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Effective knowledge sharing: the Tanzanian Industrial Research and Development Organization as mediator between the foreign and local sector

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Introduction

The technological environment of the South differs to a great extent from that of the North with regards to the formal structures and institutions that are less integrated and coordinated, as is the case in the North. There exists an immense technological gap between developed countries and less developed countries (LDCs), with the technological capacity of the LDCs being very low. Technological capacity represents the stock of technology producing assets, such as research and development (R&D) laboratories, learning institutions, scientists and engineers, the accumulated experience of public and private institutions, and the knowledge of managers and workers (Dunning 1993). As a result, foreign direct investment (FDI) is important for these countries in the South as a means to bridge the gap of the systems and to advance their technological capacity. Thus, the flow of FDI into those countries can potentially enhance the local capacity and lead to growth, if it is sufficiently absorbed. Moreover, 'their market scales, relative factor supplies and income-constrained patterns of demand, make their technical capabilities and their product structures incongruent with those that characterise countries that operate at or near the technological frontiers' (Dunning 1993: 26).

There is recognition by the government of Tanzania and various stakeholders, together with the advice of international agencies, of the need to develop an innovation system in order to facilitate mutual learning and knowledge sharing between various actors and to promote industrial and technological development. Efforts are in place to realize this, and a model for a national system of innovation (NSI) has been developed (UNCTAD 2001). Multinational enterprises (MNEs) and local technology service providers are part of this model. This paper is focuses explicitly on the link between an MNE and a local technological service provider with a study of collaboration that has taken place between the Tanzanian Industrial Research and Development Organization (TIRDO) and Coca Cola Kwanza Ltd.

The actors of a NSI envisaged for Tanzania include technology service providers, learning institutions, foreign affiliates, the domestic sector, government ministries and business associations. This vision is endorsed by the government of Tanzania, and other local and international stakeholders, including foreign investors. The 'national science and technology policy' is expressed in this vision, and states that the most effective way for Tanzania to benefit from possible FDI spillovers, especially in technological development, is 'by improving the capacity of its domestic sector to

learn, adapt and assimilate technology' (UNCTAD 2001: 92-93). In order for this to happen, the need for a systemic approach has been highlighted and a model for a potential system of innovation (SI) on a national level proposed (UNCTAD 2001: 85). Enterprises do not innovate or upgrade in isolation but rather through interacting with other actors, such as technology suppliers, other enterprises, customers and technology service providers (UNCTAD 2001: 84). It is argued that:

> *Only by applying such a systemic perspective and formulating policies that stimulate interaction in the system and encourage the active participation of the private sector can technologically weak economies like Tanzania be able to develop a dynamic enterprise sector and maximize the impact of FDI.* (UNCTAD 2001: 84)

The empirical context

The domestic industry in Tanzania is still characterized by an inadequate base of technology and R&D activities, due to an unfavourable environment for the R&D activities. It has also been argued that many domestic industries are not sufficiently informed about the existing R&D institutions and their potential for solving technical problems (TIRDO 2002b).

The weak technological R&D base prompted the Tanzanian government to establish sector-based centres of excellence. This has been done because a broader institutional framework is needed to support the development of the private sector. R&D in Tanzania is primarily carried out by governmental institutions (Bongenaar and Szirmai 1999). It has been shown that if the R&D capacity of the country is de-linked from the private sector, it will contribute only little or nothing to technological upgrading at the firm level (UNCTAD 2001). The main task of the industrial support organizations is to provide services, including technological advice to industry, and to help them with innovative work on their products and processes.

The role that science and technology play in the development process has not been recognized by many industrial firms, demonstrated by lack of commitment to more innovative undertakings. Even with a few that are aware, there are other barriers including financial resources, inadequate human skills and weak information system.

Foreign bodies of knowledge in the Tanzanian economy

Due to the presence of MNEs in the local system, some of the knowledge that is flowing in the system constitutes a foreign body of knowledge. Through the increasing internationalization of production and FDI, this body of knowledge forms a solid part of the local system. Additionally, inward FDI links domestic actors to economic units outside the national ones. The extent of cross-border knowledge exchange varies from system to system. Innovation systems connect domestic and foreign bodies of knowledge (Narula 2002), and this is generally the case in LDCs where the foreign knowledge base is particularly important. For local institutes, such as TIRDO, this is the context in which they are operating. MNEs constitute bodies of leading knowledge in the wider local context.

