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I. ARTICLES

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TEAMING UP OR WRITING ALONE – AUTHORSHIP STRATEGIES IN LEADING POLISH ECONOMIC JOURNALS

The returns to scientific collaboration have been widely acknowledged. The general trend observed in top scientific journals is an increase in the collaborative activities both between researchers and between institutions, especially with regard to international co-authorship. Not only is there a growing number of papers written in co-authorship, but also there is an increase in the number of co-authors. In this paper, we investigate whether similar tendencies have emerged in the scientific community of economists in Poland. Using social network analysis, we focus on collaboration between researchers publishing in five leading Polish economic journals. We find that the number of articles written in collaboration is steadily increasing. We also document a rise in the average number of authors per article. Yet, compared to what we observe elsewhere (e.g. in the top economic journals in the world) the scale of collaboration is modest. Furthermore, the increase in collaborative activity which we observe is not followed by a rise in collaboration with foreign co-authors.

Keywords: co-authorship network, Polish economic journals, collaboration strategies, scientific productivity

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1. INTRODUCTION

In Poland, like in other countries, scientific productivity is becoming more and more assessed based on publications in reputable journals. This applies to every science, and economics, which is the focus of this study, is not an exception. Publication record strongly affects academic institutions' and their employees' ability to obtain funds for scientific research (Bukowska and Łopaciuk-Gonczaryk 2013). This phenomenon is related to the growing pressure for publishing in high-impact-factor journals.

This obviously presents a challenge for authors to find and implement an optimal publication strategy. There is no doubt that a scientist's output largely

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depends on his/her ability and effort. Yet, as is shown by the existing literature, an important determinant of scientific performance is also an individual's research network (see, for example, De Stefano et al. 2013). The positive relationship between a researcher's publication record and social interactions can be expected on at least two levels. First, functioning in the research network is likely to facilitate early access to new ideas. Second, collaboration may be beneficial due to the increasing return to specialization and the need to combine ideas and skills to produce new quality in science (Agrawal et al. 2013).[1]

While the benefits from collaboration between researchers seem to be fairly universal, the actual patterns of behaviour in terms of cooperation may differ across countries, disciplines, research institutions and journals. In response to this, the present paper asks to what extent cooperative equilibria have emerged in Polish science. The focus of this paper is on economics. In particular, we examine the behaviour of Polish authors in terms of cooperation when publishing in five leading Polish economic journals: "Argumenta Oeconomica", "Bank i Kredyt", "Ekonomista", "Gospodarka Narodowa" and "Polityka Społeczna". While the decision to look at these five journals was to some extent arbitrary, it was dictated by three important considerations. First, we focused on journals published at least since 1999, therefore those that have some history of established reputation. Second, we assumed that the most influential papers are published in general interest journals rather than in field-specific journals (and consequently excluded from the analysis journals specializing in, for example, rural affairs or logistics). Third, we chose journals that over the period 1999-2012, were most frequently marked by the Polish Ministry of Science with the best evaluation. Therefore, if we assume that the Ministry's evaluation system reflects the journals' quality and prestige, we focus on those journals with the highest average quality and prestige. What should also be noted is that for publication in these journals (in comparison with other Polish economic journals) the researchers received, on average, the highest possible number of points which were later used for their assessment at their parent research institutions. In effect, from the scientists' point of view, publishing in these five journals could have been perceived as relatively more valuable than publishing in other Polish journals.

We measure collaboration reflected in the co-authorship of a published paper. Clearly, this indicator of actual cooperative behaviour is not flawless.

[1] A useful perspective to study the impact of collaboration on scientists' productivity is that of social capital theory (see, for example, Li et al. 2013).

Yet it is commonly accepted and widely used in the literature (Goyal et al. 2006; Newman 2004; Fafchamps et al. 2006). The analysis covers all the articles published in the selected journals between 1999 and 2012.

To the best of our knowledge, this paper is the first to study social interactions reflected in the co-authorship of a published paper in Polish economic journals. In fact, analyses of scientific publications (both in the domain of economics and in other domains) in Polish literature are still rare and limited. The existing works in this area focus on comparing the publishing performance of different research institutions (e.g. Kierzek 2008 and 2009; Wróblewski 2005), methods of measuring such performance (Osiewalska 2008), problems related to evaluating scientists based on citation indexes (Błocki and Życzkowski 2013) and difficulties in evaluating journals (Wilkin 2013). There are also only a few analyses of the determinants of publishing success (Wolszczak-Derlacz and Parteka 2010; Bukowska and Łopaciuk-Gonczaryk 2013; Łopaciuk-Gonczaryk 2015) and the role of collaboration between scientists (Olechnicka and Płoszaj 2008).

