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WORK EFFORT, INVESTIBLE SURPLUS AND THE INFERIORITY OF COMPETITION

by

Edgar O. Edwards

May 2, 1969

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Work Effort, Investible Surplus and the Inferiority of Competition

The elegance of the marginal productivity theory of distribution has practically banished residual theories from economic analysis. Yet the marginal productivity theory rests on the assumption of linear homogeneous production functions in a perfectly competitive world. Moreover, the theory requires in the event of a rigidity in the supply price of one of the factors of production that the quantity of it used be adjusted to its marginal product. The efforts of unions to control the supply price of labor have been analyzed along such lines. There may, however, be situations in which both the supply price and the quantity employed of a factor of production are subject to constraints and these are such that a marginal productivity solution is neither feasible nor desirable. If priority is given in this way to the remuneration and employment of one factor of production, the need for a residual theory of distribution and employment becomes apparent. Furthermore, in such circumstances perfect competition will be an imperfect institutional arrangement for achieving the desired ends.

The subsistence setting for production in many developing countries may be analyzed more effectively in these terms. The subsistence community may give a high priority to the employment of its population refusing to accept the unemployment which might be necessary if those employed were to be paid their marginal product. This kind of accomodation of the community's resources to the population it must support has most frequently been discussed in terms of an institutional wage. [e.g., 7:22]

The term "institutional wage" suggests that something better could be done in the circumstances, that the wage has been determined without full consideration being given to the economic variables and consequences involved. It would, of course, be foolhardy to suggest that economic arrangements in subsistence settings are in reality optimal. Nevertheless, analysis in terms of optimality suggests that many of the observed characteristics of subsistence societies might have been predicted by departing from the marginal productivity theory and the perfect competition which it implies. When compared with marginal productivity outcomes, these characteristics include the overemployment (in terms of numbers of workers and total work effort) and underutilization (in the sense of work effort per person) of labor and the noncompetitive organization of production.

If these characteristics can be shown under appropriate circumstances to be consistent with optimality, some of the policy prescriptions associated with marginal productivity theory and perfect competition must be brought into question. The idea that perfect competition will yield optimum results may be wrong and developing countries which seek to follow that path may in fact reduce their opportunities for growth. Reliance on the unemployment of resources as a signal that the related factor price is too high may lead to inefficient price manipulations. Indeed, the view that factor prices can be manipulated to achieve an optimum utilization of resources may in these circumstances require reexamination. Possibly a more effective approach would be to manipulate the employment of resources directly, the factor prices which emerge being optimum. I shall try to show that these outcomes,

heretical as they may appear to be, have a logical basis.

A fundamental tool for the analysis is the biological function relating the maximum amount of work which an individual can perform to the nature and quantity of the food he eats and the efficiency with which his body can transform gross food energy into bodily maintenance and external effort. Such a biological relationship must condition the individual's supply of labor in any setting, but its relevance for economic analysis is probably greatest in dealing with situations of near subsistence. Indeed in such situations this biological basis for economic theory would seem to merit recognition equal to that accorded the technological production function with which it has much in common. Professor Leibenstein has recently incorporated a function of this kind into his analysis of developing economies [8: esp. Ch. 6] and Professor Wonnacott has extended that analysis in a number of useful ways. [12] I hope to build on their very constructive contributions.

Cost and Distribution of Work Effort

An assumption critical to the analysis to follow is that the biological function relating individual effort to energy inputs exhibits diminishing returns in the relevant range. It will help to strengthen the credibility of this assumption if we make a brief excursion into the biological roots of the function.

Let us assume that the composition of an individual's diet is fixed and that it meets certain minimum but unspecified dietary requirements. Only the scale of the diet is variable.

The gross energy of the diet, i.e., the combustion value of the food,

is to be converted by bodily function into usable or net energy. The difference between gross and net energy represents energy losses of various types including indigestible or fecal energy, which varies with the type of food and the nature of the feeding animal, urinary and fermentation energy, and the heat increment of feeding (a kind of food utilization tax). [3:25 ff]

We shall assume that the first demand for usable energy is to maintain the body, any excess being energy output. In the short term of course, there could be a substitution of energy output for maintenance, but in the long term such substitution may be severely limited in scope. Energy output in the long term is therefore a function of energy input, given the human conversion mechanism, the nature of energy inputs, and environmental factors.

Figure 1 presents such a function for an individual. For later convenience energy inputs are measured on the vertical axis, energy outpus on the horizontal. The gross energy required for maintenance is depicted as the vertical distance, OM . This is converted into the net energy output, Om , which maintains the body. If energy inputs exceeds OM , net energy becomes available for growth and work. Ob represents the maximum net energy which the body can generate, and mb is the maximum net energy that can be made available for work in a steady state adult.

As drawn in Figure 1, the curve exhibiting diminishing returns throughoutp. For purposes of economic analysis, however, it is sufficient to assume diminishing returns occur at lower levels of inputs, these will be buried in the "maintenance box," and will not affect the analysis of visible effort. We make this assumption for subsequent analysis unless stated otherwise.

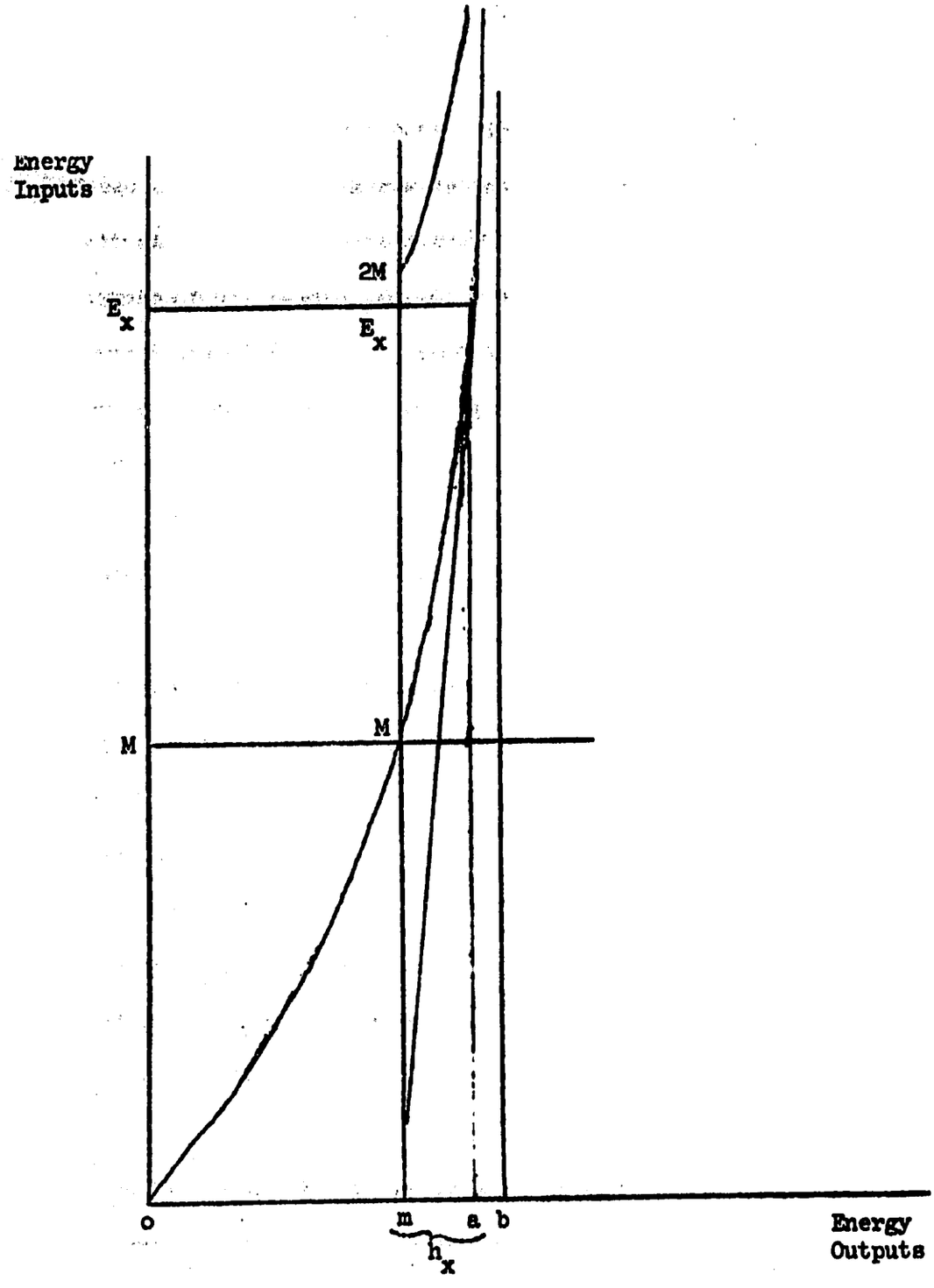


Figure 1

Dispose of the maintenance box by making m the origin. The portion of the curve to the right of m is a simple total cost curve showing for an adult the energy inputs necessary to produce various amounts of work energy. The vertical distance, mM , has the characteristics of fixed cost. The tangent to the curve which passes through m indicates equality between marginal and average cost and the minimum average cost of producing work energy. When this condition holds, work energy of ma ($= h_x$) is produced at a total cost of OE_x .[1]

Now assume that any diet must be divided equally between two identical men. The curve representing the aggregate work energies which can be generated with alternative energy inputs is the locus of points obtained by doubling the coordinates with respect to the new origin m of points on the original curve drawn for one adult.

Given our assumptions of diminishing returns and identical men, the equal division of the aggregate diet is optimum in the sense that no other will yield a larger aggregate work energy. To demonstrate that this is so, let

E = aggregate gross energy

H = aggregate work energy

m = net maintenance

α = proportion of E given to one man.

With E fixed, we wish to maximize

$$H = f(\alpha E) + f[(1 - \alpha) E] - 2m ,$$

which requires that

$$f^1 (\alpha E) = f^1 [(1 - \alpha)E].$$

As each adult has the same work energy curve and its slope is unique at each point with diminishing returns throughout, this equality also requires that = (1-), that is, the aggregate diet must be divided equally between the two men. Any other division will represent a less efficient use of the aggregate diet.[2]

For convenience we now assume that energy outputs can be measured in standard hours per week, the intensity of effort already being optimized. Notice in Figure 1 that any ray from m which intersects the single adult energy curve will do so at two points (except the vertical line at m and the tangent to the curve which passes through m). Each ray (exceptions as noted) may be assigned two values each representing hours of work per week as determined by the points of intersection. One of these values will be larger than h_x , the other smaller. For the smaller values a steeper ray means lower hours of work; for the larger values, a steeper ray means higher hours. Notice also that as curves for larger numbers of adults are constructed by increasing coordinates in proportion, the pair of per capita values assigned to any ray is independent of the size of the adult population.

