International collaboration in scientific research in Saudi Arabia: an analysis of patterns and impact

Abstract The present study sought to examine the trend and impact of international collaboration in scientific research in Saudi Arabia during the last two decades that are permeated with King Abdullah Scholarship Programme (KASP). Using the Microsoft Academic Graph (MAG) data (2001-2020) we found that 64.74% of Saudi Arabia scientific output (n =158860 publications) involved international collaborations, with the United States and Egypt researchers being the most frequent partners. The proportion of international collaborations has increased slightly over time at the expense of a decreased rate of domestic collaborations. The rate of growth in Saudi Arabia scientific output was 19.82% per annum, and the growth was associated with international collaboration rather than purely domestic collaboration. Moreover, internationally coauthored publications received more citation than domestic publications. Of note, publications with overseas first author had higher citation rate than publications with domestic first author. These data suggest that the vast majority of scientific publications from Saudi Arabia was attributable to international collaboration, and this had a positive impact on the quality and visibility of Saudi Arabia science.

Introduction

Advances in science and technology are major contributors to economic growth. The case of South Korea offers a great exemplar of the role of science and technology in economic development. Within three decades, South Korea has achieved economically what other Western countries have taken a century to realize. The achievement of South Korea, or the "Korean Miracle", are attributable to many factors, but science and technological innovation are among the most important contributors. In Australia alone, it has been estimated that advances in science had accounted for 20 to 30% growth in economic activities, employment, and exports. Although most scientific and technological advances are incremental and largely invisible to the public, the combined and cumulative progress resulting from these advances have had perceptible impacts on the economy. Scientific research and technological innovation can play a major role in allowing developing country to achieve economies comparable to those observed in developed countries.

Scientific research produces new information and knowledge that can promote technological innovation which, in turn, produce quality goods and services. Thus, scientific research can be considered a driving force for positive evolution in developing countries. One indicator of scientific research is the number of publications in peer-reviewed journals. "a robust and positive correlation between the number of peer-reviewed scientific publications and the knowledge economy had demonstrated in a previous study (Nguyen and Pham 2011).

Across the world, international collaboration in scientific research has increased rapidly in recent decades. Between 1986 and 1999, the proportion of internationally co-authored publications has increased by two-fold (Archi- bugi and Coco 2004), and in some countries, this proportion has risen to 40% (Schmoch and Schubert 2008) or 50% (9). In fact, collaboration in research is now the norm rather than exception, and this is also true for developing countries. For instance, in China, approximately half of all papers in healthcare science have been resulted from international collaborations (Chen et al. 2016). In Malaysia, approximately 40% of medical research papers published between 2001 and 2010 had an international collaboration component (Low et al. 2014).

An interesting finding of this study is that there was a linear correlation between the proportion of international collaboration and the journal impact factor (Low et al. 2014), suggesting that papers involving an international collaboration are of higher quality than those without such collaborations. In developing countries, due to lack of expertise and poor infrastructure, international collaboration in scientific research is also regarded as an effective way to build scientific capacity and share resources (Wagner et al. 2001).

Saudi Arabia is a developing country that can be a good case study of the benefit of international scientific collaborations. The country has a long tradition of higher education and science. Governments have advanced that education and science were essential for achieving visions of a better future for Saudi Arabia. Saudi Arabia has been open since 1932. In parallel with its economic growth, the government has gradually increased budget for science and technology (S&T).

Over the past two decades, scientific research activities have also increased substantially as reflected by the number of peer reviewed publications (Nguyen and Pham 2011; Manh 2015). However, it is not clear how much of the growth in scientific activities was driven by international collaboration, and whether the rate of collaborations has changed over time. We hypothesize that the growth in scientific research in Saudi Arabia during the past two decades has been driven by international collaboration, and that international collaboration results in higher quality research that produces a greater impact as compared to pure domestic collaboration research.

The goal of this study was to test the hypotheses by identifying patterns of collaborations (domestic and international) in Saudi Arabia scientific research by using co-authorship as a marker. We pursued three specific aims as follows: (1) to define the structure of scientific output from Saudi Arabia; (2) to determine the level of domestic and international collaborations in Saudi Arabia science; and (3) to determine the impact and quality of publications involving international collaborations publications vs purely domestic publications.

