HUMAN CAPITAL AND TECHNOLOGICAL DEVELOPMENT IN NIGERIA

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DECLARATION

I hereby declare that this thesis has been written by me and that is a record of my own research work. It has not been presented before in any application for higher degree.



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CERTIFICATION

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ABSTRACT

Investment on education and health/nutrition create the human capital necessary for raising the productivity of labour and other factors and the economic well-being of workers and their families. Therefore, it is assumed that investment in human capital is necessary for economic growth and household welfare. However, Economists agree that for an economy to grow, human capital is necessary but not sufficient, hence, technology has been attracting critical attention. These two variables are closely linked as a well educated society is better able to innovate, invent, and adopt new technologies.

Apart from human capital and technology, other related factors playing key roles in the economy include; capital stocks of machines and materials, research and development, labour productivity, degree of economy's openness, and government policies. These factors are studies as role players and their impacts examined on the growth of the Nigerian economy within a theoretically framework called, the National System of Innovation - (N.S.I.). It is in the light of the above that this thesis was designed to study and estimate the relationship between the real per capital G.D.P. and above factors and draw implication(s) for economic growth as a broad objective.

The endogenous growth approach OLS. regression model analysis revealed that, in Nigeria, physical capital (both domestic and foreign stocks) is a major determinant of economy's growth; human capital is poorly formed and

developed, vital ingredient (R & D) for building and cumulating technology is weakly based abroad, thus, yielding low growth contribution; labour productivity was negative, probably, a result of human capital mal-formation; and, the direction of the economy's openness was of insignificant benefit.

The major problems identified in the study include wrong placement of Nigeria's seemingly adequate expenditures on human capital formation and generating more local research and development activities to produce local capital goods, produce more of other goods, particularly for global markets, and thus build a pool of innovative entrepreneurs. On the basis of findings and implications advanced, recommendations are made as solutions to identified problems.

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ABBREVIATIONS AND ACRONYMS

'Best practice'	Fully developed
C.O.E.	College(s) of Education
D.W.	Durbin-Watson Statistic
F.D.I.	Foreign Direct Investment
F.G.N.	Federal Government of Nigeria
F.I.I.R.O.	Federal Institute of Industrial Research Oshodi (Nigeria)
F.O.S.	Federal Office of Statistics (Nigeria)
G.D.P.	Gross Domestic Product
G.N.P.	Gross National Product
H.N.D.	Higher National Diploma
I.D.C.	Industrial Development Centre (Nigeria)
M.N.Cs.	Multi-National Corporations
M.C.E.	National Certificate of Education (Nigeria)
N.D.E.	National Directorate of Employment (Nigeria)
N.I.C.	Newly Industrializing Country
N.S.I.	National System of Innovation
N.M.B.	National Manpower Board (Nigeria)
O.E.C.D.	Organisation for Economic Co-operation and Development
O.N.D.	Ordinary National Diploma
POLYTECH.	Polytechnic
PRODA	Project Development Agency (Nigeria)

R^2	Adjusted Co-efficient of determination
R. & D.	Research and Development
S.A.P.	Structural Adjustment Programme
S.S.A.	Sub-Saharan Africa
S. & T.	Science and Technology
t-value	student statistic
T.F.P.	Total Factor product
T.T.S.	Teacher Training School
V.T.S.	Vocational Training School

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE RESEARCH PROBLEMS

In contrast to the exceptionally rapid pace of technological change and industrial transformation experienced among the East Asian newly industrializing countries (NICs) over the past three decades or so, sub-Saharan Africa (SSA) countries as a whole have displayed a slow rate of change if any at all. Indeed, in most SSA countries including Nigeria, there is a clear evidence of economic and industrial stagnation and crisis. Although, the factors responsible for the latter have been identified in diverse sources (see for instance, Collier and Gunning, 1997), most analyses put the blame on low-level human capital.

Human capital refers to the ability of an individual to make competent economic decisions; as such, it includes education and skills endowment, health and nutrition, etc. as endowment of an individual. However, given emphasis on skills training in technological accumulation, most studies on the role of human capital in technological change have focused attention on investments in education and the extent of skills acquisition through formal and informal channels and mechanisms.

The empirical literature provides comparative data on Nigeria and the Newly Industrializing Countries (NICs) on human capital which will motivate specific questions on Nigeria's human capital performance (see table 1.1). The following points distinguish Nigeria from the NICs.

TABLE 1.1: Indicators of Human capital for Nigeria and selected NICs

	NIGERIA	S.KOREA	INDIA	BRAZIL
Enrollment ration (% age group enrolled in:				
Primary				
1970	37	103	73	82
1991	71	107	98	106
Secondary				
1970	4	42	26	26
1991	20	88	44	39
Tertiary				
1970	2	16	5(1965)	12
1991	4	20	n.a.	12
Education stock (school years of education per person between age 15 and 64 (1987)[a]	2.54	5.13	3.39	5.52
% share of each tier in average education stock (1987):				
Primary	91.7	85.4	70.5	84.2
Secondary	7.5	14.0	26.0	10.1
Tertiary	0.9	0.6	3.5	5.6
Adult illiteracy (% Total 1990)	22	4	52	19
Tertiary students in Science & Engineering (S & E)[b] total pop.	0.1* 0.08* (1990)	1.39 (1987)	0.21 (1980)	0.40 (1983)
Tertiary students in Engineering % total population	0.08* 0.02* (1990)	0.54	0.06	0.13
Students in Technical and Vocational Training (% working population)	0.2 (1987)	3.6 (1986)	0.1 (1983)	1.8 (1980)
Stock of scientists and engineers ('000)	78.1[c](1992)	361.3(1986)	2000('85)	1362(1980)
- per ml population	765	8,706	2,564	11,475
Expenditure on human capital (% GDP)	4.4(1980) 3.0(1985)	4.9(1985)	3.7(1985)	2.9(1984)
Central Government expenditure on health & education, % total govt. exp. (1989)	3.6	20.5	4.4	10.3

Table 1.1: Notes:

Figures in brackets refer to years.
* includes university and polytechnic students.
** includes only university students.

[a] Regional averages drawn from Nehru et al (1993) are used to proxy country education stock: thus, for Nigeria we used education stock for SSA; South Korea is proxied by East Asia; India by South Asia, and Brazil by Latin America.

[b] Includes agriculture, engineering and technology, environmental design (e.g. architecture), medicine and health sciences; pharmacy; general science (e.g. chemistry, mathematics); veterinary science.

[c] Extrapolated from 1970 base of 19,792 assuming annual growth rate of 10 - 15%.

Sources: World Bank (1991, 1994); Mowery and Oxley (1995, Table 7); Nigerian Data on Science and Engineering Students are from, FOS (Nigeria) various issues; and Afonja, Oni and Sraku-Lartey 1997)

Educational enrollment at all tiers grew rapidly for Nigeria and SSA. as a whole (see Psacharopoulos and Woodhall, 1985; Knight and Sabot, 1990), as from the 1970s but still remain inferior to the levels achieved in the NICs. While only 20% of Nigeria's secondary school age population in 1991 attended secondary school, more than four times that percentage did so in South Korea and twice in India and Brazil.

Compared to the NICs, far fewer students in the Nigerian educational system go into vocational/technical schools (VTS). For instance, South Korea has eighteen times better statistics and about 4% (in 1991) of the tertiary school age population in Nigeria entered university - compared to 20% in South

Korea and 12% in Brazil - worse still, less than 1% of those who fail to attend university even attend VTS to acquire occupational skills.

With regard to education stock (school years of education per person between ages 15 and 64 years), Nigeria's statistics of 2.54% (in 1987) is only a little over 50% of South Korea's, 75% of India's and 46% of Brazil's These data suggests that Nigeria possesses a far less educated workforce than the NICs.

The stock of Science and Technological (S & T) manpower, measured by stocks of scientists and engineers per million of the population, is conspicuously low in Nigeria even in absolute terms. The Nigerian statistics in 1992 reads: 765 compared to 8,706 in 1986 for South Korea; 2,564 in 1985 for India, and 11,475 in 1980 for Brazil. Yet, Nigeria is known to harbour the bulk of the S & T manpower in sub-saharan Africa (see, Eisman, 1979; Wad, 1984; Afonja et al; 1997). Note that, these statistics do not discount quality differences which are know to have deteriorated rapidly in SSA since the 1980s (see, Zymelman, 1993; Lall, 1991).

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TABLE 1.2: Basic Indicators of Output Growth (TFP) for Nigeria and selected NICs

Countries	GNP per capital (1989) (US $)	Average Annual Growth Rate (1965-89)	Total factor productivity TFP contribution to GDP Growth (%)
NIGERIA	250	0.2	5% (1950 - 91) -0.1 (1970 - 79) -403 (1980 - 91)
SOUTH KOREA	4,4000	7.0	56.4 (1955 - 70) 41.2 (1970 - 80)
INDIA	340	1.8	39.1 (1950 - 80) 0.2 (1970 - 80)
BRAZIL	2,540	3.5	22 (1960 - 74)

Sources: World Bank Table (1991)
Dike (1995) - TFP data on Nigeria.

Comparative technological growth - proxied by the contribution of total factor productivity (TFP growth rate in GDP growth above displayed in Table 1.2. indicates that Nigeria lags far behind the NICs.

1.2 RESEARCH PROBLEMS AND QUESTIONS

The comparative data presented above suggests a number of questions regarding the effectiveness of Nigeria's national system of accumulating technology. Indeed they suggest that the Nigerian system exhibits a certain weakness with regard to human capital accumulation. If, as our data indicate, Nigeria's educational enrollment at all levels has improved significantly since

the 1970s, but the performance of the Nigerian economy still lags behind that of the newly industrializing countries (NICs) in terms of supply of scientific and technical (S & T) manpower, then, there must exist some problems with the system. The problem could be that the course emphasis in biased against science and technical course or it could be that resources channelled into S & T education are insufficient.

Also, why are far fewer Nigerian tertiary level students going into science and technology fields? The problem could be that the incentive system is biased against science and technical graduates in the labour market, i.e. there is low demand for S & T manpower, so that wage rate is placed inferior relative to what obtains in other courses.

These are issues that require investigation. Consequently, this research proposes to study Nigeria's human capital accumulation processes focusing on the impact of national institutions, macro-economic policies and mechanisms that structure and influence human capital accumulation in Nigeria. Essentially, this is a study of human capital accumulation in Nigeria within the national system of innovation framework.

