The Workers Compensation Tail Revisited

Presented by

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CAS Annual Meeting
Seattle, WA
November 16-19, 2008

Overview

- The Objective
- Previous Research
- The Data
- The Loss Development Model
- Findings
- A Note on Mortality
- The Elder Care Cost Bulge Re-examined
- Conclusion

The Objective

- Payments on workers compensation claims may continue on for many decades
  - Knowledge of the run-off pattern of very mature claims is highly relevant to NCCI ratemaking
    - There are very few large workers compensation triangles available, and those triangles that are available are sparsely populated
  - In what follows, we try to shed light on the run-off pattern of large workers compensation triangles by re-examining a large medical triangle studied by Richard Sherman and Gordon Diss

Previous Research

- Sherman and Diss studied the run-off pattern of the medical component of permanent disability claims of a SAIF (State Accident Insurance Fund, Oregon) triangle (accident years 1926-2002)

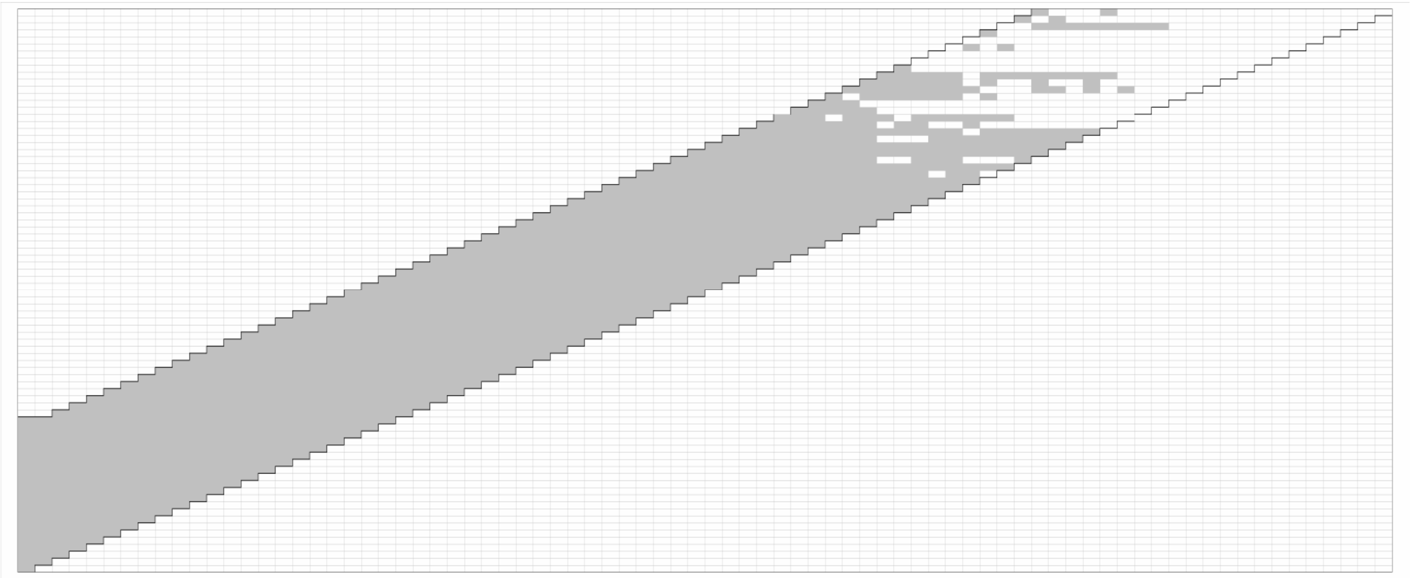
- The gist of this study is that there appears to exist a bulge in the incremental payments for very mature claims
  - The authors hypothesize that this bulge is due to “added costs of caring for the elderly”

The Data

- Main characteristics of the triangle
  - The triangle is sparsely populated
    - The triangle consists of a narrow band of diagonals
  - For the first 40 of the 80 accident years, no cumulative payments are available
    - Note that it is those early accident years that provide information on the high-maturity incremental payments
  - Taken together, the triangle appears more suited for learning about the run-off pattern than for computing a “definitive” number for the tail factor

The Data

- There are 80 accident and development years



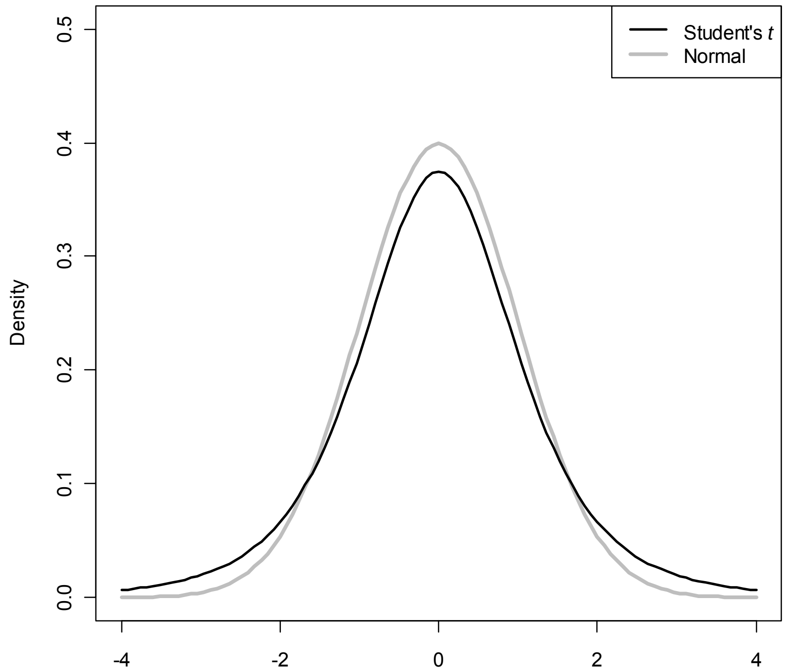
- Gray cells indicate available incremental payments
- The highest-maturity payment falls into the 67th development year

The Loss Development Model

- Main features of the model
  - The model is Bayesian and estimated by means of MCMC (Markov-Chain Monte Carlo simulation)
    - We run a burnin of 1 million, followed by 1 million iterations (of which we collect every 500th draw to limit demands on computer memory)
  - The model fits to the log incremental payments, using a *t*-distribution with 4 degrees of freedom
    - The *t*-distribution with 4 degrees of freedom is widely used in robust regression (the objective of which is to make the regression results insensitive to outliers)
    - For triangles that are more densely populated, the degrees of freedom of the *t*-distribution can be determined endogenously

