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Abstract Knowledge, research, and innovation are of crucial importance for the competitiveness of an economy and a recipe for economic development not only for developed and developing countries, but also for entities surviving a political abnormality, such as the Palestinian territories. As Palestinians are currently planning for their future viable state, the policy and decision makers should formulate relevant science, technology, and innovation policies that encourage the different national sectors to utilize the available innovation potentials and the experience and support of other countries, for developing a competitive economy. Conducting and analyzing a community innovation survey on two major Palestinian industrial sectors, namely quarrying and stone fabrication and the food and beverages sector, brought about very promising indicators and showed high innovative potentials in both sectors. Employment, export, and revenues are clearly improved in innovative enterprises. Lack of cooperation between the industrial sector and the higher education and research and development institutions is found to be a major problem that should be tackled in order to strengthen the enterprises' ability to innovate.

Keywords Community innovation survey · Palestinian industries · Palestinian economy · Quarrying and stone fabrication · Food and beverages

Introduction

Innovation is key to growth and competitiveness in modern economy and the benefit of innovation to both enterprises at the corporate level and the economy at the

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national level are irrefutable. From an enterprise perspective, innovation entails the introduction of new products, processes, and services which allows an enterprise to reduce its production costs, access new markets, or develop new ways of doing things. In developed countries and countries in transition, innovative enterprises usually augment the general competence base in their field and trigger learning processes [37]. In such countries, enterprises are established with many institutions that support innovation in addition to existing frameworks that protect the intellectual rights. Such supportive prerequisites ensure that the outcomes of innovation have a positive impact on the growth of the national economies, the long-term competitiveness in the global market, and the welfare of the societies. In stark contrast to this, enterprises in developing countries lack such supportive networks. Developing countries usually are deficient of the solid technological base that research and development requires; they face political instability and have a low per capita GDP, an underdeveloped infrastructure, minimal spending on R&D, and they lack harmonized policies. When, under such circumstances, enterprises try to make some profit despite serving customers with low incomes, the necessity to brave those obstacles has triggered a determination in many enterprises to innovate from other areas of their business structure, including manufacturing, logistics, marketing, and customer service. This is the case in many developing countries and entities, including the Palestinian territories, where Palestinians are currently in the process of building their future viable "state" while emancipating from a long military occupation.

Traditionally, innovation is measured on the basis of research and development (R&D) expenditure and patents. While R&D only measures the input side of the innovation process, patents cover innovations that are deemed to be patentable by the patent applicant and have never before been introduced to the market. An alternative instrument is the innovation survey, which provides quantitative and qualitative statistical data on innovation activities and the successful introduction of different types of innovations into the market. The first innovation surveys were conducted in the 1950s [6] and have been further developed since [29]. In 1992, the OECD and Euro Statistics formalized and standardized the instrument [23]. This led to the formulation of the Oslo Manual [24, 25], in which the conception of innovation is defined and which specifies particular input and output parameters to quantify innovation. Finally, based on the Oslo Manual, the Community Innovation Survey (CIS) was developed. By the means of this instrument, the innovation process can be described, its economic weight measured, its effects evaluated, and its mechanisms (cooperation, resources, obstacles, etc.) can be identified over a certain period of time. It produces comparable indicators based on a harmonized methodology, as a representative sample of the chosen sectors is asked to fill in the survey questionnaire. The indicators encompass different levels, from compound indicators for decision makers, to sets of indicators for general policy makers, to detailed indicators for specialists designing specific policy recommendations. Since the beginning of the 1990s, several modified CIS were conducted, starting with the CIS 1, conducted in 1993 for the period of 1990–1992, followed by CIS 2, CIS 3, and later CIS 2004 and 2006, the latter covering the period of 2004–2006. Finally, the most recent CIS 2008 was conducted for the period of 2006–2008.

Positioning Developing Countries in Terms of Research and Innovation

The relevance of science, technology, and innovation (STI) for economic development has been widely documented in the literature in the last decades. Departing from the linear model and technological change being considered as exogenous to the economic system, neoclassical and evolutionary approaches are now considering research, development, and innovation as the core elements of competition. Policy making is guided towards optimizing subsidies under monopoly and perfect competition, while technology policy issues can be summarized in terms of general options [18]: Evolutionary perspectives [21] are more recent and less articulated as a body of theory. Their cornerstone lies in the relationship between the economy, on the one hand, and the rate and direction of technological change, on the other. These theories reject optimality [16, 17] and are rooted in the behavioral theory of the firm [30]. The tacit nature of knowledge [31], diversity, learning capabilities, extending options, and selection mechanisms become the cornerstone of the theory. Competition is not viewed in terms of price only, but also in terms of cost and qualitative advantages that result from adaptation to technological change. *Systems of innovation* are the most recent of all approaches [9, 16, 22, 35]. The idea that lies behind this approach is that although the firm is the key element of the system of innovation, firms alone cannot promote new knowledge. There is a whole system of interconnected actors, such as firms, knowledge infrastructure, and interfaces, as well as institutions that are active in the process of knowledge creation and transfer. An efficient national system of innovation may lie behind the economic success of a nation, while less efficient systems explain limited innovative behaviors and economic backwardness. Efficiency here does not relate to any kind of optimality, but rather to the ability of the elements of the system to interconnect so that they become an engine of progress. Networking (formal and informal) constitutes the mechanism that allows systems to operate. Universities and educational establishments play a crucial role and learning is central on how innovation patterns emerge.

