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The Effects of the EU's Scientific Cooperation Programmes on the Eastern Partnership Countries: Scientific Output and Broader Societal Impact

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The Effects of the EU's Scientific Cooperation Programmes on the Eastern Partnership Countries: Scientific Output and Broader Societal Impact

Honorata Mazepus, Dimiter Toshkov, Tatsiana Chulitskaya, and Ina Ramasheuskaya

Abstract

Scientific cooperation between the European Union (EU) and its Eastern neighbours has grown rapidly since the early 2000s. This cooperation holds great promise to influence not only the science and innovation sectors, but also to affect the practices and values of research communities in the Eastern Partnership (EaP) countries, their public policies, and societies at large. In this paper we aim to assess the impact of scientific cooperation with the EU with a focus on three countries of the EaP: Belarus, Moldova, and Ukraine. Our analysis is divided into two parts: first, we focus on the scientific impact and conduct a bibliometric analysis that tracks several important indicators of the scientific output of Belarus, Moldova, and Ukraine for the period of 2000-2016; second, we address the broader impact on the scientific community, institutions, and society by analysing new data from expert interviews. In terms of scientific output we find that while the EU has not radically transformed science in the EaP countries it might have provided it with an essential lifeline of support. We also uncover clear evidence for positive impact of cooperation with the EU on the participating institutions from the EaP countries, but very little evidence (so far) about effects on public policies or significant impact on society at large.

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Contents

1. Introduction[1]

In this paper we aim to assess the impact of international scientific cooperation with the European Union (EU) on three countries which are part of the Eastern Partnership (EaP): Belarus, Moldova, and Ukraine. Potentially, this impact is broader than purely scientific and might extend to affect the practices and values of research communities in EaP countries, public policies, and society at large. International scientific cooperation has grown very rapidly since the 1990s (Georghiou 1998; Glänzel et al. 1999). The EU encourages and funds international collaborative research projects between the member states and with third countries (Glänzel et al. 1999). Scientific collaboration can have many advantages, such as pooled financial resources and ideas, developing expertise, and access to equipment (Katz and Martin 1997: 8).

Already in the 1990s, scholars observed the increasing importance of the EU as a collaboration partner for candidate member states, but also more generally for developing and advanced countries (Glänzel et al. 1999). The question of the impact of such collaborations became a subject of scholarly investigation itself. Existing research has focused primarily on assessing the impact of international cooperation on various aspects of scientific publications, for example numbers of co-authored works and their citation rates, and on assessing the benefits in terms of academic output for different countries and within different disciplines (Bote et al. 2013).

The goals of many international research projects funded by the EU are broader and include impact not only on academic communities but also on societies at large. Measuring the influence of cooperation on scientific output is challenging, but assessing the impact of international scientific cooperation more generally is an even more daunting task. There are several reasons that make the measurement of the broader impact of scientific cooperation difficult. First of all, it is hard to define and operationalize impact beyond the publication output. Second, the implementation of research findings in the economy and society can have a substantial time-lag. Third, the broader impact of cutting-edge research is often unpredictable. Finally, the influence of research projects on policy-making depends on the willingness of political actors to adopt the proposed solutions. The unwillingness or reservations of state actors to act upon scientific evidence constitutes a challenge in democratic countries and might be even more pertinent in non-democratic ones, especially in the field of social sciences.

The EU-STRAT project to which this paper contributes is particularly interested in the impact of EU scientific programmes on the long-term development of bilateral and multilateral ties between the parties involved in the collaborative projects, and the support for the emergence of democratic societies and vibrant economies in the EU neighbourhood. In this paper we build on the findings of the earlier working paper 'Science Policies and International Cooperation in the Eastern Neighbourhood of the European Union: An Overview' (Chulitskaya et al. 2017), which provided an overview of the science policy in Belarus, Moldova, Ukraine, and the EU and took stock of the international projects in which the three EaP countries have been involved. The working paper

[1] The qualitative questionnaires were designed by Dimiter Toshkov, Ina Ramasheuskaya, and Tatsiana Chulitskaya with the help of Honorata Mazepus. The qualitative interviews were conducted by Ina Ramasheuskaya and Tatsiana Chulitskaya (Belarus), Tatiana Parvan (Moldova), Oleg Grytsenko (Ukraine), and Dimiter Toshkov and Suzan Saris (EU member states). Ina Ramasheuskaya coordinated the data collection in the EaP countries and organized the analysis of the data. The bibliometric data was collected by Suzan Saris and analysed by Dimiter Toshkov. The final text was written by Honorata Mazepus and Dimiter Toshkov. We thank Antoaneta Dimitrova, Elyssa Shea, and Matthew Frear for their useful comments, as well as the audience of the EaP Plus conference in Chișinău, Moldova (30-31 May 2017).

identified institutions in the EU and in the EaP that collaborated in the Seventh Framework Programme for Research and Technological Development (FP7) and Horizon 2020 (H2020) programmes.

The next step in our investigation of scientific cooperation between the EU and EaP is to assess the impact of cooperation. We do that in a two-step approach: First, we focus on the *scientific* impact and conduct a bibliometric analysis that tracks several important indicators of the scientific output of Belarus, Moldova, and Ukraine for the period 2000-2016: a period in which cooperation intensified and the three countries participated in an increasing number of joint projects and programmes with the EU. Second, we address the *broader* impact on the scientific community, institutions, and broader society. We do this by analysing new data derived from several dozen semi-structured interviews with policy experts, project coordinators, working scientists, and think-tank researchers in the three EaP countries *and* in the EU member states that are or have been engaged in EU-EaP scientific cooperation.

The analysis reveals a complex and nuanced picture of the impact of the scientific cooperation of the EaP countries with the EU and Russia. In terms of scientific output, the EU might not have radically transformed or elevated science to a higher level in the EaP countries, but it might well have provided a lifeline of support that has been essential for avoiding collapse. In terms of broader impact, there is clear evidence for positive impact on the participating institutions from the EaP countries, but very little evidence (so far) about effects on public policies or significant impact on society at large. We discuss possible reasons for this and the barriers for realization of the full potential of scientific cooperation.

The remaining part of this paper is structured as follows: in Part I we clarify the methodology and then present the results from the bibliometric analysis. In Part II we introduce and analyse qualitative data from the expert interviews. The concluding section collects the main findings and conclusions.

2. Part I. Exploring Changes in the Scientific Output of Countries in the EaP Region between 2000 and 2016

This part of the paper analyses the scientific output of the countries in the EaP with an emphasis on the role of EU funding and collaborations with partners from member states of the EU. The focus is on three of the EaP countries: Belarus, Moldova, and Ukraine. But in order to highlight the specificity of the patterns observed in these countries, the report also introduces data on current 'new' EU member states (Bulgaria and Latvia), as well as countries that are not part of the EaP (Kazakhstan) or that participate to a lesser degree in the EU initiatives for scientific cooperation (Azerbaijan). The time period being analysed is from 2000 to 2016. More specifically, the report traces:

a) Changes in the overall size of the scientific output in these EaP countries;
b) Changes in the share of publications that have received funding from various countries, programmes, and agencies (with a focus on EU, German, and Russian funding);
c) Changes in the co-authorship country networks;
d) Changes in the thematic subject distribution of the scientific output.

Altogether, the analysis builds towards an assessment of the impact of scientific cooperation with the EU on the scientific output of the EaP countries. The assessment, however, does not amount to a formal impact evaluation, because of several difficulties. First, there is no single cut-off point at which scientific cooperation with the EU can be said to begin in the different countries included in the analysis: it is a gradual process of phasing in into various programmes and initiatives. Second, due to the time-lag of scientific publication, the major effects of participating in the main scientific cooperation programmes of the EU (FP7 and H2020) would only become visible in the (near) future.

Third, there are no good counterfactuals to the three countries of interest that can provide leverage for identifying and estimating the causal effect of EU collaboration: countries that are in principle comparable either also participate in EU scientific cooperation or have rather different domestic economic and political conditions. Finally, important provisos regarding the use of bibliometric data to assess scientific output apply: publication numbers do not capture all aspects of scientific output; the particular databases we work with do not incorporate books, which are important in some subfields; even when publications in scientific journals are an appropriate measure of output, they do not directly capture the impact of this output. Nevertheless, by analysing the changes in the indicators listed above, the analysis provides a rich and nuanced picture of the developments in these countries over the last 17 years, and the patterns being described certainly make some interpretations of the impact of scientific collaboration with the EU more plausible than others.

2.1. Measuring scientific impact

The most commonly used way of measuring scientific impact is the use of citation-based measures (Wang et al. 2013). Although not unproblematic (Katz and Martin 1997), citation frequencies are assumed to reflect to some extent the scientific utility of a study and are an indication of its quality and impact (Lawani 1986). To measure the impact of collaboration, scholars estimate the numbers and citations of co-authored papers. Studies have shown that the frequency of collaboration differs per discipline, and that the difference is especially visible between 'hard sciences' (physics, mathematics, mechanical engineering) and 'soft sciences' (philosophy, political science, sociology) (Bandyopadhyay 2001). However, since citation numbers need a relatively long period of time to accumulate, they are not very well suited for assessing the impact of recent developments, such as the ones we deal with in this paper.

The statistical bibliographic (bibliometric) method of impact assessment has advantages as it is relatively cheap, non-intrusive, reliable and verifiable, and it can utilize large datasets (Katz and Martin 1997). The same method is used to estimate the scientific impact of international collaboration, only here publications included in the analysis have to be co-authored by scholars based at institutions in different countries. This method provides information about the academic productivity of international collaborations in terms of publication number and in terms of the popularity of their findings in the academic community.

International collaboration, similarly to collaboration in general, varies substantially per discipline. Physics and astronomy, engineering, biochemistry, genetics, and molecular biology lead in the percentage of publications that result from international collaboration (Bote et al. 2013: 395). Social sciences and humanities have one of the lowest levels of collaboration among scientific fields (Bote et al. 2013: 394f). They have, however, experienced the largest gains in terms of citations of internationally co-authored work by comparison with other disciplines (Bote et al. 2013). This is, of course, a result of the low starting level of international collaboration, but the trend is positive.

The differences in terms of the frequency of international cooperation are visible not only across disciplines, but also across regions and countries, where the size of the country and the size of the scientific community and its 'inherent co-operativity' influence the need to find collaborators abroad (Glänzel et al. 1999: 189). Assessment of the output of collaboration by the 10 new EU member states in the field of social sciences showed variation in the frequency of collaboration among the states (Marshakova-Shaikevich 2006). Other studies show that the gains in citations depend on the origin of the scholar with whom one cooperates; for example, collaboration with the scholars from the United States (U.S.) results in only small gains in terms of impact (Bote et al. 2013: 403). In addition, scholars who participated in academic mobility programmes have a higher co-publication rate with scholars from their former host institutions, but they do not lose their academic independence measured by publications without co-authors from these host institutions (Jonkers and Cruz-Castro 2013).

However, international collaboration does not always increase citation rates (Leimu and Koricheva 2005b). The frequency of citations of collaborative work seems to be driven by multiple factors. For example, a study of factors driving citation rates in ecological research showed that gender of the author (favouring males), country of publication (favouring English-speaking countries), ranking of the university (favouring top universities), and the direction of study outcome with respect to the tested hypothesis (favouring the argument made) influence the citation rate (Leimu and Koricheva 2005a).

In a recent working paper produced under the auspices of the IncoNET project, a team of scholars[2] delivered a bibliometric analysis of the EaP Countries' international co-publication output (IncoNET EaP 2016). The objectives of their analysis overlap to some extent with the ones of the current paper. However, while the main focus of the IncoNET working paper was on identifying in a comprehensive way the scientific output of the EaP countries, our focus is on establishing the influence of the EU on the development trajectories of the countries over time. Therefore, while the IncoNET team used both major bibliographic databases, SCOPUS and Web of Science, we focus only on the latter (see below), but cover a longer period (2000-2016 vs. 2003-2013). Furthermore, we measure and analyse different indicators, such as the publication funding sources, and adjust the total publication numbers for the relative size of the population and economies of the countries.

2.2. Methodology and empirical approach

The analysis presented in this paper is based on bibliometric data extracted from Thomson Reuters' Web of Science platform. In particular, the Science Citation Index Expanded (SCI-EXPANDED) and Social Sciences Citation Index (SSCI) collections were used. To identify the relevant data records, we conducted a search for the name of the country in the 'ADDRESS' field. The records were restricted in terms of timespan (year of publication from 2000 to 2016) and document type ('article', 'proceedings paper' or 'letter'). The data extraction took place in May 2017 and reflects the state of the databases at that time.

To acquire all relevant records for a country we used different spellings and wildcard characters (for example, 'B*ELARUS*', which would return 'BYELARUS', 'BELARUS', 'BELARUSSIA', etc.). After inspecting the records, we excluded ones that were obviously wrongly placed (for example, the address field featuring the Moldova National Museum Complex in Romania). All the parsing and processing of the data was done in the 'R' language and environment for statistical computing and graphics (version 3.4.0) and the package 'bibliometrix' (version 0.1) (Aria and Cuccurullo 2016).

We identified the home countries of each publication's (co-)authors by parsing the 'C1' (Author Address) and 'RP' (Author Address) fields. The source of funding was identified by looking into the 'FU' (Funding Agency and Grant Number) and 'FX' (Funding Text) fields and identifying relevant patterns (for example, 'ERC' or 'NSF') via regular expressions. The scientific field(s) of the publications was recovered through parsing the 'SC' (Subject Category) field.

2.3. Empirical results

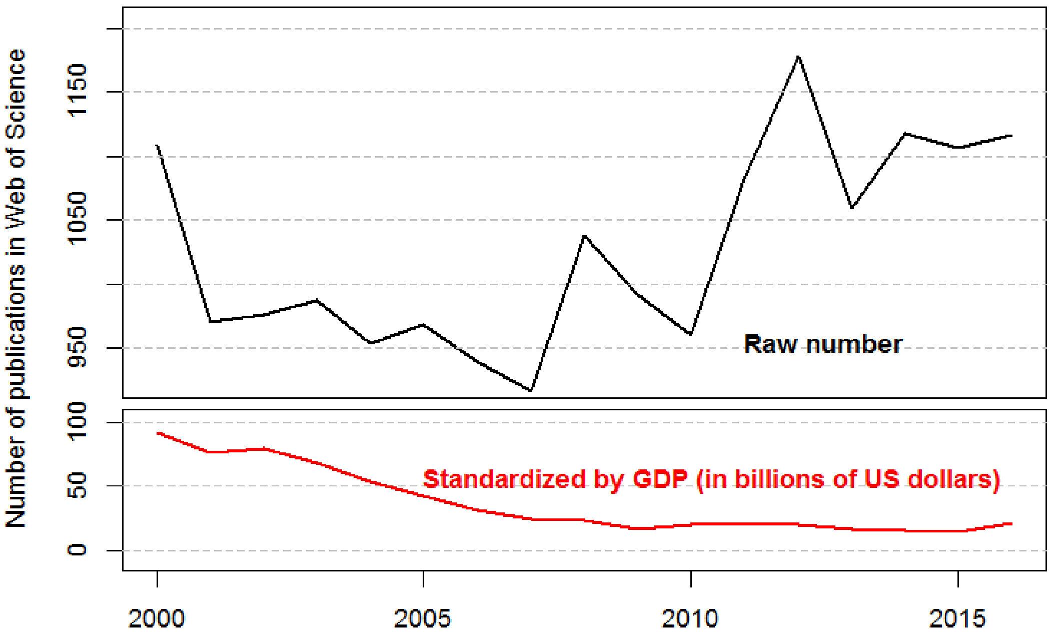
The results will first be presented for each of the main countries of interest: Belarus, Moldova and Ukraine, and then in a broader comparative context that brings in additional data on other post-Soviet states and Eastern European countries that are currently members of the EU.

[2] Hanna Scheck, Carmen Heidenwolf, Katharina Büsel, Philipp Brugner, Johannes Simon, Ivan Zupan, Joachim Kaufmann, and Alexander Degelsegger

2.3.1. Belarus

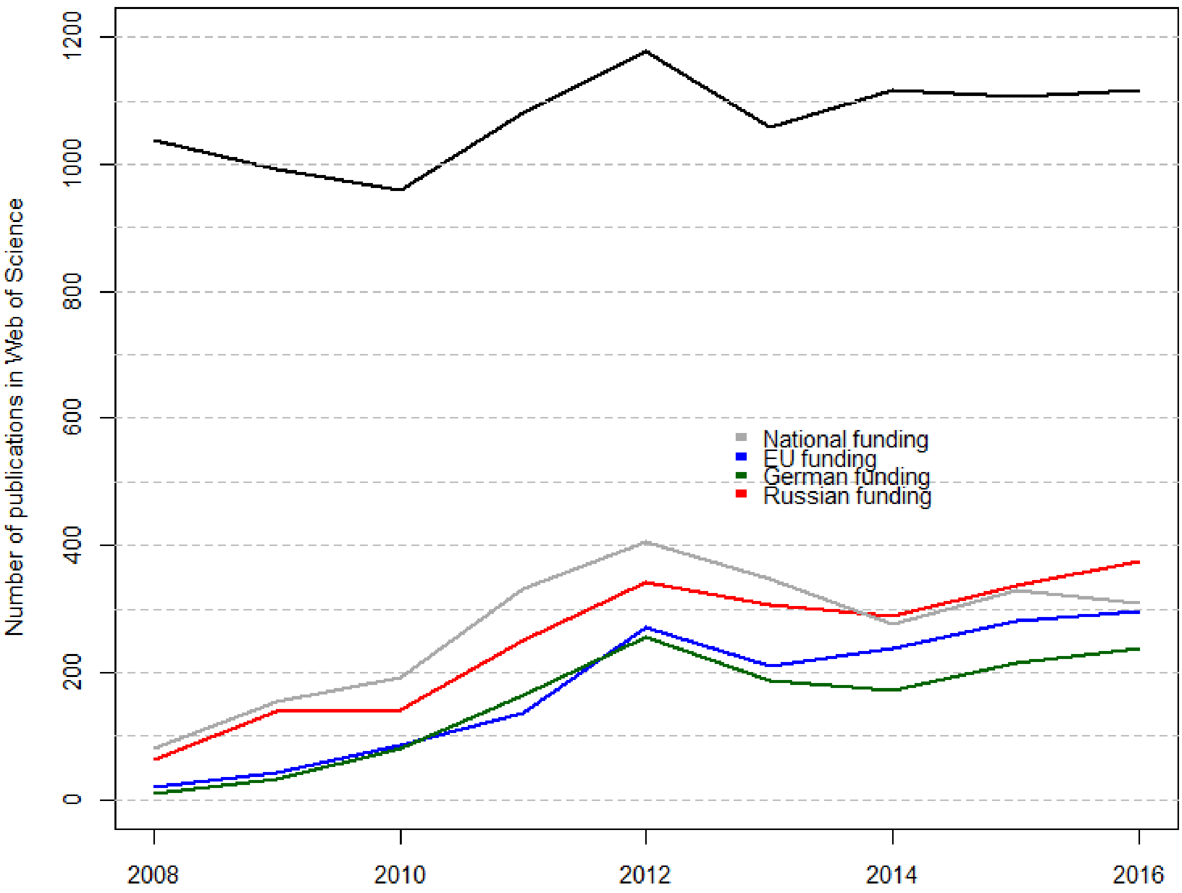
We identified 17,466 relevant records in Web of Science's SSCI and SCI-E for the period 2010-2016 that include at least one (co-)author from Belarus. Figure 1 shows the trend in the number of publications over time. In 2000, approximately 1100 publications can be found, but the number drops significantly to around 910 in 2007, after which there is an somewhat inconsistent recovery so that from 2014 onwards the numbers are pretty similar to the ones from the beginning of the observation period in 2000 (the peak of 1178 is in 2012). When we standardize the raw numbers by the GDP of the country, the story is different: there is a gradual decline until 2009, when 16.3 publications per billion of GDP (in USD) are registered, after which the number stabilizes between 15 and 20 publications per billion. The growth in the scientific output after 2007 only manages to keep the output proportional to the economic wealth of the country, but not to reach the levels of the year 2000.

Figure 1. Number of publications with a (co-)author from Belarus in Thomson Reuters' Web of Science SCCI and SCI-E (raw numbers and standardized by GDP)



Turning to the funding sources, Figure 2a plots the number of projects that have registered EU, Russian, German or national (Belarusian) funding for any of the (co-)authors. When we consider all publications (as in Figure 2a), we note that the share of both national and foreign-funded publication grows over time, especially until 2012 after which it stabilizes. The ranking does not change much with Russian funding being most common, followed by EU, and German funding. National funding seems to drop, however, after 2012. At the end of the observation period in 2016, roughly 34 % of all publications report Russian funding, 27 % EU funding, and 21 % German funding for at least one of the co-authors. There are other notable funding countries, such as the U.S. (20 % in 2016), China (19 %), Turkey (17 %), Brazil (16 %), and Portugal (18 %).

