

---

---

# **THE ECONOMICS OF TECHNOLOGY**

## **WORKING PAPER NUMBER 3**

---

---

### **PRODUCTIVITY AND INDUSTRIAL DEVELOPMENT IN SUB-SAHARAN AFRICA**

By: Howard Pack  
The University of Pennsylvania

December 1990

Bureau for Program and Policy Coordination  
U.S. Agency for International Development

Technology Assessment Policy Analysis Project  
A.I.D. Contract No. PDC-0091-C-00-9092-00  
SRI International

## CONTENTS

Introduction . . . . .	1
I. What is Wrong with Sub-Saharan Africa Industrial Development? . . . . .	4
II. The National Policy Environment . . . . .	10
1. The Short Run . . . . .	10
2. The Longer Term . . . . .	11
III. Productivity Improvement at the Industry Level . . . . .	17
3.1 The Short Term . . . . .	17
IV. The Firm Level . . . . .	20
4.1 Improving the Productivity of Existing Programs . . . . .	20
4.1.a. The Role of Competition in Obtaining Greater Productivity . . . . .	24
4.2 Obtaining High Productivity From Newly Established Firms . . . . .	26
V. Labor . . . . .	32
VI. The Small Scale Industrial Sector . . . . .	33
VII. The Policy Package . . . . .	34
References . . . . .	35

## Introduction

There is great concern about the prospects for industrialization of Sub-Saharan Africa (SSA). Much of the literature dealing with this question has typically been addressed from a neoclassical view that assumes underlying elasticities of supply are very high and that all that is necessary is to improve the pricing structure including the privatization or rationalization of publicly owned enterprise. Limited attention has been given to technical and allocative efficiency within firms that raise supply curves to high levels and may result in inelastic supply curves as well. The emphasis on trade liberalization is mainly devoted toward gains from intersectoral reallocation of resources, the expansion of efficient sectors and firms, and the exit or improvement of inefficient sectors and firms. Nevertheless, the evidence so far seems to be that structural adjustment policies including both macro and trade liberalization (elimination of quantitative restrictions (QRs) and tariff reduction) seem to have had as their major effect, increased capacity utilization as more raw materials and intermediate goods become available.<sup>1</sup> There is no evidence of improvement in performance in either total factor productivity or firm's choice of technology, two measures of improved economic performance; neither direct measures of these have been adduced nor indirect measures such as lower DFCs or ERFs.

---

<sup>1</sup> See for example the internal analyses of World Bank staff members with respect to Ghana, Cote de Ivoire, Nigeria and Zambia in Meier and Steel [1989], Chapter 6.

While it is obvious that incentive structures matter, the sole emphasis on price incentives is not consistent with simultaneous assertions about the constraints imposed on development by limited human capital, partly reflecting the colonial heritage. One could expect a fairly elastic supply of agricultural production as the technology currently employed remains largely traditional, the knowledge of production activities is relatively routinized, and farmers can thus respond to price incentives. In contrast, there is limited systematic knowledge in the large scale industrial sector of the technology of production, largely reflecting the paucity of trained personnel. As an extreme example, Mlawa (1982) found that there were three trained textile engineers in Tanzania's eight large locally owned textile factories! In contrast, multinational owned textile firms in Kenya utilize about twenty trained textile technicians per plant.

While price denominated policies have been critical in Asia and could undoubtedly contribute greatly to Latin America's growth, the current conditions of early industrialization in SSA militate in favor of attention to the generation of technological competence. Without an increase in competence, the responsiveness of output to even the best designed structural adjustment program is likely to be limited. Prices are one half of a scissor, the other being technological competence. NICs are not cut from a pattern of prices alone.

Price and technology improving policies are not mutually exclusive: indeed they may reinforce each other. Thus, a plausible argument can be made that in Korea and Taiwan, the move towards neutral incentives between domestic and foreign sales stimulated technologically simple labor intensive exports and these in turn facilitated the acquisition of technical competence in the

form of advice from foreign purchasers. Moreover, the export earnings made possible greater payments for technology licenses and permitted the purchase of foreign machinery that embodied considerable technology and also permitted local technicians the opportunity to gain mastery in its use and in its adaptation to local conditions. While the same sequence of liberalization - simple exports - technology purchases may be feasible in SSA, there are important differences.

The Asian NICs clearly had considerably more human capital at the beginning of their rapid growth period than do current SSA countries. Comparisons of stocks and flows of education confirm this. Moreover, Hong Kong and Taiwan benefited from the substantial influx of experienced industrialists and technicians from mainland China while Koreans had gained considerable technical skills during the Japanese occupation (Pack [1990], Pack and Westphal [1986]). If there are useful lessons to be drawn from the NICs for SSA, it may be from Singapore which had relatively low levels of education and technical competence, compensating for these by the extensive use of foreign technical knowledge, particularly MNCs. The main point though is that price policies in Asia were necessary but not sufficient to account for the growth of industrial output. Technical competence was a critical facilitating factor.

The paper concentrates on the generation of technical competence in large scale industry. It does not consider in detail the pricing policies of the government nor the export facilitating activities of government and the private credit markets. The former are by now part of the general lore of

development economists and the latter has been the subject of considerable recent research.<sup>2</sup>

This paper considers SSA's industrial performance, beginning in Section 1 with an overview. Section 2 considers the policy environment and strategies such as resource based industrialization and basic industries that have been advocated. Sections 3 and 4 consider the possibilities for improving the performance of industry and their constituent firms. Sections 5 and 6 briefly consider the quality of labor and the role of the small scale industrial sector. Policies to improve productivity are considered in Section 7 while policy conclusions are presented in Section 8.

#### I What is wrong with subsaharan Africa industrial development?

To ask the question of this section is to accept that an area as poor as subsaharan Africa (SSA) should engage in large scale industrial production. It is now widely understood that given the current location of population in rural areas and given that the major economic activity in terms of both employment and output is agriculture, any sustained improvement in living standards will require improvement in agricultural productivity. Methods of achieving such improvement in smallholder agriculture are fairly well understood: local agricultural research, an improved extension system,

---

<sup>2</sup>For a good survey of the many financial and infrastructure requirements for entry into export markets see Rhee [1989]

improved rural infrastructure, and importantly, a price structure designed to provide incentives rather than one discouraging production.

