Industrialization Options for the Poorest Countries

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I. Introduction

This paper considers how the poorest countries, measured in GDP per capita, can improve their living standards through industrialization. GDP per capita is closely though not perfectly correlated with the HDI and the use of either standard shows a very large percentage of the worst-off countries are in sub-saharan Africa (SSA). Moreover, of the lowest ranking countries, they are among the few that have experienced significant declines in per capita GDP and other indices over the last quarter century and have experienced few sustained periods of improvement.

The most fundamental need in SSA and other very low income countries is to revitalize the agricultural sector. Abundant evidence suggests that the sector has been harmed by policy measures that severely discriminate against it. Farmers receive lower prices than warranted by world prices, pay higher prices for productive inputs due to tariffs on imports, have little access to rural credit, suffer from an absence of research that is specific to their agro-climate requirements, and rarely benefit from agricultural extension services. All of these deficiencies are amenable to improvements in government policy. The first step in improving living standards is to rectify the intensity of discrimination against the agricultural sector. Perhaps new development in technology services such as the various World Bank web sites can aid governments in learning about appropriate policies or improve the training of agricultural extension agents. But the required changes in policies have been understood for a long time – the difficulty in implementation is a political rather than a technical one.

In contrast, the requirements for successful industrial development are less well understood yet great hopes have been placed on new information technologies as a potential benefactor of the industrial sector in poor countries. Some of the optimism has been generated by the performance of the Indian software sector in recent years. But the software sector is very different than manufacturing. Moreover, it holds few hopes in the near term for a country like Tanzania in which secondary school enrollment is still very low and university education is received by less than 1% of the population. Even in India, the software sector will have few benefits for the hundreds of millions of people who rely on bullocks as their main source of capital and subsist on less than $1 per day. Later in

this paper, I will discuss the implications of the newest technologies, particularly the internet, for production in the poorest nations. Like many other previous magic bullets, it seems unlikely that the internet will offer a panacea for the difficult problems that currently characterize African manufacturing. Similarly optimistic predictions about the role of main frame computers and then of PCs were voiced in previous decades with no visible results. I will concentrate on the industrial sector as this is the sector that is not limited by soil quality and climate. Nevertheless, it is conspicuously weak.

II The Background in Africa

In 1975 the relative per capita income of many of the poorest countries was a much higher percentage than it was twenty years later. The income per capita of sub-saharan African countries in the years 1975 and 1995 relative to that in a number of Asian countries is shown in Table 1. The relative declines were enormous. In the case of Indonesia and Thailand, SSA on the average had greater per capita income in 1975, an advantage that was reversed by 1995, the ratio for Indonesia going from 1.83 to .50, that for Thailand from 1.08 to .18. While the Asian nations were not by rich by DC standards in 1975, Korea and Taiwan had experienced a decade of significant growth and many of their human development indicators, including life expectancy, infant mortality, and education were already quite good. They had begun a demographic transition and had undergone significant economic transformation from countries with a substantial percentage of GDP and employment in agriculture and small scale informal sector enterprises to a higher value added per worker industrial structure.

Some of the Asian countries such as Korea and Taiwan had dramatically closed the relative gap between themselves and the OECD countries by 1975 yet all of their success had been achieved without the benefits of the then newest technologies. Certainly the accessibility and the use of the internet were not issues nor did these Asian countries "leapfrog" from relative backwardness to high technology. Rather than vault into the newest technologies, they moved slowly up the ladder of economic complexity.

The issue facing the poorest LDCs is to replicate, in the early decades of the 21st century, the four decade old achievements, of previous success stories. Despite all of the discussion of convergence among countries, divergence has been the rule in the last

decades for most countries.[1]

If by 2010 the poorest countries could achieve the absolute human development indicators of 1975 of Korea or other countries shown in Table 2, it would constitute an extraordinary achievement and greatly enhance the welfare of their populations. While declining relative income per capita and growing absolute gaps across countries are understandably of concern, the critical issues for the poor are the number of calories and micronutrients consumed per day, the acquisition of a third shirt, the ability to purchase a bar of soap or a toothbrush. Increases in absolute income in say Kenya enables such purchases regardless of whether Kenya is falling further behind the U.S. in relative per capita income. While some would argue that Kenyan farmers may be made unhappy by the increasing purchases of home theatre systems in western Europe, it is unlikely that for most residents of very poor countries relative income disparities across nations are nearly as important as their own absolute levels of consumption.

What is required to bring improve the lot of the mass of population in the poorest nations? Among the requisites are the following fundamentals:

1. increased rates of saving and investment;
2. improvement in education, especially primary and secondary, including that for girls;
3. a stable macroeconomic framework that limits inflation and government deficits, the latter being conducive to inflation which reduces the ability of the private sector farms and firms to perform effectively. Roughly balanced budgets prevent the public sector from absorbing the limited saving of the private sector;
4. the maintenance of a relatively stable real exchange rate
5. openness to international trade of goods and services as well as ideas, the latter taking the form of international technology flows such as technology

[1] See Pritchett,

licenses;

6. the provision of adequate infrastructure such as roads, telecommunications, and electricity, an absence of any of these greatly hindering sustained economic development;
7. a legal system that enforces contracts;
8. limits on corruption.

Absent the presence of most of these "fundamentals," the poorest countries will not perform well. While many cross country regressions attempt to parse the relative contribution of each of these factors to growth in per capita income, the results about the individual contributions are highly variable, depending on the periods chosen and the variables used. There are only a few robust results (Levine and Renelt, 1992) and the identification of the contribution of individual factors cannot be solved by forming panel data sets (Pritchett, 2000).

In the case of the poorest countries, it seems unlikely that sustained growth can be achieved without considerable progress on the fundamentals. Assuming for the rest of the discussion in this paper that many of the fundamental conditions are achieved, what are the dimensions of the development problem, particularly in Africa, and how can these be addressed?

III. Some Stylized Facts About African Manufacturing

As shown in Figure 1, most SSA countries have low ratios of manufacturing value added, VA_M, to GDP. In 1990, the last year for which relatively complete data are available, eighteen countries exhibited VA_M/GDP ratios below .10 and only ten countries had higher ratios. It is likely that countries not reporting data would be largely in the lowest group with ratios below .05. Overtime most nations have a constant or falling share. Part of the stagnation or decline in relative manufacturing output in SSA can be attributed to Engel effects. As real per capita income declined after 1975, the demand for manufactured goods often fell by a still higher percentage, reflecting its higher income elasticity than that for agricultural products.

