UNDERSTANDING UNCERTAINTY IN LOSS RATIO ESTIMATION: A TOP-DOWN APPROACH

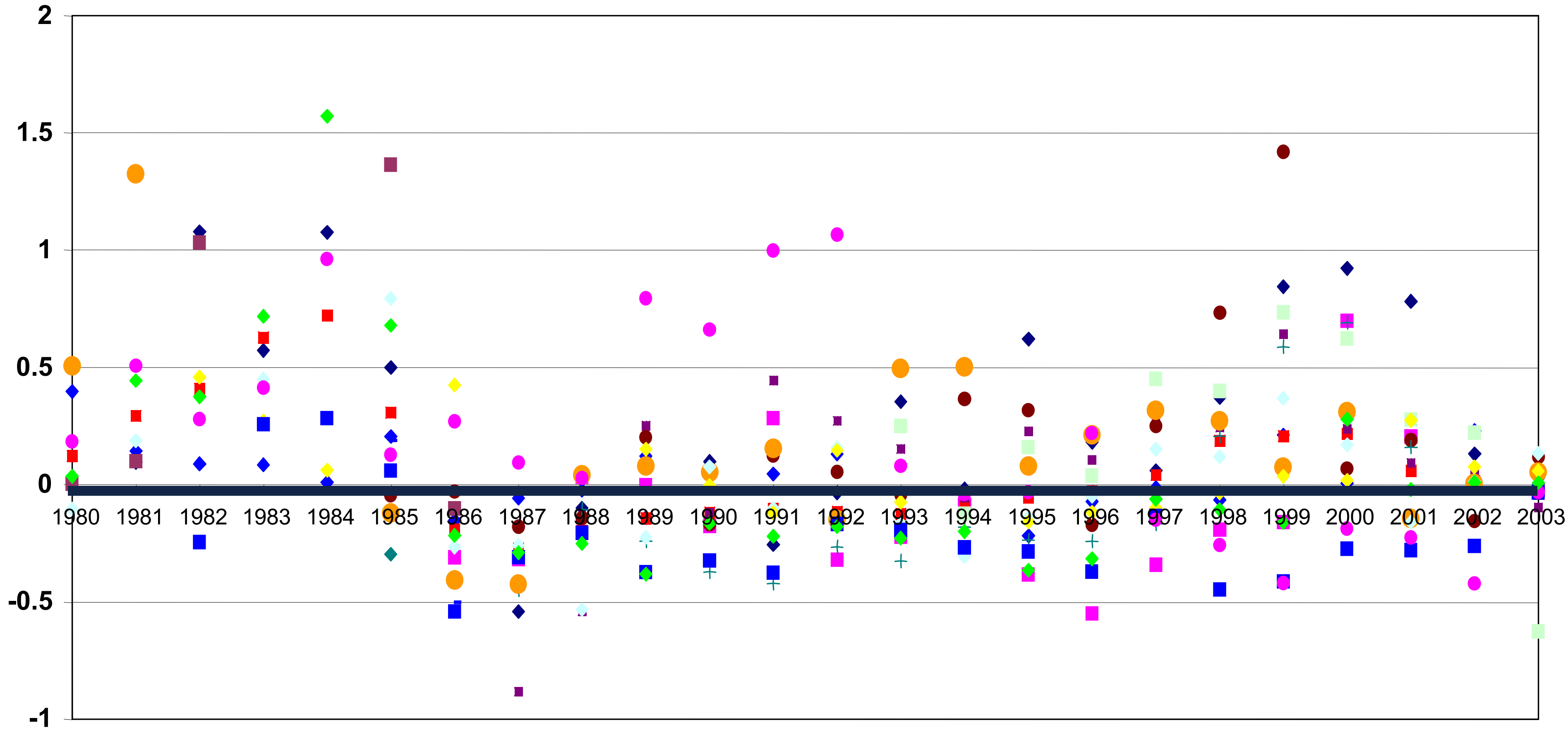
CONTRIBUTING FACTORS

- Factors contributing to uncertainty in LR estimates include
  - data issues (flawed data; finite sample size)
  - projection issues (selection of trend, development, OLF)
  - judgmental adjustments for factors that not directly quantified
  - unforeseen external influences (law / coverage changes)
- Most research has focused on effects of finite sample size
- But this is not the only issue – and often not the most important

CONTRIBUTING FACTORS

- Usually companies do a good job of estimating LRs
- But sometimes the industry as a whole is very wrong
  - Supports idea that finite sample size is not the key driver of estimation error
- For long-tail casualty lines:
  - LR estimation error correlated to the market cycle
  - Persists over a number of years
  - Not surprising since in these lines it takes longer for the effects of changing influences to become fully evident

