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GC Analytics™

The Reinsurance Value Proposition
A Question of Market Value

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Concurrent Session CS-10

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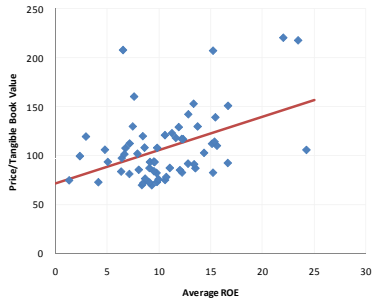
Agenda

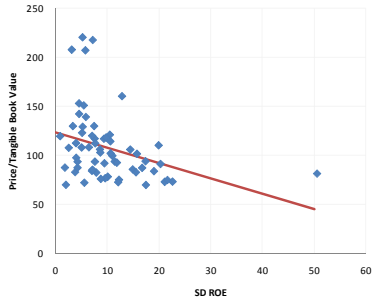
- Earnings volatility and value among insurance firms
  - Some empirical observations
- Is underwriting risk "priced" in the capital markets?
  - An empirical investigation
- "Risk Valuation for Property-Casualty Insurers"
  - (To appear in ***Variance***)
  - A Tale of Four Models
- Price and growth strategies
  - Refining the Firm Life Annuity model
- The Underwriting Cycle
  - Dynamic strategies over time

Earnings volatility and value
Some empirical observations

No surprise – higher earnings means higher value



More interesting – increased earnings volatility has lower value



But wait!

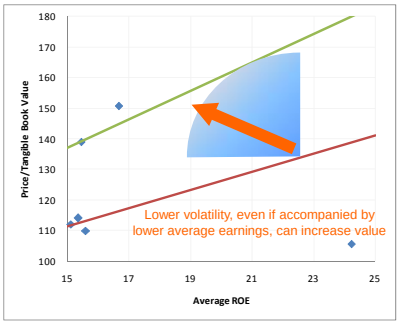
- What if higher volatility is associated with lower earnings?
- We must study the effects *jointly*
- Sharpe ratio (average/volatility)?
  - A start, but not comprehensive enough
- Modulation model:

$$P/B = \alpha + \begin{pmatrix} function\ of \\ StdDev\ ROE \end{pmatrix} \cdot \begin{pmatrix} Average \\ ROE \end{pmatrix}$$

Volatility *modulates* the relationship between average earnings and value

Visualizing the modulation

Good news for reinsurance – lower volatility can be paid for



But wait!

- Shouldn't we expect this from the Capital Asset Pricing Model (CAPM)?
  - Higher volatility ("beta") commands higher returns
- But that's *systematic* (correlated with capital markets) volatility
  - Reinsurance operates on *underwriting* volatility
  - which is *not* correlated (at least, not much) with capital markets
  - so is considered *non-systematic*
- If all we're seeing is a picture of CAPM, then that is not good news for reinsurance.

Is underwriting risk "priced"?
An empirical investigation

The Wall Street valuation model

Actually, the Gordon Growth Model

Retained earnings
Provision for growth

$$P/B = \frac{AverageROE - GrowthRate}{CostOfCapital - GrowthRate}$$

Determined by CAPM

$$r = r_f + \beta \cdot (r_m - r_f)$$

Turning the Wall Street model into a regression model

$$\frac{AveROE}{P/B} = \alpha + \beta_{sys} \cdot \begin{pmatrix} Systematic \\ Volatility \end{pmatrix} + \beta_{nonsys} \cdot \begin{pmatrix} NonSystematic \\ Volatility \end{pmatrix}$$

If only systematic risk matters: $H_0 : \beta_{nonsys} \equiv 0$

This is the statistical hypothesis to test.

Not so fast….

- In CAPM, volatility refers to *market returns*.
- Here, we are talking about volatility of *earnings*.
- Not quite the same, but in the same spirit.
  - Systematic volatility is component correlated with S&P returns
  - Nonsystematic is the component uncorrelated with S&P returns

Results

- Regression R-square = 0.36, highly significant
  - β_{sys} is highly significant (shouldn't be a surprise)
  - β_{nonsys} is significant at 3.8%, rejecting the null hypothesis
- Total required return, for the median firm, breaks out as follows:
  - 0.0948 = total
  - 0.0462 = risk-free rate - growth rate
  - 0.0401 = systematic risk premium
  - 0.0085 = nonsystematic risk premium
- If you could trim nonsystematic volatility by 33%, ***say by introducing a reinsurance program,*** then…
  - Total required return would go down by 28bp.
  - That would increase (modeled) market cap by 3%
  - Equivalent to increasing average earnings by 3%
- Good news for reinsurance: it has a measurable market value.

