

Open Innovations and International Collaboration in the Context of Emerging Economies

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Abstract

In this paper we examine how firms perform open innovation in the context of an emerging economy. Specifically, we investigate how Jordanian pharmaceutical firms collaborate internationally, over a period of time, for open innovations and how this influences their innovation performance. The research is based on four detailed case studies of leading firms. We find that participating in international collaboration has a positive influence on open innovation performance, but only when the form of collaboration is highly integrated and the internal R&D can absorb and adapt innovation. In particular, the greater the degree of open innovation, the higher the innovation performance. Internal R&D and external innovation strategies are found to complement each other, demonstrating that a strategy of open innovation is not a substitute for internal capabilities, but rather a development path to developing higher innovation performance.

Keywords: open innovations, pharmaceuticals, emerging economies, R&D investment, international collaboration

1. Introduction

Firms in emerging economies tend to catch up with the technology frontier in advanced economies through formal and informal knowledge transfer channels (Forbes & Wield, 2008). Whilst the empirical support for open innovation is growing, there are still many questions regarding the role and limits to its application in different contexts and cases (Trott & Hartmann, 2009; Wang et al. 2011). For example, most of the research has been in the context of firms in advanced economies, and has focused on the role of intellectual property. In this paper we examine the role of innovation in an emerging economy context, and the potential contribution of international collaboration to the development of innovation capabilities and performance. We operationalize open innovation in terms of the degree of knowledge integration in a collaborative relationship. We identify how firms in this context organize themselves for innovation, both internally and externally to investigate what effects participation in international collaboration have on the degree and type of innovation performed, as shown in Figure 1.

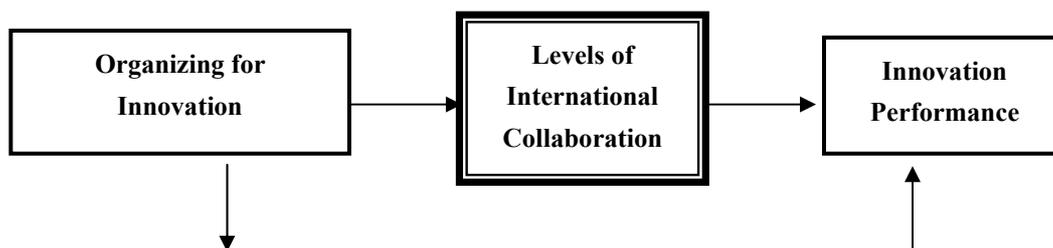


Figure 1. The relationships explored in the study

2. The Literature Review

The literature on firms in emerging economies suggests several innovation strategies and different evolutionary

paths for technological learning and innovation (Kale & Little, 2007). Using the examples of the East Asian electronics firms, Hobday (1995) chronicled the gradual transition where local firms move from learning to produce efficiently, to improvement of production and improvement of the products performance and specification, through building an intermediate level of technological capability (eg, designing or contributing to design, alone or in partnership with a foreign company, and learning product innovation skills), and finally an advanced level of technological capability (eg, designing and conducting R&D for new products). Similarly, Forbes and Wield (2008) propose a model mapping a firm's situation (its current assets and capabilities) and path/trajectory (where the firm has come from and where it might go), with multiple case study evidence from different developing countries (eg, India, Mexico, and Tanzania), and different sectors (eg, breweries, pharmaceutical, cement, etc). Forbes and Wield (2008) argue that with innovative catching up, firms initially innovate through building process innovation capability, but later may move beyond competing on price to competing on product features, eg, quality or higher value-added products. They argue that firms that innovate at the advanced level are those that are able to develop a distinctive capability having a 'proprietary' capability (eg, mechanical engineering know-how, process and routines), or through owning some intellectual property forms (eg, patents, trademarks, designs, etc). Therefore we might expect pharmaceutical firms in an emerging economy to progress in terms of innovation capability as shown in Figure 2.

