I Z A Institute
of Labor Economics
Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 15739

Aging in Style: Does How We Write Matter?

Daniel S. Hamermesh
Lea-Rachel Kosnik

NOVEMBER 2022

I Z A Institute
of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 15739

Aging in Style: Does How We Write Matter?

Daniel S. Hamermesh
University of Texas at Austin, IZA and NBER

Lea-Rachel Kosnik
University of Missouri—St. Louis

NOVEMBER 2022

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Aging in Style: Does How We Write Matter?*

The scholarly impact of academic research matters for academic promotions, influence, relevance to public policy, and others. Focusing on writing style in top-level professional journals, we examine how it changes with age, how stylistic differences and age affect impact, and how style and prior scholarly output relate to an author's subsequent achievements and labor-force decisions. As top-level scholars age, their writing style increasingly differs from others'. The impact (measured by citations) of each contribution decreases, due to the direct effect of age and the much smaller indirect effects through style. Non-native English speakers write in a different style from others, in ways that reduce the impact of their research. Scholars produce less top-flight work as they age, especially those who have produced less in the recent past, whose work is less cited, and whose styles have been more positive. Previously less productive authors are more likely to retire.

JEL Classification: B41, A14
Keywords: aging, citations, bibliometrics, language

Corresponding author:
Daniel S. Hamermesh
University of Texas at Austin
110 Inner Campus Drive
Austin, TX 78705
USA
E-mail: hamermes@eco.utexas.edu

* We thank Shira Itzkowitz for extremely careful research assistance, Pavel Jelnov for providing some of the data on authors' ages, and William Olney for some of the data on English-speakers. Helpful comments were provided by William Bley, George Borjas, Marco Caliendo, Ray Fair, Pamela Jakiela, Jamie Pennebaker, Gerard Pfann, and participants in seminars at several universities. In the interest of transparency, we note that one of the authors is included in the data set.

They shall bring forth fruit in old age. [Psalm 92:14]

I. Introduction

The essence of academic scholarship is contained in what academics write, and the rewards to successful writing - research that affects the public and other scholars - are substantial. These range from purely monetary (as an immense literature—with early examples of Holtmann and Bayer, 1970, in the natural sciences; Hamermesh *et al*., 1982, in economics; Diamond, 1986, in mathematics, shows), to honors ranging from appointment as a Fellow in some academic society to the pinnacles—a Nobel Prize in the natural sciences (and economics), a Fields Medal in mathematics (Hamermesh and Pfann, 2012; Borjas and Doran, 2015), and others. Our first major question goes behind the effects of successful scholarship to ask: Does **how** we write affect the success of our writing? Before we can answer that question, however, we examine how our writing styles vary with our demographic characteristics, most importantly, our age/experience as researchers. After all, if academic success is related to both age and the style in which we present our research, we need to separate out the indirect effects of age through style to the direct effects of age on success. Parsing out these causes allows us to get a glimpse into one possible source of the well-recognized decline in creative activity with age (Lehman, 1953; Levin and Stephan, 1991; Weinberg and Galenson, 2019; and many others), which is our second major focus.

We can delve further into the causes of the relatively short scholarly lives of academics by obtaining information on the ages when they stop producing fundamental work. Do they retire from academia because their academic production has already substantially slowed? Has their production not slowed, but become less well recognized by their peers? Or have they simply tired out or become technologically obsolete, which are possible residual explanations? We cannot test or rule out all explanations, but with information on the life-cycle patterns of academic production and its success, we can consider some of them.

To answer these questions, we need information on publishing patterns over scholars' lives, on the style of their publications, and on the impact of their research on the scholarly community, all in relation to the author's age at which the research appears. In order to examine possible reasons for declining activity, we also need information on the age at which those in our sample stopped producing top-level research.

These data requirements begin to be satisfied in a sample of all publications in the so-called "Top 5" economics journals that appeared between 1969 and 2018. This sample contains many of the most influential economics publications over the past half century, and the individuals in the sample represent the upper crust of contributors to economic knowledge. Using textual analysis to measure style, for each article we then obtain its subsequent citations to measure its scholarly impact. For each author we obtain her/his date of entry into academe, and for each we acquire information on whether they remained unretired in academe in 2018.

Section II details the sample we construct, describes the measures of style, and provides statistics describing the publications. In Section III we present the first set of main results, linking style to age and showing how deviations in style from norms that prevailed at the time of publication and in the sub-field of the research vary with age. Section IV examines how style and age relate to citations and teases out the direct and indirect (through style) impacts of age on the subsequent impact of scholarship. Finally, in Section V we analyze whether and how publishing success, and the style of published research, affect the likelihood of continuing to produce top-notch academic research, thus getting at some of the possible explanations of age-related slowdowns in productivity. We then link these to the propensity to retire from an academic position.

II. The Sample, and the Measurement of Sentiment

A. Publications in Economics, 1969-2018

The corpus of texts that we analyze consists of all 16,827 research articles published in English in the "Top 5" economics journals: *American Economic Review (AER), Econometrica (ETRCA), Journal of Political Economy (JPE), Quarterly Journal of Economics (QJE), and Review of Economic Studies (REStud)*, from 1969-2018.[1] Entries not included in the dataset are editor's notes, conference announcements and programs, auditor's reports, indexes, other similar non-research focused entries, and articles in the AEA *Papers and Proceedings*. Special symposium articles are included. Importantly, the

[1]Some of these journals, especially in earlier years, included an occasional article in French or German.

dataset utilizes entire articles, and not just article titles or abstracts, as is sometimes the basis of corpora in the literature that investigates academic research.

We exclude all entries that are comments/replies/rejoinders, etc., and also those that are Nobel or presidential addresses (American Economic Association or Econometric Society), since the former may depend on the original article being discussed, while the latter need not be purely scientific articles. These exclusions reduce the sample to 15,138 articles. With multiple authors on a majority of these articles, we have over 20,000 author/article entries. Many of the authors are "one-hit wonders," and many others appear only a few times. Since we wish to concentrate on the life-cycle relationship of age to style and scholarly impact, we restrict the sample to authors with at least five articles among the 15,138. For each of these highly successful authors we attempted to obtain the year when they began their careers, which we take as the year of receipt of the Ph.D.[2] Through online searches and emails, both to authors and, where necessary, their colleagues, both current and surviving, we obtained this measure for all but one individual (who authored six articles in the sample). Our final sample thus contains 12,814 articles authored by 1,389 different individuals.[3] We record the gender of each author (since Kosnik, 2022a, demonstrates gender differences in style even within the same sub-field in economics).[4] We also identify whether an author was a native English-speaker or not, following the criteria in Olney (2017) (and treating economists born in India or Pakistan as non-native English-speakers).

Of particular interest is the cohort of individuals who entered the profession (received their doctorate or equivalent) between 1969 and 1978. For these 359 scholars (which we call the 1970s cohort), who authored 3,562 of the articles in the sample, we can observe nearly their entire professional careers,

[2]For the 0.5 percent of authors without a Ph.D. we add five years to the date when they received an undergraduate degree and count their professional experience from that year.

[3]Because several articles may have the same pair, triplet, or even quadruplet of co-authors in the sample, only 9,280 separate articles are included. In calculating sample statistics describing authors and in estimating models, we thus weight each of the 12,814 observations by the inverse of the number of times it appears in the sample.

[4]In terms of data collected, the most similar study is Coupé et al., (2006), which considered totally different issues from the aging and style questions examined here.

thus creating a longitudinal sample of the leading scholars in this cohort whose members had 40-49 years to publish the scholarly research included in the sample.

The main source of sample selectivity is along the criterion of scholarly success—having at least five research articles in these most visible scholarly outlets in economics. We recognize that the "Top 5" are only a few of the 182 economics journals that were indexed in *EconLit* in 1969 (and of the more than 1,000 included today), and that many articles in other outlets receive more attention (Oswald, 2007; Heckman and Moktan, 2020). On average, however, articles published in these journals do attract the most attention (Hamermesh, 2018). The exclusion of authors with few "Top 5" publications is restrictive, but it allows us to follow careers over a reasonably long period of time. We admittedly concentrate on the careers of academic stars, so that in none of our analyses can we infer anything about the careers of scholars with relatively few top-level scholarly contributions.[5]

For each entry we have its length in pages (which we normalize to the word count of the *AER* before 2000). Since styles may differ by type of article, we also include the first-listed top-level *JEL* classification of each article (*JEL* Codes A-R and Z). These are aggregated into five groups: 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. We also know the decade of publication, 1969-78, …, 2009-18, which we use in transforming the raw measures of sentiment that we create.

The top panel of Table 1 describes the characteristics of the articles. They are distributed fairly evenly across the five *JEL* groups, with the exception of the smaller category of other—miscellaneous—articles. Despite the apparent growth in publishing, the distribution of articles is nearly uniform across the decades. The growth in publishing is explained by the logorrhea of authors publishing in these journals, a near tripling of page lengths over the five decades.

[5]During the decade of the 1970s perhaps 8,000 Ph.D. degrees in economics were conferred in the U.S. Our sample of 359 usable observations thus probably represents the most successful five percent of publishers in that cohort.

