Can the Triple Helix Model be the Champion for Innovation in the Countries with Low Private R&D Spending? Evidence from the Palestinian Industrial Sector

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Abstract

Understanding the innovation ecosystem is essential to science, technology and innovation policy decision-making. This paper analyses the impact of collaboration relationships between the Triple Helix spheres on the innovation performance of Palestinian industrial firms. A quantitative approach was used by employing the Generalized Linear Model (GLM) to analyze data gathered from 340 industrial firms in the West Bank. The results showed that industrial collaboration as per the Triple Helix Model is very weak and its impact on the ability of the industrial firms to introduce new technological innovation is not significant. Similar results were found for non-technological innovation, with a staggering negative relationship regarding the marketing innovation. Therefore, there is an urgent need to develop an innovation policy framework to address the above challenges. This study attempts to put forward key recommendations in this context. Further in-depth analysis will be conducted in future studies, including cross-sectors, firm size and rate of innovation.

Keywords: Palestine, Triple-Helix Model, Innovation, Innovation networks, GLM Model

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1 Introduction

The Triple Helix Model (THM) states that the hybridization of elements from industry, university and government to generate new institutional and social formats is important for the production, assimilation and application of knowledge needed for innovation output in knowledge-based economies (Etzkowitz and Leydesdorff, 2000). Etzkowitz and Leydesdroff (1995) define the THM as a "spiral model of innovation", having the ability to capture multiple reciprocal linkages at different stages of the capitalization of knowledge, including between three main actors: universities, industry and government. The overlaps between them are vital to generate new ideas, information and knowledge. The THM of innovation clarifies the synergies between university, industry, and government, whereby each of them provides one or more competences in order to provide technological and non-technological innovations. The role of universities is mainly embodied in providing R&D and new technology for the industrial sector so as to develop new or innovative products. The government or public sector enacts laws and regulations to facilitate the relationship between universities and the industrial sector.

Palestine, a developing and occupied country, suffers from weak manufacturing performance, which only contributed to around 14.1% to the GDP in Palestine in 2014 (P- C- B- S- [PCBS], 2014). Statistics show very weak R&D performance for the Palestinian private sector, with only 25% of firms investing in R&D, and only 11 patents were recorded in Palestine in 2013 (PCBS, 2013). In addition to the political instability and the constraints imposed by the Israeli occupation, the structure of the innovation framework that organizes and facilitates the flow and exchange of knowledge and technologies among the key stakeholders of the innovation process is weak.

Thus, the industrial sector needs new technologies, skills and competencies to grow and develop, which can be obtained through a systematic process of knowledge and idea

generation, built mainly on R&D efforts. This drives the Palestinian industrial firms to find innovative solutions to bridge the knowledge gap that is needed for new product development. However, market-oriented industrial firms are generally unable to provide the required knowledge and technologies because the budget allocations they devote to R&D are limited; most of their resources go into streamlining production and marketing. Therefore, THM is likely to be one of the most important solutions where universities as centers of excellence and knowledge can provide the industrial firms with the needed knowledge, technological competences and R&D, supported and facilitated by the institutional competencies of government bodies (e.g. in terms of laws, regulations, technological infrastructure, financial and non-financial subsidies, investment environment, general education and support for university research).

This study aims to determine the impacts of the collaborative relationship between THM elements on the innovation performance of Palestinian industrial firms. It sheds light on issues concerned with innovation in the Palestinian industrial sector such as innovation performance, obstacles of innovation, the innovation environments and the degree to which the industrial firms cooperate with academic institutions, the public sector, and NGOs. The importance of the study arises from its ability to tackle the collaboration relationships between the triple helix modal members as a solution to the lack of knowledge resources in the industrial sector. The study seeks to find a solution through innovation to increase the contribution of the industrial sector to GDP and employment, regardless of the many distortions caused by the long period of Israeli constraints on the Palestinian economy.

Moreover, the study introduces the THM as a non-conventional solution for the lack of knowledge and technologies that are important for industrial firms to grow and compete in an open international economy. It should be noted that Palestine considers membership of the World Trade Organization (WTO) a priority which, if achieved, will add extra competitive pressures on Palestinian industries. In the era of globalization, no firm can survive or compete in the medium- and long-run without innovation. Innovation has become the solution to competitive pressures at national and international levels. Therefore, one of the important points in this study is to introduce an innovation framework for Palestinian industries that enables them to grow and compete.

The paper is organized as follows. After the introduction, the second section discusses the key theoretical and empirical arguments concerning the THM and its applications in both developed and developing countries to generate innovations. The third section presents the methodology and data collection, while the fourth measures the effect of triple helix collaboration relationships on the innovation performance of the Palestinian industrial firms, taking into account the different collaboration forms. The fifth section summarizes the results of the empirical analysis and provides conclusions and appropriate recommendations.

