Essays on the U.S. Life Settlement Market

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St.Gallen, October 23, 2018

The President:

Prof. Dr. Thomas Bieger

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Summary

A life settlement is the sale of a life insurance policy in the secondary market of life insurance. This cumulative dissertation, revolving around the life settlement market, consists of six parts: a market primer (Part I), four research papers (Part II-V), and a case study (Part VI).

The market primer, *Introduction to Life Settlement*, delves into the history and describes the mechanics of the life settlement market. The note also introduces life settlement as a financial instrument for both policyholders and investors, while pointing out its salient legal, ethical and societal issues.

The paper, *Saving Face: The Hidden Crisis for Life Insurance Policyholders*, reveals value destruction for policyholders through lapsation of life insurance policies and demonstrates the utility-enhancing effect of enabling policyholders to monetize their policy at its fair market value. The paper proposes mandated secondary sale treatment for to-be-terminated policies, which fosters a vibrant and competitive life settlement market that is key to fair value realization of insurance.

The paper, *Pricing Life: Risk Premiums in the Secondary Insurance Market*, empirically develops a pricing model of life settlements through OLS and LASSO regressions. The parsimonious two-variable econometric model outperforms the conventional actuarial approach due to its higher accuracy and fewer assumptions. The study does not identify strong relationships between risks and life insurance policy value, suggesting inefficient risk transfer in the market.

The paper, *Dating Death: An Empirical Comparison of Medical Underwriters in the U.S. Life Settlements Market*, compares the operational underwriting processes and results of four major U.S. medical underwriters. The study uncovers consistent underwriting patterns across various samples that are indicative of intermediaries' adverse selection behavior as well as underwriters' and other market participants' myopic incentives.

The paper, *Predicting Longevity: An Analysis of Potential Alternatives to Life Expectancy Reports*, identifies deficiencies in the existing methods for predicting life expectancy and proposes a two-factor model that has the potential to improve accuracy as well as to increase efficiency in time and cost. The new proposed model combines physiological input based on advanced medical technology (e.g. telomere test) with psychological input from big data analysis (e.g. Facebook profile).

Finally, the dissertation includes the case study *Ashar Group: Brokers and Co-opetition in the Life Settlement Industry*, which investigates the industry through the eyes of the President of Ashar Group, a life settlement broker. The case describes the co-opetitive relationship the broker has with other industry players, and poses the question how to secure and enhance his position in the yet inefficient market.

Zusammenfassung

Der Terminus Life Settlement steht für den Verkauf einer Lebensversicherungspolice auf dem Sekundärmarkt für Lebensversicherungen. Diese kumulative Dissertation, die sich auf den Life Settlement Markt konzentriert, besteht aus sechs Teilen: einem Einführungsartikel, vier Forschungsarbeiten und einer Fallstudie.

Der Einführungsartikel, *Introduction to Life Settlement*, befasst sich mit der Geschichte des sekundären Lebensversicherungsmarktes und beschreibt dessen inhärente Mechanismen. Dieser Artikel stellt zudem das Life Settlement als Finanzinstrument für Versicherungsnehmer und Anleger vor und führt gleichzeitig in die zentralen rechtlichen, ethischen und gesellschaftlichen Fragestellungen ein.

Das erste Forschungspapier, *Saving Face: The Hidden Crisis for Life Insurance Policyholders*, untersucht die durch die Ablösung von Lebensversicherungspolicen verursachte Wertvernichtung für die Versicherten und zeigt hingegen die nutzensteigernde Wirkung auf, Versicherungsnehmern zu ermöglichen, ihre Police zu ihrem angemessenen Marktwert zu monetarisieren. Das Forschungspapier schlägt eine vorgeschriebene Sekundärverkaufsbehandlung der zu kündigenden Policen vor. Dies unterstützt einen dynamischen und wettbewerbsfähigen Lebensversicherungsmarkt, der für die Veräußerung von Versicherungen zu einem fairen Wert von zentraler Bedeutung ist.

Der Artikel, *Pricing Life: Risk Premiums in the Secondary Insurance Market*, thematisiert die empirische Entwicklung eines Bewertungsmodells für Lebensversicherungen. Das ökonometrische Modell mit zwei Variablen wurde durch lineare und LASSO Regressionen geschätzt. Das aufwandsarm, einsetzbare Modell übertrifft den herkömmlichen versicherungsmathematischen Ansatz aufgrund besserer Voraussagekraft bei gleichzeitig weniger Annahmen. Die Studie findet heraus, dass Risiken im Lebensversicherugsmarkt nicht adäquat eingepreist werden, was auf einen ineffizienten Risikotransfer im Markt hinweist.

Ein weiterer Artikel, *Dating Death: An Empirical Comparison of Medical Underwriters in the U.S. Life Settlements Market*, vergleicht die operativen Underwriting-Prozesse und die Ergebnisse von vier grossen US-amerikanischen medizinischen Underwritern. Die Studie deckt über verschiedene Stichproben hinweg konsistente Muster im Underwriting-Prozess auf, die auf ein adverses Selektionsverhalten der Intermediäre sowie auf einen kurzfristigen Fokus von Versicherer und anderen Marktteilnehmern hinweisen.

Der letzte Forschungsartikel, *Predicting Longevity: An Analysis of Potential Alternatives to Life Expectancy Reports*, identifiziert Mängel in den bestehenden Methoden zur Vorhersage der Lebenserwartung und schlägt ein Zwei-Faktoren-Modell vor, das deren Genauigkeit verbessern und die Effizienz erhöhen kann. Dieses Modell kombiniert physiologische Einflussgrößen, basierend auf fortgeschrittener medizinischer Technologie (z. B. Telomer-Test), mit psychologischen Inputs, welche mittels Big-Data-Analyse (z. B. basierend auf Facebook-Daten) eruiert werden können.

Schließlich untersucht die Fallstudie, *Ashar Group: Brokers and Co-opetition in the Life Settlement Industry*, die Branche aus der Perspektive des Präsidenten der Ashar Group, eines Life Settlement Maklers. Diese Studie beschreibt den Kooperationswettbewerb, den dieser Makler mit anderen Akteuren der Branche eingeht, und wirft die Frage auf, wie die Ashar Group ihre Position auf dem noch ineffizienten Markt sichern und ausbauen kann.

Cover Article (Dachbeitrag)

A life settlement is the trading of a life insurance policy. Through the settlement, the ownership of the policy is transferred from the original insured to the buyer of the policy (the investor). Consequently, the original insured receives a lump-sum (the transaction price) and no longer pays the outstanding premiums on the policy. The transaction price is higher than the "compensation" (the surrender value) that would otherwise be offered by the insurance company (the carrier) for abolition of the policy. In return, the investor becomes the beneficiary of the policy and receives the death benefit (the maturity) from the carrier upon death of the original insured, as long as the investor pays the premiums throughout the rest of the insured's life so that the policy does not lapse. Part I of this dissertation is intended as a market primer with the purpose of informing readers of the history, function, operation, roles of transaction parties, market overview and potential of life settlements in the U.S.

To date, it is still not widely known that a life insurance policy is a tradable asset, for its holder possibly the most valuable one right after real estate and automobiles. Part II attempts to raise awareness of the market and its benefits to the society. We criticize carriers' abuse of outdated lapse-supported pricing scheme, which leaves policyholders vulnerable to retrospective premium hikes. Carriers reportedly increase premium rates in the event of unanticipated insurance persistency from "bad risks", which can be caused by a wider usage of life settlement by seniors and insureds with health impairment.

Against the backdrop of rising regulatory intervention favoring life settlements, we advocate imminent abandonment of lapse assumptions in premium pricing and encourage an embrace and internalization of policy secondary sale. We propose a mandated secondary sale treatment life policies that are about to be lapsed or surrendered, which would significantly increase the size and consequently the liquidity of the life settlements market. In addition, we suggest a morbidity-contingent surrender penalty scheme targeting healthy insureds who wish to terminate a policy. Combining mandated secondary sale with a morbidity-contingent surrender penalty would ensure that the a policy's monetizable value is constantly pegged to its economic value, which, we demonstrate, would enable maximization of a policy's utility, leading to an increase in the utilitarian welfare of the society.

While a mature and competitive secondary market would exhibit obvious benefits, today's life settlement market — a relatively nascent and exotic branch of the financial market — is rapidly evolving but still frought with issues. Specifically, the trading of policies is not yet regulated nation-wide, and life policies have often been mispriced in the settlement market, reflected in the substantial differences between life settlement fund valuations and market prices. While legislation require assets to be held at fair value, some fund managers still maintain that life settlement assets cannot be marked to market. This is to the detriment of investors.

Part III of the dissertation aims to explore the parameters of a fair pricing in the life settlements market, and to provide investors with more sense of security in the trade of life policies. The study empirically develops an econometric pricing model of life settlements. In life settlements markets, practitioners conventionally price policies with actuarial models. These models require as key inputs a discount rate, IRR (internal rate of return), and the mortality curve of the insured, which is usually reverse-engineered from a life expectancy estimate. An econometric pricing model, in comparison, is advantageous in that it relies on fundamental economic relationships and works without assumptions on IRR and insureds' mortality rates.

The inherent risks in a life settlement — both idiosyncratic and systematic — causes cashflow uncertainty, which eventually affects the price of the underlying policy. To identify independent variables or risk factors relevant for pricing we draw on hypotheses derived from extant literature as well as industry practitioners. Using real-life market data, we test relationships between the risk factors and the policy value to establish an accurate pricing function. To avoid overfitting, we only include independent variables with a significant explanatory power. The two-factor model we developed through OLS (ordinary least squares) and LASSO (least absolute shrinkage and selection operator) regressions includes only life expectancy (LE) and sum of expected premium payments as independent variables. The parsimonious model exhibits a strong in-sample model fit and out-of-sample pricing accuracy, as well as a subsample robustness. This study concludes that prices can be predicted with a high accuracy using market data. In other words, going forward it is possible to conclusively determine the fair price of a life settlement based on the policy traits. Hence, the application of our envisioned model may aid practitioners in establishing market-consistent values for their portfolios.

While the life settlement valuation heavily relies on insureds' LE, the market has witnessed, and is still witnessing, material underestimation of LE, causing investors to overpay for policies. What is worse, insureds' outliving their LE estimates extends the term of premium payment and delays the receipt of death benefits, causing devastating liquidity issues of investors. Part IV of this dissertation exposes the prevailing LE practices by comparing the operational underwriting processes and outcomes of four major U.S. medical underwriters (ITM, AVS, Fasano, LSI). By juxtaposing those underwriters' LE data, we find widespread discrepancies between their LE estimates on a statistically significant level. Furthermore, we identify consistent underwriting patterns across various samples: an underwriter can be more aggressive (issuing lower LEs) for some insured cohorts while more conservative (issuing higher LEs) for others.

We present our preliminary test results to practitioners who have first-hand experience in the industry and ask for their interpretation of the findings in order to understand the reason for the frequently misstated LEs. Some blame the skewed market on mis-incentivised sellers and intermediaries of life settlements who cherry-pick low LEs to artificially elevate policy prices. Others impute underestimated LEs to "mercenary underwriters" who intentionally provide low LEs to gain business from policy sellers. Low LEs are particularly popular to sellers because they imply higher policy prices.

Through more in-depth analysis on stratified LE data, we detect signs of adverse selection behavior on the part of life settlement intermediaries.

Since medical underwriters' LE reports are not yet fully reliable, either due to information "maneuvers" or deficiencies in existing underwriting methods, we seek better alternatives in Part V of this dissertation. We propose a model that takes advantage of advances in both healthcare technology and information and communications technology. This model uses physiological input from medical procedures such as telomere test, and psychological input from social behavioral data such as a Facebook profile. The proposed method for LE estimation promises more accuracy and efficiency compared to existing methods.

To add a pedagogical touch, the dissertation ends with a business case study as Part VI, honing in on a life settlements broker — Ashar Group. As per the standard case study format, we address real-life issues faced by Ashar for students to discuss and explore in a classroom setting. The main issue featured in the study is the delicate relationship between Ashar and other market players. Against the current trend of disintermediation, Ashar is forced to compete with their downstream partners, life settlement providers, with whom Ashar used to have a purely cooperative relationship. Other challenges faced by Ashar, such as righting tarnished reputation of brokerage and the imminence of scaling the family business, are also addressed.

The case study echoes other articles in this dissertation. For example, as stated in Part II, life settlement, still unheard to many, is yet to be popularized, and Ashar struggles to address this issue; in line with findings from Part IV, Ashar fulfills its fiduciary duty for policyholders by protect information that may cause a decrease in policy value from policy buyers. With the goal of presenting a viewing angle on the market from a broker's stance, the case study affords students an opportunity to walk in practitioner shoes and to consider solutions that would improve a yet inefficient market.

Presented next are article metrics of each part. A flow chart (Figure 1) illustrating relationships of these parts follows.

Part I

Titel

Introduction to Life Settlement

Author(s)

Alexander Braun
Lauren H. Cohen
Christopher J. Malloy
Jiahua Xu

Abstract

This primer hones in on the secondary insurance market (the “life settlement” market) in the United States. We review the historical emergence of the market and, through descriptions of the market players and activity, characterize the market mechanics. By discussing legal, ethical and societal issues revolving around life settlement, we highlight current challenges and opportunities. We also provide insights for both life insurance policyholders and investors who use life settlement as a financial tool.

Presentation Record

04/2018, London
European Life Settlement Association (ELSA) Spring Symposium

10/2017, Boston
Harvard Business School (HBS) Innovation and Entrepreneurship Brown Bag Seminar

Publication Medium

Harvard Business School Background Note 218-127, June 2018

Part II

Titel

Saving Face: A Solution to the Hidden Crisis for Life Insurance Policyholders

Author(s)

Alexander Braun
Lauren H. Cohen
Christopher J. Malloy
Jiahua Xu

Abstract

The total face amount of terminated life insurance in the U.S. amounts to over two trillion dollars per annum. Little known is that, instead of allowing insurance carriers to pocket the premiums paid until termination and avoid the death claim, many policyholders may realize their policies' value through resale to the secondary market, and receive a lump-sum markedly above the surrender value. We demonstrate how the inclusion of a mandated secondary sale provision in a policy contract will affect — and ultimately benefit — the welfare of policyholders without negatively affecting that of insurance companies.

Presentation Record

09/2018, Nuremberg
45th Annual Seminar of the *European Group of Risk and Insurance Economists* (EGRIE)

08/2018, Chicago
Annual Meeting of the *American Risk and Insurance Association* (ARIA)

07/2018, Singapore
Asia-Pacific Risk and Insurance Association (APRIA) & *Nanyang Technological University's Insurance Risk and Finance Research Centre* (IRFRC) Joint Conference

07/2018, St. Gallen
7th *Institute of Insurance Economics* (I.VW) Research Seminar

Publication Medium

Working Papers on Risk Management and Insurance No. 218

Part III

Titel

Pricing Life: Risk Premiums in the Secondary Insurance Market

Author(s)

Alexander Braun
Jiahua Xu

Abstract

Life settlement prices are commonly determined by present value calculus. Yet, the asset class lacks an established approach for the determination of adequate discount rates. We estimate historical risk premiums based on a large data set of 2,863 transactions that occurred between 2011 and 2016. Subsequently, we explain the cross section of the risk premiums based on hedonic regression methodology and a comprehensive set of attributes motivated by industry know-how as well as earlier studies. Out-of-sample results indicate that market-consistent life settlement prices can be conclusively predicted by employing risk-adjusted discount rates generated with our model.

Presentation Record

07/2018, Singapore
Asia-Pacific Risk and Insurance Association (APRIA) & *Nanyang Technological University's Insurance Risk and Finance Research Centre* (IRFRC) Joint Conference

03/2018, Munich
German Association for Insurance Studies (DVfVW) Annual Meeting

01/2018, Las Vegas
Western Risk & Insurance Association (WRIA) Annual Meeting

07/2017, St. Gallen
6th *Institute of Insurance Economics* (I.VW) Research Seminar

Publication Medium

Working Papers on Risk Management and Insurance No. 217

Part IV

Titel

Dating Death: An Empirical Comparison of Medical Underwriters in the U.S. Life Settlements Market

Author(s)

Jiahua Xu

Abstract

The value of a life settlement investment, manifested through a traded life insurance policy, is highly dependent on the insured's life expectancy (LE). LE estimation in life settlements relies heavily on medical underwriting. Employing different evaluation processes, underwriters rarely agree on LE estimates, leading to valuation disparities. We use the natural logarithm of the implied mortality multiplier ($\ln k$) to compare the underwriting results of the four major U.S. medical underwriters (ITM, AVS, Fasano and LSI). $\ln k$ is normalized in terms of gender, age and smoking status, and is therefore a more suitable indicator for high-level comparison than LE estimates, especially when the compared groups have a heterogeneous make-up. Based on the analysis of life settlement samples from 2011 to 2016, we trace the patterns of underwriters' $\ln k$ in both secondary and tertiary markets of life settlements, and investigate systematic differences in their estimation. Our results show that an underwriter can, relative to peers, act more conservatively (issuing longer LE estimates) for one cohort while more aggressively (issuing shorter LE estimates) for another. We also detect signs of intermediaries' cherry-picking behavior and discuss additional theories that shed light on the convoluted LE landscape.

Presentation Record

07/2017, Poznan
Asia-Pacific Risk and Insurance Association (APRIA) Annual Conference

05/2017, Austin
Life Insurance Settlement Association (LISA) Annual Spring Conference

11/2016, Dublin
European Life Settlement Association (ELSA) Autumn Symposium

Publication Medium

Working Papers on Risk Management and Insurance No. 191

Part V

Titel

Predicting Longevity: An Analysis of Potential Alternatives to Life Expectancy Reports

Author(s)

Jiahua Xu
Adrian Hoesch

Abstract

Retirees, pension funds, and the insurance industry have all been negatively affected by the wrongful estimation of longevity. The inaccuracies in current life expectancy (LE) reports primarily result from misinterpretations of the influence of resilience factors on longevity. This study examines different and more accurate measurement metrics to minimize the risks related to biased LE calculations. By using both qualitative and quantitative research approaches, this research develops a new conceptual model: a two-factor-LE-analysis model with a telomere test as a medical basis (physiological factors) and a big data approach to filter the psychological factors to longevity. The authors suggest that the new model, together with the insights of the existing LE-projection methodologies, has considerable potential to improve LE predictions.

Publication Medium

Journal of Retirement Spring 2018, 5 (4) 9-24; DOI: jor.2018.5.4.009

Part VI

Titel

Ashar Group: Brokers and Co-opetition in the Life Settlement Industry

Author(s)

Alexander Braun
Lauren H. Cohen
Christopher J. Malloy
Jiahua Xu

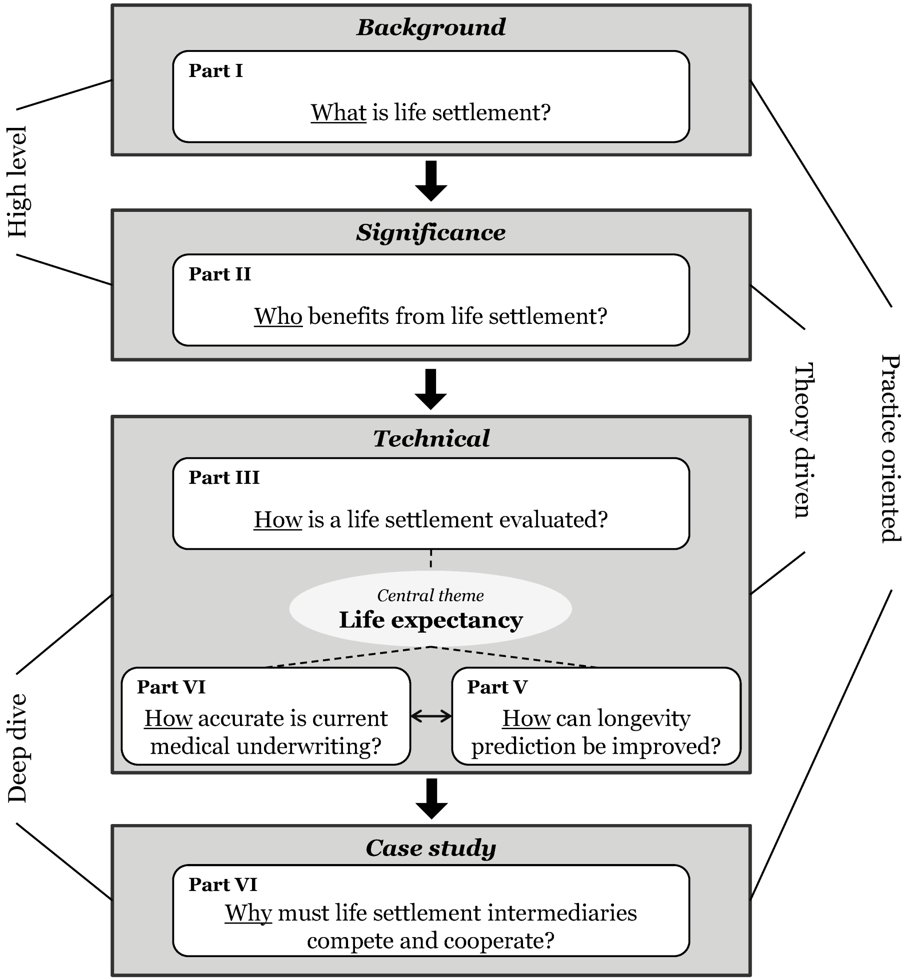
Abstract

Connecting life insurance policyholders with potential investors (called Life Settlement Providers), Ashar Group plays a pivotal role in the industry. Its current position is however increasingly being challenged by consumer-direct models, led by major providers seeking to shortcut brokers. Ashar faces a strategic dilemma in cooperating — but also competing — with these providers. Maintaining a mutually beneficial dynamic with policyholders, downstream intermediaries and other actors thus constitutes a balancing act. The context of this case is an underdeveloped market whose reputation has suffered from broker misconduct. In light of the market's legacy issues and competing business models, this case study explores strategies Ashar may pursue to secure and enhance its market position. Discussions emerging from this case study have the potential to illuminate directions for market transformation.

Publication Medium

Harvard Business School Case 218-109, May 2018

Figure 1: Structural components of this dissertation



Part I

Introduction to Life Settlement

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Abstract

This primer hones in on the secondary insurance market (the "life settlement" market) in the United States. We review the historical emergence of the market and, through descriptions of the market players and activity, characterize the market mechanics. By discussing legal, ethical and societal issues revolving around life settlement, we highlight current challenges and opportunities. We also provide insights for both life insurance policyholders and investors who use life settlement as a financial tool.

Professors Alexander Braun, Lauren H. Cohen, Christopher J. Malloy and Doctoral Student Jiahua Xu prepared this note as a basis for class discussion.

Life insurance is an asset owned by the majority of American adults (61%). Note that this 61% penetration rate is essentially at parity with home ownership (64%), and higher than that of 401(k) retirement account ownership (53%).[1] Life settlements, or life insurance settlements, allow individuals to sell their life insurance policy in a secondary market. A life insurance policy is a tradable asset, for many individuals possibly the most valuable one in their portfolio after real estate and perhaps a retirement account. The fact that the policy is tradable, however, is hardly known to the general public. When surrendering a policy to the insurance carrier, the policyholder often incurs a substantial discount on its economic value (Cohen 2013, p. 1). At the same time, the insurer keeps the difference between the policy's economic value and its surrender value. By selling a policy in the secondary market, in contrast, it is common to achieve a price markedly above the surrender value. Hence, life settlements allow policyholders to capture a much larger, if not full, share of their contracts' economic value.[2]

1 Life Settlement: a Brief History

The first legal case involving a life settlement was Grigsby v. Russell in 1911, in which the Supreme Court ruled that a Dr. Grigsby, who bought a patient's life policy and paid the premiums until the patient's death, was entitled to the death benefit proceeds from the insurer.[3] The decision bestowed upon life policies the ordinary characteristics of private property, and since then the transaction of a life policy has had a legal basis.

However, secondary sales of life insurance were rarely documented until the outbreak of the HIV/AIDS epidemic in the U.S. during the late 1980s. At that time, HIV/AIDS patients were mostly unmarried younger males who owned life insurance policies through their employers. Since their policy beneficiaries (usually their parents) were not in need of money and the projected lifespans once diagnosed were modest, policyholder-patients preferred to sell their life policies in exchange for a lump-sum payment to fund their expensive medical treatments or to simply improve their financial situation while still alive.[4] Policy buyers were willing to purchase the policies with expectations that the death benefit would soon be realized, given the post-diagnosis HIV/AIDS mortality rates at the time. Such transactions involving the life insurance policies of terminally ill insureds are termed **viatical settlements**.

[1] "Life Insurance Statistics – The News Ain't Good," https://www.accuquote.com/other/interesting-life-insurance-statistics/, "Quarterly Residential Vacancies and Homeownership, First Quarter 2018," https://www.census.gov/housing/hvs/files/currenthvspress.pdf, "Here's how many Americans don't have access to a 401(k) plan," https://www.cnbc.com/2018/03/12/how-many-americans-dont-have-access-to-a-401k.html, all accessed May 2018.

[2] Whether the full economic value can be captured depends on the pricing of life settlement and the transaction cost.

[3] Grigsby v. Russell, No. 53. 222 U.S. 149 (1911), see https://www.leagle.com/decision/1911371222us1491348, accessed May 2018.

[4] "History of Life Settlements in the US," Life Insurance Settlement Association, http://www.lisa.org/industry-resources/history-of-life-settlements-in-the-us, accessed May 2018.

Treatments for HIV/AIDS progressed quickly, much more quickly than patients or policy purchasers had accounted for. This caused the viatical settlement market for insureds with HIV/AIDS to collapse — with policies that were still in force at the time returning markedly negative investment returns to buyers.

Moreover, with the HIV/AIDS market as a cautionary tale, along with the continuous development of medical technologies more broadly,[5] the number of policies available for viatical settlements across all disease-types never fully recovered following the collapse of the market in the mid-1990s.

Nevertheless, the idea of trading life policies did re-emerge. Specifically, in 1999, Alan Buerger founded Coventry First LLC ("Coventry"), a life insurance settlement provider, in Fort Washington, Pennsylvania.[6] The firm bridged insurance and capital markets by carrying out arguably the first non-viatical life insurance settlement, and is deemed to be the creator of the modern life settlement market.[7] This market largely focuses on individuals who either no longer have a need for their insurance policy (because their children are fully grown and financially independent) or have an urgent use for the cash value built up in their policy (such as funding long-term or end-of-life care). While the latter case used to be the dominant driver of viatical settlements, the former is currently the most prevalent reason for a policy sale.

Over the years, Michael Freedman, Senior Vice President of Government Affairs at Coventry, drove the promulgation of multiple federal laws in addition to over 60 pieces of life settlement legislation.[8] With the enormous effort from Buerger, Freedman, and other market players, today's market environment for life settlements has become increasingly regulated. This is further discussed below.

2 The Mechanics of Life Settlements

2.1 The life insurance markets

The life settlement market uses the following terminology to describe three submarkets of life insurance (see Figure 2 for interactions between them):

[5] The antiretroviral therapy developed and improved over the last decades can now significantly extend HIV patients' life span.

[6] "Company Overview of Coventry First LLC," Bloomberg, https://www.bloomberg.com/research/stocks/private/snapshot.asp?privcapid=138553029, accessed May 2018.

[7] Coventry, "About Coventry – Our History," http://www.coventry.com/about-coventry/our-history/, accessed May 2018.

[8] Michael Freedman, "7 Ways the Law Protects Seniors Who Sell Their Life Insurance Policies," Life Insurance Settlement Association, September 21, 2016, http://www.lisa.org/life-policy-owners/consumer-news/2016/09/26/7-ways-the-law-protects-seniors-who-sell-their-life-insurance-policies, accessed May 2018.

The *primary market* is where the everyday issuance of life insurance policies takes place. The insurer collects periodic premium payments from the policyholder starting on the issue date, and pays the death benefit to a designated beneficiary upon the insured's decease.

In the *secondary market*, the original policyholder transfers the life insurance policy to an investor. The investor assumes the obligation to continue paying the premium payments in order to keep the policy in force, in exchange for receiving the death benefit when the insured dies. The investor becomes the new policyholder and beneficiary, but the policy's underlying insured participant remains unchanged.

In the *tertiary market*, investors trade already-settled life insurance policies between themselves.

As opposed to the initial issuance of a life policy by an insurer, which occurs in the primary market, life settlements are transactions in the secondary market for life insurance where the original insured or the current policy owners literally "settle" their contracts with investors. More generally speaking, "life settlement" can be used as an umbrella term for any trading activity of a life insurance policy, whether the original policyholder is the selling party or not.

2.2 Life settlement parties

A typical life settlement transaction involves various intermediaries, third-party servicers and other stakeholders in addition to the seller and buyer (see Figure 3 for a simplified life settlement deal flow):

Sell side

Policyholders own the policies and must pay sufficient premiums to prevent coverage from lapsing. A policyholder is usually an individual, but can also be a trust or corporation.[9]

Life insurance agents advise policyholders on their choice of policy. In the event that a policy is no longer desired, the agent is responsible for informing the policyholder of the option of a life settlement and facilitating the settlement process.

Life settlements brokers represent policyholders. Their job is to find the best price for their clients by soliciting competing offers from as many as buyers as possible.

[9] ValMark Securities, Inc., "Introduction to Life Settlements," November 11, 2014, http://www.hammerassociates.com/sites/default/files/users/hammerassociates/Introduction%20to%20Life%20Settlements%206-17-2014%20docx.pdf, accessed May 2018.

Buy side

Investors, historically known as funders, are policy buyers and ultimately bear the risk in a life settlement investment. After ownership has been transferred from the policyholder to the investor, the investor is responsible for paying the premiums and has the right to claim the death benefit when the original insured passes away. An investor can be an individual but is more commonly a bank or a fund. For tax purposes, the investor is often fronted by a special purpose vehicle (SPV) domiciled outside the U.S.

Fund managers manage life settlement funds on behalf of investors. They are responsible for policy selection and purchasing, risk management, performance reporting etc. Fund managers usually charge a management fee, which is a percentage of investors' capital drawn, and a performance fee based on the fund's return.

Life settlements providers are contractually the legal counterpart of policyholders and the investor, i.e. they are a principal in the transaction. In most states, a licensed provider is required in a life settlement. Providers' primary role is to negotiate the price of a policy on behalf of the buyer. Providers usually represent investors and resell policies to them instantaneously after purchase. In limited cases, providers also warehouse policies or even invest in life settlements themselves.

Third-party service providers

Medical underwriters, also known as life expectancy providers, evaluate the insureds' health conditions and forecast their life expectancies, based on which the policy values can be estimated.

Servicers manage premium payments and process death claims. They also optimize premiums and ensure that policies are in good standing by periodically verifying coverage with the carrier.

Tracking agents monitor changes in insureds' health status through either direct personal contact or by accessing public data, e.g. the Social Security database. They may also be responsible for obtaining death certificates and processing a claim.

Custodians / Trustees safeguard policy-related documents. They often act as the legal owner of policies while investors remain the beneficiary.

Other stakeholders

Insureds are those whose lives are referenced by the policies. Prior to a life settlement, typically insureds are policyholders and their dependents are the beneficiaries. The insured's health history is generally required for a life expectancy estimation, a key factor in policy pricing. When the document is not publicly accessible,[10] the insured may be contacted by his/her policy sellers (or sellers' delegates) to provide the latest information, usually with monetary remuneration. An insured might, however, refuse to disclose his/her personal health status, which would force a life expectancy estimation to be made based on the old record, or lead to an unclosable deal.

Carriers, or insurers, are insurance companies that issue the policies originally. They receive premiums and pay death benefits upon the insureds' deaths.

Note that roles can merge: one entity can perform multiple functions. For example, some providers and brokers also provide services such as medical underwriting and health record tracking; certain medical underwriters and servicers also offer tracking; many fund managers also invest their own money in the life settlement funds they manage. Certain roles can be dispensable in a transaction: as the economic pressure drives disintermediation in the market, a few providers are adopting a "consumer-direct" model to remove brokers from the transaction process. Table 1 presents a list of selected firms that are currently active in the life settlements space and their respective roles.

2.3 Life settlement valuation

A key aspect in life settlement transactions is the valuation of the life insurance policies. Conventionally, pricing is conducted using a classical actuarial model based on the policy's cash flow profile (premiums and death benefits) and the insured's life table (composed of periodical survival probabilities):

$$P = -C - \pi_0 + \sum_{i=1}^{\infty} \frac{({}_{i-1}p_x - {}_ip_x) \cdot DB - {}_ip_x \cdot \pi_i}{(1+r)^i}$$

P: purchase price.

C: total transaction cost including fees paid to intermediaries.

DB: death benefit.

${}_ip_x$: the probability that an insured, aged x at time 0, will be alive at time i; the probability that the insured will die between time $i-1$ and i can thus be expressed as $({}_{i-1}p_x - {}_ip_x)$; the insured's life expectancy can thus be expressed as $\sum_{i=1}^{\infty} {}_ip_x$.

π_i: premium to be paid at time i.

r: internal rate of return, also known as discount rate.

Not every policy is economically viable to life settlement investors. For investment valuation, the employed internal rate of return can vary significantly, typically ranging

[10] This happens only occasionally since it is nowadays standard in the market to obtain an insured's HIPAA (Health Insurance Portability and Accountability Act) release form.

between 10% and 25%.[11] Policies with a low premium/death benefit ratio and/or short insured's life expectancy, are more likely to be priced attractively given the aforementioned return threshold, and thus have a higher chance of entering the secondary market. Again, it should be emphasized that the life settlement market is heavily intermediated. Research indicates that transaction costs, such as commissions and third-party fees, can account for 50 to 67 percent of the policies' intrinsic economic value (Jones 2005, p. 34).

3 Market Activity

With a combined amount of over 2.5 trillion dollars per annum (Figure 4), the face value of lapsed and surrendered life insurance in the U.S. is tantamount to the real estate market loss during the recent global financial crisis (average depreciation of $2.3 trillion p.a. from 2007 to 2009). Despite this large-scale disposal of life policies, only a tiny portion thereof is resold into the life settlement market. In its heyday in 2008, the secondary market peaked at $60.2 billion of face transacted. Thereafter, the tertiary market, where already-settled policies are transacted among investors, has attracted fresh capital, while the volume of new policies entering the secondary market has declined. Interestingly but unsurprisingly, academic attention to life settlements has paralleled the volume profile of the secondary market (Figure 5).

A fall in demand possibly explains the market decline post 2008. Decreasing investor appetite due to fraudulent activities, severely misestimated life expectancies, and deliberately inflated portfolio values may be key issues here. In order to provide the insured with the opportunity to settle in the future, there was widespread sentiment in the industry about the need to drive bad actors out of the industry, and restore trust among investors.

4 Problematics and Controversies

4.1 Legal issues

While it is legally permissible to rename a beneficiary who does not have an interest in the insured's life ("an insurable interest"), a life insurance policy transacted in a life settlement must be a valid one, i.e. it must have been applied for in a lawful way ab initio. Two minimum parameters are required: (1) the insurance applicant must be honest when the policy is being underwritten; (2) the original policyowner must have

[11] AA-Partners, "AAP Life Settlement Valuation – Manual," 2017, http://www.aa-partners.ch/fair-value-valuation/, accessed May 2018.

an insurable interest. Life insurance settlements in violation of either one of these two conditions have become precedents for serious legal consequences.

In 2007, Stephen Keller, founder and owner of Kelco Inc, a Kentucky-based viatical company established in 1992, was found guilty of fraud in connection with the operation of his firm, and charged with a 120-month sentence.[12] Insurance companies typically decline coverage to individuals with a terminal illness. Kelco knowingly acquired life policies owned by HIV patients who were aware of their health status yet fraudulently took out insurance – often in the form of multiple policies. Those policies were then resold to investors; however, death claims were later refused on the grounds that the carrier deemed the policies to be void.

The issue of "insurable interest" has precedent in eighteenth century U.K., when members of the middle class started to gamble on death by taking out life policies on celebrities who were known to have health problems. While the Life Assurance Act passed by Parliament in 1774 forbade taking out a policy on another person's life without any insurable interest (Fleisher 2010, p. 571), the concept did not altogether disappear. Stranger-originated life insurance policies ("STOLI") were still allowed in some part of the U.S. in 2007.[13] Due to regulation loopholes and an appetite from investors, STOLIs were mass manufactured in the mid-2000s, resulting in numerous legal debates. To date, 126 legal cases concerning STOLI have been decided (Figure 6); with more either settled privately or still ongoing. In 2007, the NCOIL (National Conference of Insurance Legislators) model act officially defined STOLI as the initiation of a life policy for the benefit of a third-party investor, who lacks insurable interest at policy origination. The model act further states that STOLIs violate insurable interest laws and are prohibited due to their nature of wagering on life (Cole and Mccullough 2008, p. 79). Over the past decade, most states also passed laws to ban STOLIs. Today, STOLIs are a pariah in the life settlements industry.

In addition to issues arising from policy origination, medical underwriting is another aspect that has been historically susceptible to fraudulent behavior. From the perspective of a life settlement investor, both expected cash outflows (premium payments) and expected cash inflows (death benefits) depend on insureds' life expectancies (see Figure 7 for an exemplary realization of the cash flow stream on both the individual policy and portfolio level). Therefore, the distortion life expectancy estimates (LEs) has become a popular way to manipulate policy valuation. During the years of their operation, Amscot Medical Labs and Midwest Medical Review, both purportedly controlled by M.D. George Kindness, issued unreasonably short LEs, inducing substantial overpayment for policies.[14] Even after the indictment of the sham doctor Kindness,

[12] USA v. Keller, Nos. 05-6562, 05-6725. 498 F.3d 316 (2007), see https://www.leagle.com/decision/2007814498f3d3161814, accessed May 2018.

[13] SPV-LS, LLC v. Transamerica Life Insurance Company, No. CIV 14-4092. (2016), see https://www.leagle.com/decision/infdco20161209c70, accessed May 2018.

[14] State of Texas v. Retirement Value, LLC, NO. D-1-GV-10-000454 (2011) see https://www.ssb.texas.gov/sites/default/files/files/news/RetirementValueNoticeFilingReceivers_04-30-2011.pdf, accessed May 2018.

a number of life settlement brokers and providers continued to accept the knowingly unreliable LEs from Kindness's underwriting firm Midwest.[15] Later, in 2013, the SEC charged Life Partners Holdings Inc. for employing an ineligible medical underwriter, Donald T. Cassidy, to issue unfounded LE estimates, which had been systematically and materially underestimated.[16] The State of Florida, home to many retired people, spearheaded the regulation of medical underwriters by enforcing the triennial filing of a mortality table and A/E (actual to expected) death results.[17] Texas followed by regulating underwriters through a licensing requirement.[18]

Legislation of life settlements is complicated by the fact that the U.S. life insurance industry is regulated at the state — as opposed to federal — level. Thus, depending on the state, life settlements may be subject to securities regulations (Casey and Sherman 2007), as well as tax (Gardner et al. 2009) and privacy laws (Casey 2007).

4.2 Ethical and societal disputes

Despite the increasingly regulated environment, ethical controversy still surrounds the life settlement market due to the popularized industry image of "wagering on death" (Kohli 2006). Nurnberg and Lackey(Nurnberg and Lackey 2010) bluntly state that life settlements are pure betting that have "nothing to do with wise choices made by the investors."

A more tangible drawback was the possibility that an expansion of the life settlement market might trigger widespread increases in insurance premiums, which might hurt young families and small business owners who needed the coverage for basic financial protection (Martin 2014, p. 122). The reason was that insurance companies, although they sometimes denied it, included lapse rates in their policy pricing (Quinn 2008, p. 750). Life settlements lowered the policy lapse rates and reduced insurance companies' margins. As a consequence, life insurance companies might raise premium rates in order to balance their profit level.

Of course while life settlements seem to erode the profitability of the life insurance industry at first glance, this might not be the case in the long run. Secondary markets for financial products provide liquidity and thereby enhance their value. This value enhancement usually feeds back to the primary market through an expansion of demand (Doherty and Singer 2003, p. 478). Ultimately, life insurance carriers could benefit from a competitive secondary market (Gatzert et al. 2009, p. 905). Rather than

[15] SEC v. Secure Investment Services, Inc., No. 2:07-cv-01724-LEW-CMK. (2007), see https://www.casewatch.org/sec/neuhaus/secure.shtml, accessed May 2018.

[16] SEC v. Life Partners Holdings, Inc., No. 1-12-CV-00033-JRN. 41 F.Supp.3d 550 (2013) see https://www.leagle.com/decision/inadvfdco150521000534, accessed May 2018.

[17] The 2017 Florida Statutes § 626.99175 (2017), see http://www.leg.state.fl.us/Statutes/index.cfm?App_mode=Display_Statute&URL=0600-0699/0626/0626.html, accessed May 2018.

[18] Texas Department of Insurance (2017), see http://www.tdi.texas.gov/forms/fincolicense/fin430lifesetapp.pdf, accessed May 2018.

lobbying to eliminate the life settlement industry, insurance companies might embrace it and make use of life settlements to identify, concentrate, and hedge the risks (Mott 2007).

Life settlements also drive increased scrutiny of longevity risk, an issue that affects human societies worldwide. In recent decades, the West in particular has witnessed a trend of subtly shifting longevity risk to the consumer. This is tellingly evidenced in changes made to pension schemes: defined benefit schemes have often been phased out and replaced with defined contribution plans (e.g. 401(k) in the U.S.). Pensioners are no longer guaranteed a fixed payment until death under defined contribution plans, and instead must bear the risk of the annuity market at retirement, as well as the risk of financial markets in between. As societies age and the traditional pay-as-you-go social security systems come under added pressure due to the changing worker-to-retiree ratio, the ability to determine accurate life expectancies becomes increasingly important. An open market in life expectancies, enabling the wisdom of the actuary to be replaced by the wisdom of crowds, could serve as a potential conduit to that accuracy. A properly functioning life settlement market could possibly offer that window in a way that many macro-longevity markets could not (Sheridan 2014).[19]

5 Life Settlement as a Financial Tool

5.1 From the perspective of policyholders

For original policyholders who wish to discard a policy, a life settlement is almost always a better option than lapsing or surrendering: when choosing between getting something and virtually nothing from an unneeded asset, the former is the obvious pick. The proceeds can fund a comfortable retirement, or ameliorate the devastation of severe diseases, helping insureds spend their remaining life with comfort, peace, and dignity (Quinn 2008, p. 759).

Insureds are often the best judge of their own health condition and they can take advantage of this information asymmetry in deciding what to do with their life insurance policy. Between opting for a life settlement or keeping a policy, the former is the more rational choice economically when the insured believes him/herself to live beyond the point where the death benefit starts to be exceeded by the overall cost including all the premiums and their time value — a risk that the life settlement company can better absorb than an individual policyholder given the pooling concept (Leimberg and Gibbons 2003, p. 521).

In addition to the aforementioned benefits, a life settlement can also remove the policy from the taxable estate and put more cash into a business, an acquisition, or an individual's retirement (Friedman 2004, p. 51).

[19] Pension buy-ins / outs for example are too large and infrequent.

It is, however, advisable for individual policyholders to compare various options, e.g. disposing of policies through life settlement vs. keeping policies in force through borrowing when it becomes unfeasible to self-finance the premiums. It should also be noted that life settlements can be performed through multiple avenues. Policyholders should be aware that they can sell their policies "consumer-direct" or via a broker. Both approaches have their pros and cons: through the consumer-direct channel, policyholders can save the broker fee by selling directly to life settlements providers or even investors, but face the risk that they might not get the most competitive price. By using a broker, policyholders must pay a certain fee, but the hired broker has the fiduciary duty to negotiate the highest price for the sellers.

5.2 From the perspective of investors

Since the insured's remaining life time — the primary driver of a life settlement return[20] — is independent from the highs and lows of traditional financial markets, life settlements have a low observed correlation with other asset classes (Bajo-Davo et al. 2013, p. 22). Due to this characteristic, introducing life settlements into an investment portfolio can enhance diversification. There are several approaches to investing in life settlements. An open-end life settlements fund acts much like a stock fund where investors can enter and leave over time based on a mark-to-market valuation. In a closed-end structure, all investors join at the initial investment period and are then "locked in" until the fund's maturity date. Investors capture the returns from death benefits and any residual returns from the market sale of any in-force policies that remain. As they typically hold over a hundred policies, life settlement funds are — at least theoretically — in a better position to diversify idiosyncratic longevity risk than individual investors. Although it barely occurs due to the aforementioned risk and tax reasons, investors could theoretically make direct investments in life settlements without being involved in a fund.

While life settlements could potentially generate attractive returns for investors, the longevity risk the asset class entails, if not properly estimated, could be detrimental to performance. In the past, the tendency to systematically understate life expectancy estimates had resulted in large negative impacts on life settlement investments, leading to portfolio distresses (e.g. EEA Life Settlements Fund[21]), liquidations (e.g. ARM

[20] To be precise, we refrain from using the term "life expectancy" here, which is produced ex ante and determines the purchase price, whereas the actual "remaining life time" can only be determined ex post and drives the realized return.

[21] David Trinkwon, "EEA Investors' Group Update," October 2, 2017, http://eeainvestors.com/wp-content/uploads/UPDATE-20180316.pdf, accessed May 2018.

Life Settlement Fund[22]), write downs (e.g. Assured Fund[23], AIG[24]), foreclosures (e.g. Lifetrade Fund[25]) and bankruptcies (e.g. New Stream Secured Capital[26]). In addition, the long maturity nature of life settlement investment provides unscrupulous asset managers the time and opportunity to overvalue their portfolios before risks are exposed (Braun et al. 2015).

