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AGING AND PRODUCTIVITY,
RATIONALITY AND MATCHING:
EVIDENCE FROM ECONOMISTS

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ABSTRACT

Economists' productivity, as measured by publication in leading journals, declines very sharply with age. Additional evidence shows that this is a rational response to economic incentives and/or changing physical or mental abilities: There is no difference by age in the probability that an article submitted to a leading journal will be accepted. The probability of acceptance does show increasing heterogeneity with age that is related to the author's quality, consistent with models of optimal investment in human capital and especially with occupational matching models.

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Wages peak well before retirement. The usual explanation of the wage drop late in the work life is that productivity eventually declines because falling returns on marginal investments in human capital with age generate decreases in the optimal amount of investment. A noneconomist might admit that this is correct, but would also note that another plausible cause is that people eventually become physically and/or mentally less productive and less capable of learning new skills. In this note I use some unusual data to document the decline in productivity with age and to examine its causes.

I. Age and Publication among Economists

There is substantial evidence that economists' incentives to publish diminish with age. The additional lifetime earnings generated by an extra article decrease at each age and diminish as the horizon becomes shorter. Tuckman and Leahey (1975) estimate that the marginal payoff for economists in their fifties may be one-tenth that for economists in their late twenties, and Sauer (1988) demonstrates that this remains true accounting for the quality of publications and their impact on other scholars. There is no direct evidence that physical/mental deterioration occurs in this group, but there is some evidence for the population generally (Lydall, 1968, pp. 113 passim.)

Lehman (1953) demonstrates the early peak in productivity in a variety of endeavors, and Diamond (1986) documents the pattern for several scholarly pursuits. The first row in each pair of years in Table 1 presents a similar exercise for economists, showing the ages of authors of full-length

refereed articles in leading journals (the American Economic Review, Journal of Political Economy and Quarterly Journal of Economics).¹ The median age of authors in the 1980s and 1990s was 36. Scholars over age 50 when their studies are published are a minute fraction of all authors in these journals. Creative economics at the highest levels is clearly a young person's game.²

That is as true in the 1990s as it was in the 1960s, though the age distribution of authors does seem to have shifted rightward slightly in the late 1970s. This may have occurred because the age when people write their Ph.D. dissertations, thus effectively entering full-time scholarly research, increased sharply during the 1970s due to later matriculation and longer duration of graduate education (Ehrenberg, 1991).

The second row in each pair in Table 1 shows the age distributions of random samples of the membership of the American Economic Association in years near those for which the authors' ages were tabulated.³ The distributions are heavily concentrated between 36 and 50. Decadal variations reflect rapid expansion of American universities in the middle and late 1960s, stagnation in the 1970s and much of the 1980s, and a possible fragmentation of the profession in the 1980s as specialized associations expanded. A substantial percentage of AEA members is over age 50, implying that older economists are greatly underrepresented among authors in major journals relative to their presence among those who view themselves as part of the economics profession.

II. Rationally Declining Productivity

The outcomes of the publishing process suggest that economists' behavior is quite consistent with incentives, whether these arise from economic considerations facing workers whose abilities do not diminish with age, or from declining inherent capacities. The results are not informative, however, about whether workers are aware of these incentives and/or changed capacities. Information on age and productivity reflects outcomes, not the process that generates them.

One possibility for examining whether the outcomes reflect rational responses by scholars to changing incentives and capacities is to examine people's behavior as they age. That is, do older economists continue trying, albeit with little success, to produce high-quality scholarly research? Or do they instead recognize their diminished capacities and the decreasing economic returns to scholarship and decrease their rate of production, presumably optimally cutting investment in themselves?

To distinguish between these possibilities I obtained data on a random sample of initial submissions to one of the three major journals during a four-month period in 1991. (Some of the data were initially supplied by the journal's office for use in Hamermesh, 1994.) Refereeing at this journal is double-blind, so that the chance that referees (though possibly not the editors) were affected by authors' reputations is reduced. The ages of the authors of these 313 papers are measured in 1993 to make them comparable to the other

data and to account for the probable two-year average lag between submission of a paper and its publication. Information on age is available for over 99 percent of all authors.⁴

The first two rows of Table 2 show that the distribution of submitters at this particular journal has many more older economists than are represented by the data on publications in Table 1. Partly this may be because I cannot separate notes (excluded from Table 1) from full-length articles. Partly too it could just be an unusual random draw. The most important result in Table 2 is in the third row: The acceptance rate is remarkably constant across the three age groups.⁵ On average, there is no decline with age in the acceptance rate of papers submitted to this major journal.⁶

