TECHNICAL CHANGE AND THE MULTINATIONAL CORPORATION: SOME BRITISH MULTINATIONALS IN KENYA & INDIA

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ABSTRACT

This working paper follows I.D.S. W.P. 229 which looked at the behavour of subsidiaries of seven Brish multinationals on Kenya with respect to the generation and acquisition of new technology. In this study the behaviour of the seven Kenyan subsidiaries is compared with that of eight Indian subsidiaries.

CONTENTS

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Technical Change and the Multinational Corporation: Some British Multinational in Kenya and India

Introduction

This research focuses on one aspect of the link between developed and underdeveloped economies as embodied in the presence of multinational firms in Kenya and India. The primary aim of the research has been to gauge the different response of some multinational firms to the operating conditions in two underdeveloped economies as there is a noticable absence of empirical research into the activities of these subsidiaries with respect to the generation, and acquisition of new technology.

A total of eleven subsidiaries have been studied. Ten are British based and of these four have been studied in both Kenya and India, three in Kenya alone and three in India alone. One Dutch based multinational is also included in the Indian sample. Detailed investigation has been undertaken through the medium of interviews and other supplementary research to establish how the subsidiaries of these firms set about obtaining technology for their operations and how the parent organises the acquisition and generation of technology suitable for the operations of their subsidiaries.

It should be stressed that no attempt has been made to obtain detailed quantitative estimates of the operations of these subsidiaries or their parents. The main reason for this has been that the research has been undertaken in part in the form of interviews. It is not believed that the responses with regard to financial expenditure given in these interviews is sufficiently accurate to enable detailed analysis of a precise nature. Instead an attempt has been made to draw out the 'qualitative' aspects of their activities, focussing less on the precise estimates of expenditure on particular activities, but more on whether these activities take place, and in what form they occur.

Some limitations of this study follow from its limited scope. No attempt is made to analyse certain implications of technical change to some basic interests of the host countries. For instance, issues such as whether technical change effected by the multinationals is consistent with factor endowment is not examined. The question whether technical change has been detrimental to a more appropriate and desirable indigenous technology is also not evaluated. These limitations of the scope here are obviously inherent in a short-term study like this.

The discussion of the research will take the following form. Firstly an attempt will be made to define more clearly what is meant by technology and to differentiate between change in three spheres of

technology - production, product and materials technology. The distinction will also be drawn between proprietary and non proprietary technology and between embodied and disembodied technology. Technical change in the three spheres may be generated within the subsidiaries or may be obtained from parent, or non-parent sources external to the subsidiary.

The second section of the research offers a brief description of each of the subsidiaries in the sample and compares their relative turnover, capital intensity etc. This is followed by a third section which discusses the orientation of technical change in the eleven subsidiaries, drawing the distinction between changes in production, product and materials technology, and change resulting from other inducements.

The fourth and fifth sections of the research deal with the acquisition of new technology. In the former the generation of technical change within the subsidiaries is considered and particular attention is given to the role of quality control activities in this process. The latter section considers the purchase of parent and non-parent technology, and distinguishes between the right and the ability of subsidiaries to determine their own sources of supply. Consideration is also given to the types of technological collaboration entered into by the subsidiaries.

The sixth section of the research considers the mechanisms used by the seven firms to circulate new technology. Particulary important here is the use of disembodied technology as a mechanism of circulation. This is followed by a seventh section which deals with the stimulation of forward and backward linkages as a result of the presence of these seven subsidiaries in Kenya and India. Consideration is given to the nature of entrepreneurship which results from these linkages.

The conclusion follows and sets out the basic results of the research. It then considers the sources of variance in the behaviour of the subsidiaries with regard to the generation and acquisition of new technology. The research is concluded by a brief discussion of some other points of interest which have arisen.

I. A Few Introductory Points (1)

A distinction has been drawn between three spheres of technical change in this research. There are changes in production technology, changes in materials technology and changes in product technology. In the case of product technology, three sub-spheres have been distinguished -- product innovations, adaptations and differentiations. The recognition of these differing spheres it is believed will assist in the under-standing of the research results.

The distinction has also been drawn between embodied and disembodied technology. In the case of disembodied technology the difference between man-disembodied and firm-disembodied technology has been noted. In the latter case, the departure of particular strategic individuals from the enterprise may lead to a loss of this technology. In the former case, the disembodied technology is incorporated in the organisation of the firm and is not lost with the departure of specific, individuals. Similarly the research notes the ... differences between proprietary and non-proprietary technology, and in the former case between parent and non-parent proprietary technology.

A final introductory point is that the research is concerned with the generation and acquisition of technology by the subsidiaries. The generation of technology may result from formalised research and development activities or it may arise, as Katz found in Argentina, through trouble-shooting induced changes in the technology. It may also arise, as it is argued in the latter part of this research, through quality control activities in the subsidiary. The ability to acquire technology is itself a technology of a disembodied kind, so some attention has also been placed on both the rights and the abilities of the subsidiaries to acquire technology independently from the parent.

II. The Sample of Firms.

(a) Kenyan Sample

Subsidiaries of seven British multinations were interviewed. Three of these firms were in the consumer goods sector, of which two produced pharmaceuticals, cosmetics and baby products. For the other firm in this group, the largest in the sample, tea and coffee are the main products. Two of the other firms were in the intermediate goods sector. One of these, which produces cement [2], is the most capital intensive subsidiary in the sample the other, assembles buses, trucks and four-wheel drive vehicles[3] Finally there are two capital goods subsidiaries. One is an engineering design and installation firm and the other manufacturers tea processing equipment. It is of some value to give a brief description of each of the seven subsidiaries in the sample. Table 1 summarises the most important features of each of these firms, and table 2 provides an estimate of the degree of capital intensity[4]

A number of points emerge from Table 1. The three consumer goods industries (pharmaceuticals and tea) all export some of their output, with the share being particularly high for the tea producer. All three are characterised by a high parent share of equity (100 per cent, 100 per cent

and 88.75 per cent respectively)- it is not clear why this should be the case, but it may be related to the relative simplicity of these firm's operations which means that equity-holdings is a relatively important control-mechanism for the parents(5) (by extension the same should occur in the case of the vehicle assembly operation, which is another relatively simple operation - in this case, however, the government has enforced a local shareholding in negotiations to set up the new assembly plant). The two pharmaceutical firms have similar import content, but differ in size and propensity to export.

The two intermediate good firms (cement and vehicle assembly) are similar in anumber of areas. Neither exports any output, both have a relatively low value added per employee both have a relatively high turnover and a relatively low share of parent equity. The main difference between these two firms arises with respect to their propensity to import - the vehicle assembler has the highest and the cement manufacturer the lowest propensity to import of all the firms in the sample.

The two capital goods firms are characterised by smallness of size - they have the lowest turnover, the lowest employment and the smallest fixed capital of the sample. They have a greater tendancy to export and relatively high share of parent equity. The most striking thing about these firms is their high level of value added per employee in spite of their small fixed capital - this suggests that dismbodied technology is an important input in their operations.

Since we are interested to some extent in the production technology used by each of these subsidiaries, it would be useful to have some indication of the capital-intensity of each subsidiary. The measure which is chosen to reflect this capital intensity is the value of fixed capital (machinery and equipment) per employee. This is the best indicator available, the main problem being that it only reflects embodied technology. This works to the disadvantage of Firm F and, to a lesser extent, of Firm C, both of which have invested resources in human capital. Another disadvantage of this measure is that it works to the disadvantage of firms with an old stock of capital - that is Firms C and F.

The cement producer emerges as the most capital intensive firm in the sample. It is followed by the two pharmaceutical firms. The similarity of the ratio for these two firms represents the similarity of their operations (mixing ingredients, pressing pills and packaging). The low figure represented

for the vehicle assembler reflects the fact that this subsidiary only assembles at a simple level. The tea producer also appears to be labour intensive, despite the fact that the value of its fixed capital in aggregate terms is the largest of all the firms in the sample - this partly reflects the labour intensity of tea and coffee cultivation and partly the fact that much of its capital is held in the form of land, rather than machinery. The two capital goods producers are the most labour intensive firms in the sample. This is not unexpected and, as already mentioned, leads to the observation that the disembodied technological input for those firms is probably high.

(b) Indian Sample

Subsidiaries of eight multinationals were interviewed in India, seven of which were British firms and one of which was Dutch. Four of these subsidiaries (two pharmeceuticals, one edible oils and soap and one tea and allied products) were predominantly producers of consumer goods, although they did also manufacture some intermediate goods. The other four subsidiaries were mainly concerned with the production of intermediate goods (i.e. vehicle assembly, electronics, tyres and packaging materials.) The basic [illegible] characteristics of these eight subsidiaries are shown in table 1.

In spite of government policy that majority ownership should be Indian, particularly in low technology sectors, all of the subsidiaries are owned predominantly by the parent. The relatively high share of parent held equity in the tea producer in perhaps explained by the fact that the relatively low technology involved requires the parent to exercise control through equity holding, rather than through technological links.

Only the tea producer, the tyre manufacturer and the vehicle assembler show a sizeable proportion of exports as a percentage of sales. In all cases imports are a small proportion of sales. It is perhaps suprising that the range of value of sales per employee in the different subsidiaries does not vary more widely (with a maximum of £5457 and a minimum of £2376), since the range of activities varies so widely.

Measuring capital intensity by the written down value of capital per employee (table 2) the most capital intensive of the Indian subsidiaries are the vehicle assembling and tyre producing subsidiaries. These are followed by the two pharmeceutical subsidiaries (with a broadly similar range), then the electronics firm, the packaging subsidiary. The tea producer appears to be the least capital intensive of the subsidiaries.

(c) Comparison of Kenyan and Indian Samples.

A total of eleven different firms were studied in the two countries. Of these four firms were studied in both India and Kenya (tea and alied products, two pharmeceutical firms and one vehicle assembler). Three firms were studied only in Kenya (cement, refrigeration and engineering design, and tea machinery) and four only in India (electronics, edible oils etc, tyres and packaging materials). Comparison between the Indian and Kenyan subsidiaries is of course /compounded by the familiar problem of choosing a suitable measure of value. The method chosen has been to convert local currencies to the unit of account of the parent (with the exception of the Dutch subsidiary), that is pounds sterling. This is considered as the least worst alternative available and if not too much precision is required, it does allow some meaningful comparison.

The most striking difference between the two samples id their relative size. Only one Indian subsidiary (C, a pharmeceutical producer) is smaller than any one of the Kenyan subsidiaries and in all four cases where matching subsidiaries were studied, the Indian subsidiary had a larger turnover. The turnover of the largest Kenyan subsidiary was only 27% of the size of that the largest Indian subsidiary, and that of the smallest Kenyan subsidiary was 12% of the turnover smallest Indian subsidiary.

The second striking difference between the two samples is their situation with regard to foreign trade. In all four matching cases the share of export in sales for the Kenyan subsidiaries was higher as was the share of imports in sales. The evidence form the non-matching subsidiaries (with the exception of zero exports by the Kenyan cement producer) confirms this pattern.[c]

Capacity utilisation in Kenya was generally higher than that in India, as was the share of equity held by the parent. Employment and the value of fixed capital tended to be higher in India and this reflects the relatively large size of the Indian subsidiaries noted above. There is a clear tendency for the Indian subsidiaries to be more capital intensive than the Kenyan ones (see table 2). The likely explanation for this phenomenon is one of the product composition of the subsidiaries - for example the Indian vehicle assembling vehicles, plant manufactures components and presses bodies as well as assembling vehicles while its Kenyan counterpart only partially assembles its products.

Table 1: Some main features of the sample firms

	A Tea and allied products		B Pharmaceuticals etc,		C Pharmaceuticals etc,		D Cement	E Vehicle Assembly		F Refrigerations and engineering design	G Tea Machinery	H Electronics	I Edible oils soaps, etc	J Tyres	K Packaging Materials
	Kenya	India	Kenya	India	Kenya	India	Kenya	Kenya	India	Kenya	Kenya	India	India	India	India
Turnover £	17,650,000	54,570,000	937,399	16,210,000	2,352,940	3,960,000	5,082,353	2,403,947	22,200,000	882,353	470,588	28,250,000	66,490,000	64,330,000	21,330,000
Issued Capital £	10,000,000	3,070,000	188,235	329,904	705,882	3,550,000	1,764,706	26,471	3,564,800	130,588	52,160	6,220,000	7,720,000	6,900,000	3,180,000
Issued capital plus reserves £	12,105,960	7,470,000	196,470	668,974	1,000,000	11,460,000	1,800,706	55,833	4,280,000	182,586	n.a	11,180,000	20,090,000	10,300,000	5,070,000
Pre tax profit as % of issued capital plus reserves	28.9	36.6	26.3	24.7	82.4	3.8	20.5	125.6	45.1	20.3	n.a.[d]	47.2	21.0	27.6	21.5
Fixed Capital															
(i) Original Cast	2,962,929	n.a	194,248	n.a	n.a.	n.a.	3,001,113	n.a	n.a	13,214	9,412	n.a	n.a	n.a	n.a
(ii) Written down	1,781,769	2,420,000	103,241	6,570,590	145,882	1,170,000	1,580,784	12,387	6,860,000	4,518	2,000	5,500,000	12,750,000	16,440,000	4,340,000
Employment	14,000	10,000	132	5,200	200	1,176	380	125	4,350	115	38	7,500	n.a.	11,277	9,000
Capacity utilisation %	100	28-50	75[a]	50-60	100	50-80	75[d]	75[a]	50	100	100	100	80-85	70	70
Share of market %	27	15-28	3-60	30-40	10-40	50-100	50	17-80	45-50	50	30[(a)]	30	15-40	25-30	11-18
Exports as % sales	88	20	10	2	30	3	0	0	15	30	15	5.3	8	30	1
Imports as % of sales	13[f]	very small	40[f]	5[g]	35[f]	10[e]	7[f]	95[f]	4[g]	40[f]	60[g]	7[e]	10[e]	4[g]	n.a
Equity held by parent %	88.75	75	100	70	100	60	14	45	61	74	61,4	62	85.1	56.1	61
Turnover per £ Employee	1261	5,475	7,102	3,117	11,765	3,367	13,375	19,232	5,104	7,673	12,384	3,767	n.a	5,705	2,376

(a) Estimate

(a) Estimate

(b) Much of fixed investment in land (£12,621,068 in 1974)
Newly constituted firm in operation for only three months.

(c) Constrained act from working at full capacity due to shortage of railway trucks .

(e) In process of revaluing assets

(f) Raw materials only.

(g) Raw materials and spares.

Table 1: continued

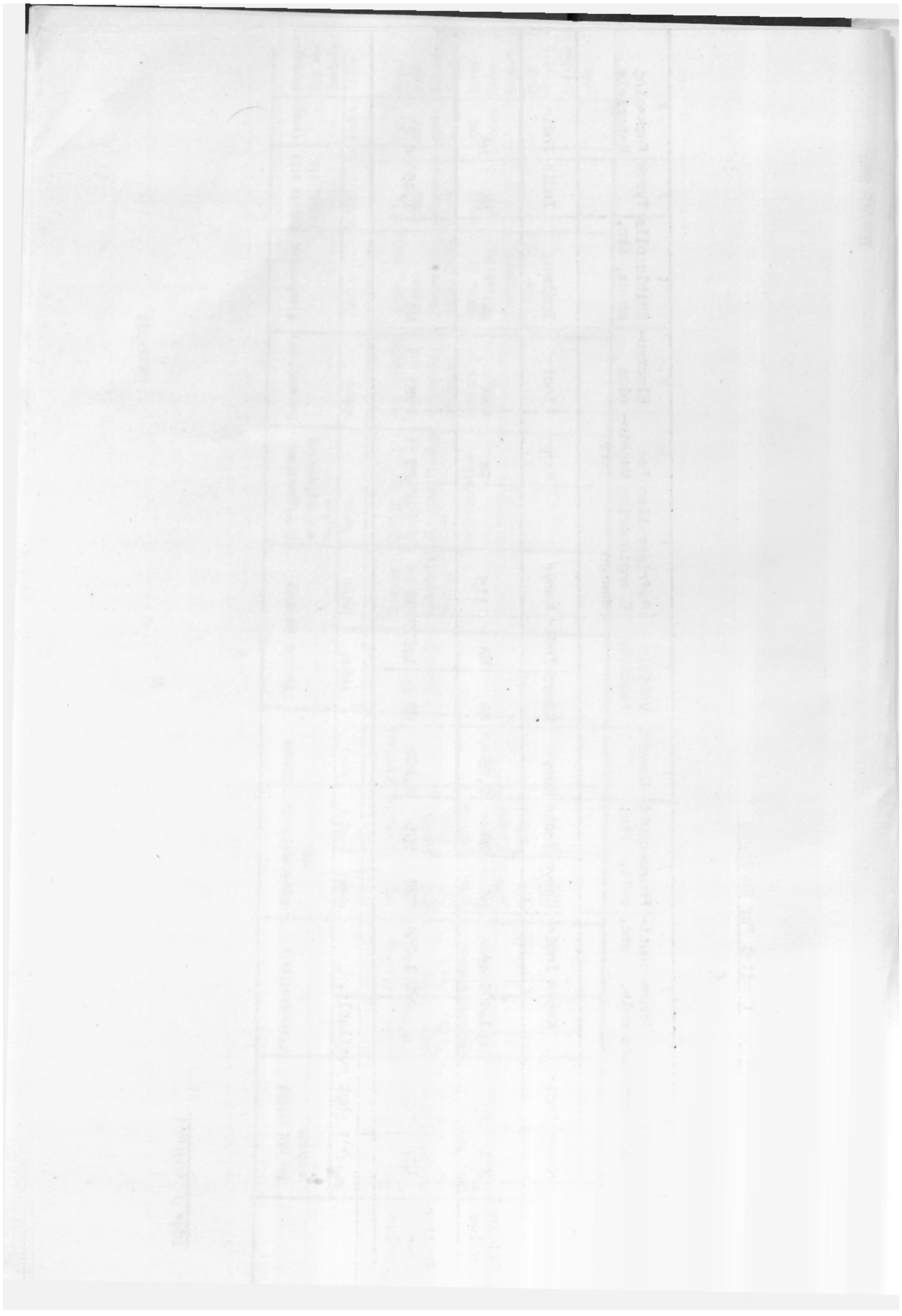
	Tea and allied products		Pharmaceuticals etc.		Pharmaceuticals etc.		Cement	Vehicle assembly		Refrigerations and engineering design	Tea machinery	Electronics	Edible oils soaps, etc.	Tyres	Packaging materials
	Kenya	India	Kenya	India	Kenya	India	Kenya	Kenya	India	Kenya	Kenya	India	India	India	India
ducts	Tea, Coffee, Instant tea, Cinchona Tara	Tea Coffee Spices, Oleoresin	Cough tablets, Baby foods, Pharmaceuticals	Pharmaceuticals, Baby foods, Contraceptives	Cosmetics and toiletries, Pharmaceuticals, Agro-Chemicals	Insulin, Vitamins, Penicillin Agro-Chemicals	Portland cement	Vehicle assembly	Chasses Vehicles Industrial Engines	Design and Installation of air conditioning and refrigeration	Tea handling drying and conveying equipment Factory design	Lamps, radio Cinema Projections, Sound equipment, TV scientific Equipment, X Ray equipment	oils, soaps detergents tooth paste etc.	Car and cycle tyres and tubes	Metal containers, Crown corks Paper Packages Plastic bottles etc.

