Foreign Direct Investment and Technology Transfer to Nigerian Manufacturing Firms- Evidence from Empirical Data

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The paper investigates the vertical effects of FDI on Nigerian manufacturing firms. Specifically, the paper asks, do Nigerian manufacturing firms benefit from FDI? As an investigation into the vertical effects of FDI, the paper attempts to establish whether manufacturing firms in Nigeria that receive FDI benefit from technology flows which comes along with foreign capital. The paper employs data from the World Bank Nigerian Manufacturing Survey, 2001. Probit regression was employed for the purpose of analysis. We found that Nigerian manufacturing firms that receive FDI employ more technology than non-FDI firms, essentially due to the influence of foreign capital. We concluded that FDI is beneficial to Nigerian manufacturing firms, since one of the major constraints to the productivity of manufacturing firms in Nigeria is dearth of technology.

Keywords: Foreign Direct Investment, Technology Transfer, Manufacturing Firms, Productivity, Nigeria

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I. Introduction

The debate on the role of Foreign Direct Investment (FDI) in recipient countries, especially the less developed countries is an old one. Narula (1997) observed that, recorded debate in the literature on the merits and demerits of FDI started in the 1960s; it appeared in the works of Reuber *et al* (1973) and Lall and Streeten (1979) and is still far from over. Many studies have found positive complementarities between FDI and domestic firms in host economies; Mansfield and Romeo (1980), Rhee and Belot (1989), Rozelle *et al* (1996) Chung (2000), Kinoshita (1998), Djankov and Hoekman (1999), Sousa (2001), Aitken and Harrison (1999); others have found negative effects, Aitken and Harrison (1999), Konings (2001), De Backer and Sleuwaegen (2003), Caves (1996); yet others claim that the effects are non-existent. Even as studies are still inconclusive on whether the overall effects of FDI on firms in host economies are positive or negative, many countries have placed attracting FDI high on their agenda. Javorcik and Spatareanu (2004: 2) noted that, despite being important to public policy choices, there is little conclusive evidence on whether firms benefit from foreign presence in their country.

In Nigeria, no foreign economic policy has received significant attention from the late 1990s, as debt cancellation and FDI. The United Nations Conference on Trade and Development, UNCTAD (1999: 48-49) reported that by 1999 Nigeria has signed six (6) bilateral investment treaties (BITs) and eleven (11) double taxation treaties (DTTs) aimed at encouraging the inflow of FDI. In effect, the Overseas Development Initiative, ODI (1997) noted that by the end of the 1990s, Nigeria was the second largest recipient of FDI among low-income countries, among which were China, India, Bangladesh, Vietnam, and countries of African region. Important, however, is that such policies that seek to attract FDI should be informed by some empirical evidence on the role of FDI in the Nigerian economy. And research on the impact of FDI on the performance of firms in Nigeria is rather scarce. It is in the light of this that, this paper investigates the impact of FDI on

technology transfer to Nigerian manufacturing firms with a view to informing macroeconomic and organisational policy. At the macroeconomic level, policy makers can use the outcomes of the research in formulating macroeconomic policies that can sustain positive spillovers between foreign and domestic firms. Corporate executives, on the other hand, could find the study useful in identifying the possible benefits domestic firms can enjoy from the presence of international capital in the domestic economy, especially in the area of technology transfer.

The paper is divided into six sections. This introduction is the first section. Section two looks into the factors affecting FDI flow into the Nigerian economy, followed by section three which is a literature review on the impact of FDI on technology transfer to host economies. Section four presents a brief explanation of the methodology employed. In section five, we present and discuss the results of the investigation. Section six is conclusions and recommendations.

II. Factors Affecting the Flow of FDI into the Nigerian Economy

The unpredictability of autonomous FDI flows has made it difficult for research to determine with a high degree of specificity which factors are the major determinants of FDI flow. Researches on the industry-specific and host-country determinants of FDI flow have resulted to a non-consensus among scholars.

Though Banga (2003: 24) has argued that until recently there was a strong consensus in the literature on why Multinational Corporations (MNCs) invest in specific locations. Banga (2003) found that FDI is attracted to those economic fundamentals like large market size; low labour cost, in terms of efficiency wages taking into account the productivity of labour; availability of high skill levels captured by secondary enrolment ratio in the economy; lower external debt reflecting the financial health of the economy; and extent of electricity in the economy. Nunnenkamp (2002) and Kokko (1994) agreed with Banga (2003) that the non-consensus among scholars on the determinants of FDI is a recent

phenomenon. Nunnenkamp (2002) has argued that the determinants of and motivations of FDI in developing countries have changed recently in the process of globalisation. Kokko (1994) agrees that as a result of globalisation, it would no longer be sufficient to offer promising markets in order to induce FDI inflows.