Aside from longevity risk, investments in life settlements involve other risk types such as: 1) *premium risk*, which pertains to an increase in premiums of an in-force policy, 2) *default risk*, which is linked to the uncertainty in the insurance carrier's ability to pay death benefits should financial distress occur, 3) *rescission risk*, which is associated with insurance carriers' refusal to pay the death benefit due to a lack of insurable interest or other fraudulent behavior at issue, 4) *liquidity risk*, which describes the ability of investors to liquidate their assets in a crisis, 5) *foreign exchange risk*, which is relevant when the life settlement fund is raised in currencies other than U.S. dollars, and 6) *legal and political risk* that can put investors in an unfavorable position due to change in laws or policies (Braun et al. 2012, pp. 216–222). Therefore, potential investors, while drawn to the attractive portfolio characteristics of life settlement investments, were also justifiably weary of the considerable risks involved in this asset class.

6 Summary

This note describes the historical development and operational mechanics of the life settlement market in the United States. It also discusses salient legal, ethical and societal issues surrounding life settlements. While many issues that currently plague the industry are yet to be resolved, and the market has yet to be transformed into a transparent, competitive, and regulated one, life settlements had the potential to become a powerful financial tool for both policyholders and investors.

[22] William Robins, "ARM life settlement fund appoints liquidators," Citywire, October 15, 2013, http://citywire.co.uk/new-model-adviser/news/arm-life-settlement-fund-appoints-liquidators/a709523, accessed May 2018.

[23] Ruth Emery, "Assured Fund Imposes Exit Restrictions on Investors," Money Observer, May 17, 2011, http://www.moneyobserver.com/news/17-05-2011/assured-fund-imposes-exit-restrictions-investors, accessed May 2018.

[24] Zachary Tracer, "AIG Has $832 Million Cost on Death Bets as Hedge Funds Gain," Bloomberg, February 14, 2014, https://www.bloomberg.com/news/articles/2014-02-14/aig-takes-832-million-charge-on-death-bets-as-hedge-funds-gain, accessed May 2018.

[25] Donna Horowitz, "Wells Fargo Issues Foreclosure Notice Against Lifetrade Fund Sep 2012," The Life Settlements Report, VI(15):8–9, September 6, 2012.

[26] Dan Rivoli, "Creditors Slam Financing Plan in New Stream's Ch. 11," Law360, April 13, 2011, https://www.law360.com/articles/238951/, accessed May 2018.

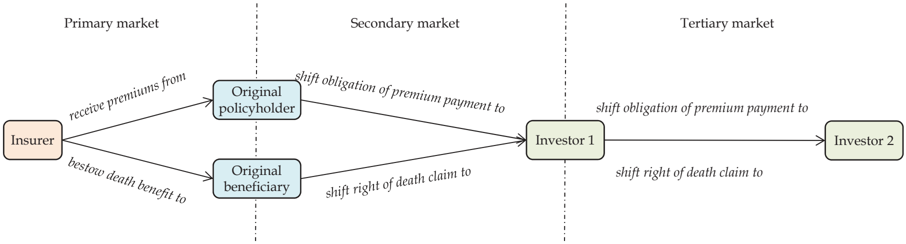
Table 1: Major players in life settlements

Role	Firm
Broker	Ashar Group, LLC
Broker	Welcome Funds Inc.
Broker	Ashar Group, LLC
Broker	Welcome Funds Inc.
Investor	Apollo Global Management LLC
Investor	American International Group Inc
Investor	Resscapital AB
Investor	Carlisle Management SCA
Provider / Servicer	Coventry First LLC
Provider / Servicer	Maple Life
Provider	CMG Life Services Inc
Provider	GWG Life Settlements LLC
Provider	Berkshire Settlements Inc
Provider	The Lifeline Program
Medical underwriter / Servicer	ITM TwentyFirst LLC
Medical underwriter	AVS Underwriting LLC
Medical underwriter	Fasano Associates
Servicer	Asset Servicing Group LLC
Trustee	Wells Fargo

Source: LISA (Life Insurance Settlement Association) members, see http://www.lisa.org/find-a-lisa-member; The Life Settlement reports, The Deal.

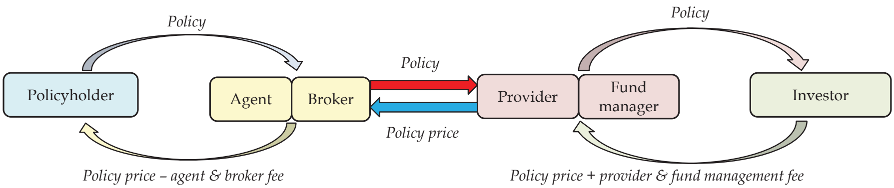
Note: The list is non-exhaustive.

Figure 2: Dynamics of life insurance submarkets



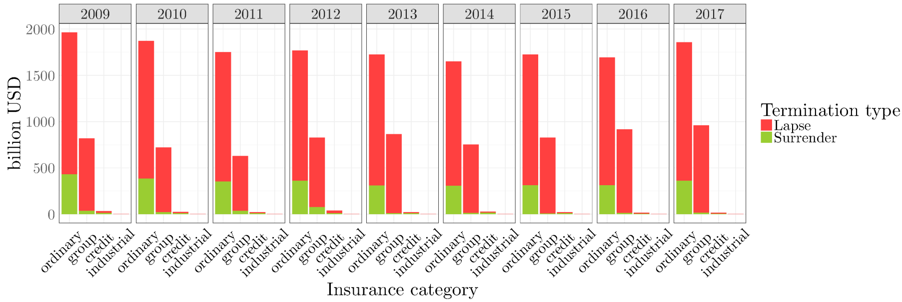
Source: Authors' own illustration.

Figure 3: Life settlement deal flow



Source: Braun et al. (2018a). Asahr Group: Brokers and Co-opetition in the Life Settlement Industry. *Harvard Business School Cases*, Issue 9-214-109.

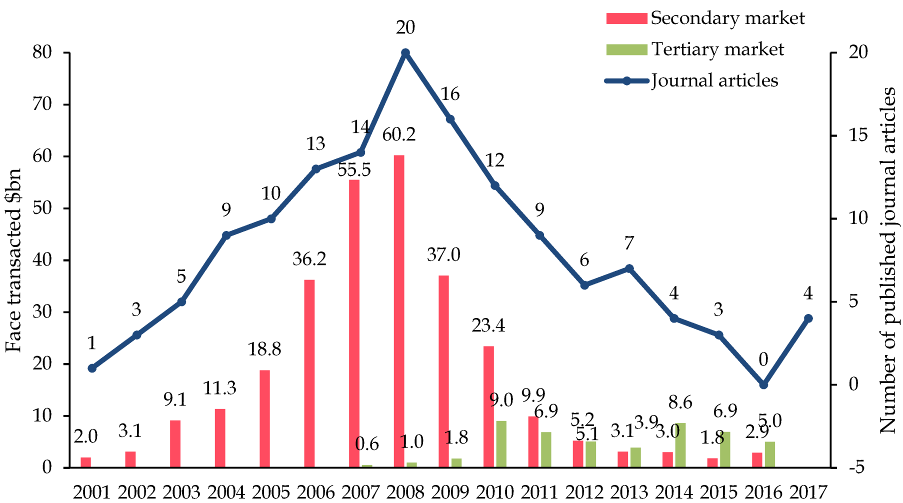
Figure 4: Annual face value terminated



Source: The U.S. Life industry Briefing book, SNL financial (S&P Global Market Intelligence).

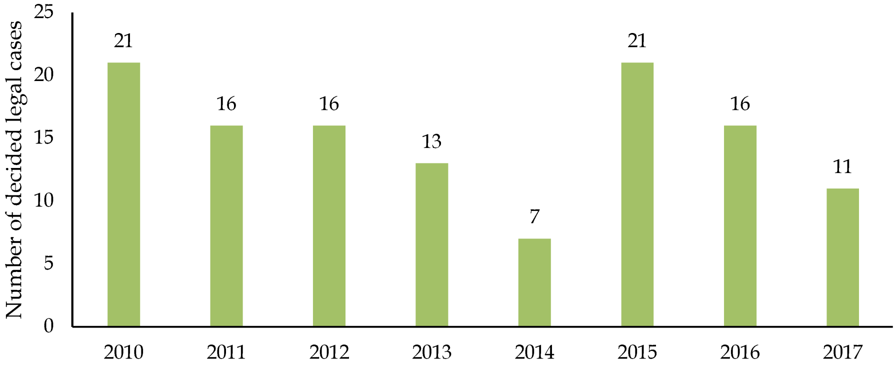
Note: Insurance categories: ordinary — individual life insurance; group — often offered through the workplace; credit — primarily offered by lending companies; industrial — burial insurance.

Figure 5: Annual face transacted vs. number publications



Source: Roland (2016). Life Settlement Tertiary Market Dynamics. Fasano 13th Annual Longevity Conference, Washington; AA-Partners (2016). Annual Transaction Volume for Secondary and Tertiary Market & Outstanding Total US Life Settlement Volume.

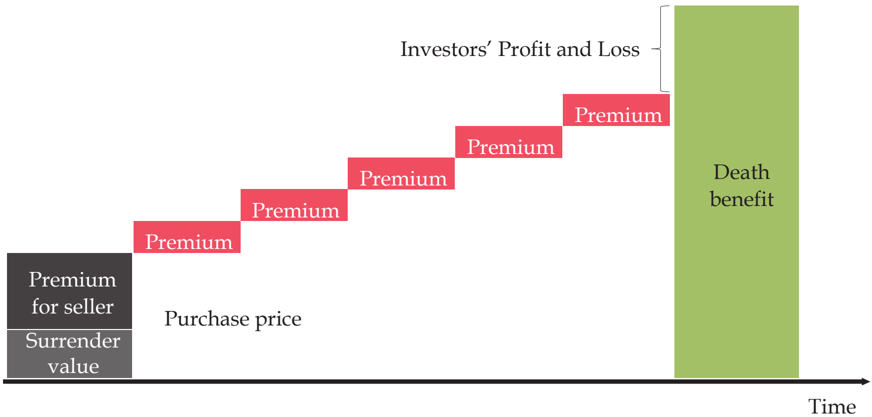
Figure 6: STOLI legal cases decided



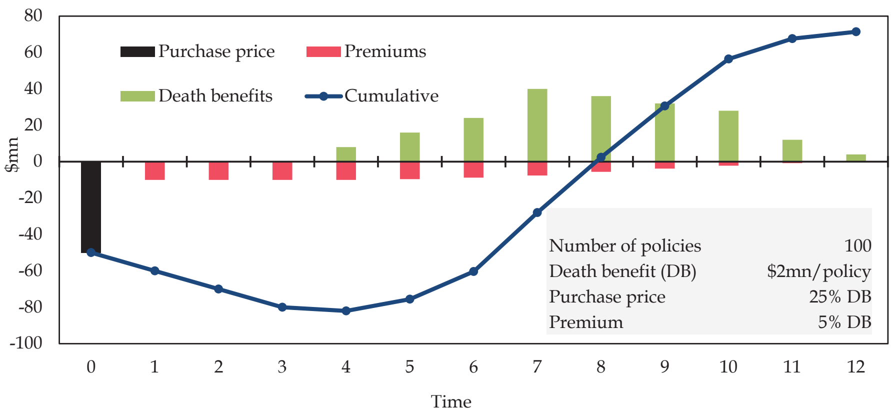
Source: Authors' own illustration based on data collected from https://www.leagle.com/, accessed May 2018.

Figure 7: Exemplified life settlement cash flows

(a) Individual policy level



(b) Portfolio level



Source: Braun (2017). Securitization of Life Settlements: Challenges and Opportunities. *AAP Life Settlement Roundtable*, Zurich.

Part II

Saving Face: A Solution to the Hidden Crisis for Life Insurance Policyholders

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Abstract

The total face amount of terminated life insurance in the U.S. amounts to over two trillion dollars per annum. Little known is that, instead of allowing insurance carriers to pocket the premiums paid until termination and avoid the death claim, many policyholders may realize their policies' value through resale to the secondary market, and receive a lump-sum markedly above the surrender value. We demonstrate how the inclusion of a mandated secondary sale provision in a policy contract will affect — and ultimately benefit — the welfare of policyholders without negatively affecting that of insurance companies.

This paper was presented at Harvard Business School Seminar Fall 2017. We thank participants for their comments.

1 Introduction

Over 33 million life insurance policies have been terminated prematurely[27] each year since 2008, giving rise to a combined face value of $2.5 trillion dollars (Figure 8), roughly equivalent to the real estate market loss through the recent global financial crisis ($2.3 trillion p.a. from 2007 to 2009) (Federal Reserve 2012, p. 113). While the losses in the housing market have triggered hundreds of academic papers, media firestorms, industry responses, as well as numerous regulatory and policy changes, there has been no such reaction to the apparently commensurate policyholder losses in the life insurance market. Little known to the average person is that the intrinsic value of a life insurance policy can be realized through a secondary sale: a so-called life settlement. The average price for a life insurance policy sold to the secondary market is $340,000,[28] over three times as large as the average American's 401(k) savings ($104,300) (Campbell 2018). The amount policyholders forego in personal wealth through life insurance termination, deliberately or not, is staggering — hundreds of billions of dollars over the past decade alone.

This crisis has been largely hidden from the general public as the scale of the problem is not widely understood. We suggest a simple and low-cost policy mechanism for rectification and demonstrate its positive impact on the utilitarian social welfare. The proposed reform involves mandated offer-for-sale treatment of life insurance policies: whenever a life insurance policy is to be terminated, it would immediately be placed in the secondary market for sale. The new equilibrium would yield more equitable risk transfer and value realization, which could go a long way to prevent the billions of dollars in annual policyholder value currently being misdirected.

The remainder of the paper is structured as follows: Section 2 reviews current practices and issues in the life insurance market; Section 3 proposes a reform to address the issues; Section 4 demonstrates the welfare-enhancing effect of the proposed reform; Section 5 discusses the operationalization of the reform; Section 6 concludes.

2 Current State of the Life Insurance Market

2.1 The secondary market of life insurance

The value of a policy depends on an insured's life expectancy in relation to premium rates. Life settlement investors are interested in policies held by insureds with comparatively short life expectancies. These are typically elderly people with a health impairment. Unlike viatical settlements, which involve terminally ill insureds, life

[27] This includes policies lapsed and surrendered. Source: The U.S. Life industry Briefing book of the SNL financial (S&P Global Market Intelligence).

[28] Data from AA-Partners.

settlements mainly focus on senior insureds: from 2011 to 2016, the insured's average age at settlement date was 76.3. Although smaller-face policies have started to gain traction, due to inefficiency in the market, investors continue to show preference for large-face policies. Over the last five years, the average face amount transacted was as high as $1.9 million with a median of $1 million. Consequently, settled policies mainly tend to originate from California, New York, Florida and Texas, where older, wealthier people are more likely to retire and reside (Blake et al. 2013, p. 513) (Figure 9). On average, the transaction price is 18% of the policy's face value. Currently, the total face amount of settled policies that are still in force is $100 billion (Roland 2016).

Investors usually have an insured's medical history analyzed before making a purchase. Since medical information for insureds whose policies have been terminated is generally unavailable, it is difficult to empirically assess how many of those policies would have qualified for a secondary sale. The estimated size of the untapped life settlement market is commonly represented by the total face amount of ordinary life insurance terminated by seniors above 65 (Welcome Funds 2013), which approximates $148 billion (see Figure 11).[29] If this market potential had been fully realized, the size of the life settlement market would have increased by 50-fold by now.

With roughly $148 billion of face value eligible for settlement in 2017 (and similar values for other years), how much could the original policyholders have expected to receive through settlement? Using the average empirical "transaction price / face amount" ratio of 18%,[30] we arrive at an estimate of $26.6 billion. That is to say, had those policyholders sold their policies to life settlement investors instead of terminating them, they would have received an aggregate $26.6 billion in cash. To put it into perspective, this amount exceeds the drug invoice spending for long-term care and home health care in the U.S. in 2017, which was $20.6 billion (IQVIA 2018).

Apart from low awareness, another reason for the underutilization of life settlements is some people's distrust of the industry due to its troubled past. The industry is to some extent still challenged by its legacy issues associated with "STOLIs", or stranger-originated life insurance policies mass produced by life settlement intermediaries and investors in the mid-2000s (Braun et al. 2018b). As the industry becomes increasingly regulated, misconducts such as STOLIs are thankfully becoming less common.

However, the strongest headwind at the moment originates from an "unhealthy" pricing dynamic endogenous to the mechanics of the current U.S. life insurance market. The following discussion highlights unsustainable practices in the industry and identifies salient shortcomings.

[29] It should be noted that not all policies from insureds above 65 are economically viable as a life settlement, and this results in overestimation. On the other hand, policies from younger insureds and group policies are occasionally also settled, which leads to some underestimation. We suppose those two effects offset each other to some extent, and the estimator's net deviation from reality is insignificant.

[30] Derived from AA-Partners' database.

2.2 Lapse-supported pricing

When carriers employ lapse-supported pricing, they set competitively low premiums to gain market share (Richmond 2012, p. 661), expecting that they will not have to disburse some of the death benefits. A gain in market share through low premiums is, however, only a short-term win.

The carriers' perspective

Carriers set premiums such that they would at least break even from the transaction, should their assumptions on termination and mortality be accurate. Policy termination impacts carriers to varying degrees depending on insureds' characteristics. Termination on the part of young and healthy insureds with long life expectancies harms carriers, as the latter would ordinarily receive premiums from those insureds for an extended period and pay out death benefits in the distant future. On the other hand, termination from more senior and unhealthy insureds, with short life expectancies, brings carriers windfall profits, as they are relieved of the obligation to pay out the death benefit in the near future — significant amounts compared to the foregone premium payments (Leimberg et al. 2006). Consequently, persistency from older or unhealthy insureds, when unanticipated, harms carriers' profitability.

Carriers' profitability heavily depends on the termination of insureds with short life expectancies, as they are not financially prepared to disburse death benefits to those insureds' policies. Termination by these insureds is essentially utilized by carriers to (i) set competitively low premiums to gain market share; and (ii) counterbalance the loss of good risks from their books, due to termination on the part of young and healthy insureds.

Just as price and demand influence each other in conventional markets, the carriers' premium setting and the insureds' termination behavior reinforce each other: carriers anticipate certain termination patterns among insureds and set the premiums accordingly; the insureds' termination behavior is correspondingly influenced by the insurance premiums. At equilibrium, the insureds' aggregate termination pattern should be in line with the carriers' prediction.

The current market equilibrium, predicated on this "lapse-supported pricing", is delicate, and carriers who extensively employ lapse-supported pricing are vulnerable to unanticipated policy persistency. For instance, if, ceteris paribus, there were zero termination (see Table 2), carriers would make a loss from the life insurance business. Gottlieb and Smetters (2016) quote a negative profit margin of -12.8% for life insurance carriers in the absence of policy lapsation.

Forfeiture-based planning can also be found outside the insurance industry. Airline companies, for example, oversell a flight assuming a certain number of no-shows. While a healthy level of overbooking brings efficiency and profitability, an overly aggressive forfeiture assumption is counter-effective. It upsets those passengers rejected from boarding and damages the airlines' image and reputation, thus affecting demand.

Similarly, aggressive lapse assumptions in the life insurance industry renders carriers susceptible to unanticipated policy persistency (Bakos and Parankirinathan 2006, p. 48). Although the insurance carriers claim to disregard lapse rates in pricing (Quinn 2008, p. 750), empirical lapsation still largely influences their profitability. Notably, the adverse selection in life settlements creates an imbalance of lapsation, such that insureds with impaired health and below-average life expectancy (i.e. "bad risks" from the perspective of carrier) are assured to remain in the pool. This differs from the secondary loan market, where adverse selection lets lenders (e.g. banks) utilize secondary sale to off-load distressed debts from their book (Gande and Saunders 2012).

As the lapse rate of the "bad risks" decreases, carriers receive more of the premiums that would otherwise be discontinued at termination, but pay out higher total benefits that outweigh the increase in premium receipts. In 2017, U.S. carriers received $138 billion in life insurance premiums and paid out $107 billion in benefits. With $24 billion of operational expenses deducted,[31] the net income amounted to $7 billion. This net income has been at a stable level for the past 5 years and is expected to remain so, absent any drastic market events. However, if the annual $26.7 billion worth of policy value taken away from terminating policyholders were to be returned, carriers would not only have their profit reduced, but they would actually make a loss (Figure 10). This decline in net income represents a covert value transfer from policy terminators to carriers. I Based on the zero-sum proposition in the insurance industry, policy terminators have surrendered the value of their own assets to "assist" insurance companies in achieving their current level of profitability.

The insureds' perspective

Lapse-supported pricing leads to systematic problems, notably retrospective premium adjustment, and, ultimately, to skewed peer-subsidization. We can break down policy terminators into those which would end up bringing carriers a cash surplus, and others which would cause a deficit. The former are insureds with a sufficiently long life expectancy at the point of termination, whose expected premium payments would exceed the expected death benefit. The latter, conversely, are insureds with relatively shorter life expectancies, usually the ill and seniors, whose expected premium payments for their remaining life would be insufficient to offset the expected death benefit. In other words, the former's policies have a negative intrinsic value at termination while the latter a positive one. As established above, the latter outweighs the former from a monetary perspective, and by prematurely terminating their policies that contain a positive value it is the latter insureds who have been the "helping" carriers avoid further

[31] Data collected from SNL.

losses. Those insureds enable lapse-supported pricing and subsidize other policyholders who pay competitively low premiums.

Peer-subsidizing is a fundamental concept of insurance: through pooling, the fortunate subsidize the unfortunate. With lapse-supported pricing, however, ill and senior policyholders — the unfortunate, who terminate their valuable policies that would otherwise benefit their estate — become the subsidizers (Atmeh 2011, pp. 130–131). Carriers are often described as money-hungry entities, taking advantage of ill and senior people (see e.g. Bayston 2016), but as a matter of fact, the current skewed subsidization mechanism is culpable.

2.3 Retrospective premium adjustment

Longevity is an increasing societal concern: many countries, the U.S. included, are facing the challenge that the growth of their pension funds cannot keep pace with a growing senior population. Ironically, it seems that carriers, who stand to benefit from lengthening life expectancies, also struggle with profitability, demonstrated by the series of premium increases recently conducted. The last couple of years have witnessed multiple premium raise incidents initiated by leading insurance companies such as AXA, Transamerica Lincoln National and Voya (Hanson 2017).

Spontaneous increases in the premiums of in-force policies are already deterring potential life settlement investors and the secondary market is becoming a victim of its own success. Most policies affected by premium raises are large-face and have been issued to senior insureds: precisely the type of policies sought after by investors. Raises ranged between 5% and an incredible 600%, causing tremendous losses in life settlement investments. Lapse-supported pricing is counted as a major reason for premium instability. For example, John Hancock recently announced to increase premiums "as a result of changes in [their] expectations of [...] lapse experience" (Jeffrey Leonard v. John Hancock 2018, p. 3). Carriers that did not factor in the effect of the life settlement at pricing are exposed to unexpected losses and are trying to remedy this ex-post. While knowingly risking lawsuits and reputational damage, carriers would justifiably raise premiums to recoup their losses due to underpricing,

3 Value Recapture

Life insurance is a financial instrument. Just like other financial instruments such as bonds, life insurance' economic value is based on its cash flow profile. As discussed, lapse-supported pricing potentiates unanticipated premium increases and results in unjust wealth redistribution (skewed peer subsidization). The central question, therefore, is how to change the lapse-based status quo, and transform a vicious cycle into a virtuous one that maximizes utilitarian social welfare.

In accordance with Partial Equilibrium Theory, a perfect secondary market is needed to ensure that a policy's price, i.e. its payout to policyholder, is permanently pegged to its economic value. In pursuit of a perfect secondary market, we propose a simple, low-cost policy mechanism for rectification. The proposed intervention — featuring three rules — addresses issues in the market stemming from lapse-supported pricing practices, as well as harnesses untapped potential:

A. It is mandated to place policies up for secondary sale before termination.

B. Policies valued with negative economic value would charge an equivalent amount of surrender penalty when terminated.

C. Premiums of in-force policies may not be raised.

Rule A: Mandated secondary sale

A contractual provision that automatically places a policy in the secondary market when the policy is threatened to be terminated would help policyholders monetize the policy value. With every policy available for secondary sale, carriers make life insurance products more attractive, since policyholders will have their policy value protected. Potential consumers will be more willing to purchase policies knowing that they are given an additional option to forfeit their policies, and that the losses associated with early termination of policies can be mitigated.

Rule B: Surrender penalty for negative economic value

The prior provision would largely benefit policyholders by enabling them to monetize their insurance policy, as long as the policy has a positive economic value. However, it is not sustainable to fully realize the life settlement potential without taking other measures, since that would negatively impact insurers' profitability. As benefits paid to life settlement insureds originate from the insurance pool, measures have to be taken to deter policyholders from terminating an insurance contract when the policy has a negative value. Therefore we suggest that when policies have a negative economic value, the surrender penalty is pegged to that value.

Rule C: Prohibition of persistency-induced in-force premium increase

Our first suggested provision will only work if carriers are prohibited from raising premiums of in-force policies due to misprediction in lapsation. People purchase insurance policies to gain certainty in undesired situations. However, they are often unaware of, or underestimate, the risk of a premium increase. The benefits a premium increase brings to carriers are twofold: (i) their revenue increases; (ii) their costs decrease, because they expect to pay lower death benefits due to increased lapsation. For those forced to terminate their policies due to a rate hike ("shock lapse"), all the premiums they have paid to date are lost, with no opportunity of any future benefit.

A provision to prohibit persistency-induced premium increases of in-force policies is especially critical in the context of life settlements. Otherwise, carriers would be incentivized to set competitively low premiums to attract consumers, as they understand that if need be, they may retrospectively raise premiums afterwards. A moral hazard exists when premium hikes evokes termination on the part of insureds, because they cannot or do not want to pay the higher premiums, which in turn financially benefits the carrier. Moreover, if persistency-induced in-force premium increase is allowed, carriers can target policy groups most commonly seen in the life settlement market, and make those policies costlier, and even uneconomical, to keep in force. This would strangle the very interest in investing in life settlements, as a policy's value would completely depend on such maneuvers, leaving policyholders' interest unprotected.

We are, however, not opposed to premium raises in newly issued policies. In fact, we encourage carriers to set premiums appropriately at policy issuance. This is discussed later in this article in more detail. We refrain from discussing premium increase caused by exogenous effects such as low interest rate, since those effects have little to do with the insurance market mechanism.

4 Impact of Mandated Secondary Sale (MSS)

Next, we analyze the impact of the proposed regime, mandated secondary sale with variable surrender penalty ("MSS"), in a theoretical framework. To simplify the theoretical demonstration, we apply the following set of assumptions

i) The primary insurance market, where insurance carriers issue policies to insureds, is always perfectly competitive.

ii) With MSS, the secondary market of life insurance is perfectly competitive.

iii) Insurance carriers and investors are risk neutral.[32].

iv) Information on insureds' health status is symmetrical, i.e. every market participant holds the same view on an insured's mortality profile.

v) Markets are frictionless, i.e. there is no transaction costs, sales provisions, taxes etc.

[32] This can be justified by noting that allowing risk aversion to affect decisions taken by employees with varying risk appetites of institutional investors or insurance companies would result in decision inconsistencies (Zweifel 2015, p. 89)

Let PP denote policy price. PP has the following meanings:

If the insured wants to forfeit an owned policy by a) terminating the policy with the carrier, then PP represents the surrender value SV that the insured obtains from the carrier; b) selling the policy to an investor in the secondary market, then PP represents the highest price achievable to the insured.

Let Δ denote the *price-markup*,[33] i.e. the difference between PP and the policy's economic value EV:

$$\Delta := PP - EV \tag{1}$$

At $t = 0$ when an insured enters an insurance contract with a carrier, Equation $PP_0 = EV_0$ always holds due to Assumption i). In reality, carriers usually do not charge insureds anything other than premiums, which means $PP_0 = 0$. In that case, perfect competition among carriers leads to fair pricing of a policy, i.e., $EV_0 = PP_0 = 0$.[34]

Based on Assumption ii), the perfect competition in the secondary market induced by MSS ensures $PP \equiv EV$, i.e. insureds can always monetize the economic value of a policy when they forfeit it. Therefore,

$$\Delta^{MSS} \equiv 0$$

4.1 Effect on pricing

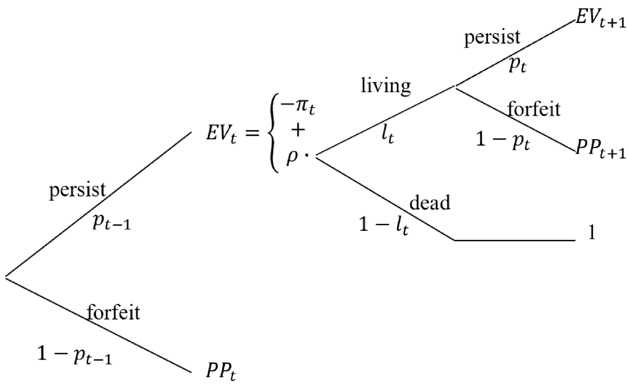
General setting

Define an insured cohort as a group of insureds with the same age who share the same mortality profile. A cohort is therefore homogeneous and insureds in a cohort are issued identical insurance contracts at the same time. The value of a policy from a cohort is dependent on the following components:

1. if the policy is forfeited, then the policyholder's payoff is PP.
2. if the policy is kept in force, then the policyholder retains the economic value of the policy EV. To persist in the policy, the insured pays the premium π, and expects a payoff that considers:
    a. the insured dies within the next period, and the policy pays out 1;
    b. the insured survives the next period, and the policy's payoff depends on whether the policy will be forfeited or kept in force.

[33] Despite the name of the variable, Δ can be positive, zero, or negative ("price-markdown").
[34] Similar to the equality of two legs of a fairly priced swap.

Assume cash flow only occurs at period start, i.e. at $t = 0, 1, 2, ...$, but not between periods. The tree plot below illustrates the average payoff of policies from a cohort:



where

$\{\pi_t\}_{t\in\mathbb{N}_0}$: a policy's premium amount at time t. Premiums are paid in advance, i.e. premium payment at t guarantees coverage between t and $t+1$.

$\{l_t\}_{t\in\mathbb{N}_0}$: survival rate between time t and $t+1$.

$\{p_t\}_{t\in\mathbb{N}_0}$: persistency rate between time t and $t+1$.

We can thus express EV_t in a recursive manner:

$$EV_t = -\pi_t + \rho\Big\{l_t\big[p_t EV_{t+1} + (1-p_t)PP_{t+1}\big] + (1-l_t)\Big\}$$

Plugging $PP_{t+1} = EV_{t+1} + \Delta_{t+1}$, as derived from Equation 1, into the equation above:

$$\begin{aligned} EV_t &= -\pi_t + \rho\Big\{l_t\big[p_t EV_{t+1} + (1-p_t)(EV_{t+1}+\Delta_{t+1})\big] + (1-l_t)\Big\} \\ &= \rho\Big\{l_t\big[EV_{t+1} + (1-p_t)\Delta_{t+1}\big] + (1-l_t)\Big\} - \pi_t \end{aligned} \tag{2}$$

We can also transform Equation 2 into a non-recursive format (transformation see Appendix):

$$EV_t = \sum_{j=t}^{\infty} \frac{\Big\{\rho\big[l_j(1-p_j)\Delta_{j+1} + (1-l_j)\big] - \pi_t\Big\}\rho^{j-t}\prod_{i=t}^{j} l_i}{l_j} \tag{3}$$

Under MSS

By plugging $\Delta_t^{MSS} = 0, \forall t$ into Equation 3, we can simplify the formula for EV_t^{MSS} :

$$EV_t^{MSS} = \sum_{j=t}^{\infty} \frac{\left[\rho(1-l_j) - \pi_t^{MSS}\right] \rho^{j-t} \prod_{i=t}^{j} l_i}{l_j} \tag{4}$$

Carriers and insureds have the exact inverse positions on a policy: a carrier's profit from a policy is the negative value of the policy's economic value ($-EV_t$). To ensure that MSS does not affect its profitability, a carrier can issue policies with premiums adjusted such that the policies' economic value estimated at issuance remain the same with or without MSS:

$$\begin{aligned} & EV_0^{MSS} = EV_0 \\ \Rightarrow & \sum_{j=0}^{\infty} \frac{\left[\rho(1-l_j) - \pi_j^{MSS}\right] \rho^{j-t} \prod_{i=t}^{j} l_i}{l_j} = \\ & \sum_{j=0}^{\infty} \frac{\left\{\rho\left[l_j(1-p_j)\Delta_{j+1} + (1-l_j)\right] - \pi_j\right\} \rho^{j-t} \prod_{i=t}^{j} l_i}{l_j} \end{aligned}$$

One possible solution would be:

$$\forall t, \pi_t^{MSS} = \pi_t - \rho l_t(1-p_t)\Delta_{t+1}$$
$$\begin{cases} < \pi_t, & \Delta_{t+1} > 0 \\ = \pi_t, & \Delta_{t+1} = 0 \\ > \pi_t, & \Delta_{t+1} < 0 \end{cases}$$

Absent MSS, carriers are the monopsonistic buyer of policies, and policy price is its surrender value SV, i.e. $\Delta_{t+1} = SV_{t+1} - EV_{t+1}$. If $SV_{t+1} > EV_{t+1}$, then MSS-based premiums π_t^{MSS} would be adjusted lower than current lapse-based premium π_t; If $SV_{t+1} < EV_{t+1}$, then π_t^{MSS} would be adjusted higher than premium π_t.

MSS enables full monetization of policies, and does not alter a policy's economic value despite the adjustment in dollar premiums. Therefore, in line with Doherty et al. (2004, p. 115), we believe demand will not decrease because of MSS.

MSS also frees carriers from making assumptions on lapsation (no persistency rates included in Equation 4). With a lapse assumption de-emphasized in policy pricing and a reduced uncertainty regarding future lapse rates, carriers would solely focus on predicting mortality trends and be more likely to price policies appropriately up front. This would make retrospective premium adjustment due to erroneous lapse assumptions unnecessary, leading to a more resilient pricing system.

4.2 Effect on welfare

General setting

Let u denote the policy's utility to its insured, measured in monetary units. At purchase, a policy's utility to an insured u is no less than the policy price PP, such that the insured obtains a positive surplus ($u - PP \geq 0$) by acquiring the policy. The policy's surrender value SV must be no greater than PP ($SV \leq PP$); otherwise insureds can arbitrage by acquiring a policy and forfeiting immediately. Naturally, no insured would forfeit their policy at issue date.

With the passage of time, policies' economic value and utility to insureds change. For some insureds, keeping the policy in force remains worthwhile. For others, the opportunity cost becomes too high, and the policy's utility falls below the surrender value. Consequently, those insureds will choose to terminate the contract.

Assume that both carriers and investors are risk neutral with no non-monetary utility, hence their policy's utility is based solely on the policy's economic value EV. Table 4 summarizes the utility of various parties associated with the issuance of a policy.[35]

The carrier's and investor's utility, depending on whether or not the insured opts to keep a policy in force, is slightly more complex. First, we investigate a carrier's and investor's utility separately, according to the insured's mode of forfeiture in Table 5 Panel A, and then we present the utility overview in Table 5 Panel B.

A policy's utility u is positively related to its economic value EV, but they are not necessarily equal. Define u^e as the utility of a policy beyond its economic value:

$$u^e := u - EV \tag{5}$$

u^e denotes an insured's personal perspective on the policy's *excess utility*,[36], the non-monetary part of the policy utility. The value of u^e depends on the insured's personal situation. Factors that can influence u^e include, but are not limited to, the insured's liquidity situation and bequest motive. Ceteris paribus, u^e will be higher if the insured has adequate cash, and lower if the insured experiences a liquidity crisis and the insurance becomes less affordable; u^e will be lower if the insured's beneficiary

[35] Policyholders can in theory also purchase policies back from investors.

[36] Similar to Δ, despite its name, u^e can be positive, zero, or negative ("deficient utility").

becomes financially independent, and conversely higher if the beneficiary is financially dependent and the insured's bequest motive is high.

Based on Equation 1 and Equation 5:

$$PP - u = \Delta - u^e \tag{6}$$

We have the following lemma:

Lemma 1. *Δ and u^e defined as above. At the time of issuance of a policy*
1. if $u^e > \Delta$, an insured acquires the policy;
2. if $u^e < \Delta$, an insured does not acquire the policy;
3. if $u^e = \Delta$, an insured is indifferent whether or not to acquire the policy.
If the policy is owned by an insured, then
1. if $u^e > \Delta$, an insured keeps the policy;
2. if $u^e < \Delta$, an insured forfeits the policy;
3. if $u^e = \Delta$, an insured is indifferent with regard to keeping or disposing of the policy.

The proof is self-explanatory.

Supply and demand of policies

Since a cohort is per our definition homogeneous in mortality profile, each policy in a cohort has the same economic value EV in the actuarial sense, and hence can be forfeited for the same price PP. Therefore, given Equation 1, every policy also gets the same price-markup Δ.

However, the excess utility of each policy in a cohort can vary. Let m denote the total number of policies in a cohort and $\{u_i\}_{i=1,2,..,m}$ the excess utility of the policies. $F_u(x)$ denotes the cumulative frequency function of $\{u_i\}_{i=1,2,..,m}$, representing the total number of policies surrendered or sold at a given price x. $F_u(x)$ can be expressed as:

$$F_u(x) = \sum_{i=1}^{m} \mathbb{1}_{u_i \leq x} \tag{7}$$

where $\mathbb{1}_A$ is an indicator function defined as:

$$\mathbb{1}_A = \begin{cases} 1, & \text{if } A \text{ is true} \\ 0 & \text{if } A \text{ is false} \end{cases}$$

Based on Equation 6 and Equation 7, the policyholder surplus for the whole cohort, denoted by *PhS*, can be expressed as:

$$PhS = \sum_{i=1}^{m} (PP - u_i)\mathbb{1}_{u_i \leq PP} = \int_{-\infty}^{PP} F_u(x)dx \tag{8}$$

The total number of policies that will be forfeited can be expressed as:

$$\sum_{i=1}^{m} \mathbb{1}_{u_i \leq PP} = F_u(PP) \tag{9}$$

Let Q denote *policy supply*: the total amount of policies that an insured cohort forfeits. In line with the supply-demand demonstration for conventional commodities, curve $F_u^{-1}(Q)$ drawn on a $Q \to u$ plane (Figures 12-14) represents the marginal cost of the cohort's policy supply at supply volume Q. *PhS* equals the area bounded by lines $Q = 0$, $u = PP$ and curve $u = F_u^{-1}(Q)$.The light blue shaded area in Figures 12-14 represents the value of *PhS* in case of $\Delta \neq 0$.

Unlike insureds, policy buyers who take over insureds' policies are only concerned with the economic value. Therefore, the surplus generated by each policy acquired equals $EV - PP$ ($= -\Delta$, based on Equation 1). Given that the number of policies forfeited by insureds is $F_u(PP)$, the total surplus of buyers (including carrier and investor), denoted by *BrS*, obtained by taking over those policies, can be expressed as:

$$BrS = -\Delta F_u(PP) \tag{10}$$

The marginal cost of acquiring an additional unit of a policy equals *PP*. Hence the *policy demand* curve is $u = PP$.

Utilitarian social welfare without MSS

Without the enforcement of MSS, Δ can deviate from 0. Specifically, in the complete absence of the secondary market, an insured who wishes to terminate an insurance contract has to do so by surrendering the policy to the carrier. The carrier has the monopsony power (Doherty and Singer 2003, p. 471; Kohli 2006, p. 112), and can set any level of surrender value *SV* for "buying back" a policy. Let PP' denote the market clearing price without MSS. Since the carrier is the sole buyer of policies, *SV* is the highest and only price available for insureds ($PP' = SV$), and buyers' surplus *BrS* is the carrier surplus. The carrier's payoff arising from policy termination is two-fold: on the one hand, the carrier pays the terminating insureds each the amount of *SV*; on the other hand, the carrier is relieved of the insurance liability for each policy terminated, which is equivalent to the economic value EV of the policy.

Depending on the value of Δ, BrS can be negative, zero, or positive. The absolute value of BrS represents the area of the rectangle bounded by lines $Q = 0$, $u = PP'$, $u = EV$ and $Q = F_u(PP')$ (Figures 12-14).

Figure 12 illustrates a case with $\Delta > 0$, where the carrier loses from the cohort's forfeiture of policies. This type of cohort typically consists of insureds who have developed little or no health impairment since policy issuance and have longer life expectancies than estimated at policy underwriting. Therefore, those insureds are expected to pay premiums, should their policies persist, for a long time before a death claim, and their policies often have an $EV < 0$. In that case, if the carrier does not charge a surrender penalty or charges only an inadequate surrender penalty such that $SV - EV = \Delta > 0$ (note that $PP' = SV$), the carrier would suffer a negative surplus ("deficit") from the loss of good risks from their book.

This undesired termination, however, is not necessarily detrimental to the carrier. Should the carrier have made accurate assumptions on termination ex ante, the deficit caused by terminating insureds would have been anticipated, and surplus would have been gained from other insured cohorts that can make up this deficit. Figure 13 illustrates a case with $\Delta < 0$, where the carrier gains from the cohort's forfeiture of policies. This type of cohort consists of insureds whose health is more impaired and their life expectancies shorter. In this case, if the carrier offers only an inadequate surrender value such that $SV - EV = \Delta < 0$ (note that $PP' = SV$), the carrier would benefit from policy termination, for it can now shed the liability of EV at a lower price, namely SV.

Figure 14 highlights an extreme scenario that can be observed in cohorts of terminally ill insureds. Due to an extremely short LE, those insureds' policies have a very high EV. In that case, if the surrender value SV offered by the carrier does not reflect the high EV at all, such that Δ is significantly below zero, then no insured in the cohort is willing to terminate the policy. They would prefer keeping their policy in force, knowing that their beneficiaries will receive the death benefit in short order.

The insured cohort surplus is enhanced from zero to a significant amount through MSS. However, MSS does not change the carrier surplus in this particular case, which equals zero with and without MSS. This likely explains the widespread implementation of a free accelerated death benefit (ADB) rider for the terminally ill: the carrier loses nothing, and instead, gains goodwill for enhancing the insureds' welfare.

Utilitarian social welfare with MSS

Let PP^* denote market clearing price with mandatory secondary market offer. Plugging $PP^* = EV$ and $\Delta = 0$ into Equations 8 and 10,

$$PhS^{\text{MSS}} = \int_{-\infty}^{EV} F_u(x)dx \tag{11}$$

$$BrS^{\text{MSS}} = 0 \tag{12}$$

Figures 12-14 show that BrS^{MSS}, sum of the buyer's (carrier's and investor's) surplus, would be pushed to zero, as demonstrated in Equation 12.

With MSS, if a policy $EV < 0$, the carrier penalizes the policy termination with an amount up to the absolute value of EV. Thus, the carrier is able, and has the incentive, to set $SV \leq EV$: the carrier surplus is always greater when $SV \leq EV$ than when $SV > EV$.

If the carrier wants to compete with secondary market buyers and buy back policies, it needs to set $SV = EV$, i.e. $\Delta = 0$. If the carrier sets $SV < EV$, then insureds will sell their policies in the secondary market (Doherty and Singer 2003, pp. 473–474) for a price of EV rather than forfeiting for a price of SV. From the carrier's perspective, the policies are kept in force, hence zero surplus. After being purchased by an investor, a policy is expected to be kept in force until maturity. This is because an investor would only terminate a policy if the surrender value is greater than the economic value, and, as discussed, carriers would not allow that. Therefore, the expected net liability the carrier assumes for the policy is EV. For the carrier, this is no different than granting the insured a surrender value of EV right away.

The welfare impact of MSS on insureds and the carrier varies across cohorts. With a healthy cohort as illustrated in Figure 12, through a decrease of Δ from positive to zero, insurance persistency is increased and carrier surplus is increased from negative to zero, whereas insured surplus is decreased. With an unhealthy cohort as illustrated in Figure 13, through an increase of Δ from negative to zero, insurance forfeiture is decreased, carrier surplus is decreased from positive to zero, and the insured surplus is increased.

To summarize, in the case of absent MSS, the carrier gains from the unhealthy terminators and loses from the healthy terminators. Even if the carrier ultimately breaks even, absent MSS, those fortunate enough to maintain good health are additionally advantaged as they are subsidized by the unfortunate. MSS redistributes wealth and reverses this dynamic. More importantly, no matter with which cohort, MSS always enhances the total welfare of all insurance market participants through the retention of the deadweight loss. Combining Equations 8, 10, 11 and 12, the deadweight loss caused by not implementing MSS is:

$$
\begin{aligned}
&(PhS^{\text{MSS}} - PhS) + (BrS^{\text{MSS}} - BrS) \\
=&\left[\int_{-\infty}^{EV} F_u(x)dx - \int_{-\infty}^{PP} F_u(x)dx\right] + \left[\Delta \cdot F_u(PP)\right] \\
=&\int_{PP}^{EV} F_u(x)dx + \Delta \cdot F_u(PP) \\
=&\int_{PP}^{EV} \left[F_u(x) - F_u(PP)\right] dx \qquad (13)\\
\geq& 0 \qquad \because F_u(x) \text{ is monotonically increasing}
\end{aligned}
$$

MSS impact on policy utility throughout time

The above comparison only suggests that, with regard to social welfare, MSS is more Pareto-efficient than the status quo at any given point in time, all other things being equal. It is, however, noteworthy that some policies' forfeiture is postponed due to MSS while others are accelerated. That is to say, MSS causes some surplus to materialize earlier, and some later, compared to the general setting. Therefore, we need a measurement to compare the welfare impact of MSS throughout time.

We assume that MSS alone does not engender any factor that changes u^e: if all external conditions hold, then u's change will be fully and solely reflected by EV's change, and u^e will remain the same. From Tables 4 and 5 at any point of time, the total utility a policy brings to society (insured + carrier + investor) equals u^e ($u^e = u - PP$), whether the policy is being kept in force or at the point of being acquired by the insured. This can be intuitively explained by the zero-sum nature of insurance from a purely economic perspective: wealth is transferred between individual insureds and carriers through life insurance, but not generated. Therefore, the economic gain and loss of insurance participants (insured + carrier + investor) cancel out eventually, and the only value that insurance adds to society is through the policies' utility beyond their economic value, i.e. policies' excess utility u^e as defined in Equation 5.

