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# Determinants of FDI Spillover in the Kenyan Manufacturing Industry: Firm-Level Evidence

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**Abstract**

Technological spillovers from foreign direct investment and their determinants and impacts in a host country's growth process are some of the most widely debated issues in development economics. The proponents of endogenous growth theory and evolutionary economics contend strongly that spillovers have positive ramifications for economic growth. This paper adopts a framework re-conceptualizing spillovers in terms of learning and capability building to examine the determinants of spillovers in the Kenyan manufacturing industry. From the results, key determinants of spillovers included systemic support structure, absorptive capacity, firm learning, systemic embeddedness, firm training, and trade orientation. The findings provide possible implications for policy makers.

*Key words*: foreign direct investment; technological spillovers; technological learning; systemic support structure; systemic embeddedness; Kenya

*JEL classification*: F2; L1; L6; O1; O2

## 1. Introduction

Technological spillovers from foreign direct investment (FDI) and their determinants and importance in a host country's growth process are some of the most widely debated issues in development economics. Proponents of endogenous growth theory and evolutionary economics emphasize the importance of spillovers in technology and innovation, both of which are important elements of long-run economic growth (Romer, 1990; Grossman and Helpman, 1991). Developing countries are typically poor, technically backward, and often characterized by low levels of physical investment, technical change, and innovation (Rasiah, 2005; Gachino, 2010a). In contrast with developed countries, Romer (1993) claims that developing countries suffer from "idea gaps" and "object gaps." They suffer from idea gaps since they generally lack economic-value-adding ideas such as knowledge and technology. Additionally, they suffer from object gaps due to scarcity, or all

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together lack of physical capital, such as automated factories equipped with state-of-the-art machinery, and efficient transport and communication networks, such as roads, railway, ports, airport facilities, and telephones.

In light of this debate, spillovers are presumed to be one of the ways through which such idea and object gaps can be filled. This is based on the premise that multinational corporations (MNCs) are characterized by firm specific assets—ownership characteristics—which enable them to invest abroad (Caves, 1982; Aitken and Harrison, 1999; Dunning and Lundan, 2008). Such investments are likely to be accompanied by spillovers often perceived to include techniques and advanced know-how in production technology, organization, management, marketing, commercialization of research and development (R&D), and innovations. Architects of endogenous growth theory further emphasize that for technology and innovation development to take place, positive spillovers must be accompanied by tremendous accumulation of capital and knowledge through concerted learning effort, R&D, and human capital development (Lucas, 1988; Romer, 1990). This is supported by evidence based on East Asian economies that relied heavily on FDI, such as Malaysia and Singapore, and is sometimes referred to as the FDI-led growth process (Rasiah, 2005).

While there is general consensus on the importance of spillovers—theoretically—in economic growth, there is yet to be an empirical consensus on spillover occurrence. This has been an existing conundrum. Despite the long history of this debate, the question as to whether positive spillovers occur remains unanswered (Wooster and Diebel, 2010). It is therefore not surprising that Rodrik (1999) asserted that "today's policy literature is filled with extravagant claims about positive spillovers from FDI but the evidence is sobering." To date, empirical determinations on spillovers have remained inconclusive with one side favoring spillover occurrence and the other reporting no spillovers (Aitken and Harrison, 1999; Smarzynska-Javorcik, 2004; Buckley et al., 2007; Meyer and Sinani, 2009; Gachino, 2011). Clearly the determinants of spillovers cannot be examined easily when their existence remains unresolved.

One of the reasons advanced for the controversy over spillover occurrence is that methodologies used have largely remained within the neoclassical tenets and have failed to keep pace with recent developments in endogenous and evolutionary literature, which provide a more suitable analytical platform for examining technology and innovation issues. For instance, spillover occurrence cannot be appropriately explained using simple linear aggregate analysis, as technological spillovers are exceptionally difficult to deduce from aggregate data. Such spillovers include knowledge flows that are invisible, tacit, and imperfectly understood. Their occurrence is therefore determined by multiple factors which are extremely hard to track and examine. Some of the factors include the role of the state (government policies), infrastructure, and a variety of social-institutional factors, such as cooperation, coordination, and trust among entrepreneurs. Other factors often neglected include networks and linkages to support structures, such as productive centers, financial institutions, research organization, and academic institutions.

Based on these limitations, some recent studies have attempted to go beyond existing techniques by proposing new analytical frameworks for estimating spillover occurrence (Gachino, 2010a). However, few studies if any have attempted to go beyond concentrating on whether spillovers occur to determine the actual extent of spillover occurrence. Similarly, few studies try to examine spillover determinants. This paper is an effort to contribute to the literature by addressing the following questions: Does the presence of foreign firms stimulate spillover occurrence? If yes, what determines their occurrence?

This paper is organized into six sections as follows. Section 2 presents the Kenyan context on FDI and spillovers. Section 3 presents the analytical framework. Section 4 presents data and methodology. Section 5 discusses the results, and Section 6 presents the conclusion and policy implications.

## 2. FDI and Spillovers in Kenya: Justification

Kenya is perhaps uniquely suited for FDI and spillover analysis among countries in Sub-Saharan Africa for several reasons: First, the country has a relatively mature manufacturing industry dotted with a long history which dates back to the colonial era. During this period, enormous foreign capital investment was made. It is believed that the early entry of foreign firms, especially British MNCs, enabled Kenya to develop a comparative advantage in her manufacturing industry compared to other countries in the region. Although there was a slight decline in FDI inflow in the early 1990s, foreign entrepreneurs and expatriate firms have already developed a major presence and constitute important linkages between MNCs and local entities. These arguments tend to support a widely held belief that Kenya's success in the manufacturing industry can be attributed to the existence of FDI. For a comprehensive and detailed analysis of FDI and spillovers in Kenya see Gachino (2009, 2010b).