Data and methods

Data

The data used in this study were extracted from Microsoft Academic Graph (MAG) database. The Microsoft Academic Graph (MAG) is a heterogeneous graph containing scientific publication records, citation relationships between those publications, as well as authors, institutions, journals, conferences, and fields of study. The Microsoft Academic Graph (MAG) databases encompass more than 244,000,000 publications, covering all fields of scientific research. We chose the Microsoft Academic Graph (MAG) database because its large coverage scope. The Microsoft Academic Graph (MAG) is also used by used by government agencies as a tool for in-depth analyses of scientific and technological trends and the development of statistical indicators on science, technology and innovation (STI).

We downloaded the entire set of publications published in Microsoft Academic Graph (MAG) that include any of the Saudi Arabia affiliations in their affiliations during the period of 2001 and 2020. The criteria of inclusion were publications published in English language. We included conferences, books, journals, and patents. The resulting dataset included, among others, the following variables: list of authors, affiliation, area of research, and the number of citations up to 2020. Each publication included a list of institutional affiliation or affiliations of each author. For

each publication and each author, we extracted the country or countries of affiliation "Based on the information, we classified an article into one of the following three groups: (a) single authored publications; (b) national collaboration, if the publication had more than one authors' affiliations and all affiliations were based in Saudi Arabia; and (c) international collaboration, if the publication had at least one author whose affiliation was overseas.

Based on the research area classification, we grouped the articles into 19 broad groups materials science, medicine, chemistry, computer science, biology, mathematics, engineering, physics, environmental science, geology, psychology, business, geography, economics, sociology, political science, history, art, and philosophy. It should be noted that some publications were classified into more than two research areas, therefore the sum of individual research areas did not necessarily add up to the totality of publications.

Data analysis

We used mostly descriptive statistical methods to analyze the data. For trend comparison purpose, we divided the study period into four 5-year subperiods: " 2001-2005; 2006-2010; 2011-2015 and 2016-2020". The rate of growth was estimated by Computer Annual Growth Rate (CAGR), (ending Year)/(beginning year)$^{(1/(n-1)}$ -1. In this formulation, n is the number of Years in the data set.

In addition, we quantify the degree of collaboration for each research area by the collaboration coefficient (CC). The CC was determined as follows: let P_j be the number of publications with j authors, N be the number of publications, and A the maximum number of authors in a research area, the coefficient is defined as: $CC = 1 - (\sum^{A}_{j=1} (1/j)P_j /N)$. This coefficient ranges between 0 (for no collaboration, single author publications dominate) to 1 (for total collaboration).

We didn't consider quality and impact factors because they vary from time to time. For the analysis of citation, we further classified an article according to first authorship status: (1) Dom: if the article has no international collaboration; (2) IC.IA: if the article was internationally authored, and the article's first author has an overseas affiliation; and (3) IC.SA if the article was internationally authored, and the article's first author was based in Saudi Arabia.

Based on the country of affiliation, we used a network analysis method to construct a network graph of research collaborations between countries in the world, with Saudi Arabia being at the center. In this method, the weight of connection between any two countries was defined by the number of publications. All analyses were conducted using Python 3.7 and Excel Workspace on the Window platform.

Results

Trends of scientific output

Between 2001- 2020, Saudi Arabia published 181,130 publications in Microsoft Academic Graph (MAG). However, after excluding 22270 publications that had incomplete information, 158860 publications were available for further analysis. Analysis by broad research area showed that almost 73% of the publication output was concentrated on just 5 areas: materials science (18.17% of total output), followed by medicine (16.93%), chemistry (16.70%), computer science (13.10%),

and biology (8.28%). Research in mathematics, engineering, physics, environmental science, geology, psychology, business, geography ,economics, sociology, political science, history, art and philosophy each accounted for less than 8.28% of total scientific output (Fig. 1).

