

Academic research in innovation: A country analysis

Abstract

Many countries are investing a lot in innovation in order to modernize their economies. A key step in this process is the development of academic research in innovation. This article analyzes the leading countries in innovation research between 1989 and 2013 from an academic perspective. The aim of the study is to identify the most relevant countries in this field and the leading trends that are occurring during the last years. The work also introduces a general perspective analyzing the research developed in several supranational regions. The main advantage of this contribution is that it gives a global overview of the current academic state of the art in the area. The analysis focuses on the most productive and influential countries in innovation research classifying the results in periods of five years. The leading journals in the field are also studied individually identifying the most productive countries in each of the journals. The results show that the publications of each country are biased by the country origin of the journal. The USA and the UK are the leading countries in this field being the UK the most productive one in per capita terms among the big countries.

Keywords: Innovation; bibliometrics; country analysis.

Introduction

Innovation research is a quite new topic in academia because it did not received serious attention until the twentieth century with the work of Schumpeter (1934). Today, many countries give a lot of importance to this field with a strong emphasis on the connection with research & development (R&D). The leading management associations also recognize the importance of this area with the inclusion of one fundamental section on innovation among its main topics. For example, the Academy of Management has the Technology and Innovation Management Division and the Strategic Management Society has the Knowledge and Innovation Group. Moreover, there are some journals strictly dedicated to this field including the Journal of Product Innovation Management and Technovation. Additionally, there are many journals that dedicate a huge number of pages to this area including Research Policy, R&D Management, Technological Forecasting and Social Change and Technology Analysis and Strategic Management.

From an academic perspective, it is important to classify all the material published in a research field in order to be concerned on the leading trends occurring in the discipline. This problem is usually assessed with bibliometrics which is the research field that studies quantitatively the bibliographic material (Broadus, 1987). This concept is becoming very popular thanks to the development of computers and internet. Bibliometric studies are also common in innovation research. Several authors analyze different issues including the most cited papers, leading journals, authors and universities. A general overview was presented by Fagerberg et al (2012). They considered a wide range of issues including the most cited works, the most relevant contributors and universities, the leading journals and the most popular topics. Martin (2012) also analyzed the most cited works by studying the evolution of the field since the origins. Shafique (2013) also provided a list of the 100 most influential publications although he also considered other issues including the most relevant journals. His

results were focused on leading management and economics journals but the specialized journals did not appear in the analysis with the exception of Research Policy and the Journal of Product Innovation Management. Thongpapanl (2012) also studied the leading innovation journals but with a focus on the specialized ones. He developed a cross-citation analysis in order to identify the number of citations given by each of the specialized journals to the other ones. From a general perspective, he also found the top management journals were also among the leading ones in the field. This work followed the previous research developed by Cheng et al. (1999) and Linton and Thongpapanl (2004). Similar results were also found by Cancino et al. (2015) although they also divided the analysis in periods of five years in order to see the evolution throughout time. The results indicated that before the leading management journals were more influential. But recently, the specialized journals are gaining importance strongly motivated by the growth of research worldwide that includes a strong increase in the number of researchers that are producing more articles.

Some other studies focus on the most productive and influential authors and institutions. Fagerberg et al. (2012) considered this issue although he only considered the top ten or twenty which is a short number in order to provide a complete analysis. Thieme (2007) studied the top innovation management scholars by using fourteen leading management, marketing and innovation journals. Yang and Tao (2012) extended Thieme's approach considering the results between 1991 and 2010. They also studied the leading universities in the field. This approach followed the analysis developed by Linton (2004) that studied the leading business schools distinguishing between the US and the rest of the World. Some other authors develop bibliometric studies focusing on the Journal of Product Innovation Management including Biemans et al (2007; 2010) that studied the journal between 1984 and 2003 and Durisin et al. (2010) between 1984 and 2004. Currently, there is no study that analyzes innovation research from a general perspective considering the most productive and

influential countries in this academic field.

Thus, the aim of this article is to develop a country analysis identifying the most productive and influential ones taking into account several bibliometric indicators. First, the study presents a continental perspective in order to see how the supranational regions are evolving throughout time. Second, the work presents a global perspective analyzing the countries with the highest number of articles, and citations. Next, the analysis divides the results in periods of five years in order to see how the results are evolving throughout time. Fourth, the study considers the leading countries in seven specialized journals that are very influential in innovation research and some other leading management journals. The main contribution of this approach is that it provides a general overview of the leading countries in innovation research. Thus, by looking at the tables it is easy to identify the countries that strongly investigate in innovation. In general, the results indicate that the USA and the UK are the most influential countries in this discipline. The results of the UK are particularly remarkable because in per capita terms they are much higher than the USA. Netherlands and Canada also present very good results according to their size.

