Creative Careers: The Life Cycles of Nobel Laureates in Economics

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At what stage of their careers are scholars most creative? Even beyond its intellectual challenge, this question has obvious practical significance. If they do not ask it in any other context, most scholars consider it in evaluating appointments and promotions in their own departments, as they try to assess the likely future path of other scholars' research.

In view of the practical importance of the life cycle of scholarly creativity, it is surprising that it has received little systematic study, and virtually none by economists. This may be because many academics think they already understand it. Many economists, for example, appear to believe creativity is the particular domain of the young. One prominent economist, President Lawrence Summers of Harvard University, vetoed offers of tenured professorships to two 54-year-old scholars out of concern for what the university's dean of the faculty called the problem of "extinct volcanoes." In support of Summers, a 35-year-old professor of earth sciences explained that "It's more exciting to be around a place where things are going on now - not a place where people have done important things in the past." (Golden 2002).

There is a systematic relationship between age and scholarly creativity, but it is more complex than many academics appear to assume. By studying the careers of a group of Nobel laureates in economics, we will show that there are two distinct life cycles of scholarly creativity, with peaks at very different stages. The evidence furthermore reveals that which path a scholar follows is related to the nature of his work. This understanding of the life cycles of innovative economists constitutes an important step toward a theory of human creativity in general.

Conceptual and Experimental Innovators

Recent research on the careers of modern painters, poets, and novelists has revealed that there have been two very different types of innovator in each of these activities. (Galenson 2001, 2003, 2004). The basic distinction between the two turns on whether the individual artist works deductively or inductively. Conceptual innovators, who are motivated by the desire to communicate specific ideas or emotions, have precise goals for their works. They often plan them carefully in advance, and execute them systematically. Their innovations appear suddenly, as a new idea produces a result quite different not only from other artists' work, but also from the artist's own previous work. In contrast, the goals of important experimental innovators are ambitious but vague, as they seek to present perceptions that are less precise. The imprecision of their goals leads them to work tentatively, by a process of trial and error. They arrive gradually and incrementally at their major contributions, often over an extended period of time.

The long periods of trial and error often required for important experimental innovations make them tend to occur late in an artist's career. So for example Paul Cézanne, Robert Frost, and Virginia Woolf all arrived at their greatest accomplishments after many years of work. Conceptual innovations are made more quickly, and can occur at any age. Yet the achievement of radical conceptual innovations depends on the ability to perceive and appreciate extreme deviations from existing conventions, and this ability tends to decline with experience, as habits of thought become more firmly established. The most important conceptual innovations consequently tend to occur early in an artist's career. Thus for example, Pablo Picasso, T. S. Eliot, and Herman Melville all made their greatest contributions early in their long lives.

The distinction between deductive and inductive innovators applies equally to economists. Conceptual economists pose precise problems, and solve them deductively. They may do this throughout their careers, but their most general - and consequently most important - innovations tend to come early in their careers, when they are more likely to challenge basic tenets of the discipline that are widely treated as rules by more experienced scholars. In contrast, experimental economists may pose broader questions, which they solve inductively by accumulating evidence that serves as the basis for new generalizations. The more evidence they can analyze, the more powerful their generalizations, so the most important experimental innovations are often the product of long periods of research.

This paper extends the study of the life cycle of creativity to a select group of innovative economists. Based on the analysis presented above the hypothesis to be tested is that economists who have made important conceptual innovations should tend to make their most important contributions earlier in their careers than their counterparts who have made experimental innovations.

Data

We measure the importance of work using citations. Citations were collected from the Web of Science, an on-line database comprising the Social Science Citation Index, the Science Citation Index, and the Arts and Humanities Citation Index.[1] We collected the number of citations to all works in each year of each laureate's career made between 1980 and 1999.[2] Citations measure influence.