OTHER LIABILITY OCCURRENCE: % CHANGE FROM OLR TO ULR



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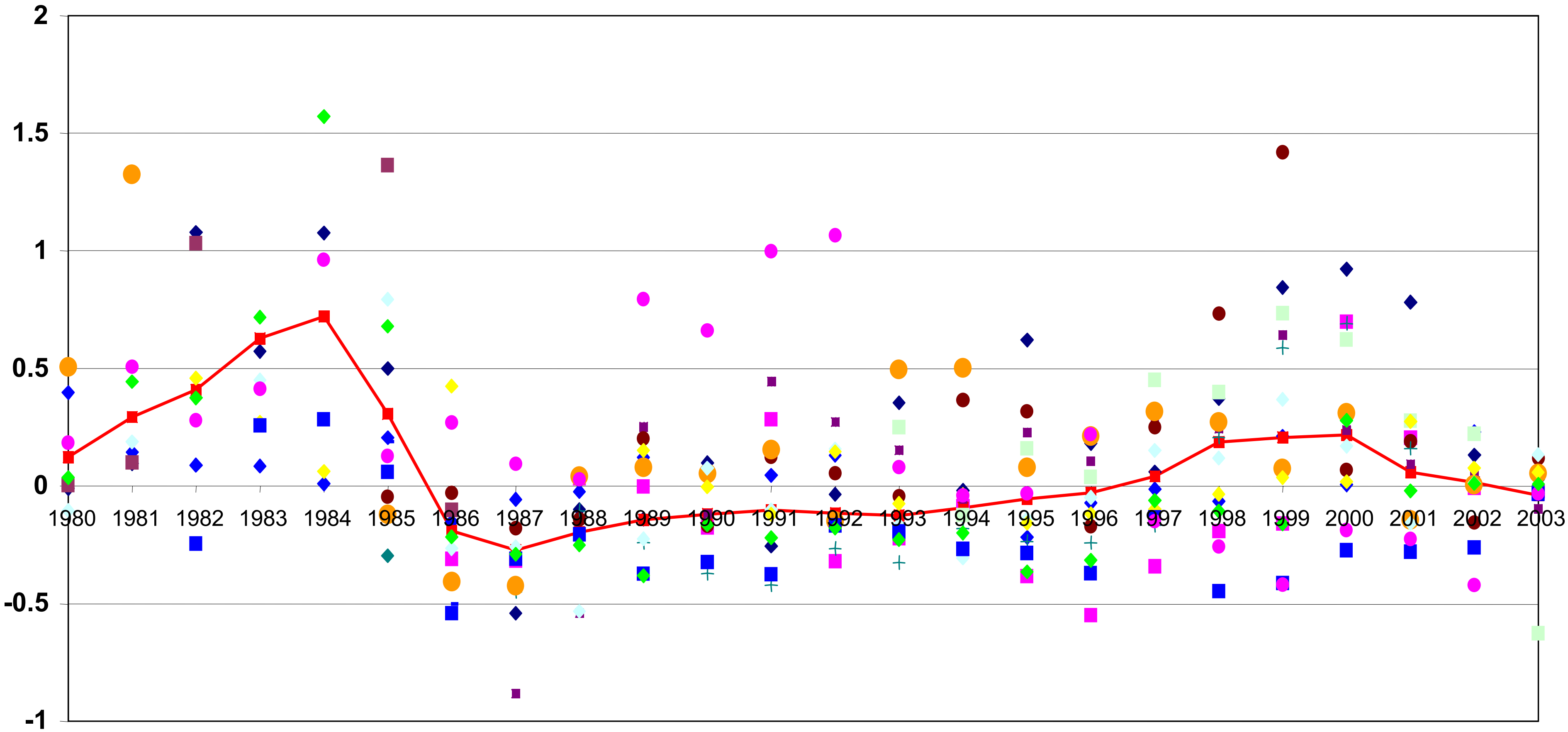

