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Effects of Technology Transfer from Developed Nations and Developing Economy: The Nigeria Experience

Augustine Okon Jacob[1, *], Okon Joseph Umoh[2]

[1]Department of Management, School of Management Science, Heritage Polytechnic, Ikot Udota, Eket, Nigeria

[2]Department of Economics, University of Uyo, Uyo, Nigeria

Email address

drjacob.ao@gmail.com (A. O. Jacob)

[*]Corresponding author

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Abstract

Technology is the application of scientific knowledge for practical purpose, especially in industry, advances in computer technology, machinery and devices developed from scientific knowledge. It will reduce the industry's ability to spend money on new technology. Technologies, most often, are invented or developed in one country but utilized and enjoyed in different parts of the world. Technology capability is the capacity to produce more efficiently to establish better production facilities and to use the experience gained in production and investment to adapt and improve the technology in use. The processes through which technology invented in one part of the world is utilized or enjoyed in other parts of the world is what is generally referred to as technology transfer or technology diffusion. The need for technology transfer from the LDCs from the developed countries arises on the following grounds; to overcome backwardness, to Increase Productivity, to Reduce Poverty, Inequalities and Unemployment, to Increase the Growth Rate, to Fill Technological Gap, to Develop Basic and Key Industries and Infrastructure, to Make LDCs Competitive, to Solve Balance of Payment Problem, to Solve Socio-Economic Problems, to Save Time and Money. The purposeful application of information in the designed, production and utilization of goods and services. The most appropriate package of technology transfer should be one that contributes to increasing the level of technology, generating employment, reducing inequalities and increasing the growth rate in the LDCs, the main way of doing this is to build on what can be obtained from abroad while developing local capabilities in areas where it takes the most sense. Technology also extends to services, manufacturing, and agriculture, creativity in production planning, creativity in marketing and innovative management. It is the wider sense that we should be discussing the need, channel and problems of technology transfer from the developed nations to developing (LDCS) countries like Nigeria.

Keywords

Developing Economy, Developed Nations, Technology Transfer, Nigeria

1. Introduction

Technology is defined in terms of high-level manpower in scientific, technical and engineering fields, and expenditure on research and development as a percentage of Gross Domestic Product (Ake, 1984: 106). Bozeman (2000: 629) sees technology transfer as the movement of know-how, technical knowledge, or technology from one organizational setting to another. This implies that it is not merely the movement of product(s) that is technology transfer but also the knowledge of its use and application. Mittleman and Pasha (1997; 19) present a somewhat broader view of the concept technology transfer, which states that it is the movement of knowledge, skill, organization, values

and capital from the point of generation to the site of adaptation and application. Here, the site of adaptation and application could be within a country or outside the country. Manfield (1975: 373) made an important classification of technology transfer which classified technology transfer into vertical and horizontal technology transfer. Vertical transfer refers to the transfer of technology from basic research to applied research to development and then to production respectively, while horizontal transfer of technology implies the movement and use of technology used in one place, organization or context to another place, organization or context (Ramanathan, 2009; 5). Technology is a body knowledge devoted to creativity tools processing actions and extracting of materials. The term technology is wide and everyone has their own way of understanding the meaning of technology. Technology is often identified with knowledge about improved machinery, product and processes. But Harry 2013 uses a wider connotation according to her; technology consists of a series of techniques. It includes methods used in marketed and non-marketed activities, nature and specifications of the product produced and its techniques it also includes managerial, marketing and information services. It encompasses the organization of productive unit in terms of scale ownership.

Technology also extends to services, manufacturing and agriculture. Technology alone is not innovation. True innovation requires creativity in marketing and innovation management.

According to Ramanathan (2009), economists have recognized the fact that transfer of technology is at the heart of the process of economic development/growth, and that the progress of both developed and developing countries depends very strongly on the extent and efficiency of such transfer.

*Technology Transfer has spurred great interest among academic researchers and policy makers. Among some indicators of technology transfer's ascension are the following

Since 1980. The US congress has passed no less than eight major policy initiatives dealing with technology transfer and means of promoting it; similar trends have occurred in other nations. (Lederman, 1994; Fujisue, 1998; Licht and Nerlinger 1998; Bozeman, 2000)

*At least one journal the journal of Technology Transfer is devoted exclusively to Technology Transfer and several professional organizations include technology transfer in their mission statement (Bozeman, 2000).

