

El CINVESTAV y el SNI: 21 años de producción científica (1991-2011)

SNI and CINVESTAV 21 years of scientific production (1991-2011)

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Resumen

El presente trabajo muestra la productividad que han tenido los investigadores del Sistema Nacional de Investigadores (SNI) adscritos al Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional (CINVESTAV). La productividad se mide utilizando el número de publicaciones en revistas indizadas en el Institute of Scientific Information (ISI) producido por Thomson Reuters. La muestra incluye a todos los investigadores del CINVESTAV que pertenecieron al menos un año al SNI y el periodo de análisis es de 21 años (1991 a 2011). En el trabajo también se compara la productividad con cinco universidades más: la Universidad Autónoma de México (UNAM), la Universidad Autónoma Metropolitana (UAM), el Instituto Politécnico Nacional (IPN), la Universidad de Guadalajara (UdeG) y la Universidad Autónoma de Nuevo León (UANL). Se observa que la productividad del CINVESTAV tiene un liderazgo en cuatro de las siete áreas del SNI.

Palabras clave: SNI, CINVESTAV, Productividad Científica.

Abstract

The present work shows that productivity researchers have attached to CINVESTAV (CINVESTAV) National Research System (SNI). Productivity is measured using the number of publications in journals indexed in the Institute of Scientific Information (ISI)

produced by Thomson Reuters. The sample includes all CINVESTAV researchers belonging to at least one year SNI and the analysis period is 21 years (1991-2011). At work productivity is also compared with five universities: the Autonomous University of Mexico (UNAM), the Autonomous Metropolitan University (UAM), the National Polytechnic Institute (IPN), the University of Guadalajara (University of Guadalajara) and the Autonomous University of Nuevo Leon (UANL). It shows that productivity has CINVESTAV leadership in four of the seven areas of SNI.

Key words: SNI, CINVESTAV, Scientific productivity.

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Introduction

In Mexico, since the creation of the National System of Researchers (SNI) in 1984, the academic sector has made a special emphasis on scientific productivity, especially in those publications and citations. Although in more recent Regulations SNI mentioned as research products, books, book chapters, patents and technological developments, the consultative commission still give an important weight to publications and citations, especially in Exact Sciences and Biology Chemistry and Health Sciences. Other research products such as books, book chapters and patents, are more valued in the other four areas of knowledge: Social Sciences, Humanities and Behavioral Sciences, Agricultural Sciences and Biotechnology and Engineering.

The National Research System (SNI) and the CINVESTAV (CINVESTAV), are undoubtedly two pillars of Mexican scientists who have contributed to scientific development in our country, the first to recognize the work of people engaged in the creation of scientific and technological knowledge in Mexico, and the second with the conviction to perform and promote scientific research in Mexico and offer quality graduate studies.

CINVESTAV was created in 1961 as an autonomous public agency, and began with four departments: Physics, Physiology, Mathematics and Electrical Engineering. Since its creation emphasized the educational reform of the seventies, in the creation of the National Council of Science and Technology (CONACYT) and other policies of the time

(SAPIENS, 2011). Currently, the CINVESTAV has only postgraduate studies, 29 masters and 28 doctorates in the four areas of knowledge and research that has had since its inception, it has also awarded more than 8991 degrees between 1961 and 2011, and 91% of researchers are part of SNI.

The SNI was created in 1984 as a result of one of the most severe economic crisis in our country. In the academic sector impacted in a dramatic decrease in purchase of equipment and infrastructure for research and wages of those working in the sector, which generated a significant brain drain and those who were abroad had no intentions to get back. The drastic loss of purchasing power caused many researchers had to get two jobs. SNI was why was conceived as a program to financially support the most productive researchers in the country. Today, the SNI far from a system of supports or grants to supplement the salary of a researcher, he has become a more complex system, that is, if a system of individual assessment, can now be considered an evaluation system institutions.

This work aims to visualize the productivity of researchers who have been part CINVESTAV, at some point, the National System of Researchers. The period of analysis is 1991-2011, and the statistics shown by gender, area of knowledge and age of the CINVESTAV. The analysis refers to both publications as appointments in the Institute of Scientific Information (ISI), currently produced by Thomson Reuters. The analysis also shows how CINVESTAV productivity compared to other universities such as UNAM, UAM, IPN, University of Guadalajara (University of Guadalajara) and the Autonomous University of Nuevo Leon (UANL). ISI publications were obtained from the National Report Thomson Reuters generated in 2012. The database of the members of SNI was provided by CONACYT.

1. The National System of Researchers.

The July 26, 1984 was created SNI by decree of President Miguel de la Madrid in response to the situation facing the scientific community by the crisis of 1982. It was then formulated as a choice of financial support to this community, but at the both as a means of recognition for his work. A plus thirty years after its creation, the SNI has also been an economic support, support for the creation of uniform standards in the scientific evaluation of the whole country, so lucky to belong to this system not only affects wages but on the status of the scientific community.

The effects of individual level are extrapolated to institutional, as the SNI has become a decisive factor assessment for universities and / or research centers, which is why many universities have made efforts to count among its ranks researchers this distinction, because in a way reflects the quality of the research conducted within the institution.

In Figure 1 we can see that the growth of the system was held in 1991-1993, leading to a drop in the number of researchers. In 1997 this recovers and makes a faster rate of growth compared to previous years.

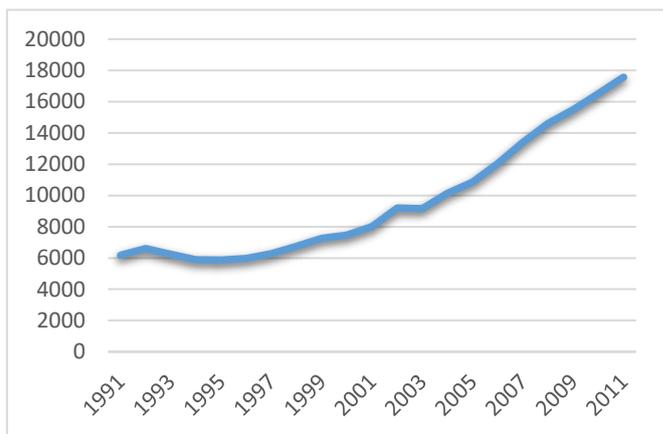


Figure 1. Number of researchers assigned to the SNI.

The decrease observed between 1992 and 1994 shows the change in Regulation (Asomoza Palacio, 2005) which was implemented for the -a income from 1993 was required to join this system reach the degree of doctor, so many members left (see Figure 2). In addition, it is noted that members were mostly left candidates, while other levels were not significantly change.

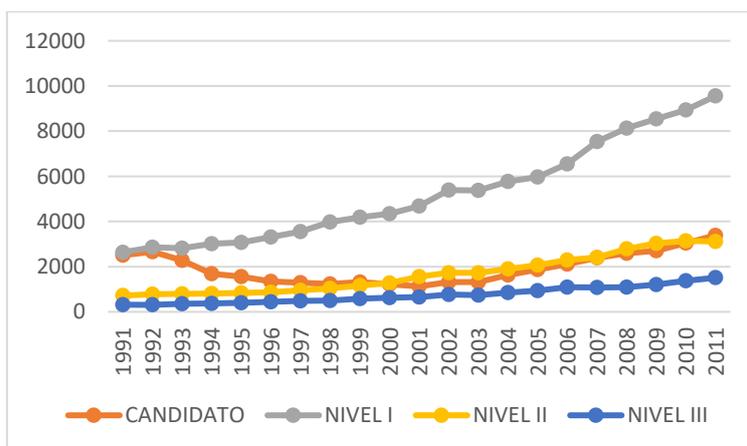


Figure 2. Number of researchers per level in the SNI

Although the SNI was divided into four areas of knowledge from 1991 to 1998 and later extended to seven (Figure 3), these show growth over time, highlighting areas Biology and

Chemistry 2, and one Science Physics and Mathematics and Earth Sciences as those that concentrate more researchers.

