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A Dynamic Analysis of the Effect of Growth on Property-Liability Insurers

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What is Dynamic Financial Analysis?

- **Dynamic**
  - Stochastic, variable
  - Not deterministic, fixed, static
  - Reflects uncertainty
- **Financial**
  - Integration of underwriting and finance
  - Assets *and* liabilities
- **Analysis**
  - "An examination of a *complex*, its elements and their relations"
  - *Complex*: "a whole made up of complicated or interrelated parts."

Public Access Model

- DFA Model for Property-Liability Insurance
- Developed by Miller, Herbers, Lehmann & Associates actuarial consulting firm
- DynaMo3
- Available at: www.mhlconsult.com

What Can DFA Do?

- DFA is to financial planning what confidence intervals are to loss reserving
- DFA allows users to examine the distribution of potential financial developments under specific conditions
- DFA allows users to change the conditions and examine the effects of the change
- DFA is a critical step in financial risk management

Objectives of this DFA Model

- Develop a financial model for a United States property-liability insurer that is:
  - Realistic enough to be useable
  - Simple enough to be understood

What Does This Model Do?

- Simulates results for the next 5 years
- Generates financial statements
  - Balance sheet
  - Operating statement
  - IRIS results (Regulatory tests)
- Indicates expected values and distribution of results for any value selected

Specific Provisions of DynaMo3

- Six separate, but interrelated modules
  - Investments
  - Underwriting
  - Interest rate generator
  - Catastrophes
  - Taxation
  - Loss reserve development
- Two lines of business
- For each line of business
  - New business
  - 1st renewals
  - 2nd and subsequent renewals

Key Variables in *DynaMo3*

- Financial
- Underwriting
- Catastrophes

Key Financial Variables

- Short-term interest rate
- Term structure of interest rates
- Default potential
- Equity performance
- Inflation
- Mortgage pre-payment patterns

Interest Rate Generator

Cox-Ingersoll-Ross one factor model

$$\Delta r = a(b - r)\Delta t + s\sqrt{r}\varepsilon$$

r = short term interest rate

a = speed of reversion = .2339

b = long run mean interest rate = .05

s = volatility of interest rate process = .0854

Δr = annual change in r

Δt = one year

ε = random sampling from a standard normal distribution

Key Underwriting Variables

- Loss frequency
- Loss severity
- Rates and exposures
- Expenses
- Underwriting cycle
- Loss reserve development
- Jurisdictional risk
- Aging phenomenon
- Payment patterns
- Reinsurance