* Technology Transfer agents is a job title now listed in many government employee and civil service manuals all around the world (Bozeman, 2000).

*During the past two decades, the terms technology transfer or technology diffusion have appeared in the titles of hundreds of articles and books (Bozeman, 2000).

2. Literature Review

2.1. Reasons for Transfer of Technology

The need for technology transfer from the LDCs from the developed countries arises on the following grounds:

2.1.1. To overcome Backwardness

LDCs are in the backward state of technology. Their technological backwardness is reflected in high average cost of production despites cheap labor in low productivity in labor and capital in the predominant of untrained and unskilled workers and high capital output ratio. Technological backwardness, in turn, has led to their economic backwardness which is reflected in poverty, in equalities and unemployment. The transfer of technology from the developed countires brings advanced productions techniques and machines, innovations in product and skilled personnel, organizational experience and marketing technique e.tc.

2.1.2. To Increase Productivity

The transfer of technology from the developed countries is required by the LDCs to increase the productivity of labor, capital and other factors of production in order to lower per unit cost of production. This can be done by transferring capital-intensive/technologies from the developed countries.

2.1.3. To Reduce Poverty, Inequalities and Unemployment

The three pressing problems of the LDCs are poverty; inequalities and unemployment which can be solved by raising the level of income of the can provide larger employment opportunities to the poorer people. This will tend to raise their incomes and help in reducing poverty and inequalities.

2.1.4. To Increase the Growth Rate

Technology transfer is needed by the LCD's to increase the growth rate of their economics. For this a long-term policy of technology transfer is require for them. Edward 1990 has classified the long term economic growth in relation to the technology level into three stages. According to him, the critical determinant of long-term economic growth is the difference between T (technology level) and W (wage level)

In the first stage, the rate of growth is slow because the technology level (T) is lower than that of wage (W) as explained in figure 1. In the figure, the T curve is like a logistic curve, with an increasing growth rate Y at first and then a decreasing rate.

$$Y=F(T-W) \quad (1)$$

Where Y is the rate of economic growth.

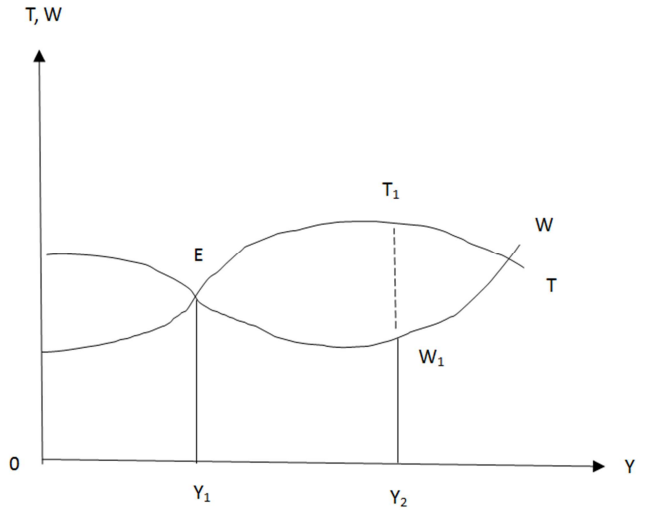

Figure 1. *Rate of Growth.*

The W curve is S-shaped with the rate of increase decreasing at first because of underemployment and increasing at a later stage when labor becomes scarce. The low income countries fall in this stage which is to the left point E in the figure. It is the second stage OY_1 level onward that the growth rate is fast increasing because T is fast increasing and is higher than W. The majority of LDCs of southeast and East Asia and Latin America fall in this stage. Technology transfer increases the technology level and widens the gap between T and W, thereby increasing the rate of economic growth (Y). It is T- W_1 at OY_2 level in the figure. After OY_2 level, the third stage begins in which economic growth slows down after maturity. The T curve is increasing at a decreasing rate and the W curve is rising at an increasing rate because of relatively scarcity of labor. This is the stage in which the developed countries are today.