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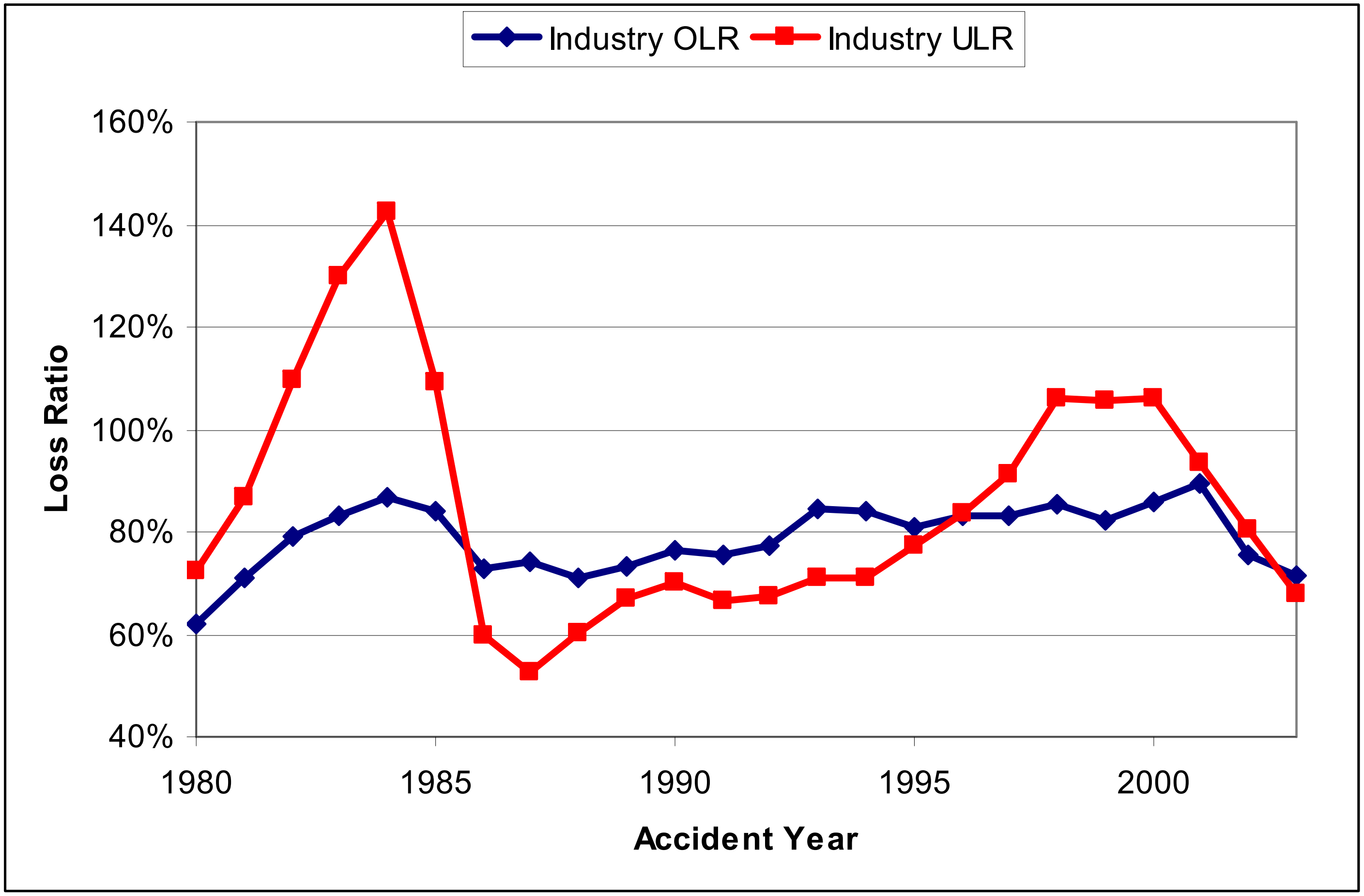


- Clearly some error is not diversifying away
- Magnitude and direction of industry error change over time

TOP-DOWN APPROACH

Define estimation error ratio R = ULR / OLR

For a single company: average over a long time frame yields “company bias”

- Might differ from 1.0 depending on reserve strategy

For a single accident year: average over a large number of companies yields “industry delusion” for that accident year

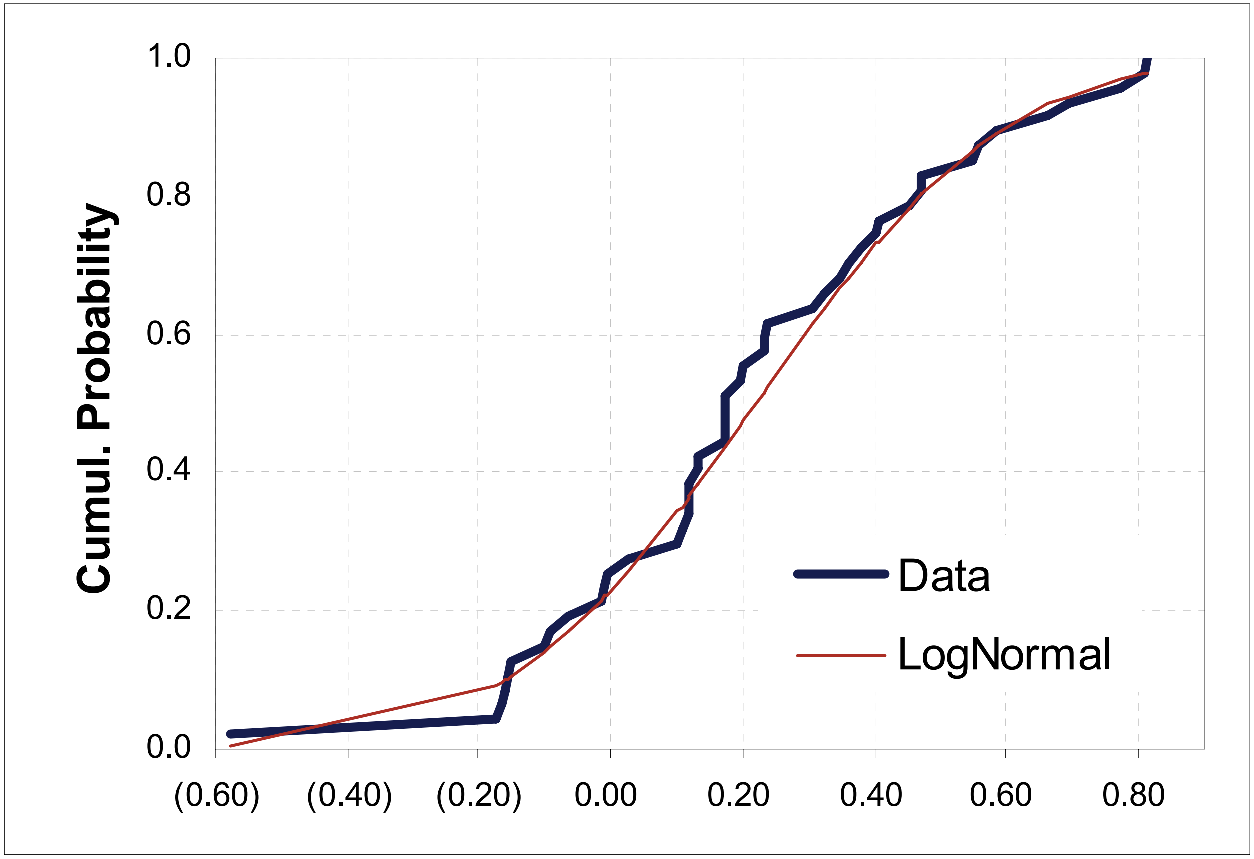
- Difference between industry’s initial view of loss potential for that AY and true loss potential