The domestic knowledge base is further developed by the technology and knowledge transferred from the foreign sources. However, the domestic system needs to be in a position to internalize the input of the foreign knowledge sources. This ability to develop adequate capabilities to absorb the knowledge output of the collaboration with MNEs is one important challenge.

With regards to macro implications for the SI, there need to be appropriate conditions not only within technology service providers, but also within the whole economy and society, i.e. social capabilities need to be present. Another challenge is related to the general gaps in the systems that exist in LDCs. Even if LDCs can learn from MNEs, due to increased cross-border activities, there is the problem of internalising the input and the question of relevance of the input. Regarding the rather basic problems that many companies in Tanzania are facing, concepts such as those conveyed to TIRDO through the collaboration with both Coca-Cola are of secondary priority. The local firms have to struggle with problems as for example low level of human and physical resources. Consequently, issues like improving the working environment are not prioritized. The input of ideas resulting from the collaboration with MNEs is therefore only productive and with potential for wider application where the ideas can be transferred to different contexts. This means, not directly from the foreign firm to a local one, but rather finding a form for application in another context.

The following case study focuses on different forms of interaction between a foreign affiliate, as representative for the private, foreign industries, and TIRDO a local technological service provider. It is investigated how knowledge of importance for economic development is shared and diffused between various actors in the economy with TIRDO being the key translator between the foreign and the local actors. Thus, the transfer of knowledge occurs through the interactions between the MNE and TIRDO. A specific case of collaboration between TIRDO and a MNE is examined and an analysis is provided of how the knowledge that TIRDO has gained in this collaboration is further distributed and applied in the wider local context. The paper examines how some of the knowledge transferred in the collaboration can 'spillover' to the wider local context. This is important in order to know whether the available knowledge is actually shared between all relevant actors and re-implemented in new ways.

The Coca Cola Kwanza Ltd, foreign affiliates and TIRDO, a local R&D organization have been identified as actors in a potential innovation system and are thus key actors for the diffusion of knowledge in the economy. They complement each other through the interactions in various projects. One can observe a one-way technology and knowledge transfer, and a process of interactive learning and technological adaptation, creating innovative linkages between the two actors in the system.

Objective of the paper

Based on the above, the paper analyzes how far knowledge available in foreign-owned companies can contribute to an improvement in the technological capabilities of host countries. The analysis will seek to examine the reality of knowledge sharing from the interaction of FDI in manufacturing industry in Tanzania with the help of

TIRDO, and its implications for application to wider local uses. There is a section that explores the role of FDI and MNEs in LDCs and examines what determines their impact on the technological development of the host country. First, different kinds of FDI and the potential for spillovers are discussed. Based on this, a discussion highlights those issues that deal with the MNE, as actor of technology transfer, and the significance of the host economies' ability to absorb technological capabilities.

We focus on how the spillovers from FDI in Tanzania in the form of technology and knowledge can act as a catalyst for industrial upgrading. Consequently, aspects on transfer of technology and its implications for the overall economic development of host countries can complement concepts of innovation theories.

Analytical framework

In order to analyze the role of the different actors for sharing knowledge and contributing to technological development, a holistic perspective is needed which would also include elements of the local system. In this regard, the concept of innovation system approaches (ISA) is an appropriate concept, combined with central elements of the theoretical debates on MNE and FDI impact on domestic technological capabilities. The ISA has been chosen in order to have a suitable framework for analyzing the interactivity between different actors in a system. Theories on FDI and technology transfer are specifically utilized to highlight the role of MNEs as sources of foreign knowledge within the local economy and to underline the potential for technology and knowledge transfer that can take place in these interactions.

Innovation system definitions

Innovation system approaches focus on the study of innovation and technological development, and consist of a multitude of contemporary endeavours to study the complexities involved in the creation and diffusion of new technology into society. Considered in this way, the innovation system approach is used as a conceptual tool for the analysis of the underlying processes leading to innovation:

> *The essence of the innovation system approach is that the innovation capacity of a country (region, sector) is determined not only by the innovation capacity of its individual firms and organisations, but also how they interact with each other and with the public sector.* (Bonilla and Johnson, 2001: 5)

An innovation system can thus be summarized as being a composite combination of institutions supporting learning processes and technological accumulation, and is thus a useful analytical framework if one intends to examine the interaction between various actors in the economy where knowledge is flowing.

