Institut für Finanz- und Aktuarwissenschaften

Quantifying the Effect of Adverse Selection on Life Settlement Pricing

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- This talk is based on joint work with Daniel Bauer, Georgia State University and Nan Zhu, Illinois State University

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Motivation and overview of this talk

A question many Life Settlement Investors, at one time or another, have asked is:

- "Why, when most LE providers have advertised A/E ratios that would suggest that their LE estimates are accurate, does my portfolio perform worse than expected???"

In this talk, we will…

- … give a short overview of several potential reasons
- … investigate one specific reason, i.e. **asymmetric information** (and in particular **adverse selection**) in more detail
- … explain how Life Settlement Pricing Models can be adjusted to account for adverse selection

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Statistical biases of A/E measures and other explanations for underperformance of Life Settlement Portfolios

What is Asymmetric Information?

Is there Asymmetric Information in Life Settlements?

Asymmetric Information and Life Settlement Pricing

Summary and Outlook

Statistical biases of A/E measures

The "early years": counting based approach to assess the quality of LE-providers

- Count how many people have died before their LE and how many have died after their LE.
- This method yields meaningful results only after all individuals have either died or outlived their LE.
- Before that time, it makes the LE-provider look more conservative, because at the beginning, only early deaths are possible.
- **Methodology is statistically biased. Bias is larger for "young" portfolios.**

Today: Actual to Expected Ratios

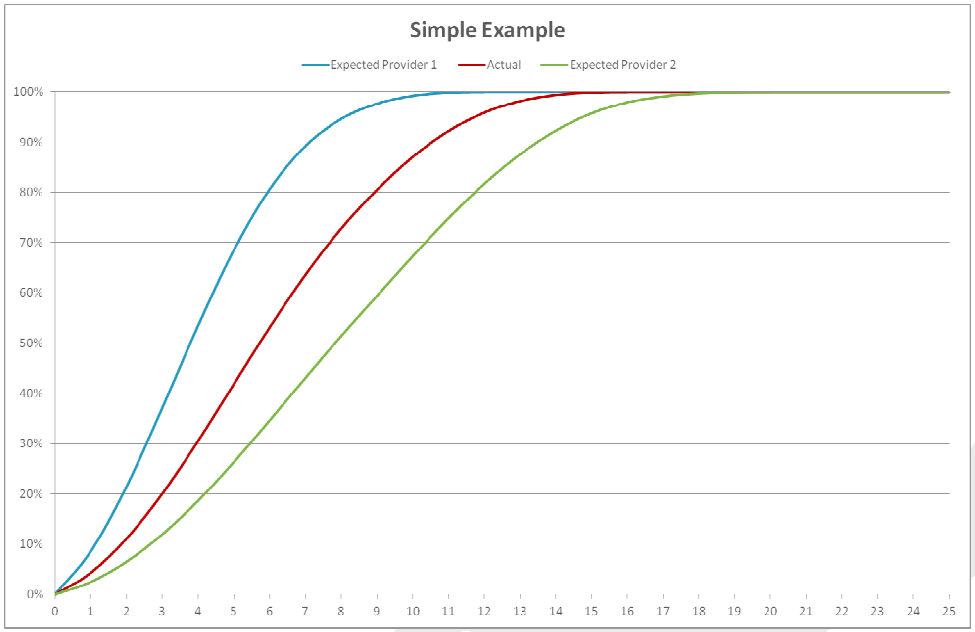
- A/E-ratio: actual number of deaths divided by expected number of deaths.
- An A/E-ratio of 100% means that between time of underwriting and today, exactly as many individuals have died as was predicted by the LE-provider.
- An A/E-ratio close to 100% is therefore seen as an indication for good underwriting.
  - However, this will not always be true, since for "old" portfolios the A/E-ratio is artificially "pulled towards a value of 100%" even if all LE estimates were systematically wrong.
  - This will be explained in the next slide.
- **Methodology is statistically biased. Bias is larger for "old" portfolios.**