Figure 2a. Number of publications with a (co-)author from Belarus in Thomson Reuters' Web of Science SCCI and SCI-E per funding source (all publications)

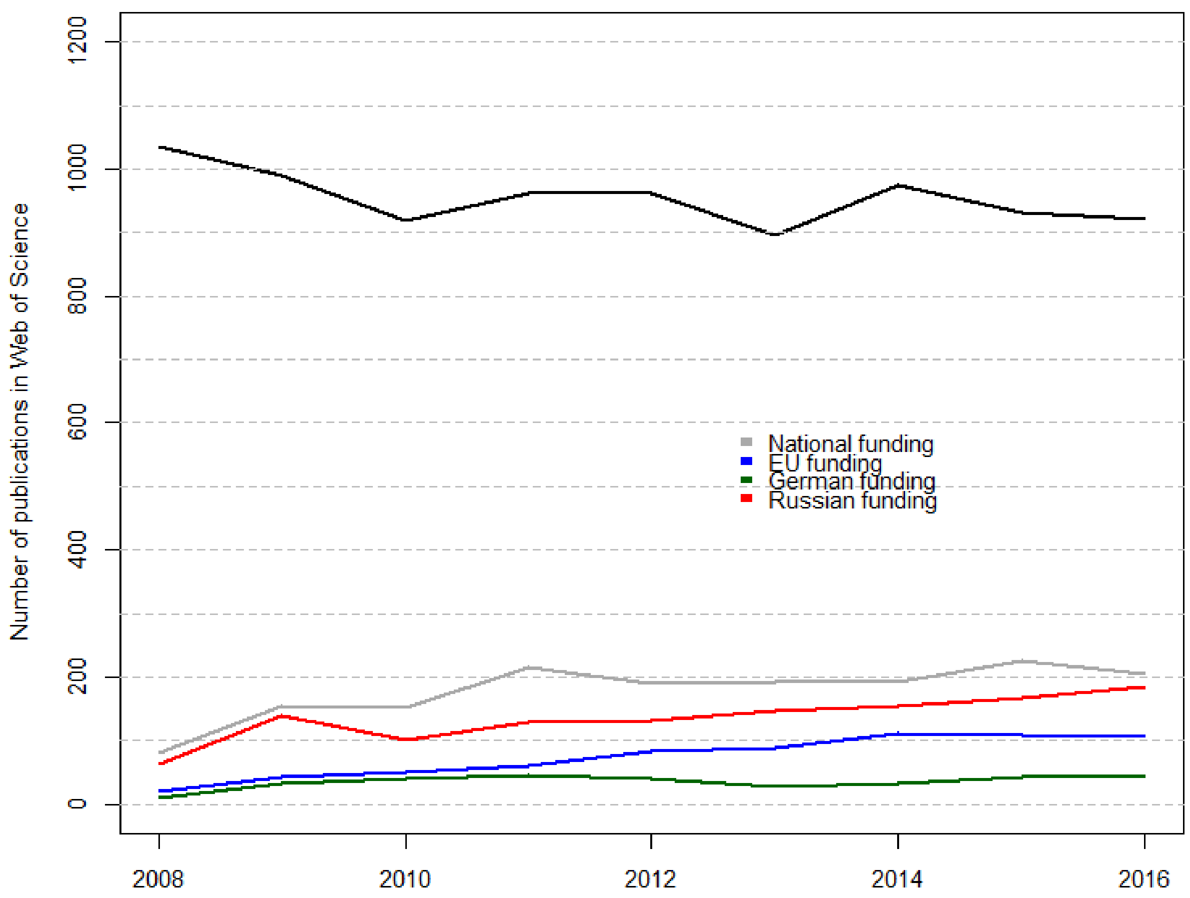


At this point, however, we should note that the participation of Belarus in one single enormous scientific cooperation project skews the numbers. This is the ATLAS Experiment at CERN, which compromises over 3000 scientific authors from about 182 institutions[3]. This collaboration produces a huge number of scientific publications, and, typically, publications resulting from the project have a large number of co-authors from various countries. These publications also report funding from EU, Russian, and various national sources as well.

[3] ATLAS experiment is an international collaboration project run at CERN (European Organization for Nuclear Research) in Geneva, Switzerland. It is 'a general-purpose particle physics experiment' that is 'designed to exploit the full discovery potential and the huge range of physics opportunities that the Large Hadron Collider provides', for more information see: http://atlas.cern/discover/about and https://home.cern/about.

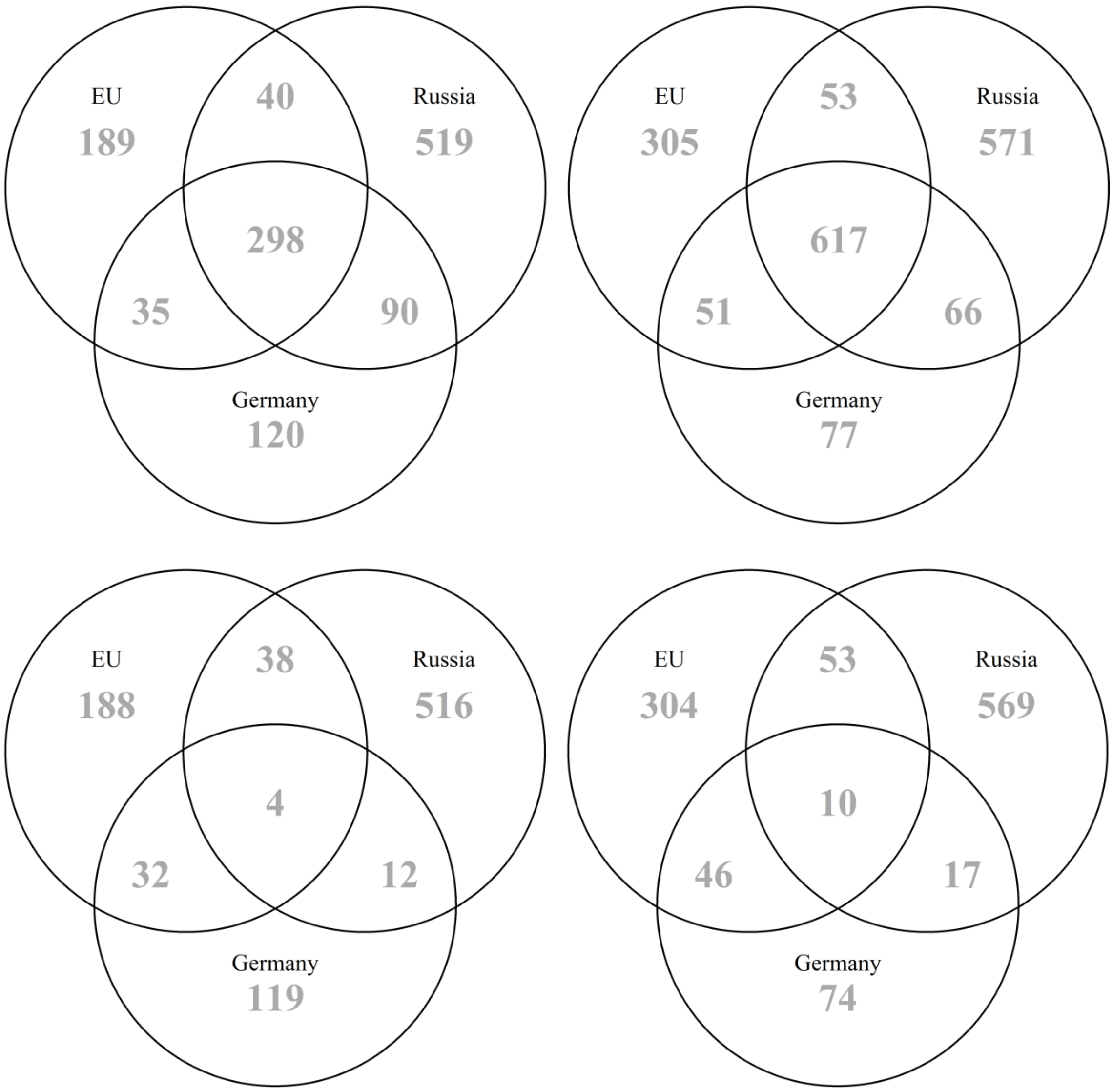
Overall, in the set of Belarusian publications after 2008 there are 1056 publications related to the ATLAS collaboration (detected by having funding from CERN), or 11 % of all publications. If we exclude this huge single collaboration and the publications resulting from it, the trends in funding sources looks slightly different (Figure 2b). First, there is no increase but a slight drop until 2010 and no recovery in the total number of publications when ATLAS-related ones are excluded from the count. Second, the relative shares of foreign-funded publications are significantly lower, although the ranking of sources remains the same: Russia is at 16 % in 2016, the EU at 9 %, Germany at 4 % (the U.S. is at 3 % and countries such as China, Turkey and Brazil hardly register anymore). The relative share of German funding notably declines after 2011.

Figure 2b. Number of publications with a (co-)author from Belarus in Thomson Reuters' Web of Science SCCI and SCI-E per funding source (excluding ATLAS-related publications)



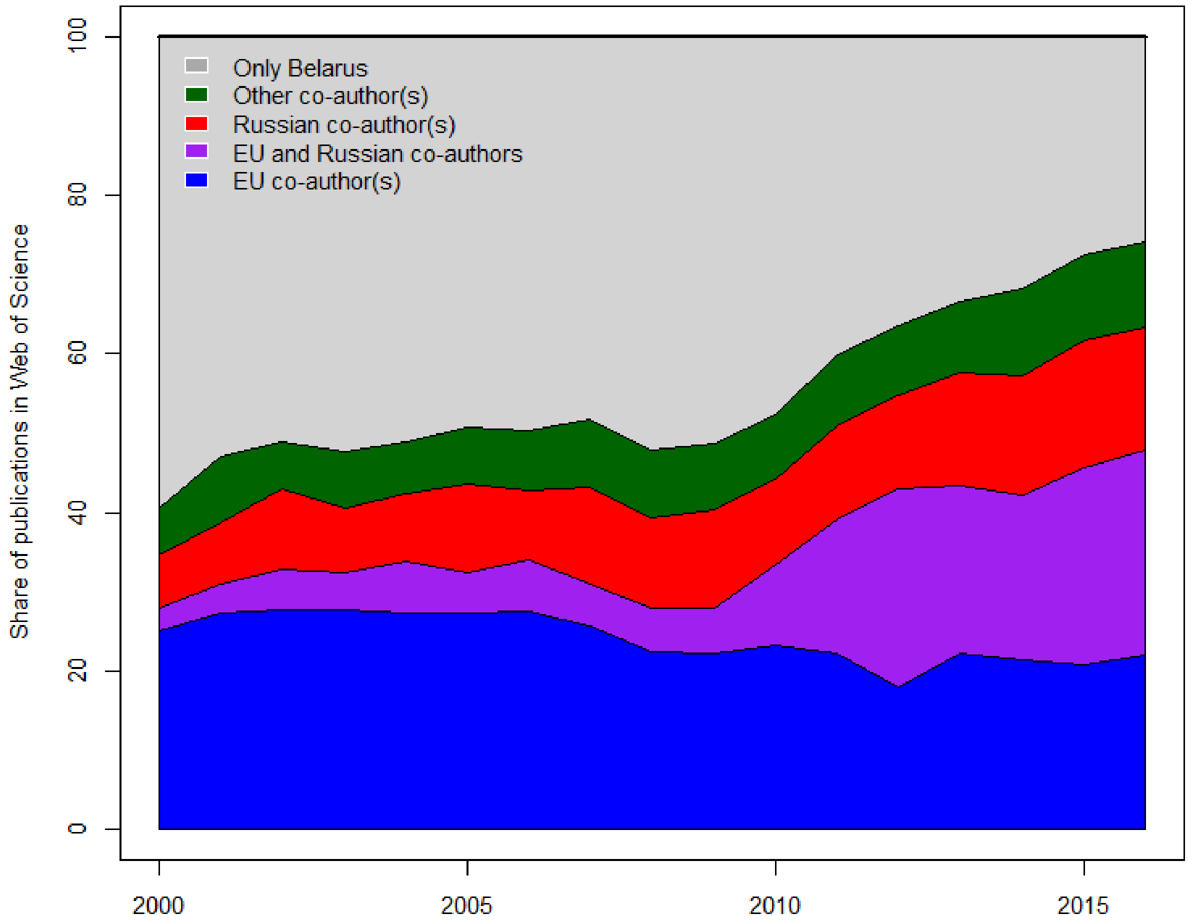
The ATLAS collaboration can also account for the great overlap in funding sources from Russia, the EU, and Germany visible in the two Venn diagrams (for 2000-2012 and 2013-2016) plotted on the top row of Figure 3. When ATLAS-related publications are excluded (bottom row of Figure 3), publications with multiple sources of funding are still present, but not so prominent. For example, in the period of 2013-2016, 63 out of 413 publications, or 15 %, of the publications that reported EU funding also reported Russian one; 38 % of German-funded publications also had EU funding and 18 % had Russian funding.

Figure 3. Venn diagrams of sources of funding for publications with a (co-)author from Belarus in Thomson Reuters' Web of Science SCCI and SCI-E. Left 2000-2012; Right 2013-2016; Top: all publications; Bottom: excluding ATLAS-related publications



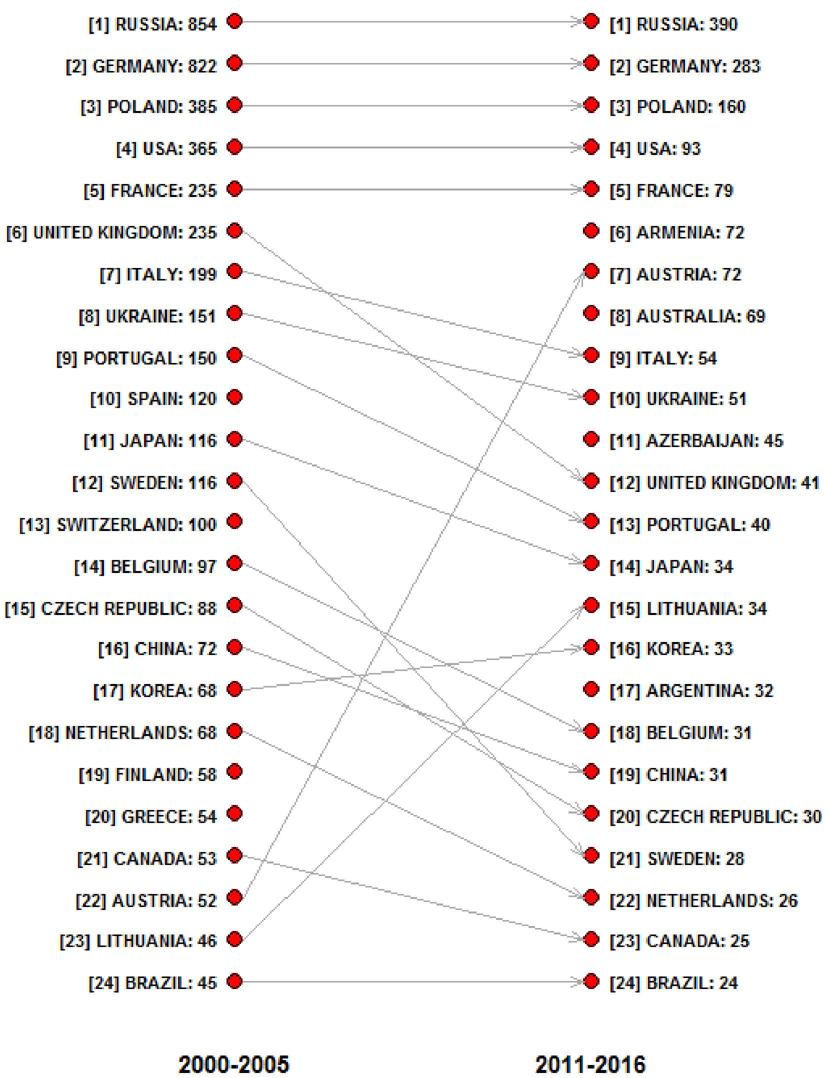
The ATLAS collaboration also influences a lot the patterns of co-authorship over time. Looking at Figure 4, which takes into account all publications, we note that the share of publications with authors only from Belarus has declined dramatically from 59 % in 2000 to 26 % in 2016. The share of publications with EU-based co-authors (but not jointly EU-based and Russia-based) has remained roughly the same, which implies, however, that the EU share of all publications with a foreign co-author has declined (from 62 % to 29 %). Again, the big share of publications with Belarusian, Russian, and EU-based co-authors is due mostly to the ATLAS project. When we exclude these publications, most of the patterns remain very similar, although the overall level of cross-country collaborations is around 12 % lower and the share of publications with EU and with Russian co-authors is significantly reduced.

Figure 4. Shares of publications with a (co-)author from Belarus in Thomson Reuters' Web of Science SCCI and SCI-E per co-author country (all publications)



When we examine the changing patterns of co-authorship per country, it is better to exclude the ATLAS-related projects because otherwise all the partners from this project come towards the top, although there are no links between Belarus and these countries outside of this single project. Therefore, in order to get a sense of the collaboration networks that characterize Belarusian science more generally, these publications have been left out. Figure 5 shows the rankings of the top 24 most popular countries in which co-authors with Belarusian scientists are based. As we can see, there is considerable continuity, with the top five countries – Russia, Germany, Poland, the U.S., and France – retaining their rankings. There are changes in the second tier, however, with Armenia scoring very high in 2011-2016, as well as Azerbaijan.

Figure 5. Ranks of the top 24 co-authorship partner countries of Belarusian scientific publications featured in Thomson Reuters' Web of Science (SCIE & SSCI) in 2000-2005 and 2011-2016 (excluding ATLAS-related publications)

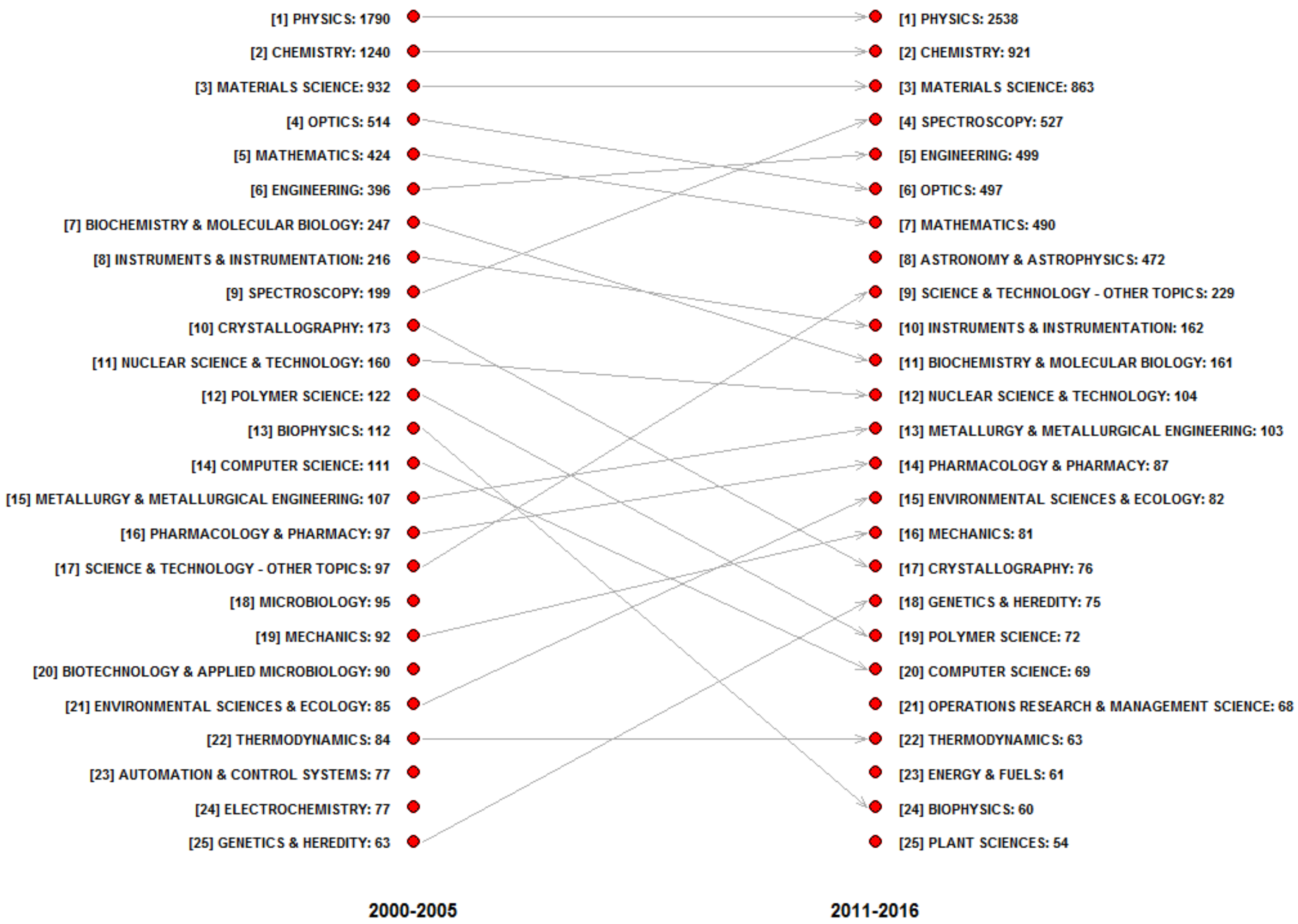


Many of the EU member states actually drop in the ranks (for example, the United Kingdom, Italy, and Spain), but others make strides (for example, Austria and Lithuania). The relatively small absolute numbers, especially in 2011-2016, make dramatic rises and falls in the rankings rather easy.

The changes in the last element of the scientific output under investigation, the distribution per scientific field, are presented in Figure 6. The top three fields remain the same in the period of 2011-2016 compared to 2000-2005: 'physics', 'chemistry', and 'materials science'. However, there are bigger reshuffles below these than was the case for Moldova (see below). 'Spectroscopy' makes a big jump to rank four, as well as 'astronomy' to rank eight, while both 'optics' and 'mathematics' experience small relative declines. 'Environmental sciences' as well as 'ecology' and 'genetics' are other relative gainers, together with 'operations research' and 'management science'. Compared to the Moldovan output, it is notable that there are some social science fields represented in the scientific output of Belarus, although not in the top ranks.