Table 2: Fixed Capital Per Employee

£

	A		B	C		D	E		F	G	H	I	J	K
	Tea and allied products		Pharmaceuticals, etc.	Pharmaceuticals, etc.		Cement	Vehicle assembly		Refrigeration & engineering design	Tea Machinery	Electronics	Edible oils soaps, etc.	Tyres	Packaging Materials
	Kenya	India		Kenya	India		Kenya	India						
Original value	211	NA		1,471	NA	NA	NA	NA	NA	115	247	NA	NA	NA	NA
Written Down value	127	242		792	1,264	729	995	4,160	99	1,577	39	53	733	NA	1,450

NA: Not available.



III. The Orientation of Technical Change

Each of the subsidiaries were asked to describe the main reasons inducing them to introduce new technology and also which spheres of technology most concerned them with respect to technical change. (As we have seen there are three spheres in which change can take place and frequently links arise between these spheres so that changes in one may lead to changes on another). The subsidiaries were further asked whether government regulations or pressures or other factors were an inducement to technical change. The purpose of these enquiries was to establish whether there exist any common patterns which might suggest that certain types of firms are more concerned with change in a particular sphere of technology.

(a) Kenyan Sample

Production Technology and Technical Change

The main concern with regard to production technology lies in the reduction of unit costs. Two of the subsidiaries, tea producing and tea processing machinery were very concerned with the reduction of unit costs. Two other subsidiaries - cement and pharmaceuticals (C) - were moderately concerned and the other three subsidiaries did not consider that reduction of unit costs was an important consideration for them. The main points are summarised in table 3.

None of the subsidiaries were led to change production technology due to the use of local inputs, as import licences were freely available. Climatic conditions were also not a strong inducement to change in production technology, since climatic conditions on Nairobi (where all seven subsidiaries are situated) are temperate tather than tropical.

(i) Strong motivation for reduction in unit costs

The reasons for this strong desire to save unit costs in the tea subsidiary are clear. Firstly it is difficult to differentiate either tea or coffee by changes in product and in any case this subsidiary has a joint marketing agreement with most other tea producers to market tea in the local market. There is therefore little scope for the sort of product differentiation which would enable the firm to increase or maintain profit margins in a competitive market without reducing unit costs. Secondly the Kenyan subsidiary is operating in a competitive market and is squeezed at both ends. International competition is intense from other firms and from other subsidiaries in the Group. Locally the subsidiary is also under some pressure as Africanisation of the economy is largely focussed on the agricultural sector and small-holder tea cultivation is expanding with government support. The subsidiary is therefore forced to concern itself with cost reduction in order to maintain its margins.

The main bias of this cost reduction is the saving of inputs such as fertiliser, herbicides and fuel. The subsidiary is currently focussing less attention on saving labour costs, partly because labour is abundant and relatively cheap, partly because of the political consequences involved, partly because of the adjustment to new energy and fertiliser costs and partly because no suitable labour saving method of plucking has been developed. Savings of labour in past years have / nevertheless been considerable. For example labour input per hectare on tea estates dropped from an average of 2.9 per hectare in 1958 to 1.5 per hectare in 1972/3; similar gains in labour productivity have been made in processing tea as well. Langdon argues that the experience in South Asia has taught the company to shed as much labour as possible while it had the freedom to do so (7).

In addition to this focus on the saving of inputs, the subsidiary is concerned to increase the productivity of its capital. In this case capital is held in the form of land, rather than machinery and equipment and considerable increases in output per acre have been achieved over the years through land intensification practices.

This cost reduction has been achieved by a combination of efforts. The introduction of herbicides and fertilisers has come with the assistance of multinational agro-chemical firms operating in Kenya. To some extent cost saving also result from the subsidiary's own efforts -- new strains of tara trees and vegetative production tea bushes were developed in trial programmes and some benefit has also arisen from disembodied technical change in the subsidiary such as the introduction of better supervision over tea pluckers. Other subsidiaries in the group have also been of assistance and there has been a transfer of growing, cultivating and processing practices from other subsidiaries of the Group in South Asia.

Cost saving has been the main inducement to the manufacturer of tea processing machinery. Indeed it is partly for this reason that the firm moved its tea-equipment manufacture from the United Kingdom to Kenya. The dominant activity of this firm is the fabrication of machinery and, because demand is too small to allow for production line assembly, the production technology is labour intensive. Technical progress in production is predominantly disembodied and as the labour force has increased in skill, unit costs of production (in real terms) have decreased.

(ii) Moderate Inducement to reduce unit costs.

The cement subsidiary appears to have little capability to change the core technology "materials processing" in Pack's terms (8) which it uses

Some cost saving associated with small tasks such as

cleaning where labour has been substituted for the machinery which would be used in a high-wage economy. Their main concern is the reduction of energy costs and they are giving some thought, in collaboration with the parent, to burning waste materials as a source of energy - there is no sign that this has yet led to specific measures. Changes in production technology basically arise from improvements introduced by machinery suppliers, but once again this does not refer to the core technology as there have been no changes made to the original core process and there are no concrete plans for expansion.

(C)
One pharmaceuticals subsidiary reported that cost reduction was of moderate importance. For example scale economies have led them to develop their own tube-filling production technology.

(iii) Weak inducement to reduce costs.

For the other pharmaceuticals subsidiary (B), the growth of the market has led to the introduction of new machinery for making pills as economies of scale arise in this activity. But this was considered only a weak inducement to reduce costs.

The vehicle assembling subsidiary assembles vehicles from kits. There has been little scope for cost reduction in the past as scale (2,700 units per year) has been too small to allow for assembly line operations. They are however in the process of building a larger plant with increased capacity (4,000 units a year) and the introduction of an assembly line should lead to a marginal reduction in unit costs. This technical change is obviously of the firm-disembodied kind. There is also some sign that the move to the new plant will be associated with the use of new production techniques which are more capital intensive (e.g. pneumatic rivet guns will be used) and this change, too, should be associated with marginal savings in unit costs.

In the case of engineering design activities there is little scope for cost reduction, and the main savings are to be made in installation. The main cost savings in installation result from changes of a disembodied nature, such as the shift from site to workshop assembly in order to save labour by making supervision more effective. Although there is not much scope for changes in production technology, there is evidence that this subsidiary does have, and has used its own technological capability. One example of this concerns a large contract for about £300,000. The original intention was to install Westinghouse air-conditioners made in America. On visiting the Westinghouse plant in the United States, however, it became clear that the equipment to be installed was of a simple nature. The firm therefore bought two of these air-conditioners, and took them to pieces to

understand the principles of manufacture. They then imported some parts and fabricated 1000 units themselves. The motivation was cost-saving and the saving realised was about £50,000.

Product Technology and Technical Change

There are three types of technical change in the sphere of product technology - product innovation, product differentiation and product adaptation. Both extremes are represented in the sample of subsidiaries. In the case of the pharmaceutical subsidiaries product technology is of primary importance, while in the case of the cement producer there is no sign of product innovation, differentiation or adaptation. The other subsidiaries are all concerned to some extent with product technology.

(i) Product innovation.

For the two pharmaceutical subsidiaries, the introduction of new products is an important weapon in their competitive armoury. B, for example was established in K nya with a range of four products - at present it produces twenty-two different products. Its competitor, too, has introduced new product since its takeover of a Kenyan firm five years ago.

The tea subsidiary is attempting to diversify its product mix by introducing new products. This is a policy of the parent as well, and the decision to produce instant tea partly reflects this - Kenya has been chosen by the Group as the site of the instant tea plant. Other products introduced in Kenya are related to tea and coffee cultivation, such as cinchona and tara which are both products derived from agricultural products. It is the general policy of the firm to try and extend the range of these products and they are searching for other possibilities, particularly in the area of intermediate, rather than consumption products.

The vehicle assembly subsidiary has recently introduced a new luxury four-wheel drive vehicle on to the local market, but this is the only sign of product innovation in recent pears. In fact, in line with its parent's policy in Britain, the subsidiary is in the process of removing certain types of vehicle from its output mix, as the mix is too diversified to allow for scale economies.

(ii) Product differentiation.

The two pharmaceutical firms, in line with their strong orientatio on product technology, both differentiate some of their product lines. Th extent of differentiation is small relative to the parents' operations in Britain and their main concern with differentiation is to buid-up brand

name loyalty, rather than to introduce more than one brand of any particular product. Advertising expenditure as high as one would expect(9).

(iii) Product Adaptation.

Product adaptation is of great importance in the pharmaceutical industry, both for technical and market reasons. Because of the difference in climate between Britain and Kenya, some changes have to be made to products to ensure their 'stability' in local climatic conditions. Changes also have to be made in the product to reflect the taste of the market. For example, Firm B dominates the market for cough sweets and tablets. When the product was formulated, it was recognised that the local market liked to feel the 'strength' of the product and so a high content of menthol was added to a product which therapeutically is no different to other products on the local market. Nearly all of the products sold by the two subsidiaries are adapted to local conditions.

In the manufacture of tea processing machinery, product adaptation is an important factor for the firm and is a source of its success in the local market. Constant changes are made in product to satisfy the needs of individual customers and seldom are two identical machines produced. This adaptation to local conditions does not however lead to changes in production technology as the method of production by the subsidiary remains constant. The main changes introduced by this subsidiary are designed to simplify equipment to reduce the need for skilled maintenance staff by the user.

Engineering design, as in the case of tea machinery, implies adapting to the specific needs of customers. The subsidiary works from established engineering principles, and then designs to meet the customer's needs. In some cases the adaptation required is of minor importance, while in others significant changes have to be made to designs which had been used in the past. The main changes introduced by this subsidiary in its designs are aimed to reduce the need for skilled maintenance labour and to reduce capital costs. (This even occurs at the expense of high recurrent costs as government tenders are awarded on the basis of lowest capital cost irrespective of recurrent costs).

Materials Technology and Technical Change

The nature of the inputs available in Kenya has been a factor in technical change in the case of two of the subsidiaries in the sample. The tea producing subsidiary has pioneered the use of Simozine and Gramoxone weed control herbicides in conjunction with a subsidiary of another multinational in Kenya. This has had an effect, on the production technology used by the firm. The cement producer has had to make its choice of equipment contingent upon the nature of the raw materials available in Kenya, which

are different to those available in Europe. Although this has meant a choice of specialised equipment, this has been readily obtainable and no new advances in production technology have been required.

Other inducements to technical change

Surprisingly, there were few other inducements to technical charge reported by the sample firms. In the case of one of the pharmaceutical subsidiaries (B), the decision to expand the portfolio of products from four to twenty-two resulted to some extent from the imposition of tariffs by the government. The same firm has been induced to reformulate one of its products by the different market taste in an export market[10]. One other inducement was reported by the cement producer. In its case the long lead-time on deliveries from Europe sometimes forced it to make minor adaptations itself or to approach the foundry at the Railways Workshops to fabricate spares. This is not a frequent occurrance.

Clearly these different aspects of technical change are not isolated from each other and changes in product and materials technology have often led to changes in production technology. Instant tea production is a good example of this where a product innovation has led to the development of a complex production technology[11]. On the materials side, the availability of new pesticides has had some effect in changing the cultiveting practices of the same subsidiary. There are however many cases when changes in product and materials have little impact upon production technology. The tea processing machinery subsidiary for example has made some adaptations to its products over the years, but this cannot be said to have led to any changes in its production or materials technology.

Table 3 summarises the orientation of technical change for the seven subsidiaries and compares them with the Indian sample. It is clear that while all of the subsidiaries are concerned with cost reduction, this is only an important consideration for two of them - tea production, (which is very competitive and in which there exists little scope for product differentiation as a substitute for cost reduction); and tea processing machinery which has situated its subsidiary in Kenya largely because of cost factors.

The pharmaceutical industry is characterised by non price competition at the global level and this is reflected in the operations of the two Kenyan subsidiaries who both register a strong response to all three forms of product technology. The only form of product technology relevant to the other consumer good subsidiary (tea) is the introduction of new products and this reflects the aim of the firm to diversify out of its dependence on tea.

The two capital goods firms (engineering design and tea machinery) have a common orientation on adaptation of products. This is probably a factor common to the capital goods industry at both the Kenyan and the global level where there exist few economies of scale [12] and production is invariably tailored to the needs of customers. There exist no common factors specific to the two intermediate goods firms.

Another interesting point which emerges from this table is that there is little evidence of material input or any other factors inducing technical change.

(b) Indian Sample

Production Technology and Technical Change

(i) Reduction of costs as an inducement to technical change.

Cost reduction as a motivation for technical change did not appear to be important in any of these industries. Almost all companies, generalized saying that cost reduction would be in their interest. But it did not appear to be an important inducement to technical changes. The reasons for this lack of concern with regard to cost reduction is that most of the companies were dominant in the home market. Because of economic planning and heavy investment, India has steadily developed an inflationary pressure which acted as a brake on any plans of cost reduction. Most importantly, all the firms were marketing differentiated products, with brand names and trade marks, and this enabled them to carry forward some of the increased costs to the consumer. In some commodities where these subsidiaries operated, the Government pursued a price control policy. This was true of edible oils, drugs and tyres. But the tremendous demand for these commodities and high profit margin available to the firms hardly induced them to go into cost reduction. Thus little of new production technology emanated from the desire to reduce costs for domestic sales.

With regard to exports, most of the products being treated by the Government of India as 'non-traditional exports', receive 'compensatory assistance' to counter the rising cost element. Further, exports constituted an extremely small proportion of total sales except in tea.

(ii) Technical Adaptation and Production Technology.

Companies in all industries emphasized that they needed to adapt production technology imported from their parent. For India is a tropical country, with relatively low level of skills, different facilities in terms of infrastructure, etc and these companies had to adapt production technology. This, they all argued, is rainforced by the technical laboratories which are associated with factories and which enable them to adapt their technology

In the electronic company this adaptation has become very important. For instance, the problem of erosion is of a different magnitude in India and needs special treatment. Special lacquers had been developed to suit Indian requirements. Machines have also to be adapted.

(iii) Adaptation to Inputs and Production Technology

While using local raw materials the production technology may have to be adapted. Thus all the companies interviewed said that they had to adapt their production process to suit the local raw materials. In some companies new processes had to be introduced.

The company dealing with edible oils, soaps etc had to introduce new processes to use local raw materials. It is also developing a new process for manufacturing synthetic fatty acids from paraffin wax to meet the hard soap requirement. In this respect the parent has no previous experience.

Company B dealing in pharmaceuticals also claimed that it had to introduce a major change in production technology. Previously, the company used to import Hecogerin as the basic raw material for the Betamethosone process. Now, it has developed a process to use diosgenin, an indigenous raw materials.

Product Technology and Technical Change

Development of new products and adaptation of products already produced by the parent have been an important source of technical change in India. Both these factors are motivated primarily by the distinct market conditions that the subsidiaries have to confront. Apart from the environmental factors, they have to operate in a different cultural and social framework. While in some cases the subsidiaries have introduced products without little change, in other cases either new products had to be developed or they had to be substantially adapted:

(i) Product Innovation

The edible oils subsidiary could not just produce magarine in India. The food habits of Indian people demanded an introduction of a different product meeting the same requirement. Thus, vegetable ghee was introduced in which the company in the initial period held a complete monopoly in the market.

Similarly, a new product was introduced in the field of tooth pastes. An attempt was also made to introduce new semi-cooked food products based on Indian food items. The technology for these products was developed simultaneously in some other Government research organizations. But, the introduction of these products on commercial scale was undertaken by this subsidiary. However, the Company has had to discontinuation the production of these processeddfood products because of Government discouragement through heavy indirect reaction of

The tea company, based on domestic raw materials, generated little new technical change in raw materials. But, under the pressure of, The Foreign Exchange Restriction Act (FERA) [13] it has to go into the production of commodities which are aimed purely for export. (it has been trying to develop local meat for exports). Further, there has been a development of oleoresin from spices. Both these changes, however, emanated from the research done in the parent company which has been transferred to the subsidiary for production. In particular the parent has other subsidiaries producing corned beef for export.

The electronic company also claims to have introduced new products exclusively to the Indian markets. This includes various types of lamps and the development of piezone electric pick-up elements for record players produced from indigenous raw materials.

(ii) Product Differentiation. With the exception at the manufacturer of packaging materials, all of the subsidieries were inclined to differentiate their products on response to competitive pressures.

(iii) Product Adaptation Both pharmaceutical companies have adapted the products to suit Indian consumer needs in terms of colour, taste and packaging. But there is little evidence that these two firms have developed any new products which have not been produced by the parent or its subsidiaries. In fact, company C sends samples of its so adapted products to its parent company for its final approval.

In the vehicle industry, no new model could be introduced by the subsidiary. As a result all the vehicles produced by the company are adapted to suit the environmental conditions of India, such as road conditions weather, etc. Even the distinctly different passenger car model which has been developed for export is an adaptation of the parent company model.

In the tyre industry the thrust of technical change is again on the adaptation of the products that the parent is producing. Thus many products introduced in the Indian market are those which have been produced by the parent, but have been adapted by the subsidiary to meet the local environment. Subsidiarly on the case of the packaging industry, the emphasis is an adapting the product to suit Indian conditions.

Materials Technology and Technical Change

The most important field of technical change has been in material use. The explanation for this lies essentially in the role of Government policy. Due to extreme shortage of foreign exchange, the Government of India has imposed serious restrictions on import of raw materials. As a result, all the companies of the sample have to a large extent been forced to use local substitutes.

