_K \hat{r}_a{*}$$

Labor Market

$$0 = L_m \hat{L}_m + L_a \hat{L}_a + U\hat{U}$$

$$\hat{z} = \hat{L}_m + (L_a/L_u)\hat{L}_a$$

$$\hat{w}_a = \hat{w}_m + \hat{z}$$

Elasticities

Factor substitution

$$S_m = - \frac{\partial\left(\frac{K_m}{L_m}\right) \frac{r_m}{w_m}}{\partial\left(\frac{r_m}{w_m}\right) \frac{K_m}{L_m}} \qquad S_a = - \frac{\partial\left(\frac{K_a}{L_a}\right) \frac{r_a}{w_a}}{\partial\left(\frac{r_a}{w_a}\right) \frac{K_a}{L_a}}$$

Output with respect to factor input/ factor shares

$$f_L = \frac{\partial f \; L_m}{\partial L_m M} = \frac{w_m L_m}{P_m M} \qquad g_L = \frac{\partial g \; L_a}{\partial L_a A} = \frac{w_a L_a}{P_a A}$$

$$f_K = \frac{\partial f \; K_m}{\partial K_m M} = \frac{r_m K_m}{P_m M} \qquad g_K = \frac{\partial g \; K_a}{\partial K_a A} = \frac{r_a K_a}{P_a A}$$

Table 2

Tax Incidence Elasticities in the Dual Model*

Panel a: Domestic Value Added Tax

	Manufactures	Agriculture	Both
M	$-\ f_L S_m / f_K$	0	$-\ f_L S_m / f_K$
L_m	$-\ S_m / f_K$	0	$-\ S_m / f_K$
r_m	$-\ 1/f_K$	0	$-\ 1/f_K$
A	$g_L S_m S_a U/J$ **	$-\ f_K g_L S_a U/J$	$g_L S_a U(S_m - f_K)/J$
L_a	$S_m S_a U/J$	$-\ f_K S_a U/J$	$S_a U(S_m - f_k)/J$
r_a	$g_L S_m U/J$	$-\ f_K U(S_a L_a/L_u + 1)/J$	$[S_m g_L\ -\ f_K(S_m L_a/L_u + 1)]U/J$
w_a	$-\ g_K S_m U/J$	$-\ f_K U S_a L_a/L_u J$	$-\ (S_m g_K + S_a f_K L_a/L_u)U/J$
z	$-\ g_K S_m U/J$	$-\ f_K U S_a L_a/L_u J$	$-\ (S_m g_K + S_a f_K L_a/L_u)U/J$
U	$S_m U(S_a U L_a/L_u\ -\ L_m g_K)/J$	$f_K S_a L_a/J$	$U[S_m S_a L_m L_a/L_u + S_m L_m g_K + S_a L_a(f_K - S_m)]/J$

* The variables are arranged by row, the sectors by column and the factor taxed by panel. Thus $\epsilon_{m,tm}$, the effect of a change of a value added tax on manufacturing output is found in the first column of the first row of the first panel.

** J refers to the Jacobian of the system: $J = f_K U(S_a L_a/L_u + g_K) > 0$.

Table 2 (continued)

Tax Incidence Elasticities in the Dual Model

Panel b: Wage Tax in

	Manufacturing	Agriculture	Both
M	" **	"	"
L_m	"	"	"
r_m	$-f_L/f_K$	"	$-f_L/f_K$
A	"	"	"
L_a	"	"	"
r_a	"	$-g_L f_K U/J$	$-g_L U(S_m - f_K)/J$
w_a	"	"	"
z	"	"	"
U	"	"	"

Panel c: A Capital Tax in

	Manufacturing	Agriculture	Both
M	0	0	0
L_m	0	0	0
r_m	-1	0	-1
A	0	0	0
L_a	0	0	0
r_a	0	-1	-1
w_a	0	0	0
z	0	0	0
U	0	0	0

