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## **Technology Transfer as Channelled by Multinational Corporations in Developing Countries :The Case of Egypt**

### **Abstract**

The main purpose of this research is to examine the effects of tacitness of technology, transferor's size, transferor protectiveness, transferee technical absorptive capacity and the protection of intellectual property rights in host country, on the choice of a Technology Transfer (TT) mode by Multinational Corporations (MNCs). This is examined in the context of MNCs working in Egypt in three industrial sectors: food and beverages, pharmaceutical and chemical industries.

The Resource Based View (RBV) is taken as a context of application. Results indicate that complexity of transferred technology and transferor protectiveness are the factors affecting TT mode choice; however, hypotheses related to transferor's size, technology codification, technology teachability, transferee absorptive capacity and protection

of IPRs in host country are not supported.

The salient findings of the present research provides evidences to suggest that complexity of technology is more related to the pharmaceutical industry than chemical and, food and beverages industries. However, the presence of IPRs laws in host country proved to be related to the chemical industry and not relating to the pharmaceutical and food and beverages industries. Other variables proved to be irrelevant.

The present study is one in a series of studies examining the role played by MNCs in Egypt.

**Keywords:** Technology Transfer, modes of entry, MNCs, FDI, knowledge-tacitness, Competitive advantages, AbouKahf Model, Knowledge-Transmission, developing countries, Egypt.

## Introduction

During the past two decades, Foreign Direct Investment (FDI) has become increasingly important in the developing economies, with a growing number of developing countries succeeding in attracting substantial and rising amounts of inward FDI. By and large, there is a direct relationship between inward FDI in relation to their size and economic development of a country. FDI involves a long-term relationship and reflects a lasting interest and control by a resident entity in one economy. It implies that the investor exerts a significant degree of influence on the management of the enterprise resident in the other economy. Such investment involves both the initial transaction between the two entities and all subsequent transactions between them and among foreign affiliates (Hill, 2012; WIR, 2013).

FDI through Multinational Corporations (MNCs) is widely viewed as an important catalyst for the economic transformation of the developing economies. The most widespread belief among researchers and policy makers is that FDI boosts growth through different channels; it increases the capital stock and employment, stimulates technological change through technological diffusion and generates technological spillovers for local firms. Nevertheless, there is a debate of whether FDI inflows through MNCs to developing countries are growth enhancing or growth retarding. Considerable volume of theoretical and empirical research have been conducted; yet, there is still conflicting evidence in the literature in this regard (Srinivasan, Kalaivani and Ibrahim; 2011).

In today's world of globalization and liberalization of international trade regimes, and given the increasing empha-

sis attached to international competitiveness, and the emergence of intellectual capital as the key wealth creating asset in most industrial economies, the importance of technology/ Knowledge as a factor determining corporate and nation's growth has increased. In the course of globalization, a number of changes have taken place over the past two decades, which have important implications for the patterns of technology generation and its international transfer. TT is seen as a key element for enabling developing countries to integrate into and compete in the global economy as well as to meet their development goals. A considerable proportion of TT to developing countries is sourced from abroad via MNCs, which constitutes the primary mechanism by which developing countries receive technology. In transferring technologies internationally, MNCs choose between two modes of transfer: direct and indirect modes (see figure 1). The choices of MNCs among **the different modes of transfer are complicated by many factors namely:** **1-** the nature of the technology; **2-** the strategy of the seller; **3-** the capabilities of the buyer; **4-** host government policy; and **5-** home country policies.

While MNCs as major actors in international technology transfer (ITT), can be easily understood- as evident by their R&D activities on one hand, and the surge of direct and indirect foreign investments on the other; it is not as easy to explain the preferences of MNCs for a particular mode of transfer. The choice of a mode of TT has many consequences on the economic development and technological stance of the receiving/ host country, since the mode of TT might entail a transfer of inappropriate technology, the creation of technology de-

pendency and the discouraging of indigenous technological development of the host country. MNCs have several objectives as part of their strategies, and thus are not necessarily the best institutions for technology creation from the national perspective of the host-developing country.

The question of which mode of TT is appropriate for Egypt and other developing economies requires an answer. The present study examines the effect of some variables that affect TT mode choice of MNCs working in the Egyptian economy in three selected industrial sectors: pharmaceutical, chemical, and food and beverages. This is, in addition to investigating the factors that affect MNCs choice of a TT mode, and whether industrial differences have an effect on the mode choice question.

## Literature Review

The term technology is used to denote that body of knowledge that enables the idea, inventions, concepts, or techniques of science to be applied for commercial purposes, therefore one must distinguish between creative activity in pure science; and technology, which seeks the application of science to readily useful and primarily commercial, ends (Lake, 1994). Technology is defined as, firm-specific information concerning characteristics and performance of production process and product design. Machines, equipments and the means of carrying out the jobs to achieve objectives or goals are all aspects of technology. According to this definition technology includes the physical structure and logical layout of components, as well as the programs, covenants, rules of conduct use, and the know-how to fulfill the requirements needed to achieve the goals or pursue the objectives (Le Master 1995).

Technology has been also defined as, a cultural system concerned with the relationships between humans and their environment (Terpstra and David; cited in Vozikis, 1996). As one type of knowledge, technology consists of both information and know-how; the former implies knowing 'what' some thing means, while the latter knowing 'how' to do something. The term technology as used in this research is broadly defined to include both hardware (embodied in equipment, turnkey plants, instrument-ts), and disembodied technical and human capital (technical services, technical data and designs, human resources and managerial expertise).

TT is defined as the transmission of knowledge that enables the recipient firm to manufacture a certain product or provide a particular service (Tsang, 1997); it is the transfer of systematic knowledge for the manufacture of a product, for the application of a process or for the rendering of a service. TT has been also defined as: the transmission of know-how to suit local conditions, with effective absorption and diffusion both within and from one country to another (Vosikis, 1996). TT also includes the purpose, application, and justification of the technology. It is what to employ, how, when and why (LeMaster, 1995). TT may be categorized as vertical or horizontal, depending on whether the process moves from basic to applied research or to develop (vertical transfer), or from use of technology in one place to its application in another place (horizontal transfer).

Technology is perceived as an intangible asset and is traded internationally either in embodied or disembodied form

The former includes the transfer of knowledge incorporated in the designs

of machinery or that embodied in the skills of migrating experts, the disembodied knowledge is transferred under contracts under which process know-how, product designs, rights to use patented knowledge or copy right designs or drawings are transferred by their owner to another party for a fee (Kumar, 1997).

A common thread running through the literature is the importance of technology as a source of superior competitive power of MNCs. Technology is a major component of Cave's "intangible assets" (UNTC, 1994); and it also appears as one of the principle sources of Dunning's "ownership- advantages" as determined by the "eclectic" approach (Dunning, 2001). Kogut and Zander define technology as knowledge that embodies the firm's comparative advantage, where the primary advantage that a firm brings to foreign markets is its possession of superior knowledge (Kogut and Zander, 2003). According to the RBV technology is considered to be one of the firm's resources- where firm's resources is composed of all assets, knowledge, employees, information systems, organizational- structure, rules, procedures that are controlled by the firm (Barney, 1991), these resources can be classified in many ways. Following Barney, the resources are categorized as physical capital resources, human capital resources and organizational capital resources. A technology can be embodied in all three types of firm resources (Tsang, 1997): physical (e.g.machinery, blueprints and technical drawings), human (e.g. skills and knowledge of technical staff) and organizational (e.g. production system and quality control procedures). It is generally recognized that technology, as a highly differentiated

range of techniques and of related knowledge, is very much firm-specific.

