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Influence in Economics and Aging

Pavel Jelnov*and Yoram Weiss†

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Abstract

We study the relationship between age and influence in a closed group of 1,000 leading economists. We consider, as a measurement of influence, monthly RePEc rankings. We find that the rankings are not related to age but are related to experience. The optimal level of experience is 30 years from Ph.D. graduation. Additionally, we observe no robust difference in the effect of age and experience between Nobel laureates and leading non-Nobelists. Finally, we find that labor economists enjoy an especially steep improvement in the rankings before they reach the peak; however, the rankings also peak relatively early in their careers.

JEL code: J24

Keywords: aging; citations; influence; Nobel; research productivity

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1 Introduction

Aging is one of the most relevant topics of interest in labor economics. The measurement of scientists' productivity as a function of age dates back at least to Dennis (1956). Scientists accumulate experience, reputation, and a professional network, but their productivity decreases because of age-related factors (Desjardins and Warnke, 2012; Barrett and Riddell, 2016; Green and Riddell, 2013; Skirbekk et al., 2004). However, influence is not the same as productivity. Thus, it may be asked whether the influence of scientists reflects the Matthew effect of accumulated advantage, where "the rich get richer and the poor get poorer" (Allison et al., 1982), or whether it reflects a non-monotonic trend. For instance, Gingras et al. (2008) show that while scientists become less innovative after the age of 40, the average number of papers in highly cited journals and among highly cited papers rises continuously until retirement.[1] Meanwhile, as scientists age, they compete over influence, at least implicitly, with younger colleagues, who may be healthier, more motivated, and more likely to generate novel concepts (Weinberg and Galenson, 2019). As one would expect, the effects of experience and a professional network on influence are positive, whereas the effects of aging and competition with younger colleagues are negative.

The complex relationship between age and influence is well illustrated with the interesting example of Gary Becker. Figure 1 shows Becker's publications and citations by year of publication and by year of citation. Becker had three particularly productive periods in terms of number of publications: in his mid-40s, in his early 60s, and in his late 70s. The most frequently cited papers were published during the first of the three peaks. However,

[1] By contrast, Sinatra et al. (2016) model the impact of a scientific article as a product of constant ability and age-independent luck and find that this model fits data.

the number of citations took off only when he was in his 60s. Indeed, in arguably his most influential work, that on human capital theory, Becker (1962) writes that "The next few years should provide much stronger evidence on whether the recent emphasis placed on the concept of human capital is just another fad or a development of great and lasting importance." This work was motivated by the contemporary economic growth (Weiss, 2015), but the rise of its influence was also affected by the emergence of high-quality microdata and cheap computational power, which led to the development of structural econometric methods and from there to an enormous body of empirical work based on Becker's theory. Becker received the Nobel Prize in 1992, and the timing of the award tells us something about his influence.

The complexity of the relationship between age and influence can also be illustrated by heterogeneity across disciplines. In Figure 2, we compare Nobel laureates in economics to Nobel laureates in physics and literature. The horizontal axis shows age, while the vertical axis shows the level of experience at the time of receipt of the Nobel (the figure considers prizes awarded from 1990 to 2019). The level of experience for laureates in economics and physics is measured by the number of years since Ph.D. graduation and the level of experience for laureates in literature is measured by the number of years since publication of the first book. The figure shows that the distribution of ages at the time of receipt of the Nobel varies across disciplines. All Nobelists in economics except Esther Duflo were at least 50 years old. Nobelists in literature had a similar age range as economists when they received the prize but a wider range of experience. By contrast, a significant number of Nobelists in physics were younger than 50 and had less than 20 years of experience, even if some Nobelists in physics were very old, including the oldest person ever to receive the prize. In this sense, economists are more similar to writers than to physicists. In our context, the lack of very young Nobelists in economics indicates uncertainty about the influence of research in economics. This observation supports the discussion in Friedman (1953) about similarity (and dissimilarity) of economics and physics.[2] Moreover, if economics is "story telling" rather than a positive science, it may require a certain level of age-dependent maturity.

Fortunato et al. (2018) describe science as "a complex, self-organizing, and evolving network of scholars, projects, papers, and ideas."[3] Hence, science is an industry where participants experience a life cycle of research while both complementing each other and competing with each other. The effect of complementarity is studied by Azoulay et al. (2010), who find that unexpected death of academic superstars diminishes the productivity of their coauthors, and the decrease is sharper the more influential the deceased star was. As for competition, its effect is studied by Reschke et al. (2018), who find that articles that are about topics that are proximate to articles that become prize-awarded suffer from a drop in citations.

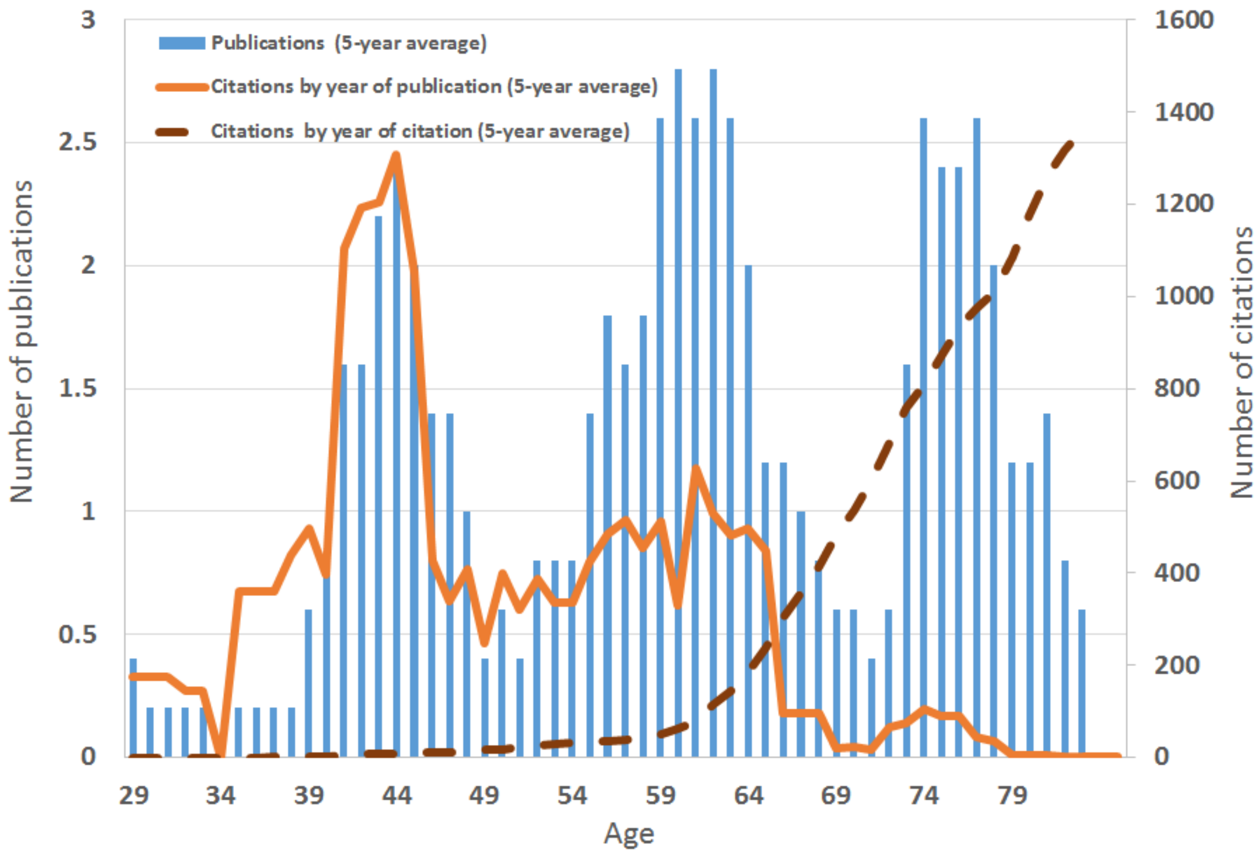
The contribution of this paper consists in studying the dynamics of influence in a closed group of leading economists. Using RePEc[4] monthly rankings of top economists, we estimate the relationship of age and experience with their rankings. The rankings are calculated from RePEc data on citations, publications, journal pages, abstract views, downloads, scientific

[2]Friedman's essay becomes even more interesting when one takes into account that it was published before the establishment of the Nobel Prize in economics and several decades before the prizes included in Figure 2 were awarded.

[3]The complex nature of institutional science motivates some authors to use models from physics, biology, and other disciplines to address the spread of citations across papers. See, for example, Clough et al. (2015), Goldberg et al. (2015), Klosik and Bornholdt (2014), and Zeng et al. (2017).

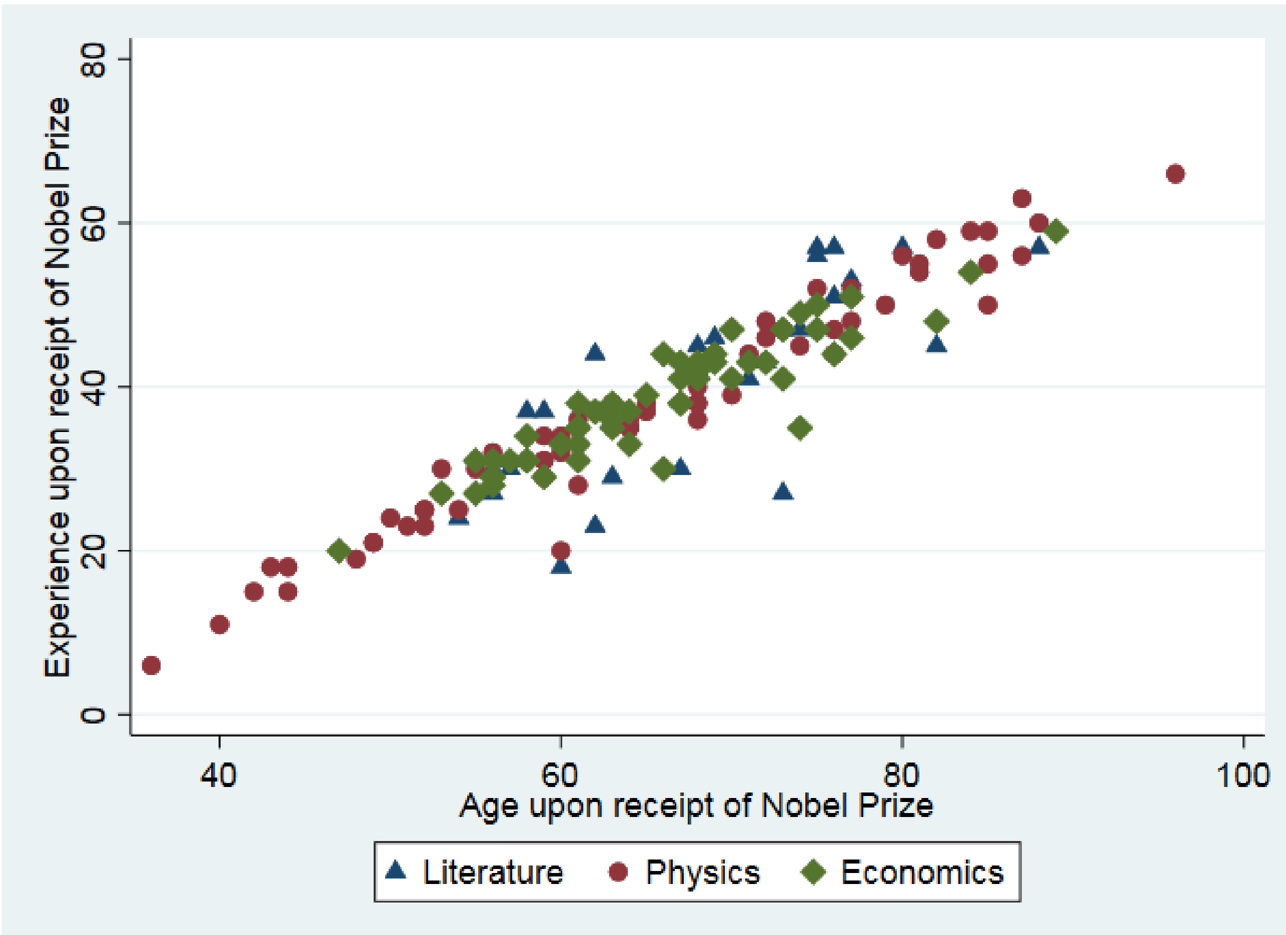
[4]RePEc (Research Papers in Economics) describes itself as "a collaborative effort of hundreds of volunteers in 99 countries to enhance the dissemination of research in Economics and related sciences. The heart of the project is a decentralized bibliographic database of working papers, journal articles, books, book chapters, and software components, all maintained by volunteers. ... So far, over 2,000 archives from 99 countries have contributed about 2.6 million research pieces from 3,000 journals and 4,600 working paper series. Over 50,000 authors have registered and 75,000 email subscriptions are served every week."

Figure 1: Publications and citations of Gary Becker



Note: The figure presents the 5-year moving average of Gary Becker's publications and citations, listed on his RePEc author page, by Becker's age.

Figure 2: Age and experience: Nobel laureates in economics, literature, and physics



Note: The figure covers Nobel Prizes awarded from 1990 to 2019. The level of experience for Nobel laureates in economics and physics is the number of years from Ph.D. graduation. The level of experience for Nobel laureates in literature is the number of years since publication of the first book or the equivalent.

network, and number of students. RePEc is open to new members and over the years it has become a popular platform that currently includes more than 55,000 research economists. The agents that we analyze are economists that are continuously ranked among the top 5% of RePEc members. Thus, we analyze a strictly balanced panel of leading economists. We rank them with respect to each other in order to remove the effect of new RePEc members. The longitudinal data enables us to control for individual fixed effects and autoregressive process of the residuals.