This paper attempts to fill this gap at least to some extent. By doing so, we aim to contribute not only to the Polish literature on the subject, but also to the broader literature focusing on co-authorship, its prevalence, development in time and the differences between journals (see, among others, Goyal et al. 2006; Moody 2004; Newman 2004; Fafchamps et al. 2006; Acedo et al. 2006). A lot of research shows that collaboration in science is increasing (De Stefano et al. 2013; Moody 2004; Acedo et al. 2006). Furthermore, the analyses demonstrate not only the rise in the number of co-authored papers, but also the increase in the number of co-authors (Goyal et al. 2006; Wuchty et al. 2007) and the growth in international collaborations (Adams et al. 2005). It is interesting therefore to see whether similar trends also characterize the publishing process in economic journals in Poland. Finally, our paper is also related to the literature on social interactions and the role that the latter play in shaping the individual's behaviour (see, for example, Bramoulle et al. 2009; Calvo-Armengol et al. 2009; Fafchamps et al. 2010).

The paper is organized as follows. It starts with a brief review of the literature on the co-authorship trends in world economic journals and scientific collaboration in CEECs. Later, the choice of data and data sources is explained. In the third section, we present the analysis of trends and patterns in co-authorship for five Polish economic journals: "Argumenta Oeconomica", "Bank i Kredyt", "Ekonomista", "Gospodarka Narodowa" and "Polityka Społeczna", covering the time period from 1999 to 2012. Finally, the results are discussed and summarized.

2. CO-AUTHORSHIP TRENDS IN ECONOMIC JOURNALS

Since the first decades of the 20th century, publishing in economics has expanded rapidly. Indeed, the cumulative stock of journal articles in economics has doubled every fourteen years (Schymura 2012). Numerous empirical studies have examined the production of scientific knowledge in economics, the patterns of co-authorship for individual economists, the development of co-authorship in certain economic subfields and the major economic journals (see, for example: Goyal et al. 2006; Laband and Tollison 2000; Hamermesh 2013). A lot of researchers paid attention to the rising incidence and extent of co-authorship in economic publications.

For example, Goyal et al. (2004 and 2006), analysed a sample of articles published in the past three decades and considered all the papers published in journals listed by EconLit to provide empirical evidence on the evolution of the world of journal publishing economists. They found that in the 1970s, the world of economics was a collection of islands (i.e. groups of mutually connected authors), with the largest island (component) having about 15% of the population, and in the 1990s economists were more integrated with the largest island covering close to half the population. Importantly, the trend showing the growing rate of co-authored papers was observed in the case of all journals listed in Econlit. This was especially evident in five general economics journals with the highest average impact factors ("American Economic Review", "Econometrica", "Journal of Political Economy", "Quarterly Journal of Economics", and Review of Economic Studies").

Card and Della Vigna (2013), who cover all the publications from 1970-2012 in "The American Economic Review", "Quarterly Journal of Economics", "Journal of Political Economy", "Econometrica" and "The Review of Economic Studies", showed that the number of authors per paper in economics has grown steadily from the early 1970s, when 75% of the articles were single-authored and the average of the authors in a paper was 1.3. By the early 1990s, the fraction of single-authored papers had fallen to 50%, and the mean number of authors reached 1.6. Most recently, in 2011-2012, more than three quarters of papers have at least 2 authors and the mean number of authors is 2.2.

To the best of our knowledge, co-authorship trends in economics in the case of Central and Eastern European countries are rather poorly documented. Several studies have analysed the research productivity and potential for economists from the region to contribute to the international literature (see e.g. Csaba 2002; Turnovec 2002; Ciaian and Pokrivcak 2005),

but surprisingly little is known about their publication strategies and the potential role that social interaction may play in improving their publication records. While there is some literature related to these issues, to the best of our knowledge, it exists only in local languages and therefore comparisons here are difficult. However, the evidence on collaboration that exists for other social sciences in transition countries is fairly consistent with the picture outlined above, referring to the trends in world economics. For example, in their study on sociologists in Slovenia, Mali et al. (2010) showed that during the period between 1986 and 2005 there was an increase in the number of co-authored publications. In particular, the percentage of single authorships dropped from roughly 80% to roughly 40%, whereas the average number of authors for scientific articles increased from slightly more than one to around 1.75. Also, Teodorescu and Andrei (2011) found that natural sciences and social sciences in transition countries have witnessed a steady growth in the share of co-authored publications, due to increased collaboration with both international and domestic colleagues[2].