2.1.5. To Fill Technological Gap

There exist a wide technological gap between the indigenous stock of technology and technology required for faster growth in the LDCs. This gap can be bridged by technology transfer from the developed countries. Modern technology supplements the available indigenous technology and also helps in modifying and adapting advanced technology in the LDCs. But as they adopt modern technology they must develop their indigenous technical skills by adapting modern technology in keeping with their factor endowments.

2.1.6. To Develop Basic and Key Industries and Infrastructure

The LDCs need technology transfer to develop basic key industries and such infrastructure. The LDCs need technology transfer to develop basic and key industries and such infrastructure as transport, communication, power etc. Their natural resources lie dormant and remain unutilized, underutilized or misutilized. This is because all these involve high risk, large capital, long gestation period and modern technology for their development. Thus technology transfer is required by LDCs to build their infrastructure, establish industries, tap natural resources and open new areas.

2.1.7. To Make LDCs Competitive

The LDCs require transfer of technology to make their economies competitive in the international market. These countries mostly export unprocessed products, raw materials and substandard articles. As a result, their products fetch low prices because their competitive power is weak in the world market. By technology transfer, they can protect their economies interests by making their goods competitive in the international market. This is possible by developing export-oriented and import-substitution industries through technology transfer.

2.1.8. To Solve Balance of Payment Problem

Transfer of technology is also needed by the LDCs to ease their balance payment situation. When the transfer of technology brings capital, machinery, knowledge, experts, etc., there is a greater inflow of resources without little remittance aboard in the early stage of development. Repatriation of profit, royalties, etc., beings after the recipient firms become fully operational and break-even. Further by helping in establishment of export-oriented and import-substitution industries, the transfer of technology tends to increase exports and reduce imports, thereby improving the balance of payments position of the LDCs.

2.1.9. To Solve Socio-Economic Problems

Transfer of new technologies proves efficient in solving many of the pressing social and economic problems of the LDCs which retard heir economic growth. For instance, the Green Revolution has shown that how the use of modern science and technology can boost grain production and put an end to malnutrition and famine in overpopulated LDCs and even make self-sufficient in the production of food grains.

2.1.10. To Save Time and Money

Moreover, the LDCs can make use of the already tested and existing benefits of modern technology without having to transverse the difficult path through which the developed nations has to pass through to achieve the high technological level, thereby saving their time and money.

2.2. Channels of Technology Transfer

One of the indices of developing or underdeveloped economy is technological backwardness or low technological advancement. Technologies are not acquired by accident, rather they are acquired through concerted efforts at research by tertiary institutions and research institutes. Discovery of new technologies, improving on existing ones and perfecting acquired technologies require concerted efforts and commitment in research at tertiary institutions, research institutes and production factories. According to Nelsen (2003: 301) universities and other institutions are the main sources of researches that lead to the development of technologies and lead compounds that are developed into new products (for example, drugs and vaccines). To Nelsen, the primary ways in which universities

disseminate their discoveries are through publications and the training of students. A study carried out by Bozeman (2006: 634) involving over 1200 universities, industries and government laboratories, disclosed that 23 percent of university laboratories view technology development as a major mission, compared to 51 percent of government laboratories. Furthermore, Bozeman's study reveals that whereas 70 percent of university laboratories see basic research as a major mission, 42 percent of government laboratories do. With regards to technology transfer to industrial organizations the study indicated that 40 percent of university laboratories were involved in technology transfer and 51 percent of government laboratories do.

For technologies to be commercialized the universities, research institutes and industrial organizations must work in synergy. Technological knowledge itself is disseminated by universities via publication but the commercial use of some of that knowledge is restricted by patents to companies to whom the universities grant licenses (Nelsen, 2003; 302). It is such patent that encourages companies to fund research and development (R&D) in tertiary institutions. Funding is very important for R&D activities to be sustainable and successful. In developed economies governments and private companies substantially fund research despite the risk involved in it. For example, though the US government in principle does not support "cloning of babies", the Clinton administration gave a research institute $50 million dollar for stem-cells research just to acquire the technology and knowledge (Harry and Ikiriko, 2013: 116). On the other hand, in most developing economies private companies' collaboration with tertiary institutions in funding research is almost absent, only the government does. Nelsen (2003: 302) observes that university research is usually at so fundamental a level (embryonic level) that investment in development involves substantial risk, because at this point neither the technical practicability nor the market acceptability of the invention is proven. According to Nelsen, more inventions will fail than will reach the market, particularly in the medical field; therefore companies will be willing to take on the risk of funding at the embryonic stage if they will be protected from potential competitors through the exclusive use of the patent.