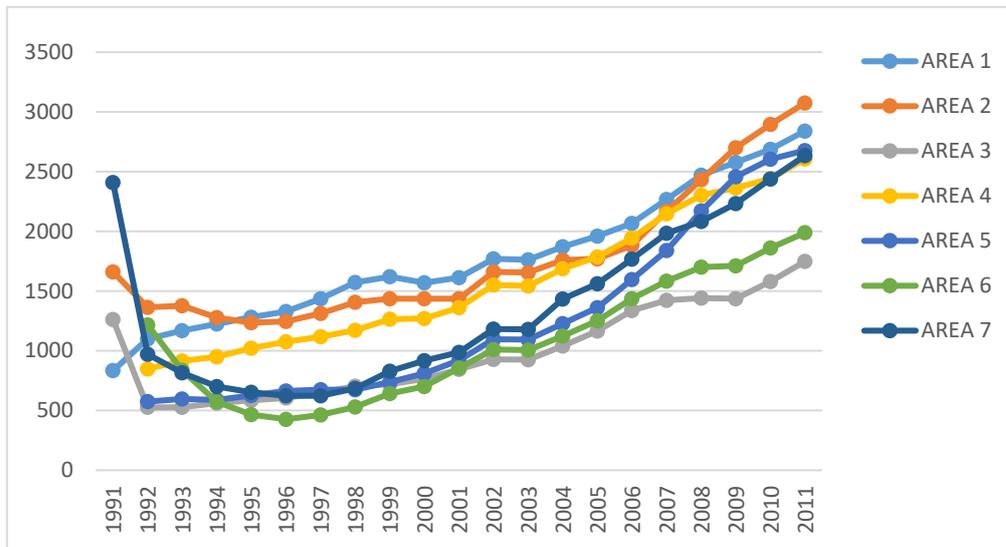


Figure 3. Number of Researchers by Area SNI.

As the number of researchers by gender, Figure 4 shows that the participation of women in the Mexican investigation remained at a nearly linear rate from 1991 to 2000; after this year further growth is observed, however, also it notes that most of the members who left the system in 1993 were the level of candidate and who were also men; the percentage of women in the system began with 24% attendance in 1991 and ended with 34% in 2011, representing an increase of 10% in 20 years.

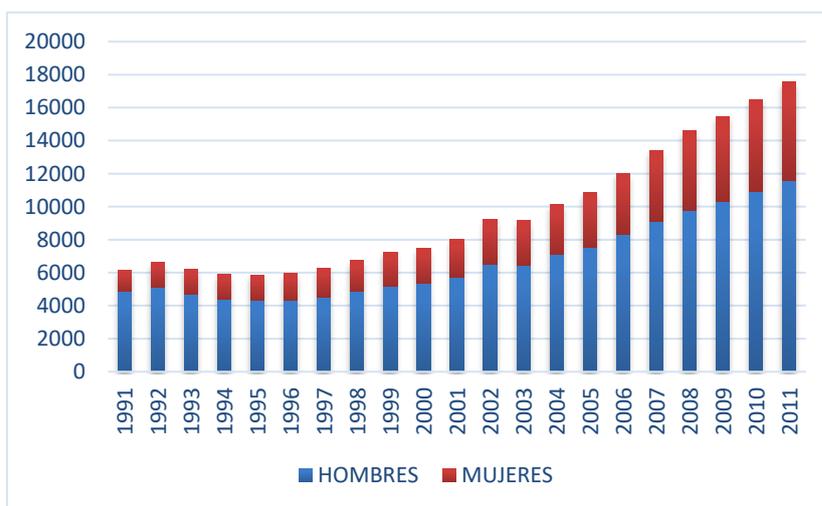


Figure 4. Evolution of SNI researchers by gender.

Training human resources in science and technology is by far a priority point of scientific political agenda in Mexico (Special Program of Science, Technology and Innovation 2014-

20, 2014). The creation of CONACYT in 1971, was a starting point for the formation of human resources at the graduate level, to the extent that the scholarship program for graduate studies at national or international level has been throughout its history the most important of that body (CONACYT, 2000). However, other governmental institutions supporting this cause, such as the recent Faculty Improvement Program (PROMEP) having a budget for the study of high-quality graduate teachers who are active in institutions of higher education from the country. With these programs, a good percentage of Mexicans have had the opportunity to do postgraduate studies.

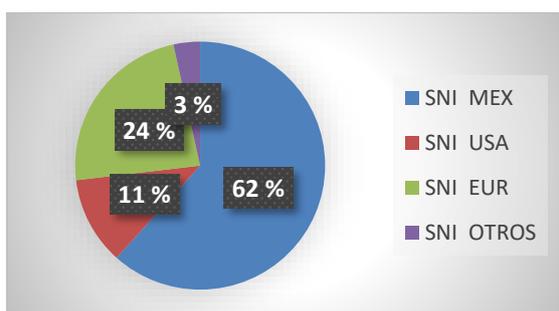


Figure 5. Percentage of SNI members by country for obtaining degree

Figure 5 shows the proportion of SNI members by country in obtaining the degree with which most researchers have studied a postgraduate course in the country, while 24% received it from a country of the European continent, 11% researchers studied a postgraduate in the United States and only 3% in other continents (Latin America, Asia, Africa and Australia). Figure 6 shows the proportion of members of the system by obtaining country level, but the NIS area of knowledge is obvious that the United States is the country with the highest demand for postgraduate studies abroad, with Europe being the second option.

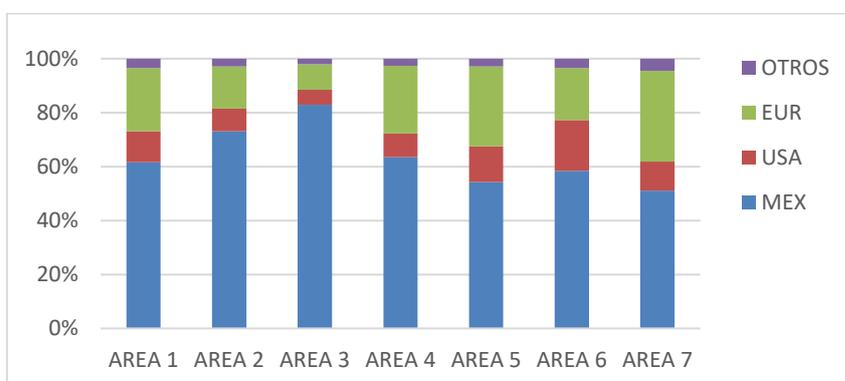


Figure 6. Percentage of SNI members by area of the country in obtaining degree

1. The CINVESTAV SNI

The participation of researchers from CINVESTAV SNI has maintained steady growth (Figure 7); in 1991 he had 339 researchers registered at SNI and by 1992 increased to 368, right in the period in which the Department of Toxicology was established. In 1994 and 1995 it fell down to 325 researchers, which could probably be explained by the change of administration in 1994 between Dr, Feliciano Sanchez and Dr. Adolfo Martinez Palomo, and the start of the 1994 crisis in our country. After 1999 he began a new growth. To this date, the center had 451 researchers, Molecular Biology departments were opened and Automatic Control, and a year later founded the Queretaro Unit and the South Headquarters was completed in Mexico City. By 2001, the researchers increased to 457 and the Department of Pharmacology was created; there was a new surge in 2005-2006, reaching the figure of 533 researchers within the system. At that time the National Laboratory of Genomics for Biodiversity was also launched, together with the Monterrey Unit, and Tamaulipas Laboratory Information Technology by the end of 2010 and 2011 was established, when the Laboratory Biosafety Level 2 was created. Now the Center has 668 researchers in the National System of Researchers.