To sum up the experience of Belarus we should note the following: First, from 2000 to 2016 in terms of absolute numbers of publications the scientific output experienced a decline (until 2007) and then a recovery. However, when the growing economic base of the country is taken into account, the picture is one of decline followed by a stable trajectory at a considerably lower level than in 2000. Second, sources of external as well as national funding are becoming more important over time, with Russian sources being top, followed by EU, and German sources from international funding. The absolute share of foreign-funded publications is exaggerated by the participation in the massive ATLAS collaboration coordinated at CERN, but the ranking of the external funding sources is robust even when excluding publications related to this project. Third, the share of EU-based co-authors with Belarusian scientists relative to all publications has remained similar over the observation period, but coupled with the dramatic increase of cross-border collaborations, the *relative* share of the EU in all cross-border collaborations has actually declined. Russia remains the most prominent co-authorship partner, followed by Germany, Poland, the U.S., and France. The ranking of the top three scientific sectors also remains unchanged from the 2000-2005 baseline period, although there are some changes further down the ranks.

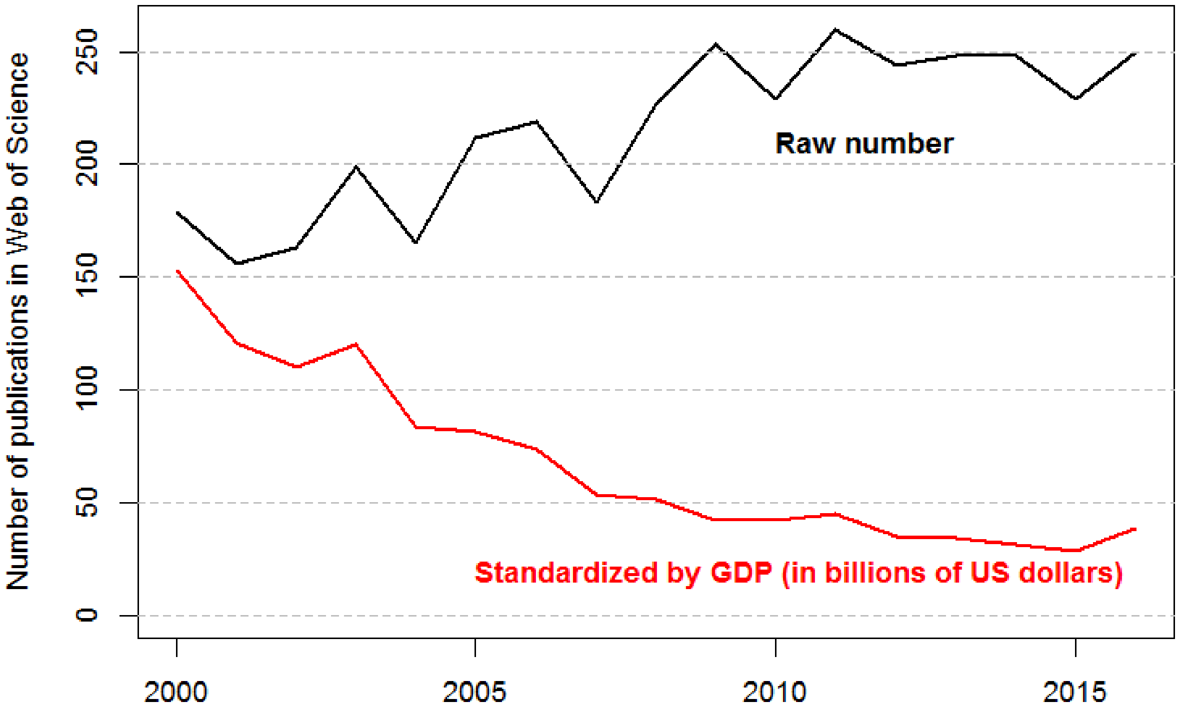
Figure 6. Ranks of the top 25 subject categories of Belarusian scientific publications featured in Thomson Reuters' Web of Science (SCIE & SSCI) in 2000-2005 and 2011-2016



2.3.2. Moldova

In total, we identified 3664 publications that fulfilled our selection criteria and had at least one co-author from an institution with an address in Moldova. Figure 7 shows the trend in the number of publications per year. The number ranges between a low of 156 in 2001 to a high of 260 in 2011. There is significant year-to-year variation, but up to 2011 the trend is mostly upwards, with the (raw) number of publications stabilizing around 245 afterwards. The trend looks rather different, however, when the numbers have been standardized (divided) by the GDP level of the country (from the previous year, in order to take into account the publication lag). Since the growth in GDP (expressed in billions of USD; data from the World Bank) during the 2000s outpaces the growth in publications, the standardized publication output trends downwards (red line in Figure 7), and the trend is not reversed until 2016.

Figure 7. Number of publications with a (co-)author from Moldova in Thomas Reuters' Web of Science SCCI and SCI-E (raw numbers and standardized by GDP)

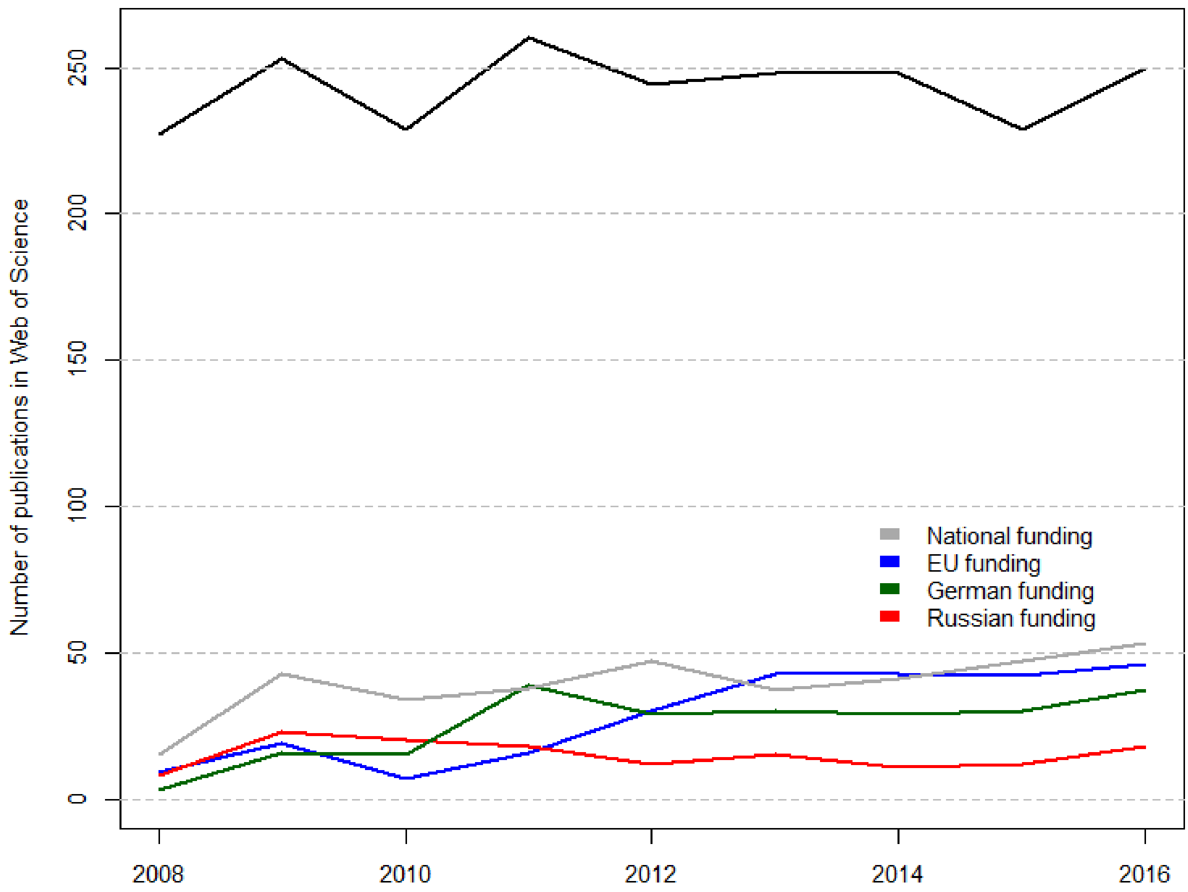


This means that in absolute terms Moldova produces more scientific publications in 2016 than in the beginning of the 2000s (roughly between 40 % and 50 % more, depending on the exact comparison years chosen). But in relative terms, when the scientific output is measured relative to the wealth of the country, the trend is the opposite: from around 120 in the beginning of the century, the number of publications per billion of GDP drops to around 35 in the period of 2012-2016. One possible interpretation is that previously Moldova has punched scientifically way above its modest economic weight, and the relative measure of the publication output is getting 'normalized' with the increasing wealth of the country over the past 17 years. Another interpretation is that Moldova has not been able to keep its scientific output growing at the same pace as the expansion of its economy. And it could be that the economic changes need more time to be reflected in the number of publications.

Next, we look at the source of funding for the publications. Although the source of funding (and text of funding) fields are available for all publications in Web of Science, it appears that they have been used systematically only after 2008, so for this part of the analysis we have to restrict our attention to the period of 2008-2016. We should also note that it could be that over time funding is reported more regularly than before, so the absolute numbers and shares might be underestimated at the beginning of the period. But we have no reasons to believe that some sources of funding (for example European vs. Russian) are systematically more or less likely to be reported in the same year, so relative comparisons should still be valid.

Figure 8 plots the total number of publications (in black) and the number of publications for which at least one author reports EU (in blue), German (in green), Russian (in red), or national Moldovan funding (in dark grey). Note that a single publication can have funding from all of these countries, so the categories are not exclusive.

Figure 8. Number of publications with a (co-)author from Moldova in Thomson Reuters' Web of Science SCCI and SCI-E per funding source

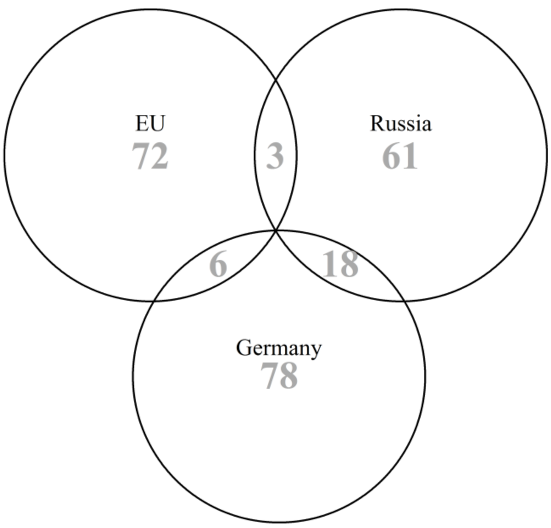


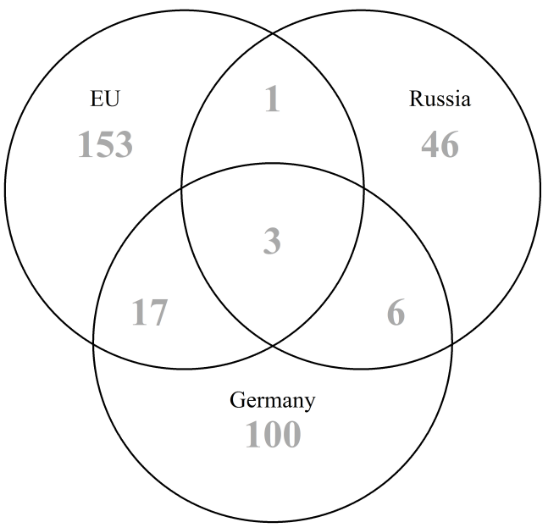
At the end of the observation period around 21 % of all publications with Moldovan (co-)authors report national funding, 18 % report EU funding, 15 % report German funding, and 7 % report funding from Russian sources. The share of national funding is relatively stable from 2009 until 2014 during which period fluctuates around 17 % (+/-2 percentage points), after which it stays at 21 % for 2015 and 2016. The share of EU-funded publications grows from 2010 until 2013 to around 17 % after which it stabilized at these values. German funding reaches a peak of 15 % in 2011, hovers around 12 % until 2015 and grows in 15 % again in 2016. Russian funding peaks at 9 % of all publications in 2010 and hovers around 4 % and 7 % afterwards. From the other important funding countries, Ukraine comes very high at 10-12 % in 2015-2016, with another peak of 8 % in 2011. Romanian funding has a presence in around 6-7 % of all publications after 2014, similar to that from the U.S.

Despite all the disclaimers surrounding these numbers, a few preliminary conclusions can be offered. First, more publications report research funding from the EU and Germany rather than from Russia. Second, the share of German funding is not too far off the share of EU-funded publications (bearing in mind some can have funding from both). Third, the share of EU-funded publications exhibits the most rapid growth in the years 2010-2013 after which it stabilizes: a trend that does not exactly correspond with the increasing intensity of participation in EU-funded projects and commitment to EU-funded programmes for international cooperation (for example, the association of Moldova to FP7 in 2012). Of course, it is too early to assess the impact of H2020 funding since the projects are ongoing.

To show the collaborative projects that have combinations of funding sources in order to better judge the relative importance of scientific cooperation with the EU, Figure 9 presents two Venn diagrams – one for the period before 2012 (left panel) and one for the period 2013-2016 (right panel) – for the three most important actors: the EU, Germany, and Russia. The figure shows that 26 % of the publications that acknowledge Russian funding (21 out of 82) also acknowledge EU or German funding as well (in the period 2000-2012; left panel). In the period of 2013-2016 this percentage drops to 18 % (10 out of 56). The shares of publications that mention German or Russian sources of funding in addition to EU ones are lower: 11 % for 2000-2012 and 12 % for 2013-2016. German funding is complemented by EU or Russian funding in 24 % of the cases during 2000-2012 and 21 % in 2013-2016. We can conclude that higher shares of the German and Russian-funded projects have co-financing by either of the other two major actors. We should also note the relatively high share of projects co-funded by German and Russian sources, especially for the period until 2013.

Figure 9. Venn diagrams of sources of funding for publications with a (co-)author from Moldova in Thomson Reuters' Web of Science SCCI and SCI-E. Left 2000-2012; Right 2013-2016

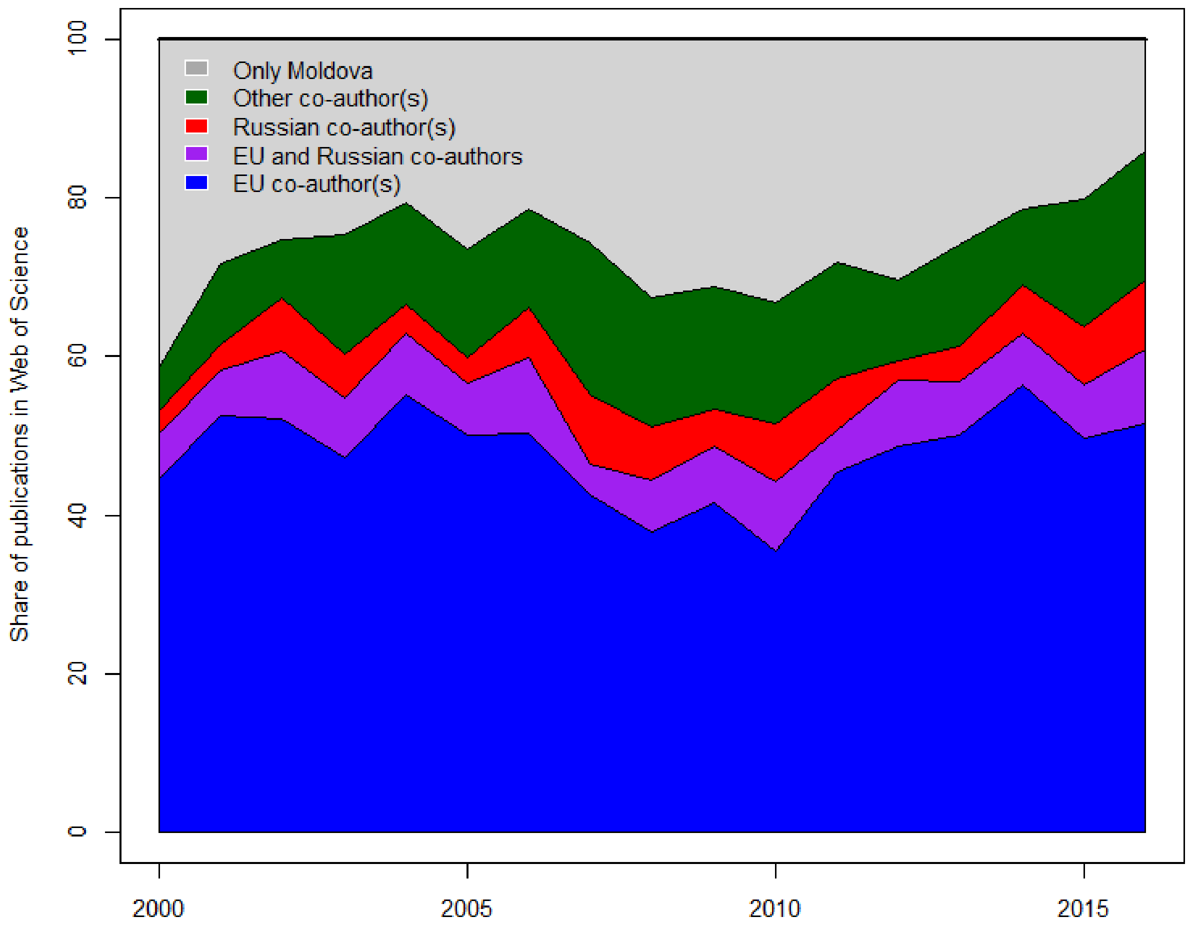




Another way to judge the importance of scientific cooperation with the EU is to examine the share of publications that have co-authors from Moldova and from any of the member states of the EU. Figure 10 plots the share of publications that have EU (but not Russian) co-authors in blue, the ones that have only Russian co-authors in red, the ones that have both EU and Russian co-authors in purple, and the ones that have co-authors by neither any of the EU member states nor Russia in dark green (the publications with authors only from Moldova are in grey). The shares are stacked.

The figure shows, first, that over time the share of publications that have (co-)authors only from Moldova has dropped: looking at the actual numbers, it has declined from 41 % in 2000 to 14 % in 2016. The share of publications with at least one co-author from an EU member state from all publications has increased slightly from 50 % in 2000 to 61 % in 2016 (but there is no consistent pattern over time).

Figure 10. Shares of publications with a (co-)author from Moldova in Thomson Reuters' Web of Science SCCI and SCI-E per co-author country.



At the same time, the share of publications with at least one co-author from an EU member state from all publications with at least one non-Moldovan-based co-author has declined from 86 % in 2000 to 71 % in 2016 (again, there is no consistent pattern over time).

In other words, Moldovan scientists are much more likely to publish with foreign-based co-authors, the share of co-publications with EU co-authors has increased slightly, but the relative importance of EU co-authors has declined, as a larger share of the publications resulting from international collaborations has a non-EU co-author now than 15 years ago. It seems that Moldova has, to some extent, diversified its co-publication partner countries towards the end of the observed period in 2016.

This diversification comes in part because of an increased reliance on Russia-based co-authors. The share of Russia-based co-authors actually increases from 8 % of all publications in 2001 to 18 % in 2016 (14 % to 21 % from those with a foreign co-author). But it should be noted that a significant share of these include publications in which co-authors from Russia *and* co-authors based in an EU member state have collaborated with Moldovan scientists. If the publications with EU co-authors are excluded from the Russian counts, the shares drop to 3 % in 2010 and 9 % in 2016 (from all publications) and to 5 % and 10 % from all multi-country publications. Yet, the percentage of Russia/Moldova co-publications that also feature an author based in an EU member state drops from 67 % in 2000 to 51 % in 2016.

We can look in more detail at the partner countries with which Moldovans co-authored articles by inspecting Figure 11, which shows the changing ranks of the top 25 partner countries between two time periods: 2000-2005 and 2011-2016. We can see from the figure that Germany remains the top co-authorship partner, with 179 of the publications in the period 2000-2005 having at least one co-author based at a German institution and 414 of the publications in the period 2011-2016. Russia is second in the early period but drops to rank eight in the latter one. It is significant that two EU member states – France and Italy – jump to second and third place. Other EU member states such as Belgium, Finland, and Austria also improve their standing during the observation period. Romania retains a relatively high rank. The U.S. ranking experiences a similar decline to the one of Russia. Despite the surge in Ukrainian (co-)funding of projects, the partner rank of the country drops from 6th to 16th. Belarus goes from 22nd to 12th. Altogether, the partner list in 2011-2016 is more geographically diversified, with Australia, Israel, China, Korea, Canada, and Japan all scoring relatively highly, along the more traditional partners from Europe and the former Soviet Union.

The last feature of the scientific output of Moldova to discuss is the presence and prominence of various scientific fields and topics. This would give an indication of possible changes in the interest and research work conducted in different scientific fields; hence, exploring possible transformation of the profile of Moldovan science as a result of increasing scientific cooperation with the EU.

