SINO-AFRICA AND TECHNOLOGICAL TRANSFER: IMPLICATION ON SUSTAINABLE DEVELOPMENT IN NIGERIA

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Abstract: Technology is critical to industrialization and economic development of any nation and it is one of the serious bottlenecks in African industrialisation. There is no doubt that technology transfer is one of the less studied subjects in China-Africa relations. Foreign direct investment is an important factor for both technology transfer and economic growth in developing countries like Nigeria. Technological advancement has also become a major challenge to industrialization in Nigeria and to improve her economy, the Nigerian government had made various efforts at acquiring foreign technology to drive the development processes. The Nigerian government had signed pact with the Chinese government in critical areas such as agriculture, manufacturing, military, industry, education and other social sectors through Technological Transfer (TT) and Technical Cooperation (TC) that will aid knowledge sharing and transfer for the purpose of improving the economy. In view of this, the study examines the implication the Sino-Africa and technological transfer on sustainable development in Nigeria. The study employed the interpretivism philosophy and the qualitative approach was adopted in data collection and analysis. Secondary data were sourced from the United Nations Commodity Trade Statistics (UNCTS) Database, Nigeria National Bureau of Statistics, and the World Trade Organisation (WTO) Statistics database, Foreign Direct Investment (FDI) figures were from the United Nations Conference on Trade and Development (UNCTAD) Database, International Monetary Fund (IMF), and the United Nations Statistics Database (UNdata). Other sources were the International Monetary Fund (IMF) Database, International Financial Statistics (IFS) of the World Bank; publications of Central Bank of Nigeria (CBN) and other agencies of government as well as newspapers and journals. Also, key informant interviews were conducted with Chinese expatriates in Lagos and Ogun State, Nigeria. Data collected were analysed using content analysis method. Findings of the study reveals that there is no clear-cut policy statement on Sino-Africa technological transfer and knowledge sharing; thus, the Nigerian government cannot sufficiently absorb new technology from Chinese multi-national corporations as most of these corporations always come as agents of Foreign Direct Investment (FDI) or contractors. The study concludes that adaptation and implementation of policy on technological transfer cannot promote sustainable development in Nigeria. The study recommends among others that knowledge and technology transfer should form the basis of a regulatory framework of the national FDI policy. Also, there is need for the establishment of training institutes in each State of the federation so as to facilitate technological transfer. In addition, there should be collaboration between the established training institutes and higher institutions of learning so that students can have practical knowledge on advanced equipment, methodologies and technologies that will engender sustainable development in Nigeria within a decade.

Keywords: Foreign Direct Investment, Nigeria, Sino-Africa, sustainable development and technology transfer

Introduction

Nigeria's economic relations with China have evolved from diplomatic relations and engagement to Africa economic destination hub as the nation is currently becoming one of the largest destinations for Chinese Foreign direct investment (FDI), technological transfer, technical cooperation as well as knowledge sharing in Africa (Osaji, 2020). Since the beginning of the Nigeria fourth republic in 1999, the Chinese government have made deliberate efforts to ensure technology transfer to its African partners. Technology transfer is always achieved through inter-state movements of human capital expertise, trade-in-technology and trade-in-products that will lead to contractual agreements of two nations (Xiaoyang & Sun, 2016). It is instructive to note that technology enhances sustainable development as it is critical to industrialization and economic development of any nation. Not only that technology is one of the serious bottlenecks in African industrialisation.

There is no doubt that technology transfer is one of the less studied subjects in China-Africa relations (Williams, 2014). Foreign direct investment is a significant factor for both technology transfer and economic growth in developing countries like Nigeria. Technological advancement has become a major challenge to industrialization in Nigeria and to improve her economy, the Nigerian government had made various efforts at acquiring foreign technology to drive the development processes. The Nigerian government had signed pact with the Chinese government in critical areas such as agriculture, manufacturing, military, industry, education and other social sectors through Technological Transfer (TT) and Technical Cooperation (TC) that will aid cross fertilization of ideas such as knowledge sharing and transfer for the purpose of improving the economy (Vanguard, 2013).

The entry of China into Nigeria's economy as a key financier and development partner has drastically changed the face of the nation infrastructures, technology and Nigeria industrialisation (Umejei, 2019). Cao Baogang disclosed that Nigeria remains the biggest market for their investment with a robust relationship spanning over 30 years. He asserts that the country deserves more than the existing training school and the needs to establish a university that would train and elevate Nigerians in the area of technological expertise should be encouraged as the Chinese government would not relent in training Nigerians at different levels. In his word, he reveals that Nigerians constitute 93% of their workforce which is more than 12,500 local staff in over 100 projects of the corporation across the nation which include the Lagos–Ibadan railway project, Abuja rail mass transit project from the FCT to Kaduna, and the Lekki Free trade zone project, among others (Guardian, 2020).