** Where a " appears the elasticity is identical to the corresponding elasticity for a value-added tax.

Table 3

The Response of GNP and Poverty

Panel a: A Tax on Wages or Value-Added in Manufactures

$\epsilon_{GNP,tm}$	$-\theta_m f_L g_K S_m U/J$
dH/dtm	$L_m S_m / f_K$
dI/dtm	$A^* S_m U[U(g_K - S_a) + L_a(g_K - S_a U) + S_a L_m L_a/L_u + L_m g_K]/J$
dG_p/dtm	$L_a S_m U[L_m g_K - US_a(1 + L_a/L_u)]/(L_a + U)^2 J$
dSen/dt	$S_m L_m (1 - L_a A)/f_K$ $- S_m L_a UA[(S_a - g_K)(U + L_a) - S_a L_m L_a/L_u - L_m g_K]/J$

Panel b: A Tax on Wages or Value-Added in Agriculture

$\epsilon_{GNP,ta}$	$-\theta_a f_K g_L S_a U/J$
dH/dta	0
dI/dta	$AS_a f_K U[UL_a/L_u + (L_a + U^2)L_a/L_u]/J$
dG_p/dta	$L_a S_a f_K U / (L_a + U)J$
dSen/dta	$AL_a S_a U f_k [(L_a + U)(1 + L_a/L_u)]/J$

Panel c: A National Tax on Wages or Value-Added

$\epsilon_{GNP,t}$	$-U[\epsilon_m f_L g_K S_m + \epsilon_a f_K g_L S_a]/J$
dH/dt	$L_m S_m / f_K$
dI/dt	$AU[(g_L S_a U + S_a L_a)(f_K - S_m) + U(L_a + U)(S_m g_K + S_a f_K L_a/L_u$ $+ S_m L_m (S_a L_a/L_u + g_K)]/J$
dG_p/dt	$L_a[S_m S_a L_m L_a/L_u + S_m L_m g_K + (S_a L_a + g_L S_a U)(f_K - S_m)]/J(L_a + U)$
dSen/dt	$L_m S_m (1 - AL_a)/f_K$ $+ U^2 L_a A[S_a(L_a + U)(f_K - S_m) + S_m S_a L_m L_a/L_u + S_m g_K]/J$

* A is compact notation: $A = w_a L_a/(L_a + U)^2 \pi$

Table 4

Qualitative Effects of Taxes in the Dual Model

	t_m	t_a	t	t_{wm}	t_{wa}	t_w	t_{rm}	t_{ra}	t_r
M	-	0	-	-	0	-	0	0	0
L_m	-	0	-	-	0	-	0	0	0
A	+	-	?	+	-	?	0	0	0
L_a	+	-	?	+	-	?	0	0	0
r_m	-	0	-	-	0	-	-1	0	-1
r_a	+	-	?	+	-	?	0	-1	-1
$z = w_a$	-	-	-	-	-	-	0	0	0
U	?	+	?	?	+	?	0	0	0

Table 5

Qualitative Effects of Taxes in the Neoclassical Model

	t_m	t_a	t	t_{wm}	t_{wa}	t_w	t_{rm}	t_{ra}	t_r
M	-	+	0	-	+	0	0	0	0
L_m	-	+	0	-	+	0	0	0	0
A	+	-	0	+	-	0	0	0	0
L_a	+	-	0	+	-	0	0	0	0
r_m	-	+	-1	-	+	0	-1	0	-1
r_a	+	-	-1	+	-	0	0	-1	-1
w_a	-	-	-1	-	-	-1	0	0	0

Table 6

Qualitative Differences in Absolute Value of Elasticities:
Neoclassical - Dual

	t_m	t_a	t	t_{wm}	t_{wa}	t_w	t_{rm}	t_{ra}	t_r
M	-	+	-	-	+	-	0	0	0
L_m	-	+	-	-	+	-	0	0	0
A	?	?	-	?	?	-	0	0	0
L_a	?	?	-	?	?	-	0	0	0
r_m	-	+	-	-	+	-	0	0	0
r_a	?	?	?	?	?	?	0	0	0