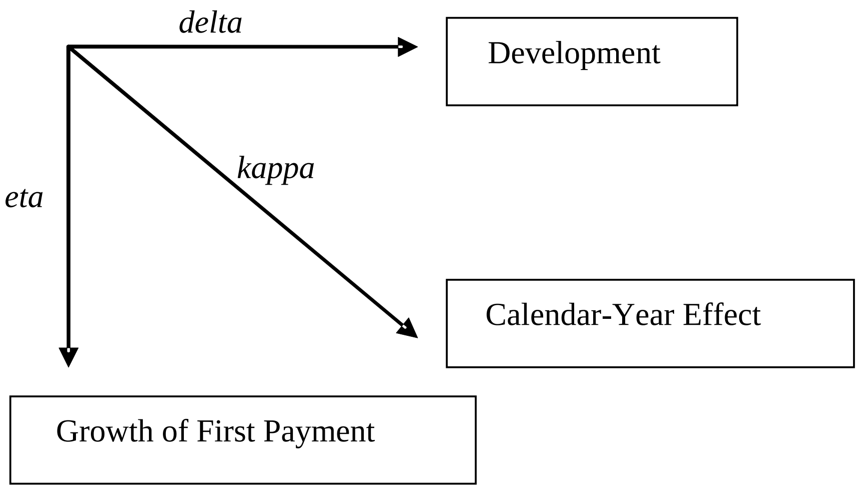
The Loss Development Model

- The *t*-distribution (here with 4 degrees of freedom) is more heavy-tailed than the normal



The Loss Development Model

- Main features of the model
  - The model distinguishes three time dimensions, which are exposure growth (which is assumed to be stationary), the calendar-year effect, and the rate of decay of calendar-year effect adjusted log incremental payments



The Loss Development Model

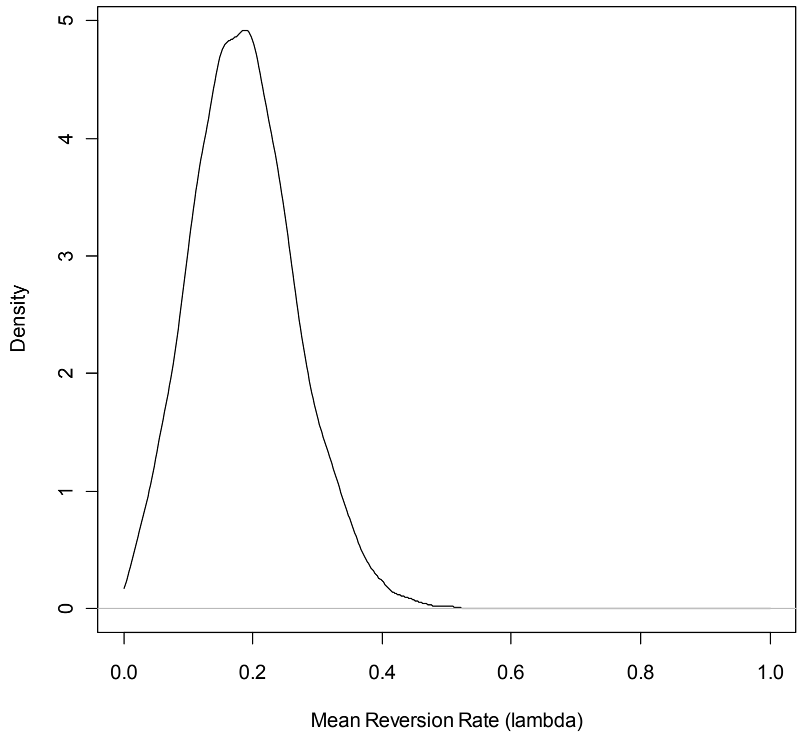
- Main features of the model, *cont'd*
  - Reversible Jump MCMC is applied, which is an estimation technique where the structure of the model is treated as uncertain
    - The structure of the model becomes a parameter that is estimated
    - Here, the model uncertainty pertains to the run-off pattern of the exposure-growth adjusted and calendar-year effect adjusted incremental payments
      - This unknown run-off pattern is modeled as a spline, the number of knots of which is uncertain, and so are the locations of these knots

The Loss Development Model

- Main features of the model, *cont'd*
  - The calendar-year effect is modeled as a stationary distribution around the Medical Care component of the CPI (M-CPI, for short)
  - The M-CPI is modeled as an Ornstein-Uhlenbeck process, which mean-reverts to its long-term stationary mean
    - We estimate the process using annual M-CPI price levels since 1935 (which is the earliest available year)

