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Elections, Productivity and Incentives of scientists in the Russian Academy of Sciences. The case of Math section.

Abstract

The paper analyzes the elections to the Russian and USSR Academies of Sciences for the Mathematics section, particularly (1) the factors that determine elections outcomes and (2) the effects of obtaining Academy membership on the productivity of scientists. The Russian sample covers 7 election episodes occurred during 1992 to 2008, and contains information on 340 candidates, including their lifetime productivities, measured by h-index, number of citations to their papers, total publications, language of the papers, and their degree of collaborative behavior, measured by the average number of coauthors they had. The Soviet sample covers 6 elections held between 1974 and 1990 excluding 1976 and contains the same information on 180 mathematicians. The results suggest that there exists a negative short-run trend in the development of the mathematics section of the Academy – scientists of top quality are not elected and those who elected experience earlier productivity drops.

Contents

I Introduction

The focus of the study is the Russian Academy of Sciences (RAS) which plays a significant role in the formulating and implementing the fundamental research agenda in Russian Federation. It unites 470 research institutions, more than 50,000 researchers (2008) and allocates about two thirds of state funds directed to basic research (Guriev et al, 2009) That is why, it is highly important to know, especially in the context of the innovative direction of development of the country, whether this organization works efficiently in modern Russia as it seemed to do in the Soviet times. By saying efficiently, I mean that the Academy optimally implements the following goals:

1. It efficiently distributes the funds according to the goals of the Russian State
2. Its members symbolize and serve as an example of excellence in science for current and the next generation of scientists.
3. It provides extensive and qualified policy advice and expertise to the government
4. It creates incentives for its members and those aiming for membership to perform better

The primary goal of this paper is to examine the implementation of (2) and (4). Particularly, I study the elections mechanism of RAS members which influence the quality of researchers in organization (2) and incentives to do research before and after the elections (4). Additionally, it indirectly affects issues (1) and (3) since elected members participate in the decision-making of RAS by casting their votes on the meetings and during the discussions with their peers. Moreover, newly elected members are the younger ones in the Academy thus more prone to initiating changes.

Two basic questions regarding the election mechanism are asked. First, which candidates' characteristics affect the probability of becoming a member. Or, looking at it in a different way, what incentives does the election process impose on scientists who want to be elected, that is, which goals and behavior should they pursue if they want be elected with greater probability.

The candidates' characteristics of concern are their publication activity, citations to their publications, language they use for academic works, as well as number and type of their coauthors. The second question deals with the effect of obtained rank of Academy member on her further productivity taking into account her natural lifetime productivity trend. RAS has two ranks - a corresponding member and a full member (a higher one). Usually, a scientist first becomes a corresponding member and after that is nominated for a full membership. Though, there are no any restrictions on the process. The desired rank (any of them) is indicated in the application profile of a nominated candidate.

The plausible feature of this study is that I consider the Academy elections in time perspective – identifying the determinants of being elected from 1974 to 2008, and the effect of obtained membership on productivity from 1946 to 2008. I look at the Math section of the Academy and there are two reasons for that. First, math section of USSR Academy was indeed an example of excellence in science and serves as a benchmark. Second, math branch was always integrated in the international science and it is easier to make publications and citations comparisons in time. Across time I differentiate mainly between two periods – the Soviet one (before 1991) and the one of modern Russia (after 1991). It is a well-known fact that fundamental research activity in Russia has declined sharply and continues to do so. According to (Nalimov and Mulchenko, 1969) the share of Russian-language scientific publications accounted for more than 20% of world publications in 1969. As of 1997-2001, publications of Russian scientists constituted 3.4% (King, 2004) and 2.6% in 2004-2008 (Adams and King, 2010). That is why, it is really important to understand the difference in incentive systems created by USSR and Russian AS[1].

It is also worth noting that in order to become a candidate to membership, a scientist should be nominated. I do not consider the nomination mechanism here. It is a separate and a very interesting question of how scientists get nominated and the factors determining it.

The remainder of the paper is organized as follows. The next section discusses the relevant

[1] AS is a shortcut Academy of Sciences thereafter

literature. The third section formulates the hypotheses. Section IV describes the data. Section V presents the results. Conclusions follow in Section VI.

II Literature overview

Elections have always been exciting for economists. However, most of the focus lies on political elections since they directly affect people's everyday lives. Much less literature is dedicated to other types of elections, for instance, elections in the academic circles. Though, the author has found several pieces of research on this.

Determinants of elections outcomes

Eugene Garfield (Garfield, 1992), regarded as one of the fathers of the sciento- and bilbiometrics, looked at Nobel prize winners and discovered that in general the average paper of a Nobel laureate (years 1960 – 1978) is cited 25% more than a paper by a non-laureate but a top cited author. Also he found that overall citations index is also about 20% higher. And if the laureates are compared to all authors who published in the journals indexed in the ISI[2] database, then the Nobel laureate receives 30 times more citations than an average author.

Hamermesh and Schmidt (2003) analyzed elections of Fellows of the Econometric Society during1990-2000 and found that increase from less than 10 to more than 50 average candidate citations[3] for two years prior to elections, increase chances to be elected (roughly) from 20% to 60%. Though, the focus of their paper was on fairness of elections. Namely, they tried to understand whether there are any candidates' characteristics other than quality such as current geographic location, affiliation and field influence election outcomes. The conclusion was that there might be some unfairness in the process which was designed half a century ago, and proposed several ways to improve the mechanism.

Regarding the Russian Academy of Sciences, there are several publications in the press on the topic. Shtern (2008) studied the 2008 elections in the physical, mathematical, biological, and "nanotechnology and IT" sections. He noticed that for most elected members their citations indices were less than the mean and median sample values. Galaktionov (2008) did the similar

[2] ISI – Institute for Scientific Information

[3] It is not quite clear from the paper what authors mean by 'average candidate citations'

exercise but using different citations database and, looking at the math section, found out that among the candidates were extremely highly cited mathematicians but they were not elected.

These adverse selection effects might lead to implications about the efficiency of the electoral procedure of the Academy. Though, if we look at the electoral rules of the National Academy of Sciences of the USA, briefly explained in (Alberts, 2005), at first sight, it does not differ much from one existing in Russia. Additionally, average age of newly elected member in the US in 2003-2005 equals 56 and in Russia during 2000s it is around 55. (Andreev and Jdanov, 2007) This in a way adds some evidence of similarity between the systems meaning that given the right people the system may lead to satisfactory results, that is elect the right people. Quoting a famous Russian mathematician Vladimir Arnold "the first-class mathematician differs from the second-class mathematician in that the first-class one prefers to work with more qualified colleagues, and the second-class one wants to see weaker colleagues around" (Galaktionov, 2008). Indeed, according to the Academy Charter (RAS Charter) "scientists contributing scientific works of primary importance are elected Full Members of the Russian Academy of Sciences; scientists contributing outstanding scientific works are elected Corresponding Members of the Russian Academy of Sciences." But what could serve as a measure of quality?

Measures of scientific contribution

There are several objective indicators. All of them are, surely, based on the evaluation scientist's main product – her publications. Some scholars just take simple sum of all the publications obtaining total publication number, some of them weigh each publication (in case it is a paper) with the corresponding journal impact factor, others multiply each publication by number of citations to it and obtain citations index of the author, sometimes paper's weight on number of coauthors. There are also scholars who consider papers published in top journals only. Apart from the citations index, another elegant measure of scientific productivity was recently proposed by Jorge Hirsch (Hirsch, 2005) called h-index. It is very popular at the moment since it takes into account both publications and citations activities. It is defined as follows:

A scientist has index $\boldsymbol{h}$ *if* $\boldsymbol{h}$ *of her* $\boldsymbol{N_p}$ *papers have at least h citations each, and the other* $\boldsymbol{N_p - h}$ *papers have at most* $\boldsymbol{h}$ *citations each.*

Certainly, one could come up with other measures of scientific activity, and, in fact, it is a very dynamic field in Information Science. For instance, see papers on Pi-index (Vinkler, 2009) or improved h-index corrected for multiple authorship (Hu et al., 2010).

In this paper I use total publications, citations index (citations-weighted publication) and h-index measures. Though, according to Garfield (1973) *"There are many areas in mathematics, number theory in particular, where the number of people working on a particular problem is so small (only three or four in some cases) that, however distinguished their work, it can never be highly cited."* That is, one should always be aware of it when assessing the results involving citations indicator (or based on citations, like h-index) as a measure of productivity. However, in the context of this work, it should not influence results much since average effects are of concern.

Incentives for doing research in Academia

Another strand of literature considers the incentives in the Academia. Salary, tenure and academic rank are the most common ones. It turns out that research productivity measured as publication and/or citations is a significant determinant of these. Regarding salary relationship, see, for instance, Kenny and Studley (1996), Moore et al.(2001), regarding tenure and academic rank – McDowell et al. (2001) , Coupe et al. (2006), Ginther and Hayes (2003), Ginther and Khan (2004), and Takahashi and Takahashi (2010), which also has salary and labor mobility as dependent variables.

As for the case of Russian and Soviet Academies of Sciences, scientists have/had the following incentives following the membership: (1) money paid just for the rank, (2) respect in the masses, (3) honor in the academic community, (4) more administrative work (probably, disincentive on average). The first one was a significant motive in the USSR and less likely so in Russia (see table 1 in Appendix, comparing salaries of Academy members in different periods). The second motive has also seem to undergo serious deterioration. First, as it stated in (Zezina, 1997) the rates of labor growth on scientific profession, due to huge propaganda of Soviet scientific achievements, was unprecedented and peaked in 1950-1970s – from 160 thousand of researchers in 1950 to 350,000 in 1960 and to 930,000 in 1970. The prestige of a full member of an academy in Soviet times was comparable with that of a senior politician (e.g. minister) (Akhmanov, 2008). Nowadays, this is not the case for sure. Second, respect in the masses hugely declined with myriads of fake "Academies" emergence in 1990s and founded by people outside of any scientific field . As for (3) and (4), it looks like that even if there were some changes, they were much less than for the first two.

Lifetime productivity distribution

And one more issues I want to discuss here which is very close to the previous one but considers research work in the time perspective, namely, lifecycle productivity in the Academia.

Productivity, that is, amount of value produced in a time period, depends on the amount of her human capital and exerted efforts (in other words time devoted to work). The dynamics of human capital is determined by investments in it and depreciation rate. The decision regarding time allocation between work, investments in human capital and other activities depend on different things. The cases in point studied in the literature are salary, job promotion incentives, job security (tenure), gender, marital status, as well as signaling mechanisms and career concerns. All of these factors shape the lifetime productivity curve. In this paper I am interested in the productivity change due to becoming a member of the Academy.

I define productivity as amount of scientific contribution (one of the measures discussed above) per unit of time. That is, productivity could be measured as average number of publications per year, or number of overall citations to the publications written in the current period. However, one might also think of a measure that accounts for the timing of citations and discount papers citations which came later[4].

Diamond (1986) examined productivity cycles of 45 UC Berkeley mathematicians. He identified a declining productivity trend in terms of publications (−0.02 per year) and citations (−0.75 per year). Additionally, for a larger sample scientists including physicists and economists of he counts number of citations per year for all the papers written before this year, which he calls returns to human capital, and finds hump-shaped over-time relationship. Oster and Hamermesh (1998) consider economics faculty from top US research institutions who obtained their PhDs from 1959 to 1983 and find the declining trend of roughly 5% a year after the peak productivity in terms of publications (therefore, the form is also hump-shaped). Also they did not find any significant difference in this decline between top researchers and the average ones. Kanazawa (2003) finds physiological and psychological reasons for a hump-shaped (with the peak at 30-40 years) age-productivity curve in creative professions (scientists, artists, jazz musicians). Jones (2010) studies the sample of Nobel laureates and great inventors and finds that the mean age of great discovery is shifting to larger values across time (because of larger investments in education). So that a famous Einstein quote *"A person who has not made his great contribution to science before the age of thirty will never do so"* may no longer be valid.

Some studies use more complicated regression specification, namely they use five-degree polynomials of time in studying the productivity trend which often results in a two-hump-shaped form. Goodwin and Sauer (1995) for a diverse but not complete sample within top40 economic faculties using a Poisson regression found a two-hump shape productivity profile with a second hump slightly lower that the first one. Similar two-hump-shaped relationships of productivity and age are found in an early study by Levin and Stephan (1989) on the sample graduate faculty of physics, earth sciences and biochemistry. Kenny and Studley (1995) did not find the second hump, however, their "right tale" (in terms of time) was too short to find it.

[4] Though author has not seen any papers implementing this idea

All of the papers above considered lifecycle productivity as is and did not identify any changes in incentives such as promotion or getting a tenure. Though some scholars using the information on the time of promotion / obtaining a tenure try to find the effect of this change in incentives. Backes-Gellner and Schlinghoff (2005) provides evidence for the United States and Germany indicating that promotion tournaments give rise to an increase in research productivity before promotion and a lapse of productivity afterwards. Moreover, they show that the career profiles of German economists is characterized by a more pronounced post-tenure decline than the profiles of their American colleagues, the reason being that the German university system lacks a second career step, namely promotion to full professor. Analyzing publication records of 650 economists who are members of the top-1000 group according to a worldwide ranking, Coupé et al. (2006) corroborate the result that promotions cause cyclical deflections in research productivity: pre-promoted economists are more productive than post-promoted ones, and tenure has an additional negative effect on research productivity.