But wait!

- Is the Wall Street Model the right way to look at insurance valuation?
- What about bankruptcy risk? Where does that fit in?

Risk Valuation
A Tale of Four Models

Risk Valuation for Property-Casualty Insurers

to appear in ***Variance*** (Casualty Actuarial Society)

Asset pricing theory

The fundamental asset pricing equation

$$M_t = E\left[\sum_{i=1}^{\infty} CashFlow_{t+i} \cdot SDF_{t+i}\right]$$

Market Value today

Stochastic discount factor (pricing kernel)

Specializations: risk-adjusted cost of capital, discounted dividends, discounted cash flow, abnormal earnings, risk-neutral valuation, …

The Wall Street model revisited

$$M_t = E\left[\sum_{i=1}^{\infty}\left(Profit_{t+i} - \left(\begin{matrix}Retained\\Surplus\end{matrix}\right)\right)\cdot\left(\begin{matrix}Growth\\Factor\end{matrix}\right)^{i-1}\cdot\frac{1}{(CapitalFactor)^i}\right]$$

Cash flow

SDF

$$= \frac{AveProfit - \left(\begin{matrix}Retained\\Surplus\end{matrix}\right)}{CostOfCapital - GrowthRate}$$

Same as before

Mechanically:

(1) Arbitrary surplus level is chosen

(2) Each year, profits (+) or losses (-) absorbed by shareholders to maintain level

(3) No bankruptcy

Economic Capital model specializes the Wall Street model

Amount of surplus is tied to level of risk (e.g., VaR criterion)

Goal is to maximize FranchiseValue = MarketValue - BookValue

$$\Delta FranchiseValue = \frac{\Delta MarketValue}{-\Delta Surplus} = \frac{\Delta AveProfit - (CostOfCapital)\cdot\Delta Surplus}{CostOfCapital - GrowthRate}$$

"EC criterion":
Does risk transformation
meet cost of capital?

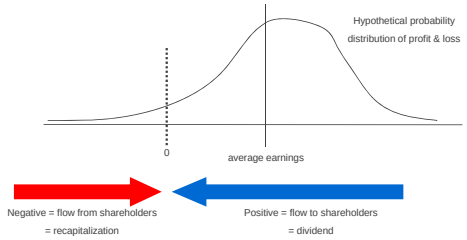
Mechanically:

(1) *Risk-based* surplus level is chosen

(2) Each year, profits (+) or losses (-) absorbed by shareholders to maintain it

(3) No bankruptcy

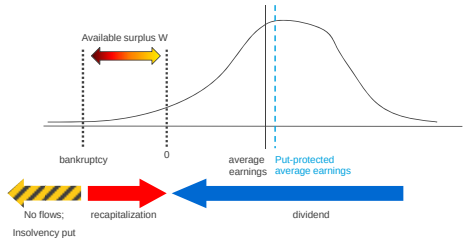
Problem with Wall Street & EC models: free cash flow to equity



FCFE pretends that recapitalization is

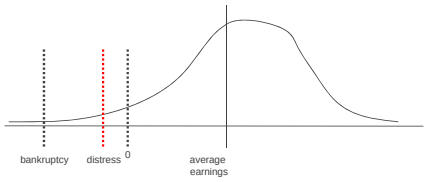
cheap, quick, and painless

Shareholders will not recapitalize if it makes more sense to walk away



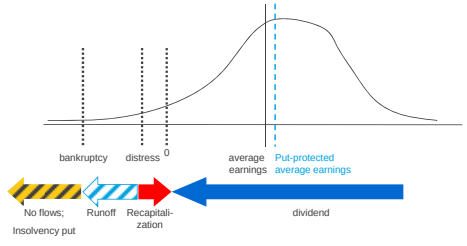
Taking insolvency risk into account
will alter the Wall Street equation

Distress happens before insolvency



What defines distress?
- Loss of ability to execute profitable business operations
- Change in perceived riskiness, ratings, credit quality, etc.
- IRIS tests, EC model, BCAR model, etc.

