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ACADEMIC INBREEDING AND RESEARCH PRODUCTIVITY OF RUSSIAN FACULTY MEMBERS[3]

The literature on the consequences of academic inbreeding shows ambiguous results: some papers show that inbreeding positively influences research productivity, measured in the quantity and quality of publications, while others show the opposite effect. There are contradictory results both in studies of different countries and within countries. Such a variety of results makes it impossible to transfer the findings from one academic system to another, and in Russia this problem has been under explored. This paper focuses on the relationship between inbreeding and publication activity among Russian faculty members. The results, using Russian data from the Changing Academic Profession survey, showed no substantial effect of academic inbreeding on research productivity. Inbred and non-inbred faculty members do not differ substantially in terms of the probability of having publications, or how many, although for inbreds such probability is slightly higher. These results are robust for different operationalizations of inbreeding and measures of publication activity. However the absence of significant differences in the number of publications may not mean the absence of a difference in their quality. The possible explanations and limitations of the standard measures of research productivity are discussed.

JEL Classification: I23; I28.

Keywords: Academic profession, Academic inbreeding, Research productivity, Faculty members, Russian higher education, Changing Academic Profession

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Introduction

Academic inbreeding is the practice of hiring a university's own graduates. It first became the focus of attention a century ago, in 1908, when Harvard president Charles Eliot mentioned it in a speech as an unwise practice (Eliot, 1908). Since that first allusion a general negative perception of inbreeding has settled in the literature and for policymakers (Gorelova & Yudkevich, 2015). There is an almost unanimous opinion that inbreeding is a harmful practice at the national and institutional level, that it leads to knowledge stagnation, as inbreds usually reproduce the ideas of their teachers and lack a broader outlook (Horta, Veloso, & Grediaga, 2010). At the same time, empirical studies show that the consequences of inbreeding at the individual level are not so unambiguous: some papers show that inbreeding positively influences research productivity, time management and academic communication of the faculty (e.g. Klemenčič & Zgaga, 2015; McGee, 1960; Wyer & Conrad, 1984), while others show it to be a negative practice because there is lower scientific productivity, a lack of openness to the international scientific community and less information exchange (e.g. Hargens & Farr, 1973; Horta et al., 2010; Horta, 2013). Most empirical studies test the correlation between hiring from inside and such characteristics of faculty members as their preferences between teaching and research, their involvement in academic society outside their university, and their research productivity[4]. Research productivity is one of the main indicators of the professional success of an academic, which affects their promotion, salary, possibilities of future research funding, and recognition (Fox, 1983). Faculty research productivity is often used as one of the measures of university rankings (Budd, 2006), which is why it is important to understand which factors may influence this indicator. Numerous studies show that inbreeding may be one of the factors affecting faculty publication activity, nevertheless, there is no commonly accepted opinion on the character of its influence: different researchers got different results in their studies of the correlation between hiring from inside and faculty member's publishing activity. Some of them found a negative correlation between faculty members' inbreeding status and their productivity (Dutton, 1980 (USA); Eells & Cleveland, 1935 (USA); Hargens & Farr, 1973 (USA); Horta et al., 2010 (Mexico); Horta, 2013 (Portugal)), while others found that inbreds did not differ from non-inbreds in terms of research productivity (Cruz-Castro & Sanz-Menéndez, 2010 (Spain); Pan, 1993 (USA); Roleda, Bombongan, Tan, Roleda, & Culaba, 2014 (Phillippines); Sato, 1992 (USA); Smyth & Mishra, 2014 (Australia); Sologub & Coupé, 2015 (Ukraine)), or were even more productive (Klemenčič & Zgaga, 2015 (Slovenia); McGee, 1960 (USA); Wyer & Conrad, 1984 (USA)). Such a variety of results makes it impossible to clearly evaluate the practise of inbreeding and complicates transferring the findings obtained in one academic

[4] Here and further in text we will use the terms 'research productivity' and 'publication activity' as synonyms.

system to another. Therefore it is necessary to study the causes and consequences of inbreeding in each system separately (especially in countries where this practice is widespread) in order to understand its impact.

This study focuses on the relationship between inbreeding and research productivity in the context of the Russian academic system. Our paper provides the first multivariate, systematic study of academic inbreeding and publication activity in Russia based on a representative national sample. The practice of academic inbreeding is widespread in the country (64% of faculty in Russia are employed by their university of graduation, according to 'Changing Academic Profession' data (Yudkevich, Kozmina, Sivak, Bain, & Davydova, 2013)) and usually it is positively perceived by academics. Nevertheless, this phenomenon and its consequences are not well-studied and only qualitative studies and case-studies exist on the phenomena (Horta & Yudkevich, 2015; Sivak & Yudkevich, 2015; Sivak & Yudkevich, 2009). It is important to evaluate the consequences of academic inbreeding in Russian academia, especially in light of the contemporary reforms and the desire to improve the competitiveness and positions of Russian universities in global university rankings (for overview see Yudkevich, 2014), where the research productivity of academics is regarded as an important criterion. Our results contribute to the understanding of the consequences of widespread inbreeding in Russia not only at the individual, but also at the institutional and national levels, and may help to adjust university hiring policies to increase the productivity of faculty members.

Our paper is organized as follows. First, we analyse the literature on inbreeding and its connection with publishing productivity from an international perspective. We pay specific attention to the peculiarities of previous studies that could influence results and to the distinctive features of the Russian academic system. Then we describe the data, variables and methods used in our research and possible limitations of the study. Then we provide results of our research and conclude with a discussion of the results.

Literature review

There is a vast volume of literature devoted to the relationship between inbreeding and research productivity of faculty members in different countries. For a long time most studies of inbreeding were concentrated mainly in the USA, where overall inbreeding rates are not very high and there are written and unwritten rules forbidding the practice (Pan, 1993). Nevertheless, in recent years more and more papers on the issue have appeared in other countries with high inbreeding rates. Some of the papers aim to

determine reasons for academic inbreeding and others are more concerned with its consequences. Among the second group of papers many studies are devoted to the correlation between academic inbreeding and research productivity measured either through the number of publications the faculty member has or through the quality of his or her works (e.g. measured through citations or h-index (Inanc & Tuncer, 2011; Smyth & Mishra, 2014)). For detailed literature review see Gorelova and Yudkevich (2015). We concentrate mainly on papers where the link between academic inbreeding and the research productivity is studied. The literature shows there is diversity in some of their characteristics, such as the operationalization of academic inbreeding, academic systems, methodology and sample design. A detailed description of these publications is given in Appendix.

Operationalizations of academic inbreeding

The analysis of literature about academic inbreeding and research productivity shows that there are different ways to operationalization inbreeding. These may be divided into several groups. The main distinction lies in the education and graduation levels used for distinguishing inbreds. Based on this parameter we found 4 operationalizations of inbreeding in the literature. According to them, inbreds are those faculty members who work in the higher educational institution where they received:

- at least one degree (any of their degrees) (Eells & Cleveland, 1935b; Morichika & Shibayama, 2015; Roleda et al., 2014; Sivak & Yudkevich, 2015; Sivak & Yudkevich, 2009; Sologub & Coupé, 2015);
- a bachelor degree (Clark & Larson, 1972; Eisenberg & Wells, 2000; Smyth & Mishra, 2014);
- the highest achieved degree (Klemenčič & Zgaga, 2015; McGee, 1960; Sato, 1992; Shen, Xu, & Zhang, 2015);
- a PhD degree (Albarrán, Carrasco, & Ruiz-Castillo, 2014; Cruz-Castro & Sanz-Menéndez, 2010; Dutton, 1980; Hargens & Farr, 1973; Horta et al., 2010; Horta, 2013; Inanc & Tuncer, 2011; Pan, 1993; Wyer & Conrad, 1984).

Also, there are some specific operationalizations of inbred faculty members, such as inbreeding by the same denominational affiliation of college (Clark & Larson, 1972) and inbreeding by the address of first publication (Navarro & Rivero, 2001). Some papers also differentiate operationalizations, depending on whether the faculty member's first position in the graduating and current employing institution or outside it. Academics who are now employed by their graduating university, but held their first position at another place are usually called 'silver-corded' (Berelson, 1960). In some studies silver-corded are not distinguished as a separate group and are regarded as inbreds (Cruz-Castro & Sanz-Menéndez, 2010;

Horta et al., 2010; Inanc & Tuncer, 2011; Wyer & Conrad, 1984), in other studies they are distinguished, but not included in the analysis (Albarrán et al., 2014; Pan, 1993) and in some other papers they are distinguished as a separate group and are compared with inbreds (Dutton, 1980; Hargens & Farr, 1973; Horta, 2013).

Operationalizations of inbreeding also differ in the levels of inbreeding considered in different papers. Most studies deal with institutional-level inbreeding when only the same higher educational and employment institution matters in distinguishing inbred faculty members. Nevertheless, some studies also deal with departmental-level inbreeding (Eisenberg & Wells, 2000; Morichika & Shibayama, 2015; Sato, 1992; Smyth & Mishra, 2014) or even laboratory-level inbreeding (Morichika & Shibayama, 2015), when it is important for defining inbred faculty members who work in the same structural unit of the graduating institution where he had studied.