With this description in mind, we now move to investigate the patterns of scientific collaboration among Polish economists in order to check whether trends similar to those described above also characterise this community. The analysis comes shortly after a brief presentation of the data.

3. DATA SOURCES

The analysis presented below is based on data on all the articles (up to six co-authors between 1999-2012, both in Polish and in foreign languages) from the five leading Polish economic journals: "Argumenta Oeconomica" (AE), "Bank i Kredyt" (BK), "Ekonomista" (E), "Gospodarka Narodowa" (GN), and "Polityka Społeczna" (PS).

Following the classification proposed by Leimu and Koricheva (2005), we distinguish three different types of collaboration: (a) domestic in-house collaboration (all authors from the same Polish affiliation); (b) domestic institutional collaboration (all authors from Poland but from more than one affiliation); and (c) international collaboration (authors from more than one country). Articles with a purely foreign affiliation have been excluded with

[2] For brevity reasons we do not discuss here the issue of why scientific cooperation, especially in transition context, may or should take place and why it is the international collaboration that seems to be especially promising as a possible catching-up strategy. An overview of relevant arguments can be found in working paper version of this article, which is Bukowska et al. (2014).

the exception of five articles and five authors. Those five foreign authors are co-authors of Polish authors in cases of other articles, so information on their collaboration record has been included as relevant for network analysis. This decision has led to the exclusion of 158 pure-foreign affiliated articles and, consequently, 190 foreign authors (84 AE, 60 BK, 6 E, 23 GN, 19 PS).

The data were obtained from BazEkon. Missing articles were added based on the journals' archives. The affiliations were obtained directly from the body of the articles. In some cases this was achieved through on-line access, but in most cases it was obtained from hard copies in a library. However there were a lot of blanks, especially in the earlier years, and affiliations differed between articles of authors with the same name and surname. Therefore, to identify the authors and establish their main affiliations, two additional data sources were used: NAUKA POLSKA & POL-on. Access to these data sources enabled not only filling in missing affiliations or deciding between conflicting affiliations, but also including scientific titles in the analysis. In this way we could also distinguish between authors with the same name and surname (and sometimes even from the same affiliation) or avoid (at least to some extent) treating authors with a change in surname (women after marriage) as different ones. Authors were treated as Polish if after identification it was found that they had Polish affiliation. In the analyses presented below the main affiliation was decided based on the up-to-date information in POL-on, in cases of missing data or doubts connected with author identification, it was completed and verified by the data from affiliations given in the articles, the data from NAUKA POLSKA and the web pages of universities.

4. TRENDS IN CO-AUTHORSHIP IN FIVE LEADING ECONOMIC JOURNALS IN POLAND(1999–2012)

The empirical strategy that we use is based on social network analysis (SNA) (Scott 2000; Wasserman and Faust 2008). The perspective of SNA is focused on a structure of relationships (ties) between interacting individuals (nodes) and assumes that this structure of interactions creates opportunities and constraints, both on the level of structural positions of egos and on the level of the whole network. There is a broad literature using SNA in research on scientific collaboration. Several authors explore its patterns and trends (e.g. Newman 2004; Acedo et al. 2006), its determinants (e.g. Fafchamps et al. 2010) and the influence of co-authorship strategies on publication success (e.g. McFadyen and Cannella 2004; Kuzhabekova 2011; Rumsey-Wairepo

2006). Our focus is on the researcher's ego-network which encompasses all his/her co-authors while taking into consideration all the articles in collaboration. The number of articles written together by two authors is treated as tie strength. The implication is the division of scientists into solitary (no collaboration at all) and collaborating ones (having a network of co-authors at least of size one, which means collaborating with at least one researcher in the time period under study on one or more articles). Another consequence is the opportunity to look at the composition of ego-networks, to explore the level of homophily (collaborating with similar authors, e.g. in terms of gender). Furthermore, at macro level, we will analyse the whole network structure, taking into consideration the level of its fragmentation and the share of the giant component (the biggest group of mutually connected scientists). Additionally, we will look at trends in collaboration statistics. Furthermore we will explore differences between the journals and inquire into different types of collaboration: within-department, domestic inter-department and international one. Wherever it is possible, we will try to refer our findings to other research.