As is well-known, publishing top-level economics is a young person's game (see Hamermesh, 2013, for cross-section evidence), as the kernel density estimates for the entire sample in Figure 1a demonstrate and as shown by Figure 1b for the longitudinal data describing the 1970s cohort.[6] In this cohort the median age post-Ph.D. at an article's publication is 10 years, with only 0.6 percent of articles published before an author received his/her doctorate. Among those with Ph.D. degrees received before 1972, only 7 percent of the articles they published in this half-century appeared when they were more than 35 years post-Ph.D.[7]

Only 0.7 percent of the articles published in 1969-78 contained female authors who were in the sample, a percentage that reached 5.7 in the decade 2009-18. The 1970s cohort is only 1.2 percent female, while 7.0 percent of sample members with doctorates 1979 or later are women. In the first three decades of our sample, 75, 78, and 70 percent respectively of authors were native English-speakers. In the last two decades (1999-2008 and 2009-2018) this fraction had fallen to 56 percent and 44 percent respectively.

The second panel of Table 1 describes the achievements of this selected sample. Nearly one-quarter of the 1,389 authors barely qualified for inclusion, with only five papers published in these outlets. The maximum number of articles anyone published in these journals during this half century is 60. Restricting the calculations to the 1970s cohort, the distribution looks quite similar to the overall distribution, although it is shifted slightly to the right.

B. *Measuring the Sentiment of Economic Research*

Sentiment analysis is a technique for identifying the emotive tenor of a piece of writing. The use of sentiment measures in economics is discussed by Gentzkow *et al*. (2019) They have been used in many areas of scholarly research, including analyses of the Old and New Testaments (Houk, 2002; Kenny, 1986), examinations of the authorship of the individual Federalist papers (Mosteller and Wallace, 1963),

[6]This is the largest cohort in the sample, accounting for 26 percent of authors. The pre-1969 cohorts included 14 percent of authors, the 1979-88 cohort 23 percent, the 1989-98 cohort 20 percent, and two youngest cohorts together 17 percent. The year of receipt of Ph.D. ranged from 1937 to 2014.

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

newspapers' reflections of economic uncertainty (Baker *et al*., 2016), and the success of online listings in affecting click-rates (Ludwig *et al.*, 2013).[8] We utilize three sentiment scores in this research: a positive/negative score (POSN), a certainty/tentativeness score (CERT), and a contemporary/past score (CONP). Each score j has been calculated as a net count of all relevant word or word-phrases in document i divided by the total number of relevant words:

(1) $$z_{iaj} = (\Sigma c_{iaj} - \Sigma t_{iaj}) / \Sigma (c_{iaj} + t_{iaj}) \text{ , } j=1, \ldots, 3 \text{ ,}$$

where z_{iaj} is the net score for article i by author a along criterion j. c_{iaj} is the count of its positive (certain) words, and t_{iaj} the count of its negative (tentative) words. CONP is calculated based on the c_{ia3} indicating future or present tenses in verbs, t_{ia3} indicating verbs in the past tense. Each of the three indicators is thus based on counts of words classified into two contrasting types. POSN is the most frequently studied sentiment in the literature on natural language processing; and while CERT and CONP are newer, they have gained traction (Pennebaker and Stone, 2003; Kosnik, 2022b).

If POSN >(<) 0, we infer that an article has a net positive (negative) emotive tone. The size of the final score indicates the degree of its net positivity or negativity. If CERT >(<) 0, an article has an overall emotive tone of certainty (tentativeness). If *CONP* >(<) 0, the article has a contemporary (past-focused) emotive tone. For all three measures the size of the sentiment score indicates the degree of the particular sentiment.

Key to any sentiment score are the words and phrases that comprise the c_{ij} and t_{ij}. Appendix Tables A1-A3 provide examples of the kinds of words and phrases in each of the three sentiment scores. The dictionaries utilized for this analysis were built up from the Harvard IV dictionary (https://textanalysis.info/pages/category-systems/general-category-systems/harvard-iv-dictionary.php), the Linguistic Inquiry and Word Count (LIWC) dictionary (Pennebaker, 2015), and the Regressive Imagery

[8]Examinations of economic writing style from a viewpoint of rhetoric have been produced by McCloskey (1998) and Goldschmidt and Szmrecsanyi (2007), among others.

dictionary (Martindale, 1990), with edits made to fit the context of writing in academic economics.[9] These edits primarily involved recognizing econometric-based words as neutral, rather than as indicative of emotive content. For example, "average," "limit," "regression," "subtract," and "ordinary" were marked as indicative of negative sentiment in the original dictionaries, but were made neutral for analyzing economics articles. Similarly, "aggregate," "natural," "validity," "append," and "value" were all marked as indicative of positive sentiment in the original dictionary, but were also treated as neutral for this analysis. Dictionary creation is a somewhat subjective endeavor, which is why we relied, as much as possible, on the category dictionaries created by previous researchers which have been honed over many years of use. We tailored them only (as is standard in the literature) within the specific context of economics and econometrics.[10]

Each of the articles in the corpus was entered into a relational database where variables associated with the articles could be independently analyzed, for examples, year of publication, journal of publication, page length, author's native language, gender, and, of course, author's age. The text itself was left unstructured and organized within a vector-space model (VSM), where each element of the vector indicates the occurrence of a particular word or phrase within the paper. The vector elements were not transformed or weighted in any way, instead being left as raw frequency counts, so that if a given word was used more than once in a paper, its degree of emphasis was reflected in a higher count and thus a higher sentiment score.

The textual analysis yielded the measures z_{iaj}. Because there are trends in style (Kosnik, 2022a; 2022b) and differences in style across sub-fields, we transform each z_{iaj} as:

$$z^{*}_{iaj} = z_{iaj} - z^{'}_{..j}, \tag{2}$$

[9]Tailoring the dictionary to the context is important, as some words have different meanings in different contexts. "Vice," for example, would be categorized as a negative word in most situations, but in a human resources managerial handbook it might refer primarily to vice-presidents and so be categorized in that context as neutral. It then would have no bearing on such a handbook's positive/negative sentiment score.

[10]After the initial word counts and sentiment scores were calculated, spot checking with KWIC (keyword-in-context) was performed to make sure the words being categorized as negative or positive really indicated such sentiment in the article.

where $z'_{..j}$ is the score averaged over all articles by all authors in a *JEL* group in a decade (so that each score is adjusted by the norm of sentiment for its sub-field and time, i.e., 25 norms). The calculations of the z^*_{iaj} also allow examining the size of the departure of style, whether positively or negatively, from the sub-field/time norm describing the article, which we measure as z^{*2}_{iaj}. Like the measures of sentiment themselves, these departures may be related to the authors' ages and to the success of their articles.[11]

As a check on the mechanical counting of words and the creation of the z_{iaj}, we took the pairs of articles that represented the extreme values of POSN and CERT among articles published 2009-18 in the *JEL* categories (H, I, J). A group of advanced undergraduates was asked to rate which article in the pair was more Positive (Certain). Of the 12 undergraduates handling each pair, 11 produced the same ranking as the computerized text analysis ($p = 0.0002$) along each of these two dimensions. This simple test provides some assurance that the mechanical ranking of sentiments accords with what a reader would perceive.[12]

The bottom panel of Table 1 lists summary statistics of the z_{iaj}, z^*_{iaj}, and z^{*2}_{iaj}. On average the sentiment of the articles in our sample is quite negative, they are written in a very tentative voice, but they do tend to be contemporary oriented. Sixteen percent of the articles have a net positive sentiment, and four percent express certainty in their sentiments, although almost none contains a net past-oriented sentiment. The crucial point to note for our empirical analyses is that there is substantial variation in sentiment across the sample along all three criteria.[13] Moreover, as Appendix Table B2 shows, while the correlations among the three measures of sentiment, among the deviations, and among their squares across the samples are

[11]Using the quadratics in z^*_{iaj} to measure departures from norms is arbitrary, implicitly assuming increasing effects as the departure increases. We re-estimated all the models in Sections III and IV, replacing z^{*2}_{iaj} by $|z^*_{iaj}|$. The coefficient estimates become slightly less significant, and the fits are not as good. This suggests that the implicit assumption of increasing effects regardless of the sign of the departure from the norm underlies the data.

[12]We subjected this manuscript to the same analysis of sentiments that underlies the body of the paper. Basing the adjusted scores on publications in the 2009-18 decade in the *JEL* group "Other," the z* scores on POSN, CERT, CONT were 0.034, 0.004, and -0.214 respectively, while those on the z^{*2} were 0.0012, 0.00001, and 0.0456 respectively. The scores on CONT slightly exceeded the standard errors of the scores in this group, while the other four scores were very close to the group means.

[13]There are also significant differences across the five journals, with all of them being more positive and more contemporary-oriented than the *AER*, and all but the *QJE* being written in a more certain voice than the *AER*, as Appendix Table B.1 shows.

positive, they are not very large. The three measures of sentiment in an economics article are nearly independent.

III. Age, Style, and Style Norms

We first consider nonparametrically how style and style norms relate to age by examining the local polynomial smoothed relationship between a sentiment measure and the Ph.D. age of authors at the time their paper was published. Figures 2a-2c show these for each of POSN, CERT, and CONP, including 95-percent confidence bands around the estimates. While these figures cover the entire range of ages when the author's articles appeared, the paucity of publications before an author received the Ph.D., or after Ph.D. age 35 unsurprisingly makes the confidence bands over those ranges very wide. The most useful comparisons are of the patterns of sentiments when the authors are between Ph.D. ages 0 and 35. Assuming a Ph.D. is received at age 28, that is roughly equivalent to between 28 through 63 years of age.[14]

These comparisons demonstrate a monotonic and highly statistically significant increase in the positivity of writing style with age over the relevant Ph.D. age range (Figure 2a), mirroring the results in Pennebaker and Stone (2003) based on laboratory experiments and a small sample of creative writers. Conversely, there is a significant monotonic decrease in the certainty of writing styles over this age range (Figure 2b). There is essentially no relation between age and the present/past orientation of the authors' styles (Figure 2c), except that even with the small sample of very senior authors, there is a significant decrease in present orientation after a Ph.D. age of 35. Notably too, there is no evidence of any discrete change in any measure of style around the time the typical academic would obtain job security (academic tenure), 5-8 years post-Ph.D.