Methods

Web of Science (WoS) is a database that classifies the articles published in some selected journals that are considered of the highest quality worldwide. Currently, it includes more than 15.000 journals and 50.000.000 publications from any of the known sciences. Some other databases for classifying scientific research are Scopus and Google Scholar. However, this study only considers the WoS for classifying the bibliographic material. In order to find the studies on innovation research available in WoS, the search process uses the keyword “innovation” between 1989 and 2013. Since the work aims to focus on a managerial perspective, only some research areas are considered including Business & Economics, Public

Administration, Government & Law, Geography, Urban Studies, Area Studies, Sociology, History and Philosophy of Science, Social Work, Social Issues, Behavioral Sciences, Asian Studies, Social Sciences and Other Topics, Transportation, Operations Research & Management Science, and Computer Science. The search obtains 40.865 articles. However, in order to focus only on research studies, the search filters this material only considering articles, reviews, notes and letters. This search was carried out in December 2014 and March 2015.

The study classifies the material by using a bibliometric approach (Merigó et al. 2015). Bibliometrics is the research discipline that studies the bibliographic material quantitatively (Broadus, 1987) providing a general overview of a research topic according to a wide range of measures. Usually, the bibliographic material is classified according to the number of publications or citations. However, there are also other measures for analyzing the data such as the *h*-index (Hirsch, 2005) that combines the number of publications with the number of citations. In summary, if a set of articles have an *h*-index of 10; it means that ten studies of the set have received ten or more citations.

The results of the bibliometric analysis are classified by using a country analysis. First, the countries are grouped in supranational regions in order to see the publication evolution of these regions throughout time (Zacca-González et al. 2014). This study considers nine regions: North America, Latin America, Western Europe, Eastern Europe, Africa, Middle East, Central, South and Southeast Asia, East Asia and Oceania. Next, the work focuses on individual countries developing a global ranking. The analysis follows the current political definitions of a country. However, when looking to the nineties, some differences occur due to the political changes that happened in this period that affect China, the old Soviet Union, Germany and Czechoslovakia. Each article is assigned to an author/s that has an institutional affiliation that includes the country of the institution. Each article gives one unit to each of the

countries included in the study. Note that this may bring some deviations since some articles may have more affiliations than other ones. However, since each country has many researchers we do not expect important deviations in this context because the aim of the study is to provide a general overview identifying those countries that are publishing research in this field.

An interesting issue when developing a country analysis is to distinguish between the total number of publications and citations and the per capita numbers. This is important because there are many well developed countries that are very productive but since they are very small their results do not become significant at a global scale. Therefore, the per capita analysis permits to identify the productivity of a country considering the number of people living there.

Results

This section presents the results of the study. First, it presents a supranational perspective throughout time. Next, the analysis develops a global overview of the leading countries in innovation research. Third, the results are divided in periods of five years in order to see the evolution of the leading countries throughout time. The section ends analyzing the leading countries in some selected leading journals.

Analysis of supranational regions

Many regions are developing important research on innovation around the World. Figure 1 presents the number of articles published annually by nine selected regions.

In the nineties, the USA was clearly leading the field. However, throughout time Western Europe has become more relevant and today publishes more studies than the USA.