No such relatively robust prescriptions are available for the large scale industrial sector. Some would argue that appropriate economic evolution should emphasize small scale industrial activities, particularly in rural areas. There is much to commend such views. Nevertheless, some types of products that will be demanded, given observed income elasticities and requirements for productive inputs (e.g. fertilizer) are more efficiently manufactured in the large scale sector. In any event, many countries have already pursued the expansion of large scale manufacturing and to ignore the existing sector would be to waste a potentially valuable set of resources. Moreover, even now there is an argument for some limited expansion of the sector to allow some types of learning whose major benefits will accrue two decades from now as the demand for the products of the large scale sector inevitably increases.

Current inefficiency in subsaharan African industry is fairly well documented using conventional measures of efficiency relative to international production such as domestic resource cost (DRC), effective rates of protection (ERP), and total factor productivity, TFP.<sup>3</sup> Unfortunately, these measures, though instructive about the overall magnitude of inefficiency, leave the analyst without a firm basis for prescribing means of ameliorating the situation. A high DRC level can be the result of technical or allocative inefficiency within firms. Technical inefficiency indicates that firms are not capable of achieving the same total factor productivity as do firms

---

<sup>3</sup>For a sample of such studies see Page [1980], Pack [1987], and Meier and Steel [1988, pp. 60-66].

employing an identical technology in other countries. Allocative inefficiency implies that firms incur higher than necessary costs by choosing the incorrect combination of capital and labor at the factor prices they currently face. A high DRC also does not provide much information about the extent of dispersion of total factor productivity (TFP) within an industry. Rather, it provides a notional measure of the degree of protection afforded the marginal firm. Thus, one does not know whether significant possibilities exist for improving productivity by the diffusion of skills from better to weaker firms or whether all firms are relatively inefficient.

Without detailed studies of the sources of inefficiency, analysts typically impute to SSA industry the difficulties that have been observed in ISI regimes in other countries: insufficient utilization of capacity due to excessive plant size in small markets or the unavailability of foreign exchange; "x" or technical inefficiency reflecting the absence of adequate competitive pressure in the protected domestic market; rents that accrue to both capital and labor in protected markets; other well known sources of high costs such as low productivity labor are typically offered as explanations of high measured DRC or ERF levels. Intrafirm allocative inefficiency is not usually noted even though it is one obvious source of higher costs and its empirical importance has been shown in Ghana (Fage [1981]) and Kenya (Pack [1987]).

Nevertheless, some of these explanations are not self explanatory. Small domestic markets and high protection levels characterized both Korea and Taiwan in the 1950s and early 1960s yet there was quite rapid growth in TFP that presumably reflected rapid learning about important aspects of production engineering. Such learning reflected prior industrial experience, higher

levels of education, and a greater interest in industrial management than in recently independent African countries in which many ambitious professionals entered government service.

In some major sectors such as textiles, recent evidence (Pack, [1987]) suggests that a major source of low productivity is the absence of horizontal specialization in which firms produce a wide range of products, a feature often noted by critics of ISI, but only recently quantified. While it is possible that more product specialization will be engendered by the greater openness associated with general tariff reductions, this is by no means certain. The domestic structure of industries including the extent and nature of vertical integration plays a key role in the determination of specialization and this structure is not readily amenable to macro policy manipulation.

Most of the inefficiencies assumed to hold in Africa on the basis of observations in other continents are amenable to at least partial correction by macroeconomic policy intervention. Successful devaluation can eliminate excess capacity by encouraging exports from underutilized plants and providing the foreign exchange for essential imported intermediate goods. A lowering of the general tariff level and a move towards unification of ERFs across sectors should generate competitive pressure to induce firm managements to seek ways to improve productivity. Gains will accrue both from intrasector improvements in TFP as well as resource reallocation across sectors in response to the move towards similar sectoral effective protection rates. Any excess returns accruing to factors of production will be reduced toward competitive levels, adding to competitiveness, and the waste of resources entailed in rent-seeking activity will be reduced. A move away from domestic orientation towards

exporting can be encouraged by a more neutral trade regime that does not set the effective exchange rate for imports above that for exports.

The standard policy measures and their assumed impact suggest that policy-based lending with fairly typical conditions are capable of solving many of the current problems of sub-Saharan industry. And indeed, at least some of the difficulties currently encountered in these countries would be responsive to a correctly specified set of changes in macropolicy instruments.<sup>4</sup> Intersectoral allocation can undoubtedly be improved; rents may be reducible; utilization levels should increase with improved foreign exchange availability. Yet some of the expected benefits from the standard package are based on assumptions that have had limited empirical verification in SSA. For example, unless increased "x" efficiency results simply from learning by doing as cumulative output increases, it is not evident that technical efficiency will be improved by greater competitive pressure. Insofar as technical improvement results from conscious, coordinated effort by managers concerned with technological improvement and investment in productivity augmenting activities, increased competition will yield its presumptive benefits only where capable managers are in place. Otherwise, increased competition may lower rents (and thereby increase international competitiveness) but not yield long term benefits in higher productivity.

Available evidence suggests that the response to an improved policy environment has not been spectacular, far from generating the twenty to thirty percent growth rates in exports characteristic of some of the ASEAN countries in recent years. A few nations, notably Mauritius, have responded to a higher

---

<sup>4</sup>An exhaustive discussion of the required pricing policies is contained in Meier and Steel [1989].

effective exchange rate for manufactured exports in recent years, but much of this additional supply has been accounted for by Hong Kong based multinationals who, of course, possess the technological capability that is missing in much of the continent's large scale manufacturing. In other SSA countries, adjustment cum liberalization programs has had little success except for the greater utilization of capacity permitted by newly available foreign exchange.<sup>9</sup> While important, greater utilization of capacity cannot be a source of sustained in total factor productivity.

In summary, while industrial productivity in SSA undoubtedly can be improved by the typical macroeconomic policy package, the magnitude of the gain is not likely to be particularly large given the widely acknowledged scarcity of experienced industrial managers, the typically smaller domestic markets, and the paucity of general industrial experience. These factors suggest that SSA industry may require more than the typical set of pricing policies if efficient growth is to occur. SSA now is not in the position of the East Asian superexporters around 1960; these countries typically had large stocks of human capital. Even in the case of the Gang of Four, particularly in S. Korea and Taiwan, price policies were hardly neutral and were often designed to galvanize technological efforts, particularly to improving the prospects of infant industries. (Pack and Westphal [1986]).