2 Literature Review

In the last two decades there has been a rapid increase in research attention discussing the triple helix as a policy to enhance innovation and improve the economic performance at the micro and macro levels (Etzkowitz and Leydesdroff, 1995; Goktepe, 2002; Rosenlund, 2015).

Etzkowitz and Leydesdroff (1997) were among the first who formulated the concept for THM, which they defined as a "spiral model of innovation, which is able to capture multiple reciprocal linkages at different stages of the capitalization of the knowledge". Similarly, Viale and Ghiglione (1998) described THM as a spiral (versus traditional linear) model of innovation which designate the relationships between three institutional setting (public, private and academic), which is able to capitalize knowledge to develop innovation. Etzkowitz et al. (2007) added that THM has three main spheres, which are university, industry and government; each has a specific role in the process of innovation, and each institutional sphere "takes the role of the other", i.e. operates its traditional function as well as in the sphere of other actors. Dzisah and Etzkowitz (2008) stated that in a knowledge-based society, THM is:

> "A movement towards collaborative relationships among the three actors, in which innovation policy is increasingly an outcome of interactions among the spheres rather than a prescription from the government or an internal development within industry".

Moreover, Goktepe (2002) described the THM as a model of technological development in terms of university, industry, and government relations. Leydesdorff (2013) denotes that the triple helix is not only the relationship between university, industry and government, but also the internal transformation within each of these spheres.

2.1 How does the THM function?

Leydesdorff and Etzkowitz (1998) developed the THM to show how an overlay of communications operates between the three institutions (university, industrial firms and government); the translations among them induce adaptation mechanisms in the institutional arrangements. Etzkowitz (2003) linked the structure of the institutional arrangements in the triple helix system with the society (i.e. 'etatistic'/ statist or laissez faire). Statist societies have extensive state involvement in the economy, particularly with regard to micromanagement of the manufacturing industry, coordinating the relations between the other actors (e.g. academia, industrial firms and trade unions) to establish new initiatives among them (Figure 1). Universities provide advanced research, government provides legislation, regulation and the general fiscal environment, and industry is the productive force. In the laissez faire society the role of the state is minimized, and the scope of private industrial firms is more liberated, enabling them to act as the prime mover of economic system development. The role of the government is mainly limited to solving macroeconomic problems related to market governance. In such society, the three institutional actors of university, industry and government are clearly separated or divided (Figure 2).

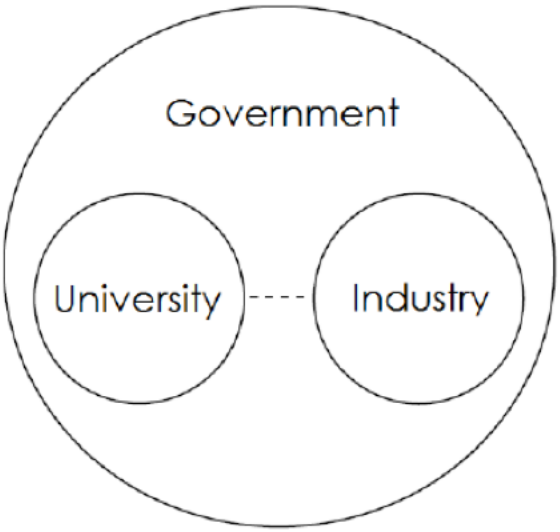

Figure 1: Etastic (statist) society

Source: Etzkowitz and Leydesforff (2000, p. 111)

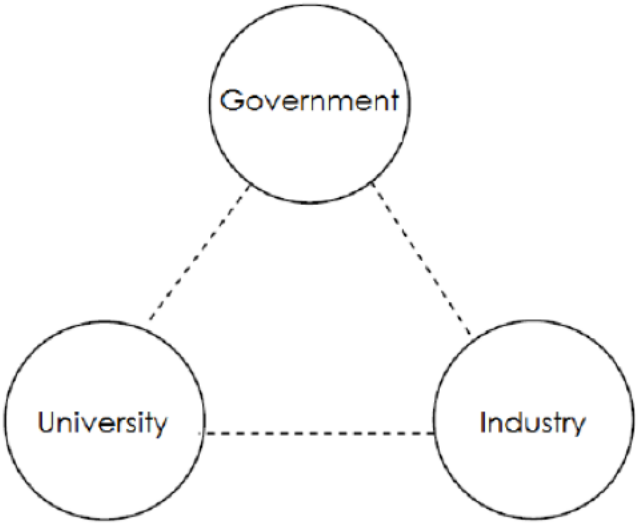

Figure 2: Laissez faire society

Source: Etzkowitz and Leydesforff (2000, p. 111)

Enthused by the development of knowledge-based economies, Etzkowitz (2008) developed a new structure for THM with two major transformations from the statist and laissez faire models. Firstly, the formation of reciprocal relations on a constant basis between the three institutional actors, and secondly, replacement of the role of industry with universities as core institutional actors (Figure 3).