Part of the reason explaining the inability of researchers to arrive at a consensus on the determinants of FDI flows is the fact that countries (both supplying and receiving FDI) may be structurally diverse. Sometimes the value definitions and choice of corporate executives (of investing companies) may influence the choice of locations and may determine whether economic, political or some other factors are given consideration in the choice of host countries. Within the reality of this non-consensus, we try to identify which factors are likely to determine the inflow of FDI, especially to Nigeria. In this regard, the study by the Overseas Development Initiative, ODI (1997), Broadman and Sun (1997), Singh and Jun (1995), Asiedu (2002), Bhinda *et al* (1999), and Pfefferman (1996) among others were found useful.

To comprehend how factors discussed in the following paragraphs affect FDI inflows in Nigeria, it is apt to distinguish between market-oriented and non-market seeking FDI. Asiedu (2002: 5) explains that the main objective of market-seeking FDI is to serve domestic markets. Thus, in the case of market-seeking FDI, goods are produced in the host country and sold in the local market. As a consequence, this type of FDI is driven by domestic demand such as large market and high income in the host country. FDI in small and poor countries is less likely to be market-seeking (Asiedu, 2002: 5). For non-market seeking FDI, goods (intermediate or finished) are produced in the host country but sold abroad.

II.1 Market Size

One of the major factors explaining the inflow of FDI into an economy is the attractiveness or the largeness of its market. Scholars have explained the inflow of

FDI into the Nigerian economy in terms of the attractiveness of its large market size. With a population exceeding 120 million, Nigeria is Africa's most populous nation, and among the 10 most populous countries in the world.

Studies conducted in various countries have indicated a well-established correlation between FDI and market size (usually proxied by the size of GDP). According to Broadman and Sun (1997) there is little doubt that the size of China's market explains, in large part, the massive FDI flows it has attracted since the early 1980s. Within China, FDI has been concentrated (over 90%) in the coastal areas. This concentration is explained by the size of Provincial GNP reflecting economic development and potential in the area.

Similarly, in Nigeria, market size is considered as a major determinant of the inflow of FDI. In 1995, Nigeria was among the highest recipient of FDI (the third) among other sub-Saharan African countries. ODI (1997) explains that for the majority of low-income countries which fail to attract FDI flows, their small domestic markets are often cited as the main deterrent. Given other economic and political shortcomings, most investors are doubtful about the value of installing a factory unless they can achieve a 'critical mass' for their products. Even in countries with large market size, the importance of high income cannot be overemphasized. Bhinda *et al* (1999: 52) explain that major indexes of a small domestic market to a foreign firm are low income (GDP per capita) which reduces purchases of high-cost goods, a resulting low domestic savings rate which limits local investment and a small domestic market measures in population. Most investors find these indexes, especially low income, as deterrents. Bhinda *et al* (1999: 5) however noted that some dynamic investors have developed three alternative strategies of dealing with these deterrents. Some focus on low cost goods in low-income countries since "there are some goods everybody must use". The second strategy (usually employed by Eastern Asian and South African firms) is to invest in high-income markets and the last is to focus on exports.

II.2 Openness of the Host Country

While access to specific markets- judged by their size and growth- is important, domestic market factors are predictably much less relevant in export-oriented foreign firms. A range of surveys suggest a widespread perception that 'open' economies encourage more foreign direct investment (ODI, 1997: 5). One indicator of openness is the relative size of the export sector. Singh and Jun (1995) indicate that exports, particularly manufacturing exports, are significant determinants of FDI flows, and their study provides strong evidence that exports precedes FDI flow. In Nigeria, though manufacturing exports may not be major determinants of FDI inflow, non-market seeking FDI is attracted to the extractive sector dominated by activities of the petroleum sub sector. The ODI (1997: 2) reported that among low-income countries in 1995, Nigeria was the second largest FDI recipient, next only to China. ODI (1997) explained that traditionally FDI has been concentrated in the extractive industries, but there has been a recent diversification into the manufacturing sector, which had 47% of FDI stock in 1992.