TOP-DOWN APPROACH

Key findings: Other Liability Occurrence

- For each accident year the R values are lognormally distributed across companies
- The mean and standard deviation of these lognormal distributions are linked
- The lognormal σ parameter can be approximated as a function of the μ parameter
- The μ parameter can be analyzed using time series methods

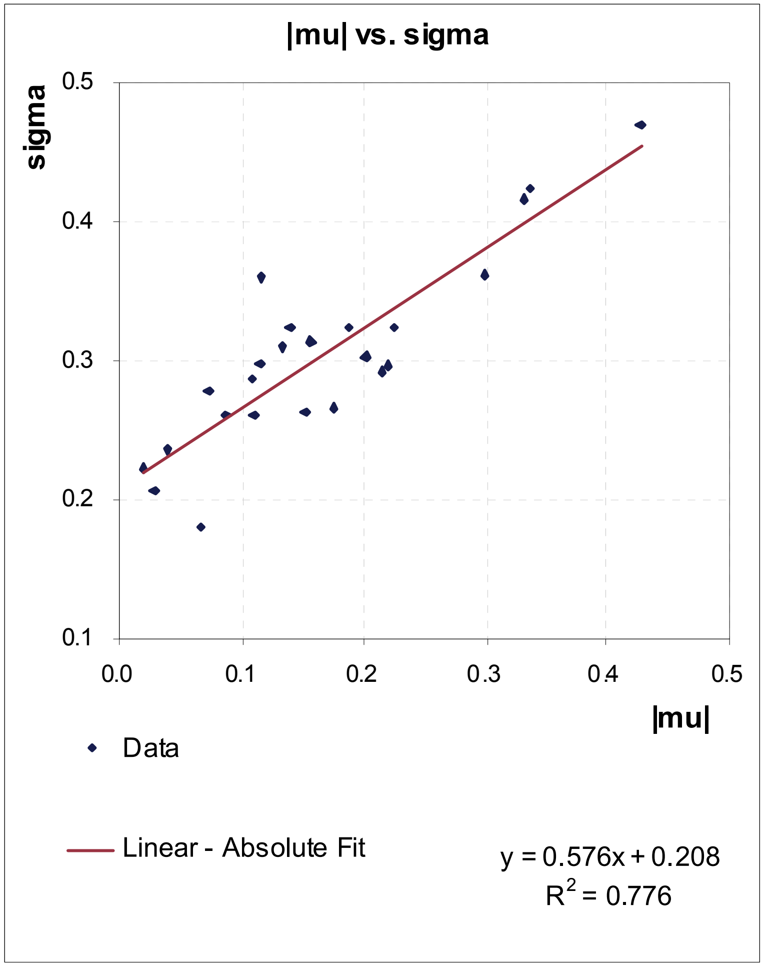
LOGNORMAL FIT



Sample lognormal fit to $R(c, t_i)$ by method of moments (AY 1999)