The number of articles has grown continuously, with the average rate of increase being 19.82% per annum. In 2020, Saudi Arabia published 21449 publications, and this output increase from 904 publications in 2001. However, there appeared to be two phases of growth. "Between 2001 and 2010, the rate of growth was approximately 13.90% per annum, and this rate was increased to 19.82% between 2001 and 2020. The research areas that recorded the strongest growth (more than 20% per year) were psychology, sociology, materials science, biology, computer science, geography, political science, philosophy and chemistry (Table 1).

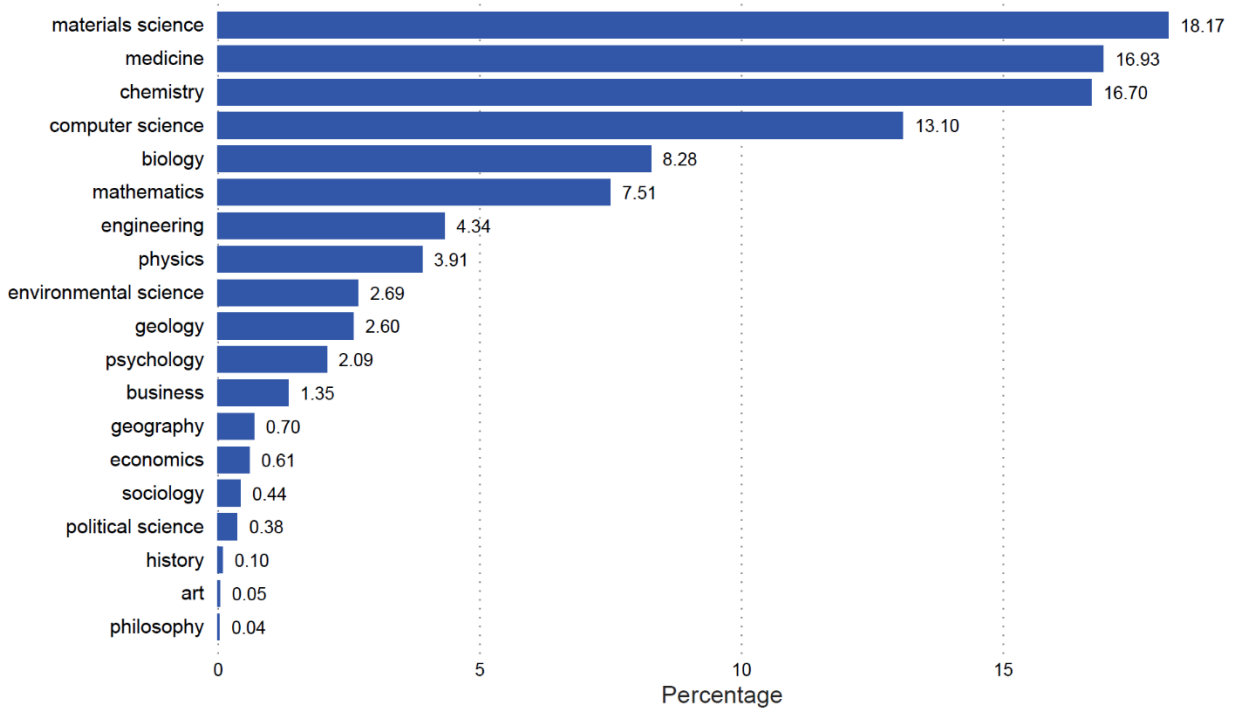

Fig. 1 Composition of scientific research output from Saudi Arabia as reflected by the proportion of scientific publication stratified by broad research area (2001–2020)

Table 1 Number of original articles from Saudi Arabia published in Microsoft Academic Graph (MAG) during the period of 2001-2020