We find that age has almost no relationship with scientist's ranking, whereas experience has a strong and robust relationship. The latter relationship follows an inverted U-shape, and the optimal level of experience is 30 years since Ph.D. graduation. Furthermore, we find that Nobelists are not different from other top economists in terms of the relationship of age and experience with their ranking. We also address possible heterogeneity between economists. To this end, we construct "families" of top RePEc members. A family can be traced to a common "ancestor" in terms of Ph.D. supervision. We analyze the largest families, and find that labor economists have an especially steep improvement in their rankings in the first 25 years of their career after Ph.D. graduation. However, they reach the peak of their rankings relatively early.

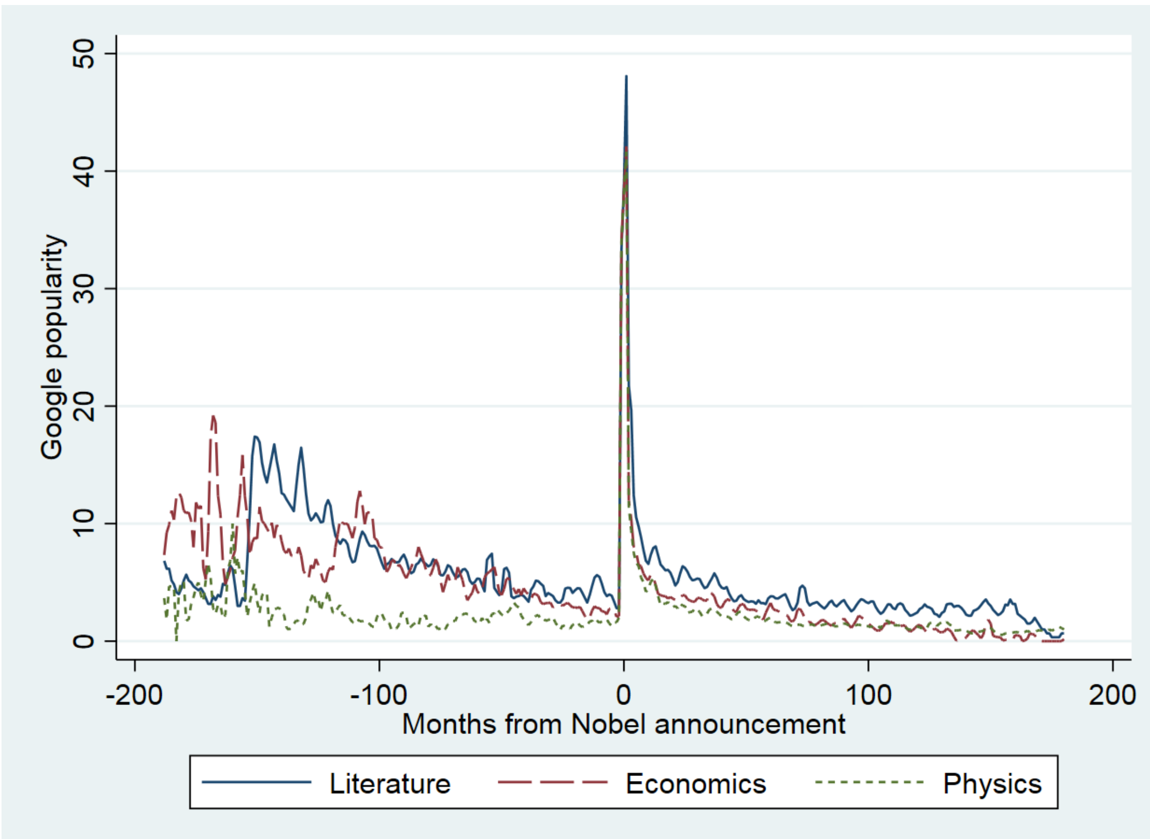
There are different types of influence, and RePEc rankings do not capture all of them. For instance, Nobel laureates enjoy popularity in the general public after receiving the prize. To illustrate this type of influence, in Figure 3, we show the Google trend (number of searches) for Nobelists in economics, literature, and physics as a function of the number of months from the Nobel announcement. Naturally, the Google trend of the Nobelists peaks immediately after the announcement and decreases gradually until it reaches the pre-prize level after several years. Prominently, before the prize there is no increasing trend in popularity. In addition, an interesting observation comes from a comparison between disciplines. Before the prize, economists are similar to writers in terms of Google trend, but after the prize they are similar to physicists.

We distinguish between Nobelists and other top RePEc members. The Nobel Prize is an external recognition of the scientist's exceptional influence, independent of RePEc. In the words of Hirsch (2005): "For the few scientists who earn a Nobel Prize, the impact and relevance of their research is unquestionable." It is therefore not easy to find a proper comparison group for the Nobel laureates. A natural comparison group is the nominees who did not win the prize (Baffes and Vamvakidis, 2011), but this data is released with a 50-year lag. We use recent data from the RePEc project, where Nobel laureates in economics can be consistently compared with top non-Nobelists.[5]

The rest of the paper is organized as follows. In Section 2, we introduce the data and provide descriptive statistics. In Section 3, we describe the estimation procedure. In Section 4, we present the results. In Section 5, we discuss heterogeneity across "families" of top

[5]Broadly speaking, the Nobel Prize is studied in empirical research using two approaches. The first approach is to see the prize as a deterministic achievement, try to figure out what is special about the laureates' background and life cycle, and ask whether the winners can be predicted (Gingras and Wallace, 2009; Wagner et al., 2015; Baffes and Vamvakidis, 2011; Van Dalen, 1999; Stephan and Levin, 1993; Shavinina, 2004; Rothenberg, 2005; Weinberg and Galenson, 2019; Ham and Weinberg, 2008). In addition, the prize is sometimes used as a benchmark to investigate the efficiency of a certain ranking methodology (Krapf et al., 2012), trends in the profession (Boettke et al., 2012), creativity (Weinberg and Galenson, 2019), and knowledge diffusion (Bjork et al., 2014). The second approach is to consider the Nobel Prize as a semi-experimental setup, where the winner and the timing of the award are, to some extent, exogenous. This approach uses the prize to estimate the effect of a positive status shock on outcomes such as collaboration, productivity, and health (Rablen and Oswald, 2008; Chan et al., 2014; Chan et al., 2015; Frandsen and Nicolaisen, 2013; Zuckerman, 1967). We follow the former approach. We do not estimate the effect of the prize, because an external intervention cannot immediately affect the aggregates that determine the RePEc rankings. Rather, we investigate whether Nobelists (even before receiving the prize) are different from other leading economists in terms of the effect of age and experience on their rankings.

Figure 3: Google trend of Nobel laureates in economics, literature, and physics



Note: The figure shows the average Google trend (number of searches) for Nobel laureates. Google releases normalized data on searches, such that the minimal value for each author is 0, and the maximal value is 100. Thus, Google trend data can be used to follow the trend of popularity of each author but not for comparison between authors in absolute terms.

economists. Section 6 concludes.

2 Data

A big panel

The full data set is the collection of rankings of the top 5% of RePEc members for the period from August 2000 to July 2019. The number of RePEc members was initially small, but has exploded since 2000, when the rankings started to be published. Specifically, the number of the top 5% of the members grew from 18 in the first ranking published in August 2000 to over 3,000 in July 2019. In order for the rankings of the economists that we analyze not to be biased by newcomers to RePEc, we chose the range of months that maximizes the number of observations in a strongly balanced panel (economists $\times$ months). Accordingly, we restrict the sample to RePEc members that are continuously ranked among the top 5%, and the selection of months range is such that the resulting data set is as large as possible. Thus, we study the dynamics of influence in a closed group, where individuals are ranked every month with respect to each other. We further restrict the sample to economists who were alive at the time of ranking.[6] The range of months that is analyzed is from March 2012 to July 2019. This is the maximal possible balanced panel with $N = 1,380$, $T = 89$, and $N \times T = 122,820$. Out of the total of 1,380 economists, 31 are Nobel laureates. Thus, the sample that we analyze consists of 1,380 economists ranked over a period of 89 months. For ease of notation, we refer to this sample as the "big panel." We normalize the ranking within this group, and, for convenience, rescale the normalized rank by multiplying it by 100. Thus,

[6] RePEc continues to rank its members posthumously.

the top economist in our data has a rank of $\frac{100}{1,380}$, while the ranks of other economists are ranged between $\frac{200}{1,380}$ and 100.

Our analysis addresses the variables of age and experience. Thus, we need to know the year of birth and the year of Ph.D. graduation of the 1,380 economists in the sample. We use different sources to find these data: curriculum vitae, personal and institutional websites, the RePEc genealogy project, Wikipedia, and the Prabook project. We managed to find both year of birth and year of Ph.D. in economics (or equivalent) graduation for 1,001 out of the 1,380 economists (72.5%). The economists in the sample have a wide range of ages from 32 to 95 for non-Nobelists and from 39 to 92 for Nobelists (see Table 1 for descriptive statistics). Hence, the efficient sample that includes age and experience consists of $1,001 \times 89 = 89,089$ observations.[7] Figure 4 illustrates the full data, the sample, and the efficient sample. It shows the number of top-5% RePEc economists on the vertical axis and the month of ranking on the horizontal axis. The large rectangle shows the sample and the smaller rectangle inside it shows the efficient sample used for estimation.

RePEc publishes the aggregate ranking and the rankings in each of the indexes that are used to calculate the aggregate ranking. The aggregate ranking is a harmonic mean of the rankings according to these indexes. In our analysis, we consider the aggregate ranking as a proxy for influence. In addition, we analyze each of the underlying indexes separately. The list of indexes has also grown significantly over the years and currently includes 37 indexes (see Table 2 for the list of indexes). The indexes consider the number of works, the number of citations (including h-index), the number of published pages, the number of abstract views and downloads from RePEc, and, recently, also the number of graduate students and indexes

[7]It is easier to find year of graduation than year of birth. The sample with experience but without age consists of $1,325 \times 89 = 117,925$ observations.

for professional networking.

Although it may happen that a relatively minor economist ranks well in RePEC, this is by far not the general case. Table 3 lists the top 10 economists according to the latest ranking, and the list includes only influential economists, such as James J. Heckman and Jean Tirole. Moreover, as we show below, Nobelists (even before the receipt of the prize) rank much better on average than others in the top 5% group. This evidence also advocates the validity of RePEC rankings as a measure of influence.

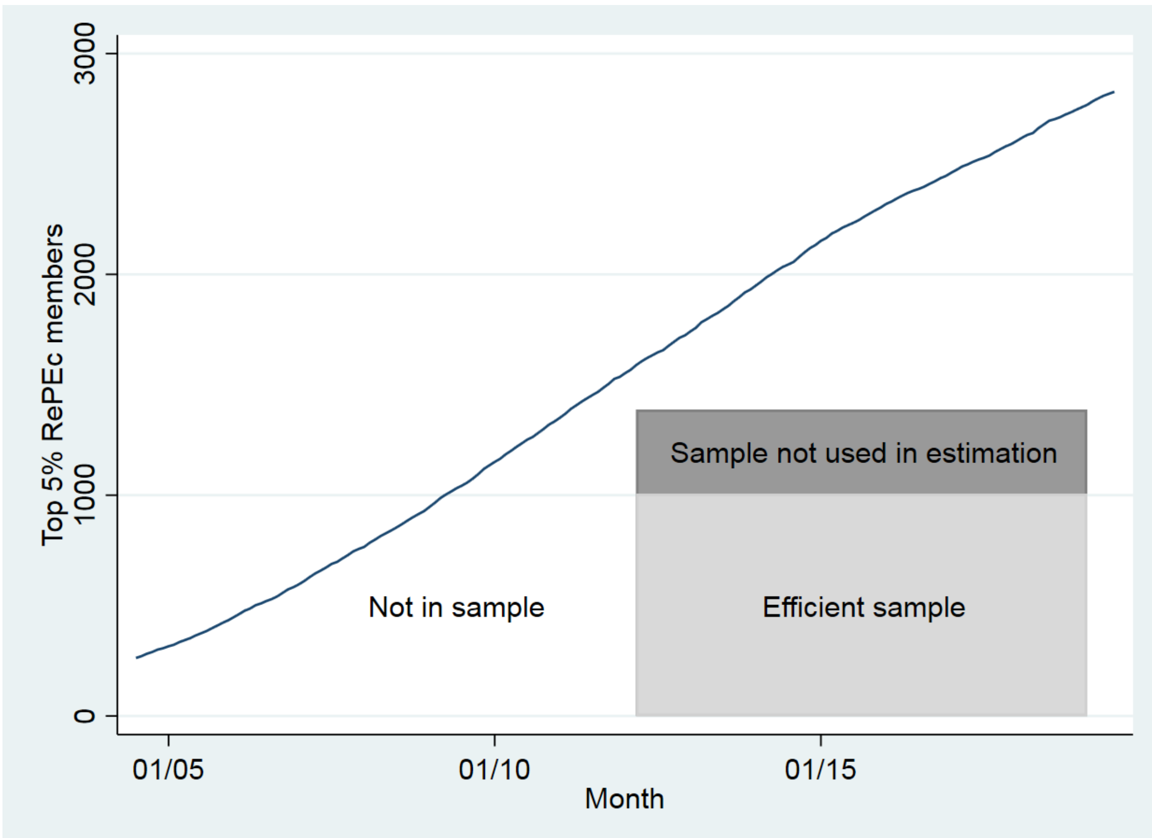
A long panel

A natural robustness check of the results is to reestimate the model with a different sample. We recall that in the big panel $T = 89$ and $N = 1,380$. For the robustness check we increase T by 50% at the expense of a lower N. Thus, we reestimate the model with $T = 133$ (July 2008 to July 2019). The largest N for a balanced panel in this period of time is 737 economists, for 598 of whom we know the years of birth and graduation. Of these 598, 29 are Nobelists. Thus, the efficient sample for the robustness check is $T = 133$ and $N = 598$. For ease of notation, we refer to this sample as the "long panel."

