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The State of the National Innovation System of Jordan: Key Actors Perspective

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Abstract

Innovation results from various interactions between a set of economic agents and enterprises, it forms a series of processes and links between industrial institutions, public agents, the university community, and research institutions to develop scientific research activities and technological development. On this basis, the study aimed to provide a better understanding of the status of the Jordanian system of innovation from key actors' perspectives in the Jordanian system of innovation. Fifteen in-depth interviews were conducted with representatives from various subsystems of the Jordanian system of innovation. The results showed a system's strengths and weaknesses, and Public-private interactions and networks in the system. Furthermore, it showed the main issues that must address and the most important financial and non-financial policy required instruments to stimulate innovation for Jordanian businesses.

Keywords: National Innovation System (NIS), sustainable development, science, technology, and innovation (STI), research and development (R&D), Jordan.

حالة نظام الابتكار الوطني في الأردن: وجهة نظر الجهات الفاعلة الرئيسة

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ملخّص

ينتج الابتكار من التفاعلات المختلفة لمجموعة من الوكلاء الاقتصاديين والمؤسسات، ويشكل سلسلة من العمليات والروابط بين المؤسسات الصناعية والوكلاء العامين ومجتمع الجامعة ومؤسسات البحث من أجل تطوير أنشطة البحث العلمي والتطوير التكنولوجي. وعلى هذا الأساس، هدفت الدراسة إلى توفير فهم أفضل لوضع نظام الابتكار الأردني من منظور الفاعلين الرئيسيين في نظام الابتكار الأردني. تم إجراء خمسة عشر مقابلة معمقة مع ممثلين من مختلف النظم الفرعية لنظام الابتكار الأردني. أظهرت النتائج نقاط القوة والضعف في النظام والتفاعلات والشبكات بين القطاعين العام والخاص في النظام. علاوة على ذلك، فقد أظهرت القضايا الرئيسة التي يجب معالجتها وأهم السياسات المالية وغير المالية المطلوبة الأدوات لتحفيز الابتكار للشركات الأردنية.

الكلمات الدالة: نظام الابتكار الوطني، التنمية المستدامة، العلوم والتكنولوجيا والابتكار، البحث والتطوير، الأردن.

Introduction

Science, Technology, and innovation (STI) can play a critical role in each of the 17 Sustainable Development Goals (SDGs), with their 169 targets. This has been clearly emphasized in the reports published by the U.N. Scientific Advisory Board (UNESCO, 2016).

These reports contained many policy briefs on science for sustainable development and indigenous and local knowledge and science for sustainable development. SAB finds a need for greater integration of science into international decision-making. It also proposes to establish international targets for national R&D funding, which the board argues will contribute to achieving sustainable development goals. This, in reality, is necessary in the Arab states more than in any state of the world. Compared to countries of the world, the contribution of Arab states to STI according to indicators is weak; a matter that has been emphasized in all of the UNESCO science reports particularly in its recent 2016 science report entitled (UNESCO Science Report, towards 2030).

There is a change in global trends and vision among international and regional organizations, non-governmental organizations, and economic groups; where it became interesting to employ science, technology and innovation in the economy of countries, projects and development plans. The main aim for countries all around the world now is to make a transition from a resource-based economy to a knowledge-based economy. Through evidences, it turns out that those countries that can steer science, technology and innovation processes toward knowledge-based economies enjoy more economic growth than those who do not (Hornidge 2011; Barkhordari et al. 2019). The end goal of this economic transition is to increase the added value of raw resources, goods and export diversification through centering on engineering and innovative industries.

If the countries want to achieve the desired economical development and technological renaissance, they must depend on their own human and natural resources and should be able to absorb and import technologies and innovations from other countries. The rapid technological change and Keeping up with the developments in science and technologies are affecting almost every area of the economy, society and culture (UNCTAD, 2018), and they reduce the burden on states, governments, and people by reducing the export of the source of wealthy raw materials, which is normally sold at low prices and it returns back in the form of innovated goods and equipment at higher prices (ESCWA, 2016).

Each country has a system of science and technology that reflects the importance that this country attaches to science and technology, and reflects the role that innovation plays in the development process in that country. The science and technology system includes elements that collectively constitute an integrated system called the National Innovation System, a new approach to innovation that relies on systems as an introduction to the practice of innovation.