I will not consider here theoretical results regarding the choice of the productivity trajectory taking into account career concerns, promotion tournaments, signaling mechanisms, and human capital accumulation, which aim to explain empirical results discussed above. One can find them using the mentioned keywords. For an extensive review of aging and productivity literature, see Skirbekk (2008).

III Hypotheses

First thing I test in this work is how the scientific contribution of a mathematician influences the probability of becoming a member of the Academy, that is being elected. Surely, as it was already discussed above, one expects this relationship to be positive. First, because it is stated in the RAS Charter that making a huge contribution in science is a prerequisite for becoming a member. Second, because if the relationship is positive, it incentivizes the scientist to work harder in order to obtain membership, which serves the mission of the Academy.

The second question I am asking here is whether there are any other determinants of the success in the elections process. And I propose two possible channels of influence. First, those authors who ceteris paribus collaborate more with others (i.e. have more coauthors) are more recognizable in the academic community and thus deserving more trust and therefore chances to enter the AS. Also, candidates may have political connections in the Academy (i.e. have current Academy members as coauthors) which also increase their chances to win. The second channel may lie in the field of loyalty to the Academy. Probably, those mathematicians who publish their papers in Russian are regarded as more loyal to the Academy or in a sense patriotic which surely may influence their chances to become elected.

The third thing I am interested in is the shape of lifetime productivity distribution of scientists.

The fourth issue I am studying in the paper is the difference between Russian and USSR incentive systems in terms of the magnitudes of the effects I considered right above.

And, finally, as a side-product of the project I am assessing the claim made by Jorge Hirsh that his index *h* is related to citations index according to the following equation: $citations\_index = const * h^2$, where *constant* lies between 3 and 5 (Hirsch, 2005).

IV Data

Candidates elections data

The candidates' full names and the elections results were drawn from the archives of Russian Academy's official newspaper "Poisk", Soviet Academy's official journal "Vestnik Akademii Nauk SSSR" and the archive of a Full Member A.P. Yershov (Yershov, 2010). Overall, there were 340 authors who participated took part in the RAS elections from 1992 to 2008, specifically in 1992, 1994, 1997, 2000, 2003, 2006, 2008. As for the Soviet Academy elections, I obtained names of 180 mathematicians who participated in USSR AS elections of 1974, 1979, 1981, 1984, 1987, and 1990[5]. The names of the winning candidates are available for all elections beginning 1938 up to now – 106 of them.

Candidates publications data

The data on lifetime scientists' productivity comes from the MathSciNet web engine, collected and supported by the American Mathematical Society. A query to the database for every mathematician in the sample was made, which extracted the full list of her articles[6] along with the following essential information on each paper: (co-)authors' IDs in the database, year of publication, number of references, language and journal. Thus, a full lifetime productivity distribution of every scientist in the sample was obtained. Though not all of the fields of the engine resulting page were easily grabbed, most of them were successfully parsed with the written Javascript code[7].

The data used in the paper is stored as two STATA datasets – one, containing information on all the papers written by the authors of concern, and another one describing authors' aggregate productivity characteristics and their elections history. The first one is used to answer the questions about the productivity distribution and its potential change following the fact of being elected, the second – to understand the elections mechanism.

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[5] There is also data for 1938 elections but I do not use it in analysis.

[6] the article was in the database if: (1) it was published in the set of journals scanned by MathSciNet (over 400 of them) (2) it was refereed no earlier than 1940, though could be published before 1940

[7] in order to extract the contents of the webpage the Greasemonkey Firefox browser plugin was used

More than 32,000 publications were written by prospective Academy members, the first indexed in the database as of 1931, and the last of 2009.

There were some problems with authors' identification. 5 of them (3 from Russian and 2 from Soviet sample) were not identified by the database. I did the manual check via Google and found out that two Russian mathematicians are computer scientists which do not have any publications though have extensive business experience. Two of them (one Russian and one Soviet) are not found by Google. The remaining soviet one is indeed a mathematician but it seems that he did not publish except a coauthored book with math problems for schoolchildren.

Not every publication had the language description. Language was identified for about 11,000 publications – approximately 6,000 and 5,000 of them are written in Russian and English respectively.

One can obtain author's citations index in two ways. First, it is directly displayed at the MathSciNet author's webpage. Second, one can sum up citations to all author's publications. These two measures do not coincide. For half of the authors one exceeds another, for another half – vice versa. Though, the correlation between them is 0.95.

It was hard to obtain the year of birth for each candidate since many of them do not have personal webpages and information on them is not publicly available. That is why, I proxy year of birth by the year of the first publication subtracting 22 which follows from the bivariate regression of year of birth for randomly chosen 16 scientists[8]on year of earliest publication (see graph 1). Though it is not a good measure for weak scientists since they may have first publications in the journals index in the MathSciNet when they are far older than 22.

Data description

There are some interesting facts about the sample I use. There are 3 mathematicians with no publications (2 from Russian and 1 from Soviet sample). There are 46 Russian and 18 soviet

[8] Actually, 30 were chosen but information was available for 16 only

scientists with zero citations index. 6 of them are elected to RAS – 4 in 2008, 2 of them – computer scientists, 1 – in 2006 and 1 in 2003. 3 of 18 Soviet zero-cited scientists were also elected to the Academy.

Average age of a candidate is 52. Average age of a candidate elected as a full member is 57 (lowest 39, highest 75), as a corresponding member – 49 (highest 69, lowest 33). Average share of Russian-language publications is 66% for Soviet and 62% for Russian candidates.

5% and 10% of RAS candidates in the sample were elected as full and corresponding members compared to 7% and 12% of USSR AS accordingly.

Summary statistics is reported in table 1[9]. Main variable correlations are presented in table 2.

Generated variables

It seemed reasonable to generate citations index and total publications index at the moment of elections. These values are closer to the information of the Academy members had at the instant of elections. However, some candidates run several times for the membership. For those I generated the average value of citations/publications she had at the instants of elections she took part in.

Share of Russian-language publication were counted as share of publication with determined Russian language divided by the sum of publication with determined English and Russian languages. Though for only third of the publication the language was identified, it might not be a very accurate measure.

[9] all tables and graphs are in the appendix

V Results

V.A Elections outcomes determinants

First, it makes sense to perform a graphical analysis. For this purpose I draw nonparametric plots of elections outcome (1 if elected, 0 if not) on the scientific contributions measures– citations index, total publications and Hirsch index (counted both at the time of elections and overall; citations and publications are also plotted in logs[10]). From figures 2-7 one can see that in both Academies *on average* the relationship is positive – the better the quality of a scientist, the more chances she has to become a member. And for the most of the range of scientific contribution measure (any of them) graphs go very closely. Though, for Russian AS relationships might seem a little bit flatter, and what is really important is that the most cited authors, or the right tale of the graph, is flat or even negative in contrast with positive relationship in USSR AS. Regarding the regression analysis, two types of models are estimated: linear OLS and probit[11]. The unit of observation is an author.

(1) $\mathbb{E}\{elected|X\} = f(X)$

(2) $\mathbb{E}\{elected|X\} = \mathbb{P}(f(X) + \varepsilon \geq 0) = \Phi(f(X))$, where

Φ(t) – normal cdf,

$$f(x) = const + (\beta_1 + \alpha_1 Soviet_i) scientific\_contribution\_measure_i + (\beta_2 + \alpha_2 Soviet_i) collaboration\_measure_i + (\beta_3 + \alpha_3 Soviet_i) share\_publications\_in\_Russian_i + \beta_4 age_i + \beta_5 age_i^2 + election\_year\_dummies$$

Citations index, total publications number and Hirsch index are used as scientific contribution measures. I could include them together in the regression equation, however, it may lead to overcontrolling since correlations between these measures are pretty high (0.7 – 0.9, see Table 2).

[10] logs in this paper are taken with the base 10

[11] The very close results are obtained if the logit model is used

There are two measures of collaboration I used. First, it is simple number of distinct coauthors of the current author *i*. Second, I counted those coauthors who were already members of the academy at the moment of the elections. I also tried to weigh these coauthors by their scientific contribution indicators (citations index, publications activity) but this did not add anything valuable to the results. The bivariate relationships between elections outcome and collaboration measures are drawn in figure 7. The same relationships for the share of Russian-language publication are in figure 8.

In order to compare the degree of difference between Russian and Soviet Academies I joined the samples of Russian and Soviet candidates. These samples intersect, that is, some of those people who were candidates to the Soviet AS and did not obtain the full membership decided to participate in Russian AS elections as well[12]. However, I treated these authors as separate observations. I also controlled for linear and quadratic terms of age and dummies for elections years and desired ranks of the candidates

The results of the regression analysis are presented in Tables 3-5. Tables 3 (OLS) and 4 (Probit) report estimations where time dummies, age and age^2 variables were excluded. As for the Probit estimation, somehow constant turned out to be negative meaning that if an author is from Russian sample and has zero scientific contribution, zero coauthors and zero Russian-language publication, her probability of winning is negative. It could be easlity explained by the fact that there are no such scientists in the sample. However, this might look strange and, that is why, I repeated the estimation including time dummies and age of the author (as well its square) exploiting OLS. The results are in Table 5. They do not differ quantitatively from those from table 3 and 4 though they have a bit lower statistical significance though a bit higher explanation power (R^2).

Citations and h-indices as measures of scientific contribution prove to significantly determine the

[12] Those who obtained ranks during the Soviet times did not have to be reelected again for the same ranks in Russian AS. Only those who wanted to obtain a higher rank, i.e. corresponding members who wanted to become full ones, did participate in RAS elections.

elections outcomes with h-index strongly significant in all of the regressions. Quantitatively, additional 100 citations or 1 point of h-index bring author from 1.5 to 2 percentage points of winning in the elections which seems to be quite low (average share of winners is 15%). The coefficients do not significantly different between Russian and Soviet AS, but as I already noted for top-cited authors it is much harder to be elected in the Russian AS than it was in the Soviet one.

What is interesting is that simple number of coauthors affect the probability of being elected in USSR AS, but not in RAS. Every 10 additional coauthors bring a Soviet mathematician from 4 to 8 percentage points. At the same time, if one looks at the number of coauthors who were members of the Academy at the moment of elections, she will see that the effect is strongly significant and robust for Russian Academy and marginally insignificant for USSR Academy (t−stat is 1.60 for the corresponding hypothesis). One coauthor from the Russian Academy adds 8-9 percentage points of winning compared to minus two to zero percentage points in the USSR AS *given* the number of all coauthors.

The variation in the language of publications do not seem to cause any statistically significant variation in elections outcomes – both for Russian and Soviet Academies. Probably, this is a consequence of insufficient observations on publications language. Though, in some specifications it turns out to be strongly significant (particularly in those with h-index as a scientific contribution measure) and quantitatively if one who write only in English becomes writing only in Russian would get from 5 to 13 percentage points which is not a small number compare to other authors' characteristics.

Also, it is worth noting that I do not deal with selection problems here assuming that there are no unobservable determinants of a scientist which influence her decision of being more productive in terms of indicators (that is publish more, publish highly-cited works or even mark up her citations index) and affect elections outcomes at the same time.

I also tried log of citations index as a measure of scientific contribution and it also worked pretty well (Table 6). The difference between Russian and Soviet authors was statistically indistinguishable. Additional 10 coauthors in USSR still gave 5-7 percentage points and those in Russia – nothing. Publications in Russian bring marginally insignificant 10 percentage points and coauthors from the Academy – significant but not robust 6-9 percentage points. It should be noted that the number of coauthors-members of the Academy that makes real difference is one – that is, whether you have them or not. As one can see from figure 7 in case of RAS coauthors apart from the first one do not play any significant role or even can harm the candidate.

The last thing I did with this sample and which cannot be observed graphically is the relationship between elections outcome and authors' characteristics over time. We already made one time separation – Russia versus USSR but are there any underlying time trends within these groups? I interacted election time dummies with h-index measure and performed the same steps I did before. The results are in table 7. It looks like that there is no any regular long-run time trend that affects the elections process.

V.B Lifecycle productivity shape and its response to obtained membership

Then, an attempt to estimate the average lifetime productivity distribution of a scientist was made. Particular interest was on the incentives change after the positive elections results. The main assumption here was that productivity distributions for most of the mathematicians have the same shape and does not change over time, though Jones(2010) found a slight rightward shift of the productivity peak as the time goes by. And, in fact, the time span 1943 – 2008 is large enough to seriously care about these effects. Anyway, it may the goal of the further studies. I do not address this issue here.

In order to obtain productivity distribution of every mathematician I divided all their lifecycles in period of 3 years beginning with the first publication year and ending with the last indexed publication in the database. Visual analysis (see figures 9 and 10) implies the hump-shape distribution similarly to results of many scholars (see literature review). Two interesting details emerge from the visuals. First, productivity of Soviet scientists was higher both in terms of quantity (publication per period) and quality or impact (citations per period). Second, their peak publications and citations period differ. For Soviet mathematicians it is about 35-50 years from the career start and for Russians – 30-35 (therefore ages 57-72 and 52-57). Let me notice here that average age of elected member if around 50.