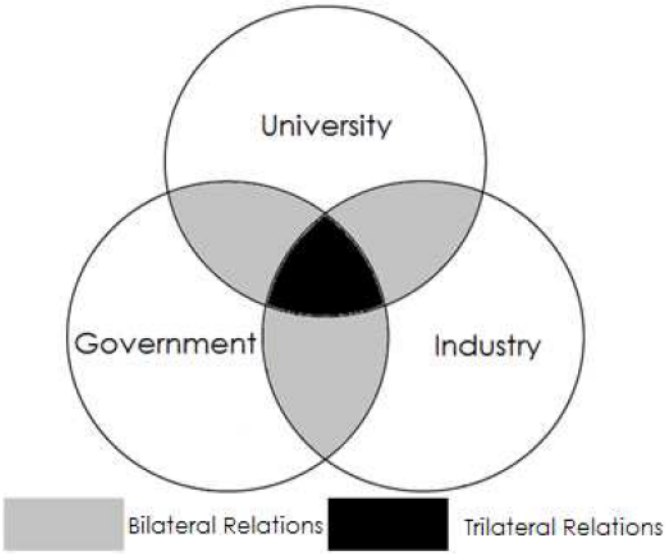

Figure 3: Triple helix society

Source: Etzkowitz and Leydesforff (2008, p. 16)

In another study, Etzkowitz (2007) confirmed that the three spheres of the triple helix are autonomous but overlapping, i.e. not completely merged, but not entirely distinct. Etzkowitz differentiated between three forms of THMs with different structures:

- Triple Helix I – the state dominates industry and academia and directs the interactions between them.

- Triple Helix II – consists of separate institutional spheres (industry, university and government) operating separately from each other. The role of the university is to provide basic research and trained persons. The industrial firms are in a competition between each other, thus they operate separately, and only linked through the market. The government role is to address problems related with market failures, and to provide solutions that the private sector cannot or will not support.

- Triple Helix III – defined as an interactive model which consists of relatively independent and overlapping spheres. The academic institutions provide basic knowledge and trained persons, and they are a source of firm-formation and regional development. The industrial sector plays in a high level the role of the university in research, training and development, while the government provides the institutional framework which supports the development of new innovative

products such as laws and regulation, tax incentives and provision of public venture capital.

Leydesdorff (2010) re-defined the nature of the knowledge-based innovation system in light of interactions between the triple helix spheres. The role of the industrial sector is to assess the way in which and to what extent R&D functions are internalized; universities define and specify their market position; and industry-university relations are enabled through the different institutional arrangements introduced by the third sphere (government), such as licensing agreements, intellectual property rights, spin-off companies, transfer office and network data etc. In other words, the government role is mainly to provide the institutional carriers of an innovation system. These carriers are expected to entertain a dually layered network in order to employ the instructional relations to constrain each other's behavior and to shape each other's expectations (Leydesdorff, 2010).

A neo-institutional perspective by Martynovic (2011) focuses on the networked interrelationships between the university, industry and government, whereby the role of innovation and knowledge in the development of an economic system is based on the ability of the triple helix actors to take the role of each other, and to stimulate interrelations among them (i.e. the ability to build interactive trilateral relationships).

Rosenlund (2015) claimed the THM is used as a framework for dialogue between the main elements of the innovation system (university, industry and public sector) to solve problems and to support each other in a collaborative way. The university provides research and education in an entrepreneurial manner. Industry realizes the value of knowledge, research and education to produce new innovative products, while the public sector can be the driver of the THM by supporting the research and development through the framework for the innovation system. Sutz (2015) notes that in the national innovation system, university structures are modeled through the interactions with other mediation actors. The government institutions operate in diverse ways: to shape the course and direction of the innovation behavior at the micro and institutional levels; to confirm the innovation health

at firm and whole country level; and to assure the smooth operation of interactions and knowledge transfer between other parts of the innovation system.

2.2 Empirical implications on THM

Several studies have employed quantitative assessment approaches for the THM to demonstrate its usefulness in delivering innovation and enhancing economic performance. Egorov et al. (2015) demonstrated an econometric method to assess the ability of the triple helix participants (science/education, business and state) to enhance the innovative activity of regions of Far-East Federal District of the Russian Federation (FEFD). He found that there is a deficiency in the educational system to create human mind and to mobilize the R&D required in the development of the region's innovative activity.