Domestic income elasticities of demand do not, however, completely determine

the sectoral structure of production if the economy exploits opportunities in the international market. The tight link between domestic production and consumption in the economies of SSA has, however, generally not been broken, manufacturing exports constituting a tiny percentage of manufacturing output. The data suggest that the economic structure is largely determined by low domestic per capita income and the resulting limited effective demand for manufactured goods.

3.A Relationships Among Sectors Within Countries

Employment in manufacturing as a share of total employment is smaller than that for value added, implying that the value added/employment ratio, VA/N, is greater than that for the entire economy. The VA/N ratio relative to that for all sectors for a number of countries is shown in Figure 2. In 1990 the ratio was above 2 in fourteen countries and below 1 in only five.[2] This may result from greater capital intensity and/or higher total factor productivity at domestic prices. If it is former, the greater value of VA/N in manufacturing does not necessarily have any efficiency implications. Capital intensity may be higher due to differences in sectoral production functions or to upward distortions in the wage-rental ratio relative to other sectors.

If greater VA/N is due to higher TFP at efficiency prices, the manufacturing sector may offer an opportunity for improving income per capita. However, TFP levels in manufacturing, measured at domestic prices, may be exaggerated if value added is increased above scarcity prices as government intervention turns the terms of trade against other sectors. For example, high rates of effective protection, before recent reforms, raised manufacturing income while reducing the value added (at domestic prices) in sectors that purchase intermediate manufactured goods at prices in excess of world prices. If sectoral value added were revalued at world prices, the share of the manufacturing sector in GDP would be significantly below the low levels that prevail.

These considerations imply that, despite its small size, the manufacturing sector in most countries in SSA may be too large relative to a sectoral structure that would

[2] The source of these data, African Development Indicators, does not contain more recent uniform data across countries.

maximize current national income at world prices. This static loss could be justified if the cost of learning sets the stage for the eventual growth of an efficient sector. So far such learning has not occurred, at least as measured by changes in labor productivity in most countries over the past quarter century. Despite its current dismal performance, many analysts believe that manufacturing provides one of the major economic opportunities in SSA, particularly in light of the low quality soil and a climate hostile to high agricultural productivity (Bloom and Sachs, 1998).

3.B African Manufacturing in an International Context

It is useful to obtain some sense of the current performance of the manufacturing sector in a variety of African economies. In particular, it will be shown that even in traditional industrial products, the capital-labor ratio in many countries is surprisingly high relative to that in the industrialized countries. Moreover, total factor productivity in is quite low relative to that in the industrialized countries. These differences have two implications: (1) the present mastery of traditional technology is very low and that high technology fixes are not likely to be appropriate given the failure to absorb technologies that are more than a century old; (2) an appropriate choice of technology, to be defined below, could generate considerable increases in income to be realized from a given investment.

Data collected from African firms by the Regional Program on Enterprise Development of the World Bank (Biggs et. al., 1995) provide, on a consistent basis, information from hundreds of firms on value added, capital stock, and labor for a number of SSA countries in the early 1990s. The average relative labor productivity (calculated as the mean of sectoral values) compared to the U.S. is shown in Table 3 for Cameroon, Ghana, Kenya, Tanzania, Zambia, and Zimbabwe for two years during which the surveys were carried out, 1992 and 1994. Also shown are the capital-labor ratio relative to the U.S. and total factor productivity relative to the U.S. averages for four sectors based upon firm levels surveys of Biggs et. al. (1995).

Labor productivity in comparable sectors is exceptionally low, except in Cameroon. Moreover, even these low figures are overestimates of true relative productivity as value added in the African countries includes a large rent component as a result of higher levels of effective protection. Relative capital-labor ratios are considerably greater implying the very low total factor productivity shown in the last panel of the table. The capital-labor ratios shown are sector wide averages across firms of all sizes – they are much greater for larger firms and the TFP of such firms is even lower than those shown in the table.

The industries for which the calculations have been done, food processing, textiles and clothing, wood furniture, and metal products are technically simple and have been in existence in industrialized countries for well over a century. In these and other sectors there is little that the "new economy" can do to help improve the woefully low productivity levels. Improved incentives, including further reductions in tariff levels, could provide the incentive to seek productivity enhancement. The necessary transfer of technology can be achieved by hiring technically trained employees on a long term basis and by suitably designed incentive contracts. In none of the sectors is proprietary technology significant thus making moot even the need for technology licensing. Given the magnitude of the shortfall from American TFP levels, a combination of policy reform and technological improvement could increase output from existing resources by 10 or 15 in most of the industries in most of the countries. Even if the firms in these nations achieved 50 percent of U.S. total factor productivity, huge increases in value added from existing resources would be possible, implying a large rise in living standards.

Another potential gain would arise if more labor intensive technologies were chosen when new investment decisions were made. Given the relatively high capital-labor ratios shown in Table 3 and the much greater ones for large firms in each country, the increases in value added from appropriate technology choice of technology may be very large though smaller than that from low levels of TFP. Before considering the options for improving TFP, I first consider the benefits from the choice of more appropriate technology.

IV Choice of Technique

If manufacturing is to yield widespread benefits for many citizens rather than confer privilege on a small group lucky enough to obtain jobs in the formal manufacturing sector, its development needs to maximize the income and employment generated by a given investment in the sector. As will be seen below, higher real income and employment will occur simultaneously if firms pursue the correct choice of technology, one that minimizes the cost of production given scarcity prices for capital and labor. Nevertheless, many firms in SSA and other low income LDCs choose capital-intensive techniques of production even when labor intensive choices exist. Such decisions result in a loss of GDP for a given investment level and generate fewer modern sector jobs than would be generated by a more appropriate choice of technology. Given the per capita income characterizing most SSA countries and their sectoral production profiles, appropriate choice of technology is an important source of potential income gains, even apart from the growth in total factor productivity (TFP).

Much of the potential use of labor rather than equipment in a plant stems from use of labor-intensive methods in "peripheral" production activities; labor, with little if any capital, can be used to transport material efficiently within the factory, to pack cartons, and to store the final product. The basis for these statements is observation of factory operations in industrial countries and LDCs. Evidence also exists that the core production process itself, whether cooking of food or production of yarn, offers efficient possibilities for using less expensive equipment and more labor per unit of output. Adaptations in the use of existing equipment, for example, increasing the normal speed of operation, offers additional opportunities to save capital and increase the relative use of labor.

