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Multinational Companies Presence and Technology Spillover: Firm Level Survey in a Case of Ethiopian Manufacturing Industry

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Executive summary
This survey is conducted at firm level in Ethiopia to investigate whether there is technology spillover from foreign firms to local firms and if so, to explore the kind of change (i.e. proxy to spillover) and the mode/channels of spillover. The previous studies often relied on the secondary panel data but unlike the previous one, this study entirely relay on the primary data. From the survey, we find that the presence of foreign firms brings technology spillover in Ethiopia but at a weak magnitude. Moreover, as confirmed in the survey, in developing countries like Ethiopia, demonstration is the most appropriate spillover channels followed by linkages. Finally, we find that changing the organizational set up and management practices is the most common reaction taken by local firms while product and process changes are proved to be the least kinds of changes against which local firms respond to MNCs influence
Keywords*:* technology spillover, product capability change, spillover channel, product change

1. Introduction

Recently, attracting MNCs become a significant policy priority in developing countries. This is so with a view to reap the positive effects of MNCs presence and hence, such companies have been widely recognized as a growth enhancing factors for host countries. Given this facts, the effects of foreign investment on developing countries are an issue that has been vigorously debated in literature on business and economics. Certainly, MNCs come with better firm specific assets (FSA) that benefits and boasts their competitive advantage over local firms. Fortunately, the benefit of MNCs is not limited to locally-affiliated firms but it can also spread to non-affiliated firms in different ways. There are myriad evidences which confirm that MNCs cannot completely control firm specific assets from leakage. The inability of the multinationals to protect the asset is due to a number of reasons. For example, domestic firms may just imitate the multinationals in terms of products, production techniques, management techniques or marketing practices. Labor may move from multinationals to domestic firms, taking with them the knowledge they acquired. Moreover, domestic firms supplying to or purchasing inputs from multinationals may be exposed to the superior technology and, hence, be able to upgrade their own production techniques. Lastly, multinationals may even force domestic suppliers to up-date production techniques to become reliable supplier. All these actions affect the business operation trends of local firms in the host country.
It is apparent that MNCs has a direct effect such as creation of jobs and injection of capital into the domestic economy. However, what lately attract the attentions of scholars are the unnoticed effects of MNCs that it brings to local firms. MNCs often come with advanced technologies, skills and innovations which may help host country domestic industries catch up with the international business operation frontier. Such effects can be categorized as indirect long term effects which -in international business literature- referred as the spillover effects. The basic premise underlying the existence of spillovers is that foreign-invested firms are technologically superior and that through their interactions with domestic firms knowledge is transferred, which, in turn, leads to productivity and market access spillover.

In fact, the term 'spillover' has not been defined very clearly anywhere in the literature when it exists with reference to MNCs, with the exception of a few authors such as Globerman (1979), Blomstrom and Kokko (1993) and Meyer (2003). In their view, spillovers are said to take place when the firm specific assets advantages of the company cannot be fully internalized, thus making the uncompensated benefits to leak from these MNCs to domestic companies, customers, as well as suppliers in the host nation. More precisely, Blomstrom and Kokko (1997) underlined that spillovers exist when MNCs cannot reap all the productivity or efficiency benefits that are followed in the host country's domestic firms as a result of the entry or presence of MNC affiliates. Such effect, according to Blomstrom & Kokko (1998), are broadly includes productivity and market access spillover effect all of which are the results of technology spillover.

Studying the long term indirect benefits of spillover is sounds much because as stated in literature the long term dependable benefits for host countries come from the spillover effect resulted because of the presence

of MNCs. When we consider technology spillover, it cannot be stated in literature in a black and white way and as stated by Gachino(2006), it is something that is complex, difficult to define precisely and by far more than a mere collection of patents, blue prints, machinery and equipment. The implication is that spillover occurrence would be therefore anticipated to be a complex phenomenon. However, occurrence of such spillovers is likely to place locally owned firms on a learning function, thus enhancing accumulation of experiential tacit knowledge.

2. Inflow of FDI in Ethiopia

Domestic investment in Ethiopia has soared since the cease of socialist government and the introduction of liberal policies in 1992. Recently Ethiopia has been made economic development strategy by emphasizing the structural change particularly by shifting of resources, especially labor, from agriculture sector to industry sector especially manufacturing sector targeting leather and textile industry. Although agriculture remains an important contributor to Ethiopia's economy, its share of GDP has been steadily decreasing. In 2014 the sector made up 42% of value-add to GDP (down from 52% in 1990), followed by services (42%), and industry (15%). As World Bank report revealed, Ethiopia has become a leading recipient of FDI flows – in relation to the size of its economy. Triggered by a belief that foreign presence stimulate technology spillover and ease market access, the government adopts a series of measures to attract MNCs. As a result, the number of MNCs has rapidly increased over time particularly in recent years; turning Ethiopia in to one of the most attractive investment destinations in the world in general and in the region in particular especially in leather and textile industries. The country is attracting investors with tax incentives, low-cost labor, strategic location for trade, and improved transport infrastructure. Owing to these measures, there is a continuous growth in the MNCs arrival in the country. For example, foreign direct investment (FDI) inflow was over at $970 million in 2013, a significantly higher level than in 2012. In 2014, Ethiopia emerged as the 8th-largest recipient of FDI projects in Africa, up from 14th position in 2013. A number of multinational companies such as Huajian Shoes, Heineken, the Blackstone Group, KKR, GE, Orange, Etur Textile, the BDL Group, Jiangsu Lianfa Textile Co, Diageo, SABMiller, PPC, and Starwood Hotels are only few of the MNCs have made significant investment in Ethiopia in the last few years.

