

Taxes, Subsidies, and Employment*

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Increasing recognition has recently been given to the urgency of promoting employment-generating techniques in surplus-labor underdeveloped countries. Theoretical attention has been largely concentrated upon the optimality of labor-intensive choices. The problem of encouraging labor-intensive techniques is almost always dismissed as being automatic in a fully planned economy and achievable through tax-subsidy measures in a market economy. In this paper we will examine some considerations relevant to an optimal design for fiscal intervention in relative prices.

It is commonly suggested that tax-subsidy policies in favor of the labor-intensive commodity will increase employment as also will tax subsidy policies against capital and in favor of labor. We will examine the validity of such statements in the context of a simple two-sector model. This model enables us to identify two approaches to increasing the total volume of employment when scarce capital stock is fully employed:(i) a shift towards more labor-intensive commodities and (ii) a shift towards more labor-intensive techniques. We can show that fiscal intervention has an effect on both these margins but simple extensions of partial equilibrium results can be misleading. Fiscal interventions in one sector may affect conditions in other sectors in the opposite direction so that the net effect on employment may be quite different from that expected by partial equilibrium analysis. This is particularly important when it is realized that recommendations are often made not as part of a package deal covering relative factor prices in all sectors but for specific sectors under review or in sectors where, for institutional reasons, these measures can be easily implemented. The approach adopted is essentially taxonomic, and the results depend entirely upon the very rigid assumptions used (see below) but they do illustrate the need to use conventional wisdom with caution.

I. THE EQUILIBRIUM OF A SURPLUS-LABOR ECONOMY

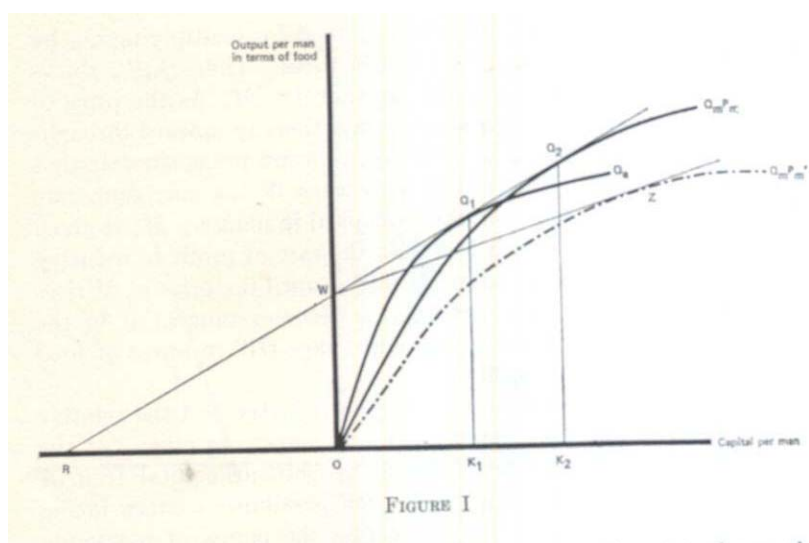
In the familiar competitive models of neoclassical theory, an unemployment equilibrium at a positive real wage is ruled out by the assumptions of wage-price flexibility and smooth continuous production functions. We can construct a surplus-labor model by dropping the assumption of wage flexibility. The model has the following characteristics:

- (a) There is a subsistence sector that produces "food", consumes the entire output, and supports a very large unemployed labor force. The marginal product of labor in this sector is zero. There is also a modern sector producing both "food" A and "manufactures" M .
- (b) There is a given capital stock K^* in the modern sector that is mobile between the two goods A and M . Capital is assumed to be a homogeneous, malleable physical commodity. There is no capital mobility between the subsistence sector and the modern sector.
- (c) Wages are fixed at the level OW in *terms of food*, and any amount of labor can be drawn from the subsistence sector at that wage rate.
- (d) The factor market is competitive in the modern sector, and hence the reward to each factor must be the same in industry A as in industry M .
- (e) The production function for each good in the modern sector is of the continuous neoclassical type with constant returns to scale. We will assume that M is more capital-intensive at any factor price ratio.