The thrust of the literature comes from advanced and middle-income countries; hence, methodologies, analyses, trends, and policies are adapted to their economic structures. Research increasingly reveals the role, dynamics, and policy role in developed innovation systems with relatively favorable enabling environments, highly skilled human resources, dense research infrastructure, sophisticated funding schemes, and well developed business models. Developing countries have different structural characteristics, determined by uncertain environments, immature market structures, and lack of resources. They traditionally rely on cheap labor, as their competitive advantage, with an inevitable negative long-term impact in their terms of trade and welfare. Cheap labor and lack of resources for policy intervention position them in a vicious circle of underdevelopment, which is difficult to break off. However, globalization intensifies market messages and competitive pressures mount. As a consequence, more and more business people in developing countries attempt to adapt to new challenges and public policies increasingly try to support national productive systems to upgrade and benefit from higher profit margins. International donors are strong supporters of this strategy. But there is limited theoretical and practical knowledge on their innovation policy dynamics.

The characteristics of developing countries restrict opportunities to break the vicious circle. Gross expenditure and business expenditure in R&D are close to inexistent with limited research resources concentrated in the university system. A first reaction, to be witnessed in the new models trying to emulate developed countries' characteristics, is to increase public research expenditure. There are, however, certain reservations about this prioritization of scarce resources, based on the absorptive capacity of the economy. The structure of the productive sector with small scale activities in traditional sectors does not create the conditions for synergies and agglomeration benefits. Although explanations about the intensity and direction of technological change among industries differ, measurements suggesting the few sectors dominating R&D activity are unanimous, and these sectors are not well represented in developing countries. The same argumentation can be used for size: The relation between innovativeness and firm size goes back at least to Schumpeter, who relates it to market concentration arguments. The dominant idea has been for a long period of time that innovative activity increases more than proportionately with firm size [32]. Later, more sophisticated analyses differentiated between the relevance of firm size and business unit size and between the relevance of size in different industries [7, 34]. But this again applies to small dynamic companies in research intensive sectors. Although literature in core countries has not resolved the debate about the importance of size for R&D productivity, it may be argued that reduced efficiency is likely to be endemic in developing countries.

The combination of sectoral specialization and size eliminates part of the debate on the importance of small dynamic companies and, finally, perfect markets are the exception rather than the rule, and regulatory frameworks have their own dynamics. The inherent uncertainty of entrepreneurship is amplified by low administrative skills and unstable regulatory frameworks and hence discourages long-term investments (typically RTDI investments) in the business sector. Hence, private and social returns on R&D investments, already difficult to capture and quantify in developed countries [12] can be assumed very low in developing ones. Given the limited knowledge of the exact correlation between technology and growth, an important question arises for developing countries regarding the resources dedicated to research and the mechanism, whether and how spillovers and externalities work. On the other hand, it is unlikely that such countries/regions will be able to invest in the really “strategic” sectors or exploit intellectual property rights that allow maximization of benefits improving existing capabilities with their scarce means. They rather focus on technology transfer, be it through learning by doing or through embodied knowledge.

This analysis suggests that productivity is very unlikely to increase through the adoption of the characteristic models applied in countries with mature innovation systems. In the press, a new set of evidence appears to emerge mainly from the rapidly growing cheap labor giants India and China. Multinationals with excellent technological resources that are based in these countries, as well as national big and small companies, use technology in a very different way: while keeping up the quality necessary for performance, they reduce all avoidable costs of additional (often unnecessary) functions and of design, thus placing technological innovation at the heart of cost cutting, albeit not in the process but in the products themselves. A variety of examples are reported. There is nothing new about companies adapting their products to the pockets and preferences of emerging market consumers. But in this

new model, companies are doing something more exciting than fiddling with existing products: they are taking the needs of underprivileged consumers as a starting point and are working backwards from there. Instead of adding ever more bells and whistles, they strip the products down to their bare essentials. There is more to this than simply cutting costs to the bone. Frugal products need to be robust and easy to use. The number of frugal products on the market is growing rapidly in India [8].

The present article examines precisely the position of a developing country with a rudimentary innovation system, unable to benefit from high tech specialization or scale. Ultimately, we try to shed some light on the innovation dynamics of developing countries, which are under great pressure to improve their positions within the highly competitive international division of labor.

This paper presents the findings of the CIS 2006 questionnaire, covering two samples of major Palestinian industrial sectors, namely quarrying and stone fabrication and the food and beverages sector. On a practical level, the CIS 2006 was translated into Arabic and implemented in cooperation with relevant regulatory bodies. Because of the geographic divide between the West Bank and the Gaza Strip, and due to the current political conditions in the Palestinian Authority (PA), the survey was conducted only in the West Bank area.