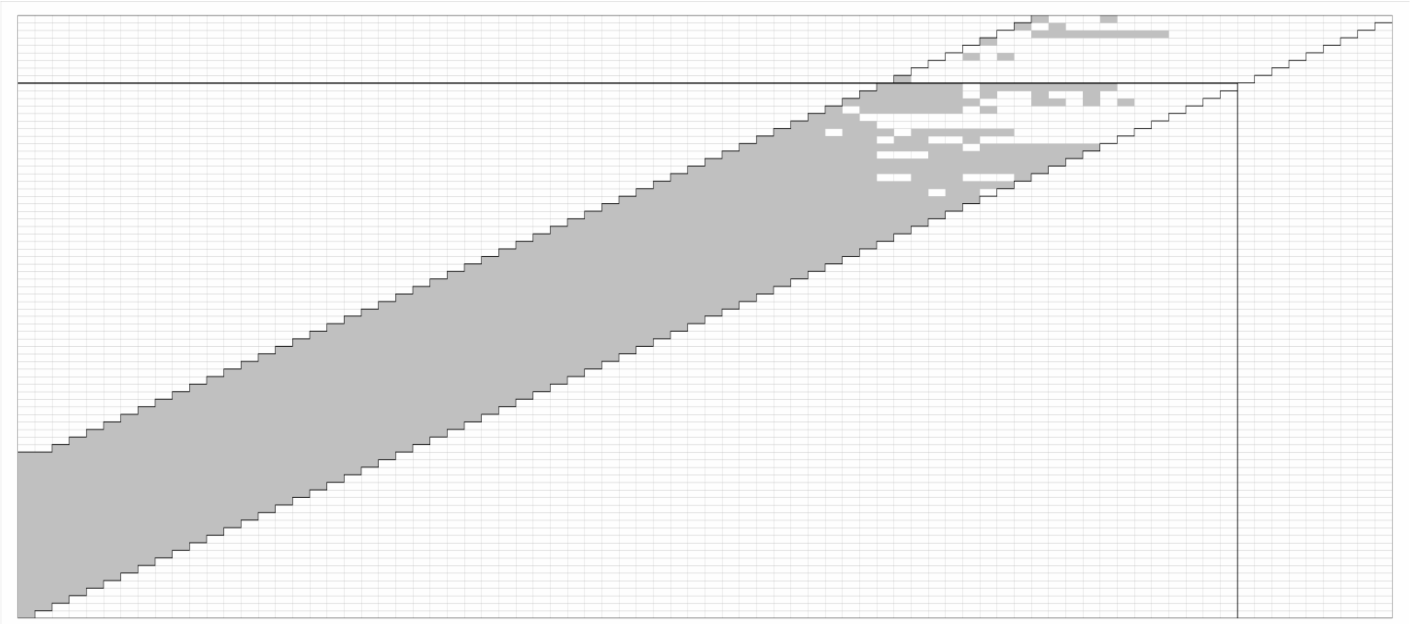
The Loss Development Model

- Mean reversion rate (logarithmic) in Ornstein-Uhlenbeck process



The Loss Development Model

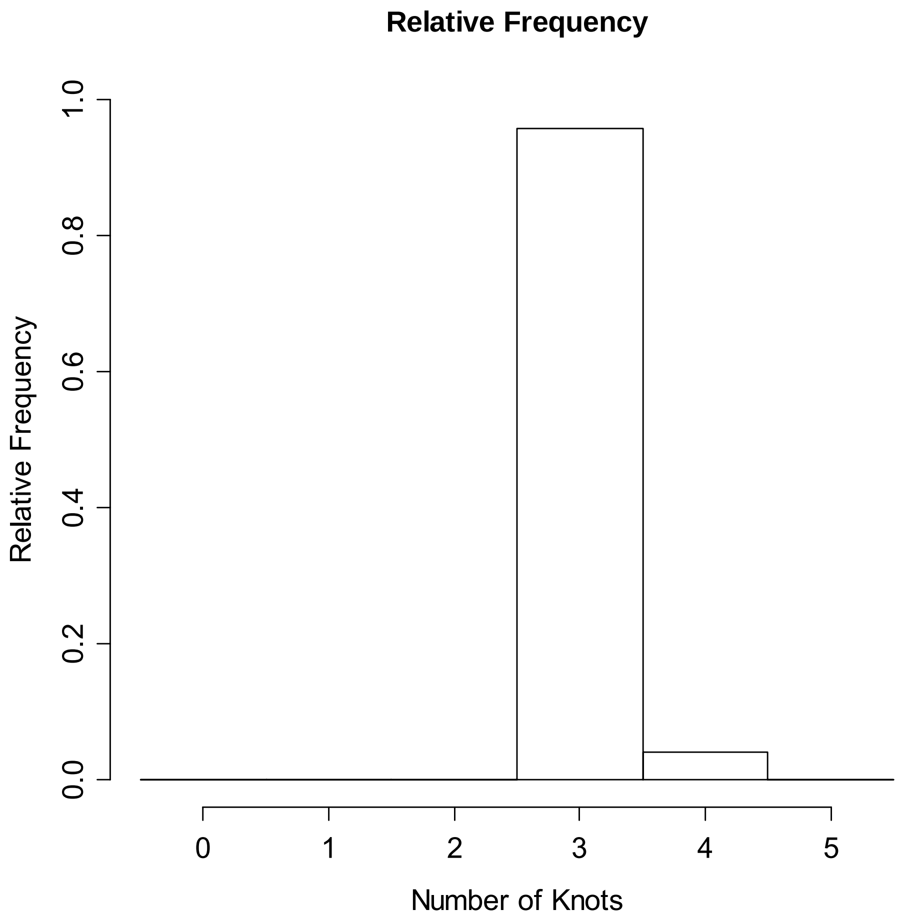
- We exclude the first nine accident years (1926-1934)