On these assumptions, we can show that there will exist an equilibrium solution such that the following are determined:

- (i) the choice of techniques in each industry.
- (ii) the relative price of M in terms of A .
- (iii) the production possibilities curve.
- (iv) the level of employment.

We take good A as the numeraire and set its price=1, while the price of M in terms of food is P_m . Given assumption (e) above, the production function for food can be expressed in terms of output per man Q_a being a function of capital per man.¹ The curve Q_a rises as capital per man rises but at a diminishing rate reflecting diminishing marginal productivity of capital. Given the wage rate W , the technique that will be chosen is the one that maximizes the rate of profit. This is determined as shown in Figure I.



$Q_1 K_1$ is output per man and the surplus over the wage OW is given by $Q_1 K_1 - OW$. This surplus accrues to capital OK_1 giving a rate of profit or rental on capital of $\rho_1 = \frac{Q_1 K_1 - OW}{OK_1} = \text{slope of } WQ_1$. It is clear that technique OK_1 maximizes the slope of WQ_1 .

The production function for "manufactures" M can also be represented in terms of output per man as a continuously rising function of capital per man. This curve can be shown

¹ This follows from the assumption of constant returns to scale. When returns to scale are not constant, output per man is not just a function of the capital-labor ratio, but also the level or scale of production. The curve Q_a can be derived from the Cobb-Douglas function $X_a = AK^\alpha L^{1-\alpha}$:

$$Q_a = A (A/L)^\alpha = AK^\alpha \quad k = \left(\frac{K}{L} \right)$$

$$\frac{\partial Q_a}{\partial k} = \text{slope of curve at } k = \alpha AK^{\alpha-1} > 0, \quad \text{since } 0 < \alpha < 1$$

$$\frac{\partial^2 Q_a}{\partial k^2} = (\alpha-1) \alpha AK^{\alpha-2} < 0.$$

in Figure I, providing we convert each level of output per man Q_m (in physical units) into output per man in *terms of food* by multiplying Q_m by P_m , where P_m is the price of manufactures. Thus $Q_m P_m$ shows output per man in terms of "food" in industry M . As the price of manufactures rises, this curve shifts proportionally upward throughout its length. Clearly P'_m is not an equilibrium price, since at that price the curve $Q_m P'_m$ shows that with wage W the maximum rate of profit (in term of food per unit of capital in industry M) is given by the slope of WZ , which is less than the rate of profit in industry A . Thus capital will move out of M into A until the price of M rises to P_m , at which level the curve $Q_m P_m$ becomes tangential to the line WQ_1 . Both industries pay the same wage OW in terms of food and have the same profit rate.²

Thus the choice of technique in each industry and the relative price of manufactures are determined *once wages are given*. At the price P_m more of M can be produced by shifting capital from A to M . We can show that the production possibilities curve facing the economy is a straight line connecting the points of maximum feasible outputs of A and M (Figure II). These are derived as follows, given total capital stock K^* and capital intensity in each industry:

$$A = \frac{K^*}{OK_1} \cdot Q_1 K_1$$

$$M = \frac{K^*}{OK_2} \cdot \frac{Q_2 K_2}{P_m}$$

The marginal rate of transformation (defined as $MRT =$ additional output of A that can be produced for one less physics unit of M) is constant and equal to the slope of the production possibilities curve.³

² Note that P_m is the only equilibrium price at which production in both industries can occur consistent with our competitive assumption. At a price less than P_m only A is produced, since no choice of technique in M can yield a rate of profit equal to the maximum rate of profit in A . At a price greater than P_m only M will be produced. Assuming that demand conditions preclude a corner solution, P_m is uniquely determined given the wage rate.