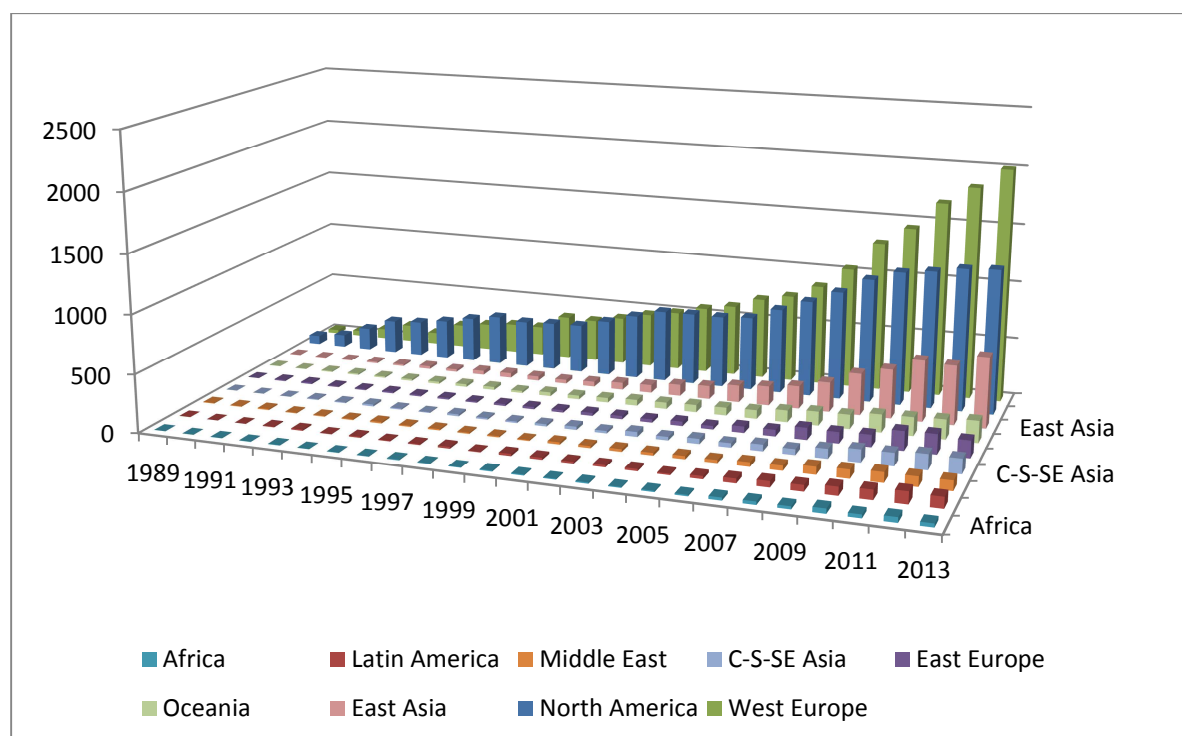


Figure 1. Annual number of articles in innovation published by each region

Note that in terms of population the productivity of both regions is quite similar although the results obtained by Western Europe are remarkable compared to other fields. East Asia is also growing significantly and during the last years it has clearly become the third most influential region. The rest of the regions do not publish a huge number of articles.

Leading countries in innovation research

Many countries are publishing a lot of research on innovation. In this section, let us look into the productivity and influence of the top 50 countries between 1989 and 2013. Table 1 presents the fifty most productive countries in innovation research. The countries are ranked according to their *h*-index although the number of studies, citations and the ratio citations/publications are also included. Moreover, the table also includes the number of articles with more than 250 and 100 citations and the productivity per person.

Table 1: Most influential countries in innovation research

R	Country	TPI	TCI	HI	≥ 250	≥ 100	TP	Pop	P/Pop
1	USA	13775	478261	268	293	1023	10446251	316017	0,044
2	United Kingdom	5455	108201	132	34	189	2719498	64100	0,085
3	Canada	1965	47323	95	29	92	1360660	35540	0,055
4	Netherlands	2070	37761	79	11	56	700428	16879	0,123
5	Germany	2208	34481	79	4	60	2148208	80767	0,027
6	France	1390	27862	74	11	52	1511784	66078	0,021
7	Italy	1678	23050	67	3	37	1124841	60784	0,028
8	Sweden	861	19248	60	10	24	472585	9738	0,088
9	China	1416	17297	57	5	22	1684979	1375475	0,001
10	Spain	1703	15926	55	3	11	839421	46508	0,037
11	Australia	1342	16207	54	2	21	842288	23685	0,057
12	Denmark	606	11804	50	5	23	264684	5656	0,107
13	Belgium	574	10611	48	3	22	363605	11225	0,051
14	Israel	341	9581	45	8	14	301299	8268	0,041
15	Switzerland	615	8861	45	1	16	485086	8184	0,075
16	Austria	401	6463	45	1	10	253131	8527	0,047
17	South Korea	728	8911	43	4	16	570380	50424	0,014
18	Japan	652	10599	41	2	12	1981580	127080	0,005
19	Singapore	352	7023	41	3	14	138300	5470	0,064
20	Taiwan	1144	9574	40	1	3	367914	23417	0,049
21	Finland	584	7185	38	3	5	220734	5470	0,107
22	Norway	438	5680	38	0	6	183198	5156	0,085
23	New Zealand	255	3196	27	1	4	155175	4545	0,056
24	Turkey	214	2101	27	0	1	312072	76668	0,003
25	Portugal	314	2640	26	0	3	145177	10478	0,030
26	Greece	244	2294	26	0	3	195382	10993	0,022
27	India	316	2044	22	0	1	692278	1263390	0,000
28	Brazil	277	1835	20	1	1	471075	203534	0,001
29	Ireland	201	1740	20	0	2	179855	4610	0,044
30	Mexico	110	787	16	0	0	167934	119713	0,001

HI, TCI, TPI = H-index, cites and studies in innovation; ≥ 250 , ≥ 100 = Articles with more than 250 and 100 cites; TP = Papers of the country in WoS; Pop = Population; P/Pop, C/Pop = Papers and cites divided by population.