1.3 SPECIFICATION OF OBJECTIVES

The above broad objective is broken into the following objective:

1.3.1 To study the institutional details of the formal educational system,

focussing on the different routes or paths which students can follow, in order to provide insight into the extent the Nigerian educational system is differentiated and practice-oriented vis-a-vis the 'best practice' system.

1.3.2 To evaluate the emphasis accorded the training of S & T manpower.

1.3.3 To estimate the probable contribution of human capital to Nigeria's long-term growth.

1.3.4 To analyse the policy implications of the findings.

1.4 JUSTIFICATION FOR THE STUDY

This study is focused on the institutional underpinnings and growth implications of human capital in Nigeria. Given that human capital focuses specifically on the human productive capacity, a study of this type is bound to improve our understanding of a major input in Nigeria's long-term economic growth. Hence, it is of significant policy relevance.

At the level of methodology, this study on Nigeria's human capital performance within the National System of Innovation (N.S.I.) framework represents the first attempt within the empirical literature to apply that framework to Nigeria. Existing studies on human capital in Nigeria, e.g. Afonja et al (1997) fail to approach the problem from this methodological framework. Consequently, these previous studies fail to capture the impact of national institutions and the growth contribution of human capital in the Nigerian economy. These are some of the issues that have captured the interest of

economists in current literature out of which little have been studied in sub-saharan Africa (SSA).

1.5 PROPOSITIONS/HYPOTHESES

The study will test the following propositions, namely, that the Nigerian system of human capital accumulation suffers from two systemic constraints which tend to undermine its effectiveness.

1.5.1 Though the formal educational system has become differentiated in recent decades (now offering different routes to students) the practice-orientation still lacks capacity to generate quantitatively and qualitatively the S & T manpower required for dynamic technological development.

1.5.2 Insufficient resources have been channelled into human capital formation. Besides, diminishing returns appear to be in operation in the system, thereby making the contribution of human capital to growth not to be proportionate to the size of human capital investment.

1.6 METHODOLOGY

1.6.1 SCOPE

This study is a macro-economic empirical investigation on the Nigerian human capital accumulation drawing empirical evidence and data from developments in three out of four decades of post-colonial development. Since we are interested in systemic and institutional processes and how these impinge upon human capital, there is need to investigate medium to long-term

periods. Therefore, the study will cover a period of twenty-two (22 years) from 1975 to 1996. This period covers two eras. The first era is the fabled 'oil boom' period of 1975 to 1985. That was Nigeria's era of opulence. The second era, 1986 - 1996, sparked off economic crisis which forced the introduction of Structural Adjustment Programme (SAP) characterised by cut-backs in investment and capital inflow as well as increasing rate of capital flights.

1.6.2 **DATA SOURCING**

Owing to the desk-prepared nature of this project, secondary data will be used mainly in this work. Data (Appendices C & D refer) and relevant information are sourced from various official publications of the Nigerian government, relevant publications of the World Bank and other multilateral aid agencies, Reports by International Research Institutions, existing academic literature on human capital, etc. by Nigerians and foreign scholars.

1.6.3 **METHODS OF ANALYSIS**

The study will be analysed using firstly, institutional analysis approach through the framework of the 'national system of innovation' (NSI) to explain the macro-economic and systemic variable and mechanisms underlying human capital formation in Nigeria such as government policies, the types and nature of formal and informal educational establishments contributing to knowledge and skills acquisition and utilization. Secondly, a quantitative multiple regression analysis will be attempted in order to capture and explain the

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apparent relative role of and contribution of human capital to long-term productivity growth in Nigeria.

1.6.4 **ORGANISATION OF WORK**

This work is divided into seven chapters. Chapter One contains Background to the Study, Research Problems and Questions, Specification of Objectives, Justification for the study, Propositions/Hypotheses and Methodology.

Chapter Two is about the theoretical framework and literature review. In chapter Three, Institutional and Structural factors are critically examined in the light of empirical evidences. Chapter Four appraises some key relevant sectors of the Nigerian economy, with Chapter Five introducing and deriving a theoretical Nigerian National system of Innovation. In Chapter six, the Study's Model is specified, the data was analysed; the results were presented and interpreted. The last Chapter, Seven presents summary and conclusion, policy implications and recommendations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 HUMAN CAPITAL ACCUMULATION

A vital resource for output production at firm or economy level is human capital. Blaug, (1993); Jakubauskas and Baumel, (1967) define human capital accumulation as, "all resources expendable to affect the ability of a human-being to develop his/her innate capacities as a worker and as an effective citizen in his/her community". The resulting human resource developed must have passed through one or more of the following - elementary through higher education, vocational training as well as the whole gamut of health, rehabilitation and welfare programmes.

Confirming the foregoing and emphasising the significance of education in the production of human capital, Killick (1993) states that:

> "education also promotes supply of entrepreneurs...the individuals who serve as the link between innovation and production; who exploits investment opportunities. Well educated/skilled population creates an economy's middle-class."

In a nutshell, human capital refers to the ability of an individual to make competent economic decisions.

The importance of human capital has been clearly recognised in recent growth studies which recognised human capital as a fundamental part of the

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production function, and a central determinant of technological advance. This recognition has been spurred on by earlier studies in the 1960s and 1970s on technical change (Arrow, 1962; Uzawa, 1965) who recognised human capital as a veritable vehicle of technical change (= innovation). These studies argue that technical progress - the rate of adoption of new, improved methods of production is a positive function of the average level of human capital available in the society (the global technological externality).

Endogenous growth theory returned to this theme from the 1980s, when it hypothesised that technological convergence and growth among countries is a function of the level of human capital among other variables (Romer, 1986; 1990; Lucas, 1988; Grossman and Helpman, 1991; Mankiw, Romer and Weil, 1992).

2.2 TECHNOLOGY AND TECHNOLOGY ACCUMULATION

Technology is a topical term variously defined and often broadly analysed. In whatever form, technology can be innovated, imitated, and accumulated towards improved factor productivity as well as increasing output generally. Drucker (1970) defines technology as, "the systematised practical knowledge, skills, methods, activities, and artifacts by means of which man pushes back his limitations and extends his capability". Onyemelukwe (1996) agrees with this definition of technology. Also, Baranson (1981) accepts these broad definitions of technology with his following clear remarks;

> "Technological self-sufficiency has become a primary goal in many of the newly industrialized nations developing plans, and strategy toward that end encompasses the progressive transfer of engineering and management capabilities rather than technology embodied only in plants and equipment."

Definitional implications are that technology at macro and micro levels is made up of stock of knowledge, skills, etc.; and all functional activities of finance, marketing and others. The abilities and capacities to build-up these technological components through technical change lead to technological capability. Learning is involved in this dynamic process. According to Bell and Pavitt (1993:261), technical change (often referred to as technical progress) encompasses any way in which new technology is incorporated into the production capacities of the economies or firms, while technological capability incorporates the additional and distinct resources needed to generate and manage technical change including skills, knowledge and experience as well as institutional structures, and linkages. Those processes that enhance and strengthen technological capability are referred to as technological learning or technological accumulation. One of these processes is human capital which is the central focus of this research; other types of technological accumulation include research and development (R & D).

The emphasis on technological learning or technological accumulation in the literature is that the (intangible) resources required to achieve dynamic industrialisation and long-term growth can no longer be considered a marginal adjunct to the resources constituting a nation's production capacity. They are becoming quantitatively much more significant, reflecting the rising knowledge-

intensity of modern industrialisation. In the industrial countries, expenditures on human capital/human resources (by firms) continued to grow (see, for instance, Wiggenhorn, 1990).

2.3 NATIONAL SYSTEM OF INNOVATION (NSI) (The Theoretical Framework)

The theoretical perspective to be employed for this research will be based on the 'National System of Innovation' (NSI) paradigm defined by Lundvall (1992) as a "social and dynamic system, constituted by elements and relationships which interact in the production, diffusion and use of new and economically useful knowledge, and encompasses institutional and structural elements and relationships either located or rooted inside the borders of nation state".

Also known as the 'National System of Accumulating Technology' the NSI, concept is premised on the idea that each country has initial endowment of productive resources but that the pace of change in the latter is influenced rather strongly by the local environment, the nature of national institutions, and the types of social, political, and economic policies prevailing within the particular 'nation state' being studied. The latter, it is argued, institutes a more appropriate point of departure in explaining and underpinning or understanding the success or otherwise of a particular system of technological accumulation or system of innovation (Bell and Pavitt, 1993). Broadly, the NSI notion is thus an articulation of the component structures of the national technological systems and its component sub-systems, (Table 2.1 refers).

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TABLE 2.1: Contrasting National Systems of Innovation

United States	Japan	Former Soviet Union	India	East Asian NICS	Latin American NICs	NIGERIA
* High Civil R&D -GNP ratio (2%)	* High civil R&D GNP ratio (2.7%) Low military/ spaced R&D	Very high R&D-GNP ratio ((3%) more than 60% in military space technologies	* Low R&D-GNP ratio (0.9%) heavily funded by the government	* High R&D GNP ratio (2%) industry. R&D takes 50% of all R&D	* Low R&D-GNP ratio (1%): Industry as % of total R&D lower than in East Asian NICs (about 30%)	Low R&D GNP ratio (0.5%) heavily funded by governments
* R&D mostly in-houses or firm-based and firm financed (70%)	* High proportion of R&D at firm level with 60-70% firm financed R&D oriented	High centralization of R&D with little autonomy for firm to decide R&D focus	* Has similarities with former Soviet Union for high level protection of technological research, priority to scientific and technological manpower and capital goods.	* R&D oriented on high technology products import of technology & FDI (mainly from Japan & United States) combine with local initiatives in technical change propelled by rising capability in initiative or adaptive R&D.	* High protected domestic markets and government ownership of industry	Autonomy for firms to decide source and focus of R&D
* Military/Space R&D high but low financed (1% GNP)	* Strong integration of R&D production and technology import at firm level	& Dissociation of R&D and enterprise and import of technology	* Preferred licensing to foreign direct investment (FDI) in technology	* Fundamental reforms carried in agragrian, education, health, etc. to create favourable preconditions for technology diffusion	* Heavily dependent on technology transfer via FDI (mostly from United States and Western Europe which declined in the 1980s	Similar to Latin America NICS.
* Strong post-graduate (Ph.D) programmes in Universities with serious emphasis on acquisition of research expertise	* System known for strong government leadership to nurture strategic/ heavy industries; pursues long term strategic technology goals	* Little exposition of firms to export competition outside military space technologies	* Acquired substantial capacities in export of patents based on adaptation and modification of imported technologies	* Strong development of human capital in science & engineering; vocational education emphasized	Weak R&D firm linkages deteriorating human capital infrastructure with lower stock of science and engineering manpower than East Asian NICs.	Low and weak R&D linkages between firms, academia, etc. Collapsing human capital infrastructe

