NBER WORKING PAPER SERIES

WHY DO OLDER SCHOLARS SLOW DOWN?

Daniel S. Hamermesh Lea-Rachel Kosnik

Working Paper 31175 http://www.nber.org/papers/w31175

NATIONAL BUREAU OF ECONOMIC RESEARCH 1050 Massachusetts Avenue Cambridge, MA 02138 April 2023

The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

NBER working papers are circulated for discussion and comment purposes. They have not been peerreviewed or been subject to the review by the NBER Board of Directors that accompanies official NBER publications.

© 2023 by Daniel S. Hamermesh and Lea-Rachel Kosnik. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

Why Do Older Scholars Slow Down? Daniel S. Hamermesh and Lea-Rachel Kosnik NBER Working Paper No. 31175 April 2023 JEL No. A14,J26

ABSTRACT

Using data describing all "Top 5" economics journal publications from 1969-2018, we examine what determines which authors produce less as they age and which retire earlier. Sub-field has no impact on the rate of production, but interacts with it to alter retirement probabilities. A positive, tentative, and contemporary writing style increases persistence in publishing. Authors whose previous work was more heavily cited produce slightly more. Those better-cited with more top-flight publications retire later than others. Declining publication with age arises mostly from habit —there is a very significant increasing positive autocorrelation of publication across the decades of a career.

Daniel S. Hamermesh University of Texas at Austin 333 West 57th Street, Apt. 706 New York, NY 10019 and IZA and also NBER hamermes@eco.utexas.edu

Lea-Rachel Kosnik University of Missouri-St. Louis 408 SSB Bldg - Econ Dept - UMSL 8001 Natural Bridge Road Saint Louis, MO 63121 kosnikl@umsl.edu

I. Introduction

That productivity declines with age in creative endeavors was thoroughly documented by Lehman (1953) and has been demonstrated since in such activities as scientific work (Levin and Stephan, 1991) and at the pinnacle of research in economics (Weinberg and Galenson, 2019). The "what" of this phenomenon is very well known; the "why" has received almost no attention. Among the many possible explanations for the slowdown are physical/mental deterioration with age, as is observed in physical activities (e.g., Fair, 1994), or technological obsolescence—a decreasing ability to produce creative work at the frontier of knowledge. It may also stem from a loss of interest in producing top-flight research, due perhaps to: 1) Boredom; 2) A declining marginal gain in earnings with additional achievements as one ages; 3) The greater attraction of other activities (e.g., administration, consulting, public service, leisure activities); 4) Discouragement because of the perception that one's recent work has had little influence; or 5) Demandside effects—an inability to obtain research support, to acquire lab space (data in the social sciences), or to induce editors/publishers to pay attention to the work, perhaps because one's approach to research questions is no longer as relevant as it was earlier. We cannot distinguish among all these possible explanations, but we can rule out some and/or determine which ones might be important. We can also examine how "pooping out" induces those in creative activities to retire from their profession.

To investigate these questions, we add to a data file started by Kosnik (2022) and expanded by Kosnik and Hamermesh (2023), which assembled information on all full-length original articles published in the so-called "Top 5" economics journals between 1969 and 2018.¹ It evaluated the writing style in each article and obtained its subsequent citations.² Because we wish to follow scholars over their careers, we include only those authors with at least five articles in these journals and obtain information on the age at which they completed their advanced degrees (Ph.D. or equivalent) and the Ph.D.-age at which they

¹The "Top 5" include: American Economic Review, Quarterly Journal of Economics, Econometrica, Journal of Political Economy, and Review of Economic Studies.

²Because about 1/3 of the articles were not indexed in Scopus, our main source of citations, we obtained Google Scholar citations to them and create an adjusted measure of citations, CIT, by deflating citations from Google Scholar by the ratio of mean citations from the two sources.

published each work. We limit the sample used in most of this note to those authors whose Ph.D. was received between 1969 and 1998, thus including three decadal cohorts, 1969-78, 1979-88, and 1989-98, allowing an examination of the entire careers of those in the 1969-1978 cohort.