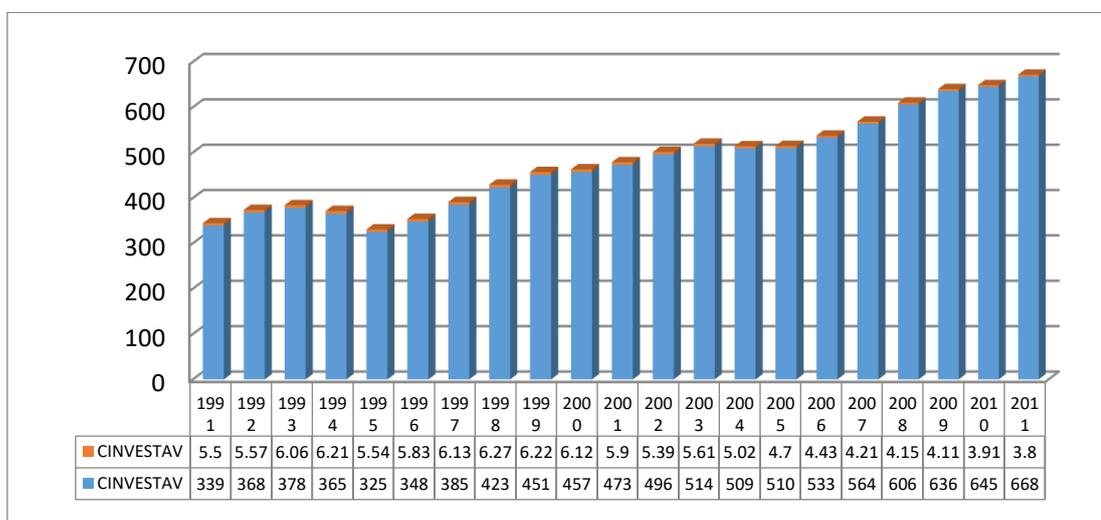


Figure 7. Representation of CINVESTAV in the SNI

During the period 1991-2011, as expected, the UNAM University has been more SNI members in its ranks, while CINVESTAV remained the second institution during 1991 to 1999. After this decade, the UAM he overcame placed as the second university with more members within the SNI. For 2011, as shown in Table 1, the UNAM with 20% representation was ranked as the first university with the largest number of members in the SIN, the UAM as the second institution with 5%, the National Polytechnic Institute as the

third with 4%, CINVESTAV the fourth with 3.8%, the University of Guadalajara and the fifth with 3.7% and the Autonomous University of Nuevo Leon as the sixth with 2.5% representation.

Table 1. Number of members of SNI by Institution

	UNAM	UAM	CINVESTAV	IPN	UDEG	UANL	TOTAL
1991	1658	311	339	154			6165
1992	1796	351	368	166	113	111	6602
1993	1869	368	378	155	117	109	6233
1994	1921	347	365	147	120		5879
1995	1859	352	325	152	136		5868
1996	1910	349	348	161	142		5969
1997	2001	354	385	185	137	100	6278
1998	2072	388	423	208	145	119	6742
1999	2216	445	451	228	165	122	7252
2000	2247	465	457	256	174	132	7466
2001	2344	483	473	277	203	136	8018
2002	2574	544	496	298	243	155	9199
2003	2725	602	514	322	270	178	9162
2004	2720	597	509	319	272	178	10 144
2005	2820	624	510	356	305	190	10 854
2006	2920	684	533	448	378	238	12 033
2007	3127	741	564	549	467	273	13 409
2008	3261	798	606	633	527	318	14 599
2009	3367	832	636	675	605	342	15 477
2010	3409	855	645	743	636	396	16 507
2011	3557	903	668	776	660	442	17 567

Source: Based on data CONACYT, 2012

Figure 8 shows the comparison between the six universities with more members from the SNI (court dated 2011), this shows that the UNAM has greater representation in the system, but is decreasing over time due to growing income system of researchers from other research centers. Moreover, this phenomenon occurs for the rest of the universities, except for the IPN, which although very little has been growing.

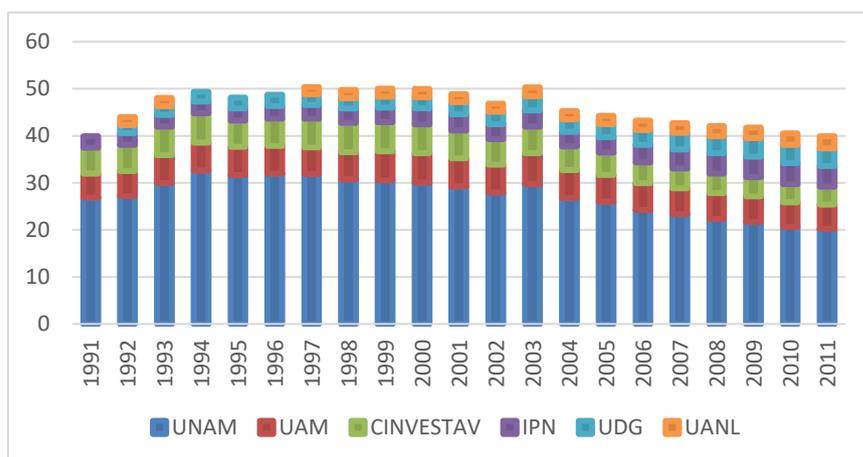


Figure 8. Proportion of members of SNI by institution.

As for the distribution of members by area of knowledge CINVESTAV SIN, Figure 9 shows that for 2011, the areas of Engineering (Area 7) and biology and chemistry are the two areas with the largest number of members SNI, both with 27%, followed by the area of Physics and Mathematics and the Earth with 18%; the areas of Biotechnology and Agricultural Sciences (Area 6) and Medicine and Health Sciences contribute 10% respectively, with 7% the area of Humanities and Behavioral (Area 4) and only 1% of Social Sciences (Area 5). The above figures can be explained by the number of graduate programs in the CINVESTAV, for example, the case that areas 4 and 5 are the least representative, in part due to the Centre only offer three PhDs and 3 masters in this area, while the Area 7 offer 9 doctoral and 10 master's degrees in the area of Technology and Engineering Sciences, making it one of the most representative.

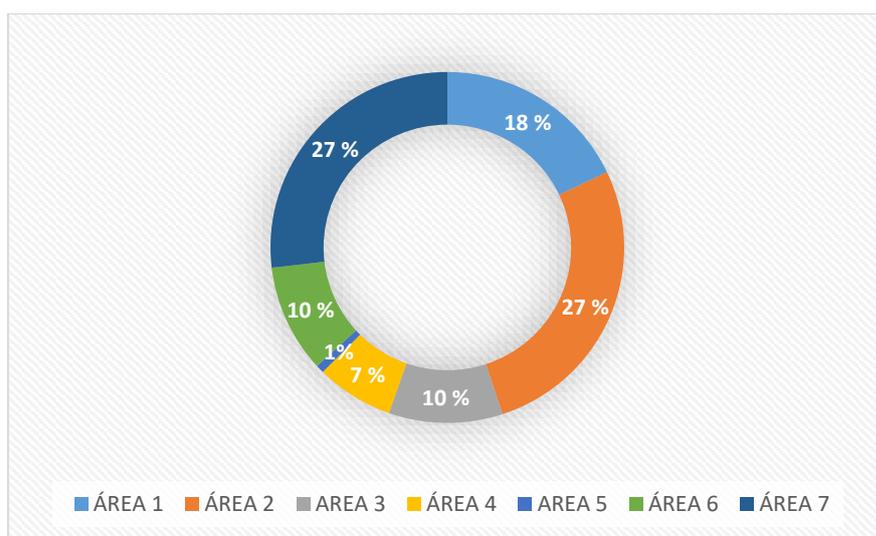


Figure 9. Distribution of members CINVESTAV by area in 2011.