Product	<i>Producing own branded formulations with their own specification</i> II	Developing new chemical entities & new drug delivery systems IV
Process	Producing generic drug under their chemical entities I	Different dosages of own branded generic drugs with specific drug delivery techniques III
Non- proprietary capabilities		Proprietary capabilities

Figure 2. Process-product-proprietary map

Source: Adapted from Forbes and Wield (2008)

Theoretically, firms can choose between two options for technological development and innovation: they can catch up with the technology in advanced economies through international collaboration, or they can try to create their own technologies through investing and developing in-house R&D. Much of the literature argues that firms are more likely pursue the first option (Forbes & Wield, 2008). Teece (2000) argues that the disadvantages associated with poor market and asset positions can be overcome if there is an organizational commitment to acquire technology developed elsewhere. Based on a survey in Beijing, Liefner et al. (2006) found that the innovating firms relied on outside contracts or international collaboration deals in the innovation process and organized R&D to internalize the foreign technology through technology transfer studies. Kim et al. (1989) found that Korean pharmaceutical firms relied mainly on international markets for both raw materials and technical knowledge needed to formulate them, while they develop their in-house R&D activities to assimilate and/or improve imported foreign technologies. Although this option requires high capabilities for investing in R&D and developing absorptive capacity, the alternative of creating domestic technology requires enormous investment in R&D as well as an environment suitable for innovation and complementary assets needed for full scale success. Several research efforts emphasize the importance of building absorptive capacity and investing in internal R&D to assimilate and apply new knowledge (eg, Chen, 2004; Cohen & Levinthal, 1990; Mowery, Oxley & Silverman, 1996). For example, Huang and Rice (2009) found a significant relationship between absorptive capacity and innovation performance. They argue that firm's absorptive capacity plays an essential role in strengthening the firm's capability to innovate especially when it performs some modes of openness such as networking and technology buy-in.

The literature on innovation collaboration suggests that firms participate in international markets to learn and obtain new knowledge, eg, technology or/and market know-how (Wincent, Anokhin & Boter, 2009). More specifically, to gain access to other firms' capabilities, gain access to new markets, and obtain support to exploit their existing capabilities (Chiesa & Toletti, 2004; Dyer, Kale & Singh, 2004). The literature also describes several features of international collaboration structure eg, equity/partial or no equity involvement, formality,

risky, level of integration or the extent to which the one partner can access the other partner activities, resources, and knowledge. It also identifies several dimensions by which the level of integration can be articulated (Chatterji, 1996). These dimensions include: (1) time horizon and the duration of collaboration; (2) level of control over people, activities, organization, information flow, etc; and (3) time and costs required for establishing the collaboration deal. The available knowledge within a collaboration deal will be constrained by the governance structure of the international collaboration agreement and the integration level that is associated with it (Hagedoorn & Duysters, 2002). As a consequence a firm will have a high level of ability to integrate and then upgrade this knowledge for the development of sustainable advantages and create new bundles of resources. This integration enhances the firm's innovation capability and consequently helps the firm to achieve high level of innovation performance (Kanter, 1994; Mowery, Oxley & Silverman, 1996).

3. Method

3.1 Research Context - The Jordanian Generic Drug Industry

Jordan is a small developing country with limited natural resources that has a population of six and half million (world factbook 2012). In general, Jordan is characterized by a weak National System of Innovation (NSI) in that property rights, capital markets, and regulatory institutions, are not nearly as well developed as they are in the developed economies (Jeflat, 2002). Furthermore, factors such as science and technology infrastructure and capital funding are not available in the same way as those in developed economies. However, despite the weak NSI, some Sectoral Systems of Innovation (SSIs) are stronger than others, especially in the generic drug sector (Abuhamad & Tidd, 2008). Jordanian generic manufacturers have built linkages outside their national context and at the regional and international level to compensate for the missing factors. We found that participation in international markets was playing an increasingly important role for Jordanian generic drugs producers.

