International Journal of Information Science and Management
Vol. 22, No. 4, 2024, 19-38
DOI: https://doi.org/10.22034/ijism.2024.2015610.1296 / DOR: https://dorl.net/dor/20.1001.1.20088302.2024.22.4.2.5

Original Research

Factors Affecting the Quantitative Growth of Iran's Scientific Production after the Islamic Revolution of Iran

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Received: 13 November 2023
Accepted: 19 February 2024

Abstract

The number of papers and scientific productions published in journals indexed in indexing/abstracting databases is used as a measure of the growth of science. One of the reasons for the ability of the Islamic Republic of Iran in various fields can be attributed to the scientific growth of Iran in recent years. This survey used scientometric approaches for measuring the scientometric indicators at hand. The research population included all papers authored by Iranians indexed in Web of Science (WOS) from 1980-2021. Accordingly, in this research, the quantitative growth of Iranian science during the four decades after the Islamic Revolution of Iran (by counting the number of indexed papers in the Web of Science) and the factors affecting the growth of Iranian science are examined. Factors such as the growth in the number of faculty members, the growth in the number of graduate students, the promotion regulations of the Ministry of Science, Research and Technology (MSRT) and the Ministry of Health, and Medical Education (MHME) along with encouraging policies for scientific production in Iran and the comprehensive scientific map of the country, Scientific research towards the needs and priorities of the country, the graduation regulations of graduate students, other social, political, cultural and international factors analyzed. The results of the four decades of Iran's science production showed that the highest amount of Iran's science production, i.e., more than 75% of Iran's science production, occurred in the fourth decade (2011-2021). In general, in the second period (2001-2021), the relationship between academic degrees and science production is significantly higher than in the first period (1980-2000). In 2023, Iran will be the fourth largest producer of nanoscience in the world with 7.30 percent of the world's science production in the field of nanoscience, and countries such as Japan, South Korea, Germany, France, England, and Italy are after Iran. The results of analysis and investigation of the research also showed that the number of graduates at both master's and doctorate levels, as well as the population of full-time faculty members of the universities, were proportional with the production of Iranian science in these years There has been an increasing trend from 1980 to 2021. Despite the ups and downs of the share of research in the gross national product in Iran, which has always decreased and was less than one percent, the growth of science in Iran has been on an upward trend. According to the number of Iranian scientific publications in the WOS database at the end of 2021, which has reached 56,000, it seems that due to the growth of Iran's scientific productions, we can hope that the number of Iranian scientific publications will reach 2026 (1404) by the end of the Horizon program has arrived.

Keywords: Science Growth, Iran, Science Production.

Introduction

Science has a social nature that is the production of human intellect and some factors are active in its development or recession, including its approaches, norms, and features of scientific institutions, and external factors affecting science (Ghadir Danesh, 2011). Scientometrics tends to study the quantity features of scientific activities by considering the four variables: authors, publications, citations, and references (Davarpanah, 2007). As one of the pioneering researchers in scientific development, Price tried to study the cumulative and quantity/mathematical aspects of the science. His scientific growth pattern combined period and scientific growth (Fernandez-Cano, Torralbo & Vallejo, 2004). These studies established scientometrics and developed scientometric studies for investigating the science and research development of agents and role-players, such as individual countries (Mokhtari, Barkhan, Haseli & Saberi, 2020).

The growth of higher education and training specialist human resources resulted in the quantitative growth in scientific development in Iran. Iran's world rank in scientific production shows that quantification and qualification both need to be developed to enhance the country's main role in the World's educational system (Saboury, 2021). However, it appears that despite the scientific growth during the last 40 years (after the occurrence of the Islamic Revolution of Iran), the level of scientific innovations and dissemination of research findings have not been developed under the scientific growth theories and criteria. In other words, despite speedy growth in sciences, the original cognitive growth in sciences has been ignored (Davarpanah & Fakhartabasi, 2021).

To clarify the growth trend of scientific research in Iran, it can be said that the share of Iran increased from .0003% in 1970 up to .29% in 2004 and 1.02% in 2008, reflecting 340% of scientific growth during 37 years (Etemad, Emami, Heidari, Sarbolouki & Mehrdad, 2003). Iran's contribution to the World's scientific research has increased ed by up to 2% in some fields, such as agriculture and engineering during 2009 and 2010. Iran ranked first in scientific research in the Middle East and 15th in the World in 2020 (Saboury, 2021), overtaking what was predicted in the Iran Vision Document for 2025. Despite this growth rate, its contribution to paper citations and research quality lagged far.

Many scientometrics studies focused on scientific growth. Larsen and Von-ins (2010) studied the rate of scientific publication in SCI and SSCI during 1907-2007 and found that traditional scientific publishing that is publication in peer-reviewed journals is still increasing although there are big differences between scientific fields. There are no indications that the growth rate has decreased in the last 50 years. Publication using new channels is growing fast. The growth rate for SCI up to 2007 is smaller than for comparable databases. This means that SCI was covering a decreasing part of the traditional scientific literature. There are also clear indications that the coverage by SCI is especially low in some of the scientific areas with the highest growth rate, including computer science and engineering sciences. The new publication channels challenge the use of big databases in measurements of scientific productivity or output and the growth rate of science. The limited data available for social sciences show that the growth rate in SSCI was remarkably low and indicates that the coverage by SSCI was declining over time. Moed, van Leeuwen & Visser (1999) trends in the research output and impact of universities in the Netherlands are examined, as reflected in scientific articles in journals

processed for the Science Citation Index. At the level of sub-fields in the natural, technical, and life sciences, there has been hardly any concentration of research activities among Dutch universities during the 80s and 90s. In the 80s and to a lesser extent in the 90s, leveling of universities' research output in natural and life sciences is a dominant trend.