Figure 11. Ranks of the top 25 co-authorship partner countries of Moldovan scientific publications featured in Thomson Reuters' Web of Science (SCIE & SSCI) in 2000-2005 and 2011-2016

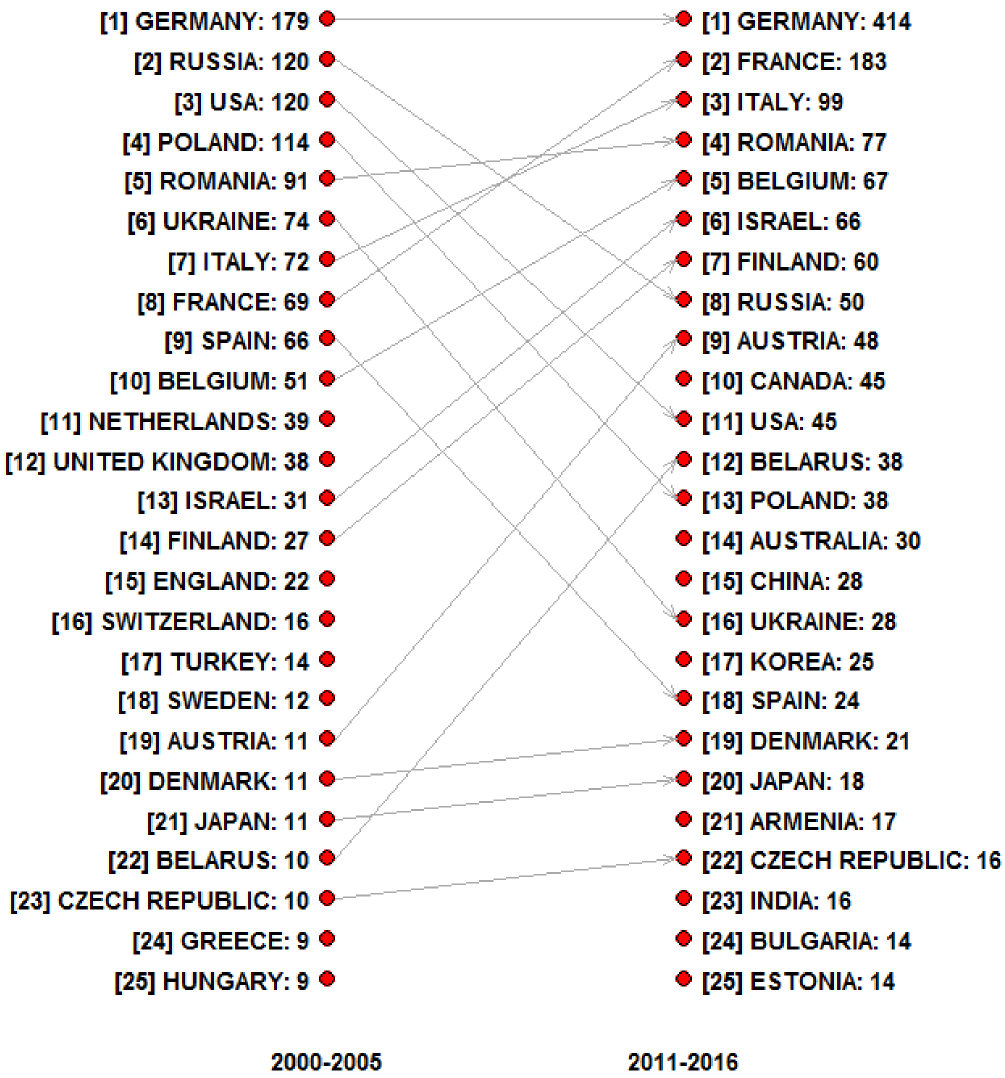
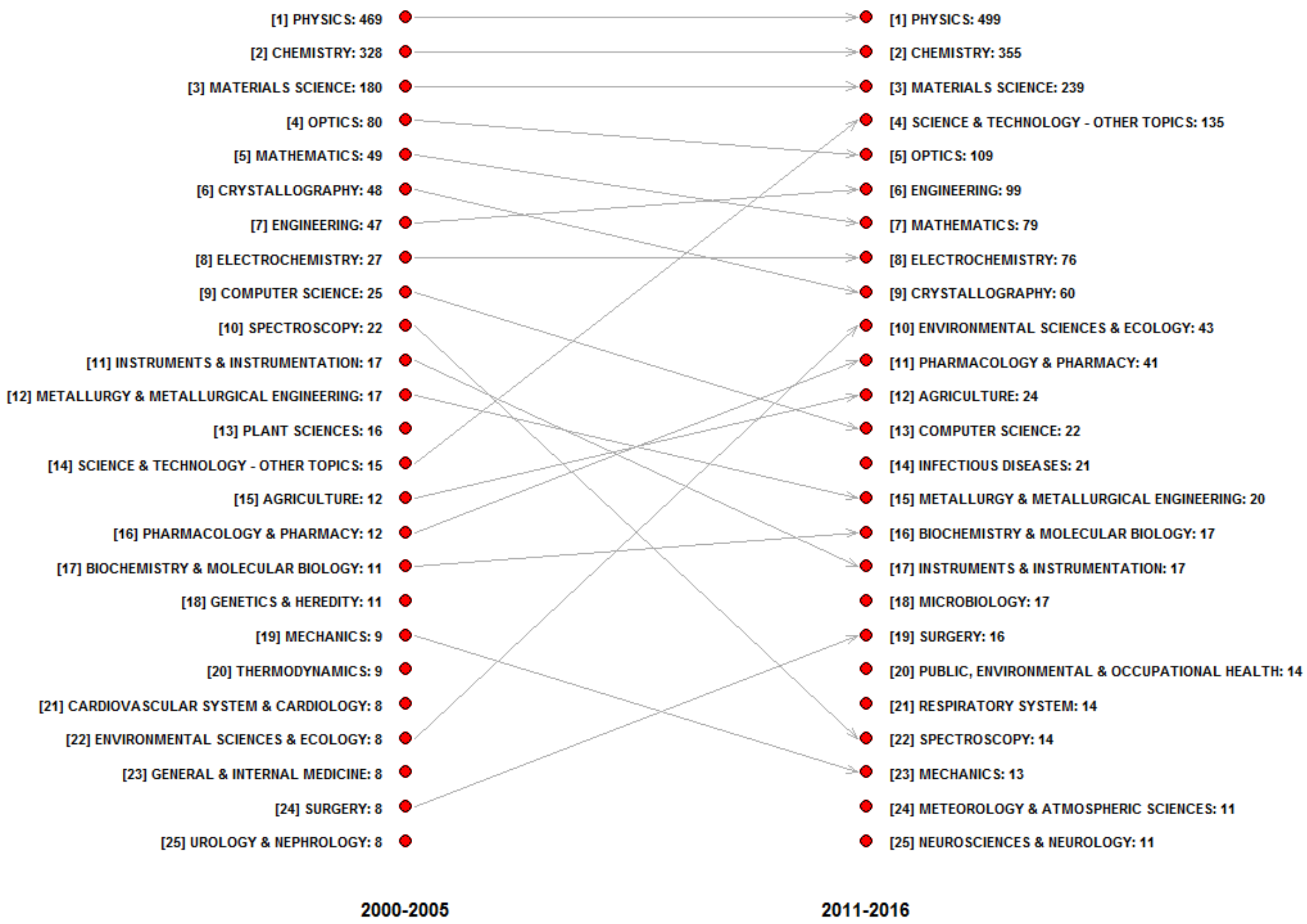


Figure 12 plots the ranks of the top 25 subject categories of scientific publications by a (co-)author based in Moldova for the two periods 2000-2005 and 2011-2016. Note that each publication has typically more than one subject category. At the top of the rankings, there is remarkable stability with ‘physics’, ‘chemistry’, and ‘materials science’ occupying the top three places in unchanged order. ‘Science and technology – other topics’ comes in at number four in the latter period but this category is obviously a rather mixed one, so we cannot infer any substantial change in the scientific profile of the country based on this. The greatest relative increase that might be revealing of an important research development is the rise of ‘environmental science & ecology’ from 22nd to 10th. In the ranks outside the top ten, there are other significant reshuffles, with ‘pharmacology’ and ‘agriculture’ improving their standing and some fields that are outside the top 25 in 2000-2005 breaking in, for example ‘infectious diseases’ at rank 14 and ‘microbiology’ at rank 18, and ’public, occupational and environmental health’ at rank 20.

Figure 12. Ranks of the top 25 subject categories of Moldovan scientific publications featured in Thomson Reuters' Web of Science (SCIE & SSCI) in 2000-2005 and 2011-2016



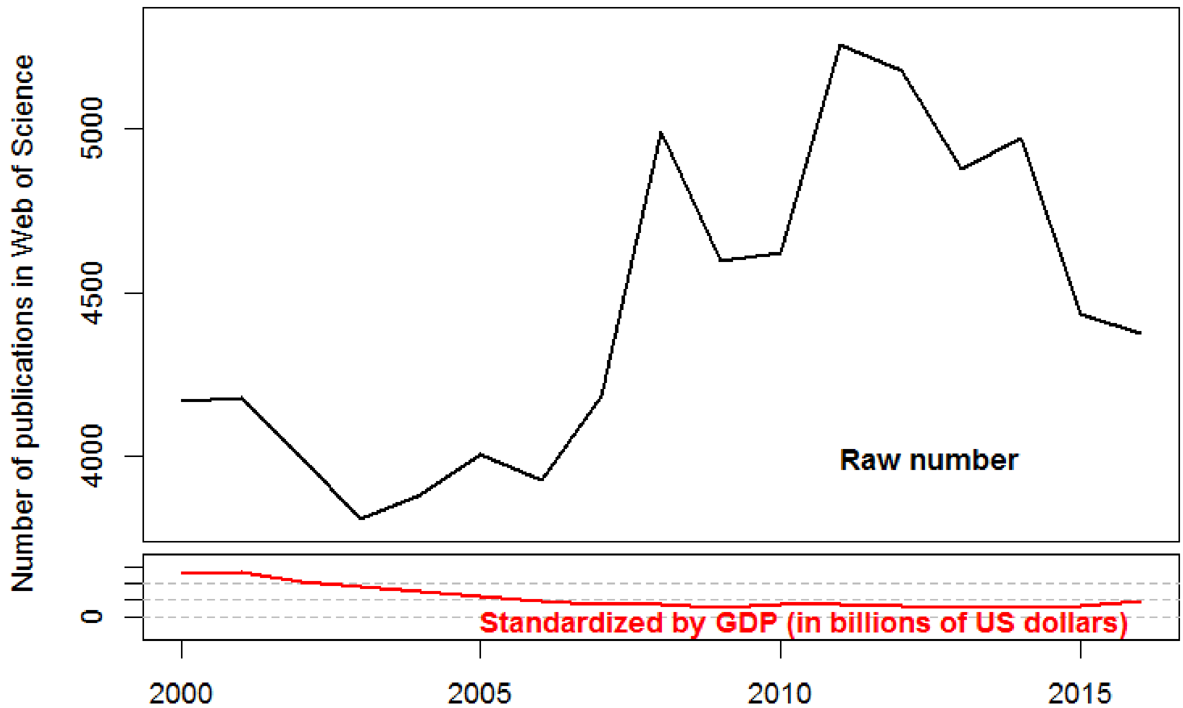
Further research should attempt to link these bibliometric developments to concrete projects and programmes for scientific cooperation that might be responsible for the relative rise of these fields. But the bottom line is that the top scientific sectors in Moldova that account for the majority of scientific publications remain pretty much the same in 2011-2016 as they were in the beginning of the century.

To sum up the trajectory of Moldovan science as revealed in the bibliometric analysis of Thomson Reuters' Web of Science data: first, in absolute numbers the number of scientific publications has increased between 2000 and 2016 between 40 % and 50 %. However, the growth in scientific output has been slower than the growth of the economy of the country, so that the number of publications relative to GDP has actually declined. Second, since 2008 the number of scientific publications by (co-)authors based in Moldova who report funding from EU sources has increased, but the increase has stalled and the share has stabilized around 2013. This is contrary to the trend of increasing commitment to and participation in scientific cooperation with the EU during the same period. Actually, German funding remains almost as prominent as the EU's, while Russian funding is lower. When it comes to co-publication partner countries, the story is complex. Co-authors from EU countries remain the most important in absolute terms but their share of all publications and all publications with foreign co-authors has actually declined somewhat. This is partly due to a slightly increasing share of publications with Russian (and Russian and EU-based) co-authors, but also to a diversification of partnerships beyond Europe and the former Soviet Union countries. When it comes to the subject profile of Moldovan science, there is remarkable stability in the top fields, and some intriguing developments in the second echelon. Altogether, there is not much evidence for transformative effects though increasing cooperation with the EU and the intensification of participation in EU projects during the period 2000 to 2016.

2.3.3. Ukraine

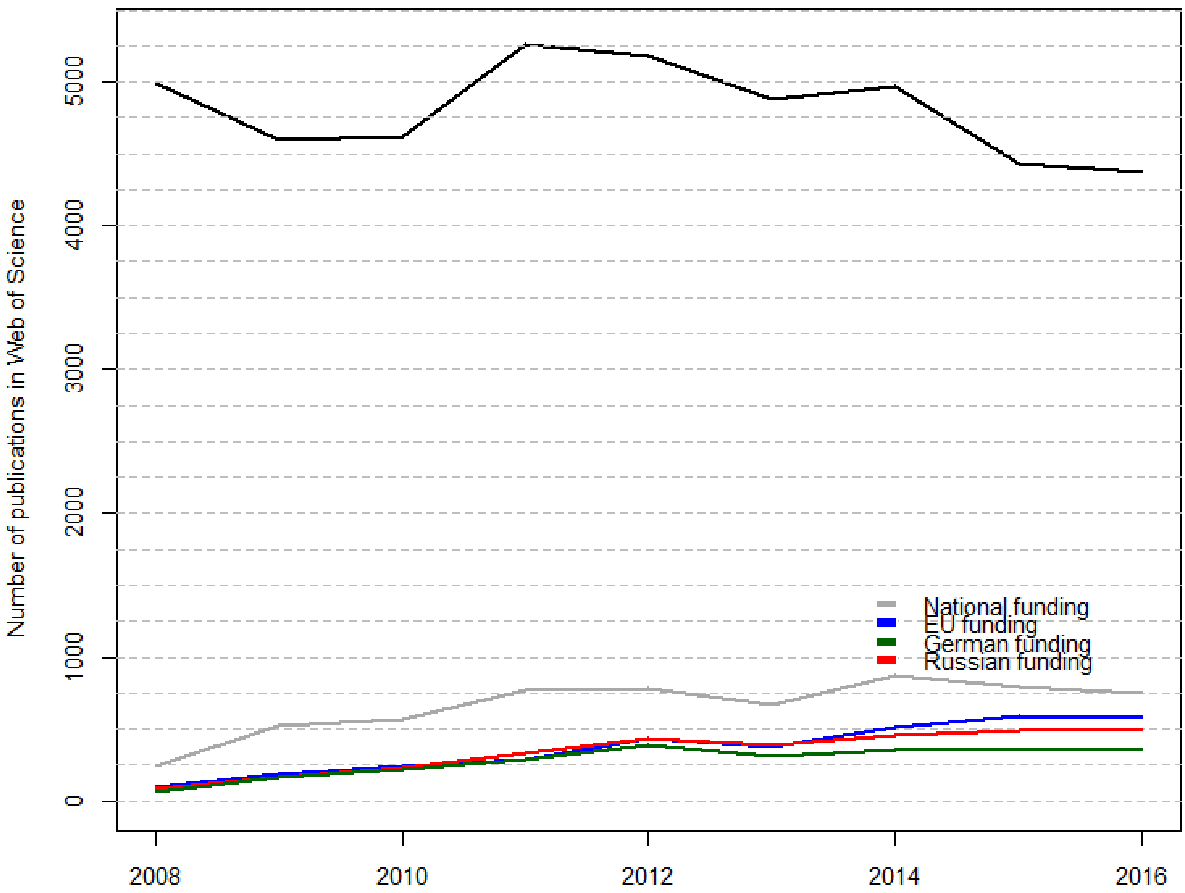
We identified 75,464 relevant publications in Web of Science SSCI and SCI-E for the period 2010-2016 that have at least one co-author based at an institution in Ukraine. Over time, the number of publications per year drops after 2001 from 4181 to a low of 3809 in 2003, after which it recovers, at first slowly and then quite rapidly, to a peak of 4991 in 2008. This is followed by another two-year drop, before rising again to a new peak of 5259 in 2011 and then a gradual but steady decline afterwards until the end of the observation period in 2016 (Figure 13). When we consider the number of publications as standardized by the country's GDP, the story is one of continuous decline from more than 130 publications per year per billion (USD) in 2000/2001 down to 25 per billion in 2009, after which the number stabilizes between 27 and 39 per billion until 2016, when it actually increases to 48 per billion (but this is due to a shrinking economy and not increasing publication output). As in Belarus, Ukraine participates in the ATLAS collaboration, so if we exclude publications resulting from this mega project, the decline vis-à-vis 2000 will be even more significant.

Figure 13. Number of publications with a (co-)author from Ukraine in Thomson Reuters' Web of Science SCCI and SCI-E (raw numbers and standardized by GDP)



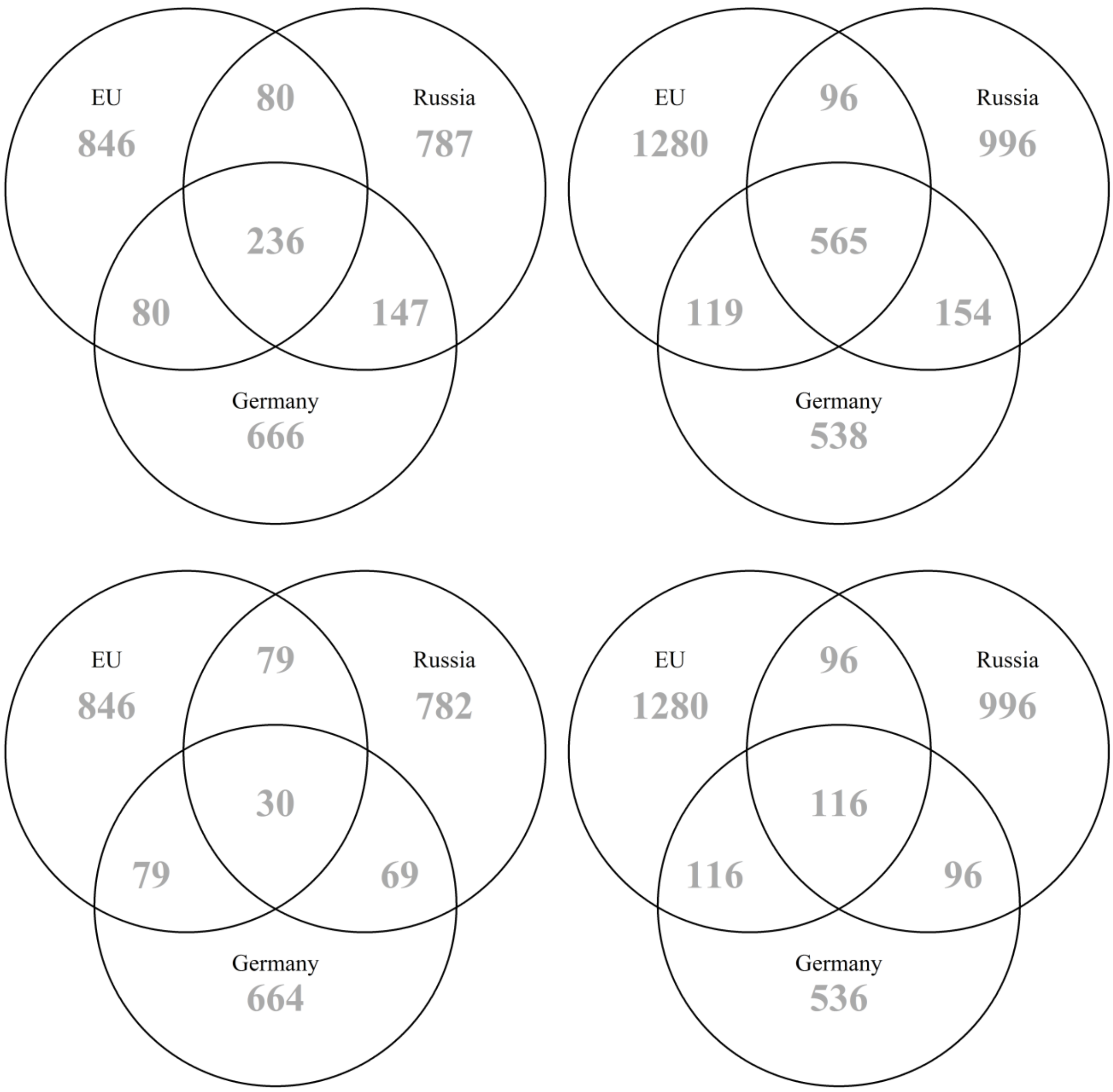
When it comes to funding sources, there is a gradual increase in all three major sources: EU, Russian, and German. Until 2012 their levels are actually very similar, after which we observe somewhat stronger growth in EU-funded rather than Russian-funded or German-funded publications. At the end of the period in 2016, approximately 13 % of the publications report some EU funding, 11 % report Russian, and 8 % report German. Projects with national funding are visible more until 2014, after which their relative share declines. The trends are similar when we exclude ATLAS-related publications, although the absolute numbers for the shares of foreign-funded publications drop 2/3 percentage points.