Jordan is one of the smallest and poorest economies in the Middle East, with 15.7 percent of Jordanians living below the poverty line (WFP, 2019). The country suffers from structural unemployment, as the economy fails to absorb the labour force and the annual inflow of new job seekers. Additionally, there is a large economically inactive population. The labor force participation in Jordan is one of the lowest in the world, with 40.1% (ILO, 2017). Creating jobs in adequate quantity and quality under the current population growth rate and the economic status-quo remains a daunting challenge. Unemployment has risen sharply in the last decade to stand at 18.7% in the fourth quarter of 2018. It is 16.6 % for men and 26.7% for women and reaches 30 percent among young people aged 18–24 (WFP, 2019).

According to WIPO in the last five Global Innovation Index (GII) reports Jordan has been considered in the ranking and its ranking drop 7 points for the year 2019 to become 86th out of 129. Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found. Below gives the major ranking for Jordan in the three indices which the Global Innovation Index includes.

Despite the breadth of studies exploring the different dimensions of the knowledge economy and innovation -as one of the pillars of the knowledge economy- in Jordan, so far, very little attention has been paid to the national innovation system. Thus, this study seeks to provide an insight of the Jordanian system of innovation from the point of view key actors in the Jordanian system of innovation in terms of strengths and weaknesses, roles and interactions in its subsystems, main issues that public policy must address, and investment tools in Research and development (R&D) and Science, technology and

innovation (STI) projects for Jordanian businesses.

Table 1: Jordan Ranking According To GII

	2015 (out of 141)		**2016 (out of 128)**		**2017 (out of 127)**		**2018 (out of 126)**		**2019 (out of 129)**	
	Score 0–100 or value)	Rank	Score 0–100 or value	Rank	Score 0–100 or value	Rank	Score 0–100 or value	Rank	Score 0–100 or value	Rank
Global Innovation Index	33.78	75	30.04	82	30.52	83	30.77	79	29.61	86
Innovation Output Sub-Index	28.26	67	24.06	77	23.96	74	24.19	67	22.12	71
Innovation Input Sub-Index	39.29	80	36.01	88	37.07	92	37.36	88	37.10	91

Note. Adapted from (global innovation index reports, 2015, 2016, 2017, 2018, and 2019).

Literature Review

Historical development of the concept of the national innovation system

The first written contribution that used the concept of the national innovation system is paper by Christopher Freeman (1982) when he was a member of the group of experts on science, technology, and competitiveness of the organization for economic cooperation and development (OECD), the paper was entitled "Technological Infrastructure and International Competitiveness", indicates through it to some ideas and opinions of Friedrich List's, which he explained in his book "The National System of Political Economy" (1841) and summarizing his view in focusing on the importance of the effective role of the government in upgrading technological infrastructure, he also discussed the critical conditions that allow free trade to contribute to economic development (Freeman,1982; 1995).

Freeman started from his analysis of the Japanese success in the field of production, research and development, as he summarized in his book “Technology Policy and Economic Performance: Lessons from Japan” the most important secrets of that success (Freeman, 1987), and he introduced within this work that the phrase "National System of Innovation" (Golden et al, 2003). Lundvall (1992) gave more detail in his book "National Systems of Innovation". His perspective was based on two assumptions, that the knowledge is most fundamental resource in the modern economy, and, accordingly, that the learning is most important process and that learning "is a social process which can't be understood without taking into consideration its institutional and social context" (Lundvall, 1992). While Nelson (1993) explained that national innovation systems result from national policies, formal and informal governmental coordination, research and development financing, and other policies that will ensure homogeneity and links between national agents for innovation (Nelson,1993).

The levels of analysis of national innovation systems have consequently evolved. According to OECD (1999), NIS analysis embraces three complementary approaches (OECD, 1999):

The micro level analyses on the internal capabilities of the firm and the links surrounding one or a few firms and focuses to examine their knowledge relationships with other firms and with non-market institutions in the innovation system, to identify weak links in the value chain.

The meso level examines knowledge links among interacting firms with common characteristics, by using three main clustering approaches; The first, sectoral (or industrial) clusters that include suppliers, markets, transportation, research and training institutes, specialized government agencies and finance or insurance that are organized around a common knowledge base. The second, spatial (or regional) clusters emphasize local factors behind highly competitive geographic agglomerations of knowledge-intensive activities. The third, functional cluster analysis utilizes statistical techniques to identify groups of

firms that are similar in certain characteristics.

Finally, the macro level, which uses two approaches; the first, macro-clustering that sees the economy as a network of interlinked sectoral clusters. The second, functional analysis of knowledge flows that are sees the economy as networks of institutions and maps knowledge interactions among and between them. This involves the measurement of several types of knowledge flows: interactions among enterprises, interactions among enterprises; universities and public research institutes, technology diffusion, and personnel mobility.