By citations per period I mean citations in 2010 (current version of the database) to publications written in the period of concern. Unfortunately I do not have information on when these citations were made, that is why I cannot measure the short-run or current impact produced by researchers at the period they published the paper. Only long-run impact of their previous work is measured. And I refer this productivity to the period when the publications emerged. And, in fact, (Diamond, 1986) points out that most of the papers are cited within 3 years and then become forgotten forever. Surely, in my sample there are many prominent mathematicians and not for all of their publications this is the case, but the productivity measure I use is also good enough.

To estimate the effect that elections produce on the productivity, the sample of elected members was considered. That is, the estimated effect would be relevant only for the population of prominent scientists, i.e. those who were once elected. After that, the papers which were written after winning elections were marked with the dummy variable – corresponding period were marked with the similar dummy as well. The coefficient corresponding to this 'after-elections dummy' would give the average productivity drop, not explained by the hump-shaped life-cycle distribution curve. In the end, I have two samples: first - a panel dataset with author's productivities as a space variable and period as a time variable, and second – sample of publications written by the authors with citations to them as a space variable and year of publication - time variable. I use the latter sample to generate not exactly the productivity measure but just average citations per publication measure, not dividing it by any time unit.

The following regression equations were considered (in the first equation the unit of observation is an author publication indexed by *i*, and time indexed by *j; in the second one i – author, and j -*

paper):

$$E(citations\,/\,publications \text{ per period})_{ij} =$$
$$fixed\_effect_i + (\beta_1 + \alpha_1 Soviet_i)\mathrm{I}(published\_when\_a\_member_{ij}) +$$
$$(\beta_2 + \gamma_2 * talent_{\mathrm{i}} + \delta_2 Soviet_i)\mathrm{vintage}_{\mathrm{ij}} + (\beta_3 + \gamma_3 talent_{\mathrm{i}} + \delta_3 Soviet_i)\mathrm{vintage}^2{}_{ij}$$
$$+ time\_dummies\_for\_decades_{ij},$$

$$E(citations\_to\_publication)_{ij} = fixed\_effect_i + (\beta_1 + \alpha_1 Soviet_i)\mathrm{I}(published\_when\_a\_member_{ij})$$
$$+ \beta_2 \mathrm{vintage}_{\mathrm{ij}} + \beta_3 \mathrm{vintage}^2{}_{ij} + time\_dummies\_for\_decades_{ij},$$

where

- *I (published_when_a_member)* – binary variable of whether the publication was published when an author has already become a member of the Academy (equals 1) or before that (equals 0). Actually, there are two variables in the specification with different corresponding coefficients – one for full membership and another for corresponding membership. When one obtained corresponding membership, there is still an incentive to work hard in order to get a higher rank. When one obtains full membership, there are less incentives to work. That is why, I expect to see different patterns here.
- *vintage* – time in years (or number of periods) passed since the first publication of the author to the year when the current publication was issued. This term and its square account for the hump-shaped form of the distribution.
- *Talent* – measure of scientific abilities. It might be the case that more talented researchers have a narrower and higher productivity peak than less ones. I use square root of citations index as a measure of talent (as you will see from subsection C of this section this is approximately h-index).
- *Soviet* (as before) indicates adjunction to Soviet sample. It is interacted with vintage term to account for evolutionary productivity curve shifts. E.g., now scientists are prone to invest in education more time at the beginning of their careers, so that their peak productivity shifts right because of large initial investments and less productivity.
- *Time_dummies_for_decades* – by including these I try to control for changes in trends of citations activities over time. Probably, in the 90s there were more mathematicians than

in 1950s, therefore the average number of citations per paper could be higher simply because of that.

The equation has a fixed effect attributed to authors' unobservable characteristics fixed in time (one may think of any innate abilities).

I do not interact talent and adjunction to soviet sample in the second equation since it proves to be insignificant which is in sharp contrast with the first specification.

I also performed the placebo regressions. That is, I generated fake *(published when a member)*–dummies, implying that author was elected 10 years (1) before and (2) after the real date of elections.

The results are reported in Tables 8 and 9.

First of all, one can clearly see that humped-shaped visually formulated hypothesis proved to be correct. What is really exciting is that interaction of talent and time periods are strongly significant and robust.

As for the main question, namely the productivity change after being elected, this is not an easy problem to interpret. Though, it seems from the true (not placebo) regressions that there is a productivity drop in RAS after academic rank obtainment compared to USSR AS, especially for corresponding members (-20% for Russia and +30% for USSR in quantitative terms). Though looking at placebo regressions we see something more. If there were an immediate drop after the rank is obtained, there would be lesser difference between the placebo rank obtainment shifted to the future since the future drop would be absorbed by the (before elected)-period and the difference would be smaller. But we do not see this. The difference becomes more in 10 years. That might mean that there is still some growth ahead. Probably if we add 10 years to the average age of the elected member (~50) we'd get her peak productivity, one we saw in the figure. And since this productivity peak is to the right from the Russian one we would see the negative difference between Russian and Soviet Academies as it is in tables 8 and 9! And the results are explained by the fact that this lifecycle cure is not truly parabolic and by including the elections outcome dummy we absorb this non-quadratic variation. But the question of why this peak is shifted to the right for Soviet mathematicians and why to the left for Russians is of concern. Where does this peak come from?

One could think that this peak comes from the elections process and notice that once a scientist is elected she may receive some of citations for free – just for popularity or tendency of youth of other followers to cite the giants. That may mean that the peak has some inertia after the election is over because of free citations. But as we see from the graph, the publications peak is even farther that citations one. That is, scientists still publish after they are elected. And publish more than before.

Left-shifted placebo variables for within-Russian AS comparison are also in favor of the hypothesis that there is an upward-sloping trend starting before the elections and continuing after them. Though the negative sign within-USSR AS (corresponding members) productivity change is unclear. Probably, this is some variation of higher order. Some Authors find the 5th degree polynomial lifecycle productivity curve. Probably, this accounts for the difference between the trough and the first peak.

To sum up, it is not clear whether the hen or the chicken comes first. Whether elections process cause this productivity drop or whether this is just a natural tendency. But how could natural tendency differ so much between Soviet scientists and Russians. Probably, the transitions period of 1990s affected it. And now the peak productivity is lower than in Soviet times.

V.C Relationship between citations and h-indices

The final hypothesis I am testing in the paper is the relationship between the citations and h-indices put forward by Jorge Hirsch and formulated as:

$citations\_index = const * h^2$, where *constant* lies between 3 and 5 (Hirsch, 2005)

The regression specification is straightforward: $E(citations\_index_i) = const * h_i^2$

The nonparametric graph and the result of estimation is in Appendix (Figure 1 and Table 2).

Indeed, the relationship is nearly quadratic. H-index squared explains 86% of variation in citations index and the *constant* equals 4.65.

The result is pretty impressive. It means that these measures could be used interchangeably. One can obtain an approximate measure of h-index from citations one and vice versa with good accuracy.

VI Conclusions

There is an objective deterioration of quality in the Russian Academy of Sciences compared to its Soviet ancestor, namely the scientific contribution indicators of newly accepted members are lowering each year. Apart from that we see dramatic changes in the elections system of the Academy. Though on average it rarely significantly differs from the USSR Academy, it often qualitatively and quantitatively does.

The most illustrative examples would be that top quality authors have less chances to be elected as Academy members than several decades ago. And those elected seem to experience earlier drops in productivity. Probably this is connected with higher administrative load that exists nowadays in the Academy or hard accommodation to the transition economy conditions.

Another unpleasant result of the analysis comes from the observation that *ceteris paribus* those who have at least one coauthor among the Academy members are much more likely to be elected in RAS than their colleagues with no such connections. The effect is 5-9 times higher than for Soviet mathematicians.

Probably, these implications should not be generalized on all of the Academy sections. However, mathematics section was always an example of academic excellence, honesty and high world-level standards. Therefore, the situation in other scientific disciplines and departments of the Academy may not be even at this level.

Among further directions of research the candidates' nomination mechanism might be considered. What factors determine it and what incentives have the people/institutions nominating the candidate could be a very interesting topic to pursue.

PS

The author hopes that this piece of research will not offend any representative of the Russian Academy of Sciences or an individual who is deeply dedicated to this organization. The essay is written with benevolent motives and is intended to help the members of the Academy and all the people not indifferent to the future of Russian Science in understanding the present situation and finding the way out.

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Tables

Table 1. Summary statistics.

Soviet sample (candidates from elections 1974-1990 except 1976)

	count	mean	sd	min	max
total citations overall	181	417.06	708.45	0	4902
total publications overall	181	107.72	88.39	1	491
total citations at election	181	211.86	426.00	0	2816
total publications at election	181	49.78	41.42	0	288
h-index overall	181	6.71	6.02	0	31
h-index at election	181	4.54	4.36	0	28
# coauthors	181	14.27	15.20	0	115
# coauthors-AS members	181	0.48	0.93	0	4
publications in Russian, share	172	0.69	0.29	0	1
elected to AS	184	0.17	0.38	0	1
elected as a Full member	184	0.07	0.26	0	1
elected as a Corr member	184	0.12	0.33	0	1

Russian sample (candidates from elections 1992-2008)

	count	mean	sd	min	max
total citations overall	338	177.07	294.90	0	2044
total publications overall	338	61.93	46.31	0	261
total citations at election	338	142.13	242.12	0	1855.4
total publications at election	338	45.60	34.88	0	206
h-index overall	338	4.37	4.04	0	18
h-index at election	338	4.05	3.72	0	18
# coauthors	338	16.44	16.72	0	115
# coauthors-AS members	338	0.18	0.50	0	3
publications in Russian, share	329	0.64	0.29	0	1
elected to AS	342	0.14	0.35	0	1
elected as a Full member	342	0.05	0.21	0	1
elected as a Corr member	342	0.10	0.30	0	1

Productivity of. Elected Soviet AS members (period = 3 years)

	count	mean	sd	min	max
citations per period	999	32.47	98.49	0	2014
log citations per period	999	0.83	0.76	0	3.304275
publications per period	999	7.25	7.92	0	64
period	999	10.09	6.86	1	40
elected Full	469	1973.63	12.53	1946	1990
elected Corr	779	1969.66	12.46	1943	1990
total citations overall	999	603.20	989.84	0	4902
total publications overall	999	141.46	121.18	0	491
h-index overall	436	10.66	8.99	0	31

Productivity of Elected Russian AS members (period = 3 years)

	count	mean	sd	min	max
citations per period	451	19.93	40.31	0	458
log citations per period	451	0.76	0.72	0	2.661813
publications per period	451	4.78	4.66	0	33
period	491	8.74	7.83	1	40
elected Full	88	2003.68	3.57	1997	2008
elected Corr	432	2002.76	3.81	1994	2008
total citations overall	451	252.45	351.44	0	1881
total publications overall	451	65.10	46.13	0	176
h-index overall	451	5.80	4.32	0	18

Table 2. **Correlations table**

Soviet sample (candidates from elections 1974 to 1990 except 1976)

	total citations overall	total citations at election	total publications overall	total publications at election	h-index overall	h-index at election	# coauthors	# coauthors-AS members	publications in Russian, share	elected to AS
total citations overall	1									
total citations at election	0.93	1								
total publications overall	0.67	0.58	1							
total publications at election	0.63	0.67	0.82	1						
h-index overall	0.88	0.74	0.7	0.61	1					
h-index at election	0.88	0.84	0.67	0.73	0.92	1				
# coauthors	0.44	0.45	0.68	0.76	0.42	0.52	1			
# coauthors-AS members	0.4	0.43	0.33	0.46	0.46	0.56	0.53	1		
publications in Russian, share	-0.34	-0.21	-0.18	-0.04	-0.47	-0.34	0.03	-0.09	1	
elected to AS	0.25	0.25	0.25	0.21	0.23	0.24	0.27	0.15	0.03	1

Russian sample (candidates from elections 1992 to 2008)

	total citations overall	total citations at election	total publication overall	total publications at election	h-index overall	h-index at election	# coauthors	# coauthors-AS members	publications in Russian, share	elected to AS
total citations overall	1									
total citations at election	0.98	1								
total publications overall	0.63	0.62	1							
total publications at election	0.56	0.58	0.96	1						
h-index overall	0.85	0.8	0.68	0.6	1					
h-index at election	0.83	0.81	0.68	0.63	0.98	1				
# coauthors	0.37	0.39	0.72	0.76	0.39	0.42	1			
# coauthors-AS members	0.15	0.15	0.14	0.13	0.19	0.21	0.29	1		
publications in Russian, share	-0.26	-0.21	-0.16	-0.09	-0.37	-0.34	-0.02	-0.04	1	
elected to AS	0.11	0.11	0.06	0.04	0.16	0.16	0.02	0.11	0.02	1