To start, we will look at the general summary of our data (Table 1). First of all, we can notice that in the case of all the considered Polish journals, articles having only one author prevail (accounting for 70-87% of articles depending on the journal). Additionally, what is worth considering here is the fact that, as regards publishing in the analysed journals, collaborating authors publish, on average, more often than solitary authors (2.59 articles vs. 1.79 articles respectively).

Table 1

Sum of articles with different numbers of authors – total for 1999-2012

	"Argumenta Oeconomica"	**"Bank i Kredyt"**	**"Ekonomista"**	**"Gospodarka Narodowa"**	**"Polityka Społeczna"**	**Total**
No of authors:						
1 author	101	771	390	475	897	**2634**
2 authors	32	152	82	94	117	**477**
3 authors	9	27	19	19	12	**86**
4 authors	1	3	4	2	3	**13**
5 authors	0	0	1	1	1	**3**
6 authors	0	0	0	0	1	**1**
Total	**143**	**953**	**496**	**591**	**1031**	**3214**

Source: authors' own

Secondly, we look at authors' characteristics and inquire who is involved in co-authorship and who decides to write only as a solitary author (Table 2). Although these numbers do not allow for drawing any definite conclusions, several interesting observations emerge that could be further developed in future research. First, we observe that scientists starting their career (*mgr* – masters of sciences, mostly PhD candidates) are among the collaborating authors more often than the other groups.

Table 2

Solitary and collaborating authors versus scientific title and gender – all the five journals together

Polish authors (scientific title in 2012)	Collaborating authors	Solitary authors	Average share of co-authors of the same gender	Total
Mgr	**21 (60%)**	**14 (40%)**	**58%**	**35**
Female	10 (59%)	7 (41%)	49%	17
Male	11 (61%)	7 (39%)	67%	18
Dr	**347 (42%)**	**477 (58%)**	**65%**	**824**
Female	143 (38%)	234 (62%)	50%	377
Male	204 (46%)	243 (54%)	72%	447
Dr hab.	**134 (44%)**	**169 (56%)**	**59%**	**303**
Female	40 (33%)	82 (67%)	44%	122
Male	94 (52%)	87 (48%)	70%	181
Prof. dr hab.	**116 (41%)**	**170 (59%)**	**73%**	**286**
Female	38 (39%)	59 (61%)	65%	97
Male	78 (41%)	111 (59%)	80%	189
Unidentified	140 (42%)	197 (58%)	62%	337
Female	75 (46%)	89 (54%)	48%	164
Male	65 (38%)	108 (62%)	69%	173
Total	**758 (42%)**	**1027 (58%)**	**61%**	**1785**

Source: authors' own

A potential explanation is that one strategy which a junior faculty can use to develop a research stream is to work collaboratively. It can be argued that younger researchers will be motivated to publish with co-authors in order to achieve a higher productivity and position in the hierarchy of the university (He 2009), while senior researchers, whose position is already established, have no such pressure (Lissoni 2011). Collaboration provides a learning opportunity for a scientist to acquire skills and knowledge not otherwise available from partners. In this case, a person in a senior position may co-work less, because the system of evaluation and promotion does not work or

in the past did not work properly (Lissoni et al. 2011). However this does not explain why full professors (*prof. dr hab.*) collaborate only slightly less often than doctors (*dr*) and assistant professors/associate professors (*dr hab.*), who still have to work for their further promotion. The possible explanation here is that PhD candidates collaborate with their supervisors, who are different kinds of professors (*prof. dr hab.* and *dr hab.*). Nevertheless in the case of our data, only 11 out of the 21 collaborating masters of sciences (*mgr*) have a professor (a *dr hab.* or a *prof. dr hab.*) as a collaborator and as many as 9 of those 11 scholars also have other co-authors in their networks. Therefore it is reasonable to conclude that scientists on different levels of the academic hierarchy have various incentives to collaborate. Junior researchers do it working for promotion and seeking expertise from higher positioned colleagues, while the latter benefit from those collaborations by having support in their research and making good use of their professional network built during their longer time in academia (Abramo at al. 2011).