The national innovation system has also witnessed a rapid spread, especially in government bodies in an attempt to understand the differences between economies concerning innovation processes and to find ways to support technological change. For example, freeman (1987) his study of the Japanese case, focused on the role of several bodies, including universities and industry, in importing technology. As for Lundvall (1992) in his study of the situation of Scandinavia, he focused on the nature of the interactive relationship between those involved in the innovation process. Finally, Nelson (1993) was focused on the technological and organizational side of the process of innovation in developed countries. These works have entrenched the new concept "national innovation system" in the industrialized countries in the northern hemisphere, and then the concept began to be transmitted to the developing world through United Nations organizations. (Intarakumnerd et al, 2002).

The concept of the national innovation system

A national innovation system is the network of institutions in the among public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies. Including enterprises and firms, their clients and suppliers, government bureaus, banks, universities and centers of productivity, and research institutes (Freeman, 1987; Lundvall, 1992; Nelson, 1993; OECD, 1997).

The concept of the system implies that there is interaction among all the different actors and stakeholders who contribute to innovation and that the system includes an environment in which innovation is made. These actors and stakeholders may do not necessarily consciously interact with each other. Actors may have different goals. For example, the entrepreneurs or inventors main aim will probably be profit, while the aim of the academic institutions may be research and training to promote innovation. While the aim of the government may be the creation of a macroeconomic environment within which innovation can take place. But even if the goals differ, each of the Actors has an impact on one another (Eggink, 2012).

A national innovation system is largely influenced by 30 determinants grouped into three levels depicted in Figure 1, and each of these determinants reflects an aspect of the innovation system, the role of micro level is providing support for main actors in the innovation system like R&D institutions, universities, organizations, and enterprises. Meso level can be considered as an important intermediary tool to convert policy decisions in practice such as clusters, technology transfer centers, and funding agencies. While the macro level is related to national policies like laws, regulations and master plans (Hamidi& Berrado, 2017).

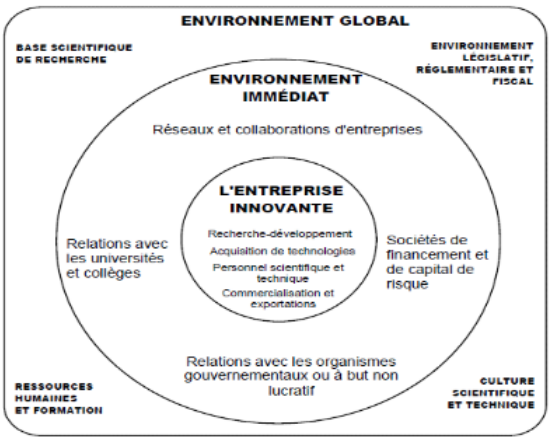

Figure 1: National Innovation System

Source (OCDE, 1997)

National innovation system in developing countries

While the study on the national innovation system concept as a whole is still at the early stage, the study on the national innovation system in developing countries is at an even more primitive stage (Intarakumnerd et al, 2002). In their analyzes of in newly industrializing economies in Asia, such as Korea, Taiwan, and Singapore Some researcher focused on how institutions and systems were built and shaped to produce "intensive learning" which help it in technological catching-up processes (Kim, 1993; Hou and Gee, 1993; Wong, 1996; Wong, 1999). The reason behind the successes of these countries is the embedded autonomy of their governments, where these governments can formulate and implement Successful economic policies, in addition, it owning sufficient and positive linkages with other actors, especially the private sector (Chang, 1997).

Dahlman and Nelson (1995) study, was one of the few studies focusing on countries, which are less technologically successful in catching-up. The study aimed to analyze the relationships among social absorptive capability, national innovation system and economic performance by measuring and comparing 14 developing countries' technological capability through use empirical data, such as R&D expenditure, S&T workforce, and educational figures. It concluded that the development of human resources is the most critical element of any successful development strategy. Besides social absorptive capability, it shows the effect of macro and incentive environments, including the importance of a strong outward orientation of the private sector on the national innovation system in the latecomer economies.

The study of Gu (1999) provides a comprehensive understanding and insights into the national innovation system in developing countries. This study elaborates that the national innovation system in developing countries has the distinctive characteristics, the most important of them is that the national innovation system is less developed by order; historically, the institutional and technological properties necessary for modern growth were not developed within their systems. Also, the market mechanisms are still under-developed, the role of the market in promoting learning needs to activate. Finally, the capital accumulation, rather than intangible assets is the main contribution to technical progress.