The immediate reasons why Ethiopian government invites foreign investors are to increasing employment opportunity and to inject hard currency in the economy. The other equally important reasons why the government entice MNCs is expectation of positive spillover as multinational enterprises play an important part in transferring production technology and market knowledge across national borders to host countries. However, most foreign investors want to engage in high profit area (like bank and telecommunication) than top priority area of the country particularly manufacturing sectors. But, by taking different measures, Ethiopian government expects positive spillover from MNCs to local firms. Accordingly, to create access for local firms to acquiring new technology and administrative knowhow the government attracts MNCs. Moreover, MNCs may also introduce the local firms about foreign market operation and share the know-how of export market operation. In the second five year plan, more emphasis is given to accelerate industrializations by attracting large number of export oriented MNCs particularly in the manufacturing sectors.

3. Literature review

The early study about technology spillover is made by Arrow (1971).He stated that technology diffusion is like the spread of a contagious disease, where personal contact is needed for the spread of the disease. Often, MNCs do not completely protect their technology from leak and spillover. For example, Kokko (1994) argued that MNCs appears to be an important channel for the transfer of modem technology to local firms if appropriate policy intervention is made. Similarly, Blomström & Kokko (1993) opined that the main benefits of MNCs to host country are stem from the inflows of new technology to local firms. By the same token, Aitken et al (1997) find that MNCs directly or indirectly affect the endogenous growth rate via technological spillover. As suggested by Pant and Mondal (2010), technology transfer from FDI in India is more likely to be achieved by the presence of foreign firms rather than by simple purchase of technology. According to Zhu (2010), the inflows of foreign investment significantly spur industrial development through technology spillover. Recent studies like Abereijo and Ilori(2012), highlighted that local firms learn new technology from the nearby MNCs. Some researchers like Giroud (2007) made the assumptions that technology is transferrable at no cost because of its public good nature. But, to the contrary, some researches reveal that, to attract MNCs developing countries have very loose environment protection policy while developed countries tighten their policy to ensure safe living environment. This opens the room for MNCs to dispose old and obsolete technology to developing countries which discourage local firm's imitation efforts. For example, according to Alemayehu and Atnafu (2009), in Ethiopia Lifan Company of Dutch assembles 1 car per day where as in their home country they have used far better productive technology than host country.

3-1. Determinant factors of technology spillover

As the old saying 'the business of business is business' still going right, MNCs bring FSA to host countries for the sake of running their own operations efficiently. The primary reasons for MNCs investment are to increase

market share and maximize wealth; but not to help host country's' growth. They interact with local firms only if there is sound economic reasons for them to do so (Mesfin, 2016). For example, Narula and Marin (2005) emphasized the importance to acknowledge that MNEs are rarely interested in the explicit transfer of knowledge and they prefer to use technologies that are suited (first and foremost) to their own needs. Only those local firms with better absorptive capacity will reap the benefit from MNCs presence.

Researchers like Kokko(1994), Blomstrom and Kokko (1998), Blomström and Kokko (2003), Chen and Kokko(2010),Abereijo and Ilori(2012), Fracasso and Marzetti(2013), Wolfmayr et al (2013), Campos et al. (2014), Mayneris and Poncet (2015) and many others confirmed that spillovers are not automatic consequences resulted from the presence of MNCs rather it depends on the absorptive capacity of local firms to identify, assimilate and exploit foreign knowledge and to imitate new technologies: size and age of the firms, turnover practice of skilled labor, investment policy of host country, ownership structure and technology gaps, degree of R&D emphasis and the like are common factors affecting the internalization of technology. Since 1970s' many research has been conducted to explore the indirect effect of MNCs on local firms but find mixed and even contradicting outcomes. Some researchers conclude that there is positive spillover but weak while others find positive and strong spillover. Still others find negative spillover whilst others conclude that there is no relation at all. In the mean time, others found relation but set precondition like absorptive capacity of recipient while others found positive spillover for horizontal but not for vertical linkage. It is naïve assumption to expect automatic positive spillover from MNCs to local firms. Thus, to investigate whether there is technology spillover or not, it is imperative to conduct an investigation. Accordingly, we framed the first hypothesis as stated below.

Hypothesis1: The presences of MNCs insignificantly spur technology transfer

3-2. Channels of technology spillover

The frequently asked question by any host country government in the developing country is "how to transfer the foreign affiliated technology to local firms in cost effective manner?'. To answer such questions plethora studies have been made both at firm, sector and industry level in both developed and developing countries. The most common mechanisms or modes via which spillover might occur can be grouped in to 4 as stated below

Skilled and Experienced Employees mobility: People are technology using animals and hence employees have indispensible importance as a conduit of knowledge spillover from MNCs to local firms (mesfin 2016). When the employees previously having experience in MNCs leave to join other local firms or start their own firm, he/she is going with the knowledge and skills that can be used by local firms and hence diffusion of knowledge and skills exists. According to Gachino(2014),this channel is quite unique from the others in that it involves technology embodied in the workers as they move between firms.

Blomström and Kokko (1998), Greenaway et al (2004), and Narula and Marin(2005), Görg (2008) and Phucharoen(2014) accentuate that so as to increase their own productivity MNE trains up local labor and, according to them, after trained and worked in MNCs , there are many cases in which they move to domestically-owned companies, taking with them intangible FSA from MNCs to local firms. To further emphasize the benefits, those moved workers could formally or informally teach the knowledge to workers of local firms and hence the effect becomes triple. As suggested by Alfaro and Chen (2013), foreign multinationals generate positive productivity externalities and Knowledge transfer through partnerships, interaction and movement in labor markets. Generally, through the worker mobility, domestic firms could be benefited from the knowledge-invested employees who have moved from foreign-invested firms to local firms. However, since MNCs have better capacity than local firms, they have higher salary structure than local firms which enable them to the best to retain skilled employees and even to the worst to attract skilled worker from local firms both of which deter the movement of employees. Such facts have been confirmed by different authors. For example, Aitken et al.(1996) argued that MNCs generally offered higher salaries – efficiency wages – than locally owned firms do.

Gachino(2010) also confirmed that MNCs often raised incentives to key productive employees which is a disincentive to workers mobility. These tendencies make the technology spillover via labor movement (as a channel) a fantacy to the host country government.