The extent to which labor can be substituted for capital varies across industrial sectors, being greater in sugar processing and textile manufacturing than in fertilizer production. Whatever the appeal to national pride, steel, fertilizer, and other products whose production can be carried out only with very large amounts of capital per worker are inappropriate products for local manufacturing in most poor countries. The basic problem is to forestall the establishment of intrinsically capital intensive sectors, any choice of technology that does exist in these being of minor importance. Indeed, a good

part of the initial success of the fast growing Asian countries was their generally correct sectoral emphasis as well as the selection within sectors of appropriate technology.[3] The fact that some of these countries, for example, Korea, eventually upgraded their industrial structure to steel, autos, non-electrical machinery, and semi-conductor chips, does not vitiate the general principle; this occurred only after the success of the labor- intensive strategy and in response to one result of this success, namely, the growth in real wages.

IV.A. Benefits of appropriate technological choice

The following presents briefly some estimates of the benefits to be obtained by a typical poor country from carefully choosing appropriate technology rather than more advanced technology. The benefits include increased income produced by the industrial sector, greater wages and profits, and greater employment. To establish some orders of magnitude it is necessary to specify both the goods to be manufactured and the alternative methods available for their production. The products and two values of investment per worker with which each can be manufactured are shown in Table 4.[4] These good are currently manufactured in many LDCs and, for better or worse, are high on the priority list when an expansion of industrial production is considered.

The products include some about which it is generally assumed that choice in production method is physically feasible - shoes, yarn, and woven cloth - as well as those in which the intrinsic nature of the production process, for example, dealing with heavy materiel processed at very high temperatures suggests that not much variation is possible –fertilizers and beer. The figures in the advanced technology column indicate the amount of investment per worker that would be required if an LDC plant were to be established with the same core machinery and material transfer mechanisms as are used in a developed country. The second column shows the amount of investment when an

[3] For a careful empirical demonstration of the role of appropriate technology in Korean development see Westphal and Rhee, 1977.

[4] Although the specific values were determined in the early 1980s, given the nature of the production processes it is likely that roughly similar alternatives currently exist, the major difference being that equipment is more costly.

appropriate technology is purchased. Appropriate, here, is defined as the combination of labor and equipment that maximizes the profitability to the firm at scarcity prices, whether private or state owned, and it can be shown that this is consistent with maximizing GDP.[5]

The appropriate technology shown is not necessarily the most labor-intensive production method available. Those that require even smaller investment per worker but are less profitable are not considered. With the exception of fertilizer and beer, the difference between advanced and appropriate technology is very large, well over 100%. Equally impressive is the variation in capital-intensity among products even when the choice is restricted only to appropriate technologies. The potential impact of selecting the right product as well as the correct process is clear.

Envision a country planning to establish new production capacity in each of the listed products, and for simplicity assume that $100 million is to be invested in one year in each of the sectors including some "wrong" sectors. What is the effect on national income, total wages, total profits, and employment of systematically choosing the appropriate rather than the advanced technology**?** Rather than present the results sector by sector, Table 5 presents a summary of the impact for the nine products as a group. The level of national income produced by the large-scale manufacturing sector can be increased by 71 percent, total wage payments by 311 percent, total profits by 51 percent, and employment by 311 percent. The significance of these figures can be stated in a number of ways. For example, for employment to be increased commensurately if advanced technology were chosen would require investment to be 300 percent greater. From another perspective, the effect of the proper choice of production method on national income produced by manufacturing is equivalent to 10 years of industrial growth at a rate of 6.5 percent per annum.

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5 The discussion in this section is drawn from my article, "Macroeconomic Implications, of Factor Substitution in Industrial Processes," Journal of Development Economics, 1982.

The impact of technology choice on disparities among individuals and households within a country can be inferred from the last three columns of Table 5. Employment in modern sector manufacturing plants is much greater when appropriate rather than capital-intensive plants are adopted. Thus a smaller percentage of the labor force is forced into marginal occupations, such as street vending or low income workshop activity.

IV.B. Some obstacles to correct decisions

Just as where one stands on a political issue often depends on the side of the legislative aisle on which one sits, the relative importance of the various obstacles to pursuing an appropriate industrialization policy, as seen by analysts of the problem, depends on more general perceptions about the process of economic development. Though almost all analysts note the same set of obstacles, the emphasis on one or another is often derived from attitudes toward public versus private ownership, the correct role for multinational as compared with domestic ownership, and the role of markets for both products and factors of production.

IV.B.1. Type of ownership

Some scholars have argued that private owners of firms are anxious to avoid dealing with large numbers of workers. While this piece of casual empiricism is undoubtedly partly correct, it does not follow that public enterprises choose more appropriate technology. The limited amount of systematic evidence on this question suggests that both types of firms choose quite similar equipment in countries where both operate in the same sector, for example, Turkey. In countries such as Tanzania, with few private firms, such comparisons are not possible; however, in these countries public sector firms appear to have chosen similar machinery to that employed in neighboring countries by privately owned companies.[6] A different binary classification is often

[6] James,

thought to be of decisive importance, namely, the difference between foreign and domestically owned firms, regardless of whether the latter are public or private. The entirely a priori argument suggests that multinational corporations (MNCs) - locating in poor countries will replicate the technology used in the home country of the enterprise, disregarding the needs of the LDC in pursuit of its own profits. Underlying this argument is the assumption that the cost of modifying a technology exceeds the saving in production cost that can be realized by using more labor whose cost is lower in the LDC than in the home country. While plausible, the issue can be resolved only by an appeal to systematic evidence.

Though individual anecdotes abound of highly automated plants being introduced by MNCS, several dozen studies using comparisons within countries of domestic and foreign firms producing the identical product largely support the hypothesis that no differences exist in the choice of plant and equipment. Where differences are present, it is the MNCs that typically show more adaptation of technology. One of the most careful studies produces the typical result in heightened fashion. Donald Lecraw compared three types of companies in Thailand: ones that are domestically owned; MNCs whose home country is another LDC, such as India or Hong Kong; and MNCs from the developed countries.[7] The highest capital per worker was exhibited by the domestic firms; the lowest by LDC-based multinationals. These and other results do not demonstrate the benevolence of MNCs nor the malevolence of domestic firms. Rather, they are manifestations of determinants of technology choice more basic than nationality of ownership - for example, the cost of obtaining appropriate equipment. Though more recent studies have not been carried out, it seems likely that foreign firms that are choosing LDC locations as export platforms to achieve lower costs are utilizing the most labor intensive equipment, consistent with cost minimization.

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[7] D. Lecraw, "Direct Investment by Firms from Less Developed Countries," *Oxford Economic* Papers, 23(9).442-57 (Nov. 1977).