Also, the weakness of the national innovation system in developing countries has been linked to several reasons, such as the fact that the micro innovative strengths that exist in these countries isolated and encapsulated and many of institutions relevant to the innovativeness do not exist. Also, industrial innovation in developing countries is highly informal, and the effective utilization of foreign technology remains more important than doing a lot of R&D in these countries. Besides, dominant cultural patterns of these countries undervalue scientific knowledge and technological innovation (Arocena & Sutz, 1999).

With regard to studies of innovation systems in the Arab region, the Noor (2013) study revealed that innovation systems exist, but they are characterized by serious weaknesses in the Arab region compared to other regions of the world, and that the structure of the economy has a significant impact on the performance of innovation systems in the Arab region, and that poor Arab systems of innovation have serious repercussions in the Arab region. These main repercussions are represented in the weak performance of the Arab region in terms of scientific and technological indicators, competitiveness indicators, technological achievement index, and weak integration in the knowledge economy index. The study showed that in order to improve innovation systems, it is necessary for the Arab region to strengthen higher education, S&T, R&D and ICT to build Arab innovation systems and achieve economic development in the Arab region.

A study conducted by Hamidi& Benabdeljalil (2013) revealed in a description and analysis of the Moroccan national innovation system that the benefits of this system are still very limited compared to the efforts and results expected. According to them, the low efficiency of Moroccan innovation system at the national level is not linked to financial resources or the skills of the actors but to weak interactions and coordination failures between actors. This failure of interaction and coordination can be explained by several types of causes: the culture of education, governance networks and interactions, and administrative procedures.

The study of Chaabouni (2008) provides a understanding into the national innovation system in Tunisia. This study Emphasize Tunisia's interest in developing specific policies for science and technology. And its efforts in created

governmental structures to encourage and support scientific and technological research and development. And launch specific programs to harness science with economic purposes. But despite the achievements made so far, the science system and the system of enterprise development are evolving more or less independently. And thinking about the link between research and innovation is implicitly dominated by the "linear" model of technology transfer.

Methodology

Sampling Strategy

Creswell (2005) indicated that in qualitative research, "the intent is not to generalize to a population, but to develop an in-depth exploration of a central phenomenon", which is best achieved by using purposeful sampling strategies. A random sampling strategy would be inappropriate for the exploration of the phenomenon of this study because the purpose here is not to generate a representative sample and then generalize the results to other contexts, but rather to learn from people who have rich information and can best help to understand the specific interest of this research, the Jordan innovation system status. Therefore, a qualitative approach was used to better understand the Jordan innovation system status based on the perspectives of particular stakeholders. The present study focused on the following questions: What are the system's strengths and weaknesses? What are Public-private interactions and networks in the Jordan innovation system? What are the main issues that public policy must to address? And what are the most important of financial and non-financial policy required instruments to stimulate innovation for Jordanian businesses?

For the representatives interviews, a snowball sampling strategy has been selected. The snowball strategy is one of the forms of purposeful sampling in qualitative research that "typically proceeds after a study begins and occurs when the researcher asks participants to recommend other individuals to study" (Creswell 2005).

Data Collection and Sample Size

There are several methods of collecting data in qualitative research and In-depth interviews are among the best suited and most commonly used instruments (Nohl, 2009). Kumar (2005) indicated that interviewing can be very flexible, when the interviewer has the freedom to formulate questions as they come to mind around the issue being investigated; on the other hand, it can be inflexible, when the interviewer has to keep strictly to the questions decided beforehand.

The literature review, especially works issued by the Royal Scientific Society in Jordan, enabled to identify the agencies, institutions and all stakeholders in the system, from which the study selected this part of a sample of interviewees, using a snowball sampling technique. A total of 15 in-depth interviews were conducted with the representatives from various subsystems, eleven men and four women, who hold top positions in their job.

At the beginning of the interview, the participant was asked for their definition of the concept of national innovation system. To ensure that, all representatives were responding to the same definition of this phenomenon, the researcher next provided the study's definition of this term as "The network of institutions in the among public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies." The representatives, then, were asked to answer the remaining questions in light of this definition.

Data Analysis

All interviews were digitally recorded (after respondents consent) and transcribed. Notes were also taken during each interview to facilitate the identification of key points and ideas made by respondents. The analysis of the data was mainly based on both the transcriptions (for digitally recorded) and annotations (during the interview).

The transcripts were subsequently read to develop a broad understanding of the subject. Content analysis techniques were then used to analyze the interviews (Denscomde, 2007). First, the data obtained through the interviews was collated in tables divided into axes that reflect the same general themes and questions as the interview structure. Then, the data was further analyzed to determine recurring subthemes and ideas which were repeated by interviewees. After multiple readings of the transcripts, the subthemes were revised and made some amendments to it. New observations, emerging themes, and

issues were also identified and included as they were discovered.

