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Innovation and Technology Transfer on Nigerian Economic Development

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ABSTRACT:

This paper present the innovation and technology transfer policies on economic transition and the constraints in Nigeria faced by R&D sector in providing innovation and technological advancement.Innovation and technology transfer are the main drivers of economic growth in today's world economy. Thus an appropriate economic policy should concentrate on strengthening these processes throughout the country and ensure smooth and effective flow of information and technology between the innovators, companies/industries, government agencies and financial institutions.The paper consists of both theoretical and practical issues. The first part of the paper describes the relations between innovation and technology transfer while the second part of the paper enumerates the economic growth with a concentration on the path to follow for effective economic growth of a transition country and key differences in comparison with more economically advanced economies. This built a framework for conducting a more empirical analysis of appropriate processes. Technology transfer is conducted through different channels and different parts, depending on the means of creating and acquiring the technology.

INTRODUCTION:

Transition economy is a special case. Countries experiences large GDP declines which resulted to large decline in economy competitiveness and increase in technology-gap in comparison to developed countries. This may insinuate certain difficulties taking into consideration of the integration process of digital economy and some specific circumstances like liberalisation of trade and production flow in Nigeria (e.g. capital, labour and technology).

The need for structural changes of the entire economy which is almost not possible without an effective technology transfer and well-defined country's innovation system. In essence, the factors that will lead to spectacular improvement in competitiveness and economic success of the newly industrialised economy despite current problems.

Providing a successful technology transfer flow between the technology holder and the technology user which will help in enables gap bridging in access to a specific technology in different means: buying, renting, lending or licensing.

Formation of technology transfer commercialisation that will give special emphasis on practical implementation of R&D efforts (e.g. closing a license agreement to exploit technology of a specific product design).

The solution to Nigeria weakness in R&D system which affect the technology transfer between research and industry sector. This complex issue is strictly correlated to Nigerian economy dominated by low and middle technology intensive industries. Most of these industries use import as the main transfer technology channel thus limiting the demand for in-house R&D, The scale of advancement in technology transfer is mostly used for implementation purposes and the capabilities of technology in the production process and some other problems encountered in advancing innovation and technology transfer.

TECHNOLOGY TRANSFER AND THE INNOVATION PROCESS:

Technology transfer is a strong factor in impacting economic growth both in the short and long term plan. The access to technology and its usage in economic processes decides the competitive position in the international labour sector.

Technology transfer is a complicated system that includes several closely related elements such as technology (embodied and disembodied; e.g. machines and licenses) and knowledge (e.g. organisational behaviour). Sometimes we understand transfer of technology in parallel with innovation where the technology embodies of specific knowledge of a product or service.The rate of technology transfer diffusion depends largely on the existing technology infrastructure e.g. the resources of technical science and R&D potential, technology transfer financing and technology start-ups, industrial advancement, instruments encouraging the innovation across the country, the scale of the country's openness to foreign competition and production co-operation (at the beginning mainly transnational corporations channels).Hence, the economic level is one of most important factors that determine the

intensity of technology transfer. In effect the diversity in the level of quality and quantity of labour will be strictly correlated with the potential flow of technology.Technology transfer can be vertical and horizontal character or both. The vertical technology flow is taking place across some specific stages of added value formation in the value chain.

R&D → implementation → production process → distribution → final buyer

Horizontal technology transfer is conducted in similar economic environments or production stages group in the diffusion process.

Laboratory ↔ laboratory; factory ↔ factory; country ↔ country

Technology transfer channels can transfer goods, services and production factors (workforce, technology, capital). In this circumstance investments related to technology transfer are separated as investments directly related to production (e.g. machinery) and investments partially related to production (e.g. distribution equipment).

