

# TECHNOLOGICAL PROGRESS AND ECONOMIC DEVELOPMENT : A VIABLE MODEL FOR NIGERIA

Adolphus Toby

Adolphus Toby is a Lecturer in the Department of Banking and Finance, Rivers State University of Science and Technology, Port Harcourt.

*The contention of this paper is that progress in science and technology accelerates the economic growth of nations. Considering the mounting developmental problems of Nigeria particularly those evidenced by declining capacity utilization and increasing unemployment a technology-based model for enhancing economic development is recommended. To achieve our goal, we must lay solid foundations by implementing proper education and we must also realize that there are certain priority policies that need to be put into operation. First, from now on the focus of our efforts to expand production must shift from the establishment of new industries to the upgrading of technologies used in existing industries; this approach will make use of the potential already existing within the production system. Next, the technology structure of Nigeria must be rationalized and controlled.*

## Introduction

Technology is simply the practice of any or all of the applied sciences that have practical value and/or industrial use. The revolution in technology and that in science are inter-related, and the current revolution in productive forces is therefore referred to as the scientific and technological revolution. Essentially it offers the possibility of using automated systems to manage natural processes in accordance with social requirements, i.e. of making natural processes follow the course desired by man and achieve the required result, which means that the natural process becomes a technological, or industrial one. In this context science must be seen as a social activity aimed at cognition of universal laws and acquisition of knowledge.

If one examines manual labour which was predominant in the period preceding the introduction of machinery, it is easily seen that it is composed of three main functions: executive (man uses his hands to perform manipulations with manual implements); that of propulsion (performed with the force of man's muscles); and managerial (man's thinking purposefully controls the entire labour process). The progress of machinery consists in the creation of devices to which these functions are consistently transferred one after another.

Each transfer represents a revolution in machine technology. It should be noted that this sequence of transfers of functions is strictly observed in the history of technology. Technology and means of pro-

duction of necessity develop historically along the course where man's functions, initially that of execution, then that of propulsion followed by that of management, are taken over by machines.

The industrial revolution in the 18th century was due to the invention of a number of machines which took over the executive function. It was the first revolution in machine technology which opened up the way to modernisation of production. The next breakthrough in the development of technology, the second revolution, was due to the invention of the steam engine, followed by other power machines, including electric motors, turbines, etc. The machines take over man's propulsion function. The mid - 20th century saw the creation of various types of automated devices to which man transferred his third function, that of operating machines and managing production processes.

It is the creation of automated systems and the transfer of the managerial function from man to automatic machines that constitute the current revolution in technology. With automation, there is no longer a need for man to participate in the production process directly; man performs the tasks of monitoring and observing the production process.

It is pathetic that the world has forgotten the pioneering role of blacks in the evolution of science and technology. While references are often

made to the work of George Washington Carver, information about such outstanding black scientists as Benjamin Banneker, Dr. Charles R. Drew, Dr. Percy L. Julian, Dr. Ernest Just and a host of others has not been available to most science/technology teachers and their students. The ancient peoples living in the interior of Africa did not pass through a bronze age. Metals were abundant there, especially iron, and the Africans discovered the use of iron so early that they passed over the bronze age in going from the stone to the iron age. Authorities in anthropology and archaeology concede that Africans were the first to discover iron, the element most useful to man. They learned how to extract iron from the ore which abounds in the interior of Africa and to refine it in furnaces, and blacksmiths throughout Africa worked the metal into useful tools. Other people learned to use iron only much later. In Africa the black made some discoveries and inventions in spite of his lack of contact with the so-called progressive parts of Asia and Europe. Scientists now give Africans credit for first discovering iron, developing stringed instruments, domesticating the sheep, goat and cow, and learning about the planetary system.

In brief, the history of man's first technological revolution indicates the following :

- \* Technological revolutions create an objective need for social and political innovations. They create a need also for identifying the areas in which new institutions are needed and old ones are becoming obsolete.
- \* The new institutions have to be appropriate to specific new needs. There are right social and political responses to technology and wrong social and political responses. To the extent that only a right institutional response will

*It is the creation of automated systems and the transfer of the managerial function from man to automatic machines that constitute the current revolution in technology.*

do, society and government are largely circumscribed by new technology.