We stress that this sample includes only those scholars who have been highly successful in publishing in the most visible venues in the economics profession. (The 359 scholars included in the 1969-78 cohort represent no more than 5 percent of all recipients of an American Ph.D. in economics in that decade.) Since our purpose is to analyze the behavior and success of those at the forefront of a scholarly activity, this restriction makes sense. It does, however, mean that we are not describing the behavior of the profession generally, but rather that of the most influential few.

II. The Data Set and its Expansion

The original data set (Kosnik, 2022) included measures of the style in which each article i by author a was written, based on textual analyses (as in the survey by Gentzkow *et al.*, 2019). Three sentiment scores —a positive/negative score, a certainty/tentativeness score, and a contemporaneity/past score—were calculated (Pennebaker and Stone, 2003). Each article's score z^*_{iaj} , where j is a measure of sentiment, j=1,...,3, was calculated as the difference between the net count of all relevant words or word-phrases (positive or negative, etc.) divided by the total number of relevant words, and the average of that quotient among all articles in that decade in one of five broad *JEL* classifications. Those are: Theory and methodology (*JEL* = C); microeconomics and industrial organization (*JEL* = D, L); macroeconomics, international economics, and financial economics (*JEL* = E, F, G); public economics, health/education, and labor and demographic economics (*JEL* = H, I, J); and other. For all three measures the size of the score indicates the strength of the particular sentiment. The data set also included the z^{*2}_{inj} , indicating the extent to which an article's style deviated from decadal/sub-field norms at the time of publication.

To make the original data set usable for examining exits from the scholarly profession, we collected CVs of the authors, obtaining information on whether by 2018 (and when) they retired, died, or switched

out of a career typical among highly successful scholars.³ CVs were obtainable for 945 of the 960 authors in the three cohorts, of whom 78 percent remained in academe through 2018. Of the 359 authors in the 1969-78 cohort, we found CVs of 346, of whom 56 percent were still in academe in 2018, 27 percent had retired, and 5 percent had died (with the remainder having left academe or moved to full-time academic administration). We exclude the small percentages of the samples who had left academic research for other employment (outside a university, or in "higher-level" academic administration).

As a check that even in this sample of highly productive scholars we see a decline in productivity with age, Figure 1a presents the pattern of output in relation to the authors' Ph.D.-ages. As has been shown for smaller samples (Hamermesh, 2013), publishing economics at this level is very much a "young" person's activity, with the median Ph.D.-age at publication being 10 years (and in Figure 1b also 10 years for the 1969-78 Ph.D. cohort).⁴

III. "Pooping Out"

We examine patterns of decline in publication with age, considering how rates of slowdown relate to prior productivity, to the scholarly impact of prior work, and to the style in which that work is written. We also consider how prior productivity and style relate to exits from academe in the form of retirement. In both analyses each observation is an individual scholar.

A. Slowing Down

We estimate a series of autoregressions describing output in each of several post-Ph.D. decades by authors' prior publications and their characteristics:

(1)
$$A_{ad} = \Sigma b_{1,d-t} A_{a,d-t} + \Sigma b_{2,d-t} CIT_{a,d-t} + \Sigma b_{3,d-t} [CIT_{a,d-t}]^2 + \Sigma \Sigma b_{4,d-t} z^*_{.aj}, j=1,2,3,$$

³Unlike in the regression estimates, these figures include the small fraction of scholars who switched into academic administration after a successful publishing career—less than 4 percent of the cohort—since Goodall (2010) suggests that their publishing success may be productive in their administrative roles.

