NBER Post-Doctoral Fellowship in Household Finance

Selling Your Longevity May Extend Your Life: Evidence from the Life Settlement Market*

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"Our new Constitution is now established, and has an appearance that promises permanency; but in this world nothing can be said to be certain, except **death and taxes**."

—Benjamin Franklin, in a letter to Jean-Baptiste Leroy, 1789

Introduction and Purpose:

People in the United States are living longer than ever before.[1] Although this new life longevity has benefited many, it has also confounded an existing problem: under-saving for retirement. While there is a burgeoning literature documenting the aggregate relationship between wealth and longevity, there is a dearth of empirical evidence causally linking wealth shocks to longevity at the individual level. Further, there is little work on whether the strength of financial institutions have real and measurable affects on life outcomes.

There are numerous plausible channels by which an individuals wealth may relate to life duration. A leading hypothesis is that financial wealth allows people to live much longer through their access to dominate goods such as food, medicine, and location. Alternatively, individuals may know that they will live longer (shorter) and rationally save (consume) more of their wealth during their working years. A separate hypothesis centers on the signaling of a person's type: the superior management of financial wealth may proxy for their interest and ability to access healthcare, and in turn, longevity.

While there are many plausible channels by which wealth relates to longevity, the aim of this paper is to causally estimate the effect of wealth shocks on life longevity. To accomplish this, I evaluate a quasi-experimental setting in the secondary market for life insurance policies, also known as the life settlement market.[2] I propose a novel instrument based on an institutional detail on the salability of secondary life insurance policies. In particular, I utilize exogenous shocks to the credit rating of the underlying insurance carriers for my identification. I argue that these shocks impact the ability of the policyholder to sell an insurance policy in the secondary market, but only through affecting the longevity of an individual through their ability to reallocate their bequest allocation. Controlling for both health, contract features, and social-economic factors, I show that both market accessibility and dollar-proceeds relate to life outcomes.

Focusing on the effects of access to financial wealth near one's end of life, I provide an example of how this relationship may work. Jane Doe (censored identity) initially purchased life insurance at the age of 47 to provide security for her family. Unfortunately, she was diagnosed with cancer and decided to sell her policy at the age of 61. With a net death benefit amount over $130,000, she was able to settle the policy for $75,000 in proceeds. In a testimonial, Jane Doe's husband said: *"These funds will be life changing as we battle for my wife's prolonged time with us....these funds will help ease that work in ways we haven't begun to imagine, beyond only paying treatment expenses as we hold out for the next targeted therapy to hit the market, at some astronomical price?"* For people like Jane Doe, selling her policy in the secondary market may have relaxed a liquidity constraint. The results suggest that people facing financial needs, and that own a modest bequest allocation, financial contracting may be good for their longevity.

Methodology

Data

This study is based on a new, proprietary dataset from a leading broker in the life settlement market. This includes data on policies, life expectancy estimates, and outcomes. The data include over 5000 policies, and 4000 individuals from 2009 through July 2016. A summary of the data can be found in **Table 1**. This paper includes both successful and incomplete transactions, and I use the interaction between policyholders and the

[1] According to US Census data, the life expectancy at age 65 was 15.2 years in 1972 and rose to 19.1 years in 2010. (Ortman et al. 2014)

[2] Life settlement refers to the sale of an in-force life insurance policy to a third-party, unrelated, investor.

broker across the lifecycle of an engagement in this paper. Geocoded, I link the Decennial Census and County Health Rankings & Roadmaps dataset at the tract and county level to control for regional variation. Further, I link a panel dataset of the financial strength of the underlying insurance carriers (eg. John Hancock, MetLife, Genworth Financial) to policies to exploit an institutional detail about the salability of a policy in a control function specification.