Different studies using different operationalizations of inbreeding receive different results on the relationship between hiring from inside and research productivity of academics even within one country. Nevertheless there are some trends, which are more common for different definitions of inbreeding:

- In studies where inbreeding is operationalized by any degree, the correlation between inbreeding and productivity is more often insignificant (in 4 papers out of 6) (Morichika & Shibayama, 2015; Roleda et al., 2014; Sivak & Yudkevich, 2009; Sologub & Coupé, 2015).
- In studies where inbreeding is operationalized by the highest degree, the correlation between inbreeding and productivity is either insignificant (Sato, 1992) or positive (Klemenčič & Zgaga, 2015; McGee, 1960).
- In papers defining inbreeding by bachelor degree, the correlation between inbreeding and productivity is more often insignificant (in 2 papers out of 2) (Clark & Larson, 1972; Smyth & Mishra, 2014).
- In papers defining inbreeding by PhD degree, the correlation between inbreeding and productivity is more often negative, especially in older studies (2 papers out of 4) (Dutton, 1980; Hargens & Farr, 1973), whereas in more recent papers the link is more often insignificant (3 papers out of 5) (Cruz-Castro & Sanz-Menéndez, 2010; Horta, 2013; Pan, 1993).
- In studies distinguishing department-level inbreeding, the correlation between inbreeding and productivity is negative (Morichika & Shibayama, 2015) or insignificant (Sato, 1992; Smyth & Mishra, 2014).

Although the correlation between inbreeding and research productivity has the same direction among studies with the same operationalization, we cannot be sure that these results are explained only by

different operationalizations of inbreeding. Researchers should take the operationalization into account when analysing the antecedents and consequences of inbreeding.

Academic inbreeding and research productivity among academic systems

The largest amount of research on the problem has been done in the USA, and the greatest variety in results is also in these studies. For instance, McGee (1960) studied junior faculty members in the University of Texas and found that inbreds produced more books and articles compared to non-inbreds, whereas Sato (1992) studied faculty members from schools of nursing and found no significant differences in the number of publications between inbreds and non-inbreds. Dutton (1980) and Hargens and Farr (1973) studied samples of faculty members from different institutions and fields and found a mostly negative relationship between inbreeding and publishing productivity. These differences may be explained by changes in academic systems which occur over time, but even within close time periods some researchers also got contradictory results in the relationship between inbreeding and productivity (Dutton, 1980; Wyer & Conrad, 1984). The results are heterogeneous not only within the USA, where inbreeding is negatively perceived and to some extent formally and informally prohibited (Pan, 1993), but they also differ within countries where this practice is widespread. A negative link was shown on the data from Mexico (Horta et al., 2010) and Portugal (Horta, 2013), but data from Spain (Cruz-Castro & Sanz-Menéndez, 2010) and Russia (Sivak & Yudkevich, 2009) did not shown unambiguous differences in the productivity of inbreds and non-inbreds in terms of number of papers published. Thus, it seems that the previous literature supports the idea that the influence of academic systems on the relationship between inbreeding and productivity. But for more valid conclusions, this assumption should be tested empirically in international comparative research, including various national characteristics.

Academic inbreeding, research productivity, and features of studies

The analysis of the literature revealed that there is diversity in the methodology and sample design used in previous studies. We explored these differences in detail and found no clear evidence that disciplinary differences, the position of the faculty member, or the type of university (selective or non-selective) affected the results on the relationship between inbreeding and publication activity. The only pattern was that in all papers where economists were included in the analysis and disciplinary differences were studied, inbred economists tended to be less productive in terms of quantity and quality of publications (Albarrán et al., 2014; Shen et al., 2015; Sivak & Yudkevich, 2009). There are no similar

patterns for other scientific fields and disciplines. The type of data used in the research (survey data or data from external objective sources like Web of Science or Scopus) and type of publications in the analysis (all types or only selective publications in Scopus and Web of Science) also do not seem to explain the diversity in results about the relationship between inbreeding and the research productivity of academics.

Based on this brief analytical literature review we conclude that the link between inbreeding and research productivity of academics is complex and is mediated by a combination of factors. That is why it is important to study this practice in each country separately, particularly in those where inbreeding is widespread. This paper looks at inbreeding and its consequences for the publication activity of Russian academics, because in Russia this practice is not well studied. Before proceeding with the methodology of the research and the results, we provide a brief overview of Russian academic system, explaining why inbreeding rates are so high in Russia.

Academic inbreeding and research productivity in Russian academic system

The Russian academic system is characterized by high inbreeding and low mobility rates (Sivak & Yudkevich, 2015). Moreover, such situation is deeply embedded in the institutional environment and is considered to be a norm. Unlike many other countries, in Russia most deans and chairs consider that hiring practices should be aimed at the university's own graduates (Sivak & Yudkevich, 2015; Sivak & Yudkevich, 2009). There are several reasons for such attitudes towards inbreeding and for such prevalence of this practice in Russia.

First, the situation was inherited from the Soviet period: in USSR it was considered very prestigious for graduates to be hired by their own universities (at least in social sciences), instead of being redirected to some other organization and only the best students would be hired by their universities (Kuzminov & Yudkevich, 2007). Now, although the USSR collapsed more than 20 years ago, the practice of hiring the university's own graduates is still regarded as a norm, as most universities, particularly the most prestigious, consider that they provide the best quality of education and, thus, consider their own graduates to be the best. Moreover, the academic system in Russia can be regarded as 'closed'. This means that it consists of a range of academic systems, and different universities have different standards of education and research which are taught to students. Thus, graduates usually fit these standards and norms best (Sivak & Yudkevich, 2008). Hiring graduates helps to reduce costs and risks, related to hiring a person from outside, when little is known about their performance (this situation is reinforced by the fact that a large proportion of universities in Russia are teaching-oriented and teaching and educational

performance are specific features which are difficult to measure from the outside) (Godechot & Louvet, 2008; Majcher, 2004).

Another reason for the prevalence of academic inbreeding in Russian universities is the peculiarities of Russian academic labour market. It is comparatively closed and vacancies are rarely announced publicly. Open competition is officially obligatory in the hiring process but in the Russian academic labour market it is a 'fiction' (Altbach, Yudkevich, & Rumbley, 2015). Closed labour markets usually reproduce themselves, because in those rare cases when open competition is announced, no outsiders participate in it, because they do not believe to have any chance in comparison to university graduates and internal candidates (Yudkevich, 2015). As Horta and Yudkevich (2015) put it, the situation is intensified by the limited rental markets, uncompetitive salaries in academia and the uneven distribution of universities by the territory. Low academic salaries prevent young academics from moving to other regions, where there are more universities and, thus, more possibilities for hiring, as their earnings are too low for renting in another region. Moreover, low academic salaries, uncompetitive compared to other sectors, make the university sector unattractive for graduates and thus, universities try to involve their best students and PhD students into teaching and research early in their studies, without allowing them to test themselves in external labour market.

These reasons show that inbreeding is an inevitable practice for Russian universities. Interviews with Russian faulty showed that, in general, they understand that this practice is harmful for academia, as it prevents the circulation of knowledge among different parts of the academic sector and leads to parochialism. Nevertheless, academics justify this practice especially when 'higher education systems are in the process of building knowledge capacity or where academic job markets are not open and developed' (Horta & Yudkevich, 2015, p. 4). At the same time, academics still see some positive functions of inbreeding: it helps to build so-called scientific schools, contributes to developing departments and disciplinary fields, helps to hire the best candidates and provides greater loyalty of new faculty members to institutions which allows them to build consistent research teams. Although academics realize the negative consequences of inbreeding, they note that it would be impossible and detrimental for universities to prohibit this practice, because in many cases, especially in the prestigious Russian research universities, internal candidates really are superior to external ones and a such ban would lead to hiring inferior candidates. Inbreeding should be decreased by some other measures, such as increasing internationalization and the development of transparent recruitment practices (Horta & Yudkevich, 2015). In recent years several decrees which can be regarded as measures for eliminating inbreeding and fostering mobility have been introduced in Russia. The main one introduced effective contracts in Russian

universities, which encourages retaining effective faculty members and firing the ineffective ones[5]. This statute has started to stimulate real competition in universities at the stages of the hiring and promotion of faculty and is supposed to make the labour market for academics in Russian more open and competitive. Nevertheless, as these innovations were introduced only a few years ago, their effects will only be evident in several years and we cannot see them in the current research.

The positive attitudes towards inbreeding in Russian academic system cited above may explain the results of previous studies of the consequences of academic inbreeding. According to them, the publication activity of inbred and non-inbred academics in Russia does not differ significantly in terms of the number of papers published, although they have different publication and communication strategies (Sivak & Yudkevich, 2015; Sivak & Yudkevich, 2009). Inbreds more often publish in the journals of their university and sometimes use their social ties to submit a paper, while publication strategies of non-inbreds are more externally oriented (Sivak & Yudkevich, 2008; Sivak & Yudkevich, 2009). Moreover, inbreds rarely cooperate with academics outside their university, while non-inbreds value cooperation on the national and international level more. Previous studies show that although inbreeding rates are high in Russia (as noted above), the consequences are unambiguous and cannot be interpreted only negatively. At the same time in previous papers academic inbreeding was analysed mostly based on qualitative data or unrepresentative samples, while we provide a quantitative analysis of this practice based on an all-Russia survey of academics. The characteristics of the data used in this research are described in the next section.