Second, the country has created institutions which are believed to be crucial in the spillover process. For instance, some of the institutions erected—like the Kenya Investment Promotion Council—helped attract foreign investment into the country. Third, the country boasts of a relatively high level of human capital necessary for spillover occurrence as they amount to absorptive capacity. They also serve as spillover occurrence vehicle in case of labor mobility. Fourth, Kenya has a major industrial strategy aimed at industrial transformation by the year 2020 and implemented within a liberalized framework. This transformation is being buttressed by another initiative, Vision 2030, which also recognizes FDI and industrial promotion as an avenue for growth and development. Hence, insight from this study might enhance our understanding of the dynamic and complementary roles FDI can play in an industrial development process. Further, the country undertakes millennium development goals. For these reasons, the study findings will contribute to the ongoing international debate on the best interventions and policy measures necessary to accelerate development and alleviate poverty.

## 3. Analytical Framework

This paper largely adopts a framework developed in Gachino (2010a) for examining spillovers. The motivation behind this approach is that existing methodologies have failed to keep pace with recent developments in endogenous and evolutionary literatures, particularly with regard to learning and capability development. The spillover process stimulates endogenous processes in firms by triggering changes over a wide array of firm operations.

In this approach, two literature strands have been adopted. The first is the literature on MNC spillovers which purports that the presence of FDI in a host country can result in technological spillovers. Early analysis to examine this was pioneered by Caves (1974) employing a production function framework which latter led to a plethora of other works employing a similar framework.

The second approach adopted relates to economics of technological innovation. This literature is based on Schumpeterian tradition, which emphasizes the importance of technological changes in learning and capability building. Examples of technological changes generally highlighted include introduction of new goods, new production processes, new markets, new resources, and new organizational forms (Schumpeter, 1934). Technological learning and capability building is viewed as a complex and continuous activity influenced by both internal (endogenous) and external influences (such as FDI). Accordingly, Schumpeter views firms as entities comprising entrepreneurs, often engaged in a vicious cycle of creative destruction in pursuit of business profit. This aspect makes technological innovation fit well under the endogenous and evolutionary economics advanced by Nelson and Winter (1982) among others. This is in addition motivated by the development of a national system of innovation framework (Lundvall, 1992). This framework fits most analyses dealing with technological changes, learning, and innovation in developing countries, where technological change and learning does not have to emanate from formal R&D institutions.

The overlap of the two literature strands can be best demonstrated using an eclectic analytical framework presented in Figure 1. The framework starts by assuming that FDI presence results in spillovers occurrence. Second, the framework demonstrates that for spillovers to occur there must be a set of crucial determinants. Third, based on FDI spillover literature, spillovers occur through various mechanisms (Gachino, 2006, 2010a). The current framework considers competition, linkage, labor mobility, and demonstration effects. Based on the technological innovation literature, we argue that spillovers can be conceptualized in terms of the technological changes as shown in the same figure. The motivation is that when spillovers occur in firms, certain technological changes will be definitely implemented. This is the only way spillovers can be detected. Due to the inability of getting to such a level of analysis, past studies had to rely on productivity techniques using odd indicators such as value added or labor productivity. The changes considered here will include product changes, process changes, industrial

engineering, marketing changes, and organizational changes. By Schumpeterian logic these changes stimulate learning, which in turn result in capability building and enhanced firm performance. It should be emphasized that although such changes can spur broader technological capability as shown in Figure 1, the scope of this paper is limited to production capability.

In this section we present a discussion on the perceived spillover determinants. Spillover occurrence and determination are both discussed in the methodology section. Determinants of spillover occurrence can be outlined in one broad proposition: in a technically underdeveloped country, the occurrence of spillovers depends not only on the presence of MNCs but also on industry type, absorptive capacity, the presence of support structure, the presence of interactions, and performance. Other factors include firm strategy, age, firm size, trade orientation, and labor market conditions. We discuss these determinants following the same format as in Figure 1.

### 3.1 Major Determinants

#### *Industrial Specificity*

Industrial specificity has a strong bearing on spillover occurrence, learning, and technological capability building since industries are different. A high level of heterogeneity with significant differences in technological capabilities and capacities to undertake technological learning and absorption exist across industries. Even technologies used by MNCs within industrial sectors often differ widely in complexity. There is a wide array of literature in support of this fact. Take for instance the garments and automobile industries. According to Gereffi (2002), garments are categorized in terms of buyer-driven chains, while automobiles are characterized by producer-driven chains. In both industries there is increased use of technology and tacit knowledge.