An overview of the existing literature on the drivers of innovation reveals the lack of knowledge about innovation dynamics in developing countries. Thus, in the following we will firstly look into some basic features of the Palestinian economy, in order to embed the two sectors studied through the survey. Against this background, we then present and analyze the survey data. We will conclude with some general observations and recommendations for further research.

The Status of Palestinian Economy

Since the creation of the state Israel in 1948, the Palestinian economy has been interconnected with the Israeli economy and has since experienced wild fluctuations. Israeli policy of tightening its control over the occupied Palestinian territories (oPt), including the land and available natural resources, is still a factor that derails any possible economical development. Israel has managed to even market its goods in the oPt, where more than three million Palestinians live. In addition, until the beginning of the 1990s, Israel absorbed more than 180,000 [13] Palestinian workers, mainly in the construction and industrial sectors. Following the signing of the Declaration of Principles (DoP) by the Palestinian Liberation Organization (PLO) and the Israeli government in 1993, both parties signed the Paris Protocol in April 1994. While explicitly recognizing the principle of "freedom of economic decision", including the right of the Palestinians to adopt economic policies, was deemed appropriate for the newly emerged PA, this protocol did not recognize the Palestinians' sovereignty over the oPt, thus prohibiting the Palestinians from formulating and implementing a viable policy for economic development [15]. The establishment of public institutions by the PA created initially more than 90,000 jobs, a number that has grown to more than 150,000 in 2010, which in turn exerted considerable burdens on the PA public expenses, exceeding 50% of the total expenses and over 70% of the national expenses [20]. The PA's main financial support comes from foreign financial assistance

institutions. Until in 2000, a total of US $2.5 billion were received, directed mainly at building up institutions, an infrastructure, and the shattered economy of the PA [40]. In 1999, the real per capita GDP reached about US $1,621, but by 2008 it had plunged to US $1,284, and in 2010 it dropped to less than 70% of the 1999 figure [39]. The PA, thus, not only relies on international aid, but to great extent still depends on the Israeli economy. Recently published Palestinian economic indicators [26] underline clearly that the Palestinian trade balance favors the Israeli economy (Table 1).

Statistics show that the GDP of 2009 recorded an increase of some 12% to US $4,634.4 billion, excluding the financial intermediation services (FISIM), as well as the net VAT on import and customs duties, which if added to the GDP of 2009, will come to US $5,147.2 billion. For the 2009 GDP figure, the contribution of the industrial sector amounts to around 13%, a figure that has not changed since 2003.

Palestinian Industrial Sector

The industrial sector of the PA includes more than 13,000 registered enterprises in the West Bank and the Gaza strip, the vast majority of which are considered micro, small, and medium enterprises (MSMEs) [27]. The PA has not established an official definition of the MSMs enterprises; however, some studies (i.e., [2, 14, 36]) that described the status of the Palestinian MSMEs enterprises suggested the definition of each enterprise based on three factors as elaborated in the Table 2.

Table 1 Development of the Palestinian economic indicators (2003–2007)

Indicators		2003	2007
GDP (million US$)	Total	4,165.3	4,135.8
	Contribution of industrial sectors (% of total GDP)	489.7 (12%)	527.3 (13%)
Number of industrial establishment		14,839	12,903
Export (million US$)	Total	280	339
	To Israel (% total export)	265 (91%)	298 (88%)
	To Arab countries	15	34
	To other countries	9	7
Import (million US$)	Total	1,800	2,835
	From Israel (% total import)	1,310 (73%)	2,397 (85%)
	From EU countries	155	275
	From Arab countries	46	66
	From Americas	43	21
	From other countries	246	76
Net trade balance (million US$)		−1,520	−2,496
Net trade balance with Israel (US$) and (% total net balance)		−1,058 (69%)	−2,058 (82%)

Table 2 Enterprise size definition (e.g., [14])

Enterprise size class	Employment (on full-time equivalent)	Annual turnover (in US$)	Registered capital (in US$)
Mico	1–4	Up to 20,000	Up to 5,000
Small	5–9	20,001–200,000	5,001–50,000
Medium	10–19	200,001–500,000	50,001–100,000
Large	20 or more	500,001 or more	100,001 or more

In this study and as far as CIS is applied, the definition used is based on the Frascati Manual [11] recommendation, which defines small enterprises having fewer than 50 employees, medium sized have from 50 to 249 and large having 250 or more employees. In the presented study, 99.12% of the enterprises fell in the small- (85.96%) and medium-sized (13.16%) category. The registration of an enterprise in the PA autonomous areas of the West Bank falls within the purview of the Ministry of the National Economy and is governed by the Jordanian Companies Law of 1964. Enterprises doing business in non-autonomous areas of the West Bank are governed by the Israeli Military Order of 1970. In the Gaza strip, the Ministry of Justice is responsible for registering companies and administering the company law. The prevailing legal framework for registering a company in Gaza is the British Mandatory Companies Law of 1929. The industrial sector is represented by the Palestinian Federation of Industries (PFI), which includes the sectors of food and beverages, construction, quarrying and stone production and fabrication, pharmaceuticals, chemicals, metal and engineering, textiles, garments and leather, paper, printing and packaging, handicrafts, plastic and rubber, and furniture industries. The PFI was established in order to facilitate the development of registered industrial enterprises by means of training activities, advocacy, and support with the national and international promotion of Palestinian products [28].