Data and methods

Data

For the empirical analysis we use data from the survey 'The dynamics of the academic profession', conducted in 2012 in Russia using the methodology of the international comparative study 'Changing Academic Profession' (CAP) (Yudkevich et al., 2013). The CAP questionnaire, translated into Russian, was used in the survey. Questionnaires were answered in three ways: self-administrated interview, face-to-face interview and email survey. The Russian version of the questionnaire contained a number of additional questions that are not in the original questionnaire. In particular, the Russian questionnaire contained questions about studying at the same university in which the respondents worked while completing the survey.

[5] Presidential Decree №597 "On Measures to Implement the State Social/Welfare Policy" dated 7 May 2012 // URL: [http://минобрнауки.рф/документы/4716]. Accessed 28 March 2016.

The sample for the research was multistage and its formation was in accordance with CAP sample methodology (Cummings & Bracht, 2006). At the first stage, 9 regions with the highest proportion of students in Russia were selected. These regions are: Moscow, Saint-Petersburg, Nizhny Novgorod Region, Novosibirsk Region, Samara Region, Sverdlovsk Region, Rostov Region, Tomsk Region, and Primorsky Krai. In each region at least one university with special status (national research university or federal university) and at least one university without special status were selected proportionally to the total number of higher educational institutions of each type in the region. As a result, 25 universities were included in the sample. All the selected universities are subordinated to the Russian Ministry of Education and Science and this imposes some limitations on the data, as some sectoral universities, for example medicine, are excluded from our sample. At each university 64 academics for the main list and 64 academics for the reserve list were randomly selected. The reserve list was used in case of inaccessibility to faculty members from the main list. The sample size was 1623 respondents.

We excluded from the sample respondents who have at least one missing answer. This was done to build models on the same data array for comparison. Also those respondents who do not teach sciences, social sciences, humanities and engineering were also excluded from the sample, because of their unrepresentativeness (only 26 faculty members). The final sample size used in the current research is 1358 respondents.

Dependent variables

Faculty research productivity was the dependent variable provided by their self-report. Four types of operationalization were used in analysis. First, the raw number of articles in books or journals published in the last three years prior to the survey. Second, the number of ‘article equivalents’ calculated as the weighted sum of articles in books or journals (1 point), edited books (2 points) and authored books (5 points) published in the three years prior to the survey. This operationalization takes into account the different types of publications and minimizes the differences between disciplines which have different traditions and estimates the importance of the various types of publications differently (Bentley, 2015; Kyvik & Teigen, 1996; Ramsden, 1994). Third, foreign-language and peer-reviewed article equivalents are used for operationalization of the publishing quality. Following Bentley (2015), who also used CAP data, we calculated these variables as the proportion of the article equivalents. The proportions of these two publication types came from respondents' answers to questions ‘Which percentage of your publications in the last three years was published in a language different from the language of instruction

at your current institution', 'Which percentage of your publications in the last three years was peer-reviewed'. Mean values for each of dependent variables shown in Table 1.

Independent variables

The data do not let us to test all the variations of operationalization of inbreeding in the literature, but we can compare inbreds by different levels of graduation and experience. Several types of operationalization were used in analysis as explanatory variables. First, inbreeding was defined by having a degree from the same university where the faculty member works. There are four types of inbreds from this perspective: undergraduate inbreds (have bachelor or master degree from the same university where they work), postgraduate inbreds (have PhD degree), having at least one degree inbreds (bachelor, master or PhD), having the highest achieved degree.

Second, four different degrees of inbreeding were defined: only undergraduate inbreds (only bachelor or master from the university where they work), only postgraduate inbreds (have only PhD degree from the university where they work), super inbreds (have both undergraduate and PhD degrees from the university where they work), absolutely non-inbreds (no degrees from the university where they work).

Third, inbreeding was defined by having a PhD degree and developing a career in the same university. There are four types of faculty members: pure inbreds (have PhD degree from the university where they work and the equal experience at this university and the general teaching experience), silver-corded (have a PhD degree from the university where they work and shorter experience at this university compared to teaching experience elsewhere), mobile non-inbreds (work and obtained PhD degree in different universities and experience at the university where they work is shorter compared to the general teaching experience), non-mobile non-inbreds (work and obtained PhD degree in different universities and experience at the university where they work and the general teaching experience are equal). Means for publication by different groups of faculty are given in Table 1.

Control variables

Control variables, potentially connected with the number of publications that a faculty member has, were also used in the analysis. The first group of control variables included individual characteristics

of academics. Some previous studies showed there are differences in publishing productivity of male and female faculty members (Bentley, 2012; Fox, 2005; Kwiek, 2015), so we also controlled for gender. Academics at an earlier stage of their career have had fewer opportunities to change jobs and work in different institutions because a lack of experience, so it can be expected there are more inbreds among them, however, they are also likely to have fewer publications. To reduce the impact of this bias we controlled for the number of years in academia—meaning research and teaching experience in the higher educational institution (excluding doctoral studies). Holding a PhD degree was another control variable. According to Russian CAP data there are a lot of faculty members (27%) who work at universities without PhD degree. Faculty members with PhD degree should have a greater number of publications This expectation was confirmed by previous research (e.g. Smyth & Mishra, 2014). Numerous papers show that faculty members, holding higher positions usually demonstrate higher research productivity (Abramo, D'Angelo, & Di Costa, 2011; Kwiek, 2015; Ramsden, 1994; Smyth & Mishra, 2014), that is why academic rank (two dummy-variables for full professor and associate professor positions) was also a control variable. As different scientific fields have different publishing patterns and peculiarities (Shin & Cummings, 2010), the discipline taught by the academic was also a control variable. We included four dummy-variables for natural sciences, social sciences, humanities and technology. Research and teaching preferences of faculty members was the next control variable. Previous studies showed that individual preferences are an important predictor of research productivity of academics in many countries (Bentley, 2015; Kwiek, 2015; Ramsden, 1994) and disciplines (Shin & Cummings, 2010). For this purpose an ordinal 4-point variable was included indicating the level of respondent's interest in research (1 for low interest).

The second group of control variables included the characteristics of the institution where the respondent worked at the time of completing the survey. It is supposed that academics with different research productivity and different publishing strategies work in higher educational institutions of different quality. Two institutional characteristics were used: (1) type of higher educational institution (two dummy-variables for 'National research university' (NRU) and 'Federal university' (FU)); (2) the prestige of the higher educational institution, measured by mean Unified State Exam (USE) scores of students, matriculated to tuition-free places. NRU and FU statuses of the institutions reflect the effectiveness of the educational process and its integration with scientific research. Mean USE scores were defined based on the Monitoring of higher educational institutions (2013)[6], conducted by the Ministry of Education and Science. Descriptive statistics of control variables are presented in Table 2.

[6] Monitoring of higher educational institutions (2013). // URL: [http://miccedu.ru/monitoring/2013/]. Accessed 28.03.2016

Data analysis

We used regression analysis with belonging to inbred groups as explanatory variables and the number of articles/chapters in books or article equivalents as the dependent variable. The number of articles/chapters in books and article equivalents are count variables with many zeros (there are a lot of faculty members in the sample who have no publications at all) (see Figure 1). This kind of data require special models for analysis: zero-inflated Poisson (ZIP), zero-inflated negative binomial (ZINB), Poisson logit hurdle (PLH), and negative binomial logit hurdle (NBLH) (Loeys, Moerkerke, De Smet, & Buysse, 2012; Zeileis, Kleiber, & Jackman, 2008). These models are mixture models in which the complete distribution of the dependent variable is split in two separate components. In ZIP and ZINB models the zero part represents the probability of excess zeros and the count part represents the non-excess zeros and non-zero counts. In PLH and NBLH models the zero and non-zero counts are clearly separated, the two parts of models represents zero versus non-zero values and non-zero counts. In terms of the variables used, the zero part assess the effect of belonging to inbreds on having at least one publication, and the counts part assess the effect of belonging to inbreds on the number of publications.

First, we compared the quality of the four models. Models are non-nested and they were compared using the Akaike information criterion (AIC). A smaller AIC value indicates better model quality. Table 3 summarizes the AIC value for four models. For articles/chapters in books and for article equivalents the ZINB and NBLH models showed the lowest and similar AICs. Figure 1 also shows that the ZINB and NBLH models predicted the observed numbers of articles/chapters in books and article equivalents better than others models. The ZINB and NBLH models were therefore used for further analysis.

Second, we calculated the ZINB and NBLH regression models to examine the relationship between academic inbreeding and publication productivity. For a simpler interpretation regression coefficients were exponentiated and transformed into odds ratios (OR) in zero-parts and rate ratios (RR) in the count parts. In percentages ($100*(e^{B}-1)$) OR reflects the percentage decrease (OR < 1) or increase (OR > 1) in the odds of having at least one publication, whereas RR reflects the percentage decrease (RR < 1) or increase (RR > 1) in expected number of publications for each unit increase in the independent variable, controlling for other predictors. Also we calculated logit regression models with fractionalized measures for foreign-language and peer-reviewed article equivalents to examine the relationship between academic inbreeding and the quality of the publications. All calculations were performed in R (R Core Team, 2015). To fit these models we used the functions `glm.nb()` from the *MASS* package (Venables &

Ripley, 2002) and `zeroinfl()` and `hurdle()` from the *pscl* package (Zeileis et al., 2008). Analysis was guided by Loeys et al. (2012) tutorial.