***Linkages with MNCs*:** MNCs do not operate their business in isolated environment. To ensure the smooth operations of their own business, MNCs in one way or another, interact with the local firms either to buy input or sale their output to local firms. Narula and Marin(2005) confirmed that MNE subsidiaries do interact with domestic external economic agents. There for local firms may be supplier or customer to MNCs and hence domestic firms supplying to or purchasing inputs from multinationals may be exposed to the superior technology and thus, local firms have an opportunity to modify their technology through reverse technology.

Most study finds strong correlation between linkage with MNCs and local firm's improved technology and productivity. Pinilla (2003) find that the productive linkage established between local and foreign companies influence the technology transfer. But there is no guarantee for the positive spillover from the bare interaction. Many literatures revealed that the absorptive capacity plays a pillar role in the technology transfer from MNCs to

local firms.

Demonstration and Imitation Effect*:* as discussed in literature, governments in host country establish "Industry area" to bring local firms closer to MNCs compound. This creates an opportunity to vigilant local firms to emulate and copy foreign owned technology. But doing so request high absorptive capacity and it is only firms with absorptive capacity can imitate the multinationals in terms of products, process, management or marketing techniques. Basically it is the effect associated with knowledge spillover and technology diffusion and transfer. According to Blomström and Kokko(1998), there may be so-called "demonstration effects" if there are arm's-length-relationships between MNCs and domestic firms and domestic firms learn superior production technologies from multinationals. As suggested by Wang and Blomstrom(1992), Girma et al (2001) , Narula and Marin (2005), Phucharoen (2007), and Abereijo and Ilori(2012), demonstration and imitation effects can occur when domestic firms have the opportunity to train/observe to imitate/ copy the FSA possess by the MNCs. Gachino(2014) state that Demonstration effects occur when locally owned firms adopt technologies introduced by MNCs through imitation or reverse engineering. It is needless to mention that local firms benefit from subsidiaries' presence when subsidiaries demonstrate new technologies and new ways to use them.

Competition Effect: it is needless to state that the presence of MNCs in local business environment intensify the competition and abolish monopolistic power. According to Gachino(2014), MNCs entry puts, automatically, competitive pressure on the domestic firms, inducing them to enhance their capabilities through increased technological learning. This effect in literature is termed as "competition effect". Early studies like Aitken and Harrison (1999), point out that MNCs might attract away demand from their domestic competitors, thus, competition effect may reduce productivity in domestic firms. Not to lose the market, local firms will do all their best. As pinpoint by Glass and Saggi, (2002), despite losing market share, the presence of foreign invested firms would pressurize the domestic firms to improve their existing production technologies and process to become reliable supplier. Similarly, the study of Sinani and Meyer(2004), confirm that even if local firms are unable to imitate the MNE's FSA, competition induces domestic firms to use their resources and existing technologies more efficiently, or to search for new and better ones. Of course many studies agreed that competition increase the speed of adoption of new technology or the speed with which it is imitated.

As stated in literature, all channels are not equally important under different condition across countries. A condition more appropriate for one of the channel may not be appropriate for other. Bearing these in mind, it is worth to assess the common spillover channel specific to Ethiopia that conduit technology from foreign firms to local firms. Thus, at this junction it is sound to formulate the second hypothesis in the way to investigate answers for such questions.

Hypothesis 2.

All channels are equally important to transfer technology from MNCs to local firms.

3-3. Reaction of local firms

The opportunities resulted because of the presence of MNCs via the above stated channels insists local firms to react by introducing appropriate changes given their real capacities such as labor and finance. According to Gachino(2014), because of the influence of foreign firms, local firms may change their main operation that give them competitive advantages. According to the authors, local firms may react by changing one or a combination of the following five categories of changes: product changes, process changes, industrial engineering, new marketing strategies, and management and organization changes. It is noted that, such changes are indicators of existence of spillover and hence are a proxy to 'technology spillover'.

Product change: because of existence of technology spillovers, local firms may introduce entirely new products or improving the existing products or even copying the products of foreign firms

Process changes: MNCs presence also brings an opportunity for local firms to change one, some or all of the followings: techniques of production process, raw materials, quality control techniques, upgrade technology to save costs and increase efficiency and so forth

Industrial engineering: *foreign firms presence with superior experience give an opportunity for local firms to learn and improve their r*epair and routine and preventive maintenance of physical capital. Activities believed to be routine and easy to foreign firms like quality management or maintenance, can be very difficult to master for local firms in the host country.

Besides local firms may introduce new technology by adopting techniques like just in time to efficiently control their stock out and overstock inventories..

new marketing strategies: the presence of nearby market efficient foreign firms operation enable the local firms to learn and improve their marketing department by new ideas skills and knowledge in domestic or foreign markets (exporting) etc.

Management and organization changes: finally, local firms may learn from MNCs to change the organizational structure and arrangements of their facility layouts for improved management and implementation of production and other routine activities to soar productivity.

The arrangements of facility layouts avoid poor layouts. Poor layout often results in minimizing efficiency and maximizing costs. According to Aderemi et al (2009) bad layout could result in congestion of materials, components and assemblies, excessive amount of work-in process, poor utilization of space, production bottlenecks at certain machines while some facilities or machine are lying idle, delay in delivery, mental or physical strain on operators or workers and difficulty in maintaining effective supervision and control. Based on the aforesaid discussion, it is imperative to investigate the most common forms/kinds of changes that is/are executed by local firms in Ethiopian so that the policy makers will capitalize on it for better harnessing the opportunity of technology transfer in the future. Accordingly, we stated the third hypothesis as follows:

