Determinants of effective university–business collaboration

Empirical study of Saudi universities

Ahmed Naser Alrajhi
Department of Economics, King Saud University, Riyadh, Saudi Arabia, and
Necati Aydin
Alfaisal University, Riyadh, Saudi Arabia

Received 23 May 2019
Revised 27 September 2019
Accepted 27 September 2019

Abstract

Purpose – The attention to the university–business collaboration (UBC) for its role in the knowledge-based economy is growing in many countries. In this context, the purpose of this paper is to conduct two surveys to explore the causes of low collaboration between the private sector and academia in the Kingdom of Saudi Arabia.

Design/methodology/approach – The first survey covers nearly 50 companies to learn their perspectives. Using the findings of the first survey, a second survey was conducted of university researchers to understand the determinants of private and public funding of research and development projects. The survey provided two types of data, namely, categorical and continuous, which were subjected to reliability and normality tests. A linear regression analysis also was utilized to explore the role of different factors on the funded projects by the two sectors.

Findings – There is a perception among researchers that the private sector is woefully underestimating research capacity of Saudi universities. One interesting finding is that publishing in journals from the International Scientific Indexing (ISI) is a strong predictor for government funding, but not for private funding. From the private sector perspective, publishing in ISI-indexed journals is not sufficient evidence of research capability. Moreover, high teaching load is a major obstacle in acquiring private funding, but not so for public funding.

Practical implications – The paper provides two main recommendations to improve collaboration. First, universities should incentivize publishing in high-impact journals more than in ISI-indexed journals to increase the faculty's research capabilities. Second, universities should reduce the teaching load of faculty involved in research projects, particularly those funded by the private sector.

Originality/value – The outcomes of this survey-based study are very valuable to the ecosystem of academia, business and government in general and for Saudi Arabia in particular, where there is a vital need to implement the right policies regarding UBC in the country.

Keywords R&D, KSA, Knowledge-based economy, University–business collaboration

Paper type Research paper

Introduction

University–business collaboration (UBC) encompasses the processes through which the knowledge developed in universities becomes the knowledge applied by businesses for their operations and future strategies. UBC is neither an end nor a collection of outputs, but many different ways of using knowledge, which exists in many forms. To some extent, UBC underpins key drivers of economic prosperity; these include innovation, foreign direct investment, human capital, scientific infrastructure, intangible assets, knowledge transfer,

The authors thank the Deanship of Scientific Research and RSSU at King Saud University for their technical support. This paper is an outcome of a research project supported by King Abdulaziz City for Science and Technology (KACST). The authors would like to express the author's gratitude and appreciation to KACST for providing the research grant for this project (GDRG Nos 59-34).

Journal of Industry-University Collaboration
Vol. 1 No. 3, 2019
pp. 169-180
Emerald Publishing Limited
2631-357X
DOI 10.1108/JIUC-05-2019-0011

intellectual property and firm creation. It is also an important source of revenue for universities. Promoting UBC and extracting its value can help universities address decreasing public funds, help businesses gain and maintain their competitive advantage in dynamic international markets, contribute to the economic development at regional and national levels, and meet the demands of the labor market to provide more relevant knowledge and skills.

In a knowledge-based economy, universities play a pivotal role in the creation and transfer of knowledge. Fostering prosperous university–business relationships aids in value creation through joint efforts and anticipated synergies. This symbiotic arrangement is beneficial for companies that lack sufficient internal research and development (R&D) capacity and expertise, while allowing universities to create and share knowledge. In fact, several US companies operating in technologically heavy industries have reported that UBC was a better use of their R&D funds than internal R&D activities (UNESCO, 2016).

The partnering of universities and the private sector expedites technology transfer. It allows companies to efficiently introduce their products and services to the market. Yet, UBC levels are relatively low. This problem is more serious in developing countries, and the Kingdom of Saudi Arabia is no exception. Saudi Arabia trails behind developed countries in the number of researchers and amount of funding. It is, however, one of three new emerging economies to appear on the world R&D map for first time, as shown in Battelle's R&D Magazine Annual Global Funding Forcast which was published in 2012. Indeed, a recent study by Hertog (2013) shows that the status quo of the private sector's R&D contribution in Saudi Arabia and other Gulf Cooperation Council (GCC) countries is still emergent.

