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EU-EAEU dilemma of Armenia: Does science support politics?

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EU-EAEU Dilemma of Armenia: Does Politics Support Science?

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Abstract

On January 1, 2015, the Republic of Armenia joined the (Russian-led) Eurasian Economic Union (EAEU) and actually refrained from entering into the alternative Association Agreement with the European Union (EU). Nevertheless, Armenian researchers have maintained a certain scientific autonomy, which is expressed in numerous international scientific collaborations with researchers from many European countries.

This paper proposes a bibliometric analysis of the international scientific collaboration between (i) Armenia and EU countries, and (ii) Armenia and EAEU countries, based on the papers indexed by the Clarivate Analytics Web of Science Core Collection database and the Russian Science Citation Index database. Results indicate that the international collaboration with researchers from countries of both blocks gradually grows, displaying similarities and differences. Although, Armenia has more collaborations with EU countries, by averaging over the number EAEU seems to prevail. In terms of citations, the EU is in the forefront both in terms of pure and

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mean numbers. At the level of single countries, Russia is the main collaborator of Armenia, followed by Germany. Finally, it has been noted that "megaprojects" significantly influence the scientific collaborations between Armenian and foreign researchers.

Key words: Scientific collaboration; Armenia-EU; Armenia-EAEU; science policy; bibliometrics; megaprojects

Introduction

After seventy years of Soviet rule, in 1991 Armenia, together with fourteen other post-Soviet countries, regained its independence[8]. Soon, these countries faced a number of political, social, and economic issues, among them also vital choices related to further integration processes. Aiming to preserve its influence in the post-Soviet region, Russia launched a new "integration project" nearly simultaneously with the dissolution of the USSR, i.e., the so-called Commonwealth of Independent States (CIS), also called the Russian Commonwealth[9]. All former soviet states, except the Baltic Republics of Latvia, Lithuania and Estonia, chose to join it[10]. As correctly mentioned by some analysts, CIS represented a sort of "civilized divorce" between Russia and the former Soviet states[11]. However, this project had been politically inactive for several years, proving to be rather impractical.

Being finally persuaded of the failure of the CIS, Russia has recently launched several new reintegration processes for former-Soviet countries. These projects include the Collective

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[8] The Soviet Union was dissolved on December 26, 1991; as a result the following 15 states appeared on the world political map: the Republics of Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kirgizia, Latvia, Lithuania, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

[9] The Commonwealth of Independent States was founded on December 8, 1991 when Belarus, Russia and Ukraine signed the "Agreement Establishing the Commonwealth of Independent States", concerning the new relations between these nations after the Soviet Union dissolution.

[10] Ukraine and Turkmenistan are associate members. In 2008 Georgia withdrew its membership from CIS. Ukraine has also announced its intention to withdraw the organization.

[11] https://themoscowtimes.com/articles/ukraine-leaving-cis-shoots-down-kremlins-imperial-ambitions-35890 21.04.2017

Security Treaty Organization (CSTO)[12] and the Customs Union[13]; the last initiative somehow imitates the European Union (EU) model.

An alternative integration project for the post-Soviet countries was also offered by the European Union (EU)[14]. In fact, Armenia has participated in several EU projects. The start of the EU-Armenia relations traces to 1999, when the EU-Armenia Partnership and Cooperation Agreement was signed, encompassing wide-ranging areas of cooperation, including but not limited to that of political dialogue, economy, trade, democracy, human rights, law-making and culture. Armenia participated to two EU projects: "European Neighborhood Policy"[15] since 2004 and "Eastern Partnership"[16] since 2009.

With the aim to strengthening cooperation with the EU, in the last decade the Armenian government negotiated the Association Agreement[17] with the EU, including a Deep and Comprehensive Free Trade Area. Later in 2013, after some agreements with Russia, Armenia abruptly decided to switch to the former (Russia-led) Customs Union, which from 2015 operates as Eurasian Economic Union (EAEU) (Vinokurov 2017). Since the economy of Armenia is

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[12] The Collective Security Treaty Organization (CSTO) was signed on May 1992. The CSTO member states are: Armenia, Belarus, Kazakhstan, Kirgizstan, Russia and Tajikistan.

[13] The Customs Union was founded in 2011 and was reorganized into the Eurasian Economic Union in 2015. Member states are Russia, Belarus, Kazakhstan, Armenia and Kyrgyzstan.

[14] The European Union (EU) is a political and economic union of several member states, which was established in 1993.

[15] The European Neighborhood Policy (ENP) was launched in 2004 based on "Wider Europe – Neighborhood" Communication, with the aim of achieving close political association and economic integration with EU's 16 Eastern and Southern Neighbors: Algeria, Morocco, Egypt, Israel, Jordan, Lebanon, Libya, Palestine, Syria, Tunisia, Armenia, Azerbaijan, Belarus, Georgia, Moldova, Ukraine.

[16] The Eastern Partnership (EaP) is a joint initiative of the EU member states and six Eastern European partners: i.e., Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine, based on a commitment to the principles of international law and fundamental values of democracy, the rule of law, human rights and fundamental freedoms. It also supports market economy, sustainable development and good governance.

[17] The Association Agreement is a bilateral agreement between the EU countries and third countries, representing a basis for the implementation of the admission process to the EU.

heavily dependent on Russia, which is also the largest foreign investor, trade partner, supplier of arms and supporter of migrant work. Armenia joined the Russia's integration project together with the three other post-Soviet republics of Belarus, Kazakhstan, and Kyrgyzstan.

The post-independence history of science in Armenia has been characterized by a kind of survival and adaptation to new dramatically changed conditions. Because of the fragmentation of the research infrastructure during the Soviet era, after the collapse of the USSR, many research institutions lost their *raison d'être*. Furthermore, Armenia and the other post-Soviet countries were drawn into a dramatic economic crisis, with further decline and without the possibility of building new collaborative networks, to preserve their scientific potential and activities. The sharp decrease in the financing for science and the absence of past collaboration networks with other Western and Eastern countries have further slowed down the development of the scientific community of the former Soviet states.

In 1991, after the restoration of independence, Armenian scientists stood before the following options:

1. Collaboration with the former soviet-states, with which there were strong historical ties.
2. Collaboration with European countries, which had historically been less accessible to Armenian scientists because of the "iron curtails" policy. However, this collaboration was encouraged by a sort of Armenian Diaspora towards European countries, as well as a brain-drain of Armenian scientists to Europe, which started immediately after the collapse of the USSR.

A third potential option of collaboration with Asian countries was practically neglected, as those countries were not very well known by Armenians. However things will probably change in the future.

Starting from the 2000s, science in Armenia entered a rapid development stage, due to several reforms in the economic, educational and scientific sectors. As a result, the number of international publications of Armenian researchers gradually grew. This was the result of promoting science, technology and encouraging the increase in scientific output, thanks to its visibility and impact on scientific collaborations (Glänzel and Zhang, 2018).

Not surprisingly, the Science Committee of the Republic of Armenia has signed different collaboration agreements with a number of countries. In several cases, these agreements resulted in bilateral grant competitions, e.g., grant projects with Russia and Belarus, separate agreements with France, Germany and the Francophone University Agency. Precisely, there is an agreement

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with French CNRs (i.e., national scientific research centers) aimed at forming joint research groups and laboratories, and another with Germany, aimed at consolidating scientific research groups for developing further collaborative projects (Horizon 2020)[18]. In addition, since May 2016, Armenian scientists have full access to the Horizon 2020 research projects and initiatives[19]. There are also non-governmental funding agencies within the EU and EAEU that Armenian scientists can apply to promote international scientific cooperation.

Although we are aware that not all research collaborations result in co-authored papers (Melin and Persson, 1996) and that there are various methods to measure research collaborations (Franceschini et al., 2012; Finardi 2015; Wang 2016), joint publications still represent an important indicator of scientific cooperation. As mentioned by the Zitt et al. (2000) "co-authorship is a complex phenomenon, which is influenced by policy decisions (such as, scientific cooperation agreements with individual countries or blocks of countries) and by decisions of individual scientists"; furthermore, "the amount of international co-publications basically depends on the size of the countries involved, their cultural and geographical proximity, including historical, linguistic, socio-economic or political affinity". Another study by Nagpaul (2003) found that geographic, socio-economic (development level) and thematic proximity is fundamental for the construction of scientific cooperation networks.

