

SWITCHING OF TECHNIQUES AND CONSUMPTION PER HEAD: AN ECONOMIC CLARIFICATION

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Using the notation of our original paper,¹ we summarize different techniques by $(n \times n)$ input matrices a, b, c, \dots and the corresponding labor requirement vectors a_0, b_0, \dots . When one sets the wage $w=1$ as a normalization, the price vector p_a , associated with any technique a , is a function of the interest rate r :

$$(1) \quad p_a(r) = a_0 [I - (1+r)a]^{-1}.$$

[In equilibrium, prices exactly cover costs, $p_a = a_0$ (direct labor costs) $+ (1+r)p_a$ (cost, including interest, of inputs, i.e., circulating capital); (1) gives the solution for p_a .] The nonsubstitution theorem assures that, given any r , say r_0 (smaller than the maximum possible rate), there is one technique, say a , which minimizes all prices, i.e.,

$$(2) \quad p_a(r_0) = a_0 [I - (1+r_0)a]^{-1} \leq b_0 [I - (1+r_0)b]^{-1} = p_b(r_0)$$

for any other technique we choose to label b .

Consider now the steady-state consumption possibility frontier of this economy. Suppose that the economy grows at a rate g , and initial labor is normalized at 1. Then, when technique a is employed, per capita consumption possibilities are given by

$$(3) \quad a_0 [I - (1+g)a]^{-1} c = 1$$

where c is the consumption vector. This can also be written

$$(4) \quad p_a(g) c = 1.$$

Ozga's point is the following. Suppose that, for the rates of interest r_0 and r_1 ($r_1 > r_0$), the corresponding optimal techniques are a and b . Is it true that the consumption possibility frontier of technique b , associated with the higher interest rate r_1 and given by

$$(5) \quad p_b(g) c = 1,$$

is necessarily lower than that associated with technique a , the optimal technique at the lower interest rate r_0 ? The answer is no. For this to be true, every element (price) in the vector $p_a(g)$ must be lower than the corresponding element in $p_b(g)$. Examples to the contrary can be easily constructed. Diagrammatically, the con-

1. "The Nature and Implications of the Reswitching of Techniques," this *Journal*, LXXX (Nov. 1966).

sumption possibility frontiers in two dimensions can appear as in Figure I.

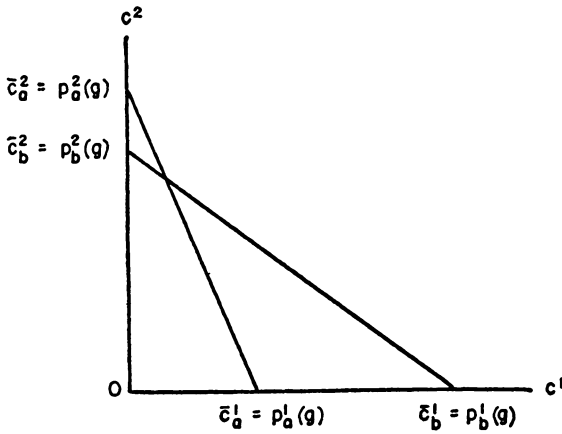


FIGURE I

This phenomena can be further exhibited by looking at the *factor-price frontier* for the two goods (see Figure II). In each diagram the vertical height at $r=g$ gives the maximum steady-state consumption of that good. In both diagrams, as one moves from r_0 to r_1 , technique *b* becomes optimal, giving a higher real wage in terms of *both* goods (by the nonsubstitution theorem). But this switch *reduces the maximum consumption of good 2 and increases it for good 1!* Where the economy ends depends on consumption habits. It is clear that one cannot say unequivocally that “consumption possibilities” have increased or decreased.

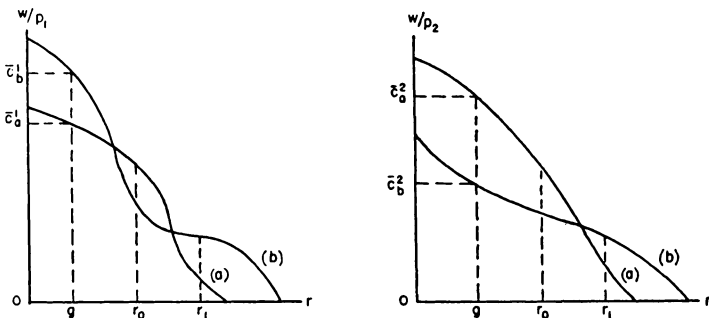


FIGURE II

It should be noted, however, that the above indeterminateness disappears once we confine the discussion to the *consumption possibility frontiers of laborers* only. The consumption vector of laborers, denoted by c_L , is given by

$$p_a(r)c_L = 1 \text{ or } p_b(r)c_L = 1$$

according to the technique employed. Since prices are monotonically increasing with the rate of interest, we know that

$$p_a(r_0) \leq p_b(r_1) \quad (r_1 > r_0),$$

and consequently the consumption possibility curves of c_L never intersect (see Figure III).

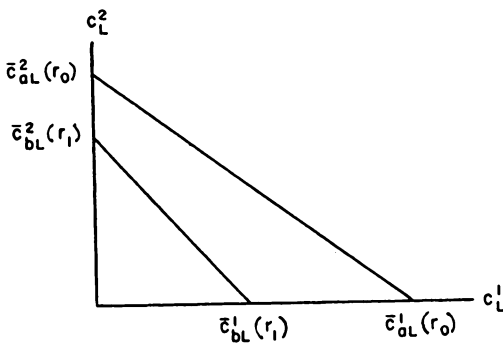


FIGURE III

The indeterminateness pointed out by Ozga is closely related to the "Wicksell effect." A change in the rate of interest changes the prices and quantities of all goods, including capital goods. While the direction of the change in prices is clear, the change in quantities depends on consumption habits of the economy and cannot be predicted a priori. Thus, if X is the vector of the amounts of goods used as (circulating) capital, the value of the capital stock is paX (with technique a). As r increases, all p 's increase, but the change in the production basket X is unpredictable. Thus the consumption possibilities of the capitalists, which depend on their profits $r(paX)$, can change in either direction.