Saboury's (2011) research shows that Iran's science production has been promoted from 1.01 percent in 2009 to 1.12 percent in 2010. Iran was among the 22nd science-producing countries in the world regarding scientific ranking (Noroozi Chakoli, Hassanzadeh & Nourmohamadi, 2010). Considering the number of indexed scientific productions in WOS, Iran was in a satisfactory position in terms of the growth rate. According to the statistics of ESI, Iran was in second place after Turkey among Islamic countries and the fortieth in the world, during the last ten years. Baskurt (2011) studied the yearly number of articles having an Akdeniz University address that appeared in the Web of Science (WoS) from 1996 to 2009. Time series analysis of the number of published articles was used to determine the impact of alterations in the number of faculty members and research funding as well as changes in the institutional and country-wide research support policies and encouragement mechanisms. Alterations in both the number of faculty members who are active in research and the total amount of research funding each year explained the general pattern of published articles. However, there was a period with significant deviations from the trend predicted by these relationships. This period, corresponding to the years 2002–2008, is discussed in terms of the effects of policy changes which may have positive and negative contributions to the predicted pattern. Moed (2018) showed that Russian publication counts strongly depend upon the database used, and upon changes in database coverage, and that one should be cautious when using indicators derived from WoS, and especially from Scopus, as tools in the measurement of research performance and international orientation of the Russian science system.

The research funds in the developing countries, including Iran have a small share of gross national product (about .5%) compared to that of developed countries (about 4%). On the other hand, an increase in gross national product increases the research funds and consequent scientific production (Baskurt, 2011). As a result, it is needed that the effect of encouraging policies on scientific production be investigated. Other affecting factors in the scientific development of Iran after the Islamic Revolution are the increased number of faculty members and graduate students, policies on the Country's Comprehensive Scientific Map and Iran Horizon for 2025, main revisions in faculty member promotion approaches in research institutions, and so on. Hart and Sommerfeld (1998) linearly correlated the growth in the gross domestic product (GDP) with the academic chemical engineering literature over a recent 26-year period for five different English-speaking countries The publication figures were also scaled to the total number of chemical engineering schools in the country; furthermore, all of these data were normalized from zero to unity, using the figures for the most recent year (1996) as the denominators, and then linearly correlated against each other. The resulting confidence levels were more than 99% for each of the individual five countries, as well as for the entire set of normalized data for all of the countries.

Chen and Dahlman (2004) assessed the effects of knowledge on economic growth. By using an array of indicators, each of which represents an aspect of knowledge, as independent variables in cross-section regressions that span 92 countries for the period 1960 to 2000, they show that knowledge is a significant determinant of long-term economic growth and 1% growth in the scientific publication can result in .22% growth in annual economic growth. One of the

factors influencing the scientific growth of Iran has been the science and technology incentive policies that have been formulated by MSRT and MHME. To create a suitable platform for promoting research activities and increasing its qualitative and quantitative level, as well as promoting Iran's contribution to the production of global knowledge, it is necessary to encourage articles published in international and domestic prestigious journals from the credit available in the research budget of that institution.

To coordinate the promotion of articles for all universities, research institutes, and educational and research institutions across the country, a regulation has been prepared and communicated to the universities and research institutions, which is referred to as science promotion policies. The meaning of incentive policies in this research is the policies formulated by MSRT and MHME to encourage their faculty members and graduate students to research and produce national and international articles. One of the factors influencing the growth of Iranian science, in addition to the science and technology incentive policies, are faculty members and graduate students at the two levels of master's degree, doctorate, and doctorate in veterinary medicine, and the growth of Iran's scientific productions in international citation indexes is due to their efforts.

A faculty member is a person who is in official or contractual employment at a higher education center affiliated with MSRT and MHME and is obliged to work all the hours of his daily work in that center. Researches and teaches. A graduate student is a person who is enrolled in a master's degree or doctorate (professional or specialized) in one of the higher education centers affiliated with the ministries of science, research and technology, and health, treatment, and medical education and is engaged in studies. Considering the increase in the number of university faculty members, as well as the increase in the number of post-graduate students and the government's policies to encourage the production of science and technology in recent years, it is necessary to investigate the mentioned factors to determine the relationship between these factors and the growth of the number of Iranian scientific articles. Indexed in ISI should also be examined and analyzed.

Regarding related research in Iran, it can be deduced that the international scientific growth in Iran during the second and Four decades after the Islamic Revolution of Iran is the result of some factors such as ending the Ian-Iraq War, better economic states, encouraging policies for research and scientific publication as well as accessing scientific databases and making electronic platforms for scientific contribution and increase in students majoring in higher education fields (Osareh & Wilson, 2000). Moed (2016) argued that Iran developed its research and development structure in recent three decades by relying on its capacities. He believes political changes in the Middle East have come true in the Gulf States' national scientific research systems, to the extent that Iran has become by far the leading country in the Persian Gulf, and Southeast Asian countries including China and, Malaysia in 2015, and South Korea have become major scientific collaborators, displacing the USA and other large Western countries. However, collaboration patterns among Persian Gulf States show no apparent relationship with differences in Islam denominations.

In the research conducted inside the country, the statistics of Iran's science production in ISI have been examined in different years, which is based on quantitative productions and the share of Iranians in world publications, and the factors affecting the growth of science in Iran have not been studied. Regarding the research related to the production of science, Saboury and Poorsasan (2006), Saboury (2006), Noroozi Chakoli et al. (2010), Moein, Mahmoudi and

Rezaei (2007), Alijani and Karami (2007), Saboury (2010) and Niakan (2010) in their researches have studied the statistics of Iran's science production in ISI in different years, which has looked at the quantitative production and the share of Iranians in world publications. The studies showed the growth of science production in Iran and also Iran's greater contribution indicated its participation in the production of world science.

The ups and downs of Iran after the Islamic Revolution have affected its scientific trends and the scientific development in Iran as one of the bases for the country's development during the first four decades of the Revolution (1980-2022) should be evaluated. This study aimed to evaluate the quantitative scientific growth in Iran after the Islamic Revolution and the main affecting factors such as the number of faculty members and graduate students, encouraging policies, and faculty member promotion regulations.