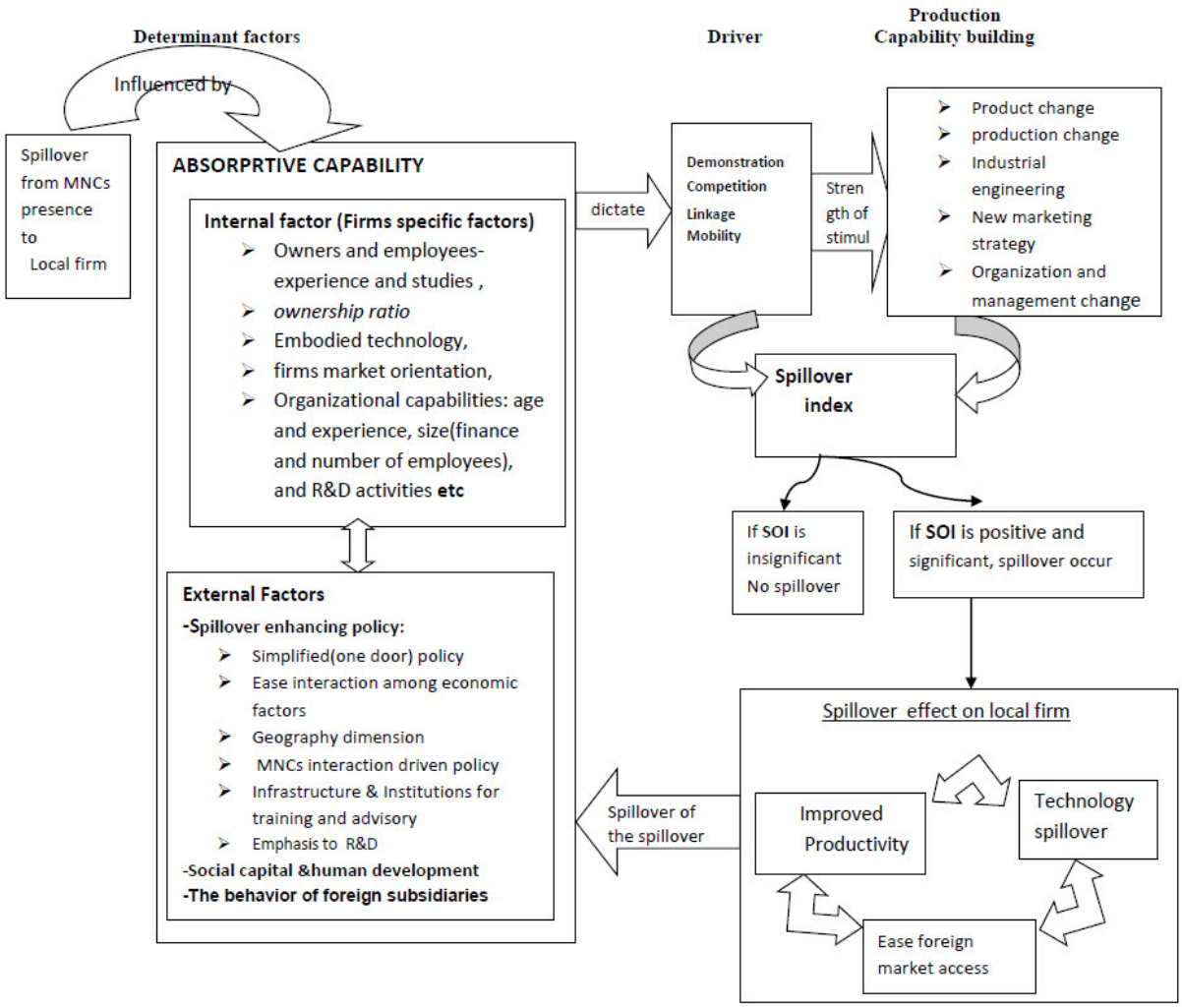
Hypothesis3: All production capability changes are uniformly implemented by local firms

4. Conceptual Frame work

To better understand the trends of technology spillover and to test the above hypotheses, we must conceptualize the relationship between different economic agents in the host countries. As rightly discussed above, the occurrence of spillover is not automatic and guaranteed. Only gallant firms with better absorptive capacity have the opportunity to harness the opportunities resulted from MNCs presence. There are different factors that affect the absorptive capacity of local firms in to which we categorized as internal and external factors.

Some of the internal factors includes quality of labor, ownership ratio, embodied technology, firms' market orientation, and Organizational capabilities like age, experience, size(finance and number of employees), R&D activities etc.

Factors from external environment includes Spillover enhancing policy such as simplified(one door) policy, ease interaction among economic factors, geography dimension, MNCs interaction driven policy, infrastructure & institutions for training and advisory plus emphasis to R&D. Moreover, the external factors includes social capital and human development trends as well as and the behavior of foreign firms all of which affect the occurrence of spillover effect from foreign firms.



Internal determinants:

Size and age of firms: it is generally true that the larger the firm size and the older its age, the better the absorptive capacity of the firm will be. Small and medium sized plants are unable to deploy new technologies, with unchanged production possibilities, and instead face the negative intra-industry effect from competition by MNCs oriented to the domestic market, resulting in gradually declining productivity. Abereijo and Ilorin (2012),emphasized on the recipient's size and age as decisive factor for spillover occurrence. Thus, size and age are an important indicator to capture the potential positive spillovers due to technology diffusion from MNCs.

Quality of employees: Given other factors constant, local firms employed qualified workers have better technology absorptive capacity than other with less qualified workers. Narula and Marin (2005) argued employing trained workers previously working in MNCs expand the knowledge base of local firms which will hasten the spillover effect. Hippel (1988) noted that,MNCs minimize the mobility of personnel through paying higher wages or select an entry mode that minimizes spillovers. Similarly, as suggested by Gershenberg (1987), Girma et al (2001) and Fosfuri et al (2001) MNEs may pay a wage premium to retain skilled employees and in any way, restricted employees movement greatly hampered the expected positive spillover.