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[1] We searched for citations under each Nobel laureate's last name and initials. For laureates who published with their middle initial, we searched for citations with and without the middle initial. To exclude citations to other authors with the same last name and initials, citations were checked against publication lists. The database lists coauthored papers under the lead author's name. Citations to the Modigliani-Miller papers were included in the counts for both laureates.

[2] Collecting citations to individual works would have been prohibitively costly given the number of

The importance of scholars depends primarily on their most important contributions. We focus on the years in which each laureate published their major works. To identify these, we first estimate the mean and standard deviation of each laureate's annual citations. Years with major works were defined as those in which a laureate's citations were 2 standard deviations above his mean.

The laureates vary in terms of the number of citations they received. We use citations to determine when each laureate did his most important work, not to make inter-personal comparisons.

Our theory distinguishes between experimental and conceptual innovators. We classify the laureates as experimental or conceptual based on our understanding of their primary contribution. Our distinction is closely related to whether a laureate's work was empirical or theoretical.

Our data cover Nobel laureate economists born in or before 1926. The 1926 cutoff ensures that both groups of laureates are from the same cohort. (The youngest experimental laureate was born in 1926.) A list of the laureates and their classification is in Table 1.

Laureates are included in our sample from the year they received their doctorate.[3] Table 2 provides summary statistics. The mean age in our sample is 56, with little difference between the experimental and conceptual laureates. The laureate included at the earliest age is Wassily Leontief, who received his doctorate at age 22. The laureate included at the latest age is Theodore Schultz, who is cited for work done at age 95. On average the laureates published major works in 4.8% of years. There is little difference between the experimental and conceptual laureates in the frequency of a major work.

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published works and the number of citations. In virtually all years with high citations, a single work dominates the citations.

[3] Laureates who did not receive doctorates are included from the time of their first cited publication.

Estimation

To estimate how the probability of a major work changes over the life-cycle for both groups of laureates, we estimate the probability that a laureate published a major work in a given year on polynomials in age interacted with whether the laureate was experimental or conceptual. Let *i* index laureates and *t* denote the calendar year. Let Age_{it} denote laureate *i*'s age in year *t*. $Experimental_i$ and $Conceptual_i$ denote dummy variables for laureate *i*'s type. Our dependent variable, $MajorWork_{it}$, is a dummy variable equal to 1 if laureate *i* had citations 2 standard deviations above his mean in year *t* and zero otherwise. Our specification is

$$MajorWork_{it} = \begin{cases} 1 \text{ if } \beta_0 + \beta_1 Experimental_i \cdot Age_{it} + \beta_2 Experimental_i \cdot Age_{it}^{\,2} \\ \quad + \gamma_0 \cdot Conceptual_i + \gamma_1 \cdot Conceptual_i \cdot Age_{it} + \gamma_2 \cdot Conceptual_i \cdot Age_{it}^{\,2} + \varepsilon_{it} \leq 0 \\ 0 \text{ if } \beta_0 + \beta_1 \cdot Experimental_i \cdot Age_{it} + \beta_2 \cdot Experimental_i \cdot Age_{it}^{\,2} \\ \quad + \gamma_0 \cdot Conceptual_i + \gamma_1 \cdot Conceptual_i \cdot Age_{it} + \gamma_2 \cdot Conceptual_i \cdot Age_{it}^{\,2} + \varepsilon_{it} > 0 \end{cases}$$

Assuming that ε_{it} is normally distributed implies a probit structure.

The units of observation for our analysis are laureate-years, with each laureate contributing an observation for each year of his career. We employ quadratics in age because cubic terms are insignificant for both groups.

Results

Table 3 presents the estimates. Figure 1 plots the probability of a major work implied by the model for both groups. Table 4 presents the implied peaks of the profiles.

The profiles for the experimental and conceptual laureates differ markedly. For conceptual laureates, the probability of a major work is 4% in the first year of the career; it rises until age 43, before declining to zero. For experimental laureates, the probability of a major work is zero at the beginning of the career. It increases until age 57, and then declines to zero.