IV.B.2. Cost of labor and capital and competitive markets

The major determinants of the choice of technology are the cost of labor and equipment and the extent of competitive pressure. A company beginning or expanding its operations may adopt a variety of methods of production, the actual decision depending on the costs of the factors of production: labor, capital, and raw materials. It has become conventional to assert that labor costs are "too" high and capital costs too low in LDCS. What is the precise meaning of these statements? I briefly consider each of the two factor costs, wages and the cost of plant and equipment, in addition to competition.

Hiring a worker entails the payment of a wage and one or more of the following: payments in kind - housing-fringe benefits, social security charges, and in some countries such supplements as "thirteenth month" salary. The cost of hiring a worker is "too" high if the value of the cash wage and other benefits exceeds the income the worker could command elsewhere, given his abilities, both inherited and obtained by education and on-the-job experience. It has long been noted that the typical employee in a modern enterprise, be it a factory, bank office, or government agency, earns considerably more than a worker in small-scale artisan shops or in self- employment, such as barbering. Modern employment also provides incomes considerably in excess of that of agricultural workers and small-scale peasant farmers. It is generally believed that the observed income differentials do not represent a reward for greater productive ability, but are artificially high and institutionally supported, reflecting government minimum wage legislation, union bargaining success, and a guilty aversion to paying lower, more appropriate wages that characterize other activities.

The statement that wages are too high thus refers to the norm of alternate income possibilities for a similarly skilled worker, either in the urban craft sector or in a variety of rural activities. It does not imply that these wages are excessive in comparison with those in developed countries or that such workers are able to afford a luxurious living standard.

The cost of utilizing plant and equipment reflects the purchase price of a factory building or machine and the interests costs incurred in financing it. More precisely, the

cost of using plant or equipment is best viewed as the annual expenditure, namely, depreciation of the initial acquisition cost and a yearly financing charge incurred as a result of a decision to purchase the capital item. The purchase cost of equipment is too low in most LDCS, in the sense that the net effect of government foreign trade policies is typically to lower artificially the amount of domestic currency that must be given up to pay for an imported machine. For many industrial products this cheapening of foreign goods is offset by a relatively high, often prohibitive tariff imposed on imported goods that compete with domestically produced goods. However, no tariff is imposed on imported equipment in order to encourage domestic investment. Thus LDC firms purchasing new equipment pay a lower price than they would if governments did not discriminate among different types of imported goods. A low purchase price is reflected in low annual depreciation charges, one of the two major components of the annual cost of using equipment.

As mentioned earlier, the second major cost is the financing charge. The interest rate paid by larger companies in the urban sector is too low as a result of governmentally imposed limitations on the rate of interest. At the existing low ceiling levels of rates, the total demand for funds exceeds the supply, and the existing supply is rationed among competing companies, none of whom is charged more than the legal maximum. Companies that are unsuccessful in this competition are forced to compete in a gray or black market in which the rates often are three or four times the official one. The successful, usually large, firms thus in effect receive subsidized loans.

Apart from measures that lead to too low a purchase price and interest rate for many investors, numerous tax regulations further reduce the annual charge for using equipment. For example, investment credits and accelerated depreciation are likely to have adverse effects on the choice of production methods, particularly in view of the already high rates of return being earned by investors, who hardly require additional incentives. The net effect of the existing set of distortions in wages and the cost of capital has biased the choice of individual firms toward production methods that use unnecessarily expensive machines rather than unskilled labor.

The ratio of labor to capital costs is usually assumed to play a decisive role in

determining the relative amounts of capital and labor used in the production process. The importance of factor prices flows from the assumption of a competitive milieu. Factor prices play a more limited role, however, in noncompetitive environments. A firm currently realizing a 30 percent rate of return on equity capital, though using an inappropriately high ratio of capital to labor, may have little incentive to search for more appropriate methods that raise its return to 40 percent. The losses from forgone leisure and the difficulties often alleged to inhere in managing a larger labor force make such behavior plausible. If factor prices are to exert pressure toward adopting appropriate technology, competitive forces must be present. Given the small markets typical of many LDCS, such pressures are best engendered by international competition rather than by the proliferation of large numbers of small domestic companies, none of which is likely to reach economically efficient size. In the presence of high rates of tariff protection, changes in relative factor prices may have some beneficial effects, but these are likely to be highly attenuated. Thus an integral component of any determined effort to achieve more desirable factor proportions must be some increase in competitiveness in the product markets in which industrial firms participate.

IV.B.3 Political economy of appropriate technology

Even if factor prices do affect the decisions of enterprises, altering them to obtain the potential gains shown in Table 5 is likely to require considerable political astuteness.

Such alteration involves revising the existing rules by which individuals earn income in a society. Union workers and those covered by effective minimum wage legislation would have to accept a decrease in their wages relative to the incomes of the marginal urban workers and the rural poor; firms receiving subsidized loans at an 8 percent nominal annual rate of interest would have to pay 20 or 30 percent real (after inflation) rates of interest and would be subjected to increased competitive pressure as protective tariffs were reduced. Bureaucrats running the complex controls of much of the modern economy would lose their source of power, and, in some cases, substantial bribes. These changes would be required regardless of the form of ownership, private or

SOE. Although aggregate gains could be realized, each of the groups just enumerated will perceive itself as losing relative to other social groups and will not accept such losses without an intense political battle. In contrast, the probable beneficiaries are too numerous and the benefits too uncertain to induce the formation of effective advocacy groups. The potential gains from the reform constitute a classic example of a collective good from whose benefit it is difficult to exclude people, and hence no individual perceives it to be in his interest to share in the costs necessary to realize the goal. Small wonder that few countries have systematically chosen the price realignment route, and those few often only after a combination of external pressure from suppliers of foreign aid and internal stagnation.

IV.B.4. Skills and investment

I turn next to the question of whether the technical options that clearly do exist are quite as simple to implement as has been implicitly assumed previously. I will consider briefly two obstacles out of a half- dozen that may be important. These are, first, the possibility that less capital-intensive technologies, though employing more unskilled laborers, require a greater percentage of skilled labor and, second, that the information costs of learning about technological alternatives are substantial and thus a firm may find it more profitable to pursue other less expensive options to obtain increased profitability.

It is sometimes suggested that appropriate equipment requires more skilled operatives, maintenance workers, and/or supervisory abilities. Since all of these skills are in short supply, it is concluded that more modern equipment that economizes on them is desirable. The empirical basis for this view is rather tenuous, relying primarily on a few anecdotes. Assume, nevertheless, for the sake of argument that the view contains some substance.