In Indonesia, Martini et al. (2012) proposed a model of collaboration between academics, local businesses and local government to develop the economic corridors in MP3EI (Master plan for Acceleration and Expansion of Indonesia Economic Development) as a knowledge hub. One of the main implications for this research was to provide a useful foundation model for the research of knowledge hub in a knowledge-based economy. They proposed three collaboration models: (1) integrated R&D institutions; (2) vocational education program; and (3) innovation clusters. The data analysis revealed that the differences in the capabilities of academics created an imbalance in the density of knowledge among corridors.

In the business area, Martini et al. (2012) found improvement in areas for each main activity in each corridor, which means that many economic corridors still have good opportunities to grow and develop. In government areas, there are two institutions to provide macro-economic conditions necessary to expand investments in all corridors, including in university research and collaboration, as noted also by Moeliodihardjo et al. (2012). They evaluated the readiness of Indonesian universities to participate effectively in the Master plan for Acceleration and Expansion of Indonesia's Economic Development

(MP3EI) 2011-2025, through analyzing the current situation of the university–industry–government partnership. Their results indicated that the universities play a dominant role in the national research capacity, while the government has a very low contribution to the research capacity; it only allocated 0.08% of GDP to research and development, which means that the research is not a priority in the government agenda.

Moeliodihardjo et al. (2012) also found that the relationship between university and industry is still not constituted properly, and a lack of understanding about each other is found. In other words, the relationship is in the state of "institutional sphere" instead of "consensus space". The unavailability of institutional framework which organizes the relationship between university and industry leads to individual, uncoordinated partnerships instead of a coherent network of institutional partnerships. Hence, the three triple helix spheres need to build an institutional framework among them before each can take purposeful action. Empirical evidence demonstrates that sustained linkages between government, universities and the industrial partners increased research productivity of junior and senior staff in Thailand, making a direct contribution to social and economic development (Chanthes, 2012).

In 2013 the Brussels Capital Region adopted a triple helix of university-industry-government relations to guarantee successful implementation of smarter and cleaner urban freight transport (Brussel Mobiliteit, 2013). The main objective was to come up with an innovative idea to deal with a changing societal and economic context. This was translated through a list of 36 preferred actions to encourage and facilitate off-hour deliveries developed through structural consultation between the institutional spheres of the THM. Also, Verlinde and Macharis (2016) adapted a THM to describe the innovation in urban freight transport in Brussels based on the idea that innovation is driven by commercial and public actors as well as researchers. Two case studies were discussed (mobile depot in Brussels and night deliveries in Brussels), in each of which the objective was to understand how the mutual dynamic and interactions among the three spheres (industry-government and knowledge institution) can contribute to innovation in urban freight transport. Complementary roles can be effective where the industry actor's role is to come up with innovative idea for their company and execute trials, facilitated by the authorities by means

of practical help, temporarily changing the regulations or providing financial support, and researchers monitored and evaluated the new concepts.

2.3 Palestinian experience in innovation and collaboration

The discussion on industrial-academic collaboration has increased in Palestine within the last few years, aligned with global trends in this field (Abu Hanieh et al., 2015; Morrar & Abdelhadi, 2016; Morrar, 2018). Abu Hanieh et al. (2015) discussed the existing status of industry-academia partnership with relevance to engineering education, confirming that the current university-industry partnership situation in Palestine is weak, and hence it is very important to strengthen the linkages between these three elements, to develop the Palestinian industrial sector which suffers from a lack of R&D centers, low labor skills and the absence of state technical and financial support customarily available in comparable countries (i.e. not under extraordinary occupation etc.).

The government role is very important to provide a unified system to govern and encourage the innovation in small and medium enterprises (SMEs) in Palestine, and to provide an institutional framework to protect innovation-related intellectual property rights and patents. They proposed an innovative model built on "awareness and market needs feedback" in order to create modern learning techniques. The academic institutions in this model are asked to improve curricula by including sustainability concepts as well as including new teaching methods which are necessary to bridge the gap between industry and academia. In similar study about strengthening university-industry collaboration in Palestine via technology and knowledge transfer, Albydah (2016) found that the link between industry and universities is weak, which affects the innovation system in Palestine. Also, the role of government in Palestine in supporting knowledge creation and knowledge transfer is weak. He confirmed that universities are the core element in knowledge and technology transfer, which requires the development and support of research activities and it is important to establish entrepreneurship university.

Building independent knowledge and technology centers inside universities is crucial to identify and coordinate knowledge and technology transfer processes. Khatib et al. (2013) compared the innovation performance of two major Palestinian industrial sectors, namely

quarrying and stone fabrication and the food and beverages sector, confirming that the weak cooperation between the industrial sector, higher education and R&D institutions is a major problem that should be tackled in order to strengthen the ability of enterprises to innovate.