Limitations

There are some limitations of the overall approach. First, data about the number of publications were self-reported. However, self-reported data are not as biased as they are considered. Chan (2009, p. 330) noted that 'there is no strong evidence to lead us to conclude that self-reported data are inherently flawed or that their use will always impede our ability to meaningfully interpret correlations or other parameter estimates obtained from the data'. M. J. Clark and Centra (1985) also showed that self-reported data about publications correlated highly with data found in bibliometric databases. Second, having foreign-language or peer-reviewed publications may not be a good proxy for the quality of publishing. There is a large variation in quality across both peer-reviewed and foreign-language journals and books. Again, because we used self-reported data, we could not fully control the quality of publications.

Table 1. Means and standard deviations for publications by different types of inbreds

Publication type	Total sample (*N* = 1358)	Under-graduate inbreds (*n* = 700)	Post-graduate inbreds (*n* = 571)	At least one degree inbreds (*n* = 868)	Higher degree inbreds (*n* = 641)	Only under-graduate inbreds (*n* = 297)	Only post-graduate inbreds (*n* = 168)	Super inbreds (*n* = 403)	Absolutely non-inbreds (*n* = 490)	Pure inbreds (*n* = 502)	Silver-corded (*n* = 69)	Mobile non-inbreds (*n* = 291)	Non-mobile non-inbreds (*n* = 496)
Articles published in an academic book or journal	4.54 (6.46)	5.00 (7.19)	5.26 (7.06)	4.83 (6.92)	4.88 (6.84)	3.98 (6.57)	4.11 (5.58)	5.75 (7.54)	4.03 (5.53)	5.33 (7.18)	4.80 (6.07	5.40 (7.38)	3.20 (4.73
Scholarly books you authored or co-authored	0.55 (1.17)	0.57 (1.27)	0.62 (1.24)	0.58 (1.23)	0.57 (1.21)	0.49 (1.22)	0.60 (1.06)	0.63 (1.31)	0.51 (1.06)	0.62 (1.27)	0.61 (1.02)	0.58 (0.99)	0.46 (1.19)
Scholarly books you edited or co-edited	0.31 (1.02)	0.27 (0.93)	0.38 (1.28)	0.32 (1.13)	0.36 (1.26)	0.20 (0.78)	0.53 (1.74)	0.32 (1.02)	0.28 (0.79)	0.38 (1.32)	0.42 (0.95)	0.36 (0.88)	0.19 (0.72)
Article equivalents	7.91 (10.47)	8.39 (11.41)	9.12 (11.17)	8.35 (11.14)	8.42 (11.00)	6.86 (10.95)	8.17 (9.98)	9.52 (11.62)	7.14 (9.13)	9.18 (11.39)	8.68 (9.49)	9.04 (10.30)	5.86 (9.39)
Article equivalents in foreign language	0.87 (3.12)	1.06 (3.86)	0.96 (3.37)	0.98 (3.59)	0.94 (3.46)	1.01 (4.04)	0.65 (2.26)	1.09 (3.75)	0.65 (1.80)	0.89 (3.26)	1.41 (4.11)	1.06 (3.58)	0.62 (2.32)
Peer-reviewed article equivalents	3.77 (7.16)	4.24 (7.74)	4.30 (7.91)	4.00 (7.43)	4.12 (7.73)	3.34 (6.24)	3.08 (6.05)	4.83 (8.53)	3.30 (6.57)	4.41 (8.12)	3.55 (6.15)	4.16 (7.50)	2.76 (5.58)

Note. Standard deviations in parentheses.

Table 2. Descriptive statistics for control variables

Variables	Total sample (*N* = 1358)	Under-graduate inbreds (*n* = 700)	Post-graduate inbreds (*n* = 571)	At least one degree inbreds (*n* = 868)	Higher degree inbreds (*n* = 641)	Only under-graduate inbreds (*n* = 297)	Only post-graduate inbreds (*n* = 168)	Super inbreds (*n* = 403)	Absolutely non-inbreds (*n* = 490)	Pure inbreds (*n* = 502)	Silver-corded (*n* = 69)	Mobile non-inbreds (*n* = 291)	Non-mobile non-inbreds (*n* = 496)
Male	712 (52.4)	395 (56.4)	347 (60.8)	494 (56.9)	362 (56.5)	147 (49.5)	99 (58.9)	248 (61.5)	218 (44.5)	306 (61.0)	41 (59.4)	142 (48.8)	223 (45.0)
PhD degree	1001 (73.7)	504 (72.0)	445 (77.9)	635 (73.2)	445 (69.4)	190 (64.0)	131 (78.0)	314 (77.9)	366 (74.7)	383 (76.3)	62 (89.9)	250 (85.9)	306 (61.7)
Professor	233 (17.2)	109 (15.6)	88 (15.4)	143 (16.5)	89 (13.9)	55 (18.5)	34 (20.2)	54 (13.4)	90 (18.4)	75 (14.9)	13 (18.8)	78 (26.8)	67 (13.5)
Associate professor	686 (50.5)	343 (49.0)	296 (51.8)	423 (48.7)	306 (47.7)	127 (42.8)	80 (47.6)	216 (53.6)	263 (53.7)	256 (51.0)	40 (58.0)	163 (56.0)	227 (45.8)
Natural sciences	343 (25.3)	199 (28.4)	144 (25.2)	232 (26.7)	160 (25.0)	88 (29.6)	33 (19.6)	111 (27.5)	111 (22.7)	127 (25.3)	17 (24.6)	73 (25.1)	126 (25.4)
Social sciences	264 (19.4)	123 (17.6)	95 (16.6)	141 (16.2)	101 (15.8)	59 (19.9)	18 (10.7)	64 (15.9)	123 (25.1)	71 (14.1)	11 (15.9)	59 (20.3)	123 (24.8)
Humanities	319 (23.5)	115 (16.4)	82 (14.4)	151 (17.4)	106 (16.5)	56 (18.9)	36 (21.4)	59 (14.6)	168 (34.3)	79 (15.7)	16 (23.2)	101 (34.7)	123 (24.8)
Technology	432 (31.8)	263 (37.6)	250 (43.8)	344 (39.6)	274 (42.7)	94 (31.6)	81 (48.2)	169 (41.9)	88 (18.0)	225 (44.8)	25 (36.2)	58 (19.9)	124 (25.0)
NIU status	517 (38.1)	291 (41.6)	231 (40.5)	341 (39.3)	256 (39.9)	110 (37.0)	50 (29.8)	181 (44.9)	176 (35.9)	206 (41.0)	25 (36.2)	113 (38.8)	173 (34.9)
FU status	170 (12.5)	103 (14.7)	72 (12.6)	122 (14.1)	75 (11.7)	50 (16.8)	19 (11.3)	53 (13.2)	48 (9.8)	61 (12.2)	11 (15.9)	29 (10.0)	69 (13.9)
Years in academia	M=18.35, SD=13.10	M=16.51, SD=13.18	M=16.13, SD=13.22	M=16.98, SD=13.17	M=15.70, SD=12.99	M=18.62, SD=12.93	M=18.95, SD=12.98	M=14.96, SD=13.16	M=20.77, SD=12.62	M=15.43, SD=13.25	M=21.25, SD=11.90	M=24.46, SD=11.83	M=17.32, SD=12.58
Research interest (1–4)	M=2.26, SD=0.82	M=2.30, SD=0.82	M=2.36, SD=0.77	M=2.32, SD=0.81	M=2.31, SD=0.78	M=2.24, SD=0.88	M=2.38, SD=0.77	M=2.34, SD=0.77	M=2.15, SD=0.82	M=2.35, SD=0.76	M=2.41, SD=0.86	M=2.26, SD=0.88	M=2.15, SD=0.82

Note. Per cent in parentheses.

Table 3. Akaike information criterion values for models

	ZIP	ZINB	PLH	NBLH
Articles and book chapters	9186.16	6827.79	9186.21	6822.86
Article equivalents	13205.34	8086.71	13205.45	8083.66

