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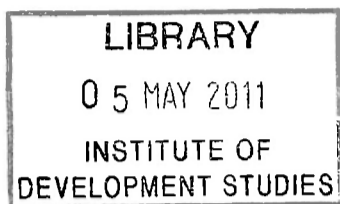
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ORGANISATION INPUT AND ECONOMIC DEVELOPMENT

By

T.Y. SHEN

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Abstract

In this paper we develop a framework in which organisation is treated as an input in a production firm. The determination of an equilibrium organisation input is described. Corresponding to the equilibrium a quasi-rent is earned by the organisation. Improvements in efficiency and technological change are regarded as substitution of organisation input for labour and capital inputs.

Development sequences of three types of firms are discussed. For the large firm in a mature economy, organisation input is primarily generated within the firm. For the small firm in a mature economy, entry and exit play the vital role. For the firm in an underdeveloped country little organisation input is generated, and there are good economic reasons why the substitution of organisation input for other inputs is inefficient. It is a better strategy for an underdeveloped country to import organisation inputs (but not organisation stocks) when they are needed, because of the relatively low costs of organisation inputs generated in the mature economies.

ORGANIZATION INPUT AND ECONOMIC DEVELOPMENT

T. Y. SHEN*

I

In the literature the relationship between "firm" and "organization" is generally ambiguous. Frequently the two terms are used interchangeably. For example, Mrs. Penrose (a leading figure in the field) had written (21.P.305) that "in any economy, the basic unit of industrial production is the firm or the enterprise, for it is the firm that acquires the factor of production, organizes them in the production process, designs the methods of production and the products, and usually surveys markets and arrange sales. In particular the firm is the organization through which innovations are put into practice". This usage is misleading. As many fruitful studies in recent years (13, 17) have shown, the behavior of the firm is significantly affected by its internal structure. The basic purpose of the present paper is to establish a framework in which organization is recognized specifically as a component of the firm. In particular organization is an input --- the "fourth factor of production" of Marshall. It performs the tasks mentioned by Mrs. Penrose, and is entitled to a remuneration like the other inputs. The central issue in this framework is to determine the relationship between organization performance and organization income. Once this issue is clarified, the role of organization in economic development can be analyzed.

What is organization? As a first approximation and in the context of a private enterprise economy, it is the team of "non-marginal product employees" in a firm (13), including managers, supervisors and staff employees like accountants, engineers and secretaries. This definition

must be extended. An organization should be time-specific with respect to the historical development of a firm, because the capability of the "team" to perform its tasks depends on how long the team has worked together on these tasks. It also includes the written and unwritten constitution, by-laws, rules, codes and habits prevailing in the firm, all of which combine to determine the roles of inputs by way of production layout, task definitions, communication channels and decision rules.¹ With these extensions a one-to-one correspondence can be established between the stock of organization at the beginning of a period and the level of its task performance, with given supply of other inputs and given technology.

Organization input is a flow. A "norm" of organization input may be defined as that input which maintains the organization stock of a firm at a constant level in a time period. But organizations are by their nature dynamic.² Individuals on the team grow and the composition of the team changes over time. The working relationship among the team members develops and the organization responds to new stimuli provided by changes in the environment. It is therefore more appropriate to define a dynamic norm of organization input as that input which keeps the organization stock of a firm growing at the average rate for the industry. When organization input for a particular firm exceeds this norm, the level of organization performance is raised relative to the industry average and its organization stock becomes larger. Thus measured against the norm, organization stock is the cumulative sum of past organization inputs.

The total organization input in an economy is more than the mere sum of organization inputs of firms. Even if we include as firms subsistence farms, governments and non-profit institutions, there is still much more to be included in the organization stock of the economy. Moral tradition, laws, informal associations and other social bonds are all part of the

organization stock. By social interaction new organization inputs are incessantly injected into the economy. These inputs can influence the performance level of firms as much as the inputs generated by their own organizations. However we will not go beyond the firm organizations in this paper and will simply assume that organization inputs originated outside of the firm organizations affect all firms to the same degree.

Turning to organization income, the differential in performance level associated with different organization stocks gives rise to quasi-rent. An organization can survive only if it manages some threshold level of task performance in the long run. It earns a quasi-rent if its performance exceeds the threshold. The coherence of an organization derives from the fact that by co-operation the members of an organization can contribute more to output than if they work individually. But this is insufficient for the survival of an organization. Only when an organization is able to earn a positive quasi-rent will its owners³ have a vested interest in keeping it going. An on-going organization, of course, has a better chance of perpetuating itself because of the cumulative nature of the organization stock.⁴ There is no need here to distinguish Schumpeter's entrepreneurial profit from quasi-rent: the former is a special case of the latter. Entrepreneurial profit is incurred when the organization input generates something novel, such as a new product or a new production relationship.

Monopoly profit, on the other hand, is something different and requires a new definition in our framework. At times the threshold for quasi-rent is raised so high that only a single firm survives in an industry. It becomes a monopoly. Quasi-rent based on the organization differential between the monopolist and the best-qualified potential entrant would still set a limit to profit unless there are other barriers to entry that permit monopoly pricing. The excess profit over the quasi-rent (based on the

organization differential) represents monopoly profit. The usefulness of this definition will be demonstrated in our empirical analysis in Section III.

We now come to the meaning of organization performance. It is useful to distinguish two types of tasks engaged in by organizations. The first is growth and technological change,⁵ the former a movement on the production surface and the latter a shift of the production surface itself. The mechanics of their execution by a firm organization have been ably described by Mrs. Penrose (20). We shall identify the organization stock responsible for this type of task as P-factor. The second type of task is to improve X-efficiency, a movement towards the production surface. The dynamics here were analyzed in two well-known papers by Leibenstein (12, 13). The associated organization stock will accordingly be referred to as L-factor.

Although the distinction between P-factor and L-factor facilitates our analysis, they are closely related. Typically growth and technological change require installation of new capital equipment. This affords a chance to break the existing inertia, the basis of X-inefficiency. On the other hand the inexperience with the operation of new technologies results in new X-efficiency. The demands for P-factor and for L-factor are therefore interdependent. On the supply side the same organization provides the resources for the build-up of both factors. Parkinson had observed that among firms there are two types of organization personalities, male and female,⁶ which are parallel to superior endowments of P-factor and L-factor. But a textbook substitution relationship underlies these personalities. X-efficiency has an upper bound defined by the production surface. Technology and growth also have an upper bound determined by the state of technical knowledge and the art of management. Diminishing returns set in when the supply of either P-factor or L-factor rises. A balance

between the factors is established by substitution. Organization personalities arise when the supply costs of the two factors vary for different firms.

It is important to stress the superiority of organization --- in comparison to individual entrepreneurs --- as a catalyst of change. Division of labor and specialization enhance the capabilities of an organization. More information is pooled. Organization behavior also tends to be more rational and deliberate (1), even though it may inhibit creativity. Dynamically the scope of growth of an organization is vastly greater. An organization has a time horizon beyond that of individuals and can absorb new members when needed. This list is by no means complete yet it should suffice to demonstrate the greater potential of organizations.