Armenia, as a small post-soviet country, has obviously deep historical, cultural, socio-economic and political affinity with other states of the former Soviet Union. There is also a linguistic affinity issue: Russian is still the *lingua franca* of many post-Soviet countries. On the other hand, the EU represents a great scientific potential in terms of modern technologies and equipment, methodologies and networks, expertise and experience.

It can therefore be said that, although the Republic of Armenia has officially decided to join the EAEU block, it is still preserving good relations with the EU countries. In fact, on 24 November 2017, the EU-Armenia Comprehensive and Enhanced Partnership Agreement (CEPA) was signed with the aim of strengthening cooperation in the areas of mutual interest, particularly in the political, economic and sectoral fields. As already mentioned, there are individual

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[18] For more information on the bilateral projects organized by the State Committee of Science, see https://scs.am.

[19] https://ec.europa.eu/programmes/horizon2020/en/news/armenia-joins-horizon-2020-work-eu-research-and-innovation.

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agreements with member-states of the EU and the EAEU. So, although Armenia has joint the EAEU, both on the macro and micro levels the decisions are much twisted.

The aim of this article is to analyze the scientific collaborations between Armenia and EU, and between Armenia and EAEU, investigating common aspects, differences and future trends. This study allows to evaluate in some way the validity of the political decision to formally join the EAEU project from the perspective of the scientific collaboration networks.

Data and Method

The present work is based on the data obtained from two databases: (1) the Clarivtive Analytics' Web of Science Core Collection (WOS CC) and (2) the Russian Science Citation Index (RSCI), developed by the Russian Scientific Electronic Library (Moskaleva et al. 2018; Mikhailov 2013). While the Armenian international collaboration papers with the EU-member countries are mainly published in international English-language journals, most of those with the EAEU-member countries are published in domestic Russian-language journals, which may sometimes contain very small portions of English-language articles. The time window of the publications retrieved from WOS CC is 1991 to 2018, and that from RSCI is 2005 to 2018[20]. From the WOS CC database, only articles, proceeding papers, notes, letters, reviews, meeting abstracts were used, while from the RSCI articles, letters, meetings, and other reviews were used. These asymmetries are mainly due to structural constraints of the databases of interest.

First, we have retrieved the publications of Armenia from the WOS CC and RSCI. To obtain all the publication data for Armenia, the following search terms and strategy were used: "Armen*" or "ARSSR" or "Ar.SSR" or "Arm.SSR" or "Yerevan" or "Erevan" or "Ashtarak" or "Byurakan" or "Leninakan" or "Gyumri" or "Abovyan" or "Echmiadzin" or "Kirovakan" or "Vanadzor" or "Goris" or "Idjevan". Afterwards, we have carried out manual data cleaning of the collected publications. For example, there were publications with the USSR affiliation that have been attributed to Armenia, and also others wrongly assigned to Armenia, which were taken off. Another common mistake in the retrieved database was due to the name of "Columbia", which corresponds to both a major US university and an Armenian city; therefore, many US publications were initially misattributed to the Republic of Armenia.

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[20] The RSCI database only includes publications from 2005.

After cleaning the database of publications from the Republic of Armenia, we have selected the papers containing the address of at least one EU or EAEU member country. Here, Armenia-EU, Armenia-EAEU international collaboration publications are classified as publications in which there is (at least) one researcher with Armenian affiliation and (at least) one researcher with affiliation of an EU country or an EAEU country respectively.

Additionally, we have identified "trilateral" publications, i.e., those with (at least) one Armenian affiliation, (at least) one affiliation from a EU country and (at least) one from a EAEU country. If a publication is signed with Armenia and several EU or EAEU-member countries, then it is allocated to the respective corresponding collaboration countries and/or blocks.

Our focus will be on the publications of the Armenia-EU and Armenia-EAEU blocks. Within these blocks, we will also evaluate the major characteristics of the Armenia's scientific collaboration with each country, the duration, the nature of the collaboration (e.g., pure bilateral cooperation or "mediated" collaboration), etc..

The scientific fields of the examined publications are determined considering the subject fields of the publishing journals. Specifically, there are sixteen subject fields are classified into 16 fields, according to the scheme proposed by Glänzel and Schubert (2003): Agriculture & Environment (AGRI); Biology (BIOL); Biosciences (BIOS); Biomedical Research (BIOM); Clinical & Experimental Medicine (CLIN); Neuroscience & Behavior (NEUR); Chemistry (CHEM); Physics (PHYS); Geosciences & Space Sciences (GEOS); Engineering (ENGN); Mathematics (MATH); Multidisciplinary Sciences (MULT); Social Sciences (SOCSCI); Arts and humanities (ARTS&HUM).

In our research, a full counting method was used, so that for each article a unitary score is assigned to each co-authoring country; for multiple EU or EAEU countries, a unitary score is conventionally assigned to each co-authoring country. Thus, some scientific products are counted more than once.

In addition, an evaluation of the top collaborations (Armenia-EU and Armenia-EAEU) using the WOS InCites Essential Science Indicators database for the 2008-2018 period was carried out.

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Discussion

The number of publications in the WOS CC database for the period 1991-2018 amounts to 17 826 (**Figure 1**). Regarding the RSCI database, it amounts to 892 for the 2005-2018 period (**Figure 1a**).

Figure 1. **Publication output of Armenian researchers in the WOS CC database (1991-2018).**
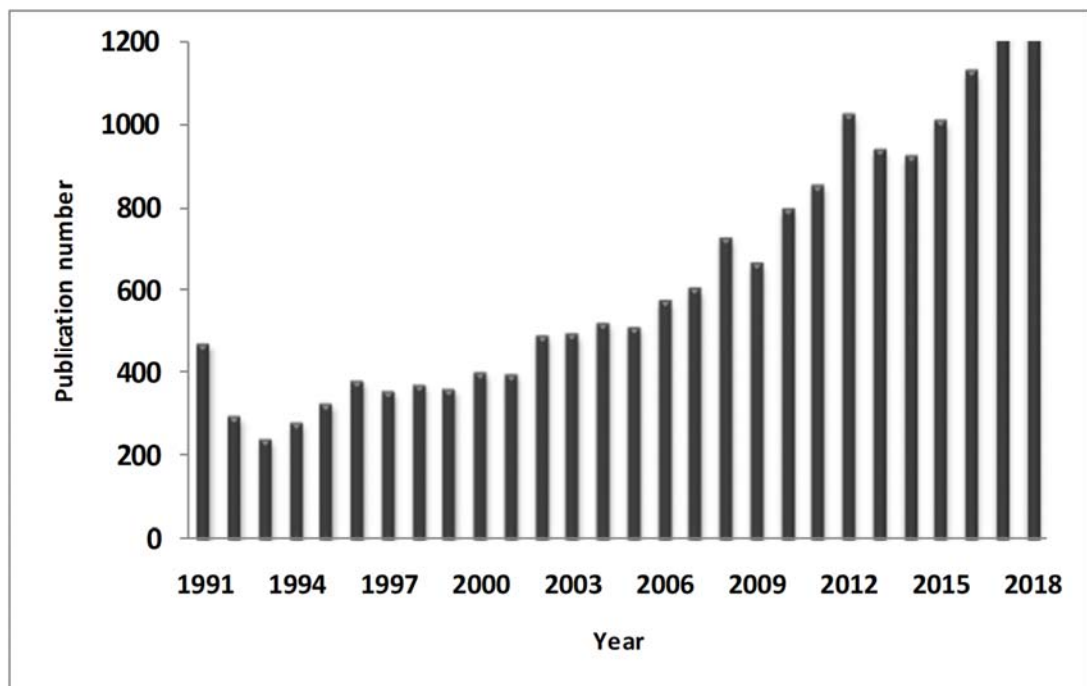
Figure 1a. Publication output of Armenian researchers in the RSCI database (2005-2018).
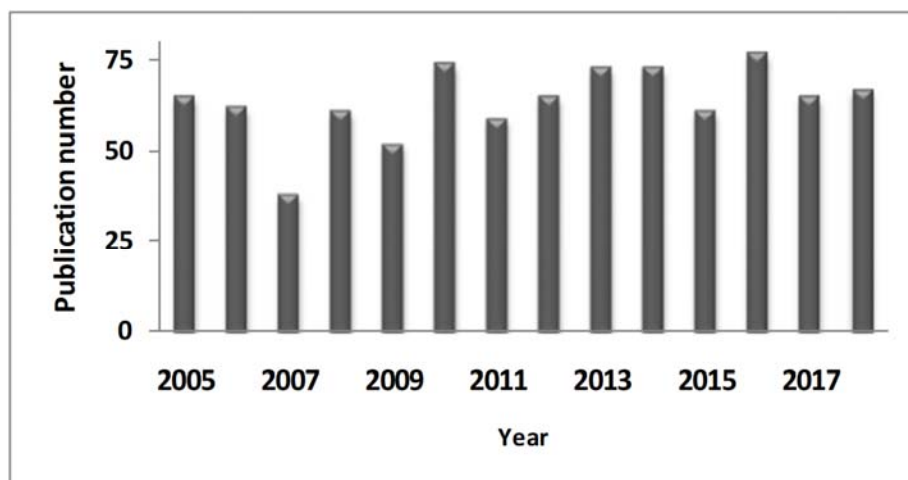
Among the papers retrieved from the WOS CC database, more than half (i.e., 8 503) are so-called collaboration papers, which will be considered in our analysis. Regarding the RSCI database, only one fifth of the papers (i.e., 181) reflect a collaboration; 160 of them are in the EU and/or the EAEU block. For the purpose of our research, we have further identified the following nine collaboration sub-groups: AM-EU; AM-EAEU; AM-EU-EAEU, AM-EU-Other, AM-EAEU-Other, AM-EU-EAEU-Other, AM-Other, AM+EU[21] and AM+EAEU[22] (**Table 1**).