Descriptive graphs

We present descriptive graphs that show the average rankings of the top 5% of RePEc members by age and experience, separately for Nobelists and non-Nobelists. In Figure 5, we plot the average aggregate ranking by age. As seen in the figure, the ranking improves (goes toward 1, the best ranking) until about age 60 and then it declines (goes away from 1). Compared to non-Nobelists, Nobelists have higher and stabler average rankings (not

Figure 4: Full data set, sample, and efficient sample



Note: The figure shows the number of top 5% RePEc members by month of ranking. The rectangle shows the biggest balanced panel ("big panel"). The bright part of the rectangle is the efficient sample. It consists of economists whose years of birth and Ph.D. graduation are known. The dark part consists of economists who are in the big panel, but either their year of birth or year of Ph.D. graduation are unknown. They are taken into account for normalization of monthly rankings within the panel but are not included in regression analyses.

Table 1: Summary statistics

	Others (alive in July 2019)					Nobel laureates (alive in July 2019)				
Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Big panel (March 2012 to July 2019, 1,380 economists)										
Age	59.8	9.5	32	95	89,089	71.1	9.7	39	92	2,759
Years since Ph.D.	29.7	9.8	2	69	115,166	44.7	9.9	12	64	2,759
Long panel (July 2008 to July 2019, 737 economists)										
Age	59.3	9.0	30	95	77,140	68.8	10.0	36	92	3,857
Years since Ph.D.	30.0	9.3	0	69	92,302	42.6	10.4	9	64	3,857

Note: The table shows the descriptive statistics of age and experience, where experience is the number of years since receipt of Ph.D. in economics or an equivalent degree. The big panel is the largest (in terms of $T \times N$) balanced panel that can be derived from the top 5% of RePEc aggregate rankings. The long panel has a by-50%-larger T than the big panel has at the expense of a smaller number of economists.

declining until their late 70s).

In Figure 6, we show the average aggregate ranking as a function of the number of years since Ph.D. graduation. The ranking improves over level of experience until reaching a peak at 50 years since Ph.D. graduation. Again, Nobelists have a better ranking on average, but the trajectory of their ranking as a function of academic experience is not different from that of non-Nobelists.

One can also plot the components of the aggregate ranking separately. There are 37 measures that RePEc uses to rank each scientist. The aggregate ranking is a harmonic mean of the economist's rankings according to these 37 indexes. The indexes measure publications, citations, journal pages, abstract views and downloads from RePEc database, quality of network, and, recently, also number of students.[8] All data on publications and citations collected by RePEc refers to scientific economic journals and books.

[8]The correlation between different indexes that measure the same type of outcome, e.g., citations, is high. Correspondingly, Besancenot et al. (2019) find that a simple citation count is a sufficient measure of citations.

Table 2: RePEc indexes used for ranking authors

Index	Description
	Number of Works
dnbworks	Number of Distinct Works
scworks	Number of Distinct Works, Weighted by Simple Impact Factor
wscworks	Number of Distinct Works, Weighted by Recursive Impact Factor
anbworks	Number of Distinct Works, Weighted by Number of Authors
ascworks	Number of Distinct Works, Weighted by Number of Authors and Simple Impact Factors
awscworks	Number of Distinct Works, Weighted by Number of Authors and Recursive Impact Factors
	Number of Journal Pages
nbpages	Number of Journal Pages
scpages	Number of Journal Pages, Weighted by Simple Impact Factor
wscpages	Number of Journal Pages, Weighted by Recursive Impact Factor
anbpages	Number of Journal Pages, Weighted by Number of Authors
ascpages	Number of Journal Pages, Weighted by Number of Authors and Simple Impact Factors
awscpages	Number of Journal Pages, Weighted by Number of Authors and Recursive Impact Factors
	Number of Citations
nbcites	Number of Citations
dcites	Number of Citations, Discounted by Citation Age
sccites	Number of Citations, Weighted by Simple Impact Factor
dsccites	Number of Citations, Weighted by Simple Impact Factor, Discounted by Citation Age
wsccites	Number of Citations, Weighted by Recursive Impact Factor
wdsccites	Number of Citations, Weighted by Recursive Impact Factor, Discounted by Citation Age
anbcites	Number of Citations, Weighted by Number of Authors
adcites	Number of Citations, Weighted by Number of Authors, Discounted by Citation Age
asccites	Number of Citations, Weighted by Number of Authors and Simple Impact Factors
adsccites	Number of Citations, Weighted by Number of Authors and Simple Impact Factors, Discounted by Citation Age
awsccites	Number of Citations, Weighted by Number of Authors and Recursive Impact Factors
awdsccites	Number of Citations, Weighted by Number of Authors and Recursive Impact Factors, Discounted by Citation Age
hindex	h-index
ncauthors	Number of Registered Citing Authors
rcauthors	Number of Registered Citing Authors, Weighted by Rank (Max. 1 per Author)
euclid	Euclidean citation score
nepcites	Breadth of citations across fields
	Abstract Views and Downloads
absviews	Number of Abstract Views in RePEc Services over the Past 12 Months
downloads	Number of Downloads through RePEc Services over the Past 12 Months
aabsviews	Number of Abstract Views in RePEc Services over the Past 12 Months, Weighted by Number of Authors
adownloads	Number of Downloads through RePEc Services over the Past 12 Months, Weighted by Number of Authors
	Network and Students
close	Closeness Measure in Co-authorship Network
betweenn	Betweenness measure in Co-authorship Network
students	Record of Graduates

Note: The names and the description of the indexes are given according to RePEc.

Table 3: Top-ranked RePEC economists

Ranking	Name	Affiliation
1	Andrei Shleifer	Harvard University
2	James J. Heckman	University of Chicago
3	Daron Acemoglu	Massachusetts Institute of Technology
4	Robert J. Barro	Harvard University
5	Joseph E. Stiglitz	Columbia University
6	Jean Tirole	Toulouse School of Economics
7	Peter C. B. Phillips	Yale University and Singapore Management University
8	Kenneth S Rogoff	Harvard University
9	Robert E. Lucas Jr.	University of Chicago
10	John Y. Campbell	Harvard University

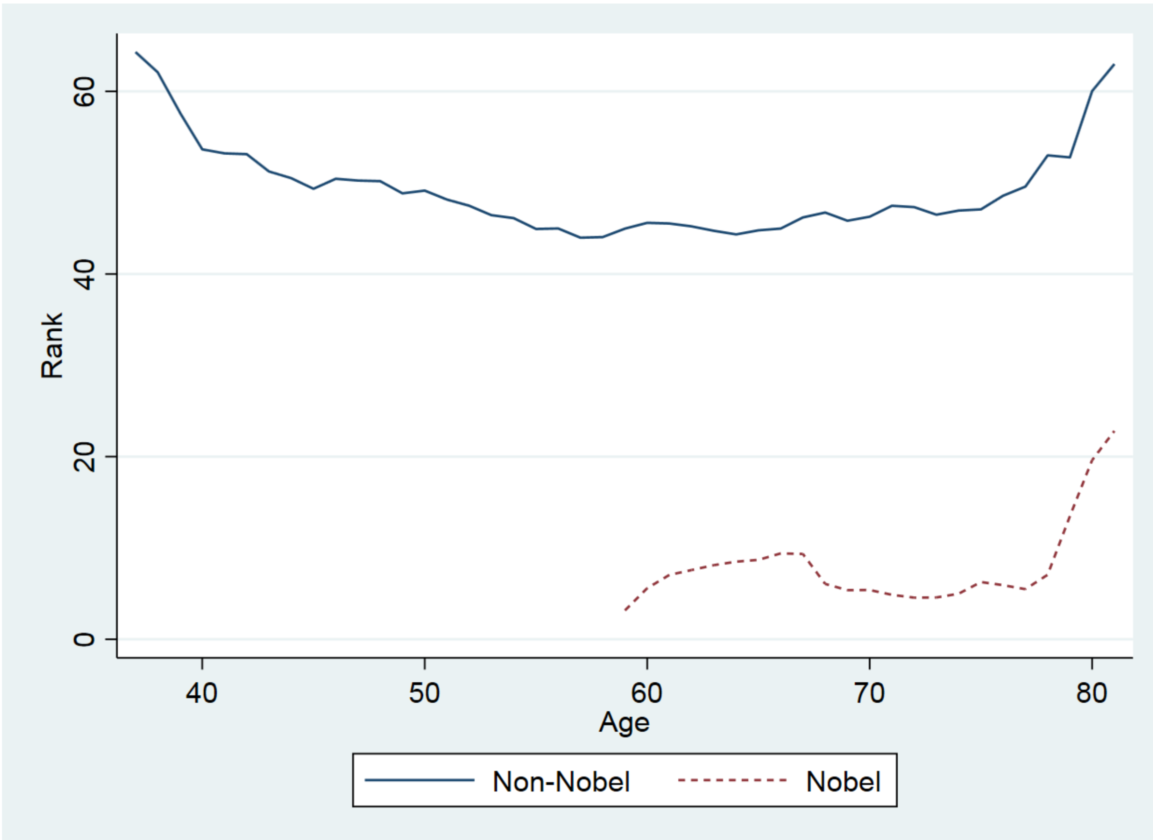
Note: The list shows the top 10 RePEC authors according to the aggregate ranking as of November 2019.

For some indexes, such as number of works and number of journal pages, there is no significant difference between Nobelists and other top economists. Figure 7 shows the average ranking in terms of the number of citations and the number of distinct works by age and years since Ph.D. graduation. We see almost no difference between Nobelists and other top economists in the average ranking in terms of the number of works as a function of age and as a function of academic experience.

However, there is a significant difference in the ranking of Nobelists and other top economists in terms of the number of citations. There is a big advantage for Nobelists at all ages and at all levels of academic experience.

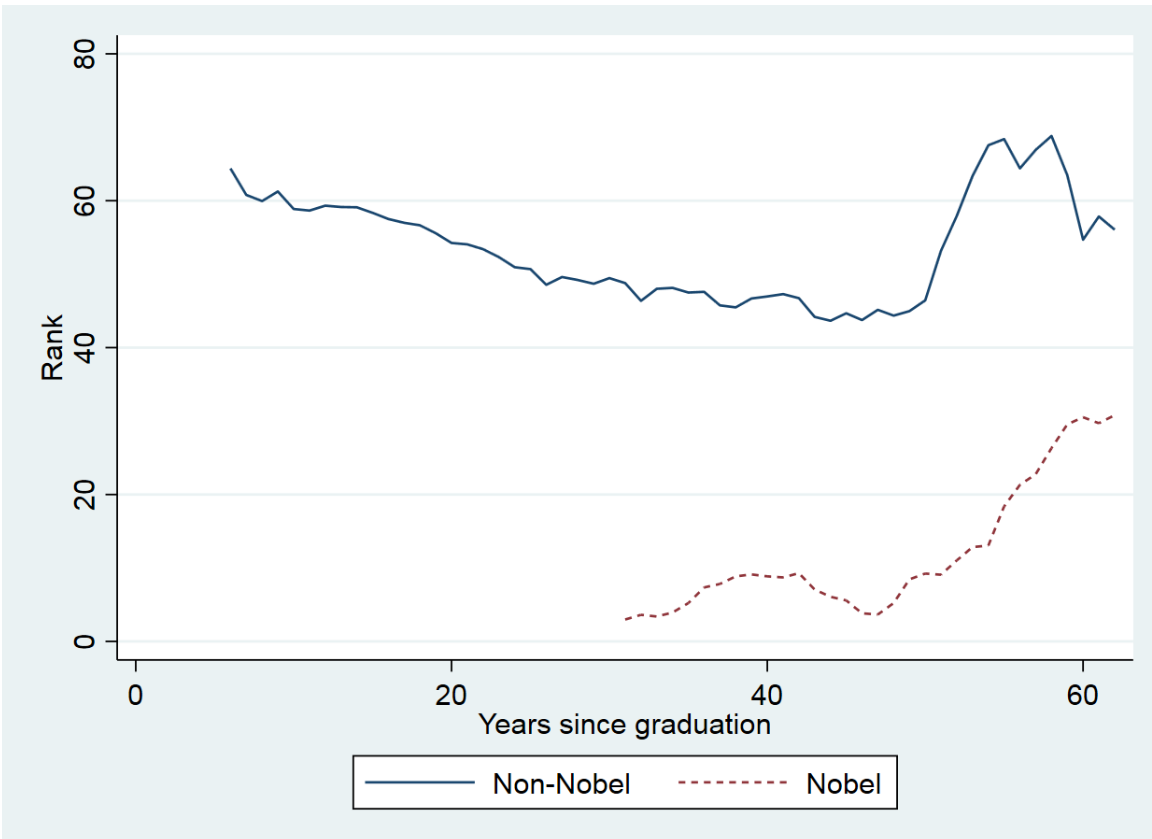
All figures show stylized facts that, obviously, are very much dependent on the composition of the top RePEc economists. In the econometric analysis, summarized below, we control for invariant unobserved heterogeneity by individual fixed effects and allow for first-order autoregressive process of the residuals.