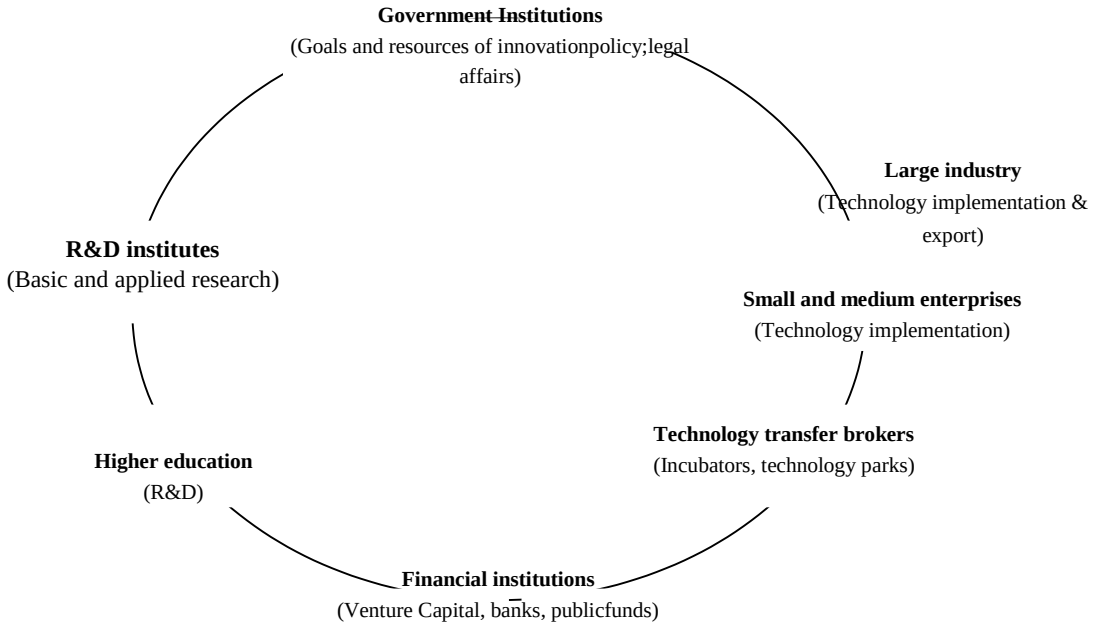
Innovation and Technology Supply:

Technology supply depends largely on innovation capabilities of a particular country or the innovation potential. Innovation should be openly understood as everything considered to be new. Innovation is the result of the primary practical usage of a certain idea. It is embodied in a scale of processes or products; therefore we can differentiate process and product innovations.

The innovation process can be analysed below.
Innovation process scheme: ***1****- R&D (basic and applied research)* ***→ 2*** *-invention (creation and documentation of technology)* ***→ 3*** *- innovation and technology implementation* ***→ 4*** *- learning of effective technology usage* ***→ 5*** *- optimization of production and organization methods* ***→6*** *- appearing of micro and macroeconomic effects of technology implementation (eg. lower material and personal costs needs, higher productivity)*

The innovation potential of a country is the sum of specific macro and microeconomic factors, which motivate the process of innovation, like income per capita, R&D, technology infrastructure. Technology transfer indicators can be based on the foreign trade specifics and international competitiveness. In this circumstance, examples can be prices in export, shares in appropriate international markets etc. One of the most frequently used indicators as to the intensity of technology transfer is the technology gap, and can be understood as difference between knowledge and capabilities of a particular country. There are several possibilities to define and measure the technology gap, this include comparisons of industries, labour productivity and capital strength. An important indicator is the level of profit generated in a country by the foreign enterprises.

National technology transfer system can have several entities. The most important are innovators (technology creators), commercial parties (companies) and central government institutions (economic policy). A detailed technology transfer follows:
Technology transfer and innovation system participants



Technology transfer channels: Technology transfer channels are the medium between particular participants in the process. Which include ways of acquiring the technology (e.g. buying, lending) and other relevant factors related to the process (e.g. flow of people, documentation, products, and capital).

Technology transfer is conducted through different channels and different parts. Depending on the means of creating and acquiring the technology, the transfer can either be internal or external. Internal technology transfer is conducted mostly inside a single part or its affiliates. This part acts as creator/innovator and user. The scope of internal process is limited by internal R&D resources and implementation capabilities. External technology transfer relies on external technology resources usually not related to buyer.