The industrial sector largely consists of family-owned and family-managed businesses [1] that employ more than 80,000 of Palestinians workers; more than 13% of the total Palestinian labor force. After the outbreak of the second intifada in 2000 and until 2007, the sector has greatly suffered and many enterprises went bankrupt as a direct outcome of Israeli occupation measures, such as the long-term closure of Palestinian areas, the prohibition of Palestinian industries from exporting their products, the destruction of the infrastructure that had been funded by foreign aid, and the prevention of Palestinian imports of needed hardware and spare parts. In 2007, after the closure of the Gaza strip and the division of the PA in the West Bank and the Hamas authority in Gaza, Israel started to ease the imposed restrictions on Palestinians in the West Bank area. The consequence has been an "opportunity" for many enterprises to actively engage in the process of upgrading the performance of their operations, for example by installing management information systems and working towards International Organization for Standardization (ISO) certifications [28], in order to expand and open new markets for their competitive products. The reasoning behind this has been the fact that Palestinian consumers are becoming increasingly selective in their buying habits, due to the greater variety of goods available, especially those imported from Israel and the region. In recent years, enterprises have

also increased their marketing activities in cooperation with relevant public institutions; such as the chambers of commerce, trade associations, and consulting firms. Their advertisement is targeted at the Palestinian public to encourage Palestinians to buy national products.

Quarrying and Stone Fabrication

Quarrying and stone fabrication (QSF) is the largest industrial sector in terms of the total number of registered and non-registered enterprises. Its share of the GDP is around 4% [26]. According to the 2008 figures, there are some 700 firms (including small workshops, quarries, stone, and marble cutting and fabrication, as well as stone for the construction industry), employing around 20,000 workers. However, only 409 firms are fully registered with the Union of Stone and Marble. The majority of the enterprises of the sector are located in the Bethlehem and Hebron districts in the southern part of the West Bank. The sector's major competitive advantage is the availability of local raw material. Quality and price are interconnected factors: better quality means higher costs for the manufacturing and supply chain. There are several firms that have achieved the ISO 9000 certification; however, there is a considerable number of enterprises that cannot retain the ISO certificates. Although enterprises have had access to fairly up to date technology in the last 5 years, only a few have upgraded their machinery on a regular basis. There is only little documentation or relevant references on the production of the sector, but the report recently published by the Palestinian Federation of Industries [28] indicated that the current production capacity of the sector is about 35 million square meters of fabricated stone and marble. The local market takes up an average of 35% of the total yearly production, while the Israeli market utilizes about 55%, and the rest is exported to regional and international consumers. Some leading Palestinian companies have successfully entered the US and European markets. Overall, Palestinian stone and marble, with its variety of colors and characteristics, has a high export potential. As the sector consists to 98% of family businesses, the initial investments are mostly generated by family resources and savings. Most enterprises depend on commercial banks for subsequent financing, in particular when buying new machinery or developing new markets.

Food and Beverages

This is the fastest growing sector with around 200 firms (excluding bakeries) in both the West Bank and the Gaza strip, 152 of which are registered and active members of the Food Industry Association. According to the 2009 statistics, the sector's share of the GDP is 24% [26]. Enterprises in this sector operate with a wide variety of products, such as meats, vegetables (fresh and frozen), oils and fats, dairy, crops, animal feed, chocolates and confectionaries, water and soft drinks, snacks, and many more.

As food production is directly related to health and safety issues, special attention has been given by the PA regulatory bodies to ensure the quality of the sector's diverse products. Consumer's heightened awareness and the increased competition have created an additional challenge which has reflected on the continuous improvement

of product quality. Many enterprises have acquired the necessary certifications of ISO versions and HACC.[1]

Moreover, the food and beverages (FB) sector is becoming more attractive to investors, as the percentage of household spending on FB is estimated at around 42% of all living expenses [26], which emphasizes the importance of the sector. The recent total investment in the sector is estimated at US $480 million [28].

The Emerging Innovation System

In terms of an emerging innovation system, first efforts to establish an infrastructure for the development of the national economy have been undertaken, although means are limited and thus continuity always at risk. The research system is rudimentary with its very small number of researchers and almost non-existing share of the GERD/GDP. However, although the GDP per head is the lowest in the region, the literacy rate is one of the highest (94.6% for adults and 99.2% youth literacy rate[2]), based on UIS data. Equally important is the high enrolment rate in tertiary education of above 40% for the age group of 18–24 year olds, which is high, compared to middle-income countries. Initially, Palestinian students scored above average in international tests (e.g., Trends in International Mathematics and Science Studies, TIMSS) relative to MENA countries. However, more recent Palestinian performances in TIMSS show a progressive decline [19, 38].