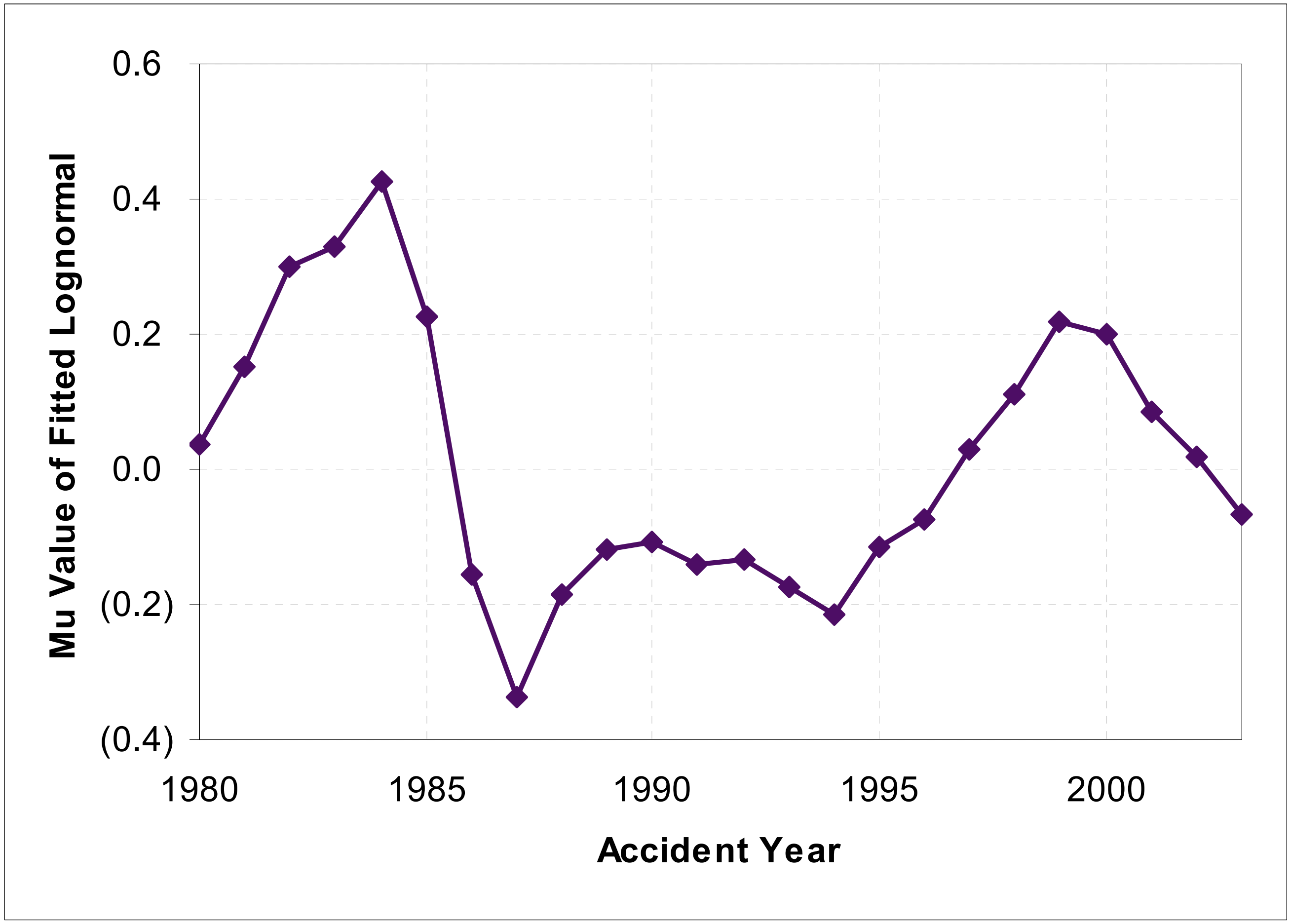
Willis

LINKAGE OF LOGNORMAL PARAMETERS

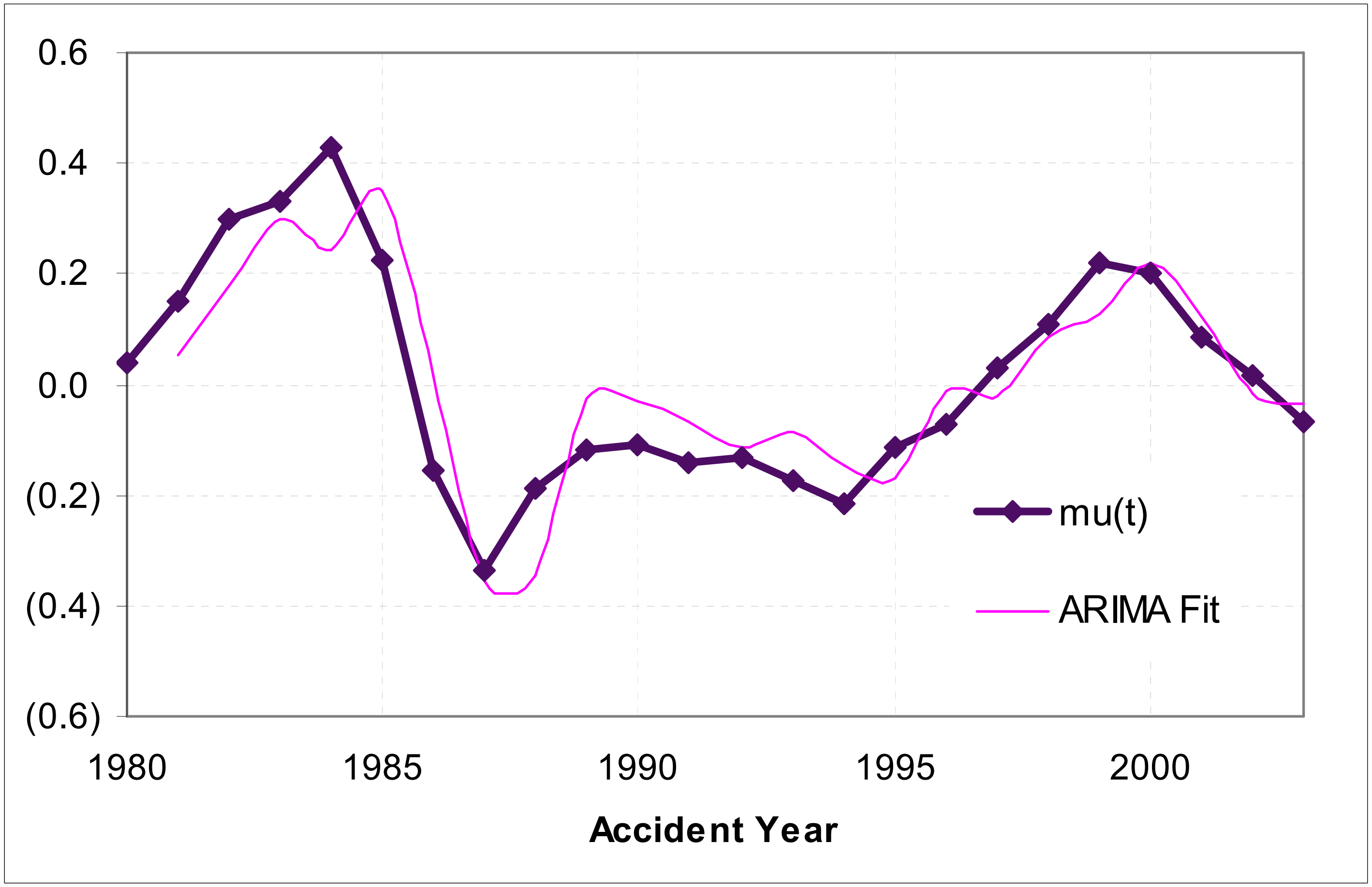