Broad area of research	2001-2005	2006-2010	2011-2015	2016-2020	Rate of growth (%/year)
materials science	544	1405	8668	18255	23.25%
medicine	1092	2291	8227	15282	18.37%
chemistry	828	1583	8970	15142	20.02%
computer science	441	1508	6235	12630	22.49%
biology	252	809	51185	6981	23.14%
mathematics	584	1237	4672	5434	17.21%
engineering	481	1035	3383	2003	15.05%
physics	231	367	2083	3536	18.92%
environmental science	138	228	1061	2851	19.81%
geology	270	391	1292	2172	15.43%
psychology	50	137	888	2246	24.71%

business	88	189	599	1275	18.32%
geography	25	71	359	651	22.07%
economics	57	126	335	449	16.07%
sociology	13	29	254	406	23.36%
political science	14	39	169	379	21.88%
history	7	6	33	105	17.54%
art	3	7	35	40	19.24%
philosophy	2	4	26	34	20.20%
All areas	5120	11462	52407	89871	19.82%

Research collaborations

Most publications had multiple authors. Based on the number of authors, we computed the coefficient of collaboration, and results are shown in Table 2. The coefficient of collaboration increased during the study period for virtually all broad research areas.

Table 2 Coefficient of collaboration between 2001 and 2020 for broad research areas

Broad area of research	2001-2005	2006-2010	2011-2015	2016-2020
materials science	0.44	0.53	0.67	0.71
medicine	0.29	0.4	0.58	0.66
chemistry	0.5	0.57	0.7	0.73
computer science	0.38	0.48	0.58	0.65
biology	0.32	0.41	0.56	0.62
mathematics	0.32	0.41	0.56	0.62
engineering	0.36	0.45	0.53	0.6
physics	0.41	0.5	0.66	0.68
environmental science	0.46	0.52	0.62	0.66
geology	0.51	0.55	0.6	0.64
psychology	0.35	0.41	0.44	0.49
business	0.35	0.32	0.44	0.49
geography	0.28	0.42	0.51	0.63
economics	0.39	0.31	0.44	0.5
sociology	0.18	0.2	0.22	0.3
political science	0.15	0.29	0.34	0.42
history	0.18	0.24	0.16	0.29
art	0.25	0.3	0.25	0.27
philosophy	0.33	0.2	0.19	0.16
All areas	0.34	0.4	0.48	0.53

Table 3 presents the extent of domestic and international collaborations based on co-authorship in scientific publications. Overall, approximately 12.69% of publications published between 2001 and 2020 were single authored. However, the proportion of single authored publications varied between research areas, with philosophy publications having the highest proportion (74.24%), followed by art (62.35%), and history (60.93%). biology, chemistry and materials science, had a lower proportion of single authored publications.

Table 3 Saudi Arabia scientific output classified by collaborative status and research area

Broad area of research	Number of publications	Single authored publications (%)	Collaboration (domestic; %)	Collaboration (international; %)
materials science	28872	7.32%	22.70%	69.98%

medicine	26892	18.84%	28.38%	52.78%
chemistry	26523	6.35%	19.38%	74.27%
computer science	20814	11.74%	27.27%	60.99%
biology	13160	5.93%	13.24%	80.83%
mathematics	11927	15.82%	15.13%	69.05%
engineering	6902	21.01%	36.48%	42.51%
physics	6217	9.44%	13.19%	77.37%
environmental science	4278	11.31%	26.09%	62.60%
geology	4125	13.28%	34.76%	51.95%
psychology	3321	31.74%	16.65%	51.61%
business	2151	31.29%	17.11%	51.60%
geography	1106	20.98%	17.72%	61.30%
economics	967	30.61%	10.65%	58.74%
sociology	702	58.26%	10.97%	30.77%
political science	601	42.10%	12.81%	45.09%
history	151	60.93%	14.57%	24.50%
art	85	62.35%	11.76%	25.88%
philosophy	66	74.24%	9.09%	16.67%
All areas	158860	12.69%	22.57%	64.74%

All singled authored papers had affiliation in *Saudi Arabia*

Approximately 22.57% of published publications had multiple domestic authors (i.e., domestic collaboration), and 64.74% had at least one international affiliation (i.e., international collaboration). biology had the highest proportion of collaboration. For instance, 80.83% of publications in biology had at least one overseas affiliation. Between 2001-2005 and 2016-2020, the number of publications was increased by 84751, and 71% of this increase was attributable to internationally coauthored publications.