The technology of a firm is the result of its accumulated experience in design, production, problem-solving and trouble-shooting activities.

Early scholars postulate that knowledge has the characteristic of a public good, and that it can be transferred and reproduced at zero cost; yet, the assumption that technology is a free good cannot stand the evidence provided by the growing literature on TT (Tsang, 1997). Moreover, while pure knowledge has the characteristic of a public good, knowledge is only one out of five distinct elements of a TT agreement **which can include some or all of the following (Contractor, 1989):** **1-** Services such as training and installation, **2-** Information which results in knowledge, **3-** Legal rights to use this information or symbols (trademarks) in certain territories, **4-** Legal or de facto restraints placed on the technology buyer, **5-** Objects such as instrumentation and equipment containing coded information. Hence, it is now generally recognized that technology, as a highly differentiated range of techniques and related knowledge, is very much firm specific and that every firm passes through a unique path of progressive accumulation of technical knowledge which is both history dependent and constraints the firm's future technological development (Tsang, 1997).

In this connection, it could be argued that, ITT from developed to developing countries via MNCs continues to be an important stimulus to industrialization and economic growth for the latter.

Firms located in developing countries stand to gain from **successful international TT in at least three ways:** **1-** improved product and service quality and

reduced prices, resulting in greater domestic and international competitiveness; 2- diversification into new products or markets, resulting in expanded business activity and; 3- "learning by doing" resulting from cooperation with technologically advanced foreign firms.

In transferring technologies the MNC chooses between two modes of transfer, figure (1) displays the salient modes, where one can realize that: internalized mode through establishing an affiliate to the home firm in the host country, and externalized through other forms of investment, for example: licensing or a joint venture (AbouKahf). The modes of TT can be classified into two broad categories (WIR, 1999), namely: direct modes- intra firm transfers (i.e. to internalize the transfer from MNC to its affiliates), and indirect modes- inter firm transfers (to externalize the transfer by depending on market mechanism, (i.e. arm's length transfer). The distinguishing feature between the two is that in internalized TT the transferor has a significant and continuing financial stake in the success of the affiliate, allows it to use its brand name and to have access to its global technology and marketing networks, exercises control over the affiliate's investment, technology and sales decisions, and sees the affiliate as an integral part of its global strategy. Externalized forms, on the other hand, lack one or all of these features, all of which have implications for the TT process for both the transferor and the transferee (Lall, 1993).

These two categories produce at least fourteen forms of technology- transfer modes (Chen, 1994; Tsang, 1997; Dunning, 1993; Contractor, 1998). **These modes are as follows:** 1- Wholly- owned foreign subsidiaries "WOS" (affiliates);

2- Joint ventures; 3- Foreign minority holdings; 4- mergers and acquisitions, 5- "Fading-out"- agreements; 6- Licensing; 7- Franchising; 8- Management contracts; 9- Turnkey ventures; 10- Contractual joint ventures; 11- International subcontracting; 12- Exporting; and 13- Strategic- alliances, 14- international exhibitions. The mode of transfer for the first four forms in the above list is internal; that for other forms is external. For the fourth form, "fading-out" agreements, the mode of transfer is internal at the beginning but external when the period of the agreement ends. The mode of transfer is mixed for the ninth and the twelfth form, contractual joint ventures and strategic alliances, where there is sharing of knowledge among the partners (Tsang 1997; Contractor 1998; WIR 1999).

The issue of which mode of TT is suitable to host countries' needs seems to hinge upon whether or not the imported technology can be effectively utilized by a recipient country with its stock of knowledge, skills and related capabilities, it has been noted that some LDCs have at times acquired the most advanced technology available, apparently as a show case of development (Vosikis, 1996).

An analysis of the strategies of MNCs for TT should properly be placed within the broader context of a discussion of the factors underlying the international involvement and expansion of corporations.

The roots of which extend from The Theory of the Firm, as conceived by Coase and developed by Williamson, which states that the market and the firm are two alternative methods of organizing exchange, and that the choice between intra-firm and market exchanges will

be based on their relative costs (Davidson and McFetridge, 1984).

There are some overlaps between the factors that condition entry mode choice, and factors that condition TT mode choice, the main reason for this is that TT is often part of a foreign market entry deal (Buckley and Casson, 1997; Tsang, 1997; Peng, 2001). Despite some overlaps between the two decisions, it is important to assert that the factors influencing ITT are more specific and quite different from that determining foreign market entry (Tsang, 1997). For example, according to the U-model of internationalization- (Uppsala model)- there are four successive stages of entering a foreign market **with increasing resource commitments**: **1-** irregular exports, **2-** exports via independent agents, **3-** establishments of overseas subsidiary and **4-** overseas production units.

However, if the firm intends to transfer a cutting edge technology or a technology with high tacit element, it has little choice-as confirmed by empirical studies- but uses a transfer mode that demands heavy resource commitment.

Thus the model is not applicable in this case; separate treatment is therefore required and will be followed.

Many theories have tried to answer the question of what determines the

choice between inter-firm and intra-firm TT? I.e. why a firm would internalize its proprietary advantages by retaining technology within its hierarchical control? In addition, when is it appropriate to share this proprietary advantage with other parties through market transfer mechanisms?

In terms of Theories explaining TT activities, Table (1) summarizes examples of TT theories. As based on this table, it is important to refer that, many theories have been put forward to explain MNCs TT activities, the original theory, however, ignored to a large extent the economic costs and business aspects of TT. Rather, it concentrated on the "public good" nature of technological knowledge and on its ability to move at low costs across countries, especially from advanced to less developed countries to the great advantage of the latter. Gradually it was realized that costs are involved in creating the needed infrastructure, in training professional staff in the host country to be able to install and operate the new technologies, to adapt the new technologies to the conditions in the host country, to create markets for new products.