A differentiating strength of this dataset is the large number of objective measures of life expectancy estimates at the individual level. Investors are primarily concerned about the uncertainty in life longevity of a policyholder. To address this, they often higher third party underwriters, akin to a rating agency for credit markets, to evaluate the historical and future health prospects of an individual and provide life expectancy estimates. Thus, longevity measures are controlled for by all available medical data, at the individual level.

Given this broad dataset, I am able to control for contract features, including net death benefit, projected level premiums, and asset valuations. With health as a major input into life estimates, I utilize data from multiple third party underwriters including both mean estimate, median estimates, age, gender, and mortality multipliers. Linking the data at the address level, I am further able to control for social-economic conditions at the census block level.

Empirical Strategy

The econometric challenge to understanding bequest adjustments and longevity is the issue of reflexivity and endogenous choice. Observing that individuals who sell their policy live longer is equally consistent with individuals being more attentive to their health. Similarly, it is also consistent with individuals having superior knowledge of their longevity, with investors facing a lemons problem (Akerlof 1970). Understanding the causal contribution of financial constraints on life outcomes is a key challenge for these reasons.

To overcome this econometric issue, I propose a novel instrument based on an institutional detail on the salability of secondary life insurance policies. In particular, I utilize exogenous shocks to the credit rating of the underlying insurance carriers for my identification. I argue that these shocks impact the ability of the policyholder to sell an insurance policy in the secondary market, but only through affecting the longevity of an individual through their ability to reallocate their bequest allocation. The credit rating of insurance carriers – which were overwhelmingly investment grade prior to the great recession – were subsequently reevaluated in 2008 and afterwards. In my sample, about one third of the insurance carriers face a downgrades to junk (BB+ or Ba1 for S&P or Moody's, respectively). These downgrades make policies from lower credit carriers near impossible to sell in the secondary market. This is because investors are now concerned about the *convolution* between counterparty risk of the underlying insurance carrier, in addition to an individual's life longevity. Because policies are a negative carry asset, the increased risk may push the net present value below zero, and thus cannot be sold.[3]

Relying on broker data, stories of investor preferences can be ruled out. Further, alternative stories of fraud and anticipation can also be ruled out with my dataset. Due to recent regulation, most individuals need to hold their insurance policy for at least two years, and sometimes up to five years, prior to selling in the secondary market. This reduces their ability to anticipate credit downgrades of their carrier or their future health.

Initial Results

Given the available data and the questions asked, I use a broad set of estimation methods in this paper. I look forward to the possibility of continuing this work at the NBER.

Relation Between Institutional Strength and Individual Longevity

To begin, I use a linear probability model (LPM), to demonstrate the statistical relationship between life longevity (dependent variable) and carrier rating. I summarize these results in **Table 2**. The analysis shows that statistical

[3]The follows the logic that an investor cannot pay less than zero for an insurance policy when the outside option is to lapse at no cost.

relationship exists, even after controlling for contract features, individual health and carrier x time fixed effects.

Given the left censoring of my variable of interest (time to death), a more appropriate estimation method is a hazard model. Of the possible options, a Cox proportional hazards model is used. The Cox proportional model is among the most popular in settings similar to this because of its flexibility of the base hazard function. The econometrician avoids having to make arbitrary, and possibly incorrect, assumptions about the form of the baseline hazard. I summarize my results using Cox proportional model in **Table 3**. The results also point to a positive relation between life longevity and the financial strength of the insurance carrier.[4]

Control Function Specification

To make causal statements, I use a two-stage estimation method where the first stage is the decision to offer a price based on credit rating of the policy. I define the instrument, $Z_{i,t}$, as the financial strength of the insured's carrier at time of attempted sale. The variable converts a letter rating into a scaled rating. The scale is linear, with larger numbers indicating the best financial strength. The first stage logit regression is:

$$\Pr\left(Bid_i = 1\right) = \Lambda\left(\mu + \delta^{'} Z_{i,t} + \gamma^{'} H_{i,t} + \theta' R_i + \eta' P_i\right) \tag{1}$$

The outcome variable $Bid_{i,t}$ is a dummy variable that takes the value 1 if an investor i receives a bid at time t, and 0 otherwise. The right hand side function $\Lambda(\bullet)$ is the logistic cumulative distribution function. The controls for the insured's health, regional, and policy characteristics are given by $H_{i,t}$, R_i, and P_i.