While allowing a function-free view of the sentiment-age relationships, the estimates in Figures 2a-2c cannot allow for other characteristics (of authors and articles) that might determine the style in which the articles are written. The top panel of Table 2 thus presents linear estimates relating the deviation in

[14]Receiving a Ph.D. in economics at age 28 is fairly precocious: The average age during most of the sample period hovered around 31 (Scott and Siegfried, 2008); but it is conceivable that the more successful researchers are those who finished their degrees more quickly than average.

sentiment (the z^*_{ij}) to Ph.D. age, holding all the covariates constant: gender, native English-speaker, journal indicators, *JEL* group, and decade of publication. The standard errors of the parameter estimates are clustered on authors. The estimates essentially reproduce the results in Figures 2a and 2b, including a statistically significant positive effect of age on POSN, and a statistically significant decline with age on CONP, no doubt arising from the significant sharp drop observed in Figure 2c among the oldest authors. These results imply that, as authors age, they write less dismally, in an even more questioning manner, and with an increasingly backward-looking emphasis. The bottom panel includes author fixed effects, thus adjusting for any personal idiosyncrasies in style. The signs of all three estimates remain the same, with the impacts of age on positivity (present orientation) remaining statistically significantly positive (negative).[15]

The right-hand side of each panel in Table 2 presents the same estimates but only including authors in the 1970s cohort. This restriction allows concentration on a group whose backgrounds and professional life experiences were probably more homogeneous than those of the entire sample. The estimates in the first panel are similar in magnitude in most cases to those for the entire sample, although with a sample size only 28 percent of that in the entire group, their standard errors are larger. The fixed-effects estimates are much smaller than those for the entire sample, but they still show the positive positivity-age relationship, and the negative relationships of the other two sentiments to age. The overall conclusion from Figures 2 and Table 2 is that there is some evidence that sentiment changes, all else equal, as authors continue writing, becoming more positive and less present-oriented (opposite from the secular trends for the profession as a whole found in Kosnik (2022a; 2022b)).

The estimates of the impact of being a native English-speaker on style are striking: Natives write less positively, with less certainty, and with less present/future orientation than do leading economists whose mother tongue is not English. To the extent that style affects scholarly impact, which we examine in the next section and which was examined in a small experiment by Feld *et al*. (2022), these effects are

[15]There are no significant differences by *JEL* code in the impacts of age on any of the measures of sentiment. Also, adding a quadratic in age suggested that the relationships of age to the sentiment measures are essentially linear.

important. They are also fairly large, amounting to differences in the full sample (the 1970s cohort) of -0.13 (-0.25), -0.25 (-0.42) and -0.19 (-0.30) standard deviations in the three measures of sentiment.

We know that writing style differs by sub-field, but another question is whether the impact of age on style differs by sub-field as well. Separating the more and perhaps less formal *JEL* groups, so that the former is the first three of the five aggregated *JEL* categories, the latter the final two aggregates, we re-estimate the models in Table 2 for the two groups separately. Except for POSN, for which the age gradient is significantly more positively sloped in the less formal groups, there are no significant differences in this estimate between the two pairs of *JEL* groups. In the estimates for the 1970s cohort there are no significant differences for any of the sentiment measures.

With co-authorship increasing steadily over the half-century of our sample, perhaps the results simply reflect correlations of style with the number of co-authors. Adding the number of co-authors to the models in the panels on the left-hand side of Table 2 hardly changes the estimated effects of author's age on writing style. Adding the same measure to the estimates based on the 1970s cohort has similarly small effects. Additional coauthors, however, do make writing styles more positive, more certain, and less present-oriented, both in the full sample and in the 1970s cohort.

One might be concerned that, with so many authors having only five entries in the sample, the results arise from the characteristics of the least successful among this group of very successful scholars. As robustness checks, we re-estimate the equations discussed above, first restricting the sample to exclude the 24 percent of authors (13 percent of articles) with "only" five publications, then excluding the 68 percent with fewer than 10 publications (46 percent of articles). The results with the first exclusion yield uniformly larger (in absolute value) effects than those shown for the entire sample in Table 2. With the even stricter exclusion, the effects of age on the deviations of POSN and CONP from style norms become slightly larger, perhaps because the most prolific authors, those with ten or more publications in the sample, stake out their stylistic identities later in their careers than other authors.

Figures 3a-c show local polynomial smoothed representations of the relation between age and the z^{*2}_{iaj} –the squared deviations of the sentiment measures from their decadal/sub-field norms. The results are

even clearer than in Figures 2: Deviations from the norms of positivity (actually, mostly negativity) fall with age; those with certainty (actually, mostly tentativeness) rise with age, while there is no relation of the squared deviations of present-orientation to age over most of the range (although the squared departures fall significantly within the small sample of very senior authors).

Table 3 presents the same models as in Table 2, with the same additional controls and the same sample restrictions, describing the determinants of the z^{*2}_{iaj}. The estimates for the entire sample suggest that only deviations from contemporaneity are affected by age (rise with age); deviations from norms of positivity and certainty are not related to age; but the fixed-effects estimates, which include journal and *JEL* controls, demonstrate that increasing age leads to significant increases in the departure of sentiment along all three dimensions from decadal/sub-field averages. Once we account for author fixed effects, we observe that, as authors age, their writing increasingly differs from that of others working at the same time and in the same areas—they become more unusual. Restricting the sample to the 1970s cohort strengthens this conclusion: The estimates for all three measures of sentiment depart increasingly and significantly from the time/sub-field norm as authors in the 1970s cohort age.[16] The writing of scholars in economics becomes increasingly idiosyncratic —both more or less positively, both more or less certainly, and both more or less present-oriented—as they gain experience.[17]

Most of the estimated impacts of age on the deviation of sentiment and the squared deviation from the norm are statistically significant for the full sample, although not for the 1970s cohort. Based on the fixed-effects estimates for the entire sample (the 1970s cohort), for the z^{*}_{iaj} they are 0.14 (0.03), -0.06 (-

[16]As with the estimates in Table 2, we examine the robustness of the estimated effects on the z^{*2}_{iaj} by adding a measure of the number of coauthors on each article. These additions do not alter any conclusions about the relationship between age and style. Nor is the presence of additional coauthors associated with greater departures from any of the style norms. We also examine the robustness of the estimated effects to restrictions on the sample by excluding the less successful members of the sample. We impose successive restrictions on the sample, initially excluding authors with only 5 entries, then those with fewer than 10 entries. Examining only the fixed effects estimates for the 1970s cohort, both restrictions increase the absolute values of the point estimates for POSN and CONT, reduce that for CERT.

[17]We re-estimated all the models discussed in this section replacing indicators of the *JEL* group with the raw *JEL* classifications, and replacing the decadal indicators with the indicators of the year of publication. Neither of these changes altered the general conclusions drawn from the estimates shown in the tables.

0.03), and -0.10 (-0.05) standard deviations for POSN, CERT, and CONP respectively. For the z^{*2}_{iaj} the effects are 0.09 (0.12), 0.25 (0.17), and 0.12 (0.18) standard deviations. Age is related to sentiment—significantly so for the squared deviations of departures from norm—and the impacts of age on the size of the departure, positive or negative, from decadal/sub-field norms are not small.

The CONT-age gradient was negative, while the $CONT^2$-age gradient is positive. Both of these results are due to behavior exhibited in publications in the sample from before 2000. In the final two decades of our sample the gradients are both essentially flat. The former change might arise because today's older economists bring a lesser economic-historical slant to their publications than did their predecessors of earlier generations. Older economists now deviate no more than their younger colleagues from sub-field/decadal norms of style.

The results for the impact of native English-speaking on departures from norms are less clear-cut than their impact on the levels of style, but there is some evidence that native English-speakers depart less from field/decadal norms in positivity and certainty than those authors whose mother tongue is not English. On contemporaneity, on the other hand, native English-speakers' writing styles differ more from the norms of their time and sub-specialty. In terms of the size of these effects, in the full sample (the 1970s cohort) they range from -0.01 (-0.15) standard-deviation differences in POSN and CERT, to a 0.12 (0.16) standard deviation difference in CONP.

IV. Age, Style, and Citations

We measure the scholarly impact of articles by the number of subsequent citations received. We recognize the imperfections in this measure, but: 1) It is a relatively objective measure; 2) It correlates well with various outcomes, including salaries and departmental/institution rankings (Hamermesh, 2018); 3) It correlates well with subjective evaluations by teams of economists (Checchi *et al*., 2021); and 4) Although imperfect, citations are the standard metric used in the literature describing academic contributions. Ideally, we would use citation counts from the Web of Science, but we were only able to obtain them for 63.9

percent of the 12,814 observations. Accordingly, we obtained citation counts from Google Scholar for another 35.5 percent.[18] All the citation data are cumulative through August 2021.