The import content of these firms, in terms of material, (which has been calculated in the previous section) has declined mainly because of this restriction. The cheapness of some local raw materials has also, of course, encouraged this tendency, but thus has been lesser importance than the effects of government policy.

The edible oils, soaps etc subsidiary which processes raw materials amounting to 60-70 per cent of total expenditure has developed the use of a large number of local raw materials. This company's products depend mainly on vegetable oils. Hence, it concentrated on substituting local vegetable oils for the imported material. Thus new oils such as castor oil, rice bran oil, Kusum oil, neem oil, sal fat are being used as raw materials for soap making. Formerly, these oils were considered unsuitable for soap making because they had a different composition altogether as in the case of castor oil, or because they had other components which demanded adaptation of soap making process. Similarly, it has developed a local substitute for its perfumery ingredients and new essential oils. A new base for making tooth paste which claimed superior cleaning properties has been developed based on Indian raw materials.

In the pharmaceutical companies, the import content is higher. Yet, under pressure of the Government's policy, they are also directing their technical change towards import substitutes. Compay B claims to have made substitution of local raw materials and semi-processed products. However, no specific instance is given. Company C, on the other hands, has made some attempts to substitute local materials in those areas of production which are a second / of production of the company. There is no import substitution in the case of insulin, its main product.

In the tyre industry, the company is fairly well placed to subsitute local processed raw materials. For, due to various factors (including Government policy), processed raw materials are available. Almost all of these materials are produced in India, some of them with foreign technical collaboration. Even nylon tyre cord suitable for the automotive tyre industry is produced in India. Another important chemical needed in large quantities in the tyre industry is carbon black. Production in India started in 1962 by a major multinational (indeed carbon black is exported to a number of countries, including Kenya).

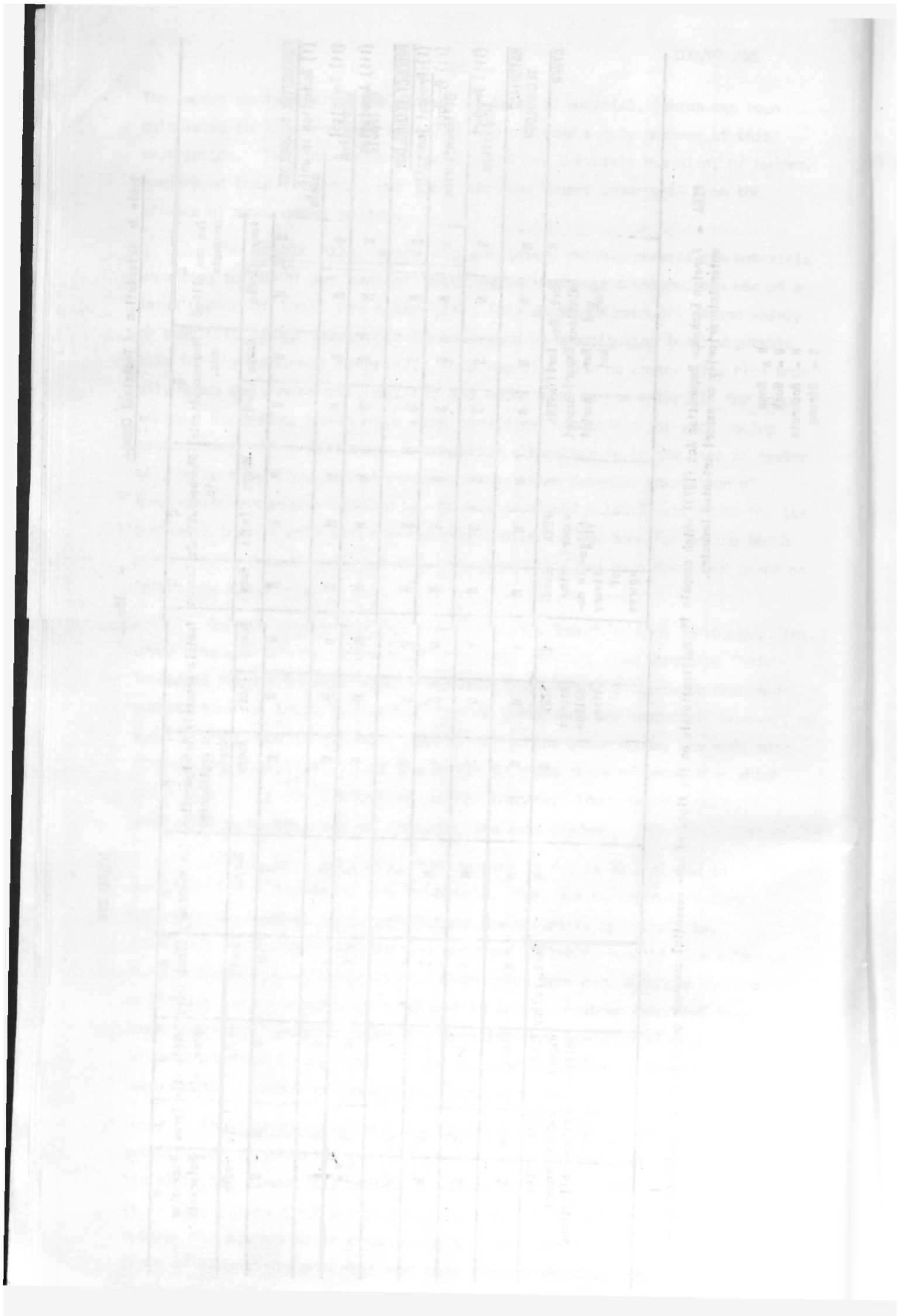
The packaging subsidiary claims that it has introduced massive import substitution in material use. It has established the suitability of Indian tin plate for almost all end-uses except for a few highly critical foodstuffs. It is also claims that a new decorative material has been developed and the company has succeeded in developing the local manufacture of a complete range of decoration material and that its entire requirements are met by

Table 3: Orientation of Technical Change

	A Tea and Allied products		B Pharmaceuticals etc,		C Pharmaceuticals etc,		D Cement	E Vehicle Assembly		F Refrigeration & engineering design	G Tea Machinery	H Electronics	I Edible oils soaps, etc.	J Tyres	K Packaging Materials
	Kenya	India	Kenya	India	Kenya	India	Kenya	Kenya	India	Kenya	Kenya	India	India	India	India
PRODUCTION TECHNOLOGY															
(i) Reduction in unit costs	S	W	W	W	M	W	M	W	W	M	S	W	W	W	W
(ii) Technical adaptation	N	M	N	M	N	M	N	N	M	N	N	S	M	M	M
(iii) Adaptation to inputs	N	M	N	S	N	M	N	N	M	N	N	S	M	M	M
PRODUCT TECHNOLOGY															
(i) Product Innovation	S	M	S	S	S	S	N	W	W	N	N	S	S	W	W
(ii) Product Differentiation	N	M	S	S	S	S	N	N	S	N	N	S	S	S	W
(iii) Product Adaptation	N	N	S	S	S	S	N	N	S	S	M	S	S	S	S
MATERIALS TECHNOLOGY	M	N	M	M	N	M	M	N	M	N	N	M	S	M	S
OTHER	N	Govt. Regulations and Fera	Tariffs Export Market	FERA export market	N	FERA export obligation	Lead-time in delivery of spares	N	FERA export obligations	N	N	Govt. policy	FERA export obligation	FERA export obligations	FERA export obligations

FERA = Foreign Exchange Reguration Act (1973) which compels the Multinationals on the field of non- essential consumer goods to reduce their equity or enter into priority or export oriented industry.

N = None
W = Weak
M = Moderate
S = Strong



(c) Comparison of Kenyan and Indian Samples.

In general it can be said that whereas the Kenyan subsidiaries are induced to introduce new technology for predominantly product requirements, the Indian subsidiaries are affected by the need to change production and materials technology as well.

In the sphere of production technology, there is some evidence that subsidiaries in Kenya are concerned with cost reduction. This is less apparrent in the Indian subsidiaries where as it appears that there is greater leeway in passing on costs to the consumer. There is no evidence of changes in production technology in Kenya which were dictated by climatic conditions, nor by the need to adapt to the use of local inputs. By contrast in India, both of these factors, and in particular the need to adapt to local inputs, were considerations which induced changes in production technology.

In the sphere of product technology, both Kenyan and Indian subsidiaries were induced to make changes. In Kenya these changes were predominantly connected with the three consumer goods industries, although the two capital goods subsidiaries were also induced to adapt their product technology. In India the need to change product technology was apparrent in all of the subsidiaries, with particular importance being placed on product adaptation and differentiation.

These was little evidence that changes in materials technology were induced in Kenya, but some evidence of this in India where a number of subsidiaries developed new inputs largely in response to government pressure.

The difference in the effect of government pressure on subsidiary behaviour in the two countries is the most obvious difference between the two samples. Indian government policy which offers multinationals the choice of divesting gradually or of moving into priority industries or increased exports appears to have been successful in prompting product innovation (eg the manufacture of ball bearings by the packaging materials manufacturer). Another important aspect of Indian government policy has been the strong pressure to import substitution which induced changes in both production and materials technology as firms adapted to the use of local inputs.

IV. Technical Change Generated Within the Subsidiary .

Given the orientation of technical change in each of the subsidiaries as discussed in the previous section it is of interest to establish the means which these subsidiaries use in generating new technology. Technical change arises from the application of science and technology to production and the more complex the technology the greater the input of

science and technology which is required. However the nature of the operations of the eleven subsidiaries in the sample makes its unlikely that there will be significantly large input of this formalised Research and Development and it is more likely that technical change will result from marginal changes to existing production techniques, products and materials.

'Research and Development' is an aggregative concept which marks a number of different types of activity. Since we are focussing on the operations of particular subsidiaries, there is some point in trying to disaggregate this set of ideas. One attempt has been made by the OECD (1969) which although it is addressed to the compilation of macro-economic statistics on Research and Development, does provide a useful framework for this disaggregation. The OECD manual defines three relevent concepts - Basic Research, Applied Research and Experimental Development.

(i) "Basic Research is original investigation undertaken in order to gain new scientific knowledge and understanding. It is not primarily directed towards any specific aim or application .... The results of basic research are generally non-negotiable and are usually published in scientific journals and circulated to interested colleagues" (p 9/10). "In pure basic research the organisation employing the investigator will normally direct his work towards a field of present or potential scientific, economic or social interest" (p 10).

(ii) "Applied research is also original investigation undertaken in order to gain new scientific or technical knowledge. It is, however, directed primarily towards a specific practical aim or objective "PO ". "The results of applied research are intended primarily to be valid for a single or limited number of products, methods or systems. Applied research develops ideas into operational form" (p10).

(iii) "Experimental development is the use of scientific knowledge in order to produce new or substantially improved materials, devices, products processes, systems or services ... Although not all development activity is of an experimental nature, experimentation is a dominant characteristic of this phase of development" (p10).

The Frascatti manual recognises that the delineation between these three categories is not always clear and arbitrary decisions in this respect may have to be made in classifying certain activities. In addition to these three activities, there are a number of borderline cases in which the activities of a firm/institution may not be easily classifiable. The main ambiguities arise in the case of prototypes, pilot plants and trial production runs.

(iv) There is one further type of activity within the operations of these subsidiaries which may lead to technical change and this is Quality Control. Most of these subsidiary operate to product specifications laid down by the parents and equality control is undertaken to ensure that these standards are met. If these standards are not met changes may have to be made in product technology (e.g. reformulations), production technology (development of new inputs) (e.g. new packing machinery) or materials technology. So technical change may well result from quality control and it is the case that for some of the subsidiaries there is no form of established experimental development or adaptative activities, and the only source of technical change may be through quality control activities. Neither the OECD nor the United States National Science Foundation include quality control activities within the course of research and development (14).

(c) Kenyan Sample

(i) Basic Research

It is not surprising that none of the subsidiaries showed any sign of undertaking any basic research, because even at the global scale it is unlikely that any multinationals would undertake either pure, or oriented basic research. In terms of the international division of scientific effort, most basic research is undertaken by Government bodies, universities and other research institutes. Much of the output of basic research is non-proprietary in nature and this is perhaps one of the factors which leads to the abstention of multinationals in undertaking basic research.

(ii) Applied Research

Given the operating conditions of the eleven subsidiaries in the sample there is no reason to expect any of them to undertake applied research (15). Even in the case of the parents of these subsidiaries, size is an important constraint and not all of the firms are large enough to undertake applied research. For example, the ten firm in this study has worldwide sales of over £379,000,000 and since 1973 has undertaken some applied research at a cost of about £750,000 per year. It has recently decided to bring this research programme to an end.

(iii) Experimental Development

The conceptual borderline between experimental development and adaptation to local environment and market conditions is difficult to define. In some cases adaptation may require experimental development at a complex technological level, while in other cases (as for example in the

product reformulations by the two pharmaceutical firms) little technological complexity may be involved. In any case, all adaptation will to some extent require experimental development, if only to see whether the product is acceptable to consumers. It has been decided, therefore, to include adaptative activities within the concept of experimental development, particularly when discussing the commitment in manpower and finance by the firm . This is because the same personnel are generally involved in both activities and it is difficult to differentiate between these two aspects. Where possible in the discussion, the distinction will be drawn between those activities which are experimental development proper and those which involve relatively simple adaptations.

Of the seven subsidiaries only four undertook any form of experimental development (table 4). The subsidiaries without this activity were one of the pharmaceutical firms (B), the cement producer and the vehicle assembler. In the case of the cement firm, the technology appears to have been too 'complex' for their limited technical skills while in the case of the vehicle assembling subsidiary, the nature of the assembly operations appears to have been too 'simple' to have allowed for experimental development. The pharmaceutical firm in question stands in contrast to its competitor (C) which did undertake some experimental development, with much the same product mix as B.

Until recently, the tea subsidiary was involved in industry-wide research on hail suppression (running at a cost of about £1.1 million per year), but this programme has been halted because of lack of results. This firm is also involved in the development of agricultural techniques such as herbicide-use as well as the use of a computer to establish optimal fertiliser patterns,but this is done in collaboration with subsidiaries of other multinational chemical firms. Firm A does have a small laboratory and most of its work concerns experimental introduction and analysis of new strains of plants.

As we have seen this firm is in the process of commissioning an instant tea plant. The technology for this tea plan is complex and follows on ten years of applied research and experimental development. Even now the technology is not satisfactory and the investment is predominantly a defensive one so that the Group as a whole will not be left behind in the generation of instant tea technology and will be able to supply the product to satisfy their customers (instant tea is predominantly used by vending machines and is not a particularly well-selling product). The parent began to build a plant in Wales in the mid 1960's, but the present plant is of a completely different technology.. All the applied research and most of it has been done in the United Kingdom. The responsibility for building and commissioning the new instant tea plant has been that of the

parent, and the Kenyan subsidiary will only be involved in managing the plant once it has been satisfactorily set-up.

The conclusion, therefore, is that while the Kenyan subsidiary of this firm is involved with some experimental development, this is limited to the development of new growing and cultivating techniques, activities which could not by their nature be undertaken in Britain. The more complex processing technology is the responsibility of the parent and/or machinery suppliers.

The tea processing machinery subsidiary was included in the sample because it proved to be unusual case of an equipment supplier manufacturing in Kenya. It undertakes no basic or applied research. It is involved in experimental development, albeit at a relatively unsophisticated level. The basic design for tea processing equipment has been stable for many years, and the subsidiary is constantly making small changes and improvements to satisfy the needs of specific customers and local conditions. There is one exception to this and that concerns the development of a new "hot-feeder" which has taken place in the Kenyan subsidiary. This is a new development in the industry and is not patended because this would enable competitors to copy, without duplicating the technology. In order to protect this process technology the subsidiary enforces strict control over entry to the plant and there have been attempts at industrial espionage by agents of Sri Lankan competitors.

The development of this "hot-feeder" is the limit of the subsidiary's experimental development. It is also 'associated' with an experiment in the use of heat regeneration (i.e. raising the temperature of air passing through the machine which may lead to a fuel saving of 40-45 per cent) which is taking place in Rwanda, but this does not involve a heavy commitment of money or manpower. An indication of the limits of its experimental development operations is that the subsidiary has made no attempt to penetrate the technology for the manufacture of instant tea, although it has supplied standard design boilers, conveyors, elevators etc for the new instant tea plant of Firm A.

Of all the firms in the sample, the engineering design subsidiary is involved in experimental development at the most "complex" technological level. The nature of its operations are primarily engineering design, which implies the adaptation of existing scientific principles/designing a system in to meet the specific needs of a customer. Generally this does not lead to "substantially improved" (Frascatti p 10) systems, but in some cases it does. For example, the firm received a contract to provide air-conditioning for one of the largest buildings in Nairobi. It was decided that the most

suitable system was unique to Kenya, and in fact there was only one other example of the system's use in Africa. The problem was that the existing 'body of knowledge' had been developed in North America and Europe and the standard text-book tables on solar-weightings stopped at 20° from the Equator (Nairobi is almost on the equator). The subsidiary therefore had to go back to basic scientific principles and generate the necessary data themselves in order to complete the job. This constitutes experimental development at a relatively high level compared to the other subsidiaries in the sample.

In the case of pharmaceuticals, firm C provides an interesting contrast with its competitor, B. As we have seen the two firms produce a similar range of products, yet while B undertakes no experimental development itself, C does. Thus C reformulates all products for the local market (although it does refer these formulations to the parent for its approval). All reformulations in the case of B are undertaken by the parent. In addition, in the sphere of production technology, C has decided to design its own tin-filling machinery in collaboration with a local engineer who will manufacture it. This does represent, to a limited extent, a capability in experimental development which is not displayed by its competitor. In fact almost 20 per cent of its equipment purchase since the takeover in 1970 have been made locally.

Table 4 summarises the activities of the subsidiaries in the sphere of Research and Development. The most striking fact which emerges from table 4 is the absence of Research and Development activities amongst the seven subsidiaries. None of the firms are involved in either basic research (neither pure nor oriented) or applied research. Indeed, given the size of the operations of the subsidiaries in Kenya the absence of these two types of research is not surprising. What is somewhat surprising is the limit of experimental development activities. Here three of the subsidiaries, with respective annual turnovers of £937,399 (Pharmaceuticals - B) £5,032,353 (Cement) and £2,403,947 (Vehicle assembly) have no experimental development activities; while the expenditure in the case of two of them (Pharmaceuticals - C - and tea machinery) is negligible.