The following sections analyze the actions necessary at the national, industry, and firm levels if productivity is to be increased in SSA industry. The analysis and policy prescriptions assume that the typical set of macro

---

<sup>9</sup>Maier and Steel [1988], Chapter 6 gives evidence from recent experience in Nigeria, Cote D'Ivoire, Ghana, Zambia and Mauritius.

policies from tariff reduction to freer capital markets is also put into place though the precise time phasing of such changes should be coordinated with those structural policies suggested here. Some of these issues are explored in Section 7.

## II The National Policy Environment

The nationwide policies to be implemented obviously depend on an empirically based diagnosis of current ills and some rough notion of the best (in the sense of comparative advantage) evolution of the industrial sector. In turn, these depend on various time periods relevant for analysis.

### 1. The Short Run

In the short term, say three years, effort should be devoted to increasing the productivity of existing plants and sectors. Most casual empiricism, the bulk of the evidence, indicates low levels of productivity though in the absence of international comparisons there is little quantitative basis for estimating the potential gains from increased productivity. Specific measures to improve productivity in the short run, apart from the macro package, depend on industry and firm level activities that will be discussed below. Such national policies as improved technical education have too long a gestation period to have an impact in the short run. Macro policies that eliminate foreign exchange shortages and quantitative restrictions should have substantial short run impact insofar as plants are underutilized because of shortages of raw materials or spare parts that are attributable to deficient foreign exchange levels or the inability of firms to spend sufficient time to obtain licenses for the required items.

## 2. The Longer Term

For longer term development, it is necessary to deal with two sets of issues: the likely sectoral structure of expansion and the binding constraints on industrial development. Again, the absence of systematic empirical documentation of the current sources of poor performance leaves casual empiricism as the major source of information though some thorough case studies of individual sectors confirm the following broad-brush interpretation.

Although there have been some spectacular successes in choosing industries and fostering their development, particularly in East Asia, the political environment and the astuteness and depth of competence of the public bureaucracy are not readily replicated in other countries.\* The evolution of sectoral structure should be market determined.

What are likely to be the characteristics of industries that can compete internationally. On conventional Heckscher-Ohlin-Samuelson (HOS) grounds, African development should be labor intensive, based on batch or continuous processing rather than one-off (typical in the engineering sectors), and arguably not requiring extensive interaction with other sectors. This last criterion militates in favor of industries that do not require local subcontracting though conventional wisdom often argues that measures to foster subcontracting improves smaller firms which in turn diffuses the benefits of larger scale development to poorer owners and workers. However, the existing evidence on the small scale sector suggests that it mainly produces simple

---

\*Pack and Westphal [1986] provides an analysis of the potential benefits from government intervention, its risks, and the exceptionally complex policies followed by Korea in achieving many of the gains. But even there, major costly mistakes arose from government intervention.

consumer goods such as clothing and furniture. Trying to establish a largely new sector that benefits from subcontracting from larger firms would require a substantial effort to generate a broad range of skills. At current levels of education and skill, the transactions costs of extensive subcontracting are likely to be very high.<sup>7</sup>

While specific policies designed to remedy one or two deficiencies of firms in an existing small scale sector may be feasible and effective, building an entire sector de nouveau is likely to hamper rather than help larger firms insofar as subcontractors would likely have high initial costs rather than being able to provide lower cost inputs by exploiting economies of scope. Efficient subcontracting is limited by the extent of the market and is encouraged by low transactions costs and the efficiency of potential subcontractors. In the SSA environment, the two latter requisites are not satisfied.

Similarly, establishment of larger industries with extensive backward and forward linkages to domestic firms may be a mistake. Ever since the discussion of enclave economies, the absence of "backwash and spread effects," and Hirschman's linkages there has been a view supporting the establishment of sectors with linkages, usually favorably contrasted with enclave industries. Nevertheless, unless the sector in question as well as the linked sectors are themselves efficient at international prices (have normalized DRCs  $< 1$ ), linkages are only an accounting entry, without any normative basis. Arguments that strategic sectors with large linkages may nevertheless be "dynamically" efficient implies that their establishment is justified by the Mill-Bastable criterion, i.e., the present value of their future social benefits (inclusive

---

<sup>7</sup>With respect to such costs in the machinery industry see Pack [1981].

of any external economies) exceeds the present value of their excess costs. While it is possible that some investment in strategic sectors may be justified on this basis, there is no empirical evidence of which I am aware that confirms this.<sup>6</sup>

As is by now well known, the HOS model does not provide predictions about specific sectors that will emerge in the long run in response to market signals. The general characteristics of the industries with comparative advantage (labor intensive, long production runs, an absence of rapid change in product specifications) can be gleaned from a properly augmented HOS model. However, such broad predictions are not helpful in public planning, particularly with respect to education. For example, cotton textiles satisfies many of these criteria and might emerge as a low DRC activity; the capital-labor ratio is potentially low (assuming the correct choice of technology), interactions with other manufacturing sectors is limited, and so on. Yet the emergence of an efficient sector might be severely constrained by the absence of a few key technicians. In more industrialized countries with a greater general education base and many trained technicians, current and prospective wages provide the requisite incentives to elicit the small additional amount of specific education required to provide a well trained chemical or mechanical engineer with the skills necessary in textile production. A similar response to market signals is unlikely in a poor African country. There are too few persons with the necessary education background or skills to make marginal changes a quantitatively sufficient source of textile engineers. This implies that even where reliance is to be placed on a market generated

---

<sup>6</sup>The most obvious cases to support such views arise in East Asia, particularly in Korea and Japan but there have been no empirical case studies even there confirming that the Mill-Bastable criterion was satisfied.

pattern of sectoral expansion, educational and skill planning must still be considered.

While it is easy to respond that a sector will not expand in a price determined market in the absence of the relevant skills as their absence implies high marginal costs, it is likely that such costs are high for all industrial sectors. While a hierarchy of profitability may exist given current factor constraints, these rankings may be greatly altered by small additions of the constraining resources. The DRCs that arise from the solution of an optimization problem with existing resources may differ widely from those emerging with a relatively small addition to the pool of specific high level skills. Measures of current comparative advantage are unlikely to be robust with respect to small changes in factor availability. Long term or dynamic comparative advantage is still more sensitive insofar as small flows of the scarcest factors will have a large impact on relative stocks

Some would argue that the sensitivity to small changes in resources militates in favor of selecting a subset of industries that conform to the general HOS criteria and fostering their development while relatively narrow long term training geared to these sectors is pursued. This approach while feasible, is clearly risky - international consultants, domestic bureaucrats, and international civil servants have no obvious advantage in "picking winners" at the seven digit SIC level. And, it would be critical if such an effort were made, to allow wrongly chosen sectors to atrophy, a difficult political issue within the African context