3.2 Research Design

The research is based on a combination of quantitative and qualitative approach. First, the research employs a quantitative approach through using an innovation survey, which was conducted across 17 generic locally owned firms. In addition, several databases, available in the Jordanian Association of Manufacturers of Pharmaceuticals and Medical Appliances (JAPM), the Higher Council for Science and Technology, Ministry of Industry and Trade, and even in some pharmaceutical firms (eg, administrative records, the annual reports, etc), were investigated to audit innovation outcomes (number of licensing agreements, number of patents, etc) in pharmaceutical firms (JNCT, 2003). This quantitative approach provided a feedback about the innovation behavior of the Jordanian generic firms as well as helped select the case studies that differed in some ways in the level of participation in international collaboration, and types and degrees of innovation. Based on this survey, four generic drug firms were selected to illustrate the variety in innovation behavior and the degree of participation in international network. There are differences across the case studies in terms of size and age of firm, but this variety does not account for the diversity of strategies and performance. Much literature argues that firm size may or may not exert a considerable effect on the adoption of innovations (Damanpour, 1992). (See Camison-Zornoza et al. (2004) for a review of the literature that investigates how firm size and other factors may or may not influence a firm's innovation performance.) The technological capabilities literature also argues that the firm's age may influence its innovation performance due to the accumulated capabilities that the firm can build up during its life. However, the evidence in our sample did not indicate that a firm's size or age were associated with its innovation performance. For example, one of the younger and smaller firms outperforms one of the larger, more established firms.

The exploratory component involves an in-depth understanding of firm's behavior and the reasons that govern its behavior; a qualitative approach was employed for the four case studies over a period of four years. A qualitative approach emphasizes processes and meanings that are not rigorously examined, or measured, in terms of quantity, amount, intensity, or frequency (Denzin & Lincoln, 2003: 8). Case study strategy provides the opportunity for an extensive and in-depth study of the firms' behavior, and the effects of NSI on their practices. Yin (2003:13) suggested that a case study is "An empirical inquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries between phenomenon and context are not clear", in other words, between strategic decision practices and methods, and the context surrounding them such as national culture and NSI. Moreover, a cross-sectional approach in design is employed, focusing on specific development projects within the four case companies.

For the four case studies, multiple sources of evidence were used including firms' documentation, archival records, and interviews. For instance, several interviews with the key managers (eg, CEOs, R&D managers, business development managers, etc) in a four case studies were conducted. Furthermore, some examples for

projects that have already been completed and some that were still in progress were considered. Although each of those sources of evidence had specific weaknesses, combining and triangulating them maximized the benefits and helped to deal with the problems of establishing the construction validity (eg, establishing correct operational measures for the concepts being studied) and reliability (eg, demonstrating that the operations of a study such as the data collection procedures can be repeated with the same results) of the case study. Issues such as subjective perceptions and interpretations of the interviewee were, to some extent, remedied by conducting several interviews with the people who were involved in decision-making in the company. Furthermore, their views were confronted with other more formal sources of information such as policy documents and annual reports. The triangulation of information helped to clarify how the available information could be reduced; it also helped to decide what information derived from the interview could be used for constructing a reliable view of the actual processes of the firm's decision-making. Multiple sources of evidence essentially "provide multiple measures of the same phenomenon in the research and rise the advantage of discovering any contradiction or fresh perspectives"(Creswell, 2003).

4. Results

4.1 *The Innovation Performance of the Case Studies*

Consistent with the previous literature discussed in section 2, the research shows that all four case studies behave similarly in that they build strong 'basic' technological capabilities. They have all developed capabilities to produce and market own brand formulations for the domestic and regional market (quadrant I and II in Figure 2). More specifically, they have all focused on building manufacturing capability for producing generics under their chemical entities, investing in quality, building local distribution channel and marketing capabilities, and deploying and exploiting their production capabilities. The research also shows that all four firms continued to develop their privately owned drugs and develop better trademarked-brand identities to move up the value-chain. Furthermore, they succeeded in achieving many regulatory approvals for their branded products at the local and regional level.

However, only FIRM C and FIRM D have so far been able to build advanced capabilities and to move their position from non-proprietary quadrants (quadrant I and II) to proprietary quadrants (quadrant III and IV in Figure 2) to compete at the international market. Both firms moved beyond competing on their branded generic drugs to competing through the introduction of new drugs with specific distinctive knowledge that is protected by the IPR system or associated with hard to imitate knowledge. FIRM C and FIRM D not only developed branded generic drugs, but also added value through incremental product innovation and through implementing different degrees of product innovation by introducing new drugs using new drug delivery techniques.