Given the nature of the question, outcome variable of interest, and non-linear first stage regression, I am unable to use a 2SLS procedure. I instead use a control function specification, also known as a two-stage residual inclusion (2SRI) method.[5] My second-stage structural equation is:

$$h(t) = h_0(t) \exp\left(\phi Bid_i + \gamma H_{i,t} + \theta' R_i + \eta' P_i + G_i\right) \tag{2}$$

Where G_i is the generalized residuals from the first stage regression. These are computed by differencing the depended variable and its estimate from equation 1. The first stage residual coefficient is an augmented regression test. Its significance would support the possibility of endogenous effects in the model specification. The other independent covariates of equation 2 are similar to the first stage covariates of equation 1.

Due to the brevity of this proposal, I have omitted the estimations and instead summarize the results. The second stage regression show that access to financial markets have a real and statistically significant relation to life outcomes. This result is most pronounced in the subpopulation of medically impaired individuals. Conducting a similar test for dollar-proceeds, there is a causal relationship between wealth and health. Roughly, $10,000 in settlement value relates to a 3% increase in longevity from the baseline death rate.

Next Steps

The unusually rich nature of my dataset also permits me to go further in analyzing other possible mechanisms responsible for the observed longevity. For example, I test for the existence of asymmetric information in this market, which has been a key focus of prior literature in financial and insurance markets. Using auction data, I am able to observe individuals that receive bids on their assets and compare between individuals that choose and do not choose to sell their asset. It reasons that individuals that believe that they will live longer than their relative life expectancy estimate would sell their assets. My initial results indicate that individuals poorly estimate their mortality and provides evidence against a possible advanced knowledge channel.

[4] For further discussion on this methodology, please see Kiefer (1988), Lancaster (1990), and chapters 17-19 of Cameron and Trivedi (2005).

[5] Control function method was first proposed by Hausman (1978). For a description of procedure, see Terza, Basu, and Rathouz (2008) and Wooldridge (2015). A recent application of 2SRI in finance can be seen in Chen, Hong, Jiang, and Kubik (2013).

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Table I
Life Settlement Summary Statistics

This table provides broad summary statistics for the dataset made available by the participating life settlement broker. Panel A is organized into three columns depending on the progression that the policy and policyholder made in selling their asset: (i) All observations includes every data point, (ii) marketed, indicates that a policy was offered to buyers regardless of the outcome, (iii) settled indicates the policy was sold. Major rows capture life outcome data, objective life expectancy estimates, and key policy data. Panel B is organized into the level of competition between investors for each asset. This includes the typical policy characteristic, price improvement, intensive and extensive margins of compeititon. More bidders correspond to higher winning bid to death benefit, greater price improvement and longer auctions.

(a) **Policy and Insured Summary Statistics**

	All Observations	LE Estimated	Marketed	Settled
Number of Policies	5218	2919	1011	630
Number of Insured Individuals	4156	2111	818	544
	Policies With Life Outcome Data			
Total Number of Observations	612	351	163	114
Observations During Study	489	297	128	91
	Life Estimates			
Average Number of Life Estimates	3.7	4.6	5.9	5.7
Average Age at Last Contact	78.8	78.8	79.8	79.6
Average Life Estimate	127.6	127.6	103.3	97.1
Standard Deviation of Estimates	76	76	56.6	52.4
	Policy Characteristics			
Average Policy Face Value	$2.67M	$2.99M	$2.48M	$2.38M
Average Annual Level Premium	$131K	$151K	$125K	$118K
Average Premium to Face Ratio	4.9%	5.2%	5.3%	5.4%