The scale of advancement in technology transfer depends on the advancement of R&D resources and the capabilities of technology implementation in the production process of the transferee. There are several possibilities of gaining technologies related to specifics of technology transfer participants.

Table 1. Technology acquisition schemes

1. Acquiring non-documented knowledge	I
2. Internal R&D	I
3. Reverse engineering	I
4. Secret acquiring through internal R&D	I+E
5. Contract R&D	I+E
6. Strategic R&D partnership	I+E
7. Licensing	E
8. Purchase (domestic or foreign)	E
9. Joint Venture	E
10. Acquisition of a company with technology	E

I = Technology transfer based mainly on internal R&D capabilities
E = Technology transfer based mainly on external R&D capabilities

Most advanced technology transfer, especially in the low and middle-income economies are conducted through international production co-operation, where the production factors flow is most complex including machinery, semi-finished goods and production factors (workforce, technology and capital). Foreign direct investments are one of most widely used channels of international production co-operation which decide about the location and level of technology transfer complexity. Therefore a long-term economic policy is needed.

Technology and Economic Growth - Theoretical Issues: Complexity of technology transfer brings about the construction of theoretical model. An interesting basis is the existing international trade and capital flows theories assuming differentiation of production factors, this supply (workforce, capital, and technology) across countries and regions.

This can be extended by Neotechnology theories of international trade like product life cycle theory, technological-gap theory and production scale theory. They argue that the cause of foreign trade is possible because of the existing differences of production supply factors across the countries. In technological-gap theory foreign trade is possible due to differences in economic development across countries; in production scale theory the gain and competitive share is possible due to high specialization and decrease of costs per produced unit.

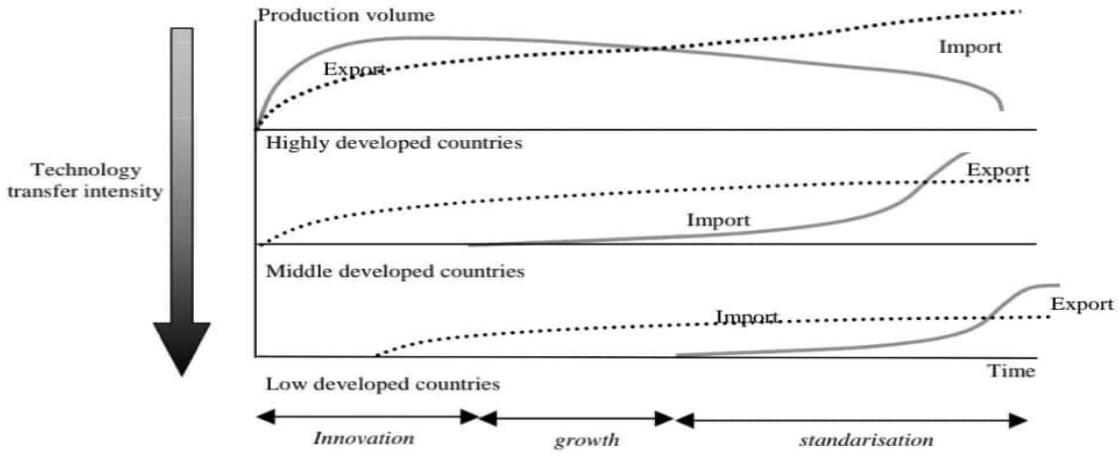
One of the theories, which can be applied in technology transfer analysis, is the R.Vernon's product life cycle theory. Vernon argues that foreign trade are technological advantages, which are embodied in innovations. Because the access to the core technologies is limited, innovations are spreading gradually and differently across countries from country innovator to country imitator (receiving country). One of the reasons for this is that countries differ in the levels of economic development and technological strength. Vernon's theory assume that time is a factor of gradual evolution of product (from innovation, growth, maturity to decline); markets (from country innovator to country imitator) and production process (from complexity to standardization).

Dynamics of technology transfer depend on the strategy of a particular innovator. Some innovator prefer expansion by technology licensing others through direct foreign investment as the most appropriate and safest solution for securing the technology and to prolong the rent from the exclusivity of ownership.

