Effects of Retirement and Lifetime Earnings Profile on Health Investment

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Abstract

This article examines the impacts of income profiles and retirement on health investments over the life cycle. We report the results of experiments where in each period of her lifetime the subject must choose how to allocate real earned income between health investment and life enjoyment in each period of a nine-period life in order to maximize aggregate life enjoyment. The key dynamic optimization challenge of the experiment to subjects derives from the fact that investments in health affect future income, but detract from current consumption. Our experimental results show that subjects investing more in health in the absence of retirement and with increasing income profiles, consistent with the qualitative predictions of the theoretical model. However, compared to the dynamic optimum, there was a systematic bias in health investments, being less than optimal in early periods and greater than optimal in late periods of life. Significant random effects due to grouping of subjects also revealed that subject behavior was affected by the decisions made by others. These results highlight the potential of lab experiments as a method to study health decisions and understand their determinants.

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1. Introduction

There are strong and cross-nationally robust associations among educational, income, health, and mortality [1, 2]. Education is perhaps the strongest single demographic predictor of mortality differentials [3, 4], and socioeconomic status in childhood predicts both income and health in adulthood. The economic implications of these inequalities are very large. For example, LaVeist and coauthors studied differences in health care cost across different American minorities [5]. African Americans, Hispanics, and Asian Americans had direct medical costs more than 30 percent greater than those faced by non-minorities, amounting to more than a $230 billion premium over a four-year period. Furthermore, after adding the indirect costs of these inequities over the same period, the tab came to $1.24 trillion.

In spite of the robustness of these empirical findings, there still exists a great deal of debate about the causal pathways underlying those relationships. Several different mechanism have been proposed to explain the causal link between education and health, including psychological factors (such as health-related knowledge, stress, and locus of control), behavioral factors (such as cigarette smoking, exercise, and diet), and access to health care services [6-9]. A principal problem of identification derives from the likely bi-directional causality that unfolds over the life course. For example, health early in life can impact educational attainment and future income. Selection biases, resulting from unobserved heterogeneities in health, could lead to overestimates of the causal links between education and health.

A similar set of problems plague our understanding of the impacts of retirement on health and mortality, a topic of growing interest as the aging of the population is increasing the costs of public support systems. Health and many other potentially unobserved heterogeneities can influence the decision to retire, leading to biased estimates of the impacts of retirement on health and forcing researchers to rely on instrumental variables as analytical tools. For example, those who expect to earn more income and to maintain good health in the later periods of life should be less willing to retire than those whose do not.[1]. It is not surprising therefore that results of the estimating procedures have been mixed with some finding negative impacts of retirement on health, disability and mortality [10-14], while others have found positive impacts [15-18].

The goal of this paper is to provide insights into the causal relationships between education and health over the life course, and the impacts of retirement on health. To overcome the myriad of obfuscations presented in 'incomplete' and self-reported field data, we have implemented a novel health investment decision experiment. We ask individual subjects to make a sequence of temporally related investment choices in health and life enjoyment. We are able to study how these subjects adjust their investment patterns given perfect knowledge of the relationships between health, expected income, and the retirement institution that will prevail at life's end. Though their decisions and outcomes are independent of one and other, the experiment also enables cultural transmission and social interaction by allowing subjects to chat in groups briefly after each of a series of lifetimes has ended, recording every statement and query that is made. Two advantages of lab

[1] The relationship between retirement and health suffers from problems of endogeneity (Dwyer, D. S., & Mitchell, O. S. (1999). Most findings analyze naturally occurring data that include self-reported health status, and carry methodological problems similar to those found in the literature studying socio-economic conditions and health.

experiments are that they simplify the complexities of real life and allow experimental control of one variable at a time, serving to increase the reliability and interpretability of data collected: in this experiment a subject always knows with certainty her current health status and the direct consequence of an investment in health, allowing her to make informed health investments and life enjoyment choices. The measures of *health* and *health investment* in the experiment are independent of the cognitive ability to accurately report them, allowing us to identify the precise relationships between health and income and retirement opportunities. Moreover, income profiles and retirement institutions are experimentally assigned to subjects, rather than reflecting endogenous choices.