It is instructive to note that the Chinese companies operating in Nigeria under the aegis of China Chamber of Commerce in Nigeria have indicated willingness to assist in many ways possible to develop human capital in Nigerian in terms of acquisition of relevant skills which would make them competitive in the global market so as to engender the nation to a sustainable development (This Day, 2021). According to Zhuo Kun, a management staff of China Harbour Engineering Company (CHEC), technology transfer has assisted Nigerians to be gainfully employed and to acquire the rightful skills that are required for

National development. As a matter of fact, the first Nigerian female train driver, was trained by the CCECC. Not only that, the company has helped several of its staff through their involvement in several projects to acquire useful skills required for national development (Kun, 2020). Shen (2013) argues that Chinese FDI to Nigeria has grown within the last decade as they serve as the largest single source and fastest-growing FDI in Nigeria. This contribution is evident as Chinese FDI had moved from $197.42 million in 2011 to $308.94 million in 2020 (Statista, 2022). According to World Bank (2020) report, many Chinese firms had set up Private Industrial Estates (PIEs) as they have alluded Nigeria as an attractive investment destination based on its large domestic market and growing middle class, as well as its access to neighboring North and West African economies. However, the Chinese government pledged to design policy that can attract Chinese investment which will afford the host government the opportunity to learn from China's own domestic technology considered to be integral part of economic success of its export-led growth strategy, and the growth of its rural areas (Africa News, 2018).

The renewed interest in the knowledge sharing has become crucial as technology transfer engenders economic development and industrialization of every nation, and the unenviable profile of Nigeria in this sphere cannot be unnoticed. Although other factors such as land, labor and capital, equally constitute critical determinants of economic development, technology transfer still maintain a predominant influence (UNCTAD, 2021). Indeed, the income gap between the developed countries and the developing countries is largely attributable to the differences in the technological generation, application and diffusion. In particular, more than 60 per cent of the differences in income levels between Nigeria and the developed countries can be attributed to differences in the stock of knowledge as this is no less an affirmation of a culture of systematic research generation and application, which Nigeria largely lacks (Africa News, 2018). Kun (2020) however noted that the Chinese technology is too advanced for the underdeveloped economy and thus cannot be effectively absorbed and utilized locally. For successful technology transfer to be actualized, the government must initiate policy and take deliberate steps to ensure that conducive environment is created. The insecurity facing Nigeria, especially the Northern part of the country is currently preventing promotion of FDI and also affecting technological transfer. There is no economy that can growth when adequate security cannot be guaranteed (UNIDO, 2020). Furthermore, lack of human capital equipped with both technical and managerial skills for industrialisation, manufacturing and construction that will offshoot the nation to sustainable development. Despite consecutive foreign policies on industrialisation by the Nigerian government to promote technical corporation, technology transfer and cross fertilization of ideas from 1999 till date, the nation economic growth is at the lowest ebb as import substitution still take prominent role in Nigeria economic affairs (Osaji, 2020).

Also, policy somersault has been a serious challenge to FDI, technology transfer and technical cooperation between Nigeria and China. Furthermore, the National Office for Technology Acquisition and Promotion (NOTAP) admits that the initiative to boost the process of effective transfer of technology to Nigeria is very much lacking. NOTAP observes that absence of a realistic policy on technical cooperation and technology transfer coupled with the inadaptability of technologies imported into Nigeria has stifled the nation technological growth which invariably is affecting sustainable development in the country (Africa News, 2018). Hence, the stagnation in the technological innovation and the

resultant failure of Nigeria to catch up in the global technology transfer race has affected the nation's development. It is this observed gap in the body of knowledge which the study intends to investigate so as to be able to articulate and make policy recommendations that will not only engender technology transfer within the framework of the law but equally foster the absorptive capacities of the national receptive infrastructure.

Objective of the Study

Against this backdrop, the main objective of the study is to examine the Sino-Africa and technological transfer with focus on its implication on sustainable development in Nigeria. The study will also analyse the existing government policy and institutional capacity on how it has contributed positively to Nigeria sustainable development.

Methodology

The study examines Sino-African and technological transfer with a focus on its implications for sustainable development in Nigeria. The interpretivism paradigm serves as the study's philosophical foundation. This is due to the qualitative method used, as the data was primarily gathered from secondary sources. An exploratory research design was employed for this study because it was found appropriate because of its flexibility to consider many different aspects of the phenomenon. This research design was used to discover the constitutional framework and the nature guiding technological transfer in Sino-Africa, as well as the role it played in sustainable development in Nigeria. Similarly, newspaper reports and opinions were content analyzed as the study adhered to the qualitative model of social research, which included textbooks, journals, articles, newspapers, and other publications. Multiple secondary sources were used to reduce the risk of error and improve the study's reliability and validity.

Review of Related Literature

For the purpose of the study, the concept adopted is tripod i.e., Technology and Technology Transfer; Sustainable Development and Sino Africa.