Table 3. Election outcome on authors' characteristics (OLS with robust SE)

elected = 1 *not elected = 0*	elected to AS	elected to AS	elected to AS	elected to AS	elected to AS	elected to AS
total citations at elections /100	**0.018*****	**0.020****				
	(2.96)	**(2.01)**				
total citations at elections/100 * USSR		-0.004				
		(-0.32)				
total publications at elections /100			0.062	0.103		
			(0.93)	(1.22)		
total publications at election/100 * USSR				-0.093		
				(-0.73)		
h-index at election					**0.019*****	**0.019*****
					(3.85)	**(3.51)**
h-index * USSR						-0.000
						(-0.00)
coauthors/10	-0.009	-0.010	-0.010	-0.017	-0.016	-0.016
	(-0.78)	(-0.88)	(-0.68)	(-1.05)	(-1.38)	(-1.34)
coauthors/10 * USSR	**0.056****	**0.060****	**0.062****	**0.081*****	**0.062****	**0.062****
	(2.15)	**(2.18)**	**(2.54)**	**(2.61)**	**(2.38)**	**(2.23)**
# coauthors-AS members	**0.081***	**0.081***	**0.089***	**0.091***	0.072	0.072
	(1.71)	**(1.71)**	**(1.82)**	**(1.87)**	(1.55)	(1.55)
coauthors-members of AS * USSR	-0.097	-0.095	-0.087	-0.088	-0.101*	-0.101
	(-1.60)	(-1.56)	(-1.40)	(-1.41)	(-1.66)	(-1.64)
publications in Russian, share	0.081	0.082	0.052	0.047	**0.133****	**0.133****
	(1.40)	(1.41)	(0.91)	(0.81)	**(2.22)**	**(2.16)**
publications in Russian, share * USSR	-0.041	-0.042	-0.051	-0.031	-0.050	-0.050
	(-0.68)	(-0.69)	(-0.85)	(-0.45)	(-0.83)	(-0.80)
Constant	0.056	0.055	0.073*	0.070	-0.018	-0.018
	(1.36)	(1.32)	(1.67)	(1.60)	(-0.40)	(-0.39)
Observations	501	501	501	501	501	501
Adjusted R^2	0.05	0.04	0.03	0.03	0.06	0.05

t statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

Table 4. Election outcome on authors' characteristics (Probit)

elected = 1 *not elected = 0*	elected to AS	elected to AS	elected to AS	elected to AS	elected to AS	elected to AS
total citations at elections /100	**0.014***** **(3.07)**	**0.017**** **(2.29)**				
total citations at elections/100 * USSR		-0.006 (-0.62)				
total publications at elections /100			0.057 (0.96)	0.099 (1.23)		
total publications at election/100 * USSR				-0.089 (-0.81)		
h-index at election					**0.018***** **(4.11)**	**0.019***** **(3.75)**
h-index * USSR						-0.001 (-0.14)
coauthors/10	-0.008 (-0.67)	-0.010 (-0.82)	-0.009 (-0.66)	-0.017 (-1.01)	-0.016 (-1.35)	-0.017 (-1.33)
coauthors/10 * USSR	**0.042**** **(1.99)**	**0.046**** **(2.11)**	**0.046**** **(2.19)**	**0.064**** **(2.26)**	**0.045**** **(2.15)**	**0.046**** **(2.07)**
# coauthors-AS members	**0.071**** **(1.97)**	**0.071**** **(1.96)**	**0.078**** **(2.12)**	**0.081**** **(2.18)**	**0.062*** **(1.77)**	**0.062*** **(1.76)**
coauthors-members of AS * USSR	**-0.084*** **(-1.76)**	**-0.081*** **(-1.69)**	-0.077 (-1.61)	-0.078 (-1.64)	**-0.089*** **(-1.91)**	**-0.088*** **(-1.85)**
publications in Russian, share	0.076 (1.21)	0.077 (1.23)	0.051 (0.84)	0.047 (0.75)	**0.138**** **(2.05)**	**0.136**** **(1.98)**
publications in Russian, share * USSR	-0.023 (-0.40)	-0.023 (-0.40)	-0.030 (-0.51)	-0.012 (-0.19)	-0.028 (-0.49)	-0.026 (-0.43)
Constant	-0.324*** (-7.57)	-0.325*** (-7.55)	-0.314*** (-7.07)	-0.317*** (-7.06)	-0.404*** (-7.79)	-0.403*** (-7.67)
Observations	501	501	501	501	501	501

t statistics in parentheses ($p < 0.10$, ** $p < 0.05$, *** $p < 0.01$), marginal effects reported*

***Table 5.* Election outcome on authors' characteristics (OLS, robust SE, time dummies, age and age² included)**

elected = 1 *not elected = 0*	elected to AS	elected to AS	elected to AS	elected to AS	elected to AS	elected to AS
total citations at elections /100	**0.015****	0.012				
	(2.28)	(1.16)				
total citations at elections/100 * USSR		0.005				
		(0.36)				
total publications at elections /100			0.040	0.076		
			(0.54)	(0.80)		
total publications at election/100 * USSR				-0.079		
				(-0.56)		
h-index at election					**0.017*****	**0.014****
					(2.97)	**(2.04)**
h-index * USSR						0.007
						(0.84)
coauthors/10	-0.015	-0.014	-0.015	-0.020	-0.021	-0.018
	(-1.18)	(-1.04)	(-0.93)	(-1.16)	(-1.62)	(-1.36)
coauthors/10 * USSR	**0.061****	**0.058***	**0.067****	**0.081****	**0.067****	**0.059****
	(2.17)	**(1.93)**	**(2.47)**	**(2.45)**	**(2.41)**	**(1.97)**
# coauthors-AS members	**0.098****	**0.099****	**0.103****	**0.107****	**0.093****	**0.093****
	(2.37)	**(2.37)**	**(2.43)**	**(2.48)**	**(2.23)**	**(2.24)**
coauthors-members of AS * USSR	-0.081	-0.083	-0.074	-0.076	-0.087	-0.094
	(-1.44)	(-1.46)	(-1.27)	(-1.30)	(-1.55)	(-1.64)
publications in Russian, share	0.079	0.075	0.062	0.062	**0.117***	0.112
	(1.16)	(1.09)	(0.92)	(0.92)	**(1.70)**	(1.61)
publications in Russian, share * USSR	-0.054	-0.045	-0.082	-0.084	-0.053	-0.006
	(-0.48)	(-0.39)	(-0.73)	(-0.73)	(-0.47)	(-0.05)
age at election	0.000	0.000	0.001	0.001	-0.002	-0.001
	(0.03)	(0.04)	(0.08)	(0.08)	(-0.22)	(-0.18)
age at election ^2	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(-0.35)	(-0.36)	(-0.39)	(-0.40)	(-0.12)	(-0.15)

year74	0.163*	0.164*	0.157	0.158	0.145	0.152
	(1.69)	(1.70)	(1.60)	(1.61)	(1.50)	(1.57)
year79	0.011	0.010	0.022	0.024	0.002	-0.007
	(0.13)	(0.12)	(0.27)	(0.28)	(0.03)	(-0.09)
year81	0.079	0.079	0.077	0.076	0.093	0.103
	(1.16)	(1.16)	(1.10)	(1.08)	(1.33)	(1.46)
year84	0.101*	0.101*	0.104*	0.103*	0.097	0.096
	(1.69)	(1.69)	(1.68)	(1.68)	(1.61)	(1.62)
year87	0.003	0.001	0.012	0.016	0.007	-0.004
	(0.05)	(0.01)	(0.23)	(0.29)	(0.13)	(-0.06)
year90	-0.079	-0.081	-0.068	-0.066	-0.080	-0.093*
	(-1.62)	(-1.65)	(-1.37)	(-1.32)	(-1.62)	(-1.80)
year94	0.215***	0.217***	0.216***	0.215***	0.218***	0.228***
	(3.12)	(3.15)	(3.09)	(3.07)	(3.19)	(3.27)
year97	0.040	0.044	0.051	0.047	0.028	0.044
	(0.93)	(0.99)	(1.20)	(1.06)	(0.65)	(0.91)
year00	0.016	0.017	0.020	0.016	0.003	0.007
	(0.33)	(0.36)	(0.39)	(0.32)	(0.06)	(0.15)
year03	0.084**	0.084**	0.086**	0.086**	0.087**	0.087**
	(2.12)	(2.13)	(2.18)	(2.19)	(2.23)	(2.22)
year06	-0.019	-0.021	-0.024	-0.021	-0.011	-0.018
	(-0.39)	(-0.43)	(-0.49)	(-0.43)	(-0.23)	(-0.37)
year08	-0.070	-0.071	-0.069	-0.068	-0.077	-0.084
	(-1.39)	(-1.40)	(-1.35)	(-1.34)	(-1.52)	(-1.64)
Constant	-7.861	-8.378	-6.642	-5.228	-8.757	-14.350
	(-0.73)	(-0.77)	(-0.60)	(-0.45)	(-0.80)	(-1.11)
Observations	500	500	500	500	500	500
Adjusted R^2	0.09	0.09	0.08	0.08	0.10	0.10

t statistics in parentheses ($p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)*

***Table 6.* Election outcome on authors' characteristics. Citations index in logs**

elected = 1 *not elected = 0*	Elected. OLS	Elected. OLS	Elected. Probit	Elected.Probit	Elected.OLS (time dummies incl)	Elected. OLS (time dummies incl)
log (total citations at elections +1)	**0.064***** **(2.92)**	**0.071***** **(2.98)**	**0.069***** **(2.82)**	**0.076***** **(2.82)**	**0.055**** **(2.07)**	**0.047** **(1.62)**
ltotcit_sov		-0.022 (-0.60)		-0.021 (-0.61)		0.025 (0.46)
coauthors/10	-0.011 (-0.99)	-0.014 (-1.17)	-0.011 (-1.01)	-0.014 (-1.18)	-0.017 (-1.34)	-0.016 (-1.20)
coauthors/10 * USSR	**0.067***** **(2.72)**	**0.073***** **(2.92)**	**0.049**** **(2.44)**	**0.055***** **(2.59)**	**0.071***** **(2.64)**	**0.067**** **(2.44)**
# coauthors-AS members	0.076 (1.61)	0.074 (1.59)	**0.064*** **(1.84)**	**0.062*** **(1.80)**	**0.095**** **(2.28)**	**0.095**** **(2.28)**
coauthors-members of AS * USSR	-0.088 (-1.46)	-0.081 (-1.34)	-0.077* (-1.71)	-0.071 (-1.55)	-0.073 (-1.29)	-0.076 (-1.32)
publications in Russian, share	0.101* (1.73)	0.091 (1.49)	0.110* (1.71)	0.099 (1.46)	0.093 (1.38)	0.093 (1.39)
publications in Russian, share * USSR	-0.068 (-1.12)	-0.038 (-0.47)	-0.046 (-0.77)	-0.015 (-0.18)	-0.072 (-0.64)	-0.069 (-0.61)
elections time dummies	NO	NO	NO	NO	YES	YES
age, age^2	NO	NO	NO	NO	YES	YES
Constant	-0.028 (-0.54)	-0.026 (-0.51)	-0.428*** (-6.98)	-0.427*** (-6.94)	-8.637 (-0.78)	-11.701 (-0.86)
Observations	501	501	501	501	500	500
Adjusted R^2	0.04	0.04			0.09	0.09

t statistics in parentheses ($p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)*

***Table 7.* Election outcome on authors' characteristics. H-index interacted with time**

elected = 1 *not elected = 0*	Elected. OLS	Elected. Probit	Elected.OLS (time dummies incl)
coauthors/10	-0.022**	-0.026**	-0.015
	(-2.00)	(-2.25)	(-1.12)
coauthors/10 * USSR	0.066**	0.057***	0.067***
	(2.51)	(2.65)	(2.66)
# coauthors-AS members	0.098**	0.095***	0.106**
	(2.41)	(2.84)	(2.55)
coauthors-members of AS * USSR	-0.104*	-0.103**	-0.106*
	(-1.95)	(-2.24)	(-1.96)
publications in Russian, share	0.068	0.082	0.071
	(1.15)	(1.32)	(1.05)
publications in Russian, share * USSR	-0.071	-0.051	-0.064
	(-1.10)	(-0.86)	(-0.54)
h-index * year74	0.000	0.001	-0.042*
	(0.02)	(0.07)	(-1.77)
h-index * year79	-0.011	-0.009	-0.022
	(-0.82)	(-0.90)	(-1.28)
h-index * year81	0.030**	0.021*	0.036*
	(2.09)	(1.95)	(1.86)
h-index * year84	0.017*	0.013	0.017*
	(1.80)	(1.63)	(1.75)
h-index * year87	-0.004	-0.001	-0.013
	(-0.59)	(-0.14)	(-1.05)
h-index * year90	-0.003	-0.004	0.019
	(-0.28)	(-0.45)	(1.50)
h-index * year94	0.036***	0.030***	0.039***
	(3.50)	(4.21)	(2.74)
h-index * year97	0.005	0.002	0.003
	(0.93)	(0.44)	(0.43)
h-index * year00	-0.007	-0.009	-0.025**
	(-1.02)	(-1.25)	(-2.25)
h-index * year03	0.017**	0.019**	0.009
	(2.11)	(2.49)	(0.83)
h-index * year06	0.007	0.007	0.020

