EXTENDED ABSTRACT

Using subjective conditional probabilities to find the causal effects of health, income, wealth, and longevity on retirement

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Introduction

Subjective unconditional probabilities, such as the probability of working after age 65 have been used in a wide variety of research, such as the effect of health on retirement, or forecasts of labor force participation. Little research has been done, however, on *subjective conditional probabilities*, such as the probabilities of working after age 70 conditional on being in good health. By asking multiple questions with varying conditions, subjective conditional probabilities can be used to recover the *subjective* causal effects of the conditions (i.e. health) on outcomes (retirement). In this paper we present results about the measurement properties of subjective conditional probabilities and based on those results we use them to estimate the causal effects of health, income, wealth, and longevity on retirement

Data

We designed and fielded a survey in the RAND American Life Panel (ALP) of individuals over the age of 50. We asked in a conventional manner about their current self-assessed health and about the probability they would be working at age 70 (P70).[1] Then we asked about the subjective probability their health would be good at age 70, the subjective probability their health would be bad at age 70, the subjective probability of working at age 70 conditional on their being good, and the joint probability of good health and working. The purpose of these questions is to study the consistency of subjective probabilities to the laws of probability and to find the format that seems to produce the highest quality data. We asked about the probability of working past age 70 sequentially conditional on wage, wealth and longevity treatments. For example, we asked about P70 conditional on a 20% wage increase and P70 conditional on a 20% wage decrease. The unconditional probabilities of working have been shown to be highly predicative of actual work outcomes in longitudinally data, so if individuals are able to report accurately conditional subjective probabilities we could find the causal effect of waves on future work effort.

Preliminary results

Subjective and objective health and retirement

[1] We asked about a target age of 70 because of the increasing labor force participation in the population at age 70 and because of the shifting effect of the Social Security full retirement age in these cohorts. The HRS has added a target age of 70 to its traditional target ages of 62 and 64.

To reduce respondent burden we grouped self-assessed health into "good" and "bad" with good being excellent, very good or good, and bad being fair or poor

We asked the subjective probability that future health will be "good" in the following way:

What are the chances that your health will be excellent, very good or good at age 70?

The subjective conditional probability was asked as follows:

Suppose when you reach age 70 your health is excellent, very good or good. In that case what are the chances that you will be doing any work for pay after you reach age 70?

Similar questions were asked about future health being fair or poor, and about P70 conditioning on future fair or poor health.

To compare the responses, we calculated P70 from the responses and compared the calculated values from the directly elicited values, that is from the unconditional P70. Table 1 shows the results. The unconditional probability (column 1) varies by current health but the main division is between those whose self-assessed health is excellent, very good or good versus those whose health is fair or poor. With the exception of those with health "poor" the conditional probabilities vary much less with current health, which indicates that conditioning works reasonably well. There is some residual variation with current health which is to be expected because the conditioning is relatively coarse; thus, someone with current excellent health may expect to be towards the top of the "health at least good" band whereas someone with current good health may expect to be towards the bottom of the band. Under the condition "health at least good" (column 3) the increase in P70 relative to unconditional P70 among those whose actual health is good or better is small (in the order of 6 ppts.) indicating that those individuals already put a fairly high probability on health being "at least good." That is, the conditioning contained only a modest amount of news. Among those whose initial health was fair or poor the gains are about 12 ppts., indicating that the conditioning contained considerable news. When the conditioning is to bad health (health at most fair) the reductions in P70 are large among those initially in good or better health (12 to 15 ppts.) and small among those already in fair or poor health.

The subjective causal effect of health is large and, with the exception of those initially in poor health, it does not vary much with current health. The overall effect, 19 ppts., is substantial compared with the current labor force participation rate in the older population: among those 70-74 the participation rate was 19.7% in 2017.

Measurement properties of conditional and joint probabilities

- We asked conditional and joint probabilities
    - Conditional: Pr(Work after 70 IF health is X)
    - Joint: Pr(Work after 70 AND health is X)
- Table 2 compares the consistency of the conditional and the joint probabilities with the unconditional ones

- Column [3] is defined as Pr(Work after 70 IF health is good)*Pr(health is good) + Pr(Work after 70 IF health is not good)*Pr(health is not good).
- Column [4] is defined as Pr(Work after 70 AND health is good) + Pr(Work after 70 AND health is not good)
- In principle Rows [2], [3], and [4] should be the same

- Results
  - The conditional probabilities are very consistent with the unconditional probabilities at all health levels.
  - The joint probabilities are much too large. It seems people do not understand joint probabilities
    - We have found this in prior
  - If the analysis needs joint probabilities, these results suggest to ask about conditional and marginal probabilities and then compute the joint probability.

Retirement and income

- We randomized three versions of the questions regarding the effect of earnings on retirement
  - **Version 1:** Suppose that Congress changed the tax system in a way that all workers above age 70 would bring home 20% more in wages compared to what they currently make. Suppose further that when you reach age 70, your health would be excellent, very good or good…
  - **Version 2:** Suppose that Congress changed the tax system in a way that all workers above age 70 would bring home 20% more in wages compared to what they currently make…
  - **Version 3:** Now imagine that you earned 20% more than you do now…
- Results from Table 3
  - Question wording does matter.
    - Version 1 specifies good health in addition to a wage increase. The effect is an increase in P70 of 13.5 ppts.
    - Version 2 increases P70 by 8.6 ppts. The wording is closest to a pure wage increase.
    - Version 3 seems ambiguous because increased earnings would normally be associated with increased effort. This may explain why the P70 only increased by 4.5 ppts.
  - A 20% cut in earnings would decrease participation by about the same amount.