The slope of any ray is, of course, the real wage per hour. The steeper the ray the higher the real wage, two levels of individual work effort being associated with each real wage. In a classical competitive wage paying economy only the larger level of effort for each wage would have significance. It is, however, a distinguishing characteristic of overpopulated situations that the lower level of effort may have greater relevance.

Population and Hours of Work

In Figure 2 total hours of work per week are shown on the horizontal axis. Energy inputs are measured on the vertical axis in maintenance units (OM in Figure 1). A family of cost curves can now be constructed, four of which are shown in Figure 2. Take the curve originating at N_x as typical. This curve is drawn for the body of workers N_x in size for which the maintenance cost is N_x (M being the unit of measurement). When average cost per hour of weekly work is at a minimum, total cost is E_x maintenance units which produces $N_x h_x$ hours of work per week. The ray from the origin drawn tangent to this curve is labelled h_x, the number of hours of weekly work per worker associated with minimum average cost. Given the family of work energy curves so constructed it will be noted that the ray designated h_x is also the curve describing the minimum total cost of producing any given number of work hours per week.

The cost structure which has been described depicts the transformation of gross energy inputs into work energy outputs. But in a subsistence setting the gross energy inputs, food, must themselves be produced by combining work energy with other factors of production. Assume the supply of these and a linear, homogeneous production function to be fixed. Assume also that hours of work are homogeneous so that total food output is unaffected by substitutions between numbers of workers and hours of work per worker provided only that the total hours of work available are not changed. Under these assumptions a total product function has been introduced in Figure 2.

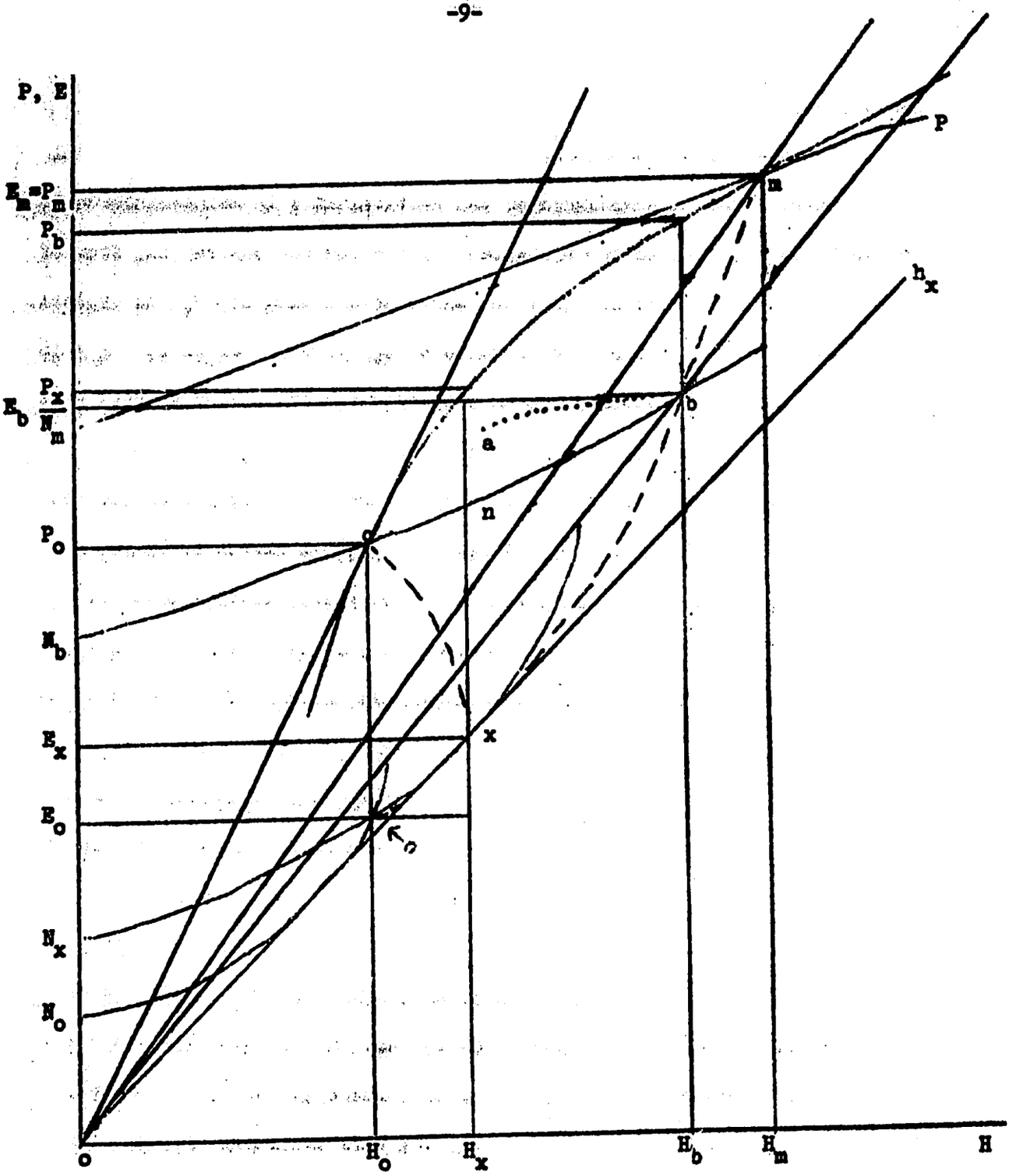


Figure 2

The model which results can be summarized in the following equations.

(1) $P = g(K,H)$ (linear, homogeneous production function according to which capital, K, and hours of work, H, are combined to produce output, P)

(2) $E = N(m = f[h])$ (cost function describing the food inputs, E, necessary to support a working population, N, when each member requires $\underline{m}$ for maintenance of himself and dependents and supplies $\underline{h}$ hours of work per week. $H = Nh$.)

(3) $V = P - E$ (investible surplus, the maximum output which could be invested).

We assume that each member of the community's working population will or can be made to work to his biological maximum so that none of the investible surplus accrues to individuals all of it going to the community as a social organization, one or more cooperatives, a monopsonist, or a number of perfectly competitive firms as the case may be. Equation (2) is a cost curve; supply considerations will be considered in a later section.

The community which accepts the responsibility to support its members will treat its population as given for the purpose of production. The cost of generating work effort will then be described by one of the family of cost curves in Figure 2, say the curve N_b. The community, wishing to maximize its investible surplus, will do so by producing that output for which the marginal product of hours of work, the slope of the total product curve, is equal to the marginal cost of generating work effort, the slope of the total cost curve.[3] That output is P_b for which the total cost of work effort is E_b. The labor cost per hour is given by the slope of the ray

drawn through the origin and point b . It exceeds the marginal product. It follows that the return to the other factor of production, capital, is less than its marginal product and is a residual.

The same community behavior with populations of other sizes would yield other equilibrium cost points such as o , x and m . The curve oxbm , which connects these equilibrium cost points describes how the quantity and cost of work effort respond to changes in population given the production function.[4] While total work effort and total labor cost rise as population increases, work effort per person falls--in Figure 2 from 1.2 h_x at o to 0.5 h_x at m . As a consequence the labor cost per person, the cost of generating his work effort, must also fall. On the other hand, the cost of work effort per hour falls between o and x but rises thereafter.

We conclude then that when a community is organized to give priority to its social obligation to support and maintain its population, leisure and poverty go hand in hand. As population grows hours of work and investible surplus per capita decline and beyond N_x total investible surplus also declines.[5]

Organisational Effects on Employment and Investible Surplus

The essential point is that this mode of community behavior enables fully employed non-labor resources to be accomodated to the employment of populations ranging in size from N_o to N_m , furnishing hours of work which vary from H_o to H_m and producing outputs from P_o to P_m . Perfect competition, on the other hand, does not permit such a wide range of

adjustment. It is premised on equality between hourly wage rates and marginal products, competition among workers ensuring that the wage is not in excess of the supply price and competition among firms ensuring that it is not below marginal product. In these circumstances the only labor cost adjustments possible in Figure 2 must lie on the cx curve, points on which represent total labor costs when hourly wages equal marginal products. When non-labor resources are fully employed the competitively organized community will employ work effort in the range H_o to H_x and produce outputs ranging from P_o to P_x. The employed population cannot exceed N_x but it might at the other extreme be less than N_o depending on the terms on which labor time will be supplied in a scarce labor situation. There will be some population whose supply curve will pass through c. It is clear, however, that any population in excess of N_x must under competitive conditions be unemployed.

These results are depicted in alternative and perhaps more familiar form in Figure 3. Here average and marginal product and average and marginal cost are related to aggregate hours of work for populations of different sizes. Each population is treated as fixed in a manner technically similar to the analysis of size of plant and equipment. Given the size of its population, which the community treats as fixed, the community utilizes that population in order to maximize investible surplus. It arranges to obtain from its population that aggregate work effort for which marginal cost equals marginal product. The curve, omm describes the equilibrium average costs of utilizing populations of different sizes. If the community is organized competitively, however, the portion, cx, of the marginal product curve