Only two of the seven Kenyan subsidiaries have experimental development expenditures of any size. In the case of the tea producer, this is understandable because some of the firm's activities such as developing new strains of tea and cinchona bush cannot be undertaken by the parent and there is no option but for these activities to be undertaken by the Kenyan subsidiary. Where the firm is able to undertake experimental development in Britain, as in the case of instant tea, it does so and the participation of the Kenyan subsidiary in the development of this technology has been negligible. The other subsidiary with a sizeable expenditure in this

respect is the engineering design firm. This would tend to support the point made earlier that it is the nature of engineering design firms that they do adapt to local surroundings by applying engineering principles to meet the needs of specific customer. (There is some overestimation of expenditure on experimental development, because not all of its design activities necessarily lead to technical change. Most do, however, in the sense that the "product" differs between designs).

These limited R&D activities follow logically from the position the firms find themselves in, and the dominant characteristic in this respect are the small size of their operations, the absence of a well developed capital goods sector in Kenya, the nature of their operations (e.g. assembly, or minimal value added, as in the case of the pharmaceutical firms) and the interest of the multinational in the parent assimilating technical change and using this as a control mechanism over the operations of the subsidiary. (16) Only in one case (pharmaceutical) where we can see a contrast between two broadly similar firms, is there a suggestion that the absence of Research and Development arises from the deliberate policy of the parent. But even here the smallness of the C's Experimental Development expenditure cautions against drawing firm conclusions.

(b) Indian Sample

All the subsidiaries have research and development or technical laboratories. The establishment of R&D departments by these firms has been motivated by a large number of factors, and it is of relevance to state these factors.

There is a national policy in India to encourage the firms to have R&D. This is expressed in terms of tax concessions and import entitlements.

Having an R&D section acceptable to the Government of India also enhances the credibility of the subsidiary in its attempts to become independent of the parent in technical matters. Further analysis of R&D establishments in the firms gives an indication that the following three factors have been very important in establishing R&D units. First, adaptation of technology and experimental development induced by Government policies and domestic market pressures can be done only through R & D in the subsidiary. This has been the case especially with respect to the edible oil and electronics subsidiaries. Therefore, the R&D sections have a long history (see table 4). Secondly, in India, the relatively cheap technical labour also encouraged the establishment of these sections. For, various aspects of technical change which can be executed by foreign technical personnel can be handled equally competently by the Indian scientists and technicians who, in addition, know the Indian factors better. Thus all R&D units have been manned by the Indians. Third, in the face of growing research activity in the national laboratories in India, these R&D units provide good monitoring units of technology development within India.

In the case of the vehicle assembler the R&D covers adaptation, quality control and designing. There is one R&D department with premises with a complete assembly line and modern design office. A test rig centre is being built up gradually; testing facilities exist for such items as electrical equipment, oil seals bearings, shock absorbers, radiators, cooling fans propeller shafts and gear boxes. R&D is given an important position in the company, and the director of R&D is an executive director. The annual expenditure on R&D and quality control activities is £138,200 and is planned to increase. It employs 20 engineers including the head and the senior officers, all of whom are Indians.

The pharmaceuticals subsidiary of B has one R&D unit which has been established at a capital cost of £160,000. Annually it spends £133,280, representing 1.1% of its total turnover. A separate microbiological laboratory for development work has also been set up in the research unit. Company C also has one R&D section, and expenditure on R&D was £54,974. But in the R&D unit there is no molecular research. Forty four people are employed, some of whom are highly qualified. All are Indians.

The electronics subsidiaries includes in R&D work only that part of research which pertains to new processes, development of products and raw materials usages. Engineering and quality controls are not included in the purview of R&D for which there are separate laboratories. The R&D unit employed 360 persons, all Indians, in 1974. £462,000 was spent on various research and development schemes in 1974. Capital equipment valued at £92,476 was installed in its 12 laboratories in 1974. The heads of these laboratories are all Indians.

The edible oils subsidiary has one of the biggest R&D section in the country. It began operating in 1969. Accumulated capital expenditure on R&D account is £913,400. Annually it spent £129,237 over the period 1968-1974, which constituted 0.7 per cent of the total turnover and 10 per cent of its profits. The entire staff, of which 30 are highly qualified are Indians and Ph.D's with international experience are preferred in recruitment. But recruits are also drawn from National Laboratories. This department is one of the six major units of R&D of the parent company.

R&D work at the tea subsidiary began very recently. The establishment of the R&D unit was the result of a need to deversify its activity. The R&D expenditure is £45,720 per year and is expected to go up to £114,550. 150 qualified people are working. All are Indians.

The packaging subsidiary began R&D in 1955 and has been especially active over the last five years. So far it has spent £687,300 on R&D. In 1975, it spent £46,820 on fresh capital equipment. The Company's

R&D establishments employ 150 people, of which 39 are qualified scientists. All are Indians.

The tyre subsidiary does not have any R&D unit as defined in the Indian context as the government did not recognize its technical unit as an R&D unit. The company finds it difficult to have one for it is argued that the type of the work to be done is of a different nature. It is estimated that £45^,200 is spent on adapting the technology annually.

(i) Basic Research

None of the companies in India had plans to do any basic research. It was argued by these companies that such basic work is being done in universities and national laboratories of India. Hence some of the companies financed a few basic research projects in universities but these activities were marginal. Since normally basic research is undertaken by the Government and is non-proprietory in its character, the companies were not active.

(ii) Applied Research

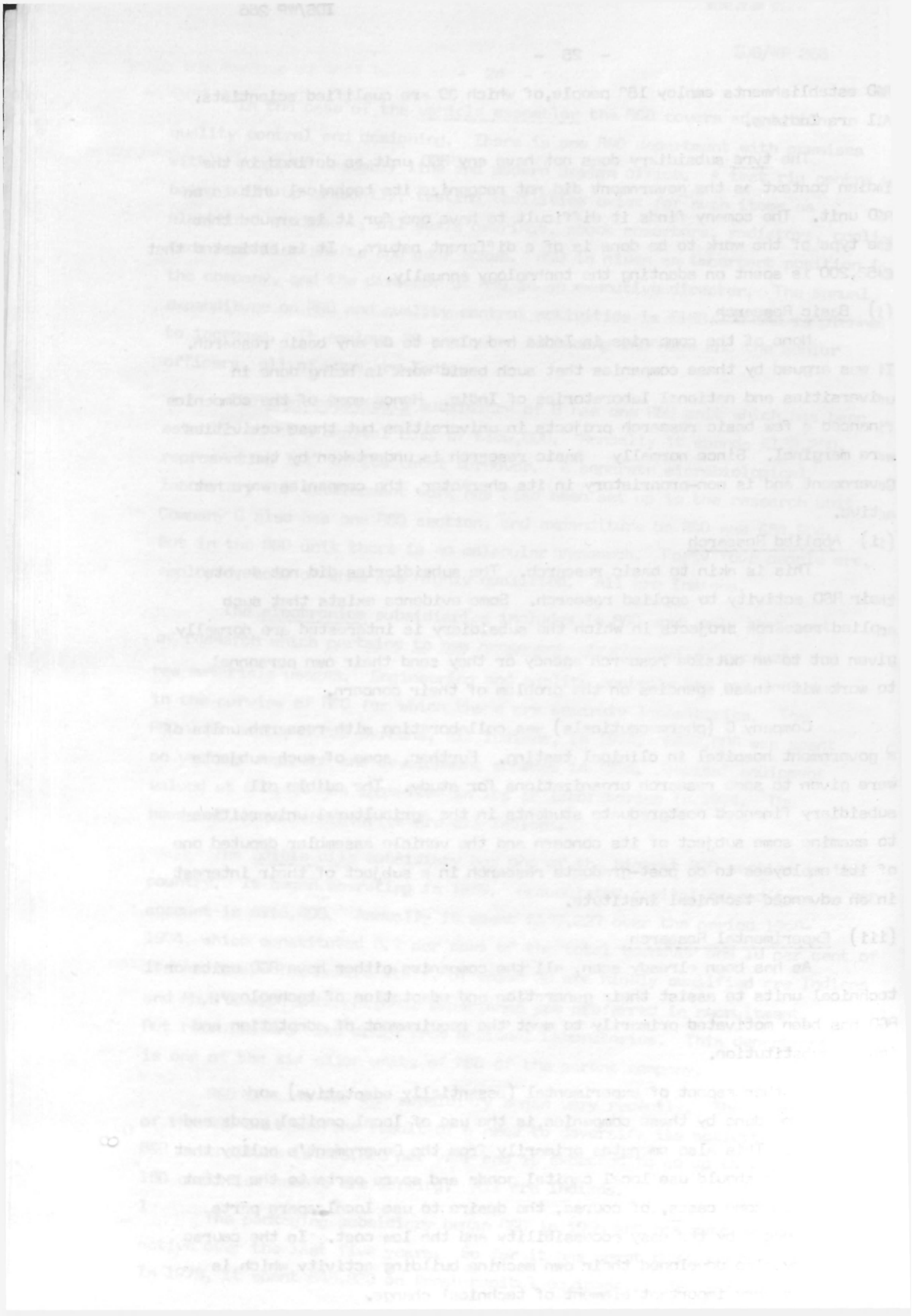
This is akin to basic research. The subsidiaries did not devote their R&D activity to applied research. Some evidence exists that such applied research projects in which the subsidiary is interested are normally given out to an outside research agency or they send their own personnel to work with these agencies on the problem of their concern.

Company C (pharmaceuticals) was collaborating with research units of a government hospital in clinical testing. Further, some of such subjects were given to some research organizations for study. The edible oil subsidiary financed postgraduate students in the agricultural universities to examine some subject of its concern and the vehicle assembler deputed one of its employees to do post-graduate research in a subject of their interest in an advanced technical institute.

(iii) Experimental Research

As has been already seen, all the companies either have R&D units or technical units to assist their generation and adaptation of technology. R&D has been motivated primarily to meet the requirement of adaptation and import substitution.

Another aspect of experimental (essentially adaptative) work that is being done by these companies, is the use of local capital goods and spare parts. This also emanates primarily from the Government's policy that all industries should use local capital goods and spare parts to the extent possible. In some cases, of course, the desire to use local spare parts has been induced by the easy accessibility and the low cost. In the course of this they also developed their own machine building activity which is considered a very important element of technical change.



Thus the tea producer supervises the manufacture of all packaging and printing machinery itself. The initial technology for this was made available by the parent. This has led to considerable adaptation and experimental technology. These machines are also expected to be sold to third parties.

The packaging company depends on the small scale industries for the supply of machinery, spare parts, rubber, plastic components, ferrous castings and electrical goods. This calls for considerable adaptation of technology as well as assistance to this sector to produce the required goods. Thus the R&D unit and the technical units have to do a considerable amount of experimental development. In addition, it has been producing packaging machinery since 1959. These concern fifty new lines.

The edible oils company buys most of its capital goods from the market including public sector companies. Some capital goods are made for it by order, whereby the unit actually develops a prototype, which is introduced for commercial use in close liaison with the machinery manufacturer. A similar process occurs with one of the pharmaceutical subsidiaries (C). Engineers at the tyre plant have been numbered on developing rubber processing machinery and spendered mixing equipment (mixing raw rubber with carbon black).

(C) Comparison between the Kenyan and Indian Samples

By contrast with Kenya, all of the Indian subsidiaries are involved in some sort of experimental research or adaptation. The fact that with one exception (electronics) this has been a relatively recent phenomenon largely suggests that this has/been in response to recent government policy.

It is unlikely that it represents merely the larger size of the Indian subsidiaries, since the level of expenditure (as a percentage of sales) by the Indian subsidiaries in three of the four matched subsidiaries is higher.

In terms of percentage of sales, the two 'big spenders' in Kenya are both capital goods producers. The reason for this high level of expenditure is probably ... because it is in the nature of capital goods subsidiaries that adaptation is made to the local environment. Unfortunately there are no capital goods subsidiaries represented in the Indian sample which makes it difficult to compare the two country samples in a more detailed way, holding sectoral activity constant. Yet there is an overwhelming feeling of larger relative experimental development efforts being made by the subsidiaries of India than in Kenya.

Table 4: Expenditure on Research and Development

	A Tea and allied products		B Pharmaceuticals etc.		C Pharmaceuticals etc.		D Cement	E Vehicle assembly		F Refrigerations & engineering design	G Tea machinery	H Electronics	I Edible oils soaps, etc,	J Tyres	K Packaging materials
	Kenya	India	Kenya	India	Kenya	India	Kenya	Kenya	India	Kenya	Kenya	India	India	India	India
BASIC RESEARCH															
(i) Pure	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
(ii) Oriented	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
APPLIED RESEACH	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
EXPERIMENTAL DEVELOPMENT AND ADAPTATION	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes[a]	Yes
MANPOWER INVOLVED	5	150	-	N.A	3[c]	44	-	-	20	10[b]	2[b]	240	350	119	N.A
COST: AS PERCENTAGE OF SALES (%)	0.2	0.08	-	1.1	0.4[c]	1.4	-	-	0.8	5.3[b]	0.9[b]	1.7	1.3	0.9[a]	0.7
TOTAL £	35,294	45,820	-	183,280	9,815	54,984	-	-	183,280	47,058	4,118	462,000	189,237	578,976	149,307
HOW LONE HAVE THESE ACTIVITIES TAKEN PLACE (years)	10	5	-	5	over 6	4	-	-	5	15	10-15	15	7	7	NA

NA: Not available

(a) Refers only to adaptation

(b) Covers cast of all design activities, not of which results on the generation of new technology. As such at overestimates expenditure on generating new technology.

(c) Covers cast of quality control department which is responsible for most adaptative research. Not all of this department's activities result in the generation of new technology. As such at overestimates expenditure on generating new technology.

One other interesting aspect of this comparison is that it does suggest that if minimum effective levels of expenditure on research and development are of importance, the Indian subsidiaries are better able to take advantage of their efforts. This follows of course from the larger turnover of the Indian subsidiaries . The largest expenditure (in absolute terms) by any one Kenyan firm (engineering design) is only 9% of that of the largest Indian subsidiary (tyres).

Quality Control

A distinction has been drawn between production, product and materials technology in our study of technical change in the seven subsidiaries. There are grounds to suppose that quality control activities by these subsidiaries may in fact lead to technical change if products are found to be of sub-standard quality and this leads to changes in product design, production technology or material inputs.

Some caution should however be exercised in discussing the link between quality control and technical change. The caution is not to dispute the links which do arise, but rather in the interpretation of the policy conclusions which result. The main problem lies in the specification of quality standards. Does it really matter if product finish 'suffers' from the use of local inputs? Perhaps of greater importance is the case of the engineering design firm; is air-conditioning in motor cars (also supplied by E) really necessary? The question of the transfer of taste patterns is one to which we shall have to return at a later stage.

(a) Kenyan Sample

All of the firms have some form of control over quality. In the case of the two pharmaceutical and the cement subsidiaries not only are the quality standards used those of the parent, but the parent is also actively involved in maintaining standards. In each of these three cases the subsidiaries argued that it is essential that the parent's standards be used to ensure the safety of those who use the products. While this may be true in the case of ethical medicines, it is less so with regard to other products such as cosmetics and toiletries. The tea producing and the vehicle assembling firms work to the same standards as their parents even though the parents are not involved in the con trol of quality.

In only two cases do the subsidiaries set quality control standards independently of those of the parent. It is probably no coincidence that these two firms - tea machinery and engineering design - are capital goods firms. Capital goods firms, as we have seen, work to the specifications of individual customers, so it is difficult for the parent to generalise quality control specifications to all designs.

The real interest with regard to quality control activities by these firms lies in the link with technical change. To take each of these in turn:

(i) Product technology. In the case of both of the pharmaceutical firms there is a strong link between quality control and product formulation. Before any new product is marketed it is checked for "stability" to see whether it stands up to local climatic conditions to the satisfaction of the parents. If not, new formulations are made. The difference between the two subsidiaries is that in the case of C the original reformulation is made by the subsidiary itself, whereas in the case of B the parent is completely responsible for this reformulation.

Quality control is also linked to product technology in the case of the two capital goods firms, tea machinery and engineering design. Here the acceptability of a particular design to a customer will affect whether the design, or a changed one, will be used again. The lessons of quality control in both cases are internalised within the subsidiary and not the parent.

(ii) Product technology. The link between quality control and production technology is strongest in the case of the vehicle assembler, the tea producer, the tea machinery producer and one of the pharmaceutical firms (C). In all of these cases the acceptability of the final product will influence the production technology. For example in the case of the pharmaceutical firms, quality control staff noticed a variation in the quality in tube filling and this was traced back to labour intensity in this packaging operation. As a consequence the subsidiary has decided to introduce new, semi-automated tube-filling machinery.

(iii) Materials Technology. The strongest link between quality control and materials technology probably arises in the case of the cement producer where the suitability of the inputs will determine whether the final product matches up to the British Standard Specifications.

All of the firms have had some form of quality control since the inception of operations, although in two cases - pharmaceuticals (C) and tea machinery-this control has only recently been set aside from production. For example, B used to have quality control as part of the production technology - they found however that it was necessary to set up an independent quality control unit responsible to the general manager and not to the production manager, if they were to have effective control over quality.

The cost of the quality control operations (see table 5) varies considerably between the firms and bears little relationship to firm size or operation. The greatest expenditure on quality control in aggregate terms

is undoubtedly that of the cement producer, although no precise estimate was available. It however possessed a well-equipped laboratory and employed a number of skilled and semi-skilled staff (one M.A. graduate and a number of technicians). Samples of inputs and outputs are regularly sent to the United Kingdom for the parent's approval. Relatively speaking, the greatest expenditure on quality control is by the vehicle assembling subsidiary, but this is probably due to the fact that in its case quality control is integrated with production. The assembly of vehicles, especially custom-made ones, requires constant checking to ensure that the vehicle is put together correctly.

Therefore with the exception of the tea producer, quality control expenditure is fairly high for all subsidiaries particularly in comparison with expenditure on experimental development and adaptation (cf. table 4).

(b) Indian Sample

All the firms in the sample have quality control activities for they all have to rely to a considerable extent on local raw materials, ancillary products and capital goods.