The σ parameter can be approximated as a function of the μ parameter

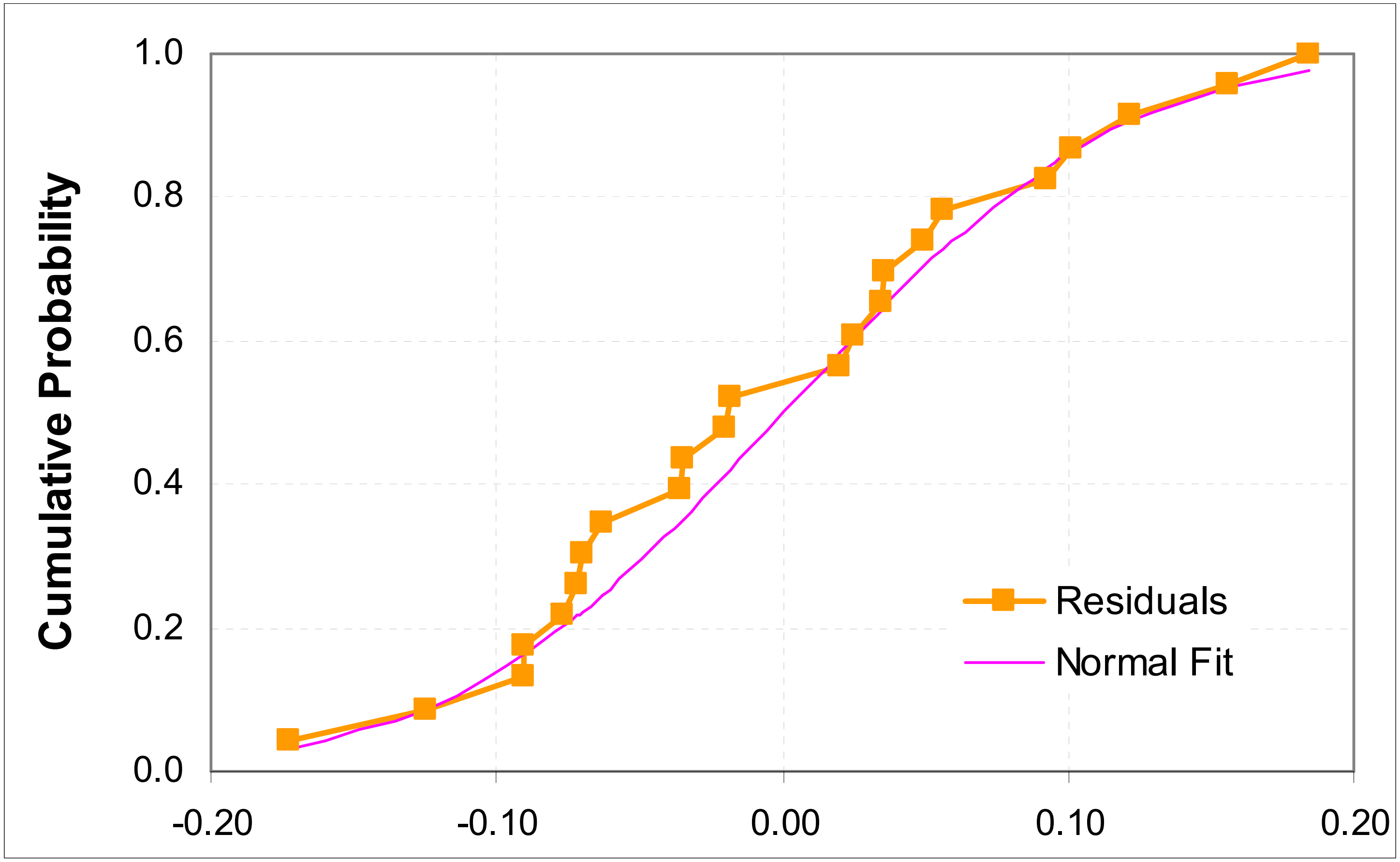
BEHAVIOR OF μ PARAMETER OVER TIME