Ownership: in literature, ownership structure is identified to be another dictating factor that determines the occurrence of spillover. Lane and Lubatkin (1998) pointed out that ownership structure matters to a domestic firm's ability to benefit from spillovers of technology transfer

Embodied technology: The relation between technology gap and spillover occurrence is found to be one of the debating issues in literature Some researcher argued that, positive spillover will be occurred if the technology gap is high while other argued moderate gap and still others suggest small gap facilitate spillover occurrence. But all researchers agree that technology gap signals something to the MNE about the spillover occurrence Wang and Blömstrom (1992) argue that the larger the technology gap, the greater the scope for learning by the local economy and hence the greater the spillover will be. Contrary to this finding, Cantwell (1994); Glass and Saggi (1998), Kathuria(2000), Görg and Greenaway(2004) and Isabel et al (2006) find that the lower the technology gap between domestic and foreign firms the higher the ability of the domestic firms to capture the benefits created by the MNE presence.

R&D practices of local firms: Liang (2007) confirmed that, domestic firms' in-house R&D capital improves local firms' capacity and facilitates learning from foreign firms. Those local firms having strong R&D culture have better capacity than those who do not have. However, researchers like Abereijo and Llori (2012) stated that majority of local firms in developing countries lack resources to modernize their R&D program and this department has neither trained worker nor has sufficient budget.

External Determinants

Beside the internal factors, there are many external factors that enhance or deter the spillover occurrence. Government policy: indisputably the business policy in the host country plays key role in the occurrence of technology transfer. For example, policies with simplified one window service, facilitating ease interaction among economic agents, gathering similar industry in the same industry area, cost effective human development policy and emphasis to R&D plays the technology spillover nature and magnitude. More over the general behavior of foreign companies play determinant role for the same. For instance, because of loose environmental protection, some MNCs supply outdated technologies for developing countries and still others are not willing to share their rich experience and even some engage in strategies to prevent know-how from leaking out all of which affect the spillover occurrence.

The existing conditions of determinant factors from both internal and external environment directly dictate the appropriate kinds of driver for the spillover occurrence. If the absorptive capacity is above the thresh hold level, than one or a combination of the spillover channels act as stimulant/catalyst and spur local firms to introduce changes. The possible changes that can be possibly taken by local firm ranges from product changes to changes in the organization set up and management practices generally referred as production capability changes. Other kinds of capability changes like investment capability changes and linkages are out of the scope of this survey. Any kinds of changes introduced by local firms because of the influence or stimuli of MNCs referred as spillover. The magnitude of the spillover occurrence can be traced by computing spillover index. The larger the spillover index, the higher the magnitude of the spillover can be. If the spillover index is large enough, than the company introduce changes and the ultimate outcomes of any changes affect overall performance of local firms. For convenience purpose we can categorize the eventual outcome in to three as improved technology, higher productivity and expanded market share beyond the local market. One can recognize that these outcomes are interwoven and interdependent i.e. the spillover occurrence of any one of these induces the occurrence of the other. For example, technology transfer leads to improve the efficiency and increase firms' productivity consequently better productivity spurs the firms to find undry demand from foreign market. On similar bases if there is export spillover, the company is encouraged to increase its productivity which in return influences local firms to upgrade technology. Interestingly, this spillover outcome goes to the reverse direction and affects the determinant factors and local firm absorptive capacity. Such spillovers of the spillover make the local firms

more strong and competent in the international market but measurement of the real magnitude of the reverse spillover more complex and are beyond the scope of this survey.

5. Methodology

5-1. Target population

Local manufacturing industries, which have already joined the foreign market, were target of this study. But to ensure data manageability, the researcher purposively selected textile and leather industries from the manufacturing industries as most foreign firms have been engaged in such sectors. Blomstro and Sjokholm (1999), as well as Nicolini and Resimini (2007) found that the degree of foreign ownership does neither affect the level of labor productivity in foreign establishments, nor the degree of spillover. Thus, for convenience purpose, we treated those firms with foreign share less than 10% as local firms. GoÈrg and Strobl (2001) conclude that the results of spillover studies do not seem to be affected by whether the studies use sector or firm level data and hence in this study, we considered only firm level data.

5-2. Sampling Techniques & Sample size

To contact the right respondents, multistage samplings were used. First, we stratified the industry as manufacturing and service sectors and then manufacturing sectors were selected as a sample. Then the manufacturing sectors were further stratified as exporting and none exporting firms and selected only the exporting firms as a sample. Finally, from exporting firms the researcher purposively targeted textile and leather industries as sample of the study because these are technology using sectors than any other sectors.

Moreover, to generate dependable data, we considered the size and age of the firm as the bases of selecting the actual respondents. This is because, the larger the size and the older the age of the firm, the greater the probability to learn and absorb technology spillover. Accordingly, we consulted the top 20 big size firms based up on their paid up capital amount and number of employee and at the same time operating in the sectors for more than 5 years. From each 20 sectors, three department heads namely: production manager, administrative manager and marketing managers who are directly related to the study were purposively selected as target respondents and hence this study conducted on a total of 60 sample sizes from 20 firms.

5-3. Data gathering

To better address the kind of local firms' reaction to the presence of MNCs, we found imperative to investigate the firm level production capability changes. Accordingly we took the five change category identified by Gachino (2006), and to exhaustively explore the type of changes implemented by local firms, the five categories are dismantled in to 5 sub questions. Thus a total of 25 different structured ordinary ranked questions were distributed to respondents. Each questions are framed in the 5 ordinary likert scale format *as 0= 'No changes', 1=very insignificant changes, 2=insignificant changes, 3=significant changes and 4=very significant changes.*

5-4. Data analysis techniques

Tthe gathered data were analyzed using the statistical tools of joint and marginal probability concepts. The joint probability can be found by taking the ratio of each cells figure by the total number of respondents (60) and the marginal probability is simply the sum of the joint probability as shown below:

$$\textit{Joint probability} = \frac{\Sigma \textit{No. of respondents in each cell}}{\textit{Total sample size}} \qquad e.1$$

$$\textit{Marginal probability of rows} = \Sigma \textit{joint probability of each rows} \qquad e.2$$

$$\textit{Marginal probability of columns} = \Sigma \textit{ joint probability of each column} \qquad e.3$$