Technology and Technology Transfer

There is no single definition of technology due to its diversity and dynamic nature. The UNCTAD defines technology as "systematic knowledge for the manufacture of a product, for the application of a process, or for the rendering of a service" (Singh & Kumar, 2022). The OECD Manual in Yin (2022) defines technology as the state of knowledge regarding ways to turn resources into outputs. Both the OECD and UNCTAD classifications agreed that technology is the organized knowledge required to produce an effect, and this categorization accurately represents the reality of the majority of transfers. Physical elements like machinery, plants, equipment, blueprints, procedures, and processes, as well as informational elements like production, quality control, management, marketing, and skilled labor, make up the two basic components of technology (OECD, 2021; UNCTAD, 2022). The process of exchanging or sharing knowledge, ideas, skills, and technology with another entity, person, or institution, as well as the acquisition of such knowledge, ideas, skills, and technology by the other, is known as technology transfer (Dietterich, 2020).

A transfer can be performed by either the market process (commercial) or the non-market process (non-commercial); there is no set and permanent channel through which it can be

done (Rambe, & Khaola, 2022). Technology transfers are complex processes that aim to achieve certain objectives (Yin, 2022). Nigeria's experience with technology transfer is a reflection of the nation's status as a developing nation. Although the transfer from the West still holds the most sway, Asia is solidifying its positions (Ajibo, Anozie, Onyeabor, Umahi, Odinkonigbo, & Agu, 2019). In Nigeria, the National Office for Technology Acquisition and Promotion (NOTAP) is responsible for the registration of technology transfer agreements. Failure to register contracts and agreements with the transferee, foreign technology transfer clauses could bar the Federal Ministry of Finance, the Central Bank of Nigeria, or any licensed bank in Nigeria from effecting any payment out of the country to the credit of the transferor of the technology (Okonkwo & Yaqoub, 2022).

Sustainable Development

The term "sustainable development" originally appeared in a United Nations study titled: “Our Common Future in 1987”, which is now commonly referred to as the Brundtland study. The Brundtland Report of the World Commission on Environment and Development in Alves (2013) defines sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Also, National Sustainable Development Strategy in Wangalwa (2015), argued that sustainable development is a targeted, long-term, comprehensive, and synergistic process that influences life's conditions and all of its facets at all levels, satisfies human, biological, material, spiritual, and social needs and interests, and eliminates or significantly reduces interference that endangers, harms, or destroys conditions and forms of life. It also doesn't burden the nation, conserves resources, and protects the environment.

In the academic literature, sustainable development is defined as the process of improving the quality of human life while living within the carrying capacity of supporting ecosystems (Willers, 1994). Pearce, Atkinson, and Dubourg (1994) define sustainable development in terms of a per capita consumption path that is constant or rising over time. Furthermore, technology transfer for sustainable development, on the other hand, represents a catalytic process for social change that seeks to foster, through education, training, and knowledge transfer, the values, behaviors, and lifestyles required for a sustainable future. It is about the learning needed to maintain and improve our quality of life for generations to come. Sustainable development encourages individuals, communities, groups, businesses, and governments to live and act sustainably, as well as giving them an understanding of the environmental factors, good moral behaviors, and economic issues involved (Ayodele, 2007).

Sino-Africa: Nigeria Perspective

China and Nigeria's current economic partnership is sometimes described as mutually beneficial (Agubamah, 2014). In 2006, China and Nigeria signed the first Memorandum of Understanding on the establishment of an African strategic partnership. As a result of the collaboration, an oil-for-infrastructure agreement was signed, and Chinese companies were given priority access to oil-processing licenses (Ajibo et al, 2019). It is instructive to note that large Chinese loans have resulted from presidential trips. President Jonathan's trip to Beijing in 2013 resulted in a $3 billion infrastructure loan, including airport expansion in Lagos, Kano, Abuja, and Port Harcourt. Nigeria received a $6 billion infrastructure loan following President Buhari's visit in 2016 (Okonkwo & Yaqoub, 2022).

More Chinese companies are also establishing themselves in Nigeria. In 2017, 3,321 Chinese companies were in existence in Nigeria, which cut across all sectors of the economy such as oil and gas, construction, trading, telecommunications, and others (Umejei, 2019; Statista, 2022). The number of Chinese companies registered with the investment agency had increased astronomically, though this figure could be much higher (Guardian, 2021). This figure is likely to have increased as a result of China's US$7.5 billion loan in 2017 for the Lagos-Kano and Lagos-Ibadan railway gauges (Adamu, 2017). After South Africa, Nigeria was the second-highest recipient of FDI in 2019. Between 2010 and 2019, Nigeria was the second-largest importer of Chinese goods after South Africa (Umejei, 2019). Over the same time period, exports to China have consistently ranked among the top five (Tiezzi, 2018).