* Strong university industry linkages, providing both private means of research funding and exchange of knowledge	* Tertiary education oriented heavily on science engineering, though industry relies less heavily on university R&D	Strong emphasis on capital goods development and human capital accumulation with stress on science and engineering		* Strong government academic industry linkages	* Nevertheless acquired capabilities in patent manufacture exports and linkages to foreign markets through MNCs.	Low Export, High Imports
* Corporate firm, venture capital and universities form strategic alliances	* Intensive protection of domestic market at early stages; but productions export oriented. Japanese acquire unprecedented export experience in high technology	* Like Japan, depends heavily on capital goods imports as major channel of technology transfer	* Export competition has dynamic effect on technological capabilities			
* Strong user-producer and sub-contractor network linkages						
* Paradigm of technology leadership entrepreneurship, strong incentive to use new technologies for domestic and international competition						

Source: Dike (1997)

From all the above broad definitions of the National System of Innovation - NSI - Lundvall (1992) extracts a narrow definition of NSI germane and expedients to this study as, "a dynamic system that displays learning as its central and social activity involving interaction of people and characterised by positive feedback and reproduction".

The national system of innovation (NSI) borrows and derives its bearings from the evolutionary and cumulative character of technological development earlier espoused by Adam Smith, Karl Marx and in modern economics by Schumpeter (1961) emphasising the role of national institutions in which the state and its policies are especially viewed as paramount.

Fine (1992) proves a succinct conceptualization of the notion of NSI, drawing from the South Korean experience, he points out that:

> "the nature of technology and technical change is pervasively transformed across major parts of the economy as a whole as a result of inter-linkages and mutual reinforcement - whether these be narrowly determined by technology alone as new raw materials correspond to new production methods or through social relations as in Karl Marx's famous reference to feudalism depending on the windmill as opposed to capitalism and the steam engine, or through institutions whether these be firms and their organisational forms, the educational and scientific establishments or the state and civil society generally." (p.14).

The reference to "inter-linkages" and "mutual reinforcements" suggests that advancing national technological capability - defined as the stock of,

resources, including production skills, linkages, institutions, etc., that enable a developing country to exploit existing technologies and if possible change them is a neccessity for economic development.

But why have Sub-Saharan Africa (SSA) countries, so far, failed to build up their human and social capital? As noted earlier, the literature suggests that the answer to this question lies in the weakness of SSA countries' national system of innovation (NSI), and the hypothesis is that SSA countries lack those national institutions, mechanisms, and the macroeconomic policies that have propelled technological change in the 'cathing-up' NICs, particularly the East Asian variety.

This research proposes, therefore, to study the effect of Nigeria's NSI on human capital against the record of the 'best practice' models found among the NICs., and developed countries as well. That is, the study proposes to investigate the nature of the institutions, public policies, national and international linkages and networks that have influenced the effectiveness or otherwise of human capital as a vehicle of technological change in Nigeria.

2.4 HUMAN CAPITAL-TECHNOLOGY - NSI

From all the foregoing concepts and theoretical framework, we infer that, since technology is simply knowledge that can be learnt and acquired cumulatively by human beings, on which much could or have been invested,

thus producing human capital, also, since technology and human capital are operational within institutionalised national system of innovation (NSI) characterised by positive feedback and reproduction (Lundvall, 1992), it can therefore be established that an economy's technology, human capital and NSI are interwoven and lend a networking approach for explaining contemporary transformation or otherwise.

The endogenous growth theory returned the above theme as from the 1980s, when it hypothesised that technological convergence and growth among countries is a function of the level of human capital among other variables (Romer, 1990; Lucas, 1988; Grossman and Helpman, 1991; Mankiw, Romer and Weil, 1992). Ever since, considerable progress has been made in studying the essential elements of the national system of innovation - NSI (Mowery and Oxley, 195); Nelson, 1992; Penska, 1990). The comparative literature has also expanded (Enos, 1991; Bell and Pavitt, 1993). These studies highlight the role of R & D, human capital, market industrial structure, technology and the state and its policies and institutions.

The role of the R &D is to create new production knowledge (= technology), and that of human capital is to nurture, instil, and transmit productive skills in the labour force, that of the industrial structure is to exploit existing knowledge and productive skills to generate goods and services, hopefully on an increasing level of efficiency.

CHAPTER THREE

3.0 NIGERIA'S HUMAN CAPITAL ACCUMULATION SYSTEM: INSTITUTIONAL CONTEXT

3.1 THE NIGERIAN ECONOMY FROM THE 1970s

Nigerian as the biggest black nation in the world got her independence from Britain in 1960. With a population of about 100 million people and a land mass of 357,000 sq. kilometres, Nigeria is blessed with land fertility and arrays of minerals - petroleum, gas, tin, iron-ore, gold, kaolin, etc. large commercial quantities with many of these minerals yet to be fully exploited or exploited at all.

Nigeria's first decade of independence was marred by political crisis and instability from 1962 and climaxed by a civil war from 1967 to 1970. An unstable polity means an unstable economy. A form of economic stability appeared from 1970. Globally, the growth of the Nigerian economy depicts the rising and falling fortunes for the country. From 1970 to 1980, the economy was in the oil boom period. It was a period when export revenues skyrocketed, external reserves built up, imports expanded and incomes rose (Iyoha, 1989). The dramatic growth of the Nigerian economy peaked and ended in 1980.

As from 1981 to date, the economy has been into a crisis which

manifested itself in several ways, including chronic balance of payment deficits, rising external debts, rampant inflation and falling Gross Domestic Product (GDP) resulting in serious domestic economic recession. The Nigerian economic growth package therefore, technically need to be investigated. A prominent set of variables in the economic growth theory worth analysing are human capital and technology or technical change of the economy. The focus and choice of approach in this work is towards answering the questions, 'to what extent have actual changes in national output being due to human capital and technical change?'; and of, 'what effect are the inherent weaknesses in the Nigerian economy as already identified?'

3.2 THE NIGERIAN FORMAL EDUCATION SYSTEM

The Nigerian formal education system began to be differentiated since the 1970s and now approximates more the German education system than the British or United States system from which it evolved. Table 3.1 below displays the various opportunities open in the Nigerian educational system against comparable opportunities in Germany and the United States.

TABLE 3.1: Comparison of Nigerian Educational System with its close equivalents in two Industrial Countries

NIGERIA (Educational Attainment)	GERMANY	UNITED STATES
(1) Terminal (6-years) Primary School Cert.	**(1)** 10 Years Elementary school	**(1)** Terminal Middle School Certificate
(2) Terminal (6 Year) Secondary School Certificate Structured into: 3-Year Junior Secondary; 3-Year Senior Secondary. Secondary School Curriculum has three tracks: (a) Conventional Grammar/Commercial; (b) Teacher Training College (TTC) - being phased out?; (c) Vocational Technical School VTS	**(2)** Middle School Certificate plus one-year classroom training. Apprenticeship training	**(2)** High School Graduate
(3) Tertiary education has four distinct tracks; (i) Terminal 4 Years (or longer) university – Bachelor's Degree - with specialised Universities in Agric, Science and Engineering apart from the conventional Universities; OR (ii) Terminal 4 Years Polytechnical Education structured into 2-Year National Diploma (ND) and 2-Year Higher National Diploma (HND); OR (iii) Terminal 3 Years Teacher Training Leading to the National Certificate of Education - NCE; OR (iv) Terminal 1 or 2-3 or 4 Years Monotechnic vocational Training in Agriculture, Co-operatives, Nursing, Surveying, etc. leading to ND or HND or Certificate.	**(3)** Terminal University/ Technical University preparatory school degree or Master certificate - 3 Years of Technical University programme; OR 4 Years (or longer) University Training	**(3)** 4 Year (or longer) Bachelor's Degree programme
(4) Post Graduate Training structured mainly into Masters and Ph.D Degrees	B Doctoral Degree Training	**(4)** Strong Graduate Training leading to Master and Ph.D Degrees

Source: Compiled from:
Blueprint for the Nigerian National Policy on Education (1979); Dike (1997).

The reform of the Nigerian education system in the late 1970s saw the adoption of a universal 6-3-3-4 system for the whole country in place of the disparate system operated by the regional educational system. The new system involved a uniform 6-year Primary School education, followed by a 3-year Junior Secondary School, a 3-year Senior Secondary School and a 4-year Tertiary (University) education. The Nigerian National Policy on Education (1981) refers.

The novelty in the system is the diversification of the secondary school curriculum to include Vocational Training Schools VTS - alongside the conventional Grammar School and Commercial Courses. The Vocational Training Schools (VTS) are geared towards providing skills, shopfloor workers to the secondary economic sector particularly and in many ways exist alongside the traditional apprenticeship system in the urban informal sector briefly discussed below. Unfortunately, the VTS. have suffered neglect, receiving neither the patronage of students nor the envisaged financial support from the government (see Tables 3.2. and 3.3).

TABLE 3.2: Nigerian Educational System; Primary, Secondary, Technical and Vocational Education; Number of Schools and Students Enrolled in 1980

Type of School	No. of Schools	% of Total Schools	Total Enrolment	% of total Enrolment
Primary School	36,683	88.7	19,589,875	90.3
Secondary School	4,495	10.9	2,010,458	9.3
Technical and Vocational	159	≈ 0.4	73,920	0.4
Total	41,227	100.0	21,674,253	100.0

Source: Moddibo and Abba (1987); In "Nigerian Alternatives".

TABLE 3.3: Trends in Educational Enrollments in Nigeria ('000) - 1963 – 1993

Year	Primary	Secondary			Tertiary		
		Grammar/ Commercial	TTS	VTS	Polytech.	COE	University
1963	2,896	251.5	na.	na.	na.	na.	5.1
1965	2,911	252.7	30.9	12.6	na.	na.	7.7
1970	3,515	310.0	32.3	13.6	na.	na.	14.5
1976	8,836	704.9	123.6	na.	17.7	28.5	39.9
1978	10,225	1,503	na.	na.	na.	na.	53.0
1988	12,690	2,723	275.2 (1984)	72.1 (1984)	51.2	67.8	161.0
1990	13,607	2,901	108.8 (1987)	1.4 (1987)	60.4	92.7	179.5
1992	14,805	3,600	na.	na.	na.	70.6	224.9
1993	15,870	4,032	na.	na.	na.	na.	na.