Figure 10 shows the distribution of SNI members belonging to CINVESTAV, according to the country of obtaining degree and also compared with other universities. You can see that in the CINVESTAV, like other institutions, more than half of its researchers obtained the degree in Mexico; also it has the highest percentage of getting degrees abroad: 50%, followed by the UANL, UNAM and UAM (47%, 43% and 41% respectively), while the IPN shows 33% and 39% of UdeG graduate researchers abroad.

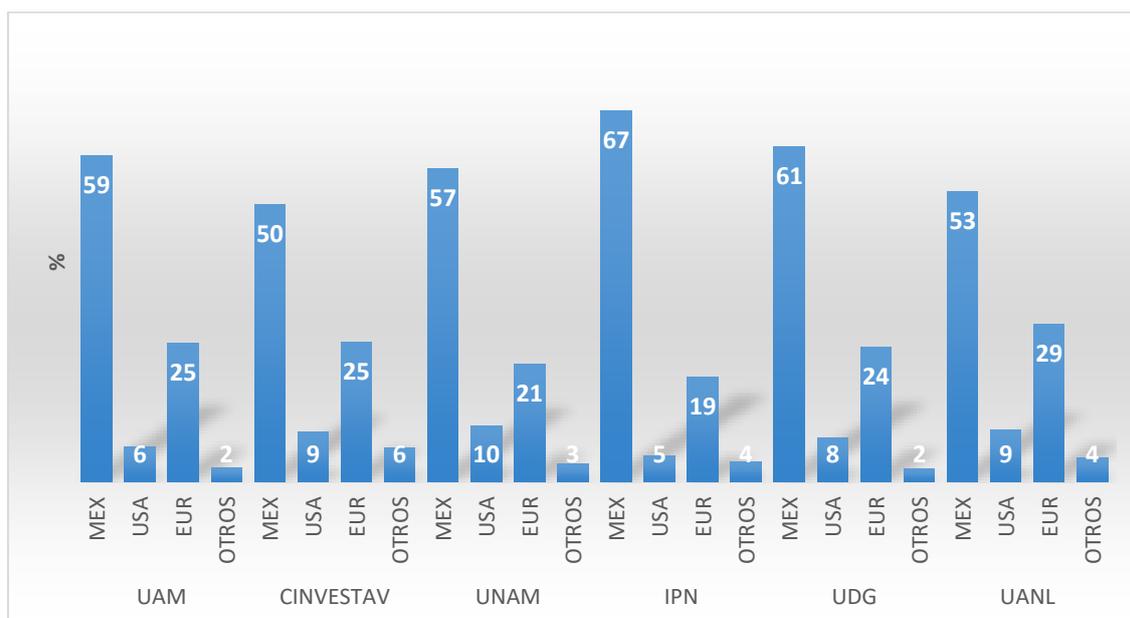


Figure 10. Proportion of SNI members by country for obtaining degree.

2. Methodology

Access to information 27 667 researchers from all areas of knowledge and have been part of the National Research System (SNI) at least one year was obtained. To measure the research results of 1991-2011, a database of publications and citations of Science and Social Sciences Citation Index, developed by the Institute of Scientific Information (ISI) was obtained; publications were obtained through a crossing of information between the base of SNI and the ISI from 1991 to 2011 along with corresponding to each item in 2011 (ISI, 2012) appointments, obtaining a sample of 266 451 articles published in that lapse.

3- Results

Scientific production

In the past three decades, Mexican researchers significantly increased the number of international publications in ISI (Figure 11). There are several reasons for this increase. In 1984, SNI was created and with it a new culture of evaluation and supervision of scientific work, prompting researchers have had to show a continuous productivity to enter and remain in this elite group of scientists. In 1991 the first World Bank loan for the Support of Scientific and Technical Activities (PACIME), and the National Council of Science and Technology (CONACYT) established new programs aimed at strengthening the scientific capacity of the country was granted and, therefore, improve conditions for scientists to publish in refereed journals. In the mid-nineties stimulus programs were established to research in most public higher education institutions. With this, the pressure to publish is greatly increased, as these new incentives came to represent up to a third of the income of a researcher. Another factor was that from the second half of the eighties saw an expansion in the number of magazines and scientific publications in the world. Virtually all countries show an increase in the number of publications.

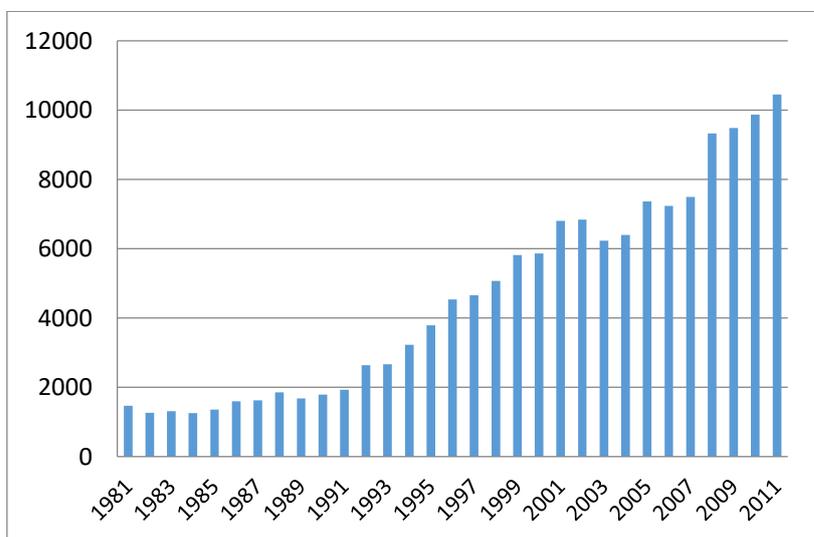


Figure 11. Publications ISI SNI Researchers.

Figure 12 shows the number of articles published in Thomson Reuters ISI, by area INS. Despite the significant growth of publications of Mexican researchers, areas 4 and 5 have remained almost constant series of publications within the study period, this largely due to the tradition of these areas not to publish this type magazines, and generate other products

such as books or chapters of the same. In both the hard sciences, areas 1, 2 and 3 have almost identical growth, unless the area in 2008 3 had stagnated and its place was taken by engineering area matching the production area 1 and 2; For its part, the area 6, which remained below the area 7, in 2007 managed to rebound to more than 4000 items matching production area almost 3. Without

But Figure 13 shows the annual average posted by members of SNI by area, where we see that the members of area 3 in 2011 published an average of 1.8 articles, while Area 1 had an average of 1.6, the areas 6 and 7 1.2 articles and the areas 4 and 5 only 0.2 articles.