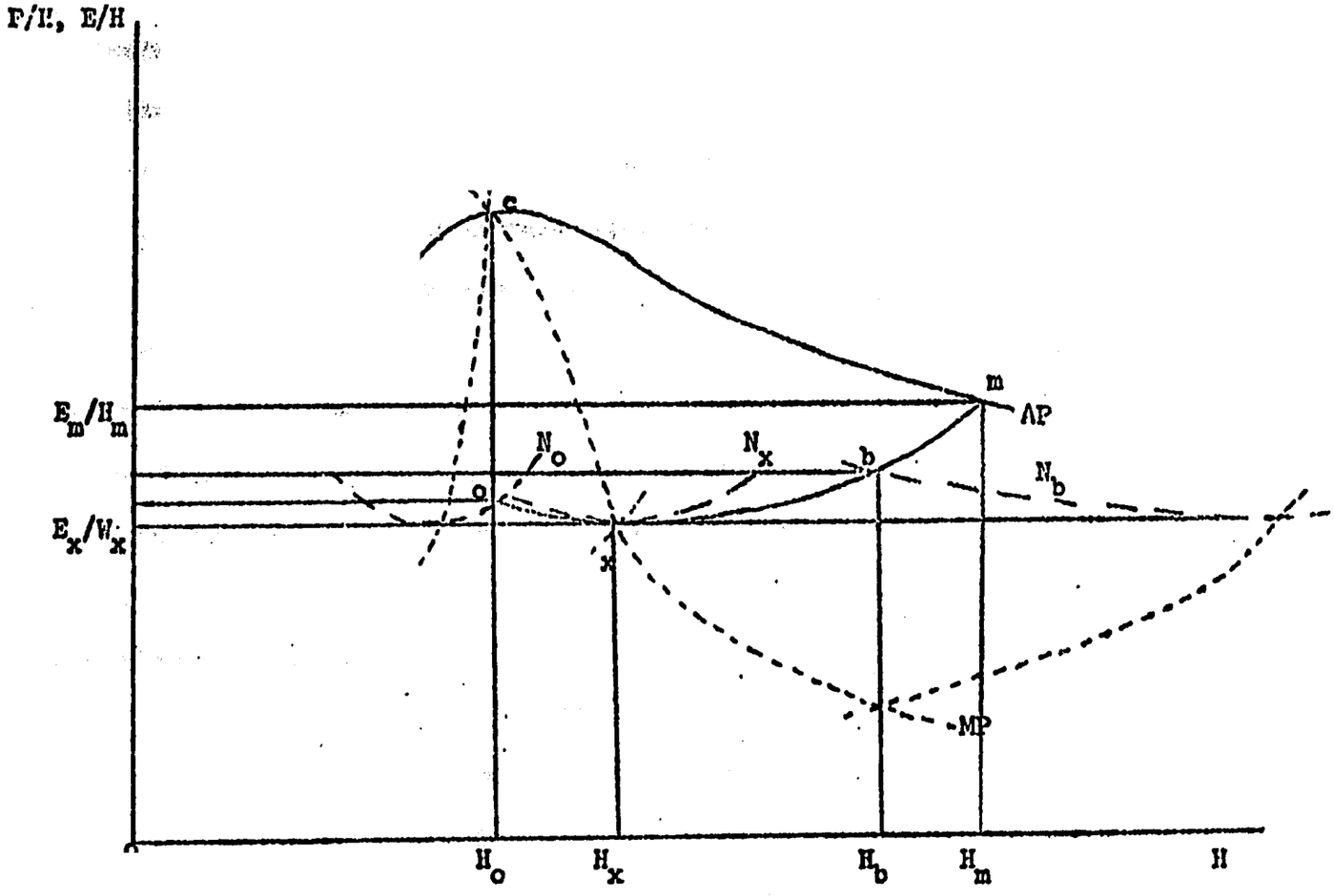


Figure 3

represents the feasible wage and aggregate hour alternatives. While population may be regarded by the community as fixed in the social sense of obligation, it is not fixed in the technological sense of production. If population is actually larger than N_x, both the profit-maximizing monopolist and the profit-maximizing set of competitors will ensure that the excess is unemployed. Whether the symptoms of surplus labor take the form of underutilization or unemployment of labor depends then, as Professor Lewis has noted [9:326-7], on the way in which economic activity is organized.

The question arises as to whether net investible surplus could be increased by reorganizing a traditional community along competitive lines with the government collecting taxes to meet the subsistence needs of the unemployed. The answer is no. Such a subsidy arrangement would leave the community worse off than it was before. It has already been established that any given level of work effort can be obtained at lowest cost from a given population by sharing the work equally. In Figure 2, for example, the cost of generating H_x units of work effort from a population N_b in size when all are equally employed, $H_x\underline{n}$, is greater than the cost of producing that work effort with N_x men, $H_x\underline{x}$. But if the population is actually N_b, we must with the employment of only N_x men provide for the subsistence needs of the unemployed. These equal $\underline{xa}$ (equal to $N_b - N_x$ on the vertical axis). Therefore the social cost of employing less than the entire labor force exceeds the social cost of full employment by $\underline{na}$, where N_x are employed, and by the difference between the curves $\underline{a}\,\underline{b}$ and $\underline{n}\,\underline{b}$ when larger numbers are employed. We see then that it is not only better to share

H_x hours of work among the H_b population, but investible surplus can be further increased by expanding the work effort of that population to H_b .

This argument would hold as strongly for a more subtle and possibly misleading type of organizational change. Suppose that only a part of the overpopulated community's resources is reorganized along competitive lines, the rest remaining as a traditional sector responsible for utilizing whatever population it must. The reorganized sector is assumed to have no additional capital and to involve no technological change. It will be profitable, however, to reduce hourly wages, increase hours of work, raise wages per man employed, fire some workers and reduce output. Apparent investible surplus and the marginal product of labor in the reorganized sector will rise.

The traditional sector accepts its responsibility to absorb the unemployed if indeed it is able to do so. Hourly costs will rise but hours of work and costs per man and marginal product will fall. Total hours of work and output will rise, but our symbol of competitive success, investible surplus, will fall. It must, as the earlier argument indicated, fall by more than the increase which occurs in the reorganized sector. The community as a whole is worse off.

But the reorganized sector can demonstrate its superiority. It investible surplus per unit of capital or of labor is higher than in the traditional sector and the marginal product of labor is higher as well. The marginal product of capital is lower but as capital is not paid its marginal product in the traditional sector, and may even be receiving nothing, this is a quibble. Perhaps it would be wise to reorganize the traditional sector

along the new lines. The result as we have seen would be substantial unemployment whose subsidy through government would leave the community as a whole worse off although the private sector would be demonstrating apparent profitability. The social cost of private profit in these circumstances might not be sufficiently apparent to reverse the reorganization and indeed such a reorganization may not be reversible. Nevertheless, the higher marginal product of labor in the competitive sector rightly suggests the social advantage to be obtained by transferring labor from the traditional to the competitive sector.

Achieving Optimum Employment of Labor

Labor will be regarded as optimally employed if, given the population and its desire for leisure, investible surplus is maximized. We shall continue, however, to treat the disutility of labor as zero, considering later the possible trade off between investible surplus and leisure.

The fundamental difference between the competitively organized and socially responsible communities is in the variables to which they directly respond. In factor markets perfect competitors adjust their behavior to factor prices; in labor markets the "active variable" is the hourly wage rate and the quantity employed (total hours) is the "response variable" in the sense that it is adjusted to the hourly wage rate. In the socially responsible community, on the other hand, the population, or more accurately the labor force, is the active variable and labor costs and hours of work are response variables.

Reference to Figure 4 may clarify the significance of this distinction for the problem at hand. Investible surplus is plotted against employment and/or the labor force. Now strictly speaking hours of work and not numbers of people is the factor of production but our ultimate interest is in investible surplus per capita not per hour of work. It should also be recalled from Figure 1 that a wage per person is uniquely related to his hours of work but that an hourly wage is generally related to two possible levels of work effort. Moreover, at a given hourly wage the perfect competitor can obtain the total hours of work he desires in two ways between which we assume he has no preference--by working a few people long hours or by working many people short hours. We assume for our experiment that a wage per man is specified to competitors.

Take in Figure 2 the wage per man represented by the ray through the origin and point m . The investible surplus which our competitors can make in the aggregate by employing a population of given size is the vertical distance between this ray and the total product curve at the point where the population cost curve intersects the ray. Performing this operation for various populations yields the data represented by the curve labelled W_m in Figure 4. By changing the given wage per man a family of such curves can be drawn of which W_c, W_m, $W_b(L)$, W_x, W_o, and $W_b(H)$ are examples in Figure 4. W_c represents the lowest wage per man shown and $W_b(H)$ the highest. Hourly wages, however, fall from the C_c curve to the W_x curve and rise to the $W_b(H)$ curve. The two W_b curves demonstrate the indifference of our perfect competitors to the number of men from whom a given

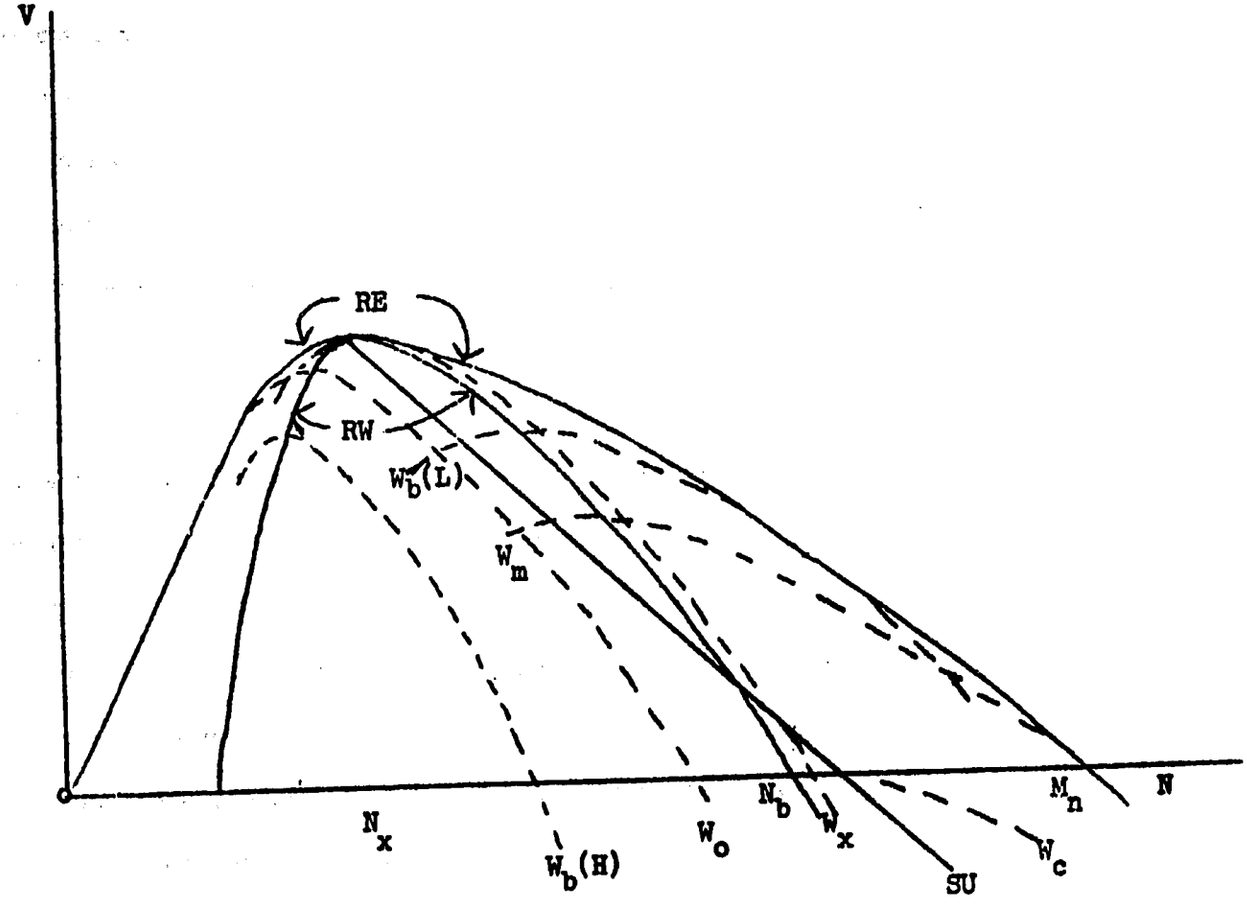


Figure 4

work effort is obtained. $W_b(H)$ and $W_b(L)$ represent the same hourly wage and yield the same maximum profit, at which aggregate work effort is the same Only the wage per man, his hours of work and the number of men employed are different.