Google Scholar is much less restrictive than the Web of Science (Hamermesh, 2018). The average citation count of the one-third of the sample with data from the former source is thus 677 (s.d. = 2,082), while that from the latter source is 199 (s.d. = 440). Authors of articles whose citations are from the Web of Science are much younger than other authors (average age since Ph.D. 10.1 versus 14.9), which results from the fact that younger authors have published more recently and that articles with Google Scholar citation counts are disproportionately (97 percent) from the earliest three decades of our sample. In order to make the measures of citations commensurate, for each observation for which citations were taken from Google Scholar we create CITES*= 199.44*CITES/677.02 where CITES are citations to the article and the adjustment is based on the sample means of citations from the two sources.[19]

Consider first the local polynomial fits of CITES* to Ph.D. age, shown in Figure 4a for the entire sample and Figure 4b for the 1970s cohort. While the relationship is very imprecise at the extremes of Ph.D. age (below age 0 and above age 35) because of the paucity of data in those age ranges, across the bulk of observations there is a clear negative relationship between citations and Ph.D. age. Moreover, the decline with age is not insubstantial; Figure 4a shows that going from age 0 to 35 cuts the estimated citations to an article by nearly half.

The difficulty with these figures is that they cannot account for the differences in the source of the citation data by year of publication (and thus implicitly by author's Ph.D. age), nor for growth in the number of journals citing economics articles, nor for the length of time over which a study could accumulate citations by August 2021. We thus estimate models similar to those presented in Tables 2 and 3, including in all the equations each author's Ph.D. age and all three measures of sentiment (and controlling in each

[18]We were unable to obtain citation counts for 0.6 percent of the observations and hence exclude them from the analyses in this section, resulting in a usable sub-sample of 12,740 observations (and the same 1,389 distinct authors in the full sample, 359 in the 1970s cohort).

[19]All the results in this section were reproduced on the separate samples with Web of Science data or Google Scholar data, with no departures from the results tabled here.

equation for the number of *AER*-equivalent pages, native English-speaker and gender, and an indicator of whether the citation measure is from the Web of Science or Google Scholar). Because it takes time for citations to accrue, we control for year of publication rather than decade; because the distribution of citations is highly skewed, all estimates are produced using median (LAD) regressions and, as before, standard errors are clustered on authors.

The top panel of Table 4 presents the estimated impacts of sentiment, age, and English-native speaker on subsequent citations, first for the entire sample (left) and then for the 1970s cohort (right). The estimates in Columns (1) and (3) show that increased age directly and statistically significantly reduces subsequent citations, as implied by the Figures. Also, however, articles written in more positive, more certain, and more contemporary styles than the decadal/field norms also generate fewer citations. For the entire sample all the impacts are highly significant statistically, while even for the much smaller 1970s cohort the impact of CERT is statistically significantly negative.

Figures 4a and 4b suggested the possible presence of a nonlinear relation between Ph.D. age and CITES*. To examine this possibility conditional on all the controls (most important, year of publication), we add a quadratic term in age to the estimates, with the results shown in Columns (2) and (4) of Table 4.[20] For the full sample and for the 1970s cohort the quadratic terms are statistically significant. In the full sample the results suggest that citations decrease with author's age until 41 years past the Ph.D., i.e., over 99.1 percent of authors. In the 1970s cohort, the responses of CITES* to age initially rise with age, turning negative 15 years past the Ph.D. (and are thus negative for 34 percent of the cohort sub-sample). We conclude that for a large fraction of publications in these top journals, articles penned by older authors receive less attention from other scholars or that they did at the peak of the scholar's career.[21]

[20]For the fewer than one percent of articles published before the author completed the Ph.D., the measure is set equal to 0.

[21]In terms of the epigraph to this article, one interpretation is that they do bring forth fruit in old age, but that it is not so succulent as the fruit that they brought forth earlier (or at least not so succulent to the tastes of younger scholars).

While positive deviations of all three measures of sentiment reduce citations significantly or nearly so, the more important question is how large these reductions are. Taking simultaneous two-standard deviation increases in sentiment scores, based on the estimates in the upper panel of Table 4 in Column (1) (Column 3), these increases reduce citations by 10 (5) percent, or 0.03 (0.02) standard deviations. Writing in a more positive, more certain, or more present-oriented way than others publishing at the same time and in the same sub-field reduces the scholarly impact of one's articles, although the effects are not large.

The bottom panel in Table 4 produces analogous results, but for the z^{*2}_{iaj}, the adjusted squared deviation measures, which we present exactly as in the upper panel—separately for the full sample and the 1970s cohort sub-sample, and without and then with a quadratic term in Ph.D. age. The squared deviations of the sentiment measures from the prevailing norms are only weakly statistically significant, with bigger departures from the norm of positivity increasing citations, but with a decrease in citations among articles whose style departs from norms more along the dimension of certainty.

Does writing in a style that departs further—in either direction—from that of other scholars lead to more or less eventual scholarly impact? Taking the estimates from Column (1) (Column 3) of this lower panel, we calculate the effect of simultaneous two standard-deviation increases in each measure of sentiment on an article's citations. These departures generate a net reduction of 2 citations, a one-percent drop, and equivalent to less than 0.01 standard deviations of citations. Departures in either direction from all three style norms reduce citations, but by very little, with similar very small impacts for the 1970s cohort.

While doubling the number of authors on an article does not double its citations, it does increase them (Hamermesh, 2018). Since we showed before that co-authorship hardly changes the impact of age on writing style, failure to include the number of authors in these estimates will not bias the estimated impacts here. Adding the number of authors to the models presented in Table 4 thus barely alters the results, with some estimates rising slightly in absolute value, some falling, and with those that are statistically significant

in Table 4 remaining so.[22] The effect of additional authors is positive and statistically significant, but far less than in proportion to the number of authors.

Another potential problem is that more senior authors are more likely to have published more articles in the sample. If so, and if having published more articles makes additional articles better cited, either because of reputational effects or simply because those who publish more top-level articles do more important work, the estimated effects shown in Table 4 may be biased. Age at publication and number of articles are correlated but not very highly—r = 0.11 in the entire sample, r = 0.15 in the 1970s cohort.

To examine this possibility, we re-estimated the models in Table 4, adding for each observation the number of "Top 5" articles that the author had previously published and its interaction with age. The estimated effects of z^*_{iaj} and z^{*2}_{iaj} on citations do not change very much, with all of them increasing slightly in absolute value from those shown in the Tables. The citations-age gradient becomes flatter the more prior publications the author has had in these journals. Most interesting, and relevant for the next Section of this study, among authors of the same age, those who had previously published more in these journals receive more citations to their current publication than otherwise identical authors. We cannot determine whether this treatment reflects higher-quality work or reputational ("Matthew") effects (Merton, 1968). Suffice it to note that the negative impact of age on citations is implicitly reduced for authors who are the more successful among the highly successful scholars in this sample.

We can decompose the total effect of age on citations using the estimates in the upper panels of Tables 2 and 4 as:

$$(3) \qquad dCITES^*/d_{AGE} = \partial CITES^*/\partial AGE \,\big|_{z^*ij} + [\partial CITES^*/\partial z^*_{iaj} \,\big|_{AGE} \cdot \partial z^*_{iaj}/\partial AGE],$$

[22]Restricting the samples, first to those with more than five entries, then to those with ten or more entries, also does not qualitatively alter the results. Even for the 1970s cohort, for which the second restriction cuts the sample to only 2,167 observations, the parameter estimates retain their signs, and the statistically significant negative estimates for CERT in Table 4 remain so.

the sum of the direct effect, the first term, and the indirect effect, the bracketed term. We calculate the effect on citations of a two standard-deviation increase in age in the whole sample. As a fraction of mean citations, the impacts are reductions of 3.0 percent, which equals 0.02 standard deviations in citations (with only two percent of the impact working through the indirect effect in (3)). The effects are similar in the 1970s cohort. Scholarly recognition decreases with author's age, but only a minute part of the decrease is due to changes in writing style with age.

We can only speculate about why there are fewer citations to articles published at the same time and in the same sub-field by older scholars and why they decrease as scholars age. One possibility is that already-established authors are favored by editors, who publish their papers even if the work is not quite so important as that of more junior authors or their own earlier work (although some evidence points against this kind of favoritism in several related dimensions, Blank, 1991).[23] No doubt other, perhaps even testable explanations are consistent with this surprising finding.

We can replace z^*_{iaj} by z^{*2}_{iaj} in (3) to calculate the indirect effects of age on citations through departures from stylistic norms, using the estimates in the upper panel of Table 3 and the bottom panel of Table 4. The decomposition differs little from that above, with a slightly larger total effect. The indirect effects again constitute no more than two percent of the total impact.

The estimated impacts of being a native-English speaker are all significantly positive, in both the full sample and in the 1970s cohort. All else equal, including the objective measures of their writing style, in the estimates for the full sample a native English-speaker receives about 4 percent more citations (5 percent in the 1970s cohort) to her/his article than would a non-native speaker. Coupled with the evidence in Table 2 that the sentiments in articles written by native speakers are less positive, less certain, and more past oriented, we can also decompose the partial effect of being a native-English speaker on citations into

[23]Testing this idea by including an interaction with an indicator of whether the author had recently published in a particular journal shows, if anything, that an article is better-cited (although not significantly) if s/he has published recently in the journal. This is not consistent with editors publishing relatively inferior papers by authors whom they had published before and supports the findings of Brogaard *et al* (2014).

its indirect effects (through sentiment) and its direct effect, again combining estimates in Tables 2 and 4). The total impact of the lesser positivity, certainty, and present-orientation of native English-speakers is an increase in citations of 0.03 standard deviations, of which half is due to the indirect impact through the sentiments expressed, half to the direct effect. The impacts in 1970s cohort are of similar magnitude.

V. Exits

In this section we further examine the patterns of decline in publication with age (shown in Figures 1a and 1b), 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 examine how prior productivity and style relate to exits from academe in the form of retirement, and, as a placebo test, to death. Unlike in the previous sections, where the units of observation were articles, here they are the scholars whose works were included in the previous analysis.