Saudi Arabia is the source of very few international patents. According to Hertog (2011), ambitious strategies of technological development and diversification into high-tech sectors are mostly limited to government-owned companies (such as ARAMCO and SABIC) that can rely on implicit sovereign backing to engage in long-term strategies of research and product development. With the move toward implementing the "2030 Vision" and the objective of diversifying the economy toward a knowledge-based economy, the R&D role of Saudi universities has become more important than before. Hence, these universities are expected to be part of the economic and social design mechanism of the country in general, especially with the cooperation of the private sector. Sustainable economic development needs strong R&D inputs in higher education as the university's function expands beyond teaching. Hence, the emphasis is on research in general and applied research in particular, especially in building strong partnerships with industries. Given these developments, it is essential to understand the impediments that have resulted in low UBC in Saudi Arabia.

In this study, we explore factors contributing to the low collaboration between the private sector and Saudi universities. We conducted a comprehensive survey of researchers at various regional universities to understand the causes of the problem from the researcher's perspective. After a comprehensive literature review on UBC, we present the regression results of our survey, along with key with recommendations.

Literature review

Benefits of UBC

According to Nieminen and Kaukonen (2001) the perception of the university as an untapped economic resource is not new, but goes back to the 1970s, when the economic and social functions of research gained more visibility in the USA. Consequently, global economic and technological development in the late 1970s and early 1980s led to new policy formulations in other industrial countries. New policies were adopted with greater emphasis on generic technologies and strategic basic research. However, it was not until the beginning of the 1990s that UBC gained more global and political prominence, including in developing countries.

Many in the literature agree that universities are increasingly becoming a source of strength in knowledge-based economy. Despite this growing role, an interesting observation is put forth by Drewry (2014) where universities tend to be modest about the extent of their research collaboration with external partners and their achievements. However, businesses are in need of interdisciplinary research approaches to address social challenges involving energy, climate change, food scarcity and water supply; these issues are critical to new markets for products and services. Universities are extremely important for knowledge-intensive activities that have the capacity to search for and benefit from valuable information, in both the industrial and service sectors. According to Mina (2015), as the world has moved into knowledge-based economy, the role of universities is becoming even more relevant for all economic sectors, as the most common consideration between these sectors remains "marketing and sales" and the empirical evidence shows variability is more a feature within sectors than between sectors.

Steinmo (2015) notes the importance of UBC in providing essential access to fundamental knowledge and the possibility of conducting high-quality research. These are an important requirement for innovation and for improving communication between industries and academics. Docherty (2015) observes from his review of various studies that graduate skills development and innovation could occur across different periods, in all sectors, and in all geographical areas, thus contributing to local economies. Leger (2012) concludes from a survey conducted at Quebec University that collaboration pays off, and the desire for rapprochement holds for researchers and business leaders alike. In addition, he indicates that, while the private sector funding for research centers certainly generates additional revenues, the practical benefits go far beyond monetary gains.

Complexity of UBC

The complexity of UBC is described well by Wilson (2012), who states that universities are an integral part of the innovation supply chain in business; this is not a simple linear supplier–purchaser transaction. The multi-dimensional nature of the supply chain is represented by a landscape of UBC, which comprises a number of highly diverse primary and secondary domains of activities. These activities range from the education of highly skilled graduates and science park developments to applied research in advanced technologies and creative industries. In this context, he notes that the concept of collaborative advantage is gaining momentum within academia, where universities operating in different spheres have begun to collaborate with each other to provide support for a particular industry. Inversely, there is a need for individual businesses to align with different domains where successful businesses often collaborate with several universities to meet their objectives.

Hewitt-Dundas and Gkypali (2017) note that one challenge facing businesses in selecting a university partner is the trade-off between accessibility and relevance of university knowledge. The authors recommend initiatives which could be useful in making academic resources available for small and especially new-to-the-market firms. These initiatives include raising awareness through information campaigns to promote the value of university collaboration. Guimon (2013) lists several obstacles UBC faces that could be summarized into three points. First, there are considerable differences between the research objectives of businesses (i.e. commercial results) and universities (i.e. basic research), especially as the returns only materialize in the future. Second, firms are interested in obtaining new patents or products and avoiding disclosure of information, while university researchers are keen on publishing their results immediately. Third, there are business concerns of confidentiality and the differences in expectations of intellectual property rights. These points are similar to concerns raised by research officials at Saudi universities interviewed in this current research, which is not surprising, given the limitations faced by UBC in developing countries.