We can also notice that female doctors (*dr*) and assistant professors/ associate professors (*dr hab.*) choose solitary strategies more often than their male colleagues. Their participation in publishing is also more modest (Table 2). The last conclusion can also be made for women with the full professor title (*prof. dr hab.)*. In the literature we often find evidence that, regardless of discipline, women publish significantly fewer articles than men (Fox 2005). The difference between women and men in productivity is also accompanied by the difference in the level of co-authorship. McDowell and Smith (1992) found the choice of co-author in a cohort of PhD holders in economics to be significantly influenced by their gender. Furthermore, they found also that the propensity for single authorship was higher among women than men. Various authors also argue that these differences affect promotion decisions to the disadvantage of women. Boschini and Sjögren (2007) examined articles from three top economic journals (1991-2002), and confirmed that co-author seeking behaviour is not neutral in regard to gender. Women are twice as likely to co-author with women than men are. Additionally, single authorship among women decreases over time. In fields with higher percentages of women authors, woman-woman co-authored articles are more frequent. Research on the development of mentoring relationships provides a possible explanation for gender differences in collaborative research. The scarcity of women occupying the upper ranks in an organization creates gender differences in access to mentors. Women have to develop cross-gender relationships, while their male peers do not. Even if potential male mentors have positive attitudes toward women, research suggests that male mentors will choose male assistants because

personal identification is a key element in the selection process (Welsh and Bremser 2005). In the case of our data, an average ego has 61% of his co-authors of the same gender as himself/herself. Furthermore, for all scientific titles, selection based on the same gender is especially characteristic for men, who tend to have a higher share of male co-authors than women do of female ones (Table 2).[3]

To make any conclusions about the level of collaboration in the five top Polish economic journals during 1999-2012 we need a reference point. As has been already noted, we did not find any analysis using economic journals from the countries of our region, but we may use data for the best western journals as a comparison. Therefore we consider the top five world economic journals ("The American Economic Review", "Econometrica", "Journal of Political Economy", "Quarterly Journal of Economics", and "The Review of Economic Studies" – Goyal et al. 2004) for the ten-year period of the 1990s, the averages for all the journals listed in Econ-Lit for the same period (Goyal et al. 2004) and the top ten journals in management for 1980–2002 ("Academy of Management Journal", "Academy of Management Review", "Administrative Science Quarterly", "Journal of Management", "Management Science", "Organization Science", "Strategic Management Journal", "Organization Studies", "Journal of Management Studies", "Human Relations", Acedo et al. 2006). Our data are more up-to-date than the reference sets, but taking into consideration that world trends in co-authorship are growing and that CEECs have to catch up, it should not create a serious problem. In the case of Polish journals we observe (Table 3) the small rate of co-authored articles (even smaller than the rate of 25% for an average journal in Econ-Lit observed by Goyal et al. 2004 during the 1970s and much smaller than the rates from the 1990s used as reference in the table), the small average number of authors per article (in comparison with Acedo et al.'s study on managerial journals) and the small share of collaborating authors (less than a half, when in the other studies it is 70% and more). In SNA, components are parts of a network which are not connected to each other. SNA research pays special interest to the giant (largest) component, which is the component of the biggest size indicating

[3] Additionally, in order to test formally, if we observe a selection process based on homophily in the case of gender, we have applied QAP correlation (procedure available in UCINET), which enables us to correlate matrices and is based on permutation tests of significance. Therefore it is especially appropriate to be used for network data, which naturally are not random samples (Borgatti et al. 2013). We have obtained a significant correlation (with p-value of 0.0002), which is a confirmation that the tendency observed in the Polish journals for scientists to choose co-authors of the same gender is not spurious.

what part of all the authors is integrated. In the case of Polish journals, the giant component contains only 3% of all authors and 8% of collaborating authors, which is very little compared to the reference studies.

Table 3

Descriptive and network statistics in comparison with earlier studies regarding top western journals

	Our study	**Goyal et al. 2004**	**Goyal et al. 2004**	**Acedo et al. 2006**
Time period	1999-2012	90-ties	90-ties	1980–2002
No of journals	5	5	at least 687	10
No of articles	3214	3705	156 454	11 022
No of authors	1875 (including 1785 Polish authors)	3171	81 217	10 176
Mean no of articles per author	2.09 (2.13 per Polish author)	1.87	2.83	2.04
Rate of co-authored papers	18%	54%	42%	-
Average no of authors per paper	1.22	-	-	1.88
No of collaborating authors	848	2470	56 639	8830
Percentage of collaborating authors among all authors	45%	78%	70%	87%
Giant component size	65	779	33 027	4625
Giant component as a percentage of all authors (collaborating authors only)	3% (8%)	25% (32%)	41% (58%)	45% (52%)

Source: authors' own

Figure 1 illustrates the network of collaborating authors in five Polish journals grouped together, between 1999-2012. The node size corresponds to the sum of articles published by the author. Triangles are men and circles are women. All Polish scientists are marked navy blue, red nodes are authors with a foreign affiliation and green are those with an unidentified affiliation. Line size means tie strength, bolder lines are for acts of repetitive collaboration between the authors. The network is very sparse, it consists of 260 components in total with 174 components (57% of all collaborating authors) of size 2, which means that the dominating form of collaboration is one-time co-authorship of only two researchers. The network's fragmentation is 0.989, which is very high and means a proportion of nodes that cannot reach each other.