Retirement and wealth

- We randomized three versions of the questions regarding the effect of wealth on retirement
  - **Version 1:** Now please think about your situation today, including your current health and financial situation. Suppose you were to inherit $500,000…
  - **Version 2:** Suppose you were to inherit $500,000…
  - **Version 3:** Suppose you had $500,000 more in financial assets than you do today…
- Results from Table 4

- Question wording does not seem to matter much.
    - Perhaps version 2 is best because it is the simplest
- $500k decreases labor force participation rate by about 13 percentage points (cuts it into ~half)

Retirement and longevity

- We randomized three versions of the questions regarding the effect of longevity on retirement
    - **Version 1:** Now imagine that scientists discover a new medicine that adds an extra ten years to your life, and those would be 10 healthy years. All other aspects of your life would be unchanged…
    - **Version 2:** Now imagine that scientists discover a new medicine that adds an extra ten years to your life, but all other aspects of your life would be unchanged.
    - **Version 3:** Now imagine that scientists discover a new medicine that adds an extra ten years to your life.
- Results from Table 5
    - Specifying good health increases the participation rate as before (version 1).
    - The other two questions are similar
        - Version 3 may be preferred because it is simpler.
    - Longevity has a negligible positive effect on the labor force participation rate (versions 2 and 3)
    - The small effects need to be analyzed: for example, someone who is highly annuitized may have only a modest response to increased life expectancy.

To be added

- Link individual-level response to the very large range of ALP data such as income, wealth, and additional subjective probabilities.
- Add additional analyses such as the effect of our measure of probability numeracy.
- Put the subjective causal response in the context of a life cycle model to ascertain their reasonableness.
- Come to conclusions about the validity of subjective conditional probabilities.

Table 1. Mean subjective probabilities of working past age 70, unconditional and conditional on health at age 70, by current health, ALP, Age 50-69

	N	P(any work at 70)			Subjective causal effect
		unconditional	if health at least good	if health at most fair	[3]-[4]
Current health	[1]	[2]	[3]	[4]	[5]
Excellent	174	29.4	36.3	16.2	20.1
Very good	530	31.8	36.1	16.7	19.4
Good	385	28.8	35.7	16.9	18.8
Fair	135	21.0	32.4	14.2	18.2
Poor	47	8.5	20.5	6.6	13.9
Total	1271	28.5	35.0	16.0	19.0

"Health at least good" conditions on health being excellent, very good or good. "Health at most fair" conditions on health being fair or poor

The entries in column [3] are calculated as Pr(Work after 70 IF health is excellent, very good or good)*Pr(health is excellent, very good or good at age 70) classified according to current self-rated health (ages 50-69). The probabilities are subjective probabilities.

The entries in column [4] are calculated as Pr(Work after 70 IF health is fair or poor)*Pr(health is fair or poor at age 70) classified according to current self-rated health (ages 50-69). The probabilities are subjective probabilities.

Table 2. Mean subjective probabilities of working past age 70, comparing the ALP reports with values created from conditional or joint probabilities, by current health, ALP, Age 50-69

	N	Unconditional P(any work at 70)		
		reported	from conditional*	from joint*
Current health	[1]	[2]	[3]	[4]
Excellent	158	30.1	33.3	54.1
Very good	476	32.3	31.0	55.0
Good	341	28.9	28.1	53.6
Fair	114	21.5	19.9	34.9
Poor	40	8.0	7.5	14.0
Total	1129	29.0	28.5	51.0

* See the text for definitions

Table 3. Mean subjective probabilities of working past age 70, unconditional and conditional on higher/lower wage after age 70, ALP, Age 50-69

	N	P(any work at 70)		
		unconditional	if 20% pay raise	if 20% pay cut
Randomized versions	[1]	[2]	[3]	[4]
Version 1	396	31.4	44.9	22.2
Version 2	412	27.5	36.1	16.9
Version 3	395	27.5	32.0	26.1
All	1203	28.8	37.7	21.7

Table 4. Mean subjective probabilities of working past age 70, unconditional and conditional on higher wealth, ALP, Age 50-69

	N	P(any work at 70)	
		unconditional	if $500k more in wealth
Randomized versions	[1]	[2]	[3]
Version 1	429	30.9	16.0
Version 2	451	27.4	13.9
Version 3	425	27.9	15.8
All	1305	28.7	15.2

Table 5. Mean subjective probabilities of working past age 70, unconditional and conditional on longevity, ALP, Age 50-69

	N	P(any work at 70)	
		unconditional	if lives 10 additional years
Randomized versions	[1]	[2]	[3]
Version 1	422	31.6	39.6
Version 2	439	28.1	31.1
Version 3	420	27.7	31.0
All	1281	29.1	33.9