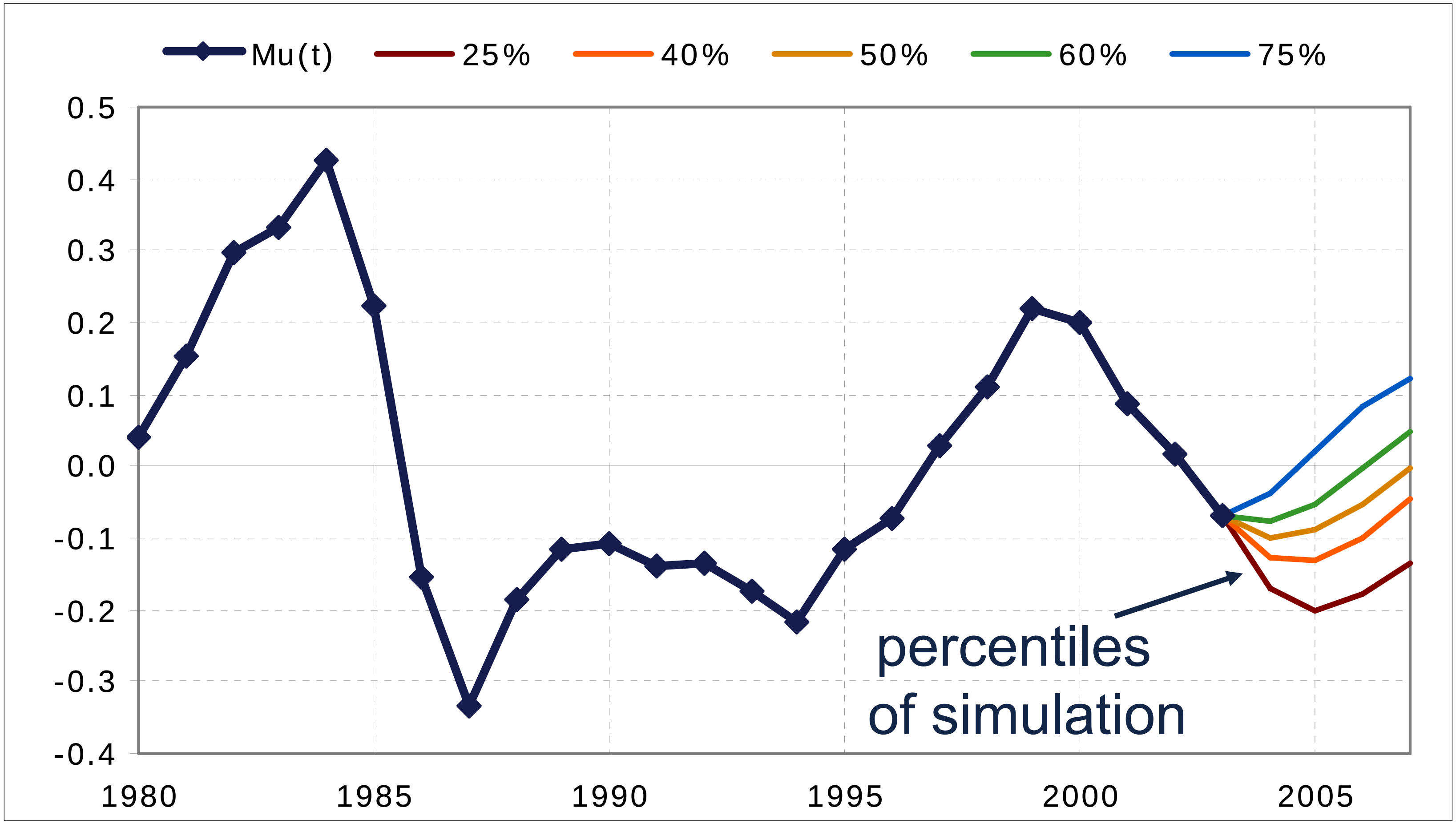
AR(2) MODEL


0.6
0.4
0.2
0.0
(0.2)
(0.4)
(0.6)
1980
1985
1990
1995
2000
Accident Year
mu(t)
ARIMA Fit