Moreover, the research shows that some of the case studies have moved up the value chain and penetrated non-traditional markets and one performed licensing-out deals. FIRM B produced eye drops from a factory in Algeria in a joint venture with a local partner (Saidal). FIRM C and FIRM D focused on Europe and the US. Both these firms obtained the GMP certificate and worked with international institutions such as the UK's Medical Control Agency (MCA) (now part of MHRA) and the US FDA, in order to facilitate commercializing their drugs in these markets. FIRM C currently licensed out some of the drugs they have developed such as Nicotine Transdermal patches, and Fentanyl Transdermal patches for a German manufacturer. In addition some internally developed tablets, such as Risperidone, Glimepiride, and Venlafaxine, are licensed out to some regional manufacturers.

4.2 *Organising for Innovation Internally: Building In-House R&D Capability*

The four firms perform R&D to facilitate the technology transfer process that underpins their international collaboration deals. For example, FIRM A's technical and deputy manager contends that in conducting the packaging deal, the R&D department played a major role in investigating techniques for improving storage capabilities, in conceiving and designing innovative packaging products, and in re-engineering the current product line to suit the Korean packaging requirements. FIRM B's R&D and D&SP manager asserts the importance of R&D departments in helping the firm produce some licensed products. However, the four case studies vary in the way they develop independent capabilities using their R&D centres. Although FIRM C and FIRM D have built new proprietary technology without expensive R&D units, these two firms have built independent product development capability through their R&D departments. FIRM C's general manager states that their R&D plays a main role in assimilating Stowic transdermal technology. FIRM D also established a separate division with the R&D department for developing injectables and building strong capability in this line. The FIRM D business development for special projects manager asserts that "*through developing high capabilities in injectables, we were able to understand our needs and acquire Instituto Biochimico Pavese*

Pharma, which specializes in different sub-lines of injectables”.

Moreover, the four case studies vary in terms of the strength of the firm’s R&D department and the number of R&D and analytical support staff in comparison to the total number of the firm’s staff, see table 1. The four firms also vary in the way they co-ordinate R&D activities with other, separate parts of the knowledge system within the firm, eg, marketing, production, quality assurance department, etc. While the co-ordination mechanisms between the R&D department and the other departments in FIRM A are normally straightforward and flow through hierarchical channels, FIRM B established a special team, the “New drug committee”, which included representatives from the R&D, marketing, and technical departments, so they could investigate any new innovation project and examine the feasibility of developing it in-house or through a collaboration deal. FIRM C and FIRM D arranged for specific departments to integrate knowledge and facilitate learning through the firm. FIRM C developed a separate Development and Special Projects Division within the business development department. This department would be responsible for nearly all phases of the development, production, and marketing of any innovation project, and would therefore need to work closely with the R&D, marketing, manufacturing, quality control, materials management, engineering, registration, and quality assurance departments. FIRM C’s top manager arranged for marketing as well as R&D to work closely with the business department staff to ensure the feasibility of any collaboration project. FIRM D, on the other hand, established a cross-function, business planning team that is led by the business development department and includes representatives from R&D.

Table 1. Summary of the internal R&D capabilities, external international collaboration, and innovation performance of the four case study firms

	<i>R&D Capabilities</i>	<i>The case’s collaboration deals</i>	<i>Key innovation</i>
FIRM A	FIRM A’s R&D department employs nine people, 6% of FIRM A’s total staff. Only one of them has a PhD qualification, while the remainder have a BSc in pharmacy.	<ul style="list-style-type: none"> • Packaging, manufacturing and distribution contracts with some international companies within MENA market • Acquiring the whole pharmaceutical part of Arab Centre for pharmaceuticals and chemicals (ACPC) to expand their production capacity. • Packaging, manufacturing and distribution contracts with some international companies within MENA market 	<ul style="list-style-type: none"> • Incremental process innovation • Packaging innovation
FIRM B	FIRM B’s R&D and analytical support team includes 67 people, around 9% of the firm’s total staff. Seven of them have postgraduate qualifications such as PhD and MSc. FIRM B assigns 4% of its sales to R&D activities.	<ul style="list-style-type: none"> • Licensing in some innovative drugs in Jordan, Middle East and North African countries • Penetrating new regional markets through setting and establishing joint ventures in some Arabic countries. • Conducting a collaboration deal for developing its own patented product with some international pharmaceutical companies and research organizations. • Licensing out of some of its brand generic drugs along with complete registration files for some regional firms 	<ul style="list-style-type: none"> • Incremental process innovation • Packaging innovation • Under licensing- Product innovation

