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Technological Spillovers from Multinational Companies to Small and Medium Food Companies in Nigeria

Isaac O. Abereijo and Matthew O. Ilori
Obafemi Awolowo University, Ile-Ife
Nigeria

1. Introduction

The economic future of developing countries like Nigeria depends to a greater extent on whether and how domestic small and medium enterprises (SMES) benefit from the present liberalisation and globalisation. This is because unlike the previous decades, the most important determinants for survival from the 1990s are now quality, speed and flexibility (Economic Commission for Africa, 2001). Empirical evidences however show that majority of SMEs in developing countries are not well prepared both for these new conditions and for the increased competition of the global markets (UNCTAD, 2005). While the trade liberalisation is increasing the ability of well-established foreign firms to penetrate remote and underdeveloped markets, the SMEs in developing countries are finding it difficult to survive or, at least, maintain their business position in the local market (UNCTAD, 2005). This is because majority of SMEs lack the adequate resources to conduct research and development (R&D) which is traditionally considered as the main source of technological innovation for competitiveness.

The central finding in the literature on innovation indicated that, in most cases, innovation activities in SMEs depend heavily on external sources for them to remain competitive (Fagerberg, 2005; Abereijo and Ilori, 2010). Equally important is the international knowledge flows through foreign direct investment (FDI), trade, licensing and international technological collaborations, which can serve as important determinants of the development and the diffusion of innovations to SMEs (Damija, Jaklič and Rojec, 2005). Infact the international lessons on SME development show that external factors such as inter-firm co-operation, institutional support, and learning from various external sources of knowledge are playing a key role in helping SMEs to build up technological capabilities that will enable them compete in regional and global markets.

FDI, as one of the external sources, is theoretically assumed to play an important role in assisting local firms to experience production externalities from technological spillovers both within industry and across industries. The empirical relevance of the spillover argument is conceptually related to the transfer of non-conventional factors of production, including technology, management skills, and motivation between foreign and domestically owned firms (Vera-Cruz and Dutrenit, 2005).

Among the channels through which technological spillover can occur from the presence of multinational companies (MNCs) are linkage and human capital. The linkage between MNCs and SMEs can help integrate SMEs into international chains of production at various stages of added value. It can also serve as one of the fastest and most effective ways of upgrading the technological and managerial capabilities of local SMEs for innovations (United Nations Conference on Trade and Development, 2006). The spillover through human capital is associated with the continuous training of employees by MNCs and the mobility of these employees toward domestic SMEs. Therefore, apart from contributing to the development of technological and managerial capabilities of the local firms, human capital spillover can also increase their absorptive capacity for technological innovations.

As a result of the potential role of MNCs in accelerating growth and economic transformation, many developing countries in general and Africa in particular, seek this type of investment to accelerate their developmental efforts. This in turn has led many African countries to put in place various measures that they hope will attract MNCs to their economies, including improving their investment environment. Specifically in Nigeria, government legislated two major laws which are meant to guarantee investments against nationalisation by any tie of government, and to ensure the free transfer and repatriation of funds from Nigeria. These laws are the Nigerian Investment Promotion Commission (NIPC) Act 16 and the Foreign Exchange (Monitoring and Miscellaneous Provision) Act 17, both of which were enacted in 1995. The NIPC was established to address the problems of multiplicity of government agencies which foreign investors confront when they come to Nigeria. All these efforts are meant to encourage, promote and coordinate foreign investment and enhance capacity utilisation in the productive sector of the economy (NIPC, 2006). This also provides an opportunity for foreign participation in Nigerian enterprises up to 100 percent ownership.

However, efforts at justifying the incentives being offered by the governments of developing countries at attracting the MNCs have made researchers to conduct various studies to establish its benefits (spillover effects) to the developing economies. Though there were positive technological spillovers from MNCs in some developing countries, the results of empirical researches are far from been conclusive (Hausmann, 2000; Kapstein, 2002; Narula and Marin, 2003). One of the reasons adduced for the inconclusiveness was that impact of MNCs depends on a multitude of factors, such as the levels of technology used in domestic production, education of the workforce, financial sector, and institutional development in the host country (Krogstrup and Matar, 2005). These factors determine whether the host country can absorb and hence benefit from MNCs.

Aside from the above factors, two main issues have been identified recently in the literature, which are also responsible for the inconclusiveness of the results (Gachino, 2007). This concerns the conceptualisation of the spillover occurrence. The first issue is the methodological approach employed in the studies; and the second is the inherent weaknesses in spillover analysis. On the issue of methodology, the occurrence and impact of MNCs spillovers on local enterprises cannot be appropriately explained using simple linear aggregate analysis in the case of non-pecuniary (technological) spillovers. This is because non-pecuniary spillovers are exceptionally difficult to deduce from aggregate macro economic data. Such spillovers include knowledge flows that are invisible, imperfectly

understood, determined by multiple factors, and difficult to track, hence difficult to investigate (Gachino, 2007).

The inherent weaknesses, according to Gachino (2007), are, first, the tendency towards 'single factor exponentiation', which makes the presence of MNCs to be the only major factor in determining occurrence of spillovers in a host country. Second, there was also a weakness due to 'automaticity or exogeneity problem', where spillovers and their effects were thought to occur automatically, thereby making the process of spillover occurrence quasi-inevitable. The third problem relates to the 'narrow conceptualisation of spillovers' phenomenon, where MNCs were the only firms taken into consideration while analysing spillovers, thereby disregarding the role and effort of local firms and other supportive factors within the national innovation system of host countries.

On the basis of the above issues, an alternative approach was suggested which will enable an appropriate assessment of the influence of interactions, learning and capability development in the spillover occurrence process (Gachino, 2007). Following on this re-conceptualisation, this chapter presents the empirical result of the assessment of the various forms of technological spillovers from MNCs to small and medium food companies (SMFCs) in Nigeria, and examined the factors that influenced the occurrence of these spillovers. The spillover occurrence was based on the presence of foreign firms (MNCs), as well as, the actual effect of the spillover channels on the production capability of the domestic SMFCs. Therefore, the productivity of these domestic SMFCs depended on their accumulated technological capabilities as a result of continuous learning due to the influence of the spillover channels.

2. Theoretical framework

2.1 Technological spillovers

Technological spillover is defined as transfer of knowledge and skills (technical and organisational) from MNCs that result in an improvement in the performance of MNCs partners, suppliers or competitor firms, as well as of the other agents that interact with them (Vera-Cruz and Dutrénit, 2005). The technological spillover thus generates productivity or efficiency benefits for the host country's local non-affiliated firms. The availability of new foreign knowledge through MNCs may benefit domestic firms as they can learn the technology from them, which allow them to upgrade their own production process, and as a result, improve their productivity.

The theoretical and empirical literature identifies two major concepts of technological spillovers, which are rent-spillovers and knowledge-spillovers (Griliches, 1992). Rent-spillovers occur when new goods are purchased at prices below those that would fully reflect the value of technological improvements from R&D investments. They can be considered as a pecuniary externality from upstream industries, whose competitive market structure may not allow firms to fully transform higher quality into higher prices. Knowledge-spillovers occur when innovation by one firm is adopted by "adjacent" firms, thus enhancing their productive and innovative capabilities. Knowledge spillovers arise exclusively as an intangible transmission of ideas; in principle, they are not embodied in traded goods, and thus they do not necessarily require economic transactions.

2.2 Forms of spillover effects

The spillover effects of MNCs to the local industries can be divided into two, namely, inter- and intra-industry spillover effects. Inter-industry (vertical) spillovers occur through foreign companies' impact on the local suppliers in different industries. Through creation of linkages between the foreign company and domestic firms, spillovers may occur when the local suppliers have to meet the demand from the foreign firm in the form of higher quality, price and delivery standards (Smarzynska, 2003). Another implication of inter-industry spillover effects is the increased demand by the MNCs for local intermediate inputs, thus increasing production possibilities in the host economy (Barrios, 2000).