⁴Even this young age overstates the degree to which top-level publishing is a young person's game, since the likely publication lag in these journals was always at least a half-year and can today be several years.

where A_{ad} is the number of articles published by author a in decade d (d=10-19, 20-29, 30-49 years of Ph.D. age), and t is the length of the lag (in decades). CIT is the average citations to the person's three most recent articles before decade d, with citations obtained either from Google Scholar or Scopus and adjusted so that the means of citations from the two sources are equal (to the Scopus mean). The $z^*_{.aj}$ are the average sentiment scores of author a's three most recent articles before decade d, and the b are parameters to be estimated.⁵ Also included are the author's year of receipt of the Ph.D. and the *JEL* group of the most recent article before decade d. We also re-estimate (1) using the $z^{*2}_{.aj}$. All authors in the three Ph.D. cohorts who were alive at the end of decade d are included in the estimates.⁶ We note that all the regressors are arguably exogenous determinants of the A_d.

Table 1 shows OLS estimates of (1) for first-order autoregressions only, since the higher-order terms in full versions of (1) add little to the explanatory powers of the models.⁷ The odd-numbered columns include the vector $z^{*2}_{.aj}$. For the vectors of sentiment scores, we present the p-value of the F-statistic jointly testing the constraint that all three sentiment scores have no impact on the outcomes. In each equation we also include the year of each author's Ph.D.⁸

Columns (1) and (2) estimate the determinants of output in the second decade of these scholars' careers. The autoregressive parameter on output in the first post-Ph.D. decade is only 0.31, reflecting the tapering off of top-level scholarly publication between the first and second decades of scholarly activity

⁵Only the three most recent articles are included to avoid the variable reflecting long-past work.

⁶Because we averaged CIT over three articles, and because we could not obtain citations for a small part of the sample, the sub-sample used in estimating (1) excludes a few authors. The estimates in Columns (1), (3), and (5) include 94 percent, 98 percent, and 99 percent of the original sample on which citations and career path were available. Re-estimating based only on those scholars remaining in academe not as full-time administrators yields qualitatively similar results.

⁷We present estimates of the fully-specified models in Appendix Table A1, without the quadratics in CIT, since the higher-order effects were linear. The correct Poisson estimates of these equations imply the same conclusions as the OLS estimates.

⁸Because the fractions of women in the samples of authors with Ph.D.-age ≥ 20 are so tiny, we do not include a gender indicator. Excluding the few women changes no parameter estimate by more than one in the second significant digit.

(Hamermesh and Oster, 1998). Citations matter too—the pair of coefficients on the measures of citations approaches joint statistical significance. Given the number of publications in the first decade of output, more is published in the second decade if the author's most recent publications are better-cited, although the marginal impact of an additional citation in the first decade is diminishing. The impact of better-cited work in the first decade on output in the second decade is not tiny, with the number of publications in the second decade rising by 0.16 standard deviations in response to an increase in citations to articles published in the first decade from the 16th to the 84th percentile. We do not tabulate the estimates of differences in subsequent publication in relation to the *JEL* group of earlier articles; but the indicators of *JEL* group have very small and statistically insignificant impacts on the number of subsequent publications.

The F-statistic on the estimates in Column (1) shows that measures of the direction of style are not jointly statistically significant. A more positive style in one's first decade does, however, lead to significantly greater output in the second decade: Two standard-deviation increases in positivity and contemporaneity coupled with a similar decrease in certainty are associated with a 0.22 standard-deviation increase in the number of articles published in the second decade. The nature of the style variables suggests that these impacts may be interpreted as causal.⁹ These results suggest that those authors who strongly believe in the implications of their work but simultaneously feel that it opens up many more questions are those who subsequently produce more top-flight work. Unlike the impact of the sentiment measures themselves, however, the estimates of the impacts of the z^{*2} show that prior deviations in sentiment scores from decade/sub-field norms have tiny and statistically insignificant effects on publication rates in scholars' second decades.

The estimates in Columns (3)-(6) of Table 1 show that style in the third (fourth and fifth) decade of publishing is not statistically significantly related to the quantity of previous top-level publications, in

⁹Neither the point estimates nor the F-statistics change much if we restrict the sample to authors with three or more entries in their first nine years. With the smaller sample size, the standard errors become almost exactly proportionately larger. The estimated autoregressive parameter remains smaller than those shown in Columns (3)-(6).

the second (third) decade. Nonetheless, two-standard deviation increases in positivity and contemporaneity coupled with the same decrease in certainty in the previous decade's work raise A_{20-29} by 0.07 standard deviations (and 0.17 standard deviations in A_{30+}). The writing style of previous publications is about as strongly linked to the amount of subsequent output in later decades of a career as in the second decade. Positive, tentative, and contemporary writing describe the previous work of those who produce more later.