We will use the concepts introduced above as the basis of a model in the next section. We will show how, under some assumptions, there is a tendency for firms to converge towards an equilibrium --- at the dynamic norm of organization input mentioned earlier. The model applies well to large firms in a mature economy; for small firms modifications are needed. We then turn to the underdeveloped economies in Section III. With an empirical illustration we focus on the difficulties in generating new domestic organization stock. In the final section we analyze the option of importing organization stock to underdeveloped economies by way of multinational corporations. We conclude that policies to build up domestic organization stock, either directly or through the instrument of multinational corporations, are of dubious merit. The direct importation of organization input when needed has a higher payoff for countries in early stages of economic development.

II

We have defined the organization stock of a firm in terms of the level of its performance. Its income is a quasi-rent based on performance differential. This provides the center piece of a model that we shall now describe in geometric terms. The limited supply of organization stock for a given firm and the inevitable diminishing returns governing its deployment suggest that the model will possess equilibrating properties. In a sense then the model represents an extension of Leibenstein's demonstration of an X-inefficiency equilibrium. Alternatively the model may be regarded as an attempt to synthesize the theories of Mrs. Penrose and Leibenstein.

The assumptions needed for our model include :

(1) Firms operate in a single-product industry characterized by competition. The price of the product is determined in each period by demand and supply. Supply is altered over time by growth of firms and by entries and exits.

(2) Each firm possesses a stock of organization and the organization "runs" the firm. The decision rule followed by the organization is the maximization of the discounted stream of quasi-rents. The same set of "complete information" about the future is accessible to all firms, but the costs of obtaining this information varies inversely with the stock of organization possessed by a firm.

(3) Differences in the "routine production" (described by the relationship between non-organization inputs and outputs) of firms are attributable to their differences in the values of the "decision variables": scale of operation, technology and X-efficiency.

(4) Cardinal indices can be assigned to represent each of the decision variables.⁷ Divisibility is implied, so that incremental changes in the

values of the decision variable are permissible. There is also irreversibility: except in the case of exit, the decision variable values do not decline.

(5) Organization input is required to execute changes in the decision variable values. In particular a positive monotonic relationship exists between organization input and the extent to which decision variable values may be raised in a period.

(6) Expansion (in the scale of operation) requires the installation of new capital equipment, and this equipment embodies best-practice technology.

(7) New technology is more capital intensive (24), and hence can be adopted only by the installation of new (best practice) capital equipment. Technological change may be carried out either by replacement or by expansion.

(8) X-efficiency improvement acts on labor productivity and affects capital productivity only because there are substitution and complementarity relationships between capital and labor.

In addition environment must remain unchanged if a firm, starting from a point of disequilibrium, is to move towards and ultimately reach an equilibrium. The most important environmental constants for our model are:

- (1) the organization stock and the organization input generated by the stock as measured against the industry average;
- (2) the rate of change of the best practice technology; and
- (3) consumer demand for the product of the industry --- assumed to be somewhat inelastic.

We start by considering the role of the P-factor in the replacement decision. In Panel (a) of Figure One, the revenue and cost associated with replacement are shown to be functions of the rate of replacement.

For the profit maximizing firm the optimal replacement rate is at the point where the distance between the two functions is at a maximum. The position of the revenue and the cost functions for a given firm is affected by two crucial factors. The first is the "technology gap", or the difference in the technology index between the firm in question and the best practice technology. Let T^* be the technology index of the best practice technology and T the technology index of the firm, then the technology gap is T^*-T . A large technology gap implies the presence of a large proportion of inefficient capital equipment and gain from replacement will be greater. Curves I, II and III in Panel (a) depict the replacement revenue function of three different plants in ascending order of technology gap.

The replacement cost function shifts with the endowment of P-factor, or the capacity of the firm organization to search and perceive profitable moves in technological change and then to plan, co-ordinate and execute the moves. A rich supply of P-factor lowers the adjustment costs for each rate of replacement and hence the replacement cost function. Curves A, B and C in Panel (a) depict the replacement cost functions of three firms in descending order of P-factor endowment.

Panel (b) reiterates the fact that the optimal rate of replacement is an increasing function of both the technology gap (T^*-T) and the P-factor endowment. If firms stay on the optimal replacement curves, then each firm will move towards an equilibrium rate of replacement as shown in Panel (c). The curves in Panel (c) are transposed from (b) with two modifications. The vertical axis now measures the rate of technological change resulting from replacement, DT_r :⁹

$$DT_r = (T_2 - T_1)_r$$

where T_2 is the technology index of a firm in Time Period 2 and T_1 its

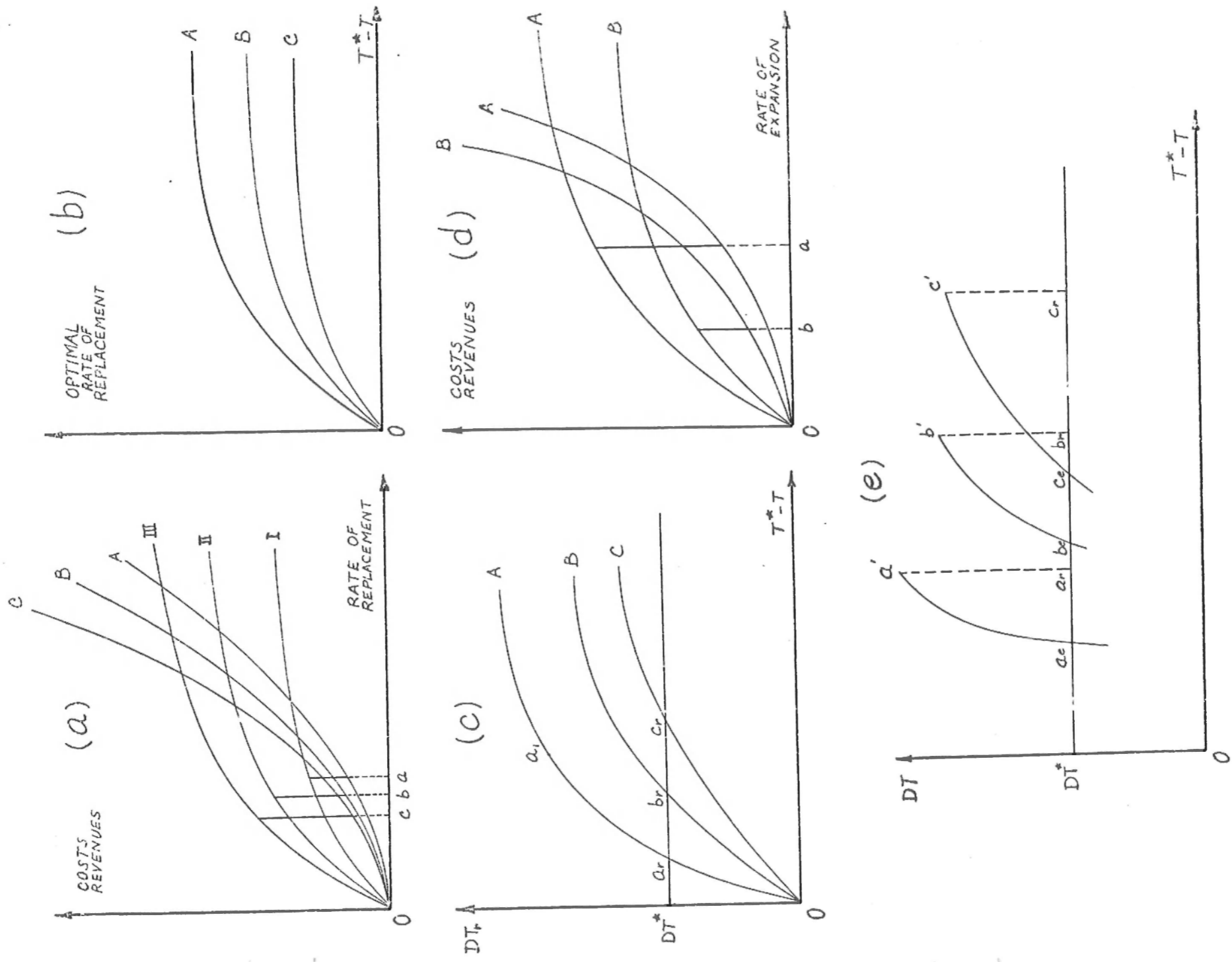


FIGURE ONE

technology index in Time Period 1. The subscript r refers to the fact that replacement is the source of the technological change. In addition, A, B and C are now time paths¹⁰ for firms with different P-factor endowments.