The USA is the most productive and influential country in innovation research. However, the UK and Netherlands obtain better results in per capita terms. Some other smaller countries also obtain very remarkable results according to their size including Sweden, Denmark, and Finland. China is the first Asian country in the ranking although its productivity per person is very low. Some developing nations also appear in the ranking including Turkey, India, Brazil, and Mexico.

Temporal analysis of the leading countries

An interesting question to analyze regarding the country rankings is the evolution throughout time. Usually, the evolution depends on the economic situation of the country that permits to focus more on research or not. Table 2 presents the most productive and influential countries in innovation research between 1989 and 1993.

Table 2: Leading countries in innovation between 1989–1993

R	Country	TPI	TCI	HI	TCI/TPI	TP	H	P/Pop
1	USA	880	64430	110	73,22	1250223	1149	3,39
2	UK	160	6547	34	40,92	293193	611	2,77
3	Canada	115	5064	26	44,03	162209	488	3,99
4	Netherlands	55	1837	17	33,4	71850	370	3,60
5	Israel	29	2010	16	69,31	37644	273	5,51
6	Germany (Fed/Dem)	70	1026	14	14,66	241585	523	0,86
7	France	46	511	12	11,11	182456	462	0,78
8	Italy	35	518	11	14,8	101000	352	0,62
9	Australia	32	572	10	17,88	76176	331	1,81
10	Sweden	17	3432	8	201,88	55457	344	1,95

The USA is the most relevant country during this period. Even in productivity per capita, only Israel, Sweden, Canada and Netherlands obtain similar results than the USA. The UK is the second most productive and influential country although the productivity per capita

is a bit lower than the previous countries. The rest of the countries are significantly below these countries. Table 3 presents the results for the period 1994-1998.

Table 3: Leading countries in innovation between 1994–1998

R	Country	TPI	TCI	HI	TCI/TPI	TP	H	P/Pop
1	USA	1813	125118	174	69,01	1364164	1226	6,57
2	UK	592	19362	66	32,71	364048	685	10,12
3	Canada	209	11278	41	53,96	179109	550	6,91
4	Netherlands	130	4267	35	32,82	92975	451	8,28
5	Italy	132	3443	33	26,08	144045	448	2,32
6	France	131	5869	31	44,8	234395	545	2,18
7	Germany	153	4260	27	27,84	305230	600	1,86
8	China (+ Hong Kong)	59	3296	23	55,86	89477	254	0,05
9	Belgium	55	1991	22	36,2	46462	323	5,39
10	Israel	44	3225	20	73,3	46183	337	7,37

The USA is the most relevant country during this period. The UK is the second most productive and influential country. The rest of the countries are significantly below these countries. Table 4 presents the top 50 countries between 1999 and 2003.

Table 4: Leading countries in innovation between 1999–2003

R	Country	TPI	TCI	HI	TCI/TPI	TP	H	P/Pop
1	USA	2491	154687	185	62,1	1408912	1192	8,59
2	UK	921	31616	84	34,33	394955	718	15,44
3	Canada	267	11591	56	43,41	184634	540	8,43
4	Netherlands	298	10516	55	35,29	103864	478	18,37
5	France	223	11497	51	51,56	258941	560	3,58
6	Germany	283	8838	50	31,23	357191	651	3,43
7	Italy	233	7070	44	30,34	176634	478	4,07
8	Australia	182	4364	34	23,98	119731	433	9,15
9	Sweden	101	5005	33	49,55	80514	417	11,27
10	PR China	94	2895	31	30,8	182304	349	0,07

The results are similar to the previous periods although the absolute numbers are higher for most of the countries. Table 5 shows the leading countries between 2004 and 2008.

Table 5: Leading countries in innovation between 2004–2008

R	Country	TPI	TCI	HI	TCI/TPI	TP	H	P/Pop
1	USA	3407	109112	134	32,03	1614336	994	11,20
2	UK	1399	38133	83	27,26	442143	642	22,63
3	Canada	495	14740	61	29,78	240888	507	14,89
4	Germany	521	13982	60	26,84	403920	579	6,35
5	Netherlands	516	14568	59	28,23	130311	436	31,38
6	Italy	378	8118	46	21,48	229177	458	6,43
7	Spain	400	7191	45	17,98	178878	396	8,70
8	France	297	7581	44	25,53	291379	513	4,61
9	Australia	352	6825	44	19,39	157986	426	16,57
10	PR China	293	6440	43	21,98	425859	390	0,22

Again the results are quite similar although the productivity still increases a lot motivated by the increasing popularity of innovation research and more journals available in WoS. Finally, Table 6 presents the results of the last period from 2009 to 2013.