To check that this startling result does not reflect the influence of other measurable effects I estimate a probit on the acceptance probability. In addition to the pair of indicator variables, age less than 36, and age 36 to 50, I also include variables indicating whether the author was a member of the AEA, was in a top 20 department (as listed in Blank, 1991), was not resident in North America, and was female. Also in the probit is an indicator of whether the author was cited by other researchers at least ten times in 1991 (was well-cited), as listed in the Social Science Citation Index. This last is a good proxy for the quality of the author's previous work (and presumably predicts the quality of the submission).

Estimates of the probit in the first column of Table 3 corroborate the results in Table 2. There is no difference in acceptance rates between authors ages 36-50 and those over 50. This is not due to any nonrandomness in submission propensities by age and quality of authors: The oldest authors are as likely to be well-cited as the middle group, which reflects perfectly their relative performance in the population of economists.⁷ The citations variable is strongly and significantly positive. A well-cited author's work has over twice the chance of acceptance as that of someone who is not well-cited.⁸ Other than that only residence outside North America has a significant (negative) effect on acceptance, perhaps a reflection of the authors' relative unfamiliarity with the kind of work the journal publishes.

III. Matching and Heterogeneity

Taken together the results suggest that on average scholars recognize one or both of the possibilities that might reduce the quality or quantity of output as they age. We can learn a bit more about the age-productivity relationship from the following slight modification of Ben-Porath's (1967) model of earnings and investment in human capital. The same point could be made in a model of workers' matching to activities (e.g., Miller, 1984). At each age the worker maximizes:

$$(1) \quad \int_t^T [W_t(1-\phi_t) + \theta_t]e^{-\rho t} dt ,$$

where the gross wage is the return on human capital, $W_t = \rho H_t$, initial human capital $H(0) = H_0$, and

$$\dot{H}_t = \phi_i W_t - \delta_t H_t,$$

where δ_t is the depreciation rate on human capital, T is the expected date of retirement, ϕ is the rate of investment, and θ_i is an individual-specific term with mean zero and some variance. The θ term may reflect innate ability, commitment to research, or any other individual-specific effect that does not vary with age.

It is easy to show that for the average person ($\theta_i = 0$) optimal investment declines as t^* increases and stops at some point, leading to an eventual decline in productivity (and wages). This arises because the horizon is getting shorter and because δ may increase with t . For people with higher θ_i , however, the stopping point for investment is later. Economic incentives continue for better scholars longer than for others, even if agents are identical in all other respects. Thus we should expect the experiences of workers as they age to become more heterogeneous, with successful authors coming increasingly from the population of higher-quality scholars as the truncation of the distribution of θ_i moves further right. Scholars with high θ_i can be viewed as having skills that match well those required for success in this activity.

To examine this possibility interaction terms between the indicator variables for age and the extent of citations were added to the probit. The

estimates are reported in column (2) of Table 3. None of the interactions is significant; but they do show that, compared to the two younger groups, potential authors over age 50 who are not well-cited are very unlikely to have their papers accepted, while those who are well-cited are much more likely to be successful.

The result is shown clearly in Figure 1, which presents acceptance rates for each age group disaggregated by citation status. (A simulation using the probit coefficients yields a similar picture.) Comparing authors age 36-50 to those over 50, it is quite clear that heterogeneity is increasing. This appears to be less true in comparing the oldest to the youngest group, but that inference is due mainly to a very small sample: Only 6 authors under age 36, the future superstars of the profession, were well-cited.

IV. Conclusion

Remarkably few older people publish successfully in major economics journals. That the acceptance rate for submitted articles is invariant with respect to age implies that scholars recognize that incentives diminish as they age and possibly that their capacities also decrease. The evidence of increasing heterogeneity as people age beyond their mid-thirties is consistent with a model of investment in human capital by agents with different inherent abilities whose match to a particular activity — high-quality scholarship -- becomes increasingly apparent with age.

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FOOTNOTES

1. No doubt other journals and non-journal outlets of scholarly work are important. These are, however, the three general journals in North America that have the biggest impact on the profession (Stigler *et al.*, 1992). Included in the table are all full-length articles except Nobel Prize and AEA Presidential addresses. Comments, replies, notes, etc., are also excluded.