According to product life cycle theory, production is being transferred from the country innovator to the country imitator at the product's maturity stage. In the first phase of product development the production process is being carried out in the country of innovator (because of specifics of production supply factors and the structure of local market demand). In the second phase, together with diffusion of products, some export activities will be established to less developed countries. In the third phase full technology diffusion takes place. Production process simplifies when the innovator fails to resist its oligopolistic position.

This often leads to move production to foreign countries in order to find relative cheaper production factors, to ensure better service of foreign markets and to internalize possessed technology.

Intensity of technology flows in the product life cycle theory



---------- =Production

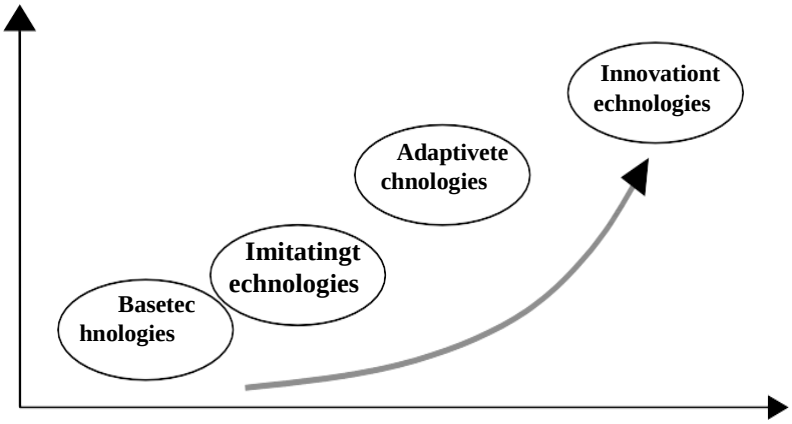
…….....…….. =Consumption

Technical progress is the key factor in economic development and decreasing the technology gap between countries. The intensity of technology transfer depends on innovation potential of a receiving country. The more advanced it is the more complicated the technology transfer will be.

The level of economic development is one of the main factors determining the intensity of technology transfer.

Technology inflow specifics and country's innovation capabilities

Innovation capabilities



Technology transfer intensity

Competitiveness–TechnologyGap

Competitiveness Ratings

Competitiveness of the economy in the long term depends on innovation potential of the economy gained through effective technology transfer. It is the key factor in comparing equalization of traditional competitiveness like cost of production factors.

The ownership and access to crucial technologies affects a country's position in the international competitiveness ratings. Without having home-developed technologies the competing in the long term would be based on accessible technologies generally, mainly through better use of an imported technology. This is especially important in the case of less developed Countries like Nigeria, which definitely lag behind more developed countries in the level of competitiveness.

Average international competitiveness rating of Nigeria in the last five years is 121

Source: based on IMD, World Competitiveness Yearbooks.

In the competitiveness research mentioned above conducted in 2016-2020 by IMD only few countries have improved their rating's position and Nigeria is among them but the percentage is very low.

It is clear that Nigeria lags behind most developed countries. Prolonging thissituation in the long term will continue to have a negative impact on the future of country economic development. Especiallytaking into account the changes in the world economy like increasing competitiveness from newlyindustrialised countries.

Innovationpotential of Nigeria–Constraintsand challenges: R&D is the key element in the innovation and technology transfer process that decides about long term economic development. With the current R&D expenditures new innovations and processes can be created. Thus there is need for more from government's budget which is highly significant.

Historically Nigeria is clearly interested in their own R&D development but lack of proper funding and implementation is the challenge. This was a result of less commitment from the concerned authority. However concentration on military technologies due to the current situation and preparing for future prevention without any transfer of these achievements into commercial implementations will a negative impact on the whole economy. Therefore opening these opportunities of economies growth to local companies that were unable to compete will be better.

Like other countries that are built by R&D system, which consist of the government and commercial contributions, R&D branch institutes such as independent institutions, institutions belonging to industry, institutions belong to government agencies and university research units can be the solution.