Table 1. Collaboration papers (%) of Armenia (AM) indexed by the WOS CC and RSCI databases, divided into nine sub-groups.

Collaboration papers sub-groups	WOS CC (%)	RSCI (%)
AM-EU	23	9
AM-EAEU	9	66
AM-EU-EAEU	4	4
AM-EU-Other	13	1
AM-EAEU-Other	3	8
AM-EU-EAEU-Other	26	0
AM-Other	22	12
AM+EU	66	14
AM+EAEU	42	78

Among the 8 503 collaborative works from the WOS CC database, only 22% are collaborations with other countries (i.e., neither from the EU nor the EAEU block). It is worth remarking that in the AM-Other group, the main country collaborating with Armenia is USA. In general, Russia is the major collaboration country of Armenia, preceding USA for twenty-five publications; the third country in the row is Germany.

Table 1 also shows that, according to the WOS CC database, the AM-EU collaboration papers are four times higher than the AM-EAEU ones: i.e., 1 980 AM-EU publications (corresponding to 23%) against 768 AM-EAEU publications (corresponding to 9%). The same tendency can be seen in the trilateral collaborations, i.e., those involving the EU and the EAEU:

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[21] With "AM+EU" we denote articles that include (at least) one Armenian researcher and (at least) one from EU.
[22] With "AM+EAEU" we denote articles that include (at least) one Armenian researcher and (at least) one from EAEU.

the AM-EU-Others sub-group exceeds nearly four times the AM-EAEU-Others sub-group. Perhaps this result would be subverted if we only considered the local, mainly Russian-language, publications.

In addition, the AM-EA papers are predominantly published in English language on international scientific journals, mostly covered by the WOS CC database. The collaborations involving simultaneously EA, EAEU and Armenia are relatively rare, amounting to only 4% in both databases.

In the WOS CC database, the co-authored publications with at least one EU-member countries amounted to 5 629, while those with at least one EAEU one amounted to 3 523. It can be seen that the numbers here are much higher than those related to pure collaborations with the two blocks. The reason is that the simultaneous collaboration with the two blocks is very frequent. Since pure AM-EU-EAEU collaboration is very small for both databases (i.e., 4%, as shown in **Table 1**), we can assume that Armenian researchers often collaborate with EA/EAEU researchers, together with researchers from other countries. Notably, a big part of this international collaboration is implemented in the framework of so-called "megaprojects"[23].

Regarding the RSCI database, the situation is quite different from that observed for the WOS CC database. In fact, in RSCI the (AM-EU) joint papers with EU are just seventeen (corresponding to 9%), while the AM-EAEU ones are 119 (corresponding to 66%). The number of joint papers with at least one EAEU member-state (i.e., AM+EAEU) is more than five times higher than that of papers with at least one EU member-state (i.e., AM+EU): 141 against 27.

Let us now broaden the perspective by comparing the publications of (1) AM (i.e. publications with only Armenian affiliated authors), (2) AM-EU and (3) AM-EAEU, so as to assess the weight of these collaborations in a more global context. In this respect, **Table 2** presents the number of publications and citations per thousand researchers of the AM, AM-EU and AM-EAEU sub-groups. It can be seen that the AM-EAEU block slightly prevails with respect to the AM-EU one, in terms of publications, for both databases. However, when considering citations per thousand researchers, the AM-EU block predominates for the WOS CC database (i.e., 13.17 against 6.43), while the result is subverted for the RCSI database (i.e., 0.006 against 0.17). In

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[23] Within this article we refer to "megaprojects" as projects involving more than ten partner organizations.

addition, the AM-EU block predominates over the AM and AM-EAEU ones in terms of citations per paper, for both databases.

Table 2. Data on the number of publications, citations and citations per paper of the AM, AM-EU and AM-EAEU sub-groups.

Armenia and Sub-groups of Collaborative Papers	WOS CC					RSCI				
	Number of Papers	Number of Citations	Papers per Thousand Researchers	Citations per Thousand Researchers	Citations per Paper	Number of Papers	Number of Citations	Papers per Thousand Researchers	Citations per Thousand Researchers	Citations per Paper
AM	17826	191447	3 961	42 543	10.74	892	541	198.2	120.2	0.6
AM-EU	1980	23 710	1.1	13.17	11.97	17	12	0.009	0.006	0.7
AM-EAEU	768	2587	1.9	6.43	3.36	119	69	0.3	0.17	0.6

Source: UNESCO Science Report 2016; Eurostat data of 2016

To enrich the analysis, we have further analyzed the so-called top papers[24] of Armenia, which somehow characterize the collaborations qualitatively. **Table 3** shows that the WOS CC database contains 198 top papers from Armenian researchers and all of them are written in collaboration. Precisely, only 17 out of 198 do not include a co-author from EAEU countries and only two top-papers are a direct result of Armenia-EU collaborations in the field of Biomedical Research and Physics (both with researchers from the UK).

Table 3. Number of Top Papers for the AM, AM-EU, AM-EU-Other and AM-EAEU-EU-Other sub-groups.

Armenia and sub-groups of Collaborative Papers	Top papers	Cites to Top Papers	Cites/Top Paper
AM	198	39118	197.5
AM-EU	2	658	329

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[24] This indicator, taken from the WOS InCites Essential Science Indicators database, is defined as "the number of papers in the top 1% of papers for the past ten years, and the number of papers of the past two years, which received a very high number of citations in the two-month period".

| AM-EU-Other | 15 | 2317 | 154.4 |
| AM-EAEU-EU-Other | 181 | 36143 | 199.6 |

**The Role of Megaprojects in the Armenian Research Collaborations**

As noted previously in the article, a significant part of the international collaborations of Armenia are being implemented in the framework of megaprojects. In 2 369 total megaprojects[25] (ATLAS, HERMES, CMS, HESS, ALICE, H1, etc.) with at least one Armenia-affiliated researcher, 1 882 involve researchers affiliated in the EU or EAEU, which means that 41.1% of joint publications with the EU and/or EAEU result from megaprojects. Specifically, the percentage of megaprojects in the AM+EAEU sub-group is 58.5%, while that in the AM+EU sub-group is 44.4%; this means that most of the Armenian scientific collaborations with the EAEU countries are not directly but mostly in the framework of big collaborations involving other countries.