Prior citations matter as much as in Column (1), albeit not statistically significantly, with a 0.12 standard-deviation increase in A_{20-29} (0.27 in A_{30+}) in response to changes from the 16th to the 84th percentile of citations to articles in the previous decade. Most important is the quantity of output in the previous decade, and it matters more than it does for output in the second decade: The autocorrelation coefficients increase as careers progress. Whether these changes result from authors' habits becoming more important as they age, or whether reputational effects and editorial inertia are generating them, cannot be inferred from the data—the results cannot be interpreted as solely the results of authors' behavior.¹⁰

Given the growth of co-authorship in economics (Hollis, 2001; Hamermesh, 2013), perhaps coauthorship helps the most successful senior economists maintain publishing at the highest levels (although at lower levels than earlier in their careers). To explore this possibility, we added to each model in Table 1 the number of authors on the person's final article in decade d-1. These additions produce only minute changes in the estimated autoregressive parameters. Moreover, the impact of recent additional co-authors on subsequent numbers of publications is negative, although never anywhere nearly statistically significant. Very senior economists who maintain a top-level publication record do not do so by attaching themselves to additional co-authors.

¹⁰Given the limitation to a particular time period (half century) of publications, the samples become progressively smaller as we move across decades (move rightward in Table 1). If we restrict the samples in Columns (1)-(4) to the 1969-1978 Ph.D. cohort, the autoregressive parameter increases across the decades as it does in the Table.

In (1) the autoregressive parameters are specified as invariant with respect to A_{d-1} . To test this assumption, we replace the A_{d-1} by vectors of several indicators of the number of publications in the previous decade (e.g., for A_{0-9} , three to five, or more than five, with 0-2 publications as the base group). The estimates in Columns (1) and (2) of Table 1 do change: Authors with three to five publications in their first decade publish less in the second decade than authors who had zero to two "Top 5" publications in their first decade, while those with more than five early publications produce still more in their second decade than in their first.¹¹ Scholars who were only quite successful (by the high standards for inclusion in this sample) early on fade, while early stars become superstars. Regardless, as re-specifications of the models in Columns (3)-(6) show, even superstars fade; and the estimated impacts of the indicators included in these re-specifications for publications in the third decade or beyond show that the autoregressive parameters in Columns (3)-(6) are linear functions of A_{d-1} .

Although the indicators of the *JEL* group of the most recent prior publication had no significant effects on the number of subsequent publications, we find substantial heterogeneity across sub-fields in the relation of current to prior publication when the equations are estimated separately by *JEL* group of the most previous decade's final publication. Nonetheless, except for the group consisting of macroeconomics, international economics, and financial economics, the increase in $b_{1,d-1}$ with Ph.D. age in the entire sample is replicated. Also, in each decade the impact of prior citations on subsequent publication is positive for most of the sub-fields.

B. Stopping

Do a relative lack of recent publishing success, the attention paid to recent research, and its style induce distinguished senior scholars to retire from their academic careers? We restrict the analysis to members of the 1970s cohort, since most authors in later cohorts were too young to have contemplated

¹¹This re-specification does not alter the conclusions that citations to articles published in the first decade of a career are positively related to output in the second decade, nor that the style of articles published in the first decade also matters. Those results also do not depend on the inclusion of a few people whose entire *oeuvre* in the data was produced in their first post-Ph.D. decade: Excluding them from these re-specifications does not change the inferences about the relation between early and subsequent publications.

retirement before 2018. Mandatory retirement laws may affect academics' choices about retiring, although the effect may be small (Rees and Smith, 1991; Ashenfelter and Card, 2002). They cannot affect Americans in this cohort, but for other countries of residence we create an indicator of whether and when a scholar would at least nominally have been subject to such a rule. We estimate probits on whether the person had retired by 2018, including A₂₀₋₂₉, average CIT to the three most recent publications before Ph.D.-age 30, vectors of style measures (the $z^*_{.aj}$ or $z^{*2}_{.aj}$), and year of Ph.D., including in the sample all those in 2018 who remained in academe or had retired (N = 281 with complete information).