FIRM C	<p>FIRM C's R&D and analytical support team includes 40 people, 13 % of the firm's staff. Three of them have postgraduate qualifications such as PhD and MSc. FIRM C assigns 5% of its sales to R&D activities.</p>	<ul style="list-style-type: none"> ▪ Manufacturing and distribution contracts with some international companies ▪ Licensing in some innovative drugs in MENA region ▪ Out-Licensing of marketing authorizations obtained in some European countries. ▪ R&D acquisition for new drug delivery techniques. ▪ Preparation and organisation the CTD (A common format for the technical documentation) for some regional firms. 	<ul style="list-style-type: none"> • Process innovation • Under licensing- Product innovation • R&D acquisition -Radical product innovation then incremental product innovation
FIRM D	<p>FIRM D's R&D team includes over 120 people, around 22% of the firm's total staff. Nearly 20% have postgraduate qualifications, such as MSc and PhD. FIRM D increased its R&D spending from US\$2.8 million in 1999 to US\$4.9 million in 2002, which constituted about 3% of its sales. In 2005 FIRM D allocated more than 5% of its net sales to its R&D activities. FIRM D established a separate division with the R&D department for developing injectables and building strong capability in this line.</p>	<ul style="list-style-type: none"> • Packaging, manufacturing and distribution contracts with some international companies within MENA market • Licensing in some innovative drugs • Continually developing injection delivery systems through merger and acquisition deals. • Continually penetrating new non-traditional markets through acquiring whole manufacturing facilities in the US and Europe, setting up a manufacturing facility in Portugal, and having specific agents (distributors) in Germany. • Out-license some of FIRM D brand generics 	<ul style="list-style-type: none"> • Process innovation • Under licensing- Product innovation • Through whole acquisition deals eg, the acquisition of Ribosepharm GmbH or the Italian Plant

In summary the study shows that all four firms build internal R&D capabilities but to different degrees. It shows that FIRM A's investment in R&D is relatively very small when compared to FIRM C, FIRM B, and FIRM D, while FIRM D has built high R&D capabilities compared to FIRM C and FIRM B. Furthermore, they organize the R&D activities with other, separate parts of the knowledge system within the firm in different way. The study also shows that organising internal R&D is mainly associated with firms' innovation performance in terms of producing branded generics or the firm's own design. Building internal R&D capabilities is necessary for Jordanian firms but is not sufficient. We found an Open Innovation strategy to be the critical factor for achieving higher levels of innovation in the context of weak national and sectoral systems of innovation.

4.3 Organising for Innovation Externally: Adopting an Open Innovation Strategy

All four firms perform participate in international collaboration, but to different degrees. FIRM A only made packaging or manufacturing deals when they dealt with international partners. FIRM A completed a partnership arrangement with a Korean firm for packaging and re-labeling biotechnological drugs.

FIRM B is mainly concerned with manufacturing, packaging and licensing-in deals when they approach international markets. FIRM B currently manufactures ten products under license from Parke-Davis (now part of Pfizer). They also conducted an agreement with Novartis AG to package and sell Novartis products in the Jordanian market. FIRM B's assistant manager contends that "... *packaging deals enable the firm to broaden its product mix with minimal effort. Our current products are also successful as we have good marketing capabilities. We found it necessary to capitalize on that by conducting manufacturing, packaging, distribution, or even license-in deals for some new products that can be easily integrated into our existing marketing programmes*". They also perform several joint ventures but at the regional level. According to FIRM B's assistant manager "... *selecting joint venture deals in Algeria helped us to commercialize its own products as the Algerian market is new and not well understood. We know that we can manage our relationship with Sidal – an Algerian manufacturer – as we speak the same language*".