- \* But the values these institutions attempt to realize, the human and social purposes to which they are applied and perhaps most important, the emphasis and stress laid on one purpose as against another, are largely within human control. The bony structure, the hard stuff of a society, is prescribed by the tasks it has to accomplish.

This may be why Peter Drucker, the Philosopher of Management, has argued that technology must be considered as a system, that is, a collection of interrelated and intercommunicating units and activities. This system can only be understood if we have a unifying focus where the interaction of all the forces and factors within the system registers some discernible effect, and where in turn the complexities of the system can be resolved in one theoretical model. Tools, processes, and products are clearly incapable of providing such focus for the understanding of the complex system called technology. Drucker noted that it is just possible that work might provide the focus,

*It is pathetic that the world has forgotten the pioneering role of blacks in the evolution of science and technology.*

might provide the integration of all these interdependent, yet autonomous variables, might provide one unifying concept which will enable us to understand technology both in itself and in its role, its impact on and relationships with values and institutions, knowledge and beliefs, individuals and society.

History has never been satisfied to be a mere inventory of what is dead and gone - that, in the words of Peter Drucker, is "antiquarianism". True history always aims at helping us understand ourselves, at helping us make what we shall be. Technological activity during the twentieth century and beyond has changed and will continue to change in its structure, methods, and scope. The world's future is likely to exist in what Peter Drucker calls "The Age of Discontinuity" underscoring the revolutionary nature of the social, technological, economic and political forces which comprise the environment of society. Tomorrow's society will surely be moulded by revolutions in the social, technological, economic and political spheres. The technology-based society will feel these forces because it is a purveyor of technology and because it is an institution, which like all institutions, will adopt new goals, attitudes, concepts, practices, and organisational forms in response to new threats and opportunities.

"Invention and discovery, social change, and economic growth are seen as overshadowing anything we have seen in the past. The industrial world will face dramatic alterations

as entire new industries based on technological advances, services, and human needs become realities", Carl Madden of the U. S. Chamber of Commerce has stated.  
**Technological Progress and Economic Development**

According to Professor Todaro, technological progress is the in-

creased application of new scientific knowledge in form of inventions and innovations with regard to capital, both physical and human. It has been a major factor in stimulating the long-term economic growth of contemporary developed countries. Glenn Seaborg expressing his hopes for better management of technology in order to attain socio-economic goals has stated that:

"Technology can be directed creatively so as to bring human society into close harmony with its natural environment. It can be made to create wealth ... It can be made to create beauty .... It can be made to bring man both greater security and more individual freedom. What it does, however, will be accomplished only when we stop blaming it for our shortcomings, reassert our mastery over it, and agree what we want to do with it."

At the 9th National Science and Technology Workers Forum in Beijing in 1982, Prime Minister Zho Ziyand said that economic targets may not be achieved without technological development; in other words, success requires progress.

Why do we value technological innovations so highly? To understand this, we should consider some possible development scenarios :-

- (1) Even without any change in the level of technology, we can boost production solely through increases in labour and capital.
- (2) Even without any changes in technology, labour and capital, we can increase production by rationalizing production factors.

In both of these scenarios, the increase in production is limited. There is, though, a third possibility:

*History has never been satisfied to be a mere inventory of what is dead and gone. True history always aims at helping us understand ourselves, at helping us make what we shall be.*

- (3) With changes in scientific knowledge and technology, there is no limitation to increases in production because progress in science and technology is limitless.

Next, let us look at the role which technological innovations play in raising the productivity of labour. According to foreign statistics, technological advances are rapidly becoming a prominent factor in the increase of industrial productivity; at the turn of the century it accounted for 5- 20 per cent, in mid-century this figure rose to 40 per cent, and in the 1970s it topped 60 per cent. At this moment, some advanced countries have already reached the position where 70 - 80 per cent of the rise in productivity is due to technological innovations.