Should this be raised to high principle and the corollary deduced that production with less advanced technology is impossible? All too often precisely this leap is made, ignoring the possibility that even if greater skills are required, they may be acquired by private or public expenditure on the relevant training. The cost of this investment must then be compared with the benefits to be obtained from the appropriate technology.

While private firms may hesitate to make such a calculation, as workers they train may be pirated away by local firms, the refusal of LDC governments, public enterprises, and inter national agencies to pursue the benefit-cost calculus is shortsighted, as is the neglect of the usefulness of subsidies to encourage private firms to consider such training.

Using the data gathered in the studies that form the basis of the calculations presented in Tables 4 and 5, the benefit-cost ratios have been calculated for two of the industries in which the skill requirements associated with the appropriate technology are in fact greater than those required by the advanced technology. The ratio of benefits to costs obtained from investing in training is considerably above 30, whereas a ratio of 1 constitutes a justification for most projects. This result suggests that even where skill shortages are currently a factor limiting the adoption of labor-intensive technology, the desirable strategy for policymakers is to advocate a bundling of the requisite education and investment funds rather than passively accepting the adoption of unnecessarily advanced technology.

IV.B.5. Cost of information

I now turn to the cost of acquiring technical information, a question that typically has not been emphasized in this context but is clearly of considerable importance in understanding a number of observed phenomena. Usable information about production alternatives, including machine and product specifications, raw material and power requirements, and typical complements of labor of various skills, is generally not readily available despite the textbook simplifications all economists use to represent technical choices. The studies on which Tables 4 and 5 are based, as well as many other studies demonstrating the existence of a considerable variety of technical alternatives, required the cooperation of a group of economists and engineers for a year or more. It is likely to be quite expensive to ascertain the relevant technical options among which a firm may choose.

It is easiest to obtain information about one or two technologies from

presentations by manufacturers of capital goods. However, in many LDCs salesmen arrive only from the largest producers in the technologically most advanced countries, such as Switzerland and Germany. Few representatives from smaller firms that may produce more appropriate equipment visit the typically sparse markets of sub-Saharan Africa or the poorest countries in other regions despite the likelihood that some of their equipment may be suitable. In general, it is time consuming and expensive to determine relevant technical alternatives - attendance at trade fairs, careful examination of large numbers of trade publications, and ascertaining the performance in operation, as contrasted with the specification of machine manufacturers all require large monetary outlays or a considerable expenditure of managerial time.

While the hiring of consulting engineers might be thought desirable, they do not accept such assignments unless the total outlay on new plant and equipment is very large as their compensation is a percentage of the amount of equipment purchases. Plant managers themselves will be reluctant to allocate much of their own or staff time to the necessary search unless the prospective payoffs in terms of reduced costs are very large, since many alternative uses exist for their time, including improvement of current levels of efficiency, finding lower-cost suppliers of raw materials, and eliciting more favorable treatment from government agencies.

The role of information permits an explanation of the good performance of MNCs with respect to technology. They can more cheaply identify relevant machinery and transfer it among subsidiaries, particularly equipment which is losing its competitive edge in countries with high and growing wages but which would be appropriate in low- wage countries. The parent company may even have established a new plant partly to utilize such equipment in the production of exports from a low-wage country. Alternatively, the local MNC manager may request that the purchasing office of the parent company perform the search for desirable equipment. Lowered cost to the local subsidiary increase the probability of the subsidiary's purchasing appropriate machinery that will allow it to take advantage of the relatively low price of labor in the LDC.

The listing of equipment on business-to-business web sites might be thought of as one solution to the lack of information in developing countries. However, a simple listing

of equipment on a manufacturer's web site is likely to be inadequate. Equipping an entire factory requires, in general, the meshing of many types of machinery, produced by a variety of firms. There are a huge number of permutations of machinery but the feasibility of actually operating many types of equipment from various manufacturers in settings in which some of the environmental parameters, for example, low quality raw materials, high humidity, and more dust, differ considerably from the country of origin, require coordination that is not available from the web sites of capital goods producers. The difficulties of optimizing equipment combinations that must be utilized sequentially solely through business-to-business websites may be likened to the difficulties of determining from a website whether two drugs are contra-indicated. Very low probability drug interactions are duly recorded to reduce the drug maker's liability yet a physician weighing the benefits from taking the two drugs and the low probability of the interaction will advise a patient to ignore the warning. In the case of obtaining equipment that can interact correctly in an LDC setting, the equivalent of a physician is necessary.

Websites can provide a menu but the choice ultimately requires considerable skills on the part of the firm making the choices. Private sector firms that have engineering competence and have faced international competition have been much better at making such difficult choices than state owned enterprises or private firms that have been protected.

V. Improving Total Factor Productivity

One mode of obtaining increased GDP from a given investment level is an improved choice of sectors and technologies, allocative efficiency. The other is through improved productive efficiency or TFP.

Two types of studies have analyzed the sources of low levels of productivity levels in SSA. The first measures the performance of firms in SSA relative to best practice firms in the OECD countries and analyzes the source of the shortfall. For example, Pack, 1987, analyzes the source of lower relative TFP in textile firms in Kenya relative to plants in the U.K. using identical equipment. Some of the lower productivity is attributable to low product specialization, a reflection of the import substitution strategy, some to inadequate management knowledge of production engineering. Relatively little

of the productivity shortfall is due to deficient labor skills. The firms investigated were large MNCs and thus it is perhaps not surprising that their performance was relatively good. Contrary to widespread views, in well managed firms African workers exhibit the same level of productivity as English workers after allowing for differences in equipment-labor ratios, the effects of short production runs, and management deficiencies.

A second approach analyzing large number of firms allows the calculation of TFP for all firms relative to the U.S. These results that were reported in Table 3 indicate very low TFP is typical of African manufacturing. The obvious question is why these dramatic differences occur. The determinants of productivity of individual firms can be proximately divided into those arising at the economy-wide level, the industry in which the firm is a member, and the firm itself.