Columns (1) and (2) of Table 2 present estimates of the determinants of the retirement decision. Regardless of which vector of style measures, the z^* or z^{*2} , is included, having published more top-level articles in the third decade of a career leads to a significantly lower likelihood of subsequent retirement from academe. The impact is also not small: Comparing the 35 percent of authors who published no top-level papers in their third decade to those who published four papers or more then (the top 12 percent of the cohort), the former are 22 percentage points more likely to have retired by 2018 (on a mean retirement probability of 0.33).¹² Replacing the continuous measure of recent publications with a set of indicators of numbers of publications shows that the negative effect of additional publications is linear in A₂₀₋₂₉.

Re-estimating the models describing retirement on sub-samples of those economists whose most recent work was more theoretical (*JEL* Groups 1-3) and those whose work might be viewed as more empirical (*JEL* Groups 4-5) shows that having published more in one's third decade produces a much larger and statistically significant drop in the probability of retirement in the former group. Most of the aggregate impact of prior publications on retirement documented on Columns (1) and (2) of Table 2 stems from the behavior of the 72 percent of the sample whose publications were more theoretical. Having more recent top-level publications has much less effect on whether those publishing in demographic economics, health, education, labor, public finance, history of thought, etc., are less likely to retire. This difference might

¹²Another incentive might be the structure of defined-benefit retirement plans, ubiquitous outside the U.S. and standard in the University of California System. Including indicators for non-U.S. based economists and those in the UC System and adding these to the equations describing retirement produces only tiny changes in the impacts of A20-29 and CIT.

suggest, since obtaining data is more important in the more applied group, that inability to access materials relevant for publishing success is not causing the relationship between past and current success in publishing.

If a scholar's recent articles are more heavily cited, s/he is less likely to choose to retire, although the estimate is not statistically significant (and the implied impact of additional citations is small). Also, the style of recent publications has no effect on the choice to retire. The possibility of being subject to mandatory retirement nearly doubles the likelihood of being retired in this sample, although the prediction is not perfect (presumably because the laws and other mandates can be circumvented).

The main conclusion is that what matters for retirement is the quantity of recent top-level output. Since retirement is the scholar's own choice (although we recognize that demand-side effects, e.g., "golden handshakes," might matter), this result suggests that the inability to publish or disinterest in publishing at the very highest level of scholarship makes previously highly successful scholars more likely to end their careers.¹³ This difference does not arise because the more successful scholars in the sample had more time early in their careers to do research: Almost all of these economists were highly successful early on. Moreover, as Appendix Table A2 shows, early-career (first or second decade) publishing has no effect on publications in one's third, or fourth and fifth decades.

We can enlarge the sample to 392 observations by adding scholars from the 1960s cohort (Ph.D. 1959-1968), obtaining their CVs, and re-estimating the model (adding an indicator of the decade when the Ph.D. was received). The impact of A_{20-29} , becomes slightly larger and more significant statistically (-0.057, s.e. = 0.016) with this expansion, but little else changes. The results in Columns (1) and (2) do not arise from restricting the sample to the 1970s cohort, the only group almost all of whose "Top 5" publications are included in our data set and who might be approaching conventional retirement ages.

¹³Their careers are finished after retirement, at least as measured by top-level publishing. Accounting for possible three-year lags from production of an article to its publication in these journals, those who had retired by 2018 produced only two top-level articles after two years past their retirement dates (compared to 838 articles before then).