Figure 2 illustrates the number of megaprojects involving researchers with Armenian affiliation. It can be seen that the year 2009 marks a turning point for the diffusion of megaprojects, corresponding to a significant increase in the number of co-authored publications.

**Figure 2. Number of megaprojects with the participation of Armenian researchers.**

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[25] The WOS CC database allowed to identify the groups of authors and then the corresponding megaprojects. On the other hand, the RSCI database does not have a tool to do this; for this reason it is not used in this part of the analysis.

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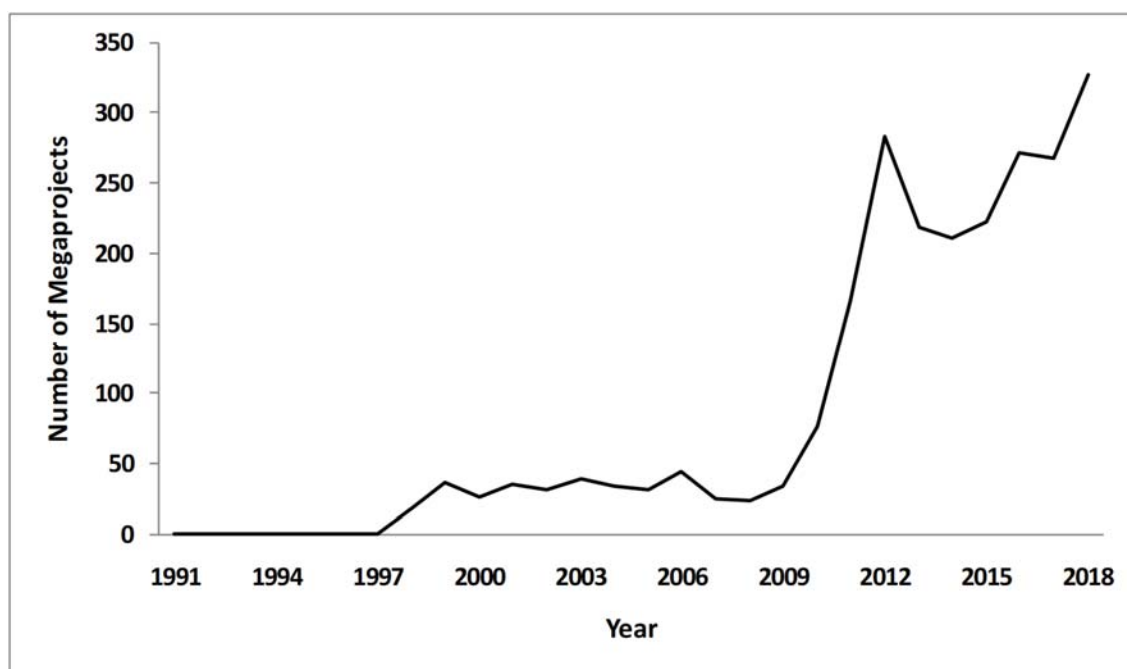
We also point out that both databases show a constant growth in the time of AM, AM-EU and AM-EAEU papers (see **Figure 3** and **Figure 4**). While according to the data from the WOS CC database, this growth is relatively rapid, in the RSCI it is lower and more fragmented. Not surprisingly, the pick of 2012 (see **Figure 3**) coincides with the pick of megaprojects (in **Figure 2**) and the publication curve resembles the megaproject curve, proving the great impact of these megaprojects in the Armenian scientific collaborations.

Figure 3. Dynamics of the AM+EAEU and the AM+EU collaboration in comparison with the gross number of Armenian publications in the WOS CC database (1991-2018).

WOS CC
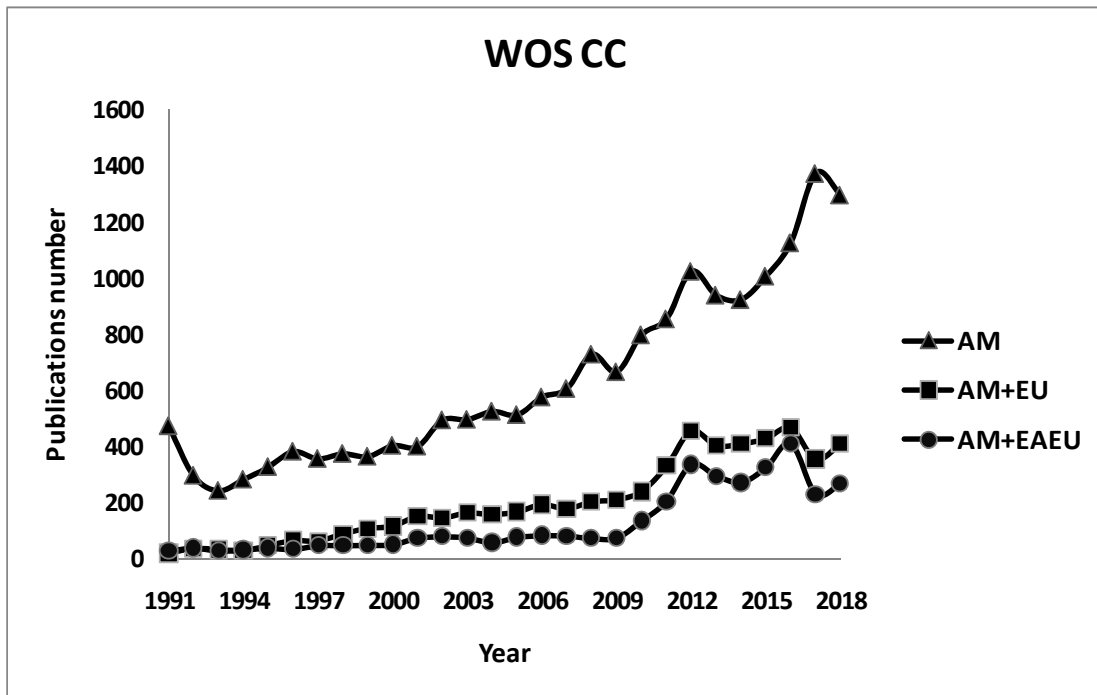
As a counter-evidence, we can study the collaborations of Armenian researchers with EU and EAEU ones, excluding megaprojects (**Figure 3a).** Again, AM+EA papers tend to prevail over the AM+EAEU ones. However from 2014 this gap seems to be gradually narrowing, as a likely consequence of the Armenian-Russian and Armenian-Belarusian joint state grant projects (Glukhov et al. 2017).