Now draw another curve through the maximum points of this family of curves. This curve describes the employment response of a competitively organized community to alternative levels of wages. The usual analysis of competition deals only with the rising portion of this "response-to-wages curve" (RW) where employment is equal to or less than N_x. Competition among workers of a larger labor force will force the hourly wage rate to its minimum at which the wage per man is W_x.

An envelope curve drawn tangent to each of the family of wage curves (except those such as $W_b(H)$ for which less than full use of non-labor resources is preferable) represents the traditional community's adjustment to different sizes of its population. Given the labor force and a commitment to its full employment the wage response of the community is the wage line tangent to the "response-to-employment curve" (RE) at that level of employment. It is the wage which maximizes investible surplus given the labor force and its full employment. It reflects the same data as does the <u>oxbm</u> curve in Figure 2.

We can now draw the following conclusion: for any labor force (and its related population) except N_x the community behavior represented by the REN curve yields a higher investible surplus than the competitive behavior represented by the RW curve. The reason is neither complex or

strange. It is that the marginal cost of producing work effort is not equal, except for the population N_x, to the average cost and to the marginal product of that level of work effort. For populations in excess of N_x marginal cost is less than average cost and investible surplus is maximized when marginal cost equals marginal product, i.e., when labor cost per hour exceeds the marginal product of labor. Indeed, when population is less than N_x, as might be expected in advanced countries, perfect competition does not lead to maximum investible surplus. In this situation marginal cost exceeds average cost and investible surplus will be maximized when marginal cost is equated to marginal product, i.e., when labor cost per hour is less than the marginal product of work effort.

Let us digress a moment to discuss another related proposition which is also valid but which may at first sight appear to be anomalous. It is that for any given wage per man appropriate to full employment as indicated by tangency with the RE curve in Figure 4, except the wage W_x perfect competition would yield a larger investible surplus than would be obtained with employment-conscious community behavior. Figure 5 demonstrates this point. Investible surplus is plotted against wager per man. We first construct a family of iso-employment curves by observing in Figure 2 for a given number of workers how investible surplus changes as the wage per man is increased. Take the labor force, N_b, as an example. At the wage represented by the ray which intersects the N_b curve at c, investible surplus is zero. As the wage per man (and aggregate and average hours of work) is increased, investible surplus rises to a maximum at the wage denoted by the ray intersecting

the N_b curve at b and for higher wages per man falls. The curve drawn through the maximum points of this family of curves and labelled REN represents employment-conscious community behavior--given employment the wage per man is selected to maximize investible surplus as on the oxbm curve in Figure 2. The RW curve drawn tangent to the family of iso-employment curves represents the competitive response to different given wage levels.

While this data contained in Figures 4 and 5 are identical, Figure 5 suggests an apparent superiority for perfect competition which may be misleading. The point is that for any wage per man below W_x, competition achieves a higher investible surplus by reducing employment, by moving in Figure 5 to geometrically higher iso-employment lines each of which represents a lower level of employment. But we have already seen when we discussed Figure 2 that the social cost of providing subsistence for the unemployed will exceed the apparent increase in investible surplus attributable to the competitive form of organization. It is cheaper to share the work than to support an unemployed segment of the population.[6]

How can our community achieve both full employment and maximum investible surplus with a population in excess of N_x? It cannot do so by encouraging perfect competition in its factor and product markets. This will result in employment of N_x the excess population being unemployed, at the minimum feasible hourly wage. That wage will equal the marginal product of those employed. What is the status in this situation of the classical view that the existence of unemployment is a signal that hourly wages are too high? Suppose in Figure 4 that the actual labor force is N_n. Full

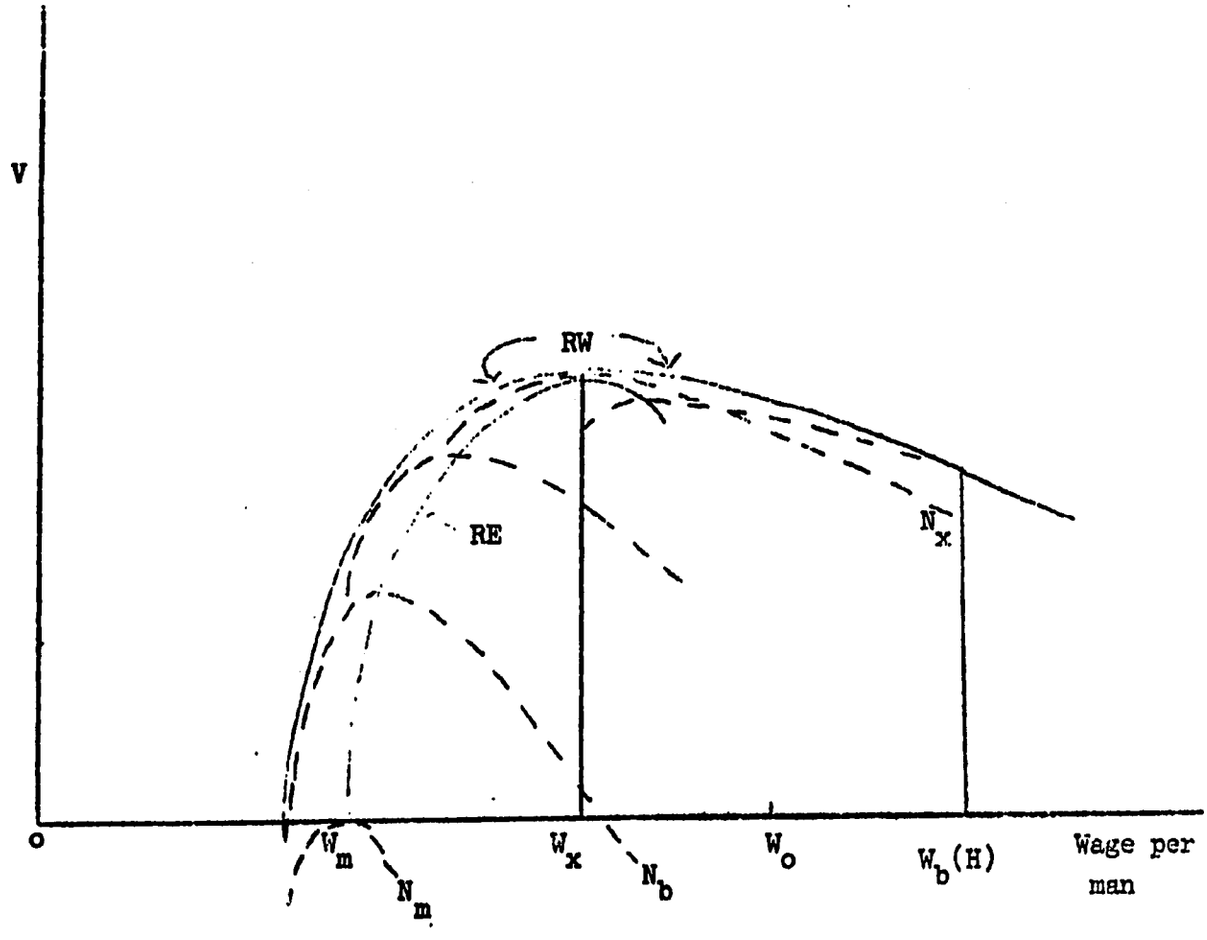


Figure 5

employment and maximum investible surplus requires a labor cost of W_b per man which implies a higher hourly cost than the competitive wage per man of W_x. To achieve full employment and ensure that subsistence costs are covered by earned incomes, hourly labor costs must rise not fall. [cf. 11.] To advise our community to maintain perfect competition and to lower the hourly wage is to propose starvation.

There is, however, one way in which our usual unemployment signal can be salvaged. The community can maintain perfect competition and require employers to pay only for the marginal cost of labor, provided the community taxes the resulting profits and undertakes to make direct supplementary payments to members of the labor force. In Figure 3, for example, the community can establish an hourly wage equal to the marginal product of H_b hours of work, tax employers for the difference between average and marginal labor cost and distribute the proceeds equally among those employed. But we cannot argue that perfect competition will naturally lead to this result in the absence of the subsistence subsidy to the employed.

Let us examine now two ways by which community intervention can improve on the competitive solution without, however, achieving optimal use of its labor force. The community can achieve full employment for some populations by specifying an appropriately low wage per man or alternatively the related high wage per hour <u>and</u> the lower hours of work per person employed. In Figure 4 the population N_b, for example, can be fully employed at the wage per man of W_c. This technique will not work for larger populations, however, and in any event it fails to maximize investible surplus.

Another technique, discussed in another context, can now be compared with the one above. That technique is to accept the perfectly competitive solution with respect to wages and employment, and tax profits for the purpose of subsidizing the unemployed. Draw a line, SU , in Figure 4 showing for any labor force in excess of N_x the investible surplus remaining after meeting bare subsistence needs of the unemployed. Its intercept on the horizontal axis will occur at the labor force whose excess over N_x will require total apparent competitive surplus for bare subsistence. (This can be determined from Figure 2.) As this is a straight line with a negative slope, it is necessary that for populations only slightly in excess of N_x the legislated wage approach yield a larger investible surplus than the unemployment-subsidy arrangement. It is possible for larger populations, such as N_b , that the unemployment-subsidy technique would be superior. This conclusion leaves out of consideration, however, the many possible denigrating effects associated with unemployment, which is characteristic of the unemployment-subsidy arrangement.

The establishment of monopsonistic arrangements may have advantages over perfect competition. Indeed, the community response-to-employment adjustment is in essence a monopsonistic solution--the community recognizes that the marginal cost of work effort is different from its average cost and takes marginal cost into account in seeking to maximize investible surplus. Private monopsonists might achieve the same result and the landlord situation in many developing countries suggests that as a class landlords may assume a responsibility to support and employ the community's labor

force. The point is that population is fixed only in a social sense and not technologically. The profit-maximizing monopsonist should realize that he can make more profits by reducing employment than he can by employing the whole labor force. If a monopsonistic solution is indeed an optimal solution we can infer that behavior is conditioned by social responsibility.