University missions and UBC

Borrell-Damian *et al.* (2014) note that, while attention toward missions of universities that normally cover teaching and research is apparent, the development of the so-called "third mission" is becoming exclusively related to UBC. The debate thereof steered toward whether it was more effective for universities to specialize in teaching or to be focused exclusively on research. Alamri (2017) holds the view that universities have faculty who specialize in variety of subjects and are usually promoted based on their research contributions. This makes it inappropriate to completely separate research from teaching missions, because they could be complementary functions. The author suggests that universities could build their distinctive reputation through research centers specializing in certain fields and gain comparative advantage in R&D areas by using research centers as economic units serving different clients.

Hewitt-Dundas and Gkypali (2017) believe that having previous experiences in collaborations increases the probability of businesses entering into future partnerships because they would realize the benefits thereof. The authors not only emphasize the role of universities as drivers for innovation and economic development, but also the value of building collaboration with businesses. However, their research identified two market failures facing firms that formulate innovation strategy: their unawareness of the potential benefits from long-term relationships and their lack of information about potential suitable university partners. Pertuze *et al.* (2010) recommend seven suggestions for businesses to ensure a successful collaboration: investing in long-term relationships, establishing strong two-way communication with the university team on a regular basis, and sharing their vision of how the collaboration can help the company by cooperating with researchers who will understand company objectives.

Leblanc (2012) believes that dealing with this environment requires greatly expanding the opportunities for the two partners to get together in the first place. It is essential that business and academia develop an understanding and common language between them, besides understanding their realities and grasping the full benefit of collaboration. This gap can be bridged and mutual interests aligned by embracing the philosophy of "trying is believing," so research centers and businesses see the merit of their partnership. Therefore, the improvement in the willingness of researchers and universities to engage in active collaboration with businesses will materialize when they have already tried such experience.

UBC in developed countries

An interesting UBC case cited in the literature is the collaboration of the American company Proctor and Gamble (P&G) with two universities, each located on the opposite sides of the Atlantic Ocean. P&G built a strategic partnership with University of Cincinnati, which is considered one of America's top 25 public research universities. This relationship benefited both partners, where the company was able to deploy modeling and simulation capabilities across its R&D projects. The university benefited in more collaborative engagements with its faculty across departments, opening up the opportunity for hiring post-doctoral candidates, undergraduate co-ops and part-time students' involvement. P&G's "Connect and Develop" strategy reached the other side of the Atlantic with Durham University, UK. Wilson (2012) studies this case, where the research capabilities and needs of both partners were identified to show how the partnership succeeded in integrating business and academic teams. This collaboration resulted in linking many academics with P&G researchers in international locations, and cover areas of research ranging from biophysical sciences to consumer psychology.

There are other international practices, some of which have been covered extensively by the report issued in 2011 by the European Institute of Innovation and Technology. The report includes 30 cases of European practices in UBC, with at least 15 focused on R&D. These cases provide very useful lessons for university management, government entities in charge of economic development and businesses interested in R&D investments through UBC. Nieminen and Kaukonen (2001) reviewed several studies with empirical evidence to show that universities are not usually the primary collaboration partners for companies.

For example, in a survey of 1,800 German manufacturing companies, only one-third had cooperation with universities, while almost two-thirds had cooperation with customers and half with suppliers. Enterprises that collaborate with universities usually seem to be relatively large and they have in-house R&D units.

Fernandez (2015) compiles an extensive report that provides 14 indicators for tracking progress in UBC. These indicators include the structure of investment in R&D and innovation completed in universities or the concentration of resources in high-quality partnerships. The report finds that UBC shows increasing dependence on international funding and knowledge sharing in publications among a limited number of high-impact areas. The report suggests further studies in the areas of employment in innovative sectors and the lifespan of firms created through collaborations with academia. The report provides very interesting examples of spin-outs, which could be useful for developed and developing countries alike.

UBC in Saudi Arabia

For many countries in the Arab world, the existing gap between universities and the private sector could be traced back to lack of research-oriented universities in the region. Knowledge transfer though education is emphasized over knowledge-creation through academic research owing to very high student enrollments and insufficient research resources. To tackle the shortage of scientific research, several Arab states have introduced initiatives and reforms to endorse innovation. According to the United Nations Educational, Scientific and Cultural Organization (2016), in particular, Saudi Arabia and Qatar have been witnessing notable progress in research output, especially compared with other comparable countries in the region.