Figure 5: Average aggregate ranking of top economists by age



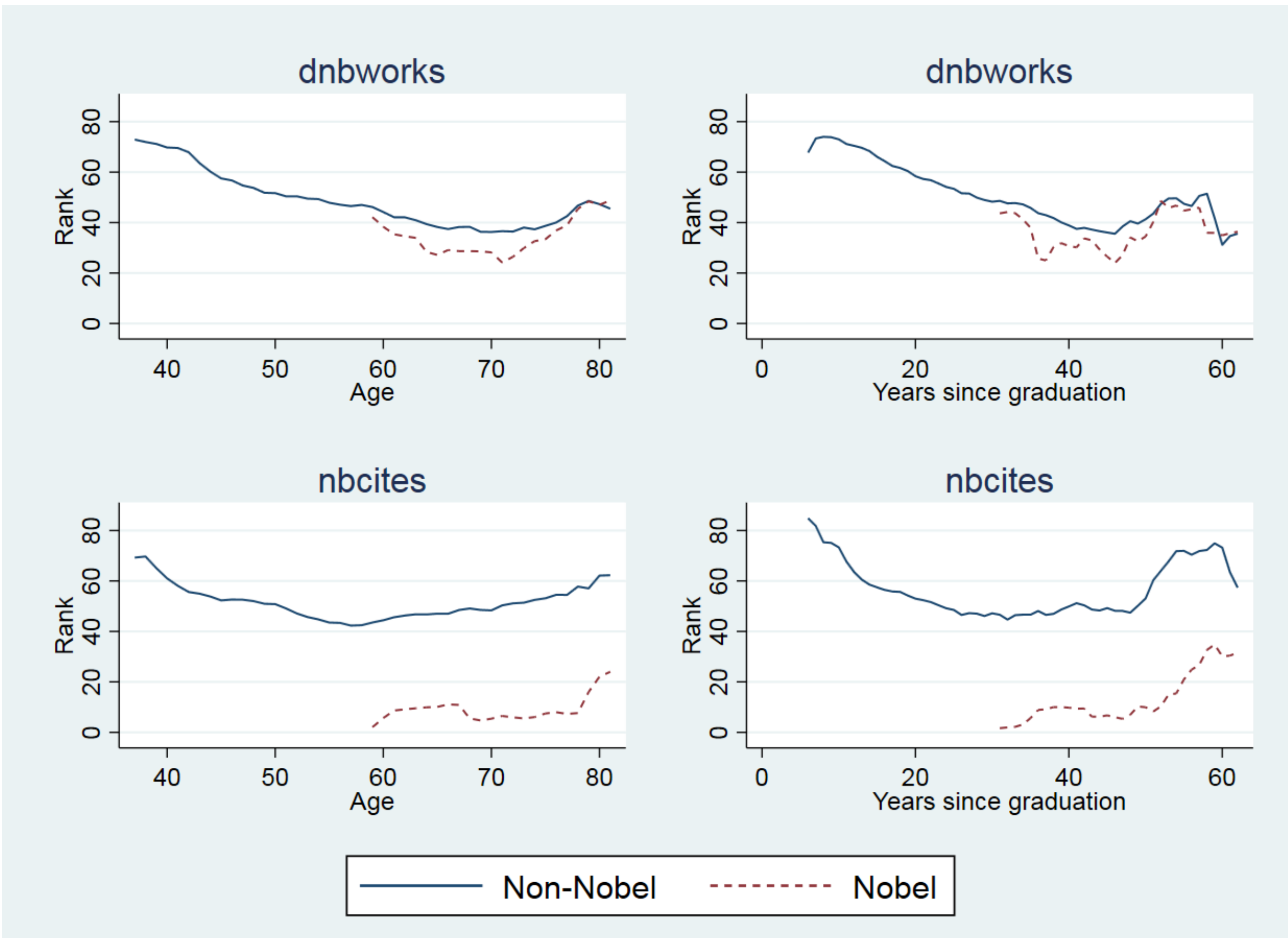
Note: The figure shows the average normalized monthly ranking (multiplied by 100) in the big panel (from March 2012 to July 2019), by age. The sample for this figure consists of all economists in the big panel whose year of birth is known: 1,001 non-Nobelists and 31 Nobelists during 89 months, 91,848 observations overall (see summary statistics in Table 1).

Figure 6: Average aggregate ranking of top economists by number of years since Ph.D. graduation



Note: The figure shows the average normalized monthly ranking (multiplied by 100) in the big panel (from March 2012 to July 2019), by number of years since Ph.D. graduation. The sample for this figure consists of all economists in the big panel whose year of Ph.D. graduation is known: 1,294 non-Nobelists and 31 Nobelists during 89 months, 117,925 observations overall (see summary statistics in Table 1).

Figure 7: Average ranking of top economists in terms the number of distinct works and number of citations, by age and years since Ph.D. graduation



Note: See the notes to Figures 5 and 6.

3 Estimation

Econometric model

We estimate a model where we consider, as the outcomes of interest, the aggregate ranking (which we use as a proxy for influence) and the rankings of the individual indexes that combine into the aggregate ranking. The main explanatory variables are age and number of years since Ph.D. graduation, which we concisely refer to as experience. We include, additionally, an interaction term between being an economics Nobelist (even before the receipt of the prize) and the explanatory variables. Thus, we estimate the age-specific and experience-specific trend in the ranking, with respect to Nobelists and non-Nobelists.

The estimated model is given as

$$R_{it} = \beta_1 Exp_{it} + \beta_2 Exp_{it}^2 + Age_{it} \cdot \gamma + Nobel_i \times (\beta_3 Exp_{it} + Age_{it} \cdot \delta) + \mu_i + \varepsilon_{it}, \qquad (1)$$

where R_{it} is the rank of economist i in month t. On the right-hand side, Exp is experience, which is defined as the number of years since receipt of Ph.D. in economics or an equivalent degree. Age is a vector of dummy variables for age groups (younger than 50, 50 to 59, 60 to 69, and 70 or more years old). Age is grouped because age and experience are collinear in the presence of individual fixed effects. $Nobel$ is a dummy variable for being a current or future Nobel laureate in economics. The grouping of age into dummy variables is different between Nobelists and non-Nobelists, because, unlike non-Nobelists, some of whom are even younger than 40, all Nobelists (before or after receiving the Prize) in our data except Esther Duflo are at least 49 years old. For Nobelists the grouping is younger than 65, 65 to 79, and

80 or more years old.[9]

Individual fixed effects are captured by μ_i. By controlling for individual fixed effects, we absorb any differences in initial conditions between economists of different ages. The only measure that matters is what happened during our data period, which is 2008 to 2019 for all of the economists that we analyse. Therefore, we estimate the gradient of influence by age during this period of time and abstract from historical conditions, such as publication and citation patterns in pre-Internet era, relevant for old but not for young authors.

The disturbance is allowed to be first-order autoregressive within each author.[10] Finally, to check the robustness of the results, we estimate two models: one where we categorize experience and consider age as a continuous variable and one where we categorize both variables. The results remain similar to the results of estimation of Equation (1).

Interpretation of the coefficients

The considered outcomes are the rankings within a closed group of 1,380 economists (737 in the long panel) who are continuously in the top 5% of RePEc members. Thus, all coefficients are interpreted as the relationship of the explanatory variable with the normalized ranking, where the normalized ranking ranges between $\frac{100}{1,380}$ and 100, the lower the better. A negative coefficient means a better ranking as a function of the explanatory variable. Because of the normalization of rankings, we interpret the coefficients as percentage points in the uniform distribution of the authors according to each ranking.

[9] Affiliation is also related to the economist's influence. It is not included in the model for the following reason. If the economist did not change his or her affiliation during the sample period, the effect of affiliation is absorbed by the individual fixed effect. If s/he did change his or her affiliation, such a change is likely to be endogenous to his or her influence.

[10] We use the STATA function *xtregar* for estimation.

The RePEc ranking data is still too short to follow the complete life cycles of leading economists. Therefore, age effect in this data cannot be fully separated from cohort effect beyond controlling for individual-specific mean ranking (individual fixed effect).[11] Thus, our estimates should be interpreted as gradients of influence within a closed group of leading economists of different ages sampled for a period of seven (for the big panel) or eleven (for the long panel) years. By saying "the effect of age on the ranking," we mean the trajectory of rankings over the distribution of ages in RePEc data, when the level of experience, the author-specific mean ranking, and AR(1) disturbance are controlled for.

4 Results

Tables 4 and 5 present the results for the estimation for the aggregate ranking (that we interpret as influence) and for the main indexes. Table 4 shows the results for the big panel (89 months and 1,001 economists) and Table 5 shows the results for the long panel (133 months and 598 economists). Column 1 shows the results for the aggregate ranking. The results show that age is not related to the aggregate ranking (the only effects that are statistically significant in the big panel are not observed in the long panel), whereas experience has a robust relationship that follows an inverted U-shape. The optimal level of experience is 32 years after Ph.D. graduation in both panels. The aggregate ranking of economists with 30 years of experience is 4.6 (in the big panel) or 2.5 (in the long panel) percentage points lower than the aggregate ranking of economists with 10 years of experience, ceteris paribus. Nobelists are not different from non-Nobelists in terms of the relationship

[11]This is *not* the age-time-cohort problem in the identification of structural parameters in life-cycle models (Schulhofer-Wohl, 2018). There is no time dimension in our data, because the average monthly ranking is always 1381/2 in the big panel and 738/2 in the long panel.

of age and influence. Thus, the difference between Nobelists and non-Nobelists, observed in Figures 5 and 6, is solely explained by different individual fixed effects.

Columns 2–9 show the results for the main indexes: number of citations, number of distinct works, abstract views and downloads of papers from RePEc, co-authorship network, and number of students. The inverted U-shaped relationship between ranking and experience is observed for all indexes except abstract views and downloads. No index shows a robust relationship with age (all statistically significant effects of age are observed in only one of the two samples). Furthermore, the difference between Nobelists and non-Nobelists is observed in the big panel for two indexes: the number of citations and the betweenness measure in a co-authorship network. However, these two effects are not robust, as they are not observed in the long panel.

In addition to the results for the main indexes discussed above, in Appendix Tables 9–13 we report full results for all indexes listed in Table 2 for the big panel and in Appendix Tables 14–18 for the long panel.

5 Heterogeneity

Finally, we investigate the heterogeneity of the relationships between age and influence. For this purpose, we need to classify the economists. However, there is no objective heuristic to do that. For instance, RePEc's classification of authors by field assigns many fields to each author. In order to be agnostic, we classify authors by academic "family," using the RePEc Genealogy project, which links about 25% of RePEc members and some non-members to their Ph.D. advisors and students. In particular, we construct "families" of economists, where an-

Table 4: Main results, big panel

VARIABLES	(1) aggregate	(2) nbcites	(3) dnbworks	(4) nbpages	(5) absviews	(6) downloads	(7) close	(8) betweenn	(9) students
Exp	-0.622***	-0.383***	-0.591***	-0.437***	-0.007	0.023	-1.306***	-1.095***	0.105
	(0.080)	(0.064)	(0.054)	(0.064)	(0.057)	(0.074)	(0.108)	(0.084)	(0.081)
Exp^2	0.010***	0.006***	0.010***	0.007***	0.000	-0.001	0.019***	0.016***	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
$Exp \times Nobel$	-0.257*	-0.209*	-0.217**	-0.116	-0.100	-0.060	-0.098	-0.402***	0.230
	(0.142)	(0.114)	(0.094)	(0.113)	(0.102)	(0.132)	(0.190)	(0.148)	(0.142)
$Age \leq 49$					*omitted*				
$50 \leq Age \leq 59$	0.106	-0.027	0.117	0.202	0.045	-0.014	-0.623**	0.287	-0.178
	(0.164)	(0.129)	(0.118)	(0.127)	(0.107)	(0.141)	(0.290)	(0.249)	(0.156)
$60 \leq Age \leq 69$	0.221	0.079	0.166	0.271*	-0.028	0.002	-0.516	0.439	-0.102
	(0.211)	(0.165)	(0.151)	(0.162)	(0.137)	(0.180)	(0.377)	(0.325)	(0.195)
$70 \leq Age$	0.270	0.164	0.163	0.266	-0.118	-0.018	0.028	1.108***	-0.069
	(0.269)	(0.210)	(0.192)	(0.207)	(0.175)	(0.230)	(0.480)	(0.415)	(0.245)
$(Age \leq 64) \times Nobel$					*omitted*				
$(65 \leq Age \leq 79) \times Nobel$	0.318	0.245	0.479	0.391	0.054	0.647	-0.337	0.585	-0.262
	(0.843)	(0.662)	(0.597)	(0.653)	(0.557)	(0.730)	(1.422)	(1.194)	(0.730)
$(80 \leq Age) \times Nobel$	0.341	0.383	0.359	0.498	0.159	0.509	-0.871	0.736	-0.024
	(1.221)	(0.956)	(0.870)	(0.942)	(0.799)	(1.048)	(2.137)	(1.828)	(1.089)
Observations	88,088	88,088	88,088	88,088	88,087	88,087	88,088	88,088	73,073
Num. of authors	1,001	1,001	1,001	1,001	1,001	1,001	1,001	1,001	1,001
Delta (30–10)	-4.621	-2.858	-4.137	-3.188	-0.0250	0.0440	-10.57	-9.420	0.713
t-value	-6.189	-4.767	-8.289	-5.347	-0.0472	0.0639	-10.46	-11.92	0.937
Optimal exp.	31.81	31.90	30.78	31.48	24.72	22.12	33.61	35.10	30.33
(st. dev.)	1.266	1.658	0.864	1.427	78.47	29.94	0.885	0.901	7.244

