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Empirical Analysis of the Relationship between FDI, Technology Transfer and Economic Growth in Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author MCE designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors MCE and AOA managed the analyses of the study. Author AOA managed the literature searches, references and corrections to the reviewers comment. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

Technology transfer (TT) and foreign direct investment (FDI) have been identified as an important conduit in the promotion of economic development. But many developing nations fear the opening up of their markets to competition and foreign investment. This paper empirically studies the relationship between FDI, TT and economic growth in Nigeria. Domestic investment (DI), human capital and the degree of openness are crucial variables used in this study mechanism. The acceptance of the twin concept of FDI and TT as a tool for economic growth and convergence in LDC has been a long item even by policy makers and economists in planning macroeconomic policy objectives and object of desired attainment. It is now a debate if exogenous or endogenous factors drive economic growth. Our objective for this research is to present the trend and ascertain the impact of FDI, technology transfer and openness of the Nigerian economy against domestic investment and the available human capital resource on economic growth. Analytical measure was used to present the trend of the variables and econometric methodology was used to provide empirical evidence on the impact of endogenous and exogenous variable in the Nigeria context. Conclusions from the findings were that domestic and external variables constitute economic growth. Furthermore, human capital was crucial for both domestic and foreign investment to strive. Technology transfer (TT) causes

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economic growth but international channels of TT did not favour economic growth. Similarly, degree of openness was found not to be a favourable channel; rather channels like University Industry (U-I), TT and taking intellectual properties to the market will propel economic growth. However, as macroeconomic activities increases with globalisation, there is the need to increase human capital investment effort and good foreign policies to make the foreign scene more additive to economic growth in the country.

Keywords: Technology transfer (TT); foreign direct investment (FDI); human capital (HC); openness; economic growth; gross domestic product (GDP).

1. INTRODUCTION

Technology transfer (TT) is the application of knowledge in the form of skills, technical know-how, design, machinery and other capital equipment in a new ground. FDI as a channel of TT which is investment made to acquire a lasting management and at least ten (10) per cent interest of asset in a domicile [1,2]. A strategic factor that influences economic growth in any country is investment. It is characterized as crucial in increasing the level of productivity. A strong correlation between investment (domestic and (or) foreign investment) and economic growth has been revealed by both theoretical and empirical studies by economists in both developing and developed economics of the world [3]. Nigeria has witnessed high inflow of FDI as a result of investment in the Global System of Mobile (GSM) telecommunication since 2000. The oil sector of the economy has also witnessed an increased level of FDI as evidenced by the increasing numbers and operations of oil Multinationals Corporation in the country [4].

FDI is a key channel in promoting TT for economic growth and development in developing countries [5]. In every FDI, there is an inbuilt TT content, management skills, marketing know-how, creation of employment opportunities and market access, which by extension increases contributes to the economy as domestic investment. In order to take advantage of this advanced technology, the host country is regarded by many scholars to have a minimum threshold of the stock of human capital. The structure of the host country's economy is also of importance to the level of benefits that can be harnessed from FDI [6].

Domestic investment (DI), human capital (HC) and the degree of openness are also crucial variables considered in this study mechanism. Human capital as the input in the production process is a catalyst for TT and FDI as it is crucial in domiciling the foreign knowledge for domestic economic use [7]. The proponent to which Nigeria import and export activities is efficient in telling us the returns of globalization (openness), if the interaction is beneficial to the country in achieving her vision 2020. The Vision 2020 document predicts that by the year 2020, Nigeria – Africa's most populous nation and the world's 6th largest crude oil exporter would have experienced the catch-up industrialization, which will catapult it into the ranks of the 20 largest global economies. The global largest economies currently are countries of the Organization for Economic Cooperation and Development (OECD) plus China, India, Russia Brazil etc. [8]. The objective of this paper is to present the trend and ascertain the impact of FDI, technology transfer and openness of the Nigerian economy with regards to domestic investment and the available human capital resource for economic growth. Furthermore, the belief and acceptance of the twin concept of FDI and TT as a tool for economic growth and convergence in LDC has been on the upsurge. This is to the extent of its inclusion in macroeconomic policy objectives and collectively desired to be attained. This

paper will investigate the potentials of TT, FDI, openness and human capital in achieving her economic potentials.