Figure 3a. Dynamics of the AM+EAEU and the AM+EU collaboration papers in comparison with the gross number of papers of Armenian researchers from the WOS CC database (1991-2018), excluding megaprojects.
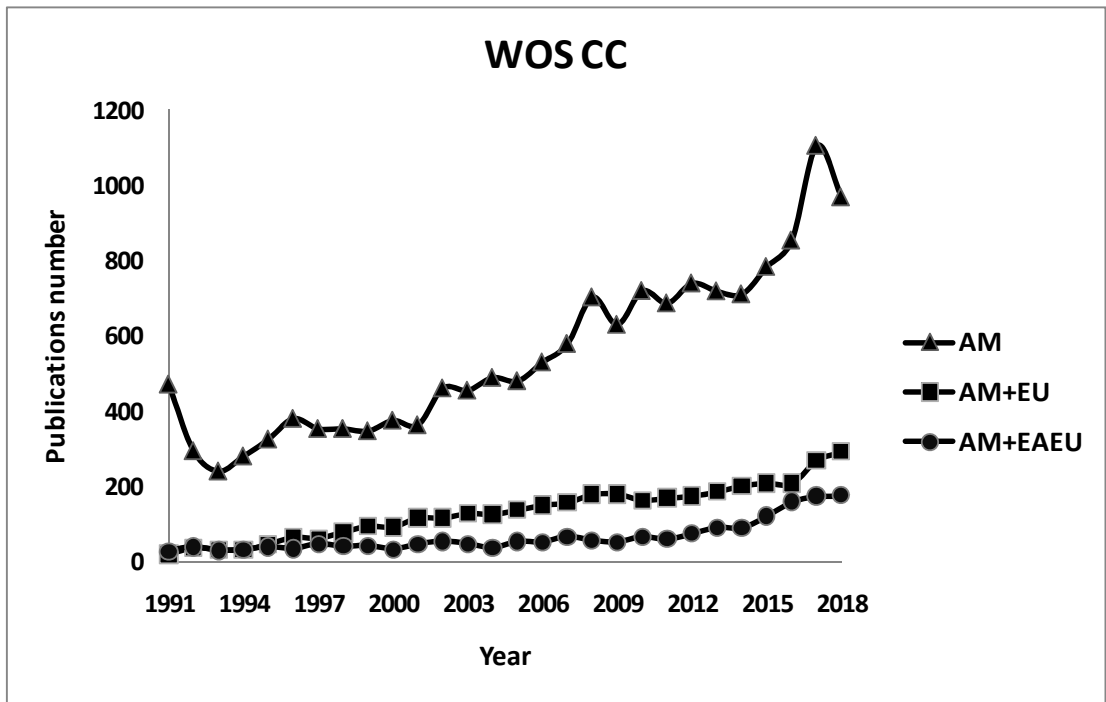
Figure 4. Dynamics of the AM+EAEU and the AM+EU collaborations in comparison with the publications of Armenian researchers, according to the RSCI databse (2005-2018).
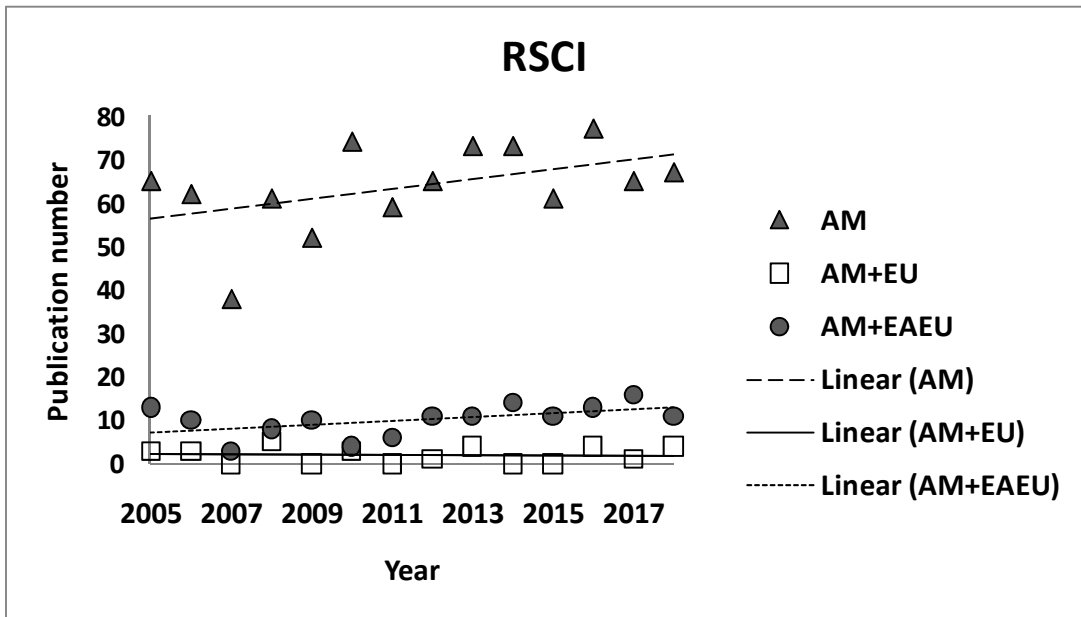
Collaboration at the Level of Individual Countries

During the period between 1991 and 2018, the number of joint AM+EU publications included in the WOS CC database amounted to 5 629, among which the top three collaborating European countries were: Germany (3 126), France (2 857) and Italy (2 598), followed by the UK (2 065), Poland (2 052), Spain (1 748), Czech Republic (1 736) and Greece (1 628)[26]. **Figure 5a** contains the Pareto chart of the totality of the collaborating countries from EU. Country name abbreviations comply with the ISO standard ISO 3166-1:1997.

Figure 5a. Pareto chart of the European countries collaborating with Armenia, in terms of publications. Data are retrieved from the WOS CC database and are related to the 1991-2018 period.
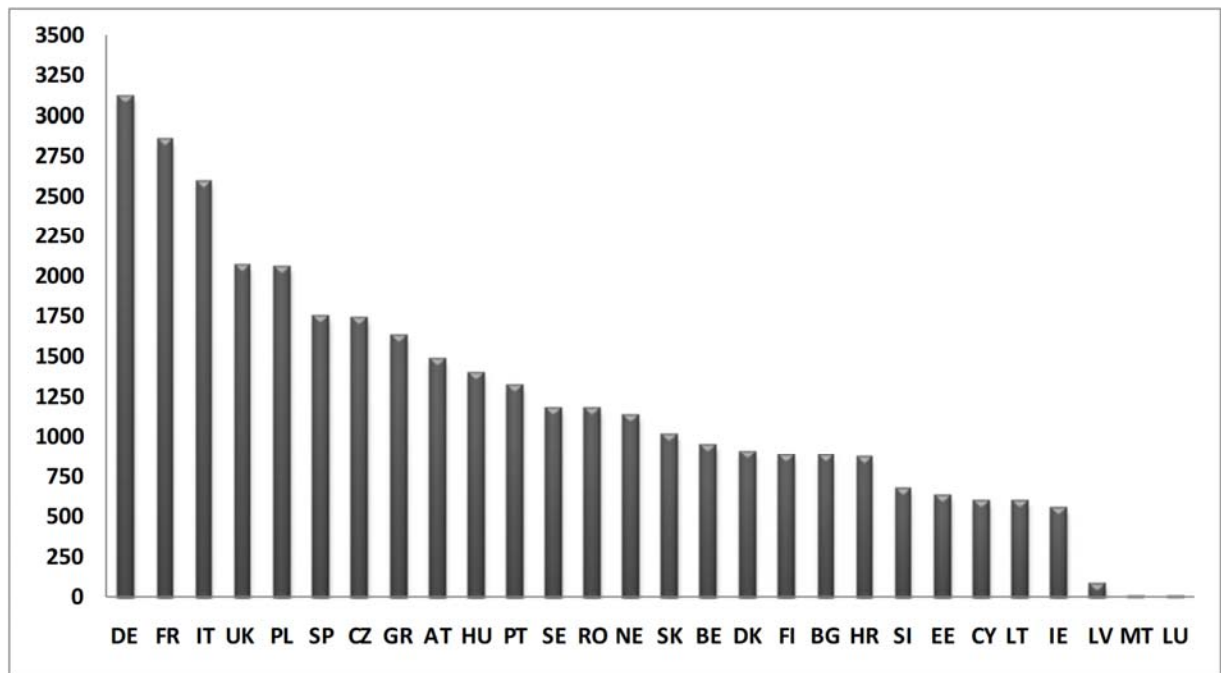
Unsurprisingly, the main collaborators of Armenia are those countries with strongest scientific potential. As mentioned, Armenia has bilateral state projects with Germany and France, i.e., the two top countries. Curiously, we note two publications in collaboration with Malta and one with Luxembourg (see **Figure 5a**); these publications are inherent to two relevant

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[26] These numbers reflect the number of times any country appears as a collaborating country in the database.

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megaprojects: Malta is one among several collaborating countries of a megaproject in the field of Medicine, while Luxemburg is one of twelve collaborators in a megaproject concerning the grape-wine production.