Clearly, u^e is only meaningful when a policy is owned by an insured. From Lemma 1 we know that a policy will only be owned by an insured if $u^e > \Delta$. Therefore, a policy's total utility to society throughout time, denoted by U, can be expressed as:[37]

$$U = \int_0^{\infty} \rho(t) u^e(t) \mathbb{1}_{u^e(t) > \Delta(t)} dt \qquad (14)$$

[37] Note that the policy does not have to be continuously in force: as long as $u^e(t) > \Delta(t)$, an insured will keep the policy in force; the insured will forfeit the policy when $u^e(t)$ drops below $\Delta(t)$ and then repurchase a "make-up" policy when $u^e(t)$ surpasses $\Delta(t)$ again.

where $\rho(t)$, $u^e(t)$ and $\Delta(t)$ are continuous time series, denoting the discount factor, the policy's excess utility, and the policy's price-markup at time t, respectively.

Since $\Delta(t) \equiv 0$ with MSS, the policy's total utility U^{MSS} is hence:

$$U^{\text{MSS}} = \int_0^\infty \rho(t)u^e(t)\mathbb{1}_{u^e(t)>0}dt \tag{15}$$

In Figure 15 we illustrate a time series of a policy's discounted excess utility $\rho(t)u^e(t)$. With MSS, $\Delta \equiv 0$ and the policy is forfeited at time t_6 where $u^e(t_6)$ drops below 0, and repurchased at t_8 when $u^e(t_8)$ rebounds to 0. As a result, the value of U, the policy's total utility to society throughout time, equals the area A+B+D+E.

Absent MSS, the policy will not necessarily be forfeited at time t_6. If the forfeiture occurs at t_3, implying $\Delta(t_1) > 0$, U equals the area of A. In connection with Figure 12, the insured often belongs to a healthy cohort, where MSS would prolong the insurance persistency until t_6, and additional positive utility equal to area B would materialize.

If the forfeiture occurs at t_{11}, U equals the area of A+B-C+D. In conjunction with Figure 13, the insured is typically part of an unhealthy cohort, and MSS would advance the policy forfeiture to t_6, avoiding the disutility of the policy equal to area C.

With Equations 14 and 15, the deadweight loss due to the non-existence of MSS can be calculated as:

$$\begin{aligned}
U^{\text{MSS}} - U &= \int_0^\infty \rho(t)u^e(t)\mathbb{1}_{u^e(t)>0}dt - \int_0^\infty \rho(t)u^e(t)\mathbb{1}_{u^e(t)>\Delta(t)}dt \\
&= \int_0^\infty \rho(t)u^e(t)(\mathbb{1}_{u^e(t)>0} - \mathbb{1}_{u^e(t)>\Delta(t)})dt \\
&= \int_0^\infty \rho(t)u^e(t)\mathbb{1}_{0<u^e(t)\leq\Delta(t)}dt - \int_0^\infty \rho(t)u^e(t)\mathbb{1}_{\Delta(t)<u^e(t)\leq 0}dt \\
&\geq 0
\end{aligned} \tag{16}$$

Given that the insurance demand and economic value will remain stable, the profit a carrier expects from an insurance business line will be little altered via MSS. Therefore, the deadweight loss that will be avoided through MSS will, in a large part, benefit the insureds.

Moreover, MSS corrects the existing skewness in peer-subsidization via adjustment in welfare distribution. MSS essentially reduces the welfare surplus of healthy people and increases that of unhealthy people, making life insurance regain its original purpose: the fortunate subsidizing the unfortunate.

5 Further Economic Contributions

5.1 Surrender penalty reserve

To ensure just peer-subsidization, it is critical to have a high persistency rate in young and healthy insureds. MSS suggests this can be achieved by having every policy sellable, even if it has a negative economic value. This would imply that insureds get charged if at termination the value of their policy is deemed negative. For those insureds, this event increases termination cost, reduces their surplus obtained from termination, and hence deters them from early termination.

There are several ways to guarantee that insureds, in the case of a negative economic value, do not walk away from the insurance contract without paying. Carriers with a rigorous credit checking system can charge a surrender penalty, similar to the existing practice,[38] simply through direct debit. For carriers averse or susceptible to credit risk, a surrender penalty reserve is one possible solution to cover the carriers' loss incurred by an early termination.

The reserve is saved in the insureds' cash account in order to accumulate interest. The money in the reserve belongs to insureds but is not at their disposal. It is held by the carrier, and can only be fully or partially released to insureds, or used to cover insured's premium payment if there is evidence for an appreciation of their policies' economic value resulting from, e.g. an exacerbated health situation.

The surrender penalty reserve can be built via deposit in a cash account. The carrier can contractually enforce deposit into the insureds' cash account to gradually build up the reserve, or take a sufficient deposit up-front, or, in its extreme form, use the format of a "single premium insurance" (Gatzert et al. 2009, p. 889) that secures enough funds in the penalty reserve. The practice resembles the existing front-loading technique widely employed by carriers. Front-loading premiums are designed to protect carriers against reclassification risk. A liquid and open secondary market eases policy trading, exposing carriers to higher reclassification risk. Enforced security deposit is a variation of "front-loading" scheme for the protection of carriers.

At policy termination, should the policy have a negative economic value $EV < 0$, the amount of the surrender penalty reserve that exceeds the actual surrender penalty equal to $|EV|$ will be refunded to the insured. Should the policy have a positive economic value ($EV > 0$), the penalty reserve will be fully returned. The money from the reserve that is returned to the policyholder is usually referred to as the "cash value" of a policy. Note that from beginning to end, the owner of a policy's cash value is the policyholder, not the carrier, and the amount of the "cash value" is largely influenced by the money deposited in the cash account by the policyholder, either voluntarily (to benefit from tax deferral), or contractually demanded by the carrier (for potential surrender penalty

[38] See Koutnik (2013, pp. 919–920) and Gatzert (2009, p. 145) for the existing practice of surrender penalty.

deduction).

To be noted is that this conceptual "surrender penalty reserve" is not to be confused with the existing "terminal reserve". While both detained by the carrier, the former is de jure owned by the policyholder and the latter by the same carrier; while both designed as a precautionary measure for a contingent liability, the former is reserved for a policyholder's surrender payment to the carrier whereas the latter for a carrier's death benefit payment to the beneficiary.

Demand effects

In the previous section we suggest that under certain assumptions MSS does not necessarily change consumers' demand for life insurance, but we do not take into account the potential effect of an up-front deposit on demand. A deposit can, in fact, affect demand in several ways.

For consumers who lack liquidity, a deposit may add to the cash drain and deter them from purchasing a policy (see e.g. Cowley and Cummins 2005, p. 202; and Daily et al. 2008, pp. 151–152). A deposit, however, also has upsides. Firstly, some consumers are willing to use a cash account for deferral of income tax (Doherty et al. 2004, p. 111; Gelfond 2009, p. 84). Secondly, the idea can block "freeloaders" with no strong insurance desire.[39] They may sign an insurance contract when there is little or no premium charge at the beginning, and terminate as soon as the low premium period ends. Those consumers are likely to be attracted by a "premium financing" scheme with a couple of years of "free coverage" after issuance. Due to their low persistency, those insureds would not be profitable for carriers but instead impose operating costs. Underestimation of those insureds' termination rate would cause policies to be underpriced.

Economic analogies

Note that the surrender penalty reserve is essentially a down payment, or a security deposit. It is to be differentiated from a "fee": the former merely serves to cover contingent charges, while the latter is a definite charge. This penalty reserve is loosely analogous to a hotel room deposit: a deposit deters guests who seek to get away from paying what they have consumed or damaged; for those who have no problem of paying for what they get, a deposit should not matter. The difference between the two is that, hotels' invoicing guests for their consumption upon checkout is retrospective; whereas carriers' penalizing insureds for what they would spend in the future, i.e. the policy's economic value, is prospective.

[39] For example, they might be risk tolerant or have no bequest motive.

The way a surrender penalty works can also be compared to margin for future contracts. The initial futures margin is the counterpart of a "security deposit" in a penalty reserve: both referring to the amount required to enter a contract. The call for more deposit and the release of partial or full deposit is equivalent to margin maintenance in the context of future contracts.

5.2 Carrier buy-back

Carriers can compete against life settlement investors by offering a competitive surrender value. Carriers' direct participation in secondary sale would increase the transaction efficiency in the market. Furthermore, consumers' interest would be better served as they would receive competitive bids from their carrier as well as from life settlement investors. It also provides consumers some leeway by keeping the existing forfeiture option on the table: if they are uncomfortable with the idea of having their life insurance policy owned by an unknown investor, they can always choose to sell the policy to their initial insurance carrier.

Carriers might prefer buying back a policy rather than having it owned by an investor, since an in-force policy also incurs operational costs to them. Due to investors' disadvantages compared with carriers, the latter's active participation in the secondary sale might discourage the former's participation, resulting in a secondary market with carriers as the majority buyers. When internalizing a life settlement, carriers have a cost advantage over third-party policy buyers because carriers can simply retire a policy without having to maintain it. In contrast, if owned by an investor, a policy is kept in force and the servicing fee (e.g. tracking cost) that it incurs needs to be considered.

Evans et al. (2013, p. 116) suggest a contractual provision that gives carriers the right of first refusal to match any viable life settlement offer. This would give carriers an additional second-mover advantage. Such a provision could, however, jeopardize market competition. While carriers' participation in life settlement is not prohibited, the norm is that they compete fairly with other life settlement buyers. In addition, carriers cannot disadvantage life settlement investors by simply offering a matching bid right before life settlement providers are about to close a deal. The life settlement business would no longer exist if buyers went through all the effort of pricing policies, only to have carriers secure them at the last minute. Such an attempt to undermine a life settlement transaction was conducted by insurer John Hancock. Coventry First LLC, the life settlement buyer in the particular case in which Hancock interfered, filed a complaint against the insurer (Hersch 2011). The case was settled in the end with John Hancock paying $2M to Coventry (Horowitz 2013a), sending a pro-competitive signal. Such development in the life insurance industry, incidentally, aligns with this paper's proposed reform.

With MSS, even when carriers become the frequent policy buyer, they do not process the monopsony power, because the pure existence of an open and free market deters carriers from setting excessively low surrender values. If a carrier decides to compete against life settlement investors, it has to strategically adjust the surrender value of a policy in close proximity to its fair market price, otherwise investors will return. That is to say, investors will only be edged out if the surrender value offered by carriers is so high that competing becomes futile. Therefore, MSS wields the autonomy of a free and competitive market to propel the monetization of policies' economic value and to accelerate the materialization of policies' full utility.

5.3 Accelerated death benefit

Carrier buy-back is not an entirely new concept. Many carriers offer accelerated death benefits for the terminally ill, who can cash out on a slightly discounted death benefit, to fund their treatment.

To date, most life insurance companies offer some form of accelerated death benefit (ADB) options: as a stand-alone insurance product, as a rider attached to a life insurance, or directly embedded in the policy contract. There are several ways for a carrier to pay out ADB. For terminal illness ADB, the NAIC model act requires carriers to provide a lump sum option. The lump sum payment can be in the form of (i) a pre-specified portion of the death benefit, (ii) the total death benefit discounted, sometimes actuarially, to the present value according to insureds' life expectancy; or (iii) a lien against the death benefit (Schmidt 1997, p. 107; Spurrier 1997, p. 810). Note that (ii) works most similar to a life settlement from the perspective of an insured, whereas (iii) resembles a life settlement from the perspective of a carrier. The carrier continues to receive premiums until the insured's death and is still liable to pay death benefit, with policy lien deducted, at the death event.

The applicability of various ADB products differ. The ADBs for terminal illness apply to insureds with a life expectancy of no longer than 12 months (Gatzert et al. 2009, p. 905; Perez 2002, p. 437). This offer is often free and included as a default provision in a life insurance contract. With this option, a carrier would maximally lose from each ADB claim a one-year premium and the one-year time value of the death benefit; without this option, the insured by default must pay the premium during the last year of his/her life so that his/her beneficiary could claim the death benefit after his/her passing. Not only is the financial loss insignificant, but also infrequent given the low prevalence of terminal illness. In fact, carriers can even benefit from the inclusion of this option, since it gives insureds flexibility which creates demand, and presents a caring image which enhances a carrier's PR. Therefore, most carriers are willing to offer the ADB for terminal illness option free of charge.

ADB also exists for chronic or critical illness, sometimes also referred to as long-term care benefit rider. Unlike ADB for terminal illness,[40] these riders are predominantly

[40] E.g. Accelerated Death Benefit Rider of William Penn, Terminal Illness Death Benefit Advance Rider of Principal Life.

subject to additional premium charges.[41]

The idea of accelerated death benefit (ADB) originated in the 1980s during the onset of the HIV/AIDS epidemic, the same event that triggered the advent of the viatical settlement market (Spurrier 1997, p. 808). As more and more carriers adopted free ADB for the terminally ill, viatical settlements simultaneously became rarer. This phenomenon demonstrates that carriers have an edge when competing against secondary market investors: between accelerating death benefit through the carrier and settlement in the secondary market, insureds seem to prefer the former, possibly because they have more trust in their carrier and do not want the added complication of introducing a third party. Consequently, viatical settlements evolved into life settlements, comprising primarily senior insureds with milder health impairments, while accelerated death benefits continue to focus on terminally ill insureds.

To date, ADB remains restricted to insureds with severe illness (Evans et al. 2013, p. 108). Expanding the applicability of ADB would certainly benefit a larger scope of insureds even without the assistance of the secondary market. So why would we suggest implementing mandated secondary sale, instead of just expanding the applicability of accelerated death benefit? The existence of the secondary market enhances market competition, gives consumers more options, and encourages carriers to devise products that can benefit consumers to the greatest extent: the coexistence of the viatical settlements market and ADB for terminally ill have ensured that the latter is a standard byproduct of life insurance with little or no surcharge.

5.4 Regulation

Officially legalized in 1911,[42] the life settlement market has become healthier and more regulated with successive legislation. Realizing the benefit of life settlement, many states started to adopt laws that would indirectly support the market. For example, Georgia forbids carriers from penalizing insurance agents for assisting policyholders to lawfully secure policy benefits.[43] This counteracts the condition of consumers being uninformed of life settlement terms due to pressure exerted by the insurance carrier on their agent. Florida stipulates that carriers suggest policyholders consult professionals before making a change to their policy.[44] This law helps policyholders be aware of the life settlement option. California stipulates that carriers should not "make any false or misleading statement for the purpose of dissuading an owner or insured from a lawful life settlement contract" or "unreasonably delay effecting change of ownership

[41] E.g. Lincoln LifeEnhance Accelerated Benefits Rider of Lincoln, Long-Term Care ServicesSM Rider of AXA.

[42] Grigsby v. Russell, No. 53. 222 U.S. 149 (1911), see https://www.leagle.com/decision/1911371222us1491348

[43] 101120.5.(6) http://www.leg.state.co.us/preclics/1997/hbills97/HB1345.htm

[44] HB 1007 626.99292, http://myfloridahouse.gov/Sections/Documents/loaddoc.aspx?FileName=_h1007er.docx&DocumentType=Bill&BillNumber=1007&Session=2017

or beneficiary with any life settlement contract lawfully entered into in this state or with a resident of this state."[45]

As long as they are able to maintain profitability in their business, life insurance carriers will be reluctant to accept any regulatory changes. However, the currently prevailing myopic lapse-supported pricing scheme is a risky strategy that negatively impacts the stability of the entire life insurance industry, an industry that is indisputably designed to provide security to its policyholders in the first instance. With the emerging endorsement for the life settlement market from the legal system, we believe that mandating a secondary sale is naturally the next step for legislators to generally protect consumers. Furthermore, the regime will accelerate the prospect of the entire insurance market reaching a new and more sustainable equilibrium.

5.5 Process kaizen

Just as end consumers are the ultimate payer of sales tax, insureds' are the ultimate bearer of the medical (re-)underwriting expenses and settlement intermediary cost. Whether explicitly stated in a contract or not, the proceeds an insured receives from selling a policy always has those operational costs deducted.

MSS involves carriers' engagement: upon consent of insureds who wish to forfeit their policies, carriers immediately place those policies into the secondary market. This reduces search cost and enhances the disintermediation of life settlements. Specifically, intermediaries, whose job is to source policies from policyholders, would most likely be eliminated from the transaction chain.

MSS also aligns with the InsurTech trend (Tempesta 2018, p. 15) of ultra-customized policies: MSS drives the surrender value of a life insurance policy to be calibrated according to the insured's personal health condition. In addition, InsurTech promotes digitization which enables process kaizen for data management, hence lowering the (re-)underwriting cost and information cost in general, making MSS more feasible now than ever. With the assistance of InsurTech and the increase in popularity of life settlements, we believe that mandated secondary sale with the option of insurer buy-back should become the new normal for the life insurance industry.

6 Conclusion and Outlook

To date, it is still not widely known that a life insurance policy is a tradable asset. This piece reveals value destruction for policyholders through lapsation of life insurance policies and attempts to raise awareness of the secondary market of life insurance and

[45] SEC. 6. 10113.3. (d) (n) https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200920100SB98

its benefits to society. We criticize carriers' abuse of outdated lapse-supported pricing schemes, which leave policyholders vulnerable to retrospective premium hikes. Carriers reportedly increase premium rates in the event of unanticipated insurance persistency of "bad-risk policies", which can be caused by a wider usage of life settlement by seniors and insureds with health impairment.

Against the backdrop of rising regulatory intervention favoring life settlements, we advocate imminent abandonment of lapse assumptions in premium pricing and encourage an embrace and internalization of policy secondary sale. We propose a simple but robust reform: a mandated secondary sale treatment of all life policies that are about to be terminated. The regime could drastically increase the amount of wealth retained by the senior population in U.S. and, in turn, help fund long-term care, longer than expected retirements, and other issues surrounding rising life expectancies. In addition, we suggest a morbidity-contingent surrender penalty scheme targeting healthy insureds who wish to terminate a policy. We further propose a prohibition on premium raises of in-force policies to guarantee the feasibility of a mandated policy secondary sale.

We believe the proposed regime will not only protect consumers' interest but also benefit the entire life insurance industry by increasing sustainability, enhancing stability and improving its reputation. Combining mandated secondary sale with a morbidity-contingent surrender penalty would ensure that a policy's monetizable value is constantly pegged to its economic value. This, we demonstrate, encourages scrutiny of human mortality, propels realization of the economic value of life insurance, consequently maximizing insurance utilization to policyholders, and augmenting the utilitarian welfare of the society.

We suggest that life carriers make a prompt business model transition to embrace and participate in the secondary sale of policies. We are confident that the new equilibrium reached through the regime change will yield higher market efficiency and a more just wealth transfer among consumers.

The study has a few limitations. While briefly discussed in the previous section, tax issues related to life insurance, e.g. concerning income tax deferral through insurance cash account or tax from life settlement proceeds, are beyond the scope of the paper and should be investigated before the implementation of the reform. Secondly, in order to simplify the demonstration and focus on the core line of inquiry, in the theoretical framework we assume risk neutrality of carriers and investors, independence of policy excess utility from policy economic value and perfect market conditions (which implies perfect competition, zero transaction cost and information asymmetry). The market mechanism under more relaxed assumptions merits further research. Thirdly, research is often limited by data availability and this case is no exception. Due to the opaque nature of the current market, We are constrained in our estimation of size and potential of the market. Due to the arbitrariness of consumers' utility function, we are unable to quantify the welfare impact of MSS. Future studies may utilize the availability of more data to conduct empirical studies on this matter.

Appendix

A Data

We use two sets of samples to depict the U.S. life insurance landscape: (i) The U.S. Life industry Briefing book of the SNL financial (S&P Global Market Intelligence); and (ii) SOA & LIMRA - U.S. Individual Life Insurance Persistency studies. The SNL sample is representative, covering more than 90% of total life insurance business in the U.S., and up-to-date, reported on an annual basis. Each year from 1996 to 2017, the total face amount of policies issued, surrendered, lapsed during the year and in force at year-end is reported. The sums are broken down by policy format: (i) ordinary / individual insurance, (ii) group insurance which is often offered through the workplace, (iii) credit insurance which is primarily offered by lending companies and (iv) industrial insurance which is mainly for burial purposes. Ordinary policies are further broken down into two categories: (i) Whole Life & Endowment; (ii) Term-life. However, the data lack granularity: no further break-down (by e.g. insureds' age, policy face value, insurance duration) is available.

The data used for the SOA & LIMRA study provide much more insight on U.S. life insurance termination pattern. The study breaks down the sample policies by attained age, issue age, policy type, duration etc. In addition, the study provides lapse rate of different cohorts (e.g. the lapse rate term policies from 65-year old insureds). Unfortunately, the sample only involves individual life insurance business from 27 U.S. life carriers, and is not up to date, with the last observation year being 2009.

We use the granularity of SOA & LIMRA study and scale the numbers up to reach the aggregate shown in the SNL database. While the LIMRA sample is incomplete, to make sure that it is not skewed, we compare the age distribution indicated from this sample and from another independent study by SOA, and find that the two distributions are similar.

B Transformation of Equation 2 to Equation 3

Equation 2 can be rewritten as:

$$EV_t - \rho l_t EV_{t+1} = \rho\left[l_t(1-p_t)\Delta_{t+1} + (1-l_t)\right] - \pi_t$$

Let

$$A_t := \rho l_t \tag{17}$$
$$B_t := \rho\left[l_t(1-p_t)\Delta_{t+1} + (1-l_t)\right] - \pi_t \tag{18}$$

We can further write down the following equation system:

$$\begin{aligned}
EV_t - EV_{t+1}A_t &= B_t \\
EV_{t+1}A_t - EV_{t+2}A_tA_{t+1} &= B_{t+1}A_t \\
EV_{t+2}A_tA_{t+1} - EV_{t+3}A_tA_{t+1}A_{t+2} &= B_{t+2}A_tA_{t+1} \\
&\cdots \\
EV_{t+n}\prod_{i=t}^{t+n-1} A_i - EV_{t+n+1}\prod_{i=0}^{n} A_{t+i} &= B_{t+n}\prod_{i=t}^{t+n-1} A_i \\
&= \frac{B_{t+n}\prod_{i=t}^{t+n} A_i}{A_{t+n}}
\end{aligned}$$

By summing the LHS and the RHS of the equation system above, we have:

$$\begin{aligned}
EV_t - EV_{t+n+1}\prod_{i=t}^{n} A_i &= \sum_{j=t}^{t+n} \frac{B_j \prod_{i=0}^{j} A_i}{A_j} \\
\lim_{n\to\infty}\left(EV_t - EV_{t+n+1}\prod_{i=t}^{t+n} A_i\right) &= \lim_{n\to\infty}\sum_{j=t}^{t+n} \frac{B_j \prod_{i=t}^{j} A_{t+i}}{A_j} \\
EV_t - \lim_{n\to\infty}\left(EV_{t+n+1}\prod_{i=t}^{n} A_i\right) &= \sum_{j=t}^{\infty} \frac{B_j \prod_{i=t}^{j} A_i}{A_j}
\end{aligned}$$

$$\because \lim_{n\to\infty}\left(EV_{t+n+1}\prod_{i=t}^{t+n} A_i\right) = 0 \qquad \therefore EV_t = \sum_{j=t}^{\infty} \frac{B_j \prod_{i=t}^{j} A_i}{A_j} \tag{19}$$

Plugging Equation 17 and Equation 18 back to Equation 19:

$$EV_t = \sum_{j=t}^{\infty} \frac{\left\{\rho\left[l_j(1-p_j)\Delta_{j+1} + (1-l_j)\right] - \pi_j\right\}\prod_{i=t}^{j}\rho l_i}{\rho l_j}$$

$$= \sum_{j=t}^{\infty} \frac{\left\{\rho\left[l_j(1-p_j)\Delta_{j+1} + (1-l_j)\right] - \pi_j\right\}\rho^{j-t}\prod_{i=t}^{j} l_i}{l_j}$$

Table 2: 30-year term profit present value

interest rate	5%	8%	11%
Net Revenue			
Pricing Lapse	912	872	12
0% Lapse	2,244	1,947	1,521
Net Benefits			
Pricing Lapse	(1,036)	(769)	(574)
0% Lapse	(4,026)	(2,889)	(2,040)
Net Income			
Pricing Lapse	(125)	103	107
0% Lapse	(1,782)	(942)	(520)

Note: Assumed rates in pricing: 12-15% in the first year, grading down to 5-8% over time. Source: SOA (1998). Insurance carriers often cite low interest rate as their reason to hike COI. While low interest rate does put carriers in stress, unexpected persistency exacerbates the situation.

Table 3: Summary of used variables and notations

Notation	Description
PP	Policy price
EV	Policy economic value
Δ	Policy price mark-up, $\Delta = PP - EV$
u	Policy utility to insured
u^e	Policy excess utility to insured, $u^e = u - EV$
$F(\cdot)$	Cumulative frequency function
U	Policy utility to society
IdS	Insureds' surplus
BrS	Buyers' (carrier and investor's) surplus
ρ	discount factor
π_t	policy premium to be paid at time t
l_t	insured survival rate between time t and $t+1$
p_t	policy persistency rate between time t and $t+1$

Table 4: Utility depending on insured's choice between leaving and taking a policy

	surplus from taking
insured utility	$u - PP$
carrier utility	$PP - EV$
total utility	$u - EV$

Table 5: Utility depending on insured's choice between persistency and forfeiture of a policy

Panel A: carrier+investor utility

	persistency	forfeiture	surplus from forfeiture	way of forfeiture
carrier utility	$-EV$	$-PP$	$EV - PP$	terminated via carrier
		$-EV$	0	sold to investor
investor utility	0	$EV - PP$	$EV - PP$	
carrier+investor utility	$-EV$	$-PP$	$EV - PP$	

Panel B: insured and carrier+investor utility

	persistency	forfeiture	surplus from forfeiture
insured utility	u	PP	$PP - u$
carrier+investor utility	$-EV$	$-PP$	$EV - PP$
total utility	$u - EV$	0	$EV - u$

Figure 8: Annual face amount terminated 1996-2017

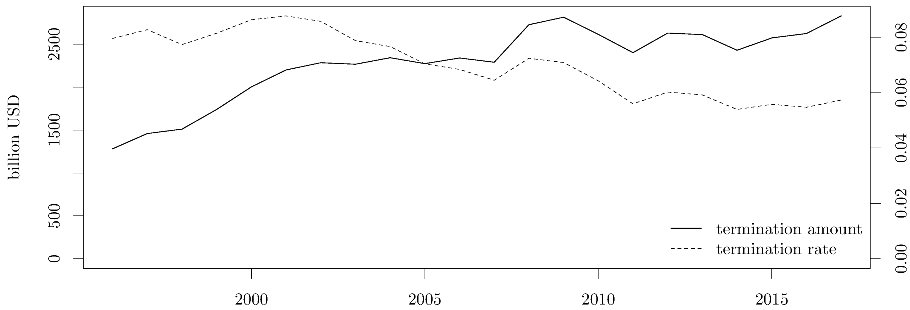
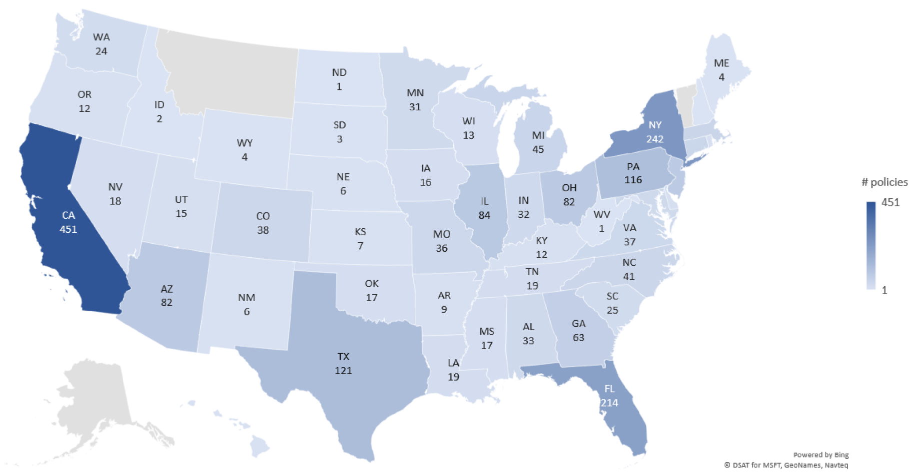
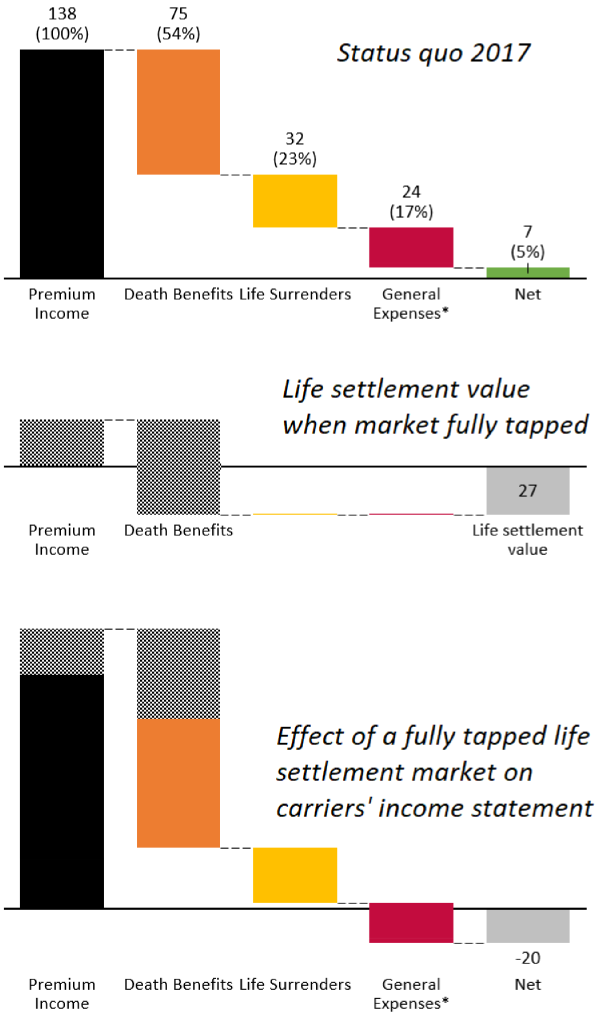


Figure 9: Life settlement by state



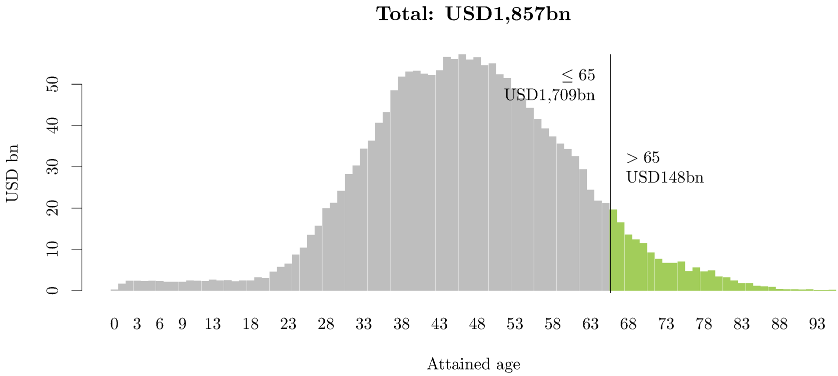
Note: Life settlements are mostly concentrated in California, New York and Florida, where wealthy people reside.

Figure 10: Life settlement effect on insurers' net income



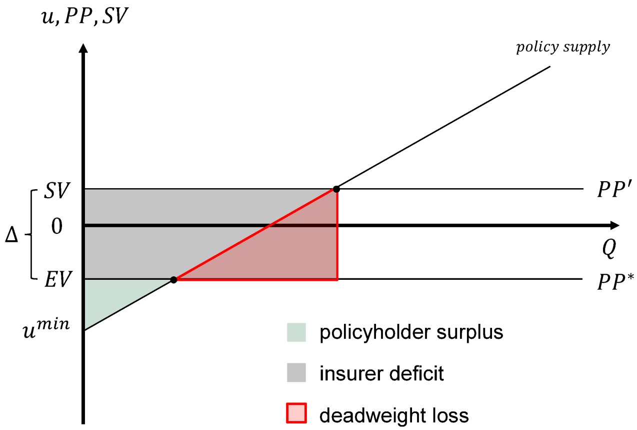
Note: *General expenses do not include insurance commissions, taxes, licenses and fees. If primary insurers leave life settlement being fully exploited, their net income would be negatively impacted.

Figure 11: Face amount of ordinary life policies terminated in 2017



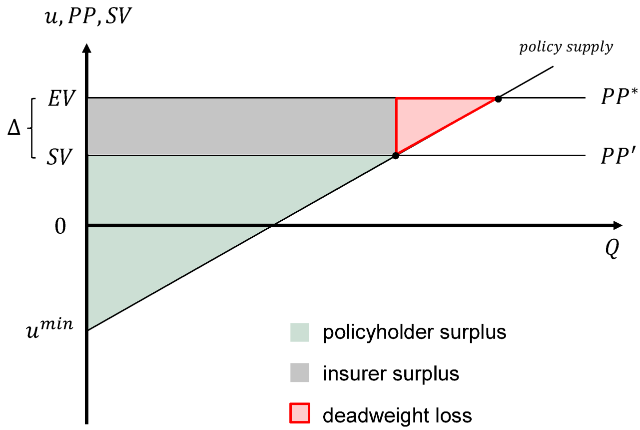
Note: The face amount of ordinary life policies terminated in 2017 totals 1,857 billion USD, consisting of 1,709 billion USD from insureds below age 65, and 148 billion USD from insureds above age 65.

Figure 12: Utility of policyholders and policy buyers: healthy insured cohort



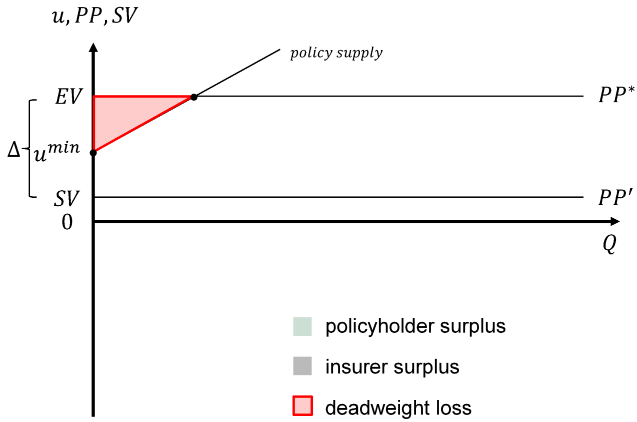
Note: With a healthy insured cohort, MSS increases insurance persistency, increases carrier surplus (from negative to zero), and decreases insured surplus.

Figure 13: Utility of policyholders and policy buyers: unhealthy insured cohort



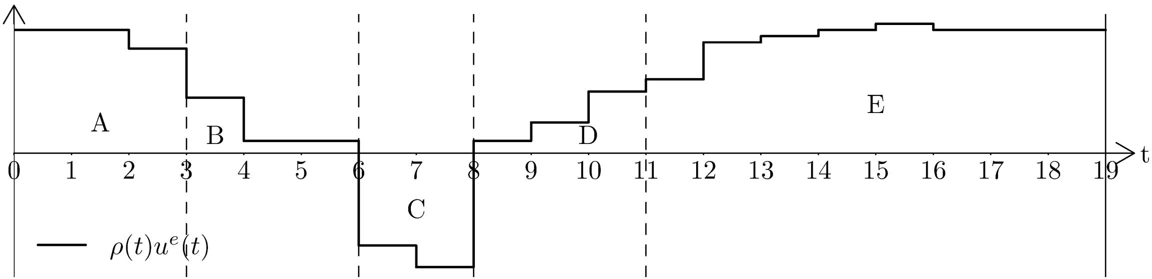
Note: With an unhealthy insured cohort, MSS decreases insurance persistency, decreases carrier surplus (from positive to zero), and increases insured surplus.

Figure 14: Utility of policyholders and policy buyers: terminally ill insured cohort



Note: With a terminally ill insured cohort, MSS reduces insurance persistency, increases insured surplus (from zero to positive), and has no impact on carrier surplus.

Figure 15: Time series of discounted excess utility $\rho(t)u^e(t)$ of insurance



Note: With $\Delta \equiv 0$, the insured disposes of a policy at $t = 6$ and re-acquires a policy at $t = 8$. The insurance's utility to the whole society, U, is thus maximized, equal to area A+B+D+E. If the policy is kept in force from $t = 0$ to $t = 19$, U equals area A+B$-$C+D+E, smaller than A+B+D+E; if the forfeiture occurs at $t = 3$ and re-acquisition at $t = 11$, U equals area A+E, also smaller than A+B+D+E.

Part III

Pricing Life: Risk Premiums in the Secondary Insurance Market

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Abstract

Life settlement prices are commonly determined by present value calculus. Yet, the asset class lacks an established approach for the determination of adequate discount rates. We estimate historical risk premiums based on a large data set of 2,863 transactions that occurred between 2011 and 2016. Subsequently, we explain the cross section of the risk premiums based on hedonic regression methodology and a comprehensive set of attributes motivated by industry know-how as well as earlier studies. Out-of-sample results indicate that market-consistent life settlement prices can be conclusively predicted by employing risk-adjusted discount rates generated with our model.

The paper is currently under review at the *Journal of Risk and Insurance*.

1 Introduction

Despite a recent uptick in scholarly activity, high-quality research on US senior life settlements remains sparse. Earlier work has mainly considered the effects on policyholder surrender behavior (see Gatzert et al. 2009), the performance of the asset class (see Braun et al. 2012; Giaccotto et al. 2015) or risk management aspects for investors (see MacMinn and Zhu 2017). Those authors who examined the pricing of senior life settlements adopted either a utility-based (see Zhu and Bauer 2013) or an actuarial approach (see Brockett et al. 2013). Building upon the work of Braun (2016) for catastrophe bonds, we establish an econometric valuation model for senior settlements based on a set of factors that consistently and reliably explain the variance of the transaction price as a fraction of the death benefit.

Senior settlement prices are known to depend heavily on the insured's life expectancy (*LE*): the longer the *LE*, the less an investor is willing to pay for the policy. The reason is that more premiums are expected to be paid, and the death benefit is expected to be received later (see, e.g., Braun et al. 2012). We provide strong empirical evidence of a negative relationship between a policy's price (expressed as a percent of the death benefit) and the natural logarithm of the insured's *LE*. In addition, our results suggest that a much better in-sample and out-of-sample accuracy can be achieved if the model equation is enriched by death benefit and premium information. Industry professionals conventionally price senior settlements by means of actuarial models. Those necessitate the input of a discount rate (internal rate of return, *IRR*) and the mortality curve of the insured that is used to derive his/her *LE* estimate (see Appendix A). We show that, even if it is possible to estimate the discount rate in a market-consistent way, the precision of our econometric model for policy prices remains superior.

An empirical study conducted by Braun et al. (2015) reveals differences between the prices at which life policies currently trade in the market and the portfolio valuations reported by certain senior settlement funds. While the International Financial Reporting Standards (IFRS) 13 and the Alternative Investment Fund Managers Directive (AIFMD) require assets to be held at fair value, some asset managers still maintain that fair valuation for senior settlements is unattainable. Our results demonstrate that market-consistent prices can be conclusively predicted by means of an econometric model that captures the key policy traits and is calibrated on historical transaction data. Hence, we provide a new perspective on senior settlements pricing that may aid practitioners in accurately evaluating their portfolios. Put differently, our easy-to-implement approach delivers a clear signal as to whether or not an individual policy — or even a whole portfolio — is held at market value. To the best of our knowledge, such a tool is unprecedented in this industry. Therefore, our study, while making an important scholarly contribution, is also of substantial practical significance.

The remainder of this paper is structured as follows. In Section 2, we discuss the data set and the key variables for our analysis and form hypotheses regarding the impact of the latter on the price and risk premium of senior settlements. Section 3 features the empirical investigation, comprising various descriptive statistics, regression models, in-sample and out-of-sample performance assessments, and robustness checks. In Section 4, we interpret our results and in Section 5, we draw our conclusion.

2 Data and Sample Selection

Our data were provided by AA-Partners Ltd (AAP), an independent consulting firm headquartered in Zurich, Switzerland, that specializes in US senior life settlements. AAP maintains a comprehensive network in the industry, through which it collects audited senior settlement transaction information on a monthly basis (see Braun et al. 2015). Our data set comprises salient deal characteristics (e.g., transaction price TP, death benefit DB, and life expectancy LE used at closing) for 2,863 transactions of various life settlement companies and covers the time period from July 2011 to December 2016. Based on AAP's own estimation, their data cover circa 20% of total market transactions before 2014, and the coverage significantly increased to 60% after 2014. Below we discuss all dependent and independent variables in our data set that enter the empirical analysis in the next section.

2.1 Dependent variables

We choose two dependent variables to proxy the value of a policy: (1) the transaction price as a fraction of death benefit (PP), and (2) the risk premium of the settlement (RP), which is defined as the IRR of the expected cash flow stream in excess of the risk-free interest rate.[46] Thus, we work with an implied risk premium derived from observed transaction prices using the mortality curve of the insured as well as the projections for premiums and death benefit. We then discuss potential consequences. The two proxies represent two different angles for the valuation of a policy: PP is cost oriented while RP is return oriented. Industry practitioners use both concepts for policy pricing. Statements such as *"we bought the policy at 20 cents on the dollar"* describe PP, whereas remarks such as *"this policy was sold at a 20% IRR"* refer to the RP. For each policy with known mortality rates and premium stream, PP and RP are linked through the present value formula, which we denote as function f:

$$PP = \frac{TP}{DB} = f(RP) = \left(\frac{\sum_{i=0}^{\infty} \mathbb{E}(C_i)}{(1+RP+r)^i} \right) \cdot DB^{-1}, \tag{20}$$

[46]Due to the persisting low-interest rate environment, IRR and RP are almost equivalent in our sample. The average difference between the two (which equals the mean risk-free rate) is 1.47%.

where

$$\mathbb{E}(C_i) = \begin{cases} -\pi_0, & i = 0 \\ ({}_{i-1}p_x - {}_ip_x) \cdot DB - {}_ip_x \cdot \pi_i, & i \geq 1 \end{cases}$$
$$RP + r = IRR$$

TP: transaction price.

DB: death benefit.

RP: risk premium.

$\mathbb{E}(C_i)$: probabilistic cash flow at time i.

${}_ip_x$: the probability that the x-year-old insured will live i periods. π_i: premium to be paid at time i.

r: risk-free rate.[47]

IRR: Internal rate of return.

According to Equation 43, a higher RP ceteris paribus results in a lower PP. Figure 28 illustrates this relationship for three policyholder age levels $x = 65, 75, 85$ years, based on a hypothetical life insurance policy of a male non-smoker. The respective premium streams were derived from our sample data by averaging the premiums per period of all universal life policies of male non-smokers who were x years old at the senior settlement transaction date. The shapes of the graphs in Figure 28 are quite intuitive. As the price of the policy is equal to the sum of the discounted cashflows — and those cashflows are net positive (the death benefit exceeds the probabilistic premium) — the price decreases nonlinearly in RP. For an RP of 0%, the present value equals the death benefit less the sum of all premium payments. In contrast, the price converges to zero as RP goes to infinity.

Both PP and RP have their relative advantages in representing policy value. PP is a more direct proxy: one can derive the dollar price of a senior settlement by simply multiplying this percentage with the death benefit. RP, in contrast, must be plugged into Equation 43 and requires the inclusion the mortality curve of the insured, a key piece of information that is not always on hand. Regarding a comparison of different policies, however, RP is a more meaningful indicator, since it normalizes for premium profiles.

In the next section, we search for independent variables worthy of inclusion in the following linear regression model:

$$Y = c + \boldsymbol{X\beta} + \boldsymbol{\varepsilon}, \tag{21}$$

[47]Using yields of U.S. treasury bonds.

where Y is proxied by either *PP* or *RP*, $\boldsymbol{X}$ denotes potential independent variables (including control variables) with coefficients $\boldsymbol{\beta}$, and $\boldsymbol{\varepsilon}$ is the error term.

2.2 Independent variables

Life expectancy

As shown in Figure 28, both of our proxies for the value of a policy (*PP* and *RP*) are strongly related to the insured's *LE*. Hence, the latter will be the key pricing factor in our econometric model. The *LE* estimates in our data set come from the four major U.S. medical underwriters (ITM TwentyFirst, AVS, Fasano and LSI). Most settlements exhibit at least two of them. In addition, for each transaction there is an *LE* figure which has been used to close the deal. The market lacks a universal rule based on which it determines the *LE* for pricing purpose. The buy and sell side can agree on the estimate of a single medical underwriter, or average the *LEs* from several. Despite the industrial jargon "blended LE", the *LE* used to close a senior settlement deal is not always a "blend" in the conventional sense: it can exceed (undercut) the highest (lowest) underwriter estimate (Figure 17). In the absence of reports from medical underwriters, a "home-brewed" *LE* may be generated. This is common for the pricing of small-face policies where the cost of obtaining an *LE* report is prohibitive. In the empirical part of this study, we will generally rely on the blended *LE*. To ensure the robustness of results underpinned by the type of *LE*, however, we will run additional checks.

In addition to *LE*, various risks associated with a policy should influence both *PP* and *RP*. Risk-averse investment behavior assumed, policies bearing higher risks are less attractive, and are thus be associated with lower prices (higher risk premiums). If the risk varies on a case-by-case basis, so should the return. This is also observed in the extreme: when presented an annuity hedge to the premium stream, investors tend to intuit that they can increase their bid, which means that they are prepared to accept a lower return. In line with Braun et al. (2012), we identify a total of five important risk types associated with senior settlements: longevity risk, premium risk, default risk, rescission risk and liquidity risk. Below we present independent variables that are employed to proxy each of these risks.