NOTES:
TTS = Grd. II Teacher Training School;
VTS = Vocational Technical School;
COE = College of Education;
Polytech. = Polytechnic

Sources: Compiled from FOS (1994).

Available information from the above tables showed that of a total of 3.01 million (Table 2.3 refers) secondary school enrollment in Nigeria in 1992 (with significant improvement on 1980 enrollment) less than 1%, followed the Vocational Training School track. Moreover, existing studies dating from the 1970s indicate that the bulk of educated manpower including engineers and science and technical manpower in Sub-Saharan Africa (SSA) is concentrated in Nigeria where the number of university faculties and postgraduate programmes far exceed that of any sub-saharan African country - (see Eisman, 1979; Wad, 1984). Nevertheless, Nigerian educational system has not produced the right mix of science and technical (S & T) manpower. A government sponsored study on this problem had concluded that;

> "Science-based courses in our institutions of higher learning have not significantly increased in spite of recent establishment of universities of Technology and other tertiary institutions," (NMB, 1986).

The NMB study just cited above found that although Science and Engineering enrollment almost doubled their shares in total university enrollment, from 23% to 43% between 1988 and 1991, the enrollment for engineering/ technology alone remained more-or-less unchanged at 11 - 12%. Furthermore, the NMB study revealed that the annual output in graduate degrees (Masters and PhDs.) in Nigerian university system stood at 5,149 in 1988, increasing to 6,924 in 1991 of which about 10% and 6% respectively was in engineering in 1988 and 1991.

But the Nigerian educational system has evolved since the 1980s particularly in context with a series of severe limitations:

(a) declining budgetary allocation in real terms (₦1238m, 1980; ₦823m, 1985; ₦449m, 1987);

(b) deteriorating standards in physical infrastructure, including laboratory facilities, classroom space, etc.;

(c) dearth of relevant textbooks, journals, etc.;

(d) dis-satisfaction and declining morale among academic staff and students like, which has often led to massive brain drain from the educational sector and (on the part of student) violent confrontations with the State Authorities, leading to prolong closure of tertiary institutions;

(e) weak university- industry linkages, which undermine corporate financial assistance to the educational sector.

In the United States of America, there is strong emphasis on graduate training at the Ph.D level with emphasis on acquisition of research expertise. Besides, there exist strong university-industry linkages, which provides both private sources of funding university-based R & D, and exchange of knowledge. In East Africa, there is strong development of human capital oriented toward science and engineering and emphasis on vocational education (Pack, 1993).

It is important to note that, current educational norms and practices in Nigeria educational system have evolved from decades of interactions with

Europeans and North American educational institutions and establishments particularly those of the United Kingdom and the United States of America. The bulk (about 80%) of academic manpower in Nigerian university faculties received their university education in these two countries.

3.3 INFORMAL CHANNELS OF SKILLS' ACQUISITION

There is the need to go beyond the formal educational system and skills acquisition mechanisms to be able to appreciate the problem of Nigerian human capital formation processes. Specifically, it is necessary to briefly highlight those skills training institutions and outfits located within the Nigerian economy:

(a) Urban Informal-sector Apprenticeship System:

This is a popular mechanism for providing technical and vocational training in the Nigerian economy. Skills acquisition in the urban informal sector is through the apprenticeship system. Here, the trainee-apprentice is attached or attaches himself/herself to a Master-Craftsman for a stipulated length of time and absorbs the specific skills through a mixture of formal instructions, observations, learning-by-doing, etc. An apprentice could compensate their masters by paying a stipulated fee; by spending far longer period than normally required in the particular trade and receiving no compensation from their masters during this period and or accepting wages less than the ruling wage rate, etc.

Besides, within the informal economy there exist vocational schools providing skills training in secretarial services, word processing and computer programming, accounting, hotel management, etc. This type of skill training institutions has proliferated since the 1980s, as individuals retrain to fit into the economic structural adjustment context emphasising self-employment.

(b) **Private Corporate Training:**

Unfortunately, little quantitative data exist in this area. Nevertheless, it is common knowledge that the large private firms in the modern sector, including the erstwhile colonial merchant firms, e.g. United Africa Company (UAC), John Holt, etc.; the manufacturing multinationals; e.g. Lever Brothers, Nestle, Michelin, etc.; the construction firms, e.g. Julius Berger, and, of course, the oil firms, e.g. Mobil, etc., all maintaining in-house training schools.

In a study of the Nigerian Breweries, Akpakpan (1985) reports that firms have run specialised in-house training courses in grain washing, filtration and boiling, laboratory operations in quality control and quality checking, maintenance engineering, etc.

Within this mechanism is a national Quota Immigration Policy on skilled foreign workers which is a notable restriction against skill transfer and acquisition in Nigeria. Firms are allocated specific number of foreign workers - mostly experts - that can be brought into Nigeria for their respective business operations.

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(c) **Government-sponsored Skills Training Programmes:**

There are various vocational and technical schools/centres/programmes running as in-house training outfits for government ministries and departments offering specialised technical training. Amongst various innovations mounted by the Nigerian government are the following institutions:

(i) The Industrial Development Centres (IDCs):

These centres were established in the 1960s under the aegis of the Federal Ministry of Industries to offer skills training and technical services to small-scale entrepreneurs as well as bridge technical know-how and management skills gaps found among Nigerian small-scale enterprises. Management services offered range from training in production planning and organisation, marketing and accounting, technical services on design and improvement of products, repairs and maintenance of machinery and technical advice on selection of projects.

(ii) The National Directorate of Employment (NDE):

This outfit was established in 1986 as a child of the Nigerian structural adjustment programme. Among the four programmes of the NDE is Vocational Skills Development (VSD), which involves among other things, an open apprenticeship scheme aimed at equipping un-employed youths with skills to enter the job market or else set up self-employment. In 1994, 106,094 trainees were reported to have benefitted from the VSD scheme (CBN, 1994).

3.4 RESEARCH AND DEVELOPMENT (R & D) IN THE NIGERIAN ECONOMY

Nigeria's national expenditure on R & D is not easy to document, precisely because of its fragmented nature. The data presented in this work refer mainly to public-sector R & D expenditure. However, overall Nigeria's R & D expenditure presently averages less than 1% of G.D.P., (see table 3.4.).

TABLE 3.4: R & D Expenditure and S & T Manpower Indicators for Nigeria and selected NICs

	Nigeria	Taiwan	S.Korea	India	Brazil
R&D expenditure % GDP	0.5 (1965-85)	1.04 (1986)	1.9 (1987)	0.9 (1984)	0.7 (1984)
R&D in productive sector % GNP	1.7[a] (1994)	0.7 (1986)	0.2 (1984)	0.2 (1984)	0.2 (1984)
No. of scientists and engineers involved in R&D, per ml population	100 (1992)	0.7 (1986)	1,283 (1986)	132 (1985)	256 (1980)

[a] Refers to R&D as % of gross fixed capital investment in manufacturing.

Sources: For Nigeria, CBN (1994, p.83), Oyelaran- Oyeyinka et al (1995) and Boutsev and Fage (1987). For the rest, Lall (1991), and Mowery and Oxley (1995).

In the paradigm catching-up Newly Industrializing countries (NICs) of East Asia namely Taiwan, South Korea, etc, where government R&D - firm linkages are far better developed than in Nigeria, the R&D expenditure - GDP ratio measure quite favourable with the level achieved in the 'O.E.C.D.' industrialised countries. In the latter, the ratio is of the range 1.5% - 2.8% (Nelson, 1993; Dike, 1997).

The importance of Research and Development (R&D) in enhancing productivity has generated enormous literature (Oyelaran, et al, 1995; Nelson, 1993; Lall, 1991; Boutsev and Fage, 1987; Dike, 1997; Mowery, and Oxley, 1995). The role of R&D is to generate new technologies, therefore, efforts in this direction are likely to be positively correlated with growth in total factor productivity (TFP) than in increasing capital intensity.

With the requisite R&D efforts, nations will find it easier to imitate the technology they face in the world market through trade and or foreign direct investment (FDI). R&D capability will promote national ability to produce new products and innovate production processes appropriate to the economy.

3.4.1 **Human Capital and R & D in Nigeria**

While not foreclosing that there might have been other negative influences on Nigeria's negative TFP from 1970 - 1990, (Table 1.1 refers), such as the nature of the market and industrial environment which are not focussed in this study, we asserts that the roles of education and R&D can not be over-emphasised. The role of education as a key factor in technological accumulation has been widely analysed in current studies. The World Bank summarised the role of education as follows:

> "Education affects productivity and growth through several channels. A better educated person absorbs new information faster and applies in familiar inputs and new processes more effectively... In the dynamic and uncertain environment of technological change, more highly educated workers have a big

> advantage..., if farmers had an additional year of schooling, it increased their profitability of adopting modern farm technology..." (World Bank, 1991, p.57).

The above analysis therefore, does indicate that, (a) low human capital accumulation, and (b) low R&D capacity might provide some explanation for Nigeria's low TFP growth.

3.5 PRICING IN THE NIGERIAN LABOUR MARKET

Wage is to labour as price is to commodity. The Nigerian labour market, where human capital is traded, reflects a clumsy pricing system. McConnel et al (1986) assert the theory that, Qualifications, Cost of Living, Job hazards, Mobility, etc. are factors considered for determining the wage to be paid to worker(s). In Nigeria, most wage determining factors are tenuously and or discriminatorily applied. The situation is exacerbated by an apparent glut (of unemployment) in the labour market.

From the colonial period, there has been a clear bias against technically-trained manpower as regards market pricing particularly in the dominant public sector. Until early 1980s, a University-trained graduate starts work in the public sector on Government Salary Scale -GL.08, while a Polytechnic-trained (HND holder) was placed on GL.07. However, this disparity was corrected before mid 1980s. Even at present, there are still traces of wage discrimination in the Nigerian labour market (see Table 3.5).