Table 7

Incidence Elasticities for Kenya, 1979

Panel a: Harris-Todaro Labor Market

	t_m	t_a	t	t_{wm}	t_{wa}	t_w	t_{rm}	t_{ra}	t_r
M	-.05	0	-.05	-.05	0	-.05	0	0	0
L_m	-.55	0	-.55	-.55	0	-.55	0	0	0
A	.06	-.11	-.05	.06	-.11	-.05	0	0	0
L_a	.15	-.27	-.12	.15	-.27	-.12	0	0	0
r_m	-1.10	0	-1.10	-.10	0	-.10	-1	0	-1
r_a	.06	-1.11	-1.05	.06	-.11	-.05	0	-1	-1
$z = w_a$	-.09	-.84	-.93	-.09	-.84	-.93	0	0	0
U	-.25	2.88	2.63	-.25	2.88	2.63	0	0	0
GNP	-.01	-.04	-.05	-.01	-.04	-.05	0	0	0
dH/dt*	.11	0	.11	.11	0	.11	0	0	0
dI/dt**	-.04	-.83	-.87	-.04	-.83	-.87	0	0	0
dG_p/dt***	-.03	.24	.21	-.03	.24	.21	0	0	0

* dH/dt is the percent change in the number of poor.
** dI/dt is the percent change in the average percent income shortfall.
*** dG_p/dt is the change in the Gini coefficient.

Panel b: Neoclassical Labor Market

	t_m	t_a	t	t_{wm}	t_{wa}	t_w	t_{rm}	t_{ra}	t_r
M	-.04	.04	0	-.04	.04	0	0	0	0
L_m	-.50	.50	0	-.50	.50	0	0	0	0
A	.06	-.06	0	.06	-.06	0	0	0	0
L_a	.16	-.16	0	.16	-.16	0	0	0	0
r_m	-1.09	.09	-1	-.09	.09	0	-1	0	-1
r_a	.06	-1.06	-1	.06	-.06	0	0	-1	-1
w	-.09	-.91	-1	-.09	-.91	-1	0	0	0
GNP	.00	.00	0	.00	.00	0	0	0	0

Panel c: Parameter Values Used

$f_L = .09$ $g_L = .40$ $\theta_m = .59$ $S_m = .5$
$f_K = .91$ $g_K = .60$ $\theta_a = .41$ $S_a = 1.0$

Harris-Todaro
$w_m = 1162$ $L_m = .17$ $L_a = .76$ $U = .07$
$w = 823$ $\pi = 1000$