There are four channels of technology transfer from one country to another and cross enterprises. They are as follows

1. Transfer of Knowledge: The transfer of technology take place when knowledge about modern technologies is passed on through scientific exchange in the form of research journals, books and other published material.
2. Commercial Channels: technology is also transfer through commercial channels on a bilateral basic from private firms, most MNCs to state owned enterprise and branches of MNCs operating in the LDCs. This is also known as intra firm technology transfer which is in the following form
   i. Turnkey projects
   ii. Specialized services such as financial, managerial, engineering, construction etc.
   iii. Project packed sales of technology which may include raw materials, machinery, equipment, spare parts, management, brand names, patents, trademarks, licensing, joint ventures, wholly owned subsidiaries, etc.
   iv. Technological package or Simple direct sales of technology which include Embodied or outright sales machinery and equipment or consulting services (Disembodied) like managerial marketing including access to foreign market and other expertise
   v. Unpacked sales of technology or direct investment in the form of machinery, equipment and raw materials, processed products, commissioning, designing, licensing, training, management or supervision.
3. Government Channel: The transfer of technology also takes place through government channels in the form of technical assistance which is not related to the direct promotion commission goals. This is usually in the form of providing educational and training facilities to students and personal of LDCs of college and institution in developed countries. Further, expert and advisors come to LDCs to advice and train people in various field of economy activity such as establishing steel plants, hydroelectric project, oil exploration and building other infrastructure.
4. International Organizations: Many international organization under aegis of the UN, the European Community, the Asian Development Bank, etc., promote, conducting seminars and short term courses, helping in research by providing necessary equipment. Sending specialists and consultants to impart training in various fields, to evaluate natural and economic resources, etc. The transfer of technology through governments and international organizations are mostly in the form of aid. Thus technology is transferred from developed to developing countries through a number of channels enumerated above. But out of them, the commercial channels are more effective, popular and important in contributing to economy development of LDCs than the other channels, even though they create many problems for the LDCs.

2.3. Problems in Technology Transfer

The problems in transfer of technology from the developed countries to LDCs arise both from the suppliers and buyers. Problems arise from the supply side because the technological markets are mostly imperfect and occupied by the MNCs. On the demand side, the purchasers of technologies have weak bargaining power due to backwardness, urgency of importing technologies. Consequently, the suppliers exploit the purchasers of technologies. Given these two basic factor, problem relating to the transfer of technology are discussed below:

1. Technological dependence; When the MNCs or the

private firms enter into agreement with the LDCs for the transfer of technologies they restrict their right to use or change or transfer technology according to their requirement this leads to technological dependence