To investigate the magnitude of spillover occurrence, it is imperative to find the spillover index. The spillover index can be computed in different ways as shown below.

$$\text{Spillover index} = \frac{\Sigma \textit{ marginal row}}{\text{Grand mean}} \text{ or } \frac{\Sigma \textit{ marginal column}}{\text{Grand mean}} \qquad e.4$$

Where the grand mean is the mean we can get given that all respondents rate their reaction to MNCs influence as high or very high.(see the details in the analysis section)

The spillover index can also be calculated by taking the ratio of row average or column average to the number of rows or columns respectively as shown below.

$$\text{Spillover index} = \frac{\Sigma \textit{ average row}}{\text{No. of rows}} \text{ or } \frac{\Sigma \textit{ marginal column}}{\text{No. of column}} \qquad e.5$$

According to Gachino(2006), there are five basic possible reactions that can be taken by local firms which are called production capability changes. These changes include product change, production change, reverse engineering, change in marketing strategy and change in organization and management practices. Often these changes are caused by one or a combination of four channels stated above. The marginal probability in the right extreme column of the table represents the 5 sub categories of changes introduced by the local firms because of the presence and influence of foreign firms. On the other hand, the marginal probability at the lower bottom of the table represents the types of channels or model (mechanism) of spillover occurrence. The joint probability reveals how significant each channel to each technology changes is. Finally, the sum of the marginal probability of the column (which is equal with the sum of the marginal probability of row) indicates the degree of spillover occurrence.

6. DATA ANALYSIS

As discussed above, the local firms react differently (ranging from changing the product to changing the organization and administration) for the influence of foreign firms. In the following discussions, we analyzed one after another just for nuance investigation by springing from Gachino(2010). In the analysis we exclude the rate of "no change" and "insignificant changes" and hence the computation is based on response rated of "significant" and "very significant" changes.

6-1. "Product change" reaction to MNCs presence

Details of changes introduced because of MNC presence	Competition	linkage	Labor mobility	demonstration	**Marginal row**
In-house new product developing	3 (.05)	4 (.067)	1 (.017)	5 (.083)	13 .271
Enhance customization by modifying existing products	10 (.17)	20 (.333)	5 (.083)	40 (.667)	75 1.253
Copying foreign firms' products	5 (.083)	10 (.17)	10 (.17)	30 (.5)	55 .923
Quality improvement of the product	30 (.5)	10 (.17)	5 (.083)	20 (.333)	65 1.086
Improved the design of product package to suit markets	20 .333	5 (.083)	10 (.17)	30 (.5)	65 1.086
Marginal column	68 1.133	49 .816	31 .517	125 2.083	**4.6**

Source: author's computation (Number in parenthesis is joint probability)

The above table depicted that the local firms reacted by changing its product (proxy to spillover) and all the stated channels have been causing these changes. As it is revealed in the marginal probability column, the common forms of product change practiced by local firm is enhancing customization by modifying the existing products(1.253) followed by improvement of quality(1.086) and changing the design of the products to suit specific market needs(1.086). In-house new product development because of the influence of foreign firm is poorly practiced.

The same table unfold the significance of the channels to induce local firms for product changes. Accordingly, the marginal probability row attests that demonstration and imitations is the most common mechanisms/modes for spillover occurrence (2.083) followed by competition (1.136). On the other hand, Linkage and labor mobility were rated as low. This result is not unexpected because different authors confirmed that foreign companies often have higher salary structures which deter the skilled employee turnover from the foreign firms to local firms. Asayehegn (2009**)** explained the Chinese-Ethiopian relation. The analysis of the study was made on the basis of four case studies of which three are managed by Chinese and one by Ethiopian manager. The finding unfolded that owing to lack of technologically skilled workers, most of the key workers are brought from home country. Moreover, since MNCs pay higher salary employees mobility is poor .Thus, the spillover via labor mobility is challenged to cause product changes in Ethiopia.

6-2. "Process change" reaction to MNCs presence

Details of changes introduced because of MNC presence	Competition	linkage	Labor mobility	demonstration	**Marginal row**
Improve process testing and measurement strategies to ensure quality standard and to comply with ISO 9000.	9 (.15)	18 (.3)	14 (.233)	7 (.117)	48 0.8
Introducing new processing techniques similar to foreign firms' process	4 (.067)	9 (.15)	5 (.083)	8 (.133)	26 .433
Apply new techniques such as Just-In-Time (JIT) and Total Quality Management (TQM) in procurement and inventory control to avoid over &under stock(to cut cost)	17 (0.283)	19 (0.317)	9 (.15)	14 (.233)	59 .988
Vigilantly control WIP inventory, and improve waste disposal practices	5 (.083)	14 (.233)	10 (.167)	13 (.05)	42 0.7
Improve the practices of procuring and consuming quality raw materials	31 (.517)	45 (.75)	25 (.417)	42 (.7)	143 2.38
Marginal column	66 1.10	105 1.75	63 1.05	84 1.40	**5.3**

Source: author's computation (Number in parenthesis is joint probability)

Table 6-2 is designed to explore the reaction of local firms in terms of introducing process/production changes because of the direct or indirect influence of foreign firms in the country. Accordingly, the table revealed that the local firms better react by changing the process than the products. The firms improve the practices of raw material procurement and consumption(2.38) followed by introducing new techniques like JIT and TQM(.988) to avoid excessive carrying cost, ordering costs and stock out cost. Introduction of entirely new process techniques and even improvement of the existing process are proved to be difficult to implement (0.7) and (0.8) respectively.

Among the four channels, Linkage is rated to be the most significant mode for enhancing process changes followed by demonstration. Generally, if local firms have vertical linkage(backward or forward) with foreign firms, it is obvious that the later pressurize the former to comply with the quality standard. This forced the local firms to improve the production process to meet the stated standard. Often foreign firms do not demonstrate the basic processes but simply show how to improve quality and reduce costs. Thus, the rate of introducing new process by any channel is very weak.