Results

Theme 1: The Jordanian system of innovation: strengths and weaknesses

The first theme captured was the strengths and weaknesses in the Jordanian system of innovation, with representatives of this system indicating the points seen in Table 2.

1.1. Perceived strengths

The interviewees mentioned the core strength sources of the Jordanian system of innovation, which was represented by several positive developments in the area of education and human resource development. These developments appear according to interviewees in the rise in rates of literacy, rise in the ratio of the population with complete primary education, increase of contribution of the private sector in all levels of schooling (primary, upper primary and secondary), and efforts some private institutions to improve the quality and relevance of education in government schools (for example, Queen Rania Foundation for Education and Development). These developments were reflected in the growth in the number of publications, numbers of PhD. holders, numbers of science and engineering graduates. According to one of the respondents, "Jordan has human capital that is able to construct well-developed economy".

The second source of strength, according to the interviewees, is the existence of a modern orientation from the state through several entities and institutions to support science, technology and innovation, which was evolved positively by drawing strategies such as the National Innovation Strategy and establishing some institutions such as the Jordan Enterprise Development Corporation (JEDCO), the Crown Prince Foundation, and funds for scientific research and innovation such as The Innovative Startups and SMEs Fund (ISSF), Scientific Research Support Fund (SRSF) and other funds and incubators. A representative of the public sector confirms that the establishment of an innovation fund with a budget close to $ 100 million under the difficult circumstances that Jordan is going through demonstrates prove Jordan's efforts to mobilize resources for science, technology and innovation activities. He also believes that the innovation environment in Jordan is relatively good, and one of the most important elements of its strength is the institutional structure and programs supporting innovation, science, and technology. A representative of the Ministry of Industry, Trade and Supply says "The economic conditions that Jordan is going through set it facing two options: either to save itself or retreat more ..., This requires continuing to improve public policies and improve the business and programs of institutions and funds linked to innovative activities and creativity". This opinion was shared by another representative of the research institutions saying "This national orientation to support innovation is important and necessary procedure to exit the bottleneck..."

A third theme that was identified as a strength resource of the Jordanian system of innovation is the existence of an advanced intellectual property environment. Some of those interviewed confirmed that Jordan has made great progress in the field of intellectual property protection, whether copyrights and industrial property. More specifically, Jordan being the first Middle Eastern nation to implement 'trade-related aspects of intellectual property (IP) rights' (TRIPS) when it joined the WTO in 2000. Furthermore, Jordan has been a member of the World Intellectual Property Organization since 1971. Joining in these agreements according to interviewees ensures the country's intellectual property law meets the requirements of international standards.

The last point mentioned by interviewees is the natural advantages, which can be considered one of a positive feature of the system, includes Jordan's strategic location in the heart of the Arab Mashreq region (a center for regional and global trade); topographic and biological diversity; and abundance of natural resources, including those suitable for the production of renewable energy (wind, sunlight). The interviewees consider these advantages could be used as levers for innovation.

1.2. Perceived weaknesses

Lack of an umbrella with a long-term strategy for innovation was the most frequent point among representatives, with the participants stating that the absence of an "umbrella" for innovation, science and technology-based activities within the government is a major problem in the innovation management process in Jordan. Moreover, in the absence of a government umbrella with long-term plans, there is often a break in programs and projects which this is detrimental to the innovation process.

This point is linked to an issue raised by some of the interviewees, related to innovation governance; they see that the

recently formulated national innovation strategy is a science and technology strategy; so that the investments are directed to S&T actors, and almost none of the national funding goes to the private sector, or capital investment funds. For example, one representative of the private sector said: "assigning the responsibility for implementing the innovation strategy to the Higher Council of Science and Technology is evidence that Jordan's approach to stimulating innovation is based primarily on scientific and technological inputs."

Interviewees also displayed another topic could come as a result of the previous point that has been identified, which is the multiplicity of innovation plans and programs between the various institutions involved in the Jordan innovation system (including overlapping functions in different ministries, unclear competencies of agencies, and weak cooperation and synergy). This situation "scattered efforts" according to a representative of research institutions leads to ineffective use of available resources. Participants emphasized that the source of overlap is due to the fact that coordination issues between the various agencies were not seriously considered. Most of the agencies used to exercise their efforts and activities in the innovation process independently, without interacting with other bodies. Also, some interviewees indicated that the process of drawing up general plans and executive programs depends on budgets "fluctuations and impacts of budgets". For example, one interviewee from GEDCO said: "What is the benefit of the innovation support program with a budget that did not exceed 10,000 this year?!"