(b) **Competition for Marketed and Settled Policies**

	One Bidder	Two Bidders	Greater Than Two
Count of Policies	436	203	372
Mean Face Value	$2.81M	$2.42M	$2.13M
Mean Winning Bid	$382.97K	$411.56K	$535.04K
Possible Number of Actual Bidders	1.0	2.0	3.9
Number of Bids	1.1	3.5	9.3
First to Last Bid (Days)	0.0	13.0	16.5
ln(Winning Bid/Minimum Bid)	0.0	0.3	0.6
Winning Bid/Death Benefit	13.3%	15.7%	25.1%

Table II
OLS Regression Showing Credit Effect on Real Outcomes

This table shows the OLS regression between life achievement checkpoints and relevant observable characteristics for policies with at least one life expectancy estimate. The dependent variable is a binary indicator, taking the value 1 if the insured individual lived longer than a the specified number of months. Fixed effects for *Carrier*×*Year of Origination*, *Entering Year*, and *Original Rating* are used. Note, *Original Rating* is based on either the financial strength at issuance if available, or the precrisis rating. Errors are clustered at the state-age decile level.

$$D_{i,j,t\to t+k} = \beta' H_{i,t} + \theta' P_{j,t} + \gamma' R_{j,t} + \delta_{j\times t_0} + \delta_t + \delta_{R_{t_0}} + \varepsilon_{i,j,t}$$

	Months Surivival				
	> 24	> 36	> 48	> 60	> 72
	(1)	(2)	(3)	(4)	(5)
Mean LE (Years)	0.010***	0.014***	0.014***	0.009**	0.009***
	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)
Age (Years)	−0.002	−0.0002	−0.004	−0.003	−0.001
	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)
log(Net Death Benefit)	0.019*	0.041***	0.047***	0.024*	0.006
	(0.011)	(0.012)	(0.012)	(0.014)	(0.015)
log(Carry)	0.014	0.005	0.035*	0.007	−0.014
	(0.029)	(0.020)	(0.020)	(0.021)	(0.019)
log(1+CSV)	−0.008***	−0.006*	−0.004	−0.003	−0.00001
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Health Care Supply	−0.001**	−0.001***	−0.001***	−0.001***	−0.001*
	(0.0003)	(0.0003)	(0.0004)	(0.0003)	(0.0003)
Scaled Policy Rating	0.009	0.037**	0.030*	0.052***	0.043**
	(0.011)	(0.014)	(0.017)	(0.016)	(0.018)
*Carrier*Origination Year FE*	Yes	Yes	Yes	Yes	Yes
Transaction Year FE	Yes	Yes	Yes	Yes	Yes
Original Rating FE	Yes	Yes	Yes	Yes	Yes
Accepted Offer:	338	245	180	134	79
Received Offer:	518	365	271	181	83
Observations	2,496	2,496	2,496	2,496	2,496
R^2	0.750	0.756	0.706	0.608	0.561
Note:					*p<0.1; **p<0.05; ***p<0.01

Table III **Credit Effect on Real Outcomes**

This table shows the estimates from a Cox proportional hazard model relating life achievement and relevant observable characteristics. A smaller estimate (less than zero) indicates a lower hazard rate as compared to the baseline. The sample relies on relevant policies with at least one life expectancy estimate. Column 1 estimates against the full sample and shows the average relation. To test the effect on subsamples, Column 2 and 3 roughly bifurcates the obvservations into impairment groups using a cutoff of a 150% mortality multiplier. Column 4 and 5 splits the entire sample into low and high income groups. The reported values to coefficient estiamtes with a negative indicating a decrease in mortality risk as compared to the baseline estimate. Standard errors are reported in parenthesis.

$$h_g\left(t|X,P,R\right) = h_{0_g}\left(t\right)\exp\left(\beta' H + \theta' P + \gamma' R\right)$$