Short of a policy of identifying emerging long term comparative advantage by subsector, can a government do anything to improve industrial sector prospects? A strategy that is not tied to specific sectoral evolution

would consist of sending a number of students for foreign training in business administration and a wide mix of engineering programs not geared to specific subsectors but appropriate for the broad sectoral categories likely to be important in SSA. These guidelines would militate in favor of mechanical and chemical engineering and against training in rapidly changing technologies represented in electrical engineering and biotechnology. The training should be at the Master's degree level; more advanced education reduces the probability of return to one's country and may reduce concern with production problems as opposed to research. One of the highest returns to aid donors would probably accrue from financing the provision of such training. While most economists point to the great benefits derived from price denominated policies by the Gang of Four, there is substantial evidence that the accumulation of human capital was particularly important in fostering industrial growth.<sup>9</sup>

With a set of skills obtained from technical and business education, the additional industry specific training will not be lengthy as particular sectors emerge. The general training will serve as a basis for either internal education by firms or formal industry specific education. This strategy for providing a broad range of training that can be transformed relatively quickly to sector specific skills will work best if the development is undertaken in conjunction with agents who already have the specific skills, for example INCs, so that the sector can emerge "naturally" as dictated by comparative advantage. I will return to the question of the appropriate agents for long term industrial development below.

---

<sup>9</sup>See, for example, Pack and Westphal [1986] on Korea and Pack [1990] on Taiwan.

There is much discussion of two long term industrialization strategies with respect to SSA, namely, resource-based industrialization (RBI) and basic industries.<sup>10</sup> The latter envisions self-sufficiency in a large number of basic sectors, particularly those manufacturing "producers" goods, best defined as exhibiting large forward linkages; increased self-sufficiency i.e. still more import substitution is espoused apparently regardless of cost. It is late in the day for proponents of this policy unless it can be shown that the sector with large forward linkages is itself characterized by a low DFC as are the industries with significant linkages. By themselves, high linkages are not a useful criterion for investment decisions.

RBI is best envisioned as arguing that industries processing local raw materials have a conventional comparative advantage in such activities. One advantage of viewing likely sectoral development from this perspective is the narrower range of industries likely to emerge and the possibility of gearing some of the necessary training to specific sectoral requirements. Nevertheless, despite its potential, the mere presence of natural resources does not establish a case for processing the resource or establishing industries based upon this material. Unless the processing or production can be carried out at internationally competitive costs, it is best to export the raw material. To take one example from a different region, the local processing of long staple cotton in Egypt has been characterized by extremely high DFCs in this activity.<sup>11</sup> Especially where the processing involves substantial scale economies and downstream marketing occurs within an

---

<sup>10</sup> A good discussion of the RBI strategy is contained in Roemer [1979]. The employment implications of RBI and heavy industry strategies are analyzed by Roemer, Tidrick, and Williams [1976].

<sup>11</sup> See Ikram [1980], Chapter 11 as well as references cited therein.

oligopolistic market, there is a strong argument for considering international partnership whether DFI, joint ventures, or some other form.

### 3. Productivity Improvement at the Industry Level

This section contains a number of observations about attempting to organize an industry such that the productivity of its constituent firms is high relative to an international standard.

#### 3.1 The Short Term

Where many firms currently constitute an industry, rather than one or two in sectors like pulp and paper, an important potential source of productivity growth is bringing each of the firms towards the level of TFP of the most efficient firm, assuming that significant dispersion exists. It has been found that textiles, sawmilling, and other industrial activities sectors in several countries exhibit a considerable amount of dispersion (Page [1980], Pack [1987]). Moreover, even the best firms may fall far short of internationally realized productivity levels and a further fillip to domestic productivity can be obtained by moving all firms, both best practice and those falling short of it, towards international productivity levels.

The conventional wisdom is that such changes will occur automatically if all firms face heightened competitive pressures from tariff reduction or the elimination of quotas. However, if weaker firms cannot respond to such inducements, they may simply face bankruptcy. This is undesirable for two reasons. First, the firms and their workers may offer significant political opposition to such national policy changes, undermining the chance of adopting socially desirable policies. Second, most SSA markets are not filled with potential entrants who will buy the physical assets of defunct firms. Hence,

bankruptcy may imply the loss of the productive power of physical equipment that is potentially profitable as well as the dispersion of a group of workers with accumulated industry-specific skills.

Assuming that the industry consists largely of privately owned firms, how can the government eliminate the dispersion of productivity (or move towards international productivity) without coercive measures that force the sharing of managerial information among existing firms. The particular policy instruments chosen depend on the source of low productivity. For example, if the problem lies in excessive product diversity or insufficient intraplant training of workers due to the fear of worker mobility (assuming that firms perceive that they bear the cost of training), explicit measures need to be taken on an industry-wide basis. These will be discussed below. If it is determined that a major problem lies in the insufficient command of production engineering, the solution lies at the firm level, discussed in the next section.

For industry-wide mechanisms to work, it is necessary to induce cooperation by the constituent firms. Assuming that firms are privately owned, a carrot and stick are both required. The stick is the threat to profitability of preannounced liberalization. The carrot is use of the tax system or loans to help firms adjust. Consider first the case of industry-wide training centers. Unless all firms are compelled to pay for such a facility, it will not be established given that benefits will accrue to each firm regardless of whether it has shared in the cost, the classic free-rider problem. Given that substantial social benefits are likely to accrue from such training, firms can be required to contribute depending on the level of gross sales, payments

being tax deductible at greater than 100 percent, though not at a level that would lead to firms incurring no net costs.

A more difficult industry-wide issue arises where low productivity results from insufficient product specialization within firms. Firms often accept very small orders in order to utilize existing equipment more fully. Nevertheless, the economies of scope they achieve by this process are more than offset by the higher costs incurred from frequently stopping the production process to allow changes in machine settings and the excess learning costs on each short run.<sup>12</sup> An optimal solution requires a narrow range of specialization by each firm, rents being precluded by the entry of each product at international prices. The conundrum here is how to achieve such specialization if it does not arise spontaneously from liberalization. In much larger, more open economies such as Canada, excessive intraplant product diversification remains a problem and it is far from clear that this would not be the case in most SSA countries even with extensive liberalization.<sup>13</sup>

A conundrum exists about how to realize specialization where it does not arise automatically from liberalization. Given the large national benefits that may be obtained, what mechanisms can be employed? The Korea-Japan solution has often been a cartel-like arrangement in which individual products are assigned to particular firms, efficiency incentives being provided by the threat of withdrawal of various government preferences unless exports are realized. This method involves considerable intervention by an extremely able bureaucracy, the political will and ability to terminate preferences, and the

---

<sup>12</sup>A more detailed analysis is presented in Pack [1987], Chapters 2 and 3.