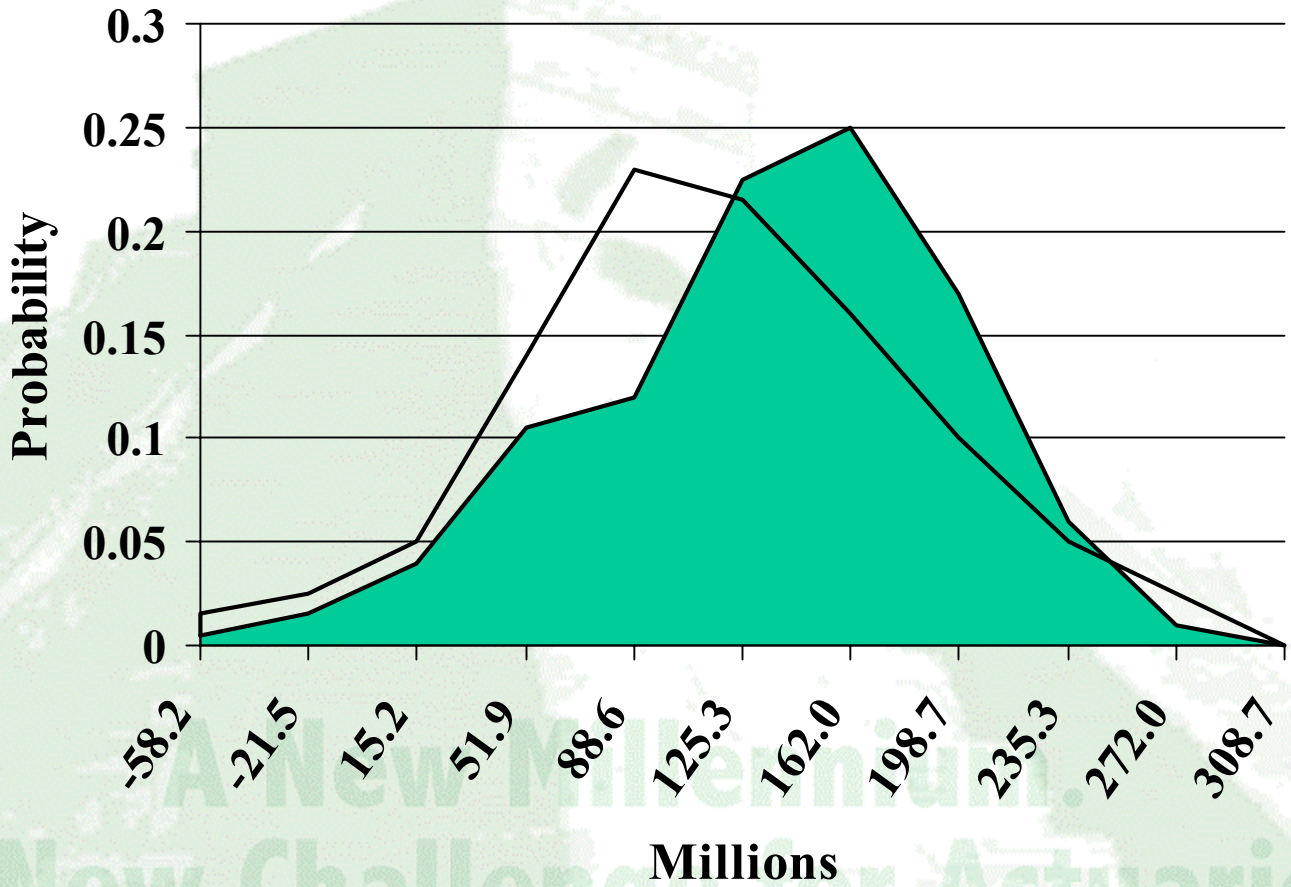
Catastrophe Risk

- Poisson distribution for number of catastrophes
- Each catastrophe assigned to a geographic focal point
- Based on focal point, size of catastrophe is determined based on a lognormal distribution
- Contagion factor is used to distribute catastrophe to nearby states
- Losses distributed based on market share by state

Year 2006 Surplus Distribution

Different Reinsurance Assumptions

Lowered Stop Loss Attachment Point



XYZ Company

- Two lines of business
  - Homeowners
  - Workers' Compensation
- Two states
  - Florida
  - Illinois
- Direct Written Premium $58.8 million

XYZ Statutory Balance Sheet
Year End 2001

Assets		**Liabilities**	
Bonds	93,000,000	Losses and LAE	34,401,570
Stocks	2,500,000	Unearned Premium	25,500,000
Cash	1,150,000	Other Liabilities	2,598,430
Other Assets	5,850,000	Total Liabilities	62,500,000
Total Assets	102,500,000		
		Surplus	49,850,000

Objective of Study

- Determine optimal growth rate for XYZ Company using DFA model
- What is the appropriate metric to optimize?
  - Future Statutory Policyholders Surplus
  - Future GAAP Policyholders Surplus
  - Income over projection period
  - Income over projection period plus terminal company value

Why Does Growth Matter?

- Growth Affects Leverage
  - Premium to Surplus Ratios
- Growth Affects Operations
  - Can infrastructure keep up with growth
- Aging Phenomenon

What is the Aging Phenomenon?

- New business has a high loss ratio
- The loss ratio declines as a book of business ages for an insurer
- Occurs for all property-liability lines
- Opposite relationship from life insurance
  - Select and ultimate experience
- Impact of current significant rate increases

What Causes the Aging Phenomenon?