Progress in science and technology has been shown to have accelerated the economic growth of some countries. As regards the period before the Second World War, the low level of technology can be cited as the reason why countries took so

Germany, managed to quadruple their economies in less than twenty years. And one of the main reasons for this lies in the improvement of technology and the swift application of new technology to production.

#### **University Education and Technological Break-Through**

Nigeria, through her educational system and particularly, through her universities can become an agent of change in the whole of Africa. And here we link the past with the present and the future, for universities, if they deserve the name, must be agents of change. This may seem to be a surprising statement: are not universities, you may ask, custodians of the cultural heritage and history of their nations, and as such do they not have a tendency, indeed a duty, towards tradition and conservation? It is certainly true that universities have an obligation to pass on to future generations the accumulated knowledge and wisdom of past generations. But it is also true that - to quote the memorable words of Franklin D. Roosevelt - 'we must

*The Soviet Union and several Eastern European countries, as well as Japan and West Germany, managed to quadruple their economies in less than twenty years. And one of the main reasons for this lies in the improvement of technology and the swift application of new technology to production.*

long to quadruple the size of their economies. It took Great Britain and France more than sixty years, Germany fifty-two years, and the United States thirty years to achieve this. After the war, however, there was a considerable speeding up, as can be seen in Table 1. The Soviet Union and several Eastern European countries, as well as Japan and West

reform if we would conserve. Universities, their teachers and their students, should be no mere blind custodians of the relics of the past, tending an ancient shrine in which the flame of inspiration burns low. The aim of higher education is not a mere extension of knowledges; it is, in Plato's phrase, 'the conversion of a soul from study of the sensible

world to contemplation of real existence'. So the principles that decide the selection of the studies of the higher education are that they must lead to reflection rather than deal with the things of sense; they must likewise be of universal application. Hence the emphasis in universities on research as well as teaching, on pioneering new boundaries of knowledge, on pushing forward the creative frontiers of the mind. The past and its heritage is no mere boxed treasure. It must be laid open, sifted and critically appraised with new techniques and insights being brought to bear in its interpretation. Our students are not there just to receive: they are there to learn to think for themselves, to flex their minds, to exploit their own human resources. It is one of the roles of a University to be conscience of society, to question the status quo. - 'It is man's ability to say "No" which brings about progress.

This is the paradox of a university. To the reactionary, it can appear to be a hotbed of revolution since it must be open to new ideas; to the revolutionary, it can be seen as an atrophied institution which resists change. It should, of course, be neither of these. In Paris, in 1973, Professor J. D. Legge of Monash University addressed the International Association of Universities on the subject of the university's role in society and what he had to say then is worth quoting: 'The task of the universities,' he said, 'is to question firmly held assumptions, to challenge prejudice, to assist society in forming its perception of itself and to serve as sanctuaries where argument is open and where thought cannot be coerced except by argument. They are not "citadels of truth".... but places where the question "what is truth?" is never finally answered.'

To be this and to do this, universities must have autonomy, the recognized right to make their own aca-

*This is the paradox of a university. To the reactionary, it can appear to be a hotbed of revolution since it must be open to new ideas; to the revolutionary, it can be seen as an atrophied institution which resists change. It should, of course, be neither of these.*

demical decisions. It is perhaps worth spending a few moments trying to define what we should, and what we should not, mean by 'autonomy' in this context. We mean the universities must be allowed to draw up their own curriculum, admit their own students, hire their staff/officers and operate their own projects.

gathering other ideas and more innovation. The broader the base of accumulated science, the more wheels that are whirling, the bigger the load of new concepts that can be supported, that become thinkable, and the faster each development can be nurtured through the stages of gestation. These stages have been identi-

Table 1

Countries which quadrupled their economies in a period of twenty years or less			
	(Years)	Growth Rate (%)	Indicator
USSR	16	9.1	Gross Social Product
Bulgaria	15	10.6	Gross Social Product
Romania	15	9.9	Gross Social Product
East Germany	19	7.8	Gross Social Product
Japan	14	10.6	Gross National Product
West Germany	19	7.8	Gross National Product
Greece	20	7.4	Gross National Product

Note : Average growth rates are calculated on an annual basis  
Source : Asia and Japan : A Search For Modernization and Identity p. 11

Whether or not Nigeria comes to its senses, corporate Nigeria cannot afford to forget for an instant what the "high" in high technology means: high rate of change. Technology is a dynamo that feeds of itself, constant

fied by Cetron et al (1985) as the "Four I's" of science and technology : ideas, invention, innovation, and finally imitation. (Another "I" - internment - is always waiting for the unwary, of course, the unsuccessful).