TABLE 3.5: Contrasting Colleges of Education/Technology Teachers' Salary Structures

NIGERIA – EUSS/YR. SCALE AS FROM 1990 (For Only Teachers in Colleges of Education and Polytechnics)			JAPAN - AVERAGE MONTHLY STARTING SALARY BY EDUCATIONAL QUALIFICATION	
Salary Scale	**University-Trained Lecturers**	**HND – Polytechnic-Trained Instructors only**	**Teacher Qualification**	**Monthly Salary (YEN)/Month as of July, 1987**
EUSS SCALE	POST	POST		(YEN)
07	Assistant Lecturer	Higher Instructor	Junior College Certificate	166,000
08	Lecturer III	Senior Instructor	Bachelor's Degree	196,400
09	Lecturer II	Principal Instructor II	Master's Degree	232,900
11	Lecturer I	Principal Instructor I	Ph.D	281,500
12	Senior Lecturer	Assistant Chief Instructor		
13	Principal Lecturer	Chief Instructor		
14	Chief Lecturer	-		

* Almost same for University teachers.

Note: Heads of Department (H.O.D), Deans/Directors and Provosts must be selected or elected from the Lecturers' Cadre.

Source:
(a) Scheme of Service for Staff in Nigerian Polytechnics and Colleges of Education - The Federal College of Education (1990).
(b) Kazuo, I. (1992), School Education in Japan.

From the above table, apart from wage, other conditions of service like career advancement, unit or establishment leadership are tilted (Notes below Table 3.5 refers) away from the Nigerian Polytechnic/VTS-trained (S&T) manpower. Contrasting the Nigerian situation with that of Japan, Kazuo (1987)

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- Table 3.5 refers -, particularly on wage, the Nigerian S&T manpower in recent past appeared being discriminated against with a different designation title and demoralising career advancement in a significant part of the labour market, i.e. the public sector. This situation, already being checked, was adversely affecting the required production of Science and Technical manpower for the Nigerian economy.

CHAPTER FOUR

4.0 NIGERIAN ECONOMY - SECTORAL APPRAISALS

4.1 AGRICULTURAL SECTOR

This was the leading sector in the Nigerian economy till 1970 contributing about 70% of the country's GDP. The sector is characterised by peasant/subsistence based low output owing to absence of modern technology. Simply, production is not mechanised as most of the farmers are peasant illiterates with little or no access to capital and thus modern technological machineries. However, technology has made some remarkable impacts particularly as regards cash exportable crops like Cocoa, and Rubber and some staple food items such as rice, cassava, yam, etc.

As far back as early 1950s, Research Institutes were established primarily for most of agricultural products stated above to make researches and develop new production techniques and matching equipment as well as high yielding and pests resisting seedling varieties. From Dike's (1991) analysis, out of Nigeria's public sector twenty-six (26) Research Institutes, fifteen (15) are agriculture oriented.

Technology progress that could have been highly recorded from the efforts of the Research Institutes is being rendered insignificant because most

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of population who are illiterate peasant farmers cannot afford the capital-intensive new production skillful techniques. However some of them are embracing high-yielding and pests resisting seedling varieties of crops with other inputs of fertilizers, herbicides, etc. on their small farm holdings.

4.2 MANUFACTURING SECTOR

The manufacturing sector of the Nigerian economy serves as a good testing ground for the applicability and adequacy of both foreign and local technology. The sector features low technological progress, imports dependency for capital and raw materials and low capacity utilization, all reportedly decreasing output growth from 1.02% in 1996 to 0.72% in 1997 (FGN, 1998 Budget). Owing to these structural problems, Dike (1991) reports that the sector's employment generation rate was about 6% in 1985 and has been declining to date. The sector thus poses a liability to the Nigerian Human Capital. Remarkably, some efforts are being made to address major problems of raw materials and capital development and or sourcing. These efforts include;

(i) the establishment of a Nigerian Raw Materials Development Council;

(ii) the establishment of local engineering design and fabrication centres called the Industrial Development Centres (IDCs) across the country;

(iii) the establishment of industrial research outfits, such as FIIRO, and PRODA; and

(iv) the establishment of yet to be completed Iron and Steel Complexes

across the country.

For the Nigerian manufacturing, the desired journey forward is just to start.

4.3 MINING SECTOR

Since 1970, the Nigerian economy's mining sector took over from the agricultural sector as the most leading economic sector. The sector has since then been contributing about 70% of the country's GDP. Mining started in Nigeria long before independence and to date with commercial exploitation of tin, coal, columbite with high concentration on petroleum since the late 1960s. The sector is also featuring high and sophisticated capital-intensive operations of very high technology. Technology as regards the Nigerian mining sector is a suspect and may not be helpful as to utilization of the country's human capital. Most non-energy solid minerals e.g. Gold, Kaolin, etc are yet to be fully exploited as sophisticated technology needed for commercial exploitation can only be sourced through foreign investment that are still being invited. Mining produces non-energy and energy minerals and Nigeria is blessed with lots of former with estimated reserves of about 16 billion barrels of crude oil, 3-trillion M^3 of natural gas, 2.5 billion tonnes of Coal and yet to tap 11,000 Mega Watts of hydropower within the energy mineral blessings of Nigeria (Sambo, 1992).

From the above sectoral analysis, it is clear that the Nigerian economy requires appropriate technological changes and sophisticated human capital

that will transform all the sectors. There is the urgent need of reversing the very low TFP of the Nigerian economy to that of rising positive indices, through a continuous improvements in the generation and utilization of Nigeria's human capital.

CHAPTER FIVE

5.0 THE NIGERIAN NATIONAL SYSTEM OF INNOVATION (THE NIGERIAN N.S.I.)

5.1 INTRODUCTION

From the previous chapters on the Nigerian economy, it is easy to describe a Nigerian National System of Innovation. A national system of innovation as defined above (chapter two) relate all institutional and structural elements dynamically so as to effect positive changes of the initial endowment of productive resources within the economy. Institutions, structures, policies and learning processes are vital elements of a national system of innovation towards technological progress.

Notable Nigerian economic structures (Agriculture, Manufacturing, Mining, etc.) appear to be operating outside syncronised networks (industrial or knowledgeable networks, Gelsing, 1992) - as each sector seemed isolated. Government's relationship with economic sector is remarkably strong as regards revenue generation through various taxes but tennous as to policies design and implementation e.g. Nigerian Banking Inspection Policies as related to increasing number of distressed banks in the economy through poor enforcement of its supervision of banks provision. These suggest that most government policies remain as paper tigers. Another policy example is the Nigerian Industrial Policy on Research.

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Research and Development (R&D) efforts are vital learning processes for realising technological accumulation. These efforts should criss-cross the boundaries of the public and private sectors of the economy. In Nigeria, R & D appears to be the public sector affairs, as firm(s) in-house or joint research works are rare despite the Nigerian Industrial Policy provisions on linkages, manpower development, technical development and particularly the offer that expenses on R & D are tax deductible, (Lambo, 1987). Little is known of R & D contacts between Nigerian universities and private businesses in the economy. For instance, universities R & D on a Nigerian Car and Alternative Energy are solely being financed by government , while R & D results gather dust on laboratory and workshops shelves with engineering prototypes shunned by firms for commercialization.

Technological accumulation or technical change can only be acquired through a well-planned learning process. In this regard, the economy's educational institutional system forms the foundational basis for knowledge - skill endowment building later fully developed by university and on-the-job research and development activities. However, the Nigerian educational system is plagued with policy focus and implementation problems from primary to tertiary levels resulting in a very low production of science and technical S & T manpower. Even the few S & T manpower in the Nigerian labour market appeared being unused or underused.

The Nigerian economy produces a lot of low technology-based consumer goods. Capital and high-technology based products are yet to be quantumly produced. Moreover, the external sector of the economy is more of importation than exportation. The economy exports minerals - mainly petroleum and some primary products. Negligible manufactured goods are being exported. Also, the Nigerian economy, however, exhibits a high contribution of Foreign Direct Investment when compared to the low FDI -GNP contributions in Newly Industrializing Countries of Asia (see Table 5.1 below)

TABLE 5.1: Contribution of Foreign Direct Investment (FDI) in Nigeria and selected NICs 1989 - 1993

Country	1989	1990	1991	1993	1993
NIGERIA:					
FDI (Net)-US$ ml.	1,882	588	712	897	900
% GNP	6.6	2.3	2.3	3.2	2.8
BRAZIL:					
FDI (Net)-US$ ml.	1,267	901	972	1,454	802
% GNP	0.3	0.3	0.2	0.4	0.1
SOUTH KOREA:					
FDI (Net)-US$ ml.	758	715	1,116	550	516
% GNP	0.3	0.3	0.0	0.2	0.0
INDIA:					
FDI (Net)-US$ ml.	252	238	141	151	273
% GNP	0.0	0.1	0.1	0.1	0.1

Source: World Debt Tables, 1996, vol.2.

It is remarkable that a low percentage of Foreign Direct Investment (FDI) to GNP suggests, the generation of indigenous innovative entrepreneurial skills and ability for the concerned growing economy. From this position therefore, we are of the opinion that, Nigerian's quest to more FDI may be an over-expectation and may undesirably be weakening the country's national system of innovation, if it has taken root at all. Periscoping through the Nigerian economy, it seemed that, the Nigerian National System of Innovation - N.S.I. - is caged.

To clear out suspicion, a brief quantitative analysis of the Nigerian economic growth with the impact of human capital and technological accumulation from which an empirical Nigerian national system of innovation derived is presented below

5.2 A DERIVED NIGERIAN NATIONAL SYSTEM OF INNOVATION

A recapitulation of all the above observations lead us to derive a National System of Innovation (NSI) for the Nigerian economy for the whole period studied, 1975 to 1996, as shown in Table 5.1 below.

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TABLE 5.2: Derived National System of Innovation for Nigeria (1975 - 1996)

R & D as a ratio of GDP	Below 0.5 percent of GDP
R & D Bases	Most R & D activities are at the public sector level, as much as 97 percent. Many firms depend on R & D by parent firm(s) overseas. Privatisation of businesses is just been encouraged.
Level of Technology	Very low. Heavy dependency on technology transfer through Foreign Direct Investment (FDI). FDI. withered under Structural Adjustment Programme (SAP).
Human Capital Formation and Utilization	Low development of human capital formations in science and engineering. Low and weak R & D linkages between firms, academia, and between the public and the private sector. Collapsing human capital infrastructures. Low research funding by industry and R & D results poorly diffused.
International Exposure	Depends heavily on export of crude petroleum and imports of consumer goods with insignificant effects on national technological capabilities and progress

Source: Compiled by the author through chapters 3, 4, and Dike (1997).