³ These results follow from the fact that the choice of technique in each industry is given independently of the output mix. At any output combination we can reduce employment in M by one man, losing $Q_2 K_2 / P_m$ of output (physical units) and releasing OK_2 of capital. With this we can increase employment in A by $\frac{OK_2}{OK_1}$ yielding additional output of

$$\cdot \frac{Q_1 K_1}{OK_1} \cdot \frac{OK_2}{OK_1} = \Delta A$$

This gives us

$$MRT = \left[\frac{OK_2}{OK_1} \cdot \frac{Q_1 K_1}{Q_2 K_2} \cdot P_m \right] \text{ as above.}$$

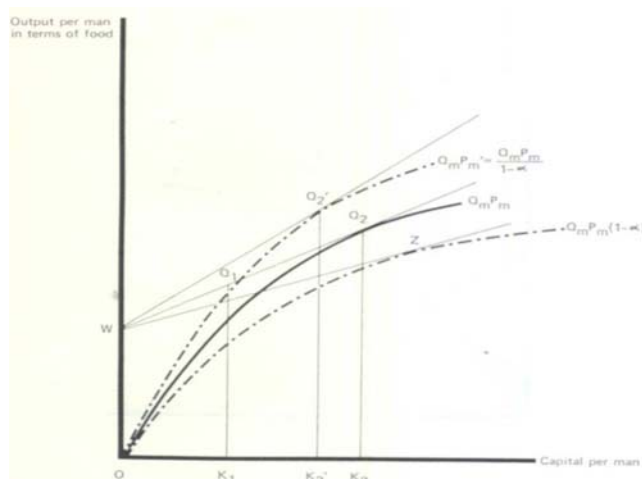
Up to now have made no attempt to fill in the demand side of the picture. Production equilibrium can be attained at any point on the production possibility curve with relative price of manufactures given by the slope of PP . If we could allow ourselves the luxury of using indifference curves, we can show the economy reaching both production and consumption equilibrium at C producing OX of M and OY of A . The marginal rate of substitution in consumption equals the price ratio (slope of PP), which differs from MRT (as discussed on page 397 above). Owing to the price distortion in favor of manufactures, this is a point of lower welfare than C' where more of the labor-intensive good is produced and employment is higher. As we move toward C' , moving MRT toward MRS , welfare increases along with employment⁴.

II THE ROLE OF COMMODITY TAXATION

In our model, tax subsidy interventions in favor of the labor-intensive good clearly increase total employment, a result completely in accordance with conventional wisdom.

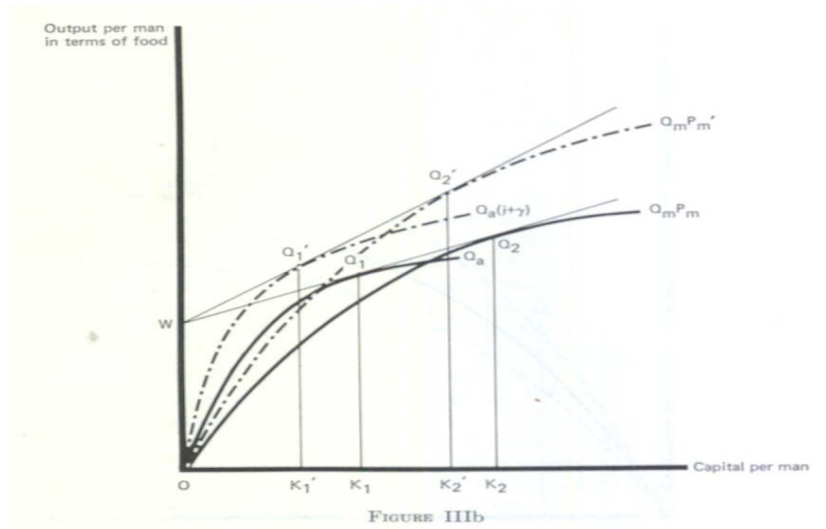
(a) Tax on Manufactures

A tax on manufactures has the effect of correcting the underpricing of manufactures by raising P_m so that the economy moves towards C' . A proportional ad valorem tax at the rate α has the effect of reducing revenue per man net of tax from $Q_m P_m$ to $Q_m P_m (1-\alpha)$ at any price P_m (Figure IIIa). It is this curve that is relevant for producer maximization, and it shows that at the price P_m the rate of profit in M would fall (slope of WZ) and the technique chosen would be more capital-intensive. Since Q_a does not