The relationship illustrated in Panel (c) resembles the ordinary adjustment model with $DT_r = \lambda(T^* - T)$.¹¹ Each act of replacement affects the value of $(T^* - T)$ in a subsequent period. Starting from a_1 , for example, the firm will move along the A-curve towards the origin. Now suppose that the best practice technology itself is changing at a constant and exogenously determined rate DT^* :

$$DT^* = (T_2^* - T_1^*)$$

where T_2^* and T_1^* are the technology indices of the best practice technology in Time Periods 2 and 1 respectively. Then clearly a_r is a stable equilibrium point for Firm A, whose rate of technological change DT_r is the same as DT^* and whose technology gap $(T^* - T)$ remains constant. If all firms are in equilibrium, then they all have the same rate of technological change. However the rate of technological change will be higher for Firm A and its capital assets will correspondingly be more advanced. Provided that the endowments of P-factor for the different firms remain constant, there will be a stable ranking of firms with respect to technology. Depending on demand there will be a marginal firm whose technology is such that it earns zero quasi-rent. To the left of the marginal firm larger and larger quasi-rents are earned by firms with smaller and smaller technology gaps.

The model is easily extended to include expansion as an option for the deployment of P-factor. Panel (d) is analogous to Panel (a), except that the rate of expansion takes the place of the rate of replacement along the abscissa. The expansion revenue function and the expansion cost functions are defined in the same way as the corresponding replacement functions.

The expansion revenue function rises with the rate of expansion as the cost of production is lowered with the greater proportion of best practice technology. The rate of increase diminishes since the demand curve for the industry is downward sloping. The expansion cost curve rises at an increasing rate because of the fixed P-factor endowment. As before, the point of maximum distance between the two functions determines the optimal rate of expansion.

The position of the curves in (d) also depends on the technology gap and the P-factor endowment. To simplify the exposition, firms are assumed to be in replacement equilibrium initially. At this equilibrium there is a one-to-one correspondence between technology gap and P-factor endowment. Firm A has a higher endowment of P-factor than B, yet their rates of technological change are the same. It is plausible that the quantity of P-factor required for replacement depends on the rate of technological change rather than on the rate of replacement.¹² Consequently Firm A (and all firms to the left of the marginal firm) has idle reserve of P-factor that may be deployed for expansion. In the meantime, Firm A already enjoys a greater familiarity with the best practice technology by virtue of its higher rate of replacement, so that it needs less P-factor to execute a given rate of expansion. This has the direct effect of lowering the expansion cost function. If the surplus P-factor is converted to L-factor, Firm A can also expect a lower routine operation costs after the expansion and hence a higher expansion revenue.¹³ Taking the two functions together, Firm A will have a higher expansion rate.

Panel (e) is akin to Panel (c). The solid curves trace out the time path of "total" technological change, DT , the sum of changes in the technology index due to replacement and due to expansion. To illustrate, Firm A at replacement equilibrium position a_r expands and its rate of total

technological change is a' .¹⁴ This brings the firm closer to T^* in the next period. The rate of replacement declines, increasing the unused P-factor available for more expansion.¹⁵ For a number of reasons, however, the time path will move down towards a_e . First, it is likely that more P-factor is required for the same installation of capital equipment if the installation is related to expansion rather than replacement. The assimilation of new staff, after all, is usually more difficult than the reassignment of existing staff. Second, for the same installation of capital assets expansion entails a smaller change of technology index than replacement.¹⁶ Third, as a firm moves closer to the ordinate (where $T = T^*$) a given installation of capital equipment (whether for replacement or expansion) has a diminishing impact on its technology index.¹⁷ Finally, as a firm continues to expand, the same rate of expansion requires a larger installation of capital assets. On the assumption of fixed P-factor endowment, the expansion cost function shifts upward and lowers the rate of optimal expansion. For all these reasons, the rate of technological change (DT) falls to a_e . Similarly Firm B comes to a rest at b_e and Firm C at c_e . Firm A by virtue of its greater P-factor endowment will enjoy a more advanced level of technology, a more rapid rate of growth and a higher quasi-rent. The rate of change of technology, on the other hand, is the same for all firms in equilibrium.

Turning to L-factor, we focus on the routine operation costs of a firm with given technology. The conclusions reached by Leibenstein (12, 13) are quite similar to our findings on technology. There is also an equilibrating mechanism which guides the firms towards an equilibrium in X-efficiency. If X-efficiency improves exogeneously as a result of organization or management innovations, competition leads to comparable increases in X-efficiency for all firms. At equilibriums, moreover, there

is a stable rank ordering of firms in X-efficiency, corresponding to their endowment of L-factor (in our terminology).

To combine P-factor and L-factor in a single model, we define a productivity index, Z , which is a product of the technology index T and an X-efficiency index E . We further define E in such a way that its value runs from 0 to 1.0, with 1.0 referring to production on the efficient production frontier. The best productivity index Z^* is equal to T^* , and each firm will be characterized by a productivity gap Z^*-Z .

The dynamics of L-factor are based on separate "pull" and "push" processes. A typical pull process is described by the situation where new L-factor input generated by a firm in a time period is proportional to its L-factor stock at the beginning of the period. In this case, firms with high efficiency and advanced technology initially will have a higher improvement in productivity.¹⁸ The locus of equilibrium points for the firms becomes a line with a negative slope instead of the horizontal line in Panel (e), leading to a widening gap between high productivity and low productivity firms. This is balanced by the push process, stressing the competitive pressure on the less efficient firm to catch up. High efficiency and advanced technology initially would result in lower X-efficiency improvement.¹⁹

If the push process is insufficient to offset the destabilizing influence of the pull process, equalization of productivity increase may still be attained by the interaction between P-factor and L-factor. In particular, X-efficiency is likely to decline with installation of new capital equipment. Hence firms with a small technology gap tend to have a larger X-efficiency gap. The neutralization minimizes the impact of the pull process. More importantly P-factor may be converted into L-factor and vice versa. Since improvements in X-efficiency are subject to diminishing

returns, L-factor is converted into P-factor for firms with a small efficiency gap. The "excess" organization stock can then be channelled into expansion, with the result that DZ is approximately equalized for all firms. Panel (e) then describes productivity change, with the abscissa relabelled Z^*-Z and the ordinate relabelled DZ. The equilibrium rate of productivity change for all firms is given by the horizontal line at a height equal to the product of DT^* and \overline{DE} , the average rate of efficiency improvement.