The intra-industry (horizontal) spillovers result from the presence of MNCs in a particular sector and its influence on the host industry's competitors (local companies in the same sector). There are five transmission channels through which intra-industry spillover effects may occur. These are competition, demonstration and imitation effects, transfer of technology and R&D, human capital, and labour turnover (Blomström, Globerman, and Kokko, 1999).

Since the presence of MNCs in any country usually results to an increased competition in the host economy, the less efficient domestic firms might be forced to improve on their production techniques. That is, the superior technology of the MNCs may stimulate efforts of domestic companies to compete, which may lead to new innovations. Such effort could be investment in human and physical capital; and the efficient use of their existing resources. This can raise the productivity of the local firms and thereby assist them to compete with MNCs. It should be noted however that the increased competition could 'crowd out' the domestic firms, especially if the market is populated with inefficient domestic firms (Taymaz and Lenger, 2004).

Demonstration and imitation effects can occur when domestic firms observe and imitate the superior proprietary technology, management and marketing skills possess by the MNCs. This channel of spillover represents "learning by watching effect" (Blomström, Globerman, and Kokko, 1999). Technological spillover effects can then occur through imitation, reverse engineering and copying of foreign companies' products or production processes.

Transfer of technology and R&D can also bring about spillover effect when the local companies, in the same industry, are aware of the existence of a particular technology or result of MNCs' R&D activities. This might enable local firms to increase productivity and build competitiveness in new areas (Mansfield & Romeo, 1980). Also, the existence of technology and productivity gaps between the foreign and local firm may stimulate spillover effects when the domestic firms are making efforts to catch up through imitation of the technology of foreign leaders. However, the risk of this channel is that if the MNCs' advanced technology is beyond the local firm's absorptive capacity, this could lead to adverse consequences for the domestic firms' market position (UN-ECE, 2001).

MNCs often invested in their employees through various trainings that cannot be easily replicated in domestic firms. The knowledge and skill gained by the local employees through these trainings can lead to technological spillover when labour turnover occurs, through "brain-drain in reverse" to the local economy (Dunning, 1970). That is, domestic employees that were trained by the MNCs can start their own business or be employed by

domestic companies. This human capital development can play a crucial role not only in the dissemination of technological knowledge from MNCs to the domestic companies, but also in the dissemination of best practices and other organisational innovations which are more difficult to disseminate in other ways.

2.3 Determinants of spillover occurrence

Based on the analytical framework developed by Gachino (2007), the occurrence of spillover in a technically underdeveloped country does not only depend on the presence of MNCs, but also on absorptive capacity, presence of support structures and institutions, and presence of interactions and trade orientation. Others include firm size and age, ownership structure, performance, labour market conditions, firm strategy and industry structure.

The level of absorptive capacity of the local firms will assist them to exploit new knowledge and technology from the MNCs. Hence, only the local firms who have accumulated technological knowledge in human resources as a result of strong R&D base can benefit from the technological spillovers from the MNCs. Moreover, beyond the internal efforts of the local firms, interactions among economic agents within the host country, as well as the infrastructural and institutional supports structures are important determinants to spillover occurrence. The interactions among the economic agents can serve as channel to technological innovations or serve as stimuli for learning and innovation. Also, the support structures such as productivity centres, technology transfer bodies, training programmes and investment promotion councils can play important role towards facilitation of innovation based on knowledge acquired in the spillover process.

Another important determinant of spillover occurrence is the strong network cohesion which supports generation and diffusion of knowledge (Freeman, 1991; Lundvall, 1992). This is important because spillover is an interactive and dynamic process, hence systemic interactions among firms, institutions, and business associations can stimulate the process of spillover occurrence. Closely related to the interactions is clustering, which can promote new product development and make diffusion of new technologies possible through information exchange and joint problem solving between firms in the same industry or different industries (Saxeniaan, 1991; Mytelka and Farinelli, 2000).

The importance of firm's size on its ability to compete and for the occurrence of spillover occurrence is also established in the literature. That is, attainment of a certain minimum efficiency scale by firms is required for competitiveness (Scherer, 1980 quoted in Gachino, 2007). While the attainment of this scale is possible in large firms because of their ability to mobilise productive resources and other services that are either external or internal to them; majority of the small firms have inadequate resources to improve their technological capabilities. Closely related to the firm's size is the influence of age on the spillover occurrence. The accumulated stock of knowledge and experience over time can increase the absorptive capacity necessary to recognise external knowledge, absorb it and utilise it for productive purposes (Gachino, 2007). However, as noted by this author, the level of experience of a firm is more important than how old the firm is. This is because it is the experience that will position the firm to enjoy greater experiential and tacit knowledge, which in turn determines the likelihood of spillovers occurrence.

Another factor that has strong bearing on spillover occurrence, learning and technological capability building is industrial specificity. This is because industries are different with significant differences in technological capabilities and capacities to undertake technological learning and absorption. While some industries are becoming high technology intensive, others have become knowledge intensive.

The firm performance is characterised by high capacity utilisation and high output performance in terms of sales and profits (Gachino, 2007). This enables such firm to undertake dynamic strategies, perform basic R&D, recruit well-trained professionals like scientists and engineers, and undertake human resource development and other enrichment programmes. Hence, a firm with high performance offers more room for learning, acquisition of tacit and experiential knowledge, all of which enhance firm's absorptive capacity. Moreover, a firm with a demonstrated strong path dependence leading towards accumulation of absorptive capacity will likely benefit from spillover occurrence. This is reflected in the firm strategy like ability to modernise its operations, diversify its products, and capture new market. Other strategies could be ability to lower overhead cost, improve quality, and broaden its knowledge base.

Moreover, participation in the export market is also noted to stimulate a dynamic learning process which can assist the local firms to benefit from spillover from MNCs. Hence, the trade orientation towards export in international markets can make the local firms to pay attention to the global tastes and preferences. It can also force them to increase their technological effort in order to learn continuously and master techniques required in maintaining international competitiveness at the world market.

2.4 Empirical studies on spillovers

Empirical studies on technological spillovers have been made with different techniques and methodologies, covering both developed and developing countries that have and have not received substantial FDI inflows. The studies also covered different time periods and used different endogenous as well as exogenous variables. The first group of empirical studies used cross-sectional data in a single year and found positive spillovers (Caves, 1974; Globerman, 1979; Blomström and Person, 1983; Blomström and Wolff, 1994; Nadiri, 1991; Blomström and Sjöoholm, 1998). But the set of second group of studies, which used panel data, found negative spillovers (Aitken and Harrison, 1999; Djankov and Hoeckman, 2000; Kathuria, 2000; Konings, 2000). The findings pointed out that many of the earlier studies, that found positive spillovers, did not introduce control variables of sectoral nature. Moreover, the third group of empirical studies considered the technological and/or productivity gap between local frims and MNCs to discriminate the existence or non-existence of spillovers (Kokko, Tansini, and Zejan, 1996; Castellani and Zanfei, 2001; Girma, Greenaway and Wakelin, 2000; Haskel, Pereira and Slaughter, 2002).

Furthermore, all of the above studies focus on intra-industry spillovers. The studies in inter-industry spillovers, through backward linkages found positive spillover effects, and negative for forward linkages (Schoors and Van der Tol, 2002; Smarzynska, 2003; Kugler, 2000). This is because spillover effect is dependent on the local absorptive capability and the level of sectoral openness (Smarzynska, 2003).

In summary, the pioneer studies showed evidence of positive spillover effects because they were based on cross-sectional data. But the more recent studies, which are based on panel data techniques, tend to show a more heterogeneous reality. While some found negative spillovers, others showed that spillovers may exist but are contingent on different factors, mostly related with technological and innovation variables.