	(0.58)	(0.58)	(1.22)
h-index * year08	-0.018	-0.020^{*}	-0.015
	(-1.63)	(-1.80)	(-1.03)
age at election			0.001
			(0.18)
age at election ^2			-0.000
			(-0.44)
year_elec			0.003
			(0.50)
year74			0.339^{**}
			(2.33)
year79			0.063
			(0.61)
year81			-0.075
			(-0.84)
year84			0.036
			(0.52)
year87			0.057
			(0.69)
year90			-0.180^{***}
			(-2.90)
year94			-0.008
			(-0.10)
year97			0.001
			(0.01)
year00			0.153^{**}
			(2.04)
year03			0.045
			(0.86)
year06			-0.096
			(-1.60)
year08			-0.032
			(-0.54)
Constant	0.059	-0.317^{***}	-5.621
	(1.36)	(-7.08)	(-0.50)
Observations	501	501	500
Adjusted R^2	0.10		0.12

t statistics in parentheses (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

***Table 8*. Productivity change after becoming an Academy member**

	(1) log citations per period	(2) citations per period	(3) publications per period
1 when Corr member this period	**-0.193***	**-18.705*****	-0.648
	(-1.91)	**(-2.63)**	(-0.92)
when Corr member this period * USSR	**0.278****	17.689	**1.629***
	(2.40)	(1.27)	**(1.77)**
1 when Full member this period	-0.200	**-22.739****	1.340
	(-0.96)	**(-2.10)**	(0.85)
when Full member this period * USSR	0.246	21.772	1.876
	(1.11)	(1.45)	(1.07)
#period	**0.064****	**-5.424***	-0.229
	(2.43)	**(-1.79)**	(-1.24)
#period * citations index^(1/2)	**0.005*****	**0.789*****	**0.057*****
	(9.87)	**(5.26)**	**(9.02)**
#period^2	**-0.001**	**0.299***	**0.021***
	(-0.80)	**(1.95)**	**(1.78)**
#period^2 * citations index^(1/2)	**-0.000*****	**-0.035*****	**-0.002*****
	(-7.99)	**(-4.28)**	**(-7.28)**
#period * USSR	**-0.100*****	-0.658	-0.043
	(-3.68)	(-0.26)	(-0.23)
#period^2 * USSR	0.002	-0.070	-0.012
	(1.37)	(-0.56)	(-1.10)
1 if period is within 1930-1940	-0.109	-2.320	-1.059
	(-0.88)	(-0.16)	(-1.10)
1 if period is within 1940-1950	0.174**	-8.096	1.260
	(2.00)	(-0.53)	(1.59)
1 if period is within 1950-1960	0.229***	-3.258	1.810**
	(3.13)	(-0.22)	(2.52)
1 if period is within	0.370***	3.977	2.078***

1960-1970			
	(5.87)	(0.30)	(3.27)
1 if period is within 1970-1980	0.233***	9.257	-0.055
	(3.96)	(1.09)	(-0.10)
1 if period is within 1980-1990	0.094*	0.329	-0.547
	(1.71)	(0.03)	(-0.97)
1 if period is within 1990-2000	0.129**	9.531	0.232
	(2.56)	(1.30)	(0.40)
Constant	0.278***	-4.237	1.873***
	(4.18)	(-0.37)	(2.96)
Observations	1370	1370	1370
R^2-*within*	0.13	0.07	0.18

period = 3 years
t statistics in parentheses ($p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)*

Table 9. Productivity change after becoming an Academy member.

Placebo experiment: elections moments shifted (+10 and -10 years)

	(1) log citations per period, shift −10years	(2) citations per period, shift −10years	(3) publications per period, shift −10years	(4) log citations per period, shift +10years	(5) citations per period, shift +10years	(6) publications per period, shift +10years
1 when Corr member this period	**0.259***** **(2.60)**	**21.190**** **(2.02)**	**-0.699** **(-1.08)**	**-0.434***** **(-5.33)**	**-16.304***** **(-3.23)**	**-2.191***** **(-3.15)**
when Corr member this period * USSR	**-0.313***** **(-2.71)**	**-35.679*** **(-1.65)**	0.433 (0.53)	**0.466***** **(4.66)**	6.968 (0.60)	**2.381**** **(2.47)**
1 when Full member this period	0.020 (0.11)	-14.708 (-1.09)	0.525 (0.45)	**-0.341***** **(-2.85)**	-2.201 (-0.34)	**-2.630**** **(-2.21)**
when Full member this period * USSR	0.027 (0.14)	-0.430 (-0.02)	1.938 (1.45)	**0.365***** **(2.62)**	1.680 (0.14)	**3.225**** **(2.17)**
#period	**0.085***** **(3.69)**	**-7.016*** **(-1.70)**	**0.534***** **(3.16)**	-0.019 (-0.73)	-2.381 (-0.76)	**-0.538***** **(-2.59)**
#period * citations index^(1/2)	**0.008***** **(14.14)**	**0.789***** **(3.86)**	**0.047***** **(8.30)**	**0.003***** **(4.78)**	0.178 (0.99)	**0.056***** **(7.89)**
#period^2	**-0.004**** **(-2.32)**	0.202 (1.07)	**-0.029***** **(-2.64)**	0.001 (0.90)	0.181 (1.13)	**0.038***** **(3.12)**
#period^2 * citations index^(1/2)	**-0.000***** **(-9.50)**	**-0.024**** **(-2.31)**	**-0.001***** **(-4.51)**	**-0.000***** **(-6.85)**	**-0.021***** **(-2.99)**	**-0.003***** **(-8.68)**
#period * USSR	**-0.088***** **(-3.81)**	1.575 (0.46)	**-0.391**** **(-2.32)**	-0.038 (-1.42)	2.933 (1.10)	-0.099 (-0.47)
#period^2 * USSR	**0.004***** **(2.69)**	-0.041 (-0.29)	**0.027***** **(2.59)**	0.000 (0.09)	-0.102 (-0.69)	-0.019 (-1.60)
1 if period is within 1930-1940	-0.271*** (-3.28)	11.172 (0.78)	-1.305 (-1.54)	0.081 (0.60)	-23.927** (-2.18)	0.532 (0.40)
1 if period is within 1940-1950	-0.263*** (-3.50)	1.329 (0.09)	-2.201*** (-3.24)	0.308*** (3.11)	-24.902** (-2.20)	4.179*** (4.50)

1 if period is within 1950-1960	-0.139**	-0.741	-2.002***	0.594***	7.971	5.401***
	(-2.21)	(-0.05)	(-3.32)	(7.75)	(0.56)	(6.87)
1 if period is within 1960-1970	-0.054	-7.044	-0.870	0.545***	-5.960	3.610***
	(-0.82)	(-0.51)	(-1.49)	(7.97)	(-0.61)	(5.45)
1 if period is within 1970-1980	0.060	0.915	-0.136	0.554***	-4.580	4.795***
	(0.96)	(0.08)	(-0.24)	(9.16)	(-0.57)	(7.59)
1 if period is within 1980-1990	-0.026	5.190	-1.756***	0.613***	9.490	5.296***
	(-0.45)	(0.65)	(-3.34)	(11.21)	(1.51)	(9.14)
1 if period is within 1990-2000	-0.108**	-1.138	-1.531***	0.573***	4.151	5.640***
	(-2.00)	(-0.14)	(-2.77)	(12.26)	(0.93)	(10.29)
Constant	-0.132**	-17.278*	-0.267	0.442***	33.421***	1.716**
	(-2.18)	(-1.80)	(-0.48)	(5.99)	(3.65)	(2.35)
Observations	1370	1370	1370	1370	1370	1370
R^2-within	0.47	0.15	0.43	0.40	0.11	0.29

period = 3 years
t statistics in parentheses (* p < 0.10, ** p < 0.05, *** p < 0.01)

***Table 10*. Change of average citations for publications after becoming a member. True and placebo regressions.**

	(1) Citations for publication	(2) Log citations for publication	(3) Citations for publication. Placebo (shift +10years)	(4) Log citations for publication. Placebo (shift +10years)	(5) Citations for publication. Placebo (shift−10years)	(6) Log citations for publication. Placebo (shift−10years)
publication written when Corr member	-3.596	-0.033	-2.840	-0.197	5.924	0.242*
	(-0.66)	(-0.39)	(-0.24)	(-1.06)	(0.85)	(2.25)
publication written when Corr member* USSR	1.488	-0.016	1.474	0.192	-11.450	-0.334**
	(0.26)	(-0.19)	(0.12)	(1.03)	(-1.58)	(-2.98)
publication written when Full member	-1.048	-0.160	-0.132	-0.032	-6.694	-0.072
	(-0.14)	(-1.34)	(-0.06)	(-0.97)	(-1.11)	(-0.77)
publication written when Full member *USSR	-0.477	0.152	0.000	0.000	3.406	0.060
	(-0.06)	(1.22)	(.)	(.)	(0.54)	(0.61)
years since 1st publication	0.688*	0.007	0.580*	0.004	0.745**	0.004
	(2.50)	(1.54)	(2.26)	(1.00)	(2.73)	(0.92)
years since 1st publication ^2	-0.003	-0.000	-0.002	-0.000	-0.003	-0.000
	(-1.15)	(-0.94)	(-0.81)	(-0.08)	(-1.24)	(-0.03)
1 if publication written in 1930-1940	31.169	0.329	30.996	0.323	30.229	0.288
	(1.88)	(1.28)	(1.87)	(1.25)	(1.83)	(1.12)
1 if publication written in	26.905*	0.238	26.805*	0.239	26.507*	0.215

1940-1950						
	(2.25)	(1.29)	(2.24)	(1.29)	(2.22)	(1.16)
1 if publication written in 1950-1960	22.315*	0.241	22.087*	0.242	21.671*	0.229
	(2.27)	(1.58)	(2.25)	(1.59)	(2.21)	(1.50)
1 if publication written in 1960-1970	24.462**	0.265*	24.675**	0.270*	24.798**	0.275*
	(3.04)	(2.11)	(3.07)	(2.16)	(3.09)	(2.20)
1 if publication written in 1970-1980	19.052**	0.259**	19.155**	0.259**	19.932**	0.286**
	(3.04)	(2.67)	(3.07)	(2.68)	(3.19)	(2.94)
1 if publication written in 1980-1990	13.148**	0.205**	13.248**	0.204**	14.502***	0.234***
	(3.05)	(3.07)	(3.10)	(3.08)	(3.36)	(3.49)
1 if publication written in 1990-2000	6.363*	0.097*	6.372*	0.100*	6.794*	0.112**
	(2.29)	(2.24)	(2.35)	(2.37)	(2.49)	(2.64)
Constant	-23.239*	0.069	-22.749*	0.077	-20.831	0.126
	(-2.11)	(0.41)	(-2.07)	(0.45)	(-1.89)	(0.74)
Observations	2906	2906	2906	2906	2906	2906
R^2-within	0.00	0.01	0.00	0.01	0.00	0.01

log citations for paper = log(citations +1)
t statistics in parentheses ($p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)*
** $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*

Figures

Figure 1. Proxying (year of birth) AS (earliest publication year MINUS 22)