2. FOREIGN DIRECT INVESTMENT IN NIGERIA

FDI comprises not only merger, acquisition and new investment, but also reinvested earnings and loans and similar capital transfers between parent companies and their affiliates. Countries could be both host to FDI projects in their own country and a participant in investment projects in other counties. A country's inward FDI position is made up of the hosted FDI projects, while outward FDI comprises those investment projects owned abroad [2].

Crude oil refining, transportation and storage, production of liquefied natural gas, manufacture of gas cylinders, valves and burners, processing plant for refined mineral oil, petroleum jelly and grease, Chemical industries, Fertilizer plants, Petrochemical plants are some huge industrial activities. In the telecommunication sector, since 2000 there has also been FDI into these areas. Another area that is worth mentioning is the fast food restaurant industry. Various kind of fast food restaurants are now located in major cities of the country. The trend of the components of FDI is illustrated in Fig. 1 below. The trend of the figure bellow shows a direct relationship between the contribution of FDI and economic growth.

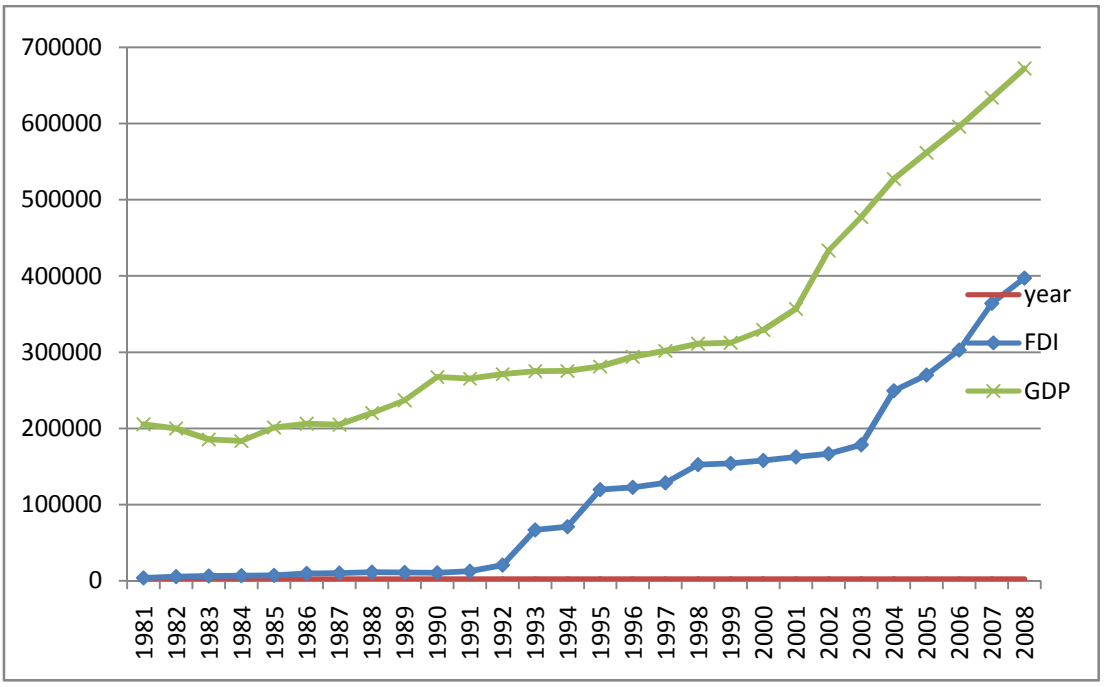

Fig. 1. Trend of FDI and GDP in Nigeria

3. TECHNOLOGY TRANSFER (TT) IN NIGERIA

Technology transfer according to [9] is the processes by which technological knowledge moves within or between organizations. International technology transfer (ITT) refers to the

way in which this occurs between countries. He further explained that the technological knowledge that is transferred can assume various forms.TT is a package, visible or not visible of idea, skill and tacit knowledge to a new ground. It can be embodied in goods (including physical goods, plant and animal organisms), services and people, and organizational arrangements, or codified in blueprints, designs, technical documents, and the content of innumerable types of training. It can equally be communicated through flows of tacit knowledge that has not been fully codified, and remains embodied in the skills of people. TT is a package, visible or not visible of idea, design, skill, tacit knowledge to a new ground. For example, the use of ICT software and hard ware in banks, also in the power sector. Nigeria uses almost 100 per cent imported technology according to [10]. But it can be presumed that with indigenous education system and sound human capital development overtime would domesticate these technologies for local and industrial use.