To date, little has been accomplished concerning human ability to solve dynamic programming problems in the lab. Previous experiments on dynamic decision-making have studied how subjects adjust inventories and hire employees in a supply chain scenario [19, 20]. To our knowledge, this is the first laboratory conducted dynamic programming environment that aims to embody a model of health investment. The first goal was to simply examine how well subjects comply with the predictions of a theoretical dynamic programing model of our health investment model. Our second goal was to improve our understanding of the effects that changes in lifetime income profiles and retirement institutions have on health investment choices. The third and fourth goals were to assess whether there are any systematic behavioral biases in dynamic decisions about health, and whether there are any effects of cultural transmission, produced by individuals being able to observe the choices of others and being able to 'chat' with them in written communications. A fifth goal was to establish a reliable platform which could later be used to examine even more complex health decision-making problems such as determining the

value of insurance, public or private, under threat of sudden health 'shocks', and assessing the consequence of social rewards in life enjoyment and health investment.

We employ Grossman's theoretical framework to study health investment choices [21, 22]. This model treats investment in health as a human-capital investment; health directly affects income through improved productivity but also combines with consumption to produce life enjoyment. The individual's problem consists of maximizing aggregate lifetime utility or enjoyment. To achieve this goal, in each period she must choose how to allocate earned income across health investment and life enjoyment. There are two experimental treatments: A) a life with and without retirement, and B) a flat vs. a tiered income stream. The tiered and flat income streams are designed to capture the effects of different levels of education on the distribution of earnings over the life course, while compensating for pure income effects. In the U.S., for example, those with high school degrees experience higher income than those with Bachelor's degrees until about age 30, at which point those with more education earn more [23]. This is because income remains essentially flat with age for those with less education, while it grows with age for those with increased education.

The model predictions we test are: (1) health investments early in life will have greater marginal impacts on lifetime utility than investments later in life, (2) extending the work life (i.e., delaying retirement) increases optimal investments in health; (3) compensated shifts in income earning potential from earlier to later in life will increase optimal investments in health (i.e., as would be expected by educational investments -see references 24 and 25 for this prediction as an extension of the Grossman model) and (4)

postponing retirement and shifting earnings to later in life will interact, producing the large effects on lifetime health. The next section of the paper outlines the theoretical model that structures the experimental design and payoffs to subjects, in detail.

2. Theory and Methods

2.1 The Health Investment Problem: Theory and Experimental Design

Following Grossman, we model health as a state variable that depreciates with time, but can be improved by investments (in this case monetary). Thus, health evolves dynamically in this way;

$$H_{t+1} = H_t - d_t + I_t \qquad (1)$$

where the subscript t, represents the period of life, d_t represents the natural deterioration of health from period to period during the individual's lifetime, and I_t is the investment in health made during period t.

Health affects the individual's period to period utility (life enjoyment) through two routes. First, income earned in each period, R_t, is a positive function of current health and can be consumed immediately to increase life enjoyment, or invested to enhance future health. In the experimental environment, a subject earns her income each period through a time-limited harvesting task. The time allowed to generate income is proportional to her current health (simulating time not spent working or working at less than full efficiency due to reduced health). Second, the subject's current health interacts directly with her consumption expenditures to determine utility (simulating a reduced ability to enjoy life

when health has deteriorated). Each period the subject must allocate earned income between health investment, I_t, and life enjoyment, L_t. Investing in health increases the subject's health, his future income-generation time, and the marginal utility of life enjoyment. In contrast, spending on life-enjoyment directly increases the subject's overall utility, which ultimately determines her experimental payoff.