Asiedu (2002: 8) noted that the impact of openness on FDI depends on the type of investment. Market-seeking and non-market seeking FDI are expected to respond differently to openness of a host economy. Asiedu (2002: 8) explains that when investments are market-seeking, trade restrictions (and therefore less openness) can have a positive impact on FDI. The reason stems from the "tariff jumping" hypothesis, which argues that foreign firms that seek to serve local markets may decide to set up subsidiaries in the host country if it is difficult to import their products to the country. In contrast, export-oriented FDI and therefore, non-market seeking may prefer to locate in a more open economy since increased imperfections that accompany trade protection generally imply higher transaction costs associated with exporting.

II.3. Political Risk

The ranking of political risk among FDI determinants remains somewhat unclear (ODI, 1997: 5). To measure political risks, many studies use a combination of political instability (which measures the probability of a change in government) and political violence (the sum of the frequency of political assassinations, violent riots and politically motivated strikes).

Using the above operational definition, Asiedu (2002: 9) supports ODI (1997) that the empirical relationship between political instability and FDI flows is unclear. Whereas Jasperson *et al* (2000) and Hausmann and Fernandez-Arias (2000) find no relationship between FDI flows and political risk, Schneider and Fry (1985) find an inverse relationship between FDI flows and political risk. Bhinda *et al* (1999: 61) contended, however, that stable government has encouraged investment in Tanzania, Uganda, South Africa and (until recently) Zimbabwe. According to them, stability need not entail democracy so much as an enabling environment for business. They further noted that social instability and crime are equally important. Most potential OECD investors feel they would be unsafe in Africa's cities, in spite of increased policing. ODI (1997: 5) explains that where the host country possesses abundant natural resources, no further incentive may be required, as is seen in politically unstable countries like Nigeria and Angola, were high returns in the extractive industries seem to compensate for political instability. So long as the foreign company is confident of being able to operate profitably without undue risk to its capital and personnel, it will continue to invest.

II.4. Labour Costs and Productivity

Labour costs and productivity are another class of determinants of FDI. Most studies, however, suggest that for labour cost to be an inducement for FDI, it has to be associated with a relatively high labour productivity. The reality in most African countries is that lower labour costs though widely prevalent, is not

sufficient inducement for the inflow of FDI, as labour productivity in most of these countries is usually low. Except in peculiar cases, most countries (like Nigeria) with dense population are usually associated with low labour costs and are therefore potential attractions to FDI. As mentioned earlier, however, low labour productivity hinders FDI even in highly populated countries as investors search for labour with better value.

II.5. Infrastructures

According to the ODI (1997: 6) infrastructure covers many dimensions, ranging from roads, ports, railways and telecommunication systems to institutional development (e.g. accounting, legal services etc.). Thus, both social and economic (including financial) infrastructures are relevant to our definition. Though views differ on whether poor infrastructure is a minor or major incentive, majority view hold that poor infrastructure is a major disincentive. Surveys in sub-Saharan Africa indicate that poor accounting standards, inadequate disclosure and weak enforcement of legal obligations have damaged the credibility of financial institutions to the extent of deterring foreign investors. Bad roads, delays in shipment of goods at ports and unreliable means of communication have added to these disincentives (ODI, 1997: 6) Bhinda *et al* (1999: 53) reinforced this view; high domestic interest rates due to inflation, inefficient local financial intermediaries (and to the effects of capital inflows themselves!) were also strong deterrents. To the degree that financial sector problems or underdevelopment deter local investment, they also deter foreign investors by indicating a low local investor confidence. Riddell and Cockroft (1991) noted that financial infrastructures are also vital, and South Africa's developed banking system, akin to many first world countries, enables it to attract significant FDI.

Despite the role that infrastructures could play as incentives to attract FDI, evidence points to the decay in infrastructures in Nigeria. Social, economic and financial infrastructures are on the verge of collapse. Nigerian roads are largely

un-motorable and electricity generation has remained a major problem. AfDB/OECD (2004: 258) reported that the total generating capacity of Nigeria's existing power stations is estimated at 5,400 megawatts (MW). However, only 1,600 MW (29 percent) of this is actually generated. They further noted that electricity supply has been unreliable, leading to high production costs for companies, which are forced to procure and run their own power generating facilities.

Thus, if infrastructures are incentives to foreign investors as evidenced in a number of studies, then Nigeria's ability to attract FDI is hindered by the dearth of social, economic, financial and legal infrastructures.