Technology transfer (TT) can also be looked at differently in terms of application of knowledge. There are three main players in this process: universities for example Obafemi Awolowo University (OAU) or research centers; National Office for Technology Acquisition and Promotion (NOTAP); and industry (Benue Cement Company (BCC) Nigeria ltd) or the public.

In Nigeria, TT is managed by The NOTAP, an agency under the aegis of the Federal Ministry of Science and Technology was established by Decree No. 70 of 1979, as the National Office of Industrial Property (NOIP). NOTAP activities include but not limited to the Evaluation/Registration of Technology Transfer Agreements; Promotion of Intellectual Property; Technology Advisory and Support Services; Commercialization of R&D Results; Research Industry Linkage; Production of Compendium Management Information System; Publication of Project Profiles on R&D Results. Nigeria may have saved over N90 billion from technological transfer agreements between 1983 and 2006, disclosed by NOTAP. A total of 4,529Technology agreements were registered from 1983 to December 2009. The Service sector having the highest number of TT deals with 1,748 agreements. Taking technology education to schools and Mapping TT in tertiary institutions would increase technology human capability and infrastructure development in the country. This people are doing a great job, but a lot fallow ground is still yet to be ploughed for technology adoption and adaption in the country. Table 1 below shows the recorded TT deals from 1983 to 2009.

Where, Solid Mineral and Chemical Sector (SMC), Service sector (SER), Agro -Allied sector (AGRO), Engineering sector (ENG) and Gross Domestic Product (GDP).

Furthermore, an empirical finding of the effect of sectorial technology transfer activities in the country on economic growth is germane. Regressing TT deals from 1983 to 2009 on GDP is illustrated after examining their unit root to determined how the variables behaves below (Table 2a).

From Table 2b, the result showed that the technology transfers proxied by number of technological transfer agreement activities captured by NOTAP in the country positively add to economic growth in Nigeria in the form of Solid minerals and chemical materials used in manufacturing, technologies from abroad in service, engineering and agriculture sectors.

The regression result shows that technology transfer in the model explains or determines 55% variation in gross domestic product. This is statistically supported by the overall significance of the model (*f* statistics) as the *f tests* showed that the model is statistically significant at 5 per cent level.

From the result above, TT is additive to economic growth in Nigeria and if intensified, will help the country achieve the required economic development. The choice of lag logarithm is that the effect of such TT agreement is expected to materialize with time.

Table 1. Number of technology transfer (tt) agreements and per sectors in Nigeria (1983 – 2009)

Year	Total TT registered	TT agro	TT SMC	TT ENG	TT SER	GDP(Nominal)
1983	23	73	48	89	21	53,107.38
1984	116	44	31	31	10	59,622.53
1985	277	88	98	78	13	67,908.55
1986	240	68	90	64	18	69,146.99
1987	131	36	60	25	10	105,222.84
1988	276	49	173	38	16	139,085.30
1989	218	55	71	73	19	216,797.54
1990	308	64	146	75	23	267,549.99
1991	294	61	108	95	30	312,139.74
1992	181	64	52	52	13	532,613.83
1993	116	38	45	16	17	683,869.79
1994	141	46	41	16	38	899,863.22
1995	132	36	43	34	19	1,933,211.55
1996	93	12	51	24	6	2,702,719.13
1997	95	19	43	25	8	2,801,972.58
1998	98	23	37	28	10	2,708,430.86
1999	70	22	17	20	11	3,194,014.97
2000	67	17	24	13	13	4,582,127.29
2001	87	14	29	23	21	4,725,086.00
2002	79	14	18	18	29	6,912,381.25
2003	90	20	26	13	31	8,487,031.57
2004	83	9	24	13	37	11,411,066.91
2005	146	14	29	39	64	14,572,239.12
2006	149	20	34	24	71	18,564,594.73
2007	170	19	23	28	100	20,657,317.67
2008	139	15	16	27	81	24,296,329.29
2009	157	14	16	15	112	24,794,238.66
Total	**4,529**	**954**	**1,748**	**996**	**831**	