V.A The National Economy and Technology System

V.A.1 The National Economic Policy Framework

It is a staple of the development literature that national economic policy can affect the productivity levels of firms. A policy of import substituting industrialization leads to limited competition and weakens incentives to seek methods to improve efficiency. Opportunities presented by ISI or distorted exchange rates provide opportunities for rent seeking that are larger than those to be realized from improving efficiency. The low profitability of exports may discourage firms from entering foreign markets and they do not obtain the spur to innovation and cost reduction arising from the need to reduce costs and increase quality. Finally, a domestically oriented strategy may reduce the availability of foreign exchange, leading to limits on the ability of firms to import machinery and intermediates. The countries of SSA have large export sectors, almost entirely resource based, but the real value of these exports has stagnated or declined in most countries. Nevertheless there is a need for imported inputs given the low levels of production of intermediate and capital manufactured goods with SSA. Hence, the failure of exports to grow limits the ability of manufacturing to expand. In the last decades, the decline in real export earnings may have reduced capacity utilization and led to a lower level of TFP through the reduction of the variety of inputs.

Apart from the incentive regime, the functioning of the national economy can affect the productivity of firms more directly, for example, an erratic electricity supply can reduce TFP measured on an annual basis by leading to interruptions in production. If firms respond to this by building their own generators, they will incur capital costs that are greater than competitors in other countries, further increasing their unit capital input. Lee and Anas (1990) have shown that such costs have been considerable in Nigerian manufacturing.

V.A.2. The National Technology System

The evidence of this paper suggests that the manufacturing sector in SSA is considerably below the world best practice frontier. If income levels are to be raised, this gap must be reduced. Most of the discussion of poor African performance concentrates on policy variables, largely because one looks for a lost key under the lamppost regardless of where it was lost. Price denominated policy changes such as import liberalization may generate a need for firms to respond to a newly competitive atmosphere. But in the absence of a supply of such inputs and of the firms' understanding of their own needs and the ability to productively absorb these new inputs, there is likely to be a limited increase in long term TFP rather than a short term increase in capacity utilization. A critical issue in Africa is the generation of the appropriate institutional structure to support industrialization.

Some of the requisites are clear – more trained engineers and technical school graduates are important. Mlawa (1983) reported that the eight major Tanzanian textile mills employed six trained textile engineers. Comparable plants in Kenya, run by MNCs, each had six to ten. Given that the high explicit and opportunity costs of training, the appropriate mix of skills, domestic versus foreign training, and so on require careful thought. But assuming that their will be automatic response of enrolments as a shortage of textile engineers appears is to place too much faith in the speed of response.

Changes in the domestic education structure are necessarily intermediate to long term issues. In the shorter run, firms facing the need to upgrade their technical capabilities have a number of options. Among the more effective short term solutions is the hiring of foreign consultants employed by the firms. Here there may be a role for

international agencies as screening agents as this is a very imperfect market. There is also a risk of aid agency failure as many of the consultants hired directly by these agencies appear to have obtained the contracts without regard to demonstrated ability. Individual countries can also facilitate the use of consultants by expediting the approval process. Often governments have engaged in a form of import substitution in this area, requiring proof from the firm that no existing nationals are adequate substitutes and adding on to this onerous tax provisions.

A characteristic of all African countries is an exceptionally low level of technology licensing. This stands in marked contrast to the experience in many of the Asian countries in which governments encouraged licensing as a cost-effective method of improving productivity. Though questions have arisen about the "fairness" of the terms of licensing agreements,[8] it is nevertheless quite clear that even if LDC firms pay costs greater than marginal costs of delivery, the cost of improving existing practice by a given percentage through licensing is less than if firms had to achieve these improvements through their own R & D. Here, too, there may be a role for government in reviewing technology agreements and helping firms to obtain better terms. But experience in other countries suggests this is likely to be expensive in terms of the opportunity cost of the reviewers.

Apart from transfers of foreign knowledge, the experience of the Asian countries suggests that domestic technological institutions may be important. KIST in Korea, ITRI and the China Productivity Center in Taiwan, China and others institutions were able to respond to the production problems of firms and also helped to generate a corps of trained professionals who then became important in diffusing knowledge among firms. While no econometric evidence exists on the role of these institutions, anecdotal evidence abounds[9]. Such institutions are all the more important in light of the geographic "thinness" of African manufacturing and the smaller likelihood that normal labor mobility and interchange of ideas will diffuse technology. As in other areas of potential

[8] In particular, whether licensees should be expected to pay part of the initial R & D cost of the technology or simply the marginal cost of transmission.

[9] See Dahlman and Sanikone, 1997.

government policy, this strategy has a risk unless the demand exists to utilize such services. India has three exceptionally capable textile research institutes sponsored by contributions of firms in each of three textile producing regions. Nevertheless, during the period in which the sector was protected from external competition and domestic competition was limited by investment licensing, the sector did not achieve any significant productivity growth and its level of TFP was quite low.

V.B. Industry Level Impacts

Most SSA countries have a very small manufacturing sector. There are limited possibilities for intra and inter industry interaction. For example, in Kenya there are five integrated textile factories, several located hundreds of miles from the closest textile plant. The potential gains flowing from interfirm interactions within the same sector, such as informal discussion of production engineering problems encountered by managers, joint training, or the availability of a pool of workers with experience within the sector doesn't exist.[10] Similarly, inter-industry interaction is largely absent. For example, in many countries, a set of local, specialized firms that take advantages of economies of scope to service the larger firms, is absent.

The sparseness of industrial development is quite clear – the relatively low levels of manufacturing in national output are accompanied by small number of large firms present in each sector. Table 6 shows the number of firms in each two digit sector for Colombia and Tanzania, (countries with similar populations) the countries being determined by the availability of internationally comparable sources. The number of firms in Tanzania is very small, less than 5% of that in Colombia in most sectors. Moreover, these sectors are broadly defined and include many subsectors - there may be only one firm producing a given product - an environment not conducive to horizontal interfirm learning through the exchange of knowledge. Moreover, insofar as smaller

[10] For a contrast see Saxenian's (1995) description of the extensive interaction among firms in Silicon Valley.

firms are often suppliers of specialized intermediates to the larger firms (as well as manufacturing final products), the data imply that the advantages of specialized input suppliers is largely lost, firms producing a large range of products, many requiring specialized equipment used for only a fraction of each day.

Table 7, adapted from Biggs, et. al. (1995), documents this phenomenon for Ghana, Kenya, and Zimbabwe, the data being derived from firm level information. The vast majority of firms in the sample do not subcontract locally and those that obtain 50 percent or more of their inputs through subcontracting is 2 to 3 percent. Economies of scale and scope are both lost in addition to any externalities. This absence of subcontracting is not, of course, solely an African phenomenon but holds in many LDCs. Explanations have ranged from the absence of trust to the costliness of establishing subcontracting. Yet such interactions have been important to development in many of the Asian countries such as Taiwan, China, and Japan.

