

Assessing the Impact of R&D on Innovation in Qatar

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An Overview

- OECD (2002) defines R&D activities as "*Research and experimental development (R&D) that comprises creative work. It is carried out on a systematic basis in order to increase the stock of knowledge, include knowledge of man, cultures and society, and the use of this stock of knowledge to devise new applications*"
- Qatar and other GCC countries are endeavour to diversify their economies through increasing the share of non-hydrocarbon sector in their GDP. This includes increasing the role of innovation and entrepreneurship in the economy.

An Overview

- In doing so, GCC governments have allocated significant funds for R&D activities in order to increase the level of innovation.
- In 2008, Qatar ratified law No 24 on “Supporting and Organizing Scientific Research”, that states clearly that the government is committed to allocate 2.8 percent of its total revenue to finance R&D expenditures.
- In 2018, the government established the Research and Innovation council, which is mandated to develop strategies and to implement specific programs to support research and innovation activities.
- Nevertheless, the R&D activities in Qatar face a number of challenges that were reflected in Qatar’s ranking in Global Innovation Index (GII) as Qatar is ranked number 52 out of 132 countries in 2022

GCC Ranking in GII 2022

- Table 1: Comparative between GCC ranking in GII

NO	Country	Ranking	Input	Output
1	Bahrain	72	50	86
2	Kuwait	62	66	66
3	Oman	79	62	87
4	Qatar	52	38	67
5	Saudi Arabia	51	37	65
6	United Arab Emirates	31	18	52

Research Issue and Objectives

- This situation raises the issue of the impact of R&D expenditures on innovation in Qatar and other GCC countries consequently addressed the following research question: ***“What is the impact of R&D activities on innovation in Qatar”?***
- So, this paper aims to achieve two objectives, first is to review the relation between R&D and innovation, and the second is to examine the efficiency of R&D expenditures in GCC countries.
- We used quantitative research methods through measuring the influence of R&D expenditures on innovation by using the efficiency of productivity of R&D expenditures.



Literature review

- There are many scholarly works that examined the productivity or the performance of R&D activities employing quantitative research methods, such as regression models, panel data analysis and data envelopment analysis (DEA).
- The DEA analysis is employed by many scholars to assess the performance or productivity of R&D activities at country level or to compare between countries, for example:
- Sharma & Thomas (2008) used Data Envelopment Analysis (DEA) to explore the relative efficiency of the R&D processes in developing and developed nations. A sample of 22 developing and developed nations, which their spending on R&D exceeding 0.75% of GDP, were assessed for their R&D technical efficiency.
- They found out that only Japan, South Korea and Slovenia were achieving technical efficiency.

Literature review

- A similar study conducted by (Kocher, Luptacik et al. 2006) to assess the productivity of R&D in OECD countries using both models of DEA (CCR and BCC) during the period 1980 -1998. They found out that using CRR (Under constant returns-to-scale), the US emerges as the only efficient country. While, when they used BCC (increasing returns-to-scale), With the exception of the US, all countries in our sample display increasing returns-to-scale, and thus have the potential to raise their efficiency by scaling up their research activities.
- **In 2019, a study by Asamra, et al.** used DEA to assess the performance of R&D in Indonesia that carried out by public research institutions, where the input is number of researchers and the output is number of publications. They found out that R&D activities are close to efficiency in public research institution and the efficiency score is improving from year to another.

Literature review

- Further, this study listed previous studies that assessing R&D using DEA from the perspective input/ output as follows: Table 2

No	Researchers	performance	Input	output
1	S. Lee, and H Lee (2015)	Public research institutions: 10 government research institute that produces 1481 projects.	budget, researcher.	Publication and patent
2	M. Coccia (2008)	100 research units divided per scientific field	researcher and researcher fellow	Publication
3	P. Khoshnevis and P. Teirlinck (2018)	R&D active firms	Expenditure, R&D intensity, employee, patent acquisition.	Turnover per employee, Net added value per employee, turn over.
4	J. Park, J. Kim, and S. Sung, (2017)	Korean Public Organizations	researchers, budget, etc.	patents, papers, etc.