Materials and Methods

This survey used scientometrics approaches for measuring the scientometrics indicators at hand. The research population included all papers authored by Iranians indexed in the Web of Science (WOS) from 1980-2022, In December 2023, by referring to the WOS database and using the advanced search section of the WOS, all scientific products of Iran were extracted from this website with the Address field and the period from 1980 to the end of 2021, and the articles and scientific products of Iran in this time It was analyzed by Refine by Countries/Regions. The total data related to Iran's scientific products in this database is 514870 documents. The research data was extracted through the search in the advanced search section of the International Web of Science reference database. The search formula in the advanced search section of the Web of Science citation database is as follows:

AD=Iran

Timespan: 1980-01-01 to 2021-12-30 (Index Date)

all faculty members and graduate students of Iranian universities under the supervision of MSRT and MHME during 1980-2021.

For gathering data, a search was done in the WOS address section by limiting the results to the period of 1980-2021 to search papers produced by Iranian authors/affiliations/research institutes. The annual numbers of full-time faculty members and graduate students were collected from the Higher Education Research and Programming Organization (Institute for Research and Planning in Higher Education, 2021) which maintains the higher education statistics for MSRT and MHME. The contents of faculty member promotion regulations and encouraging policies for authoring research papers in the two ministries as well as the text of Iran's comprehensive scientific map were analyzed too.

Results

The growth of science in Iran after the Islamic revolution has been affected by various factors and indicators. These factors were further investigated and based on that, the conceptual map of the research was formed, which is shown in Figure 1. Scientific growth of Iran includes the Promotion Regulations of MSRT and MHTME, faculty members, graduate students, a scientific map of Iran, scientific research towards the needs and priorities of the country, the graduation regulations of graduate students, and other social, political, cultural, and international factors.

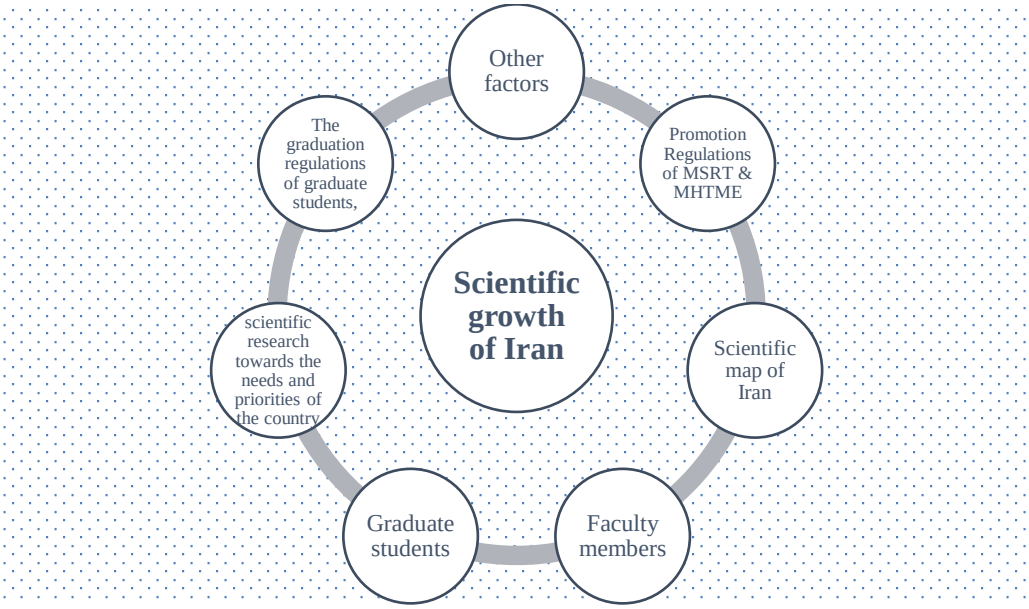

Figure 1: Conceptual Map of The Research: Analysis of the Conditions of the Growth of Science in Iran after the Iranian Islamic Revolution.

Table 1 shows the annual trend of growth in Iran's scientific production during 1980-2021. In the first decade, the growth was low due to the events just after the Revolution and the war of Iraq against Iran. In the second and third decades, especially in the fourth decade, the growth has been considerably increased. This is tangible from 2004 and the highest growth rate belonged to the fourth decade after the Revolution, with a share of 75% of all growth rates in the period.

Table 1
Iran's Annual Scientific Production during 1980-2021

Year	No. of papers	% of total production	Year	No. of papers	% of total production
1980	342	%0.066	2001	1811	%0.351
1981	266	%0.051	2002	2452	%0.476
1982	163	%0.031	2003	3306	%0.642
1983	152	%0.029	2004	4359	%0.846
1984	141	%0.027	2005	5699	%1.10
1985	138	%0.026	2006	7386	%1.43
1986	184	%0.035	2007	10706	%2.07
1987	163	%0.031	2008	13632	%2.64
1988	165	%0.032	2009	16850	%3.27
1989	152	%0.052	2010	19602	%3.81
1990	189	%0.036	2011	25489	%4.95
1991	236	%0.045	2012	27319	%5.30
1992	257	%0.049	2013	28183	%5.47
1993	333	%0.064	2014	30215	%5.86
1994	388	%0.075	2015	31715	%5.796
1995	488	%0.094	2016	36055	%6.15
1996	612	%0. 118	2017	39578	%7.68

Year	No. of papers	% of total production	Year	No. of papers	% of total production
1997	738	%0.143	2018	42326	%8.22
1998	1045	%0.202	2019	48945	%9.50
1999	1187	%0.230	2020	54414	%10.56
2000	1471	%0.285	2021	56018	%10.88
Total	514870	100			

Figure 2 better depicts the growth trend of scientific production in Iran during 1980-2021. As the figure shows, the speedy growth starts from the third decade (2000-2010) and reaches the top in the fourth decade.