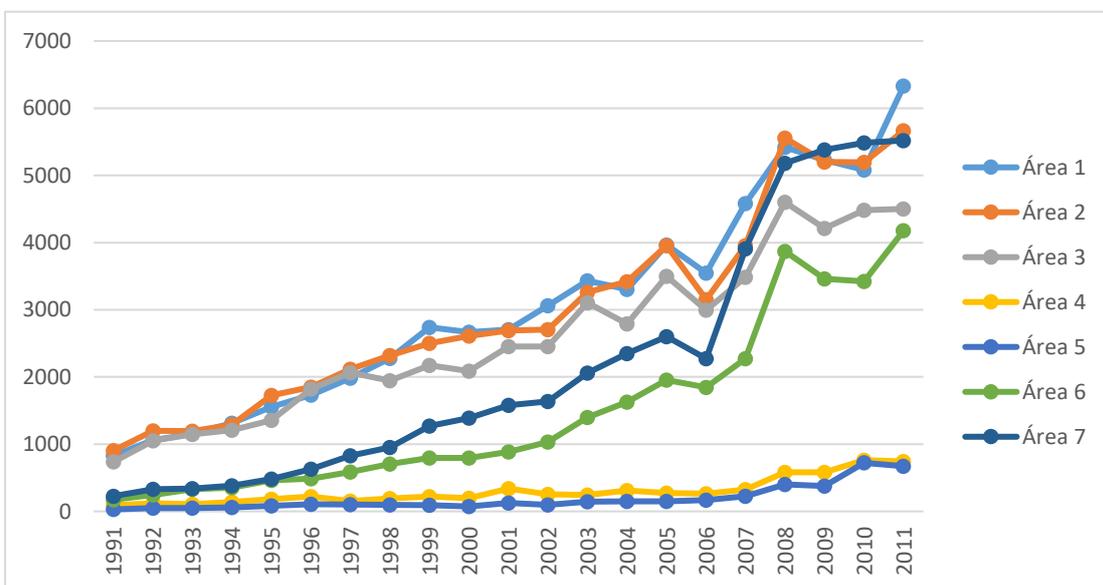


Figure 12. Total Posts per year for areas of the SNI

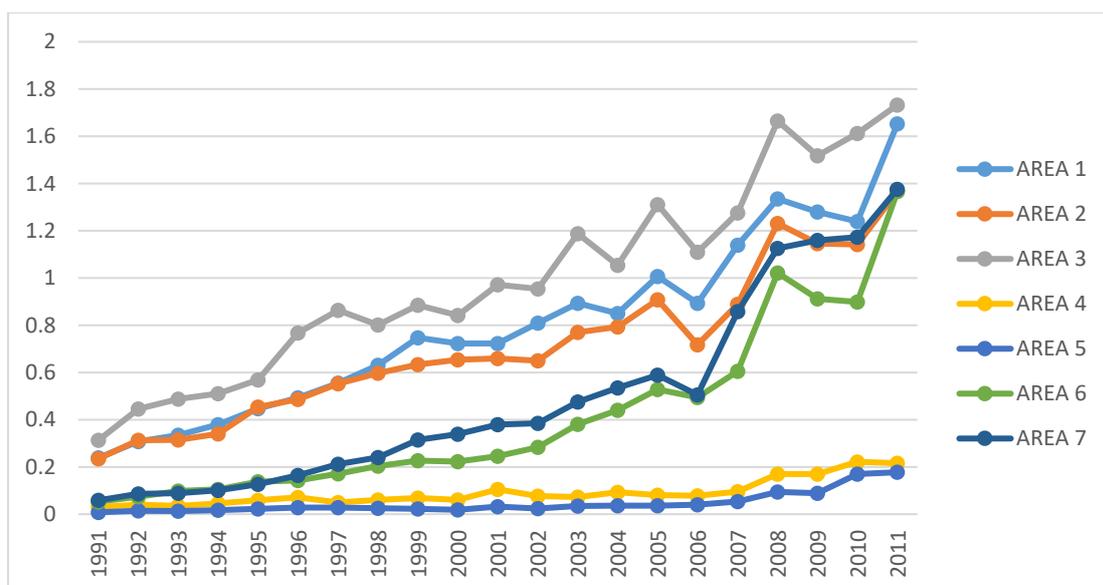


Figure 13. Average annual Publications by SNI area.

5.1.2. The scientific productivity in the CINVESTAV.

In Figure 14, we can see that in the early nineties the difference of the average of publications by institutions was very small, however, with the passage of time CINVESTAV took off and remained in the lead; Also, the UNAM remained second until 2007 when the IPN matched his production, but in later years the Institute turned into second place. For its part, the UAM that until 2000 was located in the third position, was overcome with minimal difference in the UANL that from 2007 exceeded the UAM; Finally, the University of Guadalajara remained in last place.

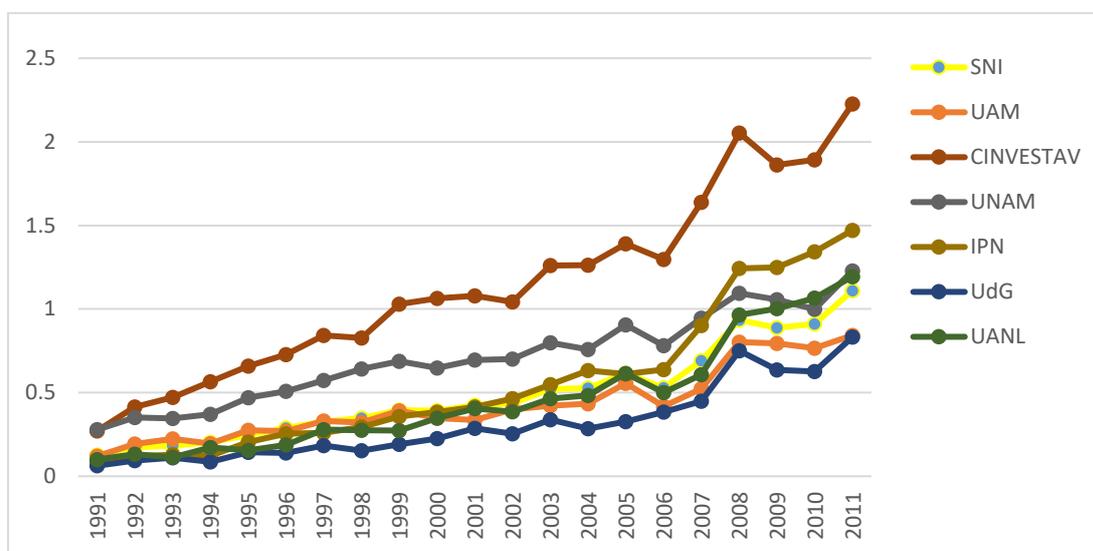


Figure 14. Average annual publication by Institution

Following is a breakdown of the average of publications is presented annually for selected institutions, and compared with the average productivity of SNI by knowledge area.

In area 1 (Figure 15), CINVESTAV maintains the lead with an average more than 4 items in 2011. The UNAM has a productivity slightly above average with almost NIS 2 items in 2011. The productivity of the UAM in turn, it presents a sustained growth very similar to the overall average, however, after 2006 drops below this in 2011 to reach an average of 1.2 articles. The IPN and UANL present an interesting growth from both institutions in 2006 and 2011 equal to 1.2 UAM items.

In area 2 (Figure 16), again the productivity of CINVESTAV and UNAM are superior to other institutions. However, in 2006 there is a very important for the rest of the institutions, so that the IPN after being below the overall average achieved by 2011 overcome and have achieved an average growth of 1.7 articles, surpassing the 1.5 items CINVESTAV and

standing below 1.8 UNAM. For its part, the UAM new account is held very close to the overall average and ends with an average of 1.4, while the UANL has UdeG 1.2 and 0.9.

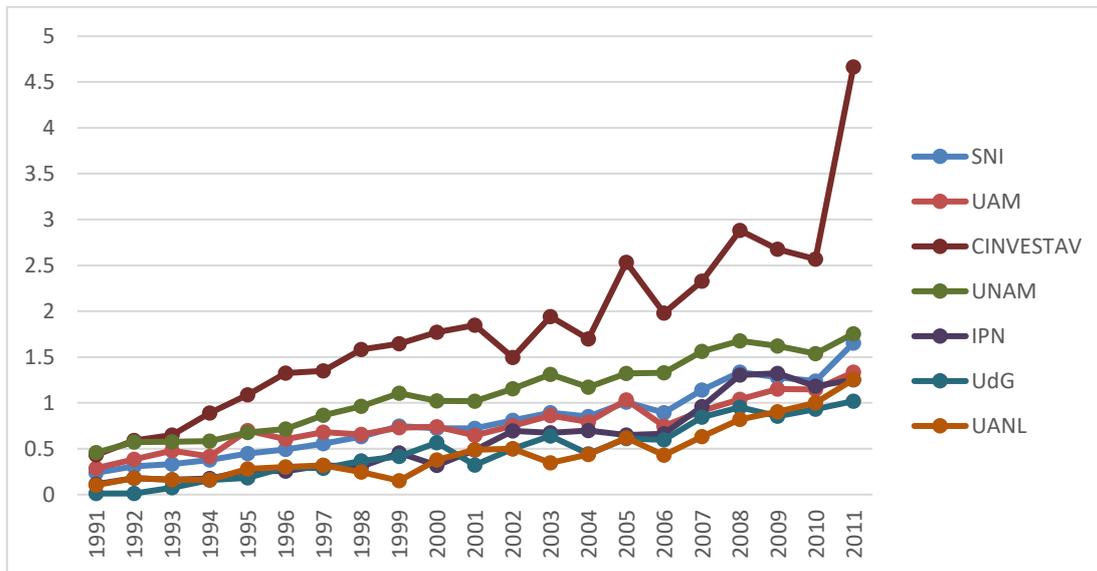


Figure 15. Average annual publication Area 1.