In the pharmaceutical companies, the quality control on raw materials is very tight. Firm C devotes considerable attention to enforce strict quality control on the raw materials that it purchases from local producers. The quality control standards are set by the parent. In fact sending the sample for final checking with the parent ensures that the quality control as developed by the parent guides the subsidiary in this operation. Perhaps these strict quality control standards have not permitted this company to use the local raw material for production of one of its major products - insulin. The argument of the subsidiary is that it is not possible to enforce such quality control over their supplies.

In the case of the company of tea and allied products there is quality control of local materials. In this case, the subsidiary has its own standards.

The packaging company also has regular quality control activities. The standards of the parent are modified to a certain extent by the local subsidiary so that it would be able to use local raw material because government has refused to permit the import of a large number of raw materials. However, in one commodity the company is imposing a quality standard of the parent and declining to use local material produced by a public sector company.

Quality control is a dominant activity in the vehicle company. It has to enforce it not only on its production, but also on the various ancillary products it uses. The standards of the parent are slightly

modified and adapted to its own needs, but since some of the standards are internationally accepted the company relies on parent specifications. For instance, the ancillary requirements are met by the companies which have collaboration with other foreign ancillary producers. In the case of small scale industry it developed its own quality control standards and facilitates production with that. There is a close link between production technology and quality control and considerable adaptation takes place.

In the edible oil company, the quality control measures are developed by the subsidiary. This is for two reasons. First, it has to use local raw material and a considerable amount of substitution has taken place. Secondly, some products are developed mainly for Indian consumption.

Then electronic company, due to considerable dependence on local resources, has adapted its production technology touse these local products. They have developed their own quality standards in use of raw materials, spare parts etc.

The tyre company places great emphasis on quality control. Since it has to rely on local raw materials, its main concern is to ensure quality control and adapt its production technology to it. This has to be done with regard to material, product and production technology.

The role of quality control in technical change has to be understood not so much in the generation of new technology, but in terms of adaptation in the subsidiary and the independence of the subsidiary from the parent in selecting quality control standards. The subsidiaries of the sample, with the exception of pharmaceuticals and vehicles, are to some extent independent of the parent in determining quality standards and using local materials and ancillary products. However it is doubtful whether this can be attributed to any initiative of the subsidiary. For a large number of such sources of raw materials and ancillary units were developed through active policies of the Government and massive Indian private and public investment in various sectors. What these subsidiaries did was to respond to these developments. Very often, this response has not been free and adequate, and is constrained by a large number of factors. Some companies have not responded to the extent that might be expected as revealed in the case of pharmaceuticals and packaging companies.

(c) Comparison of the Kenyan and Indian Samples.

Unfortunately no information is available for expenditure on quality control in the Indian subsidiaries, nor on the number of manpower involved in these activities. The major conclusion which emerges from the comparison of the two samples is the relative lack of difference between the behaviour of

	A Tea and Allied products		B Pharmaceuticals etc,		C Pharmaceuticals etc.		D Cement	E Vehicle assembly		F Refrigeration & engineering design	G Tea Machinery	H Electronics	I Edible oils, soaps, etc,	J Tyres	K Packaging Materials
	Kenya	India	Kenya	India	Kenya	India	Kenya	Kenya	India	Kenya	Kenya	India	India	India	India
Whose standard on Quality Control	Parent	Partly parent	Parent	Parent	Parent	Parent	Parent	Parent	Parent	Subsidiary	Subsidiary	Partly parent	Partly parent	Par-ent	Mainly parent
Role of Parent in Quality Control	None	Not very Active	Active	Active	Active	Active	Active	None	Active	None	None	Not very Active	Not very Active	Act-	Active
How long has Quality Control taken place	Since inception	NA	10 years	NA	2 years	NA	Since inception	Since inception	NA	Since local design	1½ years	NA	NA	NA	NA
Manpower in Quality	No seperate staff	NA	4	NA	4	NA	12	18	NA	No Separate staff	Senior production staff	NA	NA	NA	NA
Cost of Quality Control as % of Sales	No separate cost	NA NA	£5,294 0.56	NA NA	£9,815 0.42	NA NA	NA NA	£10,94 0.46	NA NA	£9,412 1.97	£2,354 0.5	NA NA	NA NA	NA NA	NA NA
Link with Technical change															
(i) Production technology	No	No	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
(ii) Product technology	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
(iii) Materials technology	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes	Yes	Yes

NA: Not available.

the subsidiaries on the two countries. Where differences do arise (as in the independence of the two capital goods firms in setting their own standards), they are largely explained by sectoral activity rather than by country differences.

In most cases the parents are involved in setting quality standards. They are similarly involved in the maintenance of these standards. There are identifiable links between quality control activities and technical change in all three spheres of technology. Where figures are available on the level of these expenditures, they appear to be relatively high in relation to expenditure on research and development.

V. Technical Change from Sources External to the Subsidiary

The eleven subsidiaries all rely on external sources for for technical change (as little is generated by themselves) although the extent of course varies. Associated with the reliance on external sources is the question of the participation of the parent in supplying this technology. This important point concerns the 'independence' of subsidiaries, for while it may be true that most subsidiaries are 'dependent' upon external sources for technical change, some may be more 'independent' than others from their parents in the acquisition of this new technology. The question of who is responsible for the actual choice is thus important; but so, too, is the question of the ability of the subsidiaries to make the choice themselves.

The problem will be examined in three stages - firstly examining the rights of subsidiaries to acquire new technology independently from the parents (17) and then establishing whether these subsidiaries have the ability to choose this technology (table 6). Finally there will be some discussion of the mechanisms used to obtain this technology from external sources (table 7).

(a) The Kenyan Sample

The complete spectrum of independence is represented in the sample of subsidiaries. Three of them (engineering design cement production and tea machinery) have complete autonomy of choice. Three others (tea production and both of the pharmaceutical firms) have some autonomy and one (the vehicle assembler) has no autonomy at all (although in this case it is not clear whether the lack of autonomy reflects a lack of ability to make independent choices).

(i) Complete Autonomy of Choice.

In the engineering design subsidiary the design of products is entirely in the hands of the subsidiary. Since the parent is predominantly engaged as a contractor and in the manufacture of heavy refrigeration machinery, as opposed to the design of air conditioning and refrigeration systems

practised by the subsidiary, there is little option for the parent but to allow the subsidiary,

complete autonomy in this respect. The subsidiary is also independent in its choice of sources for production and materials technology, but since its parent is the 'leader' in the production of refrigeration equipment, the subsidiary does purchase these inputs from the parent (this makes up only about 20 per cent of all their imported inputs). In theory the subsidiary is able to buy this refrigeration equipment from another source, but since this has not yet occured there is no way of knowing how real this autonomy is.

Not only does the tea machinery subsidiary have complete autonomy in the choice of its technology, but it purchases none of it from the parent. This unusual case arises from the rather special circumstances surrounding the presence of this subsidiary in Kenya. Unlike any of the others in the sample (and also, to the best of the author's knowledge, unlike any other subsidiary in Kenya), the parent has moved all of its tea machinery manufacture to Kenya and produces none in the United Kingdom.

In cement production, the substance of the parent's relationship to this subsidiary lies not so much in the form of equity (of which it holds only 14 per cent), but in the form of the Technical Services Agreement. At an earlier stage the Technical Services Agreement was held by another firm and all of the core equipment of the plant was provided by a third Danish multinational. Since the British parent assumed the responsibility for the Technical Service Agreement, no new core equipment has been installed. Yet in the case of all purchases of peripheral production technology and materials technology the subsidiary has had the right to independent choice. The complication which arises in this respect is that the personnel responsible for making these choices are in large part supplied by the parent in terms of the Agreement; so that in fact the parent actually makes much of the choice although normally the subsidiary has complete autonomy.

(ii) Some Autonomy of Choice

The tea subsidiary has some autonomy in the purchase of new technology. In the case of materials technology it has almost complete autonomy. Since these comprise largely of agricultural inputs and packaging materials (which are made locally) this autonomy is not surprising. In the case of production technology, this autonomy is more limited - some machinery is purchased locally (such as that produced by G) and some is acquired through the parent from firms in South Asia and Europe. In the case of the instant tea plant which comprises the most 'complex' of all production technology installed, the parent has been completely responsible for the choice of suppliers, even though some of the less 'complex' items were acquired locally from G.

While both of the pharmaceutical subsidiaries possess some measure of autonomy, the degree is greater for C than for B. The latter subsidiary only has some autonomy in the acquisition of inputs (19). All production technology is purchased through the parent, although the subsidiary is consulted about it. Product technology is the responsibility of the parent, which involves one of its consultants in the reformulation of specific products for the local market.

By contrast C has considerably more autonomy. Like B it purchases most of its inputs from non-parent sources - only 20 per cent of raw material and processed inputs come from the parents. It is also involved in the acquisition of new production technology and as we have seen in the case of the tin-filling machine mentioned earlier, it is to a small extent involved in generating this production technology locally. This subsidiary also has some autonomy in the sphere of product technology, where it undertakes all reformulations for the basic market (the parent has the right to veto these changes). These two subsidiaries, while similar in product mix, provide an interesting comparison of the effects of parent policy on subsidiaries.

(iii) No Autonomy of Choice

The vehicle assembling subsidiary is completely reliant on its parent for new technology. All product technology is supplied by the parent as is almost all materials technology in the form of knocked down kits. There will be a slight change in future in that the new assembly plant will also assemble vehicles produced by a German car firm, but in this case too the subsidiary will be reliant on the German firm for both product and materials technology. In the case of production technology, the subsidiary relies on its parent. The spot welder to be introduced in the new assembly plant is to be built in Britain to the parent's design; similarly the jigs to be used in the new plant are to be designed by the parent, although some of the more simple jigs will be built in Kenya.

Closely related to the rights of a subsidiary to choose new technology autonomously is its ability to do so, for without this ability any nominal autonomy may be useless. In three cases the subsidiaries were 'frustrated' in that they were obliged to refer to the parent when they were able to make the decisions themselves. In three other cases the rights of the subsidiary to choose technology autonomously from the parent coincide with their ability to make this choice.

The two pharmaceutical firms (particularly in the case of materials technology) were to a limited extent tied to the purchase of parent technology in spite of being able to obtain these from other sources. The tea producer routed the purchase of some of its production technology through the parent when it was almost certainly capable of making these purchases independently. The cement producer is a rather special case in that while it had the nominal autonomy to purchase new technology independently from the parent, without the participation of the parent in the operation of this subsidiary (in the form of the Technical Services Agreement) this autonomy would have been purely nominal.

The autonomy of the two capital goods subsidiaries is clear when referring to table 6. Not only do both have the right to independent choice, but they also possess the ability. In the case of the vehicle assembler there exists a coincidence between the subsidiary's rights and abilities to choose independently in that it has neither the right nor the ability to make these choices itself.

(b) Indian Sample.

There is little evidence that the Indian subsidiaries were given the right to make choices with regard to new production, materials and product technology without referral to the parent. Some independence was allowed to the tea and edible oils subsidiaries, but there is no clear indication of why these two subsidiaries were treated differently by the parents, other than the fact that they are the two oldest subsidiaries in the sample.

In contrast to the limited rights of the Indian subsidiaries to choose technology without reference to the parents, the Indian subsidiaries displayed a clear ability to make these independent choices. All of the sample were gauged to have a 'high' or 'very high' ability to choose their own technology.

(c) Comparison between the Kenyan and Indian Samples.

There appears to be a sharp contrast in the relationship of the Kenyan and Indian subsidiaries to their parents (table 6). While the Kenyan subsidiaries appear to have some latitude in exercising their own choice of technology, this latitude is constrained by their apparent inability to use this nominal independence. (The exceptions to this are the two capital goods subsidiaries who choose technology independently from their parents. It is argued that this is a characteristic of capital goods firms in underdeveloped countries in that by their nature they are forced to adapt to local circumstances. It also reflects the particular nature of these two subsidiaries in that the tea machinery manufacturer is the only subsidiary of this type within the firm, and the engineering design is one of two small subsidiaries operating in underdeveloped countries.)

Table 6: Right and Ability of Subsidiary to Choose Technology Independently

	A		B		C		D	E		F	G	H	I	J	K
	Tea and allied products		Pharmaceuticals etc.		Pharmaceuticals etc.		Cement	Vehicle assembly		Refrigeration & engineering design	Tea Machinery	Electronics	Edible oils, soaps, etc.	Tyres	Packaging Materials
	Kenya	India	Kenya	India	Kenya	India	Kenya	Kenya	India	Kenya	Kenya	India	India	India	India
The right to autonomous choice	Some	Some	Little	None	Some	None	Complete	None	None	Complete	Complete	None	Some	None	None
Ability for autonomous choice	Some	Very high	Some	High	Some	High	Little[a]	None	Very high	Complete	Complete	Very high	Very high	High	Very high

(a) Subsidiary only has ability because of presence of parent personnel through Technical Services Agreement.

By contrast the Indian subsidiaries possess the ability to make an independent choice, but are constrained by the parent in exercising this ability. There is no 'proven' explanation for this contrasting picture, but one firm speculation must be that there is no cost to the parent in giving the Kenyan subsidiary the right to choose independently since in most cases the subsidiary is unable to take advantage of this latitude and there can be little harmful effect on the parent's position. This is reinforced by the fact that in most cases the senior management of the Kenyan subsidiaries are foreign nationals appointed by the parent and presumably act in the parent's interests. By contrast, in India the subsidiaries possess the potential to harm the parent's direct interests by choosing new technology independently, and given that senior management is these Indian subsidiaries are frequently Indian nationals with some loyalty to the Indian state, there is some danger of an explicit clash of interests arising if the subsidiaries are given too great a leash by the parents.

Types of Technological Collaboration

There are a variety of mechanisms open to a subsidiary in its attempt to obtain new technology, ranging from the direct purchase of equipment, through the use of licences, the purchase of blue-prints to the establishment of a Technical Service Agreement. In some cases the establishment of a subsidiary may occur in the form of a package - the parent supplies equipment, provides raw materials, supplies disembodied inputs to ensure the maintenance and operation of the plant and the disposal of output, and supervises and enforces quality as well. At the other extreme, which is generally associated with the 'independence' of a subsidiary, a subsidiary purchases capital equipment from a variety of sources, and has technological agreements with different producers - this situation is generally referred to as an 'unpackaged' transfer of technology.

The subsidiaries were approached in order to establish the mechanisms used to obtain new technology. Associated with this is the question of property rights. When production technology is generated by a subsidiary who obtains the property rights over this technology and the property rights over product technology (i.e. brand names)?

(a) Kenyan Sample

Most firms make no specific payment to the parent for technology (table 7). The most probable explanation for this is that generally technological payments are made by subsidiaries in an attempt to transfer price profits to the parent. This fact was recognised by some of the firms. One of the pharmaceutical subsidiaries made a similar observation when it replied that there was no need to double the payment for technology as account had already been taken of the parent's technological input in the payment of dividends ( ). The ethics of the matter aside, it is clear that the subsidiaries feel little need to transfer price in this way as their is no restriciton on the repatriation of dividends to the parent or because they use other channels to transfer One other factor inducing the use of such transfer pricing mechanisms is the existence of a joint venture. In this case it would be expected that the tea machinery, vehicle assembly and engineering design subsidiaries (where there exist substantial minority holdings)would make some attempt to make additional payments for technology, but there is no indication that transfer pricing has occurred in the form of technology payments.

None of the subsidiaries made technological payments to non-parents either. This suggests that the technology which they are using is either wholly supplied by the parent or is readily available from alternative suppliers. The latter conclusion follows from the fact that all machinery purchases are lump-sum payments and no royalties are involved. Presumably equipment suppliers would prefer to have ongoing payments as well as lump-sum payments and where they were operating in a monopolistic market they would be able to enforce the payment of royalties.

The importance of technology as a control measure by the parent over subsidiaries is suggested by the fact that in all cases parents obtain the property rights over new technology generated in the Kenyan subsidiaries and take responsibility for the registration of patents and brand names. There is no clear pattern in the number of patents registered by each of the firms. All of the firms producing final output have registered patents, neither of the intermediate product firms (cement and vehicle assembly) holds patents and one of the capital goods firms (engineering design) also holds no patents. On the other hand the firm with the most registered patents is also a capital goods producer. The number of patents held probably reflects the individual circumstances of each firm with respect to technological complexity, the sector of operations and the policy of the parent. No information is available in regard to the implementation of patents held by each subsidiary.

(b) Indian Sample

Of the eight subsidiaries, two have informal arrangements with the parent, one has ad hoc and informal arrangement, and the rest of the companies have rigorous agreements of technology transfer. These transfer mechanisms have some effect on the development of independence of the subsidiary in developing its own technology and choosing from external sources.

The edible oils subsidiary has no formal technical agreement with the parent. Hence, it does not pay any royalty. No evidence exists of the payment of technical fees. The subsidiary obtains information from the parent including confidential reports. These reports

include special, general reports and extracts. It is left to the management of the subsidiary to select any item of a technical report for application. The subsidiary receives patents and no payment is made. It is to be noted here that the subsidiary's R & D section is one important unit in the network of all R & Ds of the multinational. It is believed some important technical information is also given by the Indian subsidiary to the parent and other subsidiaries. Over the past decade nearly 900 important reports have been sent to the parent.

In an event when new technology has to be used in the subsidiary, it relies on the help of the parent. A consultant normally comes to the subsidiary for a period of 3 months to 2 years to enable the subsidiary to introduce technology. This subsidiary appears to be considerably free and even competent to develop its own technology. But there is no evidence to show that it can buy the technology outside the complex of the parent and its subsidiaries.

The tea subsidiary also has an informal arrangement with the parent with regard to technology. While it has an agreement for marketing, there is no formal agreement with regard to technology. Probably this is because in tea the technology is relatively 'simple', while instant coffee technology was developed by the subsidiary itself. But for the development of oleoresin from spices the subsidiary relied on the U.K research centre entirely. Similarly, with regard to technology necessary for meat production, the subsidiary is dependent on the parent. There is some evidence that the subsidiary is making attempts to get some technology from Indian sources. It has given projects to national research centres for study.

The electronics subsidiary has an informal arrangement with the parent. But in some cases the firm enters into an ad hoc technical arrangement when a new technology is imported and a technical fees is paid. It also receives all information free of charge. When a specific new technology has to be used by the company, a consultant or a group of consultants visit the company and the subsidiary provides an Indian understudy. It appears that the subsidiary is free to take technology from outside. But the evidence is that it relies on R & D from its well developed unit.