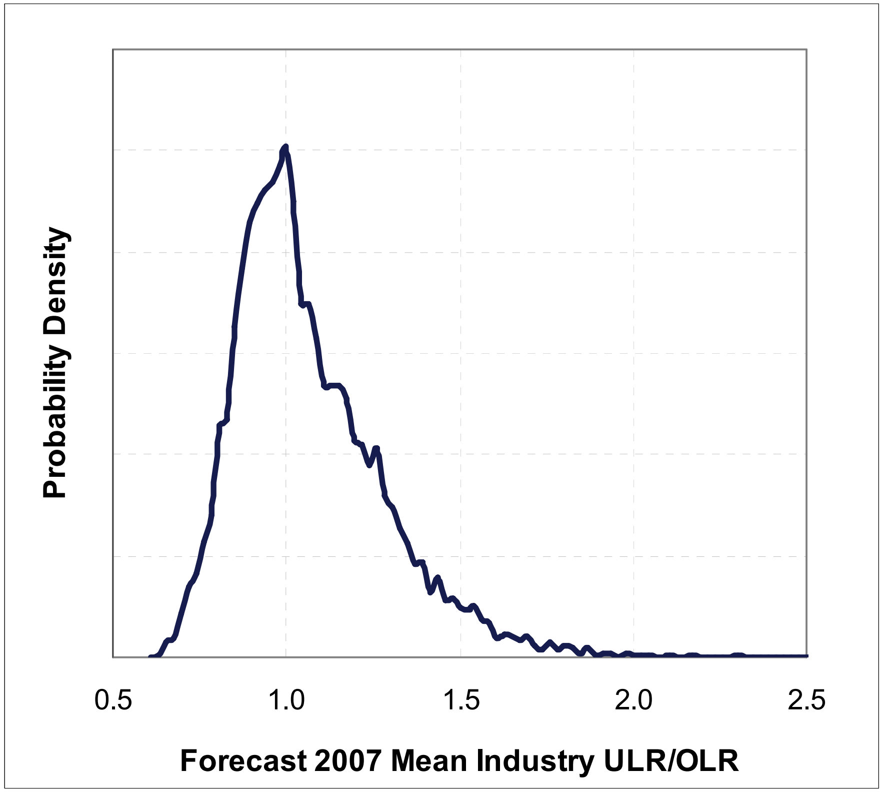
RESIDUALS OF AR(2) MODEL

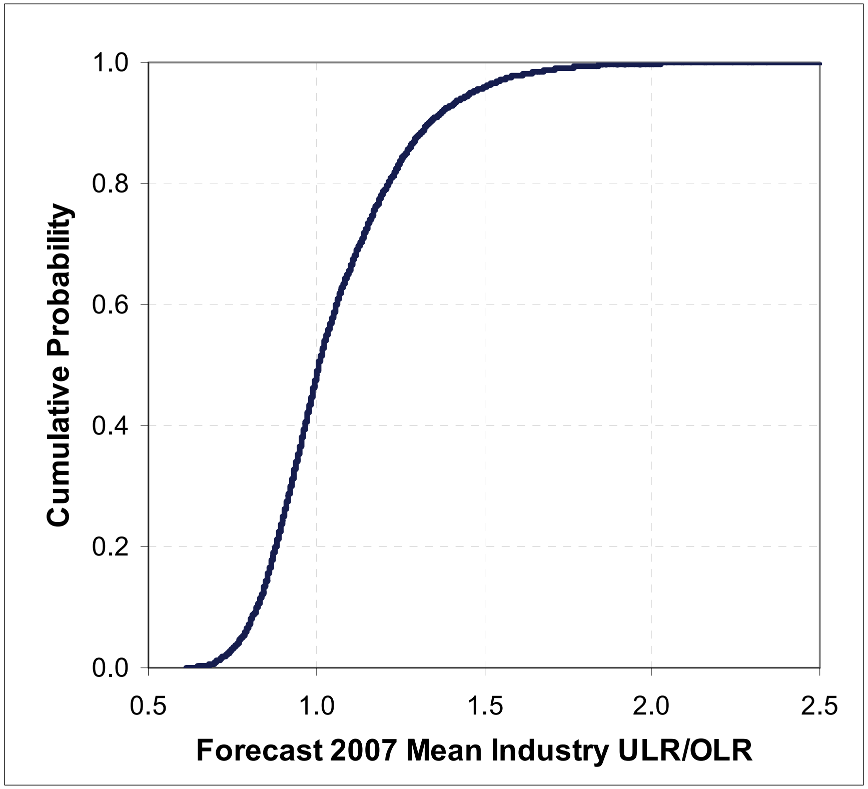


FORECASTING VIA SIMULATION



FORECASTING VIA SIMULATION





BACK-TESTING

Compared μ values fitted to data to the percentiles of the forecast distributions

	Observed	Observed Percentage		Theoretical
Quintile	Count	Incremental	Cumulative	Cumul. %
1	4	27%	27%	20%
2	2	13%	40%	40%
3	5	33%	73%	60%
4	4	27%	100%	80%
5	0	0%	100%	100%
Total	15	100%	100%	100%

Observations fit theoretical quintiles reasonably well

OBSERVATIONS

Do not necessarily expect future μ values to fall at the center of forecast distribution

- Not a precise point estimate of future μ
- Not a crystal ball to predict shifts in market

However, useful in predicting the range of future μ values

- How likely is the industry to get it wrong, and by how much?

CAVEATS

- Imperfect data
- ULR approximation
- External “shock” influences
- Intrinsic “component” influences
- Company-specific behavior

Note: back-testing suggests tail of forecast may be somewhat conservative… but with only 15 data points cannot draw firm conclusion

CONCLUSIONS

- Advantages of top-down approach
  - By its nature, incorporates all sources of estimation error
  - Does not require contemplation of dependencies among them
- Time series analysis can help quantify the likelihood and magnitude of estimation error for current and future accident years at the industry level
- May be useful in
  - Stress testing
  - Making reinsurance decisions
  - Conducting dynamic financial analysis
  - Applying enterprise risk management techniques

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