	Life Achievement				
	Full Sample	Lower Risk	Higher Risk	Lower Income	Higher Income
	(1)	(2)	(3)	(4)	(5)
First LE (Year)	-0.274^{***}	-0.456^{***}	-0.226^{***}	-0.266^{***}	-0.281^{***}
	(0.024)	(0.075)	(0.031)	(0.032)	(0.038)
Male (TRUE)	-0.335^{**}	-0.344	-0.347^{**}	-0.513^{***}	-0.110
	(0.135)	(0.263)	(0.175)	(0.181)	(0.209)
log(Net Death Benefit)	-0.146^{**}	-0.018	-0.262^{***}	-0.219^{**}	-0.086
	(0.063)	(0.126)	(0.083)	(0.087)	(0.094)
log(Carry)	0.207^{*}	0.373	0.194	0.270	0.192
	(0.115)	(0.257)	(0.134)	(0.172)	(0.157)
log(1+CSV)	0.012	-0.043	0.034^{**}	0.007	0.017
	(0.013)	(0.028)	(0.016)	(0.018)	(0.018)
Health Care Supply	0.002	-0.001	0.003	-0.002	0.005^{*}
	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)
Original Rating	0.021	-0.107	0.051	0.076	-0.033
	(0.064)	(0.119)	(0.082)	(0.089)	(0.092)
Scaled Policy Rating	-0.109^{**}	0.011	-0.133^{**}	-0.097	-0.107
	(0.047)	(0.092)	(0.059)	(0.063)	(0.071)
Stratified, Year Originated	Yes	Yes	Yes	Yes	Yes
Stratified, Age	Yes	Yes	Yes	Yes	Yes
Stratified, Median Income	Yes	Yes	Yes	No	No
Death Rate	13.7%	8.2%	19%	14.9%	12.5%
Death Events	344	101	243	187	157
Observations	2,515	1,237	1,278	1,258	1,257
Score (Logrank) Test	177.149^{***}	52.956^{***}	93.985^{***}	109.832^{***}	75.489^{***}

Note: *p<0.1; **p<0.05; ***p<0.01

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Fields of Research Interest

Corporate Finance, Insurance, Household Finance

Research

Work In Progress

Selling Your Longevity May Extend Your Life: Evidence from the Life Settlement Market

Health and Wealth, Considerations for Optimal Lifecycle Consumption with Byeong-Je An

Skin or Skim? with Arpit Gupta

We examine the role of insider ownership in explaining patterns of internal capital allocation and firm returns. Using a federal database, we are able to observe a rich dataset of fund characteristics across a large fraction of the universe of financial institutions, including firm level assets, fund level assets, investor composition, and principal investments in funds. Matching this against a set of commercial return databases, we examine the relationship between incentives and returns and the possibility of cream skimming through variations of principal investments or skin in the game. We document a "dumbbell" distribution of ownership across hedge funds, private equity, venture capital, and securitized asset funds. We find that insiders disproportionately allocate capital to internal funds with the best performance, and that insider performance predicts superior fund performance. Our results emphasize the importance of agency conflicts and compensation structures in understanding the performance of financial intermediaries.

Communication of Information in Financial Markets

Abstract The question of whether and how an investor should delegate its portfolio decision problem is of fundamental interest in finance. One possibility is that an investor can process its private information about future asset payoffs and invest directly into assets. A second is that they can delegate this decision problem to an asset manager, where the portfolio decisions are based on the asset manager's knowledge of future asset payoffs. In order for managers to attract investors, they must be able to both credibly signal superior knowledge of asset payoffs while facing the risk of revealing the actual information about the assets, all without commitment. This paper combines both of these possibilities through developing an entropy-based model of information choice, where investors can communicate their 'informativeness' rather than the particulars of their information when solving their portfolio decision problem. Linking information to trade, this paper endogenizes the decision to be a principal or an agent in a generalized setting. This paper shows that agents that are similarly informed may not be able to credibly communicate their level of information, leading to suboptimal delegation.