Subjects maximize aggregate life enjoyment (AggE) by choosing period to period how much to invest in health. Subject's health investment choices solve the dynamic programing problem represented as follows[2]:

$$Maximize: \quad AggE(\bar{I}, \bar{L}) = \sum_{t=1}^{9}(E_t, H_t) \qquad (2)$$

where the utility derived each period, $E_t(L_t, H_t)$, is an increasing function of both the expenditure in life enjoyment, L_t, and the subject's current health, H_t. The maximization problem is subject to changes in health each period (1), and a budget constraint on the allocation of earned income each period represented by:

$$R_t(H_{t-1}) \; + \; B_{t-1} = L_t + I_t$$

where B_{t-1} is any banked income the subject did not spend on either life enjoyment or health investment during the previous period. Subject earnings for the experiment were directly proportional to *AggE(**I**,**L**).*

To model the effects of income stream (for capturing the effects of education) and retirement, there were four different experimental income-earning environments. The first treatment variable dictated whether the harvest income potential during the nine period

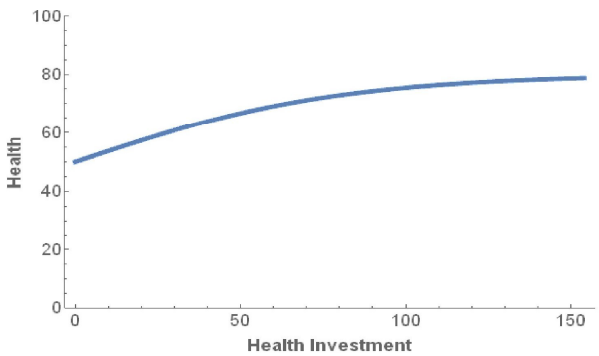
[2] Appendix 2 presents a complete description of the functional forms used in the experiments.

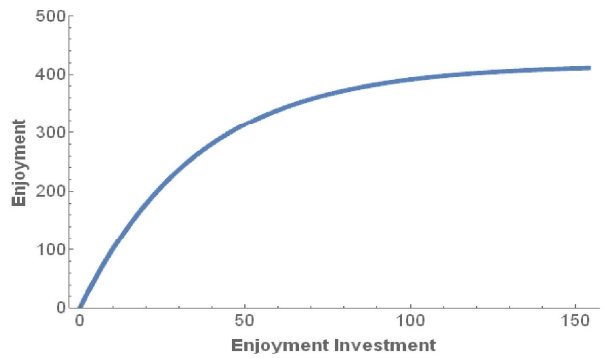
lifetime of the participant was Flat (representing the stream of the less educated) or Tiered (lower than the flat for the first three periods and higher than the flat for the remaining periods – representing the stream of the more educated). The second treatment variable dictated whether the participant was required to harvest during all nine periods of her lifetime (No Retirement) or was given a fixed income in periods 7 through 9 (Retirement) which was equal to 75% of her average harvest income during the first 6 periods of her life. In our 2-by-2 experimental design, each subject is presented with the same health investment problem during all lifetimes under one of the four different expected lifetime earning profiles: increasing or flat income combined with or without retirement. We characterized these four treatments to allow us to identify the effects that differences in expected lifetime earnings can have on health investment and corresponding health and life enjoyment.

During the investment period, subjects observed a graphical representation of the health and life enjoyment investments that made it very clear that both had diminishing returns.[3] The participant's job was to correctly balance investment of harvesting revenue between health and life enjoyment, each period of her lifetime. For example, the graphs below indicate that starting from a current health of 50, the participant could increase next period's health up to 80 by making a large investment. Meanwhile, an investment of 50 could provide the participant with immediate life enjoyment of ~300 which would be translated to cash reward at experiment's end. The participant used reciprocating scroll

[3] The first and second derivatives are calculated in the Appendix 2.

bars on the x-axis of each graph that would not allow her to spend more than the revenue she had accumulated.