#### *Absorptive Capacity*

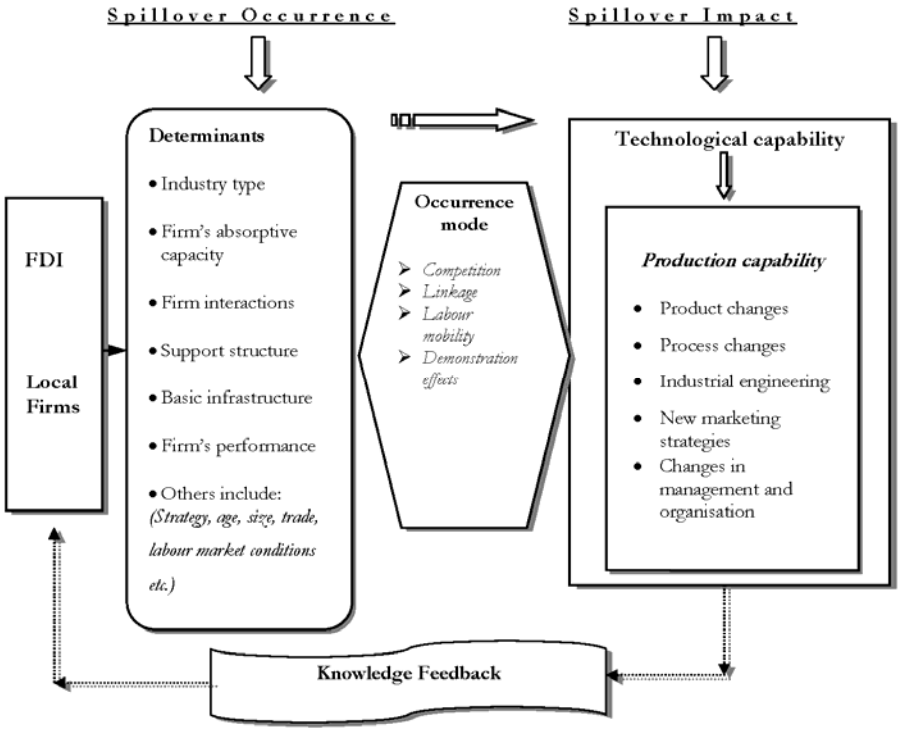
For spillovers to occur there must be high absorptive capacity. Knowledge spillovers depend on the ability and effort of the recipient parts to exploit new knowledge and technology (Cohen and Levinthal, 1990; Grossman and Helpman, 1995). A firm's internal absorptive capacity can be viewed as accumulated technological knowledge over time. Indicators like share of technical personnel and the existing level of capital investment are often considered in cases where R&D is limited. Absorptive capacity depends on the level of technological knowledge in human resources and physical capital investment, with both important for their complementary roles.

#### *Systemic Embeddedness: Importance of Firm Interactions*

The conceptual framework developed regards spillover as an extremely interactive and dynamic process, largely influenced by a multitude of socio-

economic agents and existing policies which operate in a systemic manner. A strong network cohesion which supports generation and diffusion of knowledge is emphasized (Lundvall, 1992). In light of this discussion, we hypothesize that firms' systemic interactions are important for spillovers to occur. Systemic interactions among social economic agents arise from networks and linkages created—with common ones being vertical and horizontal linkages. Other forms of networks and linkages include informal contracts, membership in formal and informal associations, and collaborations.

**Figure 1. A Framework Model for Examining Spillover Determinants**




### *Systemic Infrastructural and Institutional Support Structure*

The occurrence and impact of technological spillovers is not an automatic process and cannot be analyzed using a handful of selected factors and employing narrowly conceived frameworks. Given the dynamic, uncertain, and tacit nature of technology and knowledge, spillover occurrence is an extremely dynamic process largely influenced by a multivariate panel of factors internal or exogenous to the firms and sometimes to the country. The implication is that other things, such as provision of infrastructure and institutional support, should be considered. In this

study, focus will be on provision of infrastructure given the rudimentary nature of existing institutions.

***Firm Performance***

Another determinant of spillover occurrence is the level of firm performance. A firm is able to perform well if it has developed a substantial amount of technological capability. Such a firm is characterized by high capacity utilization and high output performance in terms of sales and profits. Such a firm would be in a position to undertake dynamic strategies, perform basic R&D, recruit well-trained professionals like scientists and engineers, and undertake human resources development and other enrichment programs. These arguments are articulated in industrial organization, which postulates that a firm's performance is a function of its own endowments, conduct, and the systemic environment characterized by interactions among economic agents (Scherer, 1980). This directly implies that a firm with high performance offers more room for learning and acquisition of tacit and experiential knowledge, both of which enhance the firm's absorptive capacity. A high performance firm is also deemed competitive—another important aspect which influences spillover occurrence. When local firms have the capacity to offer strong competition to MNCs, this prompts the MNCs to improve their techniques by transferring more recent technologies, which are in turn imitated by domestic firms.

**3.2 Other Determinants**

Another factor likely to influence spillover occurrence is firm strategy. Examples of such strategies include process modernization to enhance efficiency and flexibility of the firm, diversification into new products, and capturing new markets including exports. Still others include lowering of overhead costs, scale expansion, and quality improvement. A firm may also have a strong strategy to broaden its knowledge base through R&D or human resources development by adopting a training strategy in vocational, technical, or professional education aimed at improving skills of the technicians, equipment maintenance personnel, and other skilled workers.

Firm age is another variable likely to influence spillover occurrence. We hypothesize that firms with longer experience are considered to enjoy greater experiential and tacit knowledge. The older a firm is, the more the spillovers are likely to occur.

Another variable is firm size. To a large extent, big firms may be at an advantageous position in terms of spillover occurrence primarily on account for their ability to mobilize productive resources and other services that are either external or internal to a firm. However, not all industries require a big size in production. In many cases, scope rather than scale is important. For instance, in industries dealing with plastic components or small-batch machine tools, it is scope and not scale that is important (Piore and Sabel, 1984). It should also be emphasized that information technology has continued to play a role in making small size firms very efficient

following the increased decomposition and dispersal of production.

Trade orientation is another factor believed to have an influence on the spillover process. For instance, exports are likely to result in spillovers in two ways: first when MNCs in a host country export goods and second when local firms begin exporting. To a local firm producing for a domestic market, participation in an export market would imply adding sunk costs looking for new global markets, establishing international distribution linkages and networks, and establishing overseas transport infrastructure. A lot of time and effort is required to understand the global regulatory framework and track evolving tastes and preferences of global consumers. We hypothesize that local firms are likely to benefit from MNCs existing stock of knowledge about international markets and enable them to become exporters. This shortens their process, which would have inadvertently been longer for the local firms. This would take place if the MNCs in the host country produce for export market.