- The highest-maturity payment falls into the 65th development year

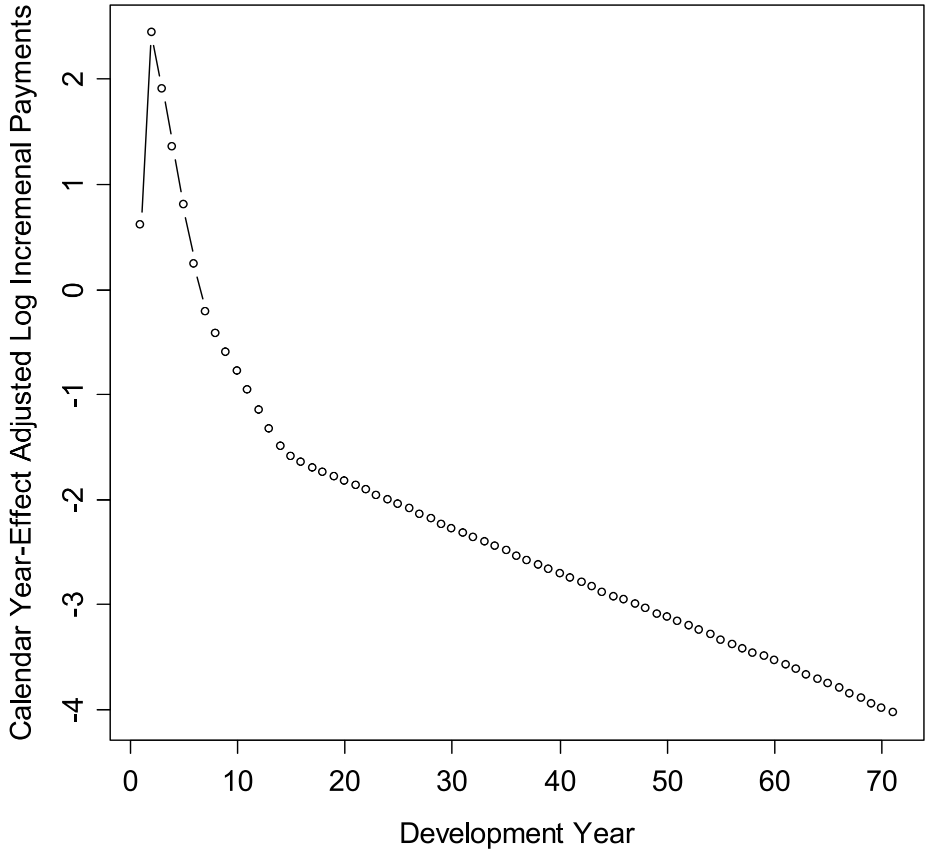
Findings

- Distribution of number of knots



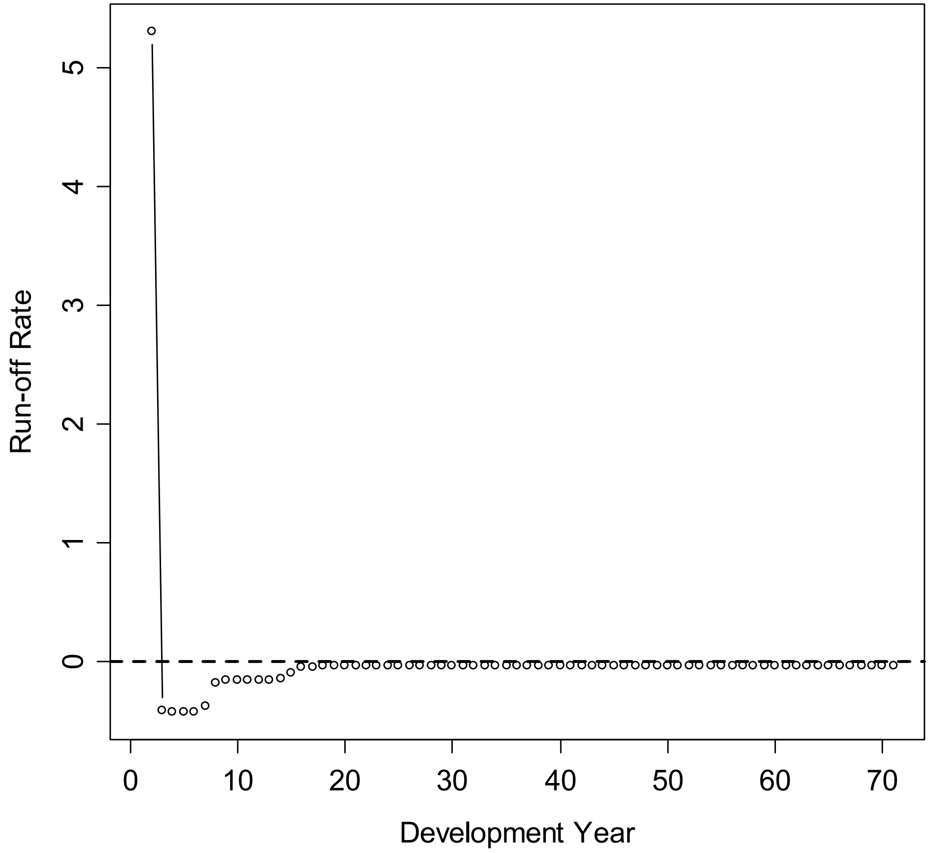
Findings

- Log incremental payment net of exposure growth and calendar-year effect



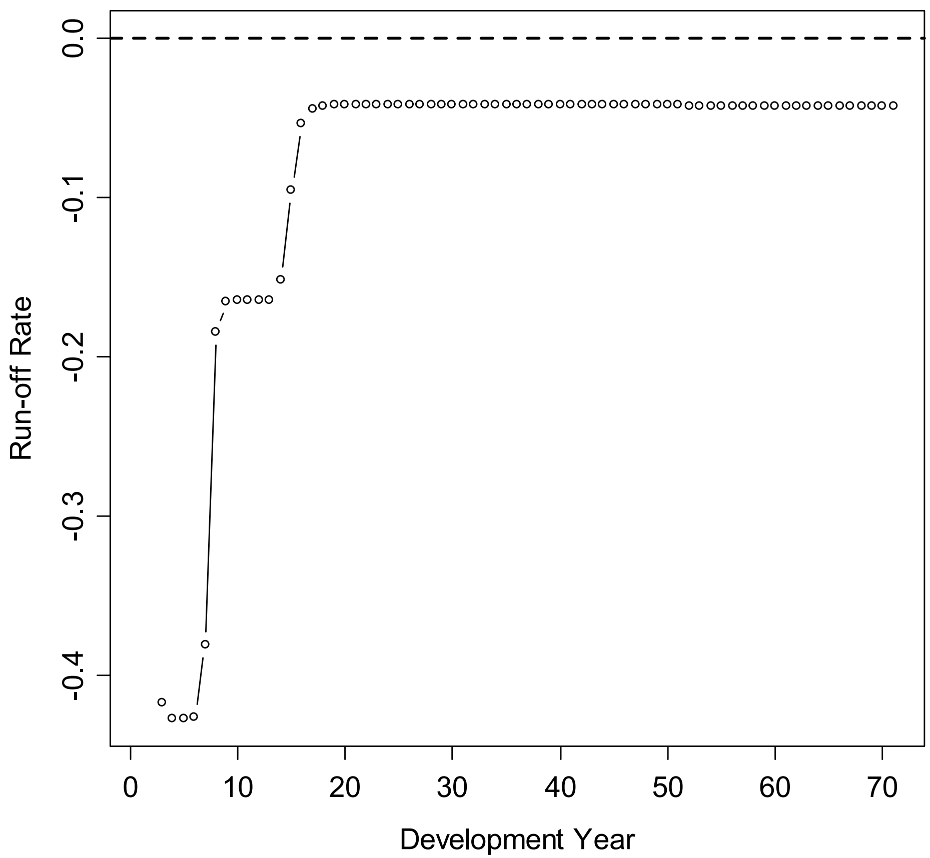
Findings

- Rate of decay (rate of decline of calendar-year effect adjusted log incremental payments)