**Table (1): Theories explaining TT Mode Choice**

TT Theory	Theory arguments: why firms internalize their proprietary advantages?
<b>1- “Appropriability” of profits or rents in foreign markets (Caves and Magee in the 1970s- cited in contractor 1998).</b>	<p><b>The two strands of this argument are:</b></p> <p><b>1-</b> Keeping their proprietary advantages (like technology, marketing skills, patents and trademarks) internal, MNC products are said to command higher prices than their local competitors in the host country.</p> <p><b>2-</b> Not sharing administrative decisions and control with local entities leaves the MNC free to set the monopolistically optimum price and “appropriate” the maximum return on assets. Hence according to this theory, for a TT to take place, the MNC must calculate as high a net (risk-adjusted) return from a licensee as it would have received from a fully owned affiliate</p>
<b>2- Imperfections in International Technology Market (Contractor, 1980)</b>	<p>This branch of MNC theory argues that the market for TT is imperfect. TT is not to be viewed as an act, but as a relationship over time, whereby the recipient learns from organizational links with the supplier, and since this supplier opt to keep proprietary company information, techniques and procedures in a non-codified manner- in fear of replication by the buyer- thus the buyer has to operate under conditions of uncertainty and on faith. This makes the technology market inefficient, thus the MNC offering a technology package in a market transaction may not be able to command as high a price or return, as compared with the MNC internalizing its own technology market.</p>
<b>3- Transaction Cost Economic (TCE) Theory (Contractor, 1980)</b>	<p>This theory is a subset of the market imperfection argument, as originally developed by Coase in the 1930s and Williamson in the 1970s, and applied to the multinational firm by Anderson and Gatignon in the 1980s.</p> <p>TCE postulates that there are three components of costs related to TT between international firms, and that these costs could have been avoided if the firm had internalized its transfer. These costs are: <b>1-</b> Negotiation and Transfer costs, including costs of transferring the information and capability to the other firm and training their personnel. <b>2-</b> The opportunity cost of forgone direct business, i.e. the forgone direct sales and profits that the firm could have made on its own in the market, had it not relinquished its presence there under the agreement. <b>3-</b> The risk of creating a competitor in markets beyond the anticipated time of the agreement.</p>

<p><b>4- Resource Based View of the Firm (RBV) (Kogut and Zander, 2003)</b></p>	<p>By challenging some of the premises of previously stated theories, advocates of the RBV call for the adoption of an Evolutionary theory of the MNE. They state that firms are social communities that specialize in the creation and internal transfer of knowledge, the decision taken by the MNC of whether to internalize this transfer or use a market mechanism depends on the efficiency of the firm in this process of transformation relatively to other firms, not on the failure of the market. They argue that the assumption of opportunism- high lightened in the TCE- is not needed. They wrote, "Since firms differ in their codes by which information is transferred, then it follows that reasonably that they should differ in their capabilities to understand and apply knowledge. The cost of transfer should differ among firms, and these differences should have an effect on the desirability to transfer technology within the firm or by license, independent of the issue of opportunism" (Kogut and Zander, 2003- pp. 519)</p> <p>The reasoning provided by the RBV concerning TT mode choice is as that, Exporting requires the smallest amount of resource commitment, but its use is very restrictive, only when the technology concerned can be embodied entirely in physical goods. As to licensing, there are in general two types of ingredients in a technology package, the first is the conveyance of patent, trademark and other rights, and the second is, the provision of technical and managerial assistance to a licensee, the transferor has to invest mostly staff time and attention in training and assisting the transferee. An international joint venture is formed when two or more firms of different nationalities pool a portion of their resources within legal organization. Commitment on resources is high in this case, where the transferor has to make organizational adjustments in order to coordinate and communicate with the joint venture. Finally, forming a WOS in a foreign country requires the greatest amount of resource commitments; in return, the transferor has the best control over the use of its technology and minimizes the risk of leakage.</p>
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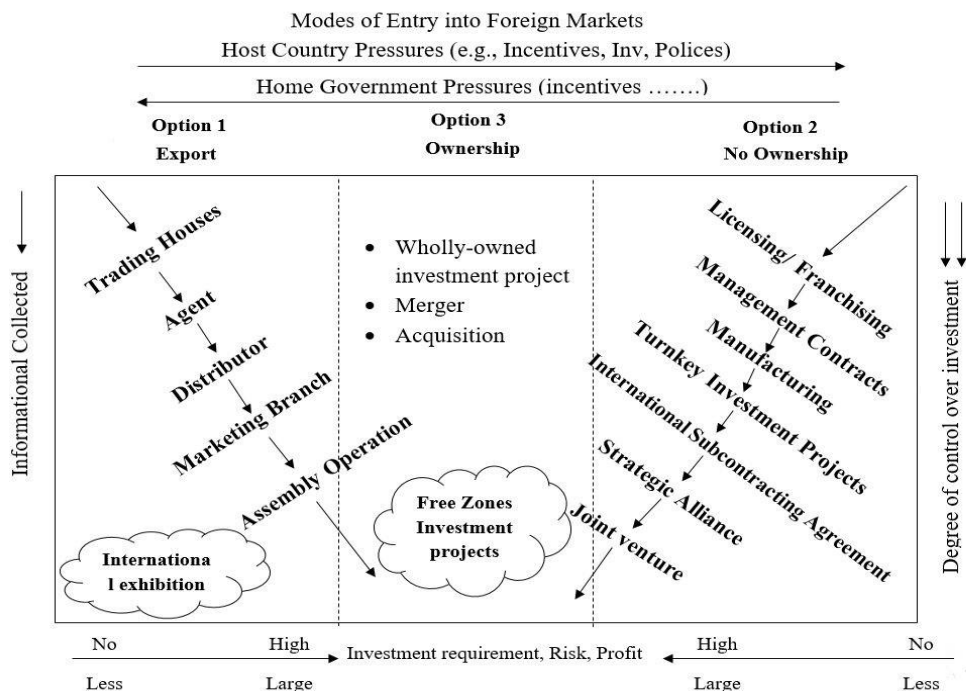


At this point it is worth noting that the trend among current studies is to try to look at TCE theory and the RBV as complementary and not mutually exclusive, where the key underlying contingency in the question of choice of equity or nonequity based alliances is the firm-specific capability in handling an alliance relationship. That is, the transaction costs that firms face in entering and managing foreign projects hinge upon a resource based analysis. This relationship proved true in the Chinese context, where the question of choosing between equity joint venture and contractual joint venture to run a foreign investment in china was examined (Wang, 2007).

Eventually, previous Studies and Scholars have developed models and have provided empirical analyses in an attempt to determine the factors that have the major influence on that strategic decision (i.e. modal choice decision), for example, a conceptual model was developed to examine influences on the effectiveness of TT across nations (Kedia and Bhagat, 1988); a framework was build for recommending TT strategies to developing countries (Tsang, 1994); a dynamic model was presented for explaining in firm's selection of ITT mode (Tsang, 1997). Empirical studies have provided lists of factors affecting the modal choice decision by the MNC, and have grouped these factors in various ways. In one of the studies addressed mainly to entrepreneurs in order to guide them when deciding to transfer technology to developing countries, the researchers propose a typology to kind of TT and the mode that suits each type (Ibrahim, Mcguire, 2001). A number of empirical studies have been focusing on how knowledge -transfer within a MNC

depends on particular factors, for example, (Minbaeva and Michailova, 2003): the characteristics of the transferred knowledge (Zander and Kogut, 1995; Simonin, 1999); knowledge sources; absorptive capacity of transferee (Szulanski, 1996; Lylyes and Salk, 1996; Lane and Lubatkin, 1998; Gupta and Govindarajan, 2000; Lane, Salk and Lylyes, 2001; Minbaeva et al., 2003); organizational context in which the transfer takes place (Simonin, 1999). Recent studies have taken the point a step further and have started to consider the theoretical context in which the research is applied. By comparing between the TCE theory and the RBV perspectives in choosing between equity joint ventures and contractual joint ventures in china, the study reached a result that the actual transaction costs firm face in TT hinge upon a resource based analysis (Wang, 2007). A common thread running through the literature is the fundamental distinction between "internalized" and "externalized" modes of transfer. This distinction corresponds to the one between foreign direct investments in wholly owned or majority- owned affiliates and other mentioned externalized forms of TT (licensing, turnkey operations, management contracts and franchising). It is worth noting that the majority of the literature focuses on the choice between FDI and licensing as alternative modes of transfer.