We collected information on each of the authors in the sample, taking from their CVs information on whether by 2018 (and when) they retired, died, or switched out of a career typical among highly successful scholars.[24] In describing the time paths of publications, we use the 1970s, 1980s and 1990s cohorts, 945 of whose 960 members had available CVs, and of whom 78 percent were in academe in 2018. In describing retiring/dying we concentrate on the 1970s cohort. Of the 359 authors in that group, we found CVs of 346. Of them, in 2018, 56 percent remained in academe, 27 percent had retired, 5 percent had died. In both sets of analyses, we exclude the small percentages of the samples who had left academia before retirement.

A. Slowing Down

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

$$(4) \qquad A_d = \Sigma b_{1,d-t} A_{d-t} + \Sigma\, b_{2,d-t} CIT^*_{d-t} + \Sigma\Sigma b_{3,d-t} z^*_{i,j}\ ,\ j=1,2,3,$$

[24]In our empirical work we ignore the small fraction of scholars who switched into academic administration after a successful publishing career—less than 4 percent of the 1970s cohort—although Goodall (2010) suggests that their publishing success is productive in their administrative roles.

where A is the number of articles published in decade d (d=10-19, 20-29, etc.), and t is the length of the lag (in decades). CIT^* is the average adjusted citations to the person's three most recent articles before decade d, the $z^*_{i,j}$ are the average sentiment scores in the person's three most recent articles before decade d, and the b are parameters to be estimated.[25] We also re-estimate (4) replacing the z^* by the z^{*2}.

Table 5 shows OLS estimates of (4) for first-order autoregressions only, since higher-order terms in full versions add little to the explanatory powers of the models.[26] (We present estimates of the fully-specified models in Appendix Table C1.) The odd-numbered columns include the vector of the $z^*_{i,j}$, the even-numbered columns include the vector of the $z^{*2}_{i,j}$. The samples are restricted to those members of the Ph.D.-age cohorts who remained in academe as of 2018—who had not retired, died, or switched occupations by then.[27] For the vectors of sentiment scores, we present the p-value of the F-statistic jointly testing the constraint that all three sentiment scores, computed as the averages of the most recent three articles' scores, have no impact on the outcomes. In each equation we also include the *JEL* group of an author's most recent publication and the year each author's Ph.D. was received.[28]

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 well-known tapering off of top-level scholarly publication with experience (and after tenure). Citations matter too: 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. With CITES* averaging only 93 for

[25] Because we averaged CITES* over three articles, and because we could not obtain citations for a small part of the sample, the sub-sample used in estimating (4) is reduced.

[26]The correct Poisson estimates of these equations imply the same conclusions as the OLS estimates in Table 5.

[27]We impose this restriction because those who are dead, most of those who are retired, and even many of those who have left academia, face different publishing incentives than those who remain academics. In any case, of the original sample 79 percent are included in the estimates in Columns (1) and (2), 71 percent in Columns (3) and (4), and 56 percent in Columns (5) and (6).

[28]Because the fractions of women in the samples of authors with 20+ years of experience are so tiny, we do not include a gender indicator in the estimates in Table 5. Re-estimating all the equations excluding the few women changes no parameter estimate by more than one in the second significant digit.

articles published by authors in this sample in their first decade, the impact of better-cited work on subsequent output, although statistically significant, is small, with additional publications in the second decade equaling 0.06 standard deviations of $A_{10\text{-}19}$ in response to a two standard-deviation increase in average citations to articles from the first decade. At the extreme of $CIT^*_{d\text{-}1}$, 1,747, the implied increase in second-decade output is substantial, however, 0.80 standard deviations of $A_{10\text{-}19}$ compared to the average.

The F-statistics testing the joint significance of the estimates of the impacts of the z^{*2} in Column (2) show that these average sentiment scores have no significant effect on publication rates in scholars' second decade. The F-statistic on the estimates in Column (1), however, shows that the direction of style—its positivity, certainty, and temporal orientation—does have significant impacts on subsequent output, with increases in positivity and decreases in certainty significantly related to subsequent publication. Two standard-error increases in positivity and contemporaneity coupled with a similar decrease in certainty are associated with a 0.39 standard-deviation increase in articles in the second decade. As with citations early in the career, style matters; and the nature of the style variables suggests that these impacts may be interpreted as causal.[29] 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.

The estimates in Columns (3)-(6) of Table 5 show that neither citations nor style in the second or third decades of publishing are related to the quantity of subsequent top-level publications (in the third, or fourth and fifth decades).[30] All that matters 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

[29]Neither 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 increases because of the sample restriction, but still remains smaller than those shown in Columns (3)-(6).

[30]The vectors of indicators of the *JEL* group of the most recent publication in decade d-1 are never statistically significant.

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.

Given the tremendous growth of co-authorship in economics, perhaps co-authorship 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 6 the number of authors on the person's final paper in decade d-1. These additions produce only minute changes in the estimated autoregressive parameters. Moreover, the impact of recent additional coauthors on subsequent numbers of publications was negative, although never anywhere nearly statistically significant. The few very senior economists who maintain a top-level publication record do not do so by attaching themselves to coauthors.

We specified equation (4) so that the autoregressive parameters do not vary with A_{d-1}. To test this assumption, in additional estimates we replaced 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 publications, with zero to two publications as the base group). The estimates describing publication in the second decade of a career, which were shown in Columns (1) and (2) of Table 5, 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.[31] Scholars who are only moderately successful (by the high standards for inclusion in this sample) early on fade, while stars early in their careers become superstars. Regardless, as the re-specifications of the models in Columns (3)-(6) show, even superstars fade; and the estimated parameters on the indicators included in these re-specifications for publications in the third

[31]This re-specification does not alter the conclusions that citations to articles published in the first decade of a career are positively related to those in the second decade, nor that the style of articles published in the first decade also matters. These results 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.

decade or beyond show that the autoregressive parameters in Columns (3)-(6) are not functions of A_{d-1}—that the linear models presented in the Table describe the data well.

B. Stopping

How do a relative lack of recent publishing success, the attention paid to recent research, and its style induce distinguished senior scholars to retire from academe? We restrict the analysis to members of the 1970s cohort, since most authors from later cohorts were too young to have been contemplating retirement before 2018. Because mandatory retirement does affect academics' choices about retiring (see Ashenfelter and Card, 2002), although not those of Americans in this cohort, but perhaps those elsewhere, we collected information on whether and when a scholar would at least nominally have been subject to such a rule, creating an indicator variable for it. We estimate probits on whether the person had retired by 2018, including A_{20-29}, average CITES* to the three most recent publications before Ph.D. age of 30, vectors of style measures (the z^*_{iaj} or z^{*2}_{iaj}), and the *JEL* group of the most recent article before that age, including in the sample all those who remained in academe or were retired in 2018 (N = 281 with complete information).

The estimates are presented in Columns (1) and (2) of Table 6. (As with the descriptions of slowing down, shown in Appendix Table C1, Appendix Table C2 shows that additional lags in A had small effects on the probability of retirement and were not statistically significant.) Regardless of which vector of style measures, the z^* the 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 36 percent of authors who published no top-level papers in their third decade to those who published four papers then (the 91st percentile in this cohort), the former are 17 percentage points more likely to have retired by 2018 (on a mean retirement probability of 0.32).[32] Moreover, replacing the continuous measure of recent publications with a set of indicators of the number of publications

[32]In some specifications we added a vector of indicators of the year when a member of this cohort received her/his Ph.D. The estimates were nearly identical to those shown in Table 6, Columns (1) and (2).

demonstrates that the negative effect of additional publication on the probability of retirement is essentially linear in $A_{20\text{-}29}$.

If a scholar's recent article is 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 from these estimates is that what matters for retirement is the quantity of top-level output. Since retirement is the scholar's own choice (although we recognize that demand-side effects, for example, in the form of offers of "golden handshakes," might also affect retirement decisions), this result suggests that the inability to or disinterest in publishing at the very highest level of scholarship makes previously highly successful scholars more likely to end their careers.[33]

We can enlarge the sample to 392 observations by adding scholars from the 1960s cohort (Ph.D. 1959-1968) to the estimates and re-estimating the model (adding an indicator of the decade when the Ph.D. was received). The impact of $A_{20\text{-}29}$, 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 result 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 a usual retirement age.

The estimates might simply be an artifact reflecting that the scholars who did retire are different from others in ways that we cannot measure, but that are correlated with recent success in publishing. 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 usable observations). In Columns (3) and (4) of Table 6 we show the estimates of what might be

[33]Their 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 articles in total more than three years after their retirement date (compared to a total of 775 articles that these retirees had produced before then).

viewed as a placebo test of the model describing retirement. 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 $A_{20\text{-}29}$ if those who died were relatively unhealthy and perhaps hence less productive during their third decade.[34] These differences suggest that the results on retirement do not arise from correlations of unobservables with both the incidence of retirement and recent publication success.[35]

VI. Conclusions and Speculations

Using analyses of textual styles of 50 years of economics research papers in five major journals, coupled with information on the articles' subsequent citations and their authors' demographic characteristics, particularly their age, we have shown that departures of writing style from contemporaneous norms within a sub-field generate less scholarly attention to an article. These deviations increase with authors' ages, contributing a small part of the decline in attention to articles that are produced by older authors, that we also document. The rate of slowdown in publishing with age is a linear function of an author's prior productivity, but the rate of slowdown in mid-career is greater if an author's prior work has been less well-cited. Having produced less top-flight research late in a career induces scholars to choose to retire earlier.