Let us now focus on the collaboration with the (post-Soviet) Baltic States, i.e., Estonia (EE), Lithuania (LT) and Latvia (LV). **Figure 5a** shows that collaboration papers with Latvia are only 89, while those with Lithuania and Estonia are respectively 598 and 630. This apparent discrepancy stems from the fact that Lithuania and Estonia are participating in megaprojects in collaboration with Armenia, while Latvia not. This implies that direct collaborations among Armenia and the Baltic states are very weak in general and the main collaborations are mediated.

To assess the effect of megaprojects on the AM+EU cooperation, we have "filtered" the graph in **Figure 5a**, excluding publications concerned with megaprojects. The seven top places remain unchanged, while there is a redistribution of places in the middle and last quartile. This is a kind of proof of the strength of the ties between Armenia and the seven top EU-member countries of the list.

Figure 5b. New Pareto chart obtained starting from that of Figure 5a, excluding papers related to megaprojects.
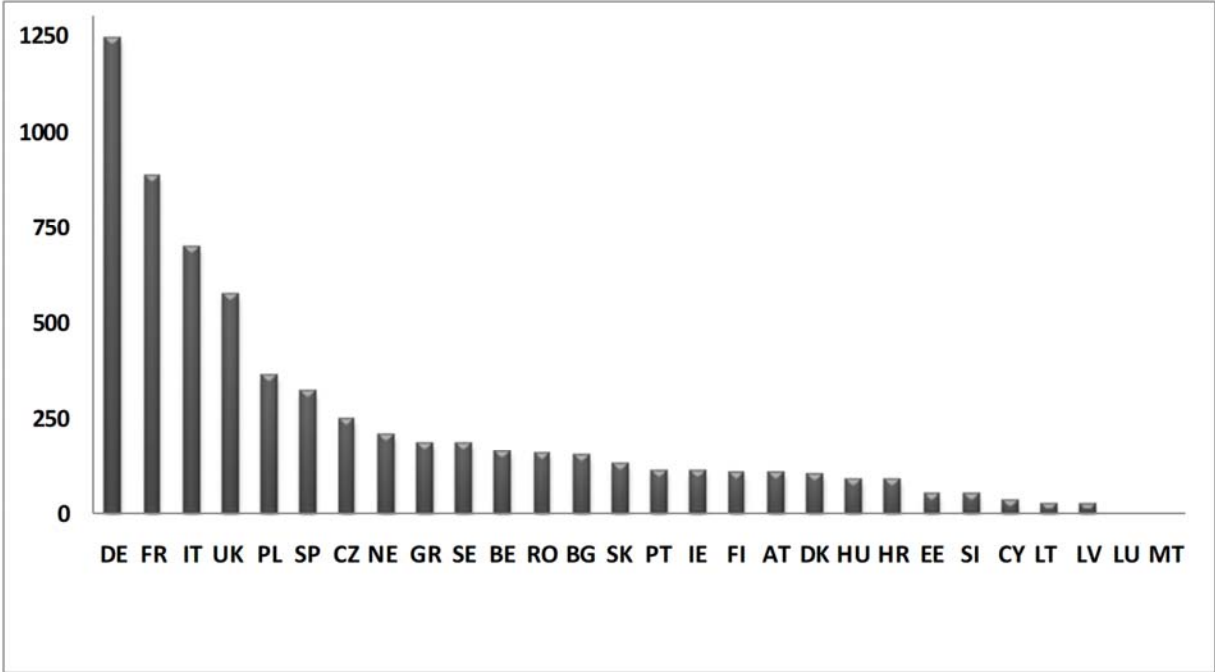
Regarding the joint papers involving EAEU researchers, according to the WOS CC database, the strongest collaborator of Armenia is Russia, followed by Belarus with just over a third of papers; Kazakhstan and Kyrgyzstan are far apart.

Figure 6a. Pareto chart of the EAEU countries collaborating with Armenia, in terms of publications. Data are retrieved from the WOS CC database and are related to the 1991-2018 period.
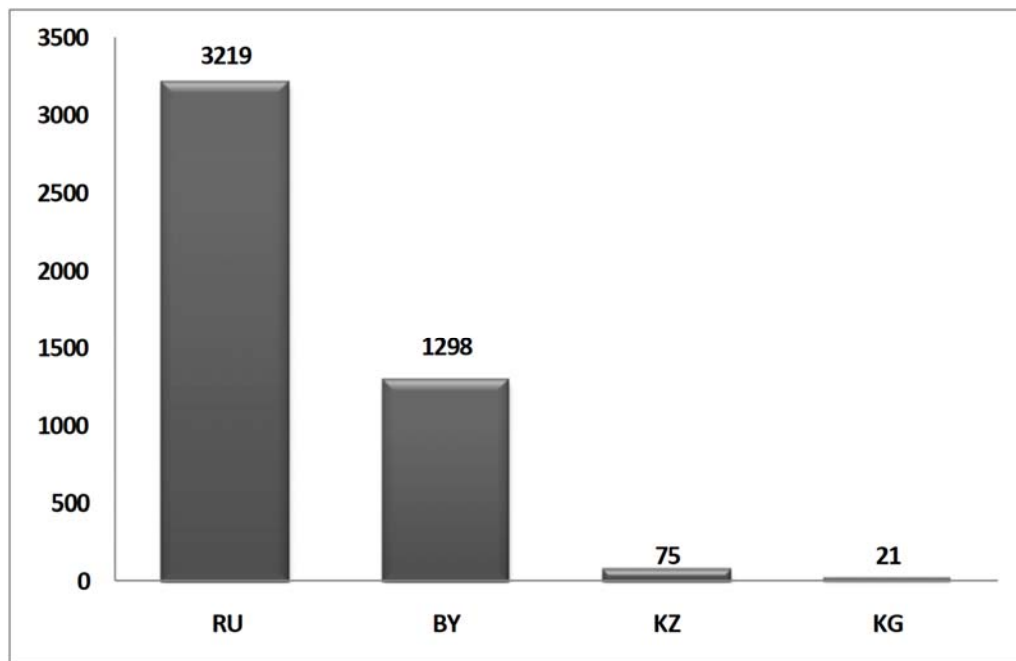

When excluding megaprojects, results are not too dissimilar even if the gap between Russia and the other three nations widens. The greatest drop is that concerning the papers in collaboration with Belarus, which means that the direct collaborations with this country are quite modest. In the case of joint publications with Kazakhstan and Kirghizistan, the role of megaprojects is negligible (**Figure 6b**).

Figure 6b. New Pareto chart obtained starting from that of Figure 6a, excluding papers related to megaprojects.
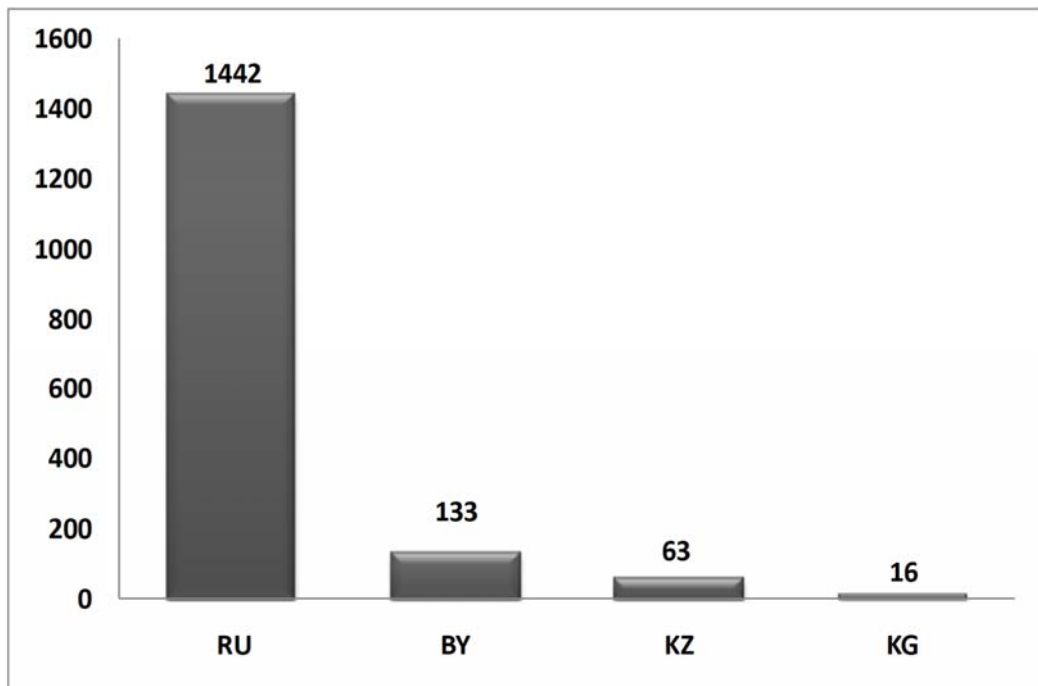
Switching to the RSCI database, the picture is a bit different. Regarding the collaboration with the EU block, Germany confirms to be the main collaborator of Armenia, while Italy, France and UK are in the mid-quartile together with Denmark. It should be noted, that the number of collaborating countries in this case is twelve (see **Figure 7a**).