The third source according to the interviewees is the weakness of university-industry relationship. Or as one of the incubators representatives expressed, "Isolated universities on social and economic requirements". There is a perception that academic and scientific institutions are self-oriented, this related of the partly to an academic evaluation process that is biased towards strictly academic indicators such as publications or the number of researchers in the scientific institutions.

In the perception of interviewees, the gap between university-industry is not the sole responsibility of the former, they confirmed on the weakness of the confidence of industrial institutions in the academic sector, according to representatives of one of the funds affiliated to the research sector "Companies interested in research activities communicate with outside consultants ...., university researchers have little practical experience, and what they possesses is theoretical knowledge ". Interviewees also argued that the strategy of Jordanian firms is also one of the causes of the gap, which are based on a short-term strategy. According to the respondents, the prevalence of a short-term strategy agenda was due to several issues like the size and structure of domestic firms, lack of its exposure to world-class competitors, and its reliance on an imitative strategy. More specifically, regarding to the issue of the size and structure of domestic firms, it turns out that 92% of Jordanian firms are very small (less than 10 employees), 7.2% are small and medium companies (10-99 employees), and very few represent large companies 0.6%.

Bureaucracy was the fourth source of weakness in national innovation system of Jordan. "Red tapes", as one representative of private sector called them, make it difficult for small businesses to thrive and are detrimental to entrepreneurship; where the Individuals and companies find their self implicated in complicated systems and procedures which include filling out paperwork, obtaining licenses, and various low-level rules that make the process slower, more difficult. A representative of the public sector stated that "weakness implementation of E-government system impedes coordination and cooperation between institutions concerned with innovation and creative activities". Actually, the representatives arguments are consistent with what has been stated in several studies, where the literature on red tape points out its negative effects on several organizational variables. For instance, reduction in benefits provided to clients (Scott & Pandey, 2000), creation a more risk-averse organizational culture (Feeney & DeHart-Davis2009), and reduced innovative and productive potential of organizations (DeHart-Davis & Pandey, 2005). Even individual variables. For instance, higher perceived red tape is related to increased intention to leave and decreased organizational commitment (DeHart-Davis & Pandey2005) and lower Public Service Motivation (Scott & Pandey, 2005).

According to the interviews, a weak entrepreneurial spirit and fear of risk were the fifth source of weakness in Jordan's (NSI). Some interviewees indicated that even though Jordan is a young country, individuals don't tend to take risks. For example, a representative of (GEDCO) evoked the results of a study prepared by the foundation about entrepreneurship in Jordan, showing that the prevalence of entrepreneurial activity in the early stages of the adult population in Jordan has

reached 8.2% for the year 2016. The interviewees said the reason for this is due to a factor related to education which is heavily focused on delivering theoretical knowledge not promote innovations. Another factor related to social and cultural barriers. for example, work failure and financial loss lead to "loss of face, not only for the individual but for the whole family" according to a private sector representative. Also, there a strong preference for working in the public sector by individuals and families to raise the social situation and achieve financial security.

The last source of weakness in Jordan's (NSI) is the weak efficiency of the Jordanian market size index, due to the small market in terms of size and purchasing power. Those who raised this point emphasized the disappearance of the middle-class, which embodies "purchasing power" and the demand for the majority of goods and services for consumers, in exchange for the expansion of the poor class with weak purchasing power.

Table 2: Strengths and weaknesses of the Jordanian system of innovation

perceived strengths	Frequency	%	perceived weaknesses	Frequency	%
developments in education and human resource development	15	100	Lack of an umbrella with a long-term strategy for innovation	15	100
orientation the state to support science, technology and innovation	11	73	multiplicity of innovation plans and programs between the various institutions	12	80
advanced Intellectual Property Environment	7	47	weakness of university-industry relationship	11	73
Natural advantages	4	27	Bureaucracy	10	67
			Weak entrepreneurial spirit And fear of risk	9	60
			the weak efficiency of the Jordanian market size index	5	33

Source: results of the interviews

Theme 2: Roles and interactions in the Jordanian system of innovation

The second theme emerged from two related questions: "What are your perceptions of the roles of agents and public and private institutions in the Jordanian system of innovation?" and "how the relationship between these agents/institutions could be characterized?" The most important point according to interviewees relates to the role of the state in activating the private sector and investors and directing investment in research and development and innovation activities by using its public policy instruments in a more strategically and effectively way.

Some of the interviewees confirm that the success of the innovation system requires a real and continuous partnership between the public and private sectors, not only the division of business and roles between the public and private sectors. The private sector representative used the term "chain links" to describe the relationship among components in the system and confirmed that missing one link will disorder of the whole system.