Based on the functional forms (described in Appendix 2), the numerical results for the optimal Health (H_t) profiles that participants should maintain by making health investments (I_t) that maximize total life enjoyment *AggE(**I**,**L**)* for the various treatments discussed earlier are given in the following table[4]:

Table 1 Optimal Health Investment per Treatment

Treatment		Optimal Health (H_t)								
Income	rev	1	2	3	4	5	6	7	8	9
Flat Retire	.87	88	90	89	86	79	65	46	24	0
Flat NoRetire	.87	89	91	92	90	86	78	65	42	18
Tiered Retire	.61/1.51	85	83	78	80	81	76	61	38	14
Tiered NoRetire	.61/1.51	86	84	81	85	88	89	87	81	66

[4] The complete solutions for all state and decision variables for each of the experimental treatments conducted are provided in Appendix 2

Given that all participants begin their lives in the same state of health (85), the optimal health trajectories in the table above display a few notable patterns. In the first three treatments, optimal investments in health decline dramatically in later periods of life. In both of the No Retirement treatments they decline relatively less than in the Retirement treatment of the corresponding earnings profile. Finally, in each of the Tiered income treatments there is a notable boost in health spending when earnings increase.

The table below captures a more quantitative representation of these outcomes and hints at some behavioral difficulties participants might encounter if their perception of optimal strategies is less than perfect. It shows the marginal rates of return for investments in life enjoyment in each period of life, and implicitly the rate of return on investment in health and banking for current and future enjoyment maximization.[5] It also shows the percentage of income earned (plus banked[6]) that must be devoted to optimal health maintenance in each period of life.

Table 2Optimal Marginal Rate of Return, % of Income Invested in Health

Treatment		Optimal Marginal Rate of Return, % of Income Invested in Health								
Income	rev	1	2	3	4	5	6	7	8	9
Flat Retire	.87	92, 82	78, 76	65, 68	54, 59	42, 48	31, 31	26, 13	19, 5	14, 0
Flat NoRetire	.87	100, 86	86, 80	74, 73	63, 67	53, 59	43, 50	33, 35	25, 0	25, 0
Tiered Retire	.61/1.51	113, 91	100, 83	87, 75	38, 63	29, 56	22, 40	22, 23	16, 0	13, 0
Tiered NoRetire	.61/1.51	124, 97	111, 89	99, 83	42, 67	34, 62	26, 56	20, 50	14, 40	8, 21

[5] This is true for all periods except where a boundary condition is met (only in periods 8 and/or 9) and the marginal return on any investment in health is dominated by investment in life enjoyment (L_t) so the optimal investment in health is zero (I_t=0).

[6] There are only 2 periods in the 36 displayed where it behooves subjects to bank some earned revenue for the purpose income smoothing: in period 8 of the Flat No Retirement regime where health will fall precipitously in period 9, and in period 6 of the Tiered Retirement regime where income falls precipitously in period 7, the first period of retirement.

Under all treatment regimes, savvy participants must recognize that between 82% and 97% of earned revenue from harvesting must be spent on health in period 1, and between 76% and 89% in period 2, while the marginal rates of return are 8 to 12 times larger than later in life: that is a skewed strategic requirement to be reckoned with in splitting earned harvest revenues between health and life enjoyment. Late in life (periods 8 and 9) under the first three treatments, participants must let go of their health and spend almost entirely on life enjoyment, but their outcomes remain quite sensitive to the little they spend on health, Under the fourth treatment, Tiered No Retirement, subjects maximize earnings by spending significantly to continue to maintain health and precision is not so important.

Every lifetime ended after nine periods unless the participant's 'health' had degenerated to the point of death before then. After each lifetime ended, every participant was reincarnated into his next unrelated lifetime.

Subjects were assigned fixed chat groups of four throughout the experiment. Between lives, subjects were allowed to chat within their chat group. Learning, which could display itself as strategy evolution across lifetimes, was expected and intended to simulate the accumulation and transmission of cultural wisdom that might accrue in the real world with overlapping generations of participants.

2.2. Methods

A total of 276 subjects allocated to 69 chat groups participated in the experiment. All experimental sessions were conducted at the laboratory of the Economic Science Institute. The protocol approved by the Chapman IRB authorize all ESI cash motivated economics experiments which involve no deception, no audio or video taping, and no invasive

procedures, food or drugs. A short description of the protocol can be attached to this submission if required. Experimental sessions lasted approximately two hours. We had 68 subjects (17 chat groups) participate in the Flat Retirement treatment, 64 subjects (16 chat groups) in the Tiered Retirement treatment, 72 (18 chat groups) in both the Flat No Retirement and Tiered No Retirement treatments. Subjects were distributed into chat-groups each comprised of four members. Membership of each chat-group remained constant for the entire experiment. Members of each chat-group were free to observe and discuss (or not) each other's performances for 90 seconds at the end of each lifetime.