Neoclassical
$w = 835$ $L_m = .24$ $L_a = .76$

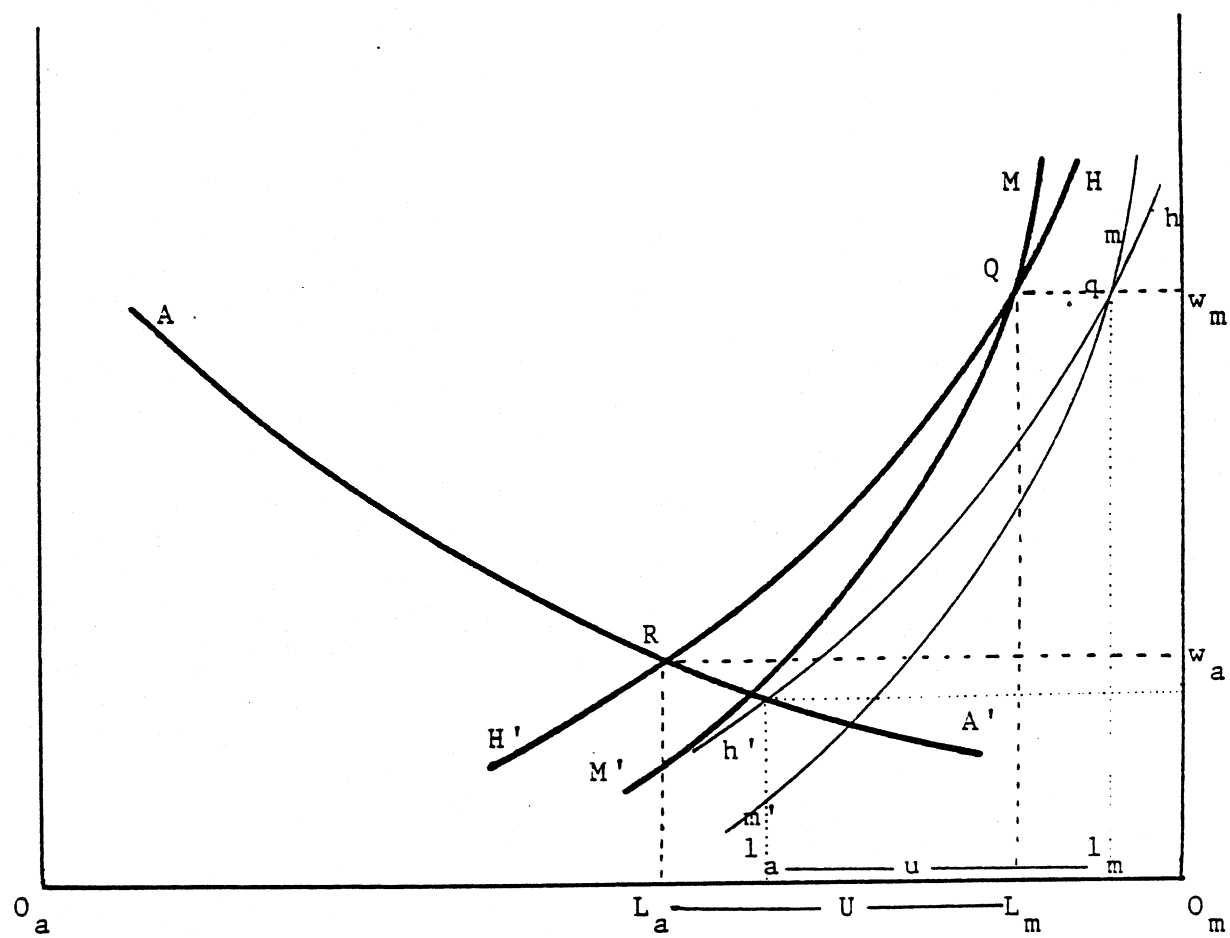


Figure 1