<sup>13</sup>For an extensive review of the literature on the role of market size in developed countries see Caves [1989].

capacity to carefully monitor exports by type. While this form of intervention has worked very well and can be justified by reference to the social losses involved where a pure market solution results in significant interim losses in output, the political and bureaucratic requirements for success are not met in SSA. In most of SSA a mechanism is needed that results in the appropriate level of specialization without the need for guidance and monitoring by the government.

One option is the assignment of products by a government sponsored industry group. Negotiations among members, without a government presence, can assign products by firms' calculation of their current comparative advantage among products. Assuming that liberalization will be implemented, the possibility of extracting rents by monopoly position in one area is minimized. The argument for government enforcement of the privately reached agreement is that of a market failure similar to natural monopoly. Each firm's cost declines as its output of the specialized product increases whereas larger total production of a varied bundle of goods will not result in reduced costs.

#### IV. The Firm Level

Two sets of issues need to be addressed at the firm level: improving the productivity of existing firms and the choice of management and ownership alternatives likely to result in the most efficient performance of new firms.

##### 4.1 Improving the Productivity of Existing Firms

As noted earlier there is no systematic evidence on the source of low productivity in the African industrial sector. Casual empiricism plus a few systematic studies, largely limited to the textile sector, suggest that short production runs and managerial technical and administrative shortcomings are

of considerable quantitative importance whereas deficient labor skills do not loom large in explaining low productivity. Measures that might remedy excessive product variety in existing firms have been suggested above. Better managerial practice is addressed in this section.

There are two aspects of managerial competence that are of interest, namely, a move towards existing international best practice and trying to keep up with changes in static best practice. The importance of the latter varies among sectors depending on the rate of technical innovation in competing countries. In contrast, in all branches it is desirable that the production engineering capability of all firms should move towards the prevailing level of international best practice as long as the marginal cost of achieving such a movement is less than the marginal revenue from the resulting additional output. In addition, where there is substantial diversity among companies within a country, the diffusion of knowledge from more to less productive firms can provide a significant addition to the benefits from international diffusion.

I will first consider measures to help firms realize extant international best practice. Many mechanisms have been suggested to obtain the implantation of international knowledge within developing countries. These include the hiring of short term international consultants, the establishment of an industry-wide research and consulting group, the purchase of licences and other knowledge from foreign firms producing similar products, and so on. Most suggestions along these lines envision relatively short periods of contact between those outside and inside the firm, the assumption being that simply identifying production problems and suggesting solutions is sufficient. In contrast, the major productivity augmenting program at the firm level

should, I believe, consist of hiring a group of skilled foreign nationals to be employed for three to five years in each of the firms. Their contracts should be based on their performance, defined to include both improvement in critical production engineering parameters as well as training local replacements. Advocacy of this mode of knowledge transfer is based on the following perceptions.

A considerable literature, based largely on historical evidence, suggests that the diffusion of technology - both new processes and new products - results mainly from the movements of individuals from firm to firm and from country to country; a critical dimension of this mode of technology transfer is sustained contact between transmitters and recipients of knowledge. The precise behavioral reason for the importance of sustained person-to-person contact is rarely articulated (but see Arrow, 1969): possible interpretations include the role of tacit or uncodified knowledge (Nelson and Winter [1982]); the importance of an advocate of a particular change in breaking down an organizational equilibrium that favors the low productivity status quo (Pack and Pack [1977]); and the reduction in uncertainty and the cost of information acquisition when a person with production experience is on hand - as opposed to the abstract and locally untested technical possibilities available from other sources. Whatever ultimate combination of reasons accounts for the decisive role of individuals in the transmission of operational command over new processes and products, there is no evidence that the diffusion of best-practice routines can be effectively achieved by other modes such as that provided through licensing of specific processes. Information recently collected in the Republic of Korea confirms the role in knowledge diffusion of informal personal contacts although more formal modes such as advice from purchasers of exports and knowledge obtained from recently

returned Koreans with U.S. work experience are also important. (Westphal, Kim, and Dahlman [1985]; Westphal, Rhee and Fursell, [1981]).

In most African countries there are a small number of firms in each modern industrial subsector, a desirable pattern given the smallness of the typical market and the need to realize economies of scale. Unfortunately, the reverse side of the coin is that firms cannot rely on interfirm mobility or informal contacts with other firms to derive new production knowledge or knowledge of better practices. Rather than the knowledge "leakages" from firm to firm that constitute a quasi-public good in more developed countries, engineering information is likely to be more closely guarded in the SSA context - firms cannot assume that they will receive inflows roughly equal (statistically) in value to the outflows of information that would characterize a more thickly populated industrial sector.

Given the absence of interfirm mobility, limited informal contact, and little transmission of foreign methods by returning nationals or purchasers of exports, some mechanism to substitute for these modes of technology transfer is desirable. Licenses, technical aid from foreign manufacturers, and a central consulting group composed of domestic technicians constitute alternatives to the long-term hiring of individuals by firms. The necessary changes in production engineering are not, however, likely to be implanted on a one-shot, short term or sporadic basis typical of these alternative modes for transferring knowledge. Problems arising from the variation in products or processing environment occur frequently. Changes in the nature of raw materials, new product designs, and new developments in production engineering will pose unanticipated problems whose solutions will differ from those obtained with earlier practices and in different locales. Adaptability in

these dimensions is particularly important as industries become export oriented and the changing world market, even in relatively standard products such as textiles, necessitates changes in design or material use. The critical importance of maintaining an ability to keep up with technical changes is carefully developed by Lall [forthcoming] in the case of India. Successful absorption of improved production engineering practices requires not only initial learning but also an ability to modify practices as circumstances change. The implementation of the necessary adaptations on an ongoing basis can best be undertaken by those with a medium to long term commitment to the firm. Moreover, learning by local personnel about how to respond to similar future challenges is also likely to best be learned by observing specific behavior in a sequence of responses to external changes rather than from one or two cases.