Longevity risk

Longevity risk means that an insured may live longer than expected. It is the most prominent risk in senior settlements and emanates primarily from the possibility of inaccurate (too short) *LE* estimates. Below we discuss a number of independent variables that are linked to this type of risk.

LE: Life expectancy. Shorter *LE*s are associated with higher longevity risk, since they are more likely to be underestimated than longer ones (Xu 2019). Hence, apart from the direct impact of the *LE* on the price or the risk premium, there may be an indirect longevity risk effect. Regarding the relative price *PP*, however, we do not expect the latter to be strong enough to offset the negative relation with *LE* as illustrated above. Turning to the risk premium *RP*, in contrast, the elevated riskiness of shorter *LE*s should be reflected in higher values. Thus, we arrive at the following hypotheses:

H1(a): PP has a negative relation with LE.

H1(b): RP has a negative relation with LE.

DB: Death benefit. Insureds whose death benefit (*DB*) is high tend to be wealthy people (Verdon 2010) who have access to advanced healthcare and therefore exhibit a greater longevity compared to their less well-off peers. Policy *DB*, however, is regularly not disclosed to medical underwriters and consequently not captured in their *LE* estimates. Hence, policies with higher *DB* values can be expected to exhibit a degree of higher longevity risk, leading us to postulate:

H2(a): PP has a negative relation with DB.

H2(b): RP has a positive relation with DB.

DI: Difference in LE estimates. Conventionally, a senior settlement requires *LE* certificates from at least two medical underwriters. As *LE* estimation involves different quantitative models and subjective judgment, results concerning the same life can notably differ between underwriters (Xu 2019). The variable *DI* denotes the gap between the longest and the shortest *LE* estimate for a given policy. The larger this deviation, the higher the uncertainty surrounding the accuracy of the *LE* and, in turn, the longevity risk. Therefore, we expect to find the following effects:

H3(a): PP has a negative relation with DI.

H3(b): RP has a positive relation with DI.

MK: Market. MK is a binary variable that indicates whether the transaction occurred in the secondary ($MK = 0$) or the tertiary market ($MK = 1$) of life insurance. Other things being equal, a secondary policy carries a higher longevity risk than a tertiary one due to the adverse selection effect of insureds (see Bauer et al. 2014): insureds who are inclined to sell their policies usually think they are healthy, and most likely this feeling reflects their real health condition regardless of what their medical records imply. Those insureds believe that monetization now, through a senior settlement, is a more favorable position than continuing to fund their insurance. That said, we postulate that:

H4(a): PP has a positive relation with MK.

H4(b): RP has a negative relation with MK.

NO: Number of LE estimates. *NO* is a binary variable denoting the number of *LE* estimates from the four biggest medical underwriters (ITM TwentyFirst, AVS, Fasano and LSI) considered in a transaction. If multiple *LE* estimates are available, $NO = 1$. Otherwise $NO = 0$. In line with Januário and Naik (2014), we suppose that buyers associate less longevity risk with a policy for which multiple *LE* estimates are available. Consequently, they are willing to pay a higher price or accept a lower risk premium:

H5(a): PP has a positive relation with NO.

H5(b): RP has a negative relation with NO.

AGE: Insured's age. The life expectancies of older people are more difficult to forecast due to paucity of historical data (see, e.g., Bahna-Nolan 2014). Consequently, policies of more senior insureds are likely to include a higher degree of longevity risk, and should therefore be associated with a lower (higher) price (risk premium):

H6(a): PP has a negative relation with AGE.

H6(b): RP has a positive relation with AGE.

CO: Premium convexity. We borrow the notion of premium convexity from Januário and Naik (2014) and define the variable *CO* as the sum of time-weighted premium fractions:

$$CO = \sum_{i=0}^{T} \frac{i^2 \cdot \pi_i}{\sum_{i=0}^{T} \pi_i}, \tag{22}$$

where π_i is the dollar amount of premium to be paid at time i. *CO* captures the "latent" longevity risk associated with insureds' outliving their *LE* estimates: ceteris paribus, the more convex a premium stream is, the heavier the loss a policy buyer would suffer should the insured live longer than expected. Hence:

H7(a): PP has a negative relation with CO.

H7(b): RP has a positive relation with CO.

Premium risk

Premium risk pertains to a hike in the premiums of an in-force policy, which means higher cash outflows for investors. In line with this reasoning, we introduce the following variable:

PM/DB: Sum of expected premiums as a fraction of the death benefit. The current premium level is known to be an indicator for the likelihood of increases. Sheridan (2017), e.g., suggests that low-premium policies are more likely to experience premium rises. We use the sum of expected premiums PM normalized to DB to denote the premium level:

$$PM = \sum_{i=0}^{LE} \pi_i, \tag{23}$$

Other things equal (especially LE), the lower PM/DB, the higher a policy's premium risk. Senior settlements with lower premium level should therefore be priced more conservatively, namely with a higher RP. At the same time, however, lower values of PM/DB signal smaller future cash outflows and thus make room for higher transaction prices. This direct impact is expected to overcompensate the indirect risk effect. Accordingly, we formulate the following hypotheses:

H8(a): PP has a negative relation with PM/DB.

H8(b): RP has a negative relation with PM/DB.

Default risk

The insurers' default risk, or credit risk, is linked to the uncertainty in their ability to honor claims should financial distress occur. An insurer's A.M. Best credit rating is a good proxy to gauge this risk.

RT: Credit rating. For each policy, RT is a binary variable that denotes the insurer's credit rating assigned by A.M. Best, a U.S.-based rating agency with a focus on the insurance industry. For policies issued by A-rated (A-, A, A+, AA-, AA, AA+, AAA) insurers, $RT = 1$, otherwise $RT = 0$. A higher rating implies a lower default risk associated with the payout of death benefit. Therefore, we expect to find the following relationships:

H9(a): PP has a positive relation with RT.

H9(b): RP has a negative relation with RT.

Rescission risk

Rescission is the revocation of a contract. In the senior settlements market, it means the insurance carriers' refusal to pay the death benefit. This could happen due to a lack of insurable interest or other fraudulent behavior at issuance (Chancy et al. 2010). This risk can be proxied by the vintage of a policy (Sadowsky and Browndorf 2009).

VI: Vintage. The vintage of a policy is represented by the time elapsed between the issue and the settlement date. The sooner a life insurance policy is available for sale after its issuance, the more likely it is that investors would believe the policy was originated with the intention to be life-settled. As a carrier can contest a claim in the absence of insurable interest, policies with shorter vintage carry higher rescission risk, and should therefore achieve lower prices than policies with longer vintage. Hence:

H10(a): PP has a negative relation with VI.

H10(b): RP has a positive relation with VI.

Liquidity risk

Liquidity risk describes the ability of investors to liquidate their assets in a crisis. The semi-liquid nature of the senior settlements asset class implies high liquidity risk. We assume the same level of liquidity risk for all policies, and let the constant term c capture this risk factor.

2.3 Control variable

The control variable PT represents the policy type. $PT = 1$ designates universal life policies and $PT = 0$ other types. We have also considered variables such as cash surrender value,[48] total premium until policy maturity, transaction date, smoking status, and mortality multiplier, as well as interactions between variables. For succinctness, we refrain from reporting these results, because there is either a lack of sound existing theory for these variables, or a conceptual overlap with the factors already discussed in this section (e.g. between mortality multiplier and LE). In addition, the inclusion of these regressors does not improve our results.

3 Empirical Analysis

3.1 Descriptive statistics

In this section, we provide a variety of descriptive statistics. Before estimating the different regression models, we divide the overall data set into two subsamples. Sorted chronologically, the first two thirds of the transactions are used for model development

[48] Cash surrender value (CSV) is the money that sits in a policy's cash account. In instances of large CSV, the policy owner can enjoy a "premium holiday" where premiums are debited from the account and no out-of-pocket premium payment to the insurer is needed. CSV represents the opportunity cost of a policy and theoretically forms the floor of the policy price. We do not deduct CSV from TP, because the premiums in our sample are optimized. Therefore, any CSV effect is already captured through the premium stream.

and in-sample fitting. The rest is reserved for an out-of-sample precision analysis. Table 12 contains the number of observations (n), mean, median, minimum (Min.), maximum (Max.), and standard deviation (StDev.) for the major variables in the full sample as well as the two subsamples. To get a sense of the typical transaction characteristics, consider the following values: the average PP amounts to 26.87% at an average life expectancy (LE) of 6.64 years, an average PM/DB of 26.35%, an average death benefit (DB) of USD 1.8 million, and an average risk premium (RP) of approximately 22%. PP varies considerably across all policies in the sample, which is indicated by the respective standard deviation, as well as the minimum and maximum values. It can, for example, be as low as 0.25% or as high as 85.38%. The range of PM/DB is even wider. A high standard deviation is also observed for the death benefit (DB), for which the minimum and maximum values differ by almost USD 30 million.

Further descriptive statistics for different categories of senior settlements in the sample are presented in Table 7. When focusing on gender, we observe that the majority (71%) of the insureds in our sample are male. Even though the age of the average male is 2 years lower than that of the average female, their respective LEs differ only slightly. Apart from that, we notice that nonsmokers dominate the sample (97%). The average age of nonsmokers (78 years) is significantly higher than that of smokers (72 years). Despite being that much older than the average smoker, the LE of the average nonsmoker is one year longer, leading to an average gap of 7 years between the two groups' expected age at death. In line with their lower LE, both the mean PP and RP for policies of smokers is higher than for those of nonsmokers. Furthermore, secondary market transactions make up nearly 70% of the sample. While the mean LE is roughly the same for secondary and tertiary market deals, the average insured of the latter is 7 years older. This implies that health impairments are substantially larger in the secondary market, as also reflected by the higher mortality multiplier k. Accordingly, secondary market transactions, on average, exhibit a higher PP. Concerning policy type, we notice that the sample comprises mainly universal life contracts (84%). The average PP, PM and DB are considerably lower for term life and whole life than for universal life policies. It is also evident that the average insured's age differs greatly among these product categories. In terms of credit ratings, nearly the whole sample (96%) consists of policies from A-rated carriers, which seem to be associated with a lower average RP than those of B-rated or unrated insurers. Finally, about 17% of the policies originate from California, and 56% were sold in the years 2015 and 2016. Interestingly, VI increases with the transaction year, indicating that most issuance dates lie between 2002 and 2004. In this period, the number of manufactured policies, including stranger originated life insurance (STOLI), was relatively high.

3.2 A Market-Consistent Econometric Model

Our goal in this section is to derive a parsimonious econometric model for our dependent variables PP and RP. Following Braun (2015), we start by examining the functional relationship between LE and the price multiplier PP. To this end, we consider linear, log-linear, polynomial and exponential models (Figure 19). Due to an obvious inferior in-sample fit compared to the other specifications (considerably lower R^2), the linear model can be ruled out immediately. While the remaining three alternatives exhibit a similar performance, the cubic polynomial model requires four parameters instead of two, and is thus the least parsimonious. Comparing the log-linear and the exponential model, we believe that the former is superior. The reasons are two-fold:

1. The log-linear model naturally restricts the range of the independent variable (LE) to positive rational numbers, which makes practical sense;
2. The log-linear model yields a negative price when LE is sufficiently large. In contrast, the price generated by the exponential model converges to zero. In reality, a policy can indeed become a liability (i.e., have a negative present value) when LE is so large that the present value of premiums to be paid exceeds that of the death benefit.

Having said that, we continue with an analysis of additional variables that may increase the explained variance. To this end, we rely on forward selection in a series of ordinary least squares (OLS) regressions with Newey-West robust standard errors. Accordingly, $\ln LE$ is included first, followed by the stepwise addition of other variables. To be selected, the latter need to exhibit a statistically significant coefficient and deliver the largest improvement in the model fit among their peers.[49] Root mean square error (RMSE), coefficient of determination (R^2), adjusted R^2 (R^2_{adj}), and Bayesian information criterion (BIC) are employed as performance indicators to assess how well a combination of coefficients and variables explains the sample data.[50] A complementary analysis for cross-validation using the Least Absolute Shrinkage and Selection Operator (LASSO) method can be found in Appendix C.

We start with PP as the dependent variable. The corresponding results are shown in Figure 20. When using $\ln LE$ as the sole regressor, we obtain RMSE $= 0.108$, $R^2 = 0.689$, $R^2_{adj} = 0.689$, and BIC $= -3{,}044$. The best possible model with two predictors additionally includes PM/DB. In this case, the RMSE decreases to 0.094, R^2_{adj} increases to 0.765, and BIC improves to $-3{,}572$. Thus, the introduction of PM/DB leads to substantially better results. When we add $\ln DB$ as a third variable, however, the model fit only improves slightly (RMSE $= 0.092$, $R^2_{adj} = 0.774$, and BIC $= -3{,}636$).[51] The same is true for all further regressors. Hence, we decide to stick with the two-variable model:

$$\widehat{PP} = c - \beta_{LE} \ln LE - \beta_{PM} \frac{PM}{DB} \tag{24}$$

[49] Backward deletion and exhaustive selection deliver virtually the same results and are thus not reported here.

[50] For a formal definition of these performance indicators refer to Appendix B.

[51] As DB denotes a positive dollar amount, it is advisable to use the logarithmic form of the variable $\ln DB$ for the regression (see, e.g., Wooldridge 2009).

With little existing research on quantitative analysis of senior settlement risks, we lack empirical and theoretical precedents on the relationship between risk premium and risk proxies of a senior settlement. Therefore, we directly engage in a stepwise selection of explanatory variables for *RP*, without illustrating functional relationships between *RP* and any risk proxy. The results for *RP* as the dependent variable are presented in Figure 21. Unlike *PP*, whose variance is sufficiently explained solely through $\ln LE$, *RP* appears to be more erratic,[52] which likely explains the lack of literature on this topic.[53]

Of all examined alternatives, the three-regressor specification exhibits the lowest RMSE and BIC. Moreover, R^2_{adj} only slightly improves when further independent variables are added. Therefore, we select the following model for *RP*:

$$\widehat{RP} = c - \beta_{LE} \ln LE + \beta_{DB} \ln DB - \beta_{PM} \frac{PM}{DB} \qquad (25)$$

Despite the fact that we decide to rely on two parsimonious models for our dependent variables percentage price *PP* and risk premium *RP*, it should be emphasized that the majority of effects in Figure 20 and Figure 21 is statistically significant. Furthermore, the postulated signs of the effects for both dependent variables were correctly anticipated in the second section. Hence, we find evidence for all hypotheses presented above, apart from $H4(b)$, $H9(b)$, and $H10$. Judging by the standardized regression coefficients, however, the impact of all but the two or three most important factors is comparatively minor. Therefore, it makes sense to restrict the econometric pricing models to the dominant predictors.

3.3 Out-of-sample analysis

Judging by the in-sample fit statistics considered above, the econometric model for *PP* performs much better than that for *RP*. We now further evaluate the relative accuracy of these two alternatives in an out-of-sample analysis. To this end, we employ the fully specified and calibrated models shown in Equation 24 and Equation 25 to predict the prices of all transactions in subsample 2, which was exclusively reserved for this purpose. Based on the differences between observed and fitted values for each of the two dependent variables, we calculate the following performance indicators: mean error (ME), mean absolute error (MAE), root mean square error (RMSE) and out-of-sample R^2.[54] The results of out-of-sample analysis are illustrated in Figure 22 and Figure 23.

[52] The existing literature on senior settlements does not include a model that is well suited to explain *PP* or *RP* (*IRR*). One of the few promising attempts was made by Januário and Naik (2014), who have used *IRR* as the dependent variable in a regression with various specifications. However, their model only explains a minor part of the variance of *IRR*.

[53] This is known as the file drawer problem.

[54] A formal definition of is included in Appendix B.

The 45-degree line (red, dashed) in each plot implies equality between model prediction (horizontal axis) and empirical observation (vertical axis). The points above (below) it represent underestimation (overestimation). Deviations from the line correspond to pricing errors.

Figures 22(a) and (b) illustrate the accuracy of the regression models for *PP* and *RP*, respectively. For the former, both the scatter plots and the four statistical performance indicators indicate only slight differences regarding in-sample and out-of-sample performance. For the latter, in contrast, many observations are severely misaligned with the associated estimates. *RP* is much more volatile than $\widehat{RP}$, and its extreme values in the right tail ($RP > 0.5$) are barely captured by the model. Consequently, the 95% prediction interval is much wider than in Figure 22(a).

Furthermore, in order to enable a direct comparison of the pricing performance of the two models, we convert the estimated risk premiums $\widehat{RP}$ into predictions for the percentage prices $\widehat{PP}$ using function f described in Equation 43. The corresponding results are illustrated in Figure 23. Compared with Figure 22(a), we observe an inferior precision both in-sample and out-of-sample. Hence, our suggested regression model for the direct prediction of *PP* seems to be more suitable than the common industry approach of running an econometric model for *RP* and, in turn, employing the respective estimates for an actuarial computation of *PP*.

3.4 Robustness test

Having selected the two-variable linear regression model for *PP* as the most effective way of estimating senior settlement prices, we further assess its robustness. To this end, we tranche our data set according to policy types, carrier ratings, and medical underwriters and recalibrate the model for each subcategory. Subsequently, we again evaluate both the in-sample and out-of-sample performance. The transaction date that separates the in-sample and the out-of-sample data remains 10/14/2015.

The results for the subsamples of different policy types and carrier ratings are shown in Table 8. In all six cases, the in-sample statistics appear satisfactory (e.g., R^2_{adj} over 67%) and the impact of $\ln LE$ is similar. However, the coefficient for PM/DB turns out markedly lower (more negative) for *whole life* and *term life* than for *universal life* policies, indicating a higher sensitivity of the senior settlement price to the expected premium stream. In addition, we observe an insignificant relationship of PM/DB and *PP* for policies of unrated insurers. All other parameter values deviate only marginally from the results displayed in Figure 20. This confirms that policy type *PT* and rating *RT* have a negligible impact on *PP*, such that their exclusion from the model was warranted. Since the subsamples *whole life* and *no rating* comprise less than 30 observations each, the model's out-of-sample performance in these categories is poor. This result is likely to occur due to insufficient information for a proper model calibration.

As discussed in the second section, we generally use the *LE* at closing of a senior settlement transaction for model estimation. Recall that this parameter is determined by the buy and sell side during negotiations, and can be a single estimate provided by a specific medical underwriter or a blend of various values. In the following, we exclusively employ *LE* estimates of the same underwriter for the recalibration of our econometric model. Consistent with the latter, *PM* is also recalculated according to Equation 23. As shown in Table 9, the model fit remains generally stable. The *LE* figures of LSI, however, are associated with a notably weaker in-sample and out-of-sample precision than those of ITM, AVS, and Fasano. Again, this could be attributable to the fact that the LSI subsample is relatively small. In any case, we may conclude that our pricing model is well suited for the vast majority of senior settlement deals (i.e., those with *LE* estimates by ITM, AVS and Fasano).[55]

Another observation in Table 9 is that c, β_{LE} and β_{PM} differ considerably between underwriters. E.g., the sensitivity of *PP* to $\ln LE$ is higher and the sensitivity of *PP* to PM/DB is lower for Fasano than for AVS. This variation in the coefficients results from the differences in *LE* estimates between the large medical underwriters (Xu 2019). The latter is illustrated in Figure 18. Hence, we believe it is important to run underwriter-specific model calibrations and price predictions.

4 Discussion on the Risk Premium

In actuarial models both *LE* and *RP* influence the policy price. Therefore, we cannot completely rule out the possibility that investors have taken risks into account by modifying life expectancy estimates instead of discount rates when valuing a policy. If *LE* encompasses most of the risk information rather than *RP*, then the former should be more relevant in pricing than the latter. This could, to some extent, explain why our two-variable model is better suited to explain *PP* than an econometric approach for *RP* in combination with an actuarial calculation of *PP*.

Moreover, the risk premiums applied by investors for the pricing of transactions were not included in our data set. Therefore, we proxied them through implied risk premiums (*RP*) that we estimated from the deal *IRRs* by means of Equation 43, given prices, premiums and mortality rates. Deviations may thus arise, since the mortality rates for each deal also had to be inferred from the reported *LE* using Equation 41. The preceding relies on two assumptions: (1) *LE* is the mean of an insured's survival distribution; (2) an insured's mortality rates exhibit a constant ratio with regard to the standard mortality rates of his cohort (the mortality multiplier k).[56] Practitioners sometimes use median *LE* instead of mean *LE* and/or a different mortality table than the VBT15-ANB, which we applied in this study, to extract standard mortality rates.

[55] Only 7 transactions in the full sample are accompanied by an *LE* of LSI alone.

[56] The crudeness of cohorting varies. Valuation Basic Tables (VBT), for example, are gender-smoker-distinct and age-specific. More granular tables also consider primary impairments.

Additionally, in clinical judgment, mortality rates are determined ad hoc instead of multiplying standard rates. The application of different mortality rates could result in discrepancies in *RP*.

The characteristics of the *IRR* also contribute to the disjunction between an applied and an implied *RP*. If the sign of the probabilistic cash flow C_i changes more than once (such as $-,+,+,+,-\ldots$[57]), function f can be non-monotonic[58] and Equation 43) may have two positive roots. The algorithm that we applied in this study to determine the implied *RP* systematically searches an interval from lower to upper limit for the root (zero) of Equation 43. If multiple roots exist, the smallest is selected. In reality, however, the choice of *RP* is unknown to us. This trait makes *RP* a less coherent and reliable proxy than *PP*. One may consider the usage of the modified internal rate of return (*MIRR*), which can easily resolve the aforementioned problems associated with IRR. However, the measurement of *MIRR* requires assumptions on reinvestment and finance rates which vary between investors and is thus difficult to implement in this study.

Failing to estimate right tail values of *RP* as shown in Figure 22 does not translate into a considerable negative impact in the accuracy of *PP* estimation as illustrated in Figure 23. This is because *PP* becomes inelastic to changes in *RP* at high levels of *RP* (see Figure 28). In sum, the partial inelasticity of *PP* to *RP*, together with the non-injectivity of function $f: RP \to PP$ discussed in the paragraph above, are explanations for the observed alignment between our price predictions based on implied risk premiums $\widehat{PP}(= f(\widehat{RP}))$ and the true market prices *PP* that were computed based on unobserved risk premiums *RP* (Figure 23(b)). Our results indicate that an econometric model is well suited to explain the variance in *PP* but less so *RP*. Yet, predicted risk premiums $\widehat{RP}$ still produce sufficiently good price estimates.

5 Conclusion

We examine the impact of a wide variety of determinants on the pricing and risk premiums of senior life settlements using a large sample of observed transaction prices and deal characteristics. Our empirical analysis provides evidence for the majority of hypotheses discussed in the second section. More specifically, we are able to confirm that the longevity risk, premium risk and default risk associated with a policy generally reduce its price. In addition, most types of risk exposures also increase the risk premium (*RP*) demanded by senior settlement investors. However, the risk premium does not seem to be influenced by the fact that a policy is sold in the secondary or tertiary market (*MK*). Similarly, the default risk of the carrier, as measured by its rating (*RT*), does not

[57] This barbelled cash flow pattern can be generated by very high probabilistic tail premiums $({}_ip_x \cdot \pi_i)$ greater than the probabilistic death benefit receipts $({}_{i-1}|q_x \cdot DB)$. See Sheridan (2013) for an example.

[58] The non-monotonicity can also be observed from Figure 28 where $x = 65$, $k = 1$.

play a role here. The only risk category with no influence on either senior settlement pricing or risk premium is rescission risk (proxied by VI).

Based on the aforementioned findings, we propose an econometric pricing approach for senior settlements. Despite their statistical significance, the impact of most determinants, such as number of LE estimates for an insured (NO) and difference between the highest and the lowest LE estimates (DI), is substantively small. Hence, a parsimonious model based on life expectancy estimates and expected premiums is sufficient to predict policy values with a high accuracy both in-sample and out-of-sample. Applying Occam's razor, the proposed econometric model does not require additional assumptions with regard to the insureds' mortality and the discount rate, which is advantageous compared to the classical actuarial pricing approach for senior settlements. Once its parameters have been estimated, the econometric model can be used for transactions or portfolio valuations. Accordingly, our findings rebut the claim of certain fund managers that market-consistent prices are unattainable for senior settlement assets.

The make-up of risk premiums merits further research. Although we were able to provide initial evidence on its size and composition, our findings are restricted by the fact that we needed to rely on implied instead of applied values. The former were derived using an arbitrarily chosen mortality table and are thus subject to the inaccuracies described in the previous section. Consequently, a confirmation of our results based on the true risk premiums used in real-life transactions is desirable. In line with this reasoning, it would be important to shed further light on the question of whether investors conduct their risk adjustments by modifying life expectancy estimates or risk premiums. Finally, our study revealed a high expected return on senior settlement investments. However, there is anecdotal evidence of historical underperformance (An 2014; Braun et al. 2012), which calls the realizability of these return figures into question. This problem could be addressed by a cash-flow-based performance analysis for senior settlement funds.

Appendix

A Calculation of *LE*

In senior settlements, the life expectancy *LE* is usually estimated as follows:

$$LE = \sum_{i=0}^{\infty} {}_{i+1}p_x = \sum_{i=0}^{\infty} ({}_{i}p_x \cdot {}_{i|}p_x) \tag{26}$$

where

$${}_{i}p_x = \begin{cases} 1, & i \leq 0 \\ \prod_{j=0}^{i-1} {}_{j|}p_x, & i \geq 1 \end{cases} \tag{27}$$

$${}_{i|}p_x = \sqrt[n]{\max(0, 1 - k \cdot {}_{\lfloor \frac{i}{n} \rfloor|}Q_x)} \tag{28}$$

iQ_x: the standard mortality rate that the x-year-old insured's demographic cohort will live i periods.

k: the customized mortality multiplier that describes the relationship between the insureds' mortality rate and the standard mortality rate of the insureds' demographic cohort iQ_x.

${}_{i|}p_x$: the x-year-old insured's one-period conditional survival probability at time i, the probability that the insured will be alive at the end of the $(i+1)^{\text{th}}$ period, given that the person is alive at the end of the i^{th} period.

n: number of periods in a year (e.g., months: $n = 12$).

B Model performance measures

Let y_i be the observed values of a variable and $\hat{y}_i$ the estimated values using model M that contains p explanatory variables (constant term not counted). Performance measurements of model M include (Braun et al. 2015, pp. 837–840):

Mean error (ME):

$$\text{ME} = \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)}{n} \tag{29}$$

Mean absolute error (MAE):

$$\text{MAE} = \frac{\sum_{i=1}^{n}|y_i - \hat{y}_i|}{n} \tag{30}$$

Root mean square error (RMSE):

$$\text{RMSE} = \sqrt{\frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{n}} \tag{31}$$

Coefficient of determination (R^2):

$$R^2 = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y}_i)^2} \tag{32}$$

Adjusted R^2 (R^2_{adj}):

$$R^2_{adj} = R^2 - (1 - R^2)\frac{p}{n-p-1} \tag{33}$$

Bayesian information criterion (BIC):

$$\text{BIC} = k \ln n - 2 \ln p(y|\hat{\theta}, M) \tag{34}$$

where $\hat{\theta}$ denotes the estimated model parameters.

C LASSO regression

Consider the regression:

$$y_i = \beta_0 + \beta_1 x_{i1} + \ldots + \beta_p x_{ip} + \varepsilon_i, i = 1, \ldots, n \tag{35}$$

The OLS estimator $(\beta_0, \beta_1, \ldots, \beta_p)^{\mathrm{OLS}}$ and the LASSO estimator $(\beta_0, \beta_1, \ldots, \beta_p)^{\mathrm{LASSO}}$ are solved as below (Tibshirani 1996):

$$(\beta_0, \beta_1, \ldots, \beta_p)^{\mathrm{OLS}} = \arg\min \left\{ \sum_{i=1}^{n} (\varepsilon_i)^2 \right\} \tag{36}$$

$$(\beta_0, \beta_1, \ldots, \beta_p)^{\mathrm{LASSO}} = \arg\min \left\{ \sum_{i=1}^{n} (\varepsilon_i)^2 + \sum_{j=1}^{p} \lambda |\beta_j| \right\} \tag{37}$$

The LASSO regression presented in Figure 24 corroborates the variable selection conducted with OLS regression in Section 3.2. For *PP* modeling, two variables are selected ($\ln LE$ and $\frac{PM}{DB}$) at $\lambda = 0.027$. Likewise, for *RP* modeling, three variables are selected ($\ln LE$, $\ln DB$ and $\frac{PM}{DB}$) at $\lambda = 0.017$. In both cases, a decrease of λ, which increases number of variables selected, does not markedly improve the regression performance with regard to both R^2 and RMSE.

Table 6: Descriptive statistics

	n	Mean	Median	Min.	Max.	StDev.
Full Sample (01/07/2011 – 12/31/2016)						
DB (kUSD)	2,863	1,832.78	1,000.00	20.00	30,000.00	2,583.92
PP (%)	2,863	26.87	20.84	0.25	85.38	20.66
PM/DB (%)	2,863	26.35	26.62	0.00	96.50	17.28
CSV/DB (%)	2,838	1.64	0.00	-4.02	44.42	4.15
RP (%)	2,863	21.89	16.60	-1.95	247.48	21.59
LE (years)	2,863	6.64	6.26	0.43	28.50	3.76
AGE (years)	2,863	77.89	80.31	20.22	97.80	11.32
VI (years)	2,698	11.99	10.34	1.14	36.92	7.07
k (—)	2,863	67.92	3.31	0.39	4,625.67	273.45
Subsample 1 (01/07/2011 – 10/14/2015)						
DB (kUSD)	1,909	1,969.67	1,000.00	25.00	25,700.00	2,665.91
PP (%)	1,909	25.29	19.89	0.32	83.08	19.45
PM/DB (%)	1,909	26.85	27.10	0.00	96.50	16.90
CSV/DB (%)	1,909	1.75	0.00	-4.02	44.42	4.44
RP (%)	1,909	21.43	16.51	-1.95	245.11	20.94
LE (years)	1,909	6.92	6.58	0.50	28.50	3.69
AGE (years)	1,909	78.35	80.58	20.22	97.80	10.61
VI (years)	1,810	11.07	9.56	1.14	33.21	6.70
k (—)	1,909	55.97	3.05	0.39	4,387.30	239.18
Subsample 2 (10/14/2015 – 12/31/2016)						
DB (kUSD)	954	1,558.85	750.00	20.00	30,000.00	2,389.40
PP (%)	954	30.04	22.63	0.25	85.38	22.57
PM/DB (%)	954	25.33	25.58	0.00	90.13	17.98
CSV/DB (%)	929	1.43	0.00	0.00	26.59	3.45
RP (%)	954	22.81	16.68	-1.62	247.48	22.81
LE (years)	954	6.08	5.13	0.43	23.34	3.83
AGE (years)	954	76.98	79.24	30.84	96.91	12.58
VI (years)	888	13.86	12.74	1.15	36.92	7.43
k (—)	954	91.83	3.91	0.63	4,625.67	330.40

Note: This table shows the number of observations (n), mean, median, minimum (Min.), maximum (Max.), and standard deviation (StDev.) of the major variables for the full data set and the two subsamples for the in-sample and the out-of-sample analysis. The binary variables introduced in the previous section have been omitted.

Table 7: Descriptive statistics for different categories

		n (—)	Percent (%)	$\varnothing DB$ (kUSD)	$\varnothing PP$ (%)	$\varnothing PM/DB$ (%)	$\varnothing CSV/DB$ (%)	$\varnothing RP$ (%)	$\varnothing LE$ (years)	$\varnothing AGE$ (years)	$\varnothing VI$ (years)	$\varnothing k$ (—)
Gender	Male	2,025	70.73	1,765.45	26.17	26.72	1.63	21.30	6.77	77.22	12.41	46.14
	Female	838	29.27	1,995.49	28.57	25.45	1.68	23.32	6.32	79.51	11.00	120.53
Smoker	Non smoker	2,784	97.24	1,853.58	26.77	26.43	1.64	21.74	6.66	78.05	11.97	68.21
	Smoker	79	2.76	1,099.97	30.51	23.38	1.65	27.14	5.87	72.32	12.58	57.61
Market	Secondary	1,991	69.54	1,772.16	27.58	24.01	1.77	23.28	6.68	75.71	11.71	92.26
	Tertiary	872	30.46	1,971.20	25.27	31.69	1.36	18.71	6.54	82.88	12.59	12.34
Policy type	Universal life	2,407	84.07	1,959.60	23.79	28.94	1.77	20.52	7.00	80.24	11.95	20.01
	Term life	161	5.62	534.58	57.23	4.52	0.01	27.84	3.37	58.02	10.91	490.04
	Whole life	48	1.68	611.17	41.49	16.27	2.11	28.59	4.35	62.75	14.29	329.72
	Others	247	8.63	1,680.52	34.27	17.24	1.39	30.08	5.76	70.89	12.75	208.70
Rating	A-rated	2,760	96.40	1,838.95	26.82	26.57	1.63	21.54	6.67	78.03	11.91	65.73
	B-rated	65	2.27	1,533.78	27.13	22.42	2.17	26.22	6.09	75.36	14.77	81.69
	No rating	38	1.33	1,896.18	30.13	16.66	2.10	40.03	5.32	72.59	12.70	203.11
State	California	482	16.84	1,916.54	25.59	25.99	1.73	22.01	7.01	77.69	11.19	72.85
	New York	315	11.00	2,260.75	25.99	26.68	1.35	18.81	6.91	77.80	10.73	53.90
	Florida	252	8.80	2,286.95	24.28	25.51	1.67	22.84	6.86	79.63	11.39	50.56
	Texas	142	4.96	1,167.29	30.98	21.74	1.34	24.24	6.27	73.94	12.43	138.66
	Pennsylvania	130	4.54	1,728.73	25.75	24.60	1.88	24.81	6.77	78.08	14.14	28.79
	New Jersey	105	3.67	1,737.20	29.18	23.98	1.51	19.56	6.83	76.25	11.96	48.55
	Arizona	93	3.25	1,596.87	24.25	29.63	1.34	19.60	7.12	78.17	10.25	64.89
	Others	1,344	46.94	1,721.45	27.71	27.17	1.72	22.20	6.38	78.17	12.57	70.72
Transaction year	2011	191	6.67	1,835.61	24.19	26.24	1.72	19.52	7.35	78.58	7.69	54.67
	2012	246	8.59	2,324.99	23.70	25.50	2.34	23.99	6.71	79.81	9.19	18.09
	2013	344	12.02	2,180.21	21.73	28.49	1.92	23.56	7.17	78.06	10.58	76.90
	2014	480	16.77	1,760.20	24.26	27.42	1.77	21.20	6.99	78.72	11.68	39.00
	2015	807	28.19	1,803.80	28.78	26.16	1.43	20.16	6.67	77.38	12.82	69.37
	2016	795	27.77	1,602.70	30.37	25.25	1.43	23.26	5.99	77.09	13.91	98.61

Note: In this table, the sample is classified according to gender, smoking status, market, policy type, insurer's credit rating, originating state and transaction year. For each category, presented are the number of observations (n), mean death benefit (DB), policy price as a fraction of death benefit (PP), sum of premiums as a fraction of death benefit (PM/DB), cash surrender value as a fraction of death benefit (CSV/DB), risk premium (RP), life expectancy (LE), insured's age (AGE), vintage (VI) and mortality multiplier (k).

Table 8: Robustness test of different policy types and rating classes

Policy type	Universal life			Term life			Whole life		
	Coeff.	p	sig.	Coeff.	p	sig.	Coeff.	p	sig.
c	1.20	0.000	***	1.23	0.000	***	1.44	0.000	***
$\ln LE$	-0.20	0.000	***	-0.19	0.000	***	-0.24	0.000	***
$\frac{PM}{DB}$	-0.34	0.000	***	-0.53	0.000	***	-0.87	0.017	**
BP test	192.100	0.000	***	0.419	0.811		1.477	0.478	
Performance	In-s.	Out-of-s.		In-s.	Out-of-s.		In-s.	Out-of-s.	
n	1,645	762		72	89		23	25	
ME	0.000	0.001		0.000	0.012		0.000	0.010	
MAE	0.066	0.078		0.080	0.103		0.080	0.130	
RMSE	0.090	0.104		0.097	0.129		0.098	0.190	
R^2	0.716	0.714		0.737	0.646		0.803	0.366	
Rating	A-rated			B-rated			No rating		
	Coeff.	p	sig.	Coeff.	p	sig.	Coeff.	p	sig.
c	1.24	0.000	***	1.02	0.000	***	1.25	0.000	***
$\ln LE$	-0.21	0.000	***	-0.17	0.000	***	-0.23	0.000	***
$\frac{PM}{DB}$	-0.36	0.000	***	-0.34	0.001	***	-0.05	0.761	
BP test	166.645	0.000	***	5.075	0.079	*	1.787	0.409	
Performance	In-s.	Out-of-s.		In-s.	Out-of-s.		In-s.	Out-of-s.	
n	1,865	895		31	34		13	25	
ME	0.000	0.009		0.000	0.046		0.000	-0.050	
MAE	0.069	0.084		0.079	0.095		0.060	0.124	
RMSE	0.094	0.110		0.099	0.119		0.075	0.146	
R^2	0.767	0.760		0.669	0.762		0.858	0.496	

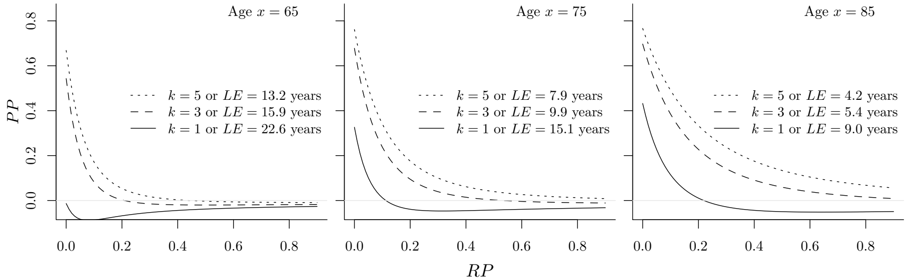
Note: This table shows the calibration result of the two-variable model applied to different policy categories. We test the significance level of Newey-West standard errors. Therefore, although the Breusch-Pagan test (BP test, see Breusch and Pagan (1979)) indicates the presence of heteroscedasticity with some policy categories (especially *universal life* and *A-rated* policies), the applicability of the model is confirmed by the coefficients' high significance level. The calibrated model performs very well with *universal life*, *term life*, *A-rated* and *B-rated* policy categories, but less so, due to sparse data, with *whole life*, and unrated (*no rating*) policies. In-s.: in-sample estimation (using Subsample 1). Out-of-s.: out-of-sample prediction (using Subsample 2).

Table 9: Robustness test with *LE* from different medical underwriters

Underwriter	ITM			AVS			Fasano			LSI		
	Coeff.	p	sig.	Coeff.	p	sig.	Coeff.	p	sig.	Coeff.	p	sig.
c	1.07	0.000	***	1.22	0.000	***	1.32	0.000	***	1.00	0.000	***
$\ln LE_{\text{underwriter}}$	-0.18	0.000	***	-0.20	0.000	***	-0.23	0.000	***	-0.18	0.000	***
$\frac{PM}{DB}$	-0.29	0.000	***	-0.33	0.000	***	-0.16	0.000	***	-0.14	0.001	***
BP test	107.361	0.000	***	118.347	0.000	***	33.017	0.000	***	13.072	0.001	***
Performance	In-s.	Out-of-s.		In-s.	Out-of-s.		In-s.	Out-of-s.		In-s.	Out-of-s.	
n	1,291	522		1,686	810		307	115		94	66	
ME	0.000	0.029		0.000	0.004		0.000	0.013		0.000	0.041	
MAE	0.088	0.103		0.070	0.086		0.073	0.075		0.069	0.094	
RMSE	0.115	0.131		0.094	0.113		0.101	0.109		0.086	0.142	
R^2	0.622	0.636		0.731	0.726		0.802	0.764		0.508	0.431	

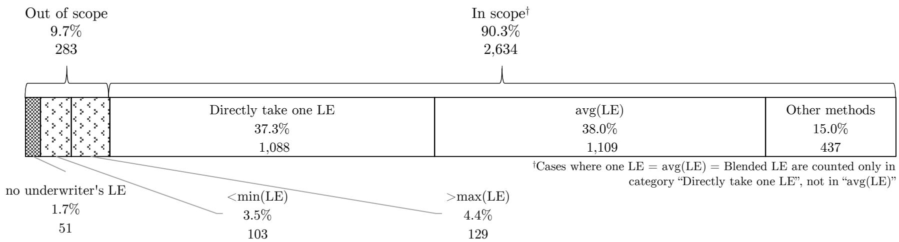
Note: The table shows that model $\widehat{PP} = c - \beta_{LE} \ln LE - \beta_{PM} \frac{PM}{DB}$ stands when LEs from ITM, AVS or Fasano are applied. We use heteroscedasticity-consistent Newey-West standard errors to test the significance of coefficients. The model performs well when LE estimates from ITM and AVS are used. The model's relatively poor performance for LSI does not diminish the applicability of the model, since there are few policies underwritten by LSI alone — only 7 cases in our whole sample.

Figure 16: Price multiplier ($\frac{TP}{DB}$) against risk premium (RP) by mortality multiplier (k)



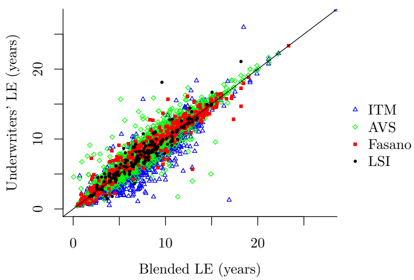
Note: For simplification, a 0% risk-free interest rate is assumed, i.e. $RP = IRR$ (see Footnote 46). Consistent with Equation 43, PP is negatively related to LE and RP. The mortality multiplier k represents the degree of the health impairment of the insured. The higher the value of k, the shorter the respective LE for a given age (see Appendix A for details). Put differently, for a constant k and RP, a higher age is associated with a shorter LE and therefore higher PP.

Figure 17: Distribution of blended LE



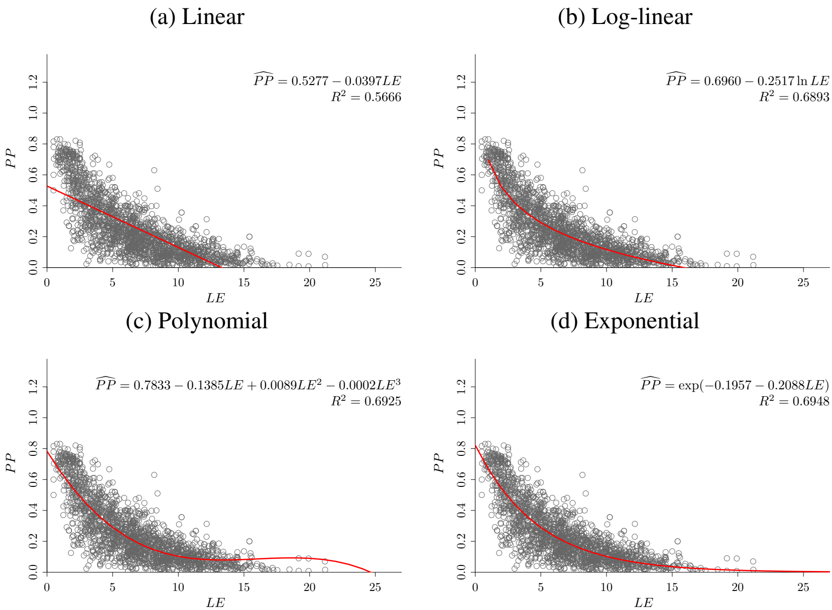
Note: This figure summarizes the various methods used to derive a blended *LE* for the closing of a senior settlement transaction and indicates their relative degree of implementation. In most cases, the blended *LE* lies within the range of *LE* estimates issued by the medical underwriters. In rare cases, the blended *LE* falls below the lowest, or exceeds the highest, estimate.

Figure 18: Blended LE versus underwriters' LE



Note: The figure illustrates the relationship between blended LEs and underwriters' LEs. In most cases, blended LEs lie between the highest and the lowest LE estimates. Relationships between underwriters' LEs are not constant: for example, ITM has a propensity for issuing shorter LEs than Fasano at the lower end of life expectancies (the left-hand side of the chart), and the inverse at the upper end of life expectancies (the right-hand side of the chart).

Figure 19: Functional relationships between *PP* and *LE*



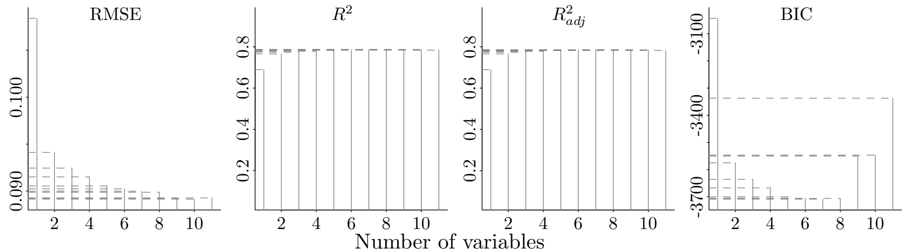
Note: This figure illustrates the fit of four model specifications that describe the functional relationship between *LE* (x-axis) and *PP* (y-axis): linear, log-linear, polynomial and exponential. Judging by the explanatory power, parsimony, and economic plausibility, we select the log-linear model as a basis for further analyses.