Teaching

Columbia Business School

Teacher Assistant, **The Psychology and Economics of Consumer Finance (MBA, EMBA)**, Prof. Stephen Zeldes, and Prof. Eric Johnson, Winter 2016

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Teacher Assistant, **Managerial Economics (MBA)**, Prof. Paolo Siconolfi, Fall 2013, 2014

Professional and Executive Education

Sole Instructor, **Financial Education for Interns**, Edgewood Management, Spring 2014, 2015, 2016

Sole Instructor, **Financial Education for Interns**, Loeb Partners, Spring 2015, 2016

Head Teacher Assistant, **Columbia Executive Education for Debevoise & Plimpton**, Fall 2015

Past Employment

BlackRock, Associate, Blackrock Alternative Advisors (BAA), August 2011 to July 2012

Bloomberg LP, Financial Software Developer, Trading Systems, June 2008 to March 2010

Fellowships, Honors, and Awards

Doctoral Research Grant, Chazen Institute of International Business, Columbia Business School, 2016

Distinguished Paper Award, Finance Department, 2016

Columbia Business School Doctoral Fellowship, 2012-present

Academic Presentations

NYU/Penn Conference on Law and Finance, 2017 (Expected)*

Canadian Economic Association (CEA), University of Ottawa, 2016

PhD Finance Seminar, Columbia Business School, 2015, 2016 (x2)

Annual Student Seminars, Columbia Business School, 2015, 2016

*(*indicates presented by coauthor)*

Past Employment

BlackRock, Associate, Blackrock Alternative Advisors (BAA), August 2011 to July 2012

Bloomberg LP, Financial Software Developer, Trading Systems, June 2008 to March 2010

References

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Re: Reference for Kunal Sachdeva

January 24, 2017

To Whom It May Concern:

Kunal Sachdeva is currently a fifth-year Ph.D. student in Finance at Columbia Business School. He has been considered by faculty one of the most creative students of his cohort. I strongly recommend him for the NBER Post-Doctoral Fellowship on Household Finance. Kunal could have gone onto the job market right now, but in the end he felt that he would be better off waiting till his job market paper is more polished. In the meantime, he will have an adequate research portfolio (with three finished papers) by June this year to graduate if he so chooses. Therefore spending the next year as a post-doctoral fellow in an exciting research environment is his best option.

Kunal has been working on a novel idea on a unique dataset for the main chapter of his thesis. He was able to construct a comprehensive dataset on the secondary market transactions of life insurance policies from accessing the records of a leading broker in the business. The fact that he was able to obtain such a dataset (without prior personal relation) speaks to his entrepreneurship and interpersonal skills. He then matched the transaction data to personal information, especially longevity. He has been studying several research questions: First, what motivate people to sell their life insurance policies? Second, does the market prices (the bids) for the insurance policies entail additional information about a seller's longevity beyond the predictions from actuarial information? Third, is the financial resources afforded by selling the policies improve the quality of life, and hence the longevity of the seller?

The secondary market of the insurance policies has rarely been studied by financial economists. We know relatively little about the market, and have highly diffuse priors about the questions that Kunal is

trying to address. I think he is taking an unusual and less travelled path compared to most Ph.D. studies. He does not have a thick literature from which he could borrow research designs and motivate research questions. I highly commend his creativity and independence. In the past two years, he has spent huge effort in putting the data together from piece-meal layouts and matching information from different databases that were not connected before his endeavor. Now the data and most of the analyses are in place, he should be able to wrap up this main chapter of his thesis pretty soon.

Overall, I think that Kunal has been doing extremely interesting research work whose theme matches closely to the interest of your institute on household finance and financial security of people. His work will generate a lot of interest given how little we already know about the market and the topic. I hope that you will consider his application seriously. Please let me know if you need more information from me.

Sincerely,