A Value Added Tax in Manufacturing

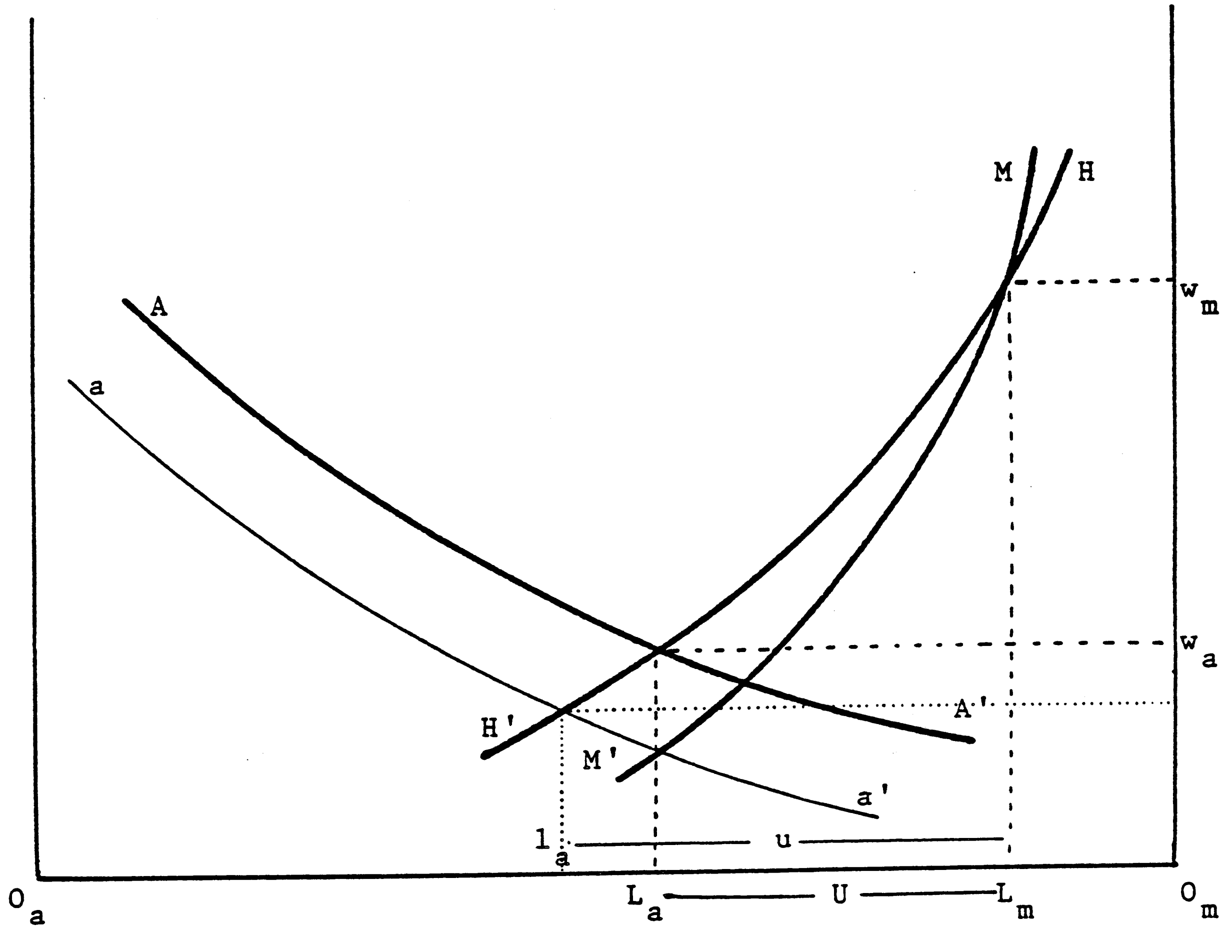
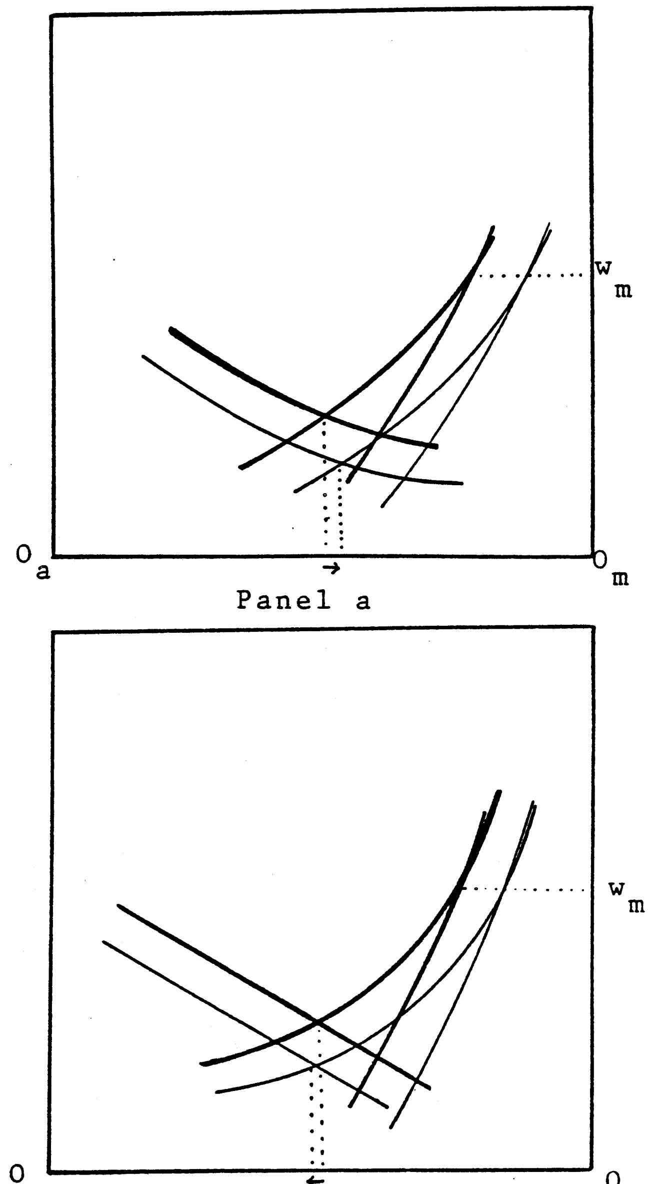