Figure 20: Regression models for *PP*

Standardized coefficient

Number of variables	c	$\ln LE$	$\ln DB$	$\frac{PM}{DB}$	DI	RT	MK	PT	NO	AGE	VI	CO	df	RMSE	R^2	R^2_{adj}	BIC
11	***	-0.67 ***	-0.10 ***	-0.30 ***	-0.05 ***	0.04 ***	0.08 ***	0.02	0.03 **	-0.09 ***	0.00	-0.02	1,710	0.089	0.784	0.782	-3,337
10	***	-0.68 ***	-0.09 ***	-0.29 ***	-0.05 ***	0.03 ***	0.07 ***	0.03	0.03 *	-0.10 ***		-0.02 *	1,810	0.089	0.786	0.785	-3,546
9	***	-0.67 ***	-0.09 ***	-0.29 ***	-0.05 ***	0.03 ***	0.08 ***		0.03 **	-0.09 ***		-0.02 *	1,811	0.089	0.786	0.785	-3,550
8	***	-0.67 ***	-0.09 ***	-0.29 ***	-0.05 ***	0.04 ***	0.08 ***		0.03 **	-0.09 ***			1,900	0.090	0.786	0.785	-3,706
7	***	-0.67 ***	-0.08 ***	-0.29 ***	-0.04 ***	0.04 ***	0.08 ***			-0.08 ***			1,901	0.090	0.786	0.785	-3,708
6	***	-0.68 ***	-0.08 ***	-0.29 ***		0.04 ***	0.08 ***			-0.08 ***			1,902	0.090	0.785	0.784	-3,705
5	***	-0.68 ***	-0.08 ***	-0.29 ***			0.08 ***			-0.08 ***			1,903	0.091	0.783	0.783	-3,700
4	***	-0.66 ***	-0.09 ***	-0.32 ***			0.07 ***						1,904	0.092	0.778	0.778	-3,667
3	***	-0.66 ***	-0.09 ***	-0.31 ***									1,905	0.092	0.774	0.774	-3,636
2	***	-0.69 ***		-0.31 ***									1,906	0.094	0.766	0.765	-3,575
1	***	-0.83 ***											1,907	0.108	0.689	0.689	-3,044

Model selected:
$\widehat{PP} = 1.237 - 0.209 \ln LE - 0.356 \frac{PM}{DB}$



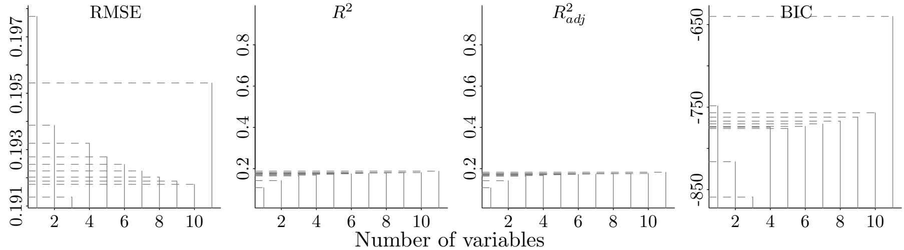
Note: A two-variable linear model that includes ln*LE* and *PM*/*DB* is considered to be most effective in describing *PP*. This selection is validated by the LASSO regression presented in Figure 24(a) from Appendix C. Significance levels of 0.1, 0.05 and 0.01 are marked with "*", "**" and "***" respectively (sic passim).

Figure 21: OLS regression modelling for *RP*

Standardized coefficient

Number of variables	c	$\ln LE$	$\ln DB$	$\frac{PM}{DB}$	DI	RT	MK	PT	NO	AGE	VI	CO	df	RMSE	R^2	R^2_{adj}	BIC
11		-0.28 ***	0.19 ***	-0.21 ***	0.06 **	-0.03 *	-0.04	-0.04	-0.09 ***	0.06	0.00	0.09	1,710	0.195	0.188	0.183	-640
10		-0.27 ***	0.17 ***	-0.21 ***	0.06 **	-0.03 *	-0.04	-0.05	-0.09 ***	0.07 *		0.07	1,810	0.192	0.181	0.177	-757
9		-0.27 ***	0.17 ***	-0.21 ***	0.06 **		-0.04	-0.05	-0.09 ***	0.07 *		0.07	1,811	0.192	0.180	0.176	-762
8		-0.27 ***	0.18 ***	-0.22 ***	0.06 **			-0.05	-0.10 ***	0.07 *		0.07	1,812	0.192	0.179	0.176	-767
7		-0.28 ***	0.17 ***	-0.22 ***	0.06 ***				-0.11 ***	0.05		0.07	1,813	0.192	0.177	0.174	-770
6		-0.29 ***	0.18 ***	-0.19 ***	0.06 **				-0.09 ***			0.07	1,814	0.192	0.175	0.173	-773
5		-0.28 ***	0.18 ***	-0.20 ***					-0.07 **			0.07	1,815	0.193	0.173	0.171	-776
4		-0.28 ***	0.16 ***	-0.21 ***								0.07	1,816	0.193	0.169	0.167	-774
3	***	-0.28 ***	0.16 ***	-0.20 ***									1,905	0.191	0.165	0.164	-859
2	***	-0.24 ***		-0.21 ***									1,906	0.194	0.143	0.142	-816
1	***	-0.33 ***											1,907	0.198	0.108	0.108	-748

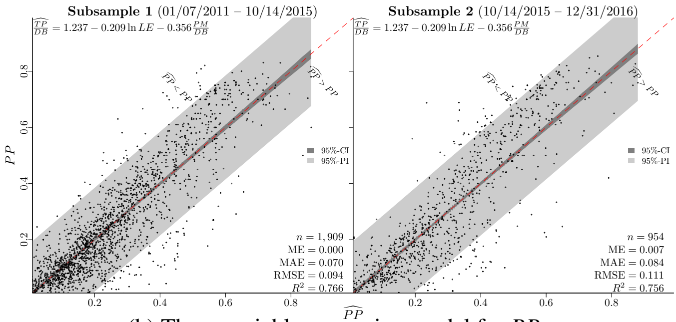
Model selected:
$\widehat{RP} = 0.295 - 0.092 \ln LE + 0.027 \ln DB - 0.253 \frac{PM}{DB}$



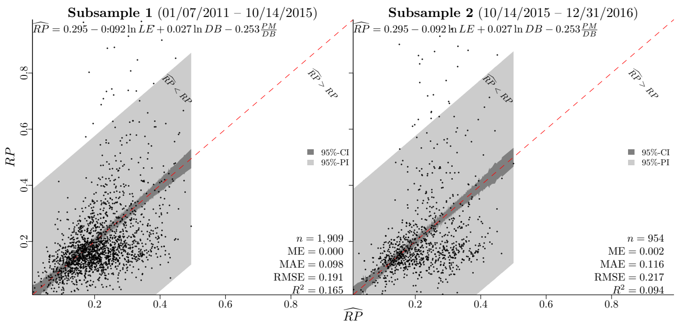
Note: A three-variable linear model that includes $\ln LE$, $\ln DB$ and PM/DB is considered to be most effective in predicting *RP*. This variable selection is validated by the LASSO regression presented in Figure 24(b) from Appendix C. However, none of the regression models has a strong explanatory power on *RP*.

Figure 22: Observed versus fitted values for *PP* and *RP* (in-sample and out-of-sample)

(a) Two-variable regression model for *PP*

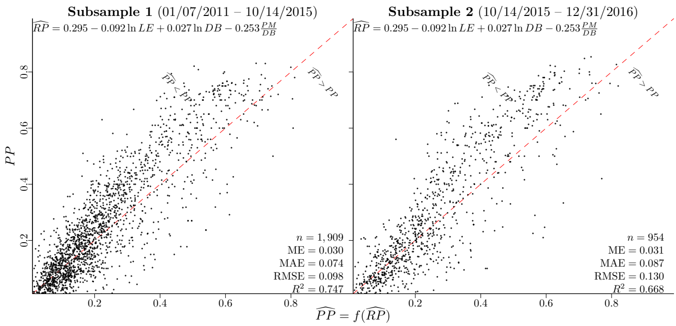


(b) Three-variable regression model for *RP*



Note: This figure shows the observed values of the dependent variables (*PP* and *RP*) plotted against their respective model predictions ($\widehat{PP}$ and $\widehat{RP}$). The two-variable regression model for *PP* shows a high accuracy for both in-sample estimation (using Sample 1) and out-of-sample prediction (using Sample 2), as illustrated in Figure (a). In contrast, the three-variable regression model for *RP* performs poorly, as illustrated in Figure (b). CI: confidence interval. PI: prediction interval.

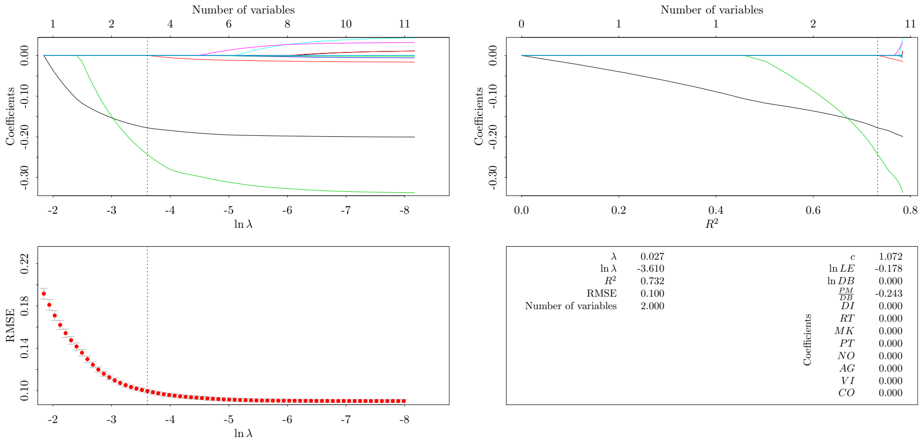
Figure 23: Observed versus fitted values for *PP* based on econometric predictions of *RP*



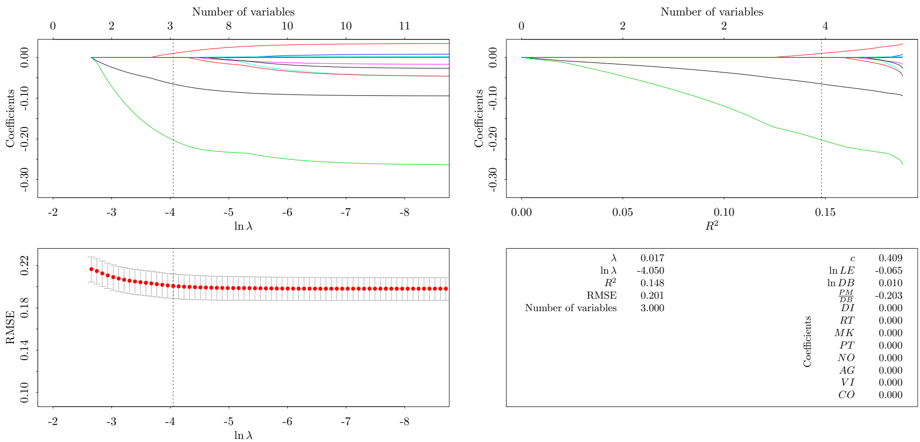
Note: In this figure, we plug $\widehat{RP}$, calculated with model selected in Figure 21, into the actuarial formula Equation 43, to calculate $\widehat{PP}$. We then plot *PP* against $\widehat{PP}$. The figure shows that, if we model *RP* first and then use the *RP* estimates to calculate *PP* actuarially, we can achieve a decent accuracy in *PP* estimation. However, compared to modelling *PP* directly as shown in Figure 22(a), this method has a slightly worse performance, requires more assumptions (e.g. on insureds' mortality rates), and is less convenient to implement.

Figure 24: LASSO regression modeling

(a) LASSO regression modeling for *PP*



(b) LASSO regression modelling for *RP*



Note: In-sample data are used for the LASSO regression. Variables selected in (a) and (b) coincide with those in Figures 20 and 21 respectively.

Part IV

Dating Death: An Empirical Comparison of Medical Underwriters in the U.S. Life Settlements Market

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Abstract

The value of a life settlement investment, manifested through a traded life insurance policy, is highly dependent on the insured's life expectancy (LE). LE estimation in life settlements relies heavily on medical underwriting. Employing different evaluation processes, underwriters rarely agree on LE estimates, leading to valuation disparities. We use the natural logarithm of the implied mortality multiplier ($\ln k$) to compare the underwriting results of the four major U.S. medical underwriters (ITM, AVS, Fasano and LSI). $\ln k$ is normalized in terms of gender, age and smoking status, and is therefore a more suitable indicator for high-level comparison than LE estimates, especially when the compared groups have a heterogeneous make-up. Based on the analysis of life settlement samples from 2011 to 2016, we trace the patterns of underwriters' $\ln k$ in both secondary and tertiary markets of life settlements, and investigate systematic differences in their estimation. Our results show that an underwriter can, relative to peers, act more conservatively (issuing longer LE estimates) for one cohort while more aggressively (issuing shorter LE estimates) for another. We also detect signs of intermediaries' cherry-picking behavior and discuss additional theories that shed light on the convoluted LE landscape.

1 Introduction

In the 1980s when AIDS became an epidemic in the U.S., many of those infected were willing to sell their life insurance policy in order to alleviate financial hardships due to medical treatment and/or loss of employment (LISA 2016). A life insurance trade, conducted when the original policyholders are terminally ill, is called a viatical settlement (Stone and Zissu 2006, p. 66). Originating from viatical settlements, the life settlements market emerged and evolved. The trading of life insurance policies nowadays is usually driven by a different set of factors: policy sellers are not necessarily severely ill; they sell their life insurance for reasons such as unaffordable premiums, urgent need for cash, or deceased beneficiaries (An 2014, p. 12). If an insured cancels a policy, the person ceases to pay the regular premiums and receives a lump sum equal to the surrender value, while the insurance carrier no longer pays the death benefit to the original beneficiary. Since this cash-out would in most cases be undervalued (Doherty and Singer 2003, p. 451), the insured could alternatively sell the policy to an investor who would then become the policy beneficiary.

With a collective price severalfold the surrender value, and a double-digit average expected return in some life settlement funds (see e.g. Januário and Naik 2014, p. 3), the trading of life insurance policies can be attractive to both policyholders and investors. Since the life settlements industry is hardly affected by traditional financial markets, and its risks are uncorrelated with that of conventional investment vehicles (Cowley and Cummins 2005, p. 220), it is an apt device for funds such as pension or hedge funds in view of portfolio diversification (Braun et al. 2018b). At the time of writing, life insurance policies with a total face value of USD 2 to 3 billion are traded annually in the secondary market (where insureds sell their life insurance policy directly to investors), and up to USD 10 billion in the tertiary market (where investors trade insurance policies between themselves) (Figure 25).

Dates of death are the determinant of realized return in life settlements investment. Life expectancy (LE) estimates — predictors of those dates of death — are the key valuation driver in the life settlements industry: ceteris paribus, the higher the LE estimate, the lower the price an investor is willing to pay for the policy, as the expected number of premiums to be paid by the buyer of the life insurance increases and the death benefit is expected to be received later. In the life settlements industry, the professional determination of LE, based on the health and medical information of the insured, is called medical underwriting. The independent entities conducting such forecasts are known as medical underwriters. An LE estimate is usually provided to potential life settlement investors by the sell-side intermediaries of the life settlement transaction, who usually order LE certificates from one or more medical underwriters.

Today, there are four companies that provide the vast majority of medical underwritings for the life settlements market: ITM (ITM TwentyFirst LLC, formerly 21st Services LLC), AVS (AVS Underwriting LLC), Fasano (Fasano Associates Inc) and LSI (Longevity Services Inc, formerly Examination Management Services Inc). These four U.S. medical underwriters have all been in business for at least 15 years and are considered to be among the most important in the field (Russ 2005, p. 5).[59] Assessing the accuracy of the medical underwriters has been a big challenge for the life settlement industry. Although each of the medical underwriters will license their historical underwriting data for a fee, there are no publicly available reports. Furthermore, there is no consensus as to how the accuracy of LE estimates should be assessed,[60] and no perfectly unbiased methodologies exist (Bauer et al. 2018; Fasano 2013). When reporting their underwriting performance, underwriters are free to choose their methods (usually not described in detail in their performance reports) and to interpret the results. While professional actuaries can find some guidance in the Actuarial Standard of Practice on how to interpret and assess life settlements underwriters' reports, the standard leaves actuaries with considerable leeway to exert their own judgement, in terms of e.g. mortality tables selection (Actuarial Standards Board 2013, p. 17).

Medical underwriting for the life settlement industry is known to be an imprecise science (Xu and Hoesch 2018), affected by the inaccurate baseline mortality tables inherited from the wider life insurance market. Mortality rates of elder populations, which account for the majority of insureds in life settlements, were difficult to accurately estimate due to deficient life data. The A/E (actual to expected) ratio on insureds between age 80 and 89 of VBT08-ANB,[61] for example, turned out to be a dismal 61.6% (Bahna-Nolan 2014). Historically, the medical underwriters for the industry have underestimated life expectancy as insureds have been living longer than originally projected (Seitel 2008, p. 56). Over the years, underwriters have updated their underwriting methods multiple times,[62] resulting in an overall lengthening of LE estimates.

Adding to the historical LE underestimation from the underwriters' side (Cook and Ezell 2008) is the natural incentive of intermediaries to obtain the shortest possible LE estimates. Sell-side intermediaries such as life settlement agents and brokers are motivated to inflate the policy price using short LE estimates (Braun et al. 2015, p. 188). Buy-side intermediaries such as providers and fund managers, although obliged to serve the investors they represent, also have an incentive to convince investors to bid

[59] Many former underwriting companies such as Midwest Medical Review and Amscot Medical Labs are no longer in business. While new medical underwriters have entered the space in recent years, they do not seem to have gained significant market shares.

[60] In October 2010, AVS Underwriting, 21st Services, EMSI and ISC Services formed Life Expectancy Providers (LEPr) that took a position as to the reporting of A/E (actual to expected) that was different than that of the Life Insurance Settlement Association (LISA), where Mike Fasano, President of Fasano Associates, was a board member. While LISA advocated using the original LE estimates provided to the clients (Horowitz 2010, p. 8), LEPr preferred to include, in addition to historical basis A/E ratios, restated LE estimates in evaluating their forecast accuracy (LEPr 2011, p. 5).

[61] The Society of Actuaries (www.soa.org) issues Valuation Basic Tables (VBT) circa every seven years since 2001. Each VBT table is designed for a certain combination of an age calculation approach (age-nearest birthday (ANB) / age-last birthday (ALB)), a gender (male / female) and a smoking status (smoker / non-smoker)) of insureds (see Table 11).

[62] ITM updated its underwriting method in 2005, 2008, 2013 and 2014, AVS in 2008 and 2012, and Fasano in 2008.

as high as possible with short LE estimates (see e.g. Braun et al. 2018a), increasing the chance of closing a transaction[63] and earning commissions and fees (see Figure 26). Only policies with a sufficiently low LE relative to premiums can attract investors. If an insured's LE estimate is so long that the present value of the expected future premium stream exceeds the present value of the death benefit, a life settlement investor would not find it economically desirable to purchase the policy.[64] Intermediaries shopping for short LE estimates could partially explain why some underwriters have claimed a high level of accuracy but investors have not seen commensurate results (Table 10). A persisting bias to short LE estimates is also evidenced by the steady stream of negative publicity, including portfolio distresses (e.g. Trinkwon 2017), liquidations (e.g. Robins 2013), write downs (e.g. Emery 2011; Tracer 2014), foreclosures (e.g. Horowitz 2012) and bankruptcies (e.g. Rivoli 2011).

Based on an empirical analysis of LE estimates from ITM, AVS, Fasano and LSI with an emphasis of the first two,[65] we seek to identify underwriters' patterns in LE forecasting, and to promote a better understanding of the prevailing landscape of LE estimates. In the absence of comprehensive date-of-death data we are restricted to focusing on the relative difference between the underwriters rather than on their absolute performance. We indeed discover evidence of systematic, statistically significant differences in LE estimates between medical underwriters, and detect signals of intermediaries' cherry-picking behavior.

The rest of the paper is structured as follows: in Section 2 we describe medical underwriting in the life settlements market and introduce the mortality multiplier k as well as its economic significance; in Section 3 we present the data and demonstrate empirical analysis; in Section 4 we discuss potential remedies for a more sustainable market; in Section 5 we conclude.

2 Medical Underwriting and the Economic Significance of the Mortality Multiplier

In Figure 27, we juxtapose the process flows of the four largest medical underwriters in the U.S. — ITM, AVS, Fasano and LSI. ITM's underwriting process is mostly

[63] Of all policies ever considered for settlement, only around 10% are eventually traded (Cohen 2013, p. 3). The rest are discarded due to policyowners reneging, incomplete information on the policies, or financial unattractiveness to either party (price too low for the policy seller or expected return too low for the policy buyer).

[64] Investors may still be willing to acquire a policy with a negative net present value (NPV). This can occur in a portfolio transaction in the tertiary market. The economically undesirable policies will be priced at zero and investors will lapse the policies after the portfolio purchase.

[65] Due to the higher market share of ITM and AVS compared to the other two underwriters, we have abundant data to conduct diverse statistical analyses on ITM and AVS, whereas for Fasano and LSI we mostly apply descriptive analyses due to sparse data, especially in the early sample period and in the tertiary market.

algorithm driven, while AVS, Fasano and LSI's underwriting is based on manual review. Each method has its pros and cons. An algorithm-based approach can limit underwriters' subjectivity and provide consistent, reproducible results. Nevertheless, due to high-paced developments in today's healthcare environment, any historical, data-based algorithm needs to be continuously updated. A case-driven approach enables human judgement to add value in some instances (Siegert 2010, p. 11).[66] However, manual underwriting can be inflexible as back-testing is almost impossible whenever a methodological improvement is made, because that would entail all of the pre-improvement cases being manually re-underwritten.

To estimate an insured's LE, an underwriter selects the suitable mortality table corresponding with the insured's demographic and medical characteristics. Underwriters usually have their own proprietary mortality tables and employ some version of the debit-credit underwriting approach. Starting from a base mortality multiplier of 100%, an insured's individual mortality multiplier is "debited" (increased) in the case of a negative health record (e.g., a smoking habit, need for assistance with activities of daily living), and is "credited" (decreased) in the case of a positive one (e.g. athletic lifestyle, absence of family disease history). The applied mortality multiplier is the determinant of the insured's mortality curve, from which an LE estimate is derived. The derivation process is formally described below.

Denote the basic mortality rates of an x-year-old insured as $\{{}_{i}|Q_x\}_{i\in\mathbb{N}}$ and the insured's mortality multiplier as k. The insured's mortality rates can thus be expressed as:

$$ {}_{i}|q_x = \begin{cases} 0, & i \leq 0 \\ \min(1-\varepsilon, k \cdot {}_{i}|Q_x), & i \geq 1 \end{cases} \tag{38} $$

where ε is a small, positive, arbitrarily pre-determined number (e.g. 10^{-5} or 10^{-6}). The individual survival rates are:

$$ {}_{i}|p_x = 1 - {}_{i}|q_x = \begin{cases} 1, & i \leq 0 \\ \max(\varepsilon, 1 - k \cdot {}_{i}|Q_x), & i \geq 1 \end{cases} \tag{39} $$

Thus, we can calculate ${}_{i}p_x$, the probability that the insured is alive at the end of the i^{th} period given that he or she is alive at time 0, as below:

[66] For example, if an older individual is brought in for a physical that produces a low FEV1 ratio (a measure of pulmonary function), an inflexible approach might assess a high mortality rating based on the low, seemingly objective result. However, it is often the case that older people who are brought in by well-intentioned children for physicals, are not in the best of moods. In those cases, a low-level effort on a pulmonary function test could produce a misleadingly poor test result for which trained underwriters using a holistic approach would adjust.

$$ {}_i p_x = \begin{cases} 1, & i \leq 0 \\ \prod_{j=0}^{i-1} {}_{j|}p_x, & i \geq 1 \end{cases} \tag{40} $$

A typical LE measurement, the curtate life expectancy,[67] is calculated as follows (see e.g. Olivieri and Pitacco 2015, p. 173):

$$ LE = \sum_{i=0}^{\omega} {}_{i+1}p_x \tag{41} $$

where ω represents the terminal age, typically 121 years old.[68] Ultimately, LE is a function of two inputs: i) base mortality rates $\{{}_{i|}Q_x\}_{i \in \mathbb{N}}$, and ii) individual mortality multiplier k. The first input, $\{{}_{i|}Q_x\}_{i \in \mathbb{N}}$, entails the demographic information of the cohort to which a reference insured belongs. If, for example, one uses VBT tables to determine the mortality rate basis as per industry standard, then $\{{}_{i|}Q_x\}_{i \in \mathbb{N}}$ is age-, gender-, and smoking-specific. The second input, k, only entails information of an insured's health impairment relative to the cohort average and represents an underwriter's personal judgement. Ceteris paribus, a greater k implies faster mortality rates, hence a lower LE and a higher policy value. The positive relationship between k and policy price is elaborated in a formal fashion below.

Let TP denote the transaction price of a life policy, DB the death benefit, $\{\pi_i\}_{i \in \mathbb{N}}$ the premium stream, and r the internal rate of return (IRR) used for pricing. A policy can be priced as follows:

$$ TP = -\pi_0 + \sum_{i=1}^{\omega} \frac{{}_{i-1}p_x \cdot {}_{i-1|}q_x \cdot DB - {}_i p_x \cdot \pi_i}{(1+r)^i} = \sum_{i=0}^{\omega} \left({}_i p_x \cdot \frac{\frac{{}_{i-1|}q_x}{{}_{i-1|}p_x} \cdot DB - \pi_i}{(1+r)^i} \right) \tag{42} $$

Let $PP := \frac{TP}{DB}$, $\nu_i := \frac{\pi_i}{DB}$, $\delta_i := \frac{{}_{i-1|}q_x}{{}_{i-1|}p_x}$. We can thus express PP, policy price normalized to policy death benefit, as:

$$ PP = \frac{TP}{DB} = \frac{\sum_{i=0}^{\omega} \left({}_i p_x \cdot \frac{\frac{{}_{i-1|}q_x}{{}_{i-1|}p_x} \cdot DB - \pi_i}{(1+r)^i} \right)}{DB} = \sum_{i=0}^{\omega} \left({}_i p_x \cdot \frac{\delta_i - \nu_i}{(1+r)^i} \right) \tag{43} $$

[67] The curtate LE is the expected number of complete periods lived. In this paper, LE refers to "mean LE". In practice, LE can also be short for LE50, or "median LE", which is the time span during which the unconditional survival rate drops from 100% to 50%.

[68] To date, the only person verified to have lived more than 121 years is Jeanne Calment of France (1875–1997) who died at age 122 (Whitney 1997).

To assess the economic influence of k in depth,[69] we simulate three universal life policies (the insured being a male non-smoker at age 65, 75 and 85 respectively) using our main sample data (see Section 3.1 for sample description). For each scenario, we extract the relevant transactions according to the corresponding insured's gender, smoking status and age (e.g. only transactions with a 65-year-old male non-smoker are considered for the first scenario), and then take the average premium rates of those transactions on a monthly basis to build simulated premium rates $\{\nu_i\}_{i \in \mathbb{N}}$.

Figure 28 illustrates how different levels of k affect the $r \to PP$ curve. Given a certain positive r, a higher k indicates a larger PP. Similarly, given a certain positive PP, a higher k implies a higher r. When k is too small, PP can be constantly negative regardless of the choice of r. Policies with such a low k would not enter the market normally, or would be lapsed once purchased.

An economically viable life settlement requires $PP > 0$, i.e. the price of a policy must be positive.[70] To achieve a positive PP, k must be sufficiently large. We observe from Figure 28 that the bar of k becomes lower as age x gets higher: for the policy to be economically meaningful, k needs to reach a higher threshold when $x = 65$ than when $x = 85$. Furthermore, we notice that at the same level of k and r, PP increases with the increment of x. This is to say, when an insured is old enough, his/her policy can be worth the investment even if the person is relatively healthy. As shown in Figure 28 with the insured's age $x = 75$ or 85, a policy from an insured with standard health ($k = 1$) can also have a positive net present value (NPV). In reality, this can happen when, for instance, the policy was issued as "preferred" by the insurance carrier — which reflects an above-average health status at policy issuance and consequently lower premium rates as compared with the "standard" class — but the insured's health status deteriorates to "standard" after issuance. Another explanation might be "front-loading", a premium pricing scheme commonly employed by insurance carriers to enhance policyholders' commitment (Hendel and Lizzeri 2003). A front-loaded policy overcharges at the beginning of the coverage and undercharges at a later stage, such that a policy from a senior insured, provided that s/he purchased the policy at a young age, is cheap to maintain. The policy is thus also economically viable to life settlement investors even if the insured has an average health status.

[69] We later show k in its log form in Figure 28 to be consistent with further analysis in this paper.
[70] In the case of a positive surrender value, the policy price needs to exceed the surrender value for a transaction to be viable.

3 Empirical Analysis

3.1 Data

Main sample

The main sample which we used to commence this study was provided by AA-Partners Ltd (AAP), an independent consulting firm specialized in life settlements. AAP maintains a comprehensive network in the life settlements industry through which it collects data from participating firms. AAP receives transaction data with salient deal characteristics (e.g. price, face amount, premiums,[71] LE estimates) from various life settlement providers on a monthly basis. This sample consists of life settlement transaction data, most of which (3,127 out of 3,236) entail LE data. Out of 3,127 lives, 2,172 were estimated by at least one of the main U.S. medical underwriters (ITM, AVS, Fasano, or LSI). The data, covering the period January 2011 to December 2016, include both secondary and tertiary market transactions. The LE estimates are deemed actual by the date of transaction.[72] In our sample, 84% of the transacted policies are universal life policies, and according to AAP, the premiums of most of those policies have been optimized to the bare minimum payment that keeps the policy in force.[73] The total face value of all the insurance policies in our sample data amounts to USD 6.4 billion, while the settling of those policies was priced at USD 1.2 billion in total. Table 12 summarizes characteristics of the life settlements sample.

Although Table 12 presents descriptive statistics of LE estimates by the four medical underwriters side by side, the figures need to be compared with caution because not all the underwriters have evaluated the same deals. Deals are distributed across underwriters and markets, the vast majority having two LE estimates. Specifically, out of the 3,236 deals, 2,261 took place in the secondary market, 1,365 of which involve at least two of the aforementioned medical underwriters; and 975 deals were settled in the tertiary market, 807 of which were evaluated by two or more of the four medical underwriters (see Table 13). Deals with at least two LE estimates provide a strong basis for the analysis of the underwriters' practices relative to each other. Table 14 further

[71] Premiums are current to the date of settlement. Note that recently, life insurance carriers have been raising premiums on in-force policies, exposing premium risk into the life settlement business.

[72] To be precise, the average time elapsed from LE estimation date to the transaction closing date in the secondary market is merely 3 months. An LE estimate older than six months would typically be annulled and replaced by a refreshed estimate. Therefore in the secondary market, the LE date difference is negligible. In the tertiary market, some LE data may be outdated when, for instance, original insureds refuse to provide their latest medical records. In such cases, AAP reverse calculated the implied mortality multiplier k, and reapplied k to standard mortality rates to retrospectively calculate the LE estimate as of the transaction date.

[73] The most common policy type in life settlements is universal life (UL), which is characterized by flexible premiums (Blake and Harrison 2008, p. 11). UL combines life insurance and savings and allows the policyholder to control the amount of money devoted to the savings component. Life settlement investors almost exclusively devote zero dollars to the savings account.

lists the numbers of settlements evaluated simultaneously by two underwriters. As LE estimates appear to be highly correlated, they may be viewed as a manifestation of the true underlying LE. We focus on those settlements to create meaningful comparisons between underwriters. We are particularly interested in the relationships between ITM and AVS, since the data from Fasano and LSI are relatively sparse. Later in the paper we discuss the results of a descriptive analysis on the sparse data, for which statistical testing lacks explanatory power.

Figure 29 depicts the relative market share of the four underwriters. In 2013, ITM's market share dropped dramatically while Fasano's experienced its peak. Shortly thereafter, the market normalized with ITM and Fasano returning to their previous market shares. The change in market share at the time could be explained by that fact that in January 2013 ITM announced a change in its debit-credit system and mortality tables which led to an extension of 19%, on average, of its LE estimates (Horowitz 2013b, p. 2). The methodological modification was in response to the high rate of over-survivorship of insureds previously underwritten by ITM (Granieri and Heck 2014, p. 5).

Side samples

Two anonymous investors also provided LE-related information on the in-force policies from their life settlements portfolios. All of the policies are from the tertiary market, and have been evaluated by (and only by) both ITM and AVS at the request of investors. The LE data from the side samples are not covered by the universe of the main sample, i.e. there is no overlap. The three samples are not mixed together but analyzed separately. In the later part of the paper, we compare LE landscapes across samples to obtain a view of medical underwriting from the standpoint of both intermediaries and investors.

From the policies included in the side samples, we filtered out joint policies, and for the sake of comparability omitted the policies where the underwriting dates from ITM and AVS were more than 45 days apart in order to minimize the impact on estimate differences due to potential health-changing events occurring between the two underwriting dates.[74] Table 15 presents the descriptive statistics of the filtered data from the two side samples.[75] Side sample 1 consists of 584 policies, underwritten between November 2015 and November 2016. Side sample 2 is composed of 552 policies, covering the period June 2009 to October 2016.

[74] While an *actual* dramatic health change within 45 days might be rather rare, an *estimated* health status is likely to be largely influenced by e.g. a medical test report issued between two underwriting dates.

[75] We have conducted additional analyses using data without applying the filter of underwriting date difference, and the findings do not change.

Reverse engineering of $k_{\text{underwriter}}$

As a great many of lives in our sample data are simultaneously evaluated by several underwriters (Table 13), we can directly compare the LE pairs to see which underwriters tend to give shorter estimates and which longer. However, whenever two series of LE estimates are not referenced to the same group of insureds and/or not were not issued around the same time, the direct comparison of those LE estimates can be misleading. For example, a demographic group of 60-year-old people with a standard health condition naturally has a longer average LE than a group of 90-year-old also with a standard health condition. On account of this, we use the implied mortality multiplier k to proxy the degree of LE adjustment from base mortality. We consider k to be more suitable than LE, especially for a comparison of medical underwriting in demographically heterogeneous cohorts, since k serves as a measurement of relative health impairment that is normalized to age, gender, and smoking status.

Since underwriters' base mortality curves are not publicly available, we employ the four VBT15-ANB tables (gender and smoker distinct) as input for $\{_i|Q_x\}_{i\in\mathbb{N}}$. By plugging $\{_i|Q_x\}_{i\in\mathbb{N}}$ together with $LE_{\text{underwriter}}$ into Equations 39-41, we solve for the implied mortality multiplier $k_{\text{underwriter}}$, where underwriter $\in \{\text{ITM}, \text{AVS}, \text{Fasano}, \text{LSI}\}$. The value of k in our samples ranges from 0.2 to 6,000. Extremely high k's are associated with severely ill individuals with a future mortality curve significantly different from the baseline table. Since underwriters' own mortality tables might differ from VBT15-ANB, an implied k can deviate from the original mortality multiplier stated on an LE certificate.[76] Yet by applying the same set of mortality tables to solve each LE-corresponding k, we standardize the k's and make them directly comparable. To tone down the impact of those large k's from severely impaired lives on the aggregate results, we employ a log transformation for the variable.[77]

3.2 Findings

Comparison between underwriters

We start by investigating the differences in LE estimates between medical underwriters. From Table 14 we observe that in our main sample, ITM provides shorter LE estimates on average than all the other three underwriters in both the secondary and the tertiary market. While differences in LE estimates also exist among AVS, Fasano and LSI, the magnitude is much smaller and the significance level is much lower. Since we are

[76] Compared to VBT15-ANB, ITM's baseline mortality tables have lower rates while AVS's have higher rates. Therefore, a mortality multiplier of 100% stated on an LE certificate issued by ITM implies $k_{\text{ITM}} < 100\%$; analogously, a mortality multiplier of 100% issued by AVS implies $k_{\text{AVS}} > 100\%$, given that k_{ITM} and k_{AVS} are reverse calculated using VBT15-ANB, instead of underwriters' own tables.

[77] We also conduct additional analyses excluding outlier transactions with $\ln k_{\text{underwriter}} > 4$ (10% of total sample) and the findings do not change. For brevity, those results are not reported but are available upon request.

looking at the exact same transactions in both sub-samples, there is no difference in age or health impairment that could explain the divergence in LE estimates.

When LE estimation is proxied by k, there remain significant discrepancies between underwriters. Figure 30 takes AVS as a benchmark and notes its differences from ITM and Fasano with regard to $\ln k$. From Figure 30 we observe that AVS's evaluation is closer to Fasano's than to ITM's: compared to $(\ln k_{\text{Fasano}} - \ln k_{\text{AVS}})$, the distributions of $(\ln k_{\text{ITM}} - \ln k_{\text{AVS}})$ are more right-centered (larger μ), more volatile (larger σ), more negatively skewed (larger γ) and more fat-tailed (larger κ).

The time series of average $\ln k$ across all transactions from ITM and AVS per quarter are plotted in Figure 31. The line shapes of the two underwriters are similar, as indicated by the high correlation of their LE estimates in Table 14. $\ln k_{\text{ITM}}$'s quarter average is constantly higher than $\ln k_{\text{AVS}}$ throughout the whole sample period in both secondary and tertiary markets. Fasano's and LSI's data are not plotted due to a dearth of data in some periods and in the tertiary market. Discrepancies in LE estimates between ITM and AVS do not seem to diminish over time, possibly because LE disparities are tolerated, presumably by sophisticated investors. After mastering estimation patterns of different underwriters, those investors price in their confidence in the LE estimates on a particular trade.

Underestimated LEs might arise due to myopic underwriters who intentionally provide low LE estimates to gain business from intermediaries, as the intermediaries usually present to their investors the LE estimates they order from underwriters. However, while underestimation may bring medical underwriters more business from policy sellers in the short term, it compromises investors' confidence and interest in the long run, and places the whole life settlements industry in jeopardy. For underwriters valuing sustainability (which we believe are the majority), a wrong LE projection could have been an honest mistake on account of varyingly deficient underwriting methods (Figure 27). Hence, we pursue more in-depth analyses.

Comparison between cohorts

Underwriters apply differing mortality tables and debit-credit methodologies (see Section 2). No underwriting approach is perfect, and each underwriter has their "quirks": particular medical fields and/or demographic cohorts where they are viewed to be more accurate than their competitors. To explore the underwriting pattern between ITM and AVS, in all three samples we compare the demographic characteristics for lives where $k_{\text{ITM}} < k_{\text{AVS}}$ with those for lives where $k_{\text{ITM}} > k_{\text{AVS}}$. For nominal variables such as gender (either male or female) and smoking status (either smoker or non-smoker), we run χ^2-tests to check distribution homogeneity across the two groups. For numeric variables such as age and health impairment, we apply the Kolmogorov-Smirnov test (KS-test) to compare distributions between the two groups. Significant differences can be detected in distributions of gender and health impairment between the two subsets.[78] On a statistically significant level, subset $k_{\text{ITM}} < k_{\text{AVS}}$ is composed of proportionally more male lives (Figure 32), as well as more healthy lives (healthiness proxied by $\frac{\ln k_{\text{ITM}} + \ln k_{\text{AVS}}}{2}$, Figure 33) as compared with the other subset. The distribution of those features is shared among all three samples.

For robustness checks, we run regressions on the difference in LE estimates between ITM and AVS with respect to policy characteristics, including health status (proxied by average log mortality multiplier, $\overline{\ln k}$), gender and smoking status (Table 16). The results show that $(LE_{\text{ITM}} - LE_{\text{AVS}})$ increases when an insured is healthier (smaller $\overline{\ln k}$) and is male, indicating that when using AVS' underwriting as a benchmark, ITM's underwriting appears more conservative (higher LE) with healthy and male lives than with unhealthy and female lives. The finding holds throughout our three samples and corroborates Figure 32 and Figure 33.

ITM pointed out one of their underwriting features: their system emphasizes an insured's very positive and very negative health factors, tending to indicate a lower k than their peers for a very healthy insured, and a higher k for a very unhealthy insured. ITM's assessment of its own underwriting is thus in accordance with our findings (Figures 32-33 and Table 16).

Comparison between secondary and tertiary markets

Differences in k also exist between the secondary and tertiary markets. All underwriters appear to accelerate mortality rates in the secondary market more heavily than in the tertiary market, mostly at a highly significant level. We observe from Figure 34 that the density curve of $\ln k$ in the secondary market runs on the right (the larger $\ln k$ side) of the tertiary market curve for all underwriters.

Both the conditional mean of $\ln k$ per period and unconditional means across the whole sample are higher in the secondary market than in the tertiary markets, for both ITM and AVS (Figure 35). The analysis is based on all transactions for each underwriter, but the same conclusion can be drawn when only those deals with LE pairs are considered (Figure 31). While we observe $k_{\text{ITM}} > k_{\text{AVS}}$ in both the secondary and the tertiary markets, the discrepancy $(k_{\text{AVS}} - k_{\text{ITM}})$ is smaller in the tertiary market (Figure 31). In addition, we detect a higher likelihood for policies in the tertiary market to receive $k_{\text{ITM}} < k_{\text{AVS}}$ than policies in the secondary market (Figure 36). This finding is in line with Table 16 which shows that using AVS as a benchmark, ITM's underwriting is more conservative (higher $LE_{\text{ITM}} - LE_{\text{AVS}}$) in the tertiary market than in the secondary market.

The observation that k in the secondary market is larger than in the tertiary market might be due to the fact that health impairments of insureds in the secondary market could

[78] No distinguishable patterns are detected concerning smoking status, age or policy face value.

indeed be more severe than those in the tertiary market. The finding that ITM assesses relatively conservative estimates in healthy lives gives credence to this assumption, since it explains why $k_{\text{ITM}} < k_{\text{AVS}}$ is observed more frequently in the tertiary market than in the secondary market (Figure 36).

Lives being healthier in the tertiary market than in the secondary market might be explained by the survivorship bias. The more health-impaired policyholders die first before even a chance of a tertiary transaction to take place. Therefore, those whose policies are settled in the tertiary market are naturally healthier ones who still remain alive at a future time since the initial secondary transaction. Secondly, policies of healthy insureds (reflected by low k or large LE), which have a long expected maturity, are more likely lapsed or sold to the tertiary market, especially when the policy seller is facing a liquidity pressure. Thirdly, the conjecture that insureds are healthier in the tertiary market can be backed by a legacy issue. Historically, most LE estimates were generally too short. During the early-mid 2000's, a large number of policies (mostly stranger-originated life insurance, or STOLI) with underestimated LEs were traded in the secondary market. Many of those policies were arguably not supposed to enter the market in the first place as evidenced by poor subsequent performance. With the passage of time, underwriters adjusted their estimating methodologies and the LE estimates extended in general. As a result, underlying insureds of policies originated at the height of the STOLI boom are generally healthier than their successors. When those early policies from the secondary markets enter the tertiary market, underwriters revalue those lives using updated methods with extended base survival rates, which lowers the implied mortality multipliers.

One might also argue that k's are deliberately inflated by medical underwriters in the secondary market. As discussed in Section 2, high k's are desired by settlement intermediaries, who are underwriters' clients. Therefore, exaggerated k's could attract new business. New business also means valuable information of new lives for medical underwriters in the secondary market, and ample data of lives is critical for underwriters to test their methods. In addition, underwriters usually get to review lives they have already examined in the secondary market, as, for the sake of consistency, investors tend to stick with the same underwriter for the LE estimate update of a given life. In short, an order to estimate the LE on a new life from the secondary market means very likely repeat orders for reviewing that life in the future. This argument has been challenged by underwriters. ITM, specifically, claims to issue longer LE estimates (lower k) for secondary policies than for tertiary policies, as their mortality tables for the two types of transactions differ (21st Services 2013, p. 3), which is however not directly observable in our data sample. The rationale behind this discrimination is the adverse selection by insureds (Bauer et al. 2017; Zhu and Bauer 2013). It is widely understood that insureds are usually a better judge of their own health condition than medical underwriters, who evaluate lives solely based on sometimes incomplete medical records. Insureds who are interested in selling their policies are usually those who feel fit (and most likely this feeling accurately reflects their real health condition) despite what their medical records imply (Bauer et al. 2014). They benefit considerably from life settlements on account of the high price of their policies, since their medical records indicate undue impairments (A.M. Best 2016, p. 15). ITM has observed from their own database that the adverse selection's effect on mortality rates disappears a couple of years after the settlement, hence fewer mortalities in early durations for secondary market cases. In addition, the huge backlog suffered by ITM and AVS (Horowitz 2016a) may not cause these underwriters to worry about too little business, but rather the opposite.

Detection of intermediaries' cherry-picking

While the main sample demonstrates that ITM tended to issue shorter LE estimates than AVS (indicated by points representing $k_{\text{ITM}} > k_{\text{AVS}}$), the side samples reveal a different picture (Figure 37). In contrast to the main sample, subset $k_{\text{ITM}} < k_{\text{AVS}}$ accounts for the majority of the side samples. We also note that the k's in the side samples are generally smaller than those in the main sample. Despite the common features, a reason must be found to explain differences observed between the main sample (intermediaries' data) and the side samples (investors' data), specifically why cases with $k_{\text{ITM}} > k_{\text{AVS}}$ mostly occurred only in the main sample.

A possible explanation is that life settlement intermediaries of the transactions in the main sample might have shopped for LE estimates in their favor and/or discarded LE estimates that might impede the closing of a deal. Such cherry-picking by intermediaries can cause a skewed picture of the underlying underwriting pattern. To verify this, we compare the subset with only one LE estimate against the subset with multiple LE estimates (Figure 38). Whichever underwriter is considered, the subset with only that particular underwriter's LE estimate generally received a higher k than the subset with additional LE estimates. In other words, lives with a single LE have received more aggressive LE estimates than lives with multiple LE estimates.

Insureds with their LE only estimated by a single underwriter might *appear* less healthy, possibly because the other, longer LE estimates were withheld. The lives with a single LE estimate might have never been given to an underwriter who would have assigned them longer LE estimates. Alternatively, other underwriters' LE estimates might have been issued but then discarded or never disclosed by intermediaries.