Some of the propositions implied by our model are consistent with previous empirical findings on U.S. firms. The innovator firms are fast growers (16) and there is a "distinct relationship between the base year technology and the growth performance of manufacturing plants" (22). On the other hand our model appears to offer no explanation for two conspicuous phenomena: the paramount importance of entry and exit and the impermanence of relative technology ranking of given firms. Of 2686 manufacturing plants in a sample, we found (22) that 1617 had exited between 1935 and 1959: 60 percent of the initial total.²⁰ In addition: "technology difference represents one of those persistent but impermanent competitive advantages" and "initial competitive advantages by plants with more advanced technology were largely dissipated within a decade" (22). Obviously we need to re-examine the assumptions of our model.

It is useful to distinguish two development sequences for firms in a mature economy. For small firms two important modifications to our model must be made. Because small firms have limited capital equipment, the divisibility assumption cannot be maintained. In the meantime the small stock of organization possessed by a small firm is insufficient to plan, install and start up new capital equipment. Instead this task is usually performed by the capital equipment manufacturers. Since the initial

P-factor input is provided from outside, the organization stock of the firm no longer bears any relationship to its level of technology. These two features completely change the development sequence of the small firm from that predicted by our model. Whatever the organization stock possessed by the firm, it earns a high quasi-rent in its early life because of its small technology gap. The quasi-rent may be kept up for a while with improvements in X-efficiency. Nevertheless, because of the lumpiness of capital equipment relative to its total asset, expansion is not a real alternative even though the firm is earning high quasi-rents. The lack of an opportunity to display its organization capabilities also prevents the firm from distinguishing itself in the outside capital market. Subsequently its technology gap is widened by obsolescence, while new opportunity to improve on its X-efficiency becomes increasingly more limited. The quasi-rent declines, crosses the zero threshold and the firm expires. This life cycle is still further shortened in many cases by the departure of key individuals in the firm organization. The smallness of the organization makes it vulnerable to such departures.

This sequence appears to be consistent with the empirical findings mentioned earlier. Several features may be noted. First, organization has almost no import in the development sequence --- which may well explain why organization was neglected in the neo-classical theory of the firm.²¹ Superiority in the organization stock has only a minor impact on quasi-rent. Since the firm could not expand, generation of new organization input is also discouraged. Second, entry and exit alone are crucial: new technology and improvement in X-efficiency in the economy are both direct results of new entries, while the average productivity is also raised by the exit of aged firms. Third, the rate of entry and exit is determined by the rate of change of the best practice technology through the

mechanism of quasi-rent determination. This preserves our conclusion that productivity increase in the industry is determined by the rate of increase of the best practice technology.

But our model is by no means irrelevant. With the organization revolution large firms - sometimes created, sometimes formed by merger, sometimes by growth of the exceptional small firms - are becoming increasingly important in a mature economy, and our model gives a fairly realistic description of the large firms. With a large firm the P-factor relevant for the planning and installation of new capital equipment is "internalized" because the firm organization is large enough to handle it and has a competitive advantage in doing so based on its intimate knowledge of the firm. The P-factor endowment of the firm is therefore responsible for the technology gap, just as we have assumed in the model. The lumpiness of capital equipment also loses its significance: relative to the total assets of the firm most capital equipment may be regarded as divisible. Large quasi-rents earned in a period can be used for immediate expansion. Superior P-factor endowment will not remain idle, and ample incentive is provided for the generation of new organization input. The large organization also has a continuity and a stability. With stable stocks of P-factor and L-factor the firms are likely to stay in equilibrium. For large firms, therefore, organization assumes a central role both in productivity increase and in determining the fortunes of the firm. This is true unless the firm turns into a monopoly — then the situation will be quite similar to the underdeveloped economy case to be described in the next section.

III

As the catalyst of technological change and efficiency improvement, organization input is at the heart of economic development. But what type of organization input is needed? What determines its supply? Are government policies called for? We will discuss these issues in abstract and then introduce some illustrative empirical evidence. It turns out that despite the limited supply of organization input in underdeveloped economies, the required P-factor can usually be supplied from abroad with the installation of new capital equipment. The demand for L-factor is insignificant: in early stages of development the wage rate is so low that wage savings from higher efficiency may not even compensate for the costs of organization input. Large efforts to build up domestic organization input do not appear to be justified.

Cultural norm, personality traits, inexperience and level of education are among the factors (9) limiting the supply of non-marginal product workers in modern sectors of underdeveloped economies. To accommodate the shortage of the organization stock, most of the plants were planned, installed and set up for operation by foreign capital equipment manufacturers or technical assistance teams. Little domestic P-factor is used. As a consequence a small organization stock often runs a relatively large firm. This is important because the capacity to generate organization input by existing organizations is minimal: they do not have the personnel to carry out further technological change or improvement in efficiency by themselves.

The generation of organization input domestically faces another handicap because of the large technology gap between the modern sector and the traditional sector. The gap presents an enormous advantage to the modern sector firms, enabling them to earn a high quasi-rent despite their

small organization stock. The absence of a distinct causal relationship between organization stock and quasi-rent removes the profit incentive to generate new organization inputs. The situation is often aggravated further by monopoly. The technology gap leads to an increasing market share for the modern sector firm in its market area and ultimately to monopoly. Threat of foreign competition is eliminated by trade barriers and new domestic entries are barred by the narrowness of the market or by political maneuver. In such a vacuum there is no need even to generate enough organization input to keep the organization stock intact. There is no pull, no push.

In a mature economy a significant portion of organization input is associated with the establishment of new firms. We have shown this in connection with the small-firm sequence in the last section. The incentive is provided by the prospect of earning quasi-rents and is enhanced by a well-developed market for organizations: the stock market. For many organizers of firms the motivation comes from their expectation of a quasi-rent associated with the technology gap between the best practice technology capital equipment they install and the marginal technology in use by aged firms. The organizers contribute little organization input initially: the P-factor input for starting the plant is lent by the capital equipment manufacturers. Later on they may generate some L-factor to meet the competition. Other organizers are more ambitious. They wish to enter into the large firm development sequence. They try to put together enough organization stock to generate organization inputs for expansion. If they are successful they will be richly rewarded in the stock market. Organization is traded in the stock market at a price equal to the excess of market valuation of a firm over its net worth. The price is based on the capitalized sum of the expected stream of

quasi-rent. Since traders have a rather short time horizon and discount the future heavily, short term growth performance and high profits are very much favored. This stimulates the generation of organization input. Although most of the organizers do not succeed in lifting their firms out of the small firm sequence, their efforts bear fruit.

These considerations must be watered down considerably in an underdeveloped economy. The market for organization is either non-existent or paper thin.²² Opportunities for new entry are limited and new organizations have little incentive to build large organization stocks. To begin with the low level of purchasing power limits the number of industries where a modern enterprise may hope to succeed. In the eligible industries the established monopoly or oligopoly has enacted barriers to entry that bear little relationship to organization stock. Even when a foothold is successfully established by a new firm, the large ready-made profit due to the technology gap based on foreign-supplied P-factor removes incentives to build up an organization stock.