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 5: Main results, long panel

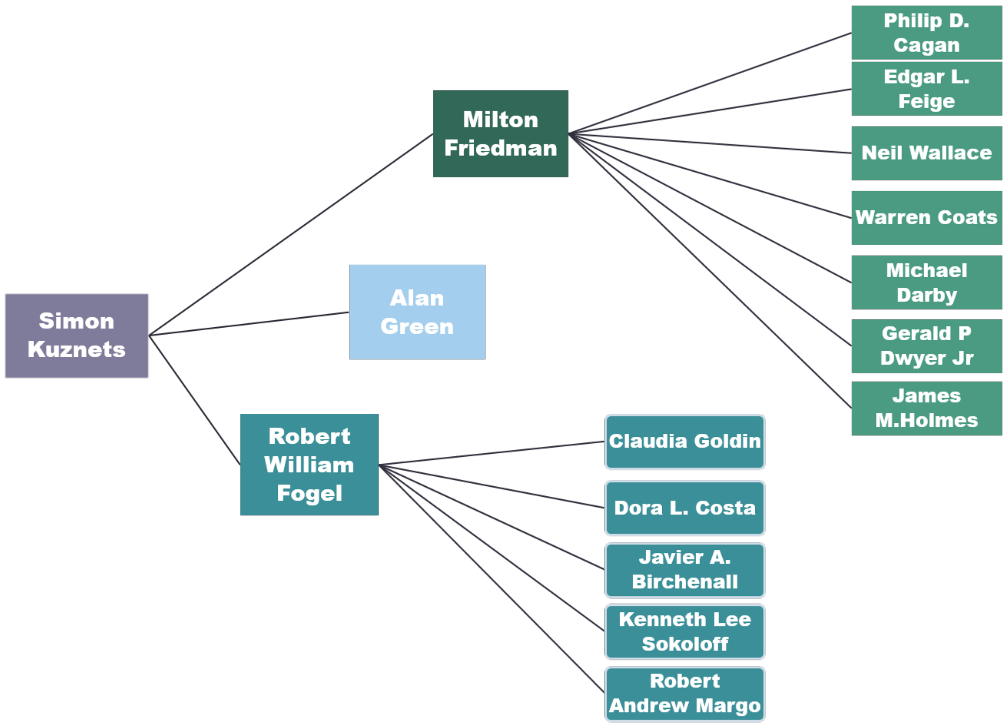
VARIABLES	(1) aggregate	(2) nbcites	(3) dnbworks	(4) nbpages	(5) absviews	(6) downloads	(7) close	(8) betweenn	(9) students
Exp	-0.341***	-0.076	-0.450***	-0.282***	-0.116*	-0.043	-1.069***	-0.964***	0.177
	(0.087)	(0.068)	(0.071)	(0.081)	(0.064)	(0.074)	(0.148)	(0.120)	(0.115)
Exp^2	0.005***	0.001	0.007***	0.004***	0.002*	0.001	0.015***	0.013***	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
$Exp \times Nobel$	-0.087	-0.059	-0.148	-0.103	0.039	0.006	-0.126	-0.298**	0.165
	(0.117)	(0.091)	(0.095)	(0.109)	(0.087)	(0.101)	(0.185)	(0.149)	(0.142)
$Age \leq 49$					*omitted*				
$50 \leq Age \leq 59$	0.057	0.090	0.096	0.036	0.390***	0.153	-0.648	-0.202	-0.023
	(0.167)	(0.126)	(0.146)	(0.151)	(0.115)	(0.133)	(0.423)	(0.367)	(0.230)
$60 \leq Age \leq 69$	0.187	0.139	0.265	0.076	0.484***	0.282*	-0.654	-0.077	-0.031
	(0.211)	(0.160)	(0.185)	(0.191)	(0.145)	(0.168)	(0.513)	(0.448)	(0.269)
$70 \leq Age$	0.240	0.249	0.221	0.058	0.339*	0.146	-0.376	0.497	-0.065
	(0.270)	(0.204)	(0.236)	(0.244)	(0.185)	(0.215)	(0.621)	(0.543)	(0.321)
$(Age \leq 64) \times Nobel$					*omitted*				
$(65 \leq Age \leq 79) \times Nobel$	0.085	0.102	0.229	0.192	-0.049	0.304	-0.498	0.361	-0.280
	(0.624)	(0.472)	(0.543)	(0.566)	(0.430)	(0.499)	(1.352)	(1.156)	(0.701)
$(80 \leq Age) \times Nobel$	0.235	0.046	0.256	0.402	-0.033	0.021	-0.714	0.272	-0.003
	(1.010)	(0.764)	(0.880)	(0.916)	(0.695)	(0.806)	(2.101)	(1.818)	(1.047)
Observations	78,936	78,936	78,936	78,936	78,936	78,936	52,624	52,624	43,654
Num. of authors	598	598	598	598	598	598	598	598	598
Delta (30–10)	-2.515	-0.626	-3.372	-2.074	-0.921	-0.315	-9.283	-8.980	1.972
t-value	-3.149	-1.006	-5.176	-2.792	-1.561	-0.463	-6.617	-7.909	1.807
Optimal exp.	31.67	34.02	32.00	31.65	33.23	31.68	35.36	37.44	45.05
(st. dev.)	2.356	9.121	1.472	2.658	5.524	16.20	1.375	1.396	12.23

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

cestry is defined by Ph.D. supervision. The families that we manage to construct have up to four generations. A family can be traced to a common ancestor. Some economists belong to more than one family, because they have multiple Ph.D. advisors who themselves belong to different families. Figure 8 shows, as an example, the family headed by Simon Kuznets (even though Kuznets himself did not have an opportunity to be a RePEc member). It does not include all Kuznets' descendants but only those listed in RePEc genealogy project. The natural interpretation of families is their relationship to specific fields of economic research. We focus on the five largest families that we found in the RePEc data, whose common ancestors are Kenneth Arrow, Lawrence Katz, Wassily Leontief, Rudi Dornbusch, and Tjalling Koopmans. We estimate Equation (1) for each of the five families (we do not pool families, because some economists belong to two families). Because there are only a few or no Nobelists in each family, we exclude the interaction with Nobel status from the model. Tables 6–8 show the results for the aggregate ranking, number of citations, and number of distinct works. The results for the co-authorship network and number of students indexes appear in Appendix Tables 19–21.

We indeed observe heterogeneity. In particular, the first three decades of post-graduate experience have a stronger positive effect for the "labor" Lawrence Katz family, compared to the "macroeconomic" Wassily Leontief family. We find that an economist who belongs to the Lawrence Katz family advances 18 percentage points in the aggregate ranking between the 10th and 30th year after Ph.D. graduation. However, she reaches the peak of her influence as early as 26 years after Ph.D. graduation (25 years in the long panel), while her counterpart in the Wassily Leontief family does so in 34 years (36 years in the long panel). Thus, labor economists reach the peak of their influence 10 years earlier (in terms of years since Ph.D.

Figure 8: Simon Kuznets' "family" in the RePEc Genealogy project



Note: The figure shows Simon Kuznet's Ph.D. students and their Ph.D. students in the RePEc Genealogy project.

graduation) than macroeconomists. The "macroeconomic" Rudi Dornbusch family is similar to the "macroeconomic" Wassily Leontief family in terms of the effect of experience on the number of citations and works. This similarity between two families of macroeconomists suggests that the coefficients are not spurious. The coefficients for the main indexes for the other two families are statistically insignificant.

Table 6: Aggregate ranking (big families)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
			Big panel					Long panel		
VARIABLES	Arrow	Katz	Leontief	Dornbusch	Koopmans	Arrow	Katz	Leontief	Dornbusch	Koopmans
Exp	0.560	-3.831***	-0.787***	-0.730*	0.321	-0.503	-2.418***	-0.684***	-0.547	0.432
	(0.422)	(0.786)	(0.222)	(0.387)	(0.377)	(0.679)	(0.628)	(0.203)	(0.453)	(0.407)
Exp^2	-0.011	0.073***	0.012***	0.012*	-0.006	0.008	0.048***	0.010***	0.009	-0.007
	(0.007)	(0.019)	(0.003)	(0.007)	(0.005)	(0.011)	(0.015)	(0.003)	(0.008)	(0.006)
$Age \leq 49$					*omitted*					
$50 \leq Age$	-0.265	0.660	0.391	-0.233	0.374	0.781	0.381	0.139	-0.302	0.677
≤ 59	(0.688)	(1.219)	(0.551)	(0.588)	(0.752)	(1.109)	(0.845)	(0.470)	(0.538)	(0.764)
$60 \leq Age$	-0.026	0.646	0.944	1.362*	0.520	0.914	-0.537	0.245	1.400*	0.902
≤ 69	(1.042)	(2.685)	(0.775)	(0.721)	(1.006)	(1.414)	(2.719)	(0.671)	(0.731)	(1.026)
$70 \leq Age$	0.246		0.469	1.784	0.119	1.569		-0.222	1.870	0.912
	(2.383)		(0.981)	(1.480)	(1.302)	(2.244)		(0.830)	(1.712)	(1.329)
Observations	2,640	1,760	7,304	2,024	2,464	1,848	1,452	8,316	2,640	2,244
N. of authors	30	20	83	23	28	14	11	63	20	17
Delta (30–10)	2.304	-18.00	-6.460	-5.017	1.678	-4.011	-10.06	-6.017	-3.472	3.311
t-value	0.621	-4.188	-2.912	-1.745	0.440	-0.683	-2.934	-2.969	-1.069	0.801
Optimal exp.	25.18	26.14	33.93	30.47	27.08	33.28	25.25	35.70	29.29	32.43
(st. dev.)	6.677	2.154	3.609	4.423	11.94	12.81	2.518	3.991	5.545	9.523

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 7: Number of citations (big families)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
			Big panel					Long panel		
VARIABLES	Arrow	Katz	Leontief	Dornbusch	Koopmans	Arrow	Katz	Leontief	Dornbusch	Koopmans
Exp	0.387	-3.904***	-0.376*	-0.752**	0.265	-0.764	-2.312***	-0.078	-0.014	-0.013
	(0.371)	(0.804)	(0.205)	(0.363)	(0.231)	(0.617)	(0.595)	(0.169)	(0.422)	(0.256)
Exp^2	-0.010*	0.079***	0.007**	0.013**	-0.005	0.009	0.054***	0.002	0.001	-0.000
	(0.006)	(0.019)	(0.003)	(0.006)	(0.003)	(0.010)	(0.015)	(0.002)	(0.007)	(0.004)
$Age \leq 49$					*omitted*					
$50 \leq Age$	0.115	0.772	0.260	-0.343	0.061	1.115	0.576	0.075	-0.904*	0.897**
≤ 59	(0.593)	(1.201)	(0.483)	(0.566)	(0.438)	(1.047)	(0.856)	(0.368)	(0.492)	(0.425)
$60 \leq Age$	0.503	-0.338	0.530	2.063***	0.033	1.286	-0.831	0.308	1.509**	0.858
≤ 69	(0.898)	(2.630)	(0.679)	(0.695)	(0.586)	(1.336)	(2.782)	(0.524)	(0.668)	(0.572)
$70 \leq Age$	0.830		0.763	3.141**	0.217	1.318		0.480	2.892*	1.030
	(2.056)		(0.859)	(1.418)	(0.761)	(2.117)		(0.648)	(1.568)	(0.743)
Observations	2,640	1,760	7,304	2,024	2,464	1,848	1,452	8,316	2,640	2,244
N. of authors	30	20	83	23	28	14	11	63	20	17
Delta (30–10)	-0.506	-14.88	-1.945	-4.310	1.365	-7.745	-3.195	-0.0650	0.657	-0.498
t-value	-0.155	-3.382	-0.950	-1.596	0.585	-1.451	-0.981	-0.0385	0.217	-0.191
Optimal exp.	18.77	24.71	26.98	28.04	26.92	40.54	21.48	20.88	6.089	-21.81
(st. dev.)	8.398	1.796	5.749	3.462	8.828	13.48	1.590	21.92	142.3	678.9

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 8: Number of distinct works (big families)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Big panel					Long panel				
VARIABLES	Arrow	Katz	Leontief	Dornbusch	Koopmans	Arrow	Katz	Leontief	Dornbusch	Koopmans
Exp	-0.253	-1.893***	-0.802***	-0.653*	0.387	-1.033*	-0.687*	-0.339**	-0.569	0.170
	(0.257)	(0.352)	(0.137)	(0.367)	(0.249)	(0.603)	(0.382)	(0.152)	(0.438)	(0.253)
Exp^2	0.001	0.029***	0.011***	0.011*	-0.003	0.016*	0.006	0.004	0.010	-0.002
	(0.004)	(0.008)	(0.002)	(0.006)	(0.003)	(0.009)	(0.009)	(0.002)	(0.008)	(0.003)
$Age \leq 49$					*omitted*					
$50 \leq Age$	-0.108	0.987*	0.145	-0.276	-0.802	0.441	0.426	0.162	0.231	-0.737
≤ 59	(0.460)	(0.572)	(0.365)	(0.580)	(0.534)	(1.112)	(0.466)	(0.356)	(0.496)	(0.478)
$60 \leq Age$	0.245	0.432	0.237	-0.274	-0.915	0.435	0.876	0.113	0.288	-0.605
≤ 69	(0.702)	(1.269)	(0.514)	(0.712)	(0.716)	(1.422)	(1.482)	(0.508)	(0.673)	(0.641)
$70 \leq Age$	1.444		-0.013	-1.815	-2.029**	1.145		-0.183	-1.411	-0.336
	(1.583)		(0.652)	(1.449)	(0.924)	(2.243)		(0.629)	(1.585)	(0.830)
Observations	2,640	1,760	7,304	2,024	2,464	1,848	1,452	8,316	2,640	2,244
N. of authors	30	20	83	23	28	14	11	63	20	17
Delta (30–10)	-4.503	-14.61	-7.347	-4.175	5.085	-7.661	-8.776	-3.916	-3.728	2.171
t-value	-1.987	-7.585	-5.383	-1.528	2.019	-1.473	-4.204	-2.581	-1.185	0.843
Optimal exp.	180.8	32.58	36.88	29.41	58.20	31.78	55.41	47.29	29.75	55.61
(st. dev.)	908.6	4.034	2.541	4.321	27.63	5.092	53.94	12.24	5.384	53.32

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

6 Conclusions

In this paper, we use the rich and growing RePEc database to capture several years of implicit competition for higher ranking between leading economists of different ages. We find that age does not affect the RePEc ranking, while experience does. Economists reach the peak of their ranking 30 years after Ph.D. graduation. This pattern varies across fields. In particular, labor economists reach the peak earlier than macroeconomists, but the return on experience that they enjoy before reaching the peak is higher. Scientists whose exceptional influence is recognized externally by the Nobel Committee are not different from others in terms of the effect of age and experience on their ranking. To conclude, we find that even though the relationship between age and scientific influence in economics is observed as a stylized fact, the biological factor of aging does not explain this relationship.