Within the Nigerian environment, the results of the survey conducted by Narula (1997) could not give a precise result as to whether or not technology is being transferred from the foreign firms to the domestic firms. Infact there is historical suspicion that MNCs possess skills and tangible technology that are available locally and are therefore making above normal profits based on better access to capital, and because of their sustained and growing presence (Biersteker 1987, Onimode 1982). Akinlo (2004) examined the effect of FDI on growth in Nigeria, using data from 1970 until 2001. The result of this study pointed out that it cannot unambiguously be said that FDI is growth enhancing. This is because FDI environment in Nigeria is characterised by its focus on oil industry, which is an extractive industry. The results further show that FDI in Nigeria only has a positive impact on growth after a considerable lag. Hence, FDI in the Nigerian case does not have the same effect as it has had in Asia and Latin America. Akinlo (2004) therefore speculates that this was due to the nature of the extractive oil industry, which has very little linkages with other sectors because; as with most natural resource industries there is rarely a requirement for substantial inputs and intermediate materials, procured from local suppliers.

Furthermore, a study by Ayanwale and Bamire (2004) examined the impact of FDI on productivity at the firm-level in the agro/agro-allied sector of the Nigerian economy. Data were obtained from those companies listed in the first tier market (comprising firms with some foreign components), and the second tier foreign exchange markets (involving domestically owned firms) as contained in the publications of the Nigerian Stock Exchange Commission and Central Bank of Nigeria. The result of this study showed that there was positive and significant spillover effect at the firm level, but with little or no spillover effect on labour productivity.

3. Conceptual framework

Contrary to the traditional technique where spillovers were conceptualised in terms of productivity gains, spillovers is re-conceptualised in terms of learning and capability building within the firm (Gachino, 2007). This is because firm's productivity depends on the accumulated technological capabilities over time where constant and continuous learning leads to a dynamic process of technological accumulation. Based on this re-conceptualisation, spillover from foreign firms is accepted to bring about learning in domestic firms by providing raw materials, resources or specific stimuli that triggers various forms of technological changes in the domestic firms.

Firm level technological capabilities which can be improved through spillover effects are investment, linkage, production, and complimentary capabilities (Lall, 1992; Rasiah, 2005). Investment capability includes skills and knowledge used in the project identification, feasibility studies and preparation, design, setting up and commissioning of a new industrial project or the expansion and/or modernisation of existing ones. Linkage

capability refers to skills, knowledge and organisational competence needed to transfer information, skills and technology to, and receive them from, component or raw material suppliers, subcontractors, consultants, service firms, and technology institutions. Such linkages affect both the productive efficiency of the enterprise and the diffusion of technology through the economy, and also deepen the industrial structure.

Production capabilities include basic skills such as quality control, operation, and maintenance. It also includes advanced skills such as adaptation, improvement or equipment stretching; and the most demanding activities such as research, design, and innovation. All these skills determine how well technologies are operated and improved; and how in-house efforts are utilised to absorb technologies bought or imitated from other firms. The complementary capabilities include organisation and marketing capabilities. The former consists of skills that are required to relate and co-ordinate the necessary functions so as to utilise effectively various existing capacities both in the firm and outside the firms. Marketing capabilities includes the knowledge and skills required for collecting market intelligence, the development of new markets, the establishment of distribution channels and the provision of customer services.

Based on the above categorisation of technological capabilities, occurrence of spillovers is likely to place domestic enterprises on a learning path, which will then increase their potential to learn, and to accumulate experiential tacit knowledge. In this study spillover was conceptualised in terms of learning and production capabilities building only. The four channels of spillover occurrence identified from the spillover literature were considered, which include linkage, labour mobility, competition, and demonstration effects (training). For each of these spillover occurrence channels, five types of technological changes associated with production capability for spillover occurrence were considered. These are product changes (product innovation); process changes (process innovation); industrial engineering; new marketing strategies; and management or organisation changes.

3.1 Model specification and measurement of variables

The magnitude and nature of FDI spillovers have been identified by employing various direct and indirect approaches. The direct approaches relate productivity measures of host country firms or industries to, among other things, the extent of foreign ownership in the host country. Indirect approaches examine different aspects of the interaction between MNCs and domestic firms that are reasonably related to FDI spillovers. These include technology licenses, vertical linkages, copying of technology introduced by foreign investors, impact of FDI on host country market structure, especially competitiveness, labour training, and performance of R&D by MNC affiliates in the host country. While the direct approach has been investigated through statistical studies, the indirect approach is investigated through more structurally oriented studies (Kathuria, 1998).

However, given the weaknesses in the analysis of spillovers, as discussed before, it is clear that occurrence and impact of MNCs spillovers on local enterprises cannot be appropriately explained using simple linear aggregate analysis. It is only firm level analysis that is capable of offering a well-grounded understanding of relationship among firms, including MNCs' influences on local firms (Gachino, 2007).

3.2 Study variables and measurements

This study used the following categories of variables to identify the various forms of technological spillovers that were from the MNCs to local small and medium scale food companies (SMFCs) in Nigeria. These were knowledge spillover, SMEs' absorptive capacities, and spillover index (SI).

3.2.1 Knowledge spillovers

Knowledge spillovers to local firms happen when local firms get the benefits from higher knowledge related to product, process, or market technologies from MNCs (Blömstron and Kokko, 2003). Direct indicators were used, and they were related to some of the spillovers channels that have been identified in the literature, which are competition, linkage, labour mobility and demonstration effects. Qualitative analysis of knowledge spillover is based on the work of De Fuentes and Dutrénit (2006), and was carried out through the following factors: entrepreneur's previous experience and training in multinational companies; employee's experience and training in multinational companies; formalisation of linkages with multinational companies; and kind of linkages established with clients.

The first two factors are related to the spillovers mechanism of human capital mobility and training effect, while the last two are related to the backward linkages mechanism. Table 1 presents the variables that were used to build these four factors.

The variables used for spillovers through human capital mobility include:

i. Whether or not owner and/or employees had worked with MNCs.
ii. Years of experience in MNCs by the owner and/or employees (in years).
iii. Specific management levels where the employees had worked. That is, whether policy, management (middle), or operational (low) level.
iv. Types of experience in the MNCs. That is, whether in production, product development, quality improvement/assurance, or management section.
v. Whether or not they had undergone training courses while in MNCs. This was measured in terms of number and focus of the training, whether it was production- or management-related.

Linkage with MNCs by the SMEs can occur through backward or forward link, which could affect the local firms positively in terms of efficiency and quality of outputs (De Fuentes and Dutrenit, 2006). Therefore, the variables measured were:

i. Whether or not there was any linkage with MNCs by the domestic SMFCs.
ii. Average number of such relationship.
iii. Type of linkage, whether it was a contractual or an informal relationship.

The kind of linkage established is measured in terms of whether the domestic SMFCs:

i. shared the MNCs production and laboratory facilities.
ii. received technical advice/assistance from MNCs, such as product quality analysis.
iii. received assistance from MNCs for quality improvement of their products.
iv. received assistance in procuring processing equipment.
v. had joint projects with MNCs.

vi. received training for their employees by MNCs.
vii. received assistance in entering new markets.

3.2.2 SMEs' absorptive capacities

Absorptive capacities are the ability of firms to recognise the value of new information, assimilate it and apply it to commercial ends, which is critical to their innovative capabilities (Cohen and Levinthal (1990), cited by De Fuentes and Dutrenit, 2006). Direct indicators were employed for the analysis of absorptive capacities using four indicators. These are human resources, embodied technology, characteristics of the firm's owner, and other organisational features of the firm. These indicators were entrepreneur (owner) and employees' experience and studies; embedded technology in equipment; and organisational capabilities. Others are learning and innovation activities; and linkages established with other local agents.