- Possible explanations:
  - Difficulty in initial underwriting
  - Winner's curse on new business
  - Correlation of willingness to switch insurers and loss experience
- New business contains a high percentage of unidentifiable poor risks
- Possible impact of CLUE (Comprehensive Loss Underwriting Exchange)

How *DynaMo3* Reflects Aging Phenomenon

- Age of book of business
  - New
  - 1st renewal
  - 2nd and subsequent renewals
- Renewal rates
  - Mature business more likely to renew
- Premiums levels
- Pure premiums

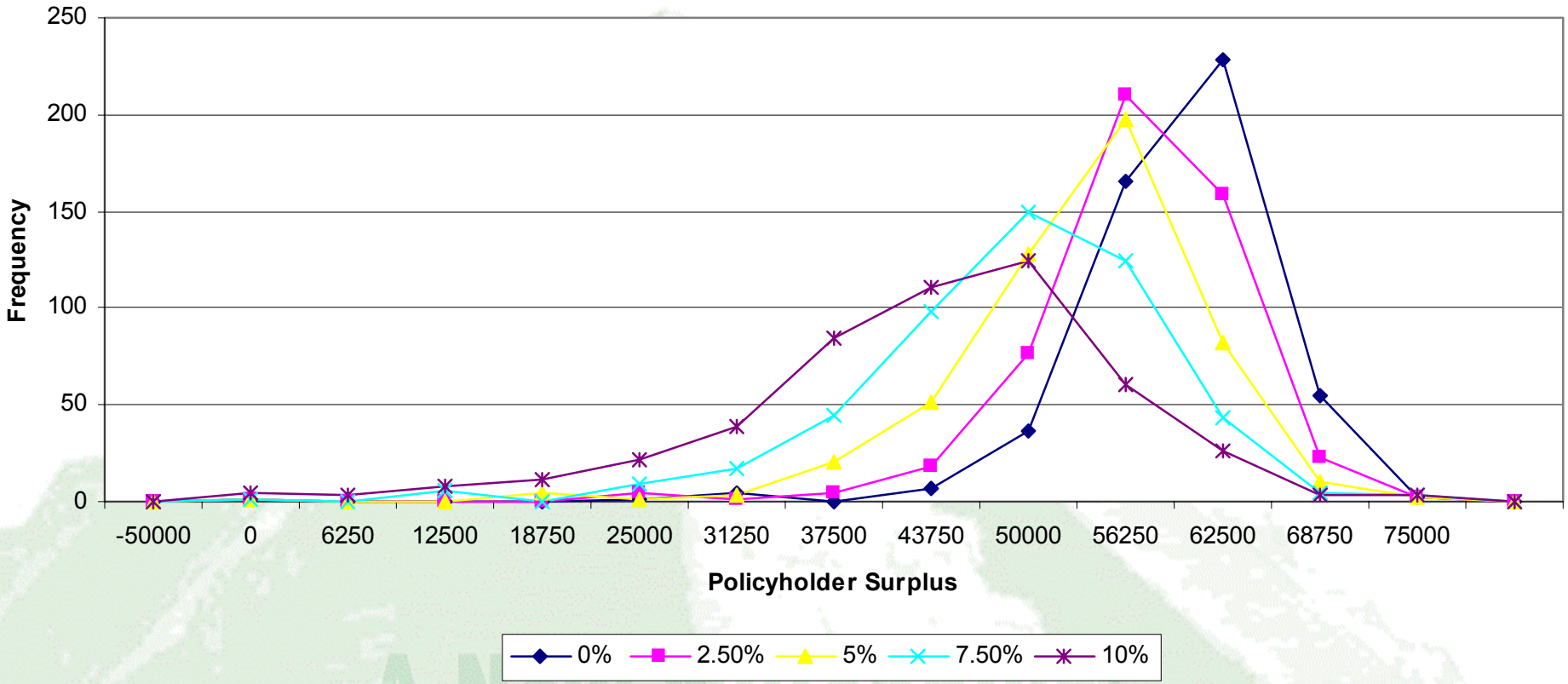
Approach

- Assume different growth rates
  - Over a potential range of 0 - 10%
- Run 500 simulations for each growth rate assumption
- Compare means and distributions of results

Exhibit 4
Statutory and GAAP Surplus and Gross Income for Different Growth Rates
Mean Values of 500 Simulations