2.3. Statistical Approach

In order to handle the repeated and clustered nature of the experimental design, we employed a mixed fixed and random effects linear model to analyze the data. Each subject made 63 repeated health decisions over seven lives of nine periods each, and subjects were clustered in chat-observation groups. Therefore, the model had to take into account the lack of independence among observations within and among individuals in groups. To do this, the model estimates the fixed effects of life, period, and experimental treatment, while assessing the random effects for chat group and individual.

3. Results

3.1. Test of the Qualitative Predictions of the Theoretical Model

The results reported below are based on the choices made during the last seven of the ten lives each experimental subject lived, because by life 4, the complexities of the computer interface had been mastered, the degree of harvesting proficiency stabilized, the

relationship between health and payoff had been digested, and the probability that any subject would die prematurely due to totally inept harvesting or decision-making had decreased to almost zero. We report 63 investment choices for each subject: 7 lifetimes with 9 periods in each life.

Table 1 below presents the results of mixed model regressions with fixed main effects of life, period, and experimental treatment, and fixed interaction effects of period by treatment, and random effects for individual subject and chat group[7]. Dependent variables in these regressions are amount invested in health, health, income, and the proportion of current plus banked income invested in health. The data show strong and significant effects of all fixed effects for all dependent variables (with the exception of life on health investment). Of particular note are the significant interactions of treatment by period. In addition, there were significant random effects at the level of both the chat group and the subject.

[7] Table 2 in Appendix 3 presents the complete results of mixed random and fixed effects models, run hierarchically. Each dependent variable, Health Investment, Health, Income and Health Investment/Income, was regressed as a function of various experimental design variables: lives, periods, dummy variables using the Flat Retirement treatment as the baseline, and adding interaction terms between the periods and the treatment dummy variables.

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Independent Variables		Dependent Variables							
		Health Investment		Health		Income		Health Invest /Income	
Fixed effects	**Numerator df**	**F**	**Sig.**	**F**	**Sig.**	**F**	**Sig.**	**F**	**Sig.**
Intercept	1	3308	0.000	11154	0.000	7299	0.000	8147	0.000
Life	6	2	0.134	20	0.000	36	0.000	5	0.000
Period	8	2300	0.000	4142	0.000	1945	0.000	2369	0.000
Experimental Treatment	3	31	0.000	7	0.000	62	0.000	9	0.000
Period * Experimental Treatment	24	251	0.000	252	0.000	1171	0.000	67	0.000
Random Effects		**Var.**	**Sig.**	**Var.**	**Sig.**	**Var.**	**Sig.**	**Var.**	**Sig.**
Residual		229	0.000	80	0.000	173	0.000	0.045	0.000
Subject		32	0.000	39	0.000	57	0.000	0.003	0.000
Chat group		26	0.000	23	0.000	34	0.000	0.002	0.000

To aid in the interpretation of these regressions, Figure 1 plots the expected marginal means for each of the dependent variables by treatment and period: a) Health Investment, b) Health, c) Income and d) the ratio of Health Investment over Income Available. These figures show that subject behavior supported the qualitative predictions of the theoretical model.

The marginal means of health investment for each treatment support the four main predictions of our theoretical model. First, health investment decreases across periods of constant income potential, while relative health investment (investment/income) decreases constantly from beginning to end of life. Second, health investment in Tiered treatments, as predicted, start below those observed in Flat treatments for periods 1-3, but then increase above those observed in Flat treatments for periods 4-6. Third, as predicted by the model, the absence of a retirement plan leads individuals to increase the amount they invest in health, not only for the last periods of their lives, but also for all previous periods. Finally, the tiered income profile interacts with the no-retirement condition to produce the largest impacts on life time health (prediction 4).