The variables for owners and employees experience and training include the educational qualifications of the owners and that of employees in charge of production, marketing, and administration. They also included various trainings that the owners and the employees had undergone, especially in the area of quality improvement, innovation, and marketing strategies. The variables measured included type (tertiary or non-tertiary) and highest educational qualifications acquired by the owner and the employees. Others were their areas of specialisation, number of on-the-job and off-the-job training programmes undergone by the owners and employees within the last five years. Tertiary education included highest qualification from Polytechnic or University. Area of specialisation was indicated as science/engineering/technology related or management/finance/art related. The trainings undergone by the owners and employees were specified as product development, quality improvement, and quality assurance. Full time employees including scientists/engineers and others were specified in terms of numbers.

The variables under embodied technology in equipment were level of automation and age of processing equipment. The level of automation was measured in terms of number of computerised equipment, and average age of the processing equipment was measured in years (De Fuentes and Dutrénit, 2006).

The variables under organisational capabilities were age of business, relationship with MNCs, existence of R&D activities, and types of training programmes attended by owners/employees, existence of interactions with MNCs and receipt of quality award.

Learning takes place through internal and external sources. Internal learning takes place through learning from experience in the process of production, commercialisation and use; and in the search of new technical solutions through R&D. External learning occurs through interaction with suppliers, competitors, customers, consultants, associates, universities, research institutes offering technological services, agencies and governmental laboratories, business development centres among others. Therefore, the variables that were considered included:

i. Types of training programme attended by the owner and employees. These could be products and process, and new marketing programmes, human resource management, product development, quality maintenance, strategic planning, and marketing.

Factors	Variables	Measurement
a. Entrepreneurs' mobility	• Work experience with MNCs	Either Yes or No
	• Years of experience with MNCs	Number of years
	• Specific management level where the entrepreneur worked.	Either at policy level, management level, or operational level
	• Types of experience in the MNCs.	Either experience in R&D, or production, or management.
	• Training courses attended while working with MNCs	Number of training attended
	• Focus of the training.	Whether in product/process development, market development, strategic planning or general business management.
b. Formalisation of linkages with MNCs	• Existence of relationship with MNCs	Yes or No
	• Years of relationship with MNCs	Number of years of relationship.
	• Types of relationship.	Whether contractual or informal.
c. Kind of linkages established with MNCs	Existence of: • Backward linkages • Forward linkages • Access to MNCs facilities • Technical support or advice • Development of joint projects • Sharing knowledge of export	• Whether or not the local SMFCs: - Supplied production input(s) to MNCs - Purchased production input(s) from MNCs - Shared the MNCs production and laboratory facilities - Received technical advice/ assistance from MNCs - Received assistance in quality improvement of the product - Received assistance in entering new markets - Were assisted by MNCs in procuring processing equipment - Staff were trained by MNCs

Table 1. Study Variables and their Measurement

ii. Interactions with external agents. This was indicated by whether or not they had interactions with universities, research institutes, and business associations.

The indicators for this variable were number and type of relationship with suppliers, competitors, research institutions, industrial associations. All the variables used to build the absorptive capacity indicator and their measurements are shown in Table 2.

Factor	**Variable(s)**	**Measurement**
Owner's and employees'† experience and training	Educational background of Owner and the employees. That is, i. Non-tertiary education (Primary or Secondary or Technical or NCE*) ii. Tertiary education (Polytechnic or University or Postgraduate	Non-tertiary = 1 Tertiary = 2
	Area of specialisation of owner and the employees. Whether: i. Non-science or engineering or technology (that is, management or finance or art or social science), or ii. Science or engineering or technology	Non-science = 1 Science = 2
	Previous training undergone by owner and the employees within last 5 years. That is, whether in: i. General business management, or ii. Product development or Quality assurance/improvement	General business management = 1 Product development or Quality improvement or assurance = 2
	Skills of workforce. i. Number of technicians ii. Number of engineers iii. Number of scientists	Percentage of technician (technologist)/scientists/engineers of total workforce
Embedded technology in the processing equipment	i. Level of automation, that is: (a) Manual (b) Semi-automation (c) Full automation	Manual = 1 Semi-automation = 2 Full automation = 3

Factor	Variable(s)	Measurement
	ii. Average age of the processing equipment	More than 5 years = 1 Between 3 and 5 years = 2 Less than 3 years = 3
Organisational capabilities	Number of years in business (age of company)	Age of business in year
	Relationship with MNCs i. No relationship	No relationship = 1 Existence of Relationship = 2
	ii. Description of relationship	Informal = 1 Formal = 2
Learning and innovation activities	Internal sources through: i. Research and development (R&D) activities	• No R&D activities = 1 • Existence of R&D activities = 2
	ii. Attendance of training programme by owner and employees in the areas of new products or process or marketing development, quality assurance or maintenance, and strategic planning.	• Training related to new product or process or marketing development, quality assurance or maintenance, and strategic planning = 2 • Training not related to the above = 1
	External sources through: i. Interactions with universities, research institutes, and business associations	Level of importance of each interaction to the acquisition of knowledge in the company. • Not important = 1 • Important = 2 • Very important = 3

† Employees here are production or marketing or administrative managers
* NCE means National Certificate of Education (middle level teacher)

Table 2. List of Variables Used to build Absorptive Capacity Indicator of SMFCs

3.2.3 Effects of the spillover mechanisms on the learning and technological changes

In order to establish the effect that spillover channels had on the learning and technological changes of domestic SMFCs, the spillover index was calculated. This was based on the work of Gachino (2007). Each of the four channels of spillover occurrence, which are competition, linkage, labour mobility and demonstration effects, was conceptualised in terms of learning and dynamic technological changes that had taken place in the production capacity of each of the SMFCs surveyed.

For each of the spillover occurrence channel considered, five types of technological changes associated with production capability were used as proxies for spillover occurrence. These were product changes, process changes, industrial engineering, new marketing strategies, management, and organisation changes. The degree to which each change took place was also determined subjectively in the firms on a continuous gradual ordinal scale ranging from a minimum score of 1 representing "nothing happened" to a maximum score of 7 representing "very much had happened". An index was then computed and used in the quantitative determination of spillover occurrence as well as spillover determinants.

3.3 Computation of the spillover Index

In the questionnaire, each of the SMFCs was asked to evaluate the effect of each of the four channels of spillover occurrence on the five types of technological changes associated with production capability. For example, the firms were asked to rank the effect of linkage with MNCs on the product changes; process changes; industrial engineering changes; new marketing strategies; and management and organisation changes in their companies. This was premised on the assumption that due to linkage with MNCs, each of these domestic SMFCs would react by undertaking changes ranging from production to organisational changes. For each factor, each firm was asked to indicate subjectively the degree of perceived change due to linkage on the basis of scale provided (Table 3).

The spillover index (SPO Index) was then developed from the ranking indicated by each SMFCs. The use of index to evaluate firm level processes and activities is used when dealing with complex technological capability issues in developing countries (Gachino, 2007). The average spillover indices, C, L, M, and D computed for competition, linkage, labour mobility, and demonstration effect respectively were calculated (Table 4). The arithmetic average of all the four channels of spillover occurrence was taken as the composite spillover index. That is, SPO Index equals Composite average of C, L, M, and D.

The calculated spillover index (SI) of each SMFC ranged from 1 to 7. That is, SI value of 1 indicated that the combined influence of all the four channels of spillover had no effect on the production capacity of such SMFC. While SI values of 2 and 3 indicated an insignificant effect and little effect on the production capability respectively. Also, SI values of 4, 5, 6, and 7 were indication that the channels of spillover had moderate, considerable, much, and very much effect respectively on the SMFCs' production capability.

Type of Production Capability	**Effects on each Production Capability**	**Ranking by importance No effect ----> Much effect** 1 2 3 4 5 6 7
Production Changes	• Developing new products. • Improving our products.	