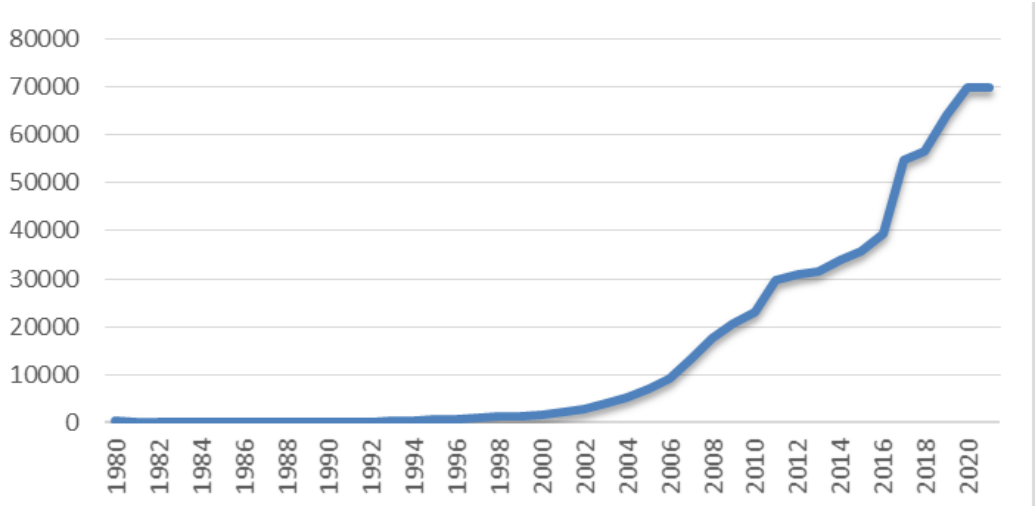

Figure 2: The Growth Trend in Iran's Scientific Production dring 1980-2021

For analyzing the effect of the number of full-time faculty members and graduate students on the growth rate of scientific production, the annual number of these groups in MSRT and MHME during 1980-2021 was collected and compared with the number of papers indexed during these years. Table 2 shows the annual number of graduate students (separated by their educational level) in comparison with the number of papers published during the studied years. The table shows that growth trends in graduate students and scientific production in these years were not uniform.

Table 2

The Annual Number of Graduate Students in MSRT and MHME Compared to the Number of WOS-Indexed Papers Published by Iranians from 1980-2021

Year	No. of papers	MD	PhD	MS	Total
1980-1981	342	1200	724	1840	3764
1981-1982	266	700	650	850	2200
1982-1983	163	500	254	247	1001
1983-1984	152	831	436	206	1473
1984-1985	141	2787	203	366	3356
1985-1986	138	2972	181	847	4001
1986-1987	184	4811	88	1499	6398

Year	No. of papers	MD	PhD	MS	Total
1987-1988	163	5876	564	1469	7909
1988-1989	165	5752	650	1802	8204
1989-1990	152	5800	800	1850	8450
1990-1991	189	4784	1037	1989	7810
1991-1992	236	4847	1023	2087	7958
1992-1993	257	4868	1282	4112	8237
1993-1994	333	4418	1544	4181	10143
1994-1995	388	4668	1866	4158	10692
1995-1996	488	4895	1861	5596	12352
1996-1997	612	4964	1839	6730	13533
1997-1998	738	501	1920	7197	14132
1998-1999	1045	4899	2073	7861	14833
1999-2000	1187	3978	1719	7980	13677
2000-2001	1471	4038	1868	9249	15155
2001-2002	1811	3374	2421	9932	15727
2002-2003	2452	3328	2440	10902	16670
2003-2004	3306	3303	2902	14104	20309
2004-2005	4359	3403	3220	16863	23486
2005-2006	5699	42838	15836	76588	135262
2006-2007	7386	41136	16899	80377	138412
2007-2008	10706	40475	19309	92991	152775
2008-2009	13632	43377	27190	146605	217172
2009-2010	16850	47725	31456	183426	262607
2010-2011	19602	49581	35106	228602	313289
2011-2012	25489	53101	39525	290672	383305
2012-2013	27319	52973	47315	405042	505330
2013-2014	28183	60900	58683	454978	574561
2014-2015	30215	67221	73437	580000	720658
2015-2016	31715	71914	94410	722253	888577
2016-2017	36055	78015	115191	774766	967972
2017-2018	39578	84429	140558	764370	989357
2018-2019	42326	87494	141077	656286	884857
2019-2020	48945	93335	152006	598890	844231
2020-2021	54414	95412	147409	513342	756163
2021-2022	56018	102279	163934	500471	766684

However, these two growth rates were proportional. Figure 3 better depicts these trends.

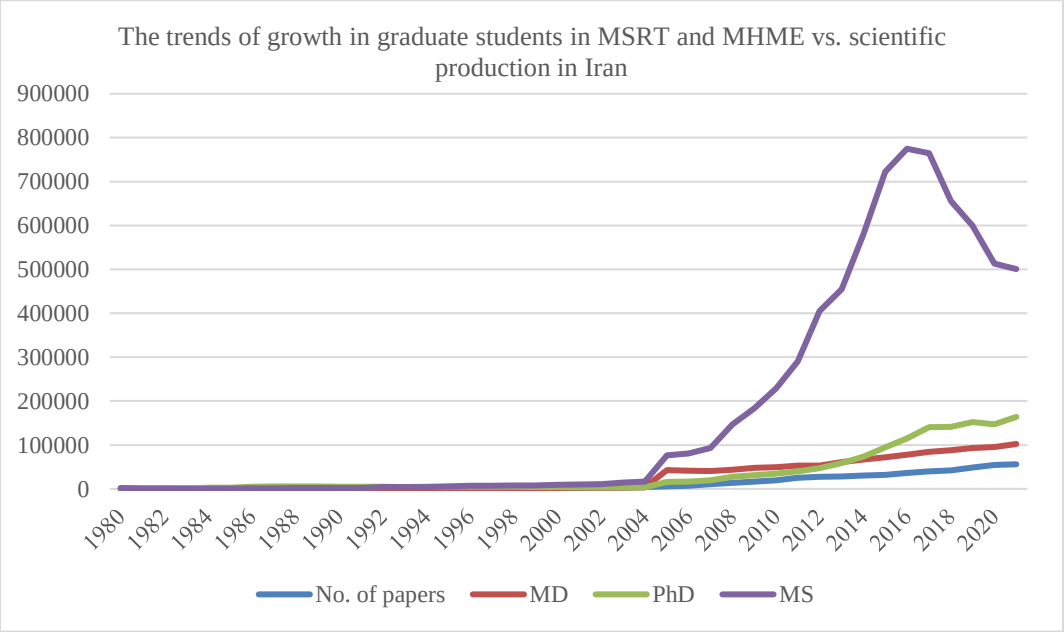

Figure 3: The Trends of Growth in Graduate Students at MSRT and MHME vs. Scientific Production in Iran dring 1980-2021

Table 3 compares the number of full-time faculty members (separated by their scientific ranks) affiliated with the studied ministries with the number of WoS-indexed papers published under the name of Iran in the studied period.