Importation by a firm is also believed to have a positive relationship with spillover occurrence. A firm is likely to increase dramatically its level of technological knowledge particularly when imports are sourced from countries with frontier R&D and innovative capabilities. Imports of new capital and intermediate goods are viewed as some of the main channels for international transfer of knowledge, technology, and innovation. In this regard, countries that participate in imports benefit from the foreign technologies. Proponents of international trade have elaborated this in detail (Grossman and Helpman, 1995). By importing, the firm learns through imitation, becomes innovative, and at the same time builds absorptive capacity necessary to absorb spillovers.

Labor market conditions often influence spillover occurrence, learning, and capability building. When analyzing labor market conditions, the most common factors examined include wages and affiliation to trade unions. Related studies examining the role of labor market conditions indicate that good labor conditions can positively contribute towards industrialization by stimulating competitiveness (Piore and Sabel, 1984). The same studies have shown the converse to be also true, that there is a low road to industrialization when good labor market conditions are not observed.

In the current context, we argue that when a firm observes good labor market conditions, it is bound to pay high salaries and wages, offer fringe benefits, and provide staff with training opportunities and enrichment programs. In such cases, however, workers are less likely to leave their jobs. Hence the premium paid to professionals and skilled and technical workers translates into reduced spillover occurrence, which would inadvertently occur through mobility of such workers. Contrary to the above, if labor market conditions are just fair, uncertain or even bad, the mobility of workers is bound to be high and so would be the chance of accompanying technology spillovers.

## 4. Data and Methodology

### 4.1 Data

The data used in this paper comes from a survey undertaken in Kenya in 2004–2005 covering food processing and machine engineering industries. The sample was drawn using the proportionate probability sampling technique. 180 firms were successfully surveyed; 78 (43%) foreign firms and 102 local firms (57%). A firm was defined as foreign owned if it had foreign ownership of nominal capital (equity) of at least 10%. This is the benchmark used by the Kenyan National Authorities, OECD and non-OECD transition economies, and UNCTAD. By firm ownership, the sample included 105 (58%) food-processing firms and 75 (42%) machine engineering firms.

### 4.2 Methodological Setting

As stated in Section 3, spillovers are conceptualized in terms of technological learning and capability building. Firm-level capabilities can be categorized in several ways drawing from the main proponents of capability literature, including Lall (1992), Bell and Pavitt (1993), and Rasiah (2005). Useful categorization of technological capabilities considers the functions they perform and the degree of complexity as the two classificatory principles. Thus, it is possible to single out investment and production linkages as shown in Figure 1—other forms of capability are regarded as complimentary capabilities. Due to the magnitude and scope of work involved, this paper focuses on production capability and identifies the associated learning and technological changes.

The following technological changes are considered as proxies for spillover occurrence: production changes, process changes, industrial engineering, new marketing strategies, and management and organization changes (Figure 1). As shown in the figure, these changes can be associated with both foreign and local firms. The degree to which each change takes place is determined subjectively in the firms on a continuous gradual ordinal scale ranging from a minimum score of 0 representing "nothing happening" to a maximum score of N representing "very much." On the basis of this scale, an index *SPO INDEX* , is computed, which is then used in the quantitative determination of spillover occurrence and spillover determinants (as the response variable). It should however be acknowledged that the index inevitably suffers some potential drawbacks as it is largely based on firms' own subjective assessment.

The spillover index is estimated for all four modes of spillover occurrence, competition $C$ , linkage $L$ , labor mobility $M$ , and demonstration $D$ as depicted in Figure 1. The spillover index is computed for each mode as:

$$SPO\ INDEX_{Firm-level} = Composite\ Average(C, L, M, D)\ . \quad (1)$$

Similar results of the *SPO INDEX* can be computed by the technological change average as:

$$SPO\ INDEX_{Firm-level} = Composite\ Average(PD, PR, RM, MS, MO). \quad (2)$$

The spillover index for the whole manufacturing industry can then be computed from either equation as sample arithmetic mean. As an example, using (2) we have:

$$SPO\ INDEX_{Industry-level} = 1/N \sum_{i=1}^{N} \{Composite\ Average(PD, PR, RM, MS, MO)\}, \quad (3)$$

where the $N = 180$ firms surveyed comprise the sample.

The *SPO INDEX* assumes an ordered framework ranging between 0 and 5 on a Likert scale as follows:

$$SPO\ INDEX = 0, 1, 2, 3, 4, 5, \quad (4)$$

where $SPO\ INDEX = 0$ represents "none" and 5 represents "highest" spillover occurrence.

In determining spillover occurrence, a two-stage estimation approach was adopted first to check the consistency and robustness of the results and second to provide a wide set of results for examining spillovers in the context of a country that is technically backward. In the two stages, limited dependent variable estimation techniques—binomial and ordered logit estimation techniques—were used.

For the binomial approach, the data was classified into two categories on the basis of *SPO INDEX*. Firms with an index above the center categorical score of 3 were classified as having strong spillover occurrence (SSPO) while those rated below 3 were classified as firms with weak spillover occurrence (WSPO). In contrast, the multinomial ordered logit approach incorporates additional ordinal information in the spillover index. For a full formulation of both approaches see Greene (2012). Note that the full operationalization of all variables used is as per the analytical framework is presented in Table 1.

## 5. Results and Interpretation

### 5.1 Descriptive Analysis

Table 2 presents a descriptive analysis of each of the spillover determinants identified in the conceptual framework. There was average spillover occurrence in both the food processing and machine engineering industries. Although spillover occurrence in domestic firms seemed higher than in foreign firms in the two industries, it was not statistically significant. Foreign presence was higher in the food processing than in the machine engineering industry. Foreign presence was computed following Aitken and Harrison (1999) by normalizing foreign equity with the firm's share of employment in the industry.