V.C Firm Specific Determinants of Productivity

As just noted, the characteristics of the national economy and the structure of the industry of which the firm is a part will affect its productivity. But many of the major determinants of TFP occur at the firm level. It is convenient for expositional purposes to consider two groups of firms, those on the domestic best practice frontier and those not achieving it. The wide dispersion of TFP about best practice in SSA, greater than that in other regions, raises the question of the sources of such dispersion. Thus I will analyze why productivity is so low even among the best local firms and then consider why even this low level has diffused so little among the first in a country.

V.C.1 Best Practice Firms - Static Issues

In principle, firms can buy knowledge and the same physical inputs and achieve similar TFP. While economists are fond of the abstract concept of a production function, there are no encyclopedia entries or websites describing how to obtain maximum output from a given collection of inputs. University trained engineers will have studied many of

the elements of a technology but will not have learned to deal with all the permutations that arise in actual production situations in a developing countries where unexpected problems may arise from the need to use materials with properties not envisioned by the machine producers, polluted water, erratic energy, and different climatic conditions. Some of the knowledge required to deal with these may be incorporated in machinery or in systems that transport material among work stations. Some of the requisite knowledge is codified and is transmitted by the sellers of equipment (the temperature or humidity in a weaving shed required to reduce defective cloth).

Some of the observed productivity shortfalls reflect responses of firms to incorrect policy. For example, the characteristic relatively short production runs may reflect an optimal response of firms selling in the more profitable domestic market rather than taking advantage of the economies of specialization and producing for export. But some of the knowledge that is necessary to increase output per bundle of inputs is not-codified or is tacit. It is not written down in any usable form, typically requires production experience to alter it to local conditions, and is embodied in individuals. Many firms in SSA lie below international best practice partly because of the absence of such knowledge.

Detailed studies of SSA firms find they have imported much of their machinery. If such equipment were utilized at its potential, the productivity differences of the magnitude that currently prevail would not exist. Some knowledge is missing. Best practice firms appear to be quite inefficient relative to those in the industrialized countries, even when using similar equipment. This reflects the absence of the “software” rather than that of hardware. The low TFP level of best practice firms may partly reflect optimal responses to the policy environment but micro evidence also suggests deficient technological effort and knowledge. A key issue is whether this reflects rational firm response to the absence of competitive pressure or whether the firms are simply too isolated to know they could improve their condition and earn greater profits given the levels of protection.

There are a number of channels that firms could employ to improve their productivity, for example, the hiring of foreign firms or individuals as consultants, the

use of technology licensing agreements, and efforts by the firms' own staff to learn about the technology. The evidence from intensive samples suggests that even best practice firms do not engage in such practices with the intensity that is typical of firms in countries that have succeeded in industrial development. For example, only nine of 214 firms surveyed by Biggs et. al. have signed technology licensing agreements and only 17 have signed technology assistance agreements with foreign firms.

Nevertheless, in explaining differences from best practice, technology variables such as technology licensing do not have large coefficients. Analyzing short run cost functions for all firms Pack and Paxson (2000), using Biggs'sample, find most technology variables are not significant - variations in value added are accounted for largely by differences in labor input – measures of technological variables such as foreign licenses and advanced education are not generally significant. This is at variance with the experience of Asian NICs where case studies and some econometric work show that the acquisition of foreign technology and domestic education have been important components of the growth process. This discrepancy in patterns may be explained by the absence of a competitive environment in most of SSA – while the presence of technology provides the necessary condition for improved productivity, if there are limited competitive pressures, there will be no pressure to employ these successfully.

V.C.2 Non-best practice firms

There is more variation in TFP among firms in SSA industries than in other regions. Even the limited knowledge of the best practice firms is not diffused as widely as in other regions. Partly this may again represent a rational response to a lack of incentives – there is no need to hire away some knowledgeable workers from a more efficient firm in the absence of competitive pressure. And, there are no incentives, especially in view of the relatively small size of firms and the considerable fixed costs involved, of attempting to enter licensing agreements or hire consultants.

But part of the high variation of TFP may precisely reflect the low density of SSA manufacturing. Much of the diffusion of knowledge in "dense" industrial sectors presumably arises from the interchange of personnel in whom tacit knowledge is embodied. Such flows cannot result when factories are very far from each other and firms

tend to be self contained.

The basic problem in African manufacturing is not the absence of either capital or complementary inputs but the low productivity realized with them. While output could nevertheless be made competitive with other countries if either low wages/and or the correct exchange rate are present, the absence of improvement in currently low TFP levels implies a low real wage for workers and their dependents even if output grows through exports or domestic sales.

Can low TFP levels be improved? The policy variables suggested by cross-country regressions to explain bad African performance are not incorrect but they miss an important issue. A contraction of parallel market premia would result from better exchange rate management combined with import liberalization. Such changes may generate a perception of the need to respond to greater competitiveness and thus lead to a demand for inputs that would permit the desired response. But in most SSA countries there is no set of supply side institutions that can help firms. There is no evidence that liberalization policies have in fact succeeded in raising TFP for more than a year or two, largely as a result of increased capacity utilization as the foreign exchange constraint is softened (World Bank, 1994).

It could be argued that in light of this, industrialization is premature. Only when the supply of inputs is there and firms are capable of recognizing the need for them and absorbing them will industrialization be appropriate. Yet given the constraints imposed by the difficulty of improving agricultural productivity, some effort to foster industrialization may be desirable. The institutional requirements are significant and the dangers of intervention must be recognized. But there is also some hope given the experience in Asia, albeit with more favorable initial conditions. It is also useful to note the low TFP levels in Korea in the late 1960s to avoid undue pessimism (Pilat, 1994). In manufacturing more than in other sectors, international technology transfer may be feasible. The country fixed effects of soil, sun, and rainfall are absent.

Finally, in most SSA countries it is likely that the industrial sector is currently too thin to generate productivity augmenting interactions among firms. The difficulty is that

such lacunae are not easily corrected by public policy. While an attempt to encourage firms with backward and forward linkages could be attempted, in most countries this has simply led to inefficiency in the protected supplying or purchasing sectors. For example, in Tanzania, the creation of upstream sectors such as pulp and paper plants and textile mills yielded few downstream benefits, either in their vicinity or in the rest of the country. Clusters that arise in response to market signals are clearly preferable.