The estimates might be an artifact reflecting unmeasurable differences among the scholars that are correlated with recent publishing success. To examine this possibility, we estimate the same equation but with the outcome being whether the scholar had died by 2018, using the sample of those who were either dead or still alive in academe and not retired (N = 204). Columns (3) and (4) of Table 2 present the results of this placebo test. Although the coefficients on both variables describing recent publications have the same negative signs as in the first two columns, neither is anywhere nearly significant statistically, and both are much smaller in absolute value. Moreover, given evidence that an author's death reduces citations to previously published papers (Aizenman and Kletzer, 2011, and by inference, Azoulay *et al.*, 2010), the estimated impact of prior citations in this placebo is probably biased negatively. The same may be true for $A_{20:29}$ if those who died had been relatively unhealthy and hence perhaps less productive during their third decade.¹⁴ These differences suggest that the results on retirement do not arise from any correlations of unobservables, particularly poor health, with either the incidence of retirement or recent publication success. One might interpret these results of this placebo test literally as a direct test of "publish or perish:" In this sample the estimates suggest that those are not substitutes.

IV. Conclusions and Extensions

The rate of slowdown in publishing with age is largely a linear function of an author's prior productivity, but the rate in mid-career is greater if an author's prior work has been less well-cited and written in a more positive but more tentative style. Having produced less top-flight research late in a career induces scholars to retire earlier, especially among those in more theoretically-based sub-fields. Both of these conclusions are based on a sample of the very top researchers in economics, so that we cannot infer from their behavior whether similar changes with age occur more broadly in scholarship generally.

We have documented one source of the diminution of top-flight scholarly activity with age—the decreasingly warm reception paid by other scholars. But other than randomness, the main apparent cause

¹⁴We also estimate a multinomial logit for members of both samples used in this sub-section, with the outcomes remaining in academe, retiring, or dying. The estimates are almost identical to those listed in Table 2.

of the decline appears to be habit; in other words, those scholars who have been the most productive remain so, albeit at a diminished rate of productivity. "Pooping out" is mostly endogenous, whether because of technological obsolescence, loss of interest (one's own or that of editors), boredom, reduced financial incentives (perhaps due to limits in many universities on maximum salaries, or to the flattening of earnings growth with age), flight to administrative roles or other alternative paths, or some other factor or combination of factors that might be classified under the general rubrics of benefits/costs of remaining employed.¹⁵ One additional possibility is that relatively unproductive senior scholars increasingly feel out of place, perhaps feeling a loss of respect and prestige, among their more productive younger colleagues. In a profession where there are often binding upper bounds on salaries, one's relative position in the market for prestige may be very important.

The various findings suggest additional questions, some of which might be answerable with additional data. Here we can only speculate about them in the context of our results. For example, academic economics for those near the top of their field, like the people in our sample, is a very easy existence: Minimal teaching, no publication requirements, and salaries that may not increase with academic pay generally but that are far above average pay in an economy. Why retire? Using academia as an example for high-paying occupations should be a way to learn more about why people generally retire rather than stay on or switch to part-time work (which academic jobs can become, *de facto* if not *de jure*).

Future research exploring these various motivations would be particularly useful from a policy angle. Understanding the causes of declining output with age among top academic researchers might lead to appropriate financial incentives, technological assistance, or some other such malleable factor, that could keep top-level output continuing. Findings on this specific issue might even apply not just to academia, but to other fields where top-level employees' productivity tends to decline with age. For sectors and industries that are "aging out" or having difficulty attracting younger workers, this could be very important.

¹⁵Subrahmanyan Chandrasekhar, Nobel-Prize winning astrophysicist, remarked that receiving early scholarly prominence could have diverted his research and caused him to "lose his motivation to continue doing science." [*University of Chicago Magazine*, February 2023, p. 43].