6-3. "Reverse engineering" reaction to MNCs presence

Details of changes introduced because of MNC presence	Competition	linkage	Labor mobility	demonstration	**Marginal row**
Buying new technology similar to or better than foreign firms to automate the machine	13 (.217)	14 (.233)	11 (.183)	10 (.167)	48 .8
Improving preventive maintenance & cost effective repair &replacement of physical property to avoid breakdown rates	31 (.517)	52 (.867)	45 (.75)	30 (.5)	158 2.633
Upgrade the existing technology & equipment to save energy, cutting cost and raising productivity	20 (.333)	42 (.7)	35 (.583)	20 (.333)	117 1.95
Entering into an agreement with another firm to use or manufacture their product which is protected by intellectual property rights (IPR)	10 (.167)	25 (.417)	10 (.167)	13 (.217)	58 0.967
Improving technology infrastructure of laboratories & testing facilities	12 (.2)	37 (.617)	23 (.383)	18 (.30)	90 1.5
Marginal column	86 1.433	170 2.833	124 2.067	91 1.517	**7.85**

Source: author's computation (Number in parenthesis is joint probability)

Table 6-3 is framed to explore the practices of reverse engineering because of the presence of MNCs nearby local firms premises. Accordingly, the table shows reverse engineering is more commonly exercised than changing the product and/or the processes. Among the indicators of technology changes, the local firms capitalize on the improvements of preventive maintenance, repair & replacement of physical property to avoid breakdown rates(2.633) followed by improving technology structure of laboratories and testing facilities(1.5). But introducing new technology because of the influence of foreign firms is rarely practiced. This is because of

the fact that local firms have no financial and human capacity to do so and licensing is also practiced poorly for the same stated reasons.

Among the channels, linkage plays a significant role to enhance reverse engineering followed by demonstration and competition. Labor mobility rated low to catalyze technology transfer. Local firms who established vertical or horizontal and forward or backward linkages with foreign firms have better opportunity to be supported by foreign firms through demonstration. Such local firms learn to reduce break down rates through proper maintenance, repair and replacement of key capital properties.

6-4. "Marketing strategy change" reaction to MNCs presence

Details of changes introduced because of MNC presence	Competition	linkage	Labor mobility	demonstration	**Marginal row**
Improving the promotion strategy	23 (.383)	14 (.233)	31 (.517)	15 (.25)	83 1.38
Changing trade orientation (import-oriented to export-oriented or vis-versa)	21 (.35)	20 (.333)	5 (.083)	10 (.167)	56 0.933
Improving the pricing strategy	15 (.25)	10 (.167)	10 (.167)	12 (.20)	47 .783
Improving the distribution strategy	33 (.55)	21 (.35)	5 (.083)	20 (.333)	79 1.317
Modifying product packages including guarantee and warrantee to customers	42 (.7)	45 (.75)	20 (.333)	30 (.5)	137 2.283
Marginal column	134 2.233	110 1.833	61 1.017	87 1.45	**6.6**

Source: author's computation (Number in parenthesis is joint probability)

The above table is designed to find out whether local firms introduce marketing strategy changes because of the influence of foreign firms and if so which channel is more significant for such changes.

Consequently, the table unfold that local firms introduce market strategy changes because of foreign firms influence. Among the stated indicators of market strategy changes, local firms changes its product packaging and introduces new forms of guarantees and warranties to their customers.(2.283) followed by improvements of promotion strategies(1.38) and distribution strategies(1.317). Changing the trade orientation and pricing strategy as a response to foreign firms' presence is proved to be difficult and hence rated as low.

The most significant channels for spurring the introduction of marketing change is competition (2.233) followed by linkages. Strong competition forced the local firms to improve their marketing tactics like product package improvements followed by improvement of distribution and promotion. Labor mobility and demonstration have rated poor to introduce marketing strategy changes.

6-5. "Organization and Management changes" reaction to MNCs presence

Details of changes introduced because of MNC presence	Competition	Linkage	Labor mobility	demonstration	***Marginal row***
Introduce new organizational setup similar to foreign firms for better monitoring the productivity process	30 (.05)	34 (.067)	45 (.017)	50 (.083)	159 2.65
Establish new administrative system similar to foreign firms to improve cooperation across departments	20 (.17)	25 (.333)	45 (.083)	40 (.667)	130 2.167
Establish new branches for better productivity	15 (.083)	10 (.17)	33 (.17)	30 (.5)	88 1.467
imitate layout of plant, facilities and machineries from foreign firms for easy access and efficient operation	30 (.5)	40 (.17)	55 (.083)	50 (.333)	175 2.917
Recruit more skilled and efficient personnel	20 .333	15 (.083)	50 (.17)	30 (.5)	115 1.917
Marginal column	115 1.917	124 2.067	195 3.25	200 3.333	**11**

Source: author's computation (Number in parenthesis is joint probability)

Among the five product capability change (proxy of spillover) carried out by local firms in response to foreign firms' influence, changing the organizational set up and management practices is the most commonly exercised one(11). This result is consistent with the findings of previous studies. As stated by different authors,

introducing organization and management changes are less risky and less expensive than any other forms of changes and are simple to implement. Among the stated indicators of organization and management changes, changing the layout of plant, facilities and machineries from foreign firms for easy access and efficient operation is the most practiced one (2.917). This change plays a significant role for the local firms as Plant layout constitutes a very important technological effort that could save huge sum of production cost. According to Aderemi,et al(2009), bad layout could result in mental or physical strain on operators or workers and difficulty in maintaining effective supervision and control. In the mean time, bad layout also results in congestion of materials, components and assemblies, excessive amount of work-in process. Besides, poor layout ends in unbalanced capacity utilizations which results in idle capacity in some line while there is bottleneck in another line.