We stress that all our conclusions are based on a sample of the very top researchers in economics, and that we cannot infer from this selected sample whether similar changes with age occur in the careers of less successful Ph.D. economists in the same cohorts. With that caveat in mind, we have documented one

[34]We 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 6.

[35]We can also interpret these results as a direct test of "publish or perish." In this sample the estimates suggest that these are not alternatives.

source of the diminution of top-flight scholarly activity with age—the decreasingly warm reception paid by other scholars, due in small part to changes in the style of writing as an author ages. But other than randomness, the main apparent cause 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, flight to administrative roles or other alternative paths, or some other factor or combination of factors.

The various findings suggest a variety of 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 burdens, 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? Is it a desire for uninterrupted leisure, including the complementarity of non-work time and substantial retirement pay; embarrassment at being unable to keep up with the publication success and interest/enthusiasm of younger colleagues; financial bonuses that induce retirement, or health concerns (one's own, or a family member's)? 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 the construction of 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 indeed.[36]

[36]For example, in the hydroelectric power industry (Keyser and Tegen, 2019) 26 percent of the workforce is least age 55, posing concerns about recruitment and the transfer of industry-specific knowledge.

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.

Pierre Azoulay, Joshua Graff Zivin, and Jialan Wang, "Superstar Extinction," *Quarterly Journal of Economics,* 125 (May 2010): 549-89.

Scott Baker, Nicholas Bloom, and Steven Davis, "Economic Policy Uncertainty," *Quarterly Journal of Economics,* 131 (Nov. 2016): 1593-1636.

Rebecca Blank, "The Effects of Double-Blind versus Single-Blind Reviewing: Experimental Evidence from the *American Economic Review*," *American Economic Review,* 81 (Dec. 1991): 1041-67.

George Borjas and Kirk Doran, "Prizes and Productivity: How Winning the Fields Medal Affects Scientific Output Prizes and Productivity," *Journal of Human Resources,* 50 (Summer 2015): 728-58.

Jonathan Brogaard, Joseph Engelberg, and Christopher Parsons, "Networks and Productivity: Causal Evidence from Editor Rotations," *Journal of Finance,* 111 (Jan. 2014): 251-70.

Daniele Checchi, Alberto Ciolfi, Gianni De Fraja, Irene Mazzotta, and Stefano Verzillo, "Have You Read This? An Empirical Comparison of the British REF Peer Review and the Italian VQR Bibliometric Algorithm," *Economica,* 88 (Oct. 2021): 1107-29.

Tom Coupé, Valerie Smeets, and Frédéric Warzynski, "Incentives, Sorting, and Productivity long the Career: Evidence from a Sample of Top Economists," *Journal of Law, Economics and Organization,* 22 (April 2006): 137-67.

Arthur Diamond, "What Is a Citation Worth," *Journal of Human Resources,* 21 (Spring 1986): 200-15.

Jan Feld, Corinna Lines, and Libby Ross, "Writing Matters," Unpublished paper, Victoria University of Wellington, March 2022.

Matthew Gentzkow, Bryan Kelly, and Matt Taddy, "Text as Data," *Journal of Economic Literature,* 57 (Sept. 2019): 535-74.

Nils Goldschmidt and Benedikt Szmrecsanyi, "What Do Economists Talk About? A Linguistic Analysis of Published Writing in Economic Journals," *American Journal of Economics and Sociology,* 66 (April 2007): 335-78.

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.

----------, George Johnson, and Burton Weisbrod, "Scholarship, Citations, and Salaries: Economic Rewards in Economics," *Southern Economic Journal,* 49 (Oct. 1982): 472-81.

---------- and Sharon Oster, "Aging and Productivity among Economists," *Review of Economics and Statistics*, 80 (Feb. 1998): 154-6.

---------- and Gerard Pfann, "Reputation and Earnings: The Roles of Quantity and Quality in Academe," *Economic Inquiry*, 50 (Jan. 2012): 1-16.

James Heckman and Sidharth Moktan, "Publishing and Promotion in Economics: The Tyranny of the `Top 5'," *Journal of Economic Literature* 58 (June 2020): 419-70.

Alphonse G. Holtmann and Alan Bayer, "Determinants of Professional Income among Recent Recipients of Natural Science Doctorates," *Journal of Business*, 43 (Oct. 1970): 410-18.

Cornelius Houk, "Statistical Analysis of Genesis Sources," *Journal for the Study of the Old Testament*, 27 (Sept. 2002): 75-99.

Anthony Kenny, *A Stylometric Study of the New Testament*. New York: Oxford University Press, 1986.

David Keyser and Suzanne Tegen, "Workforce Development for U.S. Hydropower: Key Trends and Findings," U.S. Office of Energy Efficiency and Renewable Energy. Washington: 2019.

Lea-Rachel Kosnik, "Who Are the More Dismal Economists? Gender and Language in Academic Economics Research," American Economic Association, *Papers and Proceedings*, 112 (May 2022a): 592-6.

----------, "More Evidence on Gender and Language in Academic Economics Research," Unpublished Paper, University of Missouri—St. Louis, 2022b.

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.

Stephan Ludwig, Ko de Ruyter, Mike Friedman, Elisabet Brüggen, Martin Wetzels, and Gerard Pfann, "More than Words; The Influence of Affective Content and Linguistic Style Matches in Online Review on Conversion Rates," *Journal of Marketing*, 77 (Jan. 2013): 87-103.

Colin Martindale, *The Clockwork Muse: The Predictability of Artistic Change*. New York: Basic Books, 1990.

Deirdre McClosky, *The Rhetoric of Economics*. Madison: Univ. of Wisconsin Press, 1998.

Robert Merton, "The Matthew Effect in Science," *Science*, 159 (Jan. 5, 1968).

Frederick Mosteller and David Wallace, "Inference in an Authorship Problem," *Journal of the American Statistical Association*, 58 (June 1963): 275-309.

William Olney, "English Proficiency and Labor Market Performance: Evidence from the Economics Profession," *Economic Inquiry*, 55 (Jan. 2017): 202-22.

Andrew Oswald, "An Examination of the Reliability of Prestigious Scholarly Journals: Evidence and Implications for Decision-Makers," *Economica,* 74 (Feb. 2007): 21-31.

James Pennebaker and Lori Stone, "Words of Wisdom: Language Use over the Life Span," *Journal of Personality and Social Psychology*, 85 (2003): 291-301.

----------, Ryan Boyd, Kayla Jordan, and Kate Blackburn, *The Development and Psychometric Properties of LIWC2015*. Austin, TX: University of Texas at Austin, 2015.

Charles Scott and John Siegfried, "American Economic Association Universal Academic Questionnaire Summary Statistics," American Economic Association, *Papers and Proceedings*, 102 (May 2012): 631–4.

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

Table 1. Descriptive Statistics of the Sample of Articles, Authors, and Sentiments.

Articles (N=9,280)

JEL Group:	**%**	**Decade**	**%**	**Pages—Mean (s.d.)**
Theory and methodology	22.1	1969-78	16.7	11.92 (6.80)
Microeconomics, industrial organization	25.9	1979-88	22.7	14.41 (6.62)
Macroeconomics, international, financial	25.6	1989-98	19.4	19.80 (7.84)
Public, health/education, labor	15.3	1999-2008	21.0	25.79 (8.96)
Other	11.1	2009-18	20.2	34.70 (11.02)
	100.0		100.0	

Authors

	Entire sample (N=1,389)	**1969-1978 cohort (N=359)**
	%	**%**
N articles: 5	24.2	22.6
6-9	43.7	38.2
10-19	26.6	32.6
20+	5.5	6.6
	100.0	100.0

Sentiment –Mean (s.d.) Articles (N=9,280)

	Raw	**Deviation**	**Deviation^2**
POSN	-0.228 (0.188)	0.004 (0.184)	0.034 (0.048)
CERT	-0.357 (0.171)	-0.006 (0.169)	0.029 (0.051)
CONP	0.725 (0.133)	0.0002 (0.129)	0.017 (0.047)

Table 2. Relationship of Relative Style to Ph.D. Age[a]

	Entire sample, 12,814 articles, 1,389 authors			1970s Cohort, 3,562 articles, 359 authors		
Dep. Var./100 :	*POSN*	*CERT*	*CONP*	*POSN*	*CERT*	*CONP*
Years past Ph.D.	0.1010	-0.0087	-0.0529	0.0527	-0.0451	-0.0240
	(0.0288)	(0.0262)	(0.0277)	(0.0452)	(0.0422)	(0.0345)
English native	-2.3194	-4.2874	-2.5002	-4.5685	-7.1520	-3.7228
	(0.6075)	(5.5138)	(0.4623)	(1.2604)	(1.0866)	(0.6888)
R^2	0.016	0.028	0.055	0.036	0.044	0.079
			Author fixed effects[b]			
Years past Ph.D.	0.1408	-0.0492	-0.0661	0.0291	-0.0234	-0.0308
	(0.0580)	(0.0524)	(0.0353)	(0.0380)	(0.0351)	(0.0228)
R^2	0.286	0.307	0.459	0.299	0.294	0.447
			Mean (s.d.)			
Years past Ph.D.		12.98			12.91	
		(9.48)			(10.28)	

[a]Standard errors in parentheses, clustered on authors. Additional covariates included are *AER*-equivalent page count and indicators of decade of publication, journal, JEL group, native English-speaker, and gender. Decade of publication is excluded from the estimates for the 1970s cohort.

[b]Excludes indicators of gender and English-speaker.