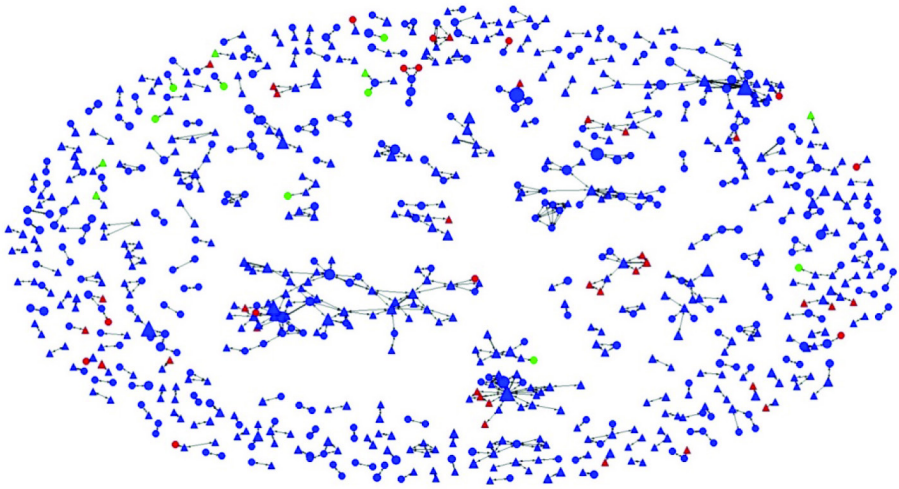

Figure 1. The five Polish leading journals – network of collaborating authors

Source: authors' own

The next step is to look at the collaboration trends in time. Based on the literature presented above, we expect that even if co-authorship rates are low, they should increase in time. It turns out that this is really so, as the rate of co-authored articles in the first seven years (1999-2005) is 15%, rising to 22% in the second half of the period under study (2006-2012). Similarly, the share of collaborating authors in the period increases from 35% to 46% and the size of the giant component rises from 3% to 5% (in reference to all authors collaborating in the period). This is visualized in Table 4.

Table 4

Comparisons between 1999-2005 and 2006-2001 – descriptive and network statistics for all the five journals in total

Time period	**1999–2005**	**2006–2012**
No of authors publishing in the period	1147	1068
No of collaborating authors in the period	400	496
Percentage of collaborating authors among all authors	35%	46%
No of articles	1784	1430
Rate of co-authored articles	15%	22%
Size of largest component	11	26
Size of largest component as a percentage collaborating authors	3%	5%

Source: authors' own

Figure 2. enables a more detailed analysis of changes in time. It illustrates trends in collaboration for all Polish journals taken together. As it turns out, similarly to the trends in the literature discussed above, we can observe an increase of collaboration in time (both the share of articles in collaboration and the average number of authors per article grew). However, the cooperation structure does not change, as around half of the articles in collaboration is co-authored by researchers from the same affiliation (faculty). Furthermore, the share of articles including foreign co-authors is very low and stable over time. What is also interesting is that trends for articles written in Polish are very similar to the trends observed for articles written in other languages, which means that the increase in collaboration is not caused by the rising share of articles in foreign languages.