In its broadest sense, innovation can be described as 'the first application of knowledge in a new way, with commercial success' (OECD 1992). Another important feature of innovation is its process nature, as illustrated by Kline and Rosenberg's interactive model (OECD 1992). Kline and Rosenberg emphasize the dynamic

exchanges between internal and external sources of knowledge, indicating the importance of interaction. In this paper, we view innovation in line with the notion of learning economies as a process in which knowledge plays a central role as contributor to economic growth. Consequently, knowledge becomes a commercial good in itself, explaining also the explicit focus on knowledge sharing and the knowledge source in this paper.

The role of FDI and MNEs in technology transfer

The literature on FDI and MNEs is focused on those aspects that consider MNEs as the actors and the source of technology transfer to LDCs. In that sense, these factors play a central role in the development process of host country economies, as providers of technology and skills, and through technology development and diffusion in the host country. The technology transfer can take various forms. For example, the transfer of skills through training is considered as a valuable contribution of MNEs to LDCs (Lall 1996). Essentially, FDI may be exploited by the host country as a means to advance technological upgrading. It is however important to underline the fact that FDI may contribute to technological accumulation and economic growth but is not the 'driving force' of economic development (Narula 2001) since FDI has to be domestically enabled if it is to lead to activities in terms of technological and industrial development.

Different kinds of FDI exist. There are four main motives for investment: seeking natural resources, seeking new markets, restructuring existing foreign production through rationalization, and seeking strategically related assets. The main kinds of FDI that currently are directed to LDCs are 'resource-seeking FDI' and 'market-seeking FDI' (Narula and Dunning 2000: 105-152). As a result, different FDI activities have a different potential for spillover. It is therefore important for countries to attract the right kind of FDI that potentially leads to maximum spillovers. Indeed, the effect of MNEs on the technological capabilities of recipient countries depends very much on the kind of FDI that is undertaken (Dunning 1993). The right type of FDI is therefore required if FDI is to promote technological upgrading for host countries (Narula and Dunning 2000). However, the extent of FDI being a means for technology upgrading depends on the absorptive capabilities of the technologies that exist in the local context.

Effective transfer and adaptation of technology are important influential factors for economic development. Essential questions in relation to MNEs within the industrial sector are therefore how to create skills in a certain country and how to obtain benefits that spillover (Lall 1996). As our material shows, an organization like TIRDO can play an important role in facilitating this process.

Technology transfer

Chen argues that 'the transfer of inappropriate technology by [transnational corporations] is explained by the inappropriate policies and economic conditions of host countries' (Chen 1996). This refers to underdevelopment of capabilities. Chen conceptualizes (1996) the indirect effects of MNEs as spillovers. These spillovers are

called interindustry if other industries and the whole economy are affected and intraindustry if these externalities are restricted to the industry in which the foreign-owned companies operate (Chen 1996: 187). Thus, in order for technology transfer to be effective and successful, the components of the receiving context plays a crucial role.

According to Chen, the difficulties of defining technology transfer results from the fact that 'technology is knowledge, not a product' (ibid. 82). In other words, transfer of technology, following a broad definition, involves transfer of knowledge. In the case of cooperation between foreign affiliates and TIRDO, it is additionally a transfer and knowledge sharing between countries on different levels of technological development. Whatever definition is chosen, it is widely accepted that a key factor for economic success in nearly all societies is 'the ability to create, acquire, learn how to use and effectively develop technological capacity' (Dunning 1993). Therefore, it is of major importance to examine how knowledge available at the MNEs can be applied in the wider local context so as to contribute to economic growth in the long run.

The case study

We investigate the issue of knowledge sharing in a specific case of collaboration that has taken place between TIRDO and Coca-Cola Kwanza where the indoor air quality was tested. Coca-Cola represents a successful FDI project in Tanzania. For Coca-Cola Kwanza, there is a huge potential for soft drinks market because of the hot climate.

The actors in the collaboration

TIRDO is a parastatal organization that started operating in 1976 as an industrial research organization. It was set up to conduct research and provide consultancy to industry. The main purpose of the research is to develop products and processes that are suitable for the Tanzania industrial environment. The core of TIRDO's activities is advanced use of local resources to promote indigenous technology and to utilize raw materials in economic ventures. Services to industry include instrumentation maintenance and repair, chemical analysis, energy management, cleaner production, material testing, machining welding and fabrication, industrial information in the form of industrial databases, and collection of technical and reference books and reports, journals and catalogues. Moreover, TIRDO offers training to industrialists and entrepreneurs. A crucial task for the organization is also to adopt and transfer technology to local firms. Hence, TIRDO can be seen as serving as a mediator between the foreign sector and the domestic private sector.