Table 3. Relationship of Squared Style Deviation to Ph.D. Age[a]

	Entire sample, 12,814 articles, 1,389 authors			1970s Cohort, 3,562 articles, 359 authors		
Dep. Var.:	$POSN^2$	$CERT^2$	$CONP^2$	$POSN^2$	$CERT^2$	$CONP^2$
Years past Ph.D./100	-0.0051	0.0032	0.0241	0.0421	0.0462	0.0410
	(0.0066)	(0.0063)	(0.0100)	(0.0114)	(0.0113)	(0.0171)
English native	-0.0634	-0.5418	0.4446	-0.7365	-0.8551	0.6864
	(0.1387)	(0.1368)	(0.1104)	(0.3313)	(0.2973)	(0.1799)
R^2	0.014	0.020	0.030	0.026	0.033	0.049
			Author fixed effects[b]			
Years past Ph.D./100	0.0239	0.0670	0.0309	0.0288	0.0482	0.0383
	(0.0162)	(0.0169)	(0.0143)	(0.0109)	(0.0126)	(0.0086)
R^2	0.193	0.203	0.315	0.212	0.204	0.325

[a]Standard errors in parentheses, clustered on authors. Additional covariates included are *AER*-equivalent page count and indicators of decade of publication, journal, JEL group, native English-speaker, and gender. Decade of publication is excluded from the estimates for the 1970s cohort.

[b]Excludes indicators of gender and English-speaker.

Table. 4. Relationship of Citations to Relative Style and Ph.D. Age, LAD Estimates[a]

	Entire sample 12,740 articles, 1,389 authors		1970s cohort, 3,531 articles, 359 authors[b]	
POSN	-11.52	-12.05	1.04	-0.21
	(4.63)	(3.17)	(7.56)	(7.29)
CERT	-25.37	-26.14	-20.73	-24.31
	(4.71)	(4.70)	(7.06)	(7.91)
CONP	-26.96	-27.87	-7.00	-8.29
	(10.03)	(10.12)	(13.41)	(14.20)
Ph.D. Age at Publication	-0.62	-1.15	-0.45	4.31
	(0.12)	(0.29)	(0.23)	(0.55)
Ph.D. Age^2	--------	0.014	-------	-0.14
		(0.007)		(0.02)
English Native	5.65	4.76	7.89	6.28
	(2.73)	(2.79)	(3.46)	(3.69)
Pseudo-R^2	0.046	0.046	0.016	0.026

Table 4, cont.

$POSN^2$	35.02	34.61	35.10	8.88
	(20.98)	(20.76)	(21.07)	(23.24)
$CERT^2$	-12.23	-9.99	4.88	2.68
	(9.93)	(10.76)	(9.69)	(8.98)
$CONP^2$	-46.83	-49.32	-18.21	-10.84
	(27.80)	(28.23)	(20.95)	(23.12)
Ph.D. Age at 48 Publication	-0.65	-1.02	-0.48	4.29
	(0.13)	(0.30)	(0.24)	(0.54)
Ph.D. Age^2	--------	0.009	-------	-0.14
		(0.007)		(0.02)
English Native	7.74	7.64	10.13	9.14
	(2.74)	(2.79)	(3.27)	(3.68)
Pseudo-R^2	0.044	0.044	0.016	0.025
CITES* : Mean		199.44		170.20
(s.d.)		(613.30)		(520.27)

Table 5. First-order Autoregressions of Decadal Publications[a]

Ind. Var.:	Decade:	2nd[b]		3rd[c]		4th or 5th[d]	
A_{d-1}		0.317	0.317	0.530	0.526	0.599	0.606
		(0.037)	(0.037)	(0.035)	(0.034)	(0.055)	(0.056)
$(CIT_{d-1})/100$		0.053	0.047	0.021	0.018	0.049	0.003
		(0.024)	(0.024)	(0.021)	0.020)	(0.071)	(0.071)
$(z_{ija})_{d-1}$ vector		0.02		0.51		0.09	
$(z_{ija})^2_{d-1}$ vector			0.41		0.32		0.32
(p-value of F(3, N-K))							
R^2		0.160	0.151	0.400	0.402	0.514	0.506
N		715	715	470	470	202	202

[a]Includes indicators for individual year of Ph.D. and JEL group of final article in previous decade.
[b]All authors with Ph.D. year<1999, >1968, who remained in academia.
[c]All authors with Ph.D. year<1989, >1968, who remained in academia.
[d]All authors with Ph.D. year<1979, >1968, who remained in academia.

Table 6. Determinants of the Probability of Exiting Academia After 30+ Years[a]

	Retire[b]		Die[b]	
$A_{20\text{-}29}$	-0.043	-0.045	-0.014	-0.015
	(0.018)	(0.018)	(0.010)	(0.010)
$(CITES^*_{20\text{-}29})/100$	-0.028	-0.028	-0.013	-0.011
	(0.020)	(0.020)	(0.013)	(0.012)
Subject to mandatory retirement	0.261	0.260	0.048	0.043
	(0.090)	(0.089)	(0.073)	(0.071)
$(z_{ija})_{d\text{-}1}$ vector	0.96		0.87	
$(z_{ija})^2_{d\text{-}1}$ vector		0.43		0.52
(p-value of F(3, N-K))				
Pseudo-R^2	0.079	0.086	0.054	0.068
N	281	281	204	204

[a]Probit derivatives, including indicators for *JEL* group.
[b]Ph.D. year 1969-78, in academia for 30+ years.

Table A1. Examples of Positive and Negative Words in Text

Positive	Negative
optimal	low
satisfy*	bad
good	lack of
efficien*	without
incentive	cannot
consistent	negative
no doubt	work
perfect	poor
unique	no information
improve*	reject*

Table A.2. Examples of Certain and Tentative Words in Text

Certainty	Tentativeness
always	almost
clearly	depending
correct	doubtfully
definitely	generally
every time	might
invariably	sometimes
irrefutably	sort of
truly	suppose
undeniably	unclear
wholly	vaguely

Table A3. Examples of Contemporary and Past Verbs in Text

Contemporary	Past
admit	admitted
arrives	arrived
follows	followed
happens	happened
manage	managed
knows	knew
ranks	ranked
sees	saw
trusts	Trusted
wants	Wanted

Table B1. Journal Style Scores, Adj. for JEL Code and Year, 1969-2018, N = 9,280[a]

	POSN	*CERT*	*CONP*
AER	-------	-------	-------
ETRCA	0.0439	0.0369	0.0565
	(0.0059)	(0.0054)	(0.0040)
JPE	0.0073	0.0094	0.0013
	(0.0060)	(0.0055)	(0.0041)
QJE	0.0043	-0.0136	0.0056
	(0.0061)	(0.0056)	(0.0042)
REStud	0.0448	0.0414	0.0629
	(0.0061)	(0.0056)	(0.0042)
R^2	0.017	0.018	0.047
Range	[-1, 0.45]	[-1, 1]	[-0.529, 1]

[a]Includes indicators for individual years and main *JEL* codes.

Table B2. Correlation Matrices of Journal Style Scores Adjusted for JEL Code and Year, 1969-2018

Sample Period and Size

	1969-2018, N = 12,814			**1969-78 Cohort, N = 3,531**	
	CERT	*CONP*		*CERT*	*CONP*
POSN	0.087	0.128	*POSN*	0.069	0.056
CERT	-------	0.122	*CERT*	-------	0.051

	$CERT^2$	$CONP^2$		$CERT^2$	$CONP^2$
$POSN^2$	0.069	0.057	$POSN^2$	0.064	0.058
$CERT^2$	-------	0.051	$CERT^2$	-------	0.001

Table C1. N^{th}-order Autoregressions of Decadal Publications[a]

Ind. Var:	Decade:	3rd[b]		4th or 5th[c]	
A_{d-1}		0.506	0.508	0.450	0.478
		(0.037)	(0.036)	(0.061)	(0.058)
A_{d-2}		0.053	0.046	0.096	0.114
		(0.033)	(0.032)	(0.053)	(0.051)
A_{d-3}				0.066	0.081
				(0.042)	(0.039)
$(CIT_{d-1})/100$		0.040	0.038	0.055	0.021
		(0.023)	(0.023)	(0.065)	(0.062)
$(CIT_{d-2})/100$		-0.029	-0.030	-0.011	-0.021
		(0.023)	(0.023)	(0.027)	(0.027)
$(CIT_{d-3})/100$				0.039	0.042
				(0.033)	(0.030)
$(z_{ija})_{d-1}$ vector		0.31			
$(z_{ija}^2)_{d-1}$ vector			0.27		
(p-value of F(6, N-K))					
$(z_{ija})_{d-1}$ vector				0.83	
$(z_{ija}^2)_{d-1}$ vector					0.08
(p-value of F(9, N-K))					
R^2		0.417	0.417	0.505	0.535
N		453	453	189	189

[a]Includes indicators for individual year of Ph.D. and JEL group of final article in previous decade.
[b]All authors with Ph.D. year 1969-88 who remained in academia.
[c]All authors with Ph.D. year 1969-78, who remained in academia.