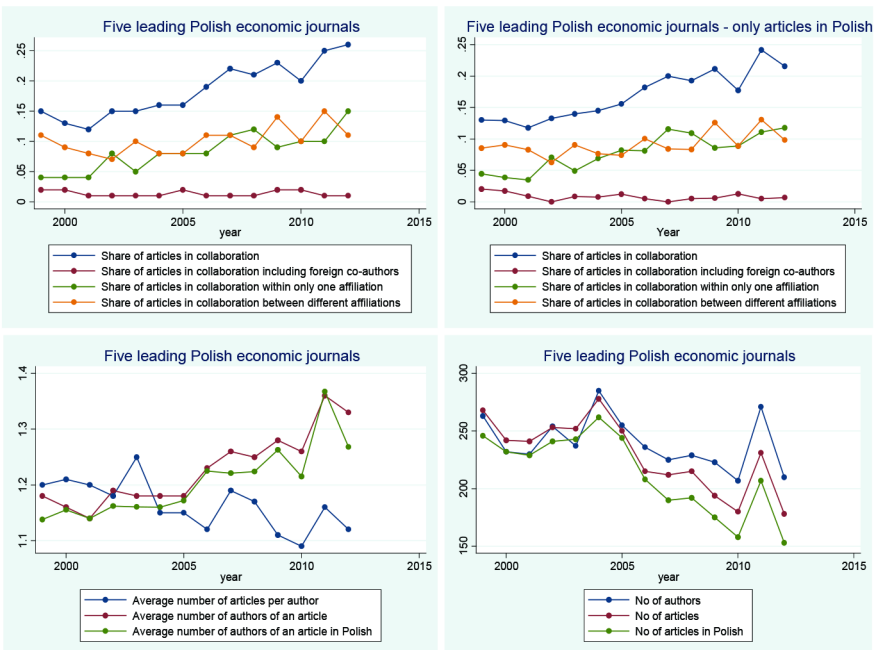

Figure 2. Collaboration trends in the five Polish journals taken together: 1999–2012

Source: authors' own

So far we have mostly analysed collaboration in all the journals taken together. It is interesting to see what the differences are between the journals. Figure 3 depicts the percentage of articles having only one author (no collaboration), the percentage of articles having at least one co-author

with foreign affiliation (foreign collaboration), the percentage of articles having all authors from the same affiliation (all authors from the same affiliation) and the percentage of articles in collaboration, with no co-authors with foreign affiliation and having at least two authors from different faculties – at the same or at different universities – or from other different affiliations, e.g. the National Bank of Poland and the Faculty of Economics, the University of Warsaw (other national collaborations). As can be concluded, "Argumenta Oeconomica" is the leader in terms of all types of collaboration. It has especially comparatively high share of foreign collaboration.

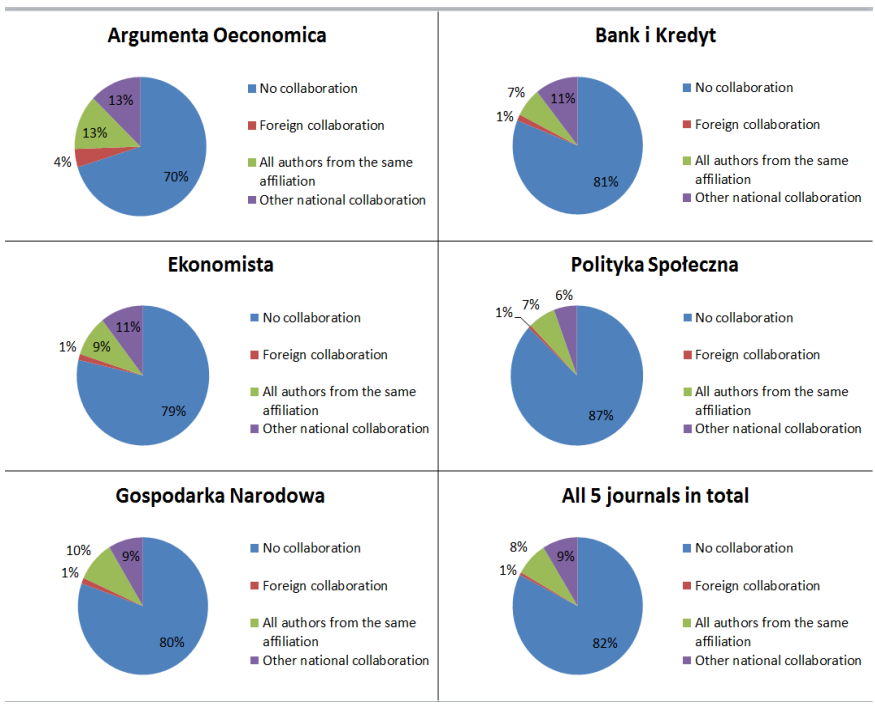

Figure 3. Types of collaboration in different journals

Source: authors' own

Further comparisons can be made based on Table 5. "Argumenta Oeconomica" is the only journal where the number of collaborating authors exceeds the number of solitary authors (collaboration as a co-authorship within a given journal). The highest share of solitary authors (almost two

times as many as collaborating authors) can be observed in "Polityka Społeczna". It can be noticed that "Argumenta Oeconomica" is the only journal where all articles are in English, and "Polityka Społeczna" is the only journal where all articles are in Polish.