There was an increased in the proportion of international collaboration publications. During the period of 2001-2005, almost 26% of Saudi Arabia scientific output had an international coauthor or coauthors, this proportion raise to 71% during the period of 2016-2020. The increased was observed mainly in materials science, and chemistry. Nevertheless, some research areas recorded a decrease in international collaboration: engineering.

Countries of collaboration

Overall, Saudi Arabia had collaborated with more than 163 countries around the world. The top 20 countries of collaboration are shown in Table 4. Among the top 20 countries, 10 were classified as scientifically advanced or developed countries. The United States was the leading partner for Saudi Arabia, with each accounted for 18.76% of total scientific output from Saudi Arabia, and this proportion was followed by Egypt (14.10%). Collaborations with China, India, and United Kingdom also accounted for a considerable share of Saudi Arabia scientific output. In fact, the top 10 countries accounted for almost 79.43% of the collaborative publications.

Table 4 Top 20 countries that have had scientific collaborations with Saudi Arabia during the period of 2001 - 2020

Country	2001-2005	2006-2010	2011-2015	2016-2020	Total (2001-2020)	Percent of total (%)
United	454	1416	8328	14960	25158	18.76%
Egypt	142	730	6091	11955	18918	14.10%

China	22	156	2535	7607	10320	7.69%
India	41	243	2839	7084	10207	7.61%
United	191	476	3256	6082	10005	7.46%
Pakistan	38	219	2227	7239	9723	7.25%
Canada	113	355	2343	3349	6160	4.59%
Malaysia	15	152	2264	3590	6021	4.49%
Australia	28	145	1625	3321	5119	3.82%
Germany	31	199	1829	2850	4909	3.66%
France	40	181	1457	2592	4270	3.18%
Turkey	64	152	1264	2163	3643	2.72%
Italy	25	98	1190	2145	3458	2.58%
South	13	79	987	1962	3041	2.27%
Spain	9	86	1099	1694	2888	2.15%
Japan	18	107	928	1692	2745	2.05%
Tunisia	6	3	399	1709	2117	1.58%
Qatar	6	21	390	1407	1824	1.36%
Netherlands	15	60	702	1040	1817	1.35%
Iran	1	36	641	1113	1791	1.34%

Figure 2 visualizes the inter-country collaborations. Overall, there were 35 countries that formed the network structure of international collaborations in Saudi Arabia scientific output between 2001 and 2020. Evidently, the figure colored the mostly developed countries such as United States, Germany, and Canada in green.

Fig. 2 Patterns of international collaborations in scientific research based on authors' affiliations of publications that have been published in Microsoft Academic Graph (MAG) during the period of 2001 – 2020. The thickness of connected line reflects the number of jointly coauthored publications.

International collaboration and impact

Using the criteria described in the Methods section, we grouped the articles into three groups: domestic authors (DOM), internationally collaborated publications with domestic first authors (IC.SA), and internationally collaborated publications with overseas first authors (IC.IA). Overall, approximately 43.91% of total publications were IC.IA, 20.84%were IC.SA, and the rest (22.57%) were DOM.

Citation analysis

To assess the association between international collaboration and research impact, we selected a subset of articles there had been published between 2011-2015, and then determined the number of citations those publications had received after the publication. This analysis was based on the evidence that the adequate citation time window for most scientific areas is at least 5 years (Wang 2013). In virtually some scientific areas, citation rate was substantially higher for internationally authored publications compared to domestic publications (Table 5). For example, in biology, the average citation per internationally coauthored publication (81.40%) was higher than publications without international collaboration (12.09%). Moreover, in research areas such as economics, mathematics and chemistry, internationally coauthored publications higher citation rate than domestic publications.

Table 5 Average citation per publications that had published during the period of *2011-2015* classified by area of research and collaborative status.