Table 3
Comparing the Number of Full-Time Faculty Members (Separated by their Scientific Ranks) with the Number of WoS-Indexed Papers by Iranians

Year	No. of papers	Instructor	Lecturer	Assistant professor	Associate professor	Full professor	Total
1980-1981	342	1224	3787	2974	990	604	9579
1981-1982	266	1667	3046	2657	1047	663	9080
1982-1983	161	1000	3000	2650	800	550	8000
1983-1984	152	1100	2800	2700	750	450	7800
1984-1985	141	650	3046	2809	654	259	7418
1985-1986	138	1023	3261	3020	648	288	8240
1986-1987	184	1357	3317	2960	641	325	8600
1987-1988	163	1143	3401	2979	689	374	8586
1988-1989	165	1297	3668	3071	683	352	9071
1989-1990	152	1431	4302	3292	643	353	1021
1990-1991	189	720	4400	4200	780	406	10506
1991-1992	236	555	4574	4513	883	428	10953
1992-1993	257	466	5388	4744	903	460	11961
1993-1994	333	488	7259	5792	1105	512	15156
1994-1995	388	598	7505	6137	1186	536	15962
1995-1996	488	548	8035	6474	1227	551	16835
1996-1997	612	566	8548	6867	1137	563	17681
1997-1998	738	454	8703	6958	1287	587	17989
1998-1999	1045	531	8659	7411	1259	603	18499

Year	No. of papers	Instructor	Lecturer	Assistant professor	Associate professor	Full professor	Total
1999-2000	1187	579	8313	7276	1356	643	18168
2000-2001	1471	473	8418	7862	1371	689	18813
2001-2002	1811	340	8196	8929	1529	852	19846
2002-2003	2452	320	8429	8848	1680	874	20151
2003-2004	3306	374	8429	9522	1870	947	21142
2004-2005	4359	319	8379	10377	1966	959	22000
2005-2006	5699	317	8243	11448	2305	1098	23411
2006-2007	7386	333	7921	11498	2714	1285	23751
2007-2008	10706	884	20281	14992	2929	1450	40536
2008-2009	13632	713	27104	20040	3742	2036	53635
2009-2010	16850	996	27708	20691	4123	2069	55587
2010-2011	19602	1222	28598	24780	5567	2588	62755
2011-2012	25489	1488	28723	25137	5762	2708	63818
2012-2013	27319	2511	28789	26594	6364	2840	67098
2013-2014	28183	1416	29021	28319	6789	3007	68552
2014-2015	30215	680	28897	30678	7304	3281	70840
2015-2016	31715	525	28344	34293	8949	4018	76129
2016-2017	36055	224	27961	37477	9806	4629	80097
2017-2018	39578	268	24192	39731	10975	5147	80313
2018-2019	42326	263	23767	42942	12330	6296	85598
2019-2020	48945	206	22793	43911	13021	6328	86259
2020-2021	54414	201	21996	44367	13855	6856	87275
2021-2022	56108	200	21327	44037	14294	7031	86889

As can be seen, the number of faculty members and the number of published papers both increased steadily in these years. Figure 4 depicts the trend.

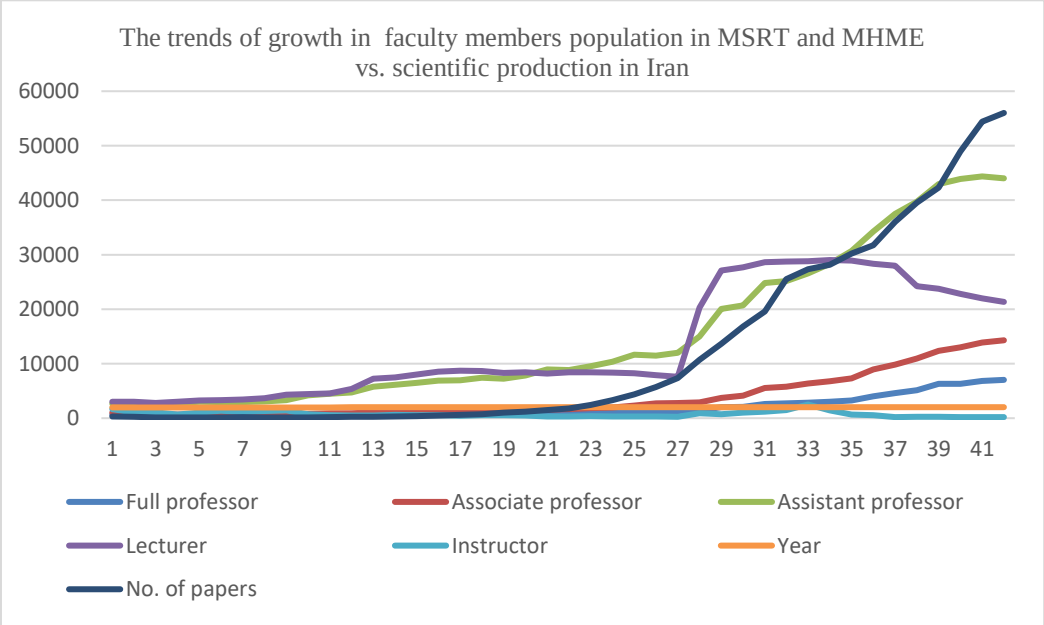

Figure 4. Number of Full-Time Faculty Members (Separated by their Scientific Ranks) In MSRT and MHME with the Number of Iran's WOS-Indexed Papers (1980-2021)

Pearson's correlation test was used to determine the relationship between scientific degree variables, as well as scientific rank and the amount of science production (Table 4). It should be noted that the sample included 42 cases (42 years), which reflects scientific productions in a period of 42 years. According to Table 4, the results indicated the existence of a significant relationship between scientific degree and science production. In this way, the highest correlation coefficient was related to a doctorate and then a professional doctorate. In the case of the scientific rank, the two relationships of full professor and assistant professor had the highest significant relationship with science production, and educational instructor had the lowest relationship. Also, the relationship between the instructor and science production was negative and insignificant (this is because the number of instructors has decreased over time).