Wilson (2010) argues that this gap is still large between the GCC countries (such as Saudi Arabia) and OECD countries in spending on UBC. He reviewed several indicators such as innovation and knowledge-based economy to conclude that, in general, Gulf countries still lag. While developed countries spend more than 2.5 percent of their GDP on research, the GCC countries spend less than 1 percent of their GDP on average. This situation has been changing with the growing attention on investing and spending more on R&D projects in most of these countries. According to Al-Sultan and Alzaharnah (2012), Saudi Arabia seems to be adjusting where its R&D spending has witnessed substantial growth from 0.25 percent of GDP in 2000 to over 2 percent in two decades. The data published in 2018 by the World Economic Forum show that Saudi Arabia is ranked twenty in spending on R&D. Alamri (2017) rightly points out that the existing long-term plans to transform the economy into a knowledge-based require stronger actions by Saudi universities, such as utilizing its specialized research centers as revenues generating units. In fact, Gethami's (2007) field-based study of the role of research centers in Saudi universities shows that such centers have assumed, albeit recently, an active role in supporting the operation and management of knowledge in innovating and developing information.

Saudi Arabia could adopt Guimon's (2013) suggestions for stimulating UBC through, for example, designing suitable R&D funds and matching grants. The author cites a study on Chile and Colombia that shows that UBC significantly increased the incentives for businesses to introduce new products with positive implications for employment through higher mobility of labor between the economic sectors. The simplicity of these measures makes it practical for developing countries to implement them. However, Zuñiga (2011) cautions that, in many developing countries, institutional constraints, such as employment regulations for civil servants and restrictions on creating private organizations at public universities, greatly limit academic entrepreneurship and the commercialization of patents. Hence, developing countries, in particular, need to double efforts to overcome these challenges in order to fully benefit from UBCs.

Determinants of UBC in Saudi Arabia

We conducted two different surveys to understand the causes of low UBC from both the business sector and university perspectives.

The business sector survey questionnaires comprised 34 questions covering factors related to UBC. We chose to conduct the survey randomly between the three main cities in Saudi Arabia: Riyadh, the capital city; Jeddah, the largest seaport on the Red Sea and the second largest city; and Dammam, one of the major administrative centers for the Saudi oil industry and the capital of the Eastern Province. The first part of the survey was conducted from April to August 2016, and the last part from September to December 2017. We received responses from 46 major companies.

Our first survey revealed two major findings. First, the R&D spending by the private sector in Saudi Arabia seems to produce very little outcomes in terms of patents and commercial products. Most private spending it thus considered within corporate social responsibility that is geared toward image building than producing economic values. Therefore, R&D money is a form of transfer spending than investment for higher returns. Second, the absence of collaboration between universities and the private sector is a major impediment for low R&D spending by the private sector. From the private sector perspective, this is due to a lack of strong research capabilities and strategic collaborations. Out of 44 companies, 31 reported that they did give money to the third parties for R&D projects. However, two-third of those projects was conducted abroad. This is clear evidence that the private sector does not trust the research capacity of local academic institutions.

In May–June 2018, we conducted our second survey to explore the university perspective. We designed the questionnaire based on the findings of the company survey in order to explore factors affecting low private sector support for R&D from the perspective of university professors. The questionnaire comprised three sets of questions: demographic questions; questions related to objective factors affecting R&D capacity; and questions related to subjective factors affecting R&D capacity. We did share the questionnaire with some experts to assure the soundness and relevance of the questions before sending it out to the participants. We targeted 20 prominent universities in Saudi Arabia, but excluded newly established ones with the assumption that it takes time for universities to establish R&D infrastructure.

Survey sample

The university survey was conducted through a Google survey between May and June 2018. The questionnaire was provided both in English and Arabic languages. We received responses from 309 individuals from these universities. In our analysis, we dropped those who did not have a doctoral degree, assuming the importance of such a degree for conducting advance research projects. With this exclusion, the sample size reduced to 261, which is rather large for a statistically significant analysis. The participants are fairly distributed among the targeted universities, though few universities are relatively over-represented. Our target population was active researchers. Therefore, we contacted the deanship of research at those universities to access the target population. The participants were largely those who are in contact with the deanship of research at their universities. We received participation from all targeted universities, except one, King Abdullah University of Science and Technology. The manager of research services at this university declined to share our survey with their faculty members by claiming to be a private university.