On average, subjects seem to have understood the compounding effects that investing in health has in this dynamic setting under all treatments. They correctly perceive the appropriate tactic required to maximize their lifetime objective given the return on each unit invested in health not only induces a greater ability to enjoy life but produces higher income all subsequent periods. They also implicitly understand that in No Retirement treatments, even greater health is needed to generate income and life enjoyment in periods 7-9. Figures 1a and 1b show increased health investment in periods 4-6, resulting in health for the No Retirement treatments exceeding that for Retirement treatments.

Another indication that subjects seemed to understand the interaction among income, health, and health investment can be observed in the greater levels of health investment, health and income revealed for the Tiered No Retirement treatment in Figures 1a, 1b, and 1d. These subjects took advantage of the greater potential income during the periods 7-9 that this treatment offers. To do this, they needed to arrive at period 7 considerably healthier, and willing to invest a higher proportion of their income in health, than their peers in the other treatments. The yellow line in Figure 1b reveals that they did in fact accomplish this.

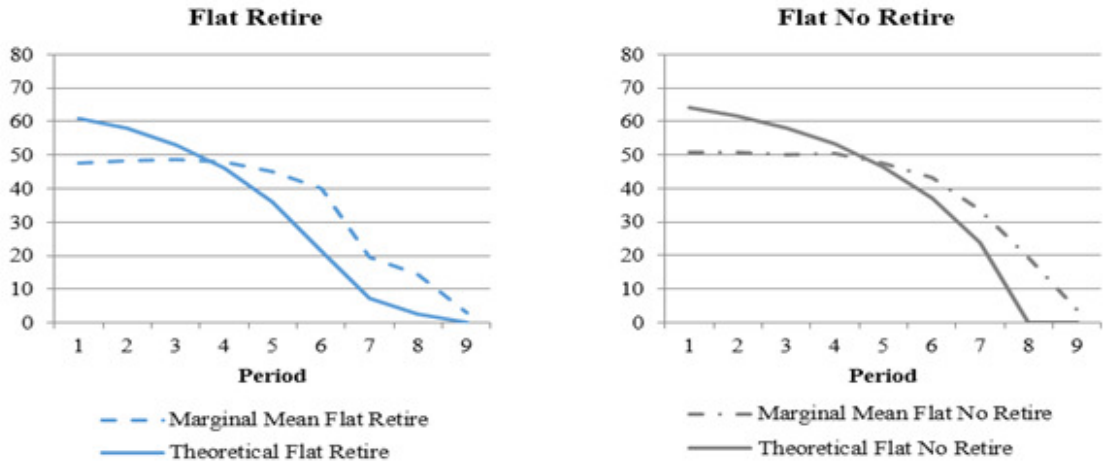
Figure 1c, displays that on average subjects recognized the different implications that the optimal health-investment strategies have for each treatment. Although the means of health investment for periods 1-3 of Tiered treatments were below those of Flat treatments, on average those in Tiered treatments were investing a larger proportion of their income than those in Flat treatments during those periods: more evidence to support

the claim that subjects perceive the qualitative implications of the model governing the decision environment in which they are imbedded.

Figure 1 and the regression analysis above support the qualitative behavioral predictions of our model. We now proceed to evaluate how mean health investments compare to precise model predictions for all treatments.