Type of Production Capability	Effects on each Production Capability	Ranking by importance No effect ----> Much effect 1 2 3 4 5 6 7
	• Copy or imitate competitor's products.	
Process Changes	• Improving processing techniques. • Improving raw material and quality control. • Upgrading our technology and equipment to raise productivity.	
Industrial engineering changes	• Replacement of our processing equipment. • Upgrading our processing equipment. • Repair and maintenance of our processing equipment	
New marketing strategies	• Improve our marketing department with new ideas, skills, and knowledge in domestic or foreign marketing. • Diversify our products.	
Management and organisation changes	• Undertake organisational changes for better management and implementation of production and other routine activities that enhance the firm's efficiency. • Introduction of information technology for quick and better decision making.	

Source: Gachino (2006), but modified.

Table 3. Reaction to Competition Pressure Ranked by Order of Importance

Spillover conceptualization	Channels of Spillover Occurrence				
	Competition (C)	**Linkage (L)**	**Labour Mobility (M)**	**Demonstration (D)**	**Average Score**
Product Changes (Pd)	Pd_c	Pd_l	Pd_m	Pd_d	PD
Process Changes (Pr)	Pr_c	Pr_l	Pr_m	Pr_d	PR
Repair & Maintenance (Rm)	Rm_c	Rm_l	Rm_m	Rm_d	RM
Marketing Strategy (Ms)	Ms_c	Ms_l	Ms_m	Ms_d	MS
Management & Organisation (Mo)	Mo_c	Mo_l	Mo_m	Mo_d	MO
Average Score	**C**	**L**	**M**	**D**	**SPO Index**

Source: Gachino (2006)

Table 4. Composition of Spillover Index (SPO Index)

3.4 Evaluation of factors responsible for the occurrence of technological spillovers

The spillover index is taken as a proxy for spillover occurrence in the literature (Gachino, 2007). Also, spillover occurrence is a function of individual firm's resource endowment and their interactions with socio-economic agents, which is also determined by a number of factors relating to the absorptive capacity of domestic firms. Therefore, spillover index (SI) was taken to be a function of SMFCs' absorptive capacity. The variables considered were age of company; percentage of Nigerian ownership; and percentage of technicians, scientists, and engineers. Others were highest qualification of entrepreneurs (owner), production manager, marketing manager, and administrative manager; area of specialisation of entrepreneurs (owner), production manager, marketing manager, and administrative manager. Other variables used were previous work experience of entrepreneurs (owners), production managers, marketing manager, and administrative manager with MNC. The average age of the main processing equipment, level of automation of the processing equipment, and number of year in relationship with MNC were also used.

The influence of these variables on spillover index of SMFCs was then estimated using categorical regression model. Correlation technique was also employed to determine the relationship between the dependent variable (SI) and independent variables.

4. Methodology

The study was carried out in Southwestern Nigeria, which comprises of Lagos, Oyo, Osun, Ogun, Ondo and Ekiti States. However, the study was limited to Lagos, Ogun, and Oyo States because the activities of MNCs are most prominent in this part of the country. The sample population for this study consisted of domestic small and medium scale food manufacturing companies operating in this part of Nigeria. The samples were drawn from the database and directories of National Association of Small Scale Industries (NASSI), National Association of Small and Medium Scale Enterprises (NASME), and Manufacturing Association of Nigeria (MAN), specifically from the directory of the Association of Food, Beverage and Tobacco Employers (AFBTE). However, only small and medium companies with more than 10 full time employees were surveyed (CBN, 2004).

Considering the sub-sectors where the SMFCs are most prominent, the methodology for sampling was stratified random sampling with the stratification based on 7 sub-sectors, which are Roots and Tubers products; Fruit juices and Drinks; Bakery products; Beverage; Fat and oil; Wines and Spirit; and Dairy products. Based on the Baseline Economic Survey of SMEs in Nigeria by the Central Bank of Nigeria (CBN) in 2004, a total population of 455 companies was identified within the Food, Beverages and Tobacco sectoral group in the study area (CBN, 2004). Out of this population, 200 were randomly selected from the directories.

The primary data were collected through interview and structured questionnaire, directed at the Managing Director and/or the Production, Marketing and Personnel Managers. The questionnaire was designed to elicit information on the educational background, experience and training of the business owners and key employees, especially those in charge of

production, management, and marketing. Data were collected on the technology embedded in the processing machinery and equipment, and organisational capabilities. The questionnaire also elicited information on learning and innovation activities, new market programme, product and process innovation; linkages established with MNCs and other local agents, and types and format of these linkages. Others data collected were owner's and employees' job mobility, in terms of experience in MNCs and position and the various job-related training undergone; and reaction of the each firm to the spillover occurrence channels in terms of technological changes effected in their production capability. The completed questionnaires were analysed using the descriptive and inferential statistics using Statistical Package for Social Scientists (SPSS) version 15.

5. Results and discussion

Out of the 200 questionnaires administered, 150 were retrieved, with only 112 usable, representing 56% of the whole questionnaire administered. Within the usable ones there were 4 food companies (3.6%) from Roots and Tubers sector, 22 (19.6%) from Fruits juices and Drinks sector, 51 (45.5%) from Bakery products sector, 4 (3.6%) from Beverage sector, 15 (13.4%) from Wines and Spirit sector, and 16 (14.3%) from Dairy products sector. The main products of these companies included white and yellow garri, plantain chips, apple juice, blackcurrant, flavoured milk, orange and pineapple juice, and milky juice. Other products were baking powder, biscuit (coaster and sweet cream), bread (buttered, chocolate and sliced), and sausage. The remaining products included chocolate drinks, sweet, gin, wine, rum, yoghurt, ice-cream, milk (liquid and powdered), and strawberry.

5.1 Channels of technological spillovers from the MNCs to SMFCs in the study area

Technological spillovers from MNCs occurred in the food companies through two main channels, which were linkage and labour mobility.

i. Linkages

About 45% of the SMFCs had one or more forms of linkage with the MNCs in the studied area (Table 5). Among the MNCs that SMFCs had linkage with, 68% of the MNCs operated within the Food, Tobacco, and Beverage (FTB), while 8% and 4% operated within the Chemical and Pharmaceutical, and Electrical and Electronics industries respectively. Also, 12% of the SMFCs had linkages with only one MNC, while 60%, 24%, and 4% of them had linkages with 2, 3, and 5 MNCs respectively.

The various types of linkages included purchasing of inputs (raw materials) from the MNCs (36.6%), being subsidiary of MNC (3.6%), and supply of inputs (raw materials) to MNCs (1.8%). Other forms of linkage indicated were outsourcing whereby some parts of the production of MNCs were done by some SMFCs; and provision of assistance to SMFCs by MNCs in the purchase of processing equipment (0.8%). Some SMFCs also had access to one or more facilities of the MNCs. About 25% of the SMFCs indicated that the MNCs provided training for their staff, and 6.3% received technical assistance from them. About 6.0% also had access to the MNCs' laboratory facilities to conduct quality control, physical and chemical analyses of their products. One of the owners of the SMFCs indicated that a MNC assisted in pushing the product of his company into the international market.

These types of relationship between the SMFCs and MNCs were expected to serve as stimulus for learning and innovation in the local food companies. Earlier empirical results from some developing countries, including Nigeria, also confirmed this assertion (Blalock and Gertler, 2008; Javorcik, 2004; Ajayi, 2001, 2007). Spillovers occurred through vertical relationship (through backward linkage) rather than horizontal relationship. Specifically in Nigeria, there was adoption of production sub-contracting among the food, beverages and tobacco, chemicals and pharmaceuticals and textiles, wearing apparel and leather industry groups after the introduction of structural adjustment programme in 1986. This sub-contracting of production among firms was perceived as very important in reducing the costs of production (Ajayi, 2007).