REFERENCES

- Joshua Aizenman and Kenneth Kletzer, "The Life Cycle of Scholars and Papers in Economics: The 'Citation Death Tax'," *Applied Economics*, 43 (Nov. 2011): 4135-48.
- Orley Ashenfelter and David Card," Did the Elimination of Mandatory Retirement Affect Faculty Retirement," *American Economic Review*, 92 (Sept. 2002): 957-80.
- Pierre Azoulay, Joshua Graff Zivin, and Jialan Wang, "Superstar Extinction," *Quarterly Journal of Economics*, 125 (May 2010): 549-89.
- Ray Fair, "How Fast Do Old Men Slow Down?" *Review of Economics and Statistics*, 76 (February 1994): 103-18.
- Matthew Gentzkow, Bryan Kelly, and Matt Taddy, "Text as Data," *Journal of Economic Literature*, 57 (Sept. 2019): 535-74.
- Amanda Goodall, Socrates in the Boardroom: Why Research Universities Should Be Led by Top Scholars. Princeton, NJ: Princeton University Press, 2010.
- Daniel Hamermesh, "Six Decades of Top Economics Publishing: Who and How?" *Journal of Economic Literature*, 51 (March 2013): 162-72.
- -----, "Citations in Economics: Measurement, Uses, and Impacts," *Journal of Economic Literature*, 56 (March 2018): 115-56.
- ------ and Sharon Oster, "Aging and Productivity among Economists," *Review of Economics* and Statistics, 80 (Feb. 1998): 154-6.
- Aidan Hollis, "Co-authorship and the Output of Academic Economists," *Labour Economics*, 8 (September 2001): 503–30.
- Lea-Rachel Kosnik, "Who Are the More Dismal Economists? Gender and Language in Academic Economics Research," American Economic Association, *Papers and Proceedings*, 112 (May 2022): 592-6.
- ----- and Daniel Hamermesh, "Aging in Style: Seniority and Sentiment in Scholarly Writing," NBER Working Paper No. 31150, April 2023.
- Harvey Lehman, Age and Achievement. Princeton, NJ: Princeton University Press, 1953.
- Sharon Levin and Paula Stephan, "Research Productivity over the Life Cycle: Evidence for Academic Scientists," *American Economic Review*, 81 (March 1991): 114-32.
- James Pennebaker and Lori Stone, "Words of Wisdom: Language Use over the Life Span," *Journal of Personality and Social Psychology*, 85 (2003): 291-301.
- Albert Rees and Sharon Smith, "The End of Mandatory Retirement for Tenured Faculty," *Science*, 253 (Aug. 23, 1991): 838-9.

Bruce Weinberg and David Galenson, "Creative Careers: The Life Cycles of Nobel Laureates in Economics," *De Economist*, 167 (2019): 221-39.

Table 1. First-order Autoregressions of Decadal Publications^a

Ind. Var.: A _{d-1}	Decade:					
	2nd ^b		3rd ^c		4th or 5th ^d	
	0.309 (0.032)	0.310 (0.032)	0.467 (0.029)	0.463 (0.029)	0.592 (0.043)	0.599 (0.043)
(CIT _{d-1})/100	0.078 (0.047)	0.070 (0.047)	0.052 (0.038)	0.049 (0.038)	0.196 (0.130)	0.175 (0.132)
$(CIT_{d-1}/100)^2$	-0.0018 (0.0016)	-0.0017 (0.0016)	-0.0009 (0.0010)	-0.0008 (0.0010)	-0.0023 (0.0017)	-0.0023 (0.0017)
$(z_{i.a})_{d-1}$ vector $(z_{i.a})^2_{d-1}$ vector (p-value of F(3, N-K))	0.11	0.41	0.37	0.40	0.35	0.48
R ²	0.142	0.139	0.350	0.350	0.468	0.467
Ν	875	875	639	639	331	331

^aIndicators of Ph.D. year and JEL group of most recent article in d-1 are included.

^bAll authors with Ph.D. year 1969-98. Includes all alive at decade's end.

^cAll authors with Ph.D. year 1969-88. Includes all alive at decade's end.

^dAll authors with Ph.D. year 1969-78. Includes all alive at decade's end.