Eventually, as based on AbouKahf model (2010), Figure (1) displays the salient modes of entry into foreign markets. Each mode represents a mechanism through which technology can be transferred directly or indirectly and apart from how significant is the degree of transferring such technology.



- Each option has its own advantages and disadvantages- See relevant textbook.

→ Refers to progress toward next step (with everything stable).

↓ Information & knowledge about host market.

↗ Degree of control over the investment project/ market (the higher the degree of commitment the large the quantity and types of information collected, the higher the degree of knowledge...about the host market in consequence the higher the degree of control over both the investment project & the market).

**Figure (1): Aboukahf Model (Modes of Entry into Foreign Markets**

## Research Methodology

Based on literature review and in the context of the RBV, **this research tests the following hypotheses:**

**There are two types of resource constraints** faced by the firm when deciding to transfer technology. The first is the capacity of the firm's existing managerial personnel, where it takes time for newly hired managers to familiarize themselves with the firm's working procedures, systems and culture (Tsang, 19-97); this constraint is the result of the intimate relationship between human

and organizational resources. The second is the firm's existing financial base. There is a limit to the firm in its ability to raise its debt or equity capital. **These two constraints are more serious for small than for large firms; thus it is hypothesized that:**

**H1: the Larger the Transferor's Size, the more the Transferor will favor Transfer modes that require High Resource Commitment.**

Technical knowledge generally consists of two components, namely explicit and tacit (Kogut and Zander 1993,

2003; Tsang, 1997). The former is codified in blue prints, designs, drawings and specifications, while the latter is kept in human brains. Following Kogut and Zander, complexity is defined as “the number of critical and interacting elements embraced by the entity or activity” (Kogut and Zander, 2003). Complex technology cannot be codified in full even if it is mature. Therefore tacit knowledge has to be transferred through intimate human interactions. More resources, especially human resources, are required on the part of the transferor; thus it is hypothesized that:

**H2: the more Tacit is the technology/ Knowledge, the more the Transferor will favor transfer modes that require High Resource Commitment.**

Following previous research findings (Kogut and Zander 2003; Robinson 1991; Davidson and McFetridge 1984; Contractor 1984; Teece 1977), Tacitness is measured by three constructs, namely: Codifiability, complexity and Teachability; **thus it is hypothesized that:**

**H2.1:** The more the Technology/ Knowledge is Codified, the more the Transferor will favor Transfer modes that require Less Resource Commitment.

**H2.2:** The more Complex is the Technology/ Knowledge, the more the Transferor will favor Transfer modes that require High Resource Commitment.

**H2.3:** The more Teachable is the Technology/ knowledge, the more the Transferor will favor Transfer modes that require Less Resource Commitment.

A successful TT needs the active participation of both the transferor as well as the transferee. The transferee is obliged to devote substantial resources into his productive system (Tsang, 1997).

Manufacturing experience, firm size and R&D intensity are important determinants of absorptive capacity.

When the transferee has low absorptive capacity the transferor has to put in more efforts and the process takes a longer time than is normally required. Frequent close interactions are needed; thus it is hypothesized that:

**H3: When the technical Absorptive Capacity of the Transferee is Low, the Transferor will favor Transfer modes that require High Resource Commitment.**

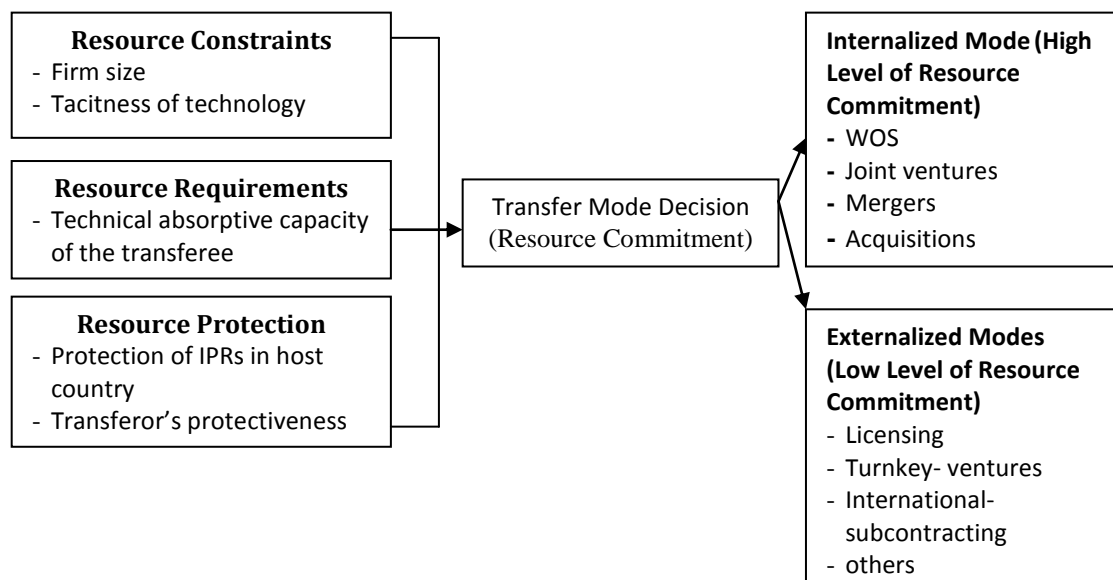
It is in the transferor's interest to guard against the leakage of his crucial technical know-how. Public policy of the host country concerning IPRs protection is an important factor to be considered by the transferor, especially when the host government is a developing one, as the record of patent protection is generally poor in developing countries (Tsang, 1995). Thus it is hypothesized that:

**H4: When the protection of Intellectual Property Rights (IPRs) is poor in the Host Country, the Transferor will favor Transfer modes that require High Resource Commitments.**

The importance of technology to the transferor's business is an important factor to be considered in choosing the technology transfer mode. This importance relates to product fields where substantial funds have been invested, or where the transferor holds a technological lead and has the resources to undertake direct investment (Baranson 1970, p.435- cited in Tsang, 1997), this importance is reflected in the attitude of the transferor where he acts in a protective way against the leakage of his know-how. Thus it is hypothesized that:

**H5: The more protective is the Transferor towards his Technology/ knowledge, the more the Transferor will favor Transfer modes that require High Resource Commitment**

The following figure, figure (2) represents the research framework that presents the variables understudy.