Broad area of research	Non-international collaborative publications	International collaborative publications	Relative citation index[a]
materials science	23.45	67.29	2.87
medicine	26.51	54.6	2.06
chemistry	17.71	71.89	4.06
computer science	28.87	53.73	1.86
biology	12.09	81.4	6.73
mathematics	13.23	72.46	5.48
engineering	37.43	45.08	1.2
physics	11.8	71.77	6.08
environmental science	21.88	64.99	2.97
geology	28.56	56.48	1.98
psychology	14.78	69.91	4.73
business	19.27	53.66	2.78
geography	20.54	60.47	2.94
economics	8.81	73.57	8.35
sociology	12.9	51.61	4
political science	13.54	45.83	3.38
history	11.11	33.33	3
art	33.33	50	1.5
philosophy	0	42.86	NA 0

[a]Relative citation index in this table is defined as the ratio of the average citation of papers that had international collaborations over that of papers that had no international collaboration

Further analyses of citations by collaborative and first authorship status are shown in Fig. 3. "As can be seen from the figure, for each research area, IC.IA publications received, on average, the

highest citation, followed by IC.SA publications. Non-internationally coauthored publications had the lowest average citation rate. This trend was observed for virtually all areas of research.

Discussion

In modern scientific research, the production of scientific knowledge, either in developing or developed countries, is a collaborative effort. Collaboration between developing and developed countries can be seen as an effective approach to build research capacity for scientifically less advanced countries. An enquiry into the trend of collaboration over time could provide an indication of a country's status and useful lessons for ''science diplomacy''. Results of the present study indicate that during the past 20 years a large proportion of scientific publications from Saudi Arabia, a developing country, has resulted from international collaboration. The study shows that while international collaboration increased, the proportion of domestic collaboration decreased slightly, suggesting that the research capacity of Saudi Arabia has improved over time.