2. High Cost; The seller prefer to sell technologies in project package which are tied to specific project or products. The buyer are compelled to buy such technologies which require the purchase of raw materials, machines, spare parts and services of parent companies at cost much higher they are normally by 30 – 40%.
3. Hinder Development of Local Entrepreneurship; Often, the MNCs transfer new technologies to their own branches in the LDCs. But these branches do not share the new technologies to their own benefits. As a result, new technologies do not enter other spheres of national economies and thus reduce the opportunities for the development of local entrepreneurship.
4. Manipulate Prices; When the MNCs transfer technologies and operate their own branches in the LDCs, they manipulate the price of their products to their own advantage and thus keep most of the gains to themselves. It restrictions are placed by the host country on the transfer of profits to the parent company, they use these in holding the majority shares of other the companies, thereby spreading their economic strength in the country and preventing the growth of related industries locally.
5. Tax Evasion; At the time of technology transfer, the foreign firms insist on large tax concessions from the host country in the form of tax holiday, repatriation of large percentage of profits. When technology transfer is of the direct investment type, the MNCs which operate their branches in the LDCs resort to tax evasion through transfer pricing. They are largely engaged in intra-firm trade by shipping goods from one industry to another or providing services from the parent office to all branches in different countries. They charge arbitrary prices in such intra-firm transactions and manipulate their accounts so as to evade taxes in the host country.
6. Exploitation of Workers; When technology transfer is tied to the training of workers in new skills and trade in the host country, they are unable to shift to other industries. Thus the mobility of labor is restricted. As a result, such firm exploits the workers by forcing them to work for longer working hours. The cause psychological and nervous stains. If the workers are engaged in chemical and allied industries, they are liable to professional diseases.
7. Social Tension; These are large wage differentials between workers training of workers in new technologies and workers engage in local firms in the LDCs. Such wages differentials increase income inequalities. An elite class of workers is created which leads to a dual society and cause social tension within the economy, thereby retarding growth.
8. Limited Labor Absorption; Developed countries mostly transfer capital intensive technology to the LDCs which has limited labor absorption capacity. Such a technology fails to solve the acute problem of unemployment in LDCs.
9. Worsens Balance of Payments; Technology transfer leads to the repatriation of large sum of profits, royalties, fees, etc., to supplier countries. This worsens the balance of payments situation of LDCs after the initial period of inflow of capital is over. If technology transfer is of the direct investment type, then the repayment of interest and principal will create the debt problem which will further worsen the balance of payments situation of the LDCs.
10. Outmoded Technology; Often the MNCs export outmoded and discarded technology to the LDCs. Such a technology is somewhat cheap and of a lower capital intensity, but it entails high cost in terms of repeated breakdowns and constant repairs. In the absence of the availability of spare parts in the supplier country, such technologies become useless and bring huge loss to the purchasers in the LDCs.

2.4. Appropriate Package of Technology Transfer

In the light of the problem faced by the LDCs in technology transfer question arises: what is the most appropriate package of technology transfer for them? Technology transfer as a package consists of capital, technology managerial and marketing skills and information services rather than just the flow of financial resources.

The most appropriate package of technology transfer should be one that contributes to increasing the level of technology, generating employment, reducing inequalities and increasing the growth rate in the LDCs. It is, therefore, argued that the technologies transferred to the LDCs are very capital intensive for the giving factor endowments and factor market conditions preventing in them. But the developing countries have different factor endowments and factor market conditions. They are also in different stages of growth. It is therefore, better to have an electric approach for explaining the most appropriate package to technology transfer to the LDCs.

It can be concluded on the basis of product cycle hypothesis that for the LDCs producing for exports the more appropriate technology transfer should be labor intensive. This is because the production of standardized products for exports is more in line with their conditions. This has been a case with many southeast and East Asian countries.

On the other hand the LDCs engaged in the production of products at the maturing stage primarily for domestic market should be transfer basically capital intensive and technology intensive techniques from abroad. Such activities include miming and the manufacture of automobiles, machines tools, electrical equipment and a variety of consumer goods. This has been the case in many countries of Latin America. This is because domestic market oriented firms do not have

comparative advantages over the foreign suppliers of such products.

The second factor that governs the most appropriate technology transfer to LDCs is the stage of economic development of an LDC. Countries with different levels of development exhibit different characteristics in terms of

i. the availability of skilled labor and managerial staff
ii. the range of available techniques
iii. the extent of factor price distortions.

The availability of skilled labor and managerial staff is essential for the effective supervision of workers for the use of labor intensive techniques. If the extent of factor price distortions is small and the range of available techniques is large, a more appropriate package of technology transfer to the LDCs in the form of capital technology is possible. But in these LDCs where various institutional barriers in factor markets exist in the form of labor codes and protectionist policies, they result in serious factor distortions and structural characteristics pointing towards low level of development.

3. Conclusion

LDCs should import such a package of technologies that is easy to learn, diffuse and assimilate in keep with their factor endowments and technological capabilities. The acquisition of technological capability is the most important factor to overcome the problems faced by an LDC. Technology capability is the capacity to produce more efficiently to establish better production facilities and to use the experience gained in production and investment to adapt and improve the technology in use. The main way of doing this is to build on what can be obtained from abroad while developing local capabilities in areas where it takes the most sense. In other words, technological capability is meant to select, diffuse and build on established technology from abroad. It can be promoted by government actions in providing education, training and R and D facilities, fostering internal and external competition and encouraging the development of information services and quality controlling the LDCs. The right use of technology transfer in the LDCs depends on the existence of technological capabilities.

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