Table 5

Comparisons between the five Polish journals – descriptive statistics

Journal	"Argumenta Oeconomica"	"Bank i Kredyt"	"Ekonomista"	"Gospodarka Narodowa"	"Polityka Społeczna"
No of Polish authors	157	588	363	408	635
No of foreign co-authors of Polish authors	6	16	10	8	8
No of unidentified authors	0	39	0	0	9
No of Polish cooperating (within the analysed journal) authors	83	254	162	163	221
Average no of articles	1.17 (MIN=1; MAX=3)	2.20 (MIN=1; MAX=15)	1.80 (MIN=1; MAX=13)	2.16 (MIN=1; MAX=14)	2.21 (MIN=1; MAX=25)
No of Polish solitary (within the analysed journal) authors	74	334	201	245	414
Average no of articles	1.23 (MIN=1; MAX=6)	1.63 (MIN=1; MAX=22)	1.64 (MIN=1; MAX=8)	1.51 (MIN=1; MAX=14)	1.64 (MIN=1; MAX=21)
No of articles	143	953	496	591	1031
No of articles in Polish	0	893	484	573	1031
Rate of co-authored articles	29%	19%	21%	20%	13%
Average number of authors per article	1.37	1.23	1.27	1.24	1.15
No of components	37	97	59	63	86
No of components of size 2:	24 (65%)	68 (70%)	42 (71%)	43 (68%)	61 (71%)
Size of largest component	4	27	13	13	16
Fragmentation	0.986	0.986	0.986	0.988	0.988

Source: authors' own

That said, the network of "Argumenta Oeconomica" is very disconnected and of a small biggest component. It should be noted though, that the number of articles in this journal in the whole period is very low in comparison to other journals (especially "Bank i Kredyt" and "Polityka Społeczna"). "Bank i Kredyt" and "Polityka Społeczna" can be compared as having a similar number of authors and articles. It can be noticed that "Bank i Kredyt" has more collaboration: a higher share of collaborating authors, a higher rate of co-authored articles and a bigger size of largest component. The networks of "Ekonomista" and "Gospodarka Narodowa" are similar, but in "Ekonomista" there is a higher share of authors who are collaborating authors.

CONCLUSIONS

It is widely acknowledged that the structure of a researcher's network may importantly affect his/her performance. In particular, collaboration with other scholars may positively impact an individual's publication record. Consequently, cooperative behaviour may be an important element of a researcher's publication strategy. In this paper we verify to what extent this is reflected in the patterns and trends of co-authorship in the five Polish leading economic journals between 1999 and 2012.

The general picture that emerges from this analysis is the following. The number of articles written in collaboration is steadily increasing. We also document an increase in the average number of authors per article. Yet, compared to what we observe elsewhere (e.g. in the top economic journals in the world) the scale of collaboration is modest. Furthermore, the increase in collaborative activity which we observe is mainly due to collaboration between Polish co-authors. Moreover, almost half of this collaboration comes from one institution and this observation is stable over time, suggesting that the share of collaboration between different departments is not increasing. Nevertheless, the evidence we show provides some support for the fact that the community of economists in Poland is becoming more integrated. However, it also suggests that publishing in the top Polish economic journals may be unattractive for foreign collaborators and/or that publishing in these journals does not require the strategy to engage in cooperation with colleagues from abroad.

Collaboration is most frequent for "Argumenta Oeconomica", which has the longest record of articles published in English and does not accept papers written in Polish (as opposed to the other journals in our sample). For that journal we also observe the relatively highest share of articles written with

foreign collaborators, although these articles still account only for 4% of all articles published there in the analysed period.

Our analysis can be surely extended in a number of ways. One obvious direction would be to include in the analysis articles published in journals other than the five investigated here. This is because it might be the case that publication strategies, including patterns of collaboration, differ between high-impact and low-impact journals. Another one would be to more clearly relate collaboration strategy to authors' productivity. Finally, useful insights could be provided by analysing the factors encouraging collaboration. We hope therefore that the presented research will be followed up by other studies, so that the ongoing discussion about publication performance in Polish science (in particular in economics) will gain more substance.

We believe that the analysis presented here may be of relevance for researchers, research institutions and the scientific authorities as it may be directly related to the debate about changes in the legislation regulating the functioning of Polish science (adopted so far, and the possible directions of its further evolution). Last but not least, it may also be useful for journal editors. Definitely, a more in-depth analysis should follow and complement the picture. However, a starting point, i.e. describing the current situation as far as the cooperative activities of economists publishing in the leading Polish economic journals are concerned, needs to be carried out. We hope that this paper may act as a first step in that wider project.

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