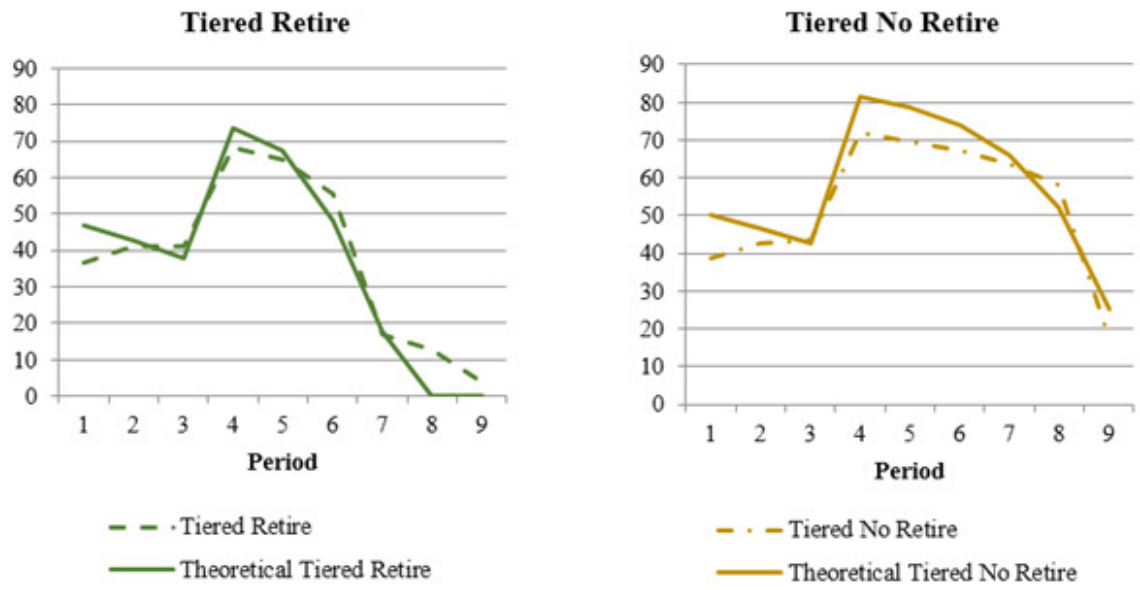
3.2. Comparisons of Subject Behavior with Theoretical Optima

Figure 2 compares optimal health investment derived from the theoretical model with observed health investment for the two flat income profile conditions, with and without retirement respectively.



Three facts are easily observed from Figures 2a and 2b. First, qualitatively, the observed and theoretical curves have similar shapes. Second, however, mean health investments for periods 1-3 are below the optimal health investments predicted by the model for both of

the Flat treatments. Third, the mean health investments for periods 6-9 are above the optimal health investments predicted by the model for both flat treatments. This suggests that subjects understand that health investments early in life produce greater marginal effects of lifetime enjoyment, as they monotonically decrease investments with each period, but they underestimate, both early and late in life, how much they should bias investments. Figure 3 compares observed and optimal health investments for the tiered conditions.



The match in the shapes of the observed and theoretically predicted curves is striking. Again, in both Tiered treatments, with and without Retirement, initial health investments for periods 1 and 2 are below the optimal predicted by the model. Subjects display the same bias in all treatments. In the Tiered Retirement treatment, Figure 3a, significant deviations from the theoretical predictions are for fewer periods than in the Flat Retirement treatment. Also, we see that although subjects raised their health investment in period 4, when their income opportunities increase, their health investments for periods 4

and 5 fall below the optimal predicted by the model. Similar to the Flat Retirement treatment, the mean health investments for periods 6-8-9 are above the optimal investments predicted by the model for Tiered Retirement. Finally, we note that in the Tiered No Retirement treatment, Figure 3b, mean health investments are very close to optimal for the final periods 7-9 of life.

4. Discussion and Conclusions

These findings support the four main predictions motivating our experimental design. First, consistent with human capital models of health investment [21, 22, 25] in which investments have decreasing marginal impacts with age, subjects in all conditions reduced the proportion of their earnings invested in health with each period as life progressed. In the flat income profile, absolute investments in health also decreased with each period. Second, the rising income profile with age was associated with higher average investments in health over the life course and higher health in the last three periods of life. This was true even in the retirement condition, under which health no longer had direct effects on income during those last three periods. Third, retirement had dramatic effects on health investments and as such, on health at each period. For both the tiered and the flat income profiles, retirement not only lowered health in the last three periods of life, but also lowered averaged investments in health in the first six periods of life, compared to the no retirement condition. This reflects subjects' recognition that health in later life depends on investments early in life. Finally, the combination of a rising income profile with extending the work life interacts to result in the largest effects on lifetime health. Overall, after the first three lives during which subjects were still learning and performed much worse,

subjects, on aggregate, tracked the optimal decision path quite well. This is promising, as determining the optimal path presents a formidable computational task.