Source: NOTAP 2011, GDP (millions of naira)

Table 2a. Augmented Dickey Fuller (ADF) unit root test

Variables	0	1	t	1t
GDP	**-0.874943**	**-3.355595**	0.059651	
TT	-1.488457	-5.275533	-2.002245	
SERV	1.418760	-3.216151	0.053031	
AGRIC	-1.107190	-6.555956	-2.943367	
ENG	-1.929107	-4.974193	-3.196194	
SMC	-1.239788	-5.519584	-3.249238	
OPENNESS	-2.187719	-4.611810	-1.924070	
NETEXPORT	1.628945	-2.404168	-0.147780	
FDI	1.594095	-1.248377	-0.183408	-2.319581
HC	-2.093740			
POP	-0.235698	-5.164336	-5.318397	

Source: Computed by Authors (2013)

Table 2b. Regression of TT content effect on GDP

Dependent variable: D(GDP)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-2.62E+08	53520918	-4.888709	0.0001
TT	1738.712	2785.911	0.624109	0.5387
T	131397.7	26697.97	4.921636	0.0001
R-squared	0.558515	Mean dependent var		951582.0
Log likelihood	-391.0881	F-statistic		14.54846
Durbin-Watson stat	1.603097	Prob(F-statistic)		0.000083

Source: Computed by Author (2013)

4. EMPIRICAL REVIEW (FDI, TECHNOLOGY TRANSFER AND ECONOMIC GROWTH IN NIGERIA)[1]

Empirical evidences [11,12,2] seem to support the assertion that foreign firms through FDI do transfer technologies to their affiliates. This process which can equally allow positive externalities to unaffiliated firms in Nigeria and can in turn increases growth through productivity and efficiency gains by local firms. Examples of these firms are; fast food restaurants, manufacturing firms, oil and gas, and communication sectors and the banking firms etc. so the degree of openness of the country is additive to economic growth [13].

FDI also contributes to economic growth via technology transfer. Trans-nationals companies (TNCs) can transfer technology either directly (internally) to their foreign owned enterprises (FOE) or indirectly (externally) to domestically owned and controlled firms in the host country [14]. Spillovers of advanced technology from foreign owned enterprises to domestically owned enterprises can take any of four ways: vertical linkages between affiliates and domestic suppliers and consumers; horizontal linkages between the affiliates and firms in the same industry in the host country; labour turnover from affiliates to domestic firms; and internationalization of R&D [15].

[2] *FDI is one of the strategies for promoting TT in enhancing economic growth and development in developing countries. 'In every FDI, there is an inbuilt TT content'.*

According to [8], the rising and falling of a nation's economy and technology depends on their ability to adopt and adapt these new technologies. The state of technological capability in Nigeria is worrisome. The prospects for development of the knowledge stocks necessary and sufficient to kick start a sustained industrial revolution is not fully in place now and needs more adoption and adaption of such technologies.

In Nigeria for instance, R & D expenditure as a percentage of GDP is very low. The number of scientists and engineers in R & D (per million populations) is less than 5, patents production is almost zero, weak institutions, manufactured exports constitute less than 5 per cent of total merchandize exports. Still, per capita income is about $400, which is less than Ghana's $600 and less than 10 per cent of Malaysia's roughly $5000. Nigeria's low score on S & T manpower reveals indirect evidence of the economy's weak innovation capability. It also explains why Nigeria has so far been unable to put manufactured exports on the world market let alone ECOWAS market [8].

5. INTERNAL VERSUS EXTERNAL VARIABLES AND ECONOMIC GROWTH

Bengos and Sanchez-Robles [16] asserted that even though FDI is positively correlated with economic growth. Host countries require minimum human capital, economic stability and liberalized markets in order to benefit from long-term FDI inflows. On the other hand, the endogenous school of thought opines that FDI also influences long-run variables such as research and development (R&D) and human capital [11,12]. So, domestic economic activities are crucial in attracting foreign investment. A level of human capital and infrastructural baseline is a prerequisite in attracting FDI. Investment in critical sectors like electricity, human capital, financial services, political stability, roads and security are germane to attracting FDI and economic growth in Nigeria.