The five other subsidiaries have very tight technical agreements to transfer technology. It is relevant here to point out that all technical collaboration agreements have to be approved by the Government of India and normally such agreements would be permitted for a period of five years. Of course agreements entered into prior to this policy are permitted to continue until they lapse.

The two pharmaceuticals subsidiaries' R & D are accompaned by rigorous technical agreements. Company B had a formalized agreement with the parent. Under this agreement, the subsidiary was entitled to receive from the parent engineering and design services, patent rights, technical known-how involved in the process of basic manufactures, R & D expert assistance etc., on payment of a fee of 2½% of net sales. This agreement came to an end in 1973. The subsidiary renewed it on July 1, 1973, and for this they sought the Government's approval, which, it is believed, has now been granted. The technical fees remitted in the year 1974 amounted to £335,402. There is also a Trade Marks Agreement under which the subsidiary was granted trade marks for more than 100 products. This agreement is for a period of fifty years beginning from 1968. The parent has linked the corporate name with the capital holding of 51 per cent.

Company(also has two technical agreements which were signed in 1948 and 1965 respectively. The extension of the agreement has been permitted by the Government of India. Under this agreement, the parent is expected to provide all the technical know-how including personnel to the subsidiary. Various royalties have to be paid. As a research contribution the company pays £3,259 annually to the parent. There is no evidence to show that the company buys technology from outside.

The vehicle subsidiary also has a technical collaboration agreement with the parent, first entered into in 1955. Under this agreement the parent provides technical know-how, design and drawings. The parent deputes planning engineers from time to time to advise the subsidiary on layout and running of the factory. It also makes available services of key technical personnel whenever it is required. The agreement makes it obligatory that all imported components are imported from the parent and reserves the right to inspect the parts manufactured in the subsidiary. The parent also acts as a purchasing agent for the company for all imported raw materials and plant on payment of handling charges. Under the

agreement the parent has permitted the subsidiary to use its trade marks. Any technical problem of the subsidiary can be referred to the parent. In fact there appears to be an necessity to refer most of the important problems to the parent. The subsidiary paid a technical fee of £ 5000 per annum to the parent for five years and it pays royalty of 1¾% on net sales. The agreement runs for 20 years and remains in force unless specifically terminated. The subsidiary is seeking renewal and is negotiating with the Government.

The packaging subsidiary has two know-how agreement with the parent. One is in products and the other in machine building. The agreement with reference to machine building will expire in 1978. The government is holding up the renewal of the agreement on packaging on the ground that there is no need for . Purchase of technical know-how costs the company £ 27,492 per annum.

The tyre subsidiary has also a formal agreement with the parent. Under this, all information, processes and inventions applied for relating to the manufacture of goods made by the company will be made available. It also grants a licence to use such processes and protected by the latter's patents, upon payment of a proportionate part of the cost of acquisition, discovery or development and of any royalty. This agreement was signed, on January 1, 1957. Besides providing technical know-hoe for manufacture of automobile typres, it also provides the technical know-how for manufacture of tennis balls. The technical know-how agreement expired in 1969. was some difficulty in getting it extended. However, the agreement was extended and expired in 1974. It is now under re-negotiation.

The implications of these informal, ad hoc and formal arrangements of technical transfer on technical change in the subsidiary can be summed up as follows: (i) The difference between the formal and the ad hoc on the one hand and the informal on the other is in terms of explicit payment of technology transfer. In the informal arrangement there is no specific royalty or lump sum payment,whereas in others there is. (ii) Regarding information, technical and otherwise, all firms contend that they get all information. Investigation lends some credence to the view (that they do get this information) but some critical technical information is withheld especially in the companies where there are formal arrangements or transfer. (iii) The subsidiary depends in all these cases on

the parent. In some respects the dependence is very high. In the case of drugs, the dependence of the subsidiaries on the parent is almost total. There is hardly any significant freedom for these companies to be independent in technically choice. This is also the case with the tyre and vehicle companies.

There is room to believe that the formal agreements have made the subsidiaries feel that they cannot develop or acquire new technology of importance without the parent. This also appears to occur in ad hoc arrangements. In cases where there is no such agreements there is some feeling of independence, while with formal agreements, in the event of failure of extension, there is some fear that the subsidiary may lose many competitive advantages of trade mark, brand name etc. This is particularly strong in the case of drug companies.

This obviously leads to the question of whether the subsidiary has any competence to purchase technology from external sources. This is a difficult question for the non-technician to answer. Yet the interviews conducted by the investigator with management, engineers and technicians of the companies and experts in these fields in various governmental research bodies leads to the following observations.

First, companies have the technical competence to choose from external sources. As has already been seen the R&D units and other technical departments are well served by highly qualified Indian technicians and engineers. Second, these personnel are extremely capable, and they have been rated as such by the parent company. In fact, there is demand for these experts from the parent staff and by other subsidiaries. Thus the suspicion exists that the capabilities of these people are normally thwarted because of the reliance or an 'expert' from the parent company. This is true of all companies in the sample.

(c) Contrast between the Kenyan and Indian Samples.

The contrast between the two samples is clear. Whereas only two out of the seven Kenyan subsidiaries had formal agreements, six of the eight Indian subsidiaries had formal agreements and the other two had informal agreements. All of these formal agreements were accompanied by specific fixed payments for technology.

Table 7

Types of Technological Collaboration

	A		B		C		D	E		F	G	H	I	J	K
	Tea and allied products		Pharmaceuticals etc		Pharmaceuticals etc		Cement	Vehicle assembly		Refrigiration engineering design	Tea Machinery	Electronics	Edible oils, soups, etc	Tyres	Packaging Materials
	Kenya	India	Kenya	India	Kenya	India	Kenya	Kenya	India	Kenya	Kenya	India	India	India	India
Technological Collaboration with Parent	Formal	Informal	None	Formal	None	Formal	Formal	None	Formal	None	None	Ad hoc and informal	Informal	Formal	Formal
Technical Payments	Fee	Not Specific	-	Fees Royalties	-	Royalty	Fees and Royalty	-	Fees and Royalties	-	-	Ad hoc fees	Not Specific	Royalty	Royalties
Technological Collaborationwith non-parent	No	NA	No	NA	No	NA	No		NA	No	No	NA	NA	NA	NA
Property rights over technology generated in subsidiary	Parent	Parent	Parent	Parent	Parent	Parent	Parent	Parent	Parent	Parent	Parent	Parent	Parent	Parent	Parent
Number of Parents registered locally	8	NA	5	NA	13	NA	0	0	NA	0	11	NA	NA	NA	NA

The reason for this contrast is clear and reflects a pattern found in other parts of the world (20). Where government attempts to control the level of dividends repatriated by a subsidiary to a parent, the firm develops other channels in which its effective profits may be remitted. In Kenya there is as yet little pressure by government to limit the repatriation of dividends, so that there is little need for the firm to develop formal technology agreements. In India government controls are long standing and pervasive and firms tend to take the opportunity of formalising agreements for the payment of technological inputs which may have (or may not have) been supplied by the parent or other subsidiaries.

It is interesting to note that without exception in all subsidiaries in both countries, the parent obtains the property rights over new technology which may have been developed by the subsidiaries. This confirms the view that control over technology is of particular importance to the parent in its global strategy and in its control over subsidiaries.

VI. Circulation of Technology through the Firm

To some extent foreign investment occurs in underdeveloped countries because the technological capability to undertake these investments does not exist without the participation of the foreign investors. Since the presence of these foreign investors reflects this technological and organisational capability the parents are concerned to maintain property rights over technical change (see previous section). It is natural that the foreign investors will want to keep subsidiaries abreast of developments within the firm and the industry to ensure that the subsidiaries operations reflect this technological ability. The sample subsidiaries were therefore questioned with regard to the mechanisms used by theparent to circulate technology (both parent and non-parent) through the firm. This circulation of technology through the firm is essentially a disembodied technology. As we have seen this can be a combination of firm-disembodied and man-disembodied technology.

(a) Kenyan Sample

While most of the firms had organized a system through which to transmit technical change through the corporate body, there were two exceptions - tea machinery and vehicle assembly. At the other extreme

was one of the pharmaceutical subsidiaries (B) and the rest were ranged between these two extremes.

Some System of circulating technology

All subsidiaries of the tea producing firm have a development committee which examines new ideas and changes in method. A similar committee exists in the parent. These new ideas are circulated through the firm via the Board, where divisional directors are expected to report on relevant changes in their subsidiaries, and at the same time to pass on changes generated in other divisions to their own subsidiaries.

Of greater importance to the subsidiaries, however, is the exchange of visits by skilled manpower. The Kenyan subsidiary is for example sending someone to Assam where the local subsidiary is having trouble with growing coffee. They also assist small-holder production in Kenya in this way, and, via the Commonwealth Development Corporation, they are sending someone to Swaziland to assist in small-scale tea growing schemes. In all cases there is no charge for these services, but the recipient subsidiary is expected to pay the cost of the visit if exchange control regulations permit this.

The Kenyan subsidiary has also received assistance in this way. When they were contemplating building an instant coffee plant in Kenya, they turned to one of the other subsidiaries whose growth had largely followed from their success with instant coffee. Frequent visits were made to this subsidiary by high level manpower from the Kenyan subsidiary and drawings were obtained, as well as advice on the best methods of processing.

Following the closing down of their Research and Development section, the Group has established a Technical Services Division, which acts independently from the Board. It scrutinises monthly reports sent in by subsidiaries and evaluate whether it has any specialised services to offer. Where it has, it makes direct contact with the subsidiary to offer advice and this frequently results in the dispatch skilled manpower to the subsidiary.

With respect to obtaining non-parent proprietary technology the operations of the Kenyan subsidiary must be seen in relation to the Group's decision to give up all Research and Development and to buy in

new technology from other firms. Some non-parent proprietary technology therefore comes through the parent. The Kenyan subsidiaries of other multinationals are another source of non-parent proprietary technology and have been particularly important in enabling the subsidiary to keep abreast of development in herbicides and fertilisers.

As we have seen the subsidiary of firm B (pharmeceuticals) undertakes no expenditure on either Research and Development or on adaptation. It relies completely on the parent for new technology. The Kenyan subsidiary relates to three Divisions in the parent in this respect.

(i) Technical Services Division. Once the Kenyan subsidiary specifies a need for certain equipment the actual choice is made by the Technical Service Division of the parent, which will suggest its choice to the Kenyan subsidiary. In the unlikely event of continued disagreement (as capital expenditure of more than £1,200 is discussed three years in advance), Technical Services will send someone out to discuss the problem, or the discussion will take place on the manager's annual visit to the parent. The full instructions for operating the plan as well as precise instructions for mixing any new formulations are supplied by Technical Services.

Technical Services Services is responsible for quality control and sets out the required standards. It is also responsible for the design of new buildings, scaffolding and platforms. These designs are undertaken in London by the parent of another British construction firm which has a subsidiary in Kenya, and the design follows discussions by the two parent firms in London.

If there is any difficulty in operating the plant Technical Services will assist. For example the Kenyan subsidiary is experiencing difficulties in the quality control section and Technical Services are sending a consultant out for six weeks.

(ii) New Products Division. In most cases the Kenyan subsidiary identifies a need for a new product. The formulation of this product is undertaken by the New Products Division of the parent. In some cases the Kenyan subsidiary will be instructed to either produce or market a new product developed elsewhere in the firm. The New Products Division circulates a quarterly list of new products to all subsidiaries, but hitherto this has not provided the Kenyan subsidiary with any new products.

(iii) Marketing Services Division. This division is responsible for marketing and advertising. Since marketing conditions vary throughout the firm's subsidiaries, the activities of this division are confined to the realm of new ideas rather than of specific marketing techniques.

The subsidiary of the other pharmecuticals firm (C) has contact with two Divisions of the parent.

(i) Marketing Services Division. This division is mainly concerned with training, advertising, and marketing. It sends circulars at monthly intervals to all subsidiaries, but there is also direct contact with the Kenyan subsidiary on specific problems.

(ii) The Technical Services Division. The main concern of this division is with regard to the purchase and operation of production technology. The Kenyan subsidiary clears all machinery purchases with this division and goes to it for advice on specific problems where necessary. This division is also responsible for circulating new formulations.

Subsidiaries are also able to contact each other directly without going through the parent. Advice may be sought from a subsidiary operating in similar conditions with regard to product formulations as well as production technooogy. Access to non-parent technology is made through the parent and the Technical Services Division keeps the subsidiary informed of developments which it considers to be relevant.

The main link between the parent and the Kenyan subsidiary of Firm D (cement) is not through equity (where the parent only holds 14 per cent), but through a technology agreement. It was not possible to obtain details of this technology agreement, but the broad outline is that the parent supplies a Technical General Manager, a Works Manager and an Electrical Engineer. It also gives the subsidiary access to new developments in technology and assists with specific problems which arise. Occasionally the parent is asked for advice with regard to the purchase of new equipment, but since there have been no major purchases for some years, few problems have arisen. Monthly reports on production are sent to the parent.

The circulation of manpower is another way in which the parent assists the Kenyan subsidiary. Two or three times a year, they are visited by someone from the parent. He informs them of advances made elsewhere in the firm and considers specific problems of the Kenyan subsidiary in the light of his experience in other subsidiaries. Should he not be able to offer advice on the spot (he only stays for a few days), he will consult with colleagues in London and write back with their views.

In earlier years the parent of the engineering design subsidiary sent manpower out from the United Kingdom to fulfil specific contracts, but since the Kenyan subsidiary begun to undertake its own designs, this has become much more infrequent, and it seldom occurs now that the local subsidiary has generated its own design expertise. However use is made of visits oto the parent and the Managing Director and General Manager make annual visits to the parent, and senior design staff make bi-annual visits, or visits on particular problems. This is an important channel for the Kenyan subsidiary in its attempts to keep abreast of parent technology. Circulation of lower level manpower through the firm is an important mechanism and personnel are sent to the United Kingdom on courses or to spend some time working in the parent's operations.

The Kenyan subsidiary may write to the parent on specific problems. Where the parent has this technology readily available, it will be freely offered, but where it requires specific work by the parent, the subsidiary will be expected to bear the costs. The Managing Director is on the circulation list for confidential design manuals of the Group's activities, and this is an important method of keeping abreast of the parent's activities - until recently he was the European Marketing Manager for the parent firm, so this too assists in the Kenyan subsidiary's ability to keep abreast of parent technology.

The activities of the Kenyan subsidiary are broader than those of the parent. The parent concentrates its activities in refrigeration technology, while the local subsidiary complements this with work on air-conditioning. It is important therefore for the Kenyan subsidiary that it keeps abreast of non-parent technological developments. This is done in three ways. The first is through trade journals which informs them of developments by machinery manufacturers. The second is by visits from the main non-parent suppliers and the third is through

visits to the suppliers. The Managing Director visits one supplier in Israel (manufacturing under licence from the United States) twice a year and visits the main United States supplier approximately once a year.

No System of Circulating Technology

The Kenyan tea machinery subsidiary is completely responsible for the manufacture of tea processing equipment and is autonomous from the parent in this respect. As a consequence the contact between the parent and the Kenyan subsidiary is limited to financial matters. The subsidiary maintains its access to non-parent technology through trade journals but since it is basically a capital goods firm the relevant production technology is mainly simple machine tools.

The vehicle assembly subsidiary operates at a simple technological level, as we have seen. The main input of the parent is to design drawings for jigs used in the assembly of vehicles, and in the case of the new assembly plant, to design a new spot welder. There is little contact with the parent, therefore, with regard to technology. Were the Kenyan subsidiaries to have problems it would go to the parent, but there is no occasion when this has happened. The limits of their technological problems / concern, for example, a blown motor, and this can be easily solved by purchasing an (imported) replacement in Kenya.

Table 8 summarises the system used to circulate technology through the firms. It can be seen from the table that five out of the seven Kenyan / subsidiaries use a firm-disembodied technology (i.e. a specific division catering for the needs of subsidiaries for communicating technical change to subsidiaries). The exceptions are vehicle assembly, where the technology used in 'simple' and the main objective of the parent is the sale of knocked-down kits, and tea machinery where the subsidiary, for reasons which have already been explained, has a large measure of independence from the parent.

In the case of three firms - engineering design and the two pharmaceutical firms - a regular system of circulars exists to keep subsidiaries informed of technical change. In only one of these cases, however, (that of pharmaceuticals, B) do any of the subsidiaries consider theis not to be an effective form of transmission. A more effective form of transmission is that of the transfer of personnel

(i.e. man-disembodied) from parent to subsidiary and vice versa - three of the firms have regular visits organised, but all of the subsidiaries benefit when skilled personnel are seconded from the parent or another susidiary for a number of years.

(b) Indian Sample

Without exception the Indian subsidiaries were linked into the flow of technology through the corporate body. All subsidiaries received regular cirulars from the parent informang them of new technological developments in the firm. All subsidiaries also received regular visits from the parent, and with the exception of the tea producer, all subsidiaries regularly sent personnel to the parent to acquaint themselves with new technological developments.

(c) Contrast between the Kenyan and Indian Samples

The Indian subsidiaries do appear to be more closely linked into the flow of technology through the firm than the Indian onces. A number of factors explain this difference. It may be due partly to the different composition of the two samples, since the Kenyan sample included two capital goods subsidiaries who operated relatively independently from their parents. It may also be explained by the relatively large size of the Indian subsidiaries. For example the vehicle assembly subsidiary in India regularly received circulars from the parents, received visits from parent personnel and itself sent personnel to the parent. The same is true for the subsidiaries of one the Indian pharmecutical firms (C). By contrast the Kenyan subsidiaries of these firms were less closely linked to these systems of intra-firm circulation.

Size in itself may be one aspect, but a more likely one is the nature of the subsidiaries operations. Whereas the Kenyan subsidiary of the vehicle assembler merely assembled kits, the Indian counterpart was engaged in manufacture as well. Similarly the Indian pharmeceutical subsidiary (C) actually manufactured chemicals itself, rather than importing inputs and mixing them, as their Kenyan counterpart did. Clearly the level of technology involved is greater with regard to the Indian subsidiaries and the need for locking into the firm's system of curculating technology is more pressing.