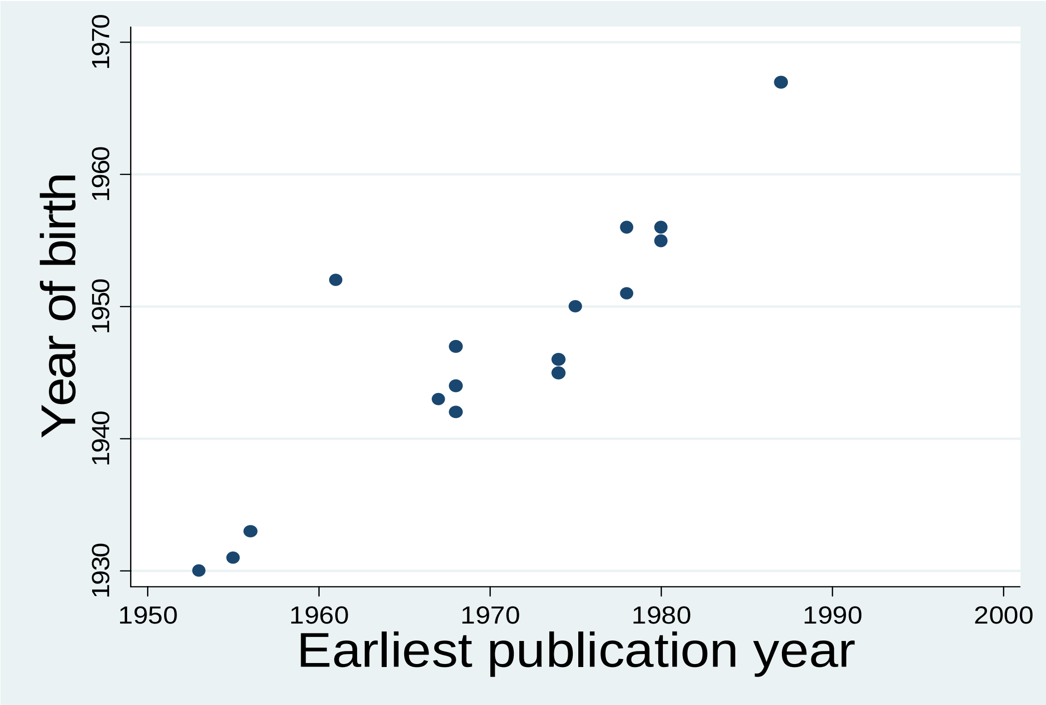


Figure 2. Locally weighted regression of being elected on citations index

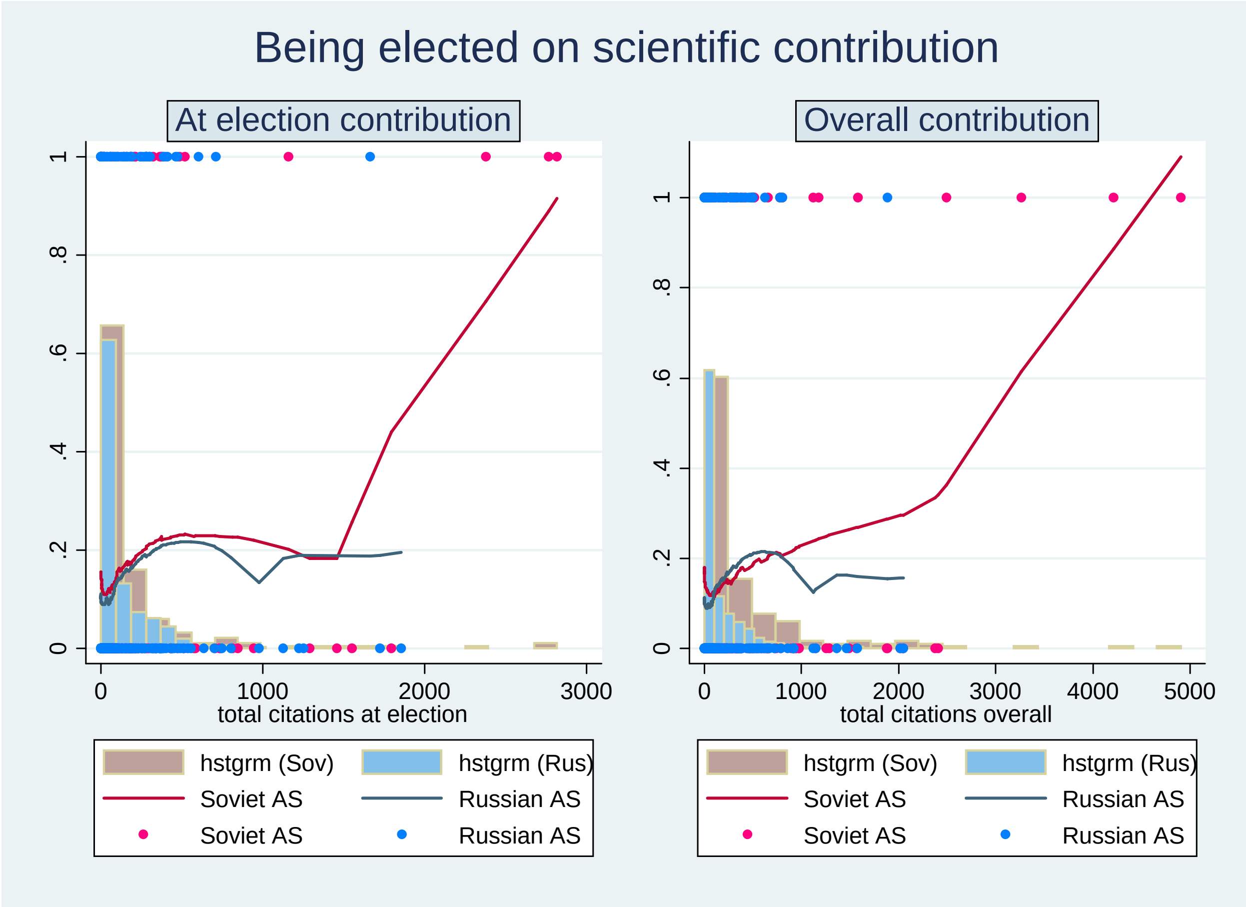


Figure 3. Locally weighted regression of being elected on log citations index

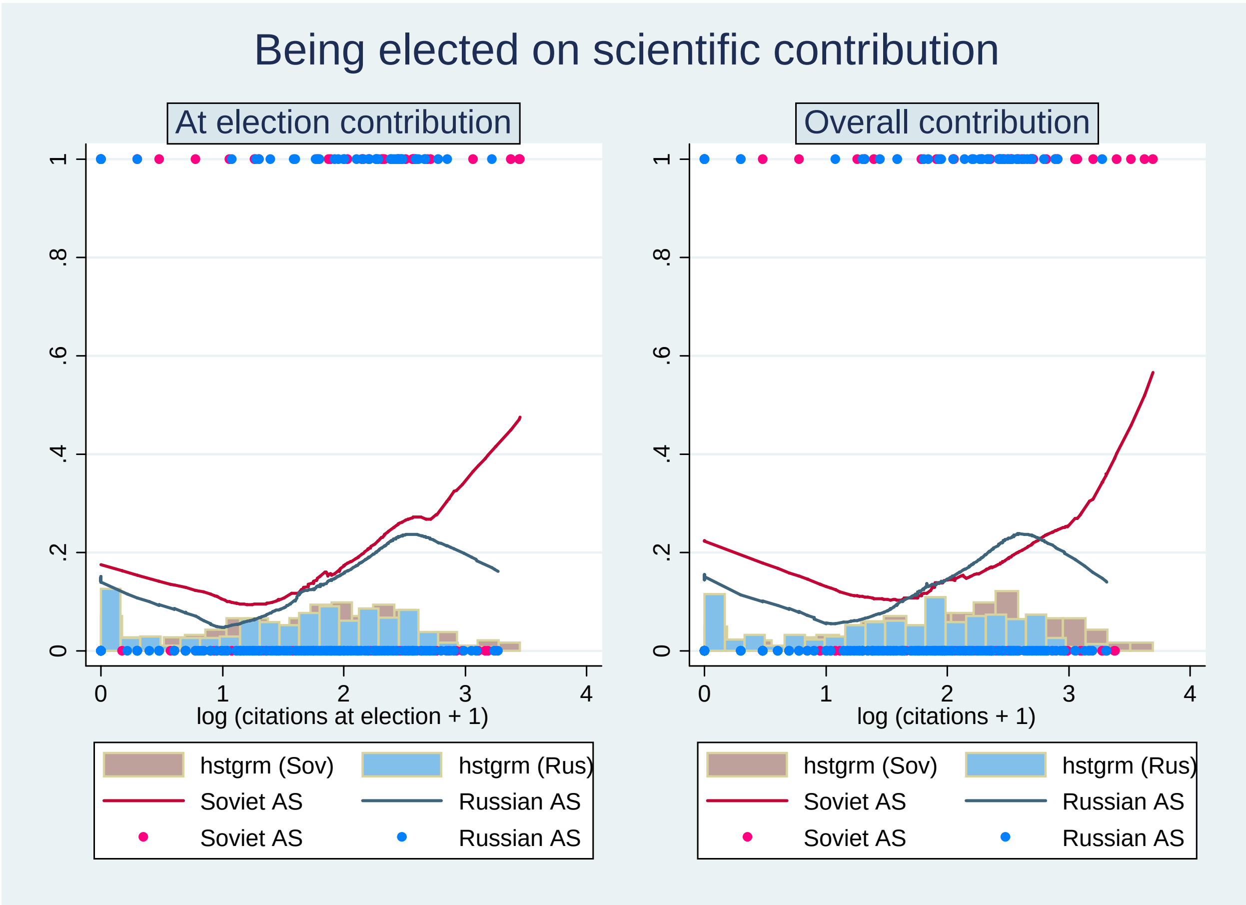


Figure 4. Locally weighted regression of being elected on publications

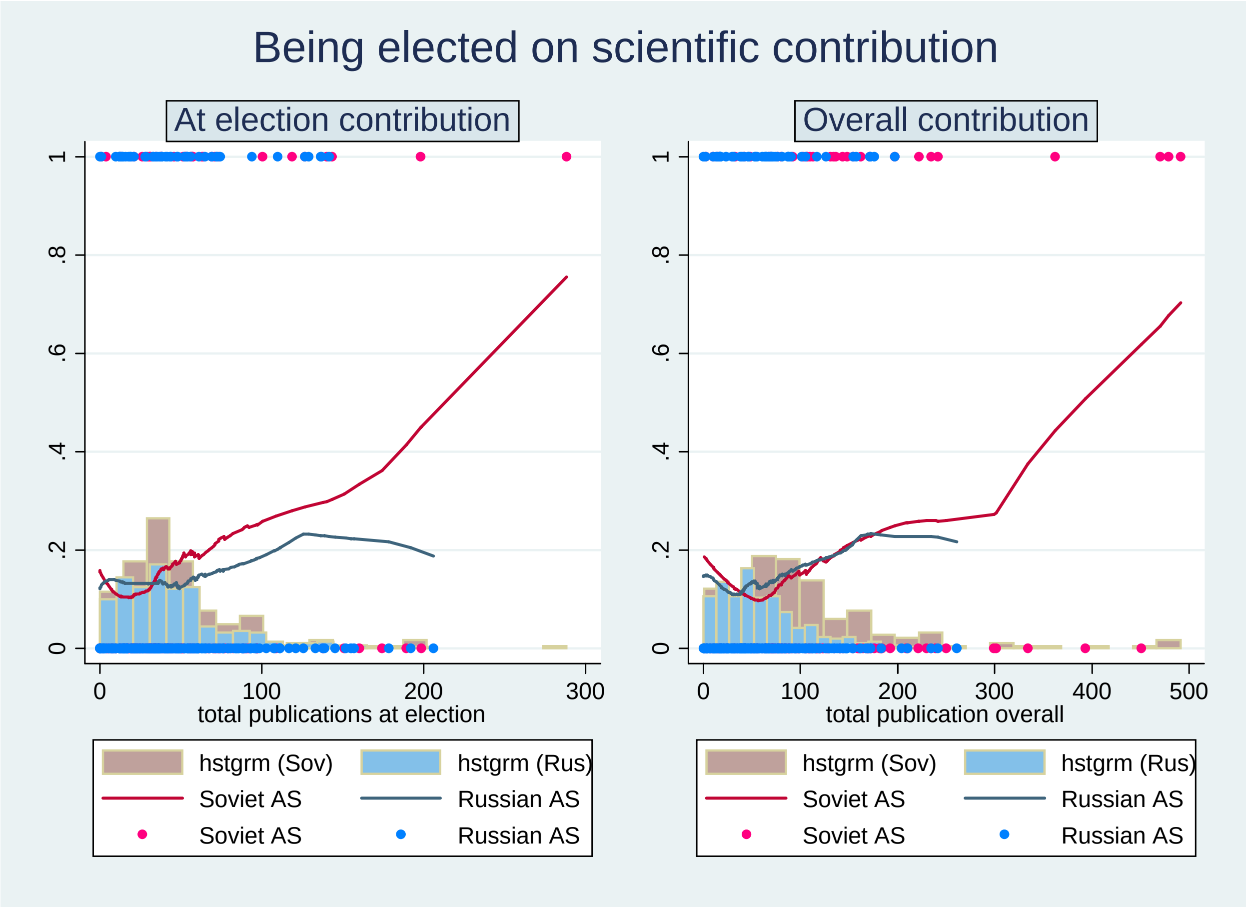


Figure 5. Locally weighted regression of being elected on log publications