The limited supply of organization may be illustrated by empirical data. We will take Nigeria as an example. The deficiency of organization stock in Nigeria is brought out by the relative ratio of management, professional and clerical personnels (the "non-production workers" or Leibenstein's "non-marginal product employees") to production workers in industrial establishments. The former is a crude index of the stock of organization, if the quality of organization is disregarded for the time being. The latter is an index of firm size. Deficiency of organization stock is then reflected by a low "NP/P" ratio.

Table One presents comparable data for Nigeria and for the United States.²³ In Columns (1) and (2) the number of establishments with 20

TABLE ONE : COMPOSITION OF LABOR FORCE IN NIGERIA AND IN THE U.S.

I N D U S T R Y	ISIC CODE (Nigeria)	SIC CODE (U.S.)	(1)		(2)		(3)		(4)		(5)		(6)	
			No. of establishments with 20 or more workers/Total Number of establishments in the sample		Ratio of Non- Production workers to Production Workers		Ratio of average Non-Production worker remuneration to average production worker remuneration							
			Nigeria	U.S.	Nigeria	U.S.	Nigeria	U.S.	Nigeria	U.S.				
Meat Products	201	201	7/10	2018/5300	.26	.26	4.8	1.4						
Dairy Products	202	202	3/4	2885/7885	.35	1.20	3.6	1.2						
Grain Mill Products	205	204	2/6	1088/3555	.34	.43	5.1	1.3						
Bakery Products	206	205	41/70	2122/5366	.20	.71	2.5	1.3						
Sugar Confectionary	208	2071	5/6	411/1211	.14	.21	5.6	1.9						
Miscellaneous Food Preparations	209, 220	209	9/9	1428/2478	.37	.51	3.5	1.5						
Beer Brewing	213	2082	6/6	180/222	.41	.47	3.5	1.3						
Soft Drinks	214	2086	8/13	1530/3905	.33	1.59	4.3	1.5						
Textiles	231, 232	22	32/34	4368/7104	.11	.11	5.4	2.0						
Footwear	241	314	16/21	912/1193	.13	.10	5.2	2.3						
Wearing Apparel	243	23	11/15	13011/28457	.10	.13	3.3	2.1						

19(a)

I N D U S T R Y	ISIC CODE (Nigeria)	SIC CODE (U.S.)
Saw Milling	251	2421
Furniture and Fixtures	260	25
Paper Products	272	264
Printing	280	275
Tanning and Travel Goods	291, 293	3111
Rubber	300	3069
Basic Industrial Chemicals	311	281
Vegetable Oil Milling	312	2093
Paints	313	2851
Miscellaneous Chemicals	319, 321, 329	289
Bricks and Tiles	331	3251
Cement	334	3241
Concrete Products	339	3273

19(b). 1981

(1)	(2)	(3)	(4)	(5)	(6)
No. of establishments with 20 or more workers/Total Number of establishments in the sample		Ratio of Non-Production workers to Production Workers		Ratio of average Non-Production worker remuneration to average production worker remuneration	
Nigeria	U.S.	Nigeria	U.S.	Nigeria	U.S.
33/46	2575/13372	.11	.11	4.7	1.6
40/55	3313/10478	.17	.20	3.1	1.7
6/8	1196/2495	.20	.29	5.0	1.6
55/77	2848/19511	.35	.28	2.5	1.3
7/8	256/525	.11	.15	4.0	1.7
33/35	620/1173	.13	.31	3.8	1.5
4/6	897/1905	.83	.52	4.5	1.4
31/62	22/47	.09	.33	5.1	1.3
7/8	654/1788	.53	.88	5.3	1.3
23/27	527/2204	.28	.53	7.1	1.4
5/7	400/512	.13	.16	9.6	1.8
5/5	179/188	.14	.21	4.8	1.5
10/12	716/3451	.20	.27	5.6	1.5

I N D U S T R Y

ISIC
CODE
(Nigeria)

SIC
CODE
(U.S.)

Basic Metals

341, 342

339

Metal Products

350

34

Electrical Equipment

370

364

19(c).

ALL INDUSTRIES ABOVE

ALL INDUSTRIES IN ECONOMY

(1)	(2)	(3)	(4)	(5)	(6)
No. of establishments with 20 or more workers/Total Number of establishments in the sample		Ratio of Non-Production workers to Production Workers		Ratio of average Non-Production worker remuneration to average production worker remuneration	
Nigeria	U.S.	Nigeria	U.S.	Nigeria	U.S.
3/3	426/1060	.23	.29	6.4	1.2
38/40	9210/26975	.16	.28	4.8	1.5
9/10	813/1951	.52	.24	4.1	2.0
			.26		
			.38		

or more employees versus the total number of establishments in the two samples are given. The Nigerian sample has in fact a larger proportion of "large" establishments in most industries. This implies that the Nigerian sample consists mainly of modern — rather than traditional small-scale — establishments. With a few omissions all the industries covered in the Nigeria Industrial Survey are included in the table so we have a nearly complete picture of modern industries in Nigeria.

Two results are noteworthy. A comparison of Columns (3) and (4) shows that the NP/P ratio is much lower in Nigeria than its counterpart in the U. S. for practically all the industries. In addition we may look at the last two figures in Column (4). Judging from the U. S. experience, the industries with a foothold in Nigeria have a much lower NP/P ratio than average. This deficiency in the quantity of organization stock will certainly be worsened if the organization quality is also taken into account. At the same time the limited supply of organization members is probably also responsible for the high remuneration to the non-production workers in Nigeria. As demonstrated in Column (5) and (6), the average non-production worker in Nigeria earns four times as much as the production worker, while the non-production worker in the U.S. earns only twice as much. This immediately suggests that it might be difficult in Nigeria to substitute organization for labor — or to raise labor productivity by greater organization input. We now proceed to look at the question more closely.

In the first six columns of Table Two the different components of value added are given. The first four shares, expressed as a percent of value added, are calculated directly from the Nigerian Industrial Survey. The fifth column is calculated from capital assets data in the survey on the following assumptions :

- (a) the interest charges are 10 per cent of the total capital assets;

TABLE TWO. PROFIT
(All share figures expressed

I N D U S T R Y	(1)	(2)	(3)	(4)
	Production worker share	Non-Production worker share	Excise tax share	Other costs share*
Meat Products	.16	.20	.02	.09
Dairy Products	.19	.24	-	.09
Grain Mill Products	.04	.07	-	-
Bakery Products	.14	.07	.05	.04
Sugar Confectionary	.09	.07	.17	.03
Miscellaneous Food Preparations	.035	.045	.60	.01
Beer Brewing	.03	.07	.42	.02
Soft Drinks	.07	.10	.09	.08
Textiles	.17	.10	.13	.03
Footwear	.22	.15	.28	.10
Wearing Apparel	.18	.06	.05	.05
Saw Milling	.27	.14	.02	.03
Furniture & Fixtures	.25	.13	.02	.08
Paper Products	.14	.15	-	.08
Printing	.36	.32	-	.06
Tanning & Travel Goods	.18	.08	.06	.09
Rubber	.20	.12	.10	.02
Basic Industrial Chemicals	.04	.15	-	.02
Vegetable Oil Milling	.13	.06	-	.25
Paints	.05	.14	.19	.09
Miscellaneous Chemicals	.08	.16	.08	.05
Bricks and Tiles	.20	.25	-	.05
Cement	.09	.06	.08	.02
Concrete Products	.18	.20	-	.10
Basic Metals	.17	.25	-	-
Metal Products	.17	.13	.08	.06
Electrical Equipment	.09	.19	-	.12
Average	.145	.137		

* Include rental payments, professional fees, office material, telephone, postage, insurance, advertising, hired transport and water.

