Scientometrics (2012) 93:931–936
DOI 10.1007/s11192-012-0735-4

Effects of war on scientific production: mathematics in Croatia from 1968 to 2008

Jasna Dravec Braun

Received: 22 November 2011 / Published online: 1 May 2012

Abstract Since 1968 the Croatian Mathematical Society has issued annual reports on activities of its members in the scientific journal *Glasnik Matematički*. Based on these data was analysed production of mathematical scientific articles published in national and international journals in the period of forty years. A rough estimate of the intensity and dynamics of the publication shows that the publication of the reference period can be divided into two stages separated by the War in Croatia. After a period of uncertainty of the 2nd World war the period preceding was characterized by establishing new institutes, colleges and university departments. After the War in Croatia a gradual but large increase in the number of published articles was evident, especially in foreign journals. The War diminished technical writing almost to the zero while increase of scientific production was 9 times greater in 2008 than in 1968.

Keywords Scientific production · War · Mathematics · Discipline development

Mathematics Subject Classification 01A90 · 01A60 · 01A61

Foreword

Monitoring, promotion, evaluation and assessment of scientific activities, has always been closely related to the work and activities of scientific societies. The scientific field of mathematics in Croatia is inseparable from the work of the Croatian Mathematical Society since 1990, of the Society of Mathematicians and Physicists of the Croatian Socialist Republic from 1946 to 1990, respectively. Since 1968 the Society has issued annual reports on activities of its members in the scientific journal *Glasnik Matematički*. After monitoring

Electronic supplementary material The online version of this article (doi:10.1007/s11192-012-0735-4) contains supplementary material, which is available to authorized users.

J. Dravec Braun (✉)
Faculty of Science, Department of Mathematics, University of Zagreb, Zagreb, Croatia
e-mail: jdravec@math.hr

the work of members of the Society, it is possible to give an overview of the development of mathematics in this period of time in Croatia with the help of the analysis of the quickest ways of scientific communicating—publishing scientific papers.

The annual reports on activities of the Society's members include, among other things, bibliographical information on scientific and professional papers and books that they published in the current year (*Glasnik Matematički*, 1968–1999; *Glasnik Matematički*-Prilozi, 2000–2008). Although these bibliographic data cannot be considered a bibliography, they may serve as the monitoring of trends in the development of scientific field of mathematics in Croatia.

Based on these data, the mathematical scientific articles published in national and international journals in the period of forty years (1968–2008) were analysed.

Production of scientific articles

In previous studies it was shown that in the period from 1980 to 2000, in journals indexed in Science Citation Index, mathematics participated with 0.51 % of the total production of Croatian science (Bencetić Klaić and Klaić 2004). That, however, is not the most authoritative secondary publication of mathematics for comparison with "world's science", because many respected mathematical journals are not index in it. A large number of mathematical journals are indexed in the world's leading reference journals such as Zentralblatt für Mathematik, Mathematical Reviews and Referativniy Zhurnal Matematika, which during the second half of the last century grew into prominent international bibliographic databases and bibliographic citation databases in the scientific field of mathematics: ZentralblattMATH, MathSciNet and Referativniy Zhurnal Matematika.

In Croatia there were not many mathematical journals, and there were not many journals from other sciences in which mathematics is of such significance to justify publishing in such journals. Before the War in Croatia two mathematical journals were published: *Glasnik Matematički* and *RAD JAZU, Razred za Prirodne Znanosti-Matematika.*

Note that at that time as domestic periodicals were also considered those serials that were published in former Yugoslavia. These were: *Automatika*, *Acta Universitatis (Niš)*, *Matematika, Matematički Vesnik*, *Prilozi MANU (Skopje)*, *Publikacije Elektrotehničkog Fakulteta Univerziteta u Beogradu*, *Publikacije Instituta za Matematiku (Beograd)*, *Radovi Matematički*, *Statistička Revija*, *Tensor Novi Sad* and *Tehnika.*

After the war, starting with 1996, in Croatia began the publication of the journals *Mathematical Communications* (Osijek) and KOG (Zagreb). In 1998 began the publication of *Mathematical Inequalities and its Applications*, and since 2007 *Journal of Mathematical Inequalities* and *Operators and Matrices*, both in Zagreb.

Strong influence on the dynamics of scientific activity also had dramatic economic and political changes in the early nineties, whose turning point was the War in Croatia.

A rough estimate of the intensity and dynamics of the publication shows that the publication of the reference period can be divided into four stages (Figs. 1, 2).

In the initial period from 1968 to 1977 not much was published in international and national journals, but there was a tendency of greater production in the few national journals. This period characterizes the small scientific community who could not produce many scientific papers. This period was stable after a period of turmoil of the 2nd World war which established new institutes, colleges and university departments.