An R&D institute in a LDC context, such as TIRDO in Tanzania, does not have quite the same position as a similar institute in a developed country. TIRDO provides more support to the local industry, or strictly speaking to industry in general, rather than doing R&D in the sense of being a leading institution in the field of science, technology and innovation. Its main task is to find solutions to the problems occurring in the different areas of industry. Based on their findings, improvements that lead to

innovations do occur, and these can also be seen as effective cases of knowledge sharing.

Coca-Cola Kwanza Ltd is a subsidiary of a South African company that produces beverages under the Coca-Cola franchise. The company with the present ownership was established in 1996. The construction and subsequent commissioning of a $25 million Coca-Cola bottling plant in Dar es Salaam is seen as a highly successful MNE. The company employs 134 persons. Coca-Cola Kwanza started collaborating with TIRDO in 1997 in a project concerned with energy and environmental auditing.

Indoor air quality study
Coca-Cola Kwanza Ltd requested expert advice from TIRDO to conduct a study on the indoor air quality in its warehouse. The study was of importance to determine the existing health risk and to mitigate them through the imminent remodelling. TIRDO's task in the project was to measure the emissions level and to see if the warehouse provides an environment that is acceptable for workers health and safety welfare. The objective of the study was to quantify six parameters emitted from forklift truck in the warehouse. The sampling involved six pollutants, i.e. carbon dioxide (CO_2), carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen oxide (NO), nitrogen dioxide (NO_2) and general hydrocarbons (HC) (TIRDO 2002a).

Coca-Cola Kwanza expected TIRDO to contribute with technical knowledge that it did not have in-house. Studies were carried out because MNEs have to conform to standards in relation to health and safety regulations. In this particular case, TIRDO's local expertise was sought due proximity which implied lower costs and stronger knowledge exchange.

TIRDO as mediator between foreign affiliates and the local private sector
There are two ways of initiating the knowledge sharing process. First is the pro-active approach: TIRDO develops an idea based on accumulated knowledge. The idea is tested at TIRDO by developing a pilot plant. Later, the tested idea is taken to entrepreneurs or others who can further develop or utilize the idea. When investors or entrepreneurs accept the idea they are implemented into a project within the system. The second approach is a re-active one. An organization such as Coca- Cola Kwanza approaches TIRDO with an idea they already have, and ask how this idea could be further developed. This approach is a two-way system.

Transforming knowledge: mediating between foreign and local knowledge

Our case shows the concepts that have been introduced to TIRDO through the collaboration with the MNE can be further applied to wider, local uses. These concepts include, among other things, methodologies, approaches and techniques for undertaking industrial energy and environmental auditing. The implications for application to local uses are however rather difficult due to the challenges that the local industries are facing such as the transition of ownership from government to private, a low link between R&D institutes and the industry, low competitiveness, and

absence of stringent legislation on product quality and environmental issues. There is no simple model where the transferred knowledge, in terms of the concepts applied in projects, can be directly translated to the local industry. These challenges therefore hinder TIRDO in their efforts to transform knowledge learned when collaborating with foreign-owned companies.

On the basis of this empirical evidence, it can be concluded that the interaction between the foreign sector and the local private sector via a meditating institution, such as TIRDO, constitutes the basis for a knowledge sharing processes. Technology service providers and foreign affiliates both form an important knowledge source. Neither the MNEs nor TIRDO are in charge of the knowledge but have in cooperation developed the knowledge for the projects. They are complementing each other rather than excluding, and have both delivered important inputs for the collaboration and the system as a whole.

One can observe not only a one-way knowledge technology transfer but also a process of interactive learning and technological adaptation, creating innovative linkages between the two actors. In these interactions, we find that knowledge, and in a broader sense technology, is shared between the actors.

In the initial phase of the collaboration, a stage of learning could be identified. The concepts, such as studying the indoor air quality, have been learned and are at a later stage further developed and partly applied and adopted to a wider local context. During the collaboration, TIRDO received information and knowledge that might be applicable to their daily work. It cannot, however, simply transfer it because the technology has to suit the local environment where environmental legislations is not as stringent as in the developed countries where the MNEs originate. Though TIRDO's collaboration with domestic enterprises is constrained by the factors above mentioned, it has more opportunities for future contacts with local industries since ongoing globalization is slowly pushing the industries to adhere to environmental, occupational and safety standards.