Table 4

Pearson's Correlation Coefficient Relationships in the Entire Sample

		MD	PhD	MS	Full professor	Associate professor	Assistant professor	Lecturer	Instructor
No. of papers	Pearson Correlation	.944**	.950**	.924**	.989**	.993**	.985**	.807**	-.163
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.302
	N	42	42	42	42	42	42	42	42

** indicates significance

To compare the above relationships in two time periods from 1980 to 2000 and from 2001 to 2021, similar statistical analyzes were performed (Table 5). According to Table 5, the results indicated that a different correlation pattern prevails between the variables in some cases in these two decades. Thus, in the first 20-year period, there was no correlation between a doctorate and science production, while in the second period, this relationship was significantly high and significant.

In general, in the second period, the relationship between academic degrees and science production is significantly higher than in the first period. Also, regarding the relationship between scientific rank and scientific production, except for the scientific rank of the instructor, in other cases, the correlation between scientific rank and scientific production increased significantly in the second period. But in the case of the lecturer, this relationship has become negative and significant in the second period.

Table5

Pearson's Correlation Coefficient Relationship Between Two Periods of Iranian Science Production

Period			MD	PhD	MS	Full professor	Associate professor	Assistant professor	Lecturer	Instructor
First period (1980-2000)	No. of papers	Pearson Correlation	.739**	.160	.915**	.854**	.858**	.839**	.719**	-.521*
		Sig. (2-tailed)	.000	.489	.000	.000	.000	.000	.000	.016
		N	21	21	21	21	21	21	21	21
Second period (2001-2021)	No. of papers	Pearson Correlation	.886**	.936**	.860**	.981**	.989**	.985**	.604**	-.083
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.004	.722
		N	21	21	21	21	21	21	21	21

** indicates significance

For monitoring the possible effect of encouraging policies for scientific production and faculty member promotion regulations on scientific production in Iran, the content of related policies and regulations was analyzed. Regarding the regulations for faculty member promotion, three documents approved during the studied period for the promotion of faculty members in the two ministries were studied and related items on the third close of the documents (regarding research activities) were explored and analyzed. Table 6 shows some items that regard scientific production noted in different faculty member promotion regulations in the two studied ministries. These items show the importance of indexed papers in promoting Iranian faculty members and the consequent effect on scientific production at an international level.

Table 6
Items Regarding Scientific Production Noted in Different Faculty Member Promotion Regulations

MHME	MSRT
- Dedicating certain scores for publishing scientific papers in internal and international research journals	- Dedicating certain scores for publishing scientific papers in internal and international research journals based on the prestige of the journal at hand (Item 2-4)
Scoring .5-5 for original research papers indexed in ISC and/or ISI-indexed journals	2/3 of the minimum scores needed for promotion from associate professor to full professor should be achieved from papers published in ISC or ISI-indexed journals.
To promote to full professor rank, an ISI-indexed paper with three citations is needed for educational faculty members. To promote to full professor rank, 3 ISI-indexed papers with three citations are needed for research faculty members.	Dedicating the highest score for highly-cited or hot topic papers published in ISI or high-prestige indexing databases

Considering encouraging policies for scientific development and growth, the documents that have been formally approved in MSRT from 2004 were analyzed. In encouraging policies for MSRT, it has been noted that all educational and research faculty members with ISI-indexed and ISC-indexed papers where Iranian-related institutes and universities are affiliated should be encouraged. In encouraging documents approved by MHME, the Research Deputy should encourage and financially support Iranian authors publishing papers in high-prestige journals indexed in International-level databases. Therefore, some points can be argued by considering the related items included in faculty member promotion regulations and policy documents for encouraging scientific production as follows:

1. Encouraging authors to write papers for journals indexed in high-prestige indexing databases, such as ISI motivates Iranian researchers to author in Internationally-scoped and known indexing databases.

2. From 2004, with the enforcement of some encouraging policies in MSRT, the scientific production made by Iranian researchers has increased as can be seen in Table 1. The scientific production rate was 20% during 1980-2004 and has increased up to 75% during the last decade (2011-2021) as the result of these policies and regulations.

3. Despite no encouraging items in the promotion regulations of 1998, that of 2008 and

the encouraging policies of 2005 emphasized the necessity of publishing papers in internationally indexed journals. This positively influenced the scientific publication growth at an international level in recent years.

Scientific map of Iran

Another factor that has been investigated regarding the growth of Iranian science after the Islamic Revolution of Iran was the comprehensive scientific map of the country. In 2013, the Supreme Council of the Cultural Revolution (2013) approved the comprehensive scientific plan of the country to achieve the lofty ideals of the holy system of the Islamic Republic of Iran and notified various organizations of the country for implementation. In the second chapter of the Comprehensive Scientific Map of the Country, the Islamic Republic of Iran, indicators for the favorable state of Iran's science and technology in the 2026 (1404) horizon of the map are presented. In this research, the indicators of the state of scientific publications in Iran are examined based on the goals of the comprehensive scientific map of the country.