21(b).

ESTIMATES. NIGERIA

as percent of value added)

(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Capital Share	Residual Profit Share	Production Worker share in U.S.	Non-production worker share in U.S.	(7) - (1)	(8) - (2)	Efficiency multiple (US:Nigeria)	Potential Quasi-rent
.18	.35	.44	.15	.28	-.05	5.7	.13
.33	.15	.18	.26	.01	.02	10.5	.17
.15	.74	.18	.10	.16	.03	1.9	.02
.15	.55	.26	.24	.12	.17	11.2	.13
.24	.40	.30	.12	.21	.05	4.3	.07
.06	.25	.17	.13	.135	.085	1.5	.01
.13	.33	.23	.14	.20	.07	2.0	.015
.47	.21	.13	.31	.06	.21	7.2	.06
.28	.29	.45	.10	.28	.00	3.9	.13
.27	-.02	.48	.11	.26	-.04	4.3	.17
.05	.61	.44	.12	.26	.06	4.5	.14
.25	.29	.51	.09	.24	-.07	5.7	.22
.12	.60	.42	.14	.17	.01	6.1	.21
.25	.62	.32	.15	.18	0	4.8	.11
.38	-.12	.46	.17	.10	-.15	9.2	.32
.08	.51	.48	.12	.30	.04	3.6	.13
.35	.21	.36	.17	.16	.05	8.1	.175
.22	.43	.17	.12	.13	-.03	4.3	.03
.15	.41	.19	.08	.06	.02	13.3	.12
.16	.47	.17	.19	.12	.05	4.6	.04
.34	.31	.21	.16	.13	0	4.7	.06
.25	.25	.47	.13	.27	-.12	5.6	.16
.39	.36	.22	.07	.13	.01	4.2	.07
.50	.02	.35	.14	.17	-.06	6.3	.15
.25	-.07	.45	.16	.28	-.09	5.5	.14
.16	.40	.38	.16	.21	.03	5.3	.14
.09	.51	.31	.15	.22	-.04	3.7	.065
.246	.336	.323	.147	.178	.010	5.6	.118

(b) book value machinery, equipment and motor vehicles depreciate at 6 percent per annum; (c) buildings depreciate at 3 percent per annum; and (d) the total capital share is the sum of interest charges and depreciation charges calculated according to (a), (b) and (c). The 10 percent interest rate is based on the assumption that modern sector investors in Nigeria have access to subsidized capital. The depreciation rates are higher than the average figures for the U. S. to reflect poorer maintenance. The estimates are of course quite crude, but an error of 20 or 30 percent will not affect our conclusions significantly. Finally Column (6), the "residual profit share", is the remainder after the five shares from Columns (1) to (5) have been subtracted from value added.

The results are striking. With the exception of four industries a very large residual share is left, often in excess of either the capital share or the labor share. According to our earlier arguments, this residual share has little to do with organization stock; it is mostly associated with the technology gap between the modern sector and the traditional sector in Nigeria and with monopoly profit. If we make some fairly realistic assumptions, it is possible to estimate the general magnitude of these two components. The necessary assumptions are :

(1) The Nigerian economy consists of a modern sector and a traditional sector.

(2) In Nigeria the wage rates in the modern sector and the traditional sector are the same and are determined by the marginal productivity of labor in the traditional sector. Marginal productivity of labor also determines the wage rate in the U. S.

(3) Each industry in the modern sector in Nigeria employs the same mix of capital goods as its U. S. counterpart.

(4) The labor productivity difference between the U. S. and the

Modern sector in Nigeria is explained solely by differences in efficiency. For each industry there is an "efficiency multiple" which could be used to convert labor inputs in the two countries to identical efficiency units.

(5) The substitution possibility is highly limited.²⁴ Thus despite the large difference in relative factor prices, the same labor (measured in efficiency units) and capital combination are used to produce a given sum of value added in the modern sector in Nigeria as in the U.S.

(6) Technological advance is labor saving. The technology gap between the modern sector and the traditional sector (for an industry) is reflected by differences in marginal productivity of labor in the two sectors.

(7) Quasi-rent based on organization differential is irrelevant. Hence for each industry a single efficiency multiple may be used, and the residual share is attributable to technology gap and monopoly.

Under these assumptions it follows immediately that the technology gap between the modern sector and the traditional sector in Nigeria is measured by the wage share difference between the U. S. and Nigeria. Let us define :

$MP_{N,T}$: marginal productivity of labor in the traditional sector of Nigeria.

$MP_{N,M}$: marginal productivity of labor in the modern sector of Nigeria.

MP_U : marginal productivity of labor in the U. S.

ϵ : the efficiency multiple.²⁵

Now consider the value added produced by one Nigeria production worker in some industry in the modern sector. The wage share in this case is, by Assumption (2):

$$(\text{Wage share})_{N,M} = MP_{N,T}$$

The wage share of the same value added in the U. S. is, also by Assumption (2):

$$(\text{Wage share})_U = \epsilon MP_U$$

From Assumption (4),

$$MP_{N,M} = MP_U$$

Hence:

$$MP_{N,M} - MP_{N,T} = (\text{wage share})_U - (\text{wage share})_{N,M}$$

By Assumption (6) we conclude the wage share difference "measures" the effect of the technology gap. To put it in another way, the wage share difference represents exploitation by the user of modern technology. Despite the higher marginal product of production workers they are paid the wage in the traditional sector. Since capital user costs are approximately equal in the modern sector of Nigeria and in the U. S., the wage share difference is the profit reaped from the technology gap. If the modern sector pays a higher wage than the traditional sector, the wage share difference then understates the technology gap.

Column (9) in Table Two shows that technology gap on the average accounts for more than one-half of the residual share. Under our assumptions the remainder is attributed to monopoly profit based on monopoly pricing.²⁶ Practically the distinction of the two types of profits is of some significance. Investment in industries with large technology gap raises the general level of productivity in the country while investment in industries with high monopoly profit provides meager social benefit. A quantitative estimate of the two components — such as we have just attempted — is therefore useful for policy making in investment allocation, taxation and tariffs.

Using Nigeria as an example, we have now verified our earlier argument that firms in underdeveloped countries enjoy high profits from technology gap and from monopoly.²⁷ The high profits undermine the incentive to generate organization input. To illustrate, let the target efficiency for a firm be the level of labor efficiency in the U.S. Assuming other firms in the

industry remain behind without progress, the quasi-rent resulting from the burst of organization input is calculated by multiplying the production worker share in Column (1) of Table Two by $(\alpha - 1)/\alpha$, where α is the efficiency multiple given in Column (11). Results of the calculation are given in Column (12). Evidently the quasi-rent under such optimal circumstances is still small relative to the residual share already accrued to the firm. Actually the crucial point is that the generation of organization input may not be efficient at all if the generation implies a substitution of non-production workers for production workers.²⁸ If a doubling of non-production workers is needed to accomplish the higher efficiency, for example, the quasi-rent from wage saving will be more than wiped out by the increase in the share of non-production workers. The wage rate is simply too low for wage saving to be worthwhile and non-production workers too expensive (and perhaps too ineffective as well) to be employed for the replacement of production workers.