Morrar (2018) studied the development of R&D key performance indicators (KPIs) in Palestine, noting that national R&D has gradually become more visible between researchers and policy makers, which is consistent with the increasing debate at the regional and international levels about innovation development in developing countries facing tight competition from international companies due to globalization and open trade operations. He found a disconnection between R&D mainly from universities and innovation output; for example, only nine patents were registered as a result of all R&D activities Palestine in 2011. Many of the R&D research studies in the universities are not market-oriented or tailored to the needs of the business sector, but are undertaken for individual academic objectives such as career progression. Hence, important recommendations were made to develop R&D or innovation networks including different actors (universities, industry, government and non-government institutions) of the R&D system, which eases the flow of knowledge among them, minimizes R&D risk and ensures a market-based R&D strategy.

The role of the government is crucial to facilitate the interactions or linkages between the different members and enhancing the dynamism of the national R&D and innovation system, as well as to provide the institutional framework to protect intellectual property rights and improve the business climate. The private sector is ultimately required to improve its internal R&D environment, which is necessary to tap into the R&D activities developed by universities and public research centers. Morrar and Abdelhadi (2016) found that 53% of knowledge-intensive business firms in Palestine reported difficulty in finding cooperation partners for innovation as the main obstacles of innovation for their firms. Also, the lack of access to capital and finance is the factor with the greatest negative impact on product and process innovation as well as the organizational and marketing innovation.

3 Research Methodology and Data Collection

A quantitative approach was used in this study to assess the impact of collaboration relationships between the triple helix spheres on the innovation performance of the Palestinian industrial firms. The Generalized Linear Model (GLM) is used. It is a flexible generalization of Ordinary Least Square (OLS) regression and allows response variables that have error distribution models other than a normal distribution. A Wald test (coefficient restriction) was used to test the null hypothesis (i.e. that the coefficients of the insignificant variables all equal zero), measuring how close the unrestricted estimates came to satisfying the restrictions under the null hypothesis, which means that if the restrictions in the null hypothesis are true, then the unrestricted estimates should come close to satisfying the restrictions. The empirical model is described as follows:

$$Innovation_i = \beta_0 + \beta_1 Univcoll + \beta_2 Govcoll + \beta_3 Univcoll*Govcoll + \beta_4 NGOcoll + \beta_5 Orgbody + \beta_6 Degrrocol + \beta_7 Intobs + \beta_8 Extobs + \beta_9 Innoenvi + \beta_{10} Localmrk + \beta_{11} Nationalmkt + \beta_{12} Israelmkt + \beta_{13} Intnatiomkt + U_i$$

Empirical Model

The dependent variable 'innovation' denotes the innovation output which divided into four main types: 'product innovation', 'process innovation', 'marketing innovation' and 'organizational innovation'. The innovation output was measured using a five-point Likert scale. The GLM model was run separately for each of the four innovation types. The independent variables which include the triple helix interactions or links in addition to a group of control variables are described in Table 1.

Table 1: Description of the econometric model variables

Variable	**Description**
Prodinno	Product innovation in industrial firm
Procinno	Process innovation in industrial firm
Orgdinno	Organizational innovation in industrial firm
Mrkdinno	Marketing innovation in industrial firm
Univcoll	Collaboration between industrial firm and academic institution(s)
Govcoll	Collaboration between industrial firm and public institution(s)
Univcoll*Govcoll	Measures interaction in academic and public (government) institutions. In other words, it shows if the collaboration of the industrial firm with the public institution improves the efficiency or feasibility of the collaboration with the academic institution, through increasing positive impacts (product innovation)
NGOcol	Collaboration between industrial firm and NGO(s)
Orgbody	The importance of having an organizational body which coordinates or organizes the relationship between the industrial, academic and public institutions
Degrrocol	The awareness of the industrial firms of the importance of the collaboration relationships between the helix model partners
Intobs.	The internal or intra-firm obstacles of innovation
Extobs	The external or extra-firm obstacles of innovation
Innoenvi	The innovation environment in Palestine
Localmrk	Shows if the industrial firm products target the local market
Nationalmkt	Shows if the industrial firm products target the national market
Israelmkt	Shows if the industrial firm products target the Israeli market
Intnatiomkt	Shows if the industrial firm products target the international market (export)

With regard to triple helix collaboration relationships, there are main interactions: industry-university, industry-government and industry-NGOs (Table 2). Here we separate the link between industry and NGOs, because the latter is a major sector in Palestine that plays a key role in knowledge transfer from the international atmosphere to the local market (e.g. in terms of industrial associations, chambers of commerce, international institutions etc.). Table 2 describes the percentage of industrial firms which link with other triple helix spheres. We found that around 25% of the industrial firms have links with one or more government institutions, around 18% with one or more of the universities, and only 4.7% with the NGOs. We also add to the above econometrics model the interaction between "industry-university" and "industry-government". It is important to show if the links with government institutions increase the efficiency of industry-university collaboration or not.