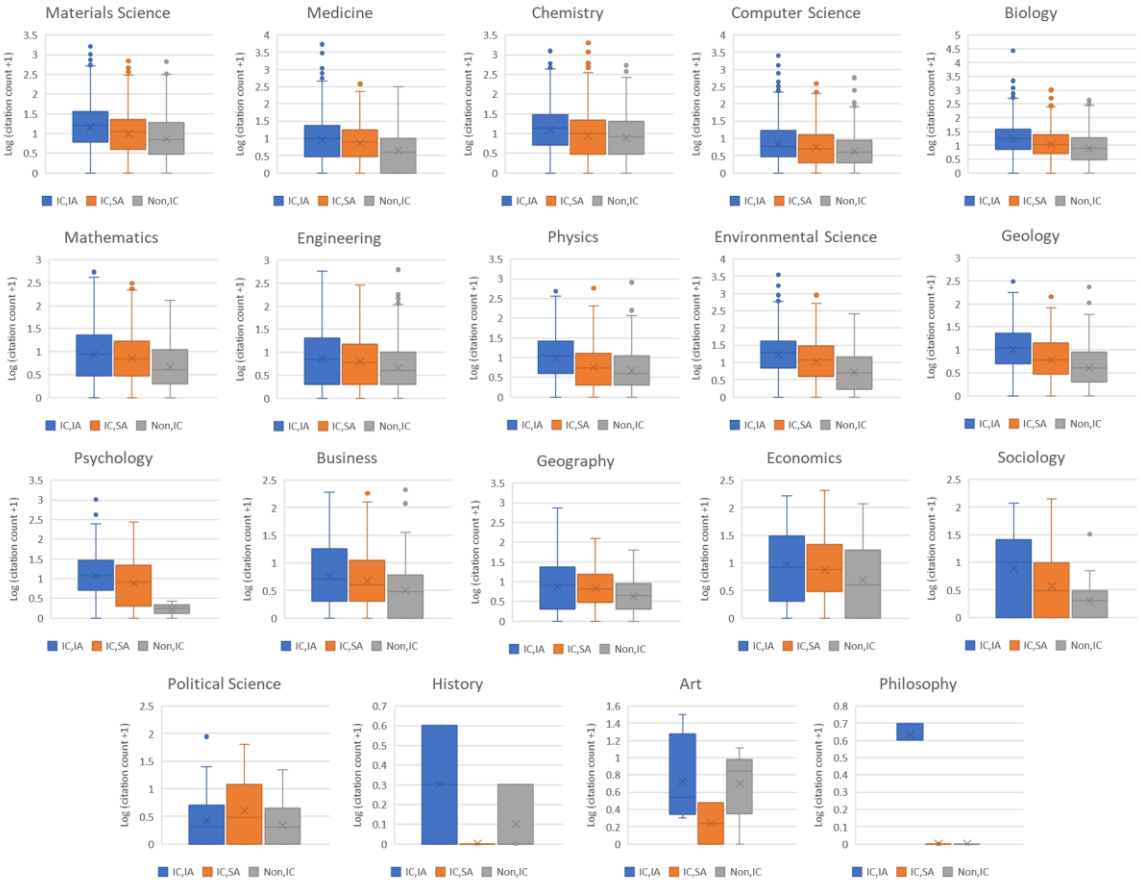

Fig. 3 Distribution of citations classified by broad area of research and first authors' affiliation. ''Dom'' non-internationally coauthored publications; IC.SA internationally coauthored publications with Saudi Arabia based first author's affiliation; IC.IA internationally coauthored publications with overseas first author's affiliation.

We would like to further elaborate five points from these primary findings:

First, our results suggest that although scientific activity in Saudi Arabia has increased substantially over the past 20 years, the proportion of the world's science coming from Saudi

Arabia is still very low. Moreover, most (64.74%) of the growth in Saudi Arabia scientific output during the past 20 years resulted from international collaboration.

Second, our results suggest that Saudi Arabia is still very much in the growth phase of research capacity building, which is characterized by a high level of international collaborations, but nonetheless, over this time, domestic output has increased. The high level of international collaborations is a feature indicating dependence on other countries for research capacity building. At present, the majority (87%) of the scientific publications from Saudi Arabia are multiauthors, indicating that research collaborations have played an important role in the production of scientific knowledge production in Saudi Arabia. In this study, we distinguished between national (domestic) collaboration and international collaboration. Only 22.57% of the total output was attributable to national collaboration, whereas 64.74% was attributable to international collaboration. It should be noted that more scientifically advanced countries such as China, Taiwan, South Korea, Turkey, and Brazil had a lower rate of international collaboration ranging between 30 and 40% (Royal Society 2011; Kim 2005). Of interest, the share of internationally authored publications has slightly increased over time. In the mean time, we note that the coefficient of collaboration has increased over time. These trends indicate that domestic collaboration was on the decline at the expense of international collaboration.

We found that international collaboration was more common in experimental research fields such as life sciences and earth science, suggesting that collaboration was more likely in the form of resource sharing. Indeed, research in the life sciences and earth science requires a heavy investment in expensive technologies that are required for experimental work which could explain the high rate of international collaboration. In clinical medicine, there are also critical needs for technical skills and data collection across countries which might account for the high proportion of multiauthored publications.

Third, Saudi Arabia has largely collaborated with more scientifically advanced countries, particularly the United States and Germany. Between 2001-2005 and 2016-2020, the number of publications with US first coauthors have increased. Increased collaboration with its former adversary, the US, can be interpreted as a sign of improved science diplomacy between the two countries to address issues of common interest, including infectious diseases and the environment.

It has been assumed that scientific collaboration could improve the quality and impact of scientific research (Katz and Hicks 1997). Our results are consistent with this assumption. We found that publications with more coauthors attracted more citations. For example, the median citation of single authored publications was only 1, but this was increased to 3for publications with 2–5 authors, and 7 for publications with more than 10 authors. Our finding is consistent with a previous study (Leimu and Koricheva 2005).

Forth, it is not surprising that publications with international authorship accrued more citations than publications without such collaboration. Indeed, internationally coauthored publications were more heavily cited as publications from domestic authors, and this finding is consistent with previous studies which found that publications with international coauthorship had a greater visibility compared with domestic publications (Katz and Hicks 1997; Glanzel 2001; Hara et al. 2003; Khor and Yu 2016). This is evidence that Saudi Arabia has benefited from international collaboration research projects.