Figure 14. Number of publications with a (co-)author from Ukraine in Thomson Reuters' Web of Science SCCI and SCI-E per funding source (all publications)



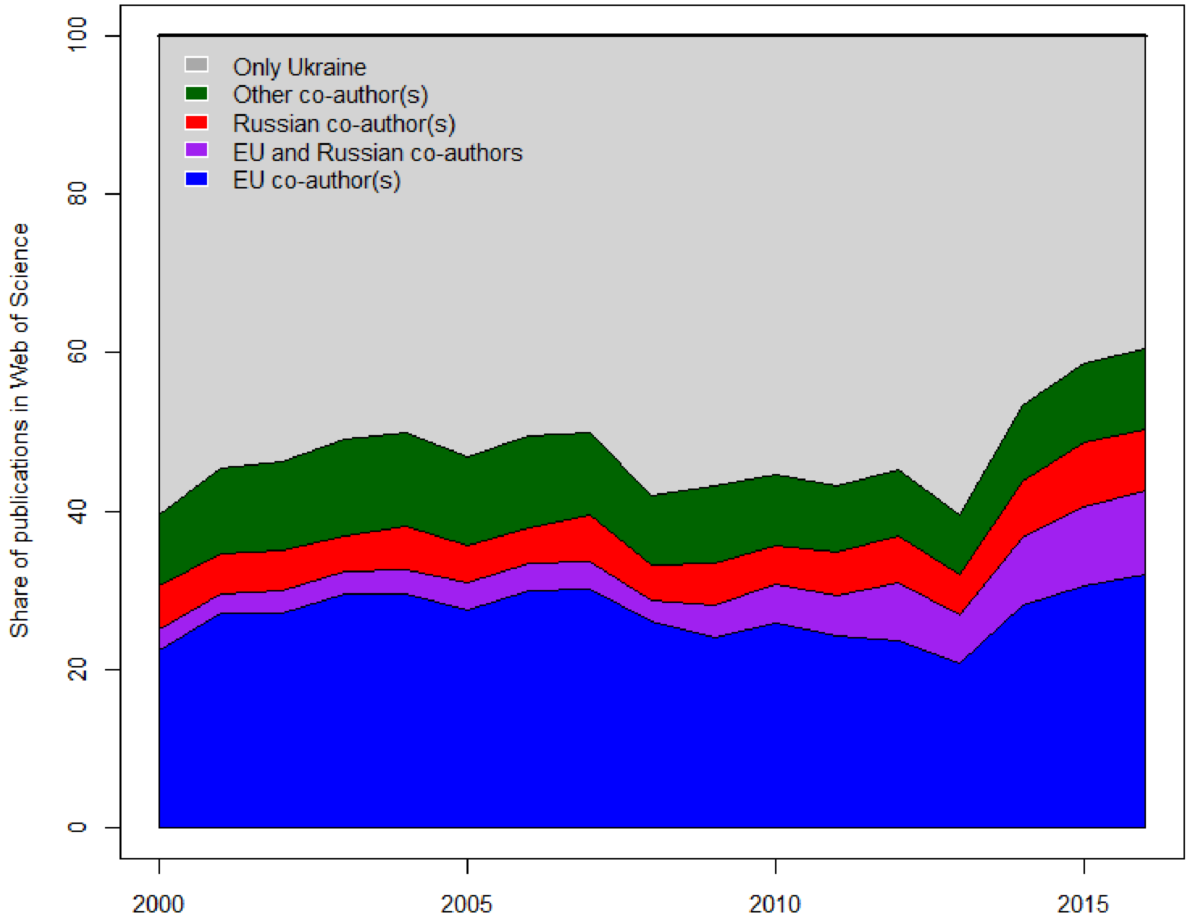
The Venn diagrams show that there is a considerable number and share of publications that report simultaneously more than one source of funding from the main three identified in this paper. This is especially the case when the ATLAS-related publications are taken into account, but to a lesser extent also when they are excluded (bottom line of Figure 15). For example, for the period 2013-2016, 24 % (308 out of 1,304) of the publications that report some Russian funding also report either EU or German funding, or both. 38 % of the cases that have German funding, have funding from other sources as well (bottom-right panel).

Figure 15. Venn diagrams of sources of funding for publications with a (co-)author from Ukraine in Thomson Reuters' Web of Science SCCI and SCI-E. Left 2000-2012; Right 2013-2016; Top: all publications; Bottom: excluding ATLAS-related publications



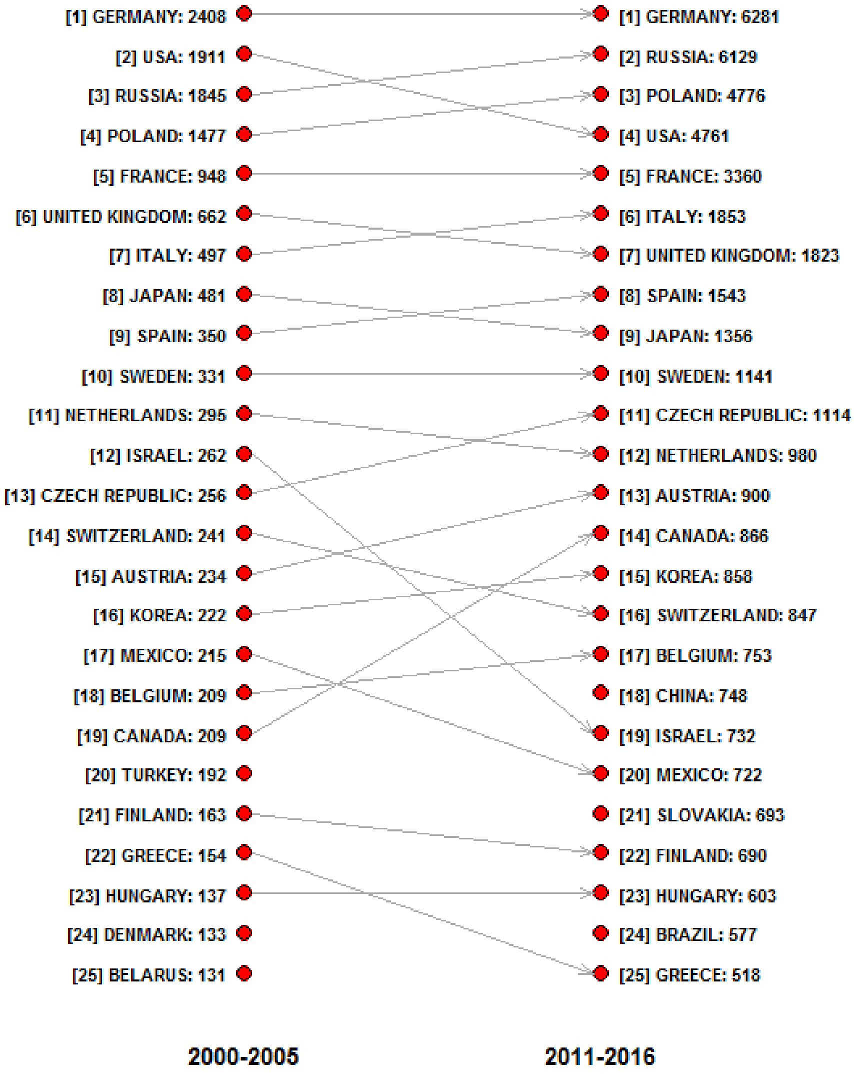
Turning to the countries of residence of co-authors working with Ukraine-based scientists, Figure 16 shows the distribution over time. The share of articles that have only Ukraine-based authors has declined from 61 % in 2000 to 40 % in 2016, with the increase most dramatic after 2013. EU member state co-authors have the largest share, and one that is increasing (in relative terms) during the observation period: from 25 % in 2000 to 42 % of all publications in 2016. But in terms of the share from all multi-country co-authored publications, the EU portion is much more stable, ranging between 64 % and 70 %. Of these, the part that is co-authored with Russia-based authors grows, as explained above mostly due to the ATLAS collaboration. The share of only Russian collaboration is stable at around 8 % of all publications and 13 % of the cross-country collaborations. Ukraine also maintains a relatively high and growing number of collaborations with co-authors from countries other than the EU or Russia: around 10 % of all and 17 % of the cross-border collaborations.

Figure 16. Shares of publications with a (co-)author from Ukraine in Thomson Reuters' Web of Science SCCI and SCI-E per co-author country (all publications)



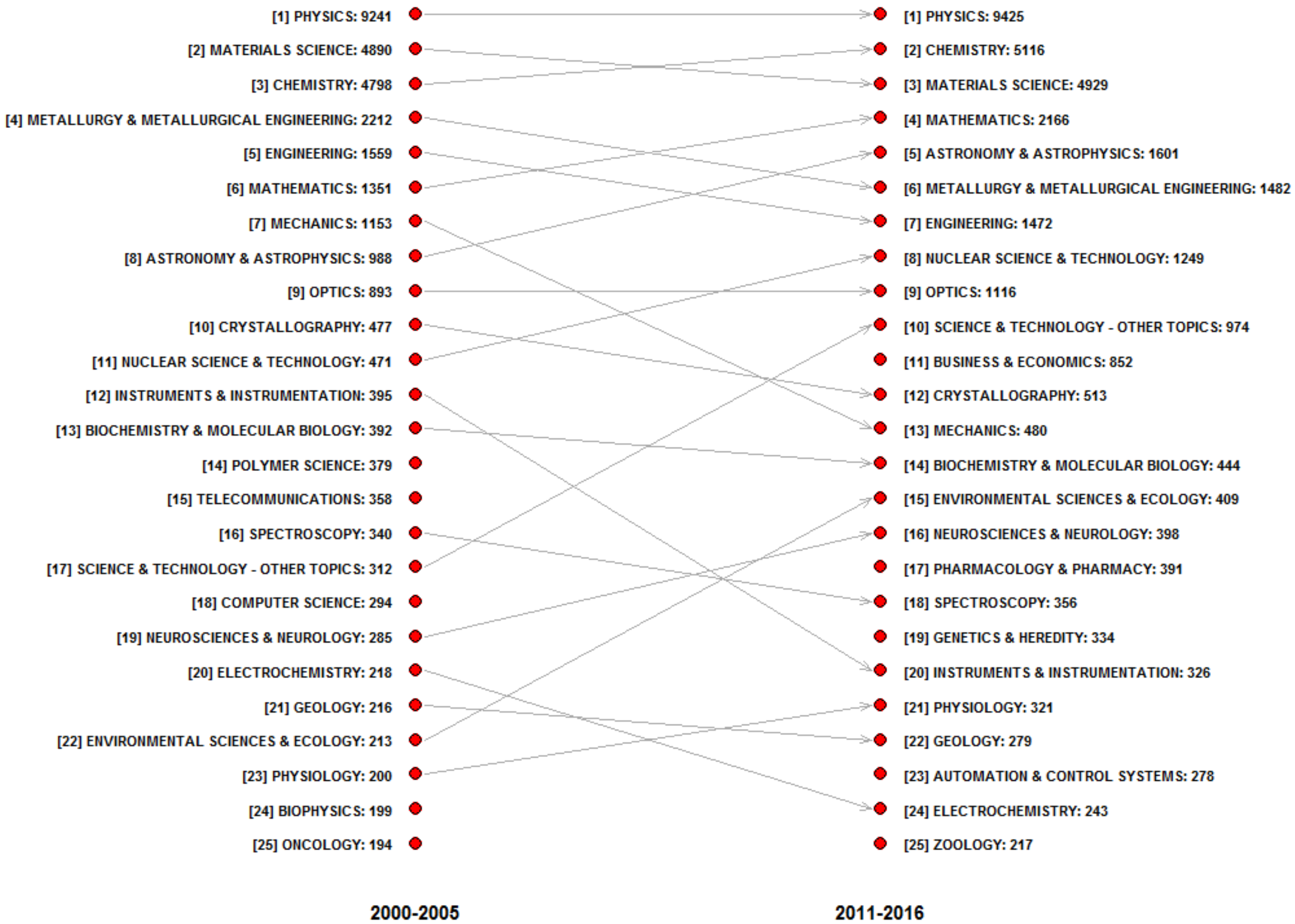
When we examine the more detailed distribution of co-authors per country (Figure 17), we can note that Germany remains the top partner, followed by Russia (which improves its rank for the period 2013-2016 compared to 2000-2005), Poland (which also moves up a place), and the U.S. There is quite some stability in the second echelon as well, with the Czech Republic and Canada making the most spectacular increases over the period.

Figure 17. Ranks of the top 25 co-authorship partner countries of Ukrainian scientific publications featured in Thomson Reuters' Web of Science (SCIE & SSCI) in 2000-2005 and 2011-2016 (excluding ATLAS-related publications)



Finally, when we consider the scientific fields in which Ukrainian scientists have published over the past 17 years in cooperation with the EU, we find 'physics' on top throughout the period (Figure 18); 'materials science' and 'chemistry' switch second and third place; 'mathematics' and 'astronomy' both rise, while 'engineering' experiences a relative decline. 'Nuclear sciences', 'environmental sciences' and 'ecology', and 'business & economics' also improve their ranks, together with other fields such as 'genetics' and 'zoology'. Again, it is possible to try to trace some of these developments to concrete projects for cooperation with the EU in these areas in future research.

Figure 18. Ranks of the top 25 subject categories of Ukrainian scientific publications featured in Thomson Reuters' Web of Science (SCIE & SSCI) in 2000-2005 and 2011-2016



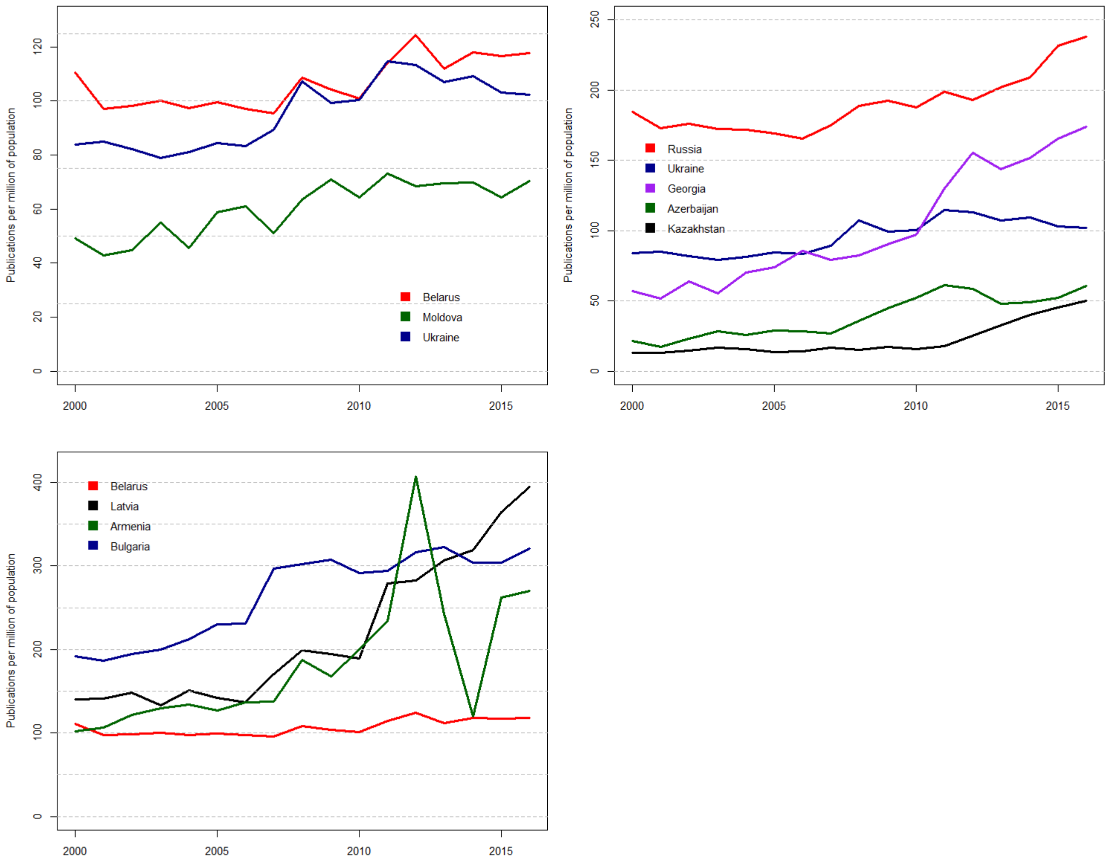
Summarizing the findings on Ukraine, we see that Ukrainian science has experienced a turbulent period in terms of productivity. Publication numbers have declined, recovered, declined again, and recovered again. But when we adjust for the growing (until 2013, and with the exception of 2009) economic base of the country, the trend is one of decline of the publication output relative to economic wealth. Participation in the ATLAS project has attenuated these trends. The EU is the most important foreign funding source for (co-)publications by Ukrainian scientists, followed by Russia and Germany. However, the share of EU-funded publications has not grown dramatically over the period of analysis, despite the intensification of scientific cooperation by the EU. Russian and, even more so, German funding often complements EU sources. EU-based co-authors have the largest presence, and the share has grown moderately (while still at a very high absolute level). There is not much change in the ranking of the countries of residence of co-authors, with Germany remaining top and Russia second. When it comes to scientific fields, there is again continuity at the top with some reshuffles in the lower ranks.

2.4. Comparisons

So far the analysis has presented the trajectories of Belarus, Moldova, and Ukraine in isolation, but it is instructive to compare their experiences side by side, and also to other countries from the region and beyond. In this section we juxtapose the patterns in the three countries analysed so far, and we put these patterns in the context of the wider region of Eastern Europe and the former Soviet Union.

Figure 19 shows the number of publications (standardized by population). The first panel features the countries analysed previously: Belarus, Moldova, and Ukraine. We can see that Belarus has the highest number of publications per million (between 100 and 120), followed by Ukraine (between 80 and 110), and Moldova (between 40 and 75). Over the entire period, there is a slight upward trend, but it is not consistent. Ukraine for example experiences significant growth until 2011, when it actually caught up with Belarus, but undergoes a decline afterwards. There is stagnation in the number for Moldova (after 2009) and Belarus (2011).

Figure 19. Number of scientific publications featured in Thomson Reuters' Web of Science (SCIE & SSCI) 2000-2016 per million of population in countries from Eastern Europe and the former Soviet Union



To put these numbers in context, the second panel in Figure 19 adds the estimates of scientific output for Russia, Georgia, Azerbaijan, and Kazakhstan. To keep the figure readable, only one country from the three that are in our main focus – Ukraine, is plotted. In the context of these countries from the former Soviet Union the pattern of Ukraine (and Belarus and Moldova) is not typical. Russia experiences significant growth (from around 160 to around 240), and Georgia even more so (from around 50 to around 175 publications per million). In terms of the absolute size of the scientific output (standardized by population), the three countries from the EaP we analysed so far fall somewhere in-between, with Russia and Georgia (and as we will shortly discuss, Armenia) having higher numbers, while Azerbaijan and Kazakhstan having lower ones. Over our period of analysis, both Azerbaijan and Kazakhstan experience high growth (especially after 2007 and 2011, respectively). Admittedly, this growth is from a lower base, but it is quite rapid and, in the case of Kazakhstan at least, sustained, and brings these countries close to the size of the scientific output of Moldova. The third panel of Figure 19 adds the trajectories of Armenia, as well as Latvia and Bulgaria – two countries from Central Eastern Europe that joined the EU (in 2004 and 2007, respectively). Belarus is included for comparison (note the change in the range of the y-axis across the panels).

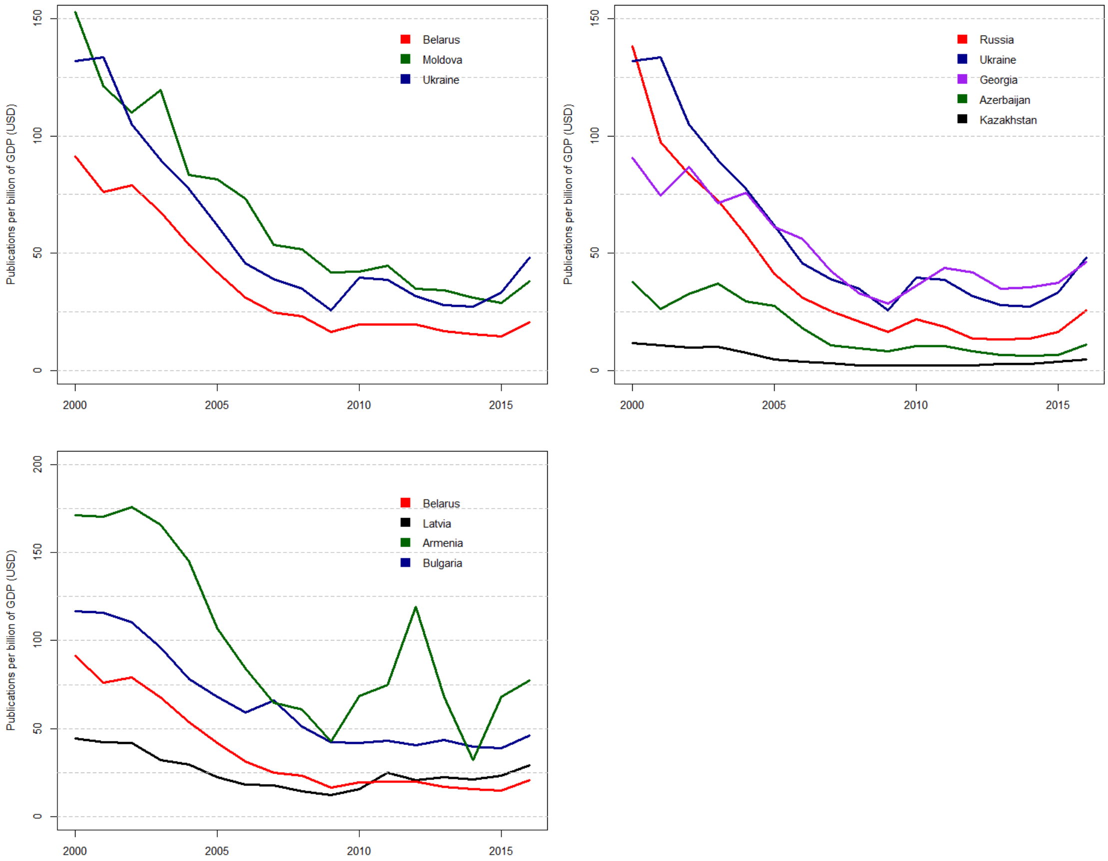
Armenia starts from a similar level as Belarus in 2000 but undergoes spectacular growth to end up at around 250 publications per million at the end of the period (the variation in the numbers between 2012 and 2014 seems aberrant, but 2016 looks reasonable within the overall trajectory). Bulgaria's output also grows by more than 50 % during the period, and from a higher starting value, but the increase levels off around 2007, when the country joins the EU. The trajectory of Latvia is different, with sustained and rapid growth after 2006 that brings it top of the league (of countries included in this analysis).