Table 2: The degree of collaborative relationships between triple helix spheres

Collaboration relationships	Yes	No
Industry-Universities	17.9%	82.1%
Industry-Government	25.3%	74.7%
Industry-NGOs	4.7%	95.3%

4 Research Data

A paper-based questionnaire was used to collecting data about collaboration for innovation in the THM in the Palestinian industrial sector. A random sample of 520 industrial firms in West Bank was selected, and 340 questionnaires were answered (a response rate of around 65%). We excluded industrial firms in the Gaza Strip and East Jerusalem due to the logistical difficulties of access caused by the Israeli occupation. Micro industrial firms (i.e. those with less than three employees) were also excluded, since these are generally family businesses with very low focus on innovation. This was evident from the response rate (less than 10%) in the pilot study which was implemented on a sample of 40 firms to figure out to how much the questionnaire and sample is fitting the Palestinian industrial sector.

One challenge in measuring innovation outcomes is the subjective nature of many of the questions used in the surveys. Most surveys directly ask firm managers and owners whether they have implemented any "new" products, processes, marketing methods, or organizational practices or "significant" improvements in existing ones in the last three years. The answer to this question is is a highly subjective concept. A main challenge arises when trying to capture what is the significant improvement in the product. Also, the distinction between innovation and mere product innovation is very difficult. Here, we ask the question about product, process, organizational and marketing innovation in a different way. For example, to measure product innovation, we asked the firm to how much or what extent your firm could add significant improvement in quality of current goods, provide new items for the establishment, or provide new item for the market. A five-point Likert scale was used ranging from "Doesn't apply" indicating that no innovation was noted to "very high" to show that new product innovation was registered.

5 Results and Analysis

This section presents the data analysis using the GLM model, and the results are discussed to answer the main research question of whether the Triple-Helix-Model explains part of the Palestinian Industrial Sector development in terms of their ability to innovate. As mentioned in the methodology, the innovation is considered in its broadest sense and covers the four types of innovation as per the Oslo Manual categorization; product, process, organizational and marketing (Mortensen and Bloch, 2005). Each type of innovation was measured in a separate model using the model architecture shown in Equation 1.

$$Innovation_i = \beta_0 + \beta_1 Univcoll + \beta_2 Govcoll + \beta_3 Univcoll*Govcoll + \beta_4 NGOcoll + \beta_5 Orgbody + \beta_6 Degrrocol + \beta_7 Intobs + \beta_8 Extobs + \beta_9 Innoenvi + \beta_{10} Localmrk + \beta_{11} Nationalmkt + \beta_{12} Israelmkt + \beta_{13} Intnatiomkt + U_i \quad \text{Equation 1}$$

Where $Innovation_i$ represents each type of innovation separately. For instance, the GLM model was tested separately to measure the impact of collaboration as per the THM on product innovation, as shown in Equation 2.

$$Prodinno_i = \beta_0 + \beta_1 Univcoll + \beta_2 Govcoll + \beta_3 Univcoll*Govcoll + \beta_4 NGOcoll + \beta_5 Orgbody + \beta_6 Degrrocol + \beta_7 Intobs + \beta_8 Extobs + \beta_9 Innoenvi + \beta_{10} Localmrk + \beta_{11} Nationalmkt + \beta_{12} Israelmkt + \beta_{13} Intnatiomkt + U_i \quad \text{Equation 2}$$

5.1 The impact of industrial collaboration as per THM on technological innovation

Prior to running the GLM models for both product and process innovation, which represents the technological part of innovation, a normality test was conducted using Jarque-Bera test for the normality, which showed an error less than the 0.05 level of significance, which means that we reject the null hypothesis at which the error term is normally distributed (H0: u is distributed $N(0,\sigma^2)$). One way to address the problem is to employ some form of robust regression to handle the model and lead to the best linear

unbiased estimator (as long as there is a departure from normality). As mentioned previously, GLM is a robust OLS estimator that efficiently handles un-normality of error.

The analysis of the impact of industrial collaboration as per the THM on the ability of the industrial firms to introduce new product/process innovation revealed that none of the collaboration indices has a significant impact on the probability of firms to have product or process innovation. In other words, the collaboration for innovation among the triple helix actors did not make an impact on the technological innovativeness of firms. Table 3 shows the results of two GLM regression models for product innovation.