References

Allison, P. D., J. S. Long, and T. K. Krauze (1982): "Cumulative advantage and inequality in science," *American Sociological Review*, 615–625.

Azoulay, P., J. S. Graff Zivin, and J. Wang (2010): "Superstar extinction," *The Quarterly Journal of Economics*, 125, 549–589.

Baffes, J. and A. Vamvakidis (2011): "Are you too young for the Nobel Prize?" *Research Policy*, 40, 1345–1353.

Barrett, G. F. and W. C. Riddell (2016): "Ageing and literacy skills: Evidence from IALS, ALL and PIAAC," *IZA Discussion Paper No. 10017.*

Becker, G. S. (1962): "Investment in human capital: A theoretical analysis," *Journal of political economy*, 70, 9–49.

Besancenot, D., A. Maddi, et al. (2019): "Should citations be weighted to assess the influence of an academic article?" *Economics Bulletin*, 435, 435–445.

Bjork, S., A. Offer, and G. Söderberg (2014): "Time series citation data: The Nobel Prize in economics," *Scientometrics*, 98, 185–196.

Boettke, P. J., A. Fink, and D. J. Smith (2012): "The Impact of Nobel Prize Winners in Economics: Mainline vs. Mainstream," *American Journal of Economics and Sociology*, 71, 1219–1249.

Chan, H. F., L. Gleeson, and B. Torgler (2014): "Awards before and after the Nobel Prize: A Matthew effect and/or a ticket to ones own funeral?" *Research Evaluation*, 23, 210–220.

Chan, H. F., A. S. Önder, and B. Torgler (2015): "Do Nobel laureates change their patterns of collaboration following prize reception?" *Scientometrics*, 105, 2215–2235.

Clough, J. R., J. Gollings, T. V. Loach, and T. S. Evans (2015): "Transitive reduction of citation networks," *Journal of Complex Networks*, 3, 189–203.

Dennis, W. (1956): "Age and productivity among scientists." *Science*.

Desjardins, R. and A. J. Warnke (2012): "Ageing and skills: A review and analysis of skill gain and skill loss over the lifespan and over time," Tech. rep., OECD Education Working Papers.

Fortunato, S., C. T. Bergstrom, K. Börner, J. A. Evans, D. Helbing, S. Milojević, A. M. Petersen, F. Radicchi, R. Sinatra, B. Uzzi, et al. (2018): "Science of science," *Science*, 359, eaao0185.

Frandsen, T. F. and J. Nicolaisen (2013): "The ripple effect: Citation chain reactions of a nobel prize," *Journal of the American Society for Information Science and Technology*, 64, 437–447.

Friedman, M. (1953): "The methodology of positive economics," *Essays in positive economics*, 3, 145–178.

Gingras, Y., V. Lariviere, B. Macaluso, and J.-P. Robitaille (2008): "The effects of aging on researchers' publication and citation patterns," *PloS one*, 3, e4048.

Gingras, Y. and M. Wallace (2009): "Why it has become more difficult to predict Nobel Prize winners: a bibliometric analysis of nominees and winners of the chemistry and physics prizes (1901–2007)," *Scientometrics*, 82, 401–412.

Goldberg, S. R., H. Anthony, and T. S. Evans (2015): "Modelling citation networks," *Scientometrics*, 105, 1577–1604.

Green, D. A. and W. C. Riddell (2013): "Ageing and literacy skills: Evidence from Canada, Norway and the United States," *Labour Economics*, 22, 16–29.

Ham, J. C. and B. A. Weinberg (2008): "Geography and innovation: Evidence from Nobel laureates," Tech. rep., Working Paper, Ohio State University.

Hirsch, J. E. (2005): "An index to quantify an individual's scientific research output," *Proceedings of the National academy of Sciences*, 102, 16569–16572.

Klosik, D. F. and S. Bornholdt (2014): "The citation wake of publications detects Nobel laureates' papers," *PloS one*, 9, e113184.

Krapf, M., J. Schläpfer, et al. (2012): "How Nobel Laureates Would Perform In The Handelsblatt Ranking," *Regional and Sectoral Economic Studies*, 12.

Rablen, M. D. and A. J. Oswald (2008): "Mortality and immortality: The Nobel Prize as an experiment into the effect of status upon longevity," *Journal of Health Economics*, 27, 1462–1471.

Reschke, B. P., P. Azoulay, and T. E. Stuart (2018): "Status spillovers: The effect of status-conferring prizes on the allocation of attention," *Administrative Science Quarterly*, 63, 819–847.

Rothenberg, A. (2005): "Family background and genius II: Nobel laureates in science," *The Canadian Journal of Psychiatry*, 50, 918–925.

Schulhofer-Wohl, S. (2018): "The age-time-cohort problem and the identification of structural parameters in life-cycle models," *Quantitative Economics*, 9, 643–658.

Shavinina, L. V. (2004): "Explaining high abilities of Nobel laureates," *High Ability Studies*, 15, 243–254.

Sinatra, R., D. Wang, P. Deville, C. Song, and A.-L. Barabási (2016): "Quantifying the evolution of individual scientific impact," *Science*, 354, aaf5239.

Skirbekk, V. et al. (2004): "Age and individual productivity: A literature survey," .

Stephan, P. and S. Levin (1993): "Age and the Nobel Prize revisited," *Scientometrics*, 28, 387–399.

Van Dalen, H. P. (1999): "The golden age of Nobel economists," *The American Economist*, 43, 19–35.

Wagner, C. S., E. Horlings, T. A. Whetsell, P. Mattsson, and K. Nordqvist (2015): "Do Nobel Laureates create prize-winning networks? An analysis of collaborative research in physiology or medicine," *PloS one*, 10, e0134164.

Weinberg, B. A. and D. W. Galenson (2019): "Creative careers: The life cycles of Nobel laureates in economics," *De Economist*, 167, 221–239.

Weiss, Y. (2015): "Gary Becker on human capital," *Journal of Demographic Economics*, 81, 27–31.

Zeng, A., Z. Shen, J. Zhou, J. Wu, Y. Fan, Y. Wang, and H. E. Stanley (2017): "The science of science: From the perspective of complex systems," *Physics Reports*, 714, 1–73.

Zuckerman, H. (1967): "Nobel laureates in science: Patterns of productivity, collaboration, and authorship," *American Sociological Review*, 391–403.

Appendix

Table 9: Regression results: Number of works, big panel

VARIABLES	(1) dnbworks	(2) scworks	(3) wscworks	(4) anbworks	(5) ascworks	(6) awscworks
Exp	-0.591***	-0.535***	-1.092***	-0.371***	-0.477***	-0.950***
	(0.054)	(0.067)	(0.071)	(0.064)	(0.070)	(0.073)
Exp^2	0.010***	0.009***	0.017***	0.006***	0.008***	0.015***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Exp \times Nobel$	-0.217**	-0.300**	-0.263**	-0.303***	-0.376***	-0.501***
	(0.094)	(0.119)	(0.125)	(0.113)	(0.123)	(0.128)
$Age \leq 49$			*omitted*			
$50 \leq Age \leq 59$	0.117	0.046	0.193	0.105	0.057	0.229
	(0.118)	(0.138)	(0.222)	(0.133)	(0.143)	(0.223)
$60 \leq Age \leq 69$	0.166	0.033	0.813***	0.182	0.087	1.234***
	(0.151)	(0.178)	(0.291)	(0.171)	(0.183)	(0.292)
$70 \leq Age$	0.163	-0.037	0.823**	0.157	0.013	1.195***
	(0.192)	(0.226)	(0.371)	(0.218)	(0.233)	(0.373)
$(Age \leq 64) \times Nobel$			*omitted*			
$(65 \leq Age \leq 79) \times Nobel$	0.479	0.341	1.223	0.355	0.375	1.277
	(0.597)	(0.709)	(1.046)	(0.683)	(0.732)	(1.059)
$(80 \leq Age) \times Nobel$	0.359	0.369	-0.079	0.154	0.300	0.011
	(0.870)	(1.027)	(1.623)	(0.990)	(1.060)	(1.635)
Observations	88,088	88,088	88,088	88,088	88,088	88,088
Num. of authors	1,001	1,001	1,001	1,001	1,001	1,001
Delta (30–10)	-4.137	-3.714	-8.255	-2.633	-3.302	-7.383
t-value	-8.289	-5.937	-12.41	-4.395	-5.095	-10.81
Optimal exp.	30.78	30.62	32.15	31.01	30.58	32.71
(st. dev.)	0.864	1.191	0.663	1.663	1.384	0.798

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 10: Regression results: Number of pages, big panel

VARIABLES	(1) nbpages	(2) scpages	(3) wscpages	(4) anbpages	(5) ascpages	(6) awscpages
Exp	-0.437***	-0.637***	-1.280***	-0.381***	-0.619***	-1.162***
	(0.064)	(0.083)	(0.090)	(0.072)	(0.084)	(0.088)
Exp^2	0.007***	0.010***	0.020***	0.006***	0.010***	0.018***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Exp \times Nobel$	-0.116	-0.171	0.151	-0.164	-0.202	-0.007
	(0.113)	(0.147)	(0.158)	(0.128)	(0.148)	(0.154)
$Age \leq 49$			*omitted*			
$50 \leq Age \leq 59$	0.202	0.158	0.327	0.235	0.229	0.276
	(0.127)	(0.172)	(0.255)	(0.144)	(0.177)	(0.249)
$60 \leq Age \leq 69$	0.271*	0.261	0.872***	0.338*	0.393*	1.058***
	(0.162)	(0.221)	(0.333)	(0.185)	(0.227)	(0.324)
$70 \leq Age$	0.266	0.250	0.988**	0.343	0.387	1.187***
	(0.207)	(0.282)	(0.424)	(0.236)	(0.289)	(0.412)
$(Age \leq 64) \times Nobel$			*omitted*			
$(65 \leq Age \leq 79) \times Nobel$	0.391	0.196	0.636	0.158	0.164	0.790
	(0.653)	(0.883)	(1.234)	(0.742)	(0.903)	(1.202)
$(80 \leq Age) \times Nobel$	0.498	0.441	-0.677	0.341	0.372	0.189
	(0.942)	(1.279)	(1.875)	(1.071)	(1.310)	(1.825)
Observations	88,088	88,088	88,088	88,088	88,088	88,088
Num. of authors	1,001	1,001	1,001	1,001	1,001	1,001
Delta (30–10)	-3.188	-4.704	-9.565	-2.904	-4.776	-9.084
(st. dev.)	-5.347	-6.068	-11.39	-4.321	-6.087	-11.08
Optimal exp.	31.48	31.71	31.93	32.29	32.55	32.83
(st. dev.)	1.427	1.279	0.702	1.893	1.372	0.782

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 11: Regression results: Number of citations (part I), big panel