Concerning how to characterize the quality of interactions between public and private agents, all interviewees agree that it is difficult to characterization of the interactions as being "symbiotic". Instead of that, it was described as "antagonistic", according to one of the academic sector representatives. A representative of the private sector explained this situation by saying: "There is a rivalry between the two sectors expressed by the transactions, and the decisions that are taken to increase the state's financial returns from taxes, fees and other measures that the private sector sees it hostile measures, not calculated results, and do not achieve only a further decline backward".

Some participants citation several experiences of interacting private institutions with public or semi-public institutions, and with universities which they considered to have been positive like (faculty for factor program), (industrial scientific research and development fund), (engineering partnership council with industry). Those emphasized the desire of the public

sector to stimulate the private sector, but the problem is existences a bureaucracy that leads to slowness in decision-making. Despite previous examples of positive interaction with universities, there is, as already stated, a perception that academia is very much self-oriented, which impairs the quality and effectiveness of interactions.

In the same context that the representatives discussed, an example can be provided by Sultan and Soete (2012) who explained that clusters and networks are important effective instruments for the promotion of innovation, development of economy and business as well as location marketing. They also considered that clusters around ICT and pharmaceutical industries are exist in Jordan, but could generate increased leverage when these clusters are sufficiently supported by public authorities.

Theme 3: The main issues that public policy must to address.

The third theme focused on the main issues for public policy to address to make the Jordanian system of innovation more effective, with the interviewees summarizing appropriate solutions for improvement from their perspectives seen in Table 3, which some were related to the problems facing their institutions.

Reforming the education system, promoting technical training and an entrepreneurial spirit was the most frequent suggestion among the representatives whose discussed the necessity implement reforms in teaching methods in order to transform students into creative thinkers, also introduce the programs and competitions to encourage young entrepreneurs and provide them basic business skills and access to mentors. A representative from the ministry of higher education and scientific research called to "provide advice to the school leaver that includes not only information on higher education options, but also information on vocational training and apprenticeships..., and at the university level, give the graduates career advice that encourages career choices beyond public sector positions."

Based on the respondents, develop a supportive environment for innovation is the second issue to address. There is an opinion between some participants in the interviews that there is a need to further develop the legal environment and provide more institutional security. For example, cutting red tape, reduce bureaucracy and creating better regulation, for opening/closing business, importing equipment and inputs for research and development activities, patent registration; tax rates adjustment to be more logical for SMEs; facilitation of tax compliance rules.

A foster business-academia partnership is the third issue to address. Based on the respondents, the government bears the responsibility to foster these partnerships as a policy-maker and fund provider. Participants suggested several modes of collaboration; they considered that summer training of students in the industry is an effective mode to collaboration. Also, the exchange of university research and expertise was suggested as an effective way to solve industrial problems, for example, the election of industrial problems as research questions by the students. In addition, the participants recommended given support for infrastructure to academia like the donation of laboratory equipment.

Investing capital/resources in a more strategically was also suggested by respondents. The aim of this according to participants is to ensure that resources flow to all sectors concerned, and this is done by establishing a clearly defined, long-term innovation agenda guided by a vision and mission. A representative of the research institutions confirmed that "the government must define the purpose of innovation and the sectors in which research should be directed: is it in the pharmaceutical sector? Renewable energy?

Table 3: The main issues that public policy must to address

The main issues	Frequency	%
Reforming the education system, promoting technical training and an entrepreneurial spirit	13	87
develop a supportive environment for innovation	11	73
Foster business-academia partnerships	9	60
Investing capital/resources in a more strategically	7	47

Source: results of the interviews

Theme 4: financial and non-financial policy instruments to invest in R&D and STI projects for Jordanian businesses.

The forth theme focused on innovation support issue for the private sector in Jordan. As the needs of Jordanian SMEs, particularly in scaling up their research operations, cannot be met without the government expanding the scope of innovation policy, so the interviewees summarizing appropriate financial and non-financial policy instruments aimed at the private sector seen in Table 4.

Concerning financial instruments, subsidies and grants, equities, and subsidized loans was the most frequent suggestion among the representatives. There is a perception among participants in the interviews that each instrument could be more effective for a certain stage of the innovation process, and according to the type of project or sector. For example, subsidies and grants would be more effective for small companies and in the early stages of the process when the degree of uncertainty is higher. Equities (offered by venture capital firms) are also more appropriate for innovative startups and with risky high-tech venture, especially in the IT sector as suggested by one of the incubators representative. While subsidized loans are more suitable for medium and large or more mature companies. An academic sector representative suggests "A grace period for payment that is compatible with the company's cash flows may be given".