The overall conclusions from these comparisons is that the three Eastern EaP countries are still far from reaching the absolute levels of productivity of both Russia and EU member states such as Latvia and Bulgaria. More to the point, they have also been outperformed by Armenia and Georgia. Even more importantly, these last countries, together with Azerbaijan and Kazakhstan, have increased the size of their scientific output more and more consistently during our period of observation. So the relative standing of the three EaP countries analysed here in the wider context of Eastern Europe and the former Soviet Union has deteriorated.

Figure 20 plots the number of publications standardized by economic wealth (billions of GDP in USD). As already noted in the previous sections, for all three countries – Belarus, Moldova, and Ukraine, the scientific output relative to the size of the economy drops rather rapidly until 2009 when it levels off and starts to improve around 2016. But these changes are driven mostly by fluctuations in the economy and not so much in the size of the scientific output. For example, the increase for Ukraine in 2016 is not a result of more publications, but of less publications and an economy that is shrinking at a faster rate. Nevertheless, it is remarkable that relative to the economy, the scientific weight of these countries has been significantly reduced. It is also worth noting that when standardized like this, the numbers for Belarus are worse than the ones for Moldova and Ukraine.

But as the second and third panels of Figure 20 reveal, these patterns are not unique to the these EaP countries: in fact Russia and Georgia share rather similar patterns with Ukraine, and even Bulgaria and Latvia experience a relative decline followed by stagnation at that lower level of around 20 to 50 publications per billion of GDP. Also, the growth of Azerbaijan and Kazakhstan does not seem so remarkable anymore, once the size of their economies has been taken into account.

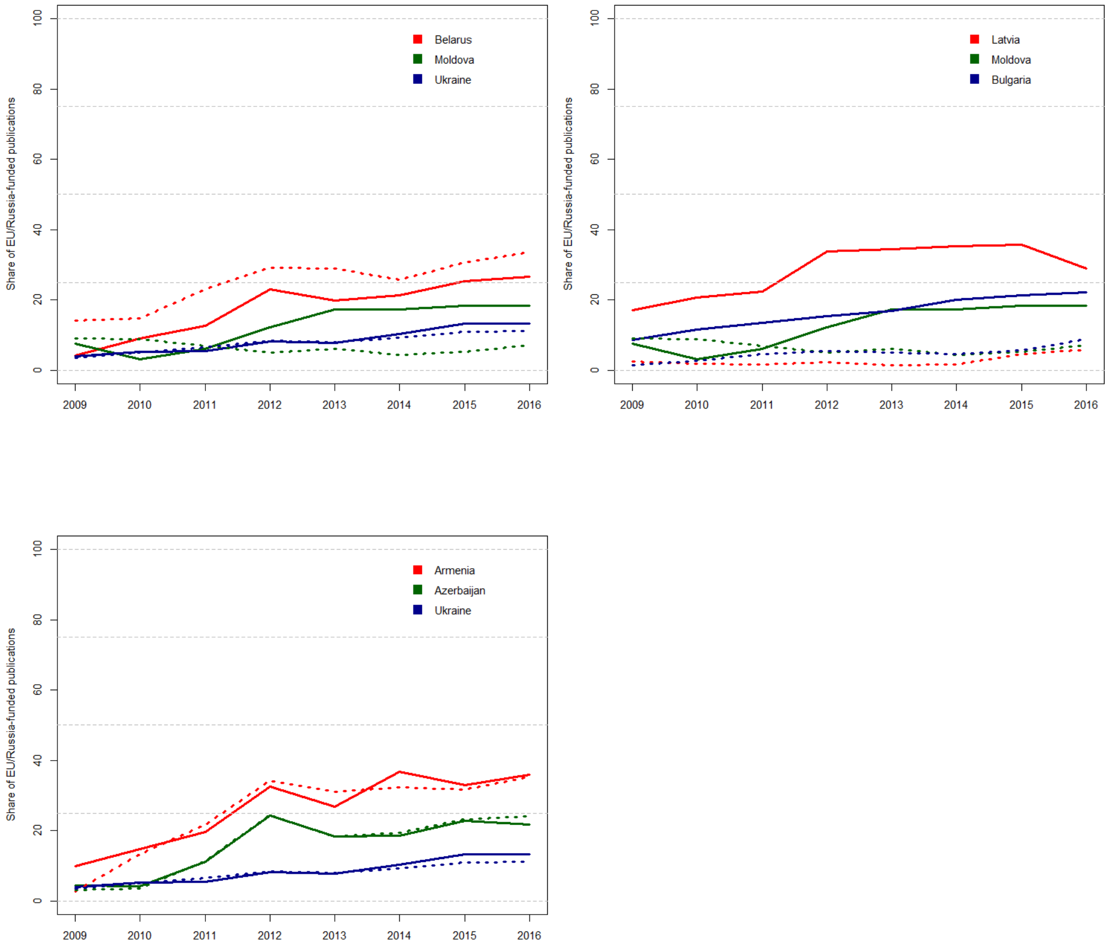
Figure 20. Number of scientific publications featured in Thomson Reuters' Web of Science (SCIE & SSCI) 2000-2016 per billion of GDP (USD) in countries from Eastern Europe and the former Soviet Union



Finally, Figure 21 traces the share of foreign-funded publications for a subset of the countries in Eastern Europe and the former Soviet Union. The share of EU-funded publications is plotted with solid lines and the share of Russian-funded publications is plotted with dashed lines. It should be noted that funding could have been for any of the co-authors of a publication, and not necessarily to the co-author of the country of interest. As a result, one article can also have funding from more than one source.

The first panel summarizes what was already presented in the country sections above. The EU has the greatest share in Belarus with slightly more than 25 % of all publications in 2016, followed by Moldova and Ukraine. But Russia has an even greater share in Belarus, while its shares in Ukraine and Moldova are lower than the EU ones (and in absolute terms). But again the numbers for Belarus, and to a lesser extent for Ukraine, are significantly affected by participation in the ATLAS collaboration, which has both EU and Russia-funded co-authors.

Figure 21. Number of scientific publications featured in Thomson Reuters' Web of Science (SCIE & SSCI) 2008-2016 per funding source in countries from Eastern Europe and the former Soviet Union. Solid lines – EU funding; Dashed lines – Russian funding



When we compare Moldova, one of the EaP countries, to the EU member states Latvia and Bulgaria, we can see that the share of EU-funded publications in which Latvia-based authors participate is somewhat higher than in Moldova (but not so compared to Belarus). However, the numbers for Bulgaria are not much different than the Moldovan ones. Moldova converges with the Bulgarian shares of EU-funded publications around 2013. But these comparisons of shares can be somewhat misleading as the total number of publications in Latvia and in Bulgaria are much higher than in Moldova, so that a much higher number of publications have some form of EU funding in these countries. Meanwhile Russian funding is at a similar level, rather lower than that of the EU, in all three countries. The last panel of Figure 21 plots the patterns in Armenia and Azerbaijan, next to Ukraine (all three countries are part of the ATLAS collaboration). In Armenia the share of both EU and Russian-funded projects is highest, at around 30 % each, followed by Azerbaijan (around 20 % each), and Ukraine. Again, the total number of publications in Ukraine is much higher, as it is a bigger country, so a smaller share can translate into a (much higher) absolute number of publications co-funded by the EU and/or Russia. Also, since the size of the Ukrainian output is bigger in absolute terms, the ATLAS project influences the results to a lesser extent than in the other two states.

2.5. Conclusion of Part I: Scientific productivity and collaborative projects in EaP countries

In this part of the paper we set out to trace the developments in the scientific productivity in three countries from the EaP region, with a focus on the possible impact of scientific cooperation with the EU on the patterns of their scientific output over the period of 2000 to 2016.

In terms of productivity, the conclusion we reach depends rather strongly on whether we decide to adjust the number of publications by population or economic wealth. Unadjusted numbers show growth, albeit uneven and inconsistent. Relative to the size of the (mostly growing) economies, the scientific output is diminished in size in Belarus, Moldova, and Ukraine. This turns out to be a pattern characteristic of the broader region of Eastern Europe and the former Soviet Union. Yet other countries in the region have managed to increase (in absolute numbers) their scientific productivity more (for example Azerbaijan and Kazakhstan, but also Georgia and Armenia) and more consistently (also Latvia).

Some of the countries experiencing strong growth have not participated in EU programmes for scientific cooperation with the same level of commitment and energy as Moldova, Ukraine, and Belarus. But it would be unfair to put the blame for slower and more inconsistent growth on the EU, as these three countries have lacked the national resources to put into scientific developments that countries like Azerbaijan and Kazakhstan have had[4].

The shares of EU-funded publications have grown in all three countries, and in 2016 the EU was the most common source of funding in Ukraine and Moldova, and second after Russia in Belarus. In absolute terms, the shares are not too far off from the numbers in some EU member states from Eastern Europe. However, countries like Armenia have even higher shares (but to a considerable degree due to one single collaborative project, ATLAS). It is also remarkable that German-funded publications are very prominent, at levels not too far behind those of the EU and Russia. Finally, we should note the relatively high level of output that has received support from a combination of EU, Russian, and/or German funding.

In terms of co-authorship networks, there are no major changes in the ranking of top co-author countries for Belarus, Moldova, and Ukraine. The presence and prominence of co-authors from EU member states has been already quite high in 2000 and has improved further by 2016. The ranking of scientific subjects has been even more stable. It would appear that the three countries have built on their existing strengths during the period, and there are only a few examples of new scientific subjects breaking into the top ranks.

Overall, scientific cooperation with the EU and participation in EU projects has been essential to maintaining the levels of scientific productivity from the beginning of the 21st century, but it has not been enough to bring the three countries' scientific output to new and higher levels. We can only speculate what would have happened in the absence of cooperation with the EU. Some countries that have kept and maintained a greater distance from

[4] Kazakhstan's President announced in 2006 the intention to dramatically increase investment in scientific research and although the scale of investment has fallen short of the target, the amount of money going into science has grown quite substantively (see Schweitzer 2008). In Azerbaijan, the National Strategy for the Development of Science in the Republic of Azerbaijan 2009–2015 also set ambitious goals and increased domestic funding for scientific research (UNESCO 2015).

EU scientific cooperation programmes have been able to grow more strongly. Yet it is unlikely that these experiences would have been possible to emulate in Belarus, Moldova, and Ukraine, countries which do not have the national resources of Azerbaijan or Kazakhstan, or the strong pre-existing partnership networks of Armenia. The combination of a growing share of EU-funded publications with an overall stable or only slightly growing total output suggests that EU scientific cooperation, together with bilateral cooperation with Russia, Germany, and some other countries (and inclusion into mega-networks such as ATLAS) has provided a lifeline to science in the EaP region, helping it to avoid collapse in the tumultuous period after 2000.

3. Part II. Towards Assessing the Broader Impact of Scientific Cooperation

Bibliometric analysis of publication numbers, funding, and co-authorship patterns cannot capture all aspects of collaboration (Katz & Martin 1997) and, as a result, does not cover all dimensions of the impact. Arguably, co-publications and citations measure only the 'inside' quality of research, which reflects a "purely professional scientific view" of impact as "commonly assessed by professional peers" (Lawani 1986: 13) in the peer-review process. On the other hand, the 'outside' quality of research "addresses the impact of science and technology on society" and "is related to the concept of quality of life and considers the achievement of various goals—economic, social, political and strategic—as well as human interests and values" (Ibid.: 14). In other words, the impact of research is also understood as "the benefits that research outcomes produce for wider society" (Donovan 2011: 176). Purely scientific excellence might not go hand in hand with societal benefits (Lawani 1986: 14).

Obviously, different scientific disciplines can offer different kind of social benefits. Consequently, different tools have been developed to assess the social impact in different fields of research (Wolf et al. 2013: 106). Moreover, these tools are often flexible and leave a lot of room for interpretation of impact itself (Cohen et al. 2010: 581). It is impossible to use the same standards of assessment for political science as for medicine or engineering or agriculture. Even within a field of science, there are differences in the nature of the discipline that may affect knowledge utilization. For example, a study of Australian social scientists has shown that scholars conducting education research perceive the impact of their studies in terms of uptake by policy makers and/or practitioners as higher than scholars of political science and economics (Cherney at al. 2013). The explanation offered for the difference in perception of the usefulness of research is that education research is oriented towards schools and local authorities from the start and therefore has conducted targeted investigations. Another possible explanation is that in the case of political scientists and economists, the research results may point to solutions that are not feasible from the point of view of policy makers. Moreover, the results of the survey with Australian academics "point to some key lessons about research quality: It is not the key priority potentially driving research use, nor is it the single most important factor in determining uptake: contacts, communication, and timeliness also matter" (Cherney at al. 2013: 795).

3.1. Methodology and data

To address the issue of assessing the broader impact of scientist cooperation we opted for a qualitative approach. In an iterative way we (a) formed an expectation as to where and how to search for possible impact, (b) examined these expectations in interviews with experts from the field, (c) adjusted our expectation, and (d) subjected these expectations to evaluation by experts again. More formal approaches to assessing the broader impact of cooperation are possible, but there is a fundamental trade-off between breadth (scope of the evaluation) and precision. We have opted for a relatively broad and comprehensive evaluation that, however, remains by necessity unquantified and, in this sense, preliminary. We could have also relied on formal assessments of the societal impact of scientific projects from official reports, but these are not always public, come too soon to measure any real impact, and could have overestimated the impact as the researchers and other professionals writing these reports have incentives to exaggerate the likely impact. Therefore, given the state of knowledge and available data, we opted for a more exploratory approach grounded in qualitative, in-depth data rather than formalized and quantified indicators. In this way, we complement the systematic quantitative analysis presented in Part I of this paper, with insights from scholars and experts who have participated in the collaborative research projects.

To collect the data for the qualitative assessment, we conducted semi-structured interviews with researchers, experts, and project coordinators who have participated in the FP7 and H2020 programmes to get an idea about other dimensions of impact for scientific collaboration between the EU and EaP scholars. We were particularly interested in whether the EaP institutions gained experience in writing and managing the projects, whether the EU projects have shaped their research agendas, whether any long-term relationships between the Western and Eastern partners have been built, and whether there have been any broader implications of the projects for the industry and society. Although these interviews cannot systematically measure the scientific impact, they can capture a very important aspect, namely bottom-up insights about the role of the projects. Focusing on the perceptions and views of those who have a first-hand experience with the projects can deliver valuable information about how scholars assess the impact of the collaboration on the institutions involved and on broader society.

Moreover, by interviewing scholars and experts from the three EaP countries (Belarus, Moldova, and Ukraine) and scholars and coordinators from the EU countries, we are offering complementary Eastern and Western perspectives on the relevance and effects of international cooperation.

To sample the researchers for the interviews, we used the database compiled for the earlier working paper (Chulitskaya et al. 2017), which listed institutions that have participated in EU projects involving EaP partners. This database identified 376 projects in which one or more EaP countries were involved: 95 with Belarus[5], 75 with Moldova and 206 with Ukraine. To identify scholars for the interviews, from this list we have selected only H2020 and FP7 projects and chose approximately 25 projects per EaP country. In this selection, we included projects from as many disciplines as possible, taking into account that most of the projects are conducted in technical/hard sciences. As much as possible, we tried to approach participants from different types of institutions (public institutes and National Academies of Sciences, universities, and think tanks), which perform different roles in the projects (consortium members, sub-contractors etc.). We identified the names of project coordinators and searched for their email addresses using the CORDIS website and the projects' websites. We also used the snowball approach, i.e. we asked our respondents for recommendations regarding other potential interviewees.[6] In each country, we approached between 20 and 45 project coordinators and participants via

[5] Our interviews in Belarus revealed that apart from participating in European projects as a partner institution, Belarusian institutions often contribute to the projects as sub-contractors. This type of participation was not included in the number of projects in our database and it brings the number of collaborative projects up.

[6] In Belarus, at this stage, the recommendations that we got from National Contact Point for FP7 and Horizon2020 – Belarusian Institute of System Analysis and Information Support of Scientific and Technical Sphere (BELISSA) were extremely useful.

email or by phone. Many of the identified project coordinators have been involved in more than one project and were therefore contacted only once. For several of the project coordinators, contact email addresses and phone numbers were not available. Many persons contacted did not reply to the interview request and several replied negatively. In Belarus, the interviewees from the state institutions requested to see the official registration of EU-STRAT project with the appropriate state body[7]. Once presented with the registration document, it was relatively easy to get participants' consent for the interviews and the respondents agreed to talk, talked freely, expressed their own opinions, and made evaluations. Most of the interviews were conducted by phone (or Skype call), with the exception of Belarus, where the interviews were in most cases conducted face-to-face at locations convenient for the interviewees.

In total, we interviewed 37 participants in EU funded projects. The total duration of the interviews varied from approximately 15 to 60 minutes. We interviewed eleven participants in Belarus, ten in Moldova, and eight in Ukraine. These interviews provided insights into the role of institutions from these countries in the projects, their experience of the projects, and perceived impact on their institutions and societies. The interviews with the project participants from the EaP countries covered cooperation with Russia as well. We have also interviewed eight participants from the EU institutions who have collaborated with one or more institutions from the EaP countries. Many of the interviewees have had experience with multiple projects (for the list of projects in which our interviewees participated, see Appendix 1). These interviews present the view of the collaboration, information about the gains, barriers, and impact from the point of view of the EU scholars and coordinators. The questionnaires used for the semi-structured interviews are attached in Appendix 2.

3.2. Empirical results from the qualitative interviews: The perspectives of scholars from EaP institutions

The interviews provided us with a breadth of insights about the impact of scientific cooperation between the EU and EaP researchers. The answers of participants of the collaborative projects allowed us to draw a rather detailed picture of how they have experienced the process and how they see the influence of their work. The following sections present the results of the interviews in a systematic manner. We have grouped the answers into overarching themes that inform us about: (1) the impact of the projects on the participating institutions and their employees; (2) the broader relevance of the projects for the scientific community, society, economy, and policy; (3) the influence of the projects on the attitudes towards the EU and understanding of the EU values and rules; (4) interpersonal dynamics, barriers and problems that participants experienced in these projects; and (5) the most important scientific cooperation partners, scientific cooperation with Russia and plans for further collaboration within the EU projects. These categories of themes emerged from the direct questions that we have asked (in other words, we intended to cover this range of issues), but they also include additional spontaneous comments provided by the interviewees. We discuss these themes country by country and provide a comparative summary in the concluding section of Part II.

[7] Projects that receive foreign support need to be registered with the State Committee on Science and Technology of the Republic of Belarus.

3.2.1. Belarus

Impact of scientific cooperation with the EU and its member states on scientific and managerial capacity of the Belarusian institutes and their employees

Belarusian participants of the collaborative projects emphasized several aspects of how the projects had affected their organizations. A common aspect mentioned in the interviews is the development of a network of contacts within the scientific community and with companies in Belarus and in Europe. One of the interviewees spoke about the impact of these projects on the socialization of young Belarusian scholars into the scientific community and several others mentioned access to state of the art knowledge in their disciplines, new methodologies, and procedures of research. Most of the interviewees agreed that the participation in the collaborative projects has had some impact on the use of methodology in research (or at least that an exchange of methods occurred.) Others talked about management experience and experience with event organization. Integration with other project teams demanded a consolidation of practices and put them in touch with specialists from bordering disciplines (for example, researchers doing fundamental research came in contact with engineers). Interviewees have also emphasized the importance of personal professional development thanks to the possibility of working with and learning from colleagues and experts.

Access to resources is perceived as having had the most obvious and significant impact on the institutions as well. The interviewees noted that funding coming from the collaborative projects allowed them to diversify the sources of funding of their organizations, pay salaries to employees, and purchase equipment and software.

In terms of the impact of joint projects on planning and management practices, the majority of interviewees admitted that to at least some extent they have borrowed some practices such as financial reporting, communication strategies, and time-management from their project partners. A couple of interviewees noted that they already had strict guidelines and rules in their organizations and that working according to EU standards sometimes contradicted national organizational culture and understanding of rules, including financial ones.

Regarding issues related to ethics and data management rules, half of the interviewees reported that they became aware of them, especially in the sphere of intellectual property. Only two of the interviewees, however, explicitly mentioned applying these rules in their organizational practice after the projects were completed. Others said they did not have any special ethics procedures or rules in the project.

Finally, according to the researchers interviewed, collaboration with EU projects improved the reputation and visibility of their institutes. A positive evaluation of the institutes by European partners gave them a competitive advantage. Moreover, one of the interviewees mentioned that his/her organization had learned that it was not inferior in terms of quality in comparison to the Baltic states. This organizational self-confidence can be seen as an unintended positive consequence of participation in the European projects.

Relevance of the projects and impact on scientific community, society, economy, and policy

Most of the interviewees see the relevance of the research themes in terms of scientific development of their country and they talked about the knowledge export and modernization of knowledge. However, they were more sceptical about the social and economic relevance of the projects, although this varied depending on the type of project. One of the interviewees noted that the improvement of the analytical competences of their organization led to better quality advice in the sphere of public policy and more adequate recommendations for political authorities. Other projects were more relevant purely for scientific development, because they tackled fundamental research questions. Others had direct practical application, for example, in the ICT field. This is also reflected in the opportunities to create or work with companies: several interviewees mentioned that companies were part of the consortia and collaboration was one of the goals of the projects. Others mentioned the potential use of the results by industry. One participant mentioned that although their project did not lead directly to cooperation with industry, people who participate in European projects can more easily find employment in business.