**Figure (2) Research Framework: Factors affecting TT Mode Choice**

## Research Variables and Measurements

### Independent Variables

The first group of independent variables, resource constraints, is concerned with two aspects: the quantity of firm's resources, expressed in the capacity of the firm's existing managerial personnel and the firm's existing financial base, these two constraints are more serious for small than for large firms (Buckley and Casson, 1997). Larger firms

generally have a wider spectrum of technical and managerial talent, which can be called on for assistance during the transfer. The second aspect is the quality of firm's resources; that is, the extent of tacitness of the technology to be transferred. It is assumed that the more complex the technology, the more likely the transfer will be through internalized WOS rather than an arm's length licensing agreement (Kogut and Zander, 2003).

The second group of independent variables, (Resource Requirements of technology), refers to the demand up on the transferor input of resources. If the demand is high, the transferor will have to choose a high resource commitment transfer mode in order to implement an effective transfer. The first variable is the technical absorptive capacity of the transferee. When the transferee has low absorptive capacity the transferor has to put more efforts and the transfer process may take longer time. The second variable relates to the host country's technical capability, like national investment in R&D, number of technical personnel per capita and national investment in education. The better the indigenous technical capability of the host country, the higher will be the proportion of licensing agreements (Contractor, 1980). However, this variable is out of the scope of this study.

The third group of independent variables, (Resource Protection), relates to the firm's interest to guard against the leakage of its crucial technical know-how. Empirical studies have found that the risk of patent infringement may provide an internalization motive for FDI (Tsang, 1997). In developing countries where the record of patent protection is poor, the firm would prefer transfer modes like joint ventures or WOS so that it has more control over the use of technology and minimize the leakage (Tsang, 1994). The second factor is the degree of protectiveness of the transferor towards his know-how.

The more protective the transferor acts, the more intra firms transfer modes he will use.

## Dependent Variable

The dependent variable in this study is the organizational mode whether the firm is a WOS, or falls within other non-equity forms- licensing, or contractual agreements. Thus the dependant variable is therefore a multi-measure, generally depicting the rising level of equity ownership, and hence resource commitment. The highest level of resource commitment is reached when the MNC establishes a branch- (green field investment, an affiliate) - generally known as WOS.

## Operational and Conceptual Definitions of Research Variables

The resource commitment construct- i.e. dependent variable- is measured in this study by using a scale ranging from one- to- six, depicting the rising level of resource commitment. Where: one, represents the lowest resource commitment; and six, represents the highest resource commitment. The scale ranges from 1 to 6 depicting rising resource commitment (from indirect to direct modes).

- Management contracts, Turnkey ventures, International subcontracting = 1
- Licensing = 2
- Merger, Acquisition, Strategic Alliance = 3
- Contractual Joint Venture, Foreign Minority Holdings = 4
- Equity Joint Venture = 5
- Wholly Owned Subsidiary (WOS) = 6

In this connection, the operational and conceptual definitions of research Independent variables are summarized in the following table, Table (1) :

**Table (1) Operational and Conceptual definitions of Independent Variables**

<b>Variable</b>	<b>Conceptual definition</b>	<b>Operation definition</b>
<b>1. Firm Size of the Transferor</b>	Many definitions has been put forward each in accordance to the way of measurement	Total number of full time employees employed in the transferor's firm (Abou Kahf, 2004)
<b>2. Tacitness of Technology/ Knowledge</b>	The degree of implicit component in a technology as related to its explicit component (Kogut and Zander 1993- 2003).	Operationalized using three constructs (kogut and Zander-1993, 2003; Robinson 1991; Davidson and Mcfetridge 1984; Aroua and Fousfori, 2000, Contractor 1981; Teece 1977): - Codifiability of technology: the degree to which the technology is articulated in documents, manuals, blue prints, and/technical drawings. - Teachability of technology: training provided to new workers. - Complexity of technology: the number of critical and interacting elements embraced by an entity or activity.
<b>3. Absorptive Capacity of Transferee</b>	The organization's ability to acquire and exploit external knowledge (Lyles, Salk and Lane 2001)	The ability of the transferee's firm to : - understand new external knowledge; - assimilate new external knowledge; and - apply that knowledge to commercial ends.
<b>4. IPRs Protection in Host Country</b>	The protections of copy rights, patents, brand names and other intellectual property possessed by individuals and firms as governed by international laws and regulations.	Transferor's perception of the degree of enforcement of IPRs law in Egypt (Ostegard JR , 2000).
<b>5. Transferor's Protectiveness</b>	Lack of transparency and permeability of the transferor towards the transferee (Simonin, 1999)	Transferee's perception of the degree to which the transferor has acted uncooperatively during TT agreements.

## Research population

The total number of MNCs working in the industrial sectors of chemicals, pharmaceuticals and, food and beverages in Egypt is 101 MNCs, as indicated by the General Authority of Free zones and Investment (GAFI). These MNCs are located in the cities of Alexandria, Cairo and Giza in seven industries.

The researcher has planned a census approached. Forty-four MNCs in the three industries showed acceptance to participating in the research, the remaining MNCs were either inaccessible, or refused to share in the research. Nineteen questionnaires returned, with a response rate of 44 %, seventeen of which are valid for analysis.

The unit of analysis MNC and the unit of observation constitutes the individual MNC executive. Questionnaire lists completed by MNCs in top managerial positions, knowledgeable of TT agreements.

## Questionnaire Design and Structure

Structured self-administered questionnaire list is designed for data collection. Based on the suggested measurements of the research variables, Likert-type five-point scale is developed. Reliability of research items is conducted using Cronbach alpha, all items proved to be reliable. Alpha coefficients ranges from .592 to .849. Convergent validity is examined using factor analysis, factor loading ranged from .5 to .9 for all variables. Discriminant validity is assessed by comparing variables alpha coefficients with their correlations with other variables. All variables were found to provide discriminant validity since their alpha coefficients exceeded their correlations with other variables. Since English is established as the major

formal language of conducting business in MNCs working in Egypt; thus, the researcher abstained the questionnaire from translation to Arabic. Hence, the questionnaire is administered in English language.

## Techniques used in data analysis

Non-parametric statistical analysis methods are used to test the research hypotheses, namely non-parametric chi square, since the sample is not normally distributed.

## Research Limitations

The study is limited to the industrial sector of MNCs registered in GAFI, in year 2006, in three selected industries: food and beverages, chemical and pharmaceutical. Egypt is taken as a context of application. The study is limited to MNCs working in three cities: Alexandria, Cairo and Giza. The study is limited to the examination of some of the factors influencing the MNCs' choice of international TT mode; namely, five research variables- (tacitness of technology, transferee absorptive capacity, transferor's protectiveness, transferor's size and protection of IPRs in host country) - as possible predictors of the reasons of the choices made by MNCs when transferring technology to Egypt.