FIRM C had several manufacturing contracts and licensing deals with many international pharmaceutical firms (eg, Rhône-Poulenc-Rorer – Germany, Mundipharma – Australia, and Trenka -Austria). In 2002, FIRM C sealed a big manufacturing deal with a German pharmaceutical company and received US\$50 million as result. They also performed some R&D acquisition deals. FIRM C acquired Stowic Ltd – a British company that develops transdermal products for drug delivery, and where several generic and novel proprietary transdermal formulations have been developed with its patented technology. FIRM C also acquired the technology, know-how and products for medical chewing gums (eg, the use of gums to deliver active pharmaceutical substances). The technology, production equipment and know-how has been taken over from TillCE GumTech AB, a Swedish innovation company involved in the development of gum based medical products.

FIRM D also conducted several manufacturing, marketing and distribution, and licensing deals. The licensing division director argued that *“By producing products under license, you take advantage of other companies doing your product development work for you. You can acquire the rights to a fully developed new product under license for as little as 10% of its actual development costs ... Furthermore, licensing-in agreements increase the level of engineering and technical expertise gained through the licensed technology. It facilitates the introduction to on-going sources of new products and technology, and increased the company image”*.

Furthermore, FIRM D set up and acquired whole generic manufacturers at both the regional (eg, Algeria, Saudi Arabia, etc) and international level (eg, Portugal, US, Italy). FIRM D acquired the Italian company, Instituto Biochimico Pavese Pharma (IBP), which specializes in manufacturing liquid and Lyophilized injectables, eg, vancomycin. This new acquisition complemented FIRM D’s manufacturing facilities for production of Lyophilized products. The idea was that, as IBP’s drugs are not registered in the MENA market, these drugs would have a good potential market and profitability if FIRM D introduced and registered them both in Jordan and some other MENA markets.

In summary, the four firms vary in terms of participation in international collaboration. While FIRM A and FIRM B are more concerned with less risky collaboration deals such as packaging, manufacturing and distribution contracts when participating in international markets, FIRM C and FIRM D are more focused on performing collaboration deals that are characterized by a higher levels of integration, complexity, and risk.

5. Discussion

5.1 The Relationship between a Firm’s Level of Open Innovation and Its Innovation Performance

There is a positive relationship between a firm’s level of participation in international collaboration and its innovation performance. Figure 3 provides a summary of the relationship between international collaboration and a firm’s innovation performance.