The universities are the main pillar of the RTDI system. TEMPUS (Europe) and the Palestinian Faculty Development Program (PFDP), which is a "public–private effort the United States Agency for International Development (USAID) and the Open Society Institute (OSI) agreed to partner with the American-based nongovernmental organization AMIDEAST to create a response to the crisis in Palestinian higher education" [33]. Palestinian civil society institutions are conducting R&D activities in various fields and in partnership with a number of International and local institutions. Their governance structure gives them a comparative advantage over local universities. Centers of Excellence are seen as an important step towards modernization. An example is the Biotechnology Research Center at Palestine Polytechnic University which was also used to establish a master's program in Biotechnology as a collaborative effort of Polytechnic University and the Bethlehem University. Such centers can lead to a sustainable infrastructure despite limited resources. They can promote better educational opportunities and develop research in areas that apply to the needs of the Palestinian society. Stakeholders have proposed centers of excellence in the following areas: water technology, renewable energy, climate change, geo-informatics, agriculture, biotechnology, medicine and public health, food security, urban planning, human rights, and good governance.

Inevitably, there are no funds and no structures available to meet the needs of the Palestinian society as evidenced by the distribution of R&D efforts in the different fields. As noted by the World Bank report: "The Palestinian education system is characterized by a proliferation of supply-driven projects lacking a strategic vision

[1] Hazard Analysis and Critical Control Point (HACCP) is a food safety management system.
[2] In http://stats.uis.unesco/ReportFolders/ReportFolders.aspx

and/or impact evaluation" [38]. Also, most of the research is donor driven. It seems, however, that despite unfavorable conditions the business sector follows an autonomous way to survival and growth.

It is worth mentioning that the effort exerted in conducting the research was jointly steered and implemented by governmental, academic, and industrial institutions. Such joint collaboration of three actors of national innovation system is a manifestation of the triple helix relations in knowledge based societies. Etzkowitz [10] suggests that knowledge producing institutions, i.e., universities have become more important to innovation in particular new products development, and while industry is the driving force for innovation, government plays the lead role in motivating and driving academia and industry. The triple helix as a model for national innovation was expanded to a quadruple helix by which a forth helix identified as media based and culture based public is suggested [4, 5]. The quadruple helix is an innovation cooperation model in which actors; public, universities, industries, and public institutions cooperate in order to produce useful innovations. Considering the ongoing policy reforms in the Palestinian Authority and in particular those concern the socio-economic, it is essentially to investigate the quadruple helix innovation system in future works.

Methodology

The targeted industrial sector is listed in Table 3 in accordance to NACE coding. Two representative samples were chosen from this registered population. The aim was to implement the Arabic version of the CIS 2006 questionnaire in both samples covering

Table 3 Total registered enterprises in both sectors classified in accordance to NACE code

Sector	Sub-sector	Number (% of total)	NACE code
Quarrying and stone fabrication	Quarrying of stone for construction	42 (10%)	CB 14.11
	Cutting, shaping and finishing of stone	367 (90%)	DI 26.70
FB	Production, processing and preserving meat and meat products	11 (8%)	DA 15.1, 15.11
	Processing and preserving of fruits and vegetables	11 (8%)	DA 15.3
	Manufacturing of animal and vegetable oils and fats	9 (6%)	DA 15.4
	Manufacturing of dairy products	24 (17%)	DA 15.5
	Manufacturing of grain mill products	7 (5%)	DA 15.61
	Manufacturing of prepared feeds for farm animals	17 (12%)	DA 15.71
	Manufacturing of cocoa, chocolate, and sugar confectionary	19 (14%)	DA 15.84
	Manufacturing of macaroni, noodles couscous, and similar farinaceous products	3 (2%)	DA 15.85
	Manufacturing of other food products	25 (18%)	DA 15.89
	Manufacturing of beverages (including alcoholic, non-alcoholic, mineral water, and soft drink)	13 (9%)	DA 15.9–DA 15.98

the observation period 2006–2008. The representative sample of the QSF sector consisted of 61 enterprises representing 15% of the total registered population (CB14.11 and DI26.70), while the size of the other sample, representing the FB sector, was 56 enterprises representing about 37% of the registered population excluding DA15.85 because of its size. The survey was administered in personal interviews by a trained MOE team and facilitated by the MOE and the PFI. The response rate from enterprises in both representative samples was 100%.

The distribution of both representative samples of the West Bank (WB) districts is shown in Fig. 1 below. The figure shows that QSF sector is primarily located in the southern part of the WB; i.e., in Hebron and Bethlehem.