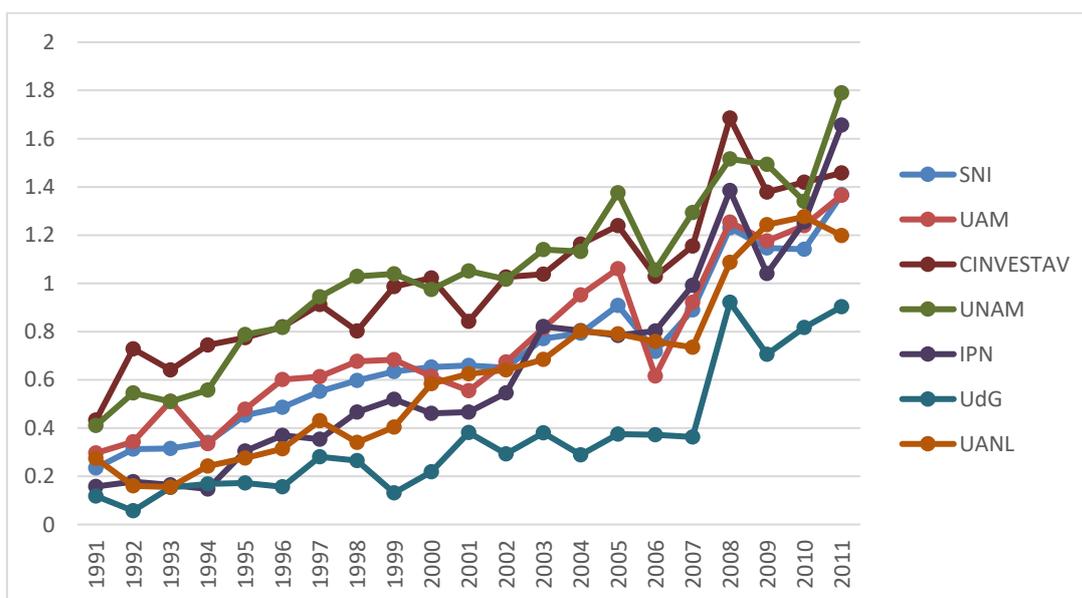


Figure 16. Average annual publication Area 2

Meanwhile, in the area 3 (Figure 17), the CINVESTAV and UNAM are the institutions with higher productivity in the area of Health Sciences. However, it appears that from 2006 to 2009 productivity exceeded that of the UAM and UNAM in 2011 ended in last place with an average of 1.1 articles. UdeG, which initially remained below average, after 2006 held a very important growth which positioned it above average and in 2011 reached the top spot with an average of 2.2 articles.

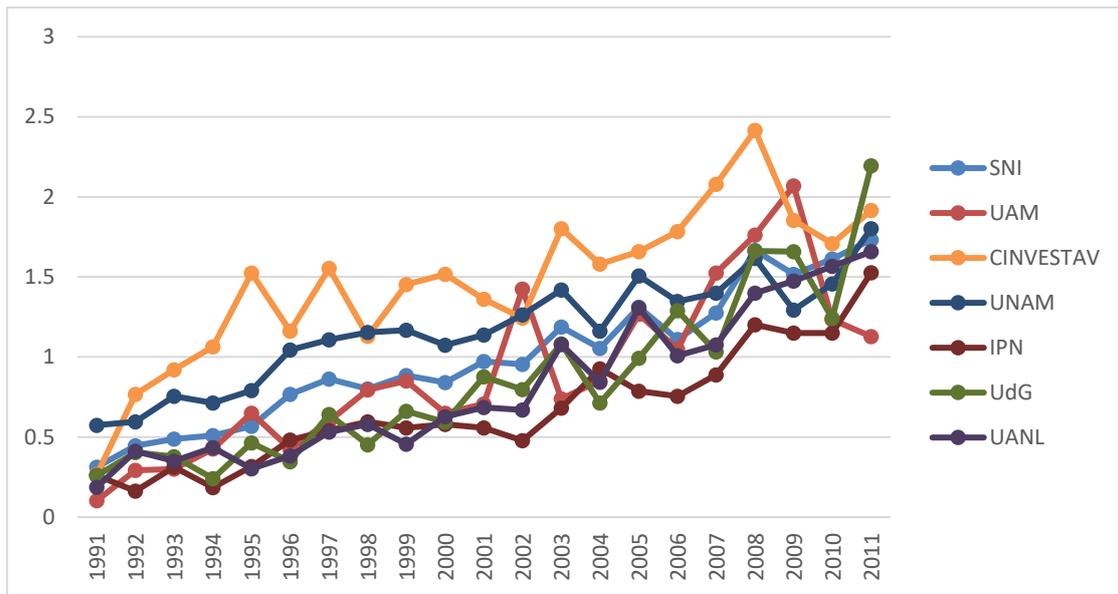


Figure 17. Average annual publication Area 3.

In area 4 (Figure 18), the UNAM maintained its leadership in productivity until 2006, where it appears that productivity IPN increased very dramatically to reach the first place, it is also noteworthy that the University of Guadalajara and UANL from 2008 manage to overcome production and UNAM, meanwhile, it remains UAM university with less productivity in this area.

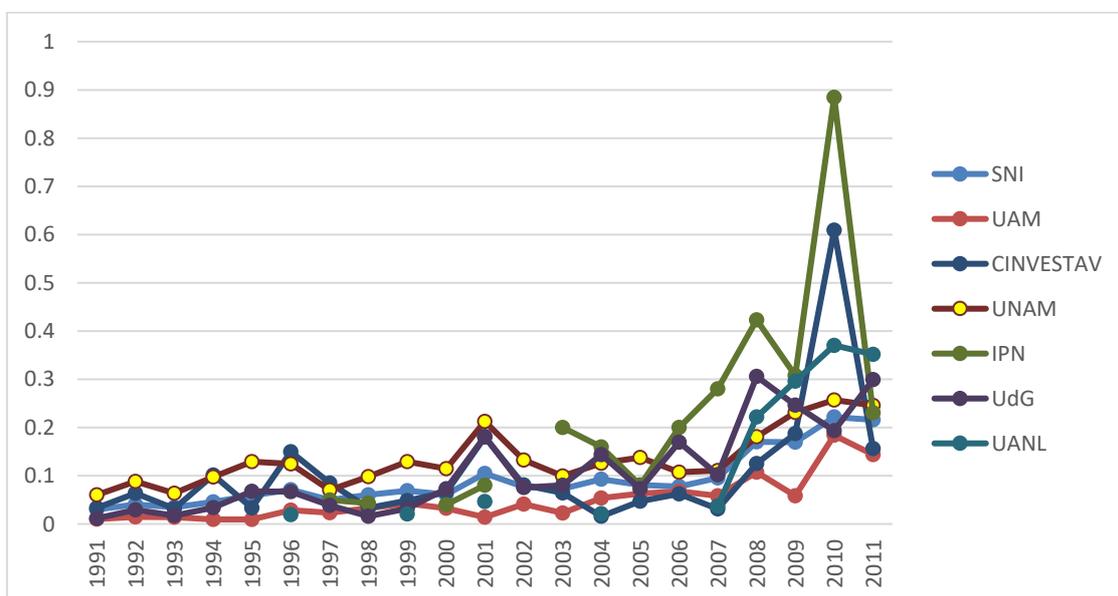


Figure 18. Average annual publication Area 4.