Reliability and normality tests

In our survey, we collected two types of data: categorical and continuous. We conducted normality data for continuous data elements. The results from both the Kolmogorov–Smirnov and Shapiro–Wilk tests show that, for all variables, the *p*-value is nearly zero. That is, we reject the hypothesis that the data is not normally distributed. We conclude that the data for all six continuous variables come from a normal distribution.

For the categorical data elements, we conducted a reliability test using Cronbach's α. If the calculated Cronbach's α value is above 0.6, the instrument is considered reliable. Particularly, if the value is above 0.7, it is highly reliable. The value for 13 categorical questions in our survey is 0.73, which indicates that the overall responses we received are highly reliable.

Descriptive data analysis

We used both objective and subjective measures to understand the causes of low R&D projects funded by the private sector. The objective measures include experience, number of patents granted, number of International Scientific Indexing (ISI)-indexed articles published, and average teaching load (ATL) per semester. The subjective measures cover 13 questions with a five-point Likert scale to explore the opinions of the faculty members on the research topic. As stated before, all participants hold a doctoral degree. They have the mean experience of 16 years.

While the majority (56 percent) of the faculty members surveyed received at least one government-funded project (GFP), only 12 percent of them received a private sector-funded project (PFP). For the GFP, 28 percent of participants received one to two projects; 16 percent received three to four projects; 3 percent received five to six projects; and 8 percent received more than six projects. On the other hand, for the projects funded by the private sector, 7 percent of participants received one to two projects; 2 percent received three to four projects; 1 percent received five to six projects; and 2 percent received more than six projects. The data clearly reveal that the university faculty has major obstacles in receiving funding from the private sector, even if they have been successfully receiving GFP.

The ATL per a semester varies quite a lot. While 25 percent of the faculty surveyed has six or fewer hours of weekly teaching load, and almost the same percentage (23 percent) has more than 12 h of teaching load. In sum, 23 percent has 9 h of teaching load, while 30 percent has 12 h. The descriptive analysis points to large variation in teaching load. While some have low teaching load, others have heavy teaching load. We hypothesize that higher teaching load leads to less opportunity to receive research grants. We will test this hypothesis in the regression analysis in the next section.

Two-third of faculty surveyed has at least one ISI-indexed publication per year. As stated before, it is important to note that we targeted faculty members who are actively involved or willing to be involved in research. Therefore, it is not surprising to see a high percentage with at least one ISI-indexed publication. In sum, 43 percent of the faculty has two or more ISI publications per year. Normally, this is expected to be a good predictor of receiving a research project. We will test this relationship by regression analysis in the next section.

Analysis of subjective measures

We asked 13 questions capturing different possible factors affecting low support from the private sector for R&D projects. We want to know whether they agree or disagree with the suggested factors. In this part, we report the responses by emphasizing the frequency percentages of "agree" and "disagree" responses. The questions were designed to capture factors related to the private sector, government, university leadership and faculty members.

For the private sector, 65 percent of participants agree that "private sectors in Saudi Arabia do not truly appreciate the value of R&D," while only 15 percent disagree. They share the same sentiment for the following proposition (Q2) as well: "The private sector in Saudi Arabia does not believe in the research capacity of the universities in Saudi Arabia." Similarly, while responding to Q11, nearly three out of four individuals agree that "the private sector in Saudi Arabia is not aware of the university research capacity." Perhaps, because of the aforementioned factors, while responding to Q5, the majority (56 percent) agrees that "Companies in Saudi Arabia prefer to do R&D investments in western countries," while only 10 percent disagrees.

Some blame the government for not providing enough support for university and private sector collaboration. For instance, 64 percent of the faculty agrees, while only 10 percent disagrees with the following statement (Q4): "The government does not provide incentives for private sector and university collaboration." Likewise, some complain about the difficulties in getting patents: almost half of the respondents (46 percent) are neutral, while 34 percent agree and 11 percent disagree with the following statement (Q3): "Patent system in Saudi Arabia is time-consuming and inefficient." The high percentage for the "neutral" response is not surprising because the participants include faculty members in social sciences as well.

The university leadership was also blamed. In response to Q7, 64 percent think that "Universities in Saudi Arabia do not provide incentives for collaborating with the private sector on R&D projects," while only 17 percent disagree. Similarly, when responding to Q9, 69 percent blame the university leadership for insufficient support "Universities do not help professors reach potential funding resources for their projects." As a result, in response to Q13, 75 percent of the respondents agree that "Professors are not aware of potential research opportunities with the private sector."