Figure 7a. Pareto chart of the EAEU countries collaborating with Armenia, in terms of publications. Data are retrieved from the RSCI database and are related to the 2005-2018 period.
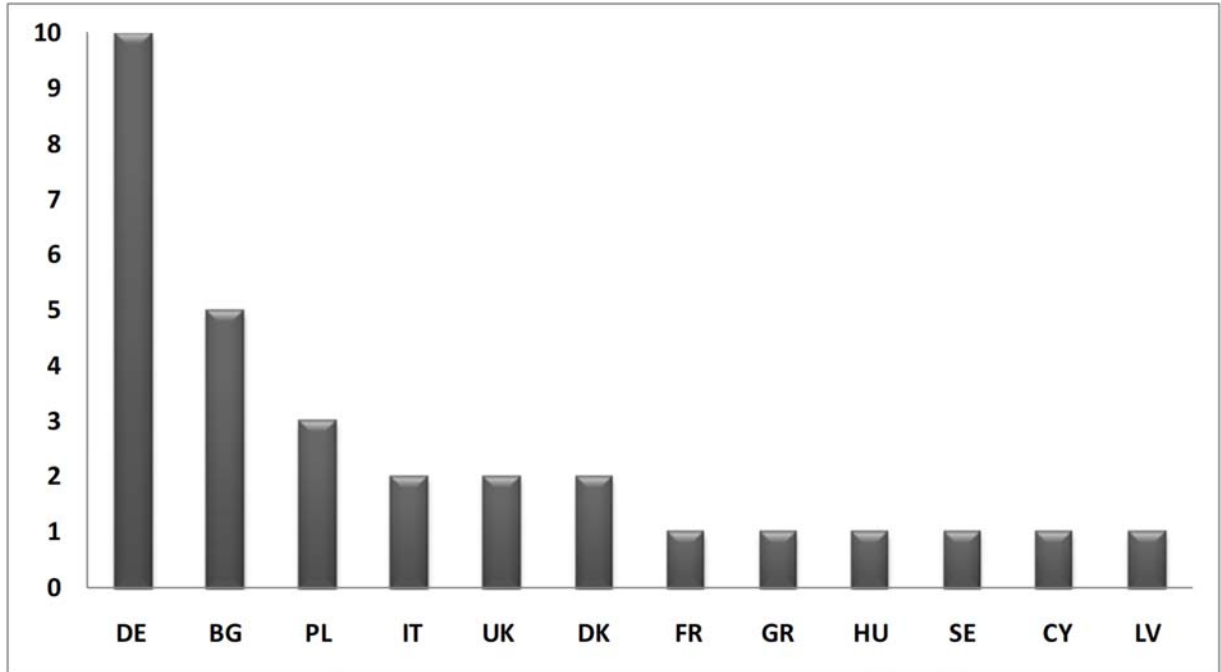
Regarding the EAEU countries, the picture is similar to that seen for the WOS CC database: Russia is the strongest collaborator, followed very far by Belarus, Kazakhstan and Kirghizistan (see **Figure 7b**).

Figure 7b. Pareto chart of the EAEU countries collaborating with Armenia, in terms of publications. Data are retrieved from the RSCI database and are related to the 2005-2018 period.
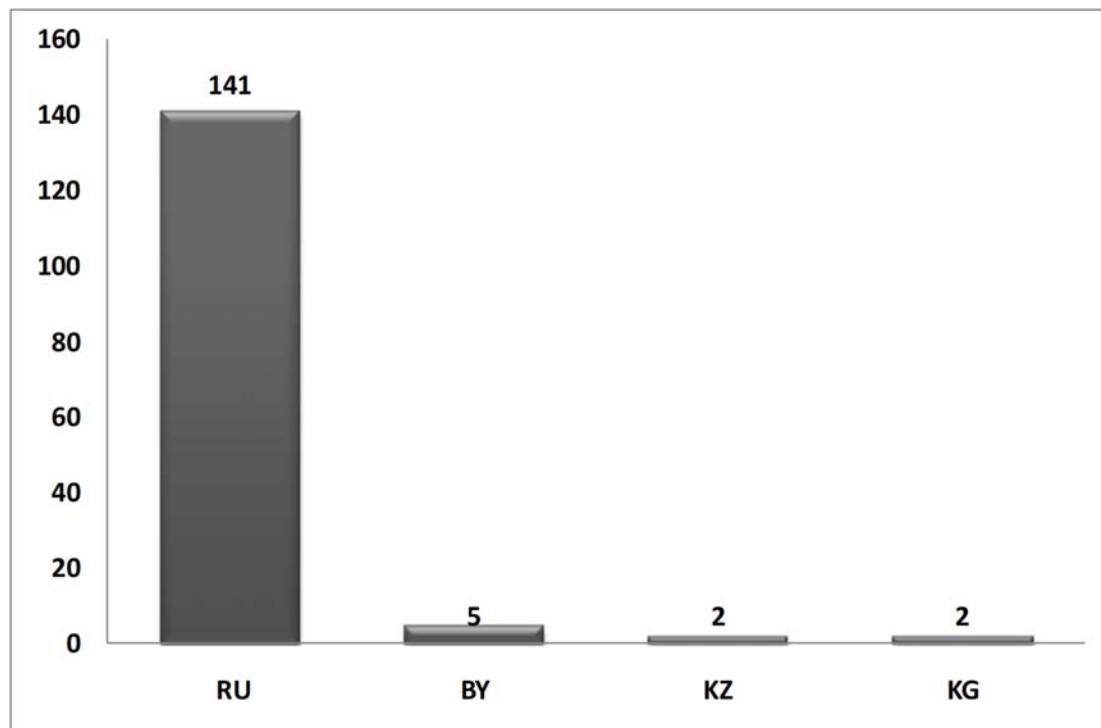

Summing up, we have the following macro results: the papers involving researchers from EU countries are 5 629 and those involving researchers from EAEU countries are 3 523. It is evident, that in gross numbers the EU has a leading position. This impression is reinforced by the fact that the collaboration with EU countries has started only after 1991 (Soviet Union dissolution). In general, Russia is the main collaborator of Armenia and most of the publications within the EAEU block are published on Russian-language periodicals. The authors believe that if the scientific relations between Armenia and the EAEU countries are renewed and become more continuous and organic, the number of joint publications will increase.

Priorities in the Scientific Fields

In the final part of our research, we have investigated the distribution of joint papers between the various scientific fields. Regarding the WOS CC database, we have nearly the same picture for EU and EAEU collaborations. The top four scientific fields fully coincide, with slight deviations in terms of percentages; the distribution of the joint papers among the other scientific fields is not so dissimilar. **Figure 8a** shows the distribution of the joint papers among the different scientific fields, according to the WOS CC database.