The above derived national system of innovation - NSI - for Nigeria (see Table 5.1) is undesirable. A needed reversal necessitates a big carefully packaged and managed investments into both physical and human capitals, set on realistic targets to generate innovative, and creative pool of entrepreneurs as well as a very high productivity of all factors of production. Dike (1991) puts the foregoing succinctly thus;

> "The fact is that as from mid 1970s, Nigeria had made a transition from the kind of low investment rate characteristic of Third World economies to the much higher investment rates typical of the developed industrial countries without, however, acquiring the technological and socio-economic pre-requisites to permit efficient management of this high investment rate" p.219.

In spite of a poor derived national systems of innovation - NSI - above, we also observed that, the Nigerian economy exhibits a potentially good and positive link with research and development (R & D), represented by letter R in the specified model below. Within the studied periods, a ten per cent increase in R & D expenditures affected the growth of the economy positively by a contribution of between three to five per cent. This predictively implies that with more emphasis on science and technological education along with research and development activities in all sectors of the Nigerian economy, a technological accumulation direction path would have been charted based on educated/skilled/healthy human capital towards a rapid economic growth for Nigeria.

Another implication from the above derived Nigerian NSI and particularly from its research and development - R & D - perspectives is its link with the physical capital stock as specified in the endogenous growth theory. It is observed that the foreign physical capital stock (ZF/Y) is deeper in the Nigerian economy than the domestic physical capital stock (ZD/Y). Equations 6.9 and 6.10 refer.

This implication reinforces current ideas in economic development literature, (see Chapter 5 above), and accepted in some newly industrializing countries, e.g. Brazil, India, and South Korea that, foreign direct investment (FDI) should not be over-expected if the economy is to generate much needed

technology, entrepreneurial skills as well as innovative activities for a sustainable economic growth. However, there is need for caution as Iyoha (1998) opines that, a developing country like Nigeria must not wave off FDI because her domestic saving capacity is very low.

CHAPTER SIX

6.0 MODEL SPECIFICATION AND REGRESSION RESULTS ANALYSIS

6.1 INTRODUCTION/GROWTH TREND OF THE NIGERIAN ECONOMY

In this study, three distinct phases 1975 - 1996; 1975 - 1985; and 1986 - 1996 were highlighted through a Time Trend analysis of per capita real GDP. The time trend regression results are 0.4%; 0.3% and 0.9% respectively for study phases periods examined. Appendix A refers.

The time trend as estimated reflects an unstable and declining trend (Dike, 1991 estimated 1.005t) of the Nigerian economy. This implies as Dike puts it, a long-run declining growth tempo. Why is the Nigerian economy unstable and seemingly declining despite abundant human and material resources?

6.2 MODEL SPECIFICATION - Regression Analysis (Endogenous Growth Approach) Model

Technological transformation in developing countries is generating a lot of interest among economists of all persuasions. Area of controversies has been what factors are responsible for observed differential rates of technological development among the less developed countries (LDCs). The controversy has led to a theoretical shift, as it were, from exogenous to endogenous economic growth theories of explaining technological change.

Greenlight of the new growth theory was kindled by earlier studies of Arrow (1962) and Uzawa (1965). Developed further by Romer (1986) and Lucas (1988), the endogenous growth economic theory identifies investments in education, health, research and development (R &D), government policies in the form of taxes and subsidies as well as stock of capital as influential factors for effecting technical change which leads to technological accumulation. The theory conditions an economy's catching-up or convergency growth efforts on the speed and quality of its technological accumulation.

Out of numerous variants of the endogenous growth theory models, the one that appears relevant and adequate to this study was developed by Grossman and Helpman (1991). Dike (1997) refers. The theory model variant emphasised that sustained economic growth comes from endogenous steady of improvements in intermediate inputs as captured in the following linear production function:

$$Y = Z^{\alpha}, E^{ß}, R, (AL)^{1-\alpha-ß-} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad 6.1$$

where:

Y is the real national output, Z, E, and R respectively are the aggregate stocks of physical, human and technological capital (i.e. R & D investment) L and A respectively are the size of the national labour force and the productivity index which summarises the state of the technical knowledge in the economy.

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From the Grossman-Helpman endogenous technological growth model specified above in equation 6.1, we discovered a missing variable vital for explaining technological economic growth of the LDCs. Equation 6.1 lacks variable that explains or captures the role of the economy's external sector. No economy is an island unto itself.

Many studies (Baranson, 1981; Dike and Ihuoma, 1993; Amsden and VanderHoven, 1996; Kokko et al, 1996; etc.) identify an economy's external sector as the channel through which foreign direct investment (FDI), capital and intermediate inputs all in form of 'inward' technology transfer are injected into the economy. Thus, apart from the external sector variable, the physical stock of capital is also divided into domestic and foreign types of capital stocks.

With equation 6.1 above augmented and expanded, the new endogenous technological growth model will take the following modified OLS linear form:

$$Y = f[ZD, ZF, E, R, M, (AL), U] \quad \text{.....} \quad 6.2$$

Equation 6.2 linear regressable form:

$$Y = ß_0 + ß_1ZD + ß_2ZF + ß_3E + ß_4R + ß_5M + ß_6(AL) + U \quad \text{.....} \quad 6.3$$

where;

Y = the real national output, i.e, the GDP;

ZD = national domestic capital stock;

ZF = national foreign capital stock;

E = national stock of Human Capital, proxied by investments on education and health;

R = national Research and Development investment;

M = national import volume;

A = productivity index - explained below;

L = size of the national labour force;

U = the error term;

$ß_0$ = the regression intercept or constant term; and

$ß_1$ - $ß_6$ = regression coefficients expected to measure the relative elasticities of variables, and all expected to be positively signed.

As regards parameter, 'A', the productivity index, we will assume that, it is a function of the existing total national capital stock per worker, which will be calculated as the sum of ZD and ZF divided by the employed labour force, so that,

$$A = \Theta \frac{ZD + ZF}{L'}, \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad 6.4$$

where,

L' is the working population, Heertje (1977). This parameter measures the degree of efficient use of total capital stock available in the economy. It is a concept from Arrow's and others postulations of learning-by-doing and knowledge (= technology) spillovers arising from the efficient utilization of the

total human capital available for production activities in the economy.

The model linear estimation in the above equation 6.3 takes the following logarithmic functional form:

$$\ln Y = \ln\beta_0 + \beta_1 \ln ZD + \beta_2 \ln ZF + \beta_3 \ln E + \beta_4 \ln R + \beta_5 \ln M + \beta_6 \ln(AL) + \ln U \quad \ldots. \quad 6.5$$

where;

all variables are as defined and specified in equation 6.3 above.

Equation 6.5 above will be programmed, run, and tested on full study period of 1975 to 1996, and on study sub-periods of 1975 to 1985, and 1986 to 1996. These equal sub-periods represent distinct eras in Nigeria's technological development as they are characterised by notable and remarkable events and policies that appeared influential on the country's macroeconomic settings.

The model clearly specified and analysed below was used to test the propositions in section 1.5 above. It was used to assess the roles or impact of human capital and technological accumulation on Nigeria's economic growth for the period 1975 - 1996. This broad division covers the period of economic boom and crisis in Nigeria. The time series data was used and Y/P_t denotes observed annual growth rates of per capita real GDP.

6.3 REGRESSION VARIABLES EXPLAINED

As specified in our model (6.3) above and buttressed by recent economic development literature, the followings are amongst notable structural variables in the long-terms economic growth performance of developing countries, namely;

(a) Capital stock - both domestic and foreign;

(b) Human Capital formation through expenditures on education, health and nutritional matters, all representing the pace of technological change;

(c) Research and development which represents investments towards technological progress through innovations; inventions; and diffusion;

(d) Import volume reflecting the economy's degree of openness; and

(e) The size and productivity of the labour force. All these are independent variables.

It is postulated that growth in variables (a), (b), (c) and (e) enhanced long-term economic growth performance but variable (d) undermines or tend to hinder that growth process.

The dependent variable used was the real per capita (Y/P_t), derived through the real gross domestic product, GDP. The value for real gross domestic product was obtained by deflating nominal gross domestic product against the appropriate consumer price index.

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To estimate the parameters of the model aside from the economic growth time trend analysis above, the Ordinary Least Square method was used and analysed through the logarithmic functions.

6.4 THE ESTIMATED RESULTS

Empirically, the Nigerian data used (Appendix C and D refer) yield the following results:

(a) **The Estimated Results (Linear Functional form)**

(i) **Period, 1975 to 1996**

$Y/P_t = 3.19 + 1.30ZD/Y + 0.78ZF/Y - 0.06E/Y + 0.32R/Y - 0.02M/Y - 1.19(AL)$

(1.18) (2.06)* (2.44)* (-0.44) (2.22)* (-0.232) (-1.43)

..... eq. 6.6

$R^2 = 88.0\%$ D.W. 1.93

NOTE: t-values are in parenthesis

* Significant at 5 percent level

(ii) **Period, 1975 to 1985:**

$Y/P_t = 1.90 + 2.99ZD/Y + 1.18ZF/Y + 0.09E/Y + 0.37R/Y - 0.29M/Y - 3.14(AL)$

(0.39) (1.59) (1.37) (0.65) (1.62) (-0.66) (-1.46)

.... eq. 6.7

$R^2 = 90.4\%$ D.W. 1.41

NOTE: t-values are in parenthesis

(iii) **Period, 1986 to 1996 -**

$Y/P_t = 6.64 + 0.36ZD/Y + 0.59ZF/Y - 0.63E/Y + 0.72R/Y - 0.17M/Y - 0.18(AL)$

(1.22) (0.54) (1.15) (-1.99) (2.04)* (-0.44) (-0.38)

..... eq. 6.8

$R^2 = 55.6\%$ D.W. 2.07

NOTE: t-values are in parenthesis

* Significant at 5 percent level

(b) **The Estimated Results (Log. Functional form):**

(i) **Period, 1975 to 1996**

$Y/P_t = 5.04 + 0.29ZD/Y + 0.31ZF/Y - 0.14E/Y + 0.28R/Y + 0.02M/Y - 0.09(AL)$

(10.40) (2.24)* (2.82)* (-2.44)* (2.68)* (0.49) (-0.38)