Finally, four questions in the survey were designed to allow for self-reflection. The participants are almost equally divided when responding to the following proposition (Q6): "Universities shall only do basic research, not applied research for business." In sum, 47 percent believe that universities shall only do basic research, while 41 percent they should also do applied research for business. In response to Q8, the overwhelming majority agrees that "High teaching load and other responsibilities of professors do not leave enough time for R&D projects," while only small minority (13 percent) disagrees. Almost half of the participants (47 percent) consider the existing reward system insufficient, while the rest disagree or are neutral to the following statement (Q10): "The reward is not significant enough to develop research projects for the private sector." Finally, the majority of the participants complain about difficulties in publishing research outcomes while working with the private sector due to the following reason (Q12): "It is hard to receive permission from the private sector for using the project data for publication" (Table I).

Determinants of receiving government funding for research

We conducted a linear regression analysis to explore the role of several factors on the funded projects. We used two separate models to capture the determinants on research funding by the government and private sector. The first model is constructed as follows:

$$\text{GFP} = \alpha + \beta_1\text{IA} + \beta_2\text{Experience} + \beta_3\text{Patent} + \beta_4\text{PFP} + \beta_5\text{ATL} + e.$$

The dependent variable is GFP, while the explanatory variables are the number of ISI-indexed articles (IA) published, the years of experience (experience), the number of patents received (patent), the number of PFP and ATL. The signs for all explanatory variables are expected to be positive, with the exception of ATL, which is expected to lessen the likelihood of getting funded projects.

Using the step-wise regression method, we tested the above model with five explanatory variables. As seen in the table below, the model with highest R^2 includes four variables, but excludes ATL. In other words, ATL is not statistically significant in explaining the variation in GFP. All other variables are statistically significant. IA has the highest impact followed by patent and PFP. In other words, the model reveals that publishing IA and owing patents are strong predictors for GFP. While the coefficient for experience is statistically significant, its value shows that experience is the least important among all variables.

	Unstandardized coefficients				Correlations			Collinearity statistics	
	B	SE	*t*	Sig.	Zero-order	Partial	Part	Tolerance	VIF
Model 1									
(Constant)	0.852	0.174	4.905	0.000					
IA	0.502	0.073	6.892	0.000	0.394	0.394	0.394	1.000	1.000
Model 2									
(Constant)	0.107	0.239	0.448	0.655					
IA	0.466	0.071	6.561	0.000	0.394	0.378	0.362	0.986	1.014
Experience	0.049	0.011	4.368	0.000	0.286	0.262	0.241	0.986	1.014
Model 3									
(Constant)	0.196	0.237	0.827	0.409					
IA	0.401	0.073	5.497	0.000	0.394	0.324	0.299	0.904	1.107
Experience	0.045	0.011	4.085	0.000	0.286	0.247	0.222	0.975	1.026
Patent	0.435	0.142	3.061	0.002	0.301	0.188	0.166	0.899	1.112
Model 4									
(Constant)	0.225	0.236	0.950	0.343					
IA	0.392	0.073	5.396	0.000	0.394	0.320	0.291	0.900	1.111
Experience	0.041	0.011	3.633	0.000	0.286	0.221	0.196	0.938	1.066
Patent	0.357	0.146	2.445	0.015	0.301	0.151	0.132	0.840	1.190
PFP	0.204	0.098	2.086	0.038	0.260	0.129	0.113	0.869	1.150

Notes: VIF, variance inflation factor; PFP, private-funded projects; GFP, government-funded projects; IA, ISI-indexed. Dependent variable: GFP; R^2 is 0.155 for model 1, 0.213 for model 2, 0.241 for model 3 and 0.254 for model 4

Table I. Determinants of research funding by the government

We also conducted a multicollinearity test to ensure the explanatory variables do not have high inter-correlations or -associations. If the variance inflation factor (VIF) value is below 1 or greater than 10, it is a sign of multicollinearity. If it is between 1 and 10, there is no multicollinearity. As seen in the coefficient table, all explanatory variables have a VIF value slightly greater than 1, indicating no multicollinearity.