Generation of organization input is therefore an efficient step only in a late stage of economic development. Before this stage is reached exploitation of the technology gap provides a more attractive option. Large increase in productivity is available, and it can be accomplished with mostly P-factors provided from foreign countries. This option is made still more attractive if capital is available at subsidized rates. There is also some empirical evidence that this is indeed the path followed by the underdeveloped countries. There are frequent comments (for example, see (2)) on their use of capital intensive modern technology despite the low wage rates. As time goes on the rise in productivity increases the level of purchasing power and widens the market. Monopoly profits, hopefully with an assistance from the government, will start to lose their importance. The option of exploiting the technology gap also vanishes gradually. It then

becomes more important to earn a quasi-rent by cultivating organization inputs. At the same time the wage rate is higher and the supply of effective organization members is greater. A substitution of organization of labor becomes meaningful. Ultimately the economy matures and the point of reference turns to the small-firm and large-firm sequences discussed in the last section. In short, our conclusion is negative. Generally speaking the organization supply is minimal in underdeveloped countries and there is little economic justification for building up a supply by arbitrary means.

IV

Our discussion in the last section deals with the domestic supply of organization input in underdeveloped countries. Another option is available: the importation of organization input from countries possessing rich accumulations of organization stock. An important distinction should be drawn here. The direct importation of organization input is usually advantageous because such organization input is often a free good or could be generated at low marginal costs in the exporting country. One such example is management know-how in the form of book knowledge. Another example --- already elaborated on in the last section --- is the P-factor input supplied by manufacturers of capital equipments. In contrast, organization input may also be imported indirectly by the importation of organization stock. The stock then generates organization inputs in the host country. When the stock is fully integrated in the form of a firm by a "super-organization" in the exporting country, we have the case of a multinational firm.²⁹ The imported firm is in a position to earn quasi-rents and monopoly profits in the same way as the domestic firms. The net benefit to the importing country is by no means obvious, and will be the subject of our analysis in the present section.

The multinational firm has been described (21, P.82) as "a business organization that is engaged in production in a number of countries through branches, subsidiaries or affiliates, which may or may not be separate entities in the several countries in which they operate. The term 'organization' implies that the entire group, including the head office as well as various types of subsidiary units, is operated within an administrative framework which knits the whole together in such a way so that the general policies and administrative and financial procedure of the group are reasonably consistent and coherent throughout the firm." Organization stands out as the distinctive feature of the multinational firm. A multinational firm usually implies also direct capital investment and foreign ownership, but what sets it apart is the fact that the entry of the firm into a country brings with it an importation of organization stock. To highlight this we will leave aside several issues in which discussions on multinational firms are often embroiled: gains and losses from foreign capital investment, effects on balance of payments, political influence and nationalism.

The multinational firm is ordinarily a "multi-divisional firm" and we may be guided by Williamson's excellent analysis (25) of this type of firm. Its standard feature is a division of labor between the general office and the divisions, after the firm has reached a size where direct supervision by the chief executive over the various divisions of the firm becomes ineffective. The general office is principally concerned with strategic decisions involving planning, appraisal, control and the allocation of resources among the competing operational divisions. It is committed to the overall performance of the firm. Each division under the general office is responsible for its operation. The advantages of this structure derive mostly from the presence of an independent elite staff and from the

restoration of the integrity to the goal-specification process — away from the squabbles and influences of divisional executives preoccupied with their vested interests.

The multinational firm therefore appears to contribute towards the rational allocation of world resources: a supra-national arrangement by which capital and organization resources both flow to countries where profit is the highest. But what determines profit? In underdeveloped countries profits are found in areas where quasi-rent from technology gap and monopoly profits are high. A multinational firm may bring with it a highly efficient organization, but efficiency or organization demand is not the main criterion used by the firm. Efficient organization may actually be wasted if wage is so low that wage saving is unimportant.

The case against the multinational firm from the point of view of the underdeveloped country goes beyond this. The frame of reference for the multinational firm differs from the domestic firm. The supply of organization stock by the multinational firm hinges on the profitability comparison for a cross section of the countries. The multinational firm also has a mobility unmatched by national firms. It can withhold further expansion or even withdraw its organization investment in a country if profitability falls. Consequently a multinational firm may pull out of a country when her growth hits a snarl — just at a time when its contribution to economic development is most needed.

The multinational firm may also stifle the growth of domestic organization stock. Drawing on its experience and vast resources, the superior organization stock possessed by the multinational firm gives the firm a competitive edge. The firm chooses the most profitable industry for its entry, and then drives off the domestic competitors. Domestic firms are left with the less profitable opportunities. Since large

profit is often needed to overcome the inertia and the cultural trap and to offset the disadvantage of initial inexperience, fewer domestic organizations will be formed.

Finally the cost of the organization stock provided by a multinational firm is also higher than that of a domestic firm. In the first place, the opportunity cost of the former is high because the multinational firm can choose to invest its organization stock among a larger set of opportunities in many different nations. The multinational firm is also likely to discount heavily the expected profits in the underdeveloped countries because of political instability and nationalism. In addition the expatriates sent by the multinational firm have to be compensated for their relocation with extra remuneration, and such costs must be deducted from the profits. In the long-run, therefore, domestic supply of organization stock will turn out to be cheaper --- provided the multinational firms have not established a stranglehold.

A rather different picture emerges if the multinational firm is given only a temporary stay in an underdeveloped country. Sometimes the technology of an industry is so complex that P-factor input supplied by the capital goods manufacturers is insufficient for the continuous operation of the firm. Alternatively some technology is not public knowledge and can be employed only with the import of an accompanying organization stock. Under these circumstances it is both necessary and often desirable to allow the temporary stay of a multinational firm --- until domestic personnel and capital have been built up to take it over. The advantage of this strategy is that the new technology is transmitted at a minimum cost. In addition, when the expatriate management team departs they leave behind --- often at no costs at all --- a tested organization structure with established codes, rules, and channels of

decision and information flow. To implement this strategy the multinational firms must be obligated to undertake training responsibilities. If the technology gap and monopoly profit are insufficient to induce the multinational firm to offer a temporary commitment, the use of foreign management teams, consulting service or training missions might also serve the same purposes.

FOOTNOTES

- *: This paper was begun when I was a Ford Foundation Faculty Research Fellow and completed when I was a Rockefeller Foundation Research Professor at Makerere University in Uganda. I would like to acknowledge the support by the two foundations. I would also like to thank Mrs. Edith Penrose and Harvey Leibenstein for their encouragement, and Bishop Shannon Mallory for retrieving the research notes for this paper from Uganda.
1. According to March and Simon (17), organizations are "assemblages of interacting human beings" and are characterized by "specificity in role, in channel and context of communication".
 2. Kaldor (10) had pointed out: "The function which lends uniqueness and determinateness to the firm — the ability to adjust, to co-ordinate — is an essentially dynamic function; it is only required so long as adjustments are required; and the extent to which it is required depends on the frequency and the magnitude of the adjustment to be undertaken."
 3. The owners of the firm are also owners of its organization so long as they are legally entitled to the decision on the disposal of organization. Because of the close complementarity between organization and capital earnings they are usually also the owners of the capital stock.
 4. "The strong commitments of individuals in interpersonal relations that are of intrinsic importance to them tend to make the continuation of the association a supreme value" (4).
 5. Since growth almost inevitably involves technological change, the two are combined in our subsequent analysis. Substitution between capital and labor with given technology is left out because we have found it (24) to be of limited quantitative significance.