Sino-Nigeria trade relations have been heavily criticized in the press and in academic writings, as Nigeria currently appears to be relying more on China for critical infrastructure development. Sansui, former governor of the Central Bank of Nigeria, stated in 2013 that "China takes primary goods from us and sells them to us as manufactured goods." According to Agubamah (2014), the Nigeria-China relationship is a lose-lose situation, not a win-win situation, as China claims. In his view, Nigeria is currently being used as a dumping ground for low-cost Chinese imports. The Chinese government, on the other hand, sees its investment in Africa as a "win-win" situation that benefits both China and Africa. At the 2018 Forum on China-Africa Cooperation (FOCAC), China's President Xi Jinping argued that the goal of China-Africa relations is to make "lives better for our people" and that cooperation should benefit both China and Africa (Tiezzi, 2018). The relationship between Chinese investment and economic growth, on the other hand, is a hotly debated topic, and specific areas of engagement, such as natural resource-backed loans, have been heavily criticized (Strange, 2013; Alves, 2013). According to Alves (2013), while resource-for-infrastructure agreements have increased access to hard infrastructure such as roads, dams, and railways, they have done little to aid Africa's economic diversification and transition from resource dependency to resource-based industrialization.

Theoretical Framework

To analyse this paper the dependency theory is considered relevant. Thus, this study is situated within the context of the dependency theory. The Dependency Theory was formulated in the 1950s by Raul Prebisch, who was at the time the Director of United Nation Economic Commission in Latin America. It states that the world is divided into two parts: the core, represented by the developed states, and the periphery, represented by the underdeveloped states. Andre Gunder Frank in Dietterich (2020) describes dependency as largely a problem created by capitalism. In this context, an imbalanced division of labor has been put in place by the developed world. The division of labor creates an exploitative relationship that is favorable to the developed nations, which receive cheap raw materials and agricultural produce from the developing countries (Dietterich, 2020). Even with the proliferation of Chinese firms into the local economy, the impact of China on the local economy is yet to be fully appreciated. There is a marked increase in literature that focuses on China-Nigeria relations and their impact on sustainable development (Yergin & Stanislow, 2002).

China will continue to be a significant part of the Nigerian economy as manifested in the construction of mega infrastructure and the provision of development loans, but little effort has been made to show off technology transfer within the Chinese MNCs into various Nigerian economic sectors which has affected sustainable development.

Government Policies on Technology Transfer and Institutional Capacity in Nigeria

A number of government policies have been formulated on technology transfer and institutional capacity in Nigeria. Some of these are discussed here.

National Technological Development Policy (NTDP): Nigeria is uniquely situated to develop a National Technological Development Policy (NTDP) with a means for measuring performance and stemming underperformance. The policy focuses on science and technology infrastructure development and the accompanying human capital development (Adamu, 2017). It emphasizes two main modes of technological development: the internal mode, which should focus on technological learning and development, and the external mode, which should focus on acquisition, assimilation, use, and adaptation of foreign technology for a functional output in accordance with international best practices (Okonkwo & Yaqoub, 2022). Arguably, a tailored internal and external policy approach to technology transfer by this institution is supposed to engender sustainable development that will promote a more sustained and credible transfer of technical know-how and skill acquisition, with its spillover effects on the economy and citizens (Umejei, 2019).

The government institutions have to rise to the call by formulating sound policies and ensuring that such policies are properly implemented in such a manner that MNCs are able to transfer skills to the citizens of the host nation through industrial attachment and form partnerships with the Chinese firm through a greater investment in education (STEM), skill learning and acquisition, research, and development (Ajibo et al, 2019). This will also incorporate the provision for the government's incentives and support for the firms and institutions that set up research and development in Nigeria. Such firms and institutions could be public research organizations, university research centers, or private firms.

2018 Presidential Executive Order

The federal government recently took a significant step to ensure the application of technology transfer requirements to all sectors in Nigeria through the 2018 Presidential Executive Order entitled 'Planning and Execution of Projects, Promotion of Nigerian Content in Contracts, and Science, Engineering, and Technology'. The Executive Order requires MDAs to promote local content by giving preference to Nigerian companies in the award of contracts, bids, and projects, but if the requisite expertise is lacking, foreign firms must demonstrate a verifiable plan for indigenous capacity prior to award (Ajibo et al, 2019). Additionally, Nigerian companies are to lead in any consultancy services involving joint venture arrangements relating to law, engineering, ICT, architecture, procurement, quantity surveying, and others (Osaji, 2020). The implication is that technology transfer requirements through local content promotion apply to all sectors in Nigeria since there is hardly any sector that does not involve some form of contracting and science, engineering, and technology. The Nigerian Local Content Act, Cabotage Law, and Guidelines for Nigerian Content Development in ICT have all been extended to all sectors in Nigeria (Eke, Ochang, Adimula, Borokini, Akintoye, Oloyede, & Ogundele, 2022).

The Nigerian Local Content Act seeks to promote the utilization of Nigerian content to foster technical capacity and capability of Nigerians, while the Cabotage Law aims to facilitate technology transfer in the maritime sector. Also, the National Information Technology Development Agency (NITDA) has a responsibility to promote the local development of software in Nigeria (Eke et al, 2022). The Guidelines for Nigerian Content Development in ICT aim to achieve the development of local skills, technology transfer, the use of local manpower, and local manufacturing in the ICT sector (Kugler, 2022). Multinational corporations in the class of Original Design Manufacturer (ODM) must provide a local content development plan for the creation of jobs, recruitment of local engineers, human capital development, and value creation for the local ecosystem.