There is another avenue of adjustment which the community might pursue in seeking to maximize investible surplus without assuming direct responsibility for doing so. Instead of influencing private behavior by prescribing wages and hours of work it can simply prescribe full employment allowing markets to establish wages and hours of work subject to the full employment constraint. The community would issue to each member of its labor force an employment chit entitling him to employment with any employer to whom the chit is presented. At any given time each employer has a given labor force which he must employ to best advantage. In this situation each employer must regard his labor force as fixed and acting as a monopsonist, employ it optimally. Each employer can, however, act to attract labor, but cannot fire workers. If initially labor is randomly allocated, some employers will have relatively large numbers of employees while others have relatively small numbers. If Figure 4 is interpreted as relating to an Individual firm, some employers may have N_x employees, others N_b employees, and others N_m employees. The larger his labor force the lower the wage the employer can pay per man. The nature of the adjustment process which would ensue cannot be described in detail here. Part of it would rest on relative profits; the rest on wages and the mobility of labor. If labor

feels that a subsistence income is guaranteed, its preferences between leisure and income must be considered, not just the cost of generating work effort. If the resulting wage differentials are such that workers seek the highest wage per man, mobility of labor will ensure that in equilibrium, wages and hours of work per man are uniform throughout the country.

Growth

The effects of growth on these conclusions can be analyzed effectively by enlarging on the useful tools provided by Professor Fei [5]. Dividing equations (1), (2) and (3) by N, we can rewrite them as follows:

$$(1a) \quad P^* = g(K^*, h)$$

$$(2a) \quad E^* = m + f(h)$$

$$(3a) \quad V^* = P^* - E$$

These three equations are depicted in the upper deck of Figure 6, subject to the condition that for each value of K^*, V^* is maximized, i.e., $g_h' = f'(h)$, the marginal product of labor hours being equal to their marginal cost.

The relationship between these curves and those usually drawn for the analysis of growth, in which work effort per person is a constant, is also shown. Assume, for example, that the wage per man is fixed at W_x and the hours of work per man fixed accordingly. As $\underline{h}$ is fixed, P_x^* can be drawn as a function of K^* alone. As Professor Fei has shown [5:55ff], the slope of this curve at any point is the marginal product of capital, and the marginal product of workers, MP_N, is the value at which the

tangent to P^*_x at the selected K^* intercepts the vertical axis. Thus, if product per man is divided according to the law of marginal productivity, for any K^*, each worker receives MP_N, the balance going as a payment for the capital he uses. With perfect competition, K^* and P^* would be determined by equality between the marginal product of labor, MP_N and the wage per man, W_x. For the wage, W_x, this condition is met at the same I^* for which $W_x = E^*$. As E^* is drawn so that the marginal product of work effort equals its marginal cost at every point, it follows that in this case marginal and average cost are also equal.

But this will not be so for other wage levels. Take W_m as an example which, being lower than W_x, implies fewer hours of work per man, say, one half of those consistent with the wage, W_x. As $\underline{h}$ is halved in equation (1a) we can draw a new P^* curve, P^*_m, simply by halving the coordinates of P^*_x. A new marginal product of workers curve can be drawn which will be equal to the wage W_m, at a K^* which is larger than that for which $W_m = E^*$. The larger apparent surplus at the larger K^* is attributable to the creation of unemployment whose subsistence costs should be deducted from the apparent surplus. In the case of K^*_m for which the wage, W_m, is optimum, the subsistence costs of the unemployed at the K^* for which $MP_N = W_m$ would exceed the apparent surplus.

The family of P^*_i curves which could be drawn each of which is associated with one of a family of W_i curves yields another family of $P_i - W_i$ curves. The envelope curve drawn tangent to this family is $V^* = P^* - E^*$, P^* itself being a curve connecting all values on the P^*_i curves for which

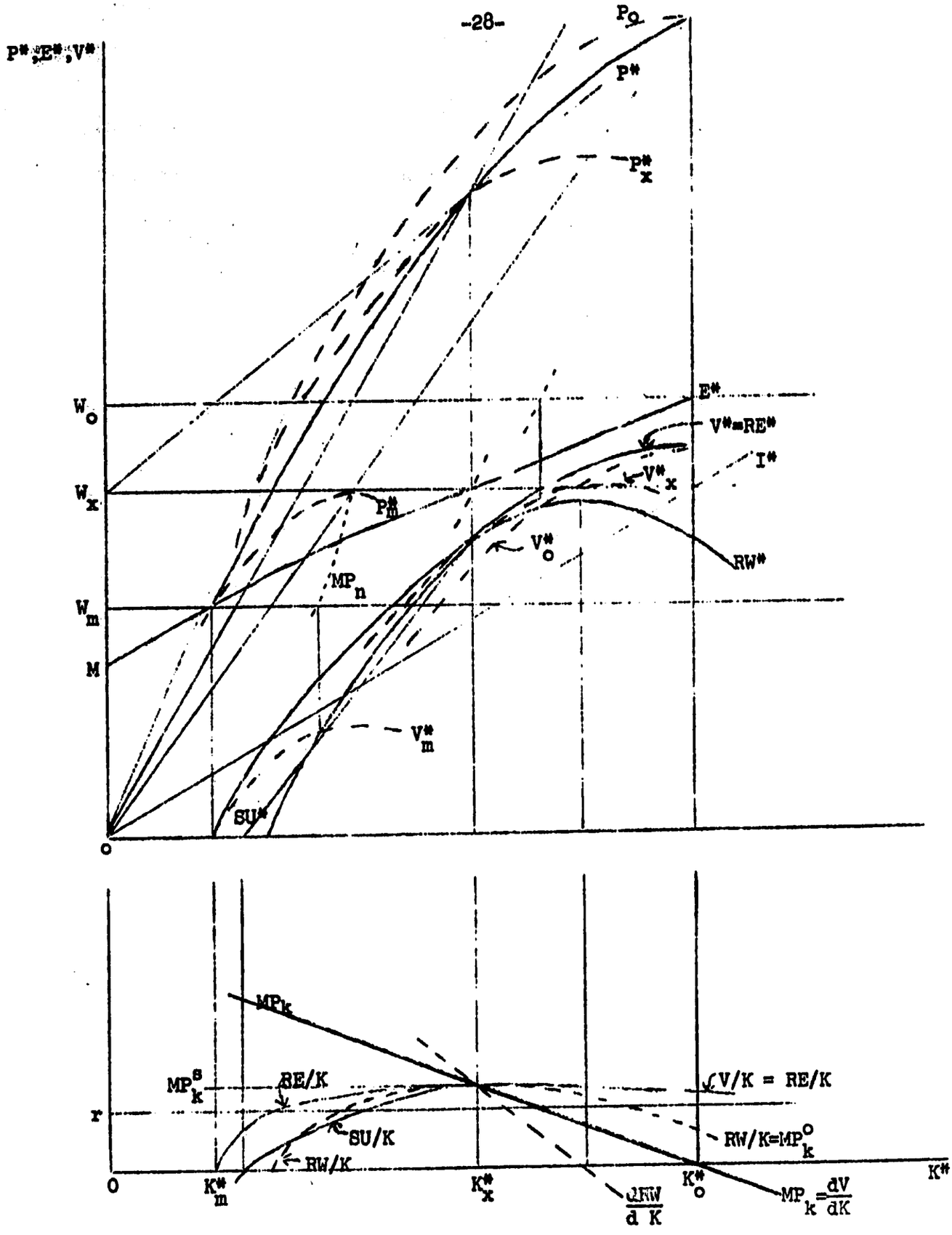

P*,E*,V*
P_o
P*
P*_x
E*
V*=RE*
I*
V*_x
W_o
W_x
W_m
M
P*_m
V*_o
RW*
MP_n
V*_m
SU*
o
MP_k
MP^s_k
RE/K
V/K = RE/K
r
SU/K
RW/K
RW/K=MP^o_k
0
K*_m
K*_x
K*_o
K*
dRW/dK
MP_k = dV/dK

Figure 6

$W_i = E^*$. The slope of V^* at each point is therefore the marginal product of capital. The slope of P^* can be called the gross marginal product of capital from which must be subtracted the marginal supplementary cost of labor, the slope of E^* , in order to obtain the net marginal product of capital.

The $V^* = RE^*$ curve in the upper deck of Figure 6 is simply a transformation of the RE curve in Figure 4. The RW^* curve, the competitive response to given wages, is also sketched and lies wholly below the RE^* curve except for a point of tangency at K_x^* . Points on the RW^* curve have been selected given wages and hours of work on the assumption that K^* can be adjusted as competition dictates. Thus K^* given W_m , for example, emerges as that for which the marginal product of workers is equal to the wage. The product per man in excess of the wage, which is revealed by the RW^* curve, is the return to the capital he uses. Thus the slope of any ray through the origin to a point on the RW^* curve represents the marginal product of capital under competition. It is important to note that the slope of the RW^* curve itself does not have this characteristic except where it is tangent to the V^* curve. Rather the slope indicates the marginal rate of return on capital.

The SU^* curve, representing competitive levels of wages and employment and the subsidized maintenance of the unemployed, has been drawn in for comparative purposes.[7]

Steady state growth in this model requires that output cover the full cost of labor plus sufficient saving to cause the capital stock, K , to

grow at the same rate as the labor force. V^* represents the maximum investible surplus which can be obtained, given any K^*, after meeting the full cost of labor. The amount of this which must be invested in order to cause capital to grow at the same rate as the labor force can be determined by drawing a ray through the origin with a slope equal to the given rate of growth of the labor force. The slope of such a required investment line is $\frac{I^*}{K^*} = \frac{I/N}{K/N} = \frac{I}{K}$, the rate of growth of capital. One I^* line has been drawn in the upper deck of Figure 6. Given this rate of growth, the maximum excess consumption per person, consumption over subsistence, needs, is determined at that K^* for which the slope of I^* equals the slope of V^*, i.e., for which the rate of growth of population and capital equals the marginal product of capital. This is the golden rule of growth. [10]

If, however, the mode of behavior is that represented by the RW curve, namely competitive response to given wages and hours of work, excess consumption is not maximized when the rate of growth equals the marginal product of capital. Indeed, excess consumption is zero whenever that condition holds, profit being required for investment and each worker receiving his marginal product which just covers subsistence given his hours of work. If excess consumption is to be maximized in these circumstances, the wage must be set so that the marginal rate of return, not the average, is equal to the rate of growth (ths slope of RW^* equals the slope of I^*). Then profit will exceed the amount required for investment by the maximum.