Statistical biases of A/E measures

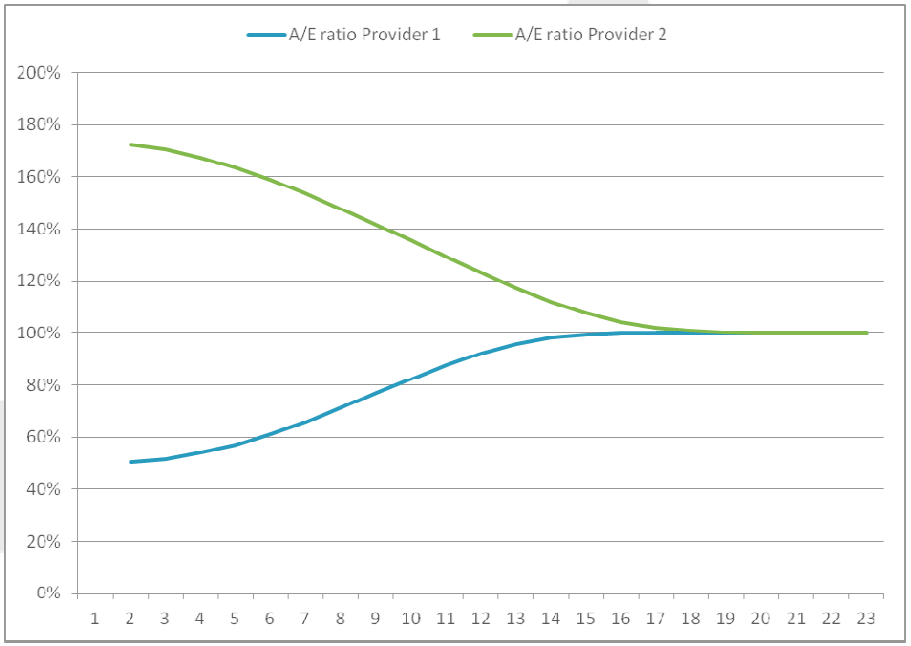
Simple hypothetical example (Two hypothetical LE-providers)

- Individuals die according to some **unknown actual mortality** (**red** in all charts).
- **Provider 1** is too aggressive by 2 years; **Provider 2** is too conservative by 2 years.

Left: expected mortality for the two hypothetical providers (blue and green) and actual mortality (red).



Right: A/E ratios for both providers.



- There are several ways to overcome this bias.

Other explanations for underperformance of Life Settlement Portfolios

A/E analyses based on so-called **restated LEs**.

- If a portfolio was acquired based on LEs before the latest methodology change, a good A/E based on restated LEs has no meaning for the performance of the portfolio compared to original LEs.
- Additionally, if the "re-underwriting" of old cases for purposes of A/E analyses is not fully consistent with today's underwriting, such A/E values might be biased. This is hard to assess in a due diligence process.

Life Settlement Population deviates from "base population" of LE-Provider's base table, e.g.

- rich = healthy,
- STOLI.

Cherry Picking of LE-certificates, i.e. broker / provider gets multiple LE-certificates and passes only the shortest one(s) to the investor.

Adverse Selection (explained below).

Moral Hazard (explained below – probably not relevant).

etc.

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Other explanations for underperformance of Life Settlement Portfolios

So we have seen that there are many potential reasons why mortality in a portfolio might be different from what you expect.

We will now have a closer look at effects caused by **Asymmetric Information.**

- Note: **Cherry Picking, Adverse Selection, and Moral Hazard** are special forms of asymmetric information!

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What is Asymmetric Information

Asymmetric Information, **Adverse Selection**, and **Moral Hazard** are sometimes confused.

- **Asymmetric information** means that in a transaction one party has access to different information than the other party.
  - In Life Settlements: Beyond the documented medical record, the insured might know how well she feels, how her body reacts to a certain treatment, how rich she is, etc.
- In the typical insurance context, **adverse selection** means that a person who knows that she is a "bad risk" buys more insurance.
  - I am a bad driver, that's why I buy more car insurance.
  - I am feeling super healthy, that's why I buy an annuity.
  - I am not feeling too well, that's why I buy a term life insurance.
  - In Life Settlements: Compared to my objective state of health (described by my medical record), I feel relatively well. Therefore, selling the policy is a good deal. That's why I sell the policy.
- In the typical insurance context, **moral hazard** means that a person acts less carefully because she knows that she is insured.
  - I have more insurance coverage, so I am going to drive less carefully.
  - In Life Settlements: I no longer have life insurance protection, so I am going to change my lifestyle (probably not very relevant?)