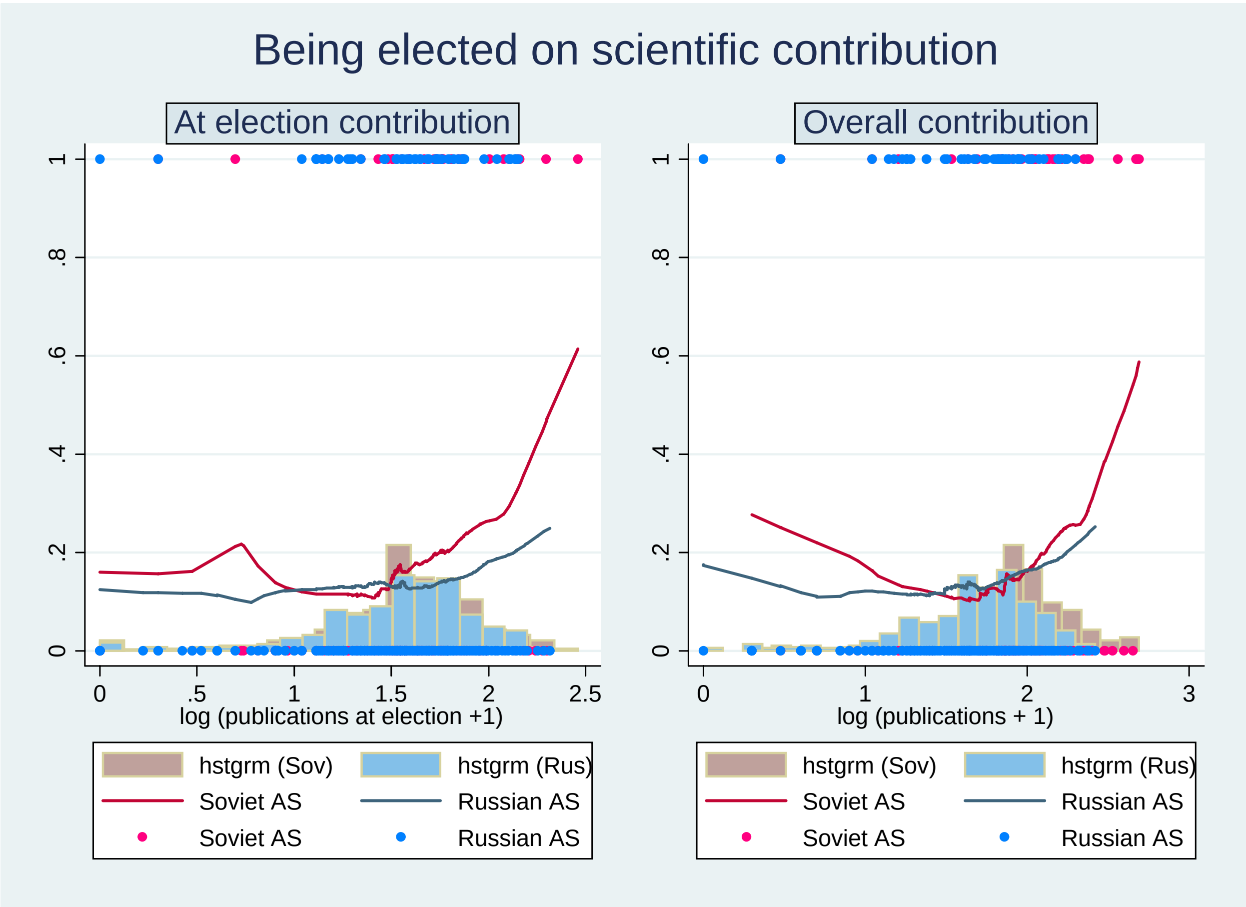


Figure 6. Locally weighted regression of being elected on h-index

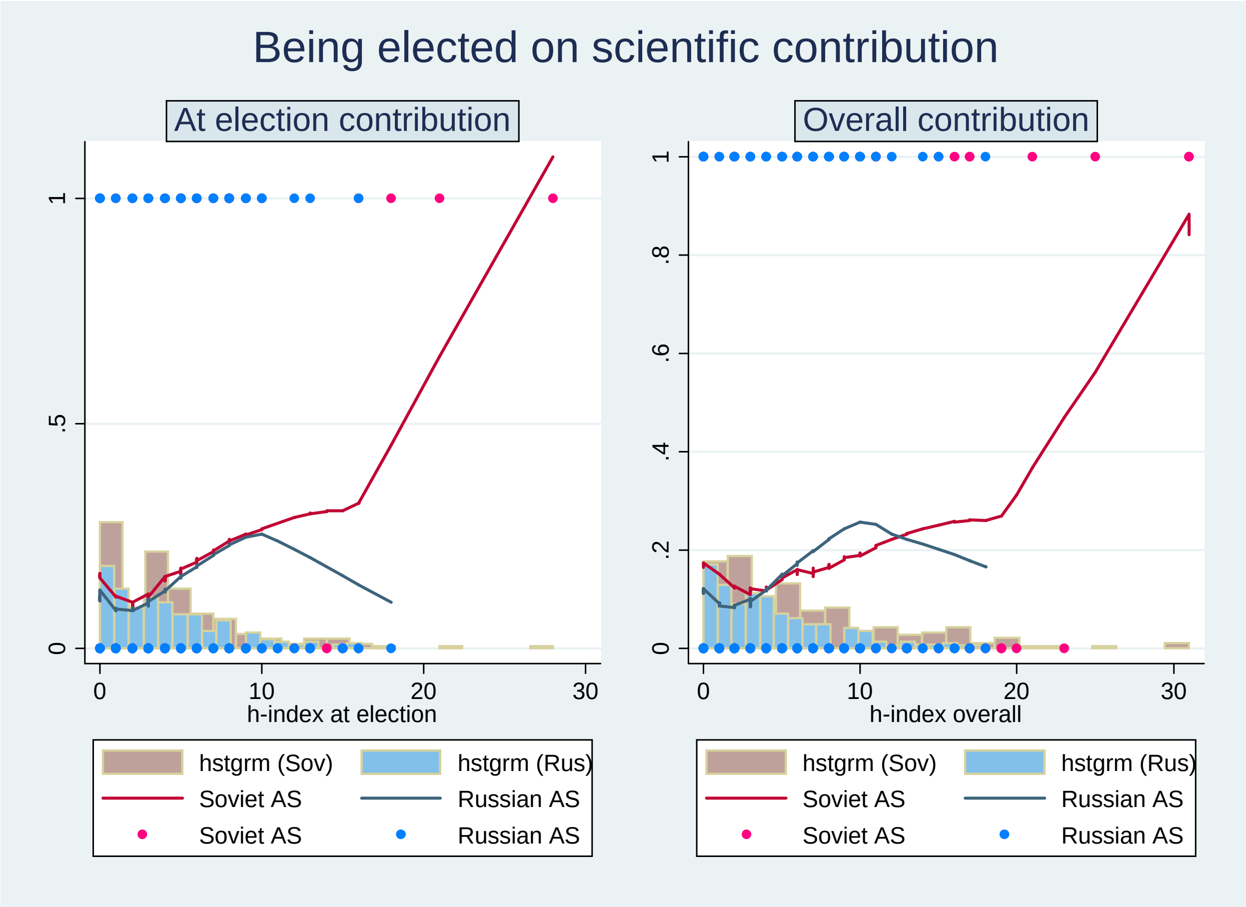


Figure 7. Locally weighted regression of being elected on # Coauthors

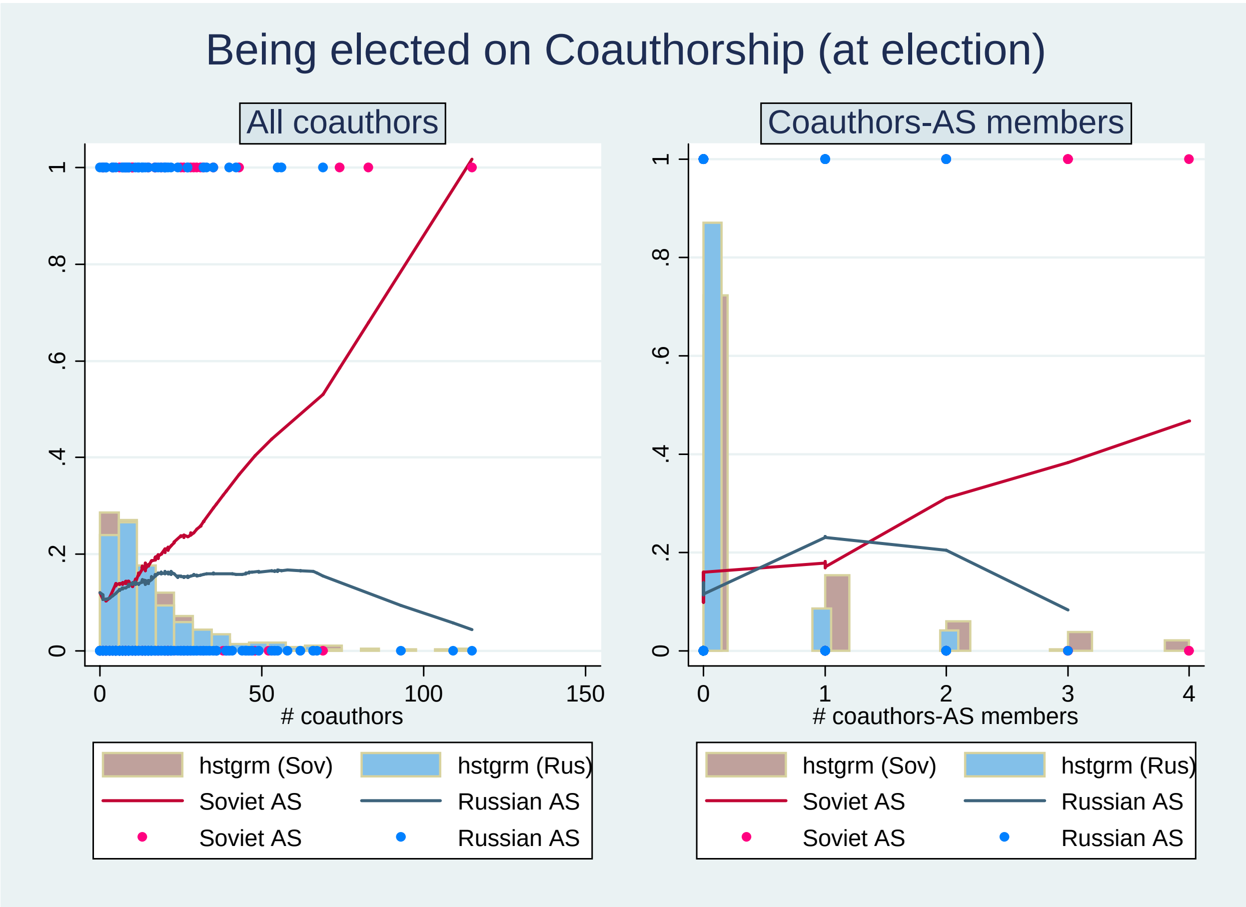


Figure 8. Locally weighted regression of being elected on Russian-language publications share

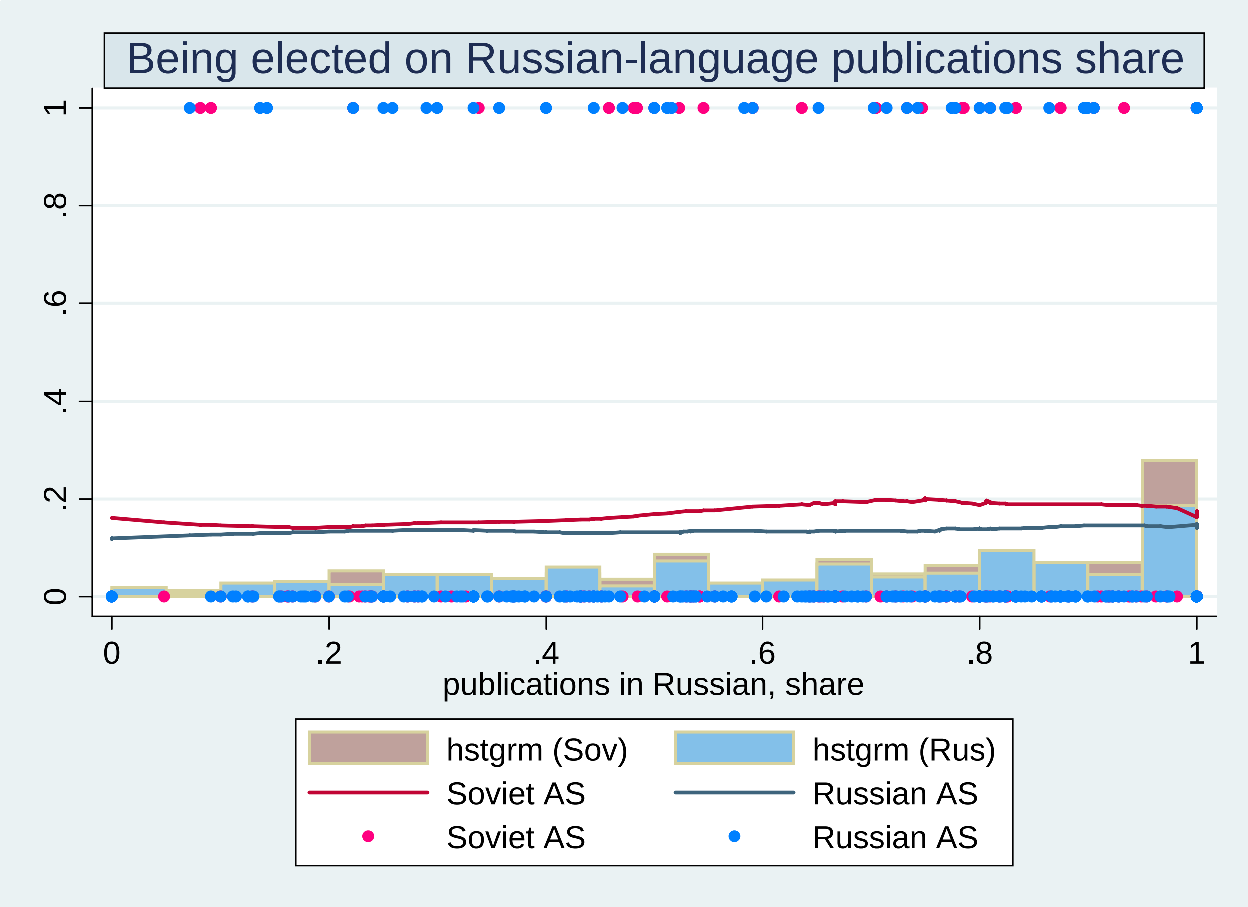


Figure 9. Lifecycle productivity of Elected Academy members(impact)