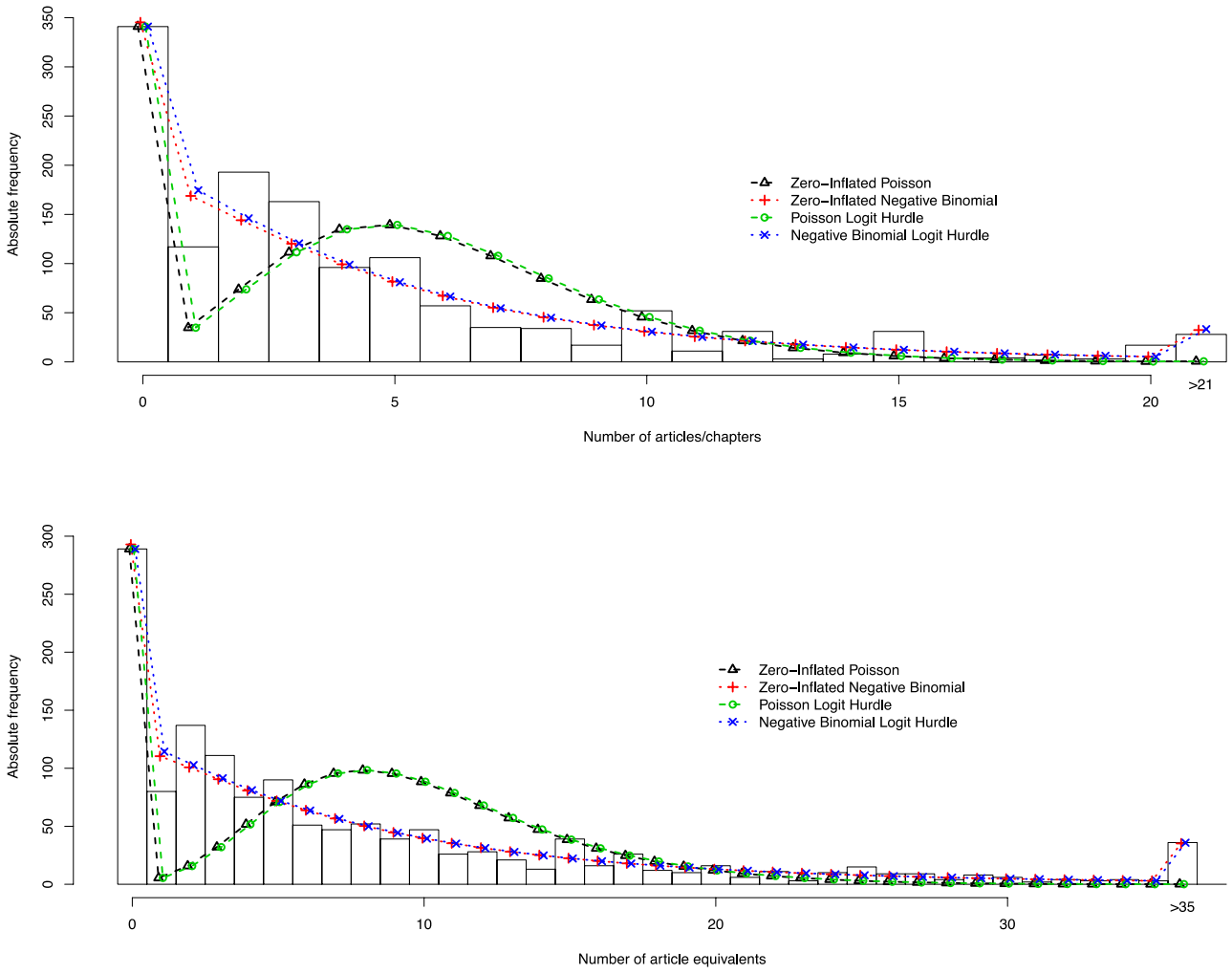

Figure 1. The distribution of number of publications (articles/chapters in books (top), article equivalent (down)). Bars represent the observed distribution. The lines represent the distribution predicted by different models (control variables only were used as predictors).

Results

The NBLH and ZINB models demonstrate almost the same results. For space reasons, we present results only for NBLH models because they are easier to interpret. Tables 4 and 5 show exponentiated regression coefficients from NBLH models for articles/book chapters and article equivalents respectively.

Inbreeding by degree from the same university

The results proved that *undergraduate inbreeding* is a significant predictor of the number of publications only in the zero part of the model. The odds of having articles/book chapters increased by 34% ($p = 0.038$) when the respondent was an undergraduate inbred, but this effect was not significant for article equivalents. Differences in publication activity between undergraduate inbreds and the other faculty members are small and not robust. For testing the effect of the *postgraduate inbreeding* on research productivity we excluded faculty members without a PhD degree and run the regression on the sample consisting only of those faculty members with a PhD degree. This was done in order to equalize the groups of inbreds and non-inbreds. Otherwise, faculty members who are inbred but simply have not yet obtained a PhD degree would be included to the group of non-inbreds. Postgraduate inbreeding was not a significant predictor of either articles/book chapters or article equivalents. There were no differences between postgraduate inbreds and the other faculty members who had obtained their PhD degree from other institutions. Inbreeding defined by having *at least one degree* from the university where faculty member works is a significant predictor of the number of publication in the zero part of the model. This type of inbred had articles/book chapters and article equivalents with higher (by 64% ($p < 0.001$) and 59% ($p = 0.003$), respectively) probability compared to the non-inbreds. Inbreeding defined by having *the highest achieved degree* from the university where the faculty member works also had a significant positive effect on the probability of having at least one publication. This type of inbred are 39% more likely to have articles/book chapters ($p = 0.022$) and 44% more likely to have article equivalents ($p = 0.017$).

The analysis revealed that there are effects only of undergraduate inbreeding, at least one degree inbreeding, and the highest achieved degree inbreeding. However, only the effects of at least one degree inbreeding and the highest achieved degree inbreeding were stable among different operationalizations of publishing productivity. For the highest achieved degree inbreeding effect *p*-values were very close to the cut off (0.05) therefore these differences may not be robust. We conclude that there was only a robust

effect for at least one degree inbreeding on the research productivity of faculty members. Inbreds having at least one degree from the university where they work had a higher probability (about 60%) of having at least one publication than faculty who do not have any degrees from university where they work. There were no differences in the number of publications between inbreds defined by different types of degree and non-inbreds.

Inbreeding by combination of different degrees from the same university

There were differences in articles/book chapters and article equivalents between super inbreds and faculty who have only one (undergraduate or PhD) degree or no degrees from the same university (absolutely non-inbreds). Super inbred faculty were the reference category in these models because according to the theory they are the most inbred. Super inbreds are more likely (by 36%, $p = 0.045$) to have articles/book chapters compared to absolutely non-inbreds, and had a higher expected number of articles/book chapters compared to inbreds who had only a postgraduate degree from the university where they work (by 22%, $p = 0.042$). But in both cases *p*-values were just below the cut off (0.05), and these effects disappeared for operationalization of publication activity by article equivalents. Therefore we conclude that there were no robust and substantial differences only between super inbreds and other faculty groups.

Inbreeding by PhD degree and first position

The results demonstrated differences in articles/book chapters and article equivalents between pure inbreds and silver-corded faculty members, mobile non-inbreds, non-mobile non-inbreds. Pure inbred faculty were the reference category in models because according to the theory they are the most inbred. The analysis revealed that the group of pure inbreds had a greater expected number of articles/book chapters and article equivalents compared to silver-corded faculty (by 27% ($p = 0.043$) and 26% ($p = 0.035$), respectively). But *p*-values were also just below to the cut off (0.05) therefore these differences may not be robust. There were significant differences between pure inbreds and non-mobile non-inbreds. Non-mobile non-inbreds showed a lower probability of having at least a single article/book chapter and article equivalent (by 35% ($p = 0.036$) and 38% ($p = 0.041$), respectively), and had fewer articles/book chapters and article equivalents (by 22% ($p = 0.006$) and 18% ($p = 0.017$), respectively) compared to pure

inbreds. Therefore we should conclude that there were robust and substantial differences between pure inbreds and non-mobile non-inbreds, but not between pure inbreds and silver-corded.

Inbreeding and the quality of the publishing

To examine the relationship between different operationalizations of inbreeding and the quality of the publishing we fitted a series of logit models where the number of foreign-language and peer-reviewed article equivalents were dependent variables. The results are presented in Table 6. The analysis revealed that belonging to any type of inbreds did not predict having foreign-language publications, but predicted having peer-reviewed publications. Specifically, undergraduate inbreds had a greater probability of having at least one peer-reviewed article equivalent (by 37%, $p = 0.035$). Super inbreds demonstrated a higher probability of having at least single peer-reviewed article equivalent compared to absolute non-inbreds (by 42%, $p = 0.016$) and compared to only postgraduate inbreds (by 49%, $p = 0.012$). There were no differences between pure inbreds and silver-corded, mobile and non-mobile non-inbreds. These effects were also just below 0.05 *p*-values, therefore the differences may not be robust. We concluded that there were no robust and substantial differences in the quality of publishing measured by having foreign-language and peer-reviewed publication between different types of inbreds and non-inbreds.

Table 4. Summary of the NBLH models for articles/book chapters

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	Count RR	Zero OR	Count RR	Zero OR	Count RR	Zero OR	Count RR	Zero OR	Count RR	Zero OR	Count RR	Zero OR	Count RR	Zero OR
Male	1.13	1.11	1.12	1.10	1.20*	1.13	1.13	1.08	1.12	1.10	1.19*	1.14	1.19*	1.13
Years in academia	0.99***	0.98**	0.99***	0.99*	0.99***	0.98*	0.99***	0.99*	0.99***	0.99*	0.99***	0.98*	0.99***	0.98**
PhD degree	1.35**	2.87***	1.38**	2.88***			1.35**	2.82***	1.37**	2.89***				
Professor	2.17***	1.21	2.14***	1.20	2.20***	1.24	2.17***	1.22	2.17***	1.25	2.20***	1.22	2.15 ***	1.23
Associate professor	1.21	0.97	1.19	0.97	1.24	0.90	1.21	1.00	1.21	0.99	1.22	0.9	1.24	0.90
Humanities	1.13	0.91	1.17	0.97	1.14	1.09	1.14	1.01	1.15	0.96	1.12	1.13	1.10	1.05
Social sciences	1.27*	0.93	1.28*	0.96	1.33*	0.77	1.27*	1.00	1.28*	0.96	1.30*	0.8	1.31*	0.76
Technology	1.12	0.80	1.11	0.79	1.14	0.78	1.11	0.74	1.10	0.76	1.14	0.75	1.13	0.77
Research interest (1–4)	1.18***	2.00***	1.18***	2.00***	1.19***	2.03***	1.18***	1.97***	1.18***	1.98***	1.20***	2.03***	1.20 ***	2.03***
NRU status	1.29**	1.96***	1.28**	1.94***	1.43***	1.87**	1.29**	1.96***	1.29**	1.96***	1.37***	1.89**	1.40 ***	1.87**
FU status	1.20	1.19	1.18	1.14	1.06	1.28	1.20	1.11	1.19	1.19	1.04	1.21	1.09	1.31
Mean USE	1.00	0.99	1.00	0.99	1.00	0.99	1.00	0.99	1.00	0.99	1.00	0.99	1.00	0.99
Undergraduate inbreds			1.14	1.34*										
Postgraduate inbreds					1.06	1.38								
At least one degree inbreds							1.02	1.64***						
Highest achieved degree									1.12	1.39*				
Absolutely non-inbred											0.91	0.64*		
Only postgraduate inbreds											0.78*	1.02		
Only undergraduate inbreds											0.84	0.91		
Mobile non-inbred													1.08	0.86
Non-mobile non-inbred													0.78**	0.65*
Silver-corded													0.73*	0.97
Log-likelihood	-3384.43		-3380.48		-2657.31		-3378.71		-3380.47		-2653.92		-2649.25	
AIC	6822.86		6818.95		5368.61		6815.42		6818.95		5369.85		5360.50	
N	1358		1358		1001		1358		1358		1001		1001	