The Local Content Act:

The Local Content Act provides a scope through its elaborate provisions, laws, and regulations that will foster the absorptive capacity of Nigerians, operating not only in the oil and gas sector but in other major sectors of the economy (Okonkwo & Yaqoub, 2022). This Act stipulates that Nigerians are supposed to be given first consideration for employment and training in any project executed by any foreign operator, and the project operator must submit an employment and training plan detailing specific job positions in which Nigerians will be placed. For all projects or contracts in excess of $100 million (USD), there should be a "labor clause" which mandates the use of a minimum percentage of Nigerian labor in the specific cadres as may be stipulated by the NCMB (Ajibo et al, 2019).

Additionally, the operator must submit to the NCMB a succession plan providing for Nigerians to understudy each incumbent expatriate job position for a maximum period of four years, at the end of which the position shall become Nigerianized (Osaji, 2020). These provisions are targeted at transferring the technical know-how capabilities from the foreign expatriates to Nigerians operating in the various economic sectors. Arguably, it can be said that the weak implementation of the Local Content Act has constituted an impediment to the realization of the inherent goals of technology transfer, which invariably affect the sustainable development of the nation (Fadeyi, Maresova, Stemberkova, Afolayan, & Adeoye, 2019).

National Office for Technology Acquisition and Promotion (NOTAP): The NOTAP is an agency overseeing intellectual property rights (IPR) and technology transfer in Nigeria. It has created Intellectual Property and Technology Transfer Offices and established offices for the transfer of intellectual property and technology in tertiary institutions throughout the nation to help inventors with IPR preparation and filing. A legislative and administrative framework, along with incentives for university academics to share their ideas and breakthroughs, have been found to be beneficial in promoting the commercialization of research outputs. The transfer of inventions from academic institutions to industry constitutes a major driver of economic growth and a catalyst for promoting sustainable living standards (Osaji, 2020). However, there are significant inefficiencies and suboptimal linkages between academic technology generation and transfer to industries in Nigeria, leading to a significant proportion of the technological knowledge generated in academic institutions to remain stagnant or underutilized (Eke et al, 2022).

The NOTAP has attempted to reduce this gap through the establishment of Intellectual Property and Technology Transfer Offices (IPTTOs) in some selected tertiary and research institutions across the country to bridge the existing gap between academia and industry. Less than 60% of academic staff members at universities in Nigeria share their research findings, and commercialization takes a backseat (Ajibo et al, 2019). Despite the fact that many institutions globally are experiencing a research boom, the rate of commercialization of research discoveries is still low in Nigeria. The optimal outcome will depend on the efficiency of the channel of communication between academic institutions and industries, the level of funding available to research institutions, the transparency of the utilization of the research fund by the research institutions, and an effective framework for assessing accountability and applying penalties for breaches (Fadeyi et al, 2019). The NOTAP must maintain an effective institution that engages in monitoring, data collection, and assessment of the performance of this linkage with a view to identifying and correcting anomalies. The quality of research results must be globally competitive and possess commercial value to afford safe reliance on them by the target industries to foster product and service innovation.

Factors Influencing Technology Transfer

The practical methods influencing cross-border technological transfers reflect the options at the disposal of countries desirous of acquiring technology. The transfer may happen at the firm's level through inter-firm collaboration and at the country's level through public sector collaboration between two or more countries (Fadeyi et al, 2019). FDI is critical in the transfer debate and essentially constitutes the touchstone of the other methods of transfer. There are various factors that necessitate technology transfer in the international arena. For instance, technology transfer occurs through the international technology market, independent merchants, joint ventures, government initiatives and exchanges involving both public and private business stakeholders, the publication of technological information through training and educational programs, and also through imitation and reverse engineering (Rambe & Khaola, 2022). All these factors contribute to the technology transfer policy in an international environment as they are discussed below:

Joint venture

Joint ventures, like performance requirements, can be driven by either the FDI policy or the non-FDI policy. They involve the joint pooling of assets, servicing, management, finance, profit, risk, production, and marketing to achieve a common purpose or objective (Ajibo et al., 2019). In the view of Kugler (2022), technology can be transferred in a joint venture arrangement through liaisons, technical training, and operational support. The recipient country acquires skill and know-how in the processes of plant design and installation, acquisition of spare parts as well as raw materials, the production processes, maintenance processes, and marketing processes (Eke et al., 2022). Joint venture arrangements constitute a prominent feature of the oil and gas industry in Nigeria. The government resorts to joint ventures as a contractual policy to engender technological spillovers that foster capacity building (Osaji, 2020). Although a joint venture may have a peculiar constraint of cash call, it is important to keep providing support to joint venture arrangements based on the peculiar advantage of knowledge spillovers to the indigenous workforce (Ajibo et al., 2019). A joint venture is similar to a public-private partnership

agreement (PPPA) since both of them involve the joint partnership, though they differ in functionality and legal specifications (Umejei, 2019).