II.6. Privatization

Though a number of economic policies may serve as determinants of FDI flow to less developed countries like Nigeria, privatization is particularly worthy of mention. This is because a number of studies have found particular evidence to support the positive role of privatization in attracting FDI; and in Nigeria, privatization has in the last decade and a half been a major policy used to attract FDI flow. Though the appropriateness of some privatization procedures in the country are still subject to debate, it is not within the context of this work to assess the privatization policy to test its relative success or failure. The ODI (1997: 6) reported that privatization has attracted some foreign investment flows in Nigeria in 1993 and in Ghana in 1995. At a regional level, ODI (1997: 6-7) reported that in 1994, 15% of FDI flows to Latin America is derived from privatization, 8.8% in sub-Saharan Africa and 1.1% in South Asia.

Though some amount of FDI flow in Nigeria has in recent years been attributed to privatisation, the programme has not generated the amount of FDI commensurate to the amount of attention it has received in Nigeria recently. The ODI (1997: 7) explained that in most African countries, a number of structural problems are

constraining the process of privatisation. Financial markets are slow to become competitive; they are characterised by inefficiencies, lack of depth and transparency and the absence of regulatory procedures. Taking into consideration such problems of privatisation in sub-Saharan Africa, Bhinda *et al* (1999: 57-58) noted that privatisation will as a result not be a magic key to FDI.

II.7. Social Factors

Social instability, crime and corruption are considered the bane of FDI flow in Nigeria. The recognition of Nigeria (ns) as top-ranking in corruption, fraud and other financial improprieties such as "419" has resulted to loss of investors' confidence to invest in Nigeria generally and particularly to partner with Nigerians. Nigerians traveling around the world are treated with caution, as they are seen to epitomize corruption, crime and other social vices. The office of the US Trade Representative, USTR (2002: 314) which is a US government department concerned with trade and international investments, has noted that fraud, theft and extortion are endemic in Nigeria and reported that in general, US investors remain very cautious about conducting business in Nigeria.

Bhinda *et al* (1999: 62) agree that corruption is a powerful deterrent to potential investors who see it as endemic across Africa. Both public and private sector organisations in most African countries are grappling with the problem of corruption. The entire bureaucratic system is entrenched with the corruption and fraud disease.

The **fDi** Magazine (2003) noted that in Nigeria "...corruption is real, it exists at all levels and is difficult to avoid". The **fDi** Magazine (2003) also noted that in Nigeria crime is an issue, particularly in the commercial center Lagos; citing cases of violent street crimes, armed robberies, muggings and car-jacking, while hostage-taking for ransom may occur in the states of Delta, Rivers and Bayelsa. On the

whole, the summary of the social problems in Nigeria indicate that social issues pose serious constraints to foreign investors in Nigeria and pushes up the cost of doing business. These are social issues that must be properly addressed to encourage the influx of FDI.

III. Foreign Direct Investment and Technology Transfer- A Review of the Literature

The debate on the role of FDI in host economies is an old one. Neo-classical economists have argued long ago that, developing countries have resource gaps in their economies, which are inimical to growth and development. They also argued that FDI brings with it resources that could wipe off these gaps and engender growth in developing economies. According to Todaro (1981: 403) the pro-foreign investment arguments largely grow out of the traditional neoclassical analysis of the determinants of economic growth. FDI is typically seen as a way of filling-in gaps between domestically available supplies of savings, foreign exchange, government revenue, technology and management skills, and the planned levels of these resources necessary to achieve development targets. Meier (1984: 324) argued in line with the neoclassical economists that, FDI brings managerial ability, technical personnel, technological knowledge, administrative organisation and innovations in products and production techniques all of which are in short supply. Odife (1989: 85) added that FDI offers an alternative to purchase of the needed technology abroad or the raising of loans in foreign markets, which are both expensive and are available only for shorter periods.

Marxist-Leninist scholars, on the other hand, have argued that multinational corporations and FDI merely perpetuate the dependency relationship between developing and developed countries. They argued that domestic firms are bound to suffer from the consequences of competition with foreign firms or even their subsidiaries/partners. Thus, they contended that, whereas FDI perpetuates the dependency relationship between developing and developed countries, domestic

firms are likely to be adversely affected by this dependency or even become edged out due to a competition in which they are the weaker side. De Backer and Sleuwaegen (2003: 45) suggested that, though investigations on the "crowding-out" effect of FDI on local entrepreneurship has mainly concentrated on developing countries, even in open-minded industrialised countries like Belgium, import competition and FDI discourage entry of new local entrepreneurs (firms) and stimulate exit of domestic firms.