In areas 4 and 5, the measure of productivity in ISI publications has been relatively very low compared to other areas of knowledge. However, a notable increase in recent years, as shown in Figure 20 in the area of Social Sciences, UNAM distinction of being the

university with the highest production, however, in recent years, precisely in 2006, most institutions have a significant growth in both the IPN CINVESTAV and UNAM surpassed UANL while UdeG manages to stay below the UNAM and, finally, the UAM kept out below the overall average unchanged.

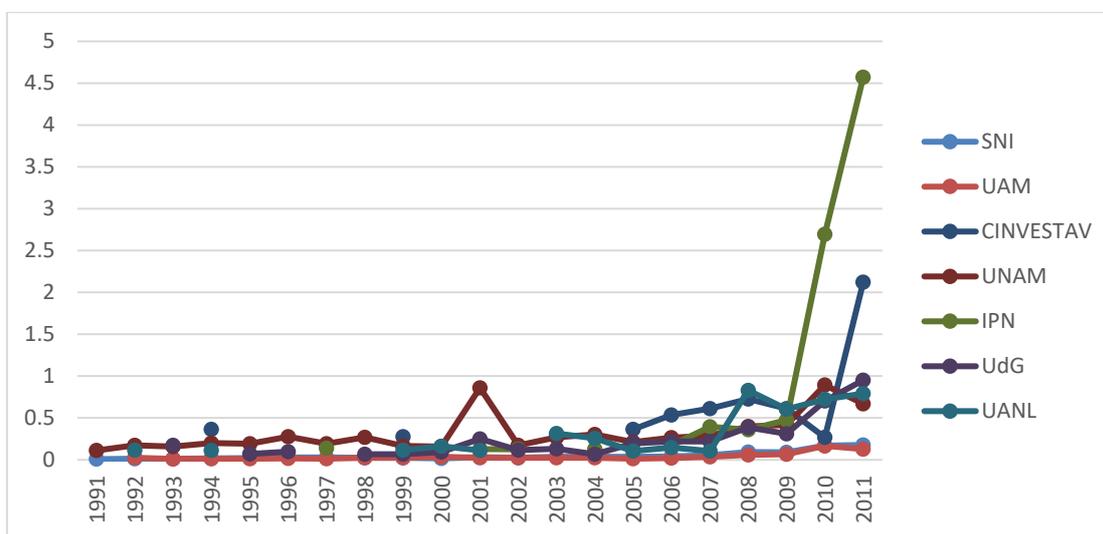


Figure 19. Average annual publication Area 5.

In the area 6 (Figure 20), CINVESTAV again stresses his productivity, however, the UAM together with the UNAM maintained a small difference in productivity in 2006 increased its productivity to the extent that overcame a CINVESTAV Articles average of 1.8 in 2011. The IPN also experienced significant growth to the extent that in 2007 exceeded the UNAM and finished with an average of 1.6 items to 2011. The UANL experienced similar growth in 2007 thus equaled UNAM.

In area 7 (Figure 21), the CINVESTAV with an average of 2.4 items to 2011 has established itself as the institution with the highest average productivity. Secondly, the UAM are as UNAM, however, in 2007 has substantial growth and exceeds 1.7 articles on average 2011, the IPN remained with an output almost equal to the average to 2006 when you have a strong drive and fight the third with the UAM and the UANL.

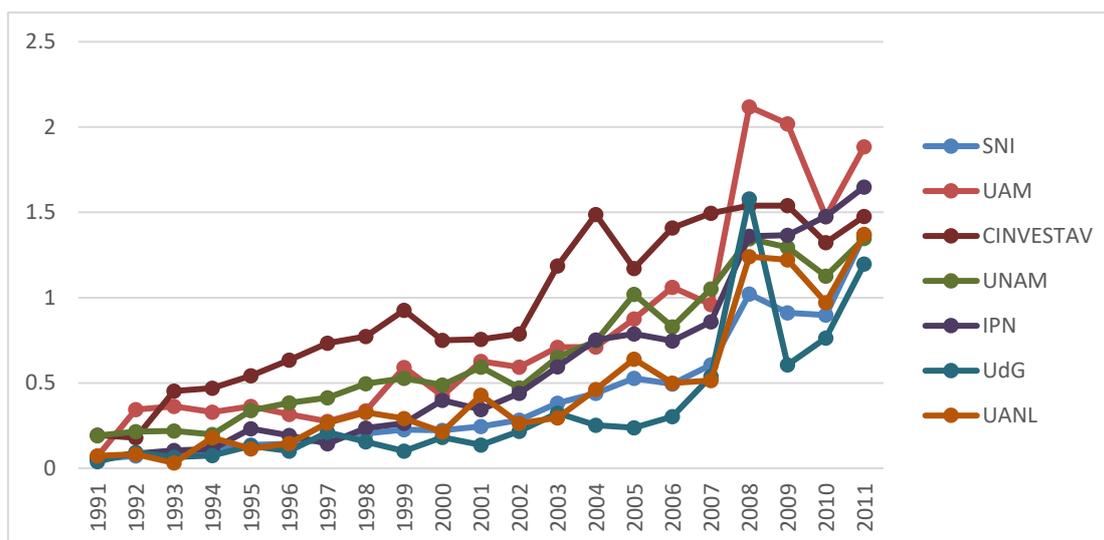


Figure 20. Average annual publication Area 6.

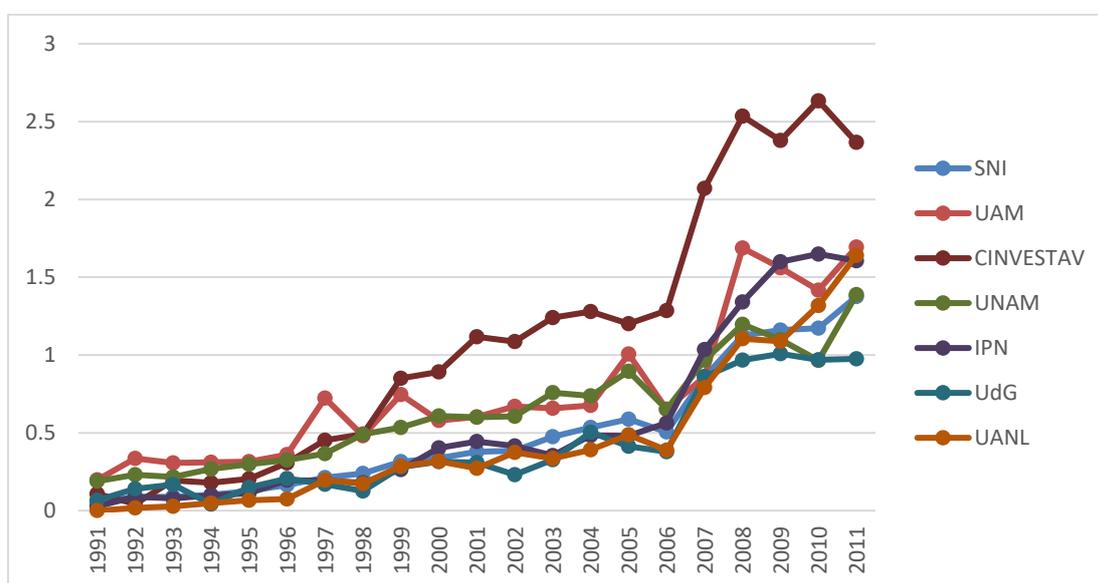


Figure 21. Average annual publication Area 7

In summary, Figure 22 shows the average number of publications during the 21 years of analysis of this study (1991-2011); this clearly shows that the CINVESTAV is the institution with the greatest historical production with an average of 1.15 articles per year, followed by the UNAM with 0.71 and third is the IPN with 0.58 publications per year.