The maximum rate of growth which can be sustained is given by the ray which would be tangent to V^*. This rate of growth of capital and labor

is identical for all modes of behavior depicted. It will permit the maintenance of a ratio of capital to labor of K^*_x. The achievement of maximum excess consumption, therefore, always requires an advanced economy, one in which K^* is equal to or greater than K^*_x.

The important residual functions depicted in the upper deck of Figure 6 have been reproduced as rates of growth in the lower deck. The I^* curve is now designated, $\underline{r}$, the rate of growth of the population. V^* becomes V/K, the maximum rate of growth which could be achieved if all investible surplus were indeed reinvested. It has two branches to the left of K^*_x, one representing the mode of behavior corresponding to full employment RE/K; the other representing competitive behavior and the subsidy of the unemployed, SU/K. The marginal product of capital, as determined by the slope of the V^* curve in the upper deck, is also shown. Another horizontal branch is drawn which corresponds to the marginal product of capital given the SU/K pattern of behavior. For any $K^* < K^*_x$, the marginal product is constant as competitors will behave as though $K^* = K^*_x$. The RW/K curve is depicted as well. It is in this transformation equal to the marginal product of capital given the mode of behavior it represents. Finally, a segment of the marginal rate of return on capital, $\frac{dRW}{dK}$, the slope of the RW^* curve in the upper deck, has been drawn.

Our three modes of behavior are now depicted in the lower deck of Figure 6. The competitive-response-to-wages form is indicated by the RW/K curve. At every point on this curve marginal productivity rules supreme--labor is paid its marginal product which equals subsistence cost

and capital is paid its marginal product. As K^* rises toward K^*_x wages and work effort per man rise but hourly wages fall inducing a more intensive use of capital and therefore an increase in the marginal product of capital. Beyond K^*_x, further increases in K^* involve higher hourly wages although wages and work effort per man continue to rise. As the marginal product of work effort rises, the marginal product of capital falls. As capital is always paid its marginal product, profit is $RW = K(MP^c_k)$ and RW/K curve also indicates the average rate of return on capital. The curve marginal to this, $\frac{dRW}{dK}$, is the marginal rate of return. Golden age growth, that which maximizes consumption in excess of subsistence needs, is determined at G_c where the marginal rate of return equals the rate of population growth.

As this differs from the usual definition of golden age growth which requires that the marginal product of capital equal the rate of population growth, it may be helpful to consider these two rules when population growth is zero. When the marginal product of capital is also zero, product per hour and per man and consumption per capita will be maximized. But all of this consumption is needed for subsistence leaving nothing for excess consumption. By reducing K^* to the point where the marginal rate of return is zero, profit per person will be maximized and as none are needed for investment, the rate of population growth being zero, excess consumption per person is also maximized.

A second mode of behavior is applicable only when K^* is equal to or less than K^*_x. Competition rules in both factor and product markets and

regardless of K^*, the level of output, wages, profits and employment will be those related to K^*_x. The smaller K^*, the larger the cost of subsidizing the unemployed as represented by the difference between MP^s_K and SU/K. The maximum rate of return which can be paid to capital, net of taxes to cover the unemployment subsidy, and the maximum investible surplus are given by the SU/K curve and except for K^*_x, this is less than the marginal product of capital.

The third mode of behavior, the social insistence on full employment, is represented by the pair of curves, RE/K and MP_K, the latter being marginal to the former. To the right of K^*_x the usual rule for golden age growth can be reinstated--maximum excess consumption is achieved when the marginal product of capital equals the rate of population growth at G. Moreover, we can confirm that for any K^*, except K^*_x, the full employment approach yields a larger investible surplus than does the competitive response to wages. It therefore makes possible a higher rate of growth and a higher return to capital, given K^*, and permits an economy to subsist at K^* as low as K^*_m. For any K^* less than K^*_x, this form of behavior also implies that capital is used more intensively as indicated by the fact that its marginal product is higher. Note, however, that capital cannot be paid its marginal product because investible surplus after meeting the subsistence cost of labor is insufficient to do so. Obviously labor is being paid more than its marginal product.

For any feasible $K^* < K^*_x$ the full employment approach involves a use of capital and labor which differs from the competitive-response-to-

wages form of behavior. Output, work effort and wages per man are higher indicating the more intensive use of capital, but wages per hour are lower indicating a more efficient use of the labor force. An insistence on full employment in these circumstances has much to recommend it.

Investment and Emigration

The maximum return to capital which can be paid in our community depends upon the method of economic organization and is given in Figure 6 for $K^* < K^*_x$ by one of the three curves, RE/K , RW/K , and SU/K , and for $K^* > K^*_x$ by either V/K or RW/K . But the social productivity of capital on which its use should depend is given by the related marginal products of capital. In the developing community the marginal productivity of capital is highest when labor is fully employed and lowest when competitots respond to specified wages. Viewing the community in isolation, we can say that capital will be most productively used when full employment is insisted upon. This is an alternative demonstration of the inferiority of competition.

We must, however, dispose of another possible argument. The marginal rate of return on capital when the developing community is competitively organized $(\frac{dRW}{d\ K})$ is greater than the marginal rate of return when the community insists on full employment (MP_K). But this simply tells us that the relative inferiority of competition is reduced as K^* is increased to K^*_x . Moreover, competitors in making capital expansion decisions view wages as fixed so that their incentive is given by the marginal product of capital as defined in the RW/K curve. When K^* increases the community finds

it desirable to raise wages and hours of work per man thus reducing hourly wages so that the marginal rate of return turns out to be higher than the marginal product of capital. This does mean, however, that from the social point of view the competitively organized community cannot support the larger populations which can survive with full employment or provide any population with a larger investible surplus.

Because the incentive for investment in the competitively organized community is given by the marginal product of capital, RW/K , and the marginal product of capital in the employment sensitive community, MP_K , is larger, capital should be more readily increased with the latter type of organization, the profitability of doing so being more apparent. If, however, competitors could be induced to respond to the marginal rate of return instead of marginal product, the incentive to invest would be greater with competition, although investible surplus would generally be smaller.

What we must question, however, is the policy prescription often advanced for developing communities that "government should (i) encourage perfect competition so that the magnitude of competitive profits is revealed in the factor market, and (ii) adopt policy measures to ensure that all competitive response to specified wages and hours of work (the RW* curve) or minimum hourly wages with subsidized unemployment (the SU* curve), there is a better approach, namely, to insist on full employment and to ensure that the investible surplus which emerges is indeed invested (the RE* curve).

It is clear from an examination of the upper deck of Figure 6 that a

once and for all increase in capital or reduction in population, either of which increases K^*, will, for values of $K^* < K^*_x$, increase investible surplus per person and investible surplus per unit of capital whichever of the three forms of economic organization prevails. Moreover, for any K^* and form of organization a proportionate increase or decrease in capital and labor force will leave investible surplus per person and per unit of capital unchanged. We can therefore conclude for developing communities that the emigration of y people who take with them less than a proportionate share of capital, yK^*, will improve the lot of those who remain, and if they take more than yK^* capital with them those who remain will be worse off.

These conclusions must be modified for advanced communities, those for which K^* is greater than K^*_x. In this range with K constant, the emigration of people without capital must reduce V/K and therefore V, total investible surplus. If, before emigration, total investible surplus was distributed among those not emigrating, the amount to be distributed among them after emigration is smaller and they are worse off. If emigrants take a proportionate share of capital with them, the welfare of those remaining is unaffected. If, however, emigrants take more than a proportionate share of capital with them, V/K, the return on capital, must rise. The non-emigrants now earn a higher return on their unchanged capital and as their labor income just covers subsistence needs, investible surplus per non-emigrant must be higher than before.

The effects of emigration and related capital movements on investible

surplus can be identified in the lower deck of Figure 6 also. The non-emigrant group always has the same capital and the same population after emigration as before. As wages just cover subsistence, the group's investible surplus, total and per capita, depends only on the average rate of return. Whatever the form of organization this is seen to rise with K^* to K^*_x and to fall thereafter. If emigrants own and take out less than a proportionate share of capital, K^* rises; if they take out more, K^* falls. For developing communities a rise (fall) in K^* raises (lowers) the rate of return and the investible surplus of non-emigrants; for advanced communities a rise (fall) in K^* reduces (raises) the investible surplus of non-emigrants.[8]

This analysis suggests that emigration of the poor or unemployed from a developing community to an advanced community will raise total investible surplus and investible surplus per capita among the non-movers in both communities. The emigration of the wealthier from a developing community will make those remaining worse off. The effect of their immigration on the former population of the advanced country will depend on whether the immigrants are relatively wealthier or poorer than the former population. If they are wealthier, the former population will be worse off; if they are poorer, the former population will be better off.

Supply Curves, Profits and Discretionary Income

The cost of producing individual work effort cannot legitimately be regarded as an individual's supply curve because this would imply that

however high the rate at which he can exchange work for income he would prefer to work such long hours that his income would just cover his subsistence. Rather the subsistence cost curve provides a guide to the individual's indifference map and indicates the minimum possible cost of obtaining any given level of work effort from him, or alternatively his biological maximum work effort for a given wage per man.

The subsistence cost curve itself might be an indifference curve but this would suggest that an individual is equally happy with bare subsistence regardless of the work effort demanded of him. The alternative would require the individual to prefer slow starvation to at least some very high levels of work effort. The indifference map in Figure 7 follows the first procedure. The assumption is made that the marginal rate of substitution between income and leisure increases as income rises. As usual hourly wages are indicated by rays through the origin, the minimum feasible hourly wage being tangent to the subsistence cost curve.