In recent times, empirical research has proliferated on the effects of FDI in host economies. Contemporary research has dwelled extensively on explaining both the vertical and horizontal effects of FDI on firms in host economies. Vertical spillovers explain effects of FDI firms on their local subsidiaries, partners or their local suppliers. Most studies report positive spillovers in these types of relationships, due to some amount of cooperation between Multinational Corporations (MNCs) and domestic firms in these categories. Horizontal spillovers on the other hand, refer to the spillover effects of FDI on domestic firms they compete with in the same industry. Results from studies on horizontal spillovers show that horizontal spillovers could be positive or negative.

However, research on the effects of FDI on firm performance in Nigeria is still very scarce. It was Narulla (1997) who commenced a pilot study on the role of multinational corporations in the acquisition of industrial technology in Nigeria. He found that developing country multinational do not necessarily acquire technology from their home country but also found that tangible technology they transfer is also acquired by domestic firms. Asiedu (2002) only studied the determinants of FDI in Nigeria among other African countries. Both studies fall short of explaining the relationship between FDI and firm performance in Nigeria or even whether FDI accelerates the process of technology transfer to domestic firms in Nigeria.

However, some empirical research done in other countries on the effect of FDI on firms' employment of technology in host economies has presented mixed results. Aitken and Harrison (1999: 605-606), for example, observed that case studies present mixed evidence on the role of foreign investment in generating technology transfer to domestic firms. Kinoshita (1998: 2), however, found that FDI is instrumental to technology transfer to domestic firms in host economies and explained that there are four channels through which FDI can possibly affect the productivity of local firms through technology transfer. These are the demonstration or contagion-imitation effect, competition effect, training effect, and through backward and forward linkages.

Evidence of technology transfer through the contagion-imitation effect is supported by Kokko (1994) and Blomstrom and Kokko (2003). In explaining the demonstration effect; differences exist in the levels of technology between foreign and local firms. Foreign firms with more advanced technologies enter a local market and introduce newer technologies to the industry. Through direct contact with foreign affiliates, local firms can watch and imitate the way foreigners operate and can therefore become more productive. This may also occur through a labour turnover from foreign to local firms in which case, employees from foreign firms are employed by domestic firms and they bring with them knowledge of new technologies employed by their former employers. The existence of this kind of channel is widely recognised in the literature. And importantly, this is one of the conduit through which technology brought by foreign direct investments can benefit domestic firms, regardless of whether they have some amount of foreign investments or none at all.

The competition effect may occur as follows: the entry of foreign firms lead to more intense competition in the local industry and local firms are forced to be more efficient in using existing technologies and resources (Kinoshita, 1998: 3). Local firms may also have to introduce new technologies by themselves in order to

maintain market shares. Increased competition may be able to eliminate monopolistic profits and enhance the welfare of a host country. Many scholars believe that through this channel, domestic firms that compete with foreign firms, their partners or subsidiaries are forced by the competition effect to adopt new and improved technical processes. Gorg and Greenaway (2004: 174) agree that unless an incoming firm is offered monopoly status, it will produce in competition with indigenous firms which leads to a horizontal spillover of technology. They further explain that even if indigenous firms are unable to imitate the multinational's technology and production processes, entry of the multinational firm puts pressure on them to use existing technology more efficiently, yielding productivity gains.

The costly effort to train local workers leads to technology transfer and productivity improvements among domestic firms (Kinoshita, 1998: 4). Though this is also associated with labour effects, many believed that training is an avenue through which FDI transfer technology to domestic firms. Kinoshita (1998: 4) explains that "training effect", is a situation in which on-the-job training may be provided by foreign joint ventures partners, foreign buyers or suppliers leading to a vertical effect of FDI on domestic firms. Often local firms train their own workers to increase product quality in order to cope with foreign entrants with a competitive edge. The arrival of new technology alone may not create productivity growth in a host country unless the labour force builds up the corresponding skills. Jovanovic (1997) explains that technologies are laws of physics that are relevant to a particular way of producing something. These laws are described in blueprints. A blueprint, however, is an incomplete description of what is useful to know about the technology at hand. This incompleteness creates a role for training and learning by doing as ways of building up the specific human capital. Thus, training which involves the accumulation of these skills is considered as an invaluable investment and an important ingredient in the transfer of technology since the skill acquired is specific to the technology.