#### 4.1.a The Role of Competition in Obtaining Greater Productivity

A textbook view of industry dynamics might suggest that explicit policy efforts to spread knowledge are unnecessary. Faced with sufficient competitive pressure, firms will be compelled to devote greater effort to the search for technical knowledge to maintain profit rates equal to those in other endeavors. This position has much force. Any effort to promote the diffusion of knowledge must be embedded within a wider policy framework designed to increase competition. Nevertheless, the view that competition is all that is required is too facile. Attribution of the success of the superexporters of East Asia solely to their reliance on market forces does not accord with the facts. (Pack and Westphal [1986]). In these countries competitive forces have been allowed full sway only after substantial technical learning has taken place and firms are internationally competitive. A liberalized economic milieu

and a policy to increase technical competence are the two blades of the scissors necessary to achieve decreased cost. Either is likely to be considerably less effective without the other. In the sub-Saharan context, most studies cite a relatively low level of technical managerial skills. If the industrial sector were exposed to competition without an attempt to improve its performance, many factories would be forced to close.

Given the preceding background, the criteria that need to be satisfied by any mechanism designed to improve productivity in existing firms include: personal supervision and interaction on a long term basis and substantial incentives to the individuals engaged in these activities. Two alternatives that satisfy these criteria exist. Individuals could be hired by the companies involved; probably the most desirable source of such technical help would be persons who are currently working in similar plants in more advanced LDCs. They are more familiar with LDC problems and their compensation is considerably lower than their peers from DCs. A second alternative consists of persons who have recently retired from similar pursuits in DCs. A large pool of such persons now exists and their talents are often wasted. Many would welcome a second career. Moreover, their salaries could be paid partly by multilateral and bilateral aid agencies, particularly where the latter have been accumulating local counterpart funds.

Regardless of which group is hired, contracts should have incentive clauses in which remuneration should be tied to agreed upon and measurable changes in productivity or specific engineering variables. The agreements should require a minimum of two years of service with some considerable part of remuneration not payable until the end of the contract.

A considerable body of informal impressions militates against the hiring of international consulting firms, a third possible mode for improving productivity in existing firms. Many of these firms have their origins in, and primary loyalty to, the industrial sectors they cater to in their home country. As a result, they may be somewhat reluctant to strengthen its potential competitors. Moreover, they have a predilection to suggest that the solution to low productivity lies in additional equipment, particularly where their country produces such machinery. Rather than addressing the difficult problems of improving the technical and organizational abilities of the firms to whom they are consulting, they often recommend a short term technical fix embodied in new equipment. While such injections of technology occasionally redress some of the initial problems that exist, within a year or two a new generation of difficulties reappears as a result of the yet to be addressed fundamental organization and software problems.

Government policy can make the long term hiring of individuals more attractive to firms by allowing technical aid costs to be deductible at rates greater than 100 percent when taxes are calculated and by not subjecting foreign nationals to local personal income taxes. Firms will face an incentive to hire in an environment in which they will face increasing international competition as tariffs are lowered and quantitative restrictions eliminated.

#### 4.2 Obtaining High Productivity From Newly Established Firms

Measures to insure that new firms realize high productivity include several already discussed. Perhaps the main consideration is that new firms must find it credible that they will not benefit from a protected domestic market for any protracted period. Even given such a policy environment, it is nevertheless the case in many SSA countries that there are few indications of

a large body of potential entrepreneurs. Thus, even where the policy makers create a policy of short term protection (preferably uniform effective protection) with a credible schedule for liberalization, one has no guarantee that the desired supply will be forthcoming. It is possible to take the view that the maintenance of the policy environment will eventually elicit the requisite entrepreneurial and technical skills. Nevertheless, many of the successful NICs have been considerably more interventionist than this (Fack and Westphal [1986], Yamamura [1986]) in an effort to accelerate the structural transformation of their economies. Such a policy may be desirable if carefully pursued, particularly the effort to augment domestic supply responsiveness.

Korea carefully nurtured domestic supply capacity by a subtle set of domestic interventions. One can interpret many of the measures that were undertaken as an effort to intervene where various market failures were known to exist (Fack and Westphal [1986]). It appears, however, that Korea had considerably greater levels of local domestic technological capability than the SSA countries. In contrast, a key constraint in SSA may be the absence of supply response. In the long run, as noted earlier, the appropriate policy is to send nationals abroad for training. In the short run, if new capacity is to be established one needs to seek mechanisms to substitute for absent domestic skills. Moreover, the long run consists of many short runs. As nationals trained abroad return, additional in-plant learning will be required and should take place in efficient factories, both existing ones whose productivity is being improved by expatriates and those that are newly established by efficient organizations. Several examples in SSA suggest that MNCs are an obvious vehicle for establishing new plants in the absence of insufficient local abilities.

Detailed analyses of productivity in Kenya and Zimbabwe (Pack, 1987, 1986) demonstrate that MNCs operating integrated textile mills have achieved production engineering performance close to that of best practice plants in the developed countries. While individual plants exhibit total factor productivity lower than that characterizing best practice plants, this largely reflects excessive product diversity. In contrast, productivity in domestically managed textile plants is very low (Pack [1987]) and low quality production engineering is a major cause Tanzania (Mlawa [1983]). The relatively high TFP of the textile mills in Kenya and Zimbabwe and their rapid achievement of such status is almost certainly due to the presence of MNCs of high quality who have been able to implant the procedures followed by some of the better firms from India, Japan, and Western Europe. These abilities, embodied in five to twenty expatriates per firm, have been critical to the success of these textile mills. The presence of these managers resulted in very low marginal costs of acquiring relevant technological information or implementation of desirable organizational changes, and the marginal productivity of such knowledge was high. Where the staff did not possess technical information it knew where to identify relevant sources quickly and cheaply and knew how to incorporate such information productively within the plant. It is precisely these abilities, allowed full scope by an improving policy environment, that have been the technological basis for the spectacular growth of clothing exports from Mauritius by Hong Kong based multinational corporations.<sup>14</sup>

In contrast, the textile sector in Tanzania has not benefited from a similar infusion of international expertise (though one such effort was

---

<sup>14</sup>Meier and Steel, op. cit., pp. 142-45.

aborted before its results could be assessed). Firms established in the 1970s were typically manned by very few trained textile technicians (Mlawa [1983]) and learning by doing has not been realized. Even routine technical problems cannot be dealt with and unusual difficulties present insurmountable obstacles given the lack of technical knowledge within the firm. The differences between Tanzania on the one hand, and Kenya and Zimbabwe on the other, suggest that one option to achieve high productivity in newly established plants is to begin with multinational management. Since the presumptive objective of initiating industrialization before local capacities warrant it is the generation of local technological capability, any enterprises begun on a base of MNC skills should have mechanisms, (and not just in the initial agreement) to insure that relevant skills are transferred.