Also, there is an opinion that tax incentives are effective in the promotion of innovation projects. The creation of these incentives help to promote an innovation culture within companies; where these incentives aim to encourage research and development by allowing deduction of expenses in them from tax obligations. A representative from the private sector considers this tool more appropriate for large companies.

Interviewees also recommended improving public procurement in such a way that price is not the main criterion. Based on the respondents suggestion, this is done through force any service or product provider to use the existed local resources or at least giving preference to local products and services, thus increasing what participants have been described as "local content". Another suggestion involved setting specific high technology specifications, this suggestion can motivate local players to develop new technologies, as this is a prerequisite for obtaining profitable government contracts. And it helps companies hesitant to invest in research and development, especially small ones, to take the appropriate decision.

As for non-financial instruments, some participants focused on the importance of leveraging the potential of the ICT sector. One of the incubator managers suggested revitalization of electronic government and regulation of electronic commerce laws. Such suggest can help innovation either directly or indirectly, for example, E-Government can reducing customer hesitation and crowding out over institutions and windows, and thus reducing the time component and the possibility of providing services and information throughout the twenty-four hours. Furthermore, in the light of E-Government, the phenomenon of bureaucracy facing the business sector may vanish.

Some of those interviewees stressed the need to create "parks" for innovation. Especially those focusing on technological R&D. These parks can be located adjacent to academic institutes. Its goal is to be an excuse to attract a large number of tech businesses to locate together. According to the interviewees, there are some obvious benefits in these parks, as one of the main mechanisms for creating scientific and cognitive convergence, especially if they can share knowledge and skills, or create an ecosystem for partners or suppliers horizontal or vertical.

Theme 4: financial and non-financial policy instruments

financial instruments	Frequency	%	non-financial instruments	Frequency	%
subsidies and grants, equities, and subsidized loans	15	100	leveraging the potential of the ICT sector	9	60
tax incentives	11	73	"parks" for innovation	6	40
public procurement	8	53			

Source: results of the interviews

Discussion and Conclusion

The purpose of this study was to provide an overview of the Jordanian system of innovation from the point of view of key actors in the Jordanian system of innovation. Four themes were identified as a result of the qualitative analysis. The respondents summarized the main perceived strengths and weaknesses respectively as:

Perceived strengths: developments in education and human resource development, orientation the state to support science, technology and innovation, advanced Intellectual Property Environment, and Natural advantages.

perceived weaknesses: Lack of an umbrella with a long-term strategy for innovation, a multiplicity of innovation plans and programs between the various institutions, weakness of university-industry relationship, Bureaucracy, Weak entrepreneurial spirit And fear of risk, and the weak efficiency of the Jordanian market size index.

According to the representatives from the Jordan system of innovation, the interactions in the system can't be considered as being symbiotic; on the contrary, it was described antagonistic. The shared perception of the representatives was that the private sector needs to step up its innovative strategies to fulfill its own potential, and this is the responsibility of the state, which could provide help by strategically using its toolbox of public policy.

The data collected from the relevant stakeholders helped to obtain a deeper understanding of the national innovation system in Jordan. In particular, mapping the strengths and weaknesses of the system helped, to a large extent, to provide recommendations on the main issues that public policy must address. For example, the representatives suggested improving basic education and vocational training, to promote the mindset of innovation. Similarly, they proposed improving university education. also, they suggested develop a supportive environment for innovation through develop of the legal environment and provide more institutional security, implement this requires reduce bureaucracy.

Furthermore, reduce bureaucracy will encourage the individual innovators, investors and the businesses to integrate into the innovation system. Although this suggestion is related specifically to the innovation system, it would be beneficial to be extending and adapting them for other sectors and systems in the country.

In order to invest in R&D and innovation projects for Jordanian businesses, the representatives suggested some of financial instruments like subsidies and grants which would be more effective for small companies, equities for startups in the IT sector, subsidized loans for medium and large companies, a tax incentives to encourage companies R&D, and public procurement for innovated products. Furthermore, they proposed for non-financial instruments such as leveraging the potential of the ICT sector specifically, the electronic government, and create "parks" for innovation.

This research adds a novel contribution to knowledge economy literature by exploring the state of national innovation system in terms of its strengths and weaknesses, roles and interactions in its subsystems, issues that public policy must to address, and instruments to invest in R&D and innovation projects for Jordanian businesses from the relevant stakeholders point of view. In terms of directions for future research, further work could be conducted on improving the indicators used to map interactions in the system.

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