When focusing on ITM and AVS, we detect additional evidence that supports the cherry-picking theory. Based on Figure 33, we have learned that compared to AVS, ITM is more conservative (reflected by larger LE, or smaller k) when it comes to healthy lives and more aggressive (reflected by smaller LE, or larger k) in the case of impaired lives. Figure 38 shows that lives evaluated by ITM alone are mostly heavily impaired, for whom AVS would likely have issued a more conservative LE estimate. On the other hand, lives evaluated solely by AVS are relatively healthy, for whom ITM would likely have issued a more conservative LE estimate. Therefore, we do have reason to believe that certain intermediaries understand the inherent biases of individual underwriters, and, accordingly, tend to select the most aggressive underwriter(s) for a particular case.[79]

Distorted incentives might also pertain to investors, or to be more precise, buy-side representatives such as asset managers and employees from investment firms, who do not necessarily invest with money from their own pocket and hence have little skin in the game. Other parties in the market complain that due to many investors' insistence on such unattainably high IRRs, a little LE "maneuvering" is indispensable to satisfy investors and to drive the business. Furthermore, some investors might underestimate the negative impact on return from inaccurate LE estimates.[80]

Cherry-picking from sell-side intermediaries coupled with tolerance from buy-side intermediaries could also explain the large A/E gap between the underwriters and the funds in Table 10. Most settled policies have been through intermediaries. Therefore, between the two insured groups — i) those who have been underwritten by the underwriters, and ii) those who have been underwritten by the underwriters AND eventually settled their policies — intermediaries' such behavior would lead to more severe LE underestimation with the latter group.

Lastly, we cannot rule out the possibility that the lives in the side samples are healthier than those in the main sample in the first instance. Particularly, the side samples might have been subject to survivorship bias, as they include in-force policies only, but not purchased and terminated policies whose original insureds have died. Between the transaction date and LE renewal date, some insureds have died, and those who survived tend to be relatively healthy. Therefore, k_{ITM} being generally lower than k_{AVS} in the side samples (Figure 37) falls in line with this possibility, since ITM treats healthy lives more conservatively than AVS.

4 Discussion

Investors still suffer from largely underestimated LEs and face unexpectedly prolonged premium payments and postponed death benefits. Some practitioners impute underestimated LEs to mercenary underwriters who pursue short-term business gain. Some blame the skewed market on manipulative intermediaries of life settlements, who select low LE estimates to artificially elevate policy prices and to collect commissions at the point of transaction closure. Others believe that investors are also responsible for the malfunctioning market, putting settlement providers under pressure by demanding unrealistically high IRRs. Irrespective of how the underestimated LEs originate,

[79] See also Braun et al. (2018a), which documents a sell-side intermediary's acknowledgement of their pursuit of short LE estimates in order to sell policies at the highest possible price for their insured clients.

[80] This is based on conversations with anonymous practitioners.

end investors are the victims. A number of steps would potentially result in a more sustainable life settlement investment environment.

First, we recommend regulated or voluntary disclosure of medical underwriters' performance using a unified calculation method that gauges underwriting accuracy. So far, medical underwriting for the life settlement industry is only regulated in Florida and Texas (Horowitz 2013c).[81] Disclosing performance has been difficult to implement universally as some underwriters claim it would expose their intellectual property.[82] However, it is practically impossible to reverse engineer the underlying methodology simply using an aggregate performance indicator. Life settlement associations can play a vital role in enforcing standards. An increase in the transparency in underwriters' performance enhances information symmetry, which would help investors identify the most qualified underwriters and push underwriters to constantly strive for accuracy.

Second, the misalignment of incentives could be mitigated by a deferral of commission payments to settlement intermediaries. It would however be tricky to find the right balance between a front-end and a back-end payment. If the back-end incentive is low enough, settlement intermediaries could just write it off in favor of the front-end fees; yet if the weight on the back end is too high, intermediaries might be deterred from doing business altogether. Hence, in order to effectively incentivize intermediaries to become more long-term oriented, a performance-based pay system must be adopted industry-wide, needless to say a challenging proposition.

5 Conclusion

The present study investigates LE estimates of four major medical underwriters in the U.S. life settlement industry — ITM, AVS, Fasano and LSI. We compare LE estimates between underwriters both within and across samples. Empirical evidence suggests that significant, systematic differences in LE estimates exist between medical underwriters. Our main sample, composed of transaction data provided by life settlements intermediaries, shows that ITM has been generally assigning lower LE estimates than its peers. However, the two side samples from investors suggest the opposite, indicating intermediaries' cherry-picking behavior. Our findings also demonstrate that underwriters exhibit patterns in LE projection associated with insureds' specific characteristics such as gender and health impairment. For example, ITM's LE estimates are relatively longer for males and healthy people, while AVS is more conservative for females and those more impaired.

[81] While Florida prescribes extensive oversight of medical underwriters, including triennial filing of a mortality table and A/E (actual to expected) results (The Florida Legislature 2016), Texas only requires them to be licensed as life settlement brokers (Texas Department of Insurance 2016).

[82] AVS, for example, refused to publish their A/E reports arguing that their underwriting methodology, namely their core competency, might be deciphered through those reports (Horowitz 2016a).

Human longevity has significantly increased over the last decades, and an expanding amount of life data on the senior insured group will become available. Thus, we expect to see continuous improvement in underwriting performance in the future. We suggest buyers beware of intermediaries' cherry-picking, and analyze underwriters' data on a regular basis to understand their underwriting patterns for a sensible valuation of life settlement deals. Furthermore, we call for the underwriters' publication of their detailed A/E ratios, to create a more healthy and transparent investment climate.

Upon availability of data, especially data of insureds' death dates, we recommend future research to evaluate the accuracy of underwriters' forecasts. We are also interested to see to what extent naïve predictions (for example using publicly available basic mortality tables) deviate from professional predictions made by medical underwriters. Lastly, the degree to which various factors, such as type of insurance or rating of insurance carrier, affects the pricing of a life settlement also merits further research.

Table 10: A/E ratios

		2008	2009	2010	2011	2012	2013	2014	2015	2016	Notes
Underwriters	ITM	—	98%	94%	—	—	—	—	—	—	$A/E = \frac{\text{number of actual deaths}}{\text{number of expected deaths}}$, adjusted aggregate ratio
	AVS	—	—	—	—	—	—	—	—	—	No publicly available information
	Fasano	—	—	—	—	—	—	—	—	97%	$A/E = \frac{\text{number of actual deaths}}{\text{number of expected deaths}}$, unadjusted aggregate ratio
	LSI	95%	94%	—	—	—	—	—	—	—	$A/E = \frac{\text{number of actual deaths}}{\text{number of expected deaths}}$, adjusted aggregate ratio
Funds	EEA	50%	52%	58%	68%	112%	90%	78%	88%	91%	$A/E = \frac{\text{actual maturity}}{\text{expected LE}}$, original LE used until June 2013, biennially revised LE used from June 2013
	RBS	—	—	—	—	45%	47%	—	—	—	$A/E = \frac{\text{number of actual deaths}}{\text{number of expected deaths}}$, unadjusted ratio
	Assured	—	—	14%	24%	55%	—	—	—	—	No specification
	Life Bond	—	34%	—	—	—	—	—	—	—	$A/E = \frac{\text{number of actual deaths}}{\text{number of expected deaths}}$, expected deaths estimated by EMSI (now LSI)

Note: The actual to expected ratio (A/E ratio) describes the relationship between an actual value and its expectation (Bauer et al. 2018). An A/E less than 1 implies LE underestimation and greater than 1 overestimation. The exact definition of A/E varies (see e.g. Footnote 60). In adjusted ratios, number of expected deaths is calculated using the revised underwriting method as of the reporting date. In unadjusted ratios, number of expected deaths as of the estimation date is used.
Sources: 21st Services (2010); 21st Services (2011); Lake Consulting Inc (2016); EMSI (2009); Boger & Associates LLC (2010); EEA Investors' Group (2016); The Royal Bank of Scotland (2013); Assured Fund (2013); Xu and Hoesch (2018).

Table 11: Excerpt of 2015 VBT Male Nonsmoker ANB Mortality Rates, $x = 80$

Duration ($i+1$, in years)	1	2	3	4	5	6	7	8	⋯
Mortality rates ($_i\|Q_x$)	0.00487 ($_0\|Q_{80}$)	0.00797 ($_1\|Q_{80}$)	0.01386 ($_2\|Q_{80}$)	0.02054 ($_3\|Q_{80}$)	0.02658 ($_4\|Q_{80}$)	0.03391 ($_5\|Q_{80}$)	0.04414 ($_6\|Q_{80}$)	0.05783 ($_7\|Q_{80}$)	⋯

Note: This table presents the standard mortality rates of an x-year-old male non-smoker. $_i|Q_x$ is the one-year conditional mortality rate, the probability that the person aged x will die in a year, deferred i years, i.e. the person is dead at the end of the $(i+1)^{\text{th}}$ year given that the person is alive at the end of the i^{th} year.
Source: www.soa.org/files/research/exp-study/2015-vbt-smoker-distinct-alb-anb.xlsx.

Table 12: Descriptive statistics, main sample

		n	Min	Median	Max	Mean
Full sample	Transaction date	3,236	07/01/2011	24/03/2015	31/12/2016	03/11/2014
	Age (year)	3,234	20.2	80.7	101.0	78.3
	ITM LE (month)	2,026	5.2	63.8	342.0	70.0
	AVS LE (month)	2,794	5.1	81.0	266.1	85.9
	Fasano LE (month)	445	6.0	111.0	280.1	104.2
	LSI LE (month)	185	17.5	97.4	253.1	95.4
Sec. mkt.	Transaction date	2,261	07/01/2011	06/03/2015	31/12/2016	23/10/2014
	Age (year)	2,261	20.2	78.5	101.0	76.3
	ITM LE (month)	1,267	5.2	61.8	312.0	68.2
	AVS LE (month)	1,913	5.1	82.4	266.1	87.8
	Fasano LE (month)	356	6.0	111.5	280.1	104.6
	LSI LE (month)	118	17.5	102.4	253.1	100.7
Tert. mkt.	Transaction date	975	14/02/2011	28/05/2015	31/12/2016	29/11/2014
	Age (year)	973	44.4	84.0	97.8	83.1
	ITM LE (month)	759	7.1	65.0	342.0	73.0
	AVS LE (month)	881	10.0	77.6	260.0	81.9
	Fasano LE (month)	89	10.0	109.0	179.0	102.8
	LSI LE (month)	67	22.3	82.8	217.4	86.2

Note: This table presents the descriptive statistics of the main sample. For every transaction, the age is current as of the transaction date, and each LE is age-adjusted accordingly.

Table 13: Number of transactions by number of medical underwriters involved

Number of LE estimates	0	1	2	3	4	Total
Secondary Market	83	813	1,257	105	3	2,261
Tertiary Market	26	142	767	40	0	975
Full Sample	109	955	2,024	145	3	3,236

Note: This table features the count of transaction deals by the number of LE estimates associated to them. The main sample mostly consists of deals with LEs from two different underwriters. Few deals are evaluated by more than two underwriters.

Table 14: Properties of LE pairs, main sample

	Δ \ n	ITM	AVS	Fasano	LSI	p \ ρ	ITM	AVS	Fasano	LSI
Full smpl.	ITM	—	1,759	168	92		—	0.83	0.85	0.79
	AVS	12.7	—	311	129		0.000***	—	0.91	0.79
	Fasano	14.1	1.1	—	18		0.000***	0.053*	—	0.97
	LSI	9.9	-4.5	2.1	—		0.000***	0.081*	0.170	—
Sec. mkt.	ITM	—	1,053	125	60		—	0.84	0.86	0.82
	AVS	14.2	—	248	91		0.000***	—	0.91	0.80
	Fasano	12.1	-0.6	—	13		0.000***	0.600	—	0.97
	LSI	9.7	-7.8	1.1	—		0.005***	0.013**	0.610	—
Tert. mkt.	ITM	—	706	43	32		—	0.82	0.84	0.67
	AVS	10.4	—	63	38		0.000***	—	0.89	0.76
	Fasano	20.1	8.0	—	5		0.000***	0.001***	—	0.99
	LSI	10.4	3.4	4.7	—		0.035**	0.473	0.058*	—

Note: We call two underwriters' LEs pertaining to the same transaction a "pair" of LEs.
n: number of LE pairs. Most deals have LEs from ITM paired up with AVS. Few deals involve both Fasano and LSI.
Δ: arithmetic mean of LE difference in LE pairs, calculated by taking the average of row LEs subtracted by column LEs. In the sample concerned, the disparity between ITM and other underwriters is the greatest. On average, ITM is shorter by 12.7 months than AVS, by 14.1 months than Fasano and 9.9 months than LSI.
ρ: correlation between paired LEs. Paired LEs are highly correlated.
p: p-value of a Wilcoxon signed-rank test. Significance levels of 0.1, 0.05 and 0.01 are marked with "*", "**" and "***" respectively (sic passim). We have also conducted paired two-sided Students' t-tests, which render similar results that ITM LEs are consistently and significantly different from other underwriters' LEs.

Table 15: Descriptive statistics, side sample

		n	Min	Median	Max	Mean
Side Sample 1	ITM underwriting date	584	02/11/2015	14/03/2016	07/10/2016	07/03/2016
	ITM Age (year)	584	64.0	84.7	98.3	84.3
	ITM LE (month)	584	11.0	76.5	283.0	85.1
	AVS underwriting date	584	02/11/2015	28/03/2016	01/11/2016	16/03/2016
	AVS Age (year)	584	64.0	84.7	98.2	84.4
	AVS LE (month)	584	12.0	74.0	180.0	79.3
Side Sample 2	ITM underwriting date	552	26/06/2009	26/05/2015	24/10/2016	18/02/2015
	ITM Age (year)	552	54.8	80.2	98.1	80.8
	ITM LE (month)	552	6.0	132.0	291.0	129.6
	AVS underwriting date	552	25/06/2009	14/05/2015	25/10/2016	15/02/2015
	AVS Age (year)	552	54.9	80.2	98.2	80.8
	AVS LE (month)	552	12.0	125.5	222.0	125.0

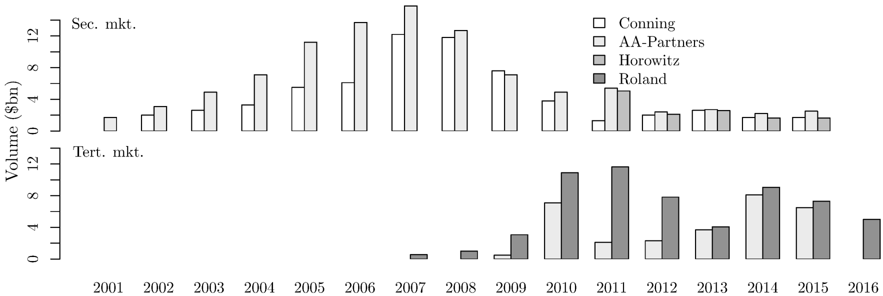
Note: This table presents the descriptive statistics of the side samples. For each policy, the age and LE are current as of the underwriting date.

Table 16: Regression: the effect of policy characteristics on the difference in underwriters' LE estimates

Dependent variable	$LE_{\text{ITM}} - LE_{\text{AVS}}$					
Sample	Main Sample		Side Sample 1		Side Sample 2	
(Intercept)	-12.028	***	13.199	***	8.657	***
	(1.288)		(1.770)		(1.464)	
$\overline{\ln k}$	-2.298	***	-18.939	***	-20.583	***
	(0.484)		(1.169)		(1.538)	
Gender (Male)	1.417		14.266	***	12.143	***
	(1.214)		(1.845)		(2.043)	
SmokingStatus (Smoker)	2.574		1.872		-7.664	
	(3.863)		(7.386)		(11.840)	
Market (Tertiary)	3.139	**				
	(1.176)					
$\mathrm{d}f$	1,683		580		548	
Adjusted R^2	0.019		0.338		0.259	

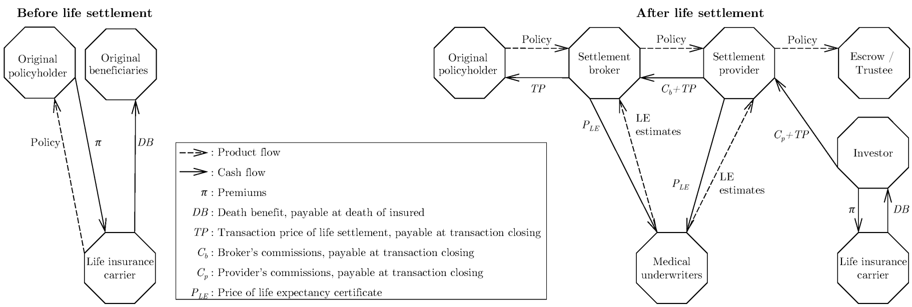
Note: Regressions include controls for insured's health status (proxied by average log mortality rate $\overline{\ln k}$) and indicator variables for insured's gender (male = 1), smoking status (smoker = 1) and transaction market (tertiary market = 1). Standard errors are in parenthesis. Significance levels of the explanatory variables at 0.1, 0.05 and 0.01 are marked with "*", "**" and "***" respectively.

Figure 25: Annual face value transacted



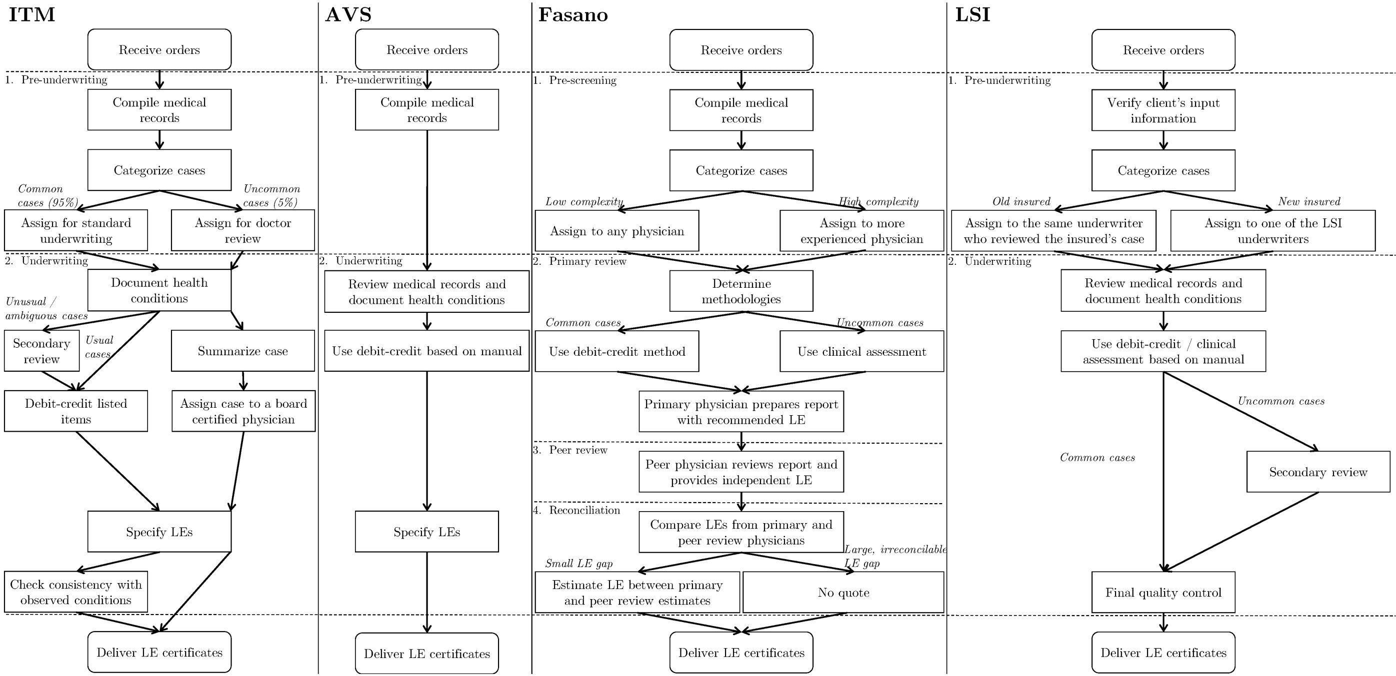
Note: The figure illustrates the change in total face value of policies transacted throughout the years. The estimation by different sources on the dollar amount varies, but the trend shown is similar. The secondary market experienced its peak in 2007 while the tertiary market has attracted increasingly more capital ever since.
Sources: Conning (2017), AA-Partners (2016), Horowitz (2016b, 2015, 2014, 2013b), Roland (2016).

Figure 26: Simplified process of a life settlement transaction



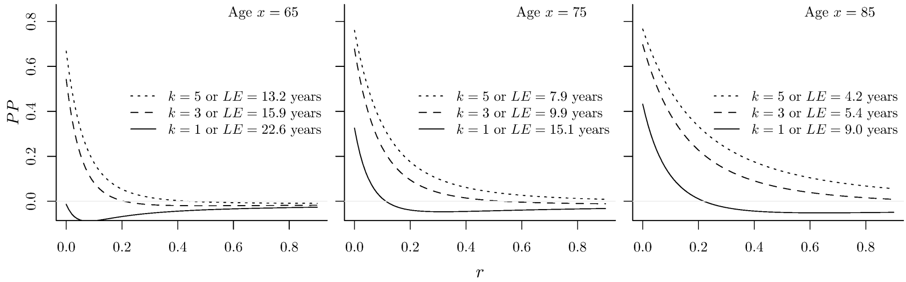
Note: Adapted from Januário and Naik (2014, p. 35) and Braun et al. (2015, p. 177), this figure illustrates the process of a life settlement transaction in the secondary market, where the ownership of a life insurance policy is transferred from the original policyholder to the investor. Intermediaries generally earn income from the closure of a transaction due to commissions and fees they charge. In the tertiary market, policies are traded between sell-side and buy-side investors. Aspinwall et al. (2009, pp. 15–18) and Braun et al. (2012, p. 200) define and elaborate on the various roles involved in a life settlement transaction.

Figure 27: Underwriting process



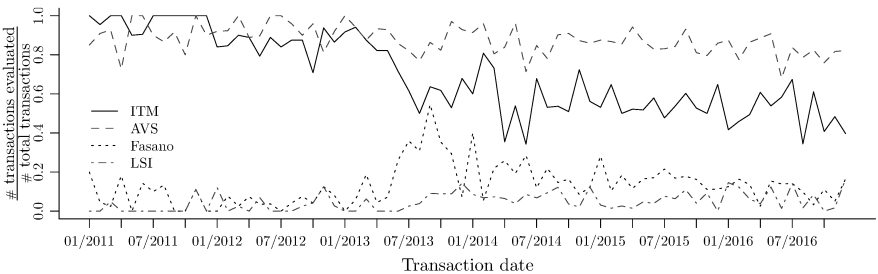
Sources: ITM TwentyFirst (2016, p. 1); LSI (2017).

Figure 28: Price factor (*PP*) against return (*r*) by mortality multiplier (*k*)



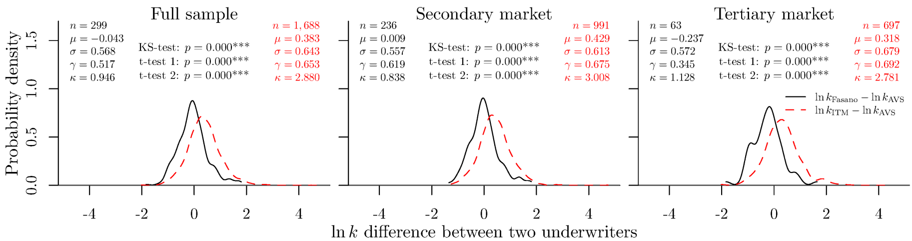
Note: This figure illustrates *k*'s effect on the $r \to PP$ curve from simulated universal life policies of an *x*-year-old male non-smoker. When *k* is not sufficiently high, *PP* can be always negative irrespective of *r*. *PP* being positive and constant, higher *k* implies higher expected *r*; *r* being constant, higher *k* implies higher *PP*.

Figure 29: Relative market shares



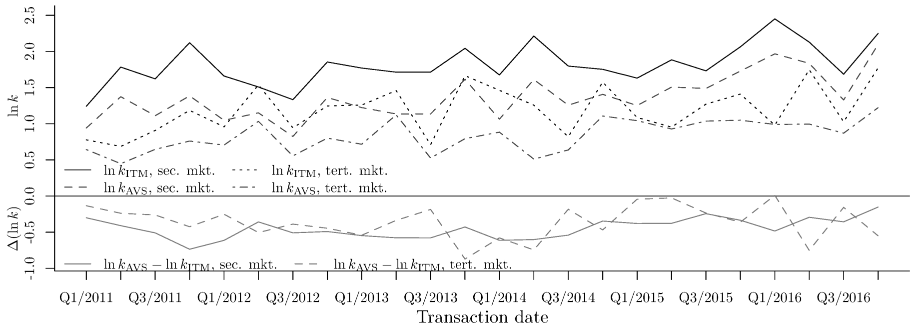
Note: Relative market shares of Fasano and LSI are comparatively stable. A sharp downturn in ITM's market share as well as a sharp peak of Fasano's can be observed in year 2013.

Figure 30: Distributions of $\ln k$ differences



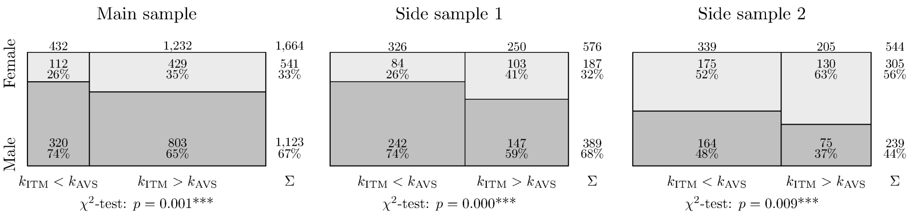
Note: n: number of observations. μ: mean. σ: standard deviation. γ: skewness. κ: kurtosis. Under the alternative hypothesis (H_0) of a Kolmogorov-Smirnov test (KS-test), the distributions of the two subsets differ. Under H_0 of an unpaired one-tailed Student's t-test (t-test 1), the mean of the subset plotted in dashed lines is less than that in solid lines. Under H_0 of an unpaired two-tailed Student's t-test (t-test 2), there is no difference between the means of the two subsets. (sic passim) The figure illustrates the distribution of $\ln k$ difference in the main sample.

Figure 31: $\ln k$ from ITM and AVS in secondary and tertiary markets, main sample



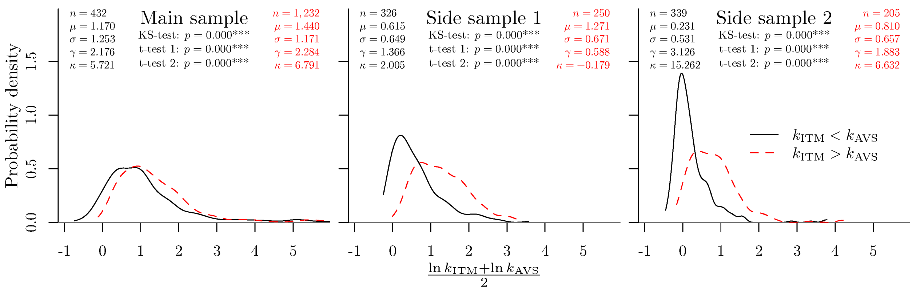
Note: This figure presents the quarterly average $\ln k$ of ITM and AVS throughout the sample period. Only deals with both ITM and AVS LEs are considered. The mean $\ln k$ of each quarter from ITM is higher than that from AVS throughout the whole sample period, in both secondary and tertiary markets.

Figure 32: Mekko plot of gender against subset $k_{\text{ITM}} < k_{\text{AVS}}$ and $k_{\text{ITM}} > k_{\text{AVS}}$ by sample



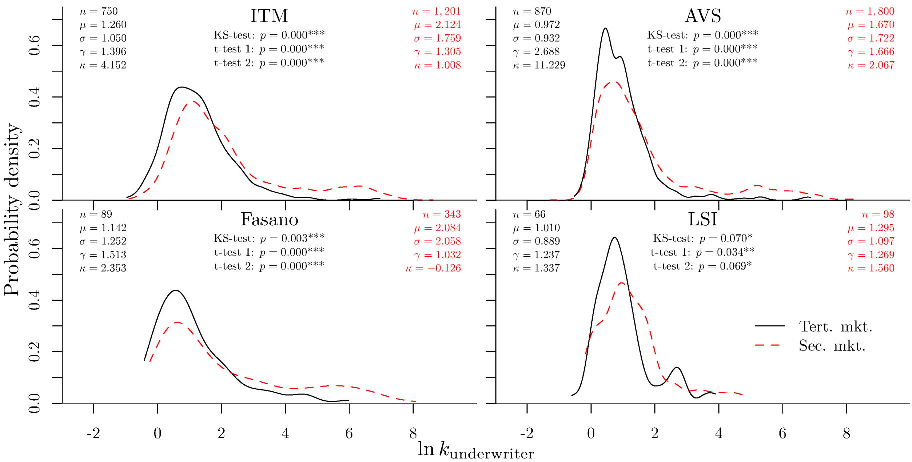
Note: The distributions on gender are significantly different between subset $k_{\text{ITM}} < k_{\text{AVS}}$ and subset $k_{\text{ITM}} > k_{\text{AVS}}$ in all three samples. Specifically, bar male (female) from column $k_{\text{ITM}} < k_{\text{AVS}}$ is taller (shorter) than that from column $k_{\text{ITM}} > k_{\text{AVS}}$, which means subset $k_{\text{ITM}} < k_{\text{AVS}}$ consists of proportionally more males than subset $k_{\text{ITM}} > k_{\text{AVS}}$.

Figure 33: Kernel density of health impairment by sample, subset $k_{\text{ITM}} < k_{\text{AVS}}$ vs. $k_{\text{ITM}} > k_{\text{AVS}}$



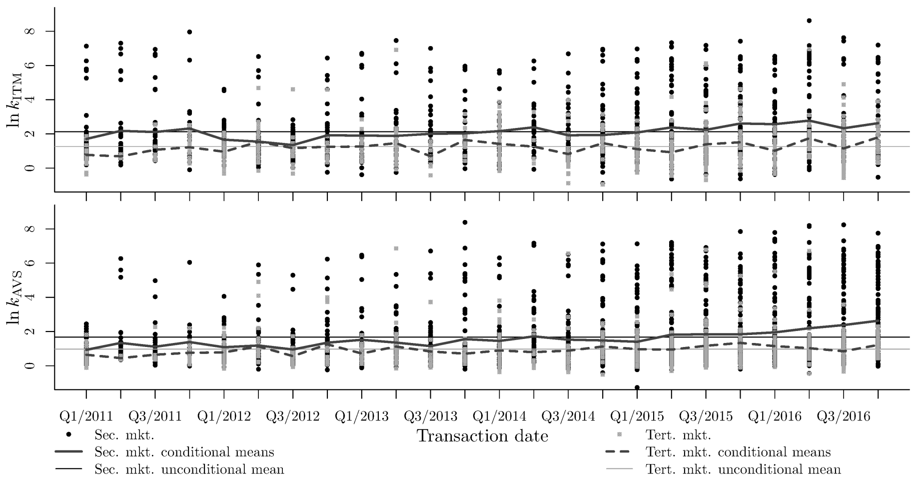
Note: The density distributions on health impairment (proxied by $\frac{\ln k_{\text{ITM}} + \ln k_{\text{AVS}}}{2}$) are significantly different between subset $k_{\text{ITM}} < k_{\text{AVS}}$ and subset $k_{\text{ITM}} > k_{\text{AVS}}$ in all three samples. Specifically, subset $k_{\text{ITM}} < k_{\text{AVS}}$ is in aggregate healthier (smaller $\frac{\ln k_{\text{ITM}} + \ln k_{\text{AVS}}}{2}$) than subset $k_{\text{ITM}} > k_{\text{AVS}}$.

Figure 34: Kernel density of health impairment by underwriter, sec. vs. tert. market



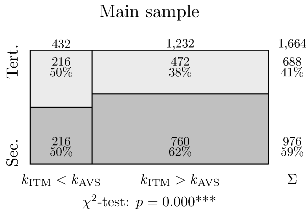
Note: The measures of central tendency (mean, mode, median) of $\ln k$ are larger in the secondary market than in in the tertiary market for all four underwriters.

Figure 35: Time series of $\ln k$ distributions by underwriter, sec. vs. tert. market



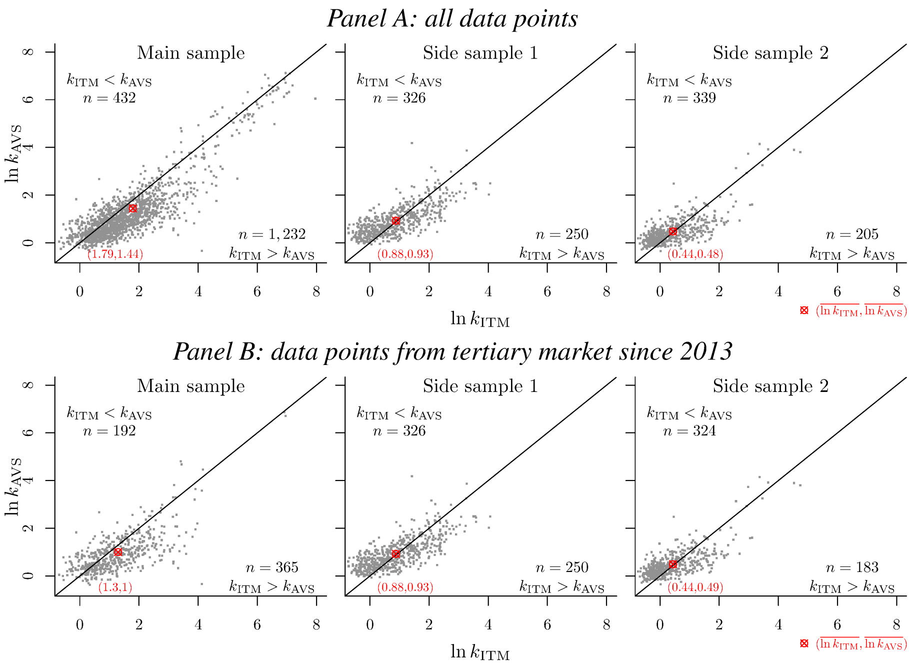
Note: For both ITM and AVS, the average $\ln k$ of each quarter is always higher in the secondary market than in the tertiary markets throughout the whole sample period.

Figure 36: Mekko plot of markets against subset $k_{\text{ITM}} < k_{\text{AVS}}$ and $k_{\text{ITM}} > k_{\text{AVS}}$ by sample



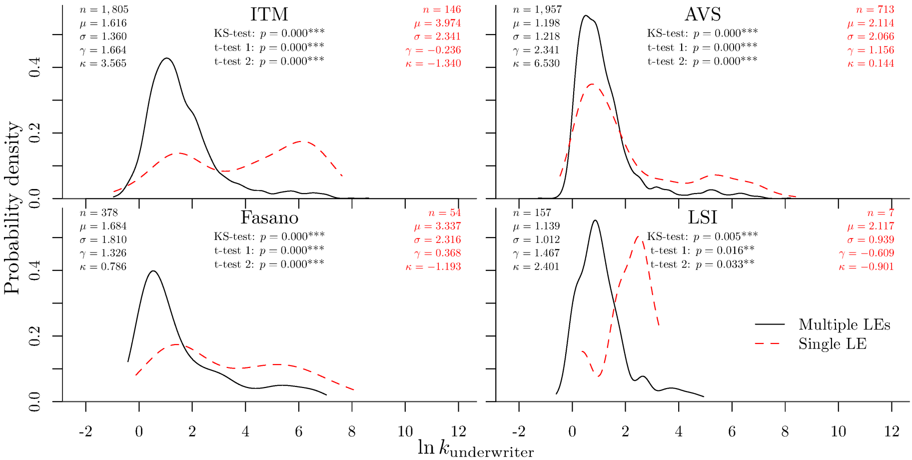
Note: The distributions on markets are significantly different between subset $k_{\text{ITM}} < k_{\text{AVS}}$ and subset $k_{\text{ITM}} > k_{\text{AVS}}$ in all three samples. Specifically, bar secondary (tertiary) market from column $k_{\text{ITM}} > k_{\text{AVS}}$ is taller (shorter) than that from column $k_{\text{ITM}} < k_{\text{AVS}}$, which means subset $k_{\text{ITM}} < k_{\text{AVS}}$ consists of proportionally more deals from the tertiary market than subset $k_{\text{ITM}} > k_{\text{AVS}}$.

Figure 37: Scatter plot of $\ln k_{\text{ITM}}$ against $\ln k_{\text{AVS}}$ by sample



Note: Points on the 45° line represent the ideal scenario when $k_{\text{ITM}} = k_{\text{AVS}}$. *Panel A* consists of all data points from our sample. In *Panel B*, we remove the secondary market data from the main sample (side samples only consist of tertiary data) and the data before 2013 (given the considerable change in ITM's underwriting methodology around January 2013). The main sample consists of more insureds with $k_{\text{ITM}} < k_{\text{AVS}}$ than those with $k_{\text{ITM}} > k_{\text{AVS}}$. This pattern is not shared by the two side samples.

Figure 38: Kernel density of health impairment by underwriter, subset with multiple LEs vs. single LE, main sample



Note: In the upper left plot, the distribution of $\ln k_{\text{ITM}}$ is compared between the subset of policies with a single LE estimate from ITM, the and subset of policies with LE estimates from ITM and some other underwriter(s). The former subset's $\ln k_{\text{ITM}}$ is in aggregate considerably larger than the latter's. This effect, although not as distinct, can be observed when the underwriter is AVS, Fasano, or LSI.

Part V

Predicting Longevity: An Analysis of Potential Alternatives to Life Expectancy Reports

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Abstract

Retirees, pension funds, and the insurance industry have all been negatively affected by the wrongful estimation of longevity. The inaccuracies in current life expectancy (LE) reports primarily result from misinterpretations of the influence of resilience factors on longevity. This study examines different and more accurate measurement metrics to minimize the risks related to biased LE calculations. By using both qualitative and quantitative research approaches, this research develops a new conceptual model: a two-factor-LE-analysis model with a telomere test as a medical basis (physiological factors) and a big data approach to filter the psychological factors to longevity. The authors suggest that the new model, together with the insights of the existing LE-projection methodologies, has considerable potential to improve LE predictions.

"If you manage a pension plan and you have, say, 10,000 retirees, and every year you have to pay a pension of, say, $20,000 per retiree… if people are living one year longer than expected, your plan has to pay $200 million additionally" (University of Waterloo 2012).

The preceding quote illustrates the consequences of uncertainty in life expectancies. Longevity risk — the risk that individuals live longer than calculated — has become front-page news in the financial planning industry. Numerous polls show that Americans are worried about outliving their assets during retirement. Financial Planning magazine published a special retirement issue in September 2014 entirely devoted to "planning for the new old." Not only are individuals interested in their life expectancy; trillions of dollars are spent, earned, and managed every year in insurance, medical, and financial institutions in which the outcomes hinge primarily on the prediction of longevity. These mammoth industries continue to operate, products continue to be priced, and individuals keep making life-altering decisions based on actuarial tables that are designed to project the longevity of populations.

With our digital footprint — millions of data points we knowingly or unknowingly produce every day – the Internet seems to know even more about us than we do about ourselves: Amazon now advises consumers which books they would like to read next. With the assistance of big data, the Internet has become a modern oracle, telling us what to do and even who we are. Taking this thought a step further and thinking about predicting how long one may live might sound abstruse at first. However, given the amount of available data of each individual human being — especially in industrialized countries — and what has been achieved with such data up until now, the idea of predicting someone's date of death does not appear that far-fetched. Understanding the importance of big data for accurate life expectancy prediction is the first step to changing traditional models into more accurate and useful ones.

Therefore, the key purpose of this article is to provide an empirical perspective on (1) the reasons that lead to erroneous predictions, and (2) the possibilities big data introduces to this field, and how it can possibly close the estimation gap between predicted and actual duration of life.

First, we will describe the conventional methods to predict life expectancy. Next, the subject of big data and its potential in longevity forecasts are introduced. Finally, a telomere testing experiment collecting primary data is added to demonstrate the validity of such a medical test.

1 The Life Expectancy Report

This section explains the computation and application of the life expectancy report. First, the calculation for individual reports will be described. Building on this, the expectancy report portfolio will be introduced and analyzed in light of the example of

Life Bond Management GmbH. Consequently, problems of the existing method and their significance will be listed.

To date, valuation of life insurance products relies primarily on life expectancy (LE) reports, especially in the life settlement market.

The two main components through which the life expectancies are calculated are the mortality table and the mortality multiplier.

1.1 Mortality table and mortality multiplier

"A mortality table is a demographic model that allows the summarized assessment of a population's mortality conditions regardless of its size and age distribution" (Statistisches Bundesamt 2017). American mortality tables concern the average mortality, also called basic mortality — the probability of a death occurring within the next year (after calculation) at a certain age and gender. They are issued by the Society of Actuaries and rely on historical data.

The mortality multiplier is used to define how much an individual's mortality differs from the average mortality (provided in the mortality table). It relies on medical underwriting, which incorporates health factors of the individual, based on medical reports. A 100% mortality multiplier reflects average mortality, as calculated in the mortality table. Anything above 100% indicates a poorer health than average; anything below shows a better-than-average health of the individual.

The combination of the mortality table (basic mortality) and the mortality multiplier allows for calculation of the probability of death for a certain individual.

Figure 39 illustrates the typical process flow of producing an LE report.

1.2 LE report: Life Bond example

To portray the implementation of LE reports, we use the case of a 78-year-old policyholder from the Life Bond Management GmbH life settlement portfolio.

As a benchmark, the expected mortality of an average 78-year-old male can be calculated with the base mortality table (Figure 40). According to the mortality table, the probability for death within the first (upcoming) year for a male individual who takes out insurance at the age of 78 is 0.937%.

Figure 40 does not include information about an individual's life expectancy because this requires information about the person's state of health. It solely depicts the expected mortality of an average 78-year-old male, where "average" means a mortality multiplier of 100%.

Before evaluating a policy, medical reports of the insured person are commonly subjected to independent medical opinions called *medical underwritings*. The goal of a medical underwriting is to get a current and very detailed report about the health status of a specific insured person in order to apply a certain mortality multiplier, which compares the insured person and his/her peer group. In the case of the 78-year-old in the Life Bond portfolio, a mortality multiplier of 300% is given. This multiplier indicates that this individual is three times as sick as the average 78-year-old male. Figure 41 depicts the shift of the bell-shape probability curve to the left, representing the 78-year-old individual's probability of death per approaching year.

Next, a deviation of 20% from the individual mortality multiplier is simulated for stress testing (Figure 42). This deviation of 20% is called a *realistic worst-case scenario* — based on historical values — and is subsequently referred to as such.

The stress test of a portfolio consisting of U.S. life settlements is based on the Monte Carlo simulation. By the simulation of a certain scenario, the extent of the investment-related risk becomes discernible to the decision maker. Because a marketable portfolio consists of multiple policies, usually between 100 and 300, the stress scenario does not refer to only one policy, but to all policies contained in the sample portfolio. The present Life Bond Management GmbH sample portfolio incorporates 156 policies with a purchase price of $58,400,000 and an insured sum of $330,000,000. The average age at the time of acquisition was 78.4 years. Eighty percent of the $100,000,000 investment was leveraged at an interest rate of 5%.

The aim of this stress scenario is to demonstrate the resulting effects of the projected internal rate of return (IRR). The following bar chart (Figure 43) illustrates the discrete probability distribution of the expected IRR with a calculated base scenario, as well as both stress scenarios.

An IRR of 17.73% is produced as the expected value in the base scenario. For the worst-case scenario (mortality multiplier: −20%), an IRR of 11.67% can be expected on average.

1.3 Inaccuracy of the LE report

The use of stress tests for companies like Life Bond Management GmbH simulates the inaccuracy of LE reports. This inaccuracy is caused by the information upon which the report is built.

Figure 44 shows that predictions based on LE reports have led to expectations far removed from the actual mortalities. This deviation can be attributed to three main issues: (1) the false application of information, (2) the lack of critical information, and (3) the incorporation of irrelevant or false information.

Medical underwritings from 2002 underscore the first issue. They predicted a life expectancy of 40–60 months for the individuals in the sample portfolio. The actual life duration, however, was 72 months longer than expected. Underwritings from 2009 predicted 36 months less than actual duration of life. Additionally, Figure 44 confirms the discrepancy between predicted and actual life expectancies. The medical underwritings by EMSI (one of the most recognized underwriting providers) show that the insured person's current state of health was classified as much worse than it actually was, and the predicted life expectancy was too short (Figure 44).

Prof. Dr. Klaus-Christian Steinwachs, professor in psychogerontology at the Friedrich-Alexander University Erlangen-Nürnberg, investigates the causes for deviation of actual to predicted life duration. His research sees two main reasons for the inaccuracy in predicting life expectancies: (1) medical improvement and the impact of new drugs and treatments, better nutrition, and healthier lifestyle were not properly incorporated in past models, and (2) the impact of individual psychological profiles, in combination with resilience factors, is missed in traditional medical underwriting.

A third reason to criticize the conventional use of medical underwritings is that the inaccuracy of LE reports is caused not only by the lack of information or wrong interpretation of existing information, but additionally by information that is easy to falsify. Medical data that is used to develop individual medical profiles can be purposely and easily influenced. For example, the question of whether a person is a smoker is falsified with the answer yes (even if non-smoker) in underwritings. False answers as such distort LE estimation, which, in the case of a life settlement, influences the price of the life insurance policy traded.

From an investor's perspective, this systematic error (Figure 44) leads to an overpricing of the policies in U.S. life settlement transactions and to much higher ongoing costs, as insurance premiums had to be paid for a much longer period. Thus, the portfolios actually delivered returns far below the estimated amount. A further point to consider is the time-consuming process to obtain a life expectancy estimate, which takes, on average, 30–45 days.