Applying the knowledge to traditional stoves

TIRDO is also undertaking industrial visits in order to see how they can help in improving different areas. Once TIRDO is allowed to interact with a domestic enterprise, which can be a hard undertaking, they come up with proposals for improvements ranging from product quality to environmental management. After a period of initial investigations, contacts and interests may be established and the more concrete cost arrangements can be done. Ideas, which are later implemented, might be those that TIRDO initially got through the project with for example the Coca-Cola Kwanza.

The problem that TIRDO is facing is that the knowledge cannot easily be transferred due to the domestic enterprises limited interest in and demand for environmental safety. This attitude needs to be understood with regards to the more basic problems the local industries are facing as opposed to MNEs. Consequently, there are not many local enterprises that see the need in conducting similar studies, unless there is a problem or they are obliged to do it. Indoor air quality is not the most urgent issue for

the local firms. However, it is though possible to apply the same equipment to different situations. An example of this is the testing of air quality resulting from traditional stoves for cooking. Through the use of indoor air measurements, information on the pollution in living rooms can be collected. These measurements might later even lead to improvements in stoves, for example in stove design. This is an example of how experience gained from collaboration with MNEs can be applied locally.

Another example is that TIRDO has been asked to undertake measurement projects at the Hotel Holiday Inn. This is another example of the use of accumulated knowledge and technology by TIRDO in the wider local context. However, in this case the knowledge is being applied again to another foreign affiliate in Tanzania, and in the tourism sector and not manufacturing. This seems to show the market for certain type of knowledge and application of technology may largely be limited to foreign affiliate.

Conclusions and recommendations

The focus of collaboration has been on the sharing of knowledge, skills and technologies among companies and public actors. In accordance with these observations, and theories of FDI and MNEs, the foreign affiliates can be regarded as knowledge sources. In many respects, there is a huge gap between those foreign companies and local institutes such as TIRDO. Therefore, the role of TIRDO is crucial as a mediator between these actors and sectors.

In the cases presented here, the MNEs were not the single knowledge sources for the projects. TIRDO was in a position to provide solutions for the companies. In this respect, interactive learning processes and real knowledge sharing, especially at the early stages of collaboration, can be identified. At this stage, both participating organizations have contributed to a productive process of learning. The interactions ended, however, when the study was finished and the final report written. At this point, the need for follow up or the search for other applications of this knowledge takes centre stage.

Based on this case study examined here, some recommendations are made. Firstly, in order to strengthen the various forms of interactions, projects that are undertaken over a longer period of time might have positive influences for further developing the NSI. Secondly, collaboration with foreign affiliates is very important, especially with regards to the technology gap that exists between the MNEs and domestic enterprises.

It is concluded that to effectively absorb the input resulting from the collaboration, the level of socioeconomic development is very important. In these cases, the innovation system received important forms of input. However, due to underdeveloped socioeconomic structures, it has been difficult to absorb this knowledge input sufficiently. There has, however, been a direct link between TIRDO and MNEs, and both parts are learning from each other, sharing knowledge and technology. The presence of MNEs has enhanced the local innovation system.

If the conditions for the technology to be absorbed and further developed are not present, technology and knowledge cannot be applied in wider local context. Therefore, a well-coordinated, effective, institutional framework, which supports interactions between foreign affiliates, with the local public sector is vital; together with efficient socio-economic infrastructures to absorb the knowledge, created through these interactions. Most importantly though, appears the role of organizations, such as TIRDO, as mediators or translators of the knowledge available in the different spheres.

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Abstract
In order for African countries to reduce poverty, knowledge sharing plays a crucial role. This paper argues that the interactions between various actors in a country are of major importance for effective knowledge flows between those stakeholders that may contribute to facilitating new knowledge of relevance for economic growth. The Tanzanian Industrial Research and Development Organization (TIRDO) is in this paper examined as a case of an organization with potential of becoming a key player for knowledge sharing between various actors in the economy. More specifically, TIRDO's role as a potential mediator between the foreign sector, constituted of multinational enterprises and the local companies is investigated. It is demonstrated how knowledge, gained through the cooperation with multinational enterprises could be shared with local companies and re-implemented in the local context. This form of knowledge sharing between actors in the economy is seen as very crucial for using the knowledge available in the economy in a way that facilitates local economic development initiatives.

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