These results on the impacts of income stream on health investments are consistent with empirically observed behavior. Duggan and coauthors, using data from the Social Security Administration Continuous Work History Sample, examined the relationship between earnings profiles and health found very similar results [26]. Not only did lifetime income positively associate with health status, a *rising* trend in income over life was associated was later ages at death than a flat income profile, even after holding permanent income constant. With respect to retirement, these results suggest one route through which continued work force participation might improve health, not only after retirement but before retirement as well, by increasing the economic gains from being healthy. It is likely that there are opposing effects of retirement, due to increased leisure time, reduced stress, but also reduced social interaction and economic motivation to stay healthy. The value of the experimental approach is that each of these factors can be manipulated independently.

There were some notable deviations in subjects' behavior from optimal expectations. In all treatments, flat and tiered with and without retirement, observed behavior reveals decreased investment in health during the first three periods of life relative to the optimum. In the flat income profile treatments, with and without retirement, towards the middle of life this trend reverses, and later in life investments in health exceed the optimum. In the tiered retirement condition, subjects appear to more accurately invest in health in the later periods of life.

There are several possible explanations for these deviations in observed behavior vis-à-vis optimal performance. One set of explanations derives from the difficulty of the task. Given the inherent complexity of solving a nine period dynamic optimization problem with nonlinear constraints and a nonlinear utility function, it is surprising how well subjects did on the aggregate. Significant health investments in periods one through three were critical to maximizing life enjoyment. In all conditions, it is possible that subjects did not correctly perceive the magnitudes of the decreasing marginal utility of health investments as periods progressed. It is also possible that they simply used some heuristic or rule of thumb (perhaps linear), by which they adjusted between period changes in investments.

Another set of explanations might involve time discounting or impatience in the subjects' performance [27]. This would explain under investment in the flat earnings condition early in life, but would not explain over-investment late in life. Alternatively, it might reflect a desire for both consumption and health smoothing over the life course. Early in life, this would mean greater investment in life enjoyment and less in health, relative to the optimum. Late in life, it would mean greater investment in health and less in life enjoyment, relative to the optimum; just as we observe. This would imply that the subjects, at least in part, did internalize the experimental states and rewards, as life enjoyment and health, respectively.

Finally, it is interesting to note that there were significant random effects, both at the individual and chat-group levels. After taking into account the treatment effects, individual- and group-level random effects accounted for close to 10% of the residual variance, respectively. This means that some people consistently invested more in health than

others. Interestingly, even though individuals were randomly assigned to four person chat-mutual observation groups, and even though their individual earnings were completely independent of each other, groups differed significantly in average behaviors. This suggests that individuals influenced each other's' behaviors, either through chat or observation. A subsequent paper will examine these group and learning effects.

To conclude, it is important to assess the value and validity of this experimental approach to understanding health behavior and health outcomes. To our knowledge, this is the first set of experiments designed to investigate investments in health in a dynamic decision process embedded in work environment with direct impacts of health and retirement on earnings. The multi-life design with observation-chat allows subjects to learn, and to influence one another, simulating cultural evolution.

At the current time, there are many important policy decisions that are undergoing debate. Changes in retirement age and incentives to remain in the work force are being debated throughout the developed and developing worlds. Links between health care coverage and employment are undergoing change with new policies in the U.S., affecting incentives to retire. These institutional and policy debates will result in very expensive social engineering experiments. Laboratory-based experiments, in advance of policy decisions, have two main advantages in the health arena. First, they are much less expensive and time consuming to get results. Second, policy decisions are likely to have multiple effects, which may be opposing; laboratory experiments allow for manipulation of each of those effects, one at a time. Since health changes dynamically throughout life, and decisions which affect

it have consequences for the future, multi-period experiments with opportunities to learn seem well suited to explore this complex domain.

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