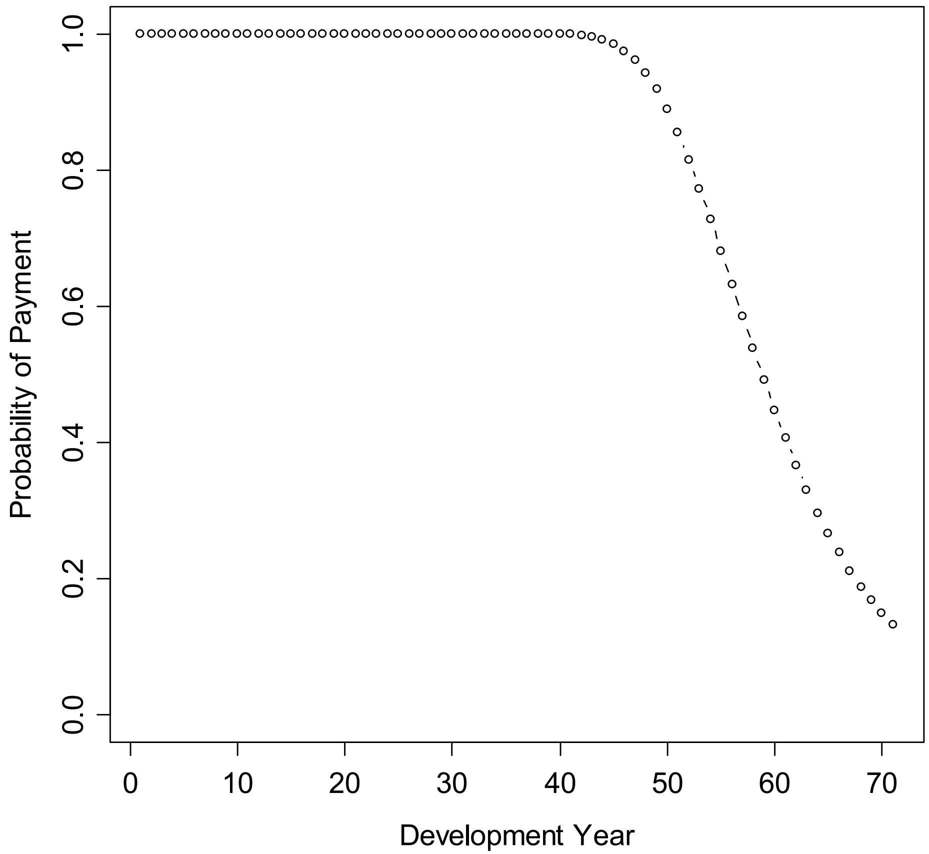
Findings

- Rate of decay (detailed view); final value: -4.24 percent



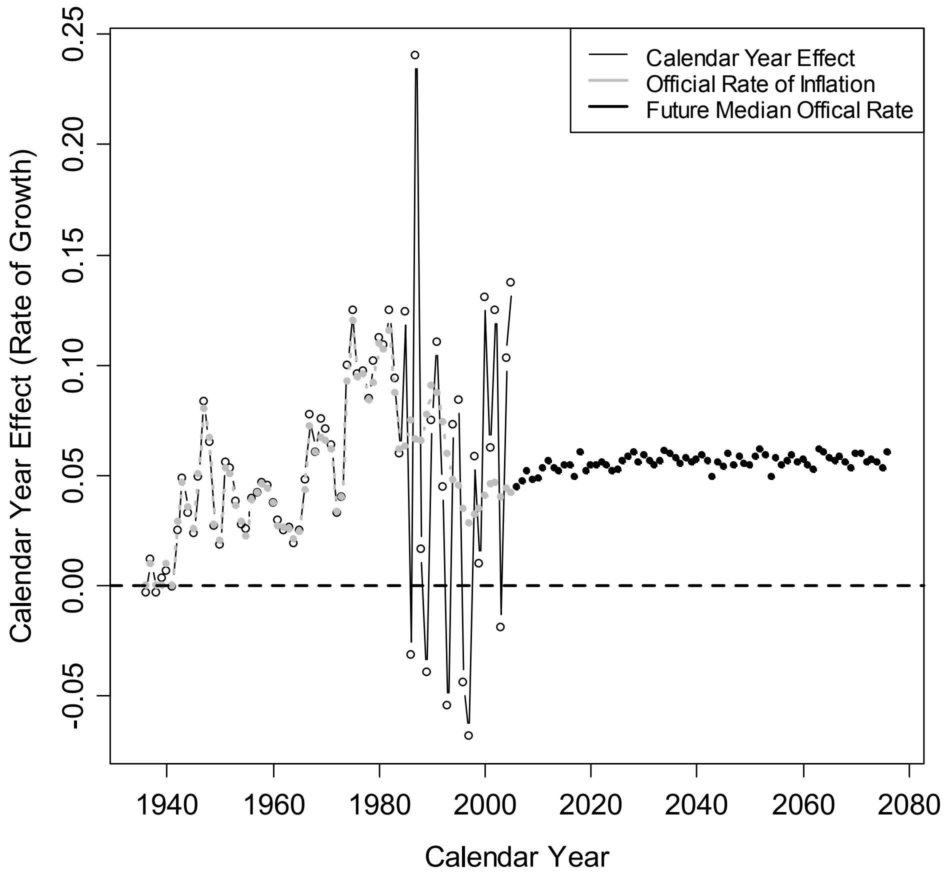
Findings

- Probability of payment



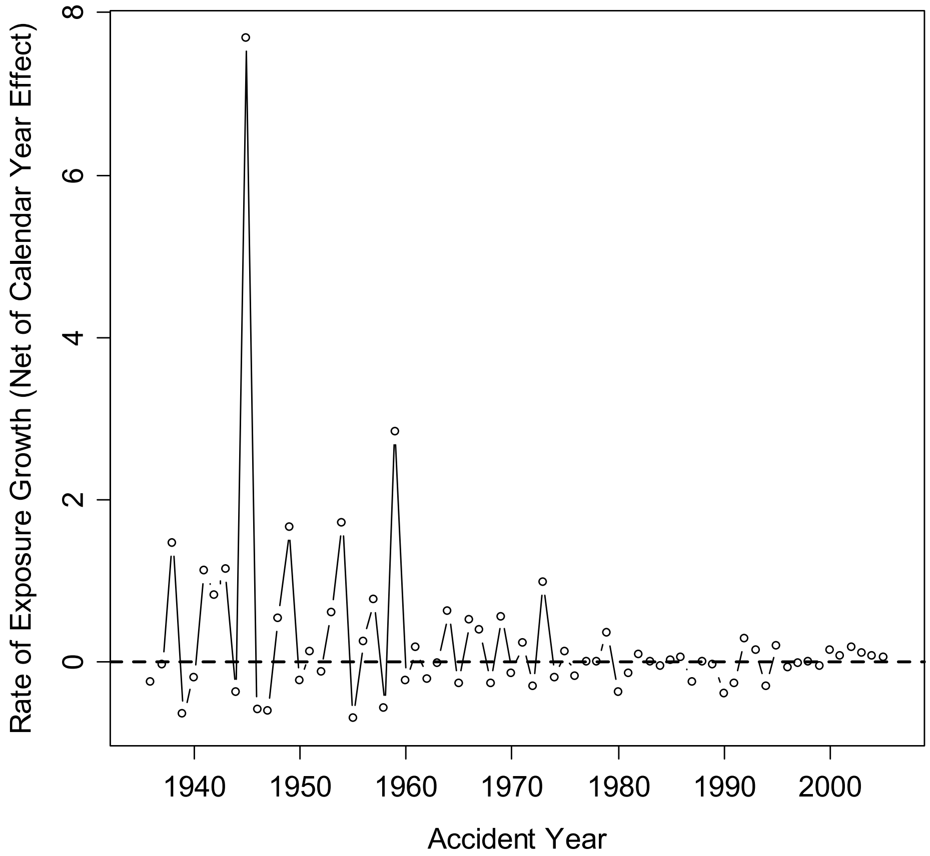