Note. Exponentiated regression coefficients (odds ratios in zero part, rate ratios in count part) are shown in Table. Natural sciences were reference category in all models. Super inbred faculty were reference category in Model 6. Pure inbred faculty were reference category in Model 7. Zero part of NBLH models predicts non-zero values. * – $p < .05$, ** – $p < .01$, *** – $p < .001$.

Table 5. Summary of the NBLH models for article equivalents

	Model 8		Model 9		Model 10		Model 11		Model 12		Model 13		Model 14	
	Count RR	Zero OR	Count RR	Zero OR	Count RR	Zero OR	Count RR	Zero OR	Count RR	Zero OR	Count RR	Zero OR	Count RR	Zero OR
Male	1.19*	1.18	1.18*	1.17	1.25**	1.19	1.18*	1.15	1.18*	1.17	1.23**	1.22	1.24**	1.20
Years in academia	1.00	0.98**	1.00	0.98**	1.00	0.97**	1.00	0.98*	1.00	0.98**	1.00	0.97**	1.00	0.97**
PhD degree	1.32*	3.34***	1.34**	3.35***			1.33**	3.28***	1.34**	3.38***				
Professor	2.02***	2.14*	2.00***	2.12*	1.98***	2.53*	2.01***	2.14*	2.02***	2.21*	1.98***	2.53*	1.95***	2.51*
Associate professor	1.26*	1.13	1.24*	1.14	1.26*	1.12	1.25	1.17*	1.26*	1.16	1.25*	1.15	1.26*	1.13
Humanities	1.15	0.97	1.19	1.01	1.18	1.37	1.17	1.07	1.18	1.04	1.18	1.39	1.17	1.32
Social sciences	1.27*	1.07	1.29**	1.09	1.37**	0.93	1.28*	1.15	1.30**	1.11	1.36*	0.96	1.38**	0.92
Technology	1.11	0.69	1.11	0.68	1.10	0.67	1.11	0.64*	1.10	0.66*	1.10	0.65	1.11	0.66
Research interest (1–4)	1.29***	2.06***	1.28***	2.06***	1.24***	2.15***	1.28***	2.04***	1.28***	2.04***	1.25***	2.14***	1.24***	2.16***
NRU status	0.99	1.63*	0.98	1.63*	1.12	1.49	0.99	1.63*	0.98	1.64*	1.09	1.52	1.11	1.49
FU status	1.00	1.12	0.98	1.09	0.99	1.16	1.00	1.05	0.99	1.12	0.97	1.14	1.00	1.19
Mean USE	1.01	0.99	1.01	0.99	1.00	1.00	1.01	0.99	1.01	0.99	1.00	1.00	1.00	1.00
Undergraduate inbreds			1.13	1.19										
Postgraduate inbreds					1.08	1.46								
At least one degree inbreds							1.05	1.59**						
Highest achieved degree									1.13	1.44*				
Absolutely non-inbred											0.88	0.73		
Only postgraduate inbreds											0.85	1.57		
Only undergraduate inbreds											0.87	0.88		
Mobile non-inbred													0.98	0.82
Non-mobile non-inbred													0.82*	0.62*
Silver-corded													0.74*	1.06
Log-likelihood	-4014.83		-4012.58		-3182.82		-4010.27		-4010.40		-3180.62		-3178.13	
AIC	8083.66		8083.15		6419.64		8078.54		8078.81		6423.24		6418.25	
N	1358		1358		1001		1358		1358		1001		1001	

Note. Exponentiated regression coefficients (odds ratios in zero part, rate ratios in count part) are shown in Table. Natural sciences were reference category in all models. Super inbred faculty were reference category in Model 13. Pure inbred faculty were reference category in Model 14. Zero part of NBLH models predicts non-zero values. * – $p < .05$, ** – $p < .01$, *** – $p < .001$.

Table 6. Summary for logit regression model for foreign-language and peer-review article equivalents

	Foreign-language article equivalents							**Peer-review article equivalents**						
	Model 15	Model 16	Model 17	Model 18	Model 19	Model 20	Model 21	Model 22	Model 23	Model 24	Model 25	Model 26	Model 27	Model 28
Male	0.93	0.93	0.96	0.93	0.93	0.95	0.96	0.90	0.88	1.03	0.89	0.89	0.99	1.02
Years in academia	0.98**	0.98**	0.98**	0.98**	0.98**	0.98**	0.98**	0.98***	0.98***	0.98**	0.98**	0.98**	0.98**	0.98**
PhD degree	2.99***	3.01***		2.99***	3.00***			1.00	1.03		1.01	1.01		
Professor	1.74	1.74	1.84	1.74	1.74	1.83	1.86*	4.06***	3.92***	4.43***	4.00***	4.10***	4.33***	4.38***
Associate professor	0.87	0.87	0.90	0.87	0.87	0.90	0.91	1.57	1.54	1.69*	1.57*	1.58*	1.62	1.69*
Humanities	0.45***	0.46***	0.44***	0.45***	0.45***	0.45**	0.44**	0.76	0.80	0.65	0.78	0.78	0.67	0.65
Social sciences	0.40***	0.40***	0.37***	0.40***	0.40***	0.38***	0.37***	0.71	0.73	0.47**	0.73	0.72	0.47**	0.47**
Technology	0.56**	0.56**	0.60*	0.56**	0.56**	0.60*	0.60*	0.61*	0.60*	0.45**	0.59*	0.59*	0.46**	0.46**
Research interest (1–4)	2.10***	2.10***	2.12***	2.10***	2.10***	2.12***	2.12***	1.68***	1.68***	1.65***	1.67***	1.67***	1.68***	1.65***
NRU status	1.71**	1.71**	1.84**	1.71**	1.71**	1.84**	1.85**	1.62*	1.60*	1.37	1.62*	1.62*	1.30	1.36
FU status	0.91	0.89	0.96	0.91	0.91	0.95	0.95	0.92	0.87	0.87	0.89	0.92	0.82	0.88
Mean USE	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.01	1.01	1.02	1.01	1.01	1.01	1.02
Undergraduate inbreds		1.06							1.37*					
Postgraduate inbreds			0.99							1.30				
At least one degree inbreds				1.00							1.25			
Highest achieved degree					1.02							1.23		
Absolutely non-inbred						0.98							0.58*	
Only postgraduate inbreds						0.97							0.51*	
Only undergraduate inbreds						1.04							0.65	
Mobile non-inbred							0.99							0.79
Non-mobile non-inbred							1.08							0.69
Silver-corded							1.28							0.74
Log-likelihood	-532.98	-532.91	-453.57	-532.98	-532.97	-453.54	-453.24	-580.92	-578.69	-443.94	-579.98	-580.01	-440.70	-443.42
AIC	1091.95	1093.82	933.14	1093.95	1093.94	937.07	936.48	1187.83	1185.38	913.89	1187.95	1188.02	911.40	916.83
Nagelkerke R^2	0.203	0.203	0.189	0.203	0.203	0.189	0.190	0.118	0.124	0.131	0.121	0.121	0.141	0.133
N	1069	1069	847	1069	1069	847	847	1071	1071	849	1071	1071	849	849

Note. Exponentiated regression coefficients (odds ratios) are shown in Table. Natural sciences were reference category in all models. Super inbred faculty were reference category in Models 20 and 27. Pure inbred faculty were reference category in Model 21 and 28. * – $p < .05$, ** – $p < .01$, *** – $p < .001$

Discussion

The current study examined the relationship between academic inbreeding and research productivity among Russian faculty members. According to our results there is no substantial effect of academic inbreeding on publication activity. Only a couple relatively robust differences were revealed. First, inbreeding defined by having at least one degree from the same university where the faculty member works demonstrates a robust positive effect on research productivity. But between at least one degree inbreds and non-inbreds there are differences only in the probability of having at least one publication. In other words, it is less common for non-inbreds to be engaged in research than for inbreds. Second, inbreds who have the highest achieved degree from the university where they work are more likely to have articles/book chapters and article equivalents compared to non-inbreds. Third, faculty members who work at the university where they obtained their PhD degree and got their first position are more productive in publishing compared to non-mobile non-inbreds, but not compared to silver-corded. These results are robust for using different measurements of publication activity.