## Research findings

Results provided by hypotheses testing indicate that complexity of transferred technology and transferor protectiveness were proven to be the factors affecting TT mode choice, which provide support for hypotheses H2.2 and H.5. The hypotheses related to transferor's size, technology codification, technology teachability, transferee absorptive capacity and protection of IPRs in

host are not supported. By industry specific differences analysis indicates that complexity of technology- as one of the constructs measuring Tacitness of technology and as a factor affecting the mode of TT is more related to the Pharmaceutical industry than the Chemical and food and Beverages industries. However, the presence of IPRs laws in host country- as one of the facets of the variable: Protection of IPRs in Host country and as a factor affecting the mode of TT was proved to be related to the Chemical industry and non relating to the Pharmaceutical and Food and Beverages industries. Other variables like: transferor size, technology codification, technology teachability, absorptive capacity of transferee, transferor protectiveness and degree of enforcement of IPRs law proved to be irrelevant.

### **Research Findings: Aggregate level**

The major finding when data is analyzed without paying attention to industrial differences is that, out of the five sets of variables affecting TT mode choice: Technology related variables, Transferor related variables, Transferee related variables, Host country related variables and Home country related variables; only two variables proved to affect the choice of TT mode by MNCs working in the Egyptian environment, namely- Technology related variables and Transferor related variables.

The technology related variable that proved to affect the TT mode choice by MNCs working in Egypt is the degree of technology Complexity- as a measure of technology Tacitness; the more complex the technology the more the transferor favors transfer modes that require high level of resource commit-

ment, and hence, the more the transferor will use direct modes of transfer- like establishing WOS in host country as a channel of transferring the required technology. This finding agrees with Kogut and Zander, 2003; Tsang, 1997; Davidson and Mc fetridge 1984; Contractor 1981; and Teece 1977. The logic behind this research finding is that complexity explains Tacitness of technology. When technology is not complex, and thus easily communicated and understood by the recipient firms, it can be best transferred through indirect modes like licensing and strategic alliances; the transferor in this case does not need to invest many resources to transfer the technology. On the other hand; technology high in tacitness are difficult to communicate to other parties, and thus requires a lot of resources to be invested on the part of the transferor, as indicated by Salk and Lane 2001, the more tacit the technology the more it is difficult to transfer and assimilate because of its social nature and causal ambiguity, especially in LDCs where learning new managerial skills requires cognitive and behavioral change.

The other two constructs that were assumed to add to the tacitness of technology were: technology codification and technology teachability. For the First construct- Codification, it was expected that the more the technology is codified the more the transferor will use indirect modes of TT and hence, less resource commitment; this hypothesis was not supported. Results indicate that technology codification did not affect the TT mode choice. This result contradicts results obtained from previous studies Berg and Holtbrugge, 2004; Kogut and Zander, 2003. The logic behind this result is that the transferor in



most of the collected data was transferring technology to his subsidiaries, and hence the knowledge transferred was considered codified to the receiving firm, since the subsidiary has to abide in its production by the formulas and processes dictated by the mother company, which is in this case the technology transferor. This result may also be attributed to the production nature of the surveyed MNCs where as indicated by Shenkar and Li 1999, different knowledge exhibit different degrees of tacitness, where manufacturing and production process knowledge is much more explicit than tacit as it is codified in manuals and procedures.

Despite logic provides answer to this result, the result should warrant the attention of Egyptian transferees and policy makers, since one interpretation to previous result stems from the fact that technologies that are difficult to codify also represent platforms for expansion into future markets (Kogut and Zander, 2003). Since they are not well understood, they are resistant to rapid imitation. At the same time, novel technologies are likely to be less codified. Due to the joint qualities of novelty and difficult imitation, knowledge that is tacit can be expected to embody the advantages of the firm to grow and expand in the future. In this way it may be evident that the transferor is transferring only old technologies to the Egyptian market, while keeping novel technologies within his firm's bounds. This may raise the problem of technology inappropriateness since it will not provide the required enhancement to Egyptian firms, and thus TT may not pay its required dues.

As for the Second construct- Teachability, it was expected that the more

easily the technology to be taught the more the transferor will choose transfer modes that require less resource commitment, that is, the transferor will choose indirect modes of transfer. This hypothesis was not supported. Again the reason for this result is attributed to the fact that most of the collected data related to transfer between subsidiaries. TT often requires the transferor to send engineers; managers and workers from the mother firm to assist in the building up of the sister firm Kogut and Zander, 2003. Also for tacit knowledge to be exchanged there need to be a close relation between the teacher and the student, where it frequently involves the active involvement of the teacher Dhanaraj, Lyles et al. (2004).

To Conclude: Tacitness of technology- as a variable determining the mode choice of TT, was explained by the degree of complexity inherent in the transferred technology; where the more complex is the technology the more the resources required by the transferor to commit during the transfer and hence, the choice of direct modes of transfer; codification and teachability of technology did not have an effect on the TT mode choice.

The transferor related variable that proved to affect the TT mode choice by MNCs working in Egypt was the degree of Transferor Protectiveness, measured in terms of the hazard of knowledge leakage during the transfer process. It was expected that the more protective the transferor is towards his knowledge the more the transferor will be willing to commit resources in order to safeguard that knowledge, and hence, the choice of a direct mode of TT. This hypothesis was supported, the result agrees with Davidson and Mcfetridge

1984; Simonin 1999. the explanation of this result is that in ITT the transferor tends to be less transparent about his know-how, incase of intra firm TT protectiveness may be identified as a source of internal stickiness, where the fear of the transferor to loose ownership, or to keep a position of privilege or superiority.

The transferor fear the risk of revealing too much to a competitor while transferring technology thus, he uses intentional policies and procedures that restrict the sharing of relevant information, become uncooperative or provide inadequate knowledge. Again the previous result should warrant the attention of Egyptian managers and policy makers, since the ability to learn through cooperative agreements does not simply rests on the firm's internal absorptive capabilities; however, it also depends on the willingness of external sources to fully cooperate. Since data analysis provides support that transferee perceive the transferor to be protective, complete TT may not be achieved, and the payoff of TT may not be capitalized

Three variables proved to have no effect on TT mode choice these include: Absorptive Capacity of transferee, Transferor's Size and Protection of IPRs in Egypt.

As for the first variable Transferee's Absorptive capacity- which is one of the transferee related variables, it was expected that the lower the technical absorptive capacity of the transferee the more the transferor will favor TT modes that requires high resource commitment, this hypothesis was not supported providing evidence that absorptive capacity of transferee was not one of the factors considered by the transferor when selecting among TT modes

to Egypt. Despite the fact that the surveyed MNCs exhibited high degrees of technology understanding, assimilation and application, which constitutes the three determinants of having high absorptive capacity as indicated by Lyles, Salk and Lane 2001; the variable proved to have no effect on the transferor's choices. This result agrees with Davidson and Mcfetridge 1984 where no relation was found between TT mode and the economic characteristics of the recipient.

However, the result disagrees with results obtained from the surge of previous empirical work indicating strong relationship between recipient capabilities and TT mode, where the literature indicate that if the demand on the transferor's input of resources is great, i.e. low absorptive capacity of transferee; the transferor will have to choose a high commitment mode of TT in order to implement an effective transfer Contractor 1980, 1984; Lin et al. 2002; Minbaeva et al. 2003; Zahra and George 2002; Mahnke et al. 2003; Simango 2000; Lorentzen et al. 2003. The logic behind this result may be explained in terms of the MNC strategy, where a MNC would assess the feasibility of the mode of TT in terms of its overall global strategy without paying attention to factors related to the transferee, especially when the transfer is directed to the MNC subsidiary. Thus a direct mode of TT may be used for strategic reasons even though licensing is a much more suitable option.