Table 3: GLM regression of the relationship between collaboration and product innovation

Dependent Variable: PRODINNO				
Coefficient covariance computed using observed Hessian				
Variable	Model 1		Model 2	
	Coefficient	Prob.	Coefficient	Prob.
C	3.051***	0.000	3.002***	0.000
UNIVCOLL	0.156	0.389		
GOVCOLL	-0.103	0.448		
UNIVCOLL*GOVCOLL	0.130	0.636		
NGOCOLL	-0.508**	0.033	-0.397	0.083
ORGBODAY	0.105**	0.048	0.096**	0.031
DEGRRCOL	-0.019	0.845		
INTOBS	-0.062	0.455		
EXTOBS	0.038	0.563		
INNOENVI	0.127**	0.024	0.131***	0.009
Localmkt	-0.508***	0.000	-0.445***	0.000
Nationalmkt	0.170	0.121		
Israelimkt	-0.133	0.247		
Intnatiomkt	0.204	0.171		
Mean dependent var	3.495		3.495	
Sum squared resid	259.253		266.287	
Akaike info criterion	2.649		2.623	
Hannan-Quinn criter.	2.712		2.645	
Deviance statistic	0.795		0.794	
LR statistic	42.931		34.101	
Pearson SSR	259.253		266.287	
Dispersion	0.795		0.794	
S.D. dependent var	0.930		0.930	
Log likelihood	-436.493		-440.914	
Schwarz criterion	2.807		2.679	
Deviance	259.253		266.287	
Restr. Deviance	293.394		293.394	
Prob(LR statistic)	0.000		0.000	
Pearson statistic	0.795		3.495	

In the THM context, such findings can highlight different insights and perspectives. Part of the explanation can be regarding the supply side and the quality of its input in industrial development and innovation. The academic and research institutions within Palestinian universities have been an issue of concern in terms of their ability to produce new scientific knowledge, technologies and innovation that can be smoothly transferred to the industrial firms to enable them to innovate in their products and processes. Most research outputs in the Palestinian universities are bottom-up, since they are usually driven by the interest of the academic individuals, who are overburdened with teaching load, and work strategically in research to be able to publish as a key promotion vehicle. Since there is a lack of coordinated research strategy at high level, this type of research is not necessarily aligned with the needs of the private sector for knowledge and technologies.

In the case of product innovation, which requires advanced knowledge and a high rate of innovation to launch, the novelty is an obvious challenge which requires fruitful application of knowledge generated by universities. Effective interactions and knowledge channels between industrial firms and universities are key to acquire and absorb technologies as process innovation. Moreover, the degree of collaboration between the industrial firms and government is very weak with regard to product innovation. For example, only around 9% confirm that the government supports the production of new innovative products (product innovation), and importing foreign technologies is difficult and few improvements and advancement are realized. The survey showed that only 6% of the industrial firms confirm that the government facilitates the arrival of foreign experts who can help in absorbing and assimilating the process technologies along with local experts from universities and industries. The innovation infrastructure is negligible in the absence of national research institutes, science and technology parks, ICT infrastructure, and incubators.

Despite the cooperation between NGOs and the industrial sector in terms of providing infrastructure, foreign experts and providing funds, there has been no significant impact of such efforts, with a lack of tangible achievement. However, results showed that the newly established Higher Council for Innovation & Excellence (HCIE) is perceived as a promising body to regulate the relationship between universities, the private sector and the government.

Regarding the demand side of innovation, industrial firms face many obstacles to innovate due to the unfriendly business environment in Palestine, in addition to the manmade obstacles caused by the Israeli occupation, in addition to the lack of a national science and technology laws and regulations that promote innovation. This was confirmed by the positive response of the innovative firms regarding the importance of the need to establish an organizational body that coordinate the relationships between the triple helix actors to facilitate the exchange of knowledge and competencies among the triple helix actors. It also coordinates the relationship between local and international sources of knowledge and global innovation networks, which will be translated into innovation output by the industrial firms.

An important insight also highlighted the issue of not seeing universities as knowledge providers in university-industry linkages. There is a lack of trust and confidence of the university ability to support industrial firms in their innovation endeavors. Considering the target market relationship with innovation activities of the firms, the results showed that the higher the local demand (the same city or area) for the firm's products, the lower the firm's tendency to implement product or process innovation, while the higher the national demand (throughout the West Bank) for the firm's products, the higher the firm's tendency to implement product and process innovation. This denotes that firms will not innovate if their products are mainly for local markets. However, many of the firms expressed their views of innovation as an important factor when it comes to export only.

5.2 The impact of industrial collaboration as per THM on non-technological innovation

Using the same model and assumptions, but for organizational and marketing innovation, the results also showed that industrial collaboration as per the THM is very weak and its impact on the ability of the industrial firms to introduce new organizational innovation or marketing innovation was not significant, and in the case of the marketing innovation, it was surprisingly negative relationship. As shown in Table 4, industrial firms' collaborative relationships with the government negatively affect their ability to introduce marketing innovation.