change, we have not drawn it in Figure IIIa. It may be imagined as tangent to WQ_2 at point Q_1 showing slope of WQ_2 as the maximum rate of profit in industry A . For the profit rate to be equalized in the two industries, P_m must rise until a new equilibrium is established at a price P'_m such that $Q_m P'_m (1-\alpha) = Q_m P_m$, i.e., $P'_m = P_m / (1-\alpha)$. At this price the posttax revenue curve facing the producer is the old techniques OK_2 with a rate of profit equal to that in A (slope of WQ_2). Note that if the entrepreneur were maximizing with respect to the new curve $Q_m P'_m$, ignoring the tax, he would be at Q'_2 with a less capital-intensive technique OK'_2 a higher pretax profit rate, but a lower posttax rate of profit.

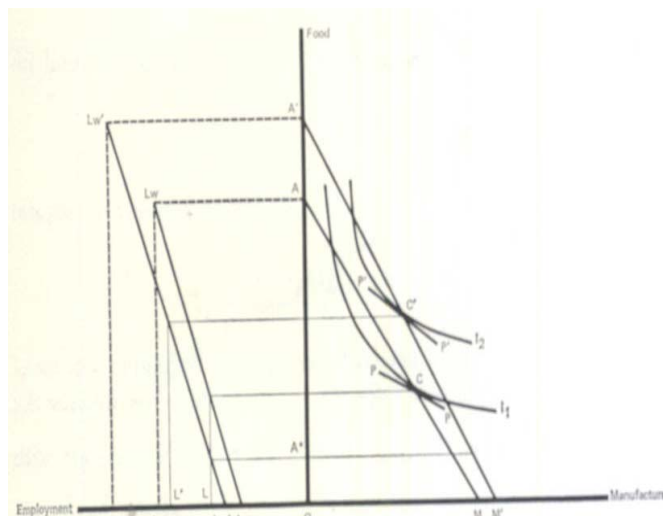
⁴ The use of indifference curves in this framework is much less justified than usual, since they take no account of employment—an important ingredient in welfare. Furthermore, the distribution of income changes along the production possibilities curve destroying the independence of the demand side from the production side of the picture.



Thus a tax on manufactures simply raises P_m leaving the choice of technique unchanged. Clearly we can set P'_m to any level desired and move along the production possibility curve toward C' . Further increases in price will take the economy beyond C' , after which increases in employment involve a lower indifference curve than at C' .

(b) Subsidy on "Food"

A proportional subsidy on food is better than a tax on manufactures in our model. The revenue curve Q_a shifts upward from Q_a to $Q_a(1+\gamma)$, where γ is the rate of subsidy (Figure IIIb). The rate of profit in A rises (slope of WQ'_1), and capital intensity falls to OK'_1 . For the rate of profit to be equalized in the two industries the price of M must rise so that $Q_mP'_m$ is tangential to the new profit line WQ'_1 . This implies a fall in capital intensity in M to OK'_2 . What is the effect upon the final equilibrium of the economy? Since capital intensity has fallen in both industries (for all output mixes), the production possibilities curve shifts out to $A'M'$, and the employment function shifts out to $L'_mL'_w$. Also the price of manufactures P_m rises to P'_m . These effects are illustrated in Figure IV. Given the new employment function, employment must increase unless the output mix shifts against the labor-intensive good so that output of A falls below A^* . But in our case both the "income effect" of the outward shift in the production possibilities curve and the "price effect" of the rise in P_m suggest an increase in output of A . The new equilibrium will be at C' with employment at L' .



III. THE ROLE OF GENREAL FACTOR TAXATION SUBSIDY

Conventional judgments prove much trickier when discussing the role of factor taxation subsidy. First, we will examine the effect of a general tax (or subsidy) on the factor applied to both industries. In our surplus-labor model there is an interesting dichotomy between the effects of a general tax on capital on the one hand and a general subsidy on wages on the other.