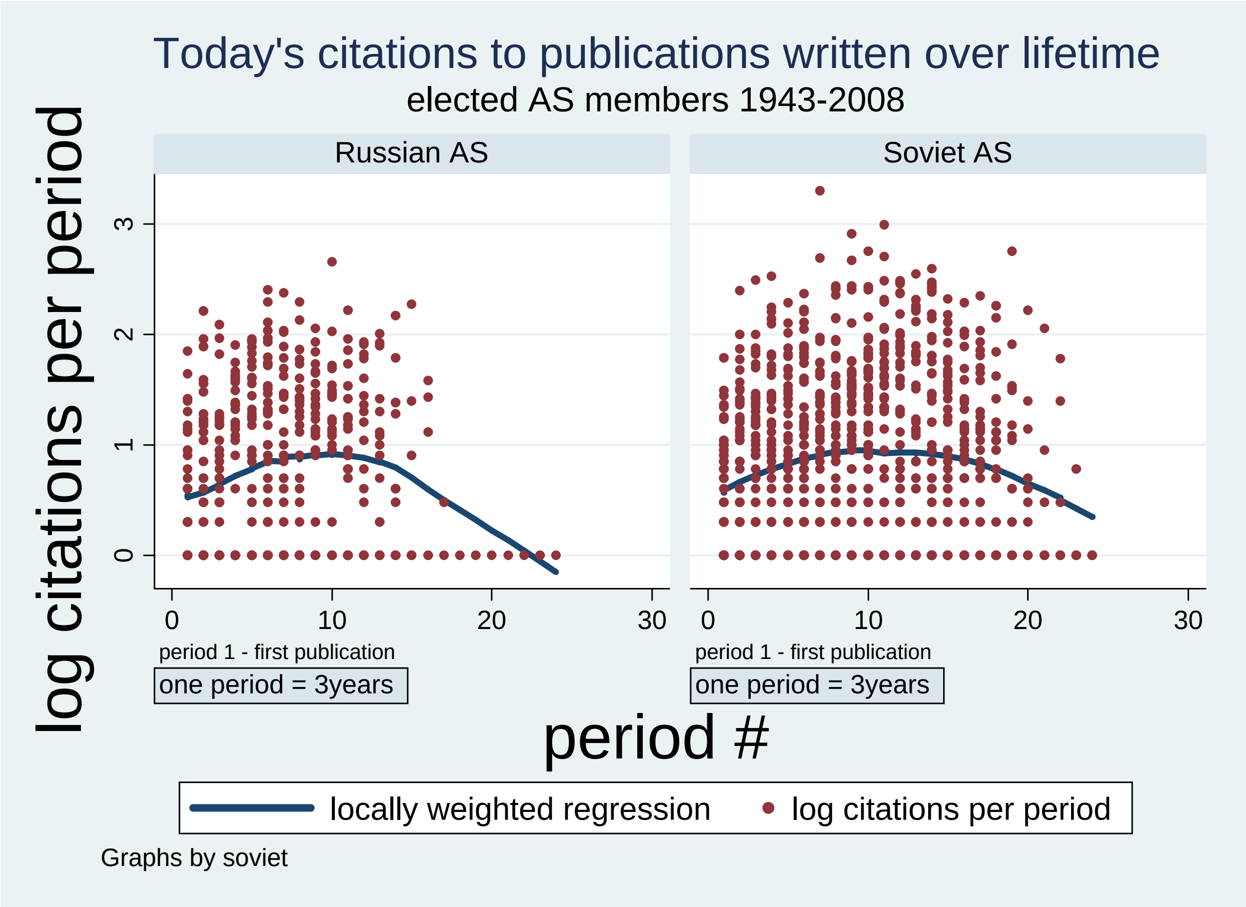
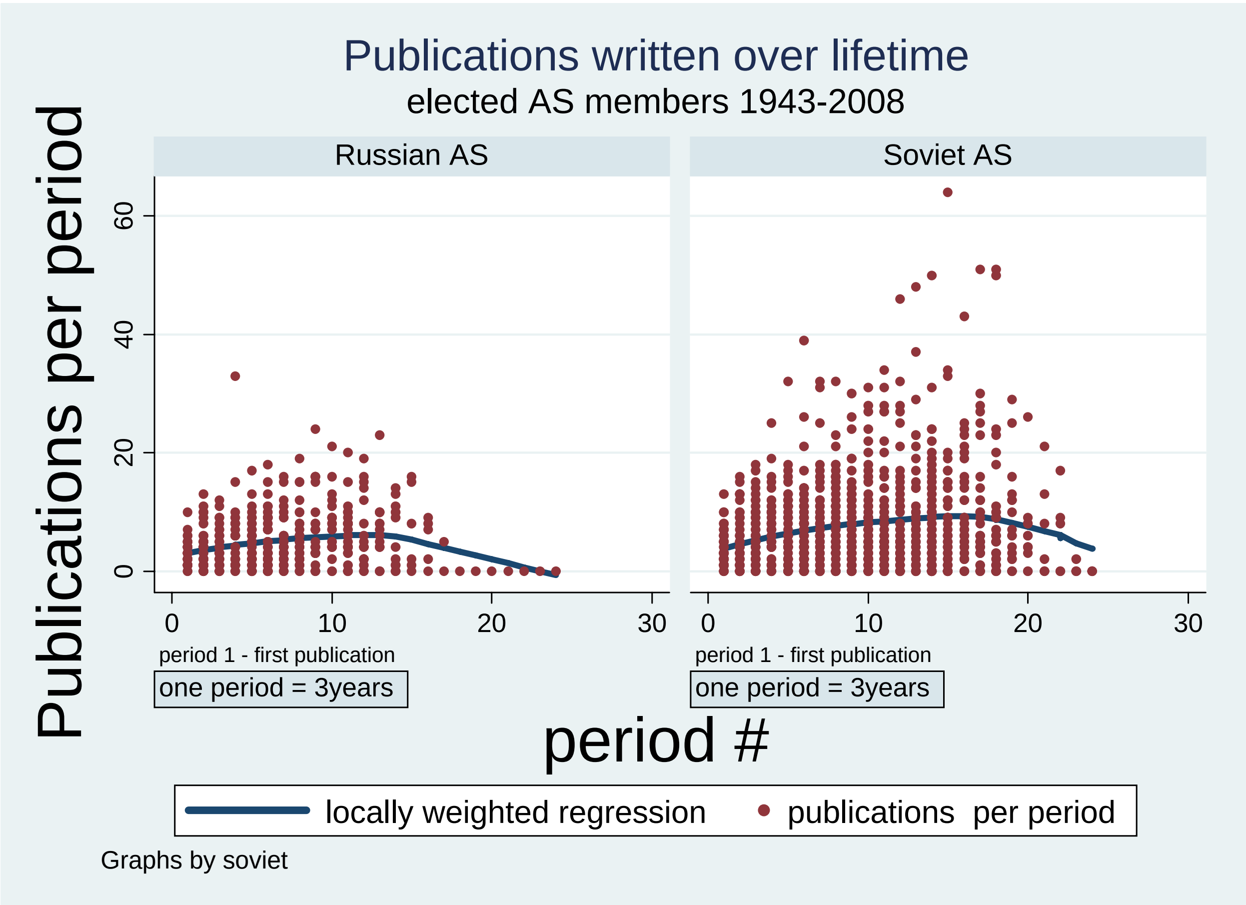


Figure 10. Lifecycle productivity of Elected Academy members (quantity)



Appendix

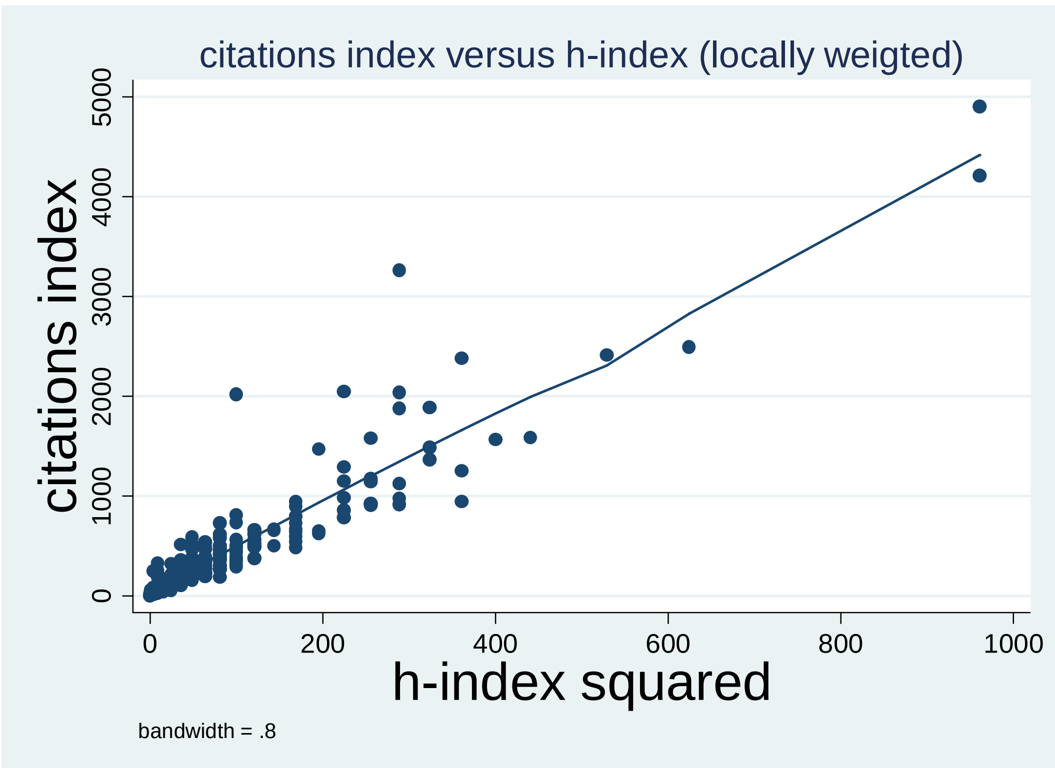
Table 1. Extra income for rank and material bonuses of Academy members[13]

Period	Extra Income. Full member	Extra income. Corr member	Average salary	Bonuses
1946-1957	5000 RUB	2500 RUB	610 RUB	Very Huge
1957-1990 (denomination in 1961)	~400 RUB (rough measure)	n/a	150 RUB	Huge
1990	5,000 RUB	2,500RUB	250RUB	n/a
2003-2008	20,000 RUB	10,000RUB	5,500 RUB	n/a
2008 - 2010	50,000 RUB	25,000RUB	19,000 RUB	n/a

Sources:

- Zezina (1997)
- http://www.ng.ru/science/2003-02-12/1_academician.html
- http://www.anaga.ru/analytcal-info/2/7.htm
- http://www.ecology.md/section.php?section=ecoset&id=1200

Figure 1. Relation between citations and h-indices



[13] Some numbers may not be fully correct. Need to be verified and completed

Table 2. OLS regression of citations index on h-index squared

	total citations
h-index squared	4.648***
	(25.35)
Constant	22.30***
	(3.59)
Observations	519
Adjusted R^2	0.860

t statistics in parentheses (p < 0.10, ** p < 0.05, *** p < 0.01)*
** p < 0.05, ** p < 0.01, *** p < 0.001*

Figure 2. MathSciNet data identification problems. Some examples

MR0629228 (83d:90108) Morozov, V. V.; Fedorov, V. V. Linear problems in the design of systems. (Russi
Moskov. Univ. Ser. XV Vychisl. Mat. Kibernet. **1981,** no. 2, 34--39, 63--64. 90B99
PDF | Doc Del | Clipboard | Journal | Article

MR0611840 (82j:90068) Suharev, A. G.; Fedorov, V. V. Optimal search for the maximum of a minimum fu
connected variables. (Russian) *Vestnik Moskov. Univ. Ser. XV Vychisl. Mat. Kibernet.* **1981,** no. 1, 45--50, {
PDF | Doc Del | Clipboard | Journal | Article

MR0572389 (83c:49062) Fedorov, V. V. On the stability of the design process. (Russian) *Zh. Vychisl. Mat*
(1980), no. 2, 306--315, 549. 49D99
PDF | Doc Del | Clipboard | Journal | Article

MR0578156 (82c:90009) Morozov, V. V.; Fedorov, V. V. Construction of a vector test for a binary preferer
(Russian) *Zh. Vychisl. Mat. i Mat. Fiz.* **20** (1980), no. 3, 630--639, 812. (Reviewer: Andrzej Wieczorek) 90A(

MR0565164 (81h:65068) Fedorov, V. V. Stochastic decomposition in extremal problems. (Russian) *Vestni*
Ser. XV Vychisl. Mat. Kibernet. **1980,** no. 1, 52--57, 73. (Reviewer: A. G. Žilinskas) 65K10 (90C15)
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This article consists of a two-page extract, translated into French by \n C. Casamatta\en, from an interview of \n D. E. Menshov \en which \n A. P. Yushkevich\en conducted in 1980 and published in 1983 [Istor. Mat. Issled. No. 27 (1983), 312--333; MR0749494 (86a:01038)]. This excerpt is supplemented by three pages of footnotes by Pierre Dugac.

In the interview, Menshov reminisces about the famous seminar of \n J. Hadamard\en at the Collège de France and recounts \n A. Denjoy's\en close ties with Russian mathematicians, particularly \n N. N. Luzin\en.

{For the entire collection see MR0771482 (85g:01005).}

Reviewed by Gregory H. Moore

Non-standard year positioning. The publication's year may be easily parsed as 1927.