Figure 2

A Value Added Tax in Agriculture



Panel b

Figure 3

A National Value Added Tax

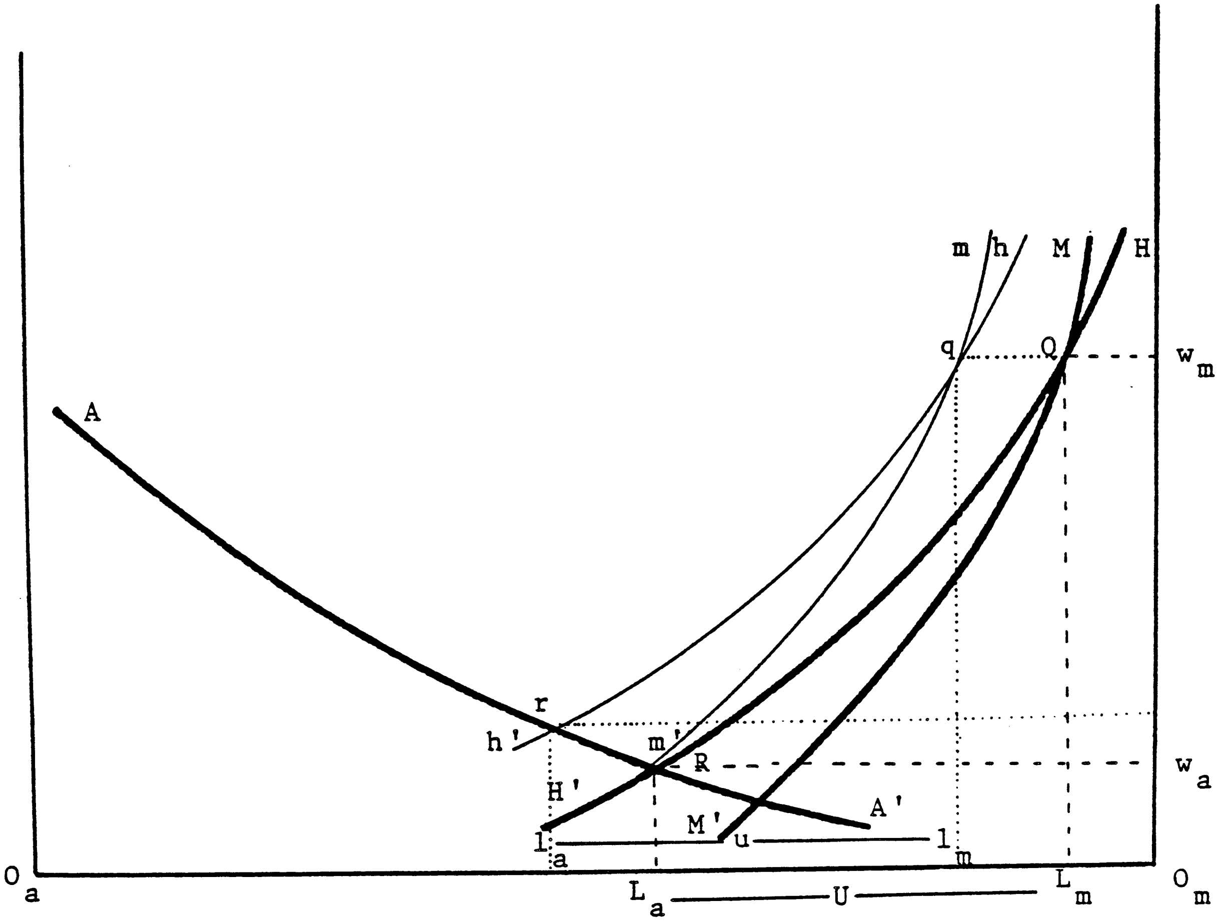