What is Asymmetric Information

So in Life Settlements, asymmetric information means that from a group of people with similar "observables" (age, smoker status, medical record, etc.), those that know they will probably live longer are more likely to sell their policies.

- Simple example: Suppose there are three groups of individuals at equal proportions in a portfolio. They have the same LE estimates based on observables but different "individual" LEs that are unknown to the LE-provider.

	Group 1	Group 2	Group 3	Average in Portf.
LEs based on observables	6 years	6 years	6 years	6 years
Individual LEs	4 years	6 years	8 years	6 years

LE-Provider:
A/E = 100%

- If an investor acquires policies from the three groups at equal proportions, there are no issues.
- But what if there is asymmetric information? Then the individuals with a shorter LE may choose not to settle whereas the individuals with a longer LE will settle.

	Group 1	Group 2	Group 3	Average in Portf.
LEs based on observables	6 years	6 years	6 years	6 years
Individual LEs	Don't settle	6 years	8 years	7 years

Investor:
A/E below 100%

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Is there Asymmetric Information in Life Settlements?

We performed analyses based on data provided by Fasano Associates:

- 78,571 individualized life expectancy evaluations between beginning of 2001 until end of 2011
- Eliminating duplicates: 52,603 records
  - 2 methods of eliminating duplicates:
    - using only the first record
    - using only the last record
  - results are qualitatively similar
- We use the following variables:
  - time of underwriting
  - age, sex, smoking status, primary impairment
  - realized death times (until Jan. 1st, 2012)
- Information for several LS portfolios:
  - We know 933 policies (of 52,603 records) were settled

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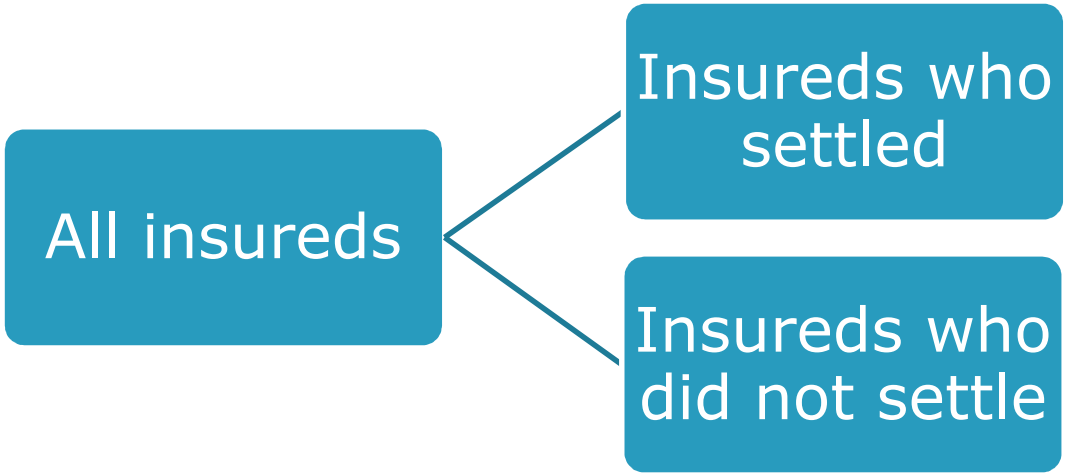
Is there Asymmetric Information in Life Settlements?

In a perfect world, we would know for all insureds whether or not they have settled their policy.