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	nbcites	dcites	sccites	dsccites	wsccites	wdsccites	anbcites	adcites
Exp	-0.383***	-1.012***	-0.512***	-1.062***	-1.845***	-1.825***	-0.425***	-1.149***
	(0.064)	(0.087)	(0.059)	(0.081)	(0.058)	(0.074)	(0.073)	(0.094)
Exp^2	0.006***	0.016***	0.008***	0.017***	0.029***	0.028***	0.007***	0.018***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Exp \times Nobel$	-0.209*	-0.260*	-0.257**	-0.276*	-0.746***	-0.546***	-0.208	-0.338**
	(0.114)	(0.153)	(0.105)	(0.142)	(0.102)	(0.129)	(0.130)	(0.166)
$Age \leq 49$					*omitted*			
$50 \leq Age \leq 59$	-0.027	0.032	0.024	0.105	0.727***	0.488**	0.049	0.128
	(0.129)	(0.201)	(0.122)	(0.184)	(0.176)	(0.212)	(0.147)	(0.220)
$60 \leq Age \leq 69$	0.079	0.255	0.086	0.323	1.536***	1.097***	0.164	0.412
	(0.165)	(0.258)	(0.156)	(0.236)	(0.230)	(0.276)	(0.188)	(0.283)
$70 \leq Age$	0.164	0.242	0.138	0.287	1.632***	1.154***	0.206	0.444
	(0.210)	(0.329)	(0.199)	(0.301)	(0.294)	(0.352)	(0.240)	(0.361)
$(Age \leq 64) \times Nobel$					*omitted*			
$(65 \leq Age \leq 79) \times Nobel$	0.245	0.644	0.320	0.258	1.395*	1.111	0.122	0.351
	(0.662)	(1.011)	(0.625)	(0.927)	(0.836)	(1.022)	(0.755)	(1.106)
$(80 \leq Age) \times Nobel$	0.383	0.450	0.410	-0.103	0.730	0.317	0.148	-0.176
	(0.956)	(1.484)	(0.905)	(1.359)	(1.288)	(1.557)	(1.090)	(1.625)
Observations	88,088	88,088	88,088	88,088	88,088	88,088	88,088	88,088
Num. of authors	1,001	1,001	1,001	1,001	1,001	1,001	1,001	1,001
Delta (30–10)	-2.858	-7.524	-3.876	-8.036	-13.94	-13.82	-3.078	-8.395
(st. dev.)	-4.767	-9.243	-7.012	-10.69	-25.72	-20.06	-4.511	-9.531
Optimal exp.	31.90	31.83	32.19	32.17	32.14	32.18	31.34	31.51
(st. dev.)	1.658	0.848	1.155	0.756	0.319	0.408	1.670	0.800

Notes: Standard errors are given in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 12: Regression results: Number of citations (part II), big panel

VARIABLES	(1) asccites	(2) adsccites	(3) awsccites	(4) awdsccites	(5) hindex	(6) ncauthors	(7) rcauthors	(8) nepcites
Exp	-0.467***	-1.077***	-1.621***	-1.758***	-0.525***	-0.361***	-0.590***	-0.572***
	(0.066)	(0.087)	(0.069)	(0.082)	(0.092)	(0.054)	(0.058)	(0.097)
Exp^2	0.007***	0.017***	0.025***	0.027***	0.009***	0.006***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Exp \times Nobel$	-0.232**	-0.311**	-0.705***	-0.588***	-0.179	-0.169*	-0.245**	-0.288*
	(0.117)	(0.154)	(0.121)	(0.143)	(0.162)	(0.096)	(0.102)	(0.166)
$Age \leq 49$					*omitted*			
$50 \leq Age \leq 59$	0.121	0.096	0.569***	0.536**	-0.162	0.021	0.041	-0.231
	(0.134)	(0.198)	(0.194)	(0.227)	(0.192)	(0.109)	(0.120)	(0.219)
$60 \leq Age \leq 69$	0.194	0.381	1.433***	1.338***	-0.138	0.103	0.189	-0.012
	(0.172)	(0.255)	(0.252)	(0.295)	(0.247)	(0.139)	(0.154)	(0.276)
$70 \leq Age$	0.306	0.380	1.532***	1.419***	-0.049	0.144	0.230	-0.079
	(0.219)	(0.325)	(0.321)	(0.376)	(0.314)	(0.178)	(0.196)	(0.346)
$(Age \leq 64) \times Nobel$					*omitted*			
$(65 \leq Age \leq 79) \times Nobel$	0.289	0.332	1.321	1.189	0.535	0.246	0.421	1.088
	(0.689)	(1.001)	(0.938)	(1.101)	(0.983)	(0.559)	(0.615)	(1.013)
$(80 \leq Age) \times Nobel$	0.451	0.256	0.891	0.682	1.314	0.121	0.419	1.068
	(0.997)	(1.467)	(1.423)	(1.666)	(1.426)	(0.807)	(0.891)	(1.543)
Observations	88,088	88,088	88,088	88,088	88,088	88,088	88,088	73,073
Num. of authors	1,001	1,001	1,001	1,001	1,001	1,001	1,001	1,001
Delta (30–10)	-3.471	-8.021	-12.27	-13.29	-3.310	-2.683	-4.392	-4.186
(st. dev.)	-5.642	-9.840	-19.11	-17.43	-3.871	-5.294	-8.156	-4.598
Optimal exp.	31.83	31.86	32.18	32.15	29.20	31.83	31.85	31.54
(st. dev.)	1.391	0.799	0.428	0.467	1.616	1.484	0.963	1.608

Notes: Standard errors are given in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 13: Regression results: Abstract views, downloads, network, and students, big panel

VARIABLES	(1) absviews	(2) downloads	(3) aabsviews	(4) adownloads	(5) close	(6) betweenn	(7) students
Exp	-0.007	0.023	-0.436***	-0.313***	-1.306***	-1.095***	0.105
	(0.057)	(0.074)	(0.082)	(0.091)	(0.108)	(0.084)	(0.081)
Exp^2	0.000	-0.001	0.007***	0.005***	0.019***	0.016***	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
$Exp \times Nobel$	-0.100	-0.060	-0.099	-0.064	-0.098	-0.402***	0.230
	(0.102)	(0.132)	(0.145)	(0.162)	(0.190)	(0.148)	(0.142)
$Age \leq 49$				*omitted*			
$50 \leq Age \leq 59$	0.045	-0.014	-0.017	-0.193	-0.623**	0.287	-0.178
	(0.107)	(0.141)	(0.157)	(0.177)	(0.290)	(0.249)	(0.156)
$60 \leq Age \leq 69$	-0.028	0.002	0.122	-0.066	-0.516	0.439	-0.102
	(0.137)	(0.180)	(0.201)	(0.227)	(0.377)	(0.325)	(0.195)
$70 \leq Age$	-0.118	-0.018	0.281	0.052	0.028	1.108***	-0.069
	(0.175)	(0.230)	(0.256)	(0.290)	(0.480)	(0.415)	(0.245)
$(Age \leq 64) \times Nobel$				*omitted*			
$(65 \leq Age \leq 79) \times Nobel$	0.054	0.647	0.652	1.112	-0.337	0.585	-0.262
	(0.557)	(0.730)	(0.811)	(0.916)	(1.422)	(1.194)	(0.730)
$(80 \leq Age) \times Nobel$	0.159	0.509	0.719	0.828	-0.871	0.736	-0.024
	(0.799)	(1.048)	(1.167)	(1.319)	(2.137)	(1.828)	(1.089)
Observations	88,087	88,087	88,088	88,088	88,088	88,088	73,073
Num. of authors	1,001	1,001	1,001	1,001	1,001	1,001	1,001
Delta (30–10)	-0.0250	0.0440	-3.295	-2.499	-10.57	-9.420	0.713
(st. dev.)	-0.0472	0.0639	-4.346	-2.947	-10.46	-11.92	0.937
Optimal exp.	24.72	22.12	32.17	33.26	33.61	35.10	30.33
(st. dev.)	78.47	29.94	1.870	3.038	0.885	0.901	7.244

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 14: Regression results: Number of works, long panel

VARIABLES	(1) dnbworks	(2) scworks	(3) wscworks	(4) anbworks	(5) ascworks	(6) awscworks
Exp	-0.450***	-0.336***	-0.512***	-0.315***	-0.342***	-0.353***
	(0.071)	(0.078)	(0.104)	(0.078)	(0.083)	(0.105)
Exp^2	0.007***	0.005***	0.007***	0.005***	0.006***	0.005***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
$Exp \times Nobel$	-0.148	-0.201*	-0.155	-0.145	-0.252**	-0.146
	(0.095)	(0.103)	(0.137)	(0.104)	(0.111)	(0.137)
$Age \leq 49$			*omitted*			
$50 \leq Age \leq 59$	0.096	0.155	-0.067	0.048	0.083	0.028
	(0.146)	(0.153)	(0.301)	(0.154)	(0.164)	(0.299)
$60 \leq Age \leq 69$	0.265	0.040	0.238	0.165	-0.015	0.456
	(0.185)	(0.194)	(0.389)	(0.196)	(0.208)	(0.387)
$70 \leq Age$	0.221	-0.025	0.317	0.131	-0.094	0.586
	(0.236)	(0.248)	(0.500)	(0.250)	(0.265)	(0.497)
$(Age \leq 64) \times Nobel$			*omitted*			
$(65 \leq Age \leq 79) \times Nobel$	0.229	0.110	0.764	0.241	0.243	0.427
	(0.543)	(0.572)	(1.101)	(0.576)	(0.612)	(1.096)
$(80 \leq Age) \times Nobel$	0.256	-0.102	0.017	0.200	0.004	-0.384
	(0.880)	(0.926)	(1.805)	(0.933)	(0.990)	(1.796)
Observations	78,936	78,936	78,936	78,936	78,936	78,936
Num. of authors	598	598	598	598	598	598
Delta (30–10)	-3.372	-2.398	-4.304	-2.374	-2.383	-3.344
(st. dev.)	-5.176	-3.372	-4.507	-3.320	-3.137	-3.482
Optimal exp.	32.00	31.10	34.53	32.11	30.70	37.96
(st. dev.)	1.472	2.095	2.176	2.316	2.178	3.980

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 15: Regression results: Number of pages, long panel

VARIABLES	(1) nbpages	(2) scpages	(3) wscpages	(4) anbpages	(5) ascpages	(6) awscpages
Exp	-0.282***	-0.427***	-0.989***	-0.265***	-0.387***	-0.732***
	(0.081)	(0.093)	(0.101)	(0.086)	(0.097)	(0.100)
Exp^2	0.004***	0.007***	0.015***	0.004***	0.006***	0.011***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
$Exp \times Nobel$	-0.103	-0.126	0.126	-0.116	-0.113	0.140
	(0.109)	(0.124)	(0.133)	(0.116)	(0.129)	(0.132)
$Age \leq 49$			*omitted*			
$50 \leq Age \leq 59$	0.036	0.201	0.567*	0.028	0.214	0.516*
	(0.151)	(0.183)	(0.301)	(0.164)	(0.195)	(0.296)
$60 \leq Age \leq 69$	0.076	0.221	0.872**	0.059	0.250	0.917**
	(0.191)	(0.231)	(0.391)	(0.207)	(0.247)	(0.384)
$70 \leq Age$	0.058	0.247	0.832*	-0.005	0.264	0.968**
	(0.244)	(0.295)	(0.502)	(0.264)	(0.316)	(0.494)
$(Age \leq 64) \times Nobel$			*omitted*			
$(65 \leq Age \leq 79) \times Nobel$	0.192	0.287	0.744	0.079	0.112	0.673
	(0.566)	(0.682)	(1.100)	(0.612)	(0.727)	(1.083)
$(80 \leq Age) \times Nobel$	0.402	0.447	0.889	0.384	0.089	0.364
	(0.916)	(1.104)	(1.805)	(0.990)	(1.177)	(1.777)
Observations	78,936	78,936	78,936	78,936	78,936	78,936
Num. of authors	598	598	598	598	598	598
Delta (30–10)	-2.074	-3.221	-7.785	-1.918	-2.971	-6.057
(st. dev.)	-2.792	-3.783	-8.382	-2.425	-3.346	-6.577
Optimal exp.	31.65	32.12	32.98	31.34	32.47	34.12
(st. dev.)	2.658	2.036	1.015	2.977	2.370	1.438

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 16: Regression results: Number of citations (part I), long panel

VARIABLES	(1) nbcites	(2) dcites	(3) sccites	(4) dsccites	(5) wsccites	(6) wdsccites	(7) anbcites	(8) adcites
Exp	-0.076	-0.437***	-0.092	-0.569***	-0.941***	-0.891***	-0.175**	-0.557***
	(0.068)	(0.101)	(0.064)	(0.095)	(0.075)	(0.087)	(0.080)	(0.109)
Exp^2	0.001	0.007***	0.001	0.009***	0.015***	0.014***	0.003**	0.009***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
$Exp \times Nobel$	-0.059	0.006	-0.075	-0.064	-0.435***	-0.214*	-0.097	-0.062
	(0.091)	(0.133)	(0.086)	(0.125)	(0.098)	(0.115)	(0.107)	(0.144)
$Age \leq 49$					*omitted*			
$50 \leq Age \leq 59$	0.090	0.117	0.068	0.228	0.299	0.280	0.152	0.181
	(0.126)	(0.232)	(0.121)	(0.225)	(0.215)	(0.252)	(0.150)	(0.253)
$60 \leq Age \leq 69$	0.139	0.203	0.045	0.262	0.526*	0.440	0.152	0.196
	(0.160)	(0.296)	(0.153)	(0.287)	(0.278)	(0.326)	(0.190)	(0.322)
$70 \leq Age$	0.249	0.151	0.164	0.365	0.631*	0.536	0.226	0.142
	(0.204)	(0.378)	(0.195)	(0.367)	(0.357)	(0.419)	(0.242)	(0.412)
$(Age \leq 64) \times Nobel$					*omitted*			
$(65 \leq Age \leq 79) \times Nobel$	0.102	0.264	0.192	-0.022	0.521	0.285	0.030	-0.033
	(0.472)	(0.860)	(0.452)	(0.833)	(0.787)	(0.923)	(0.561)	(0.938)
$(80 \leq Age) \times Nobel$	0.046	-0.124	-0.018	-0.671	0.141	-0.464	-0.019	-0.693
	(0.764)	(1.397)	(0.731)	(1.354)	(1.290)	(1.512)	(0.907)	(1.523)
Observations	78,936	78,936	78,936	78,936	78,936	78,936	78,936	78,936
Num. of authors	598	598	598	598	598	598	598	598
Delta (30–10)	-0.626	-3.374	-0.761	-4.472	-6.927	-6.873	-1.259	-4.085
(st. dev.)	-1.006	-3.657	-1.294	-5.150	-10.15	-8.583	-1.726	-4.086
Optimal exp.	34.02	32.59	34.14	32.93	31.64	32.56	31.22	31.57
(st. dev.)	9.121	2.197	7.160	1.611	0.741	0.950	4.145	1.801