Results and Discussions

The descriptive statistics of the number of employees are presented in Table 4 below. It is worth noting that the FB sector has significantly larger share of medium size enterprises (25%), than the QSF sector (8.2%, p value=0.0223, Fisher's exact test), an observation also reflected by the larger mean value of employees in the FB sector.

For both sectors, the local market, including the Israeli market, represents the largest market for their goods (Fig. 2), with the European market being the second largest outlet. This is due to the fact that the facilitation of the export of goods from the PA to the European market is part of the European Union's commitment to support the development of the Palestinian economy.

The data on technological innovation in both representative samples shows that 80% of the enterprises in the FB sector sample are technological innovators, while in the QSF sample 67% of the companies are technological innovators (Fig. 3).

The figures on enterprises' expenditure in 2006 on technological innovation activities as specified by the CIS reveals that in both sectors 80% of the funding went into the acquisition of new machinery and software (Table 5). Overall, the FB sector spent more than four times as much on machinery and software as the QSF industry. R&D activities constitute 8% of the total expenditure in the QSF sector, and 15% in the FB sector, which favors in house R&D activities. The figures reflecting R&D expenditure and their distribution are pointing towards the need of STI policies which will encourage cooperation between research institutions and industrial sectors.

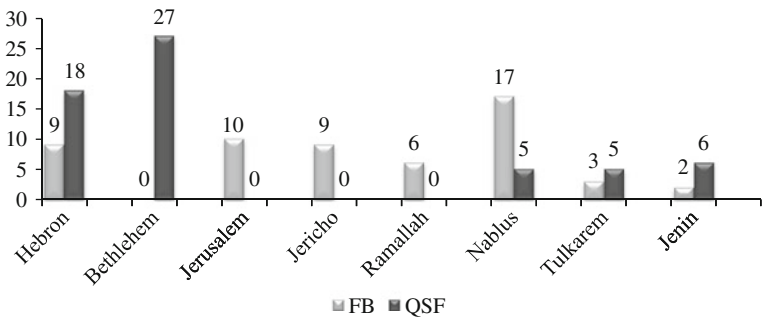

Fig. 1 Sample distribution in the Palestinian area

Table 4 Employee count descriptive by sector and in total (reference year, 2008)

Sector	Number of employees				
	Mean	Standard deviation	Median	Maximum	Minimum
QSF	23	21	19	120	4
FB	48	61	25	334	3
Total	35	47	21	334	3

The contribution of innovation to the total turnover in the QSF sector is related to technological innovation, with more than 55% of innovators stating that turnover rises with introducing new products for the enterprise, whereas in the FB industry an increase of turnover is in part linked to innovations that introduce new products to the market (Fig. 4), as more than 45% of the FB sector innovators have indicated. This outcome was to be expected, since in the last 5 years the local market for the stone and marble sector has been highly competitive with the increase of construction activities in the Palestinian districts and elsewhere.

For the technological innovation in process, the majority of innovators in both sectors are conform that the introduction of new O&M systems has improved logistics and manufacturing processes for their products. As regards product and process innovation, it is the enterprises themselves that are directly responsible for the activities. This is also confirmed by the feedback on the sources of information and knowledge which enhance innovation in the enterprises. Both sectors state that the major resource of knowledge is the enterprises themselves, with only minimal relevant information coming from higher education or research institutions. This finding is contrary to the situation in developed countries, where innovative enterprises generally do not innovate by themselves, but in the context of a network. In Europe, e.g. and particularly with respect to formal forms of cooperation, the percentage of innovative enterprises which are involved in R&D collaboration with one or more partners ranges, depending on country, from about 50% to—in the case of Denmark—97% [3].

Regarding the effect of innovation on employment, those enterprises involved in both process and product innovation record the highest increase in employment, with a lower increase to be noted by firms which have only introduced product innovation, and the least for those having only innovated their processes.

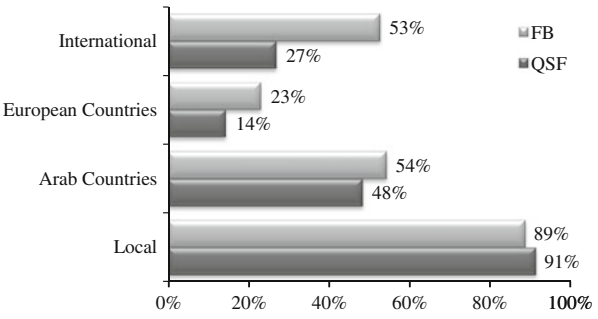

Fig. 2 Market distribution for both sectors (local means Palestinian and Israeli markets)

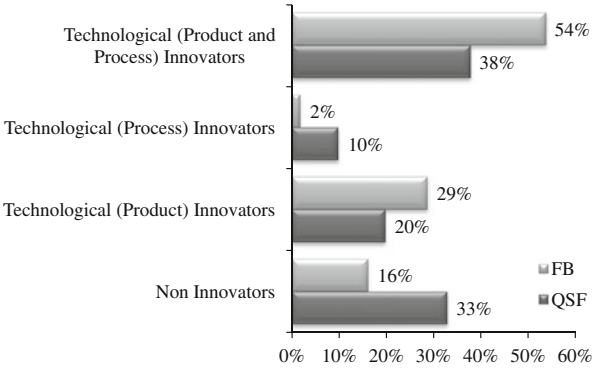

Fig. 3 Innovation status based on CIS definitions and analysis

This is to some extent compatible with what has been observed in European countries. Moreover, the growth in export performance for innovators is clearly superior compared to non-innovators.