Indigenous technological capability policies such as education, technical training, and R&D, increase the aggregate rate of technology transfer from FDI. Export promoting trade regimes (openness) are also important prerequisites for positive FDI impact to reduce technological gap existing between developed and undeveloped countries [17].

Balasubramanyan et al. [18] reported positive interaction between human capital and FDI. They had earlier found significant results supporting the assumption that FDI is more important for economic growth in export - promoting than import-substituting countries. This implies that the impact of FDI varies across countries and that trade policy can affect the role of FDI in economic growth.

The pace of technological change in the economy as a whole will depend on the innovative and social capabilities of the host country with the absorptive capacity of other enterprises in the country. Other than the capital augmenting element, some economists see FDI as having a direct impact on trade in goods and services. Trade theory expects FDI inflows to result in improved competitiveness of host countries' exports [15].

Dutse (2008) reported that the role of FDI in technology transfer and economic growth in Nigeria are for the reasons summarized as follows:

Facilitating Technology Spillover; FDI spillovers may occur in Nigeria through a variety of activities, including labour and management training, technological copying, demonstration, direct licensing of technology, and vertical linkages in the production and distribution value chains. Empirical Evidences show that the generated spillovers depends on the absorptive

capacity of local firms, limited technological gap between foreign and host country firms, and complementarity of foreign and host country technologies, the nature of FDI, the motives and attributes of the foreign investors, high education levels, wealth, fully developed financial markets, and trade openness [19,16].

Encouraging Innovation; Innovation is one of the direct benefits of FDI. It forces local firms to innovate to remain competitive by increasing competition in the host country market. Moreover, Nigerian firms could appropriate productivity benefits from R&D performed by foreign owned firms regardless of where it is performed through imports of intermediate goods produced by the foreign firm and through other channels as evidenced by the work of [20].

Allowing Technology Adoption; OECD [21] reported that FDI may further lead to technology adoption by Nigerian firms through establishing linkages with domestic firms via subcontracting and other mechanisms. By implication Nigerian firms may adopt technologies introduced by foreign firms through imitation, reverse engineering, or vertical linkages.

Developing Local Human Capital; there exist some empirical evidence that affiliates of foreign firms tend to provide training and learning than those domestic enterprises [18]. Foreign firms operating in Nigeria can enhance internal human capital Nigeria's economic growth. Foreign direct investment can enhance transfer of technology communications through training and on-the-job learning. Physical movement of workers, the human capital e.g. knowledge embodied in workers could be transferred to other components of the host economy. In the words of Sam [10], 'I have seen in the power sector, consultancy for a foreign company to come here to do feasibility and checking the status of power plants for more than $20 million. It is alarming seeing this kind of thing'. TT helps to cover the needed gap between developed and underdeveloped.

6. METHOD OF ESTIMATION

The method of estimation used is the Ordinary Least Square (OLS). We choose the OLS because the response variable (GDP) is continuous and its reaction to the explanatory variables will be well approximated by a linear regression equation [23]. Graphs were also used to show the economic dynamics and basis for our qualitative discursions. Critical study period is from 1980 to 2008. Secondary data used were sourced from [24] and [25]. Analytical measure was used to present the trend of the variables and econometric methodology was used to provide empirical evidence on the impact of endogenous and exogenous variable in the Nigeria context.

Keynes open macroeconomic model was adopted to augment the impact of domestic and foreign variable to make vivid their effect on economic growth in Nigeria. The four sector economic model explains (if not all) the determinants of economic performance of a country. Precisely

$$Y = F(C, I, G, POP, NETEXPORT) \quad (1)$$

where Y = economic growth, C = aggregate consumption, I = Investment, G= Government expenditure and POP=Active population.
Equation (1) can be further expressed as;

$$GDP = F(HC, TT, OPENNESS, FDI, POP) \quad (2)$$

Where GDP = measures economic progress
HC = Human capital investment measuring the available educational capability in the country.

OPENNESS = Export plus import divided by GDP in per cent, measuring the degree of globalization and its effect on economic growth. [22] did considered FDI and openness in his model.