Backward and forward linkages may arise when foreign affiliates engage in transactions with local suppliers and customers. For example, when the cost of communication and transportation is high, then the MNCs often choose to purchase intermediate goods from local producers. Foreign firms may provide technical assistance and training to local suppliers, or may assist them in purchasing raw materials so as to maintain the quality of intermediate goods. Even in the absence of such direct involvement, local suppliers are forced to meet demand for higher quality and on-time delivery and to innovate more (Kinoshita, 1998). This is the "backward linkages" effect. Backward linkage is encouraged in the presence of "local content requirements"- which means that foreign firms have to purchase a certain percentage of intermediate inputs in a host country instead of importing from suppliers abroad. It is also possible that technology spillovers occur through forward linkages. Kinoshita (1998: 3) explains that in many industries in developing countries, as technical complexity increases, domestic producers may seek to purchase intermediaries from suppliers whose goods are superior to those obtained from local suppliers.

It is this backward and forward linkages otherwise known or categorized as vertical effects of FDI that this paper investigates. As existing literature is replete with contending arguments on the roles of FDI in host economies, it is important that the effect of FDI on domestic firms be investigated. This is especially so in Nigeria since government has placed attracting FDI high on its agenda. This paper makes contribution to the scarce literature and empirical studies on the effect of FDI on technology transfer to domestic firms in Nigeria.

IV. Methodology

Notably, authors in this line of study have pointed to some difficulties in estimating the effects of FDI on domestic firms. Keane (2004: 1) noted that any attempt to infer the effects of FDI on domestic firms must confront a number of

severe econometric challenges. According to Keane, the econometric specifications estimated in the current literature do not seem to be closely tied to any underlying economic theory that specifies the mechanisms through which productivity spillovers might occur.

Closely related to this is the fact that, previous researches use cross-sectional data in investigating the effect of FDI on domestic firms. This is because most studies failed to overcome important data restrictions and could not access firm-level data. The danger as explained by Gorg and Greenaway ((2004: 176) is that cross-section data, particularly if aggregated at the sectoral level, fail to control for time-variant indifferences in productivity across sectors that might be correlated with foreign presence without being caused by it. Thus, coefficients on cross-section estimates are likely to be biased.

Gorg and Strobl (2003) have argued that panel data using firm-level data are the most appropriate estimating framework for two reasons. First, they permit investigation of the development of domestic firms' productivity over a longer time period, rather than at one point in time. Second, they allow investigation of spillovers after controlling for other factors.

This study investigates the effect of FDI on technology transfer to Nigerian manufacturing firms using firm-level data that covered a period of eleven years (1990-2000). The data used in this analysis was collected by the Regional Programme on Enterprise Development (RPED) Department of the World Bank in a survey research on Nigerian manufacturing firms conducted in 2001. A team of World Bank specialists conducting a survey of Nigerian manufacturing firms administered questionnaires and interview modules on a sample of 232 firms in the Nigerian manufacturing sector. The questionnaire comprising about 190 structured questions, was designed in ten (10) sections that covered most conceivable questions on firm characteristics. The structured questionnaire gave

respondents a "Yes" or "No" choice, or the opportunity to rate their responses on a likert scale with values ranging from a minimum of 1-5, and a maximum of 1-10 in cases where respondents are expected to rank a number of options. Data from this survey was collated and stored in electronic form in the premises of the World Bank in Washington, DC for the purpose of research[5].

The paper developed a hypothesis, thus:

$\mathbf{H_1}$: FDI firms have more investment in technology, and therefore, employ more technology than non-FDI firms.

$\mathbf{H_0}$: FDI firms do not have more investment in technology, and therefore, do not employ more technology than nor -FDI firms.