Furthermore, we can single out the period until the end of the 80th when there was an equal number of scientific articles in international and in national journals. At the end of

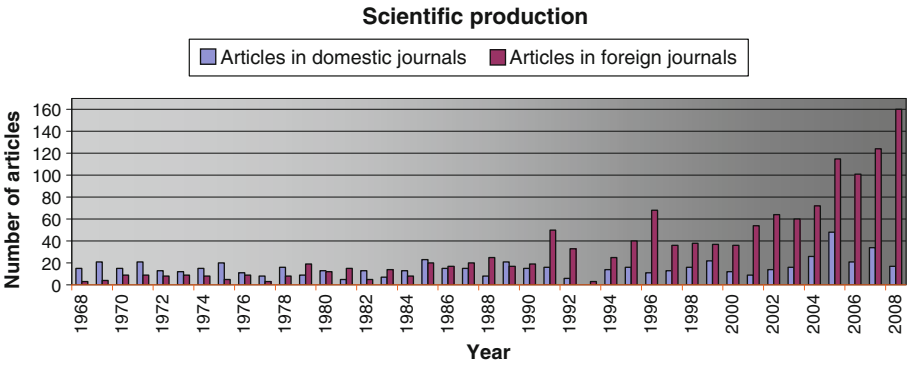

Fig. 1 The difference between domestic and foreign journals in scientific production

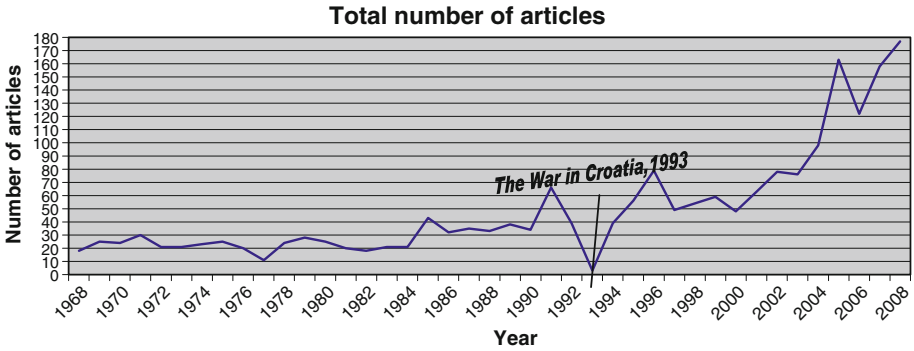

Fig. 2 Growing trend of scientific production showing brake down caused by the war activites

this period increases the number of articles in international journals, while the number of articles in national journals remains unchanged. Scientific communication with foreign countries became stronger.

These two periods are characterized by the expansion of higher education and intensification of research work. This was the basis for the formation of scientific nuclei on the existing University of Zagreb and other new universities, which were constituted in Rijeka in 1972, in Split in 1973, and in Osijek in 1974. Mathematics also developed in technical colleges and in the Faculty of economy in Zagreb. Also important was the role of the Society of mathematicians and physicists in the Social Republic of Croatia which in 1990 became the Croatian Mathematical Society. The Society's main activities are the Scientific colloquium of the society, and the publishing of the scientific journal *Glasnik Matematički*. From 1961 to 1974 a complete research work in the scientific field of mathematics was organized at the University Institute of Mathematics (Mardešić 1996). In 1974 the Institute was closed, and Department of mathematics at the Faculty of Science of the University of Zagreb took over its role in whole scientific activities of mathematics in Croatia. All the above affected the dynamics of scientific work including the publication of scientific articles (Fig. 2).

The period of the War in Croatia which followed drastically reduced the scientific activities. The year 1993 is the lowest level when not a single article was published in

national journals, but only three scientific papers were published in international journals. The devastating effects of the War turned out also in the scientific sphere of mathematics. The period after the war is the last period we consider. A gradual but large increase in the number of articles was evident in foreign journals, e.g. 2008 there were 177 articles. The number of articles in national journals significantly increases between 2001 and 2004.

There are several reasons for that. The development of universities is strong and the scientific community of mathematicians is bigger, the desire to publish in foreign journals is, for a number of reasons, stronger and computer science has a fast development. Two new national mathematical journals were established; also, two new universities: one in Zadar in 2002, and one in Dubrovnik in 2003. It should be noted that no work of local authors was published in the national journal *Operators and Matrices*, which was established in 2007. In general, the scientific production of mathematical papers has continually increased since the War in Croatia until today.

The number of articles from the beginning to the end of this forty-year period showed that recorded production in the scientific field of mathematics increased 9 times (Fig. 2). In international journals the production has increased of 8 times, while in domestic journals it increased only 3.5 times (Fig. 1).

About journals in which articles were published

They were published in the following national journals: *Croatica Chemica Acta*, *CIT – Journal for Computing and Information Technology*, *Energija, Financijska Praksa*, *Glasnik Matematički*, *Journal of Mathematical Inequalities*, *KOG*, *Mathematical Communications*, *Mathematical Inequalities and its Applications*, *Napredak*, *Periodicum Biologorum, Zavod za Znanstveni Rad HAZU*, *Varaždin*. For the period before the War in Croatia the ten journals from former Yugoslavia mentioned above, should be included.