(a) Capital Taxation

Contrary to expectation a tax on capital applied in both industries will not affect capital intensity in either industry. The effect of the tax is simply to reduce the rate of profit in both industries *A* and *M*, leaving the choice of technique unchanged. This is because in each industry the technique that maximized the rate of profit before taxation will also maximize it after taxation. This can be demonstrated algebraically. Given our production function, output per man in industry *A* can be written as a function of capital per man in industry *A*:

$$Q_a = g(k_1).$$

Given the wage rate w , the rate of profit depends upon capital intensity k_1 :

$$\rho_1 = \frac{g(k_1) - w}{k_1}.$$

Consider a situation in which a specific tax is imposed on capital at the rate γ per unit of capital:

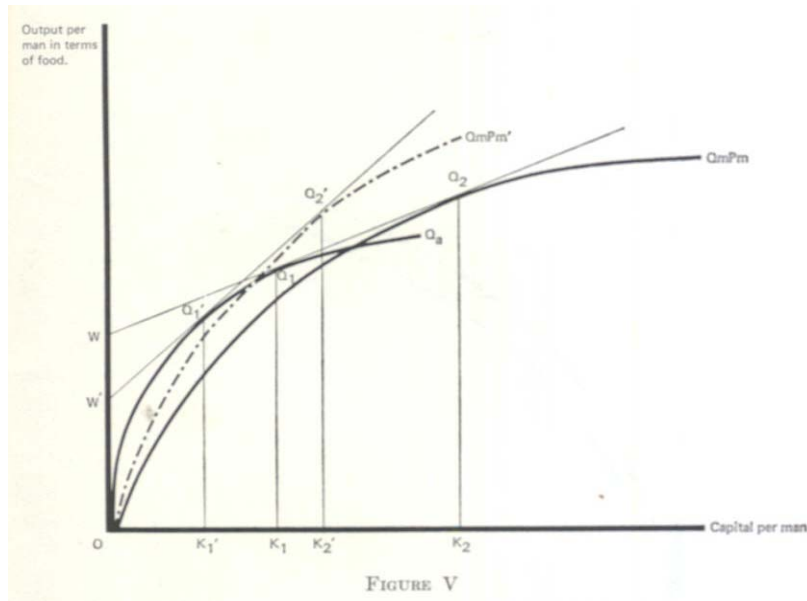
$$\rho_1 = \frac{(g(k_1) - w) - \gamma k_1}{k_1} = \frac{g(k_1) - w}{k_1} - \gamma.$$

The rate of profit (net of tax) is lower for each technique, but maximizing the profit rate with respect to k_1 amounts to maximizing the term $\frac{g(k_1) - w}{k_1}$, i.e, the rate of profit before tax. If

we start with an equilibrium situation with profit rates in each sector maximized and equalized, then capital taxation reduces the rate of profit in each sector by the same amount, and there is no incentive to change the choice of technique in either sector. This conclusion may seem intuitively disturbing but it should not be lightly dismissed as an eccentric consequence of our special assumptions. A general tax on one factor in the standard two-factor, two-good neoclassical model also leaves production equilibrium unaffected. The logic is identical to that behind Ricardo's land taxation proposals. Thus a general tax on capital in our model leaves the equilibrium of the economy unaltered except for lower rates of profit in both sectors. In effect, the supply of capital being fixed, it "bears the entire burden of the tax." When the tax is applied in one sector only, the supply of capital to that sector is clearly not fixed and the lower rate of profit leads to intersectoral shifts. This situation will be examined separately.

(b) Wage Subsidy

The assumption of perfectly elastic labor supply leads to different conclusions for the labor market. A general subsidy on wages operates unequivocally to raise employment. A wage subsidy of WW' reduces the cost of hiring labor in each industry to OW' (Figure V). The maximum profit rate in *A* rises (slope of $W'Q_1'$), and the capital intensity falls to OK_1' . A new equilibrium requires price of *M* to rise to P'_m , at which price the rates of profit are equalized and the optimal technique in *M* is also less capital-intensive OK_2' . The effects on production equilibrium are similar to those of a subsidy on food. The production possibility a cure and the employment function shift outward. Both income and price effects suggest a higher level of employment.