The second variable that proved to have no effect on the TT mode choice is Transferor's Size, it was expected that the larger the transferor's size the more the transferor will favor TT modes that require more resource commitment.

This hypothesis were not supported, results of this study indicate that size has a non significant effect on the choice of TT mode. This result agrees with results obtained by Contractor and Kundu 1998; however, their application on the service sector namely- hotel industry. The result however, contradicts results obtained from other studies like for example: Simonin, 1999 indicates that size is a moderating variable to the process of TT. A logical explanation to this result is that, MNCs have networks of connections among their different global subsidiaries which enable them to capture some of the economies of global logistics, and brand recognition, rendering size insignificant as a factor affecting their global strategy.

The third variable that proved to have no effect on the TT mode choice is Protection of IPRs in Egypt, it was expected that the protection of IPRs in host country has an effect on the choice of TT mode, in a way that when the protection of IPRs is strong the transferor will choose TT modes that require low resource commitment. This hypothesis was not supported, results indicate that no such relation is present, non significant relationship was found when the respondents were asked about two questions relating to the presence of IPRs law in Egypt as a factor conditioning TT mode choice and their perceptions about the strength of law enforcement in Egypt. This result contradicts the results obtained from previous studies Kogut and Zander, 2003; Davidson and Mcfetridge, 1984; Maskus et al., 2004; Ostgard, 2000. However, this study is inline with the results obtained from Malhotra, 2003 where protection was non significant in the examined joint ventures.

One logical explanation to this result is that for a MNC entering a foreign market, technical knowledge for a specific field is combined with experiential technical knowledge, knowledge of personal contracts and relationships, and host country knowledge all embedded in individuals, constitute a source of advantage that is difficult to appropriate. The development of knowledge and the linkages between different types of knowledge reflect history, experience, and continuity. Over time, the combination of different types of knowledge assumes the character of tacit, the unseen, and the embedded. Thus the risk of misappropriation of this combination of individual held knowledge is not a major concern for MNCs involved in joint ventures or other forms of partnerships, and unimportant for the choice of TT mode.

Again, this result warrants attention. Since the transferor is interested in guarding his technology/ knowledge to the extent of importance of the technology/ knowledge to the transferor. Since the transferor is indifferent about the existence of IPRs law and its protection this may signify the unimportance of the transferred technology to the transferor, which again means that the transferor might just be transferring old inappropriate technology.

### **Research Findings: Industry-Specific Differences level**

The surveyed MNCs exhibited some differences among the chemical, pharmaceutical and food and beverages industries. Two industries proved to be affected by the research variables more than others. The pharmaceutical industry explains the variance in Complexity of transferred technology; while the chemical industry explains the variance in

Protection of IPRs in host country. The following section details these findings.

When allowing for industrial differences and then testing the research hypotheses, results indicate that the MNCs working in the pharmaceutical industry were affected by the variable Tacitness of technology, as explained by technology complexity. That is Tacitness was one of the variables affecting TT mode choice for MNCs working in pharmaceutical industry. The more tacit is the technology the more the transferor favors TT modes that require high resource commitment.

This result indicates that the more complex the technology the more the transferor will choose TT modes that require high resource commitment. This result is inline with previous results obtained from the literature, Kogut and Zander, 2003; Davidson and Mcfe-tridge, 1984; Teccee 1977. It was expected; however, that MNCs working in the pharmaceutical industry would be affected by the variable related to the presence of IPRs protection and law enforcement, given the fact that the pharmaceutical sector is one of the IPRs sensitive sectors. The literature indicates that advances in technology have rendered some industries more reliant on IPP than other sectors; these include

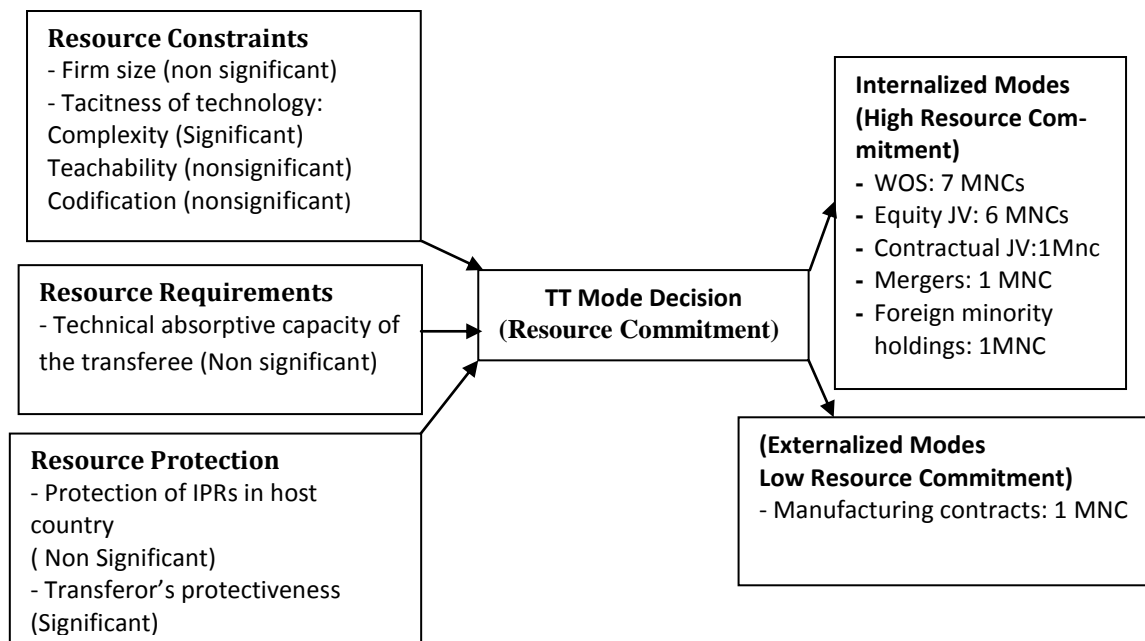
among others, the Pharmaceutical industry.

The reason for obtaining this result is the fact that most of the surveyed MNCs in the pharmaceutical industry (6 out of 8), were transferring technology among their own affiliates, thus no need to protect against the leakage of know-how. A result that is self indicating that the protection of IPRs in Egypt is perceived by the transferor as strong, since as indicated by previous research for crucial industries like pharmaceutical when the record of IPRs protection is weak MNCs would refrain from investing in that country and are less likely to set up manufacturing facilities.

Another result indicated from industry-specific analysis is related to the chemical industry, where, MNCs in the chemical industry explained the variance in the importance of the presence of IPRs law and its protection in Egypt. It was expected that when the protection of IPRs is poor in host country the transferor will favor transfer modes that requires high resource commitment.