Figure 4

An Increase in Manufacturing Capital

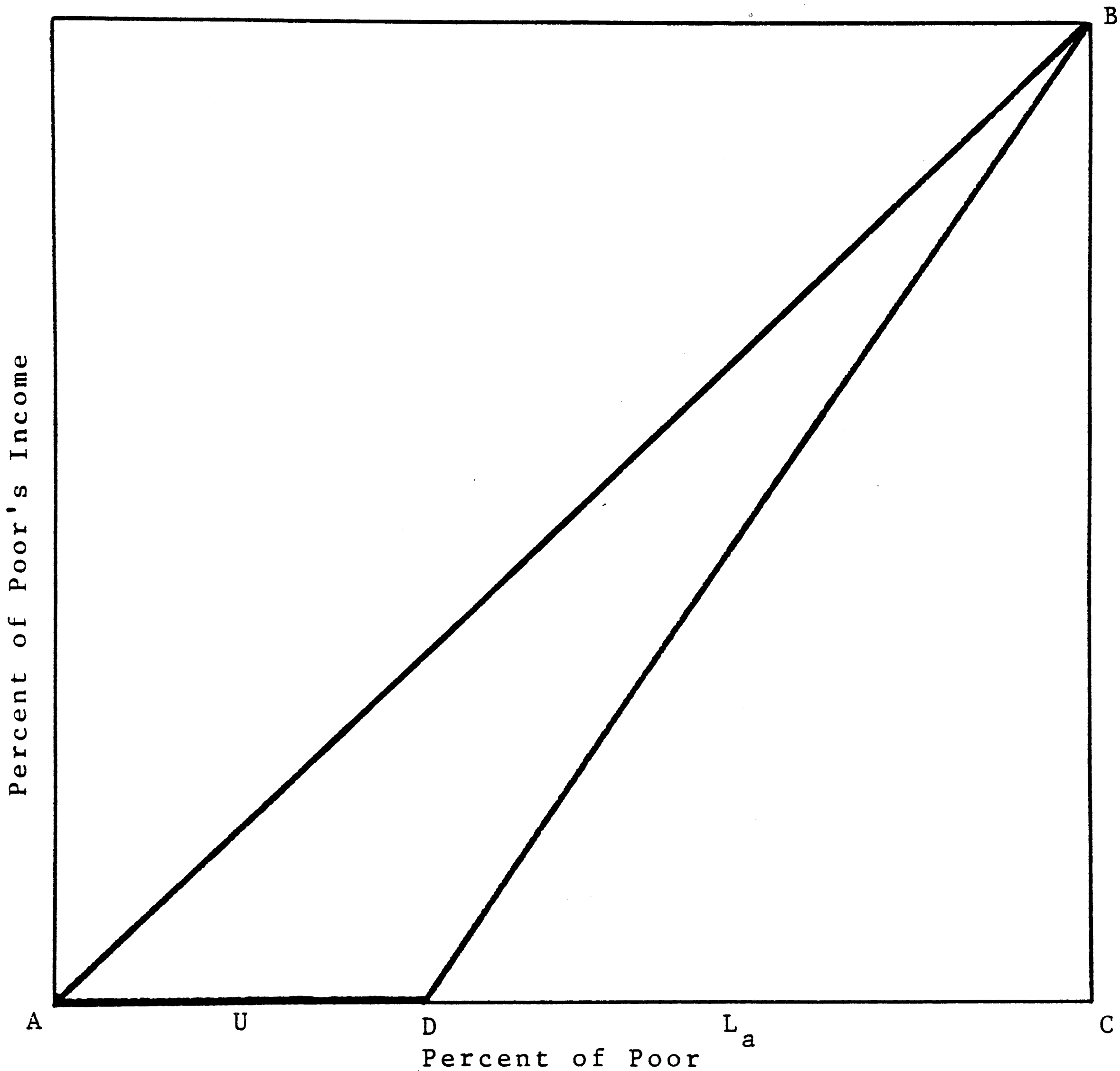


Figure 5

Lorenz Curve for Income Distribution Among the Poor