.... eq. 6.9

$R^2 = 91.7\%$ D.W. 1.91

NOTE: t-values are in parenthesis

* Significant at 5 percent level

(ii) **Period, 1975 to 1985 -**

$Y/P_t = 6.93 + 0.84ZD/Y + 0.45ZF/Y + 0.06E/Y + 0.48R/Y - 0.17M/Y - 0.88(AL)$

(5.26) (1.54) (1.12) (0.76) (1.64) (-0.67) (-1.10)

..... eq. 6.10

$R^2 = 93.6\%$ D.W. 1.77

NOTE: t-values are in parenthesis

(iii) **Period, 1986 to 1996 -**

$Y/P_t = 3.58 + 0.22ZD/Y + 0.33ZF/Y - 0.32E/Y + 0.32R/Y - 0.09M/Y - 0.33(AL)$

(3.83) (1.85) (3.11)* (-3.55)* (3.11)* (-1.03) (-1.02)

..... eq. 6.11

$R^2 = 86.0\%$ D.W. 2.32

NOTE: t-values are in parenthesis

* Significant at 5 percent level

6.5 TESTS OF THE HYPOTHESES

The linear estimated results - equations 6.6, 6.7, and 6.8 are not all that different significantly from the logarithmic estimated results of equations 6.9, 6.10 and 6.11, except as regards, dominance of domestic capital stock - equation 6.6. refers -, insignificant position of human capital as a predictor - variable in all the linear results and the tenuous positions of all explanatory variables in the equation for 1986 to 1996 period. On the whole, and as stated in 6.3 above, equations 6.9, 6.10 and 6.11 will be primarily used for hypotheses testing, findings and analytical discussion.

For 1975 to 1996 period, equation 6.9 was used for testing the hypotheses in section 1.5 above. The capital stocks, human capital formation, and research and development coefficients (0.29; 0.31; -0.14; 0.28) are strong and significant at 5 percent level. However, the coefficients of import volume and labour productivity (-0.02 and -0.09) are weak and insignificant as well as both negatively signed.

Both domestic and foreign capital stocks as well as R & D are strongly and positively linked to the dependent variable. For example, a 10 percent increase in total physical capital stocks (i.e. investment) in the Nigerian economy may predictively increase Nigerian per capita income by about 5 percent. Notably, though human capital displays a significant effect on the growth or otherwise of the dependent variable the real per capita Y/P_t, it actually reflects a negative impact on the economy for this period. For instance, a 10% increase in human capital formation expenditures (i.e. on education and health) decreases Nigerian per capita income by about one percent ((Eq. 6.9 refers). This implies that as more is invested on human capital in Nigeria, her economy gets less returns! Why?

That the impacts of import and labour productivity predictors are weak and insignificant (t-calculated, 0.49 and -0.38) are explainable and germane in this study. The positions of these variables could be explained by the severe economic depression in the Nigerian economy which curtailed its degree of openness to international trade, skills and knowledge acquisition through restrictions, and sanctions, as well as the negative impact of education which reflected adversely on labour productivity through inadequate funding of education in SAP and post SAP. Periods, resulting in poor acquisition of relevant skills and training.

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The validity of including these variables in this work is to use the findings to explain the relationship between human capital and technological accumulation, with the latter defined as the 'learning processes'.

Since most of the t-calculated (-2.24; 2.82; -2.44; 2.68, all in eq. 6.9) above for all physical capital stocks, human capital and R & D respectively are greater than t-tabulated of 2.08 at 5 percent level of significance, we accept all hypotheses in 1.5 above for the whole study period of 1975 to 1996.

Testing hypotheses for the period of 1975 to 1985 is through equation 6.10 above. The coefficients of all predictor variables except import volume and labour productivity are positively signed as expected but all are insignificantly weak statistically at 5 percent level. Remarkably, the coefficient of human capital formation is positive but very weak, i.e. insignificant. This implies that a 10% increase in human capital formation expenditures increases the Nigerian per capita income by 0.06%. This effect of human capital in the Nigerian economy for this period is very insignificant.

A change from negative to positive human capital posture could be attributed to massive investments on education and health particularly on physical infrastructure as afforded by the oil boom. Labour productivity is surprisingly negative with its coefficient at -0.88 and also insignificant. The implication here is that investment in physical capital stocks and even human

capital did not effect a positive change in the work habit of the Nigerian labour force. Probably, this is a reflection of investments in non-capital goods, education with irrelevant, little or no skill and health with little preventive medical care.

For this study sub-period of 1975 to 1985, the t-calculated of 1.54; 1.12; 0.76; 1.64; -0.67; and -1.10, for each of the variables specified in eq. 6.10 above, is less than t-tabulated of 2.22 at 5 percent level of significance. Since all predictor variables behave statistically insignificantly, all hypotheses in 1.5 above as regards this period appear suspect, even if tenuous for the effects of the oil boom.

Tests for the period of 1986 to 1996 yield almost the same but statistically stronger results as for the whole study period of 1975 to 1996. For the tests on the hypotheses, equation 6.11 was used. The coefficient of foreign physical capital stock and R & D (0.33) and 0.32) are positively signed and significant. The coefficient of the domestic physical capital stock is or remain insignificant but positively signed. Empirically, the insignificant position of the domestic physical capital stock displays the realistic impoverisation of Nigerians owing to the pains of the economic structural adjustment programme put in place then. Notably, the position of foreign physical capital stock too appear suspect - its statistical insignificance in the linear eq. 6.8 above for the same period refers. Interestingly, Magbagbeola (1998) reports that FDI into Nigeria was US$417 million in 1975, dropped to a low level of US$166 million in 1986,

but ascended an all time peak of US$1,959 million by 1994. The elasticity coefficients of imports and labour productivity are not significant as imports was severely curtailed and job losses with low workers' morale prevalent in this period. Moreover, the coefficient for human capital (-0.32) though significant is negatively signed for reasons given above.

Therefore, that most of all the explanatory variables strongly linked to the dependent variable, i.e. change in Nigerian per capita income, and their t-calculated of 3.11; -3.55; and 3.11 for foreign capital stock, human capital and R & D respectively greater than 2.08 at 5 percent level of significance, we accept hypotheses as stated in 1.5 above.

The coefficients of determination particularly of equations 6.9, 6.10; and 6.11 are 91.7%, 93.6%, and 86.0% respectively. These show that in each of these periodical cases, more than 80% of the variations in the dependent variable were explained by the independent variables. Also, all the linear equations of 6.6, 6.7 and 6.8 satisfy our coefficient of determination criterion of more than 50% set in 6.5 above.

For each of the equations above, particularly eq. 6.9, 6.10 and 6.11, the Durbin Watson statistic are 1.91, 1.77, and 2.32 respectively. The Durbin-Watson statistic for equations 6.6 to 6.8 are 1.93, 1.41, and 2.07 respectively.

Since these results are close to 2.0, it indicates that the regressions

have no serial correlation.

6.6 OBSERVATIONS ON THE REGRESSION RESULTS

The pre-SAP period of 1975 to 1985 yields results which reject the advanced hypotheses with the elasticities of all the predictor variables appearing insignificant statistically at 5 percent level, and even if assessed at 10 percent level. These results seem controversial as the period is almost equally divided between the eras of economic boom and crisis. In the light of the results above, it implies that, the economic boom signals over-shadowed those of economic crisis. Dike (1991) characterised the period thus, 'in the 1970s... high growth rates in investment and employment, ... early, 1980s, ... the collapse of capital investment'.

In the 1970s, Nigerian economy's subsystem of capital goods sector with the establishment of steel and petro-chemical plant; human capital formation as the number of educational and health institutions sky-rocketed; the market expanded by population explosion; research and development enhanced with the establishment of the ministry of science and technology, PRODA at Enugu, FIIRO at Oshodi-Lagos and Industrial Development Centres, (IDCs); general infrastructure developed with large network of roads and bridges, as well as back-up policies on goods and factor markets, such as, liberalized imports licencing, Income and Productivity Board for labour wages control; and Nigerian Standard Organisation for production and marketing of quality goods and their

interfaces were released with feedbacks in the economy in terms of remarkable economic growth rates. For example, the World Bank (1993) reports, though declining but positive, the economic growth rate of 19.3, 9.2 and 6.8 for 1970, 1976 and 1979 respectively for the Nigerian economy.

As regards this period of 1975 to 1985, it could be safely said that human capital formation and technological accumulation for the Nigerian economy received a noticeable boost, though, insufficient for good returns. Technology was cumulated through what Dike (1991) describes as 'static and dynamic transfer' during the period. This again, we observe, validate the use of national import volume as an explanatory variable in the above specified model.

Considering the foregoings, the regression results for the pre-SAP period of 1975 to 1985, we observed, look good, satisfactory and acceptable. For the economic crisis (SAP) period of 1986 to 1996, the regression results show that domestic capital stock though positively linked to the dependent variable, is statistically insignificant at five and even ten percent level. Again, Dike (1991) confirms this results that, the Nigerian physical domestic capital stock collapsed as referred above. During this period, roads became death-traps, as most Nigerian roads could not be maintained, ports closed, numerous factories went dormant or closed as their capacity utilization remain under-utilized. Ariyo (1998) reports that capacity utilization in Nigerian manufacturing industry fell from 42% in 1987 to 29.9% in 1995. Also, during this period,

national savings slumped as most Nigerians became impoverished. There was a heavy economic break-down.

Generally, the regression results presented above fairly conform with the a priori expectation of the theories on economic development, however, Nigerian policy thrust on human capital formations (i.e. on education and health) appears very weak, hence, the negative impact on the Nigerian labour force productivity and weaker effect on per capita income.

Although labour productivity appears an undermining factor to the growth of the Nigerian economy for all the periods studied, it however, improved during SAP period of 1986 to 1996 from previous period's elasticity value of -0.88 to -0.33. This could be explained that despite education and health inadequacies, Nigerians shocked, traumatized with millions jobless from early 1980s faced challenges of life. By 1990, many Nigerians decided to go back to neglected Agriculture and or be gainfully self-employed in trades and commercial operations/occupations away from the wage-earning sector of the economy.