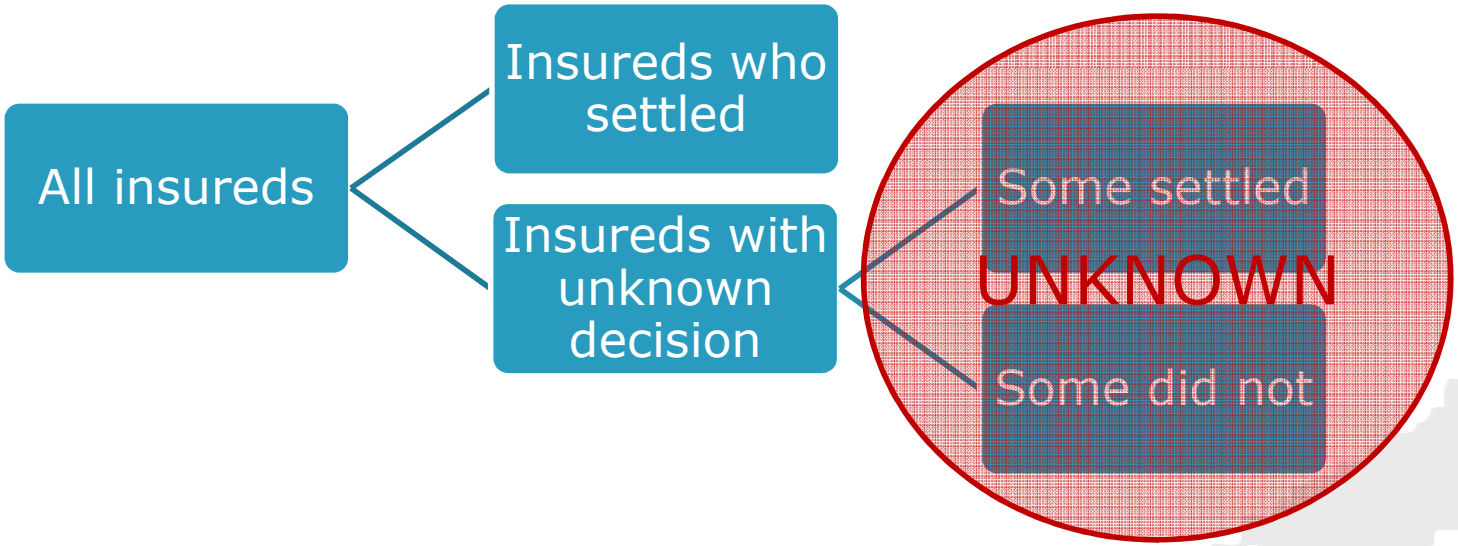
Also, we would know when they have died.

In this setting, if the **deviation between estimated life expectancy and actual remaining lifetime** showed a different pattern in the two segments, this would be an indication for asymmetric information.

Is there Asymmetric Information in Life Settlements?

In the real world, we face two issues increasing the complexity:

- We know for some insureds that they did settle. For others, the decision is unknown.



  - **Solution**: If we use an estimate for the ratio of settled policies in the "unknown" segment, we can correct for this missing information. → See below.
- Additionally, many insureds are still alive, so we can not measure the actual remaining lifetime.
  - **Solution**: Look at the difference between realized partial lifetimes (i.e. actual lifetime up to today) and projected temporary life expectancies (i.e. expected number of years lived until today according to the LE-certificate).
  - We call this difference: **Difference in Temporary LE (DTLE).**

Is there Asymmetric Information in Life Settlements?

We find that the DTLE differs significantly between the two groups.

	Estimates		
	(1) All Cases	(2) Closed Cases	(3) Remaining Cases
Earliest observation			
N	52603	933	51670
DTLE	0.1646***	0.4580***	0.1593***
$\frac{1}{N} S_N^{TR}$	(0.0050)	(0.0368)	(0.0051)
Latest observation			
N	52603	933	51670
DTLE	0.0634***	0.1466***	0.0619***
$\frac{1}{N} S_N^{TR}$	(0.0047)	(0.0292)	(0.0048)

We find clear evidence for the existence of asymmetric information.

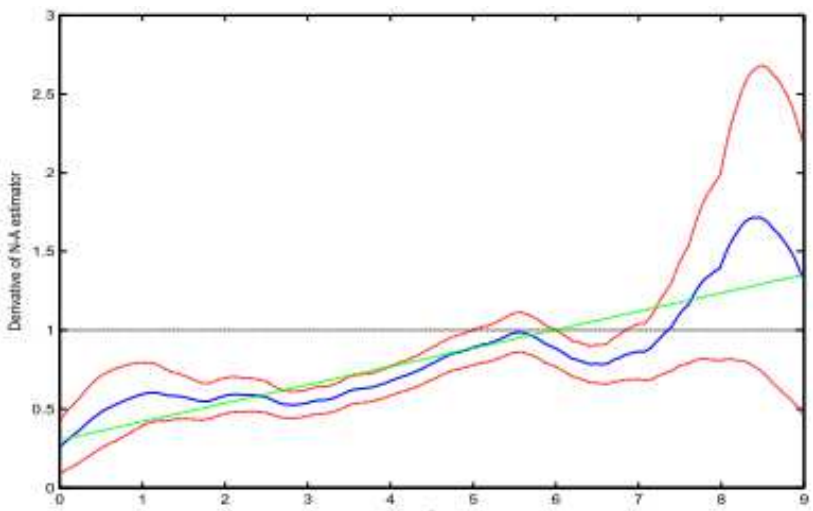
The next question is: What is the pattern of this information asymmetry over time?