**Table 1. Variables Included in the Empirical Models and Their Hypothesized Influence on Spillover Occurrence in Kenya's Manufacturing Industry**

| Variables | Variable Description | Variable Measurement | Hypothesized Influence |
|---|---|---|---|
| Technological spillover (SPO INDEX) | Spillover occurrence index | 5 if highest, 0 if none | + |
| Foreign presence (FORPS) | Foreign presence at firm level | Aitkens method | + |
| **Firm Characteristics** | | | |
| Firm size (SIZE) | Firm employment | 1 if large, 0 otherwise | + or – |
| Foreign ownership: | | | |
| (1) Foreign equity (PART) | Subscribed foreign equity | % Foreign equity | + |
| (2) Asian (KASIAN) | Firm owned by a Kenyan Asian | 1 if Asian, 0 otherwise | + |
| Firm age (FIRMAGE) | Age of a firm | Years in absolute numbers | + |
| Age square (AGESQRD) | Age of firm squared | $Age^2$ /100 | + or – |
| Machine age (MACHAGE) | Age of core production machinery | Years in absolute numbers | + or – |
| **Firm Performance** | | | |
| Capacity Utilization (CAPUTL) | Firm capacity utilization | % Capacity utilized | + |
| **Infrastructural Support** | | | |
| Infrastructure (INFRSPT) | Infrastructure support to firm | 1 Infrastructure, 0 otherwise | + |
| **Systemic Embeddedness** | | | |
| Firm interactions (INTERACTIONS) | Presence of firms interactions | 1 if interacts, 0 otherwise | + |
| **Absorptive Capacity** | | | |
| Skilled intensity (SKILL) | Share of university & technical | % Share in total employment | + |
| Technology gap (TGAP) | Value of core production machinery | 1 high tech. gap, 0 otherwise | + or – |
| **Firm Strategy** | | | |
| Diversify products (STRTPDCT) | Diversify into new products | 1 if to diversify, 0 otherwise | + |
| Process technology (STRTPRCS) | Acquire new process technology | 1 if to acquire, 0 otherwise | + |
| Broaden knowledge base (STRTRD) | Undertakes R&D | 1 if to do R&D, 0 otherwise | + |
| **Human Resource Development** | | | |
| Technological training (TRAINING) | Undertakes training | 1 if to train, 0 otherwise | + |
| **Trade Orientation** | | | |
| Exports (EXPORTS) | Exports of manufactured goods | 1 if exports, 0 otherwise | + |
| Import (IMPORTS) | Imports raw materials | 1 if imports, 0 otherwise | + |
| **Labor Market Conditions** | | | |
| Wages (WAGES) | Wages per person in a firm | Wages per person | + or – |
| Manufacturing industries | Industry type (industry dummy) | 1 if food, 0 otherwise | + or – |

An important firm characteristic expected to influence spillover occurrence is firm size, which was quantified in terms of employment level. Foreign firms were bigger in size than the local firms. This is consistent with the literature on MNCs that foreign firms have ownership advantages characterized by both intangible and tangible ownership advantages which enable them to invest internationally.

**Table 2. Descriptive Statistics by Industry and Firm Ownership**

| Variables | Local Firms Food | Local Firms Machine | All Local Firms | Foreign Firms Food | Foreign Firms Machine | All Foreign Firms |
|---|---|---|---|---|---|---|
| Technological Spillover (Index) | 3.3 | 3.4 | 3.4 | 3.1 | 3.3 | 3.2 |
| Foreign presence | 9 | 18 | 14 | 62 | 27 | 45 |
| **Firm Characteristics** | | | | | | |
| Firm size | 117 | 102 | 109 | 456 | 113 | 285 |
| Firm ownership | 52 | 63 | 58 | 48 | 37 | 43 |
| Firm age | 22 | 22 | 22 | 45 | 29 | 39 |
| Machine age | 15 | 18 | 17 | 24 | 19 | 22 |
| **Firm Performance** | | | | | | |
| Capacity utilization | 61 | 63 | 62 | 70 | 62 | 66 |
| **Infrastructural Support** | | | | | | |
| Infrastructure support | 35 | 35 | 35 | 50 | 31 | 41 |
| **Systemic Embeddedness** | | | | | | |
| Firm interactions | 31 | 25 | 28 | 58 | 27 | 43 |
| **Absorptive Capacity** | | | | | | |
| Univtechvoc | 29 | 51 | 40 | 39 | 58 | 49 |
| Technology gap | 7.74e+07 | 1.35e+08 | 1.06e+08 | 4.16e+08 | 3.10e+08 | 3.63e+08 |
| **Firm Strategy** | | | | | | |
| Diversify products | 35 | 34 | 35 | 56 | 27 | 42 |
| Process technology | 43 | 41 | 42 | 63 | 31 | 47 |
| Broaden knowledge base R&D | 18 | 15 | 17 | 54 | 31 | 43 |
| **Human Resource Development** | | | | | | |
| Technological training | 28 | 28 | 28 | 37 | 26 | 32 |
| **Trade Orientation** | | | | | | |
| Exports | 20 | 18 | 19 | 55 | 22 | 39 |
| Imports | 13 | 15 | 14 | 17 | 17 | 17 |
| **Labor Market Conditions** | | | | | | |
| Wages *('000 KShs)* | 132 | 194 | 163 | 637 | 279 | 458 |

Source: Tabulated from author's field survey.