Findings

- Calendar-year effect



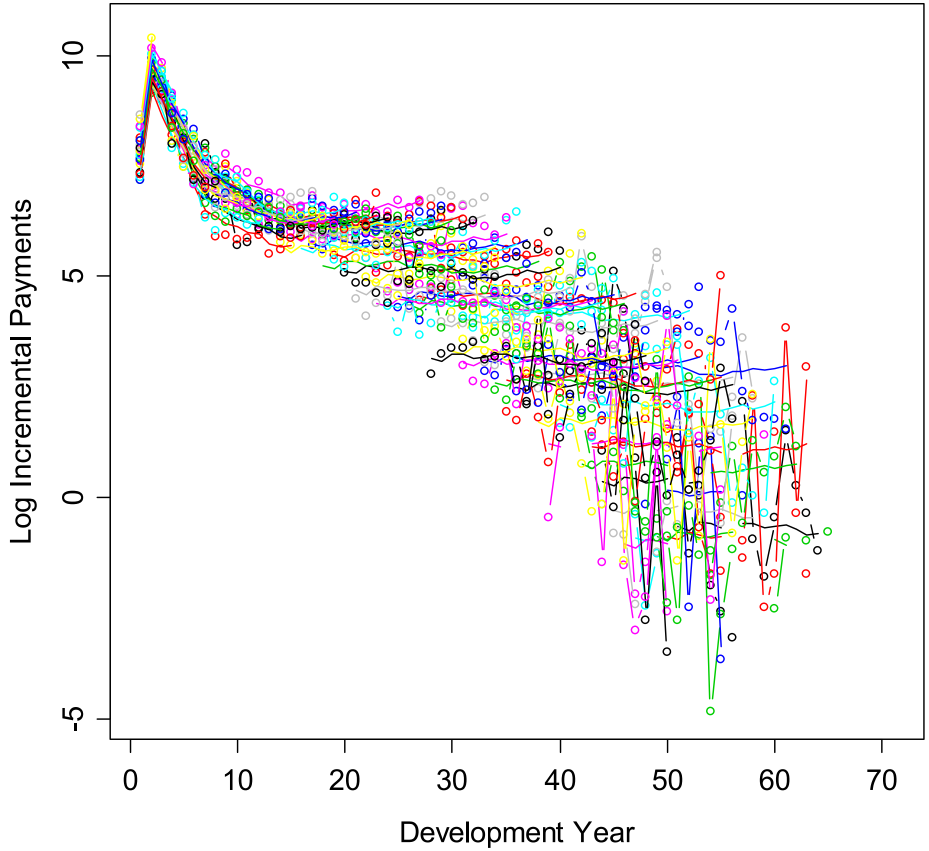
Findings

- Rate of exposure growth



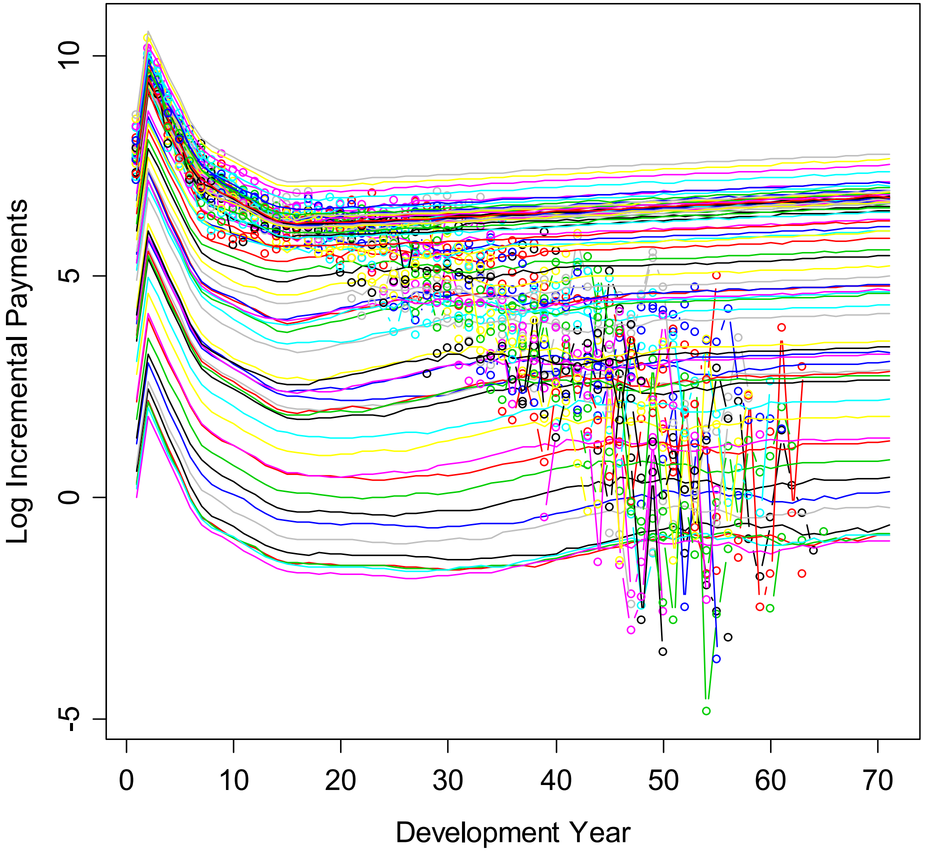
Findings

- Estimated and actual log incremental payments (1)