TABLE 8: CIRCULATION OF TECHNOLOGY THROUGH THE FIRM

	A Tea and allied products		B Pharmaceuticals, etc.		C Pharmaceuticals, etc.		D Cement	E Vehicle assembly		F Refrigeration & engineering design		G Tea Machinery	H Electronics	I Edible oils soap etc	J Tyres	K Packaging
	Kenya	India	Kenya	India	Kenya	India	Kenya	Kenya	India	Kenya		Kenya	India	India	India	India
Parent Div. catering to needs of subsidiaries	Technical services Division		Technical Services New products & Marketing Divisions		Technical Services & Marketing Divisions		Technical Services	None		None		None	NA	NA	NA	NA
Use of Intra firm circulars	NO	YES	YES	YES	YES	YES	NO	NO	YES	YES		NO	YES	YES	YES	YES
Regular visits from parent for purposes of transmitting technology	NO	YES	YES	YES	NO	YES	YES	NO	YES	NO		NO	YES	YES	YES	YES
Regular visits to parent for purpose of obtain technology	NO	NO	YES	YES	NO	YES	NO	NO	YES	YES		NO	YES	YES	YES	YES

NA = Not Available

VII. Linkages

One of the arguments used to justify the presence of multinationals in an underdeveloped economy such as Kenya is that their presence may lead to industrial linkages and thereby stimulate further industrial development. There are two forms which these linkages may take. They may be forward in the sense that the product technology of the multinational provides an opportunity for new investment which is founded on the use of these products. Or they may be backward in the sense that investment results from the supply of capital goods (production technology), or the supply of intermediate goods (materials technology) to these subsidiaries.

The existence of these linkages is of considerable importance to continued industrial development. The precise importance is affected by a number of factors, not the least of which concerns the nature of entrepreneurship which is stimulated. If the new enterprises which are established are controlled by multinationals, this will almost certainly have different implications for the economy than enterprises which are wholly-owned and/or controlled by national citizens.

The eleven subsidiaries were therefore questioned in an attempt to establish the nature of the linkages which have arisen from their operations, and some attempt was made to determine whether these new enterprises were locally-, or foreign-owned (as an indication of control).

(a) Kenyan Sample

Forward Linkages

The discussion of forward linkages is complicated to some extent by the fact that although new firms may exist which utilise the output of some of the subsidiaries in the sample, it is not possible to determine whether these new firms would have come into existence wi without the local production of their inputs by using imported alternatives. This difficulty aside, there are four cases in which it could be said that new investment was 'stimulated' by the presence of output emenating from one, or more, of the multinationals in our sample.

The tea machinery subsidiary produces machinery for the local market. Processed tea is one of the major agricultural based industries in Kenya (A for example, which produces tea, is the largest non-government employer in Kenya), and although the processing costs are only a small proportion of unit tea costs, it is a necessary stage in the production and export of tea./But even without the presence of this subsidiary in Kenya, tea production and processing would have continued. In this respect it could not be said that forward linkages have arisen as a consequence of the presence of this subsidiary in Kenya. Nevertheless it is clear that the output of this subsidiary is a necessary input in tea production and it therefore does qualify as a 'sort of' forward linkage.

The availability of cement locally allows the construction sector to operate in Kenya and even now, when there exists a temporary shortage of cement in the country, building activity is slowed by its non-availability. Once again as with most of the forward linkages, it is is feasible that the construction sector could have operated independently of the presence of this subsidiary, but this does not negate the function of the cement producers in enabling continued industrial activity in the construction sector.

The availability of transport for both goods and people is an important factor in the industrial development of Kenya. To the extent that this transport is made possible by the presence of the vehicle assembling subsidiary in Kenya, it could be said that forward linkages have arisen from its activities.

The engineering design firm is the only subsidiary in the sample where there is a strong presumption that the presence of this firm has led to forward linkages in the economy. Its presence does allow other investment to take place as for example in the case of a Danish firm which has set up a subsidiary to export flowers to Europe. Without the existence of this engineering design subsidiary in Kenya it would not have proved feasible for the Danish firm to cultivate flowers on a scale sufficient to make its operations rewarding, since it has at all times remained in close contact with the engineering design subsidiary.

Backward Linkages

There are two forms which these backward linkages may take. They may be in the sphere of production technology in which case the

linkages will concern capital good firms, or they may be in the sphere of materials technology in which case the firms concerned will be intermediate goods firms. In the case of five out of the seven subsidiaries it can be said that backward linkages have arisen.

(i) Backward linkages in production technology

The presence of the tea machinery subsidiary in Kenya is a concrete sign that backward linkages have arisen in part from the operations of the tea subsidiary in Kenya. It would be a mistake to overestimate this contribution because much of this subsidiary's production technology is still imported.

To a limited extent the operations of the engineering design subsidiary have led to backward linkages in production technology, but these linkages have been internal to the subsidiary. Recently the subsidiary has begun to manufacture its own panels by injecting polystyrene into wooden frames, and on a previous occasion (as we have seen) the subsidiary engaged in 'reverse engineering' and fabricated 1,000 air-conditioning unit to meet its own needs.

As we have seen one pharmaceutical subsidiary (C) has purchased about 20 per cent of its machinery locally since the takeover in 1970. In association with a local engineer they are designing and building a tin-filling machine to meet the increased scale of production.

The vehicle assembly subsidiary has had a few pieces of equipment manufactured locally. The jigs for the new assembly plant as well as the existing paint shop have been constructed locally to the design of the parent.

(ii) Backward linkages in materials technology

The tea subsidiary meets all of its packaging requirements from local producers, while the two pharmaceutical firms still import a proportion of their needs. In the past the link between their product technology and this importation has been strong as the only reason for not using local inputs has been the product differentiation

which they practise in common with their parents. For example, bottles have been produced locally and are used by both subsidiaries - yet some products which C manufactures (e.g. hand cream) are marketed in a bottle of a specific shape which is not produced locally. Therefore these bottles are imported. C has recently changed its policy in favour of purchasing local packaging materials, and by the end of 1976 all packaging materials should be of local manufacture. This may necessitate changes in the design of some containers. The reason for this switch is a desire to cut inventories and to lessen the lead time between purchase and delivery of packing materials.

One other subsidiary whose presence has led to backward linkages in materials technology is the vehicle assembler. A concerted attempt has been made to introduce some locally manufactured parts into the assembly operations in the new plant. This has led to the projected inclusion of locally manufactured batteries, tyres, brakes soft, trimmings, canvas and oil and air filters. The major linkage arises from the local fabrication of all bus and lorry bodies - this has led to significant activity by a large number of locally owned firms.

The position with regard to the linkages is summarised in table 9. By definition forward linkages can only arise from the presence of capital and intermediate goods firms. The onwership of these linkages are largely local in the case of the two intermediate goods subsidiaries and largely foreign in the case of the capital goods subsidiaries. In the latter case this is probably a common pattern in that much of industrial investment in Kenya is foreign owned. However, in the case of the two intermediate firms, the local ownership follows from the specific nature of these two industries - other intermediate products (e.g. packaging) are almost certainly widely used in the foreign dominated manufacturing sector.

In the case of backward linkages there is little evidence of major linkages arising with regard to production technology, with the possible exception of the tea producer, in whose case the existence of the tea machinery subsidiary is a visible testament to the existence of such a backward linkage and vehicle assembly. Generally the other production technology linkages are insignificant. This no doubt reflects the absence of a well-developed capital goods sector in Kenya. What

does exist is split between the locally owned small scale workshops (e.g. manufacturing jigs, and containers and vehicle bodies) and the larger foreign owned subsidiaries (e.g. the two capital goods firms in our sample).

The major backward linkage in the sphere of materials technology occurs with regard to packaging where a Canadian owned subsidiary dominates the field. All the consumer good firms in our sample purchase local packaging materials and this is to be expected, given the product-techno--ogy orientation of their activities in Kenya. The only other case of backward linkages in materials technology is the provision of inputs into the vehicle assembly plant and these firms are largely foreign owned. In the case of the locally owned suppliers, the vehicle assembler had to exert a great deal of pressure before they were able to stimulate these local producers.

On balance the evidence of linkages arising from the presence of the seven subsidiaries is limited. Where they do arise, the larger firms are invariably foreign owned, while the local firms are of a much smaller scale and in industries where there are few technological barriers to entry. This follows from the general nature of the industrial sector in Kenya which is only at the earliest stage of development, and which is largely dominated by foreign owned firms.

In another study undertaken on over seventy multinationals operating in the Kenyan economy, Langdon [21] found a similar absence of linkages arising from the presence of these foreign owned firms in Kenya. In the case of production technology he found that the "linkages are so limited that variations among different sorts of subsidiaries are of little relevance; the whole sector performed poorly" (page 21). Materials technology linkages were also very limited; although not to such a marked extent. Statistical analysis of his data suggests that three factors are associated with the low level of linkages - "parent firm integration", capital intensity and product differentiating activities (measured by relative advertising expenditure). Langdon explains this absence of linkages in the following terms. "Overall, though, the qualitative evidence suggests clearly that the indirect linkage impact of subsidiaries in Kenya is limited by the nature of the mnc package - its product/taste transfer implications, its capital intensive choice of technique, its integration of subsidiaries into

co-ordinated world plans, and its product differentiating style of business"(page 32).

(b) Indian Sample

In India, it is indeed very difficult to isolate various powerful factors from the role of the subsidiary in affecting linkages, for it is necessary to prove that but for the multinationals the relevant industry would not have developed. This indeed is a hard task in the context of India. In post-independence India the government's policy had been to develop various industries. In case a particular industry was not given sufficient attention, it has been a policy dedision not to establish such industries mainly for want of capital and foreign exchange resources. Therefore, the subsequent analysis in this respect confines itself to the role that the multinationals are playing in using these industries.

Backward Linkages

Backward linkages have not been important in the case of the tea subsidiary. It relies mostly on raw material produced within the country which it processes. But in producing its packaging machinery it needs spare parts, which it buys from 10-12 small producers. These producers are supplied with the technical know-how, patterns, etc. Thus it affects some backward linkage.

The edible oil company effects backward linkages only to the extent that it buys a few capital goods from the local market. The existence of this sector cannot be in attributed to the operation of the company for capital goods industry development is largely the result of Government's policy and direct participation.

Nearly 50 per cent of the vehicle assemble's requirement for ancillary products is obtained from local suppliers. The bigger suppliers with foreign collaboration came into existence independently. The growth of local small scale industry was encouraged by the government, but the company did help some of these small units by providing blueprints, technical advice etc. Thus, it can be said that it has stimulated backward linkages in this sector of the economy. But it is not possible to argue that without this, the industry would

not have come into existence for there are some important Indian units producing vehicles.

The electronics subsidiary as the vehicle company, relies considerably on the small scale units for supply of various spare parts etc. It has already been noted that the development of electronic industry has been one of the important policy objectives of the Government of India and in this sector apart from this company, public companies dominate. These small scale units were given considerable technical assistance in terms of design, blueprint quality control and in fact even/inventory control. But the company has not been directly responsible for generating any backward linkages.

A large number of raw materials are required by the tyre industry and are produced in India by various factories operating with various collaboration arrangements. Even nylon tyre cord suitable for the automotive tyre industry is manufactured in India. Carbon Black and various necessary chemicals are produced in India. The company claims that it encouraged manufacture of rubber processing machinery as in some cases where it rendered technical help. Although it is not directly linked up with purchases, the company also claims that it was responsible in persuading other multinationals to manufacture certain moulding presses, mixing mills, hydraulic press etc. locally. Further, it claims that it helped bring local manufacturers and foreign investors into existence. On the other hand there is evidence that the development of the tyre industry is the result of the entry of other multinationals and specific Government policy. It has been the policy of the Government to reduce the domination of multinationals in the sector of tyre production. Various state units are under construction. The company with its parent is supplying technology to these units. It is significant to note that the actual collaboration with these state units emanates from the parent company, with some help from the local subsidiary.

The packaging subsidiary also depends on the supply of the small scale producers. 85 small suppliers provide machinery, spares and parts, rubber, plastic components, etc. It gets these products by providing technical assistance. To that extent it generates a weak backward linkage.

Since all the firms produce mainly direct consumer products and intermediate products under which one can include some electronics and vehicles, there is little evidence of forward linkages in the sample except when they have sold to third parties some of their machinery as in the case of tea and coffee packing machinery. Thus, linkages generated by the

Table 9: Induced Linkages/ Due to Presence of Operating Subsidiaries

	A		B		C		D	E		F	G	H	I	J	K
	Tea and allied products		Pharmaceuticals etc		Pharmaceuticals etc		Cement	Vehicle assembly	in	Refrigration and engineering design	Tea Machinery	Electronics	Edible oils soap, etc	Tyres	Packaging Materials
	Kenya	India	Kenya	India	Kenya	India	Kenya	Kenya	India	Kenya	Kenya	India	India	India	India
Forward LINKAGES	None	Packaging machinery	None	None	None	None	Used in construction sector	Used in transport sector	None	Used in Manufacturing sector	Used in tea industry	None	None	None	None
BACKWARD LINKAGES (i) Production Technology	Tea machinery	spares	None	None	Packaging machinery	None	None	Jigs partshop	None	Frames (Self manufacture)	None	None	None	None	Machinery
(ii) Materials Technology	None	None	None	None	None	None	None	Bodies batteries canvas, filters etc	Components	None	None	Components	None	None	Components
Ownership of firms resulting from forward linkage	-	-	-	-	-	-	-	Local and foreign		Mostly foreign	local and foreign	Components	-	-	-
Ownership of firms resulting from backward linkage	foreign	local	-	-	local	-	-	local and foreign	local and foreign	foreign	-	local	-	-	local

NB: Particularly in India it is difficult to determine unambiguously whether a particular subsidiary has induced linkages or whether linkages result from government policy and/or demand from other firms.

The major problem with this study has been the smallness of the sample of subsidiaries. This has not made it possible to systematically explore a set of hypothese, and although this is regretable, it is believed that the absence of research in this field (23)„ justifies such a tentative papproach. The research must inevitably be seen in the context of the generation of hypotheses with regard to the behaviour of subsidiaries in underdeveloped economies, rather than in drawing definitive conclusions in this respect. One further problem has been the absence of detailed quantitative data on the Research and Development expenditure of the firms in the sample. The problem here has been that it is unlikely that the detailed information required (e.g. on the breakdoen of expenditure) can be obtained int the context of interviews with senior management. Without exception the subsidiaries did not readily have at hand precise estimates of expenditure which are relevant to this study - short of detailed research in each subsidiary (requiring the co-operation of each subsidiary and a great deal of time) there has therefore been no alternative but to sidestep the problem of quantitative data and to concentrate instead on a qualitative approach. This has attempted to establish the nature of activities undertaken by the subsidiaries and the links which they have with their parents in the acquisition of new technology.

The major conclusion which emerges from the research is that the extent of technical change generated within the subsidiaries, both in Kenya and India, was limited. Where it did occur it is largely explained by government policy (e.g. the heavy emphasis put on import substitution by the Indian government) or by geographical necessity (e.g. adaptation of production and product technology for climatic reasons; research on hail suppression in the tea industry). There is a clear indication that wherever possible, the parent prefers to undertake its Research and Development itself and to subsequently pass the results on to the subsidiary (e.g. research into instant tea technology).

The probable explanation for this phenomenon is that one of the major competitive assets of an international firm is its technology. Control over this technology represents control over present and future markets, as well as control over subsidiaries so that they operate in the parents' interests. Confirmation of this fact is found in that in both Kenya and India, property rights over thechnology generated by the subsidiaries became the property of the parent alone. There were no exceptions to this policy.

(a) Country Specific Factors

The smallness of the Kenyan economy and the its industrial sector are probably the main reasons explaining the lack of locally generated technical change. To some degree this undevelopment is countered by the role which Kenyan industry plays in East Africa - this almost certainly explains to a large extent the nature of operations of three subsidiaries in the sample. The two capital goods subsidiaries as well as the two pharmaceutical subsidiaries supply the East and Central African market from their Kenyan plants. In all of these cases some technical change results from the need to serve these different markets.

India is the second most populous country in the world. In terms of aggregate size it has one of /the largest industrial sectors in the global economy(24). By comparison with most underdeveloped economies, industrial activity in India has a long history - indeed in some sectors it predates the arrival of the colonial powers. It is thus to be expected that there would be more new technology generated in India than in Kenya and that it would be at a more 'complex' level. The research results appear to support these contentions. The Indian subsidiaries appear to have spent more, both relatively and absolutely on Research and Development than the Kenyan ones. The activities they were engaged in also appear to have been more complex e.g. while the Kenyan pharmeceutical subsidiaries mixed imported inputs and tended to concentrate on product reformulations, their Indian counterparts produced chemicals adapting existing technology to use local raw materials and intermediate inputs.

(b) Sector and Industry Specific Factors

There are a number of broad sector specific factors which influence the behaviour of the subsidiaries in their generation of technical change. As is to be expected in the global context of oligopolistic competition (which is closely replicated in Kenya and India with the major difference that the markets are generally more concentrated and less competitive than those in developed countries), the consumer goods industries are characterised by product rather than price competition.

By contrast intermediate products are generally not characterised to such a great extent by changes in product technology. When product

technology is important it is less so in the case of product differentiation than innovation and adaptation. This is reflected in the behaviour of the cement subsidiary in particular whose major concern lies in the spheres of production and materials technology.

It is in the nature of the activities of capital goods firms that adaptations of technology are made to suit the specific needs of customers. This largely explains the fact that these two subsidiaries displayed a greater tendency than any other in the sample to themselves generate new technology. They also tended to be more independent from the control of the parent, although this may be a reflection of the specific industries chosen rather than of the capital goods sector as a whole.

Aside from these broad sectoral factors (i.e. consumer, intermediate and capital goods sectors) there are a number of industry specific factors which are relevant. The operations of the tea machinery subsidiary is a case in point, in that it is a rather unusual case where the parent has moved its operations in the manufacture of tea machinery from Britain to Kenya in order to be close to the market and to take advantage of cheap labour in a relatively labour intensive process. Another example of industry specific factors is that of tea production, which unlike pharmaceuticals it is located in Kenya and India for environmental factors. This largely explains why these subsidiaries engage in particular types of Research and Development such as the use of new herbicide and fertiliser patterns and the development of new strains of tea and cinchona bushes.

(c) Firm Strategy and Market Conditions

In addition to country and sector specific factors, it is quite possible that a subsidiary's performance in respect to generating new technology also reflects the specific policy of its parent, particularly in the context of market conditions at both the global and the local level.