Foreign firms had a higher average firm age (39 years) compared to local firms (22 years). Two possible reasons could account for the wide age differential between

local and foreign firms. The first is that, according to the history of Kenya's industrialization process, foreign firms started their production activities much earlier than local firms. The second reason is that the rate of foreign manufacturing investment in Kenya declined tremendously in the late 1980s and 1990s after extensive institutional failure, infrastructure decay, and inconsistent policies (Gachino, 2006). The firm's age factor is also reflected in the age of the core production machinery.

The observation that foreign firms had a high proportion of skilled workers employed was not surprising since, according to the literature on MNCs, foreign firms have the resources to spread over heavy capital investment and to engage technically qualified manpower (Caves, 1974; Dunning and Lundan, 2008; Gachino, 2010a).

The second variable considered under absorptive capacity was the technology gap viewed in terms of the value of firm's core production machinery. A firm with the highest value of production machinery was taken as the reference point. All the firms whose value of production machinery was below the reference point but above the industry average were considered to have a low technology gap while those below the industry average were considered to have a high technology gap. Understandably, this conceptualization of the technology gap is quite limited. However, this dichotomy is appropriate for an empirical analysis focused on examining issues pertaining to production capability and associated spillovers. Table 2 shows that, as expected, the value of core production machinery used by foreign firms was higher than that of the local firms, thus reflecting the existence of a technology gap between foreign and local firms.

The proportion of firms offering technological training averaged 30% in the two industries. However, the kind of training offered differed substantially between firms: in foreign firms training was routine, internal, and often external including internationally while most local firms just offered simple in-house training usually on an ad hoc basis.

Foreign firms seemed to conduct more R&D than the local firms. This is expected given that foreign firms have resources to spread over R&D and to engage skilled scientists and engineers. However, the type of R&D done mainly involved simple activities such as quality control, materials and chemical analysis, reverse engineering, adaptive engineering, and trouble shooting. This perhaps supports the argument that MNCs usually concentrate their R&D in their home countries and conduct very little abroad (Patel and Vega, 1999).

As expected, a higher proportion of foreign firms participated in exports than local firms. However, the difference between local and foreign firms in terms of imports of raw materials was not significant.

Under labor market conditions, there was a tremendous difference between the local and foreign firms in terms of annual wages paid per person. Foreign firms appeared to pay higher wages, probably due to more advanced technology used and greater skills required than in local firms (Takii, 2009). It could also be the case that skilled workers in foreign firms have adequate capacity to bargain for high wages

(Velde and Morrissey, 2001).

### 5.2 Results and Interpretation

Table 3 and 4 presents the results of the binomial and ordered model respectively. The results of correlation tests showed that none of the predictor variables achieved high and significant correlation, suggesting multicollinearity is not a problem. The two estimated models passed the White (1980) test for heteroscedasticity and Hausman's test for endogeneity. The overall goodness-of-fit statistics—the log likelihood, the likelihood ratio (LR) test, and pseudo-$R^2$—indicated good overall performance of the two models.

For the two models estimated, backward selection was done in such a way that only variables with p-values below 0.2 would be retained. Accordingly, only marginal effects of these variables will be reported. With backward selection, the predictor variables that dropped out after failing the significance test included R&D, subscribed equity, firm performance, capacity utilization, infrastructure, and firm's strategy to introduce product changes regularly.

**Table 3. Marginal Effects: Determinants of Spillover Occurrence, Binomial Logit Estimation, Food Processing and Machine Engineering Industries Pooled**

| Variables | Slope | Std. Errors | P-Values |
|---|---|---|---|
| LFORPS | 1.858 | 0.876 | 0.034 |
| SIZE$^{\psi}$ | 3.618 | 1.980 | 0.068 |
| FIRMAGE | 0.444 | 0.197 | 0.024 |
| AGESQRD | –4.318 | 1.982 | 0.029 |
| MACHAGE | 0.212 | 0.083 | 0.011 |
| KASIAN$^{\psi}$ | 7.530 | 3.007 | 0.012 |
| SKILL | 2.811 | 1.268 | 0.027 |
| TGAP $^{\psi}$ | 6.976 | 2.771 | 0.012 |
| STRTPRCS$^{\psi}$ | 7.613 | 3.695 | 0.039 |
| TRAINING$^{\psi}$ | 6.189 | 2.973 | 0.037 |
| EXPORTS$^{\psi}$ | –6.330 | 3.036 | 0.037 |
| IMPORTS$^{\psi}$ | 1.977 | 1.519 | 0.193 |
| lWAGES | –2.088 | 0.754 | 0.006 |
| Cons | –25.566 | 12.397 | 0.039 |
| Industry dummies | *Yes* | | |
| No. of observations | 73 | | |
| Log Likelihood | –13.867 | | |
| LR-Test | 61.620 | | |
| | (0.000) | | |
| Pseudo-$R^2$ | 0.6896 | | |

Notes: The Spillover Index is taken as the response variable and represents spillover occurrence. $\psi$ indicates that the slope represents a discrete change in the dummy variable from 0 to 1.

Tables 3 and 4 show that, as expected, most of the estimated coefficients had

the a priori expected signs and many were statistically significant. From the empirical analysis, foreign presence was positive and statistically significant at the 5% level in both binomial and ordered logit estimations. This supports the hypothesis that foreign presence stimulates spillover occurrence. For example, an increase of foreign presence in the industry by 1 unit increased spillovers occurrence by 1.86 and 1.37 points in the binomial and ordered logit models respectively. Moreover, an increase in foreign presence increased the probability of high and highest spillover occurrence levels by about 2.98% and 2.6e-05% respectively (Table 4). These findings are consistent with the theoretical and conceptual framework that MNCs in a host country are associated with knowledge spillovers.