Determinants of receiving private sector funding for research

The second regression model explores the determinant factors for receiving private sector funding for R&D projects. The model is constructed as follows:

$$\text{PFP} = \alpha + \beta_1\text{IA} + \beta_2\text{Experience} + \beta_3\text{Patent} + \beta_4\text{GFP} + \beta_5\text{ATL} + e.$$

The dependent variable is PFP, while the explanatory variables are; the number of IA published, the years of experience, the number of patent received, the number of GFP and ATL. Similar to the first model for the GFP, we expect the signs for all explanatory variables to be positive, with the exception of ATL.

Using the step-wise regression method, we tested the PFP model with five explanatory variables. Overall, the R^2 is smaller compared with the GFP model because of the relatively low number of PFP among the survey participants. As seen in Table II, the model with highest R^2 includes four variables, but excludes IA. In other words, IA is not statistically significant in explaining the variation in PFP. Thus, publishing IA is not a predictor of getting funded projects from the private sector. However, all other variables are statistically significant.

As seen in the coefficient table, the signs for all significant variables are as expected. In other words, experience, patent and GFP positively contribute to the dependent variable, while higher teaching load has a negative impact on the dependent variable, as expected.

Table II.
Determinants of research funding by the private sector

	Unstandardized coefficients				Correlations			Collinearity statistics	
	B	SE	*t*	Sig.	Zero-order	Partial	Part	Tolerance	VIF
Model 1									
(Constant)	0.292	0.076	3.837	0.000					
Patent	0.446	0.087	5.126	0.000	0.304	0.304	0.304	1.000	1.000
Model 2									
(Constant)	−0.076	0.136	−0.556	0.578					
Patent	0.408	0.086	4.726	0.000	0.304	0.282	0.275	0.981	1.019
Experience	0.023	0.007	3.236	0.001	0.228	0.197	0.188	0.981	1.019
Model 3									
(Constant)	0.540	0.263	2.053	0.041					
Patent	0.369	0.086	4.267	0.000	0.304	0.257	0.245	0.954	1.048
Experience	0.023	0.007	3.249	0.001	0.228	0.199	0.187	0.981	1.019
ATL	−0.060	0.022	−2.722	0.007	−0.207	−0.167	−0.156	0.971	1.029
Model 4									
(Constant)	0.441	0.265	1.662	0.098					
Patent	0.320	0.089	3.601	0.000	0.304	0.220	0.206	0.890	1.124
Experience	0.019	0.007	2.616	0.009	0.228	0.161	0.149	0.915	1.093
ATL	−0.056	0.022	−2.553	0.011	−0.207	−0.158	−0.146	0.965	1.037
GFP	0.077	0.037	2.095	0.037	0.260	0.130	0.120	0.842	1.187

Notes: VIF, variance inflation factor; PFP, private sector-funded projects; GFP, government-funded projects; IA, ISI-indexed; ATL, average teaching load. Dependent variable: PFP; R^2 is 0.092 for model 1, 0.128 for model 2, 0.152 for model 3 and 0.166 for model 4

Similar to the GFP model, we conducted a multicollinearity test for the PFP model using the VIF value. As seen in the coefficient table, all explanatory variables have a VIF value slightly greater than 1, indicating no multicollinearity.

Conclusion

The faculty survey indicates important factors affecting low R&D projects funded by the private sector. The opinion questions reveal that faculty members are confident about their research capacity, but take an issue with the lack of awareness in the private sector. They believe that the university leadership needs to expand its guidance on pursuing private sector funding, but consider high teaching load to be a major obstacle for pursuing funded projects.

Overall, the findings from the regression analysis are in line with the responses to the opinion questions. However, the regression models point to two very important issues, especially when we compare GFP and PFP. First, publishing IA is a strong predictor for GFP, but statistically insignificant for PFP. In other words, publishing IA attracts GFP, but not private sector funding. We argue that this is due to the highly demanding nature of PFP. Publishing in ISI-indexed journals alone is not sufficient for the private sector to perceive faculty members as able researchers. Moreover, being published by ISI-indexed journals may not necessarily indicate high-quality research. Therefore, we suggest higher incentives for faculty to publish in high-ranking journals. Second, for the GFP model, ATL has no statistical significance while for the PFP model; it is statistically significant with negative impact. In other words, teaching load has no relationship with acquiring GFP, but it is detrimental to receiving private sector funding. Again, we argue that this difference is a reflection of the challenging nature of projects funded by the private sector. Therefore, we recommend universities to reduce teaching load when faculty members receive research funding from the private sector.