IV.FACTOR TAXATION SUBSIDY IN ONE INDUSTRY

We have argued above that the cases most relevant from the point of view of practical policy are those concerning tax subsidy interventions in one industry. These are also the cases calling for greatest caution. In our model there is an interesting asymmetry between the cases of capital taxation and wage subsidy.

(a) Capital Taxation

Consider the effects of introducing a tax per unit of capital in capital-intensive industry. We start with an equilibrium position with techniques OK_1 and OK_2 being used in A and M , respectively. In Figure VI the curve Q_a is not drawn for drawn for visual convenience. It may be imagined as tangent to WQ_2 at the point Q_1 . If a tax on capital at the rate γ per unit of capital is imposed in M , the initial effect (at the price P_m for manufactures) is to lower the rate of profit in M to the slope of WZ_2 , where the tax per unit of capital is equal to Q_2Z_2/OK_2 . Capital will now flow from M to A , decreasing the output of M and raising A until the relative price of M rises to P'_m . The new equilibrium is shown in Figure VI, where WQ'_2 represents a pretax rental on capital such that after taxation the rental on capital equals the slope of WQ_1 . The price P_m has risen to P'_m so that $Q_mP'_m$ is tangent to WQ'_2 , implying (by construction) equalization of the posttax rental on capital in both industries. It is easily demonstrated that capital intensity in M will fall.⁵ This means the production possibility curve tilts out from M to some point M' but remains anchored at A , while the employment curve tilts out from L_m to L'_m . The relative price of "manufactures" has risen so that any consumption effects will favor "food". The reader can assure himself that employment will increase.

⁵ Writing the rate of profit in M as $\rho_2 = \frac{f(k_2)P_m - w}{k_2}$,

where w =real wage in terms of food, the first-order conditions for a maximum with respect to k_2 are

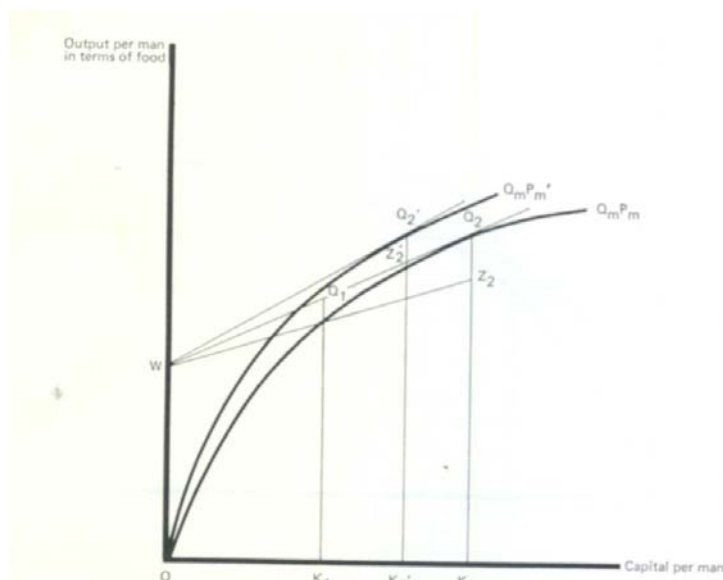
$$P_m [f(k_2) - k_2 \cdot f'(k_2)] = w.$$

From this we can see that if P rises, the term in brackets must fall. Differentiating this term with respect to k_2 we have

$$\frac{\partial}{\partial k_2} [f(k_2) - k_2 f'(k_2)] = -k_2 f''(k_2) > 0, \text{ since } f''(k_2) < 0.$$

Hence for this term to fall, k_2 must fall.