The regression model employed in the analysis is given as follows:

$techo1_{it} = a + \beta_1 fdistartup_{it} + \beta_2 fdisurvey_{it} + \beta_3 firmage_{it} + \beta_4 sectorid_{it} + \beta_5 region_{it} + \beta_6 firmsize_{it}$ ..... (i)

Where:

$tech01_{it}$ = the measure of technology of firm i at the time of survey t (1= firm with FDI,

o=otherwise)

a= an intercept

$\beta_1 fdistartup_{it}$ = firm i that commenced business with FDI at time t

$\beta_2 fdisurvey_{it}$ = firm i with FDI at the time of survey t

$\beta_3 firmage_{it}$ = the age of firm i at the time of survey t (years)

$\beta_4 sectorid_{it}$ = the sector of firm i at the time of survey (1=food and beverages sector,

o=otherwise)

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[5] *The author is grateful to Giovanni Tanzillo and Giuseppe Iarossi of the RPED, the World Bank, for granting him permission to use data and facilities of the World Bank, Washington DC on 21st and 22nd February, 2005 as a visiting Fulbright Scholar*

$\beta_5 region_{it}$ = the region where the firm *i* is located at time *t* (1=East, o= otherwise)
$\beta_6 firmsize_{it}$ = the size of firm *i*, whether small-medium or large at time *t* (1 = if large, o = otherwise)

The model is developed from the direct relationship some studies have found between FDI and technology transfer to domestic firms, especially in developing countries (Mansfield and Romeo, 1980; Chung, 2000; Kinoshita 1998 among others). These studies found that FDI in developing Asian economies transfer technology to domestic firms. The findings of Kinoshita (1998), for example, have been discussed in the literature review. We are able to, therefore, develop a probit regression hypothesizing such direct relationship between FDI and technology in Nigerian manufacturing firms. In addition to testing the relationship between FDI and technology in Nigerian manufacturing firms that have received FDI (*fdistartup* and *fdisurvey* firms), the model was also able to test whether firm age, firm size, the sector in which the firm operate and the region of the location have anything to do with the relationship.

V. Results and Discussions

The model described in section three was run on STATA statistical software. From the results in Table 1 (see appendix I), there is a significantly positive relationship between FDI firms and employment of technology. Firms in the sample that have some amount of FDI at the time of the survey (*fdisurvey* firms) have significantly greater investments (at 1% level of significance) in technology than non-FDI firms. Thus, the hypothesis H_1, that FDI firms employ more technology than non-FDI firms is accepted. The fact that firms with FDI at the time of the survey (*fdisurvey* firms) employ more technology than firms without FDI show that the influx of FDI into Nigerian manufacturing firms also come with the advantages of technology. The fact that many studies have found positive relationship between the employment of technology and firm growth show that FDI can instill growth in Nigerian manufacturing firms through technology spillovers.

It is not evident in the result whether firms in some sectors are more likely to employ more technology than firms in some other sectors. The result of the regression analysis did not point to any significant relationship between the sector of operation and employment of technology. However, the result indicates a significant but negative relationship between firms in region 2 (North) and the employment of technology. This result shows that firms in region 2 are likely to employ less technology than firms in region 1 (East). Thus, manufacturing firms in northern Nigeria employ less technology than firms in the eastern region. A major explanation for this finding emanates from the fact that the majority of oil companies operating in Nigeria, which are technical intensive, are located in oil rich eastern part of Nigeria and are likely to employ more technology than firms in the other regions.

A number of implications could be drawn from the findings above. First, is the idea that FDI serves as a machinery through which technology is transferred from the more industrialized countries to the less developed countries thereby assisting in the process of bridging the technology gap in those countries. By implication, FDI could assist in the transfer of technology into the Nigerian economy, and specifically into the Nigerian manufacturing sector. However, a number of other issues are conjoined to this. Questions like, "are domestic firms likely to benefit from this transfer of technology, or, does the technology transferred into FDI firms eventually spillover into domestic firms?" become relevant. While we did not test for the existence of horizontal spillovers within the manufacturing sector, and thus, we cannot assert that such spillovers do exist, the questions are current, timely and valid. This is because, while the transfer of technology into FDI firms in the Nigerian manufacturing can register positive effects on firm performance and the growth of the economy, a horizontal spillover effect can instill a wider range of efficiency among Nigerian manufacturing firms. This is especially because the availability of technology is a powerful variable in explaining the performance, or lack of it, of manufacturing companies.