	No of SMFCs	Percent (%)
Any Linkage with MNCs?		
Yes	50	44.6
No	62	55.4
No of MNCs that SMFCs had Linkage with		
None	62	55.4
1	6	5.4
2	30	26.8
3	12	10.7
4	0	0.0
5	2	1.7
Sector where the MNCs belong		
No response	72	64.3
Food, Tobacco and Beverages	34	30.4
Chemical & Pharmaceutical	4	3.6
Electrical and Electronic	2	1.7
Type of relationship between SMFCs and MNCs		
No response	62	55.4
Supplier of inputs (raw materials) to the MNCs	2	1.8
Purchase inputs (raw materials) from the MNCs	41	36.6
Subsidiary of a MNC	4	3.6
MNC outsourced part of the production from our company	2	1.8
Purchase equipment through MNCs	1	0.8
Facilities having access to in MNCs		
No response	67	59.8
Product certification	-	0.0
Quality control and analysis	5	4.5
Sharing of laboratory	2	1.8
Assisting in procuring processing equipment	1	0.9
Assisting in entering foreign market	1	0.9
Receiving technical assistance	7	6.3
Development of joint projects	-	0.0
Providing training for our staff	29	25.8

Table 5. Types of Linkage between the SMFCs MNCs

ii. Labour turnover and human capital development

About 38% and 8.9% of the owner managers and production managers of the SMFCs had working experience from MNCs (Table 6). Within the owner manager who had worked in the MNC, 50.0% worked in R&D department, and 38.1% in production or operation department. The remaining 9.5% and 2.4% worked in quality control and administration departments of the MNC respectively. Majority (69.0%) of these owner managers worked at operational level, while 28.6% and 2.4% had worked at management and policy levels of the MNCs respectively. Furthermore, among the production managers that had previous working experience with MNCs, 60% and 40% worked in production/operation and R&D departments respectively; and majority (80%) worked at operational level. This result also agreed with an earlier study which reported that small and medium scale firm owners within the same study area had diverse backgrounds, which included previous experiences with MNCs (Oyelaran-Oyeyinka, 2004).

Working Experience of SMFCs with Food MNCs & Level of Management	**Owner's Manager**		**Production Manager**		**Marketing Manager**		**Administrative Manager**	
	No of SMFCs	**Percent (%)**	**No of SMFCs**	**Percent (%)**	**No of SMFCs**	**Percent (%)**	**No of SMFCs**	**Percent (%)**
Working Experience with Food MNCs	42	37.5	10	8.9	-	0	-	0
Yes	70	62.5	102	91.1	112	100	112	100
No								
Department where worked	-	-	-	-	-	-	-	-
Administration	1	2.4	-	-	-	-	-	-
Marketing	16	38.1	6	60	-	-	-	-
Production or Operation	21	50.0	4	40	-	-	-	-
Research & Development	4	9.5	-	-	-	-	-	-
Quality control								
Level of Management worked	29	69.0	8	80	-	-	-	-
Operational Level	12	28.6	2	20	-	-	-	-
Management Level	1	2.4	-	-	-	-	-	-
Policy making Level								
Training Courses/Seminar Attended	12	28.6	-	-	-	-	-	-
Strategic Planning	4	9.5	2	20.0	-	-	-	-
Product Development	-	-	-	-	-	-	-	-
Marketing	16	38.1	1	10.0	-	-	-	-
Human Resource Management	10	23.8	7	70.0	-	-	-	-
Quality Maintenance								

Table 6. Working Experience of the key Personnel of SMFCs with Food MNCs at various Level of Management

About 38.1%, 28.6%, 23.8%, and 9.5% of these owner managers attended human resource management, strategic planning, quality maintenance, and product development training courses/workshops respectively. Also 70%, 20% and 10% of the production managers attended quality maintenance, product development, and human resource management respectively while working with the MNCs. It has been established that labour turnover brings about spillover when owner managers in local firms started their careers in foreign companies and/or there was brain-drain in reverse to the local economy (Dunning, 1970;

Ikiara, 2003). Hence, with the physical movement of workers from MNCs, the knowledge embodied in these workers could be transferred to the local economy. Based on the result above, the owner managers and production managers would have acquired knowledge and skill as a result of the training courses/seminars attended while working with the MNCs.

iii. Changes effected by SMFCs in their Production Capabilities due to the Channels of Spillover

Influence of Competition from MNCs on production capabilities

About 43.8% of the SMFCs modified their products to reduce the production cost as a result of competition from the MNCs (Table 7). Also, 52.7% changed the design of the product packaging, 64.7% introduced new equipment to improve production efficiency, and 31.2% introduced automation in certain areas of production. Other changes undertaken were upgrading of processing equipment (42.6%) and regular repair and maintenance of the processing equipment (40.5%). Small percentage (1.2%) of the food companies embarked on new product development in order to sustain their market share and remain competitive in the market place.

Influence of linkages with MNCs on production capabilities

About 44.8% of the local SMFCs modified their products as a result of their linkages with MNCs (Table 7). Also, 52.0% changed the design of the product packaging. The linkage channel also brought about introduction of new equipment to improve production efficiency (54.6%). It also led 40.2% of the SMFCs to introduce automation in certain areas of their production processes. Other changes which resulted from linkages with MNCs included upgrading (56.3%) and constant repair and maintenance (32.1%) of processing equipment.

Influence of previous working experience of owner/staff of SMFCs with MNCs on production capabilities

The previous working experience of owner/staff with MNCs assisted 40.2% of the SMFCs to modify their products so as to reduce production cost. Also, 54.1% of small and medium food companies changed their product packaging design. Other changes that resulted from the influence of previous working experience with MNCs were introduction of new equipment to improve production efficiency (65.5%), upgrading of processing equipment (42.2%), and repair and maintenance of equipment' (46.2%).

In summary, the above information provided evidences that there were efforts by the local food companies at effecting changes in their production technology as a result of the spillover channels. The spillover channels that brought about new product formulation in very few SMFCs were staff experience with MNCs and training received from MNCs. All the four spillover channels however resulted in improvement of production capabilities in majority of the SMFCs. The SMFCs indicated that their modification of product packaging was to make their products attractive and appealing to the consumers as those of imported substitutes. Some even sourced their packaging materials from overseas. This is consistent with some empirical studies that local firms are forced to learn and introduce appropriate changes to achieve allocative and/or technical efficiency, especially in response to

competition from MNCs (Wang and Blomstrong, 1992; Gachino, 2006). Therefore, important observation from this result is that some of the domestic SMFCs were being placed on learning function thereby increased their potential to learn. This is a form of spillovers occurrence.

Changes to Product, Process and Industrial Engineering	Percentage of SMFCs based on changes introduced as a result of the Spillover Channel of:			
	Competition from MNCs	Linkage with MNCs	Staff Experience with MNCs	Training Received from MNCs
(a) Types of Changes in Product				
Product modification through enrichment	1.2	0.2	0.2	3.2
New product formulation	-	-	1.0	1.5
Quality improvement of the product	2.3	3.0	4.5	2.3
Modifying the product to reduce the production cost	43.8	44.8	40.2	40.4
Changing the design of the product packaging	52.7	52.0	54.1	52.6
(b) Types of Changes in Production Technique				
Improvement of traditional methods of processing	-	-	-	-
Introduction of automated machines throughout the production line	0.6	0.8	2.4	2.6
Introduction of automation only at a certain area of production	31.2	40.2		28.1
Introduction of new equipment to improve production efficiency	64.7	54.6	28.6 65.5	66.2
Laying out the machines on the factory floor in a better order	3.5	4.4	3.5	3.1
(c) Types of Changes in Industrial Engineering				
Replacement of Processing Equipment	16.9	11.6	11.6	14.7
Upgrading of Processing Equipment	42.6	56.3	42.2	42.3
Repair and Maintenance of Equipment	40.5	32.1	46.2	44.0

Table 7. Various Changes to Product, Process and Industrial Engineering due to different Channels of Spillover from Multinational Companies