The index of the number of Iranian articles per million people of Iran's population

Iran's number of articles per million people (PPP1) or per capita index of scientific publications (PPC2) is one of the important indicators in the comprehensive scientific map of the country. This index is obtained by dividing the number of articles in the country by the country's population (million people). In the comprehensive scientific map of the country, 800 articles per million people are targeted in the horizon of 1404. The current population of Iran is 85 million people according to the Statistical Center of Iran (2023). Iran's science production in the WOS database at the end of 2021 was 56,000 scientific documents. According to the forecast of the Statistical Centre of Iran, the population of Iran will reach 87.7 million people by the end of 1405, according to the population growth rate of 1.24 announced by the Statistical Centre of Iran, the forecast of the population of 1404 will be 87 million people, and according to the per capita index Scientific publications of the comprehensive scientific map of the country, Iran's scientific publications should reach the number of 69,600 scientific documents by the end of 2026 (1404).

87 ×800= 69600

According to the number of Iranian scientific publications in the WOS database at the end of 2021, which has reached 56,000, it seems that due to the growth of Iran's scientific productions, we can hope that the number of Iranian scientific publications will reach 2026(1404) by the end of the Horizon program has arrived.

Index of the ratio of the number of internationally indexed articles in Iran to the number of faculty members

One of the indicators of research productivity is the ratio of internationally indexed articles to the number of faculty members (Starovoytova, 2017; quoted by Janavi, Moradi, Pakzad, 2020). In the comprehensive scientific map of the country, the optimal value of 0.4 for the year 2026 is considered for this index. According to the latest official statistics of the Higher Education Research and Planning Center, the population of academic staff members in the

[1]. Publication Per Population
[2] . Publication Per Capita

country is currently 86,889 according to the data in Table 3, and the number of scientific productions of Iran in the WOS database in 2021 is 56,000 scientific documents. According to this index, at the end of 1404, the number of indexed articles of Iran in the WOS international database should reach 34,400, which seems that the estimate of the comprehensive scientific map of the country has been realized before the end of the perspective of 2026, and the estimated amount of the comprehensive scientific map The country has not been a suitable target.

86000 x 0.4 = 34,400

Scientific research on the needs

Another factor that can affect Iran's scientific growth is scientific research in line with the country's needs and priorities. In this regard, it can be said that the country's needs and priorities have become more and more diverse due to various economic sanctions. Scientific fields such as biological technologies, optics and quantum, nano and micro, regenerative medicine, stem cells, and cognitive sciences, which are considered high-tech sciences, are among the priorities supported by the Scientific Vice President of the Islamic Republic of Iran. As stated, one of the supported and scientific priority areas of the country has been the field of nano and micro technologies.

Iran Nanotechnology Innovation Council

Nanotechnology development activities in the country started in 2000 year. In 2002, with the identification of nanotechnology as a technology with national priority, a special headquarters for the development of nanotechnology was formed to follow the development of this technology in the country.

The vision of the Iran Nanotechnology Innovation Council (INIC) for the development of nanotechnology was to develop the country's long-term activity framework in this field, and in this direction, the ten-year strategic program of nanotechnology was prepared in the headquarters and approved by the government board in August 2014. In May 2015, the Supreme Council of the Cultural Revolution, in its 582nd session, while emphasizing the strict implementation of the "Future Strategy Document", approved policies and strategies for the development and promotion of this technology in the country. This document with the title "Future Strategy Document" aims to be among the top 15 countries in the world in the field of nanotechnology and strive to continuously improve this position to generate wealth and improve people's quality of life (Iran Nanotechnology Innovation Council, INIC, 2024).

In the following, the growth process of scientific productions of Iran and the world in the subject area of nano is examined (Table 7).

Table 7

Iran's Scientific Productions in the Nano Field Compared to the Global Situation Based on the Data of the Web of Science Database During the Years 2000 to 2023

Year	No. of Iran's papers	Total world papers	Year	No. of Iran's papers	Total world papers
2000	3	971	2012	514	11150
2001	6	1403	2013	568	12833
2002	6	1890	2014	572	13626

Year	No. of Iran's papers	Total world papers	Year	No. of Iran's papers	Total world papers
2003	8	2618	2015	687	15219
2004	20	3523	2016	710	17532
2005	39	4370	2017	796	18962
2006	60	5319	2018	842	20161
2007	100	5755	2019	818	21987
2008	179	6602	2020	953	23165
2009	293	7387	2021	864	26450
2010	387	8319	2022	746	28358
2011	597	10350	2023	729	25304

According to the data in Table 7, in 2020, Iran's science production in the nano field was 953, and in the same year, world science production was 23,165, and Iran was able to allocate more than 4% of world science production in this field. In 2021, Iran's science production was 864 documents and the world's science production was 26450 documents, which Iran accounted for more than 3% of the world's science production. This is even though in 2007, Iran published 100 documents in the field of nanoscience, the world's science production this year was 5755 documents, that Iran produced only 2% of the world's science production, but in 2020, more than it has achieved 4% of world science production.

The world's top ten science-producing countries in the Nano field

According to the data in Table 8, in 2023, Iran will be the fourth largest producer of nanoscience in the world with 7.30 percent of the world's science production in the field of nanoscience, and countries such as Japan, South Korea, Germany, France, England, and Italy are after Iran.

Table 8
The World's Top Ten Science-Producing Countries in the Nano Field

Rank	Country name	Production	% of total world production
1	China	100337	33.74
2	USA	40574	13.64
3	India	31309	10.52
4	Iran	21713	7.30
5	Japan	17028	5.72
6	South Korea	16967	5.70
7	Germany	14580	4.90
8	France	10550	3.54
9	England	10374	3.48
10	Italy	8440	2.83
Total	297360		100

The graduation regulations for graduate students

Another factor that can affect the growth of Iranian science is the existence of laws and regulations of the country's universities and scientific research institutes for master's and

doctoral students to defend their master's theses and doctoral theses. In this context, it should be mentioned that in general, public universities consider the condition of defending a doctoral thesis in technical and engineering fields, basic sciences, and medical sciences to have ISI articles extracted from the thesis, and doctoral students to obtain a defense permit to print and publish the extracted articles. From treatises, they turn to publishing articles with the ISI index, which can affect the quantitative growth of scientific productions in Iran.