Public-Private Partnership Agreement (PPPA)

Public-private partnerships (PPP) offer a path for the consolidation of the efficiency and innovation of private firms with the flexibility of public sector organisations to deliver effective services (Ajibo et al., 2019). The partnerships could be in any area of specialization. A typical instance of such a partnership is the lighten-up African project involving China, 10 African countries, and the UNIDO to provide power to rural Africa (Chorev, 2023). Equally important, the United States Agency for International Development (USAID) supports the activities of the US-Asia Environmental Partnership (US-AEP). The US-AEP matches potential Asian customers with American business enterprises. So far, the US-AEP has attended to over 5000 requests from Asia, matched more than 700 Asian stakeholders, and accounted for a successful transfer of technologies worth over US$1.4 billion (UNCTAD, 2021). The PPPA has many variants, but the dominant one in Nigeria is the concession arrangement. This partly explains the establishment of the Infrastructure Concession Regulatory Commission of Nigeria (ICRC). Increasingly, Nigeria is relying on the PPPA to foster technical capacity, with the latest being the $5.8 billion Mambilla electric project in Northeast Nigeria, awarded to a consortium of three Chinese companies and expected to be completed in 2023 (UNCTAD, 2022). The expectation is that the public sector workers, together with their affiliates, will gain technical expertise through such PPPA in the processes of training, plant construction, installation, management, and overall experiential acquisition (Chorev, 2023).

Licensing Agreements

Apart from the PPPA, technology can be licensed to the technology seeker. Licensing encompasses a broad spectrum of permissions granted for the use of technology, trademarks, and patents. It includes: (1) the knowhow license, which is usually classified information and therefore not accessible to a non-party to the licensing agreement; (2) the patent license, which is used for a specific purpose such as health-related initiatives; and (3) the technical assistance agreement, which is usually tailored for the provision and supply of scientific and technological assistance and training (Ajibo et al., 2019). Others include the trademark license and the software license, tailored to suit the requirements of the parties. License contracts usually ‘involve the purchase of production or distribution rights and the underlying technical information and knowhow’ (Chorev, 2023). The general determinants of licensing decisions are related to those pertaining to FDI, particularly the size of the market, transparency, and stability (Osaji, 2020). Eke et al. (2022) stated that licensing offers two unique advantages for both the transferor (licensor) and the transferee (licensee). Apart from providing an avenue for negotiation, it provides a relevant framework for flexibility in the technology choice for the licensee and an opportunity for the licensor to be remunerated for the transfer on palatable terms. The additional factor relevant to the licensing arrangement is the confidence of the licensor firms that the proprietary technology licensed will not leak into the host economy either through the defection of personnel or copying. If this is to be expected, the foreign firms may prefer FDI, may not engage in licensing at all, or may transfer lagging technologies (Fadeyi et al., 2019).

By and large, all licensing contracts or agreements for the transfer of technology to Nigeria are registrable if their purpose or intent is, in the opinion of the NOTAP, wholly or partially related to any of the following: (1) the use of trademarks; (2) the right to use patented inventions; (3) the supply of technical expertise in the form of the preparation of plans, diagrams, operating manuals, or any other form of technical assistance of any description whatsoever; (4) the supply of basic or detailed engineering; (5) the supply of machinery and plant; and (6) the provision of operating staff or managerial assistance and the training of personnel (Ajibo et al., 2019). However, registration would be declined if the terms and conditions contained restrictive business practices and anti-competitive provisions, except as the national interest otherwise requires (Osaji, 2020). Arguably, the NOTAP needs to step up its monitoring responsibility. This would enable the agency to determine if the objective that underlines licensing is being realized and, if not, the area that requires retooling (NOTAP, 2022).

Other methods of transfer

Technology transfer can also be facilitated through the international trade as it can be accomplished in two principal ways. First, when there are imported products that are technologically superior to the locally produced products, then there is an opportunity for the adaptation by the local firms, to suit the local circumstances (Eke et al, 2022). However, this is generally done with the consent or in partnership with the technological owner. Secondly, the importation of various kinds of capital equipment or business services may foster process innovation and technical change in production by the indigenous firms (Chorev, 2023). Apart from trade, transfer can be accomplished through turnkey packages. In this approach, the transferor provides machinery and undertakes the building, provision of management expertise, and production plans. The recipient merely takes control and operates the structure (Umejei, 2019). In the process, technical know-how is transferred to indigenous firms and the local workforce through training and experience (Ajibo et al, 2019). Also, the management contract forms another method of transfer. This involves the foreign experts working in conjunction with the local workforce to manage machine operations, production processes, technical standards and other arrangements, leading to experiential spillovers, in addition to training of local workforce. Other methods of transfer include: a cooperative agreement with the international agencies; a technical assistance offered by the developed country; international alliances; and a venture capital arrangement. Nevertheless, technology remains a proprietary knowledge, which makes the transfer subject to certain constraints (Osaji, 2020).

Challenges on Technology Transfer in Nigeria

A number of factors have been identified as challenges facing technological transfer in Nigeria and these has hindered development in Nigeria.