At first glance it seems that these results mean that inbreds and non-inbreds are equally effective in publishing or that inbreds are slightly more effective. However in interpreting the results it is necessary to note two points. First, we analysed self-reported data about research productivity. Despite their relative reliability (Chan, 2009; M. J. Clark & Centra, 1985), there is no way to evaluate the quality of publications and the criteria for identifying different types of publications by the participants. It does not necessarily follow that the absence of significant differences in the number of publications between inbreds and non-inbreds means there is no difference in their quality. Previous research using data of 'Monitoring of education markets and organizations (MEMO)'[7] showed that despite the similar number of publications, inbreds published at least one article in their own university journal more often compared to non-inbreds (Sivak & Yudkevich, 2015). It is possible that inbreds and non-inbreds just have different publication strategies, which may depend on faculty member orientation (towards close colleagues and the local university community, or towards the national and international community) (Horta et al., 2010). If this is true, then it follows that the standard measures of research productivity, for example, the number of publications, have serious limitations. Having different professional norms, authorities and publication strategies inbred and non-inbred faculty members may have an equal number of publications which differ in quality. Therefore future studies comparing inbreds and non-inbreds need to measure not only the number but also the quality of publications.

[7] https://memo.hse.ru/en/

Second, the data were collected before the reformation of the Russian academic system. As noted above, introduction of 'effective contracts'[8] in Russian universities is expected to stimulate academic mobility and reduce inbreeding by encouraging only the most efficient faculty members and dismissing those who are not. This innovation is also expected to increase the research productivity of faculty members and there is a decree aimed at increasing the number of publications by Russian academics in the international journals included in databases Web of Science and Scopus[9]. However the stimulation of the publication activity prompts some faculty members to publish their articles in 'predatory' journals, characterized by requiring a fee for publication, an opaque system of peer review, very short time between submission and publication, and the large number and low quality of published articles (about 'predatory' journals see Beall, 2016). Sterligov and Savina (2016) demonstrated substantial growth of Russian publications in such journals after the introduction of programs to stimulate publication activity. Officially articles in such journals are peer-reviewed and internationally oriented, but they are difficult to compare with publications in reputable journals. Nevertheless these changes were accepted only in 2012, when the survey used in our research was conducted, and they had little time to manifest themselves in a change of faculty publication activity. That is why we should interpret our results in terms of the peculiarities of the Russian academic system prior to these changes. Previous research conducted before these changes were introduced, showed that in Russia, publishing is not considered to be a professional norm for university faculty: they tend to value teaching above research (Kozmina, 2014) and do not see a direct correlation between their productivity and professional success (Dushina & Asheulova, 2011), as effective contracts stimulating research productivity by relating it to academic salaries, have begun to be introduced in Russian universities only recently. That is why many academics in Russia consider it the norm not to have any publications at all. This is confirmed by CAP data, according to which 27% of Russian faculty members who participated in the survey did not have any articles or book chapters in last 3 years (Yudkevich et al., 2013). In this context a lack of difference between inbreds and non-inbreds can be interpreted by a general lack of desire or necessity to publish. Perhaps the changes in the Russian academia mentioned above have created new incentives for publishing, and differences between inbreds and non-inbreds have appeared. This hypothesis should be tested empirically, therefore a similar study of more recent data is required. From this point of view our results are important because they compare publish rates just before the current reforms and give a benchmark for comparison, and even allow some judgments on the effects of the reforms.

[8] Presidential Decree №597 "On Measures to Implement the State Social/Welfare Policy" dated 7 May 2012 // URL: [http://минобрнауки.рф/документы/4716]. Accessed 28 March 2016.

[9] Presidential Decree №599 "On Measures to Implement the State Policy in the Sphere of Education and Science" dated 7 May 2012 // URL: [http://минобрнауки.рф/документы/2257]. Accessed 28 March 2016.

Our results also show that different operationalizations of inbreeding lead to only slightly different results on the same dataset. For example, undergraduate inbreeding has an effect on the probability of having publications, whereas the postgraduate effect does not. But as noted above the effect of undergraduate inbreeding is not robust. Since the relationship between academic inbreeding and publishing productivity does not substantially depend on inbreeding operationalization, the results of studies where different operationalizations of inbreeding are used may be compared in general. At the same time, our literature analysis shows that it is difficult to transfer the results about relationship between academic inbreeding and research productivity obtained from the one academic system and country into the context of others. It is possible that the practice of academic inbreeding could have different consequences in different academic systems and should be assessed in different ways.

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Appendix

Classification of empirical research on the link between inbreeding and productivity, based on different operationalizations of inbreeding

Operationalization of inbreeding	**Authors**	**Specific definitions of inbreeding**	**Country**	**Sample**	**Main results**	**Link between inbreeding and productivity**
Inbreeding by any level of graduation (at least one of educational levels are received in the university of employment) Different levels of inbreeding	Eells & Cleveland (1935a, 1935b)	Level of inbreeding – institutional	USA	2036 comparable pairs of inbreds and non-inbreds from 219 institutions from 42 states	Inbreds publish less books, and the total number of publications (books and articles) is also less for inbreds, although the difference is not so evident	Negative
	Morichika & Shibayama (2015)	Level of inbreeding – institutional (graduation from University of Tokyo)	Japan	Longitudinal micro-data for the graduate School of Pharmaceutical Sciences (University of Tokyo) Two panels: 1) 32-year panel for 46 academics (full professors – principal investigators), active since 1980 2) Lab-level panel for 20 laboratories Source of data: WoS, CV and archive university data	Inbreeding at the university level has a positive effect. The external affiliation does not matter for this level of inbreeding. The positive effect of university-level inbreeding is attributed to high performance of top-school graduates. Inbreeding at university level has negative effect on lab-productivity	Positive (at individual-level analysis) Negative (at laboratory-level analysis)
		Level of inbreeding – departmental (graduation from School of Pharmaceutical Sciences within University of Tokyo)			Department-level inbreeding has a negative effect and it is mediated by pre-promotion productivity: selection for promotion of more productive academics. Inbreeding with external experience has a more strongly negative effect (explanation: relatively high performers continuously stay in the home affiliation while relatively low performers have to get external experience before promotion to full professors). Inbreeding at departmental level has positive effect on lab-productivity	Negative (at individual level) Positive (at laboratory level)
		Level of inbreeding – laboratory (graduation from the same laboratory within the School of Pharmaceutical Sciences)			Lab-level inbreeding does not have a significant effect on productivity Inbreeding at laboratory level has negative effect on lab-productivity (insignificant in case of separate analysis)	Null (at individual level) Null (at laboratory level)
	Sivak & Yudkevich (2009)	Level of inbreeding - institutional Insiders – faculty, who had graduated from the university of current employment and who had not worked anywhere else during the last academic year	Russia	Survey of faculty in economics of 150 departments of 28 higher educational institutions in Saint-Petersburg. 740 faculty and 99 department chairs were	Insiders and outsiders have different publication strategies: insiders have fewer publications in national Russian journals (better) and more – in journals of their university (worse quality in general). Outsiders, on the contrary, are more productive in national journals.	Null (but quality of insiders' publications has slightly negative connotation)

Operationalization of inbreeding	Authors	Specific definitions of inbreeding	Country	Sample	Main results	Link between inbreeding and productivity
		Outsiders – faculty who had not graduated from university of current employment. Do not matter, where they worked last academic year – only at the university of current employment, at another university or at current university and elsewhere more.		surveyed by formal questionnaire and 57 vice-rectors and economic faculty deans were interviewed	Although these difference is significant only at *p*-value = .07 level.	
	Sivak & Yudkevich (2015)	Level of inbreeding – institutional	Russia	Monitoring of Education Markets and Organizations data (2012)	Inbreds seem to be more productive by total number of publications, by their targets of publication (journals) are different from those of non-inbreds. They more often publish in their university journals (52% compared to 42% of non-inbreds).	No result (only descriptive analysis without testing statistical significance. But quality of publications of inbreds is worse)
	Sologub & Coupé (2015)	Level of inbreeding – institutional	Ukraine	424 faculty members from a random sample of about 50universities from all regions and all scientific fields in Ukraine, conducted by Centre for Society Research in 2013.	Research output (number of publications in Ukraine and CIS and in other countries during the last 3 years) does not differ for inbreds and non-inbreds.	Null
	Roleda et al. (2014)	Level of inbreeding – institutional Use modified scheme of mobility in education (inbreeding) and work, proposed by Horta (2013)	Philippines	Full-time faculty of De La Salle University (Manilla), who have publications at Scopus	Neither academic inbreeding nor academic mobility are significant predictors of research productivity of academics.	Null
Inbreeding by highest degree (the highest level of education received at the place of current work) Academics with outside working experience (silver-corded) are not considered inbreds Different levels of inbreeding	McGee (1960)	Level of inbreeding – institutional	USA	Records of 354 full-time junior faculty in University of Texas in 1957	Inbreds in University of Texas produce more scholarly books and articles compared to non-inbreds.	Positive
	Sato (1992)	Level of inbreeding – departmental (nusrsing school)	USA	Self-Study Report of 1671 faculty on tenure track from 36 schools of nursing that received continuing National League for Nursing accreditation during 1985-1988	There is no statistically significant difference in number of publications that inbreds and non-inbreds in nursing have. Rank control showed that inbreds of every rank had higher mean number of publications (insignificant difference).	Null
	Shen, Xu & Zhang (2015)	Level of inbreeding – institutional	China	Data from 2 sources: 1) CVs of 4743 faculty from 86 schools of physics, life sciences,	CAP Data: inbreds at lecturer positions have a little more publications, compared to non-inbreds, but at higher positions of associate and full professors non-inbreds	Mixed (differ on position and discipline)