**Table 4. Determinants of Spillover Occurrence, Ordered Logit Analysis, Food Processing and Machine Engineering Industries Pooled**

| | **Model 1** | **Changes in Predicted Probabilities** | | | **Model 2** | **Changes in Predicted Probabilities** | | |
|---|---|---|---|---|---|---|---|---|
| ***Variables*** | **Slope** | **Average** | **High** | **Highest** | **Slope** | **Average** | **High** | **Highest** |
| LFORPS | 1.678** | –0.0130 | 0.0130 | 1.58e–08 | 1.366** | –0.0298 | 0.0298 | 2.60e–07 |
| | (0.740) | | | | (0.545) | | | |
| LPART | 0.593 | –0.0046 | 0.0046 | 5.59e–09 | | | | |
| | (1.092) | | | | | | | |
| KASIAN$^{\Psi}$ | 7.678** | –0.2999 | 0.3000 | 5.14e–07 | 5.293*** | –0.2621 | 0.2622 | 2.97e–06 |
| | (3.156) | | | | (1.823) | | | |
| SIZE$^{\Psi}$ | 3.448* | –0.0184 | 0.0184 | 2.25e–08 | | | | |
| | (2.573) | | | | | | | |
| FIRMAGE | 0.440* | –0.0034 | 0.0034 | 4.14e–09 | 0.351** | –0.0077 | 0.0077 | 6.67e–08 |
| | (0.244) | | | | (0.143) | | | |
| AGESQRD | –4.792** | 0.0372 | –0.0372 | –4.52e–08 | –4.066** | 0.0886 | –0.0886 | –7.72e–07 |
| | (2.779) | | | | (1.660) | | | |
| MACHAGE | 0.307** | –0.0024 | 0.0024 | 2.89e–09 | 0.270*** | –0.0059 | 0.0059 | 5.12e–06 |
| | (0.127) | | | | (0.093) | | | |
| LCAPUTL | –4.610 | 0.0358 | –0.0358 | –4.35e–08 | | | | |
| | (3.850) | | | | | | | |
| INFRSPT$^{\Psi}$ | 0.370 | –0.0026 | 0.0026 | 3.14e–09 | | | | |
| | (2.176) | | | | | | | |
| INTERACTIONS$^{\Psi}$ | 4.003* | –0.0125 | 0.0125 | 1.52e–08 | 3.537** | –0.0323 | 0.0330 | 2.85e–07 |
| | (2.273) | | | | (1.735) | | | |
| LSKILL | 2.676* | –0.0208 | 0.0208 | 2.52e–08 | 1.686** | –0.0367 | 0.0367 | 3.20e–07 |
| | (1.645) | | | | (0.847) | | | |
| TGAP$^{\Psi}$ | 8.937** | –0.0418 | 0.0419 | 5.25e–08 | 7.438*** | –0.0852 | 0.0867 | 7.90e–07 |
| | (3.905) | | | | (2.590) | | | |
| STRTPDCT$^{\Psi}$ | –1.086 | 0.0126 | –0.0126 | –1.55e–08 | | | | |
| | (1.923) | | | | | | | |
| STRTPRCS$^{\Psi}$ | 10.985** | –0.0175 | 0.0191 | 2.33e–08 | 7.306** | –0.0369 | 0.0399 | 3.46e–07 |
| | (5.068) | | | | (3.205) | | | |

| | Model 1 | Changes in Predicted Probabilities | | | Model 2 | Changes in Predicted Probabilities | | |
|---|---|---|---|---|---|---|---|---|
| ***Variables*** | **Slope** | **Average** | **High** | **Highest** | **Slope** | **Average** | **High** | **Highest** |
| STRTRD$^{\Psi}$ | –3.284 | 0.1225 | –0.1225 | –1.69e–07 | | | | |
| | (3.288) | | | | | | | |
| TRAINING$^{\Psi}$ | 7.416** | –0.0754 | 0.0754 | 9.78e–08 | 5.797*** | –0.1234 | 0.1236 | 1.18e–06 |
| | (3.144) | | | | (2.038) | | | |
| EXPORTS$^{\Psi}$ | –2.933 | 0.0789 | –0.0789 | –1.04e–07 | –4.199** | 0.4211 | –0.4211 | –6.25e–06 |
| | (2.205) | | | | (1.834) | | | |
| IMPORTS$^{\Psi}$ | 3.163* | –0.0544 | 0.0544 | –6.94e–08 | 2.569** | –0.0974 | 0.0975 | 9.17e–07 |
| | (1.659) | | | | (1.312) | | | |
| LWAGES | –2.640** | 0.0205 | –0.0205 | –2.49e–08 | –2.166*** | 0.0472 | –0.0472 | –4.11e–07 |
| | (1.047) | | | | (0.644) | | | |
| _Cut1 | –8.295 | | | | 1.756 | | | |
| _Cut2 | 13.111 | | | | 18.069 | | | |
| _Cut3 | 26.745 | | | | 29.764 | | | |
| Industry dummies | *Yes* | | | | Yes | | | |
| No. of observations | 73 | | | | 73 | | | |
| Log Likelihood | –18.008 | | | | –20.092 | | | |
| LR-Test | 102.27 | | | | 98.100 | | | |
| | (0.000) | | | | (0.000) | | | |
| Pseudo-$R^2$ | 0.7396 | | | | 0.7094 | | | |

Note: The Spillover Index is taken as the response variable and represents spillover occurrence. ψ indicates that the slope represents a discrete change in the dummy variable from 0 to 1. ***, **, and * denote 1%, 5%, and 10% significance levels respectively.