6. According to the Parkinsey Law (19), there are male organizations, aggressive, outward looking and growth-oriented; and female organizations, scrupulous, inward-looking and efficiency-oriented. The male organizations acquire the female organizations in mergers.
7. An empirical attempt to assign such indices is reported in (24).
8. Replacement revenue is the difference between the present values of two streams of discounted net revenues: one stream on the assumption of zero replacement, the other on the assumption that a certain replacement is carried out in the period. Replacement cost refers to the collection of adjustment costs incurred as the result of replacement, including retraining and reorganization costs. For a more detailed discussion on the separation of routine production costs and adjustment costs, see Hart (8) and Baumol (3).
9. The transposition increases the curvature of the curves. Let the rate of replacement be $(1-\alpha)$. Then:

$$\begin{aligned} DT_r &= T_2 - T_1 \\ &= \alpha(T_1) + (1-\alpha)T^* - T_1 \\ &= (1-\alpha)(T^* - T_1) \end{aligned}$$

Since $0 \leq (1-\alpha) \leq 1$, DT_r is less than $(T^* - T_1)$ except at the origin.

The ratio of DT_r to the rate of replacement increases with $(T^* - T)$.

10. The time path interpretation further increases the curvature of the curves. Consider two plants with initial technology index T_1^1 and T_1^2 respectively with $T_1^1 = \frac{1}{2}(T^*)$ and $T_1^2 = \frac{1}{4}(T^*)$. (The superscripts refer to plant identities.) Let the rate of replacement for both plants be $(1-\alpha)$.

Then:

$$T_1^1 - T_1^2 = \frac{1}{4}(T^*)$$

$$\begin{aligned} T_2^1 - T_2^2 &= \lambda(T_1^1) + (1-\lambda)T^* - \lambda(T_1^2) + (1-\lambda)T^* \\ &= \lambda\left(\frac{1}{\lambda}\right)(T^*) \end{aligned}$$

The technology gap between the two plants has narrowed. If the two plants lie on the same replacement curve, it means that, at the same rate of replacement, DT_P is greater for the plant with a higher value of T^*-T . Hence the time path curvature is greater than the cross section curve curvature. (This conclusion requires that the curve starts from a fixed origin and is continuous and monotonic. Normally these assumptions are met.)

11. The value of λ depends on T^*-T and the endowment of Penrose Factor.
12. The required changes in work arrangement and the resistance to these changes are likely to depend on the difference in machine design rather than the number of new machines.
13. On the other side of coin, if a firm is deficient in P-factor the conversion of L-factor to I-factor to sustain a hypothetical rate of expansion will increase the routine costs after expansion.
14. Although the time path to equilibrium will be somewhat different the basic conclusions are not affected if plants do not reach the replacement equilibrium first and then expand. The key point is that a plant with idle P-factor will move closer to T^* either by replacement or expansion until its distance from T^* is consistent with its P-factor endowment. We may also note that a' is necessarily greater in its value of DT than b' and c' because (as we will argue presently) the time path from a' moves down more steeply. This condition is necessary so that the time path from b' will not cross the time path from a' , a contradiction of the main conclusion just reached from the discussion of Panel (d).
15. From the point of view of financial decisions, expansion and replacement

are generally regarded as alternative options. As de Leeuw had reported (6), firms consider depreciation allowance and savings from net profit as a single fund, to be used for replacement and expansion alike. The ratio of average post-war level of depreciation to net capital addition in manufacturing in the U. S. was 2.357.

16. Let the rate of expansion be β , and use the notations of Footnotes 9 and 10. Then concentrating on the impact of expansion on technology index:

$$\begin{aligned} DT_e &= T_2 - T_1 \\ &= \frac{\beta T^* + T_1 - T_1}{1 + \beta} \\ &= \frac{\beta}{(1 + \beta)} (T^* - T_1) \end{aligned}$$

If $\beta = (1 - \alpha)$, the rate of replacement in Footnote 9, then:

$$DT_e = \frac{1 - \alpha}{2 - \alpha} (T^* - T)$$

Since $0 \leq \alpha \leq 1$, DT_e ($= \frac{1}{2 - \alpha} DT_r$) is less than DT_r .

17. As the expression for DT_e in the last foot note shows, for given β , DT_e is smaller if the value of $(T^* - T_1)$ is lower. At the limit the plant attains T^* and its DT equals to DT^* if its rate of expansion is infinite.

18. For every firm:

$$DT = T_2 - T_1 = DT^* = C_T$$

$$DE = E_2 - E_1 = C_E$$

where C_T and C_E are exogeneously determined constants because the relative efficiency positions of the firms are assumed to be constant. It follows that:

$$\begin{aligned}
 DZ &= Z_2 - Z_1 \\
 &= T_2 E_2 - T_1 E_1 \\
 &= C_T C_E + E_1 C_T + T_1 C_E
 \end{aligned}$$

Firms with high efficiency (E_1) and advanced technology (T_1) initially will have a higher value of DZ .

19. If we assume that firms will attempt to improve their X-efficiency so that their overall cost positions relative to each other remain the same, then DZ is a constant (C_Z) for all firms:

$$DZ = C_Z = C_T(E_2 - E_1) + E_1 C_T + T_1(E_2 - E_1)$$

Here — as before — we assume that DT is a constant (as we have concluded from our model). Hence we have:

$$E_2 - E_1 = (C_Z - E_1 C_T) / (C_T + T_1)$$

High efficiency and advanced technology initially result in lower X-efficiency improvement.

20. The exit rate is associated with technology level. Of the "very advanced technology" plants in 1935 42 percent had exited by 1959, while of the "very backward" plants 79 percent had exited (22, p. 99).
21. In contrast, most of the literature on organization theory and on behavior theory of the firm applies to large firms, where organization does occupy an important place.
22. To take Kenya Stock Exchange as an example, in a 14 week period in 1966 only 44 of the 84 listed stocks were traded and 21 of these were traded in three or less weeks in this period. See (14).
23. The U. S. data are based on 1963 Census of Manufactures. Nigeria data are based on Nigeria Federal Office of Statistics: Industrial Survey, 1964-5.
24. Since there are different technologies the marginal productivity

of labor is defined despite the limited substitution possibilities.

25. In practice is computed by dividing the average productivity of labor in the U. S. by the average productivity of labor in Nigeria, with value-added as the numerator in the productivity calculation. The results are given in Column (11) of Table Two.
26. Monopoly pricing is possible despite the co-existence of a modern sector and a traditional sector because the market is segmented. Transportation difficulties and product differentiation are the principal causes of the segmentation.
27. There are of course many exceptions (7). Overcapacity due to bad planning, input shortage and other bottlenecks appears to be the chief reason for low profits or even losses.
28. A fair correlation (rank correlation coefficients of 0.74 and 0.67) was found by Delahanty (5) between changes in NP/P ratio and changes in production worker productivity in different industries in the U.S.
29. If the imported organization stock is not fully integrated we have the intermediate case of contracted management teams or consultants.

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