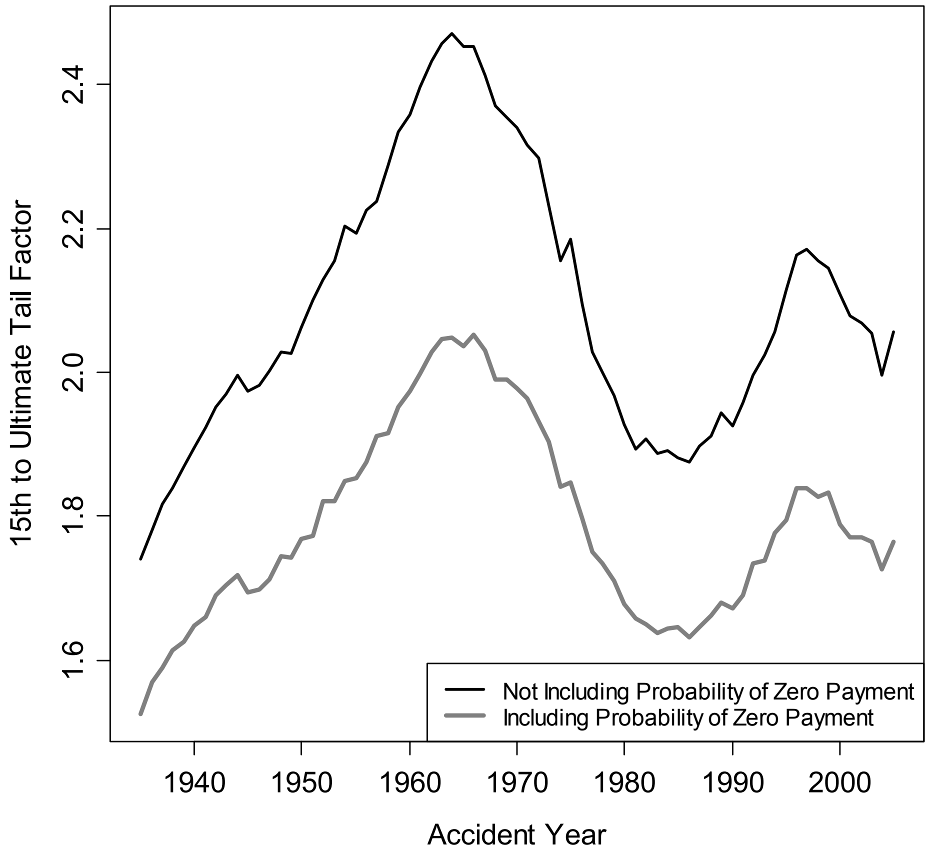
Findings

- Estimated and actual log incremental payments (2)



Findings

- Tail factor for a total of 71 payments



- Sherman and Diss tail factor: 2.469 (Table 3.5)

Findings

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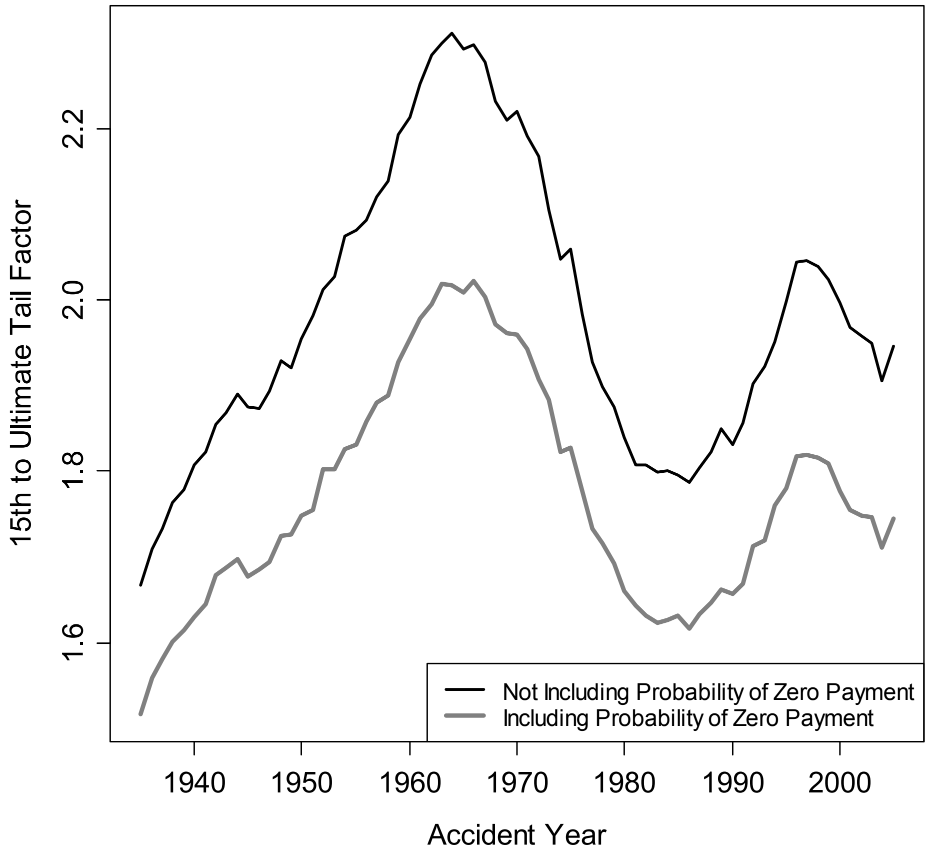


- Sherman and Diss tail factor: 2.469 (Table 3.5)

A Note on Mortality

- Effect of projected improvements in mortality in the Sherman and Diss study

Table 5.5
Indicated Tail Factors

	End of Development Year															
AY	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**
1970	3.037	2.570	2.375	2.177	1.973	1.773	1.592	1.438	1.311	1.210	1.132	1.075	1.037	1.015	1.004	1.001
1975	3.108	2.628	2.428	2.223	2.012	1.805	1.617	1.456	1.325	1.220	1.139	1.080	1.040	1.016	1.005	1.001
1980	3.197	2.701	2.492	2.279	2.058	1.842	1.645	1.477	1.340	1.231	1.146	1.085	1.043	1.018	1.006	1.001
1985	3.286	2.774	2.558	2.336	2.106	1.879	1.674	1.499	1.356	1.242	1.154	1.090	1.046	1.020	1.007	1.002
1990	3.376	2.848	2.624	2.393	2.154	1.918	1.704	1.521	1.372	1.253	1.162	1.095	1.049	1.021	1.007	1.002
1995	3.466	2.921	2.690	2.451	2.203	1.957	1.733	1.543	1.388	1.265	1.170	1.101	1.053	1.023	1.008	1.002
2000	3.549	2.990	2.752	2.505	2.248	1.993	1.761	1.563	1.402	1.275	1.177	1.105	1.054	1.023	1.008	1.002

- Source: Sherman and Diss

A Note on Mortality

- Effect of projected improvements in mortality

The NEW ENGLAND JOURNAL of MEDICINE

SPECIAL REPORT

A Potential Decline in Life Expectancy in the United States in the 21st Century

S. Jay Olshansky, Ph.D., Douglas J. Passaro, M.D., Ronald C. Hershow, M.D., Jennifer Layden, M.P.H., Bruce A. Carnes, Ph.D., Jacob Brody, M.D., Leonard Hayflick, Ph.D., Robert N. Butler, M.D., David B. Allison, Ph.D., and David S. Ludwig, M.D., Ph.D.