TT= number of Technology transfer agreements captured by NOTAP
FDI = Foreign direct investment measuring the number of foreign companies coming to reside in the country for economic purpose.

POP = % of total population between the age 15-64 known as the working and independent population in Nigeria.

$$GDP = \beta_0 C + \beta_1 HC + \beta_2 TT + \beta_3 OPENNESS + \beta_4 FDI + \beta_5 POP + U \quad (3)$$

The variables are expected to positively contribute to economic growth in Nigeria and a high coefficient of determination in that the variables comprises almost all economic activities in a small open economy like Nigeria.

The need to examine the correlation characteristics of the variables is germane to ascertain the interrelations. Below is the correlation characteristic of variable to ascertain how they relates.

Table 3 showed that the degree of openness has weak correlation FDI, GDP, TT and POP but has strong correlation with human capital. FDI, GDP, POP and HC were found to be correlated, hence, FDI relates to domestic economic growth and human capital in Nigeria but the rate at which technology transfer (TT) relates in the economy, more worrisome is the weak correlation of TT with POP, OPENNESS, FDI and even HC in the country.

Table 3. Correlation of variables

	GDP	HC	T	OPENNESS	FDI	POP
GDP						
HC	0.8368*					
T	-0.2381**	-0.5578*				
OPENNESS	0.2616**	0.5926*	-0.4144**			
FDI	0.9773*	0.9112*	-0.3075**	0.3617**		
POP	-0.9763*	-0.8758*	0.2662**	-0.3171**	-0.9889*	

Source: *Authors' construct 2013: * strong correlation and ** connotes weak correlation*

A further examination through Ordinary Least Square (OLS) regression to estimate the effect of these variables on economic growth in Nigeria is germane. Below is the estimate of the regression results in Table 4.

Table 4. Econometric Result of Internal versus External Variables and Economic Growth Nexus in Nigeria

Dependent Variable: LOG(GDP)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-3621.552	594.8514	-6.088162	0.0000
LOG(HC)	476.0259	82.17186	5.793052	0.0000
LOG(T)	-0.263325	0.150394	-1.750900	0.0946
LOG(OPENNESS)	0.456933	0.177820	2.569636	0.0179
LOG(FDI)	0.428117	0.961082	0.445453	0.6606
LOG(POP)	0.049156	19.34971	0.002540	0.9980
R-squared	0.993217	Mean dependent var		14.14828
Log likelihood	9.886075	F-statistic		614.9826
Durbin-Watson stat	0.988634	Prob(F-statistic)		0.000000

Source: Authors' Computation using Eviews 3.1

In Table 4, first the variables were processed to their stationary state to avoid being spurious. Examination of the variables after taking them to their stationary state showed that human capital, FDI and exchange rate are statistically significant at 5%, openness at 10% except domestic investment (DI) and netexport that were not statistically significant. With 98% coefficient of determination and statistically significant f-statistic of the regression indicate that the model is of best fit on the whole. Our findings showed that an increase in FDI by one unit will on the average cause in increase in GDP by 14.6 units. netexport was also positively relating to GDP. A change in the degree of openness and exchange rate showed contrary result as they negatively relates to GDP. This is in line with our earlier correlation hunch about openness.

On the domestic scene, a unit increase in domestic investment (DI) causes 6.9 units increase in GDP. Also, on the average, one unit increase in human capital causes 47 units increase in GDP.

7. CONCLUSION

Conclusions from the findings were that domestic and external variables are economic growth drivers and human capital is crucial for both domestic and foreign investment to strive. Technology transfer (TT) favours economic growth but international channels of TT are not favouring economic growth because the degree of openness is not a favourable. Meanwhile, channels like University Industry (U-I) TT that takes intellectual properties to the market will propel economic growth. However, as macroeconomic activities increases, there is need for deliberate effort to increase human capital investment and good foreign policies to make the foreign investment more favourable to economic growth in the country.

Thus, this paper strongly support innovation and technology transfer as key drivers of economic growth in today's world economy and specifically in Nigeria. Hence, an appropriate economic policy should concentrate on strengthening these processes throughout the country and ease the flow of information and technology between the various actors and stakeholders within the national system of invocation such as – innovators, tertiary institutions, companies, state agencies and financial institutions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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