Growth Rate	Statutory Policyholders Surplus in 2006 (000 omitted)	GAAP Policyholders Surplus in 2006 (000 omitted)	Gross Income 2002-2006 (000 omitted)
0%	56, 419	68,810	18,645
2.5%	53,585	67,113	15,572
5.0%	50,164	64,958	12,151
7.5%	45,854	62,007	7,783
10.0%	40,371	58,186	2,306

Statutory PHS 2006
Under Different Growth Rates



Initial Indication

- No growth is the optimal strategy
- Perhaps negative growth would be optimal
- Impact of decision to withdraw from a market

Delving Deeper – Implied Rate Change Variable

- Value based on desired growth rate and market conditions
- Underwriting cycle generator
- Four types of market conditions

Mature hard	Immature soft
Mature soft	Immature hard

- Average implied rate change values (before loss cost inflation is included)

0% Growth: 1.3%

10% Growth : –1.2%

Delving Deeper – Renewal Rates

- Renewal rates are likely to be affected by rate changes
- Higher premium rates would imply lower renewal rates
- Lower renewal rates would lower profitability of long-term business

Delving Deeper – Future Written Premiums

- Terminal value of firm would be a function of written premiums
- Optimization should be based on income during projection period plus terminal value of company
- Assume terminal value is:

  GAAP PHS + {M × NWP}

  M = multiplier reflecting future value of book of business

Exhibit 6
Gross Income plus Terminal Value of the Firm for Different Growth Rates Mean Values of 500 Simulations

Growth Rate	GAAP PHS in 2006 (000 omitted)	Gross Income 2002-2006 (000 omitted)	Net Written Premium in 2006 (000 omitted)	Gross Income + GAAP PHS	Gross Income + GAAP PHS + .6 x NWP	Gross Income + GAAP PHS + 1.0 x NWP
0%	68,810	18,645	65,776	87,455	126,921	153,231
2.5%	67,113	15,572	75,003	82,685	127,687	157,688
5.0%	64,958	12,151	85,190	77,109	128,223	162,299
7.5%	62,007	7,783	96,374	69,790	127,614	166,164
10.0%	58,186	2,306	108,602	60,492	125,653	169,094

Revised Indications

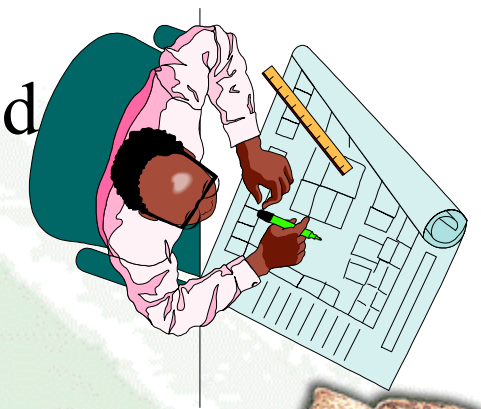
- If Value of Firm = GAAP + 60% of NWP
  - Optimal growth rate ~ 5%
- If Value of Firm = GAAP + 100% of NWP
  - Optimal growth rate > 10%

Other Considerations

- Taxation
- Premium to Surplus Ratios
  - Percent of time at unacceptable levels
- IRIS Test results
- Growth rate could vary with market condition

Caveats

- Any model is a simplified version of reality
- Parameter and process risk
- This model deals with quantifiable risk only
  - Examples of excluded items:
    - A line of business being socialized
    - Management fraud
    - Devastating meteor strike



Conclusion

- DFA can be a very useful tool for both solvency testing and strategic planning
- DFA is not the ultimate solution
- Any model must be fully understood and applied appropriately

For More Information

- On DFA
  - CAS website: http://casact.org/research/dfa/index.html
  - My website: http://www.cba.uiuc.edu/~s-darcy/
- On the Aging Phenomenon
  - D'Arcy and Doherty, 1990, *Journal of Business*, 63: 145-164
  - D'Arcy and Doherty, 1989, *Proceedings of the Casualty Actuarial Society,* 76:24-44
  - Feldblum, 1996, *Proceedings of the Casualty Actuarial Society,* 83:190-296