The relevance of the projects for the scientific community specifically seems to be appreciated more by the participants. They referred to results such as increased scientific capacity and quality, access to data, opening of new perspectives, professional growth of individual academics, and creation of islands of scientific excellence in Belarus. They stressed that local partners are perceived as equal scientific partners rather than 'third-world country' partners. Two critical comments about the impact of projects on the scientific community referred to the unequal opportunities for scholars. According to these respondents, university administrations support hard sciences more actively and in addition, Belarus is not a full member of H2020 and therefore mainly has access to mobility projects, rather than research.

A number of interviewees did not see the relevance of the projects for Belarus, either due to lack of interest on the side of the EU in Belarusian research, or to lack of implementation of European practices in Belarusian universities. Moreover, opinions about the policy impact of these projects seem to be divided. In a couple of sectors such as science policy and IT policy interviewees noted a modest change. Others said that the joint projects could have some influence because of good contacts with the authorities and membership in the National Academy of Sciences, as well as the professional reputation they had gained due to their participation in the EU projects. The other interviewees did not see or did not concern themselves with influencing policy at all.

Influence on attitudes towards the EU and on understanding of EU values

Discussing the effects of international collaboration on changing attitudes towards the EU and on understanding of EU values is seen as a sensitive topic. Only six out of eleven interviewees provided an answer to the question, while five of them did not give a response or avoided answering. Those who answered the question believed that an attitude change was visible among participants of the projects who were exposed to contacts and communication with scholars from the EU. They also got a better understanding of the European organizational culture, bureaucratic requirements, and research policy.

A couple of respondents noted that there is a limited change in attitudes and understanding of the EU among policy makers, who have slowly started to open up towards the EU. One respondent emphasized the change within the National Academy of Sciences, where the institutes that collaborate with the EU have become more open and progressive. Through this channel the information about the EU projects reaches policy makers and potentially can even have influence on regional authorities who are ready to acquire new information. However, scepticism about the policy and broader social influence seems to prevail. As one of the interviewees put it, the situation (regarding a shift of attitudes in society) could change, if there was an understanding of the necessity of cooperation with the EU on the side of the state. Moreover, a couple of respondents also said that the research community in the country was too small to influence the attitudes and values of the broader public. An alternative view presented by one of the interviewees, in line with the official stance on the issue, is that Belarus already follows European values and the EU projects can only contribute to spreading democratic values further as common values.

Interpersonal dynamics, barriers and problems

Interviewees emphasized the importance of communication and the challenges of developing an efficient communication style with other project partners. They have observed that interpersonal communication helps to correct nationalistic stereotypes. Professionalism, discipline, and mutual respect were considered important to achieve this. One respondent appreciated the professional communication within EU projects and considered it a very good practice that was very easy to get used to. She/he also observed that this type of communication is not common within public institutes and among officials in Belarus. The interviewees talked about the importance of face-to-face meetings and personal connections, too. One interviewee had the experience that it is easier to communicate with Central and Eastern European partners than with Western European partners (in particular, German ones), who were less flexible in the matter of meeting deadlines and, in his/her view did not understand that the quality of research is more important than the deadlines. In general, however, the communication, although challenging, was assessed as good.

One aspect that was mentioned by two interviewees as part of the discussion of interpersonal dynamics was the inequality in payments and budget allocations between the EU and EaP partners and a lack of transparency in contract negotiations and allocation of funds. They underlined the lack of Belarusian national funding for research in comparison with other EaP countries and Russia.

The interviewees identified many barriers and problems regarding participation in the collaborative projects. The most common answers included the language barrier, the apathy of the Belarusian scientists who did not wish, or were unable, to step outside their comfort zone (and as a result often lagged behind in terms of methodological and conceptual training), and the absence of support for applications for international projects from the Belarusian authorities and universities. Insufficient methodological and analytical skills of Belarusian academics and researchers were also named as a barrier to participation in EU projects.

The interviewees emphasized that to apply for EU projects, organizations needed to have ample resources as well as competitive scientific portfolios. However, since the funding for science and the salaries of academic staff are very limited and their administration is more oriented towards status quo preservation, Belarusian institutions do not get a chance to develop their scientific portfolio. Social sciences are in a particularly bad situation as they are not supported by the state and receive less administrative support at the university level compared to disciplines such as mathematics and physics. One of the interviewees portrayed it as a vicious circle: institutions need to have a solid scientific portfolio to be considered for the EU projects, but it is difficult to develop such a portfolio without being a part of these projects.

The international isolation of Belarus was also recognized as an obstacle in realization of cooperative projects. Nevertheless, one of the interviewees blamed the EU for only caring about securing its borders rather than other aspects of cooperation with Belarus and for being concerned mainly with Ukraine.

Another common barrier seems to also be the fact that institutions in Belarus cannot simply propose a project to the EU, but rather they have to be found by the EU partners and invited to collaborate. This limits their freedom in developing projects, but also their chances of becoming a part of a collaborative project. Moreover, institutions from Belarus sometimes participated in the EU projects as contractors rather than members of the consortia. Although they received the funding, they were not in the spotlight and their institution did not get international recognition. Nevertheless, all the scholars interviewed would like to participate in, and several are actively trying to become a part of, EU projects in the future, despite their often very limited resources.

Scientific cooperation: EU and/or Russia?

Most of the institutions represented by the interviewed scholars have participated in collaborative projects with Russian scholars. In the majority of cases, cooperation with other EaP countries happens within EU or other Western projects. Two interviewees mentioned that they had found EaP partners for cooperation within EU projects. Almost half of the interviewees did not reply to the question on which countries are the most important for their organization in terms of scientific cooperation. Two interviewees named Russia as the most important partner and one of them elaborated that this is because of their common history, economy, and existing instruments of cooperation. The increase in collaboration with Russia, however, was explained as a result of the deadlock in relations with Germany and Poland, who used to be Belarus' most important partners for bilateral cooperation within the EU. Two other interviewees believed that the EU and the West are the most important partners, one thought that although Russia is their most frequent partner, the EU is the most attractive for young scientists, and one put an equal emphasis on both the EU and Russia and Eurasian countries.

3.2.2. Moldova

Impact of scientific cooperation with the EU and its member states on scientific and managerial capacity of the Moldovan institutes and their employees

All the interviewees were very positive about the effects of participation in EU projects. They all emphasized the importance of the new contacts that they established through participation in these projects, the exchange of knowledge, experience, and methodologies, and more generally, the integration of their institutions into global research networks. Many appreciated the possibility to learn about new technologies and methods and one interviewee pointed out that being a part of the EU projects has helped them to reflect on the strengths and weaknesses of Moldovan research. Several of our respondents emphasized that the projects had long-term effects on their institutions as they initiated ongoing scientific cooperation at both a national and international level.

The interviewees were almost unanimous in their opinion that participation in the EU projects has had an influence on their method of work. Three interviewees mentioned very specific methods that they encountered and learned about, such as digital processing in holographic microscopy, automated calculation of the comparative advantage in exports with the help of international platforms, and complex macroeconomic analysis. Others also pointed out that the management of the projects, financial reporting, and time-management were new to them and different from what they were used to. In terms of planning and management, the interviewees noted that the system of setting up and conducting research projects in Moldova is different than in the EU and that they have adopted practices that enhanced the quality of their work. They learned about new, goal-oriented strategies and approaches to work. Although different projects demand different management strategies, in general the interviewees valued the experience they had gained and said they would use it when planning and managing future projects. Even where planning and management was centralized, as in the case of one of the projects that was coordinated from Paris, it was appreciated that the coordinators discussed each step of the project with the partners and valued the opinion of the Moldovan partners. One interviewee said that the project had changed his/her whole life in terms of style of work, methods, speed, communication with the supervisors, and full commitment to scientific research.

Regarding the issues of ethics and data management rules, the interviewees mentioned that they are integral part of the EU projects, so they have followed them. Moreover, although researchers are not required to follow these rules in Moldova, they try to continue implementing them in their own activities as much as possible. The aspects of ethics and good practice that several interviewees highlighted as having influenced their institutions were the policy of open access of publications, other results of the projects, gender equality and balance within the projects, and data collection (in particular the handling of survey data).

Most of the projects involved academic cooperation and were not oriented towards building links with businesses. Several of the interviewees, however, mentioned that they have developed contacts with the state industries, local companies, and NGOs. One respondent had experienced interest from foreign companies. To what extent the projects have an impact on the links with companies seems to be highly dependent on the type and goals of each project.

Relevance of the projects and impact on scientific community, society, economy, and policy

The interviewees agreed that scientific cooperation with the EU is very relevant for the scientific development of Moldova. Almost all of them emphasized that the possibility of being a part of the international research community allowed them to present their work to large scientific audiences, discuss research topics that are globally relevant, find new directions for their research, and increase their didactic and scientific potential. As a result of collaboration, courses for students were organized and the institutes were capable of attracting young people. One interviewee mentioned that as a result of the project, new laboratories were opened, facilitating research on the same level as that of the EU partners. Others talked about the improved publication record of their institutes. It seems also that exact sciences experienced more impact from EU projects than social sciences.

In terms of impact on society and the economy, the views are much more divided. Half of the interviewees thought the projects they worked on were relevant to social development and half thought that they were relevant to the development of key sectors of the economy. This seems to reflect once again that different projects can both set and achieve different goals with priority still being given to the development of the scientific community.

The interviewees were relatively positive about the relevance of their projects for policies and impact they have on the policy-making. Although a couple of them mentioned that long-term effects are still to come, several had contacts with various ministries and the Academy of Sciences. Some noted that they had influenced reforms in the agricultural and educational sector, and cooperated with the Ministry for Information Technologies on the development of the 'digital single market'. Only one interviewee was negative about the cooperation with the state authorities because of their politics and bureaucracy. Nevertheless, the researchers from Moldova in general seem to be very active when it comes to participation in round tables, cooperation with different ministries, and contacts with authorities on the regional level.

Influence on attitudes towards the EU and on understanding of EU values

All of our respondents agreed that participation in the EU programmes translated into a broader change in understanding of European values in the scientific community. Values were considered the most important unifying factor for scientific activity. Some also saw a positive change in the attitudes and understanding among policy makers and within society. One interviewee emphasized that Moldova belongs to the European culture and that European values are not foreign to Moldovan society. Another noted that their institution had an opportunity to communicate the results of projects to broader audiences on TV and in publications. Others, however, emphasized that society should have better access to information about the projects and European funding. In general though, it is difficult to assess the influence on attitudes towards the EU and understanding of the EU values on the basis of our Moldovan interviews. It is clear that the researchers appreciated the EU for giving them the opportunity to work on the collaborative projects, but it is not clear to what extent these projects were able to make policy makers and society appreciate and understand the EU as well.

Interpersonal dynamics, barriers and problems

The comments about interpersonal dynamics were mainly positive. The interviewees appreciated finding new contacts and coming together for events and conferences, and some even said that they have built a very strong team that felt like family. Within one of the projects, participants made sure that conferences were attended by different staff every time, so everyone had a chance to experience them. Our respondents did, however, identify a couple of problems. One of the interviewees mentioned that initially the partners did not trust their institution and it took time to improve their image. Another one said that the communication was difficult as the level of partners varied and each had their own vision of the project. They also talked about the difference in values and priorities, which caused some tension within the projects and required synchronization.

There were several problems of financial nature mentioned by the interviewees. One of them was the domestic system of managing research funding. In Moldova, all the funding goes to the institutes that participate in the projects through the Academy of Sciences. This complicates the process of the distribution of resources, creates delays in the receipt of funding, and causes problems with the timely realization of project tasks. The other problem was the inequality of pay for the partners from Moldova and the EU countries. More specifically, one of the interviewees pointed out that the salary for the function of a coordinator in Moldova is lower than for an ordinary employee in an EU member state.

The interviewees also identified structural obstacles to participation in the programmes for academic mobility and scientific cooperation with the EU. The scientific community of Moldova is very conservative, and according to our interviewees, it lags behind the Western community in many respects. The selection of cadres for participation in the projects was perceived as unfair. Another problem observed by the interviewees was the aging staff at the research institutes and an absence of young talented researchers to replace them. Also the language barrier was mentioned. Finally, lack of resources remained a serious obstacle. It prevented Moldovan scholars from participating in international conferences that are crucial for building networks, which can eventually lead to cooperation. The lack of resources also affects the situation of the researchers, who earn low salaries and are often forced to work in multiple institutes at the same time to survive. This leaves them with little time to write a project proposal or to actually participate in a project.

Scientific cooperation: EU and/or Russia?

Several interviewees or their institutes have experience in cooperating with Russia. In particular, they have cooperated within the EUinDepth project, Air-Q-GOV project, and are planning to submit proposals for the ERA.Net RUS Plus programme (FP7 framework). Others have mentioned laboratory collaboration and common workshops. One interviewee said that they used to have three projects with Russian institutions until 2009, but since then they have not cooperated with them. Moldovan institutes have also cooperated with all of the other EaP countries. Some of the collaborative work was conducted on a bilateral basis, but these countries cooperated mostly within the projects sponsored by the European Commission (e.g. AGRICIS TRADE, Air-Q-GOV, and Eastern Partnership Connect).

The interviewees see European countries as their main partners for scientific collaboration. Romania, Poland, Germany, and France were named most often as important partners for Moldovan institutions. From outside of the EU, Ukraine and Japan were also on the list. A couple of the interviewees emphasized that it is important to find the right partners for the field of cooperation and it does not matter much from which EU country they come.

All but one interviewee stated that they are planning to participate in the EU projects in the future, as they provide them with good experience, new ideas and approaches, and additional funding.

3.2.3. Ukraine

Impact of scientific cooperation with the EU and its member states on scientific and managerial capacity of the Ukrainian institutes and their employees

Ukrainian scholars who have responded to our request for an interview listed two main ways in which collaboration in the EU projects impacted their institutions. An essential impact of these projects was access to funding that is available for the institutes and their employees. Several interviewees emphasized that local funding is scarce and that therefore the EU projects are important as they allow for the purchase of equipment and support salaries. Moreover, interviewees noted that cooperation has positive effects on the scientific capacity of the institute, as scholars can update and exchange knowledge, work on actual tasks that lead to real results, and participate in conferences.

The method of work has not been affected very much by participation in EU projects, although a couple of interviewees noted the heavy bureaucratic strain of the projects: the strict system of control, and full agenda. One respondent said that their method of work was affected due to the extent that it was necessary to get to grips with European bureaucracy, which in their words, is at times worse than the Soviet one.

In terms of the impact of the projects on planning and management practices, the majority of interviewees (seven out of eight) had learned and adopted some new practices. This was possible due to communication with partners and the necessity of ensuring the smooth running of the projects. One of the interviewees noted that they experienced the EU as having a very bureaucratic system and strict schedules, within which every moment was planned in advance. An interviewee who had experience with projects within each EU framework (FP6, FP7, and H2020) was most critical of the EU projects planning and management system. On the basis of his/her experience with project management gained in the U.S., he/she believes that the EU framework projects are seriously behind the American ones and suggested that it is due to a principally wrong approach to project organization.

Half of the respondents reported that they have become more conscious of the issues related to ethics and data management rules. A couple of the interviewees said that their practices related to the ethics and data management were not far from those required within the EU projects and a couple of them suggested they did not learn anything new.

Most of the respondents mentioned that they are either already cooperating with companies or planning to do so, so it seems that participation in the EU projects can facilitate contacts with business. This is, however, not a priority for all project participants: for example, one interviewee stated that the question of business is not at the forefront of their activities as they are a university.

Relevance of the projects and impact on scientific community, society, economy, and policy

Most of the interviewees thought that the EU projects were relevant for the development of the scientific community in Ukraine. One of the positive effects was that international scholars became familiar with the work of Ukrainian researchers. Cooperation also positively influenced specialization and strengthened scientific potential. Moreover, these projects were relevant as they introduced new materials, new ideas, and new technologies, which resulted in new patents.

In terms of social relevance, only three of eight interviewees recognized it as being valid but they did not specify exactly how the projects were relevant to society. The majority was much more sceptical and usually responded negatively or expressed doubt in social relevance.

The interviewees were more positive about the impact of EU scientific collaboration projects on the development of key sectors of the economy. Five of the respondents thought that the projects were relevant and two of them specified that their projects involved work for Ukrainian industry and could be relevant at least for the regional economies.

Influence on attitudes towards the EU and on understanding of EU values

All of the interviewees agreed that scientific collaboration within the EU projects improved the attitudes towards the EU and enhanced mutual understanding within the scientific community. They saw these projects as part of deep changes occurring among scientists in Ukraine and believe that cooperation enriched both sides. One of the interviewees mentioned that actually the attitudes towards Europe within the scientific community were already quite positive and when they were enhanced with financial support, they became even better. Another interviewee said that it is important for the scientific community to see that Europe supports them.

Scientific influence on the attitudes of policy makers toward the EU was not perceived as high. Several respondents did not know how to evaluate it, others were critical about the understanding of the importance of scientific research by policy makers in Ukraine. One of the interviewees mentioned that in the past there used to be more interest from policy makers in scientific research and that this has recently diminished. Another respondent expressed similar views and stated that politicians did not care about natural sciences. However, one EU project participant said that it is possible that on the local level politicians' attitudes towards the EU are to some extent influenced by the projects.

Regarding the influence on attitudes toward the EU of the broader society, the answers were mixed. Four of the respondents were sceptical about this for different reasons. The projects did not get enough attention in the press and did not reach a broader audience in the first place. In addition, there were not many projects and their results were so specific that they did not reach broader society nor influence their understanding of the EU. One of the scholars pointed to the fundamental values of research, regardless of where the researcher is based. Regardless of whether research is conducted in Europe or in Ukraine, one scholar emphasized that either science is based on an objective and honest approach, or it is not science. According to this scholar, science does not have any other values besides objective truth and ethics.

Interpersonal dynamics, barriers and problems

On the level of interpersonal relations, most interviewees expressed rather positive experiences. They have appreciated the personal contacts established during the projects that have survived beyond the projects' duration. Moreover, they thought that cooperation enriched both parties involved, created friendly relations, and stimulated new plans and ideas. Sometimes, the issue of language made collaboration more difficult, but did not necessarily cause interpersonal tensions. Others noted that the communication was strict, which was linked to the desire to reach the set goals. One of the interviewees appreciated the goal-oriented approach of collaborative projects and suggested that the interpersonal relations should be connected to specific project tasks. The picture that emerges from the interviewees is that communication is sometimes difficult, but in general friendly and aimed at getting things done.

Several important barriers and problems with participation were listed by the interviewees. One fundamental one, mentioned by two scholars with extensive experience with international collaboration, is the lack of interest from the Ukrainian authorities in science and lack of support at the ministerial level. As long as the authorities do not see science as useful and do not stimulate research, cooperation with the EU will be limited, researchers pointed out. Another interviewee also noted problems with discrepancies in legal regulations regarding the projects.

The low financial and research capacity of the Ukrainian institutes limits possibilities to participate in the projects. They lack funds to purchase modern equipment and to travel abroad for their research. This is perceived as a serious barrier and makes the Ukrainian scholars less competitive and less attractive for partners from the EU. At the same time, research technologies and information are becoming more expensive and less available to the Ukrainian scientists.

The interviewees also mentioned the problem of language training and lack of experience and support with writing high quality research proposals that have a chance of being accepted. The high bureaucratization of EU funding constitutes a real barrier. Moreover, the lack of links and exchanges between the separate projects is seen as an obstacle to scientific development. One of the interviewees observed that so far the approach of the EU towards Ukraine resembles that towards a country from 'the Third World'.

The interviewees did not observe a large-scale brain-drain as a result of the EU projects. One interviewee noted that even if more Ukrainians left their country to work abroad it was very unlikely that it was caused by international collaboration. They believed that the main reason for Ukrainian scholars to leave was the unbearable conditions created by the Ukrainian political authorities.

Scientific cooperation: EU and/or Russia?

Regarding scientific cooperation with Russia, five out of eight interviewees told us that their institution has in one way or another collaborated with Russian institutes. This collaboration, however, was rather limited with the exception of space research and mostly ended after the political events in 2014. The majority of the respondents also mentioned cooperation with other EaP countries, including projects with Belarus, Georgia, Moldova, and Azerbaijan. Many of them cooperated within the framework of EU projects. All of our interviewees named the EU member states as the most important partner countries to them and their organizations in terms of scientific cooperation. A couple mentioned the U.S. and one also mentioned Russia. In addition, there has been collaboration with fast developing countries such as Iran and China. One interviewee emphasized their institution's good relations with neighbouring countries – Poland, Romania, and Lithuania. France and Germany were also named by several interviewees.

All interviewees expressed their intention to participate in future H2020 projects. They see it as the only opportunity to get funding for science, to travel abroad for research, and to purchase equipment. They also noted, however, that the competition for participation in these projects is fierce.

3.3. Empirical results from the qualitative interviews: The perspectives of scholars from institutions in EU member states

The interviewees from the EU institutions were asked to reflect about the role of Eastern partners in the collaborative projects that they have participated in.

Setting up of the projects and recruitment of partners

The responses showed that Eastern partners who have participated in the projects had different scope and degree of involvement in the projects. In some, they were only involved in the implementation of the projects, in others they had managerial functions and led work on particular work packages. In most cases, they were not involved in the drafting of proposals. Nevertheless, one interviewee with experience in a large number of projects, who has been involved in setting up and managing EU projects for many years, observed that the involvement of the Eastern partners at the initial stages of planning and drafting of the project proposals increased over time. Moreover, it was mentioned that there are 'pockets of excellence' in the EaP region that can develop project proposals, know well how to draft them, and are even better at it than many European institutes. One case which was highlighted as exceptional is the National Aerospace University of Ukraine in Kharkiv. Other teams (including ones from Belarus) were mentioned as excellent in terms of providing valuable research input.