2 Big Data

This section discusses how and why big data could better predict life expectancies, and what the limitations would be. The term *big data* is used for huge amounts of data produced in digital form. Data and its collection have existed before. However, new technological means have taken data collection to a new level — and the era of data is flourishing.

The exponentially increasing amount of data is caused by the invention and use of the Internet and digital applications. This fourth industrial revolution, ushering in the Internet of Things, the digital twin, and blockchain, creates large quantities of data each second.

Economic rationale was associated with data gathering in the past: parametric models were determined, data was analyzed, parameters were estimated, and results were interpreted. Big data, by contrast, is analyzed by an algorithm that identifies patterns, which are afterwards formed into a model for predictions (Figure 45). The industry analyst Doug Laney pointed out the three most important characteristics of big data. The three V's — volume, velocity, and variety — describe its most beneficial traits.

1. Volume: Huge amounts of information are generated and can be stored. According to Khoso (2016), 2.5 quintillion bytes of data has been stored in 2015, and 90% of all data existing in 2015 has been generated in the prior two years.
2. Velocity: Data is produced at an incredibly high speed. A combined 1.68 billion Facebook users upload 350 million images per day. And Facebook is only one of many social media channels.
3. Variety: Data of various types and sources are being retrieved every day. This includes text, images, video, audio, spreadsheets, and databases sourced from emails, video streaming websites, social media, and many more. A single query on Google can retrieve millions of files.

2.1 Advantages of big data use

Having presented a generic description of big data, the following will focus on big data that is relevant to longevity risks and life expectancy prediction. As concluded in the previous section, the inputs into the LE reports need to be improved in order to provide better predictions. Figure 46 presents a figure depicting how big data can be added to the medical data for a more accurate mortality multiplier.

Big data is increasingly available in almost every field. Due to the application algorithms, the search for topic-specific data is not obstructed by the mass of information. Health data — based on medical tests and underwritings performed at the doctor's office and laboratory — could be complemented by medical information gathered throughout the lifetime of a patient. Hospitals' and doctors' computer systems save vital information on a patient's health. Wearable and implanted health monitors (e.g., Fitbit), coupled with algorithms, have the capability to interpret information and to detect diseases a human eye might overlook. Exploiting big data would corroborate and contextualize the quantity and quality of existing information, which could be used to enhance the accuracy of longevity prediction.

2.2 Disadvantages of big data use

Big data can provide an invaluable resource to researchers and insurers (Hoffman 2014). The flaws mentioned in this section are not unique to the creation of big data; they apply to data generation in general. These shortcomings are nevertheless listed. Big data is generated either through programmed automation or manual data entry. The latter situation leaves room for flawed data due to human error or intentional manipulation.

Electronic health records (EHRs) that are used to enter medical data in hospitals are an example in which the problem of input errors commonly occurs. Clinicians sometimes mistype words or enter wrong numbers. Incomplete or wrong information can sometimes be traced back to human incompetence or laziness. Furthermore, it has been recorded that some health professionals manipulated medical records for more earnings Schulte (2012).

Another cause of flawed data is technical insufficiencies, such as voice recording applications in hospitals. Many hospitals use voice records to save information about patients. Because of a system malfunction or noise around the physician, the record may not contain the needed information.

However, the disadvantage of flawed information admittance due to human or technical faults decreases as more big data from other reliable sources is generated and used. Flawed entries are outnumbered by correct data. The increasing amount of data leads to better quality of the overall data as outliers can be detected and isolated.

An example of collecting big data without the risk of input errors is provided by *remote monitoring*: a smart system to acquire patient data while patients are residing in their homes. Remote monitoring is a relatively new term in acquiring medical data. Smart cameras and wireless transmission systems are installed in the patient's home and valuable data is sent to the hospital in real time. The smart camera works on multiple algorithms that detect the movement, audio, and video of the patient, and then feeds such information to the health care system. This type of data can provide great assistance to the data analyst because there is a lower chance of errors.

3 Alternative Prediction Examples for Life Expectancies

Predictive analytics — the method of anticipating future events through the means of big data — has huge impacts in various fields, including the health and life insurance industries. Predictive analytics belongs to the field of advanced analytics, which uses techniques of data mining, machine learning, statistics, and artificial intelligence. IBM (2010) defines predictive analytics as the process of "connect[ing] data to effective action by drawing reliable conclusions about current conditions and future events."

The following three examples from the industry show how big data could be used in the future for the prediction of life expectancy.

3.1 Cambridge: Predictive World

Predictive World is the result of a collaborative data visualization project between the psychometric center at Cambridge University, Sid Lee Paris, and Ubisoft. It is an interactive online experience in which users discover how much a cyber-system can predict by using digital records of social media behavior.

Predictive World is not used as a professional life prediction tool but rather as a prototype marketing tool for a computer game developed by Ubisoft. Nevertheless, it is a good example to show how predictive analytics describes a specific person by simply analyzing his/her digital footprint. It now already provides precise predictions. Its constant development suggests promising results in the future. Figure 47 shows the user interface of the Predictive World website, which is publicly available.

The prediction database contains 6.3 billion data points. For each individual person, 70 data-driven categories are analyzed. Data covers 250 countries, 7 different languages, detailed health data, and income and marriage data. The relationships between variables are calibrated from 70 journal articles.

Predictive World combines an algorithm named Apply Magic Sauce with two main data sources: (1) social media data and (2) geographical data.

Apply Magic Sauce is the psychological prediction algorithm developed by the University of Cambridge Psychometrics Centre. It is used to generate psychological predictions with data from Facebook and Twitter (Figure 48). Predictive World has recognized the relevance of the psychological profile for a person's health and, to be more precise, that the attitude, behavior, and functionality of the human mind are affected by thoughts, feelings, and other cognitive characteristics. Psychological factors include personality traits, psychodynamic processes, and learned cognition.

Psychological well-being and health are correlated, especially in advanced years. According to the research, there is a bidirectional relationship between physical health and subjective well-being. Diseases such as coronary heart disease and chronic lung disease in older years are associated with an increase in depression and impaired hedonic and eudemonic well-being (Steptoe et al. 2015). It is also argued that people with strong personalities and a high well-being that suffer from a dangerous disease such as cancer live significantly longer than people with the same kind of cancer and a weak psychological strength and a negative constitution (Diener and Chan 2011).

Facebook collects huge amounts of data every second: the profiles a person engages with, the amount of time one spends on the social media platform, and the content of messages. Facebook utilizes this data to build a detailed picture of each user, which can then be used to customize specific news feed and target adverts for such an individual. Even one indicator alone, such as "likes", can reveal a lot about a person: gender, intelligence, life satisfaction, sexual preference, political and religious preferences, as well as education and relationship status. Additionally, individuals can be ranked by the

"Big 5" personality traits of openness, conscientiousness, extraversion, agreeableness, and neuroticism (Figure 49). These inform, for example, whether one is impulsive, organized, conservative, or liberal.

Based on these results it is possible to make conclusions about an individual's profile. "In 2012, [Michael] Kosinski proved that on the basis of an average of 68 Facebook 'likes' by a user, it was possible to predict their skin color (with 95 percent accuracy), their sexual orientation (88 percent accuracy), and their affiliation to the Democratic or Republican party (85 percent). But it didn't stop there. Intelligence, religious affiliation, as well as alcohol, cigarette and drug use, could all be determined. From the data it was even possible to deduce whether someone's parents were divorced. [...] Seventy 'likes' were enough to outdo what a person's friends knew, 150 what their parents knew, and 300 'likes' what their partner knew" (Grassegger and Krogerus 2017).

Combining these psychological predictions with geographical data, as well as bespoke back-end data infrastructure, would enable superior life expectancy predictions. Back-end data infrastructure is created by scraping hundreds of publicly accessible databases and merging them into one database with billions of data points. Using data in this manner enables the analysis of relationships among factors such as location, gender, salary, crime risk, personality, and longevity.

Predictive World combines parameters of seven different categories with the Apply Magic Sauce algorithm, geographical data, and bespoke back-end data.

1. Demographic profile (age, gender, height, weight),
2. Preferences (music genre, car preference, literacy genre, etc.),
3. Psychology (Big 5: openness, conscientiousness, extraversion, agreeableness, neuroticism, other psychological factors),
4. Health (visits to the doctor, smoking risk, alcohol consumption, risk of dying during the year),
5. Work (job performance, interests, income, entrepreneurial performance),
6. Family (relationship status, chance of being married, breakup risk, etc.),
7. Environment (job opportunity index, cost of living index, cultural index, risk of dying during a car accident, etc.)

3.2 Deloitte: Predictive Analytics for Mortality Expectations

Deloitte enhanced a predictive analytics algorithm for insurance companies, called Deloitte Intelligent Growth (DIG). It uses name and address and third-party data such as online medical record data. DIG is powered by 150+ algorithms based on disease models. Disease models were built by combining millions of health care claims data with third-party lifestyle data. The first cornerstone of DIG contains member data from publicly accessible electronic health records (EHRs). These data have been combined with third-party marketing data at the individual level and cover tens of millions of lives. The second cornerstone is the claims data, consisting of millions of annual historical claims records from health plans that were categorized according to disease conditions. These two cornerstones form the database for the Deloitte disease model (Figure 50).

The DIG analytics tool leverages internal (based on own empirical data) and external (third-party) data to achieve maximum segmentation for each individual in order to predict mortality and morbidity scores. The required lifestyle data necessary to form an individual lifestyle cluster is purchased from the 40 biggest data vendors. The most recognized ones are AxiCom, Intermountain Healthcare, and the American Medical Association (AMA). Deloitte procures data to form the following categories:

- National indexes (wage data, occupational codes, wealth indicators)
- Deloitte disease states (lifestyle diseases, e.g., diabetes, cancers, cardiovascular, etc.)
- Purchase behaviors (spending by category, retailer transaction data, purchase triggers, etc.)
- Ailment and discharge (medical provider data, hospital visit statistics, doctor practice data, etc.)
- Automobile data (driver device usage, Carfax vehicle history, etc.)
- Lifestyle clusters (active seniors, life stage clustering, lifestyle, etc.) . Demographical sets (crime statistics, climate data, firehouse data, etc.)
- Commercial data (business hazard grade, business financial statistics, etc.)

Subsequently, the DIG predicts a longevity score similar to the mortality multiplier we know from the traditional medical underwritings.

According to Deloitte, the development of life insurance underwritings is enhanced by an automatized inspection of life insurance applications. Only 25% of all applications will need to be verified manually. A principal advantage of the Deloitte algorithm is efficiency: DIG can conduct medical underwriting one day (Figure 51) with lower costs and improved accuracy by using the complete lifestyle profile of an individual. Deloitte has scored the entire United States adult population (230 million lives).

3.3 Telomere Testing

The third application of big data featured in this article shows the approach to life expectancy prediction from an emerging medical field. Based on biological research and data, the telomere test method focuses on the length of the telomere caps at the end of chromosomes.

Telomeres are protective caps at the end of the chromosomes. They protect the chromosomes from fusion and degradation, and therefore ensure cell viability. As a person ages, cells naturally divide, and telomeres shorten over time. Cells stop duplicating when telomeres become too short. Therefore, telomere length is considered to be an excellent biomarker for aging and age-related diseases.

Telomeres are influenced by factors such as genetics, lifestyle habits, and environments. Lifestyle habits that slow down telomere attrition are proper nutrition, regular exercise, consistent and average body mass index (BMI), nonsmoking, moderate alcohol consumption, and little oxidative stress.

By measuring the length of the telomeres, a person's biological age can be determined and compared with the actual chronological age. Short telomeres are associated with many age and life expectancy related illnesses such as cardiovascular disease (CVD) and neurodegenerative diseases, diabetes, infertility, and infectious diseases. They have been linked to the development of secondary cancers, as well as high levels of psychological stress.

A telomere test requires only a blood sample of 2–3 drops. No involvement of a doctor is necessary, as the blood sample requires only a testing kit and can be sent directly to the diagnostic center.

To assess the telomere test, we performed an experiment by ordering a telomere test from Titanovo, a North Carolina-based firm that offers a direct-to-consumer telomere testing kit. We took the blood sample of a 58-year-old male tester, and then sent the telomere testing kits back to the laboratory.

The result of the Titanovo telomere test (Figure 52) shows a linear graph, which depicts the average decrease in telomere length for men. The gray area in the chart shows the 70% prediction band in telomere length for men. This means that 70% of population fits in this range and is considered normal. The dot indicates the telomere length of the participant. It lies above the mean length line of the average 55-year-old male, meaning that the telomere length of the participant is longer than the expected value, 0.06 kilo base pairs longer to be specific. They are in the 40.02 percentile, which means that the telomeres are longer than those of 59.98% of men of that age. This indicates that his telomeres are in a very good condition. Therefore, his biological age is 36 months less than his actual age of 58. Because the source of the data is the blood of the participant, mistakes connected with data collection are mitigated.

4 Combination of Medical and Big Data Approach

Based on the preceding examination of the conventional prediction methods, the disadvantages and advantages of the use of big data, and the three new approaches to life expectancy prediction, we propose an advanced theoretical model for life expectancy prediction. This *two-factor LE analysis* aims to include comprehensive data from the physical and the psychological state of the individual.

Clear advantages of the new model include the diversity, the quantity, and the quality of the data, without a significant expenditure in money, time, and effort.

An LE report whose development takes advantage of these benefits can be obtained through the use of an algorithm that processes physiological and psychological data.

The physiological data used in the new model provides similar information as the medical data from conventional underwritings. It can be collected from an individual's blood sample, as is the case in the telomere test. The telomere test has the great advantage that it cannot be manipulated because the shortening of telomeres is a lifelong process. A change in lifestyle can affect the quality of the telomeres, but only over a long period of time. It is therefore a reliable and up-to-date source of data. The next advantage is its efficiency: little effort, few expenses, and small time investment. Only one drop of blood is sufficient for the test and it can be self-administered without the help of a doctor. When sent to the lab, the blood sample can be evaluated within a week for a price of only $89–169.

The most interesting result of a telomere test for LE estimation is the biological age of an individual. As the sample telomere test from our 58-year-old male shows in Figure 52, the biological age is 55. The proposed LE prediction model takes the standard mortality table and subtracts the deviation from the biological age from the chronological age. These results yield an adjusted LE that will be used as a basis for further calculations.

The second brick of the model, complementing the medical data with a psychological profile, leverages the advantages of big data. Good examples are DIG and Apply Magic Sauce. The two-factor LE analysis model combines the developed form of both approaches, meaning that it will include data from third parties-including data on social media-on all categories that influence psychological well-being.

In this manner, detailed lifestyle patterns and changes during life can be analyzed. Additionally, psychological patterns can be detected.

The algorithm in the model uses correlations between the different psychological factors to predict a customized quantifier superior to the mortality multiplier from traditional LE reports. This quantifier reflects the individual behavior and lifestyle, which, in combination with the result of the physiological analysis, significantly improves longevity prediction.

Figure 53 depicts the composition of the twofactor LE analysis model with a telomere test as a medical basis and a big data approach to filter the psychological factors to longevity.

5 Conclusion

This article aims to provide insight into the status quo of life expectancy underwriting, and underscores the urgency of improving this state. The far-reaching risks of longevity and consequences of related uncertainty caused by inaccurate life expectancy predictions are threats that individuals as well as businesses such as insurance companies are facing. The advent of the Internet, accompanied by the increasingly sophisticated techniques in big data processing, creates the opportunity for disruptive change and developments in the field of predictive analytics.

This article addresses the problem of life expectancy prediction, first by analyzing a sample portfolio in the life settlement market and underlining the importance of improving LE estimation. The stress test of the sample portfolio from Life Bond Management GmbH shows how important it is to have precise life expectancy estimates to reach the targeted return rates.

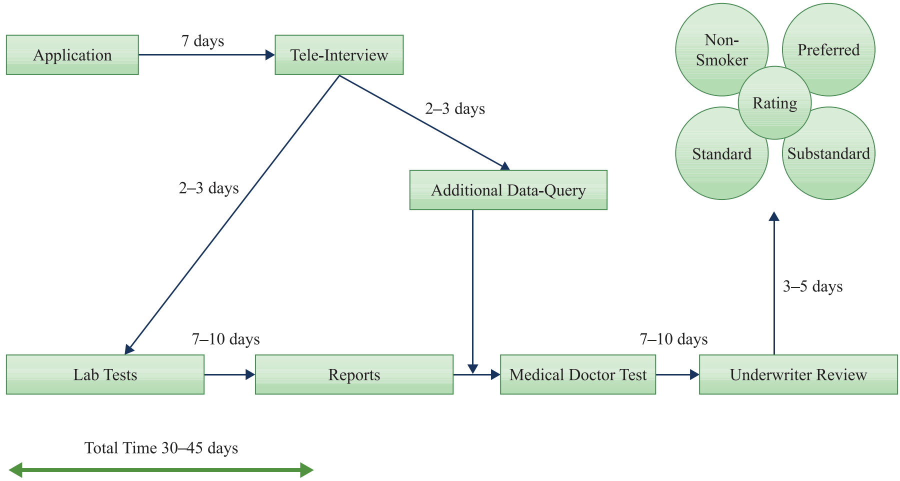
We furthermore provide insight into the use of big data for LE predictions, and discusses both advantages and disadvantages of this usage. Combining advances in information and communication technology with innovation in medical science, we develop a model that is able to overcome shortcomings of traditional LE reports, such as the issues of falsification and inaccuracy as well as low productivity. To do so, it connects the use of biological data with the use of big data, which leads to the suggestive conceptual model, which exploits all advantages of the assessed methods.

6 Limitations

Integrating big data and medical advancement in longevity forecast is gaining increased interest by the theoretical as well as the practical world. The pertinent literature is slowly growing in volume, yet remains sparse. Since the intention of this article is the provision of an overview and understanding of the matter, no empirical research has been conducted to demonstrate the superiority of the new methodology developed in this article. An endeavor to seek empirical proof may either provide support for the reported findings or uncover new aspects to the model.

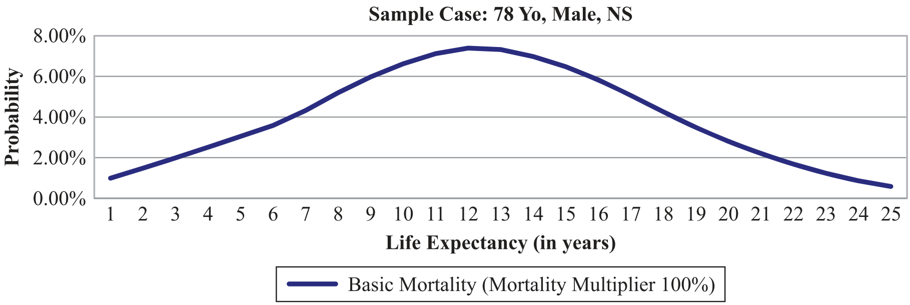
Furthermore, it should be emphasized that big data in the medical field as well as psychological data on EU citizens is not publicly available because of strict EUregulated privacy protection. This article focuses on how big data can be beneficially used for the creation of LE reports, but does not cover questionable ethical topics such as how it can be used for manipulative purposes by the "owners" of big data — big corporations and even politicians.

Figure 39: Typical LE report process



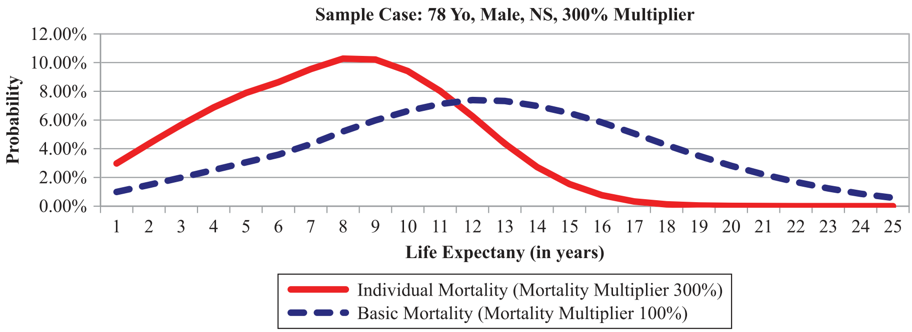
Note: Authors' own illustration.

Figure 40: Basic mortality sample



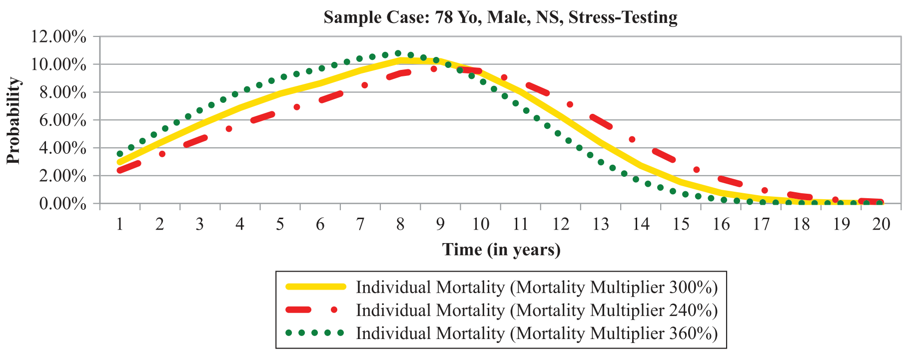
Note: Authors' illustration on Life Bond data.

Figure 41: Basic vs. individual mortality sample



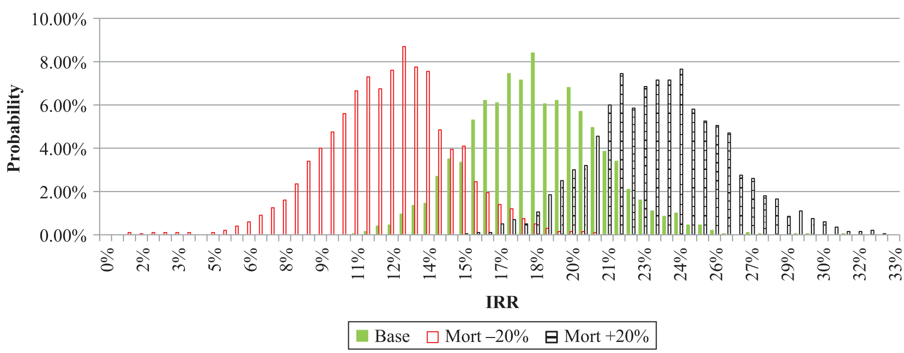
Note: Authors' illustration on Life Bond data.

Figure 42: Stress-testing sample



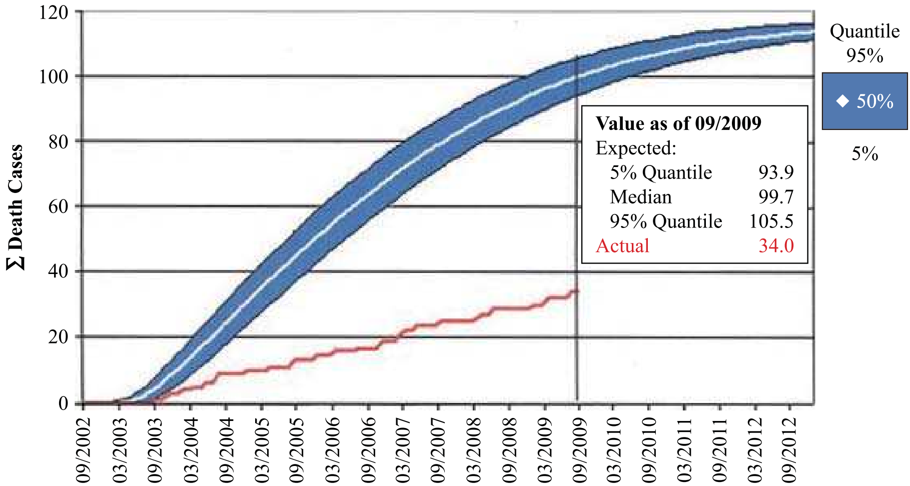
Note: Authors' illustration on Life Bond data.

Figure 43: Portfolio IRR — stress-testing



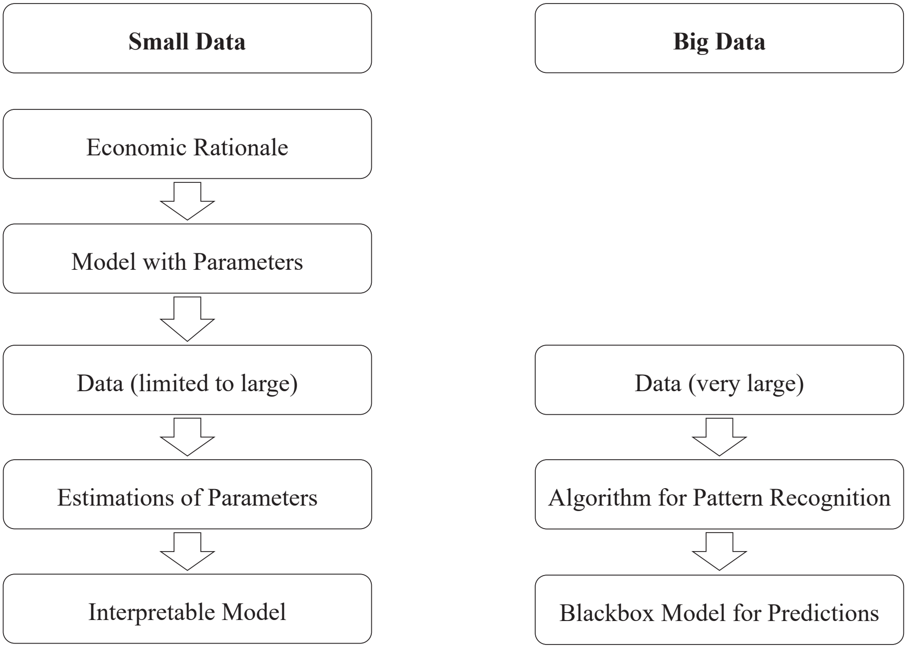
Note: Authors' illustration on Life Bond data.

Figure 44: Expected vs. actual mortalities



Note: Authors' illustration on Life Bond data.

Figure 45: Small data vs. big data procedure

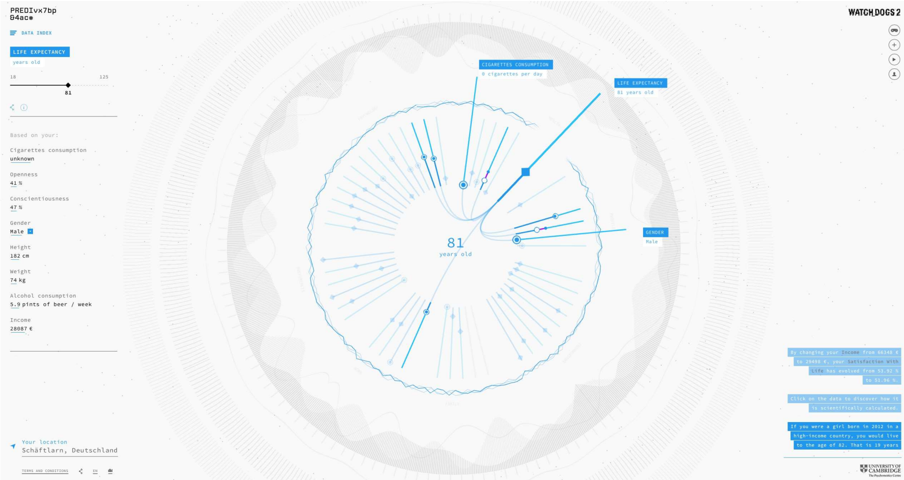


Note: Authors' illustration based on Kitchin (2014).

Figure 46: Big data visualization

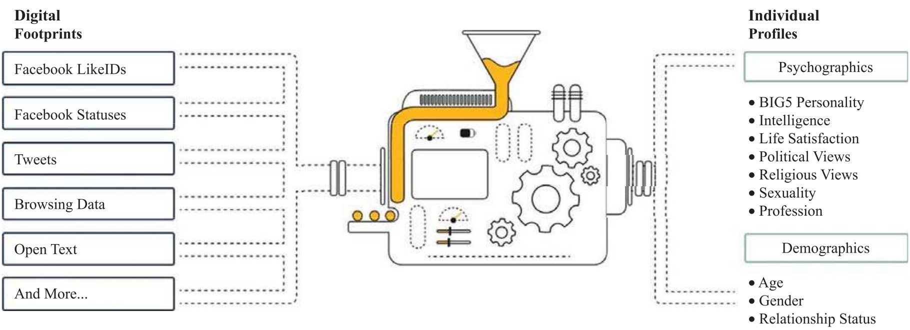
Source: Deloitte Consulting LLP (2016).

Figure 47: Predictive World: user interface



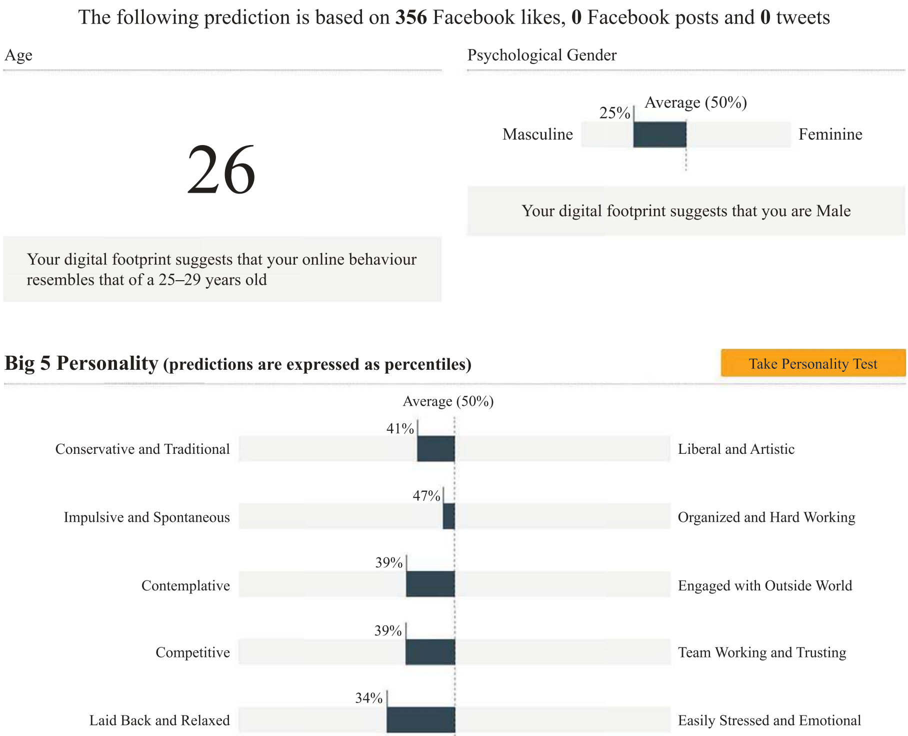
Note: Screenshot of user interface after entering basic personal information on Predictive World website https://predictiveworld.watchdogs.com/en.

Figure 48: Apply Magic Sauce algorithm



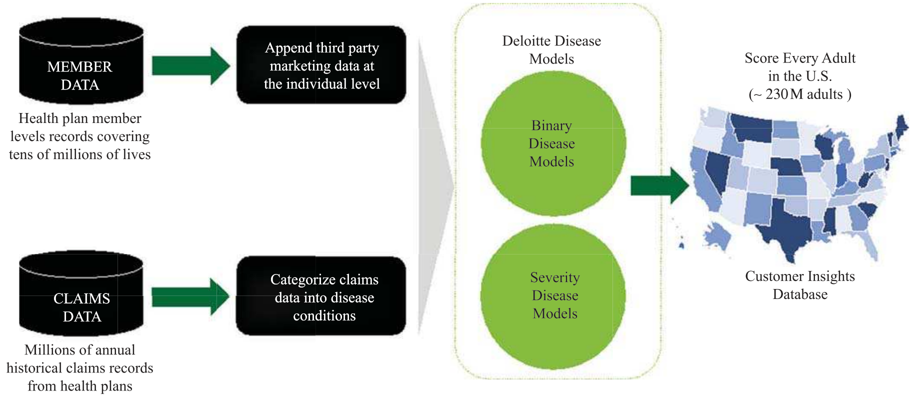
Source: https://applymagicsauce.com/about_us.html.

Figure 49: Example: an individual's profile generated by the Apply Magic Sauce algorithm



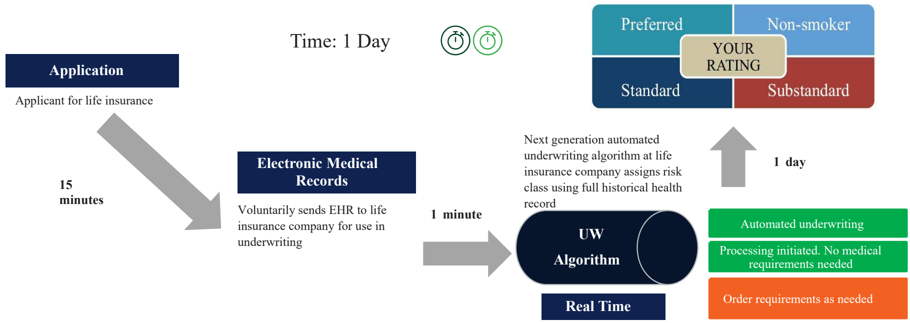
Note: Screenshot of user interface after entering basic personal information on Apply Magic Sauce website https://applymagicsauce.com/.

Figure 50: Deloitte Disease Models



Source: Deloitte Consulting LLP (2016).

Figure 51: Deloitte Enhanced Underwriting



Source: Deloitte Consulting LLP (2016).

Figure 52: Screenshot of a telomere testing report from Titanovo

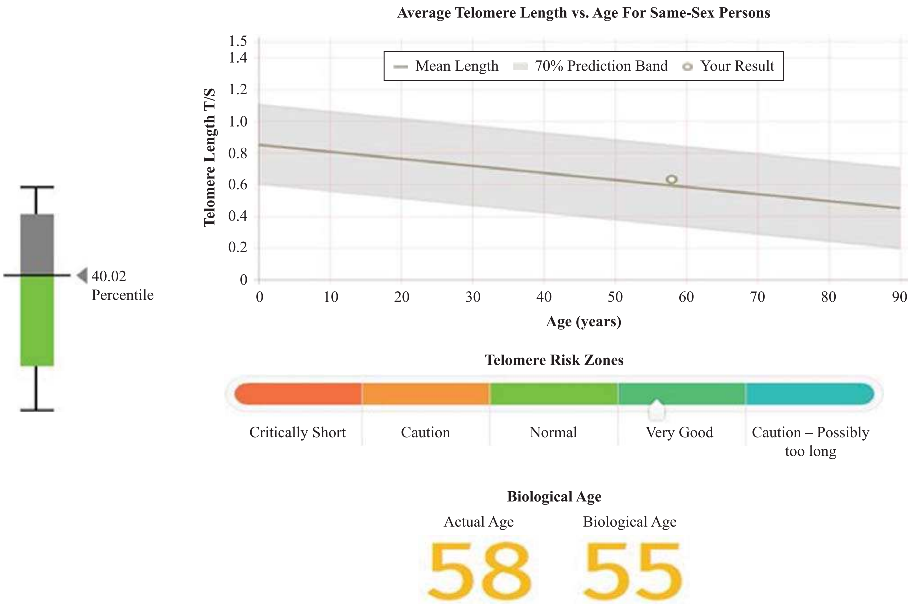
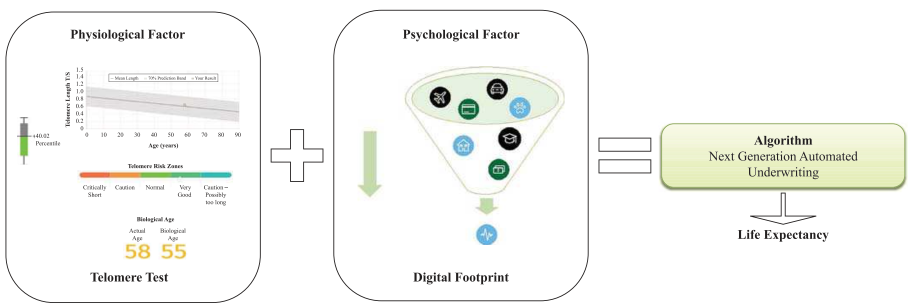


Figure 53: Two-factor LE analysis



Part VI

Ashar Group: Brokers and Co-opetition in the Life Settlement Industry

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Abstract

Connecting life insurance policyholders with potential investors (called Life Settlement Providers), Ashar Group plays a pivotal role in the industry. Its current position is however increasingly being challenged by consumer-direct models, led by major providers seeking to shortcut brokers. Ashar faces a strategic dilemma in cooperating — but also competing — with these providers. Maintaining a mutually beneficial dynamic with policyholders, downstream intermediaries and other actors thus constitutes a balancing act. The context of this case is an underdeveloped market whose reputation has suffered from broker misconduct. In light of the market's legacy issues and competing business models, this case study explores strategies Ashar may pursue to secure and enhance its market position. Discussions emerging from this case study have the potential to illuminate directions for market transformation.

Professors Alexander Braun (University of St. Gallen), Lauren H. Cohen, Christopher J. Malloy and Doctoral Student Jiahua Xu (University of St. Gallen) prepared this case. It was reviewed and approved before publication by a company designate. Funding for the development of this case was provided by Harvard Business School and not by the company.

Case Study

Back from a two-day business trip to the northeast for meetings with clients, Jason T. Mendelsohn was lying on his couch at home in Maitland, Florida watching CNN, and the only thing on his agenda for the evening was to relax. For most people, a commercial featuring a senior couple would not put them on high alert, but not so for Jason, the co-founder and President of Ashar Group LLC ("Ashar"), a leading U.S. life settlement brokerage firm.

(voiceover) "Do you have a life insurance policy you no longer need or can't afford? Now you can sell that policy for an immediate payment."

Having seen the commercial from Coventry many times, Jason could almost recite the rest of the script:

(couple) "We bought life insurance when our kids were young to protect their future. Our youngest has turned 40. We no longer needed the coverage. That got us thinking about letting our policy go, so I did research. I called Coventry Direct. I learned that you can sell all or part of your life insurance policy, even a term life policy. Turns out, people have been selling policies like ours for the past 15 years. Who knew? We sold our policy. Now we have money to help with the medical bills, and to add to our retirement."

(voiceover) "If you have $100,000 or more of life insurance, you may be a candidate to sell your policy."

With Coventry First LLC ("Coventry"), a leading U.S. life settlement provider, Jason had a complicated relationship: on the one hand, he appreciated that Coventry bought many life policies through his firm Ashar; on the other hand, Coventry's consumer-direct campaign that attempted to eliminate brokers and financial advisors from the transaction process made him understandably frustrated and uncomfortable.

After a few minutes of pacing back and forth, Jason turned off the TV. Exhausted, he decided to go to bed early as the next day he had to drive to Clearwater, where LISA (the Life Insurance Settlement Association) was to hold its Annual Life Settlement and Compliance Conference.

1 The Life Settlement Market

The life settlement market is the secondary market for life insurance, where policyholders sell their unwanted or unneeded life insurance policy to investors. Although all types of policies could be purchased, the overwhelming majority of life settlements are a policy type known as universal life, which is permanent insurance[83] that has an explicit cash savings account built into the policy. Through a life settlement, a policyholder transfers the policy ownership to a buyer and receives monetary compensation that is greater than the policy's cash surrender value. Upon the closing of the deal, the buyer assumes the responsibility for paying the insurance premiums until the earliest of 1) the insured's death, 2) the termination of coverage, and 3) the resale of the policy to another buyer.[84]

The life settlement market originally focused on viaticals, or policies from insureds with terminal illnesses and a life expectancy (LE) below 24 months. More recently, the market also included policies from senior insureds with relatively mild health impairments. Both terminally ill and senior insureds had one characteristic in common that were attractive to investors: a relatively short LE.[85] Ceteris paribus, a shorter LE translated to fewer premium payments before death claim, hence a higher return for the investor.

Firms that specialized in evaluating insureds' LEs were known as medical underwriters. ITM TwentyFirst, AVS LLC, Fasano Associates, Longevity Services Inc, and Predictive Resources were among the major medical underwriters in the life settlement industry, and all employed some version of the debit-credit approach. An insured's relative mortality was "debited" in the case of a negative health record (an illness, a family disease history, a smoking habit, need for assistance with activities of daily living, etc.) and was "credited" in the case of a positive one (athletic exercise, standard BMI, etc.). The applied mortality factor was the determinant of the insured's mortality curve, from which the LE was derived.

Investors typically valued a policy using a variation of the following actuarial formula:

$$P = -\pi_0 + \sum_{i=i}^{T} \frac{({}_{i-1}p_x - {}_{i}p_x) \cdot F - {}_{i}p_x \cdot \pi_i}{(1+r)^i}$$

P: purchase price.

T: policy maturity.

F: face value.

π_i: premium to be paid at time i.

r: internal rate of return, also known as discount rate.

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83 See Table 17 for brief explanations of major life insurance types.

84 See "Seeking Alpha in the Afterlife: CMG Life Services and the Life Settlement Industry." Harvard Business School Teaching Note 214-014, August 2013, for a description of the investor-side of this market, and "An Introduction to Life Settlements." Harvard Business School Background Note, for an overview of the entire industry and asset-class.

85 The estimated life expectancy of a senior insured for life settlement was ideally less than fifteen years (Table 18).

${}_ip_x$: the probability that an insured, aged x at time 0, will be alive at time i; the probability that the insured will die between time $i-1$ and i can thus be expressed as $({}_{i-1}p_x - {}_ip_x)$; the insured's life expectancy can thus be expressed as $\sum_{i=1}^{\infty} {}_ip_x$.

The life settlement supply chain was intermediated. In particular, aside from original policyholders (ultimate sellers) and the end investors (ultimate buyers), life settlements also commonly involved sell-side intermediaries such as financial advisors and life settlement brokers, and buy-side intermediaries such as life settlement providers and fund managers (Figure 54). Due to the inherent complexity in completing a transaction, both policyholders and investors tended to engage professionals to represent them in the negotiation. Life settlement brokers had a fiduciary duty to policyholders, which required them to assist policyholders in securing a fair market value when selling their policy. Life settlement providers, on the other hand, represented investors' interest. Providers strategically regulated themselves into the transaction process and were instrumental in shaping state regulation. To this end, most states stipulated that a life settlement transaction must involve a licensed provider, while other intermediaries such as brokers were not compulsory. Over the last decade, the combined face value of lapsed and surrendered life insurance in the U.S. amounted to over two trillion dollars each year.[86] Only a tiny portion of unwanted life policies were disposed of through resale into the life settlement market. Even 2007, the heyday of life settlements, witnessed merely $60 billion of total face value transacted (Figure 55).

2 Ashar and the Life Settlement Brokerage Business

2.1 Business development and operations

As a nationally licensed life settlement broker, Ashar[87] helped financial advisors appraise, negotiate and monetize their client's life insurance and annuity assets. The firm fulfilled its fiduciary duties to policy sellers by driving competition between a carefully vetted group of institutional buyers, sometimes delegated by life settlement providers, to negotiate the best price for a policy.[88] The firm brokered all types of life insurance policies: mostly universal life (including indexed universal life, guaranteed universal life), term life, and occasionally whole life policies.

Ashar was remunerated for assisting clients in successfully selling their life insurance policy: Ashar and the advisory team they collaborated with would earn a lump-sum success fee analogous to a contingency fee with an attorney. This fee equaled the lesser of 33% of the value created (the dollars negotiated exceeding the surrender value) and 8% of the face value, and was split between advisors and Ashar. This fee structure,

[86]The U.S. Life industry Briefing book, SNL financial (S&P Global Market Intelligence).
[87]See Appendix for a short bio of Ashar.
[88]Ashar Group LinkedIn profile, https://www.linkedin.com/company/3791334/, accessed May 2018.

also quoted in several articles,[89] appeared to be a market standard. Similar to a closing statement in a real estate transaction, all fees and costs were itemized and disclosed to clients.[90]

In comparison to other financial market brokers, Ashar's fee struck as substantial at first blush. For instance, the standard one-sided real estate brokerage fee was 6%,[91] and a stock brokerage fee was typically no more than 1%.[92] However, fees for different asset classes may not be directly comparable. Generally speaking, the more liquid and homogeneous an asset class, the lower the fee. Life settlements were relatively illiquid and heterogeneous, thus usually handled on a case-by-case basis. It was common practice for brokers to complete many iterations of policy pricing, underwriting, and negotiations with providers during the settlement process, in addition to managing all stages of the contracting and compliance process for the related advisors. A client would not be billed along the way for the months of work taking place; brokers had to bear all associated costs whether or not the policy transaction occurred in the end. Due to the contingency-based nature, life settlement brokerage fees earned on successful transactions had to absorb costs incurred on the unsuccessful ones.

Although Ashar received numerous inquiries from policyholders and their advisors each day, most of the policies Ashar received for review did not qualify for secondary sale, typically due to an insufficient intrinsic policy value. Life expectancy was the key driver in policy valuation. Instead of relying solely on the life expectancy estimation service offered by external medical underwriters as some other brokers did, Ashar conducted surveys and did its own in-house medical underwriting to pre-screen for eligibility. This was also embedded into Ashar's proprietary secondary market valuation (SMV) system (Figure 56).

After the first round of pre-screening, 70%-80% of policies were disqualified and 20-30% were followed-up on. After formal underwriting and risk evaluation,[93] only half of those remaining policies made it to closing.[94] A life settlement transaction typically took Ashar 2 to 4 months, depending on the complexity of the policy and the number of advisors working together. For instance, it was usually more complex to

[89] Viatical.org and Ovid Corp quoted 30% of the settlement value ("The Life Settlement Market & Buyers - Navigating the Life Settlement Market", https://viatical.org/blog/life-settlement-market/, accessed January 2018; "Life Settlement Companies", https://www.ovidlife.com/definitive-guide-to-life-settlements/companies, accessed January 2018); Daily (2006) and Matt Brady (2007) quoted 6% of the face value and up to 40% of the gross offer ("What is a reasonable broker's commission?" http://www.glenndaily.com/wmpwrb5a.htm, accessed January 2018; "How Much Do Agents Make On Settlements? It Depends." http://www.thinkadvisor.com/2007/09/09/how-much-do-agents-make-on-settlements-it-depends, accessed January 2018).