The Elder Care Cost Bulge Re-examined

- Generally, costs (*C*) are broken down into price (*p*) and quantity (*q*): $C = p \times q$
  - For medical care, *q* represents the number of baskets of medical services, and *p* is the price of one such basket
  - The term "added costs of care for the elderly" points to an increase in the number of baskets of services (as opposed to a increase in the price per basket)
    - Hence, in an attempt to shed light on the possible existence of a "caring for the elderly bulge," one has to elucidate the *q* in the equation $C = p \times q$
      - The general approach to discerning the quantity *q* is to divide by the price level, that is, to inflation-adjust

The Elder Care Cost Bulge Re-examined

- In what follows, we inflation-adjust using three alternative assumptions about inflation
  - We use the M-CPI
  - Nine percent rate of inflation (as assumed by Sherman and Diss)
  - Zero percent inflation
- For each concept of inflation, we proceed in three steps
  - The incremental payments are deflated, thus turning dollars into representative baskets of medical services
  - The rates of growth of the number of baskets of services (from one development year to the next) are calculated
  - For every development year, the number of baskets of medical services is calculated for one basket of medical services provided in the first development year

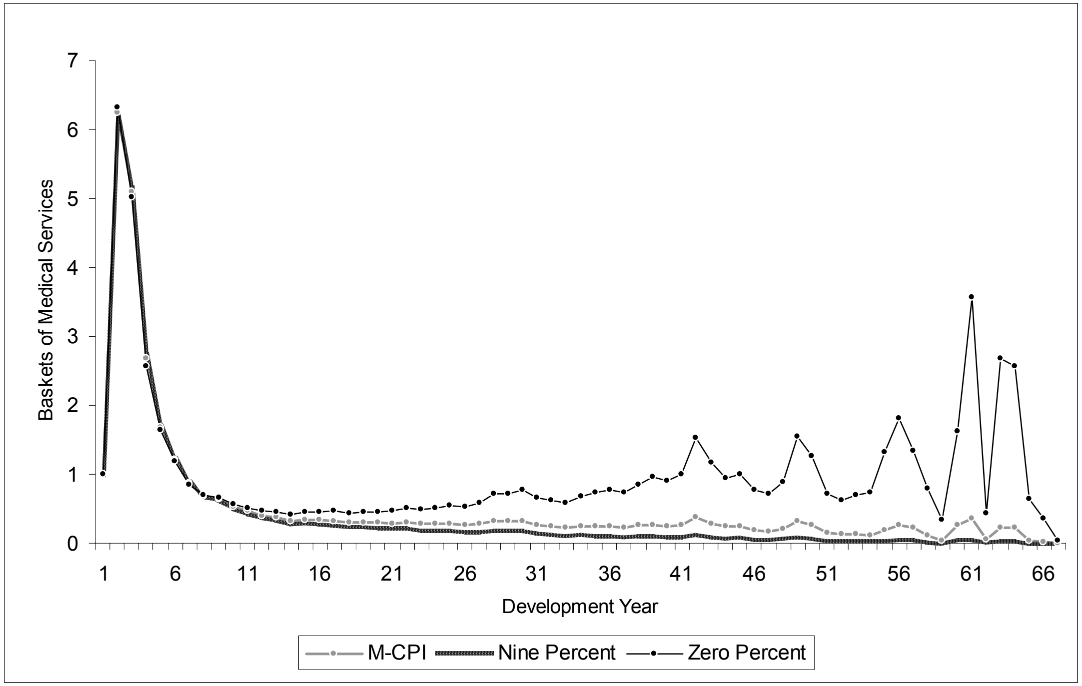
The Elder Care Cost Bulge Re-examined

- We calculate rates of decay from row-matched neighboring columns of (inflation-adjusted) incremental payments, from which we develop trajectories for the numbers of baskets of medical services
  - Here is an example of zero inflation-adjustment

N/A	#N/A	#N/A	#N/A	#N/A	1,9
N/A	#N/A	#N/A	#N/A	2,222	1,97
N/A	#N/A	#N/A	3,135	2,536	2,0
N/A	#N/A	4,235	3,565	3,601	2,97
N/A	7,832	5,886	4,058	3,240	2,4
1	11,097	7,879	4,669	3,212	2,67
15	13,483	8,643	5,199	4,160	1,9
56	13,474	9,017	5,874	3,585	2,2
70	16,077	9,230	4,110	2,752	1,7
43	16,291	7,334	3,622	3,465	1,61
78	10,936	5,533	4,281	2,761	1,27
8	8,067	4,613	3,319	1,452	89
47	9,158	3,649	3,073	1,325	60
45	10,542	4,206	1,751	1,333	77
2	10,506	5,222	2,107	1,400	94
49	10,131	2,711	1,844	1,237	55
6	8,438	4,418	2,032	1,177	1,1
57	9,167	3,106	1,739	1,421	1,0
36	9,182	4,282	2,064	1,411	1,0
50	9,096	2,936	3,215	1,292	1,2
6	9,735	4,309	2,121	1,452	1,1
2	12,462	4,215	3,687	1,998	#N/
6	15,124	5,856	3,241	#N/A	#N/
35	15,278	8,162	#N/A	#N/A	#N/
36	18,621	#N/A	#N/A	#N/A	#N/

The Elder Care Cost Bulge Re-examined

- Trajectories of number of baskets of medical services for three alternative assumptions about inflation



The Elder Care Cost Bulge Re-examined

- The preceding chart indicates that…
  - …if the rate of inflation equals zero, then there is indeed a bulge in payments late in development
  - …if the rate of inflation equals 9 percent, then there clearly is no elder care cost bulge
  - …if the rate of inflation equals the M-CPI, then there is some (statistical) noise in the incremental payments late in development, but little support for a systematic increase in payments
    - Note that late in development, payments are sparse and (statistically) noisy

Conclusion

- In projecting future medical payments, it is important to distinguish between (1) increases in the number of baskets of services provided and (2) inflation (which are increases in the price of such a basket of services)
- A re-examination of the SAIF triangle studied by Sherman and Diss provides no support for the hypothesis of “added costs of caring for the elderly” manifesting themselves in an increase in the number of baskets of medical services provided to claimants
- Given the rate of decline in the number of baskets of medical services provided, the magnitude of incremental payments is determined by the rate of inflation—such payments may increase even at high maturities