*Technology is a dynamo that feeds of itself, constantly gathering momentum and speed. It's like the self-replicating machines in some science fiction stories. Research leads to one invention, triggering other ideas and more innovation. The broader the base of accumulated science, the more wheels that are whirling, the bigger the load of new concepts that can be supported, that become thinkable, and the faster each development can be nurtured through the stages of gestation.*

gathering momentum and speed. Its like the self-replicating machines in some science fiction stories. Research leads to one invention, trig-

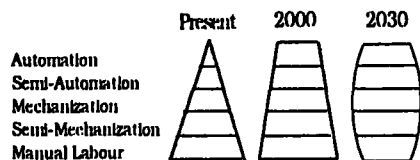
#### **A Technology-Based Model for The Economic Transformation Of Nigeria**

It is sad that six years after the introduction of the structural ad-

justment programme the Nigerian economy is still characterised by low industrial production, resulting from low level of investment and availability of financial resources. Table 2 summarises certain economic indicators of growth in Nigeria before and after the deregulation of the economy. Of particular interest is the fact that while capacity utilization in the industrial sector has fallen by over 140 per cent since the deregulation of the economy, unemployment rate has risen by over 86 per cent within the same period. The trend is not likely to improve until a deliberate and systematic technology - based development plan is embarked upon by the government.

**The Structural Model**

In searching for a technology - based model for the rapid economic transformation of Nigeria, we have to address the problem of how to accurately adjust the changes in each technology level to achieve our strategic growth target. This problem is closely related to the issue of labour employment and, therefore, it is fitting that we should focus on the number of workers in each technological level, as expressed in the diagram below:



This model ignores the other possible parameters, the inclusion of which would naturally affect the shapes generated. In keeping with the classification system now used throughout the world, the technology structure has been divided into five different levels. At present, the shape of this structure is triangular but with the realization of our economic targets in the year 2000, it will have changed into a trapezium, or truncated triangle. Since Nigeria is a populous country with an overall

Table 2

Selected Economic Indicators Before and After Structural Adjustment			
Economic Indices	1985	Current	% Increase (Decrease)
1. Interest rate	9%	40%	344.4
2. Foreign Exchange rate	₦ 1=\$1.04	₦ 1=\$18.60	1752.59
	₦ 1=Σ. 6945	₦ 1=Σ 32.52	4582.51
3. Inflation rate	5.5%	8.5%	54.55
4. Unemployment rate	2.2%	4.1%(1991)	86.36
5. Capacity utilization	14.7%	6.1(1991)	140.98
6. Foreign Debt	\$12 billion	₦33 billion	
7. Net Capital Inflow (\$ billion)	-0.6	-2.82%(1990)	370.00
8. Gross Domestic Product	2.4%	5.25%(1990)	118.75

Source: The Nigerian Economist, Vol. 5, No. 15: April 27, 1992, page 31.

low level of technology, there will no doubt still be a considerable amount of manual labour at the end of the century; this is why the base of the diagram is still so wide. Despite this, the central and upper levels - representing automation, semi-automation, and mechanization - will have become relatively broad, representing a considerable improvement in the overall level of technology. This trapezium illustrates how Nigeria's unique technology structure will develop with the widespread introduction of the production technology employed by the advanced countries in the late seventies and early eighties. Thirty years later, in 2030, the

with the development of the economy. Something else which can be deduced from the model for 2030 is that Nigeria will catch up with the advanced countries in the field of applied science technologies.

It should, however, be borne in mind that the five different technological levels shown in the diagram are not fixed and unchanging: they evolve with the passing of time and with the appearance of new technologies. Thus, the levels themselves will naturally vary from between now and the year 2030.