5.2 Factors responsible for the occurrence of technology spillovers

Organisational capabilities and working experience

More than half of the SMFCs (69.6%) indicated that their owner managers had post graduate qualification (Table 8). Also, 93.8%, 99.1%, and 96.3% of these food companies indicated that their production, marketing, and administrative managers respectively had tertiary

education. This level of education of the management team was an indication that majority of the food companies in the study area had some basic requirements for building absorptive capability for spillover. Oyelaran-Oyeyinka (2004) also found the same result within the same study area when he reported that about 63.2% of firms' owners had bachelor degree. In addition, more than half (63.4%) of the owner managers of the SMFCs specialised in science/engineering while 35.7% specialised in management related discipline (Table 8). Only one of them (0.9%) had both science/engineering and management related

	Owner Manager		**Production Manager**		**Marketing Manager**		**Administrative Manager**	
	No of SMFCs	**(%)**	**No of SMFCs**	**(%)**	**No of SMFCs**	**(%)**	**No of SMFCs**	**(%)**
Highest Qualification								
Secondary	0	0	0	0	0	0	1	1.0
Technical	0	0	3	2.7	0	0	0	0
Tertiary (polytechnic/university)	34	30.4	105	93.8	108	99.1	105	96.3
Post graduate	78	69.6	4	3.6	1	0.9	3	2.7
Area of Specialisation								
Science or Engineering	71	63.4	94	83.9	1	0.9	1	0.9
Management or Finance related	40	35.7	18	16.1	107	98.2	108	99.1
Science & Management	1	0.9	0	0	0	0	0	0
Others	0	0	0	0	1	0.9	0	0
Previous Work Experience								
SMEs Company	33	29.6	73	65.8	58	53.7	67	61.6
Large corporation/MNCs	41	36.5	31	27.8	30	28.0	10	9.0
University/Research Institutes	15	13.5	5	4.5	4	3.7	10	9.2
Government Ministry/Parastatals	16	14.5	2	1.9	16	14.6	22	20.2
Small and Large	7	5.9	0	0	0	0	0	0
Training Courses/Workshops attended by the Management Team								
Human resources management	48	42.9	-	-	1	0.9	16	15.0
Product Development	1	0.9	97	87.4	2	1.9	-	-
Quality Maintenance	-	-	2	1.8	1	0.9	1	0.9
Strategic planning	2	1.8	-	-	-	-	84	78.5
Marketing	-	-	1	0.9	99	91.7	-	-
Combination of above	61	54.4	11	9.9	5	4.6	6	5.6
Total	**112**	**100**	**111**	**100**	**108**	**100**	**107**	**100**

Table 8. Highest Qualifications, Areas of Specialisation, Previous Work Experiences and Training Courses attended by the Members of the Management Team of the Small and Medium Food Companies (SMFCs)

discipline. Majority (83.9%) of their production managers had science and engineering background. However, the remaining 16.9% of the SMFCs indicated that their production managers specialised in management/finance related disciplines. Similarly, majority of the firms also indicated that their marketing (98.1%) and administrative (99.1%) managers had relevant areas of specialisation.

About 37% of owner managers had previous working experience with MNCs, while 29.6% had worked with small and medium companies, 13.5% with university/research institutes, and 14.5 per cent with Government ministries/agencies (Table 8). Majority of other management teams worked with small and medium companies. That is, 65.8%, 53.7%, and 61.6% of production managers, marketing managers, and administrative managers had previous working experience with small and medium companies respectively. The SMFCs indicated that 27.8% and 28.0% of production manager and marketing managers respectively had previous working experience with MNCs, while 20.2% reported that their administrative managers worked with Government ministry. This result indicated that there was sizeable number of labour turnover from MNCs, especially among the owner managers. By this it can be assumed that these owner managers would have acquired some knowledge and skills from these MNCs.

Status of Embedded Technology in Equipment	**No of SMFCs**	**Percent (%)**
Sources of Processing Equipment (N=112)		
Locally Fabricated	37	33.0
Imported	70	62.5
Combination of Locally Fabricated and Imported	5	4.5
Average Age of Processing Equipment (N=112)		
Less than 3 years	21	18.8
Between 3 and 5 years	23	20.5
More than 5 years	68	60.7
Level of Automation (N=112)		
Fully Automatic	13	11.6
Semi Automatic	94	83.9
Manually Operated	2	1.8
Fully Automatic and Semi Automatic	2	1.8
Fully Automatic, Semi Automatic, Manually Operated	1	0.9
Whether the Processing Equipment are the best in the Market (N=111)		
Yes	12	10.8
No	99	89.2
Reasons for not Acquiring Recent Equipment (N=111)		
High cost of acquisition	2	1.8
Insufficient Capital to Acquire them	98	88.3
Not Applicable	11	9.9

Table 9. Status of Embedded Technology in Processing Equipment of SMFCs

All the MNCs reported attendance of training courses by their management team. These courses included human resources, production development, quality maintenance, strategic planning, marketing, and combination of these. Within the owner managers of these food companies, 42.9% attended human resources management programme and 54.4% attended combination of these programmes. Also, 87.4% of production managers attended product development related programme, 91.7% of marketing managers attended marketing-related programme, and 78.5% and 15.0% of administrative managers attended strategic planning programme.

ii. Embedded technology in processing equipment and linkages with external agents

More than half (62.5%) of the food companies reported (Table 9) that their processing equipment were imported and had been in operation for more than five years (60.7%). They further indicated that majority of the processing equipment were semi-automatic and were not the best in the market. The high cost (1.8%), and insufficient capital (88.3%) were indicated as limiting factors for the acquisition of best equipment. This probably limits the technological capabilities of these food companies to produce for export.

About 75.0% of the SMFCs had relationship with other SMFCs, 35.7% had relationship with SME business associations (such as NASSI, NASME), and 98.2% had relationship with financial institutions (Table 10). These types of relationship included support in setting up plant (92.0%), provision of technical consultancy (38.4%) and sharing of exporting knowledge (30.4%).

Organisational Capabilities	No of SMFCs	Percent (%)
Formal Establishment with Agent (N=112)		
Small and Medium Companies (SMEs)	85	75.0
Multinational food companies (MNCs)	107	95.5
Business development service (BDS) Providers	2	1.8
Universities/Research Institutes	1	0.9
Business Associations (e.g. NASSI, NASME, etc)	40	35.7
Financial Institutions	110	98.2
Types of Relationship (N=109)		
Sharing of production equipment	1	0.9
Sharing of laboratory	1	0.9
Joint development of product and processes	4	3.6
Support in setting up our plant	103	92.0
Provision of technical consultancy	43	38.4
Share knowledge of export	34	30.4

Table 10. Organisational Capabilities of SMFCs

5.3 Relationship between the factors determining absorptive capacity and spillover index

The calculated spillover indexes, the frequency and percentage of each value are shown in Table 11. Majority (61.5%) of the SMFCs had composite spillover index of 4. This showed that the influence of the spillover channels on majority of the SMFCs' production capability

was moderate. Other effects were little effect, considerable effect, and insignificant effect on the production capabilities of 30.4%, 4.5%, and 3.6% of the SMFCs respectively.

Composite Spillover Index	No of SMFCs	Percent of SMFCs (%)
1 (No effect)	0	0
2 (Insignificant effect)	4	3.6
3 (Little effect)	34	30.4
4 (Moderate effect)	69	61.5
5 (Considerable effect)	5	4.5
6 (Much effect)	0	0
7 (Very much effect)	0	0

Table 11. Percentage Distribution of Composite Spillover Index among the SMFCs

i. Relationship between absorptive capacity determinant and spillover index (SI) of SMFCs

The correlation between the dependent variable (SI) and each of the independent variables showed that there were weak but significant relationships ($p \leq 0.05$) between SI and age of company ($r=0.295$), percentage of Nigerian ownership ($r=-0.527$), area of specialisation of owner ($r=0.301$), work experience of owner ($r=0.249$), work experience of marketing manager ($r=0.272$), level of automation of the main processing equipment ($r=-0.320$), or number of years in relationship with multinational companies ($r=0.329$).