When asked if receiving any public or private support, only one firm from the QSF sector replied in the positive and specifically mentioned the sixth framework program of the European Union. In the FB sector, in contrast, public and governmental support was provided to at least five firms and five others have received support from European and other countries. This comes as no surprise, as the European Union and other countries have lately introduced support for EMS, HACCP, ISO, and other benchmark institutions for the sector.

In terms of the status of the Intellectual Property Rights (IPR), the survey revealed that the Palestinian economy does not differ from other developing countries' economies. Registering a trademark or a design and claiming copyright is significant for FB enterprises where competition is currently high, whereas it is almost negligible in the QSF industry, where traditional ways of manufacturing are still in practice (see Fig. 5).

The CIS allows for measuring the factors that are hampering innovation activities in the surveyed enterprises. For both sectors it appears that the most important hold back for innovation is costs, specifically the lack of internal and external funds and the high cost of innovation activities. This outcome corresponds to CIS results in Europe and elsewhere. The second important factor is the lack of knowledge in terms

Table 5 Expenditure on innovation activities for the year 2006

Innovation activity	QSF (US$)	FB (US$)
Intramural R&D	304,600	3,924,114
Extramural R&D	220,200	328,657
Acquisition of new machinery, hardware, and software	5,805,500	24,708,686
Acquisition of other external knowledge	77,600	285,000
Training	0	0
Market introduction to innovation	0	0
Other preparation	0	0
Total expenditure	6,407,900	29,246,457

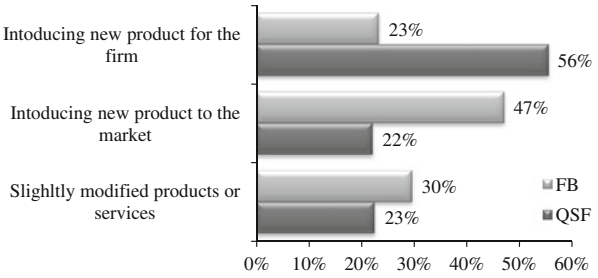

Fig. 4 Contribution to total firm's turnover

of shortage of qualified personnel and want of information on technology and the market. Again, such outcomes require careful attention from the relevant PA policy and decision makers.

A weighted, combined analysis of the two sectors reveals that there is a slightly higher overall innovation rate in the FB industry (p value=0.07). There are, however, differences in the innovation results: the FB sector has a much higher (and statistically significant) proportion of enterprises holding trademarks, copyrights, or having implemented design innovations (with p values<0.00001). The findings are presented in Table 6, below.

In our further analysis of the characteristics, effects, and factors hampering innovation in view of the differences between the two sectors, the following table (Table 7) contains only the statistical significant results.

The QSF sector has been more international market (excluding EU) oriented than the FB industry. The latter has introduced more innovations that were new to the market. As regards the innovation activities it can be observed that the FB sector had a higher rate of extramural R&D and acquisition of external knowledge, while the QSF industry had a higher rate of other preparations. The QSF sector had no financial support from local authorities, while they contributed about 10% of the support the FB sector received. Regarding innovation information, the FB sector considered the information received from institutional and public sources as more important, while the QSF sector acknowledged information received from public sources as moderately important.

As to the mix of cooperation partners and their national origin, the FB sector is more international oriented regarding (a) its internal partners (p value=0.01), (b) its supplies (p value=0.011), and (c) its competitors (p value=0.004), whereas the QSF industry shows a smaller degree of cooperation overall (90% vs. 80%), and is

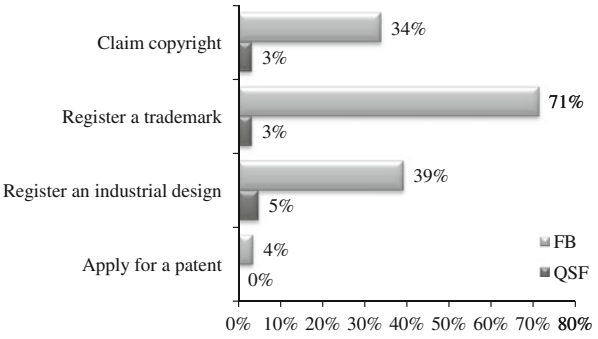

Fig. 5 IPR status in both sectors

Table 6 Comparison of innovation rates between QSF and FB sectors

Overall innovation	Sector		*p* value (Fisher's exact test)
	QSFs	FB	
	67.159%	84.457%	0.070
Innovation type			
No innovation	32.941%	15.625%	0.133
Process innovation	9.412%	3.125%	
Product innovation	20.000%	28.125%	
Both	37.647%	53.125%	
Innovation results			
Patent	0.000%	3.125%	0.274
Design	4.706%	38.710%	0.00002
Trademark	3.488%	71.875%	<0.00001
Copyright	3.488%	34.375%	0.00003

rather geared towards the local level. The effect of innovation on the product and services range was deemed much higher in the FB sector, as was the effect of innovation on entering new markets or increasing their market share, the flexibility of production or service provision, the reduction of labor costs, the reduction of materials and energy consumption per unit of output, and last but not least meeting regulatory requirements was deemed much higher in the FB sector.