Insecurity and Erratic Power Supply

The issue of insecurity, epileptic power supply, and safety in Nigeria has become worrisome and something of grave concern to all investors that are intending to invest in Nigeria as well as well-meaning citizens, most of whom continue to wonder how the country arrived at such a dastardly situation; and worse still, rather than abate, the problem is escalating and now totally out of control. These bipolar issues in Nigeria are a recurring

phenomenon that threatens the nation's sustainable development. Despite the many factors that make investment in Nigeria attractive, Chinese interviewees consistently identified poor power supply, corruption, and concerns about personal safety as major concerns when considering investing in Nigeria. The establishment of Ogun Free Trade Zone (FTZ) was also motivated by security concerns, as the Chinese firms are ready to generate their electricity. The original plans were to set up the FTZ in Imo State, in the south-east, but the insecurity and high operating risks that the region is currently experiencing made the investors relocate to Ogun State, as can be seen in Igbesa, Itori, Sagamu, and among others. In addition, concerns about kidnapping, sit-at-home orders, and personal safety have been significant factors, which is why many Chinese businesses choose to locate in Southwest Zones (SWZs). Entrepreneurs in Ogun also identified safety as a major concern for choosing that particular FTZ, as the region was perceived as safer than the area around Southeast Zones (SEZs).

Absorptive capacity and innovation capability

The development of a dynamic and competitive economy requires massive investment in the building of capacities and capabilities in the production, engineering, design, procurement, marketing and so on. The acquisition of these capacities and capabilities engenders the indigenous skill reservoirs. Absorptive capacity is critical in any viable transfer arrangement, given the necessity for the technological recipient to effectively absorb, efficiently utilize and successfully apply or adapt the received technology. Indeed, it has been discovered that one of the greatest challenges encountered in the technology transfer arrangement is the issue of absorptive capacity of the recipient. Unfortunately, a number of developing countries like Nigeria generally lack sufficient skill and know-how reservoirs to absorb, utilize and adapt foreign technology for optimal performance.

Negative Impacts of Chinese Investment

While many Nigerian respondents interviewed were generally positive about their economic and technical relationships with Chinese partners, some also expressed frustration at several instances of what they perceived as abusive business practices, including corruption and illegal smuggling activities on the part of Chinese firms. More so, some expressed anger of the highhandedness of the Chinese practices which includes, product imitation and duplication. The CEO of a Nnewi company described how the Chinese company he formed a technical partnership with had sold him products that were duplicates, using his company's own design specifications, as well as copies of German companies' goods. "They cheat us a lot! Most of the steel rims they sold to us, were either not enough as quoted in the bill of supply or of low quality," he noted. "It's terrible. I lost a lot of money and decided never to partner with the Chinese again."

Foreign Direct Investment (FDI):

Foreign direct investment is a medium for technology transfer, as countries can condition access to their internal markets on it. Transnational corporations dominate cross-border investment due to their investment in research and development as well as proprietary interest in the know-how generated (Chang, 2022). China's FDI policy hinges access to its market on a compulsory joint venture and foreign firm's establishment of research and development in the country (Kugler, 2022). Singapore's FDI policy reflects industrial

policy that targets and attracts transnational corporations, coupled with the development of indigenous skills, strengthening institutions, and specialized infrastructure, has enabled Singapore to become increasingly competitive on the global technological growth ladder (Chorev, 2023). In addition, Nigeria's FDI law and policy linkage with effective technology transfer is somewhat nuanced. The Nigerian Investment Promotion Commission (NIPC) is responsible for promoting, coordinating, and regulating inward investment in Nigeria, but nothing in the NIPC Act indicates the imperative for a transfer through the medium of FDI. The Nigerian Oil and Gas Industry Content Development Act of 2010 requires foreign enterprises operating in the oil and gas sector to ensure capacity building and utilization, as well as encourage the establishment of R&D in Nigeria, but the outcomes have been negligible due to the NCMB's predisposition to oftentimes turn a blind eye to non-compliance (Adamu, 2017). A pragmatic policy that integrates doing business in Nigeria with a realistic technology transfer responsibility and operationalizes the implementation is necessary. This integration should factor in both the linkages in the realm of FDI and the other methods of transfer, including the performance requirement (Ajibo et al, 2019).

Foreign Direct Investment, Sino-Africa, Technology Transfer and Sustainable Development in Nigeria

There is no doubt that the Chinese FDI has brought much-needed investment and infrastructure development to Nigeria, however, there have been concerns about the lack of technology transfer from Chinese companies to their Nigerian counterparts, as well as the environmental impact of some Chinese-funded projects in Nigeria (King, 2013). One of the most significant impacts of Chinese FDI in Nigeria has been in the area of infrastructure development. Chinese companies have invested heavily in roads, railways, power plants, and other infrastructure projects in Nigeria (Ibonye, 2022). This has helped to improve the country's infrastructure and boost economic growth. For example, the Chinese-built Abuja-Kaduna railway which has helped to reduce travel time between the two cities from 12 hours to just 3 hours.