Another interesting point is the number of international publications (Figure 23) that are generated by members of the SNI, in this regard as the previous figure CINVESTAV has the highest average with 0.42 items, representing 36% of its publications; UNAM is the second institution with more international publications with an average of 0.25, meaning

that 35% of articles are international; thirdly almost a dead heat with the IPN is located UANL with an average of 0.14, which represents 24% of its articles; UAM with an average of 0.1 (23% of production) is in fifth place.

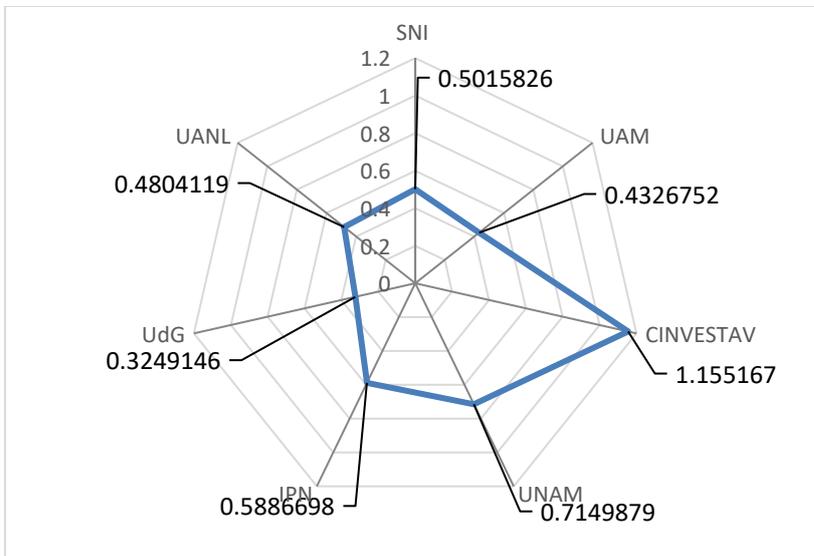


Figure 22. Average Historical Publications by Institution.



Figura 1. internacional

Figure 24 shows the average number of co-authors per article and historic university, where the CINVESTAV has an average of 174 co-authors per article. This number is so large because there area members involved in physical experiments as ALICE and reporting more than 100 authors for publication; followed by IPN with 45 after 44 UNAM and UAM with 27 co-authors per article on average.

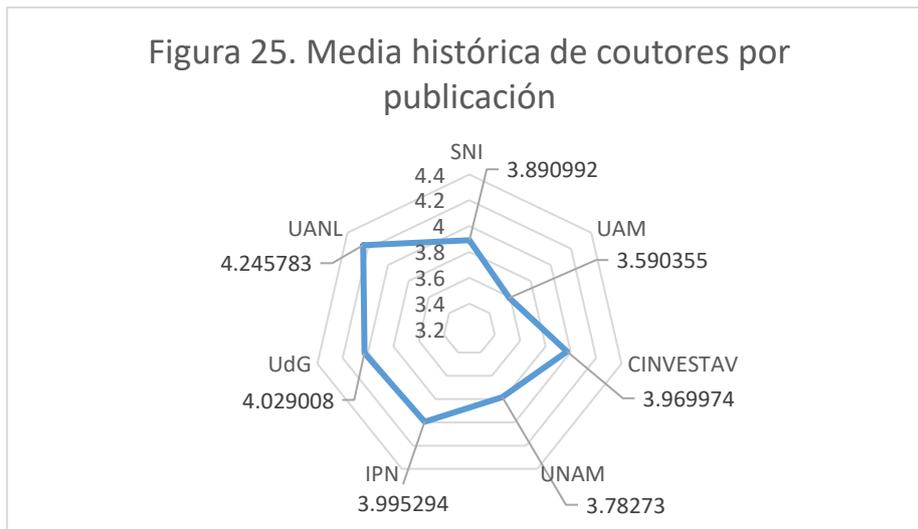


Figure 24. Average of authors for publication.

Finally, in this section we show the historical average of publications by country of obtaining degree of SNI members per university. Figure 25 shows that all researchers who obtained the degree in the United States have higher production than what obtained in Europe, only in the case of the production of members UdeG grade in Mexico is higher even than the United States.

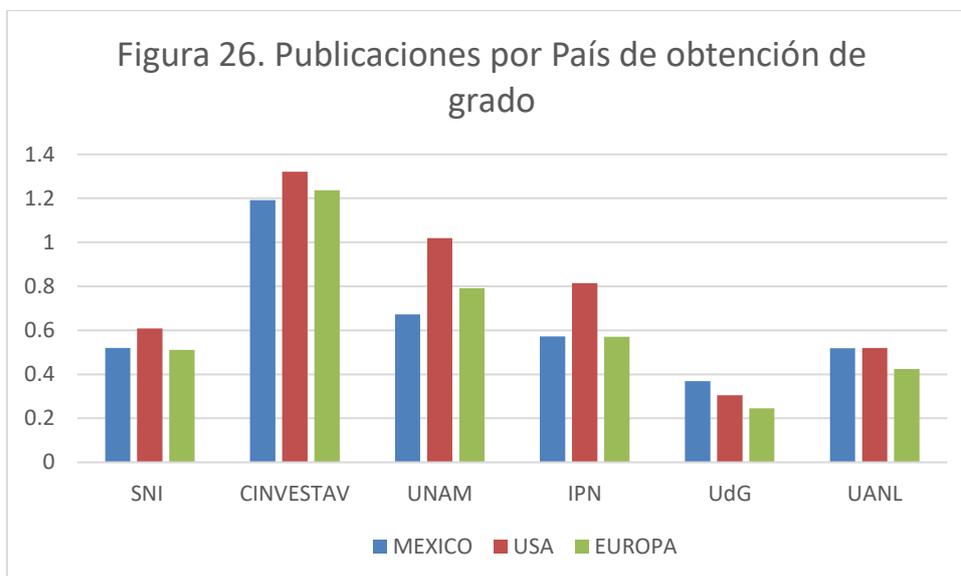


Figure 25. Average of publications by country of obtaining degree.

3. Conclusions

The importance of scientific presence of an institution of higher level has implications for social, political and economic life of our country, and certainly the CINVESTAV to 51

years of history has contributed to the advancement of Mexican society through training Highly competitive human resources at the national and international levels, in addition to the generation of scientific and technological knowledge frontier. To think that these results are the product of solitary efforts is unthinkable, because policies in science and technology have been key to fostering development and scientific prestige of an institution. In this sense, the SNI since its inception originated with the aim of recognizing the productivity and quality of individual scientists through an economic stimulus, but has only managed to increase research productivity but has become a parameter to evaluate (ranking) to institutions of higher education (Santiago Rodriguez, 2006) (Salvador Vega y Leon, 2003). That is, the SNI has fostered an apparent competition from institutions, to see who has the best researchers and who gets more research results (articles, patents, citations, etc.).

In this work the contribution of researchers CINVESTAV that belonged to at least one year SNI shows, and the production of items and the number of citations received five more universities compared. The results show that the CINVESTAV has become one of the top scientific research institutions in Mexico, in the areas of Fisicomatemáticas Sciences and Earth Sciences, Medicine and Health Sciences, Biotechnology and Agricultural Science and Engineering. CINVESTAV maintains the lead with the highest average annual publications.

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