[90] Ashar Group, "Ashar - Inquiry Packet," August 6, 2013, http://ashargroup.com/wp-content/uploads/2013/08/Ashar-Inquiry-Packet.UNI_.pdf, accessed May 2018.

[91] Robyn A. Friedman, "How to Sell Your Home Without a Real-Estate Agent," The Wall Street Journal, March 21, 2018, https://www.wsj.com/articles/how-to-sell-your-home-without-a-real-estate-agent-1521640801, accessed May 2018.

[92] "Find the Right Broker – The Directory," Forbes, https://www.forbes.com/brokers/, accessed May 2018.

[93] E.g. extension risk, carrier credit risk.

[94] This was based on conversations with Jon Mendelsohn.

broker a key-person policy than an ordinary individual policy. A key-person policy was purchased and owned by the employer, who was also the beneficiary of the policy. To value this type of policy, Ashar needed to additionally review trust documents and corporate filings.

2.2 Image and reputation

Life settlement brokers had not always enjoyed a pristine reputation, largely due to the actions of a few bad actors among them. In 2006, TV celebrity Larry King filed a complaint against a broker called The Meltzer Group ("Meltzer") for breach of fiduciary duty. Meltzer advised and represented King to sell a $5 million policy for $850,000 to Coventry First LLC. King claimed that Meltzer did not analyze whether keeping the policy was a better option, nor did they obtain competing market bids for the policy. The policy was allegedly not sold for its fair market value, and estimated to be worth at least double the amount for which it was sold. In addition, King was not informed that Coventry was the purchaser, who at the time bore a questionable reputation for allegedly paying kickbacks to brokers.[95]

To this end, in 2007, Coventry was sued by the New York Attorney General for conducting anti-competitive schemes in concert with brokers. AllSettled, a New York-based life settlement broker, was named in the lawsuit for conspiring to bid-rig with Coventry.[96] The CEO of AllSettled, Michael Krasnerman, owned another life settlement brokerage firm MK Associates. In a 2011 lawsuit Michael Krasnerman and MK Associates were charged for civil conspiracy, unjust enrichment and imposition of constructive trust and/or disgorgement. Together with other agencies and brokers, Krasnerman was accused of inducing life insurance policy purchases "by fraudulent means and by means of duress," and unjustly receiving commissions.[97]

Moreover, in 2013, the Oklahoma Department of Securities issued a cease-and-desist order to Novers Financial for selling life settlement investments in the state, as an unregistered broker-dealer.[98] In the complaint against the firm issued by the SEC in 2015, the firm was alleged to have provided life settlement investors misleading information.[99]

[95] Larry King et al. v. Alan Meltzer et al., No. CV 07-06813 (2006), see http://www.thesmokinggun.com/file/larry-king-rooked-life-insurance-scam, accessed January 2018.
[96] People v. Coventry First LLC, 2007 NY Slip Op 33089(U) (2007), see https://scholar.google.com/scholar_case?case=10537115010745550920, accessed January 2018.
[97] Dinero Corp. v. Austin Crude Holding Company, LLC, No. 09-CV-1014-MV/KBM (2011), see https://www.leagle.com/decision/infdco20110401g18, accessed January 2018.
[98] State of Oklahoma, Department of Securities, "Notice of Service on the Administrator and Affidavit of Compliance," Sep 17, 2013, http://www.securities.ok.gov/Enforcement/Orders/PDF/CeaseAndDesist-NotOppForHearing_NoversFinancial_13-079.pdf, accessed May 2018.
[99] SEC v. Novinger, No. 4:15-cv-00358-O (2015), see https://www.sec.gov/litigation/complaints/2015/comp-pr2015-85.pdf, accessed January 2018.

Given this backdrop, Ashar went to great lengths to protect and enhance its image. Over the years, the market had developed disclosure norms. As a result, many opportunistic brokers who took chances doing unethical deals in the past had been forced out of the market, although some industry players still existed from the former, less regulated period.[100] Ashar did still occasionally encounter bidders (life settlement providers) who offered remuneration in return for a deal "swinging their way," and made a point to turn those bidders down.

The Mendelsohns frequently published journal articles about leading practices,[101] and their firm had been covered by mainstream media such as Forbes[102] and Yahoo Finance.[103] Positive coverage brought Ashar immediate business, while raising awareness of life settlements and advocating collaboration with brokers. Aside from their clients, Ashar also made an effort to foster relationships with insurance carriers, broker dealers, trust companies, banks, attorneys and CPAs.

3 The Broker Channel and Dynamics with Other Market Players

3.1 Consumer-direct channel

Due to the high transaction fee and maintenance cost of policies, the life settlement market tended to favor affluent senior insureds who possessed large face value, typically multi-million-dollar, life insurance policies, preferably with some degree of health impairment (health that had declined since the policy was issued, hence a shortened life expectancy). Those seniors tended to rely on their trusted personal financial advisors when they wished to discard a life policy. Unfortunately, many of those financial advisors would let the policyholders lapse or surrender their policies, possibly because they were not specialized in life settlements and/or prohibited to disclose the life settlement option by insurance carriers.

The presence of the life settlement market was not widely known. Even if introduced to the business by consumer-direct marketers (like Coventry's television ad), potential policy sellers were still usually unaware of brokers. If a policyholder surrendered a

[100] This was based on conversations with Jason Mendelsohn.

[101] E.g. Jon B. Mendelsohn et al. (2014), Complexities of Life Insurance Policy Valuation, Estate Planning; Jon B. Mendelsohn (2016), Rethinking Life Insurance Valuation For Seniors, Trusts & Estates; Jamie L. Mendelsohn (2017), Longevity Throws a Wild Card in Even the Best-Laid Plans, Estate Planning.

[102] Shama Hyder, "Advice from the C-Suite: What Top Executives are Focused on in 2016," Forbes, March 16, 2016, https://www.forbes.com/sites/shamahyder/2016/03/16/advice-from-the-c-suite-what-top-executives-are-focused-on-in- 2016/, accessed May 2018.

[103] "Ashar Group Announces the First Life Settlement Policy Value App at the Heckerling Institute and AICPA Conferences," Yahoo Finance, January 27, 2015, https://finance.yahoo.com/news/ashar-group-announces-first-life-130700751.html, accessed May 2018.

policy, he or she only received a surrender value from the insurance carrier: an amount equal to the policy's cash account value less the surrender penalty. Since policy buyers always offered a price greater than the prevailing surrender value, selling through consumer-direct was a preferable option to surrendering from a purely economic perspective. Therefore, in theory, policyholders would be happy to accept a deal, not mindful of other, potentially better, selling opportunities.

Jason believed that through the consumer-direct model, policyholders normally received significantly less than through a broker, even net of broker fees: a policy worth $200,000 might sell for only $20,000 via consumer-direct. This was due to the industrial organization and incentives of life settlements: the consumer-direct channel was mostly operated by life settlement providers such as Coventry, who were agents and fiduciaries of investors. The buy-side of the deal looked for a bargain and had an incentive to achieve the lowest policy price, so as to generate the best rate of return on their capital. Brokers, on the other hand, were fiduciaries of policy sellers and were obligated to negotiate the best price for the sellers.

3.2 Ashar's advantage

By approaching providers directly, policyholders wittingly or unwittingly bypassed brokers and financial advisors, saving the broker fee. However, under this "go-it-alone" strategy, they had no informed advocate to ensure that they achieved a fair market value for their policy. Consequently, they may not have received the most competitive price.

Ashar attempted to rectify this by always trying to get their policyholders the highest values possible for their policies. In the life settlement space, this equated with eliciting lower life expectancy (LE) estimates for the policyholder (as the policy would then pay out sooner, with fewer premium payments — in expectation — to the investor who took the policy over). To this end, nearly all investors demanded LE certificates from independent, third-party medical underwriters; and in most cases, certificates from at least two different underwriters were required. With years of experience reviewing LE certificates from medical underwriters, Ashar knew which underwriter would potentially issue the lowest LE, based on the insured's demographic and health traits and could use this to the policyholder's advantage. For instance, ITM TwentyFirst debited dementia most heavily, so Ashar might order an LE certificate from ITM TwentyFirst when the insured had markers for dementia. In addition, Ashar analyzed the insured's medical documents to make sure that all health conditions were sufficiently debited. Ashar believed that this deep expertise and knowledge represented one aspect of their comparative advantage in which they could immediately deliver large value to policyholders.

While Ashar facilitated selling policies, it also created value by providing insight to advisors and consumers based on its analysis. Ashar understood that a policy that an investor found valuable might also be worth retaining in the policyholder's estate. On account of that, when appropriate, Ashar shared with advisors and their clients that they should consider the option of maintaining the policy.

Ashar took measures to expedite transactions. With their medical expertise and policy valuation experience, Ashar was able to set a plausible target price (Table 19). Ashar quickly identified qualified buyers, and by doing so policy sellers had more certainty that the deal would be closed in a timely fashion. Furthermore, with an accelerated negotiation phase, policyholders incurred fewer out-of-pocket premiums.

3.3 Direct competitors in the broker space

There were other active brokers in the life settlement market that competed directly with Ashar and — in a bid for more market share and control over the transaction — were becoming increasingly focused on consumer-direct marketing. While also attempting to attract business directly from policyholders (Figure 57), Ashar differentiated from other brokers by operating at the enterprise level and primarily counted financial advisors as its clients.

Ashar believed that dealing with financial advisors was more efficient and less risky. Since the ideal life settlement clients were senior, less healthy policyholders (Table 18), it was necessary for them to have someone they trusted making informed decisions in their best interest. Ashar believed that the best candidate for this job was the policyholders' financial advisor, who communicated with them on a regular basis and had the expertise to comprehend the life settlement niche. In addition, one financial advisor usually represented multiple clients and also shared some of the legal risk. Indeed, although Ashar had been mentioned in several life settlement legal cases,[104] the firm was never deemed liable in any.

Another competitive advantage was the manner in which Ashar was designed (Figure 58). Most brokers deployed the majority of their staff in sales, and the minority in back office and administrative affairs. Ashar did the opposite: 90% of Ashar employees performed market research and built cases. Their pricing team did not just implement a simple math formula, but also took historical market level and up-to-date market data (comparables) into account, performing their own analytics.

[104] E.g. Goldstein v. Berkowitz, Civil Action No. 10-4644 (FLW) (2011), https://www.leagle.com/decision/infdco20110321718, accessed January 2018; Melville Capital, LLC v. Tennessee Commerce Bank, Case No. 3:11-cv-00888 (2011), https://www.leagle.com/decision/infdco20111230a54, accessed January 2018; Life Share Collateral Holdings, LLC v. Albers, Civil No. 11-3605 (JNE/JJK) (2013), https://www.leagle.com/decision/infdco20130703a98, accessed January 2018.

4 Interactions with Life Settlement Providers (Buy-side Intermediary)

At the networking session of the LISA conference in Clearwater, a fund manager pulled Jason aside, saying: “Jason, we love working with Ashar, but you guys are giving us a hard time — you are squeezing every last dollar out of us.” While giving an apologetic smile back, Jason took this complaint as a compliment. Ashar’s job was to maximize the profit for their clients, policyholders who intended to sell their life insurance: the better Ashar carried out its job, the higher offer its client would receive from the buy-side.

Brokers bridged policy sellers and policy buyers (Figure 54). While brokers prioritized their clients’ interest, it was also vital for them to maintain a good relationship with the buy-side. Only when buy- side players (including investors, fund managers and providers) were willing to deal with brokers, could brokers get bids from them. The life settlement market was relatively small, with only a finite number of policy buyers. For each policy, brokers needed to engage as many buyers as possible, to create competition.

However, Ashar doing its job well (as in the “compliment” Jason received above), clearly did not align with buyers’ interests. The more competitive the bidders become, the higher the end purchase price would be.

If Ashar upset enough potential buyers, it would have no bidders willing to do business together, and would cease to exist as a broker. Moreover, if all auctions became too competitive, it might eventually drive more and more buy-side parties to go consumer-direct (like Coventry), completely removing brokers from the intermediation chain.

The broker fee was another factor that providers claimed was making them uneasy to use brokers, especially for those providers who concentrated on small-face policies. Given that the operational and transaction costs for settling each life insurance policy were somewhat fixed (i.e., not connected to the face value of the policy), buyers favored large-face policies because they were more cost-efficient. As the small-face market was getting tapped,[105] buyers had to cut costs to make those policies economically feasible, which often involved bypassing brokers.

5 Growth and Outlook

The consumer-direct campaigns initiated by providers attempted to convince policyholders that they would be better off selling policies directly to providers, without the intermediation from brokers. Disintermediation had also been advocated by researchers

[105] Horowitz (2017), Market Volume Grows 47% Last Year As Small-Face Policies Gain Traction.

who believed that the current high intermediation costs could retard market growth.[106] Jason believed this to be a misconception as the value-add of brokers to policyholders often dwarfed the broker fees. Jason believed some providers, though not all, had directed industry critique on broker fees, rather than considering consumer interests. Moreover, he believed that the research that had been completed to-date came from the perspective of those providers, and focused on broker fees so to take the attention away from the fact that consumers selling direct to buyers would receive significantly less than when selling through a broker.

Not to focus too much on this downside, Jason was facing the complete opposite problem in the short-run. Namely, now that more and more people participated in life settlements (partially owing to Coventry's viral TV commercials) and noticed the benefits of working with brokers, Ashar's business had been constantly growing. Ashar had been experiencing 20% increase of business annually for the past five years, and had recently closed a few hundred-million-dollar face of policy transactions.[107]

Having started as a small family business and 15 years later evolved into a high-growth multi-state organization, Ashar needed to solve how to scale the firm to best manage this growth. While hiring more people seemed an obvious solution, it would be cost-efficient to re-appoint current employees. The leaders of the firm, Jason and his brother Jon, spent much of their time on business trips and relied upon their experienced and valued team to manage the office. It was vital to have someone in the office who had the big picture of the business and was able to lead the team and streamline the operation, in order for employees to cooperate seamlessly.

Jason had long-run hopes for Ashar to be the Zillow in life settlements: to raise awareness, constructing a transparent life policy trading platform that allowed systematic yet customized transactions.

6 Conclusion

The LISA conference turned out to be worth the trip. However, on the ride back, Jason couldn't help reflecting on the issues facing Ashar. In the short run, they were growing quickly, and he needed to manage that in order to ensure a smooth future expansion. Yet any investments he executed also had to take into account long run prospects. What was the future of the life settlement market, and how would the fate of brokers, and of Ashar in particular, fit in?

[106] Warren S. Hersch, "Meet 2 Experts Calling for a Revamp of the Life Settlement Market," ThinkAdvisor, July 13, 2015, http://www.thinkadvisor.com/2015/07/13/meet-2-experts-calling-for-a-revamp-of-the-life-se, accessed May 2018.

[107] This was based on conversations with Jason Mendelsohn.

Appendix

Ashar Bio

Ashar was founded by Jason and his brother Jon B. Mendelsohn in 2003, when the viatical market started to fade and the life settlement market started to mature. Ashar did not participate in viatical settlements, operating exclusively in the life settlement space. For almost 15 years, the firm had remained a family business with Jon as the CEO, Jason as the President, and their sister Jamie L. Mendelsohn as the Executive Vice President.[108] They had a centralized back-office based in Orlando, Florida, with tenured teams in the Greater New York Metro area and Los Angeles, with roughly 25 employees nationwide.[109]

[108] Ashar Group, "Team Leadership - Ashar Group", https://ashargroup.com/who/team-leadership/, accessed May 2018.

[109] This was based on conversations with Jason Mendelsohn.

Table 17: Major life insurance types

Term life	life insurance that provides coverage against level premium for a specified period of time and typically has no surrender value
Permanent life	life insurance that provides coverage until a specific age (usually above 90) and combines a death benefit with a savings portion which can build a cash value
Whole life	a type of permeant life insurance with prescribed premiums
Universal life	a type of permeant life insurance with flexible premiums
Indexed universal life	a type of universal life insurance that allows the owner to allocate cash value amounts to either a fixed account or an equity index account
Guaranteed universal life	a type of universal life where if certain minimum premium payments are made for a given period, the policy remains in force for the guaranteed period, even if the cash value drops to zero

Table 18: Ideal life settlement clients

Policy	**Health**
- Universal life and convertible term	- Insured age 65 or older
- Typically: $100,000 - $5,000,000	- Younger if highly impaired
- Jumbo policies: $5M - $50M	- Policies issued standard or preferred
- Low cash value and low premiums	- Decline in health since issue
- Policy matures at age 100 or beyond	- Life expectancies: < 15 years
Reasons to Exit the Policy	
- No longer able to pay premiums	- Create liquidity
- Policy no longer needed	- Fund long-term care
- Financial security during retirement	- Charity or non-profit

Source: Ashar Group LLC (2017).

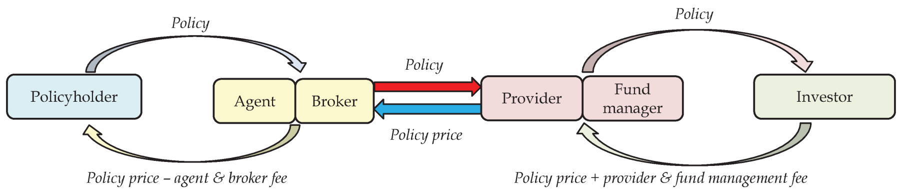
Table 19: Example of bidding process

Offer matrix	Face Value = $4,000,000 Cash Surrender Value = $109,088				
Provider 1	Offer	$411,000			$411,000
Provider 2	Offer	$800,000	$1,100,000	$1,320,000	$1,320,000
Provider 3	Decline				
Provider 4	Offer	$1,000,000	$1,250,000	$1,355,000	$1,355,000
Provider 5	Offer	$850,000	$950,000	$1,025,000	$1,120,000
Provider 6	**Accepted**	**$1,075,000**	**$1,315,000**	**$1,500,000**	**$1,550,000**
Provider 7	Offer	$1,040,000	$1,085,000	$1,100,000	$1,100,000
Provider 8	Offer	$725,000	$890,000	$920,000	$920,000
Provider 9	Offer	$875,000	$900,000	$910,000	$910,000
Provider 10	Decline				
Provider 11	Decline				
Provider 12	Offer	$480,000	$502,500	$502,000	$502,000

Source: Ashar Group LLC (2017).

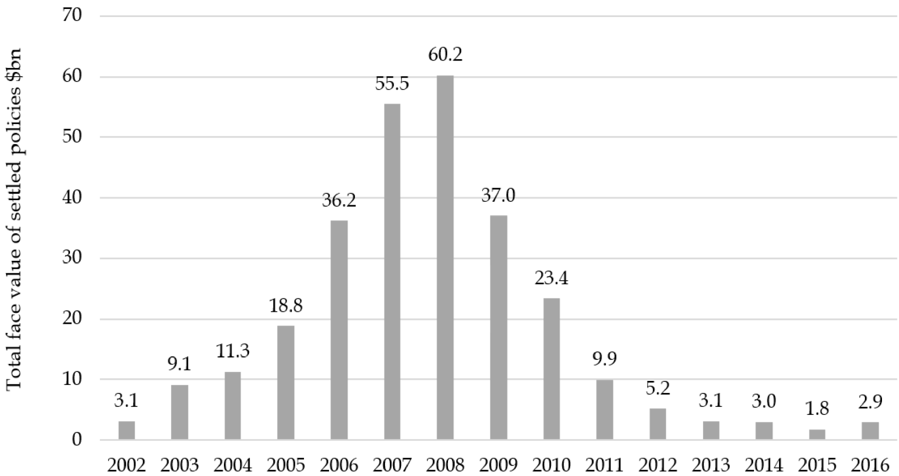
Note: High bids are always shared with providers. However, due to their pricing models, costs of capital, existing portfolio of policies, some providers may not be able to increase or want to offer more than the existing high bid.

Figure 54: Simplified life settlement process



Source: Ashar Group LLC (2017).

Figure 55: Secondary market volume of life settlements



Source: Roland (2016). Life Settlement Tertiary Market Dynamics. Fasano 13th Annual Longevity Conference, Washington.

Figure 56: Ashar's Secondary Market Valuation (SMV)

Source: Ashar Group LLC (2017), see https://ashargroup.com/how/the-smv/, accessed January 2018.

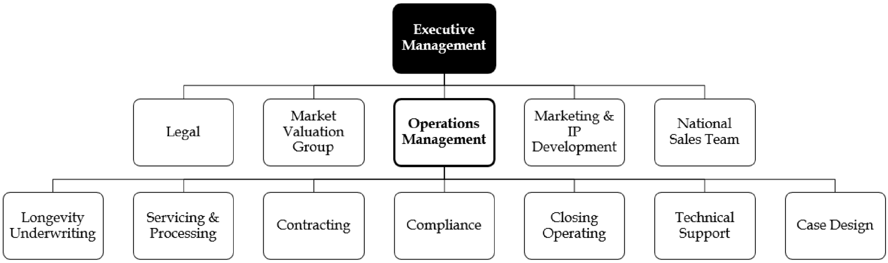
Figure 57: Ashar's internet ad

Questions of Ashar's policy value quiz:

1. What is the AGE and GENDER of the policyholder?
2. What is the MEDICAL CONDITION of the policyholder?
3. What was the SMOKING STATUS of the policy at issue?
4. What is the POLICY TYPE?
5. What is the CURRENT CASH SURRENDER VALUE?
6. What are the OUTSTANDING LOANS on the Policy?
7. What are the CURRENT PREMIUMS of the Life Insurance Policy?

Source: https://ashargroup.com/quiz, accessed January 2018.

Figure 58: Ashar org chart



Source: Ashar Group LLC (2017).

Teaching Note

1 Case Synopsis

Jason T. Mendelsohn, President of Ashar Group LLC ("Ashar"), was concerned about the rampant consumer-direct scheme led by major life settlements provider Coventry First LLC ("Coventry"). As a life settlement broker, Ashar's fiduciary duty involved soliciting competing bids from interested buyers, e.g. life settlement providers and their investors, and obtaining the best price for policyholders who wish to sell their life insurance policies. Upon the closing of a deal, the policyholder was charged a brokerage fee connected to the face and surrender value of the policy, as well as the final transaction price. Some of Ashar's downstream partners, such as Coventry, were attempting to gain business through the consumer-direct avenue, which excluded brokers from the transaction process. Jason believed brokers played an indispensable role in a life settlement transaction by assisting policyholders in realizing the fair market value of their policies; whereas, through consumer-direct and without an advocate representing them, policyholders were often in a disadvantageous negotiating position and most likely ending up under-selling their policies. Nevertheless, the consumer-direct campaign continued to gain traction.

Aside from losing potential clients to firms conducting consumer-direct marketing, Jason had also received negative feedback from life settlement companies (policy buyers) who complained that working with Ashar was barely profitable. Ashar's dilemma lay in maximizing life settlement value for policy sellers, with the accompanying fees benefiting Anshar, without squeezing policy buyers to the point they would do everything to work around the brokerage platform.

Jason was always conscious about reputational risk. Life settlement brokers suffered a tainted image owing to misconduct from past market players. Ashar, advocating transparency and compliance, was among the surviving brokerage firms. The firm image was enhanced through positive media exposure, and, despite the enduring criticism poured on brokers from other market participants and downstream challengers, had managed to maintain a steady and sturdy revenue increase over the last five years. This growth had opened up new issues for Jason: chiefly among them managing the growth of Ashar which had remained a family business since its establishment.

2 Pedagogical Objectives

The case is appropriate for either an upper level undergraduate course or graduate level courses in Financial Economics, Capital Markets, Entrepreneurship, Service Management, and Insurance Linked Securities. The case can also be used as supplementary material for the HBS industry note *Introduction to Life Settlements* and another HBS case *Seeking Alpha in the Afterlife: CMG Life Services and the Life Settlement Industry*, which features a life settlement provider.

The case is presented from the perspective of the case protagonist Jason Mendelsohn, President of Ashar Group. Students, however, are encouraged to analyze the case from a neutral perspective, distinguishing objective facts from subjective beliefs, and developing their own points of view.

The specific teaching objectives of the case include:

1. To introduce students to the life settlement market: its history and evolution.
2. To give students an understanding how a life settlement is conducted on an operational level.
3. To present students the relationships and dynamics between key power players in the market: policyholders, financial advisors, brokers, providers, fund managers and investors.
4. To engage students in devising contingency-based, strategic moves as different parties in life settlement.
5. To guide students into identifying issues present in today's life settlement market.
6. To inspire students to develop solutions for current issues and explore new business opportunities in the market.

3 Opportunities for Student Analysis

The case discussion will touch on the following points:

1. Ashar's revenue and cost structure.

Ashar's revenue came solely from commissions on life settlements, which was dependent on the face value, cash surrender value, as well as the final settlement price of the policy. To be noted is that Ashar, like most brokers, shared commissions with policyholders' financial advisors, commonly their insurance agents, who brought Ashar the case. The referring advisors' share in the commission fell between 50% and 80%, depending on the negotiation between brokers and advisors.[110]

The cost of initiating a case comprised the internal review cost, referring fee paid to advisors and life expectancy (LE) reports paid to medical underwriters. If the policy was considered to qualify for settlement, there would be additional costs incurred for

[110] Matt Brady, "How Much Do Agents Make On Settlements? It Depends." ThinkAdvisor, September 9, 2007, https://www.thinkadvisor.com/2007/09/09/how-much-do-agents-make-on-settlements-it-depends/, accessed June 2018.

contacting life settlement providers and soliciting bids. Under the existing fee structure, the commission fee could only be charged at deal closing, when the buy side and sell side signed the contract.

2. Ashar's fee structure.

The fee formula could be expressed as:

$$\min(33\%(P - CS), 8\%F)$$

where P, CS, and F stands for price offered by the buyer, stands for price offered by the buyer, cash surrender value and face value of the policy, respectively. For example, selling a \$500,000-face policy with \$3,000 surrender value for \$125,000 incurs a total fee of \$40,000, which equals the minimum of $\$(125,000 - 3,000) \cdot 33\%$ and $\$500,000 \cdot 8\%$.

By relating the fee positively to the transaction price, Ashar showed incentive alignment with the policyholders, both of whom benefitted from higher offers. The structure was, however, imperfect in that it did not reflect the cost of the brokerage service. This entails two aspects: a) The fee was a function of the policy's face, cash surrender, and the final settlement price. The value of those variables depended primarily on the intrinsic characteristics of the policy and the insured, and had not much to do with the service cost. b) The fee was contingency-based, which means cost incurred in unsuccessful cases had to be absorbed through successful cases. This implies that policyholders who had their policies settled were overpaying for the service, and the higher Ashar's attrition rate ("non-success" rate) was, the more distorted the fee structure became. In addition, absent a binding contract with policyholders at any stage of the settlement process, the policyholders had no obligation to stick with the process. The later a policyholder walked away from the deal, the more service cost incurred had to be absorbed elsewhere.

With the aid of the calculation exercise (TN Exhibit 1), students will obtain a better understanding of value distribution in life settlement, and how the broker commission is connected to policy features.

3. Ashar's handling of information.

Ashar's commission income for each case largely depended on the settlement value. The commission scheme was beneficial for the policyholder involved in the transaction, because Ashar was incentivized to obtain the highest price possible for the policy. Given the zero-sum proposition, this incentive, if overly dominant, could be damaging to the other side of the deal, the policy buyers.

Laudably, Ashar advocated transparency with clients, but as a sell-side intermediary, Ashar might not necessarily have the legal obligation to share all the pertinent information with the buy side. The instructor may ask students to imagine two scenarios, both in which Ashar detected unreported evidence which would influence an insured's LE estimate. In scenario one, the evidence demonstrated health impairment (as described in the case), while in scenario two, the evidence showed health improvement, for example, the insured was recently cured of a disease. Conceivably, Ashar only had the motivation to report the evidence they discovered in scenario one but not in two, because a lower LE would increase the settlement value while a higher one would do the opposite. In addition, Ashar's control of the information flow could skew policy value to the higher end. In fact, they maintained that they accelerated the process to prevent a potential unfavorable (long) LE from being circulated before the deal was closed, but stalled the process if a favorable (short) LE was yet to come. With their experience and expertise in life settlement, they cherry-picked underwriters who tended to issue the lowest LE estimates for a specific case, and deliberately prevented underwriters, who would potentially issue a higher estimate, from having their opinions heard.

4. The long-term impact of Ashar's way of doing business on buyers' behavior.

Due to the inherent incentive structure, Ashar was not necessarily eliciting a "fair" price for the policy as marketed, a price that would unbiasedly reflect the policy's true intrinsic value. Instead, Ashar was pursuing the highest possible price by taking advantage of information asymmetry, a strategy they called "case design". At first glance, this strategy seemed in line with Ashar's fiduciary duty: to attain as much value as possible for the client. However, it created the winner's curse that would jeopardize the market in the long run, and could eventually backfire.

One can find abundant negative media exposure on the woeful performance of many life settlement investments, including portfolio distresses (e.g. EEA Life Settlements Fund[111]), liquidations (e.g. ARM Life Settlement Fund[112]), write downs (e.g. Assured Fund[113], AIG[114]), foreclosures (e.g. Lifetrade Fund[115]) and bankruptcies (e.g. New Stream Secured Capital[116]). The culprit of the underperformance was the overall LE underestimation, which caused buyers to overpay for policies. It has been empirically demonstrated that life settlement intermediaries made a contribution to the inaccurately short LE due to their incentives.[117]

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[111] David Trinkwon, "EEA Investors' Group Update," October 2, 2017, http://eeainvestors.com/wp-content/uploads/UPDATE-20180316.pdf, accessed June 2018.

[112] William Robins, "ARM life settlement fund appoints liquidators," Citywire, October 15, 2013, http://citywire.co.uk/new-model-adviser/news/arm-life-settlement-fund-appoints-liquidators/a709523, accessed June 2018.

[113] Ruth Emery, "Assured Fund Imposes Exit Restrictions on Investors," Money Observer, May 17, 2011, http://www.moneyobserver.com/news/17-05-2011/assured-fund-imposes-exit-restrictions-investors, accessed June 2018.

[114] Zachary Tracer, "AIG Has $832 Million Cost on Death Bets as Hedge Funds Gain," Bloomberg, February 14, 2014, https://www.bloomberg.com/news/articles/2014-02-14/aig-takes-832-million-charge-on-death-bets-as-hedge-funds-gain, accessed June 2018.

[115] Donna Horowitz, "Wells Fargo Issues Foreclosure Notice Against Lifetrade Fund Sep 2012," The Life Settlements Report, VI(15):8–9, September 6, 2012.

[116] Dan Rivoli, "Creditors Slam Financing Plan in New Stream's Ch. 11," Law360, April 13, 2011, https://www.law360.com/articles/238951/, accessed June 2018.

[117] Xu (2018), Dating Death: An Empirical Comparison of Medical Underwriters in the U.S. Life Settlements

Against this context, buy-side players were becoming increasingly discretionary. Sophisticated buyers were able to tell if a broker is adverse-selecting LEs. Consequently, they either employed their own medical underwriting methodology, or dictated brokers to use specific underwriters, preventing brokers from inflating the price through LE manipulation. Even worse, for brokers, was the historical unprofitability of life settlement investments, as cited by a fund manager in the case, forcing buyers to resort to other, more cost-effective avenues of sourcing policies, e.g. through consumer-direct means. The more losses buyers experienced, the more urgent they felt to exclude brokers from the transaction process, which, as portrayed in the case, was already happening.

Students should note that brokers intermediated between policy buyers and sellers. While their job was to represent sellers' interest, cooperating with institutional buyers was a long-term business and thus they needed to take buyers' interest into account as well. Therefore, any action that over-drained the buy-side for the short-term benefit of the sell-side (and brokers themselves) was myopic and impaired the sustainability of the brokerage business.

5. The long-term impact of Ashar's way of doing business on policyholders' behavior.

Ashar did a great job hunting for the best offer available for its clients. However, the seemingly astronomical commission that Ashar charged might deter some policyholders. Ashar could argue that a) their commission level aligned with industry standard, b) the commission for one transaction did not only cover the cost incurred for that certain case, but also for many other unsuccessful cases where no charges could be levied, and c) even with the broker fee deducted, policyholders usually still stood to gain significantly more than selling without a broker.

Nevertheless, argument a) fails to reason the legitimacy of the current industry standard. Instead, it indicates that the life settlement broker market might be oligopolistic rather than perfectly competitive. Argument b) signifies the unfairness of the existing fee structure and implies that sellers with their policies settled were overpaying. Argument c) does not sufficiently justify that the commission matched the surplus Ashar created: Ashar being able to generate value for the consumer could not legitimize them taking away a significant portion of that value.

Several reasons explained why this current fee structure was still viable. Firstly, as discussed above, the broker market seemed not to be sufficiently competitive. As soon as a new player entered the market with a commission undercutting Ashar's, rational consumers would go for the new entrants. Secondly, consumers were not life settlement professionals, and many of them were not aware that the current market was a sellers' market rather than a buyers' market. As the knowledge in life settlements became more widespread and consumers became savvier, they would understand that they were the ones who owned the asset and they had the upper-hand in negotiation. As a matter

Market.

of fact, the market was witnessing an increasing number of do-it-yourself consumers who shunned the traditional broker channel.[118] In the end, while many consumers would still appreciate Ashar's service, they would have learned about the options of negotiating the commission down and independently soliciting multiple bids from potential buyers. A well-informed and rational seller would only accept a commission, if it would not exceed the opportunity cost incurred were the seller to approach several buyers and negotiate with them directly to reach the same transaction price that Ashar could obtain.

6. The development trajectory of the market.

The life settlement market was still unknown to many, and the potential of the market remained largely untapped. Plus, due to large operating and transaction costs, countless small-face policies, even if they had a positive intrinsic value, were not considered eligible for settlement. Therefore, market transformation into a larger-scale and more efficient form was in order.

As described in the case, disintermediation was gaining ground in the market. While many people from both the sell-side and buy-side stick with Ashar due to inertia, they would be able to make use of market efficiencies in the future and divert a larger share of profit toward themselves, rather than a broker. At the moment, life settlement intermediaries were the biggest beneficiaries in the market. It was quite common that a transaction's intermediary fee exceeded the expected investment gain (TN Exhibit 1 demonstrates such a situation). Since investors were bearing all the risks while still earning less than brokers, this current situation appeared unsustainable in the long term.

The growing competition among sellers caused by the increasing demand in life settlements was pushing the market to a new equilibrium. As digitization and information exchange drove market efficiency and transparency, the future life settlement market was likely to be performed primarily on accessible online platforms in an end-to-end format, which aligned with the rising of the InsurTech sector.

Students are encouraged to compare the life settlement market with other financial markets. They have the freedom to make different market predictions providing reasonable arguments.

7. Ashar's mid- and long-term strategy.

Although consumer-direct marketers were chipping away at some of Ashar's market share, Ashar was still growing, ostensibly due to the overall growth observed in the entire life settlement market. Ashar should carry on informing the populace of the life settlement option to help the market continue growing. To battle for market share against consumer-direct firms, Ashar should raise the awareness of the critical role brokers play in favor of policyholders. Ashar might also need to consider a more

[118] Warren S. Hersch, "Meet 2 Experts Calling for a Revamp of the Life Settlement Market," ThinkAdvisor, July 13, 2015, http://www.thinkadvisor.com/2015/07/13/meet-2-experts-calling-for-a-revamp-of-the-life-se, accessed June 2018.

competitive pricing strategy. The benefit from a lower commission was two-fold: a) attracting more clients; b) raising barriers to entry. Students may suggest a new commission structure, e.g. a flat basic charge + a much-reduced percentage of value created.[119] The first part of the commission corresponds to the operational cost and the second part demonstrates incentive alignment.

A lower commission would require Ashar to be more efficient: due to the commission's contingency-based nature, it must identify more policies worth settling and reduce time and money spent on valueless policies. Ashar's technology-driven strategy enabled a productivity enhancement and made a lower commission structure feasible.

Ashar should continue maintaining good relationships with both their upstream clients and downstream business partners in order to be prepared for a vertical integration.

Students may propose different strategies that address the various risks Ashar is facing, e.g. market risk politic/legal risk, operational risk, liquidity risk, and reputational risk.

4 Suggested Assignment Questions

1. Calculation exercise. (see Spreadsheet Supplement and TN Exhibit 1)
2. What was Ashar's central dilemma?
3. What were the risks involved in Ashar's business?
4. What did success mean for Ashar, and what could Jason do to make Ashar more successful?
5. Going consumer-direct was becoming increasingly trendy in the industry as a cost saving measure. Should Ashar follow the trend or would time honor Ashar's current strategy of collocating with advisors?
6. How could Ashar further increase its profit? Specifically, what should the firm do to gain more market share and how could it attract more bidders and higher bids for a policy?
7. Profit maximizing aside, how was Ashar going to manage its growth?
8. If you were a policyholder/provider/investor, do you want to involve a broker in a transaction? Why and why not?
9. What would make the life settlement market flourish and what would make it fail?

[119] Value created refers to the dollar difference between life settlement value and cash surrender value.

5 Wrap up

The case looks at the life settlement market through the lens of a broker. By studying the case, students will gain insight into how life settlement works, roles of various principal players in the market and the dynamic between them. Students should be able to recognize not only the issues facing the brokerage firm Ashar, but also consider challenges such as inefficiencies and asymmetry of information facing the whole market at the present. Students are expected to identify the cause of the issues and propose potential avenues to solve them.

6 Suggested Teaching Plan

This case is designed to be taught in a single 80-minute class session. Suggested time allotments for the various sections of the case are as follows:

15 minutes	1. Industry background a. History of life settlement, market players etc. b. How is a life settlement transaction conducted
15 minutes	2. Anshar and the life settlement brokerage business a. Business development and operations: brokers' job, fee structure; how Ashar was established, what its daily operation entails b. Image and reputation: historical cases and status quo; what Ashar does to protect the firm's image
25 minutes	3. Dynamics with other market players a. With the sell side: Ashar's fiduciary duty to sellers; calculation exercise b. With the buy side: how Ashar assist buyers in transactions, buyers' complaint about low profitability, consumer-direct campaign from Coventry and other downstream players c. With medical underwriters: Ashar's influence over life expectancy estimates d. With direct competitors: differentiators in Ashar's business concept compared to competitors
20 minutes	4. Growth and outlook a. What are the current issues in the market and how might the market evolve? b.What will future sellers and buyers likely do? c. What should Jason do?
5 minutes	5.Wrap up

TN Exhibit 1 Calculation exercise

On January 1, 2012, Ashar successfully closed a life settlement deal for policyholder John Doe. The one-million-face universal life policy provides coverage until John's 100th birthday, December 31, 2028. The owner of the policy will receive the death benefit equal to the face value only if John dies on or before that date.

Assume all cash flows occur at the beginning of a year: the insurance company charges premiums and pays the death benefit only on January 1. Column (IV) shows the premiums π_i until maturity. At the time of settlement, the policy had a cash surrender value of $500. The buyer who won the bid for the deal priced the policy with an IRR of 10% p.a.

						Suggested calculation steps		
(I) Date	(II) Age	(III) i	(IV) π_i	(V) $_ip_x$(a)	(VI) $_ip_x$(b)	(VII) $E(CF_i)$(a)	(VIII) $E(CF_i)$(b)	(IX) $PV(\pi_i)$
1/1/2012	83	0	$35,000	100.00%	100.00%	-$35,000	-$35,000	$35,000
1/1/2013	84	1	$40,000	98.00%	99.07%	-$17,417	-$27,522	$38,835
1/1/2014	85	2	$45,000	94.67%	97.50%	-$7,754	-$23,307	$42,417
1/1/2015	86	3	$50,000	88.66%	94.61%	$11,868	-$13,830	$45,757
1/1/2016	87	4	$55,000	80.18%	90.38%	$27,834	-$5,094	$48,867
1/1/2017	88	5	$65,000	70.13%	85.10%	$34,095	-$1,519	$56,070
1/1/2018	89	6	$75,000	58.87%	78.72%	$38,648	$2,672	$62,811
1/1/2019	90	7	$85,000	46.08%	70.74%	$45,501	$10,083	$69,113
1/1/2020	91	8	$95,000	32.52%	61.03%	$48,833	$18,263	$74,994
1/1/2021	92	9	$110,000	19.65%	49.76%	$45,420	$24,589	$84,306
1/1/2022	93	10	$130,000	9.73%	38.04%	$33,373	$26,132	$96,732
1/1/2023	94	11	$150,000	4.37%	28.25%	$16,504	$19,439	$108,363
1/1/2024	95	12	$170,000	1.77%	20.41%	$7,316	$13,924	$119,235
1/1/2025	96	13	$190,000	0.65%	14.38%	$2,890	$9,558	$129,381
1/1/2026	97	14	$210,000	0.21%	9.79%	$1,055	$6,660	$138,835
1/1/2027	98	15	$230,000	0.05%	6.43%	$333	$4,523	$147,628
1/1/2028	99	16	$250,000	0.01%	4.04%	$88	$2,988	$155,792
1/1/2029	100	17	$-	0.00%	2.43%	$19	$3,196	$-
1/1/2030	101	18	$-	0.00%	1.39%	$-	$-	$-
1/1/2031	102	19	$-	0.00%	0.75%	$-	$-	$-
1/1/2032	103	20	$-	0.00%	0.38%	$-	$-	$-
1/1/2033	104	21	$-	0.00%	0.18%	$-	$-	$-
1/1/2034	105	22	$-	0.00%	0.08%	$-	$-	$-
1/1/2035	106	23	$-	0.00%	0.04%	$-	$-	$-
1/1/2036	107	24	$-	0.00%	0.01%	$-	$-	$-
1/1/2037	108	25	$-	0.00%	0.01%	$-	$-	$-
1/1/2038	109	26	$-	0.00%	0.00%	$-	$-	$-
1/1/2039	110	27	$-	0.00%	0.00%	$-	$-	$-

Question 1. Calculate John's life expectancy (LE) estimated by the buyer, as well as the life settlement price, the corresponding fee that Ashar would charge, and the amount that John Doe would receive, if the buyer used the survival curve ${}_ip_x$ as shown in (a) Column (V); (b) Column (VI).

Solution 1. Using the formula provided in the case $\sum_{i=1}^{\infty} {}_ip_x$, students can easily compute the LE. To compute the settlement price, students can first calculate the expected discounted cash flow of each period $E(CF_i)$, where

$$E(CF_i) = \begin{cases} -\pi_0, & i = 0 \\ \frac{({}_{i-1}p_x - {}_ip_x) \cdot F - {}_ip_x \cdot \pi_i}{(1+r)^i}, & i \geq 1 \end{cases}$$

The corresponding formula can also be found in the case. The calculation results are as shown in Column (VII) and Column (VIII) for 1.(a) and 1.(b) respectively. By summing up the cash flows, i.e. plugging the cash flow values into $\sum_{i=0}^{T} E(CF_i)$, students will arrive at the settlement price for each scenario. Ashar's fee is calculated using their fee formula $\min(33\%(P - CS), 8\%F)$ as described in the case. The settlement price with the broker fee deducted is the amount that the policyholder receives in the end. The answers are summarized in the table below:

	1.(a)	1.(b)
John's LE (years):	7.06	9.53
Policy price:	$253,607	$35,755
Ashar's commission:	$80,000	$11,634
John's income:	$173,607	$24,121

It is now obvious that the insured's LE estimate has a huge impact on the settlement price and Ashar's revenue. The shorter the insured is expected to live, the higher the buyer is willing to offer and the more Ashar is able to charge.

Question 2. Assume the buyer bought the policy for the amount as calculated in 1.(a), and a flat risk-free rate of return of 3% p.a. Calculate the net present value (NPV) of this life settlement from the buyer's perspective, if John dies on December 31 of year (a) 2018; (b) 2019; (c) 2020; (d) 2011.

Solution 2. Students are expected to have learned the present value formula from other financial management courses. The formula is thus not provided in the case. The present value of the policy can be expressed as $PV(F) - \sum_{i=0}^{t-1} PV(\pi_i) = \frac{F}{(1+r)^t} - \sum_{i=0}^{t-1} \frac{\pi_i}{(1+r)^i}$, where t denotes the time of death benefit payment and r the risk-free rate. Column (IX) shows the value of $PV(\pi_i)$. The policy's net present value is simply the difference between its present value and price. The results are as follows:

	Date of death	t	PV policy	NPV policy
2.(a)	12/31/2018	7	$483,335	$229,728
2.(b)	12/31/2019	8	$390,540	$136,933
2.(c)	12/31/2020	9	$292,554	$38,947
2.(d)	12/31/2021	10	$185,925	-$67,682

If the insured lives for as long as his LE estimate, i.e. 7 years, the policy has a large NPV. This is endogenous given that the policy price was derived from a high IRR, 10%. As soon as the insured starts to survive his LE estimate, the NPV declines sharply. If the insured lives until year 9 as in scenario 2.(c), the NPV is only 17% of that in scenario 2.(a), and drops below half of Ashar's commission. If the insured outlives his LE estimate by 3 years as in scenarios 2.(d), the NPV turns negative. Through this exercise, students will understand that life settlement investment entails huge longevity risk, and even a moderately underestimated LE can be detrimental to the investment.

TN Exhibit 2 Life settlement compensation disclosure form

Name of broker or agent: ________________________________

1. **What is your commission schedule?**

_____ **% of death benefit**

_____ **% of gross purchase price**

_____ **% of difference between gross purchase price and cash value**

Other (please describe):

2. **Will you receive any payments from life settlement providers or other parties that are related to this transaction?**

No ☐

Yes ☐ **Please describe:**

3. **Do you owe a fiduciary duty to the policyowner?**

Yes ☐

No ☐

Signature: ________________________________

Date: ________________________________

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Curriculum Vitae

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Work Experience

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