Discussion

In the research conducted inside the country (Saboury & Poorsasan, 2006; Saboury, 2006; Noroozi Chakoli et al., 2010.; Moein et al., 2007; Alijani & Karami, 2007; Saboury, 2010; and Niakan,2010) the statistics of Iran's science production in ISI have been examined in different years (1980-2021), which is based on quantitative productions and the share of Iranians in world publications, and the factors affecting the growth of science in Iran have not been studied.

The highest rate of scientific production by Iranian researchers (over 70%) belonged to the last decade (2011-2021). Scientific fields such as biological technologies, optics and quantum, nano and micro, regenerative medicine, stem cells, and cognitive sciences, which are considered high-tech sciences, are among the priorities supported by the Scientific Vice President of the Islamic Republic of Iran. The growth process of science in some fields in Iran has been such that Iran has become the fourth science-producing country in the world in that field. One of these fields is nanotechnology. In 2000, Iran ranked 60th in the world with 9 articles related to nanotechnology, and in the region, five countries, Turkey, Egypt, Saudi Arabia, Uzbekistan, and Armenia, were ahead of Iran. In 2009, the researchers of our country were able to reach the 15th place in the world. That is, six years before the end of the strategic document, Iran will reach the goal of this document in terms of the science production index. In 2023, Iran will be the fourth largest producer of nanotechnology in the world with 7.30 percent of the world's science production in the field of nanotechnology and countries such as Japan, South Korea, Germany, France, England, and Italy are after Iran.

Analysis of the growth of science in Iran: In the scientific life cycle, we generally see four stages birth, growth, maturity, and death. The growth of science in Iran is not an exception to this rule. According to Cohen, the four stages of scientific development include the stages of emergence, normal science, crisis, and revolution (Gupta & Karsidapa, 2000). It seems that the growth of Iranian science is in the stage of normal science. The encouraging system as a control system for support and satisfaction is one of the social factors at work in scientific growth (Moed, 2016). Society induces its needs and supports researchers through its encouragement system (Davari-Ardakani, 2007). Therefore, designing an acceptable encouraging system for scientific activities not only is a motivator of research for social needs and priorities but also motivates researchers to do more research and better scientific approaches.

One reason for Iran's scientific growth was the role of research policies in encouraging scientific publication and promotion regulations for researchers. Another reason is an increase in graduate students and the expansion of new academic disciplines also scientific maps and other factors. Results indicated the existence of a significant relationship between scientific degrees and science production. The highest correlation coefficient was related to a doctorate and then a professional doctorate. In the case of the scientific rank, the two relationships of full professor and assistant professor had the highest significant relationship with science production, and educational instructor had the lowest relationship. As noted by Baskurt (2011),

there is a positive relationship between the increased number of faculty members, especially those of higher scientific ranks, and an increase in scientific production.

The results indicated that a different correlation pattern prevails between the variables in some cases in these two decades (1980-2000 years and 2001-2021 years). Thus, in the first 20-year period, there was no correlation between a doctorate and science production, while in the second period, this relationship was significantly high and significant. In general, in the second period, the relationship between academic degrees and science production is significantly higher than in the first period. Also, regarding the relationship between scientific rank and scientific production, except for the scientific rank of the instructor, in other cases, the correlation between scientific rank and scientific production increased significantly in the second period. However, in the lecturer of the coach, this relationship has become negative and significant in the second period. The relationship between the instructor and science production was negative and insignificant (this is because the number of instructors has decreased over time).

The index of the number of Iranian articles per million people of Iran's population & Index of the ratio of the number of internationally indexed articles in Iran to the number of faculty members are two indicators that are verified in the scientific map of Iran. According to the number of Iranian scientific publications in the WOS database at the end of 2021, which has reached 56,000, it seems that due to the growth of Iran's scientific production, we can hope that the number of Iranian scientific publications will reach 2025 by the end of the Horizon program has arrived. The number of scientific productions of Iran in the WOS database in 2021 is 56,000 scientific documents. According to this index (Index of the ratio of the number of internationally indexed articles in Iran to the number of faculty members), at the end of 2025, the number of indexed articles of Iran in the WOS international database should reach 34,400, which seems that the estimate of the comprehensive scientific map of the country has been realized before the end of the perspective of 2025, and the estimated amount of the comprehensive scientific map The country has not been a suitable target.

Conclusions

Factors such as the growth in the number of faculty members, the growth in the number of graduate students, the promotion regulations of MSRT and MHME along with encouraging policies for scientific production in Iran and the comprehensive scientific map of the country, Scientific research towards the needs and priorities of the country, the graduation regulations of graduate students, other social, political, cultural and international factors analyzed. For monitoring the possible effect of encouraging policies for scientific production and faculty member promotion regulations on scientific production in Iran, the content of related policies and regulations was analyzed. Also Considering encouraging policies for scientific development and growth, the documents that have been formally approved in MSRT from 2004 were analyzed.

Some items of encouraging policies as well as promotion regulations are at work in a significant increase in Iran’s scientific production in these years as the content of these policies and regulations encourage researchers to do more scientific activities at an international level. This effect is obvious in the scientific activities during the third and fourth decades after the Islamic Revolution. The results of analysis and investigation of the research also showed that the number of graduates of post-graduate courses at both master's and doctoral levels, as well

as the population of full-time faculty members of the universities of MSRT and MHME has been an increasing trend from 1980 to 2021. The demographic pyramid of faculty members in universities and research institutes is in the rank of assistant professors. In addition, the population of master's graduates has been higher than that of specialized doctorate and professional doctorate during this period.

Some applicable suggestions can be made for theory and practice. Considering that Iran is the fourth science-producing country in the world in the field of nanotechnology, the pattern of development of this field should be followed in other thematic fields of science in Iran so that in the future other thematic fields in Iran will develop like the field of nanotechnology. Further research is needed for studying the effect of factors such as the share of research budget in gross national production, items of other upper documents on the scientific growth as well as surveying researchers and faculty members' views on encouraging factors for more international scientific contribution. Increasing the share of research in the total budget up to 3% -4% of gross national production is a helpful approach to enhancing research impact and motivating specialist human resources for higher contribution.

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