Table C2. Longer Lags in the Determinants of Retirement or Death After 30+Years in Academia[a]

Ind. Var.:	**Retire[b]**		**Die[b]**	
A_{20-29}	-0.038	-0.040	-0.018	-0.016
	(0.024)	(0.023)	(0.008)	(0.009)
A_{10-19}	-0.010	-0.009	-0.001	-0.004
	(0.016)	(0.016)	0.004)	(0.005)
A_{0-9}	-0.001	0.002	-0.003	-0.005
	(0.013)	(0.013)	(0.004)	(0.004)
(Average CITES*$_{20-29}$)/100	-0.018	-0.033	-0.002	-0.004
	(0.022)	(0.022)	(0.007)	(0.007)
(Average CITES*$_{10-19}$)/100	-0.001	0.003	0.0002	0.0004
	(0.010)	(0.009)	(0.003)	(0.004)
(Average CITES*$_{0-9}$)/100	-0.010	-0.007	-0.002	0.0002
	(0.012)	(0.012)	(0.003)	(0.003)
Mandatory retirement	0.251	0.228	0.006	0.009
	(0.098)	(0.096)	(0.036)	(0.037)
$(z_{ija})_{d-t}$ vectors	0.53		0.36	
$(z_{ija}^2)_{d-t}$ vectors		0.50		0.39
(p-value of F(9, N-K))				
Pseudo-R^2	0.098	0.100	0.218	0.223
N	262	262	190	190

[a]Probit derivatives, including indicators for *JEL* group.
[b]Ph.D. year 1969-78, in academia for 30+ years.

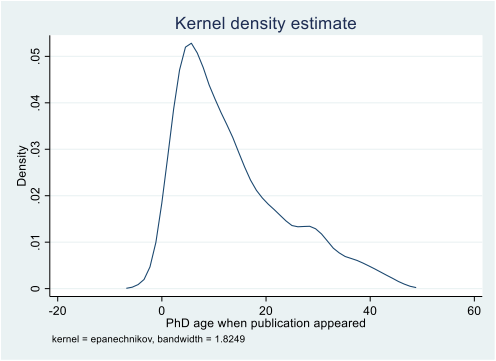

Figure 1a. Kernel Density Estimate of the Distribution of Authors' Ph.D. Ages, Star Authors "Top 5" Journals, 1969-2018.

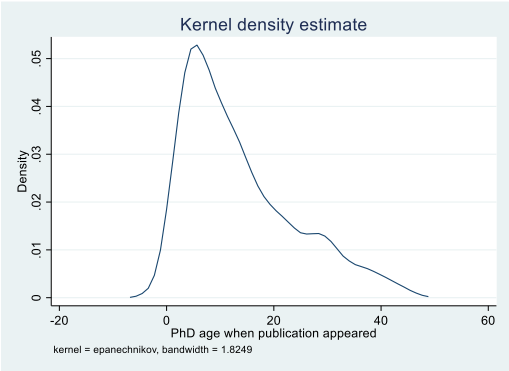

Figure 1b. Kernel Density Estimate of the Distribution of Authors' Ph.D. Ages, Star Authors 1969-78 Cohort, "Top 5" Journals, 1969-2018.

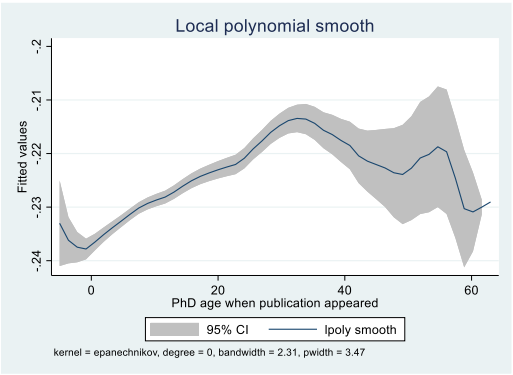

Figure 2a. Local Polynomial Smoothed Relation of Adjusted +/- Sentiment to Ph.D. Age, "Top 5" Journals, 1969-2018 (N = 12,814)

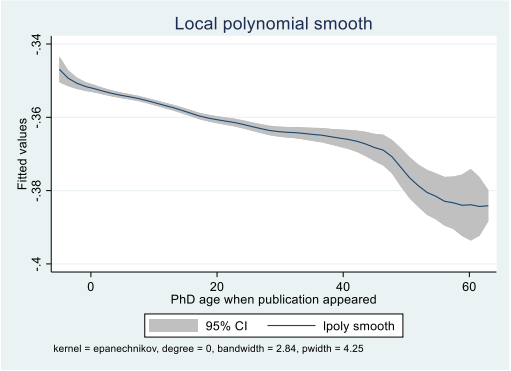

Figure 2b. Local Polynomial Smoothed Relation of Adjusted Certainty to Ph.D. Age, "Top 5" Journals, 1969-2018 (N = 12,814)

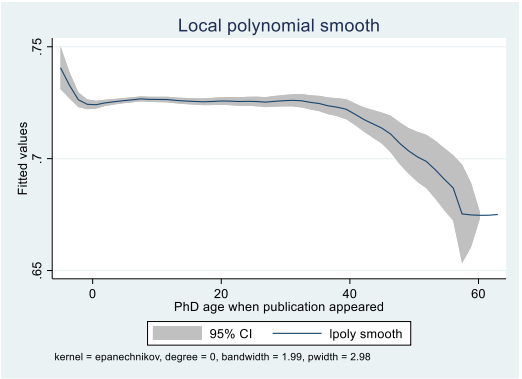

Figure 2c. Local Polynomial Smoothed Relation of Adjusted Present Orientation to Ph.D. Age, "Top 5" Journals, 1969-2018 (N = 12,814)

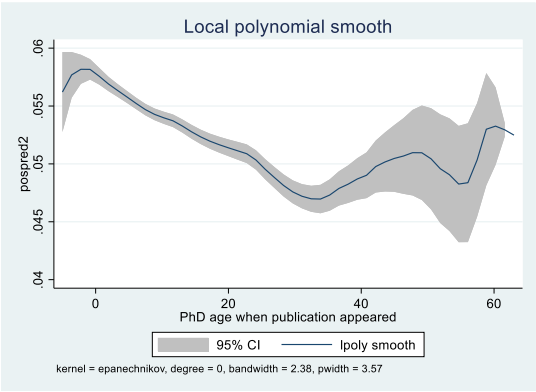

Figure 3a. Local Polynomial Smoothed Relation of Squared Adjusted +/- Sentiment to Ph.D. Age, "Top 5" Journals, 1969-2018 (N = 12,814)

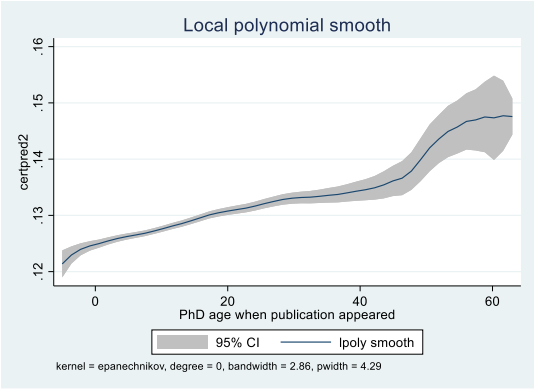

Figure 3b. Local Polynomial Smoothed Relation of Squared Adjusted Certainty Sentiment to Ph.D. Age, "Top 5" Journals, 1969-2018 (N = 12,814)

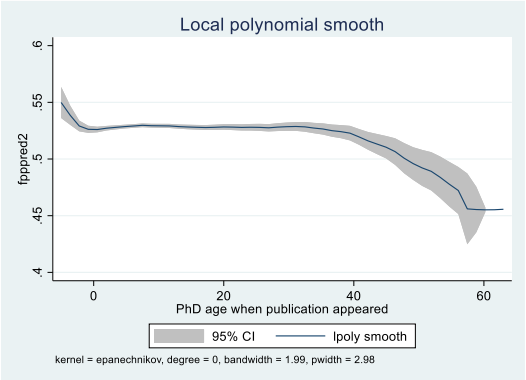

Figure 3c. Local Polynomial Smoothed Relation of Squared Adjusted Present Orientation to Ph.D. Age, "Top 5" Journals, 1969-2018 (N = 12,814)

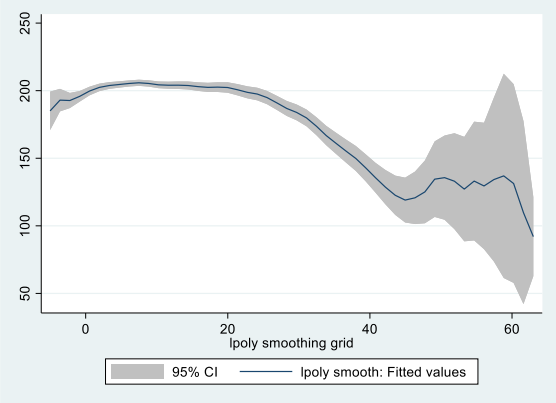

Figure 4a. Local Polynomial Smoothed Relation of Adjusted Citations (for Year of Publication and Citations Measure) to Ph.D. Age, "Top 5" Journals, 1969-2018 (N = 12,740)

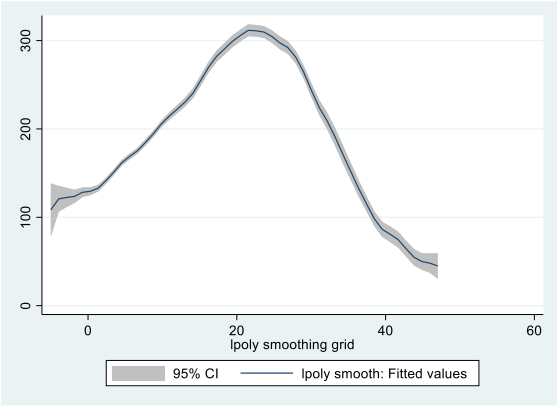

Figure 4b. Local Polynomial Smoothed Relation of Adjusted (for Year of Publication and Citations Measure) Citations to Ph.D. Age, 1969-78 Cohort, "Top 5" Journals, 1969-2018 (N = 3,531)