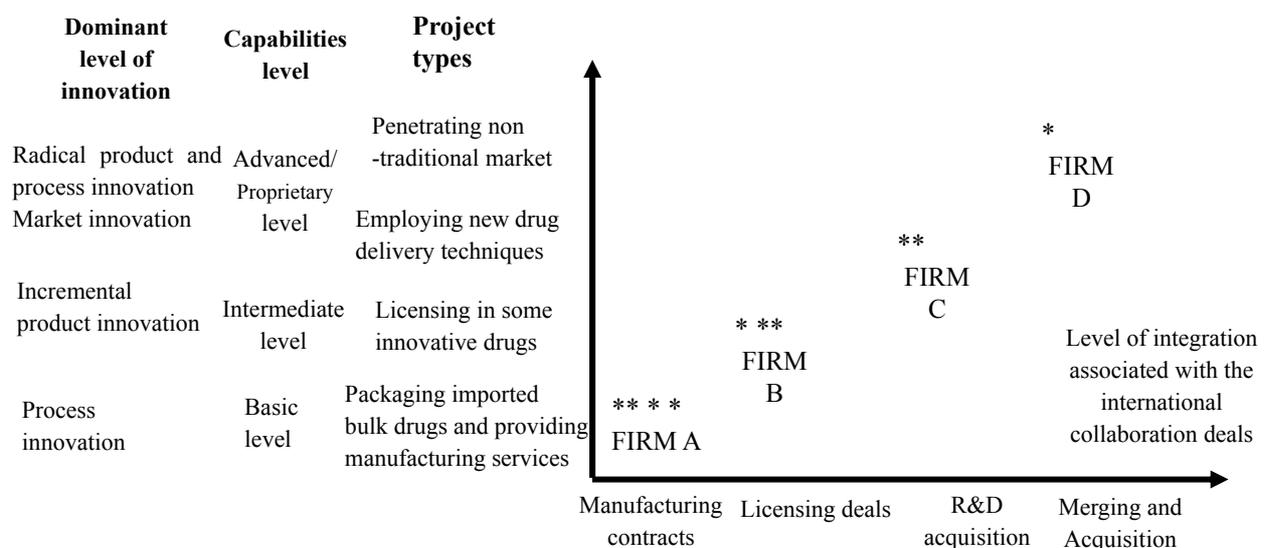


Figure 3. Relationships between form of international collaboration and innovation outcomes

Our research confirms that there is an association between the level of integration of international collaboration

project and the type and degree of innovation. Firms that performed deals characterised by a high level of integration and control such as acquisition agreements, were able to develop more distinctive capabilities, resulting in higher forms of innovation. This is in contrast to the firms which were involved only in licensing deals in which they could not have full access to the other partner's knowledge.

Clearly, cross-sectional research cannot establish the direction of causation between international collaboration and innovation performance. While participation in international collaboration may influence a firm's innovation performance, innovative firms also are more likely to participate in international collaboration to acquire new knowledge and develop their technological capabilities. However, the sequence and timing of the numerous collaborative projects and subsequent innovation outcomes does imply some strategic intent and influence.

5.2 *The Relationship between R&D Investments and the Level of Participation in International Collaboration*

There is a significant relationship between R&D investment and the firm's level of participation in international collaboration. Each firm invests a considerable amount to develop its R&D in order to develop its absorptive capacity when they are involved in acquiring knowledge developed elsewhere. Absorptive capacity is one reason for companies to invest in R&D instead of simply buying the results (eg, patents) (Cohen & Levinthal, 1990). However, our research shows that R&D investment alone does not lead to a high innovation and proprietary or distinctive capabilities. In the context of an emerging economy with weak national and sectoral systems context, investment in R&D may not be sufficient. The higher the participation in international collaboration, the higher the firm invests and develops its R&D capabilities and the higher the innovation the firm performs. The firms that participated in a high level of international collaboration were able to achieve high innovation and proprietary or distinctive capabilities. This is consistent with studies in advanced economies. For instance, based on Dutch Community Innovation Survey, Poot et al. (2009) found that internal and external strategies for innovation are complements instead of substitutes. Veugelers (1997) also found a positive relationship between a firm's investment in in-house R&D and their pro-activeness for the acquisition of external knowledge. Our study confirms the complementary nature of internal R&D and external international collaboration in the development of higher levels of innovation capabilities and performance for firms in the context of an emerging economy with weak national and sectoral systems of innovation.

6. Conclusion and Future Research

While there is a general agreement among literature that technological capabilities are critical components of their ability to compete and innovate, this paper shows that in the context of emerging economy with weak national and sectoral systems context, investment in internal capabilities may not be sufficient. We found that the higher the investment and integration in international collaboration deals, the higher the investment in in-house R&D, and the higher the achievement in innovation performance and new market penetration. Moreover, the research shows that internal R&D and pursuing open innovation through collaboration are complementary. Investment in R&D and developing a firm's internal knowledge are required to absorb external knowledge; at the same time access to external knowledge may leverage the efficiency of internal R&D activities and encourage high investment.

One limitation of this research comes from specific country and sector context. The findings are indicative rather than conclusive and cannot be generalized to other sectors or countries. Therefore, further research is needed in other sectors and countries to see if similar findings apply. Also, the case study approach cannot establish fully the direction of causation between pursuing a strategy of open innovation and firms' innovation performance. It is likely that it is an example of 'circular causation', with one set of factors influencing the other and vice versa. Innovative firms are more likely to be more open and to participate in international collaboration, and vice versa. Finally, although this study was conducted over a four years period with continuous contacts with the managers in the selected cases being made to explore if any major improvements/developments relevant to this study has happened, more longitudinal research is needed in order to examine causality in greater depth.

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