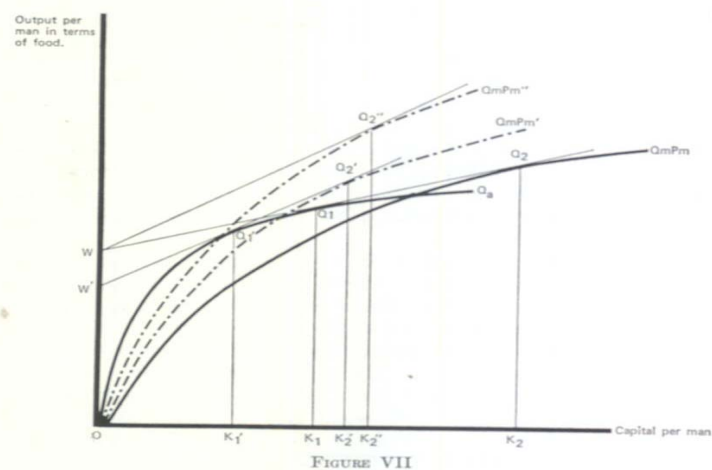
The effect to taxation of capital in the labor-intensive sector is, however, quite different. In this case we lower the rate of profit in A (technique being unchanged: see page 403 for effects for of capital taxation in our model), and the new equilibrium involves a fall in the relative price of M and a higher capital intensity in M . The production possibility curve and the employment curve tilt inward at M and L_m , respectively. Furthermore, the price change operates in favor of the capital-intensive good. These changes suggest that employment will fall.



We now have a departure from conventional wisdom. When the tax is applied to one sector only we cannot say unambiguously that taxation of capital will raise employment. By taxing capital in the labor-intensive good, we discourage production of the good in favor of the more capital-intensive good. It follows analogously that by subsidizing capital in the labor-intensive good, we may actually increase total employment. The technique in A would be unchanged, but the rate of profit would rise (a subsidy being a negative tax, the effect is symmetrically similar to capital taxation in industry A). In the new equilibrium the price of M would have to rise to a higher level P' at which the maximum profit in M would equal the new higher profit rate in A . Clearly the technique chosen in M would become less capital-intensive, implying an outward shift in the production possibility curve from M to M' , as in the case of taxation in industry M .

(b) Wage subsidies

A parallel argument will establish a similar ambiguity in the effect of wage subsidies when confined to one industry. A wage subsidy in the labor-intensive industry operates clearly to increase employment. A subsidy of WW' in A reduces capital intensity in A to OK_1' and raises the rate of profit to the slope of $W'Q_1'$ (figure VII). A new equilibrium requires the price of "manufactures" to rise to P'_m , at which price the rate of profit in M equals the profit rate in A (slope of WQ_2 = slope of $W'Q_1'$). Capital intensity in both industries has fallen (both production possibility curve and employment curve shift outwards), and the relative price of manufactures has risen; both the "income effect" and "price effect" favor higher employment. (Note that a wage subsidy in both industries lowers capital intensity of M even further to OK_2' increasing the outward shift of the production possibility curve, but leads to a smaller price increase in P_m . The relative efficiency of general or selective wage subsidy therefore depends on the response of demand to changes in relative prices.)



By contrast a wage subsidy in M has an ambiguous effect. At the old price P_m it reduces capital intensity and raises the profit rate in M above the rate in A . In the new equilibrium if profit rates are to be equalized, P_m must fall, and we can show that capital intensity in M in the final equilibrium will be lower than in the pre-subsidy situation⁶. We now have two effects working in opposite directions. While lower capital intensity implies that the production possibility curve and employment curve tilt out at M and L_m respectively, the lower- relative price for manufactures shifts demand in favor of the capital-intensive good. The result and effect on employment is indeterminate. Analogously, it follows that a wage tax in the capital-intensive industry may be less disastrous than is sometimes supposed. While it increases capital intensity in M , it also increase the relatives price of M , thus producing a price effect in favor of the labor-intensive good that mitigates the influence of the inward shift in the production function.