Table 2. Determinants of the Probability of Exiting Academia After 30+Years, 1969-78 Cohort^a

Ind. Var.	Retire ^b		Die ^b		
A ₂₀₋₂₉	-0.047	-0.047	-0.014	-0.013	
	(0.018)	(0.018)	(0.008)	(0.007)	
(CIT ₂₀₋₂₉)/100	-0.013	-0.014	-0.004	-0.002	
	(0.020)	(0.020)	(0.010)	(0.008)	
Subject to mandatory					
retirement	0.231	0.241	0.025	0.013	
	(0.091)	(0.090)	(0.055)	(0.045)	
$(z_{ija})_{d-1}$ vector	0.87		0.98		
(z _{ija}) ² _{d-1} vector (p-value of F(3, N-K))		0.36		0.190	
Pseudo-R ²	0.126	0.133	0.148	0.191	
Ν	281	281	204	204	

^aProbit derivatives. Ph.D. year is included.

^bPh.D. year 1969-78, in academia for 30+ years.



Figure 1a. Kernel Density Estimate of the Distribution of Authors' Ph.D. Ages, Star Authors with Ph.D. Received 1969-1998, "Top 5" Journals, 1969-2018.



Figure 1b. Kernel Density Estimate of the Distribution of Authors' Ph.D. Ages, Star Authors 1969-78 Cohort, "Top 5" Journals, 1969-2018.

Table A1. N'th-order Autoregressions of Decadal Publications

Decade:

Ind. Var:	3rd	4th or 5th ^c		
Ad-1	0.458	0.456	0.460	0.466
	(0.030)	(0.030)	(0.045)	(0.044)
Ad-2	0.049	0.044	0.075	0.082
	(0.028)	(0.027)	(0.035)	(0.034)
Ad-3			0.054	0.057
			(0.029)	(0.028)
(CIT ₄₊₁)/100	0.037	0.037	0.054	0.060
	(0.021)	(0.021)	(0.047)	(0.046)
$(CIT_{10})/100$	-0.022	-0.022	-0.026	-0.031
(CII _{d-2})/100	(0.020)	(0.022)	(0.022)	(0.022)
(CIT)/100			0.027	0.030
(CII _d -3)/100			(0.024)	(0.024)
p-value of vector:				
(Zija)d-1	0.07		0.92	
(Zija ²)d-1		0.55		0.19
R ²	0.374	0.369	0.445	0.461
		<i></i>		
N	616	616	323	323

^aIndicators of Ph.D. year and JEL group of most recent article in d-1 are included. ^bAll authors with Ph.D. year 1969-88. Includes all alive at decade's end.

^cAll authors with Ph.D. year 1969-78. Includes all alive at decade's end.

Table A2. Longer Lags in the Determinants of Retirement or Death After				
30+Years in Academia ^a				
Ind. Var.:	Retire ^b	Die ^b		

Ind. Var.:	Ret	ire ^o	Die	
A ₂₀₋₂₉	-0.039	-0.040	-0.007	-0.009
	(0.024)	(0.024)	(0.006)	(0.007)
A ₁₀₋₁₉	-0.014	-0.011	-0.001	-0.001
	(0.016)	(0.016)	0.001)	(0.002)
A ₀₋₉	-0.008	0.004	-0.002	-0.003
	(0.013)	(0.013)	(0.002)	(0.003)
(Average CITES* ₂₀₋₂₉)/100	-0.002	-0.011	0.002	0.001
	(0.002)	(0.022)	(0.003)	(0.003)
(Average CITES* ₁₀₋₁₉)/100	-0.003	-0.001	-0.0003	-0.001
	(0.009)	(0.009)	(0.0009)	(0.001)
(Average CITES* ₀₋₉)/100	-0.006	-0.002	-0.0004	0.001
	(0.011)	(0.012)	(0.0009)	(0.001)
Mandatory retirement	0.196	0.201	-0.002	-0.003
	(0.100)	(0.098)	(0.007)	(0.009)
p-value of vector:				
(Z _{ija}) _{d-t}	0.39		0.28	
$(z_{ija}^2)_{d-t}$		0.60		0.34
Pseudo-R ²	0.130	0.124	0.346	0.332
N	262	262	190	190

^aProbit derivatives, Ph.D. year is included. ^bPh.D. year 1969-78, in academia for 30+ years.