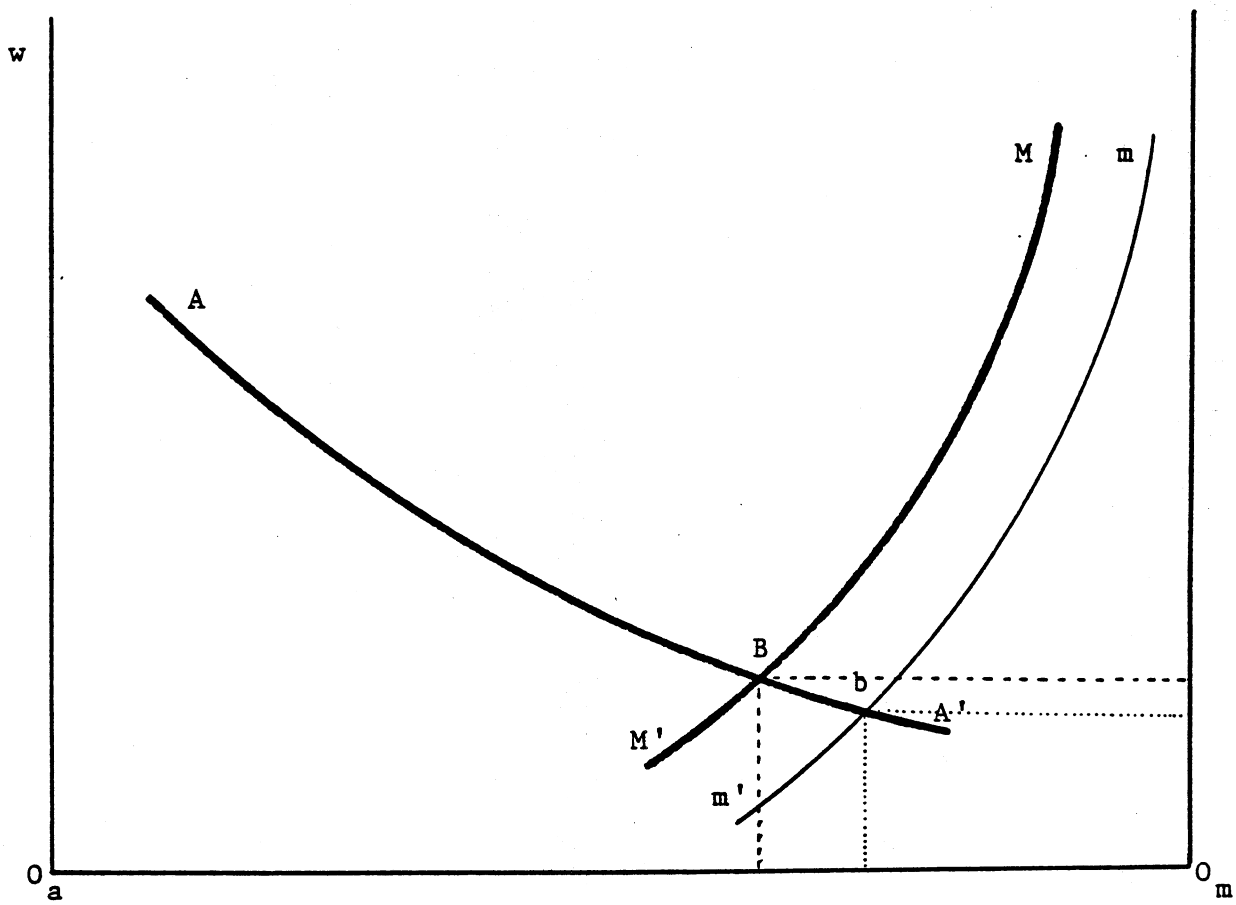


Figure 6

A Value Added Tax on Manufacturing in the Neoclassical Economy