Fifth, more importantly, we note an interesting finding that the affiliation of first authors has a significant effect on the rate of citation. Internationally coauthored publications have higher citation rates, but internationally coauthored publications with the international author of correspondence accrued even more citations than those with a domestic first author. However, it is known that the authors' affiliated country could influence the acceptability of scientific manuscripts (Baumann et al. 2011; Ceci and Peters 1982; Lou and He 2015).

However, the present findings must be interpreted within context of the strengths and limitations of the study. The major strength in this study is that we have conducted analyses on different type of publications, which allowed us to capture the full information regarding their characteristics. Our time window of 20 years should be adequate for a reliable estimate of the rate of growth, and adequate for documenting citation patterns (Wang 2013). The analysis of citations could be biased as the citation patterns may vary within a scientific area.

In summary, we have demonstrated that over the past 20 years, scientific output from Saudi Arabia has grown at the rate of 19.82% per annum, but 64.74% of the growth was associated with international collaborations, with the United States and Egypt being the most important scientific research partners. Our analysis also indicates that international collaboration has helped increase the visibility and impact of Saudi Arabia based research, which in turn, helped to enhance the country's research capacity.

References

Nguyen, T. V., & Pham, L. T. (2011). Scientific output and its relationship to knowledge economy: An analysis of ASEAN countries. Scientometrics, 89, 101–117.

Archibugi, D., & Coco, A. (2004). International partnerships for knowledge in business and academia: A comparison between Europe and the USA. Technovation, 24, 517–528.

Schmoch, U., & Schubert, T. (2008). Are international co-publications an indicator for quality of scientific research? Scientometrics, 74, 361–377.

Chen, K., Yao, Q., Sun, J., He, Z. F., Yao, L., & Liu, Z. Y. (2016). International publication trends and collaboration performance of China in healthcare science and services research. Israel Journal of Health Policy Research, 5, 1.

Low, W. Y., Ng, K. H., Kabir, M. A., Koh, A. P., & Sinnasamy, J. (2014). Trend and impact of international collaboration in clinical medicine papers published in Malaysia. Scientometrics, 98, 1521–1533.

Wagner, C. S., Branmakulam, I., Jackson, B., Wong, A., & Yoda, T. (2001). Science and technology collaboration: Building capacity in developing countries (RAND, 2001). World Bank Report MR-1357.0-WB.

Nguyen, T. V., & Pham, L. T. (2011). Scientific output and its relationship to knowledge economy: An analysis of ASEAN countries. Scientometrics, 89, 101–117.

Manh, H. D. (2015). Scientific publications in Vietnam as seen from Scopus during 1996–2013. Scientometrics, 105, 83–95.

Wang, J. (2013). Citation time window choice for research impact evaluation. Scientometrics, 94, 851–872.

The Royal Society. (2011). Knowledge, networks and nations: Global scientific collaboration in the 21st century. London: The Royal Society.

Kim, M. J. (2005). Korean science and international collaboration, 1995–2000. Scientometrics, 63, 321–339. Leimu, R., & Koricheva, J. (2005). Does scientific collaboration increase the impact of ecological articles. BioScience, 55(5), 438–443.

Katz, J. S., & Hicks, D. (1997). How much is a collaboration worth? A calibrated bibliometric model. Scientometrics, 40, 541–554.
Leimu, R., & Koricheva, J. (2005). Does scientific collaboration increase the impact of ecological articles. BioScience, 55(5), 438–443.

Glanzel, W. (2001). National characteristics in international scientific co-authorship relations. Scientometrics, 51, 69–115.

Hara, N., Solomon, P., Kim, S. L., & Sonnenwald, D. H. (2003). An emerging view of scientific collaboration: Scientists' perspectives on collaboration and factors that impact collaboration. Journal of the American Society for Information Science and Technology, 54, 952–965.
Baumann, P., Belanger, R. E., Akre, C., & Suris, J. C. (2011). Increased risks of early sexual initiators: time makes a difference. Sex Health, 8(3), 431–435.

Ceci, S. J., & Peters, D. P. (1982). Peer review–a study of reliability. Change, 14(6), 44–48. Lou, W., & He, J. (2015). Does author affiliation reputation affect uncitedness? Proceedings of the Association for Information Science and Technology, 52, 1–4.