The size of the firm was statistically significant, implying that firm size had a positive influence on spillover occurrence. Spillovers were more likely to occur in large firms than in the small firms. Besides enjoying greater economies of scale large firms are able to engage the services of skilled technical personnel. Large firms are favored by the capital market imperfections, which confer advantages to large firms in obtaining finance for technological activities.

Two of the proxies of experience and knowledge accumulated were significant at the 5% level for both models. Firm age and age-squared had positive influence on spillover occurrence. However, based on the magnitude of their marginal effects, the two variables do not seem to have much influence on spillover occurrence. The estimated marginal effect of age-squared was negative in both models, indicating that growth of spillover occurrence decreased with age following an inverted-U shaped relationship.

The Kenyan Asian variable was highly significant, suggesting that more spillovers are likely to occur in firms owned by Asians compared to non-Asians in Kenya. These results support the stereotype that the Asian firms in Kenya are more dynamic and more entrenched in high-value-added activities compared to non-Asian firms (Himbara, 1994; Gachino, 2006).

The result of interaction was significant, supporting the literature on learning and innovation which emphasizes the importance of interactions (with suppliers, customers, support institutions, and industry business associations) in firm learning and new knowledge acquisition, including accumulation of tacit knowledge. Such interactions are likely to provide information about technologies and new markets and other inputs to complement the internal learning process, such as external staff training, consulting services, and R&D grants.

Both variables for absorptive capacity had the expected results. Skilled personnel are important for spillover occurrence. An adequate stock of technically qualified manpower is necessary to absorb new technologies, modify them, and create and transfer new technological knowledge and information (Cohen and Levinthal, 1990; Lall, 1992; Rasiah, 2005). The results of the technology gap indicate that a low technology gap is necessary for spillovers to occurrence in the Kenyan industry.

The results also showed that a firm with a strong strategy of continuous modification and upgrading of its processing technology was more likely to obtain high levels of spillover occurrence compared to a firm with no strategy on machine modification or upgrading. One of the ways in which technological capability is acquired is by undertaking continuous, incremental modifications that adapt new technologies to the firm to fit specific situations or production conditions (Bell and Pavitt, 1993; Kim, 1997). Once technological capability has been accumulated, it enables high spillovers to occur since absorption capacity is enhanced.

Training was also very important in explaining spillover occurrence. This supported the hypothesis that the more a firm undertakes technological training, the more spillovers are likely to occur. Firm training results in accumulation of firm technological capability, which in turn determines the magnitude of potential knowledge spillovers. Logically, a firm that offers training and also conducts R&D is in a better position to detect new external knowledge and its value than a firm that does not. Thus when a firm invests in training and R&D, we can assume that, in the process, it increases its technological capability and absorptive capacity.

Exports had a negative influence on spillover occurrence. This is possible given that exporting firms have already reached the threshold to export. Non-exporting firms have a lot to learn and they are therefore likely to introduce many technological changes. These results contrast with widely acknowledged evidence from East Asian economies that exports contributed tremendously to development of technology capability building as a result of international spillovers occurring from interactions with more sophisticated foreign clients based abroad (Westphal, 1990). Although the binomial logit estimation failed to produce significant results for imports, the marginal effect obtained with ordered logit was high, positive, and significant at the 5% level. The implication of this result is that more spillovers occurred in importing firms than in non-importing firms. The results support the view that importing new capital and differentiated intermediate goods is one of the main channels for international transmission of technology (Grossman and Helpman, 1995).

The labor market conditions, proxied by wages, had a negative influence on spillover. This was not surprising since a firm that pays efficiency wages boosts worker morale and hence reduces mobility and thus spillovers.

## 6. Conclusion and Policy Implications

This paper used a framework conceptualizing spillovers in terms of learning and capability building to examine the extent of spillover occurrence and their determining factors. The results showed that foreign presence stimulated spillovers in Kenya's manufacturing industry.

Analysis of the spillover determinants showed that spillovers were more likely to occur in large firms than in small firms, in old firms than in young firms, and in firms with old production machinery than in firms with new machinery. More spillovers occurred in Asian-owned firms compared to non-Asian-owned firms. The data supported the hypothesis that interactions with businesses and private and public institutions were important for spillovers. Absorptive capacity was equally important in explaining spillover occurrence. Results of firm strategy showed that a firm with a strong strategy to constantly modify and upgrade its processing technology was more likely to obtain high levels of spillovers compared to a firm without such a strategy. Similarly, the training strategy in the firm was also important in explaining spillovers. The results obtained with trade orientation were contrary to expectation. Spillovers seemed to occur in non-exporting firms, implying that non-exporting firms have a lot to learn. Also, through importation, a firm was likely to increase its level of spillover. Labor market conditions had a negative influence on spillover occurrence, implying that higher wages reduced spillovers in the Kenyan context.

This study has strong policy implications. We provide just three examples based on the results obtained. First, absorptive capacity was noted to be an important factor for spillovers to occur. Hence, the government should stimulate human capital accumulation particularly in science, technology, and engineering. Second, relating to the first, the government should also encourage and support firm learning and innovation in order to build technological capabilities. Third, formal and informal interactions with institutions and business associations were important factors in the spillover process. Interactions create an atmosphere where local entrepreneurs share manufacturing experiences, market information, skills, and technological knowledge with foreign firms. The government should therefore encourage more of these interactions, perhaps by organizing routine manufacturing exhibitions, trade fairs, and agricultural shows. This should include international exhibitors, such as technology, machinery, and equipment suppliers or just ordinary manufacturing firms. The government should encourage product, process, and marketing promotions by foreign and local manufacturers. It should encourage firm and institutional visits. Joint activities such as learning and training should be equally promoted. The success story of newly industrialized countries shows that a government that does not offer continuous support and effective industrial

facilitation often fails its entrepreneurs.

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