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 17: Regression results: Number of citations (part II), long panel

VARIABLES	(1) asccites	(2) adsccites	(3) awsccites	(4) awdsccites	(5) hindex	(6) ncauthors	(7) rcauthors	(8) nepcites
Exp	-0.175**	-0.601***	-0.798***	-0.869***	-0.101	-0.072	-0.166***	-0.207
	(0.076)	(0.104)	(0.084)	(0.097)	(0.104)	(0.053)	(0.059)	(0.142)
Exp^2	0.003**	0.009***	0.013***	0.013***	0.002	0.001	0.003***	0.003
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
$Exp \times Nobel$	-0.073	-0.076	-0.400***	-0.251**	0.106	-0.027	-0.058	-0.289*
	(0.101)	(0.138)	(0.111)	(0.127)	(0.139)	(0.071)	(0.079)	(0.173)
$Age \leq 49$				*omitted*				
$50 \leq Age \leq 59$	0.144	0.243	0.220	0.320	0.097	0.112	0.135	0.108
	(0.145)	(0.247)	(0.233)	(0.273)	(0.205)	(0.097)	(0.111)	(0.327)
$60 \leq Age \leq 69$	0.083	0.187	0.360	0.449	0.235	0.168	0.222	0.333
	(0.183)	(0.315)	(0.301)	(0.352)	(0.259)	(0.122)	(0.140)	(0.385)
$70 \leq Age$	0.252	0.279	0.504	0.581	0.450	0.203	0.240	0.261
	(0.234)	(0.403)	(0.386)	(0.452)	(0.331)	(0.156)	(0.179)	(0.458)
$(Age \leq 64) \times Nobel$				*omitted*				
$(65 \leq Age \leq 79) \times Nobel$	0.145	-0.042	0.483	0.312	0.325	0.056	0.173	0.960
	(0.541)	(0.914)	(0.857)	(1.000)	(0.765)	(0.361)	(0.415)	(0.986)
$(80 \leq Age) \times Nobel$	-0.209	-0.960	0.069	-0.356	0.953	-0.307	-0.180	1.164
	(0.875)	(1.486)	(1.401)	(1.637)	(1.238)	(0.585)	(0.672)	(1.499)
Observations	78,936	78,936	78,936	78,936	78,936	78,936	78,936	43,654
Num. of authors	598	598	598	598	598	598	598	598
Delta (30–10)	-1.289	-4.527	-5.807	-6.620	-0.629	-0.584	-1.297	-1.564
(st. dev.)	-1.857	-4.735	-7.508	-7.455	-0.658	-1.207	-2.398	-1.155
Optimal exp.	31.65	32.10	31.45	32.30	29.04	33.53	32.80	32.16
(st. dev.)	3.991	1.627	0.981	1.066	9.065	7.286	3.419	5.963

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 18: Regression results: Abstract views, downloads, network, and students, long panel

VARIABLES	(1) absviews	(2) downloads	(3) aabsviews	(4) adownloads	(5) close	(6) betweenn	(7) students
Exp	-0.116*	-0.043	-0.404***	-0.362***	-1.069***	-0.964***	0.177
	(0.064)	(0.074)	(0.092)	(0.095)	(0.148)	(0.120)	(0.115)
Exp^2	0.002*	0.001	0.007***	0.006***	0.015***	0.013***	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
$Exp \times Nobel$	0.039	0.006	-0.017	0.026	-0.126	-0.298**	0.165
	(0.087)	(0.101)	(0.123)	(0.128)	(0.185)	(0.149)	(0.142)
$Age \leq 49$				*omitted*			
$50 \leq Age \leq 59$	0.390***	0.153	-0.049	-0.091	-0.648	-0.202	-0.023
	(0.115)	(0.133)	(0.167)	(0.173)	(0.423)	(0.367)	(0.230)
$60 \leq Age \leq 69$	0.484***	0.282*	-0.034	-0.003	-0.654	-0.077	-0.031
	(0.145)	(0.168)	(0.211)	(0.218)	(0.513)	(0.448)	(0.269)
$70 \leq Age$	0.339*	0.146	0.215	0.149	-0.376	0.497	-0.065
	(0.185)	(0.215)	(0.270)	(0.279)	(0.621)	(0.543)	(0.321)
$(Age \leq 64) \times Nobel$				*omitted*			
$(65 \leq Age \leq 79) \times Nobel$	-0.049	0.304	0.338	0.717	-0.498	0.361	-0.280
	(0.430)	(0.499)	(0.626)	(0.647)	(1.352)	(1.156)	(0.701)
$(80 \leq Age) \times Nobel$	-0.033	0.021	-0.318	-0.257	-0.714	0.272	-0.003
	(0.695)	(0.806)	(1.012)	(1.047)	(2.101)	(1.818)	(1.047)
Observations	78,936	78,936	78,936	78,936	52,624	52,624	43,654
Num. of authors	598	598	598	598	598	598	598
Delta (30–10)	-0.921	-0.315	-2.800	-2.635	-9.283	-8.980	1.972
(st. dev.)	-1.561	-0.463	-3.335	-3.035	-6.617	-7.909	1.807
Optimal exp.	33.23	31.68	30.62	31.46	35.36	37.44	45.05
(st. dev.)	5.524	16.20	2.047	2.412	1.375	1.396	12.23

Notes: Standard errors are given in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 19: Close network (big families)

	(1)	(2)	(3)	(4)	(5)	(2)	(4)	(6)	(8)	(10)
			Big panel					Long panel		
VARIABLES	Arrow	Katz	Leontief	Dornbusch	Koopmans	Arrow	Katz	Leontief	Dornbusch	Koopmans
Exp	-1.351***	-0.934	-0.896***	-2.345**	0.151	0.043	0.350	-1.302***	-1.375	0.825*
	(0.351)	(0.759)	(0.322)	(1.072)	(0.388)	(0.632)	(1.277)	(0.380)	(1.418)	(0.484)
Exp^2	0.025***	0.010	0.015***	0.028	0.009*	-0.001	-0.019	0.018***	0.009	-0.003
	(0.006)	(0.018)	(0.005)	(0.019)	(0.005)	(0.009)	(0.029)	(0.005)	(0.023)	(0.006)
$Age \leq 49$					*omitted*					
$50 \leq Age$	1.360	1.070	-1.566*	-1.066	-3.727***	1.986	0.832	-2.099*	-0.113	-0.474
≤ 59	(0.900)	(1.287)	(0.940)	(1.965)	(1.307)	(1.598)	(1.451)	(1.145)	(2.100)	(3.027)
$60 \leq Age$	2.334	5.500*	-1.836	-0.122	-2.559	2.566	4.252	-2.353	0.765	-0.084
≤ 69	(1.424)	(2.875)	(1.325)	(2.434)	(1.833)	(2.155)	(4.121)	(1.558)	(2.517)	(3.374)
$70 \leq Age$	-2.317		-2.666	0.824	-1.272	-1.306		-3.490*	2.155	1.178
	(2.886)		(1.682)	(4.806)	(2.268)	(3.269)		(1.866)	(4.660)	(3.800)
Observations	2,640	1,760	7,304	2,024	2,464	1,232	968	5,544	1,760	1,496
N. of authors	30	20	83	23	28	14	11	63	20	17
Delta (30–10)	-7.123	-10.43	-6.267	-24.53	10.12	0.130	-8.266	-11.57	-20.02	13.74
(st. dev.)	-2.268	-2.504	-1.948	-3.079	2.570	0.0229	-1.287	-2.991	-1.872	2.747
Optimal exp.	27.16	45.30	30.75	41.93	-8.496	23.53	9.166	36.00	73.51	119.8
(st. dev.)	2.400	46.25	4.103	10.59	26.82	126.0	20.32	3.663	110.7	157.1

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 20: Between network (big families)

	(1)	(2)	(3)	(4)	(5)	(2)	(4)	(6)	(8)	(10)
			Big panel					Long panel		
VARIABLES	Arrow	Katz	Leontief	Dornbusch	Koopmans	Arrow	Katz	Leontief	Dornbusch	Koopmans
Exp	-1.436***	-1.067*	-0.894***	-1.081	-0.690*	-0.759	1.375*	-1.040***	-0.693	0.580
	(0.368)	(0.591)	(0.242)	(0.745)	(0.357)	(0.622)	(0.723)	(0.299)	(1.009)	(0.453)
Exp^2	0.018***	0.012	0.010***	0.005	0.018***	0.007	-0.051***	0.011**	-0.004	0.001
	(0.006)	(0.014)	(0.004)	(0.013)	(0.005)	(0.009)	(0.016)	(0.004)	(0.017)	(0.006)
$Age \leq 49$					*omitted*					
$50 \leq Age$	1.052	-0.311	0.177	-0.510	-0.289	1.481	-1.020	-0.588	-0.158	-1.180
≤ 59	(0.932)	(1.160)	(0.798)	(1.611)	(1.216)	(1.560)	(1.089)	(0.985)	(1.745)	(2.811)
$60 \leq Age$	1.999	2.072	0.199	0.925	-0.090	2.093	2.595	-0.465	1.134	-0.033
≤ 69	(1.472)	(2.676)	(1.129)	(2.020)	(1.713)	(2.100)	(3.991)	(1.344)	(2.128)	(3.135)
$70 \leq Age$	1.339		0.084	0.429	-0.236	1.509		-0.893	0.786	0.830
	(2.999)		(1.437)	(3.850)	(2.115)	(3.194)		(1.611)	(3.794)	(3.533)
Observations	2,640	1,760	7,304	2,024	2,464	1,232	968	5,544	1,760	1,496
N. of authors	30	20	83	23	28	14	11	63	20	17
Delta (30–10)	-14.19	-11.51	-9.783	-17.87	0.550	-9.922	-13.33	-12.17	-16.68	12.05
(st. dev.)	-4.312	-3.488	-4.026	-3.239	0.152	-1.777	-3.507	-3.991	-2.198	2.574
Optimal exp.	39.53	43.40	44.18	115.1	19.23	57.70	13.47	48.21	-98.50	-516.0
(st. dev.)	4.766	28.70	6.465	243.1	5.203	37.51	3.104	7.508	607.4	5893

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.

Table 21: Students (big families)

	(1)	(2)	(3)	(4)	(5)	(2)	(4)	(6)	(8)	(10)
	Big panel					Long panel				
VARIABLES	Arrow	Katz	Leontief	Dornbusch	Koopmans	Arrow	Katz	Leontief	Dornbusch	Koopmans
Exp	0.215	-0.924	0.033	0.744	0.001	0.662	0.098	0.064	0.845	-0.143
	(0.569)	(0.900)	(0.262)	(1.168)	(0.446)	(1.369)	(1.436)	(0.314)	(1.591)	(0.691)
Exp^2	-0.002	0.026	-0.001	-0.018	0.002	-0.008	0.005	-0.000	-0.020	0.004
	(0.009)	(0.021)	(0.004)	(0.020)	(0.006)	(0.020)	(0.032)	(0.004)	(0.026)	(0.009)
$Age \leq 49$	*omitted*									
$50 \leq Age$	-0.009	-1.368	0.112	0.407	0.241	-0.205	-1.653	-0.046	0.437	-0.245
≤ 59	(0.818)	(1.052)	(0.614)	(1.628)	(0.850)	(1.879)	(1.164)	(0.753)	(1.874)	(2.003)
$60 \leq Age$	-0.090	-2.030	0.652	0.837	0.225	-0.585	-2.049	0.346	0.889	-0.329
≤ 69	(1.237)	(2.265)	(0.835)	(2.096)	(1.098)	(2.415)	(3.104)	(1.003)	(2.318)	(2.199)
$70 \leq Age$	0.019		-0.061	-1.515	-1.417	-0.455		-0.933	-2.031	0.601
	(2.842)		(1.025)	(4.081)	(1.397)	(4.044)		(1.168)	(4.211)	(2.515)
Observations	2,190	1,460	6,059	1,679	2,044	1,022	803	4,599	1,460	1,241
N. of authors	30	20	83	23	28	14	11	63	20	17
Delta (30–10)	2.367	2.306	-0.381	0.578	1.245	6.653	6.089	0.981	1.216	-0.0240
(st. dev.)	0.470	0.476	-0.145	0.0655	0.274	0.538	0.857	0.306	0.0995	-0.00333
Optimal exp.	44.38	17.78	12.67	20.81	-0.303	40.17	-9.535	86.67	21.55	20.17
(st. dev.)	68.57	5.149	67.33	11.68	146.8	27.50	197.3	641.5	13.86	50.68

Notes: Standard errors are given in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The estimation procedure controls for individual fixed effects and allows for AR(1) disturbance. Delta (30–10) is the difference between 30 and 10 years since Ph.D. graduation. Optimal experience is the number of years since Ph.D. graduation that minimizes the rank according to the estimated marginal effect.