With respect to the reasons for not innovating, the responses differed in the two industries. Whereas the QSF sector uniformly assigned some importance to the categories “market dominated by others”, “uncertain demand”, “no need due to prior innovation” and “no need due to lack of demand for innovation”, the FB sector considered them irrelevant. The effect of organizational innovations on “response time to customer needs”, “improved quality of products or services”, “reduction of cost per unit” and “employee satisfaction” was deemed higher by the FB sector, while being irrelevant for roughly 30% of the QSF enterprises. Finally, three quarters of the FB companies have introduced innovations related to product and/or packaging design, compared to only one third of the QSF enterprises.

Conclusions

Although a national STI policy does not exist in the PA, the survey brought promising outcomes that should be carefully considered by policy and decision makers. Clearly, innovation is taking place in the PA's two major industrial sectors, with a positive impact on turnover, employment, and exports. In terms of R&D fostering innovation, there are also indicators to be considered when developing national STI policies and strategies. Relevant potentials in both industrial and research institutions should be considered and there is a need for instruments that provide incentives for cooperation. Also, it is important to direct academic programs

Table 7 Comparison of characteristics, effects, and factors hampering innovation rates between QSF and FB sectors

Innovation characteristics	Sector		*p* value (Fisher's exact test)
	QSF	FB	
International sales	52.3%	25.8%	0.012
Innovation new to market	23.3%	65.6%	<0.001
Innovation activities			
Extramural R&D	7.0%	31.2%	0.002
Acquisition of external knowledge	23.3%	43.8%	0.039
Other preparations	42.4%	9.4%	0.001
Public financial support			
Local authority	0.0%	9.4%	0.019
Information on innovation from			
Institutional sources (medium to high importance)	21.0%	48.4%	0.013
Conferences and public sources (medium importance)	34.1%	16.1%	0.034
Conferences and public sources (high importance)	16.5%	38.7%	
Effects of innovation			
On product/services range			
Low	12.9%	0.0%	0.003
Medium	45.9%	25.8%	
High	24.7%	58.1%	
On market share			
Low	11.6%	3.0%	0.042
Medium	47.7%	30.3%	
High	23.3%	48.5%	
On flexibility of production			
Low	9.4%	3.0%	0.010
Medium	36.5%	12.1%	
High	36.5%	66.7%	
On the reduction labor costs			
Low	40.7%	15.6%	0.050
Medium	15.1%	25.0%	
High	23.3%	37.5%	
On the reduction materials and energy consumption per unit			
Low	23.5%	6.2%	0.049
Medium	32.9%	25.0%	
High	25.9%	46.9%	
On meeting regulatory requirements			
Low	12.8%	3.1%	0.033
Medium	36.0%	18.8%	
High	31.4%	59.4%	
Reasons for not innovating			
Market dominated by others			

Table 7 (continued)

Innovation characteristics	Sector		*p* value (Fisher's exact test)
	QSF	FB	
Low	29.4%	0.0%	<0.001
Medium	40.0%	31.2%	
High	21.2%	28.1%	
Uncertain demand			
Low	36.0%	0.0%	<0.001
Medium	45.3%	46.9%	
High	21.2%	28.1%	
No need due to prior innovations			
Low	57.6%	0.0%	<0.001
Medium	21.2%	12.9%	
High	3.5%	9.7%	
No need due to no demand for innovation			
Low	54.1%	0.0%	<0.001
Medium	25.9%	25.8%	
High	3.5%	6.5%	
Importance of effects of organizational innovation			
On response time to customer needs			
Low	7.1%	3.1%	0.003
Medium	37.6%	9.4%	
High	25.9%	56.2%	
On improved quality of products/services			
Low	4.7%	0.0%	0.040
Medium	32.9%	12.5%	
High	32.9%	56.2%	
On reduced cost per unit			
Low	31.4%	9.4%	0.004
Medium	20.9%	25.0%	
High	8.1%	31.2%	
On employee satisfaction			
Low	20.0%	3.1%	0.035
Medium	25.9%	25.0%	
High	17.6%	37.5%	
Design innovation	34.1%	75.0%	<0.001

towards local economic development, as this will also help to establish the necessary cooperative links. Finally, it should be noted that even though the food and beverages sector has only marginally higher proportions of innovators, it is clearly much more innovation oriented and values the effects of innovation on a variety of dimensions.

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