The tangency condition between indifference curves and wage rate lines generates a supply curve for wage incomes above W_x . Below that level, special institutional arrangements are required to make a supply curve meaningful. We shall proceed as follows. A wage per man equal to or below W_x is specified as the maximum amount a member of the labor force can receive. S Successively lower hourly wage rates (or piece work rates) are then established at which up to the maximum income can be earned. The hours of work supplied at the lowest hourly rate at which the employee can (as limited by the subsistence cost curve) and will (as limited by his indifference

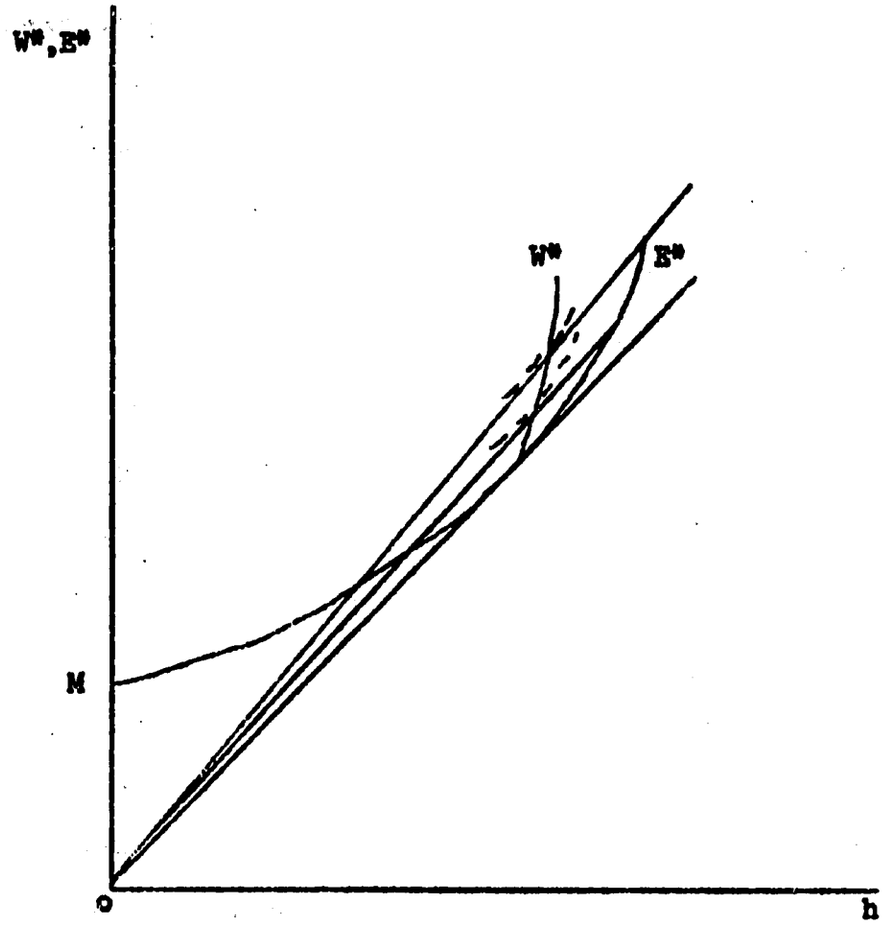


Figure 7

map) earn the maximum income is the supply related to that wage per man. Given the wage per man, competition among workers would bring about this effect. This more complicated technique can be used for higher incomes as well.

The supply curve thus produced coincides with the subsistence cost curve up to the minimum average cost but lies above it thereafter. The community by specifying minimum hourly wages in excess of minimum average cost or by meeting directly a specified amount of subsistence cost could cause the aggregate supply curve to lie above the subsistence cost curve to the left of minimum average cost also. And, of course, the supply curve could bend backward beginning at some hourly wage rate above minimum average cost per hour, but we will not deal with this possibility.

Such a supply curve aggregated for the labor force can be written

(4) $W = N(m + \theta(h)$ (wage bill, W, which will elicit $\underline{h}$ hours of work from each of N men)

We also define (5) $D = W - E$ (discretionary income of workers)

and redefine investible surplus, V, as follows:

(3a) $V = (P-W) + (W-E)$ (investible surplus equals profits of enterprises plus discretionary income of workers)

Dividing (5) through by N, we write for each worker

(5a) $D^* = W^* - E^*$

and assume that in the range for which D^* is positive,

$\frac{dH^*}{d\,h} > 0$ and $\frac{d^2D^*}{dh^2} > 0$, i.e., the marginal discretionary income demanded by a worker increases with hours of work. As $\frac{dW^*}{d\,h}$ and $\frac{d^2W^*}{dh^2}$ must both

be greater than zero, $\frac{d^2D^*}{dh^2} > 0$ implies $\frac{d^2D^*}{dW^{*2}} > 0$, i.e., in this range the higher the wage paid per man, the higher the proportion of it which must be discretionary income.

This conclusion carries with it an implication which must be put in its proper place, namely, that aggregate discretionary income, which may be saved, is maximized by giving any wage bill entirely to one person. This suggests that our earlier conclusion that an equal distribution of work (and workers incomes) is a prerequisite to maximizing investible surplus may have to be modified. This is not so. Any given aggregate hours of work can still be obtained at lowest social cost by dividing the work equally among all members of the labor force. Therefore total investible surplus, profits of employers plus discretionary income of workers, is still maximized, given aggregate work effort, by dividing the work equally. An unequal division of the same work will raise social cost and discretionary income at the expense of profits or community surplus, but total investible surplus will be reduced. Indeed, the equal division of work minimizes aggregate discretionary income while maximizing profits and investible surplus.

It is now the supply curve rather than the cost curve of labor which limits the employment and utilization of labor. Moreover, for a given labor force, the supply price exceeds the cost of generating work effort only when the amount of work effort demanded exceeds that which can be produced at minimum hourly cost. But this is precisely the criterion for distinguishing an advanced from a developing community. The analysis of

developing communities, as exemplified by total hours of work in excess of H_x in Figure 2, any labor force in excess of N_x in Figure 4 and any K^* less than K^*_x in Figure 6, is therefore unaffected because for these ranges of the variables the supply curve and the cost curve of work effort are the same.[9]

For the advanced community, however, the introduction of our supply curve modifies our earlier conclusions. First, any labor force will supply the same work effort as before only if the wage bill is higher, thus creating for the workers some discretionary income. But this implies a higher average and marginal wage per hour. What happens to profits, P-W , and total investible surplus, P-E , depends on the form of community organization.

If the community is competitively organized the initial increase in hourly wages will induce firms to reduce output and hours of work until hourly wages have fallen to equality with marginal product, which must, however, be higher than before. With given capital, the marginal product of capital and profits must be lower than before. But discretionary income has been created in the process so investible surplus may have increased and indeed it usually must. Consider that in the relevant range marginal exceeds average subsistence cost. In the neighborhood where marginal product equals average subsistence cost, the competitive case, the reduction in hours worked must reduce total subsistence cost more than total product. Investible surplus must increase.[10] We conclude that in both decks of Figure 6 to the right of K^*_x the introduction of

labor supply considerations will cause the RW curves to lie somewhat above those drawn. If discretionary income is excluded from consideration, curves reflecting only profits of enterprises, and therefore, competitive decisions, would lie somewhat below the RW curves drawn.

If the community is already organized to maximize investible surplus given the labor force, the substitution of the labor supply curve for the cost curve must reduce total investible surplus. Any given total work effort now has a higher marginal cost than before so total product, work effort and profits must be reduced. Moreover, the reduction in work effort will raise marginal product and reduce marginal subsistence cost which were equal before. Investible surplus is therefore also reduced.[11] We conclude then that in both decks of Figure 6 to the right of K_x^* the RE curves will lie below those drawn.

As it is unlikely that discretionary income of workers will be revealed in the marketplace we cannot say for the advanced community whether total investible surplus will be larger with competition or not. We can, however, say that, as output and work effort given the labor force will be larger in the advanced community when it is competitively organized, the discretionary income of workers will also be larger, and profits will be smaller. By this criterion competition is restored to its traditional position of superiority in the advanced community, but not in the developing community with which we have been principally concerned.

Policy Suggestions and Reservations

While the model discussed in this article may have a degree of internal rigor, it is very narrow in scope. Drawing policy conclusions from it is therefore a risky undertaking. The model does suggest, however, some characteristics of economic behavior and policy alternatives or insights which may merit further investigation in more realistic settings.

It has been suggested, for example, that apparent leisure and poverty may go hand in hand, that short hours of work are consistent with high labor-capital ratios while longer hours of work are profitable in more fortunate circumstances. But a number of factors relevant to such a conclusion have not been considered. The optimum intensity of work effort may vary with the magnitude and compostion of a diet in such a way that units of work effort increase within the dame or an even shorter span of time. Changes in skills, the organization of work and the nature of other factors of production have also been left aside. Seasonal considerations have been omitted and tastes and technology have been assumed constant. Moreover, social attitudes towards work, the nature of incentives and penalties, institutional patterns of work distribution, and the nature of land tenure systems have been disregarded. Nevertheless, the suggestion lingers when one notes the continuing concern with so-called underemployment in developing nations. Certainly there are circumstances in which apparent poverty may result from a voluntary preference for leisure. The suggestion here is that there are other, more usual settings in which low work effort per man is a logical way to make the most out of poverty.[12]

The suggestion has also been made that competition may be an inferior method of economic organization in developing communities from the point of view of maximizing investible surplus because it creates unemployment and results in an inefficient use of the labor force. It may, however, be an irresistible force, once stablished, for containing the rate of population growth--a kind of assist for the Malthusian checks. More to the point, nothing has been said about the uses to which an investible surplus might be put. A monopsonistic, landlord-dominated community may provide full employment and maximum investible surplus but appropriate thh latter for the luxurious living, conspicuous and otherwise, of the landlord class. [6] It is not readily apparent that maximizing investible surplus will also maximize the amount invested or direct that amount to the most profitable uses. This raises questions not only of the propensities to save of different classes of people, but also of the taxability of surplus in different hands. Efforts to tax large numbers of small competitors may be less successful and more costly than taxing a few monopsonists or cooperatives or operating through government enterprises. The suggestion remains that competition may be an inferior method of organization in labor surplus communities.

Competition implies as well that labor and capital will be paid according to their marginal products. It is in this sense a system which economizes the use of resources in an impersonal way, discarding surplus labor as it would surpluses of other resources. But if a social priority is accorded to people and their maintenance has a first claim on total

product, labor in developing communities should be paid directly or indirectly more than its marginal product, the marginal cost of generating work effort being equated to marginal product. We have then full employment and maximum investible surplus. It follows, of course, that capital receives less than its marginal product.

The model suggests as well a sympathetic view of those developing countires which insist on full employment as a top development priority. There is a danger, of course, that this insistence may be inconsistently coupled with legislated minimum wages and institutionally rigid hours of work. The suggestion rather is that unemployment might be alleviated and investible surplus increased by insisting that the labor force be employed but permitting hours of work per worker to be reduced (work sharing) and wages per man to fall although the hourly wage should rise. This approach contradicts the competitive model's response to unemployment which treats unemployment as a signal that hourly wages are too high and as a problem which can only be solved by reducing wage rates. But the competitive model ignores the fact that a wage rate which would bring about full employment is too low to permit subsistence. The low wage rate and full employment could be made consistent with subsistence by the subsidy of workers from the taxation of profits. Without this supplementary mechanism competition among firms and workers will not work. The insistence on full employment avoids the need for a subsidy arrangements of this kind.