This hypothesis was proved to be true in the case of the chemical industry, this research finding goes inline with the results obtained from previous studies Annand and Khanna, 2000; Maskuss et al., 2004. As indicated by previous studies the chemical industry is one of the IPRs protection sensitive sectors.

**Based on the realized findings, the following model figure (3) represents realized relationships among research variables.**



**Figure (3): Realized Relationships among Research Variables**

## Conclusion and Research Implications

The main purpose of this research is to examine the effects of five independent variables: Tacitness of technology, Transferor's size, Transferor protectiveness, Transferee technical absorptive capacity and the protection of IPRs in host country; on one Dependent variable: the choice of a TT mode by MNCs, which is expressed in terms of the amount of resources committed by the transferor during TT, where high resource commitment is reflected in the choice of a direct mode of TT- establishing a WOS; while low resource commitment is reflected in the choice of an indirect mode of TT- like granting a licensing. This is examined in the context of MNCs working in Egypt in three industrial

sectors: Food and Beverages; Pharmaceutical and Chemical. The RBV taken as a context of application. The census approach resulted in the cooperation of 44 MNCs out of a total of 101 MNCs comprising these three industries; 19 questionnaires are completed and returned making the response rate equals to 43 %; 17 questionnaires are valid for analysis. Out of the 17 MNCs, 8 MNCs belonged to the pharmaceutical industry, 7 MNCs belonged to the chemical industry and 2 MNCs related to the food and beverages industry. Data collected using Questionnaire lists; one key informant in each MNC was required to fill in the questionnaire- mainly manag-

ing directors. The questionnaire designed to be self-administered; however, in some cases the researcher had to run an interview with the key informant. The scale used in the questionnaire was mainly a Likert 5 point scale, ranging from 1= strongly disagree to 5= strongly agree. Data was analyzed using non-parametric methods of analyses- non parametric chi square was used- on two levels: aggregate and by industry-specific differences. Reliability and validity tests proved the constructs to be of accepted appropriateness. Research hypotheses were thus tested and results obtained.

Results of hypotheses testing indicate that complexity of transferred technology and transferor protectiveness were proven to be the factors affecting TT mode choice, which provide support for hypotheses H2.2 and H.5. The hypotheses related to transferor's size, technology codification, technology teachability, transferee absorptive capacity and protection of IPRs in host are not supported.

By industry-specific differences analysis indicates that complexity of technology- as one of the constructs measuring Tacitness of technology and as a factor affecting the mode of TT is more related to the Pharmaceutical industry than the Chemical and food and Beverages industries. However, the presence of IPRs laws in host country- as one of the facets of the variable: Protection of IPRs in Host country and as a factor affecting the mode of TT was proved to be related to the Chemical industry and non relating to the Pharmaceutical and Food and Beverages industries.

Other variables like: transferor size, technology codification, technology te-

achability, absorptive capacity of transferee, transferor protectiveness and degree of enforcement of IPRs law proved to be irrelevant. Results obtained from this study warrants the attention for further needed actions in order to link up Egypt to the global technology and innovation networks held by MNCs. While international technology transfer via MNCs can bring important knowledge to an economy, that alone is not enough. The rapid pace of technical change and the growing importance of science-based technologies in many industries call for more advanced and diverse skills and intense technical effort.

Results obtained from this study warrants the attention for further needed actions in order to link up Egypt to the global technology and innovation networks held by MNCs. While ITT via MNCs can bring important knowledge to an economy, that alone is not enough. The rapid pace of technical change and the growing importance of science-based technologies in many industries call for more advanced and diverse skills and intense technical effort. Building on the fact that bridging the technology gap between countries is necessary to foster sustainable economic development, and that technology is advancing faster than ever before;

**the researcher proposes the following recommendations in order to enable Egypt to participate in the evolving global networks of knowledge and thus increases Egypt's competitiveness as well as its economic and social development:**

1. Technological capabilities held by MNCs are difficult to acquire and diffuse unless Egypt improves its information and telecommunication infrastructures. This should be coupled wi-

th strong supporting institutions, as well as, stable and efficient legal and governance systems.

2. The cumulative forces that are increasing the gap between countries with respect to innovation performance make the role of policy increasingly important at all levels- national and international. This requires access to the international knowledge bases held by MNCs, combined with a national strategy to leverage this access for the benefit of local innovation systems.
3. Benefits should be granted to MNCs transferring technology to Egypt on the bases of how the MNC proves to increase local innovation; examples include MNCs establishing its R&D activities in Egypt. MNCs that fail to provide such requirements should not be granted privileges.
4. Joint ventures as a mode of TT might be a better option to Egypt than MNCs establishing WOS or affiliates, since a joint venture entails less foreign control, thus local goals become easier to fulfill; moreover, a joint venture may flexibly adapt to local requirements.
5. Establishing links between Egypt and MNCs innovation and production networks which can help in enhancing Egypt's technological capabilities and enables Egypt to compete better in international market. This can be accomplished through promoting inward FDI.
6. Promoting Egypt internationally as one of the centers of scientific excellence, thus attracting the innovative activities of MNCs. This can be accomplished through signing international techno-scientific cooperation, in which universities and public research centers can play leading roles through: joint scientific projects; scientific exchanges;

international flows of students and production agreements with exchange of technical information and equipment.

An important academic implication of the present study relates to the global strategy of the MNC transferring technology to a host country. Academically it is important to note that the global strategy of the MNC is an important factor influencing the transfer mode.

The second academic implication relates to the theoretical context of research application, where the results of this study have proved the importance of considering both the RBV and TCE theories as they proved to be complementary and not mutually exclusive.

The third academic implication of this research is that both the concept of "technology/ knowledge" and the concept of "transfer" are difficult to define and measure in precise terms. From a practical point of view the major practical implication of this research relates to the fact that TT is one strategy by which developing countries can break the vicious cycle of economic underdevelopment.

The results of this study indicate; however, that MNCs may NOT be effective in engendering economic development in LDCs through TT, unless the transfer of such technology also has the potential to stimulate learning and technological advancement.

Eventually, it could be argued that there are many points that need further examination concerning the modes of international TT.

This may include among others that the difficulty inherent in the process of determining the factors that conditions the choice of ITT mode stems from the fact that managers tend to use conceptually different terms including:

information, knowledge, technology and expertise synonymously. Since these concepts differ in their definition when applying from theory to practice, and from field to another the problem of defining the factors affecting TT mode choice remains undetermined. To solve this problem and determine a set of measurements, agreement among theorists and practitioners should be reached in regard to the definitions of required concepts. This requires a global exploratory research to identify how managers perceive and define different concepts related to Technology and TT and match these concepts to theory. Research in this point may require international efforts since cultural differences among nations can play an important role in this regard.

It is of great importance to refer also to the effects of home and host country rules and regulations including prohibition and incentives provided to transferor when using certain types of TT is a point that is not considered in this research and needs further examination. Finally, licensing contracts are considered an important method of TT, further research is needed concerning the bargaining powers of transferor and transferee in detailing the contract; however, this may need the joint efforts of researchers from different specializations, since the contract entails law related issues.



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