Papers from the beginning of the period between the two world wars are mainly papers from the branch of mathematics that developed in the region at that time: geometry, mathematical analysis, set theory, mathematical physics, and the history of mathematics. Their publication in international journals reflects also the scientific ties of scientists with the international community.

Due to mathematical institutions in Croatia, in the second half of the 20th Century, 13 disciplines were represented in mathematics. These are: the foundations of mathematical logic and mathematics, algebra and number theory, geometry, topology, Lie groups and representation theory, analysis and functional analysis, probability theory, mathematical statistics, differential equations and mathematical physics, combinatorial and discrete mathematics, numerical mathematics, optimization, computer science and history of science (Mardešić 1996, 2011).

The number of articles published in foreign journals increased. From the very beginning of the scientific publications more articles were published in foreign than in domestic journals, and after the war this ratio further increased to the benefit of foreign journals (Fig. 3). In the initial three-year period between 1968 and 1970 articles were published in the following international journals: *Michigan Mathematical Journal*, *Pacific Journal of Mathematics*, *Rendiconti.Classe di Scienze Fisiche*, *Mathematiche e Naturali*, *Ser.VIII*, *Mathematische Annalen*, *Journal of the Australian Mathematical Society*, *Mathematica*, *Analele Stiintifice ale Univresităţii « Al. I. Cuza » din Iaş: Matematică*, *Monatshefte für Mathematik*, *ZAMM*, *Journal für die Reine und Angewandte Mathematik*, *SIAM Review*, *Israel Journal of Mathematics*, *Econometrica*, *Bulletin de l'Academie Polonaise des*

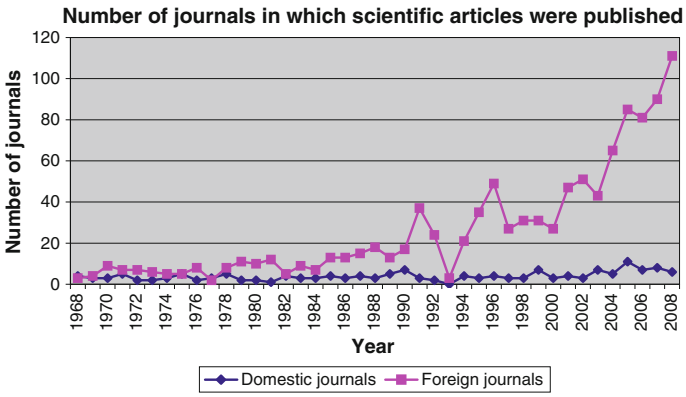

Fig. 3 Relationship between domestic and foreign journals as a choice for publishing

Sciences. Ser. des Sciences Mathematiques, *Astronomiques et Physiques*, *Fundamenta Mathematicae*, *Mathematica Balkanica*, *Acta Scientiarum Mathematicarum*, *Bulletin of the American Mathematical Society*, *Zeitschrift für Mathematische Logik und Grundlagen der Mathematik.* At the end of the considered period papers were published in 90 (2007) and 111 (2008) international journals, respectively (Fig. 3). The journals' list is shown in the Appendix (see Online Supplement).

The increase in the number of articles in foreign journals directly shows the development of Croatian mathematical community, the dispersion of disciplines and substantial increase in the number of foreign journals primarily in mathematics and computer science; most frequently, one article in each journal, sometimes two were published, but rarely three or more. The last became more common in the years 2007 and 2008 of the considered period.

Conclusion

From 1968 up to date the scientific production, as an indicator of the development of mathematics in Croatia, can be divided into two stages, separated by the War in Croatia: the transitional period of socio-economic transformation, then peace, show the trend of productivity growth in publishing in international journals, which was interrupted by war activities, continued in the quiet conditions after the war until today.

The period before the war was marked by consolidation and strengthening of the scientific community through the establishment of scientific and higher education institutions. The fifteen-year period after the war increased the number of scientists, setting criteria for scientific advancement, and an increase in the number of journals, facilitated the trend of continuous growth of scientific production in mathematics.

The War in Croatia, unfortunately, stopped the visible scientific activity in mathematics.

References

Bencetić Klaić, Z., & Klaić, B. (2004). Croatian scientific publications in top journals according to the *Science Citation Index* for the 1980–2000 period. *Scientometrics, 61*, 221–251.

Glasnik Matematički Vol. 3 (1968)–Vol. 33 (1999).

Glasnik Matematički, Vol. 35 PRILOZI (2000)–Vol. 51 PRILOZI (2008).
Mardešić, S. (1996). Matematika u Hrvatskoj poslije 1874. godine. In *Centuries of natural science in Croatia: Theory and application* (*2*, pp. 136–137) (Author of the exhibition Greta Pifat Mrzljak, Zagreb).
Mardešić, S. (2011). Matematika u Hrvatskoj poslije 1874. godine. Accessed April 11, 2011, from http://public.carnet.hr/zuh/od1874/pznaz/Matemak.htm.