The economic transition, which started years ago strongly influenced the development of research sector. There should be deep restructuring, involving the introduction of competitive mechanisms based on granted projects, closure of some non-performing institutions, and privatizing some.

A significant shortage of funds and lack of assimilation to the new market conditions decreased the research base. In just few years of research and implementation, a lots can change positively. The number of researchers are increasing everyday but implementation is becoming a big challenge. The large number of R&D institutes are changing their orientation to more commercial forms, however based on research activity. Several institutes started small-scale production based on in- house developed technologies.

Similar negative trends happens in many countries in their first years of transition period.

Foreign direct investment as a significant channel for technology transfer: The success of technology transition process largely depend on foreign direct investment inflow, which may transformed the entire economies in short time. It is because itrepresents the highest form of international production co-operation engaging the wide rangeof resource capital, technology/knowledge and skilled workforce. Technology transnational corporationsbrought firm competition which forced many local companies to restructure withtechnology and innovativeness.

METHODOLOGY USED FOR THE RESEARCH

The research area: The geographical area of this particular research work covers the some northern states of the Nigeria with much emphasis on the safest and accessible states by the researchers.

The research site and topic: The research sites visited by the researchers are research institutes, industries, innovation centres and institutions of higher learning across the accessible states on the issues hindering the technology transition in Nigeria.

Method of data collection: This study used mixed research technique thereby using qualitative content analysis on one hand, while quantitative and descriptive research on the other hand. Content analysis was used in the study. Also, information from the researchers, industries, company workers and academic professionals and students from institution of higher learning are considered also. On the other hand, research questionnaires containing structured approach was distributed randomly to about 2,000 respondents by the research assistants. Each research assistant team covers a minimum of six researchers, three institution of learning, two companies/industries and one innovation centre.

STATISTICAL TABLE FORTHE COLLECTED DATA

S/N	Source of data	Government/Industries failure	Researchers failure	Undecided
1	Researchers	**81%**	**18%**	**1%**
2	Academic professionals	**70%**	**28%**	**2%**
3	Industries/Company workers	**67%**	**24%**	**9%**
4	Students	**55%**	**47%**	**8%**

RECOMMENDATIONS:

Innovation and technology transfer have strong impact on economic development and increase in international competitiveness level of the economy. Despite some progress made in recent years Nigeria still lag far behind many countries. Thus limiting of the technology gap between Nigeria and other developing countries is of crucial importance to the success of technological integration process.

Due to the lack of effective technology transfer from R&D sector to industry, import and foreign direct investments are the main channels to be used for technology transfer.

There is a strong need of securing more funds for local R&D sector and to promote the linkages between the R&D sector and industry for proper

implementation.

To encourage innovation philosophy across Nigeria an appropriate economic policy is needed. This include e.g. tax instruments, limiting complicated administrative procedures, building and financing technology transfer institutions (business incubators, technology parks) and attracting venture capital investors. The below listened are of paramount importance for technology transfer process.

- Introduction of tax incentives for R&D and innovation
- Secure funding for applied R&D
- Improving relationships between research sector and industry
- Develop policy monitoring and evaluation practices
- Positive, indirect role played by non-governmental organisations
- Large availability of business support organisations
- Support labour market training
- Availability of skilled people for industrial activities
- Availability of venture capital activities

CONCLUSION

- Innovation and technology transfer have strong impact on economic development and increase the international competitiveness level of the every economy.
- Despite some progress made in recent years Nigeria still lag far behind her sister countries. Thus limiting of the technology gap between Nigeria and other developing countries is of crucial importance to the success of technological integration process.
- Lack of effective technology transfer from R&D sector to industry, import and foreign direct investments will drawbacks the technology transition in Nigeria.
- Availability of funds for local R&D sector and promoting the linkages between the sector and industries is of paramount important.
- Economic policies integration that will encourage innovation philosophy across Nigeria. This include e.g. Limiting complicated administration procedures, building and financing technology transfer institutions (technology parks, business incubators,) and attracting venture capital investors.

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