Possibly our analytical constructs so often designed and useful for advanced country situations, may lead us astray in considering developing

communities. If, as suggested, a marginal product wage and full employment are incompatible in developing communities without special supplementary arrangements, it should not be surprising if models based on these assumptions steer us in wrong direction.

Footnotes

[1]Similar figures appear in [8:66] and [13:282]. Much of Professor Brody's book [3] is devoted to assembling evidence in support of the diminishing returns hypothesis with respect to animals.

[2]On the other hand, if the work energy curve exhibited increasing returns throughout, the point determined above would be a minimum and the optimum use of any aggregate diet would be to give the excess over maintenance requirements to one man.

If the work energy curve first exhibits increasing returns followed by diminishing returns, low excesses of aggregate diets over maintenance should go to one man, intermediate excesses may be divided unequally, while larger excesses should be shared equally.

[3]We wish to maximize $V = g\ (K,H) - N(m + f(h)$ with K , N and m given. As the production function is linear and homogeneous, this equation can be rewritten as

$$\frac{V}{N} = g\ (\frac{K}{N}\ ,\ h) = [m = f(h)]$$

When K , N and m are given, $\frac{V}{N}$, and therefore V , is maximized when

$$g\frac{1}{h} = f\frac{1}{h}\ ,$$

i.e., when marginal product equals marginal cost.

[4]Inputs less than H_o would not be consistent with the full use of non-labor resources because their marginal product would be negative. For $H < H_o$ it would be preferable to reduce proportionately the non-labor resources used maintaining their marginal product at zero.

[5]Let $V^* = \frac{V}{N}$ and $K^* = \frac{K}{N}$. Then we can write $V^* = g(K^*\ ,\ h) - [m + f(h)]$, and it can be shown that V^* is a maximum when

$$g\frac{1}{h} = f\frac{1}{h} \text{ and}$$

$$g\frac{1}{K^*} = 0\ ,\ \text{i.e.,}$$

when the marginal product of capital is zero (or the average product of hours a maximum -H_o in Figure 2) and marginal product equals marginal cost of work

Moreover,

$$\frac{dV^*}{d\,N} = g\frac{1}{K^*}\,\frac{dK^*}{dN} + g\frac{1}{h}\,\frac{dh}{dN} - f\frac{1}{h}\,\frac{dh}{dN}$$

The last two terms are equal by definition on the obxm curve in Figure 2. and with K given, the first term is negative to the right of H_o , Therefore V^* declines as population rises.

[6] Professor Leibenstein has employed a diagram involving the RW curve in Figure 5 and one of the iso-employment curves to demonstrate the possibility of increasing investible surplus through full employment. [8:73[

There are however, two points in his argument which requires modification. We can posit employers a wage per man, which determines also his hours of work and therefore the hourly wage, and ask how many workers would be demanded when the wage per man equals marginal product. The locus of such equilibrium points (which incidentally is unlikely to be tangent to the various marginal product curves as Professor Leibenstein has depicted it in his Figure 6) represents as he says, "in a sense, a demand curve for labor." [8:71] It is, however, quite another thing to argue as he does [8:74] that competition among workers can bring about wages per man lower than W_1 in our Figure 5 or less than W_x in Leibenstein's Figure 6-6. Employers are in the business of hiring hours of work, not workers, and wages per man below W_x imply higher hourly wages. Competition among workers must be analyzed in terms of a supply curve relating hourly wages to aggregate hours of work. In Figure 3, for example, the supply curve when population is N_b is horizontal to the minimum point on the N_b curve and follows that curve thereafter. A wage per man below W_x cannot be brought about through competition among workers. [Cf. 12:287]

The second point is Professor Leibenstein's puzzling conclusion that landlords as a group are better off "to employ the entire labor force... and yet not utilize the entire labor force." [6:76]
We see in Figure 5, for example, that with a labor force of N_b the government can ensure full employment under competitive conditions by fixing the wage per man at W_c . But investible surplus can be increased by abandoning competition, raising wages to W_b and insisting on full employment. As a consequence aggregate and average hours of work and total output will increase. Clearly the labor force is more fully utilized than before. W nnacott [12:296] and Ezekiel [4:516] have also noted this discrepancy.

[7]The equation for this curve, valid for $K^* < K^*_x$ is

$$SU = -M + \left(\frac{V_x + M}{K^*_x}\right) K^* .$$

[8]This conclusion differs from that reached by Professors Berry and Soligo [1] when $K^* > K^*_x$, the range with which they deal. They use per capita income rather than investible surplus per non-emigrant as their criterion and make no deduction for subsistence needs. Let αK = non-emigrant's capital before and after emigration and βN = numbers of non-emigrants. Then the per capita income of non-emigrants before and after emigration, assuming factors receive their marginal product is,

$$MP_N + \left(\frac{\alpha}{\beta} K^*\right) MP_K$$

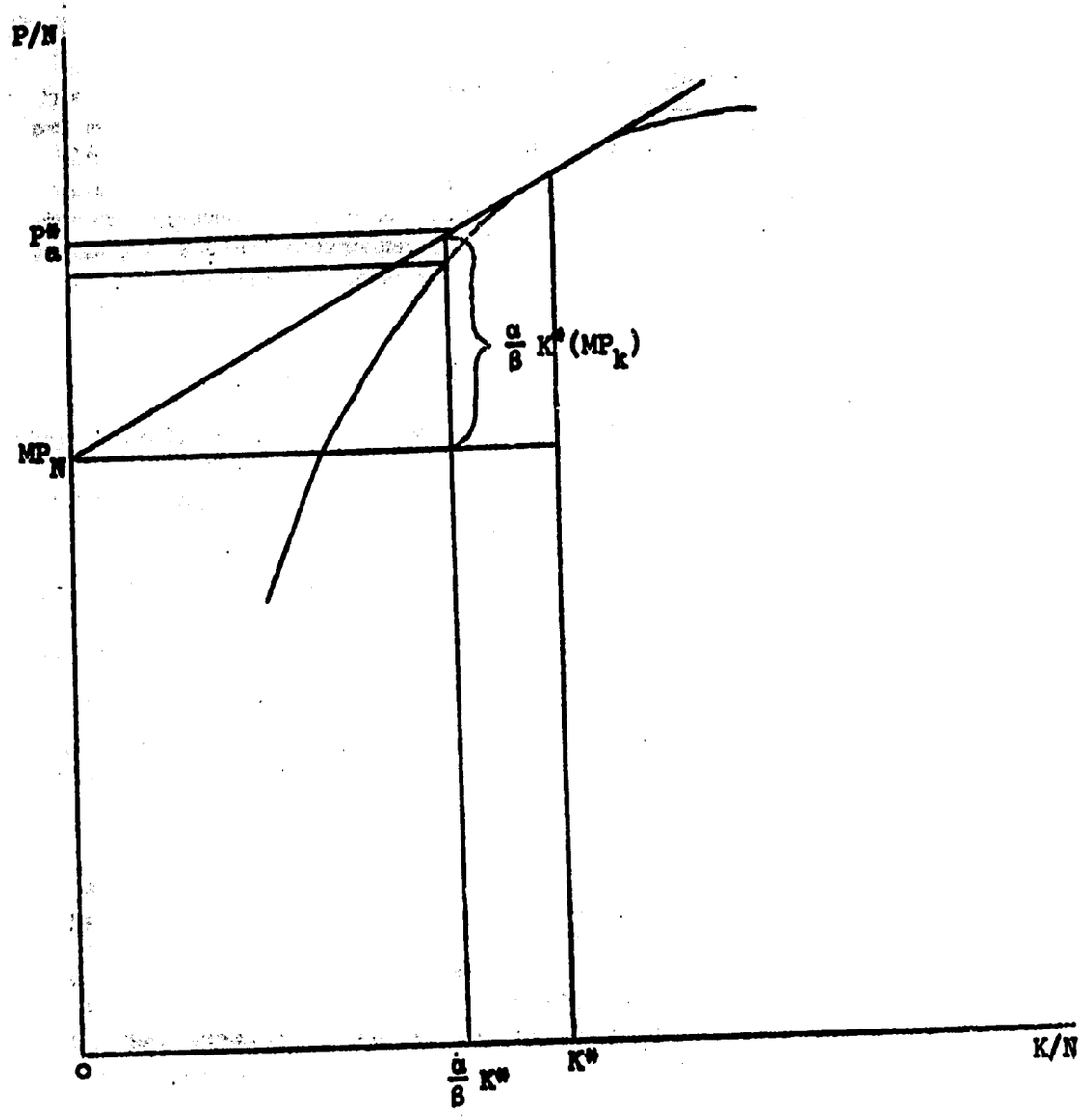
where $K^* = K/N$ before emigration and MP_K and MP_N are evaluated before emigration at K^* and after emigration at $\frac{\alpha}{\beta}K^*$. In the figure, the per capita income of non-emigrants before emigration is the wage MP_N, plus return per capita on their own capital, $\frac{\alpha}{\beta}K^*_x(MP_K)$. The sum of these two returns, is clearly greater than P^*_α at $\frac{\alpha}{\beta}K^*$, which is the group's per capita income after emigration. The conclusion is unaffected when the positions of K^* and $\frac{\alpha}{\beta}K^*$ are reversed. Therefore, in the case considered by Professors Berry and Soligo, non-emigrants are worse off with emigration except in the special case in which $\frac{\alpha}{\beta}$.

[9]We recognize, however, that a community might take leisure into account by producing with a given labor force to the point where an aggregated or community indifference curve is tangent to the total product curve. In that case we would expect the <u>oxbm</u> equilibrium curve to be unchanged at <u>m</u>, but as population decreases, to lie proportionately more to the left indicating as investible surplus per man increases that greater degrees of leisure can be afforded.

[10]Let $E/H = e$. Then investible surplus, V, can be written:

$$V = P - He \text{ , and}$$

$$\frac{dV}{dH} = \frac{dP}{dH} - H\frac{de}{dh} - e .$$



Figure, fn. 8

In the neighborhood where $\frac{dP}{dH} = e$, $\frac{dV}{dH} \quad 0$. A fall in total hours of work increases investible surplus.

[11] Investible surplus, P-E , is maximized when

$$\frac{dV}{dH} = \frac{dP}{dH} - \frac{dE}{dH} = 0$$

Behavior which now seeks to maximize P-W reduces total work effort and product so that $\frac{dP}{dH} \quad \frac{dE}{dH}$ and investible surplus is no longer maximized.

[12] Note should be taken of Ester Boserup's suggestion that increasin population is likely to be accompanied by increasing hours of work per person. [2] The thrust of her argument is that a growing population density will stimulate technological changes which on the whole will be labor using.

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