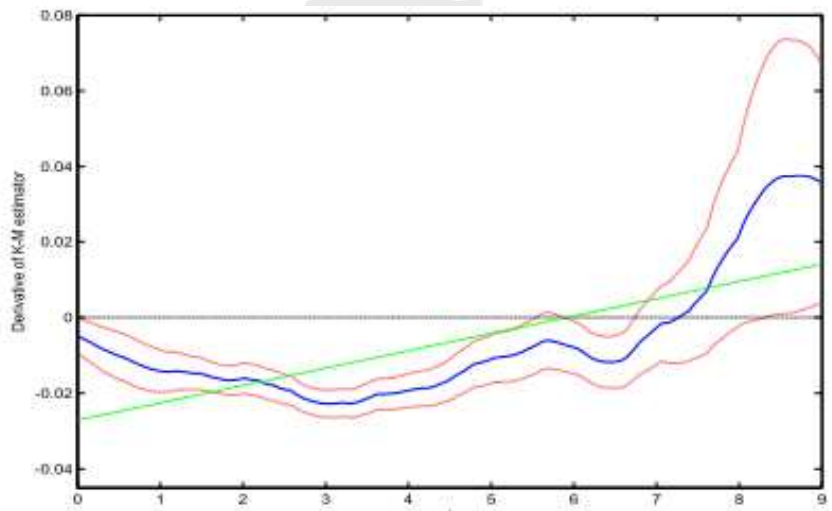
What is the pattern of this information asymmetry over time?

In order to determine the pattern of asymmetric information over time, we look at the (negative) "excess mortality" for those who have settled.

- look at **multiplicative model** and **additive model.**
- extra mortality that is not explained by any other factor than the fact that this policy has been settled.
- In the absence of asymmetric information, the multiplicative excess should be flat at 1, the additive excess should be flat at 0.

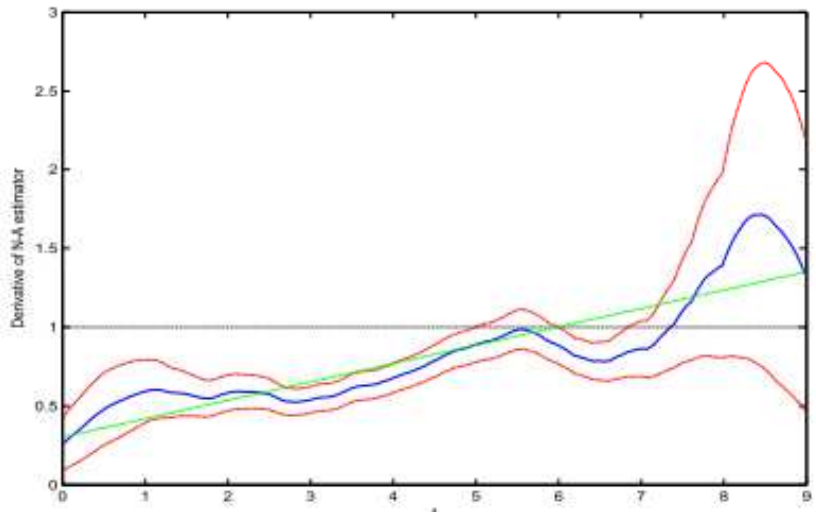
Left: multiplicative excess and 95% confidence band; Right: additive excess and 95% confidence band.