VI. CONCLUSION

These results suggest several principles for the improvement of African productivity and by extension to that in other very poor economies. First, production can at first be directed to goods that are in high local demand. The initial high prices implied by low productivity, assuming the latter is not offset by comparable low wages, implies an initial domestic orientation. The goods in question can be produced by local firms with some minor technical help from abroad. The lack of FDI, understandable given the absence of fundamentals noted above, is not critical at this stage in African manufacturing.[11] But there is a circularity that is important to emphasize, namely, the domestic demand for African manufactured products will partly be dependent on growing income in the agricultural sector. Absent such growth, manufacturing will play a small role unless local firms can enter export markets but this is contingent on improving productivity, quality control, and marketing skills that would imply the need for international links. There seem to be few prospects of this at the present time and thus any growth in manufacturing will necessarily be aimed at the domestic market, assuming that incomes are growing.

[11] Although it is not surprising that Africa has received very low levels of FDI, improving the fundamentals would attract some investment. Such investment has been critical to improving the industrial sector in a recently poor country such as China.

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Table 1

GNP per capita – current dollars

Country/Region	GNP per capita, 1975 Current dollars	GNP per capita, 1995 Current dollars	SSA relative to country/region 1975	SSA relative to country/region 1975
Sub-saharan Africa	**420**	**490**	**-**	**-**
Indonesia	**230**	**980**	**1.83**	**.50**
South Korea	**640**	**9,700**	**.66**	**.05**
Malaysia	**890**	**3,890**	**.47**	**.13**
Thailand	**310**	**2,740**	**1.08**	**.18**
China				
India				

Source: World Bank, World Development Indicators, cd rom.

Table 2

Human Development Indicators

Country/Region	Infant mortality	Life expectancy at birth	Adult literacy	secondary enrolment rate
	(1978)	(1979)	(1976)	(1978)
Sub-saharan Africa -1998	106	48.9	58	41[a]
Indonesia	120	53	62	22
South Korea	37	63	93	74
Malaysia	32	68	60	48
Thailand	68	62	84	28
China	56	64	66	51

Note: a – 1997;

Sources: World Bank, World Development Report, 1981, United Nations Development Program, Human Development Report, 2000.

Table 3

Production Characteristics of African Manufacturing, early 1990s

	Value Added Per Worker Relative to U.S.							
	Food		Textiles & Garments		Wood and Furniture		Metal Work	
	1992	1994	1992	1994	1992	1994	1992	1994
Cameroon	0.21	0.22	0.64	.65	0.72	0.43	0.57	0.75
Ghana	0.03	0.01	0.02	0.02	0.03	0.03	0.03	0.02
Kenya	0.07	0.11	0.08	0.15	0.06	0.06	0.10	0.10
Tanzania	0.03	0.02	0.09	0.08	0.04	0.08	0.07	0.08
Zambia	0.06	0.07	0.10	0.08	0.11	0.05	0.13	0.10
Zimbabwe	0.08	0.08	0.11	0.09	0.13	0.09	0.19	0.11
	Capital Stock per Worker Relative to U.S.							
Cameroon	0.33	0.25	1.13	1.00	0.47	0.29	0.26	0.37
Ghana	0.10	0.03	0.08	0.15	0.05	0.04	0.04	0.05
Kenya	0.16	0.18	0.24	0.35	0.07	0.06	0.13	0.07
Tanzania	0.11	0.10	0.37	0.40	0.12	0.08	0.05	0.08
Zambia	0.08	0.26	0.47	0.38	.09	0.17	0.12	0.07
Zimbabwe	0.14	0.09	0.29	0.11	0.11	0.06	0.17	0.05
	Total Factor Productivity Relative to U.S.							
Cameroon	0.33	0.38	0.61	0.65	0.97	0.71	0.98	1.11
Ghana	0.07	0.05	0.05	0.03	0.09	0.09	0.10	0.08
Kenya	0.15	0.21	0.14	0.23	0.18	0.18	0.21	0.30
Tanzania	0.07	0.05	0.13	0.12	0.09	0.22	0.23	0.21
Zambia	0.16	0.11	0.13	0.11	0.30	0.10	0.30	0.28
Zimbabwe	0.17	0.20	0.19	0.21	0.31	0.27	0.38	0.36

Sources: Author's calculation from Biggs et. al. 1995, U.S. Census of Manufacturing, 1992, and Jacob et. al., 1997.

Table 4

Investment per worker – Advanced and Appropriate Technologies

Product	Advanced Technology	Appropriate Technology	Ratio of Appropriate to Advanced Technology
	(thousands of dollars)		
Shoes	**2.2**	**.8**	**.36**
Cotton Weaving	**37.6**	**8.7**	**.23**
Cotton Spinning	**14.7**	**2.0**	**.14**
Brickmaking	**45.8**	**3.3**	**.07**
Maize Milling	**9.7**	**2.9**	**.30**
Sugar processing	**6.2**	**.8**	**.13**
Beer Brewing	**18.3**	**12.1**	**.66**
Leather processing	**36.2**	**15.5**	**.43**
Fertilizer	**137.6**	**122.3**	**.89**

Source: Calculated from Pack, 1982.

Table 5

Gains From Adopting Appropriate Technology

Technology	Value Added	Wage Income	Non-labor income	Employment (thousands)
	Millions of dollars per year			
Appropriate	**624**	**119**	**505**	**238.7**
Advanced	**364**	**29**	**335**	**58.0**

Source: Calculated from Pack, 1982.

Table 6

Number of Firms in Colombia, Tanzania

Sector	Number of Firms	
	Colombia - 1985	Tanzania – 1985
Food Processing	1096	138
Beverages	124	15
Tobacco	14	3
Textiles	443	77
Wearing Apparel	979	56
Leather Products	324	15
Wood Products	166	60
Furniture, Fixtures	164	15
Paper and Products	135	8
Pulp and Paper	27	3
Printing, Publishing	342	44
Industrial Chemicals	114	10
Basic, excl. fert.	71	5
Other Chemicals	280	35

Rubber Products	**73**	**8**
Plastic Products	**291**	**5**
Non-metallic mineral	**366**	**14**
Basic Metals	**83**	**6**
Metal Products	**506**	**43**
Machinery	**300**	**13**
Electrical Machinery	**180**	**10**
Transport Equipment	**207**	**20**

Source: United Nations, Industrial Statistics Yearbook, 1988

Table 7

Firms by Size of Employment	No subcontracting	>50
<10	81	2
10-49	72	2
50-99	88	6
>100	91	0
Sector		
Food	90	3
Textiles and Garments	93	0
Wood Working	68	3
Metal Working	76	2

Source: Biggs, Shah, Srivastava, 1995, Table 7.13.