Thus, it is appropriate to argue that there have been both positive and negative impact of Chinese FDI in Nigeria. Therefore, it is important to carefully consider all of the potential impact of Chinese FDI in order to maximize the benefits and minimize the risks. For instance, the Chinese FDI has had a positive impact on employment in Nigeria (Osaji, 2020). Chinese companies have created jobs for thousands of Nigerians, both directly and indirectly. For example, the Chinese-owned company employs over 10,000 people in Nigeria. However, there have also been concerns about the lack of technology transfer from Chinese companies to their Nigerian counterparts. Chinese companies often bring their own workers and equipment to Nigeria, and they do not always share their technology with Nigerian partners (Ajibo et al, 2019). This can hinder the development of Nigeria's own technological capabilities. Another concern is the environmental impact of some Chinese-funded projects. For instance, the Chinese-built Ogoni clean-up project has been criticized for its slow pace and lack of transparency.

In addition to the above, there are a number of other factors that need to be considered when assessing the impact of FDI, Sino-Africa, technology transfer and sustainable development in Nigeria (Ibonye, 2022). These factors include the quality of the Chinese FDI. Some Chinese companies are more willing to transfer technology and share their expertise than others. Hence, Nigerian government needs to have the capacity to effectively

regulate Chinese FDI and ensure that it is used in a way that benefits the country (King, 2013). The Nigeria political complexity and economic stability is well considering as the nation is relatively large and diverse. Political instability and economic uncertainty can make it difficult to attract and manage FDI (Osaji, 2020). Despite the challenges, there is potential for FDI, technology transfer and sustainable development in Nigeria through Sino-Africa economic relations. Considering all of the potential impact, there is no doubt that Nigeria can maximize the benefits of Chinese FDI and minimize the risks.

Nexus of Sino-Africa, Technology Transfer and Sustainable Development in Nigeria: Issues, Challenges and Prospects

The nexus among Sino-Africa, technology transfer and sustainable development in Nigeria is a complex and multifaceted issue. China has been a major source of investment and technology transfer to Nigeria, helping to improve the country's infrastructure and economic development. However, some critics have argued that China's investments have come at a cost to the environment and sustainable development in Nigeria (Ibonye, 2022). According to Akobundu (2019), China has contributed significantly to technology transfer in Nigeria through the Belt and Road Initiative (BRI). The BRI is a massive infrastructure investment programme that has been launched by China with the goal of connecting Asia, Africa, and Europe. As part of the BRI, China has invested in a number of major infrastructure projects in Nigeria, including roads, railways, airports, and power plants. These investments have helped to improve Nigeria's infrastructure and have also created jobs and boosted the economy.

In addition to infrastructure, China has also been a major source of technology transfer in Nigeria in the areas of agriculture, manufacturing, and healthcare (See Appendix I). For instance, China has helped to develop Nigeria's agricultural sector by providing training and equipment to farmers. China has also invested in manufacturing plants in Nigeria, which has created jobs and helped to boost the country's economy. In the area of healthcare, China has provided Nigeria with medical equipment and training, which has helped to improve the quality of healthcare in the country (Ibonye, 2022). However, some critics have argued that China's investments in Nigeria have come at a cost to the environment and sustainable development. For example, some critics have argued that China's investments in infrastructure have led to environmental degradation, such as deforestation and pollution (see Appendix II). Others have argued that China's investments in manufacturing have led to the exploitation of Nigeria's natural resources. Despite these criticisms, there is no doubt that China has played a significant role in technology transfer in Nigeria. China's investments have helped to improve Nigeria's infrastructure and economy, and they have also created jobs and boosted the country's technological capabilities.

Besides, it is important to be aware of the potential environmental and sustainable development impacts of China's investments in Nigeria. In order to ensure that China's investments in Nigeria are sustainable, it is important for both countries to work together to mitigate the environmental and social impacts of these investments (King, 2013). This could involve developing environmental impact assessments for major projects, ensuring that local communities are consulted and involved in the planning and implementation of projects, and investing in sustainable development initiatives. By working together, China

and Nigeria can ensure that China's investments contribute to sustainable development in Nigeria (Akobundu, 2019).

Conclusion and Recommendations

The paper has shown that overseas expansion of Chinese enterprises is an increasingly salient trend, adding another layer to an already complex Sino-African economic relationship. Chinese development finance and large state-owned enterprises have made major contributions to Nigeria's sustainable development in relation to infrastructure and growth, but private businesses have a significant impact on economic development via technical training, knowledge transfer, and technology transfer. The paper observes that Chinese firms can contribute to sustainable development, industrialization and the economic transformation of the country through promotion of technology transfer, technical cooperation, and spillovers. It concludes that adaptation and implementation of policies on technological transfer cannot promote sustainable development in Nigeria until there is a clear-cut policy on technological transfer and technical cooperation by the Nigerian government. The paper recommends among others that technology and knowledge transfer should form a basis of a regulatory framework of the Nigeria FDI policy. Also, there is need for the establishment of training institutes in each State of the federation for the purpose of technological transfer. In addition, there should be collaboration between the established training institutes and higher institutions of learning for students to have practical knowledge on advanced equipment, methodologies and technologies that will engender sustainable development in Nigeria within a decade.

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