Table 6: Leading countries in innovation between 2009–2013

R	Country	TPI	TCI	HI	TCI/TPI	TP	H	P/Pop
1	USA	5182	44974	69	8,68	1880846	590	16,39
2	UK	2391	17911	46	7,52	533092	410	37,30
3	Netherlands	1068	9206	39	8,62	177134	303	63,56
4	Germany	1182	8414	37	7,12	490374	375	14,66
5	Canada	875	7037	36	8,04	305577	342	24,89
6	Spain	1148	6049	31	5,27	261836	279	24,61
7	PR China	961	5654	29	5,88	845848	310	0,71
8	Italy	908	5653	29	6,23	295070	311	15,18
9	France	697	4194	28	6,02	349110	333	10,56
10	Switzerland	381	3766	28	9,88	126847	293	47,14

Again the results are similar than before although it is remarkable the growth of Spain and China to the sixth and seventh position respectively. In this period the UK is more productive in per capita terms although in absolute numbers, the USA is the most productive and influential country.

Individual journal analysis of the leading countries

Another interesting issue to consider is the importance of the countries in the leading journals of innovation. Table 7 presents the leading countries in innovation in the two most significant journals: Research Policy and Strategic Management Journal (Cancino et al. 2015).

Table 7: Leading countries in Research Policy and Strategic Management Journal

R	Research Policy					Strategic Management Journal				
	Country	TPI	TCI	HI	CI/PI	Country	TPI	TCI	HI	CI/PI
1	USA	355	19425	71	54,72	USA	291	52139	108	179,17
2	UK	349	13786	62	39,50	France	23	4410	18	191,74
3	Netherlands	150	6295	41	41,97	UK	23	2890	17	125,65
4	Germany	143	4920	39	34,41	Canada	19	2693	14	141,74
5	Italy	121	4352	36	35,97	Singapore	11	501	9	45,55
6	France	107	3365	32	31,45	Denmark	8	986	6	123,25
7	Spain	89	2314	26	26,00	PR China	7	630	6	90,00
8	Sweden	47	2050	22	43,62	Italy	8	570	6	71,25
9	Japan	43	1070	22	24,88	Australia	7	702	5	100,29
10	Denmark	49	2207	20	45,04	Sweden	5	1054	4	210,80

In both countries the USA is the most productive and influential country. However, in Research Policy the UK obtains almost the same results than the USA which is very remarkable considering that it has five times less population. Note that in Strategic

Management Journal there are fewer papers on innovation and only a small number of countries have at least one publication in the journal.

Conclusions

This study presents a general overview of the leading countries in innovation research between 1989 and 2013. First, the analysis focuses on a supranational perspective in order to see from a global perspective how is innovation research evolving throughout time. All the regions are increasing the number of publications being North America and Western Europe the leading ones. East Asia is growing a lot and currently is in the third position. The rest of the regions are also growing a lot but still far away from these three regions. The expectations for the future are that they will increase more and soon or later will reach results reasonably equivalent to the developed regions.

The USA is the most relevant country in this field with the highest number of publications and citations. However, when looking to the numbers per person, there are some other countries that obtain better results although they are much smaller and less representative from an absolute perspective. It is interesting to mention that the USA is clearly the leader in the leading management journals that regularly publish some articles on innovation. However, in the specialized journals his position is not so remarkable and obtains similar results than the UK although it has five times more population.

The UK is the second most significant country in this field and it obtains very good results considering that it is much smaller than the USA. Moreover, in the seven specialized journals considered it obtains results very close to the USA and sometimes even the first position. The rest of English-speaking countries also obtain very positive results although less remarkable mainly because they are much smaller. In Latin America, Brazil is the most productive country and obtains the twenty-eighth position of the global ranking. However,

Chile is more productive in per capita terms.

Although this work shows the leading countries in innovation research, it is worth mentioning some limitation. First, an important limitation is that many authors may work abroad so it is not easy to evaluate the research of a country. This is very common for English-speaking countries that receive a lot of researchers from abroad obtaining higher results than they should obtain with only the citizens of the country. Another important limitation to consider is that WoS gives one unit to each participating country of an article without taking into account the number of countries included in the article. Finally, it is worth noting that quantifying research is not an easy task because the nature of each specific research topic inside innovation may have different characteristics bringing a higher publication and citation volume.

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