Probably parent policy is not as important a determinant of a subsidiary's activities as are sectoral and country factors. Market conditions also influence the decision of a multinational to locate

its subsidiary in a country and the behaviour of this subsidiary in the generation and acquisition of new technology. Thus the tea produced in our sample is concentrating the introduction of new varieties and products in Kenya rather than South Asia where government pressure is felt intensely.

It is also probable that the differential behaviour of the two pharmaceutical subsidiaries represents the difference in the competitive position of the parents at the global level. While the two parents are amongst the three largest pharmaceutical firms in Britain, B is a much older and more firmly established firm than C. The latter firm, as is often the case of 'followers' in an oligopolistic market, tends to be more aggressively competitive and growth oriented. To some extent this is reflected in the behaviour of their subsidiaries in Kenya and in India.

(d) Size, Capital Intensity and Longevity

Size, either in absolute terms or as a percentage of value added, is not positively correlated with the behaviour of the subsidiaries in generating new technology (see tables I and 4). If anything size appears to be inversely correlated with expenditure on Research and Development. It is extremely doubtful however whether this coincidence is casually related.

It is doubtful, too whether longevity of operations is related to performance in the generation of Research and Development. As is also shown in tables 1 and 4, there appears to be no relationship at all in this respect. The only case where there is a clear indication that a subsidiary has increased its expenditure on Research and Development over the years is in the case of the engineering design subsidiary which was progressively expanded these activities since it began local design in the early 1960s.

The apparent inverse relationship between capital intensity and Research and Development expenditure (table 2 and 4) in Kenya reflects the fact that the two capital goods firms have a high disembodied input which of necessity must be internal to the subsidiary. This input takes the form of design staff, particularly in the case of the engineering design subsidiary. Aside from these to labour

intensive subsidiaries there is no relationship at all between capital intensity and Research and Development expenditure.

(e) Share of Equity Held by Parent

As can be seen from tables 1 and 4 there is little evidence that the share of equity held by the parent has any effect on the level of expenditure on Research and Development. It would probably be surprising if there were to be any link of this nature as the reason for disparities in parent shares of equity differ among the firms in the sample.

(f) Government Policy as a Factor

There has been little indication in this research that Kenyan government policy has had any effect on the behaviour of the subsidiaries in their generation and acquisition of new technology. In the case of one of the pharmaceutical subsidiaries, there is evidence that the imposition of tariffs by the government led the subsidiary to increase the number of products produced in Kenya - but even in the case of the pharmaceutical industry there appears to be no pattern in Government tariff policy which consistently induces subsidiaries to import raw materials and manufacture final products. It could be argued that the government's (temporary) blocking of the Technical Service Fee by the tea producerwas an attempt to induce the subsidiary to develop this technology itself- but since there is no limitation on the remission of dividends by the subsidiary itwas more likely to reflect the government's desire to prevent transfer pricing and to cut the foreign exchange loss. By contrast government policy in India has been of great importance in explaining the incidence of Research and Development by the subsidiaries. (24) Specific government policies (such as those on import substitution) have been complemented by other policies designed to increase the local availability of skilled manpower and to improve the operation of Indian research institutes. Tax incentives have been given, enforced divestment offered as an alternative to technological progress and attempts have been made to place controls over restrictive technology agreements.

The effective role of R & D as envisaged, i.e., to become independent of the parent in generating new technology and adaptation of technology has not yet been achieved in India. However, in the context of emerging policy frameworks aimed at making India highly selective in importing technology, one can anticipate that these R & D units might have to play a more important role in the future. These units have developed an adequate technical base and have trained personnel to undetake this task.

The more specific aspects of FERA (25)/ will definitely influence the operation of these subsidiaries in the coming years. Since most of these subsidiaries are not in the core sector, the parent's holding is expected to be reduced from majority ownerships to minority ownerships. As an alternative to this divestment they may be permitted to go into production for export and into essential sectors such as capital goods. Thus the tea subsidiary is beginning to produce need and push products for export. Similarly the packaging company is expected to go into the production of ball bearing, in collaboration with another foreg company. Another subsidiary is planning to enter production of printing machinery. In some cases, the parent already possesses the technology, in some cases it does not. In this context, it can be expected that the subsidiary will play a little more important role than has hitherto been the case.

Some Other Points of Interest

A number of points of interest are raised as a result of the research which do not concern the sources of variance in the behaviour of the seven subsidiaries. They do not fit into any pattern of observations so it is best to treat them individually.

of the world, which clearly has not been possible. It is the general impression though, that with the possible exception of the cement plant in Kenya (where the core plant was similar to that used in developed countries) all of the subsidiaries had chosen technology, core and peripheral, which is suitable to local conditions and which was not used by the parent. The most frequent factor influencing this choice in Kenya was the scale of the market. In India the most prevalent factor was adjustment to the use of local inputs.

The existence of these choice patterns, differentiating the production technology used by the subsidiaries from that used by their parents, should not be taken to imply that the choice was undertaken by the subsidiary itself. As we have seen, few of the subsidiaries had both bthe right and the ability to choose new technology independently from the parent.

(b) Transfer of Taste Prefcrence and Standards

There are many cases when the specification of a product influences either or both of the production and materials technology which is to be used. The transfer of taste patterns across national boundaries is an accepted phenomenon and the possibility arises that this transfer will affect the propensity of subsidiaries to adapt to the local environment. There is some evidence that this has occurred, particularly in the case of the two pharmaceutical firms. Here the desire of the parents to standardize product technology through the firm has led to the use of imported rather than local material inputs on a number of cases. Similarly the variability in quality resulting rrom the use of a labour intensive tin-filling machine has led one of the firms subsidiaries in Kenya to generate new production technology.

In the case of the intermediate and capital goods subsidiaries it is not so much the transfer of tastes, but that of standards which influences the behaviour of these subsidiaries.

(a) Core and Peripheral Activities

The first concerns the distinction between core and non.core technology used by the subsidiaries in the sample. Pack as we have seen (page 6) draws the distinction between five basic processes involved in production, of which material processing - which we have referred to as core technology - is only one. Since the ability to choose amongst different technologies is in itself a technology it may be that the subsidiearies do possess a technological capability, but this ability is not reflecte so much in generation of technical change, but rather in the choice of more appropriate techniques. It is often argued that it is in the non-core processes that the greatest flexibility of choice arises.

No systematic attempt was made in this research to establish whether the choice of more appropriate technology, particularly in peripheral activities, occurred in the subsidiaries. In part this was occasioned y by the belief that the only way to establish this was by paying visits to other subsidiaries or each firm in many other parts

In spite of these instances in which the transfer of taste patterns and standards from developed countries influences the propensity of the subsidiaries to generate new technology themselves, it would be dangerous to place too much emphasise on this phenomenon. More important factors exist which influence the behaviour of the subsidiaries in this respect.

(c) Embodied and Disembodied Technology

A distinction has been drawn in this research between embodied and disembodied (and in the latter case between man and firm-embodied) technology. The importance of this distinction is confirmed by the research. For the two capital goods subsidiaries particularly the disembodied technological input has been of great importance. Another factor of importance in this respect is the role which disembodied technological inputs appear to play in the circulation of technology through the firm - the circulation of technology through the circulation of manpower has turned out to be an important factor for most of the subsidiaries in the sample.

(d) Transfer Pricing

One of the more surprising results of the research has been the relative absence of overt transfer pricing practices associated with the transfer of technology by parents to the subsidiaries. This contrasts with the results of research in other countries, particularly in Latin America.(26) To some extent this is a reflection of the absence of barriers to the remission of dividends in Kenya, compared to other countries such as Colombia, while in India it may reflect government awareness of these practices. But there may well be other channels used for transfer-price profits which are not easily visible in relation to the questions discussed in this research. It would not be accurate therefore to conclude that no transfer pricing takes place in the operations of these subsidiaries, but at the same time there is little evidence that it occurs in association with the transfer of technology from parent to subsidiary.

(e) Quality Control

The possibility of quality control leading to the generation and acquisition of new technology has been neglected in the literature on technical change. There is however clear evidence from this investigation

that there is a relatively strong link between quality control and the product, production and materials technology used by the subsidiaries. Not only is it possible to point to specific instances where this link has occurred but the orders of magnitudes involved are also of interest (see tables 4 and 5). In Kenya not only two cases (tea machinery and engineering design) did expenditure on Research and Development exceed that on quality control. This is to be expected, as both these two subsidiaries had relatively large formalised Research and Development activities.

(f) Some Dynamic Considerations

The development of the industrial sector in Kenya is still in its infancy. Clearly this affects the behaviour of the subsidiaries with regard to their generation and acquisition of new technology. The important question which arises is whether there are factors which would lead us to believe that these (and similar) subsidiaries will become more active in the generation of their own, more appropriate products and techniques. The answer to this question must essentially be agnostic given the limited scope of the present study. The experience of the engineering design subsidiary which has gradually built-up its own (not necessarily 'appropriate') technological capability over the past fifteen years must be contrasted with that of C, the pharmaceuticals subsidiary which was previously indpendent of ties with a parent multinational.

Which of these two examples in a closer portent of the future is difficult to tell. However as the Kenyan market increases (perhaps in concert with increased exports) the pressures of scale economies are probably likely to lessen the chances of the generation of technology by the subsidiaries themselves. At present the extent of their activities in this field reflects the scale of their operations and the greater this scale becomes the more suitable will parent technology be.

One potentiallly dynamic factor does not appear to have had any affect on the behaviour of these subsidiaries in Kenya. This is the possibility of government measures inducing these firms to develop their own technology. The only example in which government measures have had any impact on the innovative activities of the subsidiaries in this sample has been the imposition of tariffs which has had some affect in inducing the subsidiaries to increase the number of products manufactured (perhaps ' assembled' is more accurate) in Kenya. Indeed

the absence of government policy (e.g. with regard to the tea subsidiary in contrast with South Asia) has probably had more affect than any policies which have been implemented over the decade since independence.

Government policy in India suggests that expenditure on Research and Development will increase in future years. This may well lead to a situation where subsidiaries consolidate expertise relevant to operating conditions in underdeveloped countries in which the parent has little experience. The situation may well arise where global strategies of the multinationals may adjust to allow subsidiaries in particular countries like India to specialise in particular spheres and be responsible for the marketing of this technology to other under developed economies (27).

However these optimistic considerations must be tempered in view of the known operating characteristics of multinational firms. To them, control over technology is vital if their globally comaetitive position is to be maintained in the future. They are therefore not likely to willingly give up the technological dominance which they have established in a particular sector of production. The power of governments to affect the international distribution of scientific activities is tempered by the relative powers of these large multinational firms, and even though the Indian government clearly has more 'clout' than that of a small country like Kenya, the power of the firms to determine the geographical location, the orientation and the appropriation of property rights over new developments, should not be lightly underestimated.

Footnotes

1. The issues on this section are treated in a more thorough fashion in earlier versions of the research. See R. Kaplinsky, Institute for Development Studies Working Paper 228, 1975 and S. Christi, Mimeo, 1975a.

2. The relationship between the two cement subsidiaries in Kenya is as follows. The British parent and a Swiss multinational each hold 14 per cent of the equity of the subsidiary in our sample, and the British parent holds the Technical Contract for this subsidiary. The British and Swiss parents each hold 40 per cent of the equity of the other cement firm in Kenya, and in this case the Technical agreement as held by the Swiss parent. It is not clear what affect these interlocking links have on subsidiary operations although the subsidiary in this sample produces only for the Kenyan market (and has announced no plans for expansion) while the competitor produces predominantly for the export market and is in the process of expanding capacity to 1.25 million tons per annum, 1 million of which will be for export.

3. The buses and trucks are assembled on a one-off basis and are tailor-made to suit the requirements of particular customers. By contrast the smaller four-wheel drive vehicles are produced on a small assembly-line. However, there is no substantive difference in technology here, as the adaptations required for particular customers of heavy vehicles concern the length of the chassis and the size of the engine which are to be installed - these changes do not require complex knowhow or heavily capitalised production technology. The existing assembly line does not assemble fully knocked down Kits (although it is hoped to do so in the new assembly plant) and some components (e.g. engines, gearbox) are imported already assembled.

4. All £ are sterling. This conversion has been made to facilitate comparison with the Indian subsidiaries and the operations of the parents in Britain. The exchange rate used is 17/- = £1 and Rs. 18.53 = £1 which were the going rates at the time the research was undertaken. The pound has been devalued recently and this means that current values in Sterling will be higher than these used in this study by over 10%.

5. For a discussion of the importance of equity as a control mechanism by parents over subsidiaries, See Kaplinsky(1976).

6. This pattern reflects the importance of foreign trade as a proportion of GNP. Thus the share of imports in GNP was % in Kenya and % in India in 197 and that of exports was % and % respectively.

7. This point and above figures on labour saving are made by S. Langdon in a private communication to the authors.

8. H. Pack. 1972.

9. In the United States selling and promotional expenses in the pharmaceutical industry range from three to four times the amount spent on R & D and account for about one third of the value of sales. See S. Lall, August 1974.

10. Recently the parent of Firm B decided to supply the Malaysian baby food market from Kenya, rather than from Britain. The problem has been that the taste of Kenyan cereal products is slightly different from that of British cereals, and in spite of attempts to change the formulation of the baby foods, the result has been the erosion of the firm's market position in Malaysia.

11. When the Group originally tried to develop instant tea technology, a different process was explored which required a change in tea input from the Kenyan subsidiary. This induced changes in production and material technology in Kenya, and were this instant tea technology to have been / said that changes in production tech..ology led to changes in both production and materials technology.

12. M. Todaro and H. Pack, November 1969.
13. FERA specifies measuring diverstment or the production of a priority good or merchandised exports.
14. For a description of the NSF definition, see E. Mansfield, 1968.

15. For a review on the literature concerning Research and Development and size of firm. See M.I. Kamien and N.L. Schwartz, March, 1975.
16. These issues are treated specifically in R. Kaplinsky and K. Hoffman 1975)b) and S. Lall, 1976.
17. In this discussion we are concerned with the autonomy of a subsidiary to specify itself the technology which it requires. This is not the same thing as the rights to purchase this technology independently. Control over capital expenditure is the main control mechanism excercised by parents over subsidiaries (see R. Kaplinsky. 1976.) and in the case of most of them subsidiaries in this sample, the parent laid down clear rules on the maximum capital expenditure (which was usually in the region of £1,000 to £2,000), which could be undertaken independently from the parents' agreement.

18. The relative autonomy of both of these pharmaceutical subsidiaries us rather surprising when comparison is made with the same industries in other underdeveloped countries. Vaitsos, (1974)for example found that the overpricing of intermediate inputs purchased from the parent was an important avenue for transfer pricing for a combination of two factors. Firstly in Colombia many of the pharmaceutical firms in question were locally owned, while in Kenya both subsidiaries are wholly-owned by the parents. Since there are no barriers in the remission of profits, in Kenya, there may be little need for such forms of transfer pricing. Secondly, neither of these firms, (particularly B), were large scale producers of these inputs. In Most cases the inputs such as aspirin powder are easily available in a competitive world market. This would suggest that subsidiary B is more likely to purchase inputs from the parent than C. Unfortunately no information was provided from B with regard to the amount of inputs purchased from the parent or the make-up of these inputs. In the case of C we do know that where the parent does 'monopolise' the manufacture of a specific input - perfume - the subsidiary acquires these from its parents.

19. Nevertheless, there are still, of course, considerations which suggest that it would pay this firm to transfer price, irrespective of the absence of Government controls. See Vaitsos (1974).

20. See Vaitosos (1974), Chudnovsky

21. See S. Langdon, 1975.

22. A.O. Hirschman, 1958.

23. For two exceptions, see Katz, 1974 and L. Fairchild, undated.

24. S. Chisti, 1975 b.

25. Foreign Exchange Restriction Act. See footnote 1e.

26. Vaitsos 1974, Chudnovsky 19

27. The case of Kirloskar, the Indian company, is instructive on this point. Initially much of its technological capability was gained through a joint venture with an american firm. Having obsorbed much through this joint venture, Kirloskar is becoming a multinational in its own right. It sells its equipment (much of it such as low-revuing diesel engines, is appropriate for other underdeveloped countries) to many other developed and underdeveloped countries and is new on the process of setting up its own subsidiaries abroad. For example there are plans to build a Kirloskar plant in Kenya before the end of the decade.

BIBLIOGRAPHY

Chisti, S. 1975 a Technical Change and Some Multinationals in India, Occasional Paper, OECD Development Centre,

1975 b Indian Government Policy and its Effect on the Generation of Technical Change by Subsidiaries of Some Multinational Firms Operating in India.

1976 Technical Change and the Multinational on India: Some Global considerations, mimeo.

Chudnovsky, D.

Hirshman, A.O. 1958. The Strategy of Economic Development, Yale University Press.

Kamien, M.I. and Schwartz, N.L. 1975, 'Market Structure and Innovation', Journal of Economic Literature, Vl. XIII No. 1.

Kaplinsky, R.,1975a,Technical Change and the Multinational Corporation: Some British Subsidiaries in Kenya, Institute for Development Studies at the University of Nairobi, Working Paper 228.

Kaplinsky and K. Hoffman) 1975 b Technical Change and the Multinational Corporation: Some Global Considerations, Institute for Development Studies at the University of Nairobi, Working Paper No. 250.

1976. Accumulation and the Transfer of Technology Issues of Conflict and Mechanisms for the Exercise of Control, World Development, Vol. 4 No. 3.

Katz, J. 1974. Technology, Dynamic Comparative Advantage and Bargaining Power, Paper presented at Symposium on Foreign Investment and External Finance in Latin America, Cambridge.

Langdom, S. 1975, The Limits of Taste Transfer Industrialisation, mimeo.

Lall, S., 1974, 'The International Pharmaceutical Industry and Less Developed Countries', Oxford Bulletin of Economics and Statistics, Vol. 36 No. 5.

OECD 1970, Fraseatti Manual, Paris.

Pack, H. Todaro, M. 1969, 'Technological Transfer, Labour Absorption and Economic Development', Oxford Economic Papers, Vol. 21 No. 3.

Pack, H. 1972, Employment and Productivity in Kenyan Manufacturing, Institute for Development Studies, at the University of Nairobi, Discussion Paper No. 54 (revised).

Vaitsos, V., 1974, Intercountry Income Distribution and Transnational Enterprises, Oxford University Press.