The most common way of recruiting partners for the projects is through an already existing network. Several interviewees noted that they have collaborated with their Eastern partners for a long time before these projects. Other ways of finding partners are through an Internet search, a call for application, or through a particular institution that works in the field (e.g. the Black Sea Commission).

Impact on the Eastern Partners

In terms of how the interviewed scholars from *Western* institutions perceive the impact of the EU projects on the Eastern partners, there were several common answers focusing on the benefits and obstacles to cooperation. One answer stressed by several respondents referred to the possibility for the Eastern partners to get access to resources. Eastern institutes are often underfunded and there is no sufficient financial support for their work from the side of the government and businesses. Interviewees talked about the EU money as helping the Eastern institutions to survive and upgrade their outdated equipment. One of the interviewees mentioned that funding not only increased the capacity of an institution in terms of research and technologies but also positively influenced the atmosphere in which the employees of this institution worked. A couple of interviewees also mentioned the organization of training events and workshops in both the EU and EaP countries. One mentioned twinning projects in which EU and EaP institutes were paired, and the researchers travelled to spend time at each other's institutes. One project in particular used a strategy referred to as benchmarking, in which experts were sent to the institutes in the EaP countries and they assessed the institute to see what could be improved in its functioning. The benchmarking has been accepted by Belarus and Moldova, but not by Ukraine. The impact of this strategy, however, is not yet possible to assess.

Apart from the financial aspect, another form of impact on the institutes is the shaping of their research agenda, resulting in the possibility to participate in more EU projects in the future. Collaboration with the EU partners also increased the awareness of the importance of scientific publications and the projects improved the publication record of the institutes from the EaP countries.

Transfer of technology has not been common according to the Western interviewees and, naturally, it is dependent on the objectives of a project. In one case, it was the Ukrainian institution that provided the technology to complete the project. Moreover, in this particular project, an impact on the Ukrainian economy can be expected, as it will result in demand for fuel that will be delivered by Ukraine.

Interviewees often struggled to assess the broader impact of the projects. In a couple of cases this is because the projects are ongoing, so the results are not yet available. Others mentioned media interest and the possibility of communicating the results to larger audiences. As expressed by one of our interviewees, one of the reasons for problems with assessing the impact is the nature of scientific work, which is a long chain of steps that add to the body of knowledge. As they mentioned, even multi-million projects follow the same logic—one step at a time. Therefore, the impact on society is often unpredictable and takes a very long time to be implemented (examples included the use of nano-particles in oncological therapy and environmental research).

In terms of a brain-drain—one potential negative effect on society—the interviewees did not observe it. Most researchers mentioned exchanges and participation in mobility programmes and workshops, but no permanent exit from local institutions.

The policy impact was mostly perceived as non-existent. A couple of interviewees mentioned a potential for influencing policy change, rather than actual change. For example, Georgian researchers are trying to implement their findings and ideas about CO2 emissions, and Moldovan partners are required by the project leaders to at least inform the relevant ministries about the interesting results of their research on water management. One of the interviewees also emphasized that it is not the role of the scientific community but of the European institutions to influence politicians.

Barriers and problems

There are several commonly mentioned problems that collaborators from the EU institutions noted. On the side of the EU, most of our interviewees emphasized the complexity and abundance of legal and financial rules and administrative requirements for the EU projects, which are difficult not only for the Eastern partners, but also for partners in EU countries. Many of the partners in the EaP countries do not have enough resources to cope with the heavy load of paperwork demanded by the EU projects. The difficulty is to some extent moderated by experience with these types of projects, but the high share of bureaucratic requirements seems to be a problem of its own. The issues with obtaining visas had a negative impact on the mobility of scholars. Scholars from Ukraine in particular had experienced obstacles in travelling to their partners in the EU. Entry to Belarus had been a problem for EU researchers. The more experienced interviewees mentioned that this has to some extent improved over time.

Other barriers mentioned by the interviewees were the communication issues in terms of language (especially older staff did not have a sufficient level of English proficiency) and more closed cultures that sometimes made it difficult to get things done. Our interviewees from the EU also mentioned the difficulty in finding information about partners, specifically because of their limited online presence. This included institutional websites that were often not well developed and not available in English.

3.4. Conclusion of Part II

Overall, the picture that emerges from the interviews, both in the East and in the West, is one that portrays scientific cooperation between the EU and the EaP countries in a very positive light, with many welcome developments spurred on by participation in joint projects. The benefits, as perceived by the Eastern partners, conform with prior expectations – access to funding, participation in networks, advancement in research methodology, opportunities for the mobility of researchers, some transfer of technologies and (administrative) know-how. Therefore, the impact of the cooperation within the EU projects on participating institutions and on scientific community in the three countries is significant and positive. Moreover, the EU and its member states are considered the most important partners for scientific cooperation. From the perspective of Western partners, the participation of institutions from the EaP countries is also seen as a success, and the quality of the scientific contributions by the EaP partners is widely agreed upon, which also translated into willingness to work together in the future.

At the same time, we find less evidence of broader societal impact or direct effects on public policies. Partly, this can be accounted for by the type of research projects that have been conducted: mainly fundamental science (prevailingly hard science disciplines), compared to only a few projects with explicit policy objectives (other than supporting science policies in the EaP countries) and direct societal relevance. From our interviews it became apparent that societal and policy impact can be expected only from very specific research projects. As far as rules and values of scientific research can be transmitted to EaP scientific communities through collaboration in any discipline, transmission of values such as democracy, rules of law, or human rights to societies and authorities seems highly unlikely to be achieved by projects focusing on physics or chemistry. Moreover, as noted by one of our interviewees, the nature of scientific endeavour is such that one piece of research rarely brings about ground-breaking results that can have grand societal and policy impact. Hopefully, over time, more of the positive effects of scientific collaboration will become apparent. For now, it is fair to say that the impact of scientific collaboration beyond the scientific community itself is perceived as minimal.

Some of the expected negative effects of scientific cooperation with the EU did not seem to be very salient. The suspected brain-drain of qualified scientists from EaP countries to the West as a direct result of participation in joint projects was not confirmed by our interviews. This could be attributed to a variety of reasons, ranging from the advanced age of many of the project participants to the family commitments of the young scientists. The administrative burden of applying for and participating in EU-funded projects, however, was often mentioned as an obstacle to scientific cooperation.

What appears to be an unanticipated effect of scientific cooperation, one that became especially visible after a decade of intensifying cooperation, is the emergence of organizational 'islands of excellence' in the EaP countries. Some organizations have the requisite expertise and increasing experience in participating in EU-funded projects, and therefore become natural partners for further collaboration. While the accumulation of expertise and experience in certain institutions is not a problem in itself, it should not remain too concentrated in a handful of institutions that become gate-keepers to collaboration. Ideally, participation in EU projects should spread out beyond the few already established 'islands of excellence'. Otherwise, over time it will get only more difficult for newer organizations to find a way into the scientific cooperation networks and projects.

4. Overall Conclusion

In this paper, we set out to assess the impact of scientific cooperation with the EU on (1) scientific productivity measured through publication output and (2) the scientific community itself and the broader society in Belarus, Moldova, and Ukraine.

The results of the bibliometric analysis that addressed our first set of goals indicate that the EU is, as of 2016, the most important source of external funding for science in Moldova and Ukraine, and a very close second to Russia in Belarus. But in relative terms the importance of EU collaborations has not increased dramatically over the past 17 years, even though the institutional basis for cooperation has been significantly upgraded through association with FP7 (by Moldova) and H2020 (by Moldova and Ukraine), as well as other initiatives. So while international collaborations have grown in importance for the EaP countries, the effects are more along the lines of substitution of other resources which are no longer available, rather than providing additional resources. For this reason, we did not observe massive expansion of scientific output. It is possible, however, that the major effects of participation on publication output are yet to be seen.

Some possible reasons for the substantial, but less than revolutionary, impact of cooperation with the EU on the publication output of the partner countries from the East were suggested in the interviews conducted to address our second set of goals. For example, partners from the EaP countries often did not participate in scientific cooperation projects as full participants, but rather as contracted parties. In many cases, this precluded them from co-authorship of the scientific output, even though they had contributed to the research process. Furthermore, many of the EU-funded projects have resulted in valuable deliverables and innovations, which, however, are not always published in scientific journals. So in this sense, looking at joint and co-funded publications may underestimate the impact of cooperation.

Our interview respondents suggested that the broad societal impact of scientific cooperation and the projects they have been involved in has been low, so far. There is limited evidence of the effects of their findings on societies and public policies in the three EaP countries, although researchers in Moldova were more positive about the impact on policy makers than the researchers in Ukraine and Belarus. It remains possible that scientific cooperation works as an instrument of diplomacy and socialization beyond the borders of scientific communities. More importantly, as noted by almost all interview respondents, scientific cooperation in EU-funded projects helped them and their organizations preserve organizational capacity, establish long lasting scientific networks of cooperation and keep up with developments in their fields. These are important elements of impact which should not be disregarded, even as we continue our investigation of the effects of scientific cooperation.

5. References

Aria, M. and Cuccurullo, C. (2016) 'bibliometrix: a R tool for comprehensive bibliometric analysis of scientific literature,' *Scientometrics* 1: 1-17.

Bandyopadhyay, A. K. (2001) 'Authorship pattern in different disciplines', *Annals of Library of Information Studies* 48(4): 139-147.

Bote, G., Vicente, P., Olmeda-Gómez, C. and Moya-Anegón, F. (2013) 'Quantifying the benefits of international scientific collaboration', *Journal of the American Society for Information Science and Technology* 64(2): 392-404.

Cherney, A., Head, B., Boreham, P., Povey, J. and Ferguson, M. (2013) 'Research utilization in the social sciences: A comparison of five academic disciplines in Australia', *Science Communication* 35(6): 780-809.

Chulitskaya, T., Mazepus, H., Ramasheuskaya, I. and Toshkov, D. (2017) 'Science Policies and International Cooperation in the Eastern Neighbourhood of the European Union: An Overview', *EU-STRAT Working Paper no. 2*, Berlin: Freie Universität Berlin.

Cohen, M. Z., Alexander, G. L., Wyman, J. F., Fahrenwald, N. L., Porock, D., Wurzbach, M. E., Rawl, S. M. and Conn, V. S. (2010) 'Scientific impact: Opportunity and necessity', *Western Journal of Nursing Research* 32(5): 578-590.

Donovan, C. (2011) 'State of the art in assessing research impact: introduction to a special issue', *Research Evaluation* 20(3): 175-179.

Georghiou, L. (1998) 'Global cooperation in research', *Research Policy* 27: 611–626.

Glänzel, W., Schubert, A.and Czerwon, H. J. (1999) 'A bibliometric analysis of international scientific cooperation of the European Union (1985–1995)', *Scientometrics* 45(2): 185-202.

International Cooperation Network for Eastern Partnership Countries (IncoNET EaP) (2016) 'Bibliometric Analysis of the Eastern Partnership Countries' International Co-publication Output', available at http://www.inco-eap.net/_media/IncoNet%20EaP_D%202%202_fin.pdf (accessed 16 November 2016).

Jonkers, K.and Cruz-Castro, L. (2013) 'Research upon return: The effect of international mobility on scientific ties, production and impact', *Research Policy* 42(8): 1366-1377.

Katz, J. S.and Martin, B. R. (1997) 'What is research collaboration?', *Research Policy* 26(1): 1-18.
Lawani, S. (1986) 'Some bibliometric correlates of quality in scientific research' *Scientometrics* 9(1-2): 13-25.

Leimu, R.and Koricheva, J. (2005a) 'What determines the citation frequency of ecological papers?', *Trends in Ecology & Evolution* 20(1): 28-32

Leimu, R. and Koricheva, J. (2005b) 'Does scientific collaboration increase the impact of ecological articles?' *BioScience* 55(5): 438-443.

Marshakova-Shaikevich, I. (2006) 'Scientific collaboration of new 10 EU countries in the field of social sciences' *Information Processing and Management* 42: 1592–1598.

Schweitzer, G. (2008) 'Science Policy in Kazakhstan' *Science* 322(5907): 1474-1475.
UNESCO (2015) 'UNESCO Science Report. Towards 2030', Paris: United Nations Educational, Scientific and Cultural Organization.

Wang, D., Song, C.and Barabási, A. L. (2013) 'Quantifying long-term scientific impact', *Science* 342(6154): 127-132.

Wolf, B., Lindenthal, T., Szerencsits, M., Holbrook, J. B.and Heß, J. (2013) 'Evaluating Research beyond Scientific Impact: How to Include Criteria for Productive Interactions and Impact on Practice and Society', *GAIA-Ecological Perspectives for Science and Society* 22(2): 104-114.

6. Appendix 1

(Non-exhaustive) List of the EU projects that the selected interviewees participated in:

European Union	Belarus	Moldova	Ukraine
COCONET/Marine biology (Ukraine & Georgia)	BY-NANOERA	Eastern Partnership Connect	FP7 SUAFRI-EPC
TIDE/Transport (Moldova)	ENER2I (ENErgy Research to Innovation)	HP-See Research Communities	FP7 SECURE-R2
ESSANUF/ European Supply of Safe Nuclear Fuel (Ukraine)	INNOVER EAST/ EaP cooperation on energy efficiency (Belarus, Georgia, Ukraine)	European Grid Initiative	IncoNet EaP
FP7 SCUBE-ICT (Belarus and Ukraine)	IncoNet EaP/ INCO NET projects/scientific capacity building	Erasmus+	INCO NET projects
FP7 IPERA (Armenia)	STI International Cooperation Network for Eastern Partnership Countries – PLUS	PRO-METROFOOD	LIGHT-TPS
FP7 BELERA(Belarus)	Idealist201	FP7-INCO SECURE-R2I	NANOMAT-EPC
FP7 SENS-ERA (Georgia)	H2020 INTELUM	FP7-PEOPLE/ International cooperative programme for photovoltaic kesterite based technologies, head	AERO-UKRAINE
FP7 KhAI-ERA (Ukraine)	BY-NANOERA	FP7-PEOPLE/Training and collaboration on material development and process improvements in oil and sugar production	NoGAP
FP7 SUAFRI-EPC (Armenia, Belarus, Georgia, and Ukraine)	Graphene Flagship	FP7-TRANSPORT/ Tangential Impulse Detonation Engine	LIGHT-TPS
FP7 SECURE-R2I (Armenia, Belarus, Georgia, Moldova, and Ukraine)	CACOMEL	FP7-ICT European Innovation Ecosystem	DEGISCO
FP7 NANOMAT-EPC (Armenia, Belarus, Georgia, and Ukraine)	TerACaN	H2020-TWINN	POEMA
H2020 HOLO (Moldova)	FAEMCAR	AGRICIS	PICASA
H2020 INTELUM (Armenia, Belarus, Ukraine)	CANTOR	EUinDepth “European identity, cultural diversity and political change”/Promotion of the improvement of	INOTLES

European Union	**Belarus**	**Moldova**	**Ukraine**
		environmental indicators of small and medium-sized enterprises	
H2020 AERO-UA (Ukraine)	NAmiceMC	Air-Q-Gov	Building capacity for University-Enterprise partnerships towards competency based training in Armenia, Georgia and Ukraine
Black Sea Horizon	BalticGrid-I	FP7 BLACK-SEA-ERA-NET	TRUST
IncoNet EaP	SCUBE-ICT	FP7-PEOPLE-2012-IRSES - Marie Curie Action "International Research Staff Exchange Scheme"	EANET
ERAnet Cofund	EGI-INSPIRE	Erasmus +/Jean Monnet actions	HUMERIA
Joint Programming Initiatives	ORIENTplus		IANUS II
H2020 Waterworks (Moldova)	GN3plus		IANUS
INNOVER EAST EaP cooperation on energy efficiency (Belarus, Georgia, Ukraine)	SECURE-R2I		ACTIVE
INCO NET projects/scientific capacity building	Horizon2020		KhAI-ERA
H2020 ERA NET/mobility (Belarus, Moldova, Ukraine)	GEANT		CORSAIR
	DphotoD		GREENCO
	METCOPH		WASIS
	Horizon 2020 SUPERTWIN		START
	MARTEC II		
	ENTIII		
	MarTERA		
	EMEurope		
	AGRICISTRADE		
	NET4SOCIETY (2,3,4)		
	ENRI-East		
	HITT-2008		
	INTAS		
	New Europe		
	Barometer (NEB) Surveys		
	European Values Study (EVS)		

7. Appendix 2

Questionnaire: interviews in the EaP countries

1. Position (e.g. "Head of research institute, deputy head of department in university) etc.
2. Type of organization (e.g. "Institute of physics", "department of sociology in university") etc.
3. Scientific cooperation projects with the EU and its member states (briefly)
4. What is the most important impact of scientific cooperation with the EU and its member-states on scientific capacity of your organization or you personally?
5. Were the project's themes and topics (of the project you have participated in) relevant for
   a) scientific development of your country?
   b) social development?
   c) The development of key sectors of the economy?
6. How do you evaluate the impact of scientific cooperation with the EU on scientific capacity of society in your country?
7. Did the participation in a scientific cooperation project(s) influenced your method of work?
8. Has the project(s) that you participated in led to cooperation between companies? Has it facilitated any new business ventures?
9. Has the project in which you participated led to the change of public policy in your country?
10. Has the project in which you participated affected your project planning and management practices? How?
11. Have you become (more) aware of issues related to ethics and data management after participating in the scientific cooperation project? If yes, has this awareness been translated into new practices and institutions (e.g. ethics board)?
12. Are there any aspects of cooperation that you would like to comment on regarding interpersonal dynamics between you/your organization and other partners from the project you have participated in?
13. Have you noticed any other indirect or unintended effects of participation in scientific cooperation projects?
14. Do you think that the influence of the cooperation programmes with the EU translates into a broader change in
    a) attitudes towards Europe
    a1) in the scientific community
    a2) among policy makers
    a3) among the broader public
    b) understanding of European values
    b1) in the scientific community
    b2) among policy makers
    b3) among the broader public
15. In your opinion, what factors limit the possibilities of scientists from our country to participate in programmes of scientific cooperation and academic mobility with the EU?
16. Have you or the organization where you work taken part in the programmes of scientific cooperation or academic mobility with Russia in 2009-2016?
17. Have you or the organization where you work taken part in the programmes of scientific cooperation and academic mobility with the Eastern Partnership countries in 2009-2016?
18. Do you plan to participate in the programmes of scientific cooperation with the EU in the future? If yes, why? If no, why?
19. In your opinion, what countries are the most important to you and your organization in terms of scientific cooperation?
20. Other comments

Questionnaire: interviews in the EU countries

We are interested in your **personal** reflections, opinions and assessments and not in a formal evaluation of your project and its results.

1. Could you tell me your function in the project and the kind of responsibilities you have (had) for the project?
2. What was the role of the partners from the Eastern Partnership countries for the project?
3. To what extent were these institutions involved in the preparation of the project proposal? If yes, were there any specific challenges to their participation in the drafting phase?
4. Did these partners have any managerial responsibilities for the implementation of the project? If yes, were there any specific challenges to their participation in project management?
5. Did these partners lead any work packages? If yes, any specific challenges or remarks about their performance?
6. How did you get in contact with your EaP partners?
7. Have you collaborated with scientists or scientific institutions from EaP countries before? If yes, which and under what programmes?
8. In your view, what was the overall impact of the project on the participating institutions from the Eastern Partnership countries?
9. On their scientific quality and productivity?
10. On their research agenda?
11. On their access to state-of-the-art facilities and equipment?
12. On the mobility and career prospects of their researchers?
13. More concretely, any of their researchers spending extensive periods of time at the Western partners or perhaps being employed after the project completion in Western Europe?
14. Has the project results in transfer of practices and institutions, such as ethics boards or data management plans?
15. Has the project resulted in any transfer of technologies (or new patents) to these institutions?
16. Has the project affected the values of the research communities in the EaP countries?
17. Has the project led to change of public policies in the EaP countries?
18. Has the project led to concrete business initiatives in the EaP countries?
19. Or helped the economies in some other way?
20. Would you say that the project has had an impact on the broader society in the EaP partner countries?
21. If yes, how (what mechanisms)?
22. If no, what could have produced such impact?
23. In your opinion (and, to remind, this is confidential) was the inclusion of partners from these countries a success?
24. Would you say that there are big differences in the organizational culture between West and East European research institutes (if yes, some examples)?
25. Would you say that there are big differences in the institutional setup for scientific research between West and East European countries (if yes, some examples)?
26. What makes it hard for EaP researchers and institutions to participate effectively (e.g. interference from state, or different accounting standards, or different administrative culture, or different standards of doing research, for example, norms about research ethics and integrity)?
27. Based on your experience, would you seek to do research work with partners from the Eastern Partnership countries again in the future?
28. Is there anything else that you want to share from your experience with collaborating with EaP institutions?

The EU and Eastern Partnership Countries
An Inside-Out Analysis and Strategic Assessment

Against the background of the war in Ukraine and the rising tensions with Russia, a reassessment of the European Neighborhood Policy has become both more urgent and more challenging. Adopting an inside-out perspective on the challenges of transformation the Eastern Partnership (EaP) countries and the European Union face, the research project EU-STRAT seeks to understand varieties of social orders in EaP countries and to explain the propensity of domestic actors to engage in change. EU-STRAT also investigates how bilateral, regional and global interdependencies shape domestic actors' preferences and scope of action. Featuring an eleven-partner consortium of academic, policy, and management excellence, EU-STRAT creates new and strengthens existing links within and between the academic and the policy world on matters relating to current and future relations with EaP countries.