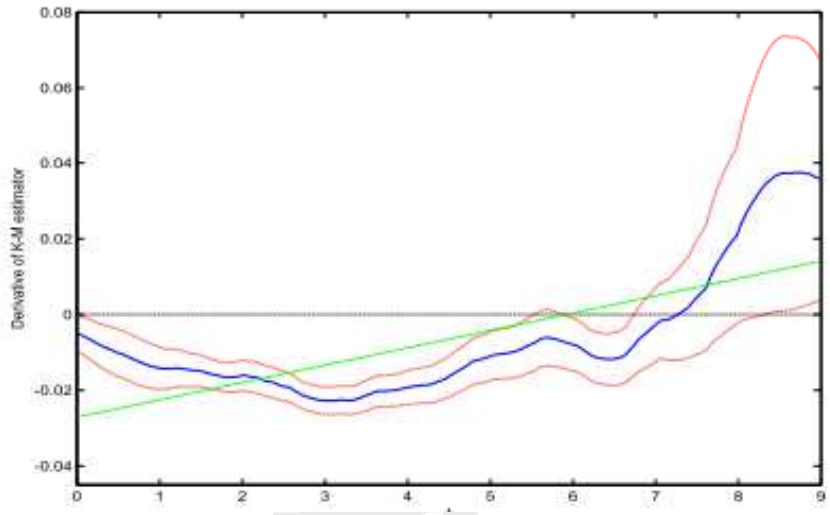




What is the pattern of this information asymmetry over time?

The results provide a clear indication that the two groups behave differently.
→This is strong evidence for asymmetric information.





- Those who settled have a significantly lower mortality.
- The effect is temporary – it wears off after five to six years.
- Indication that the reason for the difference is **adverse selection** and not cherry-picking or moral hazard.
  - Cherry picking: multiplier would **always** be lower – left graph should be straight line.
  - Moral hazard: If insureds changed behavior, difference would **increase** over time (→negative slope).

What is the pattern of this information asymmetry over time?

Robustness: Make sure that there are not alternative covariates that could explain the difference.

Measure how the mortality probability (in the model: the continuous force of mortality) is affected by all the covariates: observables and settlement decision.

- The model is:

$$\mu_t^{(i)} = \beta_0(t) + \sum \beta_j \, Obs_{i,j} + \gamma_1 1_{\{SettledObserved\}} + \gamma_2 t 1_{\{SettledObserved\}}$$

- The model gives the result that the force of mortality is indeed lower for those who have settled (and the effect is statistically significant!) and that the difference wears off over time.

	Only γ_1	γ_1 and γ_2
γ_1	-0.0132*** (0.0024)	-0.0185*** (0.0038)
γ_2		0.0017* (0.0013)

Evidence for **asymmetric information** in line with the pattern of **adverse selection.**

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Final question: Can we adjust a given LE-estimate for the effect of asymmetric information?

- Assume that the LE-provider is correct over its entire portfolio. However, due to asymmetric information, in an investor's portfolio, people live longer.
- Question: by how much???

For this, we need to adjust our results for the fact that, in the group with unknown decision, also some policyholders settled.

- If we make an assumption about the proportion of insureds who settled over the entire portfolio, we can come up with a suitable adjustment.
- Example: Male policyholder aged 75, estimated LE estimate = 10.48 years.

p	20%	30%	40%	50%
LE (adj.)	11.02	11.09	11.20	11.35
Difference	0.54	0.62	0.72	0.88

- **Adjusted LEs can be used in Life Settlement Pricing!**
- A different approach (adjusting the discount rate) can be found in Zhu & Bauer (2013), "Coherent Pricing of Life Settlements under Asymmetric Information," *Journal of Risk and Insurance* 80(3): 827-851.

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Asymmetric Information can explain (a part of the) discrepancy between LE-provider's and investor's experience.

- Policyholders will walk away from "bad" deals from their perspective (⇔ "good" deal for investor) whereas they will gladly agree to "good" deals (⇔ "bad" deal for investor)
- While different sources for asymmetry are possible, our results are in line with *adverse selection* on policyholder's lifetime, i.e. individuals appear to have and use private information regarding their LE
- Significant but temporary effect (approximately 7 years). Effect can lead to significant discrepancy between realized and estimated LE
  - **We need more (your!) data to better quantify this effect!**

Implication for Pricing

- Clearly, adverse selection affects pricing of policies: When not accounting for adverse selection, the realized rate for the portfolio will be **below** the pricing rate
- **Intuition:** No super-good deals (underestimation of mortality) in portfolio – they will walk away – but super-bad deals (overestimation of mortality)
- Need to adjust pricing!

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