Thus, that FDI firms receive technology is an indication that those firms in Nigeria that partner with or are subsidiaries to foreign firms, benefit from technology spillover through FDI. For domestic non-FDI firms that compete with FDI firms, competition may as a matter of necessity force them to improve upon their current technology or become edged out of the market. However, their ability to 'imitate' the technology of their FDI firms' competitors, in other words their 'absorptive capacity', will depend on the existing gap between their current state of technology and the one employed by the FDI firms. The wider the gap, the less likely that domestic firms will imitate technology employed by FDI firms. Glass and Saggi (1998) agree that the technology gap between host and home country indicates the absorptive capacity of host country firms. The larger the gap, the less likely are host country firms to have the human capital and technological know-how to benefit from the technology transferred by multinationals. Thus, domestic firms might 'imitate' the technology employed by FDI firms and benefit as result by experiencing improvement in their productivity, if they possess the absorptive capacity.

A point of note, however, is the possibility that the competition effect is harmful to a host economy and domestic firms when local firms are not efficient enough to compete with foreign entrants and their technology. In this case, local firms may be wiped out of the market. Similar conclusions were reached at by Aitken and Harrison (1994) and Kokko (1994). In another work, Aitken and Harrison (1999) argue that when domestic firms are unable to 'catch-up' with FDI firms technologically, FDI firms will produce at lower marginal costs than host country firms and will have an incentive to increase output and attract demand away from these firms. This will cause host country rivals (domestic firms) to cut production which, if they face fixed costs of production, will raise their average cost and, therefore, reduce their probability of survival.

However, for FDI firms (partners or subsidiaries) the improvement in technology will raise productivity and all other things being equal, reduce their average cost of production. This finding establishes that technology transfer between FDI firms and their overseas affiliates improves the technology of those affiliates and eventually reflect on their performance. Thus, at the micro level, firms that receive FDI enjoy the employment of better technology and perform better than non-FDI firms. The possibility of an aggregate positive or negative effect is subject to a macro-level investigation of the technology effects of FDI on domestic firms, especially the competition effect between them and FDI firms that employ better technology.

VI. Conclusions and Recommendations

There is evidence of vertical spillover effects through FDI, with FDI firms (partners or subsidiaries) receiving technology that help in enhancing their performance. This paper concludes that FDI could serve as a source of technology for Nigerian manufacturing firms and could facilitate the process of technology transfer in Nigeria. That FDI firms invest more in technology than non-FDI firms indicated that FDI can facilitate the sourcing of better technology in the first instance for firms that partner with foreign investors or are the subsidiaries of multinational corporations and in the second instance for wholly-owned domestic firms through possible spillover effects.

It is, therefore, recommended that the Nigerian government should at the macro level encourage the inflow of FDI because it comes along with some positive effects on firm performance in Nigeria; evidence show that FDI brings along more technology. However, in the implementation of policies that seeks to attract FDI, the Nigerian government should encourage the establishment of joint ventures and partnerships between foreign and local investors. Whereas liberalization policies will enable multinationals to establish their subsidiaries without necessarily partnering with local investors, additional incentives should be

provided to those businesses that seek to establish on the basis of partnership between local and foreign investors. This will minimize the adverse effects of profit repatriation and will enable entrepreneurs to benefit from the managerial skills and expertise of their foreign partners.

Nigerian manufacturing firms and their executives should consider FDI as a strategy of addressing the dearth of technology facing them. Foreign investors have more access to, and information on, technology sources; their capital contribution can raise the level of firm's ability to acquire technology. Previous industrialization policies like the ISI have failed due to the high cost of importing technology by both small and large scale manufacturing firms.

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Appendix

Table 1: Probit Regression Results for the Effect of FDI on Technology Transfer to Nigerian Manufacturing Firms

Dependent variable Independent variable	Technology
Fdistartup	0.0276 **0.0876**
Fdisurvey	0.1955*** **0.0637**
Firmage	-0.0015 **0.0637**
Sector 2= Wood and furniture	-0.2177 **0.1803**
Sector 4= Textile and garments	-0.1267 **0.1441**
Sector 6= Metal	-0.1889 **0.1335**
Sector 7= Chemical and paints	00.1335 **0.1199**
Sector8= Paper/printing/publishing	0.1048 **0.1402**
Sector 9= Non-metal	0.0097 **0.1312**
Sector 11=Others	0.0808 **0.9699**
Sector 12= Pharmaceuticals	0.0956 **0.0973**
Sector 13= Plastics	-0.0114 **0.1184**
Region 2= North	-0.2597** **0.1220**
Region 3= Lagos/South	-0.0852 **0.0929**
Firmsize	0.1202 **0.0793**
Prob.> x^2	0.0020
Pseudo R^2	0.1373

*, **, *** significant at 10%, 5% and 1% level respectively