Apart from their benefit in terms of relatively rapid achievement of high productivity, new plants based on MNC investment are likely to confer two other major benefits, namely, a more appropriate initial choice of technology and a greater ability to export because of their marketing expertise.

An early, large polemic, literature asserted that MNCs chose excessively capital-intensive projects at prevailing market wage-rental ratios. It was claimed that firms simply transfer, without modification, technologies developed in advanced countries. Investigation of this hypothesis (Pack [1976], Forsyth and Solomon [1977]) does not confirm it in Kenya and Ghana. More recent analysis by Ahiakpor [1989] supports earlier research in Ghana that MNCs do not use inappropriate technology. A survey of numerous studies in Asia and Africa (Pack [1979] finds no systematic evidence of the choice of excessive capital-intensity by MNCs. In contrast, locally owned firms, especially state-owned enterprises, often exhibit much greater than

appropriate capital intensity, many examples of this being found in Tanzania and other African countries. (James, [1989], Akiakpor [1986]). The correct choice of technology is important not because it provides more employment per se; rather, intrafirm allocative efficiency, the equation of relative factor marginal productivities with relative factor prices provides one route to obtaining lower unit costs. Firm costs depend not only on technical efficiency or relative total factor productivity but on allocative or economic efficiency.

These findings are surprising because MNCs typically pay higher wages, can borrow at lower interest rates either in the host country or internationally, and often are the beneficiaries of tax provisions denied to local companies that lower their user cost of capital, for example, accelerated depreciation and exemption from excise taxes and tariffs on imported equipment.

Several factors explain why, despite these differences in factor price, MNCs typically choose appropriate factor proportions. First, they can easily identify and transfer equipment among subsidiaries, especially equipment that has become too expensive to use in countries with higher wages because of its labor intensity. Indeed, the parent company may have established a new plant partly to use such equipment in the production of exports. Second, the purchasing office of the parent company typically will provide advice on the purchase of used or new appropriate equipment internationally. Given the high information cost incurred in identifying reliable equipment, such low cost aid to the local manager, in both time and explicit costs, clearly increases the likelihood of his employing appropriate equipment to take advantage of the factor prices he faces. Third, the home office can obtain a better price

insofar as the market for non-standard equipment is better viewed as having a bilateral monopoly structure rather than a competitive one.

The product areas in which African industry are likely to be competitive are labor or resource intensive ones. While such products are often standardized where they are intermediate goods such as gray cloth, there is considerable design and quality variation in typical consumer goods. If consumer goods are to be exported, maintaining an awareness of changing trends in the OECD markets including design and material components is an important activity. Even if local entrepreneurs did not need MNCs to acquire technical production knowledge, the design and marketing (D & M) information would militate strongly in their favor. While it is possible that the D & M function could be performed by local buying offices of major retailers, as has been the case in Korea, the initial location of such buying offices usually comes after demonstrated production and timely delivery capacity. The latter is particularly difficult for many local firms (Morawetz [1981]). The presence of MNCs is a good measure to cut through many of the circularities and simultaneously achieve efficient production and exports. The repatriated profits earned by MNCs relative to their equity capital needs to be compared to the separate costs of production and marketing contracts that would be needed in their absence, and the latter should form the basis for negotiation with them on fees.

Unfortunately, in the sixties and seventies some countries nationalized MNCs or forbid their entry<sup>15</sup> despite the benefits they confer. Often they were

---

<sup>15</sup>See the data on the share of manufacturing value added accounted for by public and private firms in Meier and Steel, op. cit., p.89. Many of the private firms in the four countries on which they provide data are MNCs. To take an extreme case, the share of value added originating in parastatals in Tanzania increased from 5 to 31 percent between the mid-1960s and 1980.

replaced by state owned enterprises which were notably deficient in the skills which the MNCs possess.

#### V. Labor

It is usually asserted that SSA suffers from a deficiency of skilled labor. Unfortunately, such statements lack precision. Labor productivity may be low because of the failure of firms to realize scale economies, economies of specialization or economies of scope; because of low managerial capability that results in delays in inputs arriving at work stations; because of lower machine to worker ratios or lower capacity machines than in comparable plants abroad; finally, because of deficient cognitive and manual labor skills. The implication of conventional statements is that the last is the major source of lower productivity. Nevertheless, a study that attempts to adjust for many of these factors finds Kenyan textile workers almost as productive as those in the U.K. They are employed by MNCs that have engaged in systematic training of relatively short duration. In textiles, and in many other processed oriented branches, substantial previous experience of production workers is not a prerequisite for success. Relatively short periods of classroom and on-the-job training in firms can be quite successful assuming that workers are literate and numerate, i.e. have good elementary education.

Even for such industries in which almost all production workers can be quickly brought up to high standards by a skilled management team, a shortage may exist of highly trained technicians such as electricians, machine repairers, and so on. In the short run, firms hampered by an absence of such

---

skills should have access to expatriates. While indigenization is a laudable goal, it may be very expensive in terms of the value of foregone output. Simultaneously with the import of a very small number of workers to relieve critical bottlenecks, domestic training should be expanded in vocational schools combined with on-the-job training in operating firms. Firms should receive subsidies for cooperating given the costs incurred by them and the probability of not being able to retain a high percentage of the workers so trained.

The preceding observations militate against the establishment of non-process sectors such as engineering. Whereas a high percentage of production workers for the process sectors can be relatively quickly trained, the very high level of formal education and apprentice training required in metal working, machine building, and similar activities imply that these are not sectors likely to exhibit either a current comparative advantage or one likely to emerge in the near future.

## VI. The Small Scale Industrial Sector

This paper has been entirely devoted to a discussion of the modern, relatively large scale industrial sector. At the other end of the spectrum is the informal sector characterized by small workshops with a few employees, using little electric powered equipment, and typically producing products with low income elasticities of demand. In Asia and Latin America, there is also a robust small scale industrial sector with say 10 to 50 employees that are often very efficient manufacturers of a variety of products with high income elasticities of demand. Although there is some activity of this sort in West

Africa, there is little of it in other regions of sub-Saharan Africa.<sup>14</sup> Unfortunately, very little is understood about the requirements for fostering either this sector or the informal one. While it is tempting to try to implant a sector which in other environments has proved to be efficient, and an important source of growth of output and employment, the conditions necessary to success may not be present and artificial stimulation may yield low marginal returns.