There is no doubt that technological innovations provide an im-

*A paradox does exist at present, and we cannot be sure when this will disappear, but we must not lose sight of the fact that our only hope for an increase in employment lies in the increase in productivity.*

technology structure will have developed so as to resemble the barrel shape in the diagram. The two extremities are narrower than the centre, indicating a decrease in manual labour, but without so much broadening of automation that the structure becomes top-heavy. The reason for this is that the service sector, which is usually comprised of manual labour is expected to expand greatly

portant means of improving productivity. However, some people suggest that, for a country like Nigeria with its large population, policies which promote the introduction of such technologies may aggravate the employment problem. Indeed, there does appear to be a contradiction in this. At present, some enterprises which do not actually require a large work - force attempt to alleviate the

Cont. on page 30

employment problems of the young by over-hiring. This is a typical manifestation of the contradiction seemingly implied by trying to raise the levels of employment and productivity at the same time. Yet the fact is that these two policies need not contradict each other. The reason for this is simple. It is only when we succeed in increasing productivity in the manufacturing sector on a large scale that we can satisfy increasing demands for specific items. Once this has happened, its effects will be felt in the non-manufacturing sectors, in turn helping to develop education, culture, public health, science and technology, and physical education. The result will be an increase in the demand for labour in these growing sectors, and thus a rise in productivity in the manufacturing sector will have indirectly led to an increase in employment. A paradox does exist at present, and we cannot be sure when this will disappear, but we must not lose sight of the fact that our only hope for an increase in employment lies in the increase in productivity.

### Conclusion

We must now pin our hopes on advances in science and technology as a means of attaining our economic targets. By the end of this century, we must absorb and disseminate throughout our country the technologies that the advanced

countries obtained during the 1970s and 1980s.

Being a less developed country in a technological sense does have its advantages: we can save on the long years and high costs invested by the advanced countries which originally developed these sophisticated technologies. We have the privilege of choosing and introducing those technologies that are most suitable for our needs. But of course, there are also disadvantages. Since the level of education of the Nigerian people is, on the whole, not very high, there is the problem of learning, mastering and managing these advanced technologies. To overcome such basic problems, we must take appropriate measures to raise the overall level of understanding of cultural and scientific matters. Naturally we need to lay our foundations by implementing proper education, but when we consider the importance of science and technology in achieving targeted growth, we must realize that there are certain priority policies that need to be put into operation.

First, from now on the focus of our efforts to expand production must shift from the establishment of new industries to the upgrading of technologies used in existing industries; this approach will make use of the potential already existing within the production system.

Next, the technology structure of Nigeria must be rationalized and controlled. This structure may be defined in terms of many parameters, such as size of the work-force at each technological level, the product ratio of a specific technology to total production, the composition of technologies expressed in a specified manufactured item, and the ratio of technological assets (equipment) to total fixed capital assets.

### References

- Cetron, M. A. Pagano and O. Port. *The Future of American Business: The U. S. in World competition*, New York: McGraw - Hill Book Company, 1985.
- Drucker, P. F. *Technology, Management and Society*, London: William Heinemann Ltd., 1970.
- Haber, L. *Black Pioneers of Science and Invention*, New York: Harcourt, Brace and World, Inc. 1970.
- Institute of Social Sciences, *Fundamentals of Marxist - Leninist Philosophy*, Moscow: Progress Publishers, 1985 pp. 264-5.
- Rayson, L. H. "The University as an agent of Change - The Role of Japanese Universities", in *Asia and Japan: The Search for Modernization and Identity*, ed. Andrew J. L. Armour. London: The Athlone Press, 1985.
- Rusk, R. R. *Doctrines of the Great Educators*, London: Macmillan, 1976 pp. 20 - 21.
- Shangqing, S., "China's policies for energy and Technology, and economic relations with Japan", in *Asia and Japan. The Search for Modernization and Identity*, ed. Andrew J. L. Armour. London: The Athlone Press, 1985.
- Todaro, M. P. *Economics For a Developing World*, London: Macmillan, 1977.