The F-statistic for the equality of the two profiles is 3.929 (the 95% critical value for an F-statistic with 2 and 1634 degrees of freedom is 3). The profile of the experimental laureates peaks 14.9 years later than the conceptual laureates. The t-statistic for the equality of the peaks is 3.214.

Innovation involves viewing a discipline differently than others. Experimental innovations arise from the gradual accumulation of knowledge leading to a new view, so the probability of important contributions increases with age for the experimental laureates. While techniques and exposure to existing ideas are valuable for conceptual innovators, conceptual innovators are more likely to do important work before they have become too accustomed to existing thought patterns. As a consequence the probability that a conceptual laureate does important work declines for much of his career.

Conclusion

The empirical analysis of this paper provides strong support for the proposition that there have been two very different life cycles of creativity for important scholars in economics. As in the arts, conceptual innovators in economics have tended to produce their most important contributions considerably earlier in their careers than their experimental counterparts. It appears that the ability to formulate and solve problems deductively declines earlier in the life cycle than the ability to innovate inductively. As scholars age, they accumulate knowledge related to their fields of study, and become increasingly accustomed to particular habits of thought about their disciplines. Both of these effects may increase the creativity of inductive scholars, since the power of their generalizations will tend to be greater as the evidence on which they are based increases. As experimental scholars age their efficiency in analyzing and accumulating useful information may increase, and the empirical base for their research may consequently grow at an increasing rate over extended periods. In contrast, both the accumulation of knowledge and the establishment of fixed habits of though may interfere with the ability to create radical new abstract ideations that is key to important conceptual innovations. This difference in the impact of experience on the two different types of innovator may explain why some great scholars are most creative early in their careers, and others late.

Although some academics appear to believe that creativity is exclusively associated with youth, others understand that there are two different life cycles of creativity, and that which a scholar follows is related to his approach to his discipline. When Harvard's president vetoed job offers to two 54-year-old scholars, government professor Michael Sandel observed that "a prejudice for younger over older candidates amounts to a prejudice for mathematical and statistical approaches - such as those reflected by Mr. Summers's own economics background - over historical or philosophical approaches, where people often do their best work in their fifties, sixties or beyond." (Golden 2002)

Endnote

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Table 1. Classification of Laureates.

Experimental	Conceptual		
Fogel	Arrow	Hicks	Ohlin
Friedman	Buchanan	Klein	Samuelson
Kuznets	Coase	Leontief	Simon
Myrdal	Debreu	Lewis	Solow
North	Frisch	Markowitz	Stone
Schultz	Haavelmo	Meade	Tinbergen
Stigler	Harsanyi	Miller	Tobin
	Hayek	Modigliani	Vickrey

Table 2. Summary Statistics.

	Experimental	Conceptual	Combined
Age	57.2	55.3	55.8
	(16.7)	(16.1)	(16.3)
Major Work	.0446	.0487	.0477
	(.207)	(.215)	(.213)
Observations	381	1253	1634

Note. Standard deviations reported in parentheses. Major work is a dummy variable equal to 1 if a laureate's citations are at least two standard deviations above his mean in a year.

Table 3. Age and the Probability of a Major Work, by Type.

	Point Estimate	Standard Error
Intercept	-10.759	-17.488
Experimental*Age	.331	.122
Experimental*Age^2	-.0029	.0011
Conceptual	7.748	3.534
Conceptual*Age	.0755	.0342
Conceptual*Age^2	-.0009	.0003