6.6.1 **Diminishing Returns on Education in Nigeria**

As shown in Table 1.1 in Chapter One above, Nigeria spent in the 1980s 4.4 percent of GDP on education with 0.1 percent of her population studying science and engineering. South Korea, a newly industrializing country (NIC)

spent 4.9 percent of GDP with 1.39 percent of her population studying science and engineering. This implies that Nigeria spends à lot of money on education in particular, but, she gets little or nothing as returns. This implication is confirmed by negative elasticity values for human capital in two of the periods' regression results above. Simply, the more Nigeria invests on education the less returns she receives in terms of education's contribution to the growth of the economy. Though the quantity is there, (Nigeria has the largest number of educational institutions in Africa), but the quality is questionable and seemed declining (World Bank, 1997). This observation is reflected in the above regression results by the negative productivity index (AL) of the Nigerian labour force.

The implication from this analysis could be that, the Nigerian human capital tends to be unproductive, 'as the skills acquired in schools (if any) do not match market opportunities' - World Bank, 1997. Remarkably, the Nigerian national educational policy (of 1981) coded 6-3-3-4 system of education was well packaged on paper, but poorly funded (and managed) and implemented.

CHAPTER SEVEN

7.0 SUMMARY AND POLICY IMPLICATIONS

7.1 SUMMARY, POLICY IMPLICATION, AND CONCLUDING REMARKS

The main objective of this empirical study is to shed more light on the impacts of some key economic variables on the economic growth of Nigeria.

To accomplish this, an endogenous growth theory model was specified and estimated by OLS. using data (Appendices C and D refer) for the period of 1975 to 1996. The regression results were quite satisfactory. Equations for all periods studied had adjusted coefficient of determination exceeding 85%. Hence, with the explanatory variables used, we are able to explain over eight-five percent of the systematic variations in the growth of the Nigerian economy.

Empirical study results show that physical capital, human capital and research and development are important determinants for an economy to grow. Notably, totalled physical capital stock and R & D elasticity for any of the studied period is not below 0.5 and 0.2 respectively. Human capital formation as represented by education/health elasticity is very low and for most of the periods negatively signed. In Nigeria, human capital is a weak economic growth determinant while technological accumulation through, physical capital stocks, and R & D appear as relatively strong determinant. Degree of

openness (represented by import volume) featured insignificantly, and labour productivity, we assume, negatively remains weak mainly due to variations in human capital.

The policy implication of our findings is not in doubt. If the objective is to move the Nigerian economy forward and significantly improve her industrial and technological capabilities, national educational/health policies that will strongly re-direct focus on science and engineering education as well as good health care and nutrition for a healthy, innovative and productive work-force are needed. Also, physical capital formation need to be strongly domesticated by a large pool of indigenous entrepreneurs in order to properly accumulate relevant technology through continuous local research and development activities.

These steps if properly taken will lead to the development of physical capital goods production base and markets which to date are very weak or even, not existing, as well as accumulation of appropriate technology.

We have, through the empirical analysis in this work traced the causal determinants of economic growth in Nigeria through the application of the endogenous growth theory to human capital, technological accumulation (through physical capital stock and R & D), degree of openness, and labour productivity. Finally, we are satisfied that the Nigerian empirical data is not inconsistent with a priori theoretical expectations and would be useful for future

analytical researches.

7.2 RECOMMENDATIONS

To effectively contain above policy implications and based on the analysis presented in this study, the following recommendations are considered necessary for short-, medium-, and long-term implementation.

Education apart from being well funded should be well managed and properly made functional with emphasis on science and technology for the acquisition of entrepreneurial skills and creativity. In this regard, we call for a thorough review of the Nigerian National Policy on Education towards expanding training of more scientists, engineers, doctors of medicine, and technicians to move the economy away from what Baranson (1981) describes as 'supervised operational roles to management research, design and engineering functions'. Moreover, educational funding should be carefully planned and implemented. A lot of 'adequate' fund go into Nigerian educational infrastructures and bureaucracy with very little into functional curriculum development as well as effective promotion of standards through good supervision (World Bank, 1997; Odusola, 1998).

Functional linkages should be developed between the academic communities (universities, etc), and the industries culminating in R & D.

contracts with full benefits to the economy. This should be a departure from the current practices of multinational companies funding few professional chairs in few universities, or occasional awards of scholarships, e.g. Nigerian United Bank for Africa -UBA PLC funding the M.B.A. degree of Finance at the University of Ibadan and annual awards of scholarship to Nigerians by the Nigerian Mobil Oil company.

To really promote research and development in the economy, the foreign direct investment (FDI) should not be over-expected for the emergence of indigenous industrialization backed by local researches and development efforts. Bell and Pavitt (1993) identify roles of firms, among others, in learning and developing specific production system as a feature of technological accumulation. Our idea of FDI is not to isolate the Nigerian economy from global economy (globalization), since the economy continues to enjoy the dynamic and static transfer of technology (Dike, 1991).

Baranson (1981) justifies this development strategy as follows:

> "A basic reason for acquiring technology from another enterprise (rather than one's own research and development) is that it is generally much cheaper and quicker, which is the reason why technology has become a 'commodity' in world trade", p.143.

Along this line, we recommend licensing, an element of technology transfer, for the Nigerian economy. The license is an agreement that specified

the conditions under which the recipient may employ the donor's technology. Additionally, economic managers should development more institutional capabilities to internationally search for, evaluate, select, negotiate for, assimilate, adapt, and generate new technology.

All the above may be difficult to achieve if Nigeria's domestic savings continue to be low. Savings should be mobilised to create investible funds. Solubo (1998) states, 'money follows money'. We add, low income results in low savings. For domestic savings to rise, Nigerians per capital income need go above poverty line. To achieve this, Nigerians should be encouraged to massively produce globally marketable products to move the economy from a mono-product (oil) based into a multi-product economy. A deliberate macroeconomic policy should also be adopted and implemented to encourage repatriation of flight capital estimated at nearly US$100 billion back into Nigeria (Iyoha, 1998). Nigerians are huge external savers, and so, they should patriotically repatriate these big capitals - through investment in Nigeria - back home to help develop Nigerian human capital and technological accumulation (Solubo, 1998).

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APPENDIX A

GROWTH TREND OF THE NIGERIAN ECONOMY (1975 TO 1996)

ESTIMATED REGRESSION RESULTS (LOG. FUNCTIONAL FORM):

(A) Period 1975 to 1996:

$$\text{Log } Y/P_t = 3.37 - 0.406 \text{ Time}$$
$$(24.41) \quad (-7.06)$$

$R^2 = 70.9\%$ D.W. = 0.77

(B) Period 1975 to 1985:

$$\text{Log } Y/P_t = 3.33 - 0.380 \text{ Time}$$
$$(18.76) \quad (-3.92)$$

$R^2 = 61.5\%$ D.W. = 0.67

(C) Period 1986 to 1996:

$$\text{Log } Y/P_t = 4.85 - 0.919 \text{ Time}$$
$$(5.13) \quad (-2.77)$$

$R^2 = 42.6\%$ D.W. = 0.69

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APPENDIX B

LIST OF OLS. REGRESSION MODEL VARIABLES

Y	Real national output, i.e. real GDP.
ZD	National domestic physical capital stock
ZF	National foreign physical capital stock
E	National human capital stock, proxied by national investments on education and health
R	National research and development (R & D) investment
M	National I Import volume
A	Productivity index
L	Size of the aggregate national labour force
(AL)	National labour productivity.

APPENDIX C

REGRESSION MODEL VARIABLES DATA

Year	Y/P_T (a)	ZD/Y (b)	ZF/Y (c)	E/Y (d)	R/Y (e)	M/Y (f)	(AL) (g)
1975	18.1	0.110	0.129	0.044	0.004	0.177	0.233
1976	18.1	0.178	0.126	0.045	0.004	0.192	0.329
1977	17.9	0.173	0.126	0.020	0.004	0.227	0.312
1978	16.4	0.145	0.127	0.028	0.004	0.235	0.283
1979	17.3	0.115	0.102	0.08	0.004	0.147	0.226
1980	18.2	0.146	0.082	0.032	0.004	0.183	0.228
1981	14.8	0.158	0.083	0.023	0.003	0.249	0.254
1982	13.7	0.123	0.089	0.023	0.003	0.196	0.224
1983	11.9	0.060	0.083	0.022	0.003	0.115	0.152
1984	9.2	0.032	0.054	0.014	0.003	0.071	0.092
1985	9.6	0.038	0.039	0.014	0.003	0.077	0.081
1986	8.7	0.074	0.027	0.016	0.003	0.083	0.107
1987	11.7	0.077	0.022	0.005	0.003	0.147	0.106
1988	9.7	0.025	0.061	0.016	0.003	0.127	0.091
1989	9.7	0.047	0.035	0.019	0.003	0.139	0.086
1990	10.2	0.042	0.077	0.014	0.003	0.177	0.124
1991	10.9	0.036	0.074	0.008	0.002	0.279	0.084
1992	12.5	0.040	0.067	0.006	0.002	0.263	0.111
1993	9.8	0.036	0.081	0.014	0.002	0.059	0.132
1994	8.0	0.018	0.075	0.008	0.001	0.177	0.099
1995	7.1	0.014	0.049	0.012	0.002	0.459	0.068
1996	5.9	0.016	0.055	0.014	0.001	0.305	0.076

Source:

(1) Columns (a) to (f) computed from various publications of the Central Bank of Nigeria - CBN.

(2) Columns (f) computed (as per equation 6.4) from various publications of the Nigerian Federal Office of Statistics, - FOS.

APPENDIX D

MODEL'S LABOUR PRODUCTIVITY VARIABLE (AL) DATA

Year	L (m) Nigerian Labour force (a)	L' (m) Nigerian Working Pop. (b)	A Eq. 1.6.4.4. refers (c)
1975	29.2	27.2	0.008
1976	29.9	28.6	0.011
1977	30.6	29.3	0.010
1978	31.3	30.0	0.009
1979	32.0	30.7	0.007
1980	32.7	31.3	0.007
1981	33.5	31.8	0.007
1982	34.5	32.4	0.006
1983	35.0	32.9	0.004
1984	35.9	33.5	0.002
1985	36.7	34.7	0.002
1986	37.5	35.5	0.003
1987	38.4	35.7	0.003
1988	39.3	37.2	0.002
1989	40.2	38.5	0.002
1990	41.1	39.4	0.003
1991	42.0	40.3	0.002
1992	43.0	41.3	0.002
1993	43.9	41.8	0.003
1994	45.0	42.1	0.002
1995	46.0	42.8	0.001
1996	47.1	43.8	0.001

Source:

(1) Columns (a) to (f) from various FOS. publications.

(2) Columns (c) computed as per equation 6.4.