Table 4: Robust least squares regression of the relationship between collaboration and marketing innovation

Dependent Variable: MRKINNO				
Variable	Model 1		Model 2	
	Coefficient	Prob.	Coefficient	Prob.
C	3.995***	0.000	3.716***	0.000
UNIVCOLL	-0.375**	0.038	-0.174	0181
GOVCOLL	-0.321**	0.018	-0.252**	0.027
UNIVCOLL*GOVCOLL	0.374	0.173		
NGOCOLL	0.374	0.116		
ORGBODAY	-0.012	0.809		
DEGRRCOL	-0.104	0.281		
INTOBS	-0.201**	0.015	-0.233***	0.002
EXTOBS	0.008	0.897		
INNOENVI	-0.019	0.725		
Localmkt	-0.519***	0.000	-0.510***	0.000
Nationalmkt	0.287***	0.008	0.267***	0.007
Israelimkt	0.001	0.987		
Intnatiomkt	0.201	0.175		
R-squared	0.099		0.079	
Rw-squared	0.184		0.163	
Akaike info criterion	437.042		450.257	
Deviance	198.641		199.809	
Rn-squared statistic	52.848		46.815	
Adjusted R-squared	0.063		0.065	
Adjust Rw-squared	0.184		0.163	
Schwarz criterion	490.523		472.493	
Scale	0.696		0.675	
Prob(Rn-squared stat.)	0.000		0.000	

The above results regarding the non-technological innovation are more difficult to explain, and could also indicate the severity of the problem, since in this type of innovation the intensity of required knowledge and technology is less complex than in technological innovation. Nevertheless, the collaborative relationship was also weak and had no significant impact on the firms' abilities in organizational or marketing innovation. The

same argument can also be made with regard to poor technological innovation, which is attributable to the traditional nature of the education system in Palestine and its inability to produce the knowledge and skills required by industrial firms. This is relevant to organizational and marketing innovation. Moreover, the role of the government in providing positive value to the relationship and to the industrial firms in particular is limited. For instance, only 3.5% of industrial firms confirmed that the government is contributing to capacity-building programs to train and develop their staff.

Regarding NGOs and their effort to support the industry in Palestine, it was well appreciated as a source of funding for capacity-building programs. More than 50% of the industrial firms confirmed that NGOs provide financial assistance for capacity building projects. One of the most important factors which positively affect the behavior of industrial firms towards organizational innovation is providing a conducive environment that encourages innovation inside industrial firms. The results showed that the internal and external innovation obstacles positively affect the behavior of industrial firms towards organizational innovation. Even well-established and respected firms did not demonstrate an innovation-friendly work environment, and employee turnover in these firms was very high.

In an unexpected result, the industrial firms' collaborative relationships with the government negatively affected their ability to introduce marketing innovation. This might show a misallocation of the resources that the governmental sector mobilizes to help industrial firms to create marketing innovations. It can also be explained by the current low maturity of the industry in Palestine regarding marketing innovation, whereby product functionality is the main determinant of consumer choice due to the low disposal income of most households in Palestine, with little appreciation of product design and quality packaging, in addition to the emphasis on traditional product promotion methods.

Moreover, the results show that the degree of cooperation between the industrial firms and the government is very weak in regard to marketing innovation. Only 9% of industrial firms confirmed that the government facilitates the export of new products, and just 4.5% confirmed that the government opened new markets for Palestinian products through

agreements with other countries. Moreover, the degree of cooperation between industrial firms and NGOs was very weak with regard to marketing innovation.

These results were similar to other types of innovation regarding to the fact that the Palestinian industrial firms think that there is no need for new marketing innovation for local markets, and they view such activities to be the sole preserve of exports.

6 Conclusion

The THM puts high emphasis on the role of universities. In the case of the Palestine, universities are still playing a traditional role in terms of providing education and basic scientific research. This is generally the case of many universities in the developing world, although knowledge and technology transfer to industry and additional functions of universities regarding commercialization of knowledge are key enablers of national innovation systems in developed countries. This is due to the importance of these functions for high-technology and knowledge-based sectors in the innovation process.

The current industrial collaboration as per the THM analysis showed a weak relationship and its impact on the ability of the industrial firms to innovate was not significant in all of the four types of innovations. The results of this study showed that there is a disconnect between the demand side, namely among industrial firms, and the supply side, represented in our study by the universities. The government role was not appreciated and did not show any significant effort towards improving the national innovation system in Palestine. Therefore, the government has a challenging responsibility to play an effective facilitation role in bridging the gap between industry and universities and structurally improve the education system. This includes developing an innovation policy framework to address the above challenges. Moreover, further investment in the scientific and technological infrastructure is necessary, in terms of both hard and soft aspects.

This study was a high-level analysis of industrial firms' perspectives, and further in-depth analysis from the perspectives of other national innovation actors will be conducted in future studies.

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