V. CONCLUSIONS

The above results are obviously derived from too simplistic a model to make a wide claim of generality. Nevertheless, it is interesting to note that our conclusions differ from those suggested by simple partial-equilibrium analysis, although the model used differ from neoclassical tradition only in the real wage rigidity and surplus-labor assumption. Clearly, if theoretical models are to be relevant to surplus-labor economics, it is precisely in these areas that they must depart from neoclassicism. It is important to note that our own assumption that the real wage is fixed in terms of food is a simplification. On this assumption changes in the price of manufactures P_m leave the real wage in terms of food unchanged in both industries. The situation would be somewhat different if the real wage were fixed in terms of a physical combination of food and manufactures or more generally a constant utility combination. In this case any rise in the price of manufactures would be accompanied by some increase in real wage rate in both industries. This would tends to raise capital intensity in both industries, reducing the employment-generating effects of any tax subsidy intervention that tends to rise P_m . We would, however, expect this effect to be small because the proportional weight given to manufactures and (in the case of constant utility wages) the elasticity of substitution between food and manufactures. Thus the results derived in the paper depend crucially upon the real wage being largely fixed in terms of the labor-intensive

6. The slope of $Q_m P_m$ in the new equilibrium must be the same as before although P_m is lower. Differentiating $Q_m P_m = f(k_2) P_m$ with respect to k_2 $\frac{\partial Q_m P_m}{\partial k_2} = f'(k_2) P_m$. $P_m = \text{constant}$.

Since P_m is lower, $f'(k_2)$ must be higher, i.e., k must be lower, since $f''(k_2) < 0$.

good and would need to be progressively modified as the weight given to the capital-intensive good in determining the real wage rises.

The main thrust of our argument has been that an important effect of factor taxation (subsidy) in an industry is to lower (raise) the rate of profit in that industry. This produces intersectoral effects that may have significance for total employment. The direction of the intersectoral effects is vital for the design of an employment policy consistent with other objectives of government policy. The pursuit of labor intensity through capital taxation in a particular sector under review may be counterproductive if it happens to be a relatively labor-intensive sector (e.g., agriculture).

Our analysis suggests some general rules of thumb. Factor price intervention is less ambiguous when generally applied to all sectors, although labor subsidies are more effective than capital taxation *when labor is in elastic supply and capital is not*. When selectivity is necessary, the employment promotion impact of fiscal intervention is greatest when the labor subsidies are given in the labor-intensive industries and the capital taxation imposed in the capital-intensive industries. This rule must be considered in conjunction with sectoral priorities suggesting that where the sector is a "priority sector," factor price intervention through labor subsidy is preferable to capital taxation.

An important weakness in the model is the absence of endogenously determined demand. We have discussed the impact of output and factor taxation on the production possibility curve. As we move along the production possibility curve producing more "food," total employment rises, implying a change in the distribution of income that would alter the indifference map. This lack of independence between the production and consumption side is well recognized in the literature on dualistic models and is sometimes cited as providing a two-pronged attack on unemployment: Labor-intensive technology also shifts the consumption pattern towards labor-intensive food, reinforcing the change in the factor mix by a change in the output mix. Formally, the lack of independence opens up the possibility of multiple equilibrium positions generating different levels of employment. These possibilities and their implications are not examined in this paper.

Throughout this paper we have assumed that taxes and subsidies are "revenue neutral," i.e., there are no fiscal constraints to the choice of a policy instrument. This is a traditional simplification common to much of the literature on price intervention through tax subsidy. In our model a combination of tax subsidy will always exist that will ensure revenue neutrality of the proposed package.

A final point on tax design needs to be made. In the stark simplicity of the neoclassical world with malleable capital, the "price of capital" is the rental per unit of capital that equals its marginal product. In such a world there is no conceptual ambiguity relative to capital taxation. We can define a tax on capital as either a proportional or an absolute deduction from the rental per unit of capital. In the real world, intervention with the price of capital is an ambiguous concept covering profit taxation, depreciation and investment allowances (relating to the return on invested capital), the rate of interest (relating to the price of borrowed capital), and indirect taxation on machines (relating to the price of physical capital). Translating our rules of thumb into alternative formulations using these variables is itself a complex business.

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