The positive relationship between age of the small and medium food companies and SI indicates that as the number of years in business increases the SMFCs were accumulating technological knowledge which resulted in increased absorptive capacity. The results also showed that the area of specialisation and previous work experience of the owners of SMFCs in MNCs were important for spillover occurrence. Most of the time the small and medium entrepreneurs (owners) exercise controlling influence on all the activities of their businesses. Hence, the level of scientific and technological knowledge possessed by these owners as a result of their specialisation and experience had influence on the spillover occurrence.

In addition, the positive correlation between SI and work experience of marketing manager indicates the important contribution of relevant knowledge in other human resources to the absorptive capacity of these SMFCs. However, the low (weak) value of correlation coefficients for previous working experience of owners in MNCs indicates that it is not enough to have experience in MNCs, ability to absorb tacit knowledge, codify it and apply it at their own firms is equally important. Also, the positive influence of the number of years in relationship with MNCs is a demonstration that the interactions arising from the linkage had served as a stimulus for learning and innovation among the small and medium food companies, and hence had influence on the spillover occurrence.

On the other hand, the strong, negative and significant relationship between SI and percentage of Nigerian ownership ($r=-0.527$) indicates that as the percentage of Nigerian ownership increases there was a decrease in the absorptive capacity of the SMFCs. The reason could be attributed to low level of technological competence of the Nigerian owners,

which is not adequate to recognise valuable new knowledge from MNCs. This is because the firm's level of absorptive capacity depends upon its level of technological competence as well as its learning and investment efforts undertaken to be able to use new knowledge from MNCs productively (Hamida, 2007). Moreover, minority foreign ownership could also serve as a disincentive for the MNCs' parent firms to transfer more advanced technology to its affiliate due to its reduced control over the management (Javorcik and Spatareanu, 2003).

Also, negative relationship between SI and the level of automation of the main processing equipment (r=-0.320) indicates that investment in new equipment for product/process innovation is an important determining factor for the absorptive capacity. As noted from the empirical results from the literature, relatively high technological firms benefit from spillovers through demonstration and/or competition effects (Mody, 1989). This is because such firms are not far behind the technological frontier of the industry. This could have assisted them to imitate and/or to improve their production efficiency needed for competition with MNCs' products. Using investment in new equipment as a proxy for the absorptive capacity of domestic firms, Narula and Marin (2003) also observed positive spillovers for domestic firms in Argentina which had high investment in new equipment oriented to product/process innovation.

Moreover, the regression results obtained showed that the percentage of scientists over the total workforce, area of specialisation of owner, works experience of owner, and no of year in relationship with MNCs showed statistically significant relationship. The coefficient values (β) were -0.287, 0.434, 0.432, and 0.315 for the percentage of scientists, area of specialisation of owner, works experience of owner, and no of year in relationship with MNCs respectively. The negative coefficient value for the percentage of scientists could be that the scientists employed by these SMFCs were not skilled enough to make any significant contribution to the spillover occurrence in the companies. They could also be performing routine work without any opportunity to be involved in R&D activities. Since the absorptive capacity required by firms in developing countries for spillover occurrence depends on the complementary role of the level of technological knowledge in human resources and physical capital investment (Gachino, 2007). Hence, the insignificant contributions of the technical and engineering personnel from this study could be due to inadequate physical investment in most of the SMFCs.

The positive values of correlation coefficient and significant relationship for the specialisation of the owner in science/technology/engineering and their previous work experience indicated the important of these factors. De Fuentes and Dutrénit (2006) also discovered that SMEs with high level of absorptive capacities had most of the owners with professional degree in engineering. Also, the knowledge and skill acquired, as a result of previous experience of the owners of SMFCs in MNCs, were important for knowledge spillovers. Earlier theory had established that technological or knowledge spillover could occur in the domestic firms when there is movement of employee from the MNCs to local firms.

Moreover, the interactions between small enterprises and MNCs is also an important mean through which interactive learning, information and technology can be exchanged or jointly exploited for the purpose of productive activities, which can stimulate the process of spillover occurrence.

The insignificant relationship of age of the SMFCs indicated that age had not contributed to the spillover process in these firms. The result is consistent with the assertion that accumulation of knowledge might not be taken as a simple function of firm age in developing countries, because most firms in developing countries might not be in position to accumulate knowledge over time due to lack of resources (Gachino, 2007). Also, the technical personnel did not have relevant previous work experience that could bring about spillover occurrence in these SMFCs. Therefore, having experience in MNCs is not enough for gaining the required knowledge that can be diffused through technological spillovers. This result could be explained from the type of training received by workers at MNCs. That is, as noted by Fosfuri, Motta, and Ronde (2001), if they received training in a more firm-specific technology, local firms might have less advantage in obtaining that technology as it might be costly to adapt to their own production process. The level of automation of equipment of SMFCs was not high enough to contribute to spillover occurrence. Spillover was observed to occur in Argentina domestic firms where there was high investment in absorptive capacities inform of training activities or new equipment (Narula and Marin, 2005).

6. Conclusion

This study re-conceptualised technological spillover from MNCs by linking the spillover occurrence to the technological changes associated with the production capability building in the SMFCs in southwestern Nigeria. It was observed that there was only a moderate building process of production capability among these companies. This further confirms that the occurrence of spillovers does not depend just on the presence of MNCs alone but also on absorptive capacity of the local firms.

The factors with the highest influence on the absorptive capacities among the SMFCs were area of specialisation and previous work experience in the MNCs of the owners, and year of relationship with MNCs. These results showed that, though MNCs had played an important role in stimulating learning and capability building in the local food companies in Nigeria, but promoted a minimal innovation in these companies. Hence, in order to make FDI have greater impact on future opportunities for catching up technologically there is need to re-assess and strengthen the national linkage promotion programmes and institutions in Nigeria. This will assist in smoothen the linkage relationship between SMEs with MNCs, and also with universities and research institutes. This is because a strong network which supports generation and diffusion of knowledge can only stimulate the process of spillover occurrence to SMEs. Equally important is the policy that will encourage regular update of the list of MNCs' local suppliers, and encourage joints venture partnership between the MNCs and local food companies whenever the former are embarking on expansion and upgrade of their production activities.

The study also revealed that many of the SMFCs were not able to acquire better processing equipment even when they were aware that their processing equipment were not the best in the market. The implication of this is that even when the workforce had sufficient innovation and learning capacities, the level of automation in the processing equipment could still affect the production efficiency. Therefore, there is need for policy measure to encourage the financial sector to assist the SMFCs to invest in the upgrade of their

processing equipment which could assist them to imitate the MNCs' production technologies.

The various technological capability building that can occur in small firms as a result of technological spillover occurrence includes investment, production, linkage, and complimentary capabilities (such as innovation, organisation and marketing capabilities). However, due to the magnitude and scope of work, this study focused only on the production capability of the SMFCs in the southwestern Nigeria. It is therefore suggested that further studies should focus on any or combination of these firm level capabilities.

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It is widely accepted that technology is one of the forces driving economic growth. Although more and more new technologies have emerged, various evidence shows that their performances were not as high as expected. In both academia and practice, there are still many questions about what technologies to adopt and how to manage these technologies. The 15 articles in this book aim to look into these questions. There are quite many features in this book. Firstly, the articles are from both developed countries and developing countries in Asia, Africa and South and Middle America. Secondly, the articles cover a wide range of industries including telecommunication, sanitation, healthcare, entertainment, education, manufacturing, and financial. Thirdly, the analytical approaches are multi-disciplinary, ranging from mathematical, economic, analytical, empirical and strategic. Finally, the articles study both public and private organizations, including the service industry, manufacturing industry, and governmental organizations. Given its wide coverage and multi-disciplines, the book may be useful for both academic research and practical management.

InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
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中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
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