Labor mobility and demonstrations are rated as significant mechanisms for enhancing local firms for organization and management changes. On the other hand, completion and linkages role compared to the former two channels are rated as weak. It is confirmed that, labor mobility, even if low, plays a significant role in transferring administrative related knowledge from foreign firms to local firms.

Computing spillover Index

Now let as bring the average of each change found at marginal probability influence row from the bottom of each table and compute the composite mean (grand mean) which is a proxy for "**spillover index**".

Table 6-6 spillover index table

Type of changes introduced because of MNCs influence	Competition	linkage	Labor mobility	demonstration	***Marginal Row***	***Row average***
Product change	1.133	0.816	0.517	2.083	4.549	1.13725
Process changes	1.1	1.75	1.05	1.4	5.3	1.325
Reverse engineering	1.433	2.833	2.067	1.517	7.85	1.9625
Market strategy change	2.233	1.833	1.017	1.45	6.533	1.63325
Organization and management changes	1.917	2.067	3.25	3.333	10.567	2.64175
Marginal Column	7.816	9.299	7.901	9.783	34.799	8.69975
Column average	1.5632	1.8598	1.5802	1.9566	6.9598	1.73995

Source: own computation

Before starting the spillover index calculation, let us see the figures in table 6-6 above. The column average clearly unfolded the significances of each channel in Ethiopian context. Accordingly, demonstration has directly or indirectly spurs local firms to introduce any one of the five changes followed by linkage. On the other hand labor mobility is the least followed by competition. The competition in this particular survey as we actually expect is weak because of the fact that we took only export oriented firms and hence there is no direct confrontation among our sampled firms on the local market. Thus, the completion is barely on limited area like raw material rather than demand. In the same manner, the weakness of labor mobility is not unexpected. This can be justified by the reason that-as confirmed by different authors- multinational companies pays higher salary and incentive package than local firms which is a disincentive for skilled labor mobility.

Regarding the reaction of local firms, changing the organizational setup and management practices is found to be the most common forms of reaction followed by reverse engineering and marketing strategy. These types of changes are relatively simple to imitate and implement for local firms. On the other hand, changing the product because of foreign firm influence is found to be least followed by process changes. By the same token, these results are as expected because changing the product or the process is very challenging and involves high risk for local firms to implement. Such changes require high absorptive capacity of the recipients but it is obvious that local firms in developing countries like Ethiopia, absorptive capacity is proved to be weak compared to developing countries firms.

Bearing this in mind, let us see the magnitude of spillover occurrence explained by spillover index. According to Gachino (2010), the spillover index can be computed by taking the sum of row average or column average. To be more sensible, we must express spillover index in terms of percentage by multiplying it by 100%. Note that, the sum of row average and column average gives the same results. Column average is the ratio of marginal column and number of rows. On the other hand, row average is the ratio of marginal row and number of column. In our survey, therefore, sum of column average is 6.9598 and number of number of column is 4. By the same token, in the survey it is depicted that the sum of row average is 8.69975 and number of rows are 5.

Now by taking any one of the two ratio (6.9598/4) or (8.69975/5), we can find our spillover index and hence, the spillover index becomes 1.74 i.e. 17%. This spillover index, as suggested by Gachino(2010), is used to explain the magnitude of technology spillover resulted from multinational companies to local firms.

Alternatively, we can calculate spillover index by taking the ratio of marginal row (34.799) or marginal column (34.799) by 20. Please not that if all the 60 respondents rate for all changes high or very high for all

channels, then the marginal rows and marginal columns becomes 20(see the hypothetical table stated below for reference)

The following hypothetical table designed to supplement our explanation of spillover index results we have got in our survey. Accordingly, if all respondents found their reactions high or very high, then the joint probability to all cells become 1 i.e. the ratio of cells value of 60 to total respondents of 60.

Table 6-7. Spillover index if all rates were high or very high

Type of changes introduced because of MNCs influence	Competition	linkage	Labor mobility	demonstration	***Marginal Row***	***Row average***
Product change	1	1	1	1	4	1
Process changes	1	1	1	1	4	1
Reverse engineering	1	1	1	1	4	1
Market strategy change	1	1	1	1	4	1
Org. and mgmt. changes	1	1	1	1	4	1
Marginal Column	5	5	5	5	20	
Column average	1	1	1	1		100%

Then the marginal column become5 for each of the four channels and the marginal row becomes 4 for each of the five kinds of changes. The total marginal column or marginal row then becomes 20. By dividing the marginal column by number of rows (5 in this case) we will get column average and by dividing marginal row by number of columns (4 row in this case), we will get row average. Finally, by dividing sum of row average (5) by number of rows (5) or column average (4) by number of column (4) and multiplying it by 100 we can find the spillover index percentage.

Generally, we can infer from table 6-6 that the presence of foreign firms can spur technology transfer in Ethiopia but at a weak magnitude and the channels do not have the same significance in inducing product, process, technology, marketing and organization & management changes across manufacturing firms.

7. CONCLUSIONS

In our survey, the spillover occurrences is proxied by changes in the production capabilities which includes product changes, process changes, technology changes(reverse engineering), market strategy changes and organization and management changes. As the finding confirms, all these changes are introduced in the organization but at different enormity. In the mean time, the study revealed that, all the channels play a role in spurring changes in the local firms. Moreover, the finding of the survey also revealed that there is technology spillover from foreign firms to local firms but at a weaker magnitude

According to the findings of the survey, local firms react mostly by changing organization and management practices than any other changes. To the contrary, product changes and process changes in the local firms as a reaction to foreign influence is proved to be difficult. Regarding the channels spillover, demonstration has upper hand over the other mechanisms to influence product changes while linkages significantly cause process changes and technology changes. Market changes is often caused by competition while labor mobility is paramount significance to cause changes in the organizational set up and management practices of local firms. The survey confirmed that the channels do not uniformly induce technological changes across the firms. The type of channel appropriate to induce one category of change may not work to cause changes in the other category. Thus, it is up to the policy maker to investigate the types of channel appropriate to specific changes and capitalize on it for better technology transfer.

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