2. Despite the documentation of the declining productivity of scholars as they age the fact is apparently not well known among economists. 118 economists were asked (by letter or electronic mail) to give their best estimate of the distribution of authors of full-length articles in major general journals. The means of the 94 responses were 29.5, 47.8 and 22.7 percent for the three age categories listed in Table 1. The 13 respondents who were over age 50 differed only very slightly in their perceptions of the relation of age and publication.

3. These data are based on 1000 randomly selected members of the AEA in the particular year. From each issue of the AEA Handbook (or its successor) the first 200 names listed under the letters A, D, L, R and W were sampled. Throughout I use chronological age rather than years since receipt of the Ph.D., because not all authors have doctorates.

4. Roughly 75 percent of these authors were AEA members in 1989 or 1993, and 70 percent listed their ages. Information on the other 29 percent included in the tables was obtained through telephone calls and letters.

5. Disaggregating into finer age categories, the acceptance rates and numbers of submitters are: Age less than 30, .130 (23); 31-35, .120 (100); 36-40, .115 (104); 41-45, .147 (68); 46-50, .071 (56); 51-55, .100 (30); above 55, .148 (27). The acceptance rates are nowhere nearly significantly different from each other as a group; and the largest t-statistic describing the 21 pairwise differences is only 1.33.

6. A large fraction of the papers were coauthored. If we weight the data by the number of coauthors instead of assigning each author the same weight, the results in this and the next table change only minutely. It is also not the case that successful young authors' work represents Ph.D. theses

or collaborations with senior colleagues. Only 2 papers by the 15 such authors were parts of dissertations; and only 3 of the others were coauthors of papers with senior colleagues.

7. In random samples of 100 AEA members in each group, 15 of those 36-50 were well-cited and 16 of those over 50 were.

8. Of the 408 authors 19 were heavily-cited (50 or more citations in 1991). The coefficient on an additional dummy variable for this group was positive, but the difference between the experience of this group and other well-cited authors was insignificant.

Table 1. Percentage Distributions of Major-Journal Authors and of AEA Members by Age*

Year		Age			Number of authors
		Less than 36	36-50	Over 50	
1963	Authors	51.3	46.0	2.7	111
1964	Members	32.4	41.0	26.6	
1973	Authors	61.4	32.7	5.9	153
1974	Members	43.0	33.4	23.6	
1983	Authors	46.3	50.0	3.7	188
1985	Members	25.2	52.5	22.3	
1993	Authors	46.6	47.4	6.0	234
1993	Members	19.2	51.3	29.5	
All Years	Authors	50.6	44.1	4.8	686
	Members	29.9	44.6	24.5	

*Full-length refereed articles published in the American Economic Review, Journal of Political Economy and Quarterly Journal of Economics. The authors whose ages were identifiable are 96.5 percent of the total in 1963, 99.4 percent in 1973, 98.9 percent in 1983, 100 percent in 1993, and 99.0 over the four decades. The age distributions of the AEA membership are based on random samples of 1000 members each year, taken from the American Economic Association, Directory of Members (Biographical Listing of Members) for 1964, 1974, 1985 and 1993.

Table 2. Distribution of Authors by Response and Author's Age (percentages)*

	Age			TOTAL
	≤35	36-50	>50	
Number of Submissions	123	228	57	408
Percent of Authors	30.1	55.9	14.0	100.0
Acceptance Rate	12.2	11.4	12.3	11.8
Well-cited	4.9	34.2	35.1	25.6

*Excludes 2 authors whose ages could not be discovered, 8 whose papers were still under review, and 3 who withdrew their papers before a referee's report was received.

Table 3. Determinants of the Probability of Acceptance, Submissions in 1991
(N = 408)*

Variable	(1)	(2)
Age ≤35	.281 (.293)	.669 (.466)
Age 36-50	-.023 (.258)	.424 (.466)
≥10 Citations in 1991	.675 (.211)	1.286 (.533)
Under 36 and well-cited		-.667 (.770)
36-50 and well-cited		-.739 (.577)
AEA Member	-.072 (.220)	-.052 (.222)
Top 20 department	.160 (.213)	.158 (.215)
Female	-.010 (.304)	-.034 (.307)
Foreign	-.820 (.425)	-.821 (.428)
Pseudo-R ²	.082	.088

*Probit estimates, standard errors in parentheses.

Figure 1. Probability of Acceptance by Age and Citations