References

Alamri, S. (2017), "Developments in economics of publishing and scientific research in Saudi Universities", Deanship of Scientific Research, Taiba University, Madinah.

Al-Sultan, K. and Alzaharnah, I. (2012), "Academia-industry innovation linkages in the case of Saudi Arabia: developing a university-industry triple-helix framework to promote research and development collaboration", The Global innovation Index, World Intellectual Property Organization, Geneva.

Borrell-Damian, L., Morais, R. and Smith, J. (2014), "UBC research: goals, outcomes and new assessment tools", EUIMA Collaborative Research Project Report, European University Association (EUA) Publications, Brussels.

Docherty, D. (2015), "State of the relationship report 2015: collaboration between universities and business in the UK", Chief Executive of NCUB National Center for Universities and Business, London.

Drewry, D. (2014), "UBC research: goals, outcomes and new assessment tools, forward", EUIMA Collaborative Research Project Report, European University Association (EUA) Publications, Brussels.

Fernandez, R. (2015), "State of the relationship report 2015: collaboration between universities and business in the UK", NCUB National Center for Universities and Business (compiled and edited by Rosa Fernandez), London.

Gethami, A. (2007), "The role of the scientific research centers in Saudi Universities in managing knowledge (field analytical study)", Um-al-Qura University, Makkah (in Arabic).

Guimon, J. (2013), "Promoting university-industry collaboration in developing countries: the innovation policy platform", Policy Brief, World Bank, Washington, DC.

Hertog, S. (2011), "The evolution of rent recycling during two booms in the Gulf: business dynamism and societal stagnation", in Legrenzi, M. and Momani, B. (Eds), *Shifting Geo-Economic Power of the Gulf: Oil, Finance and Institutions: The International Political Economy of New Regionalisms Series*, Ashgate, Farnham, pp. 55-74.

Hertog, S. (2013), "The private sector and reform in the Gulf Cooperation Council", Kuwait Program on Development, Governance and Globalization in the Gulf States, London School of Economics & Political Science, London.

Hewitt-Dundas, N. and Gkypali, A. (2017), "More innovation through university-business collaboration: evidence BRIEFING", The Enterprise Research Centre, The Economic and Social Research Council, Swindon.

Leblanc, M. (2012), "University-industry collaboration: researchers weigh in", message from the president and CEO of the Board of Trade of Metropolitan Montreal, Montreal.

Leger, J.-M. (2012), "University-industry collaboration: researchers weigh in", Leger Marketing, Board of Trade of Metropolitan Montreal, Montreal.

Mina, A. (2015), *University-Business Collaboration in Services vis-à-vis Manufacturing Firms*, National Center for Universities and Business (NCUB), London.

Nieminen, M. and Kaukonen, E. (2001), *Universities and R&D Networking in a Knowledge-Based Economy: A Glance at Finnish Developments*, The Finish Innovation Fund, Sitra Reports series 11, Helsinki.

Pertuze, J., Calader, E., Greitzer, E. and Lucas, W. (2010), "Best practices for industry-university collaboration", *MIT Sloan Management Review*, Vol. 51 No. 4, pp. 82-90.

Steinmo, M. (2015), "How firms use university-industry collaboration to innovate", Centre for Sustainable Energy Studies, Nord University.

United Nations Educational, Scientific and Cultural Organization (2016), *UNESCO Science Report: Towards 2030*, 2nd Revision, UNESCO Publishing.

Wilson, K. (2010), "Scientific research in the Gulf: some introductory context", Inconet-GCC Meeting, June 10, Athens.

Wilson, T. (2012), "A review of business–university collaboration", Department for Business, Innovation and Skills, London.

Zuñiga, P. (2011), "The state of patenting at research institutions in developing countries: policy approaches and practices", WIPO Economic Research Working Paper No. 4, Geneva.

Further reading

Science-to-Business Marketing Research Centre (2011), *30 Good Practice Case Studies in University-Business Cooperation*, Münster University of Applied Science, European Institute of Innovation and Technology, and European Commission.

University Industry Demonstration Partnership (2014), *10 Cases Studies of High-Valued, High-Return University Collaborations*, University Industry Demonstration Partnership.

Corresponding author
Ahmed Naser Alrajhi can be contacted at: anrajhi@ksu.edu.sa