Operationalization of inbreeding	Authors	Specific definitions of inbreeding	Country	Sample	Main results	Link between inbreeding and productivity
				economics and engineering, referring to 37 '985 universities' 2) CAP Data: 3612 academics from 68 higher educational institutions	are more productive. Non-inbreds are more productive in average. Bibliometrics Data: inbreds have more articles in both CNKI (China National Knowledge Infrastructure) and SCI (Science Citation Index) in physics and life sciences, but less articles there in engineering and economics, compared to non-inbreds.	
	Klemenčič & Zgaga (2015)	Level of inbreeding – institutional	Slovenia	728 academics, employed at Slovenian higher education institutions. Source: EUROAC survey of academic profession in Slovenia (2013)	Inbreds produce more books and articles, edit and prepare more scientific reports compared to non-inbreds. The only exception is editing international scientific books (reported by10.4% non-inbreds and 8.1% inbreds).	Positive
Inbreeding by bachelor degree Different levels of inbreeding	Clark & Larson (1972)	Level of inbreeding – the same denominational affiliation Inbreds are those faculty who had received their bachelor degree from the same college or another college with the same denominational affiliation	USA	236 faculty in liberal arts, working in 10 church-related and state small colleges in the USA: 115 faculty from church-related colleges (different Protestant denominations) and 121 from public colleges	Productivity of inbreds at church-related colleges does not differ significantly from that of non-inbreds (70% of inbreds and 75% of non-inbreds are productive) No information on public colleges	Null
	Smyth & Mishra (2014)	Level of inbreeding – departmental (law school) Inbreds – faculty hired by the LLB degree granting law school immediately after graduation Silver-corded faculty, hired by their Alma-Mater after been affiliated with another law school or university because of 1) being hired; 2) pursuing postgraduate studies; 3) private practice.	Australia	429 academics, taking assistant professor position or above in law and listed at staff web-page of one of 21 Australian law schools at June 2011	There is no statistically significant difference between the research productivity and impact of inbred and non-inbred faculty. This finding is robust to a range of different ways of measuring research productivity and impact and alternative econometric approaches Silver-corded faculty outperform other faculty on one of the measures of publications in top journals. But this finding is not robust, thus it may be concluded that they do not differ significantly from inbreds and non-inbreds.	Null
Inbreeding by bachelor (LLB) or PhD (JD) degree Level of inbreeding –	Eisenberg & Wells (2000)	Faculty is inbred if his first full-time, tenure-track teaching position is at the same law school from which the faculty member received a J.D. or LL.B. degree.	USA	Sample includes 32 law schools and approximately 700 entry-level faculty members (teaching more than 7 years)	Scholarly impact is measured by citation frequency. Results show that papers by inbred entry-level law school faculty members are much less cited than papers by their non-inbred colleagues.	No results (negative link with citation rates)

Operationalization of inbreeding	Authors	Specific definitions of inbreeding	Country	Sample	Main results	Link between inbreeding and productivity
departmental (law school)		Faculty members who started teaching at schools other than their J.D. school (silver-corded) are not treated as inbred even if they eventually return to their J.D. school			Overall pattern of performance of inbreds is inferior.	
Inbreeding by PhD degree. Inbreds include "silver-corded" – faculty who work in their Alma Mater after being employed outside it. Level of inbreeding – institutional	Wyer & Conrad (1984)		USA	3054 faculty with doctoral degree (PhD, EdD, etc) from virtually all major academic disciplines from 160 universities (345 inbreds and 2709 non-inbreds) Source: 1977 Survey of the American Professoriate	Comparison of means shows that research productivity of inbreds and non-inbreds does not differ. But adjustment for efforts (time allocation) shows that inbreds are more productive in all areas of scholarly research, compared to non-inbreds: inbreds produce more scholarly papers of different types by time unit	Positive
	Horta, Veloso & Grediaga (2010)		Mexico	414 academics from 14 higher education institutions and all scientific field Source: survey of Mexican scholars from majority of institutions and practically all fields, conducted in 2002	Inbred faculty generate on average 15% fewer scientific papers than noninbreds	Negative
	Cruz-Castro & Sanz-Menéndez (2010)	Inbreds are those academics who got tenure in the same place where they were awarded PhD (including 'silver-corded')	Spain	1583 academic scientists from all types of Spanish higher educational institutions in 3 scientific fields: Biological and Medical Sciences, Exact and Natural Sciences and Engineering and Natural Sciences. Sources: mail survey, conducted in 2005 and list of publications, included in Science Citation Index	There is no statistically significant difference in productivity of inbreds and non-inbreds, neither of them are more productive. Although, inbred status before tenure lead to production of 15.3% less papers compared to non-inbreds (*p*-value only at 0.1 level)	Null (before tenure inbreds are less productive)
	Inanc & Tuncer (2011)		Turkey	236 faulty of mechanical and aeronautical engineering departments from 4 technical Turkish universities Source of data: faculty CV and WoS and Scopus Data	Inbreeding has a negative impact on apparent scientific effectiveness of faculty. For inbred faculty, the h-index is about 89% lower when compared to the non-inbred faculty.	No results (negative link with Hirsh-index)

Operationalization of inbreeding	Authors	Specific definitions of inbreeding	Country	Sample	Main results	Link between inbreeding and productivity
Inbreeding by PhD degree. Silver-corded are defined as a separate group and excluded from analysis. Level of inbreeding – institutional	Pan (1993)	Silver-corded are not defined separately and are not included in inbreds in this study.	USA	Survey of 355 randomly selected department chairs from 11 land-grant universities from different US States from: Agriculture / Natural Resources, Environmental Sciences; Business and Management; Education, Family and Consumer Sciences; Engineering and Technology; Liberal Arts / Sciences; Medicine / Veterinary Medicine	Research productivity of inbreds and non-inbreds does not differ	Null
	Albarrán, Carrasco & Ruiz-Castillo (2014)	Inbreds are those economists who work in their PhD and first position universty	USA and Europe	Initial sample: 2605 highly productive in 2007 economists from 85 institutions Sources: 2530 scholars belong to 81 top world Economics departments and 75 are Fellows of the Econometric Society working in 2007 somewhere else Sample for inbreeding analysis: 1009 EU economists and 1589 US economists	In EU sample inbreeding variable has negative sign, but is insignificant: no clear evidence of the deleterious effect on economists' productivity a priori attributed to the inbreeding practice In US sample inbreeding variable is significant with negative sign: there is some weak evidence that inbreeding practices have some negative effect on productivity of the economists that work in the U.S. in 2007	EU sample: null (negative but insignificant regression coefficients) US sample: negative (although weak)
Inbreeding by PhD degree. Level of inbreeding – institutional Different groups of inbreds and silver-corded are defined and compared	Hargens & Farr (1973)	'Always inbred' – work in PhD department immediately after graduation 'Silver-corded' – work in PhD department after being employed outside it (secondary position, first was in another place)	USA	Systematic random sample of graduate faculty in mathematics, experimental biology, physics, chemistry. 1165 scientists. Data from 'American Men of Science' and 'Science Citation Index'	Always inbred and silver corded have less publications and citations than non-inbred, but this difference is not so evident for distinguished departments	Negative
	Dutton (1980)	Pure inbreds – highest degree, first position, and current position are in same institution Silver-corded – highest degree and current position are in the same	USA	2322 male PhD faculty of physics, economics, sociology and earth science – subsample from national general-purpose survey of faculty,	Pure inbreds publish fewer articles, but more books and monographs. There publications are less cited. Silver-corded status is not a significant predictor of publication activity and	Mostly negative (except books)

Operationalization of inbreeding	Authors	Specific definitions of inbreeding	Country	Sample	Main results	Link between inbreeding and productivity
		institution, but first position was in another institution		undertaken by American Council on Education in 1972-1973	citation level.	
	Horta (2013)	Pure-inbreds – faculty that had spent all their doctoral education and academic career at the same university, without spending outside it even a short period	Portugal	1420 academics working in 18 higher education institutions Source: online survey, conducted specifically for the research	Pure inbreds produce 20% fewer articles in international journals than non-inbreds, out-producing the latter only in the production of articles in national journals by 28%	Negative (but pure inbreds have higher internal productivity)
		Mobile-inbreds – faculty that have either spent a research or teaching spell at other university during the PhD degree or did a post-doc at other university (or did both) before taking the first academic appointment at their Alma Mater			Mobile inbreds do not differ from non-inbreds in terms of articles published in international journals, although they publish 21% more articles in national scientific outlets than the latter	Null (but mobile inbreds have higher internal productivity)
		Silver-corded faculty – highest degree and current position are in the same institution, but first position was in another institution			The same productivity in international journals as non-inbreds have, but silver-corded also out-produce the latter in the production of articles published in national journals by 40%	Null (but silver-corded faculty have higher internal productivity)
Inbreeding by address of first publication Level of inbreeding – institutional	Navarro & Rivero (2001)	Inbred are those academics whose address of first publication coincides with the current address as a faculty member	Spain, USA, UK, France	40 randomly selected researchers in each country (160 totally), holding permanent faculty positions in science departments. Source: Web of Science	In Spain only 5% of academics were not inbreds by this definition, while in 3 other countries the majority of academics worked in the university, other from that of the first publication	No results

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