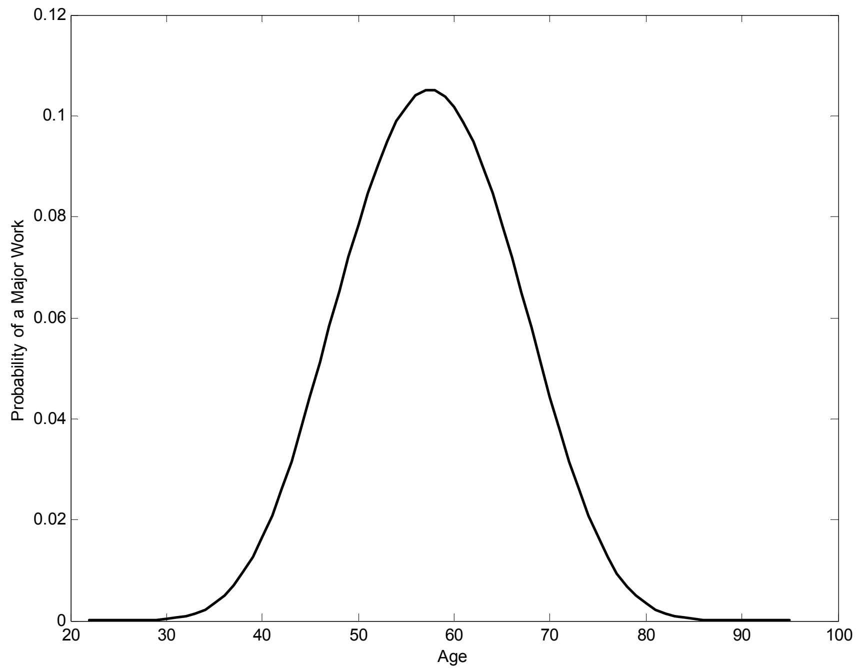
Note. Estimates from a probit model. Sample includes 1634 laureate-years.

Table 4. Peaks of the Age Profiles.

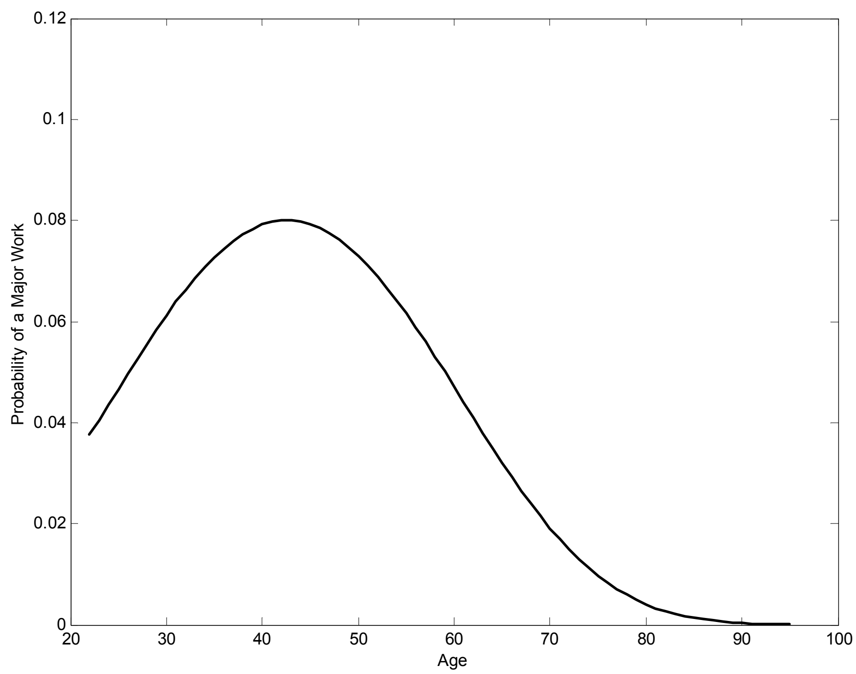
	Experimental		Conceptual
Implied peak age	57.49		42.56
	(2.13)		(4.13)
Difference		14.93	
		(4.65)	

Note. Estimates based on those in table 3. Standard errors in parentheses.

Figure 1. Age and the Probability of a Major Work.
a. Experimental



b. Conceptual



Note. Curves give the probabilities predicted from the probit models in table 3.