## VII. The Policy Package

The elements of a productivity augmenting package discussed so far should be part of a policy package that includes four elements: (1) a general reduction in tariff rates and the elimination of quantitative restrictions; (2) the provision of collateral backed loans for for improving production engineering; (3) eligibility for loans as long as firms cooperated in an industry agreement to engage in product specialization; (4) loans for new equipment or rehabilitation of older equipment would become available at the end a prespecified period.

The program of liberalization and productivity enhancement offers firms the opportunity to borrow from an industrial development bank to finance efforts to augment productivity. While productivity enhancement efforts, particularly the hiring of foreign experts is proceeding, tariffs and CEs

---

<sup>14</sup>The literature on small scale enterprises in Africa with more than ten employees is surveyed by Page and Steel [1984]. New results on the life cycle and robustness of microenterprises, roughly firms with less than ten employees is presented by Liedholm and Parker [1989].

should be reduced, first on inputs, then on the final product. The entire process is likely to have its greatest impact if the addition of technical personnel is not accompanied by a parallel attempt to rehabilitate existing equipment or introduce new equipment. Although such improvements may be necessary at some point, the management of the firm is unlikely to be able to absorb simultaneously the results of both new techniques of production engineering and physical rehabilitation; their independent effects may be confounded by the intended beneficiaries. In particular, the introduction of new machinery may mistakenly be viewed as the sole source of improved productivity. The perception of the contribution of production engineering and greater product specialization might therefore be lost.

The liberalization effort should be designed to reinforce the learning program by enabling firms to obtain inputs at world prices; the resulting augmented competitiveness should reinforce their desire to absorb the ongoing technology transfer and should increase their confidence in their ability to withstand the gradual lowering of protection on their own output.

Finally, although the precise detail of any industrial improvement effort will depend on country-specific circumstances, the provision of new machinery should be low on the agenda of planned industrial policies. One of the most important lessons of the past two decades is the relatively minor role of simple physical capital accumulation. The accumulation of technical capacity in both production and marketing appears to be much more important to sustained development success.

## References

Ahiakpor, James C.W., 1989, "Do firms choose inappropriate technology in LDCs," *Economic Development and Cultural Change* 37:557-572.

———, 1986, "The capital intensity of foreign, private local and state owned firms in a less developed country:Ghana," *Journal of Development Economics*, 20:145-62.

Arrow, Kenneth J., 1969, "Classificatory notes on the production and transmission of technological knowledge," *American Economic Review*, 59, pp. 29-35.

Caves, Richard, 1989, "International differences in industrial organization," in Richard Schmalensee and Robert D. Willig, *Handbook of industrial organization*, Volume II, Amsterdam:North Holland.

Forsyth, David J.C. and Robert Solomon, 1977, "Nationality of ownership and choice of technique in manufacturing in a less developed country," *Oxford Economic Papers* 29, pp. 258-82.

Ikram, Khalid, 1980, *Egypt: economic management in a period of transition*, Baltimore, Md., Johns Hopkins.

James, Jeffrey, 1989, *The technological behaviour of public enterprises in developing countries*, London, Routledge.

Lall, Sanjaya, 1987, *Learning to industrialise: the acquisition of technological capability by India* London, Macmillan.

Liedholm, Carl and Joan Parker, 1989, "Small scale manufacturing growth in Africa: initial evidence, working paper no. 33, Michigan State University International Development Papers.

Meier, Gerald M. and William F. Steel, 1989, Industrial adjustment in Sub-Saharan Africa, (New York, Oxford University Press).

Mlawa, Hasa Mfaume, 1983, The acquisition of technology, technological capability, and technical change: a study of the textile industry in Tanzania, Ph.D. diss. University of Sussex

Morawetz, David, 1981, Why the emperor's new clothes are not made in Colombia: a case study in Latin American and East Asian manufactured exports (New York, Oxford University Press).

Nelson, Richard R. and Sidney Winter, 1982, An Evolutionary Theory of Economic Change, (Cambridge, Harvard University Press)

Pack, Howard, 1976, "The substitution of labour for capital in Kenyan manufacturing," The Economic Journal, 86, pp. 45-59.

Pack, Howard and Janet Rothenberg Pack, 1977, "Urban land-use models: the determinants of adoption and use," Policy Sciences, vol 8, no. 1, March, pp. 79-101.

Pack, Howard, 1979, "Technology and employment: constraints on optimal performance," in S. Rosenblatt, ed., Technology and economic development: a realistic appraisal (Boulder, Westview Press)

Pack, Howard, 1981, "Fostering the capital goods sector in LDCs," World Development, 9:227-50.

Pack, Howard, 1986, An evaluation of the textile sector in Zimbabwe, processed.

Pack, Howard and Larry E. Westphal, 1986, "Industrial strategy and technological change: Theory versus reality," Journal of Development Economics, Vol. 22. No. 1, June, 1986, pp. 87-129.

Pack, Howard , 1987, Productivity, Technology, and Industrial Development, Oxford University Press.

Pack, Howard, 1990, "New Perspectives on Industrial Growth in Taiwan." processed.

Page, John M., 1980, "Technical efficiency and economic performance: Some evidence from Ghana," Oxford Economic Papers, 32, pp. 319-339.

Page, John M., and William E. Steel, 1984, Small enterprise development, World Bank Technical Paper Number 26, Washington, D.C.

Rhee, Yung Whee, 1989, 'Managing entry into international markets: lessons from the East Asian exporters,' Industry Series Paper No. 11, Industry and Energy Department, The World Bank.

Roemer, Michael, Gene Tidrick, and David Williams, 1976, "The range of strategic choice in Tanzanian industry," The Journal of Development Economics 3:257-76.

Roemer, Michael, 1979, "Resource based industrialization in the developing countries," Journal of Development Economics, 6:162-202.

Westphal, Larry E., Linsu Kim, and Carl Dahlman, 1985, "Reflections on Korea's acquisition of technological capability," in: Nathan Rosenberg and

Claudio Frischtak, eds. International technology transfer: Concepts, measures and comparisons (New York, Praeger)

Westphal, Larry E., Yung W. Rhee, and Gary Fursell, 1981, Korean industrial competence: Where it came from. World Bank Staff Working Paper no. 469 (Washington D.C.)

Yamamura, Kozo, 1986, Caveat emptor: The industrial policy of Japan, in Paul R. Krugman, ed. Strategic trade policy and the new international economics, (Cambridge, M.I.T. Press).