Research Methodology

- In order to measure the productivity of R&D expenditure, we applied data envelopment analysis (DEA) as a measure of efficiency of R&D. As it is known, productivity measures the relation between output and input which can be assessed through efficiency.
- The DEA is a nonparametric mathematical model is going to be applied to evaluate the relative or technical efficiency of comparable units (i.e. GCC countries) based on empirical data on their inputs and outputs.
- The foundation for the DEA model was laid by Farnell in 1957, and later by Charnes et al. (1978).



DEA Models

- There are two basic models of DEA:
- 1) Charnes-Cooper-Rhodes model (CCR) (implies constant returns to scale, which means that output variables increase proportionally to input variables)
- 2) Banker-Charnes-Cooper model (BCC) (assumes increasing returns to scale)

DEA Method: The characteristics of CCR model



- This model is explained through using the following way (Charnes et al. (1978), 430):

$$\max \theta_0 = \frac{\sum_{r=1}^s u_r y_{r0}}{\sum_{i=1}^m v_i x_{i0}}$$

- Subject to :

$$\frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1 \quad (j = 1, 2, \dots, n)$$

DEA Method: The characteristics of BCC model



- This model is explained through using the following way (Charnes et al. (1978), 430):

$$\max h_k = \sum_{r=1}^s u_r y_{rk} + u^*$$

- Subject to :

$$\sum_{i=1}^m v_i x_{ik} = 1$$

Empirical research - Data

Variable	Role	Definition
Gross domestic expenditure on research and development of GDP (GERD)	Input	This variable represents aggregate (business enterprise, government and higher education sector) research and development expenditure as percentage of GDP for a certain country.
Number of full-time researchers (Millions)	Output	This variable represents the number of full-time equivalent researchers per million inhabitants. Moreover, this is a direct measure of the number of research and experimental development workers.

Empirical research - Data

Variable	Role	Definition
Publications (Millions)	Output	This variable indicates the number of scientific journals (Official bulletins, magazines or publications)
Global Innovation Index	Output	This variable indicates the innovative performance of the economics each year. Moreover, it is based on global innovation trends and innovation indicators, i.e. education, infrastructure, knowledge, environment.



Results and analysis

Table 3. Efficiency scores results

DMU	2018		2021	
	CCR	BCC	CCR	BCC
Kuwait	1,00	1,00	1,00	1,00
Oman	0,29	0,31	0,54	1,00
Qatar	0,42	1,00	0,80	1,00
United Arab Emirates	0,16	1,00	0,61	1,00

Source: Own calculation.

Results and analysis

The R&D expenditures to GDP

Country Name	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average
Bahrain	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Kuwait	0.10	0.30	0.30	0.30	0.22	0.14	0.06	0.10	0.15	0.19	0.19
Oman	0.21	0.17	0.21	0.25	0.24	0.23	0.22	0.27	0.32	0.37	0.25
Qatar	0.47	0.48	0.50	0.51	0.51	0.51	0.51	0.57	0.62	0.68	0.54
Saudi Arabia	0.07	0.13	0.19	0.25	0.30	0.34	0.39	0.43	0.48	0.52	0.31
UAE	0.70	0.70	0.70	0.70	0.90	1.10	1.30	1.35	1.40	1.45	1.03

Concluding remarks

- The results show that among the observed countries for the period 2018 and 2021 only Kuwait is technically efficient based on both DEA model (score 1.00).
- In 2021 the situation is better, since all analysed countries are efficient, but only in BCC model.
- The country with lowest efficiency score in both DEA models is Oman. This can be explained by low research and development expenditure in all sectors, as well as with low number of employed researchers.



Concluding remarks

- This study compared the efficiency of R&D expenditures in Qatar compared with other GCC countries using DEA model. Through using the secondary data that available by statistical authorities in these countries, we tested the model. We found out that in 2008, the State of Qatar embraced the Qatar National Vision 2030, whose goals include transforming Qatar's economy into a knowledge-based economy.
- Therefore, R&D has been and continues to be an essential component in order to improve innovation performance. Based on DEA analysis, Qatar achieved score 1,00 in BCC model for analysed years.



Concluding remarks

- This can be explained by the fact that Qatar wants to significantly improve innovation performance, since this model assumes increasing returns to scale. Moreover, the share of R&D expenditure on higher education decreased by 10%, while the share of the business sector increased by 6.5%, and the government sector increased by more than 38% in 2021 compared to 2018.
- Limitation of the paper – lack of data for GCC countries for longer time period



Thank you for your attention



Q&A