Figure 8a. Distribution of the joint papers among the scientific fields, according to the WOS CC database.
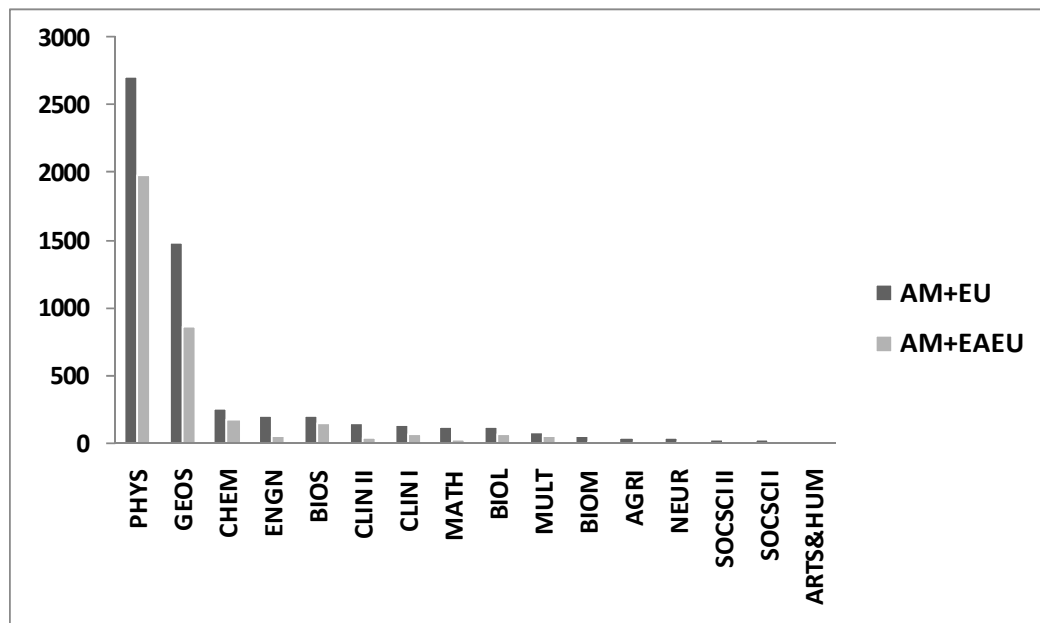
Figure 8b. Distribution of the joint papers among the scientific fields, according to the WOS CC database, excluding megaprojects.
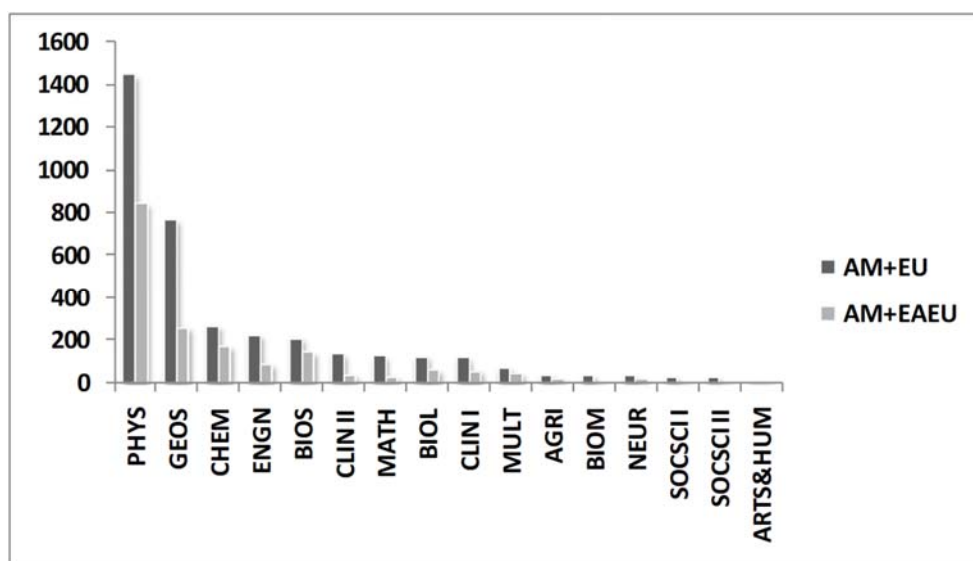
It can be seen that the prevalent scientific field is Physics, followed by Geosciences and Chemistry. In the field of Geosciences, the major forum of collaboration is represented by the sub-field of Astrophysics. Additionally, the EU cooperation is more variegated than the EAEU one, in terms of scientific fields involved.

In the RSCI database, the situation is rather different. For the two collaboration blocks, the distribution is not even. Precisely, for the EAEU joint papers, Physics is in the first place, followed by Biology and Clinical Medicine II. On the other hand, for the EA joint papers, the preferred field is Biology, followed by Physics and Biosciences. The fields of Chemistry and Geosciences, which are traditionally well represented by Armenian researchers, have relatively low positions (Gzoyan et al. 2015). Another interesting feature is the existence of collaborations in the fields of Social Sciences and Arts and Humanities for the EAEU block, which are absent for the EU block (see **Figure 9**).

Figure 9. Distribution of the joint papers among the scientific fields, according to the RSCI database.
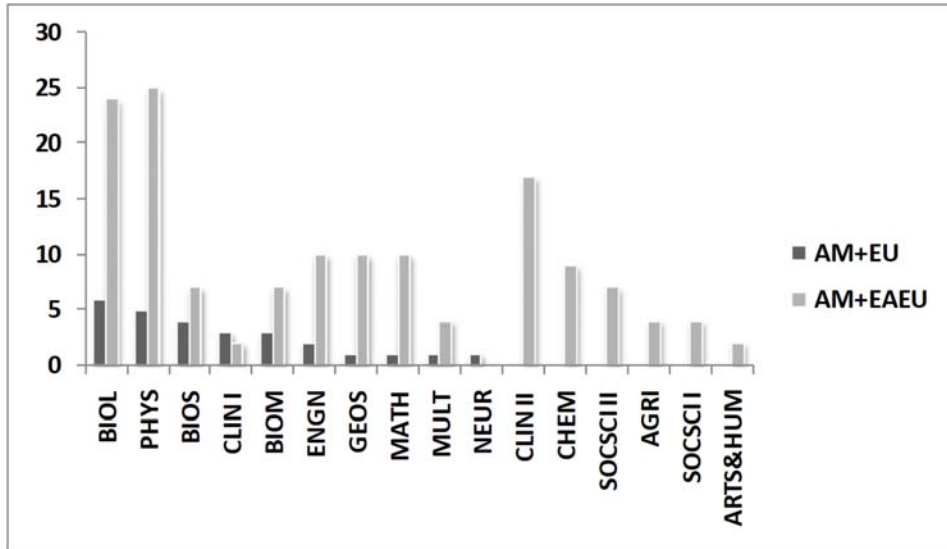
Conclusions

This article analyzed the results of collaborations between Armenian affiliate researchers and foreign researchers, in terms of publication output indexed by the WOS CC and RSCI bibliometric databases. Precisely, Armenia has 18 718 overall papers in the time window of interest; nearly 46% of these papers (i.e., 8 684) reflect international collaborations with EU researchers, while 78% of them (i.e., 6 808) reflect collaborations with EAEU researchers.

It was shown that these collaboration papers are gradually growing over time, especially those contained in the WOS CC database (i.e., typically papers in English-language international journals). This growth is less pronounced for the papers indexed by the RSCI database (i.e., typically Russian-language articles). Based on the gross count of co-authored publications, those in collaboration with EU researchers have a leading position. However, normalizing the number of publications and citations per thousand researchers, the picture is slightly different: EAEU predominates over EU in terms of normalized publications, while the situation is subverted in terms of normalized citations. Moreover, EU prevails in terms of citations per paper, according to both databases. Considering the EU block, the major collaborator of Armenia is Germany, while in the EAEU block, it is Russia. However, since the scientific links with EU countries are more recent with respect to those with EAEU countries, it can be asserted that Armenia is more inclined towards the EU.

We have also assessed the role of megaprojects in the collaborations of Armenia, which proved to influence the publication output significantly. Precisely, this role is more relevant for EAEU collaborations, implying that these collaborations are often mediated (by other countries) and not direct.

In the last part of the research, we have also assessed the distribution of the collaboration papers among the scientific fields, showing some differences between the two blocks. In general, Physics is the predominant scientific field. However, cooperation within the EU block is more "variegated" than that within the EAEU block.

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