Shareholders will not recapitalize if it makes more sense to run off



Taking distress risk into account
alters the equation further

Firm Life Annuity Model takes bankruptcy into account

Cash will flow as long as good financial condition is maintained

Firm goes into runoff if it experiences "financial distress"

Amount of surplus is arbitrary, but affects probability of distress

$$MarketValue = \frac{\begin{pmatrix} PutProtected \\ AveProfits \end{pmatrix} - \begin{pmatrix} RiskAdjusted \\ GrowthRate \end{pmatrix} \cdot Surplus}{CostOfCapital - \begin{pmatrix} RiskAdjusted \\ GrowthRate \end{pmatrix}}$$

Mechanically:

(1) Arbitrary surplus level is chosen (so choose it to maximize franchise value)

(2) Each year, profits (+) or losses (-) absorbed by shareholders to maintain surplus *as long as no financial distress*

(3) Otherwise, go into runoff (and bankruptcy)

Limitations of Firm Life Annuity Model for valuation

- FLAM *still* pretends that recapitalization is cheap, quick and painless (in some circumstances)
- Therefore, only the magnitude of one-year distress risk matters
  - Does not recognize multi-year slide into distress

Optimal Dividends model recognizes recapitalization is costly

Cash flows are optimized, under strategic control

Profitability suffers if firm experiences financial distress

Amount of capital is variable, affects probability of distress

Includes cost load for infusion of external capital

$$MarketValue = \max\left\{ CashFlow + \frac{Growth}{Discount} \cdot E\left[FutureMarketValue\right] \right\}$$

Optimal control

Cash flow *to*(+) or *from*(-) shareholders

Expectation is conditional on risk management

Definition of Market Value is recursive

Mechanically:

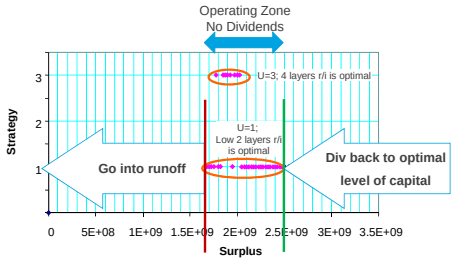
(1) Surplus level starts somewhere, changes randomly

(2) Each year, cash flows *chosen* to go to/from shareholders to alter surplus

(3) Runoff (and bankruptcy) is also a strategic option

This is a matrix equation to be solved for market value as a function of surplus level

Optimal capital strategy is typically "banded"



http://www.cb.wsu.edu/aria2009/ARIA2009Papers/Full%20Papers/session1D_Major.pdf

Comparing the four models

Increasing realism of model representation

WS/GG	EC	FLAM	OD
▪ No bankruptcy ▪ Automatic recapitalization ▪ Capital level is arbitrary ▪ Formula in means	▪ No bankruptcy ▪ Automatic recapitalization ▪ Required capital level defined by risk "appetite" ▪ Formula in means & EC	▪ Runoff after distress ▪ Automatic recapitalization @ good rating ▪ Optimize capital *level* for value ▪ Formula in distribution	▪ Profit hit after distress ▪ Recapitalization is costly, runoff an option ▪ Optimize capital *strategy* for value ▪ Numerical methods
No value for reinsurance	Reinsurance substitutes for capital	Reinsurance protects franchise value	Reinsurance protects franchise value

But wait!

- All of these models assume a "stationary" environment
  - Probability distribution of P&L the same every year
  - Constant growth in scale of operation
- What about price/growth strategies?
- What about the underwriting cycle?

Price and Growth Strategies
in the Firm Life Annuity Model

There is a tradeoff between growth and price (duh)

$$GrowthRate = Baseline + \varepsilon \cdot \left(\frac{Industry\ Rate - Company\ Rate}{Industry\ Rate} \right) + RandomError$$

Plausible values of ε:

Schlesinger - German auto insurance: 4-10

Berger - US auto insurance: ~0.5

Tradeoff affects FLAM value through several channels

- Premium rate directly affects revenue
- Premium rate affects growth rate through assumed relationship
- Premium rate affects probability of distress and insolvency

Understanding the tradeoff through some simplification

IF…

expected growth is linear (as the above model presumes), and
profit rate increases linearly in price (another simplification), and
distress risk is negligible

THEN…

price drops out of the numerator of the derivative of market value w.r.t. price and therefore…
Optimal strategy is "bang-bang"

– Price as high or as low as possible, according to the sign of the derivative

The Underwriting Cycle
Dynamic strategies over time

Growth-price tradeoff is sensitive to baseline profitability

- If profitability is **higher**, sensitivity of market value to price is **lower**
- With high enough profitability, eventually **negative**
- Indicating a low-price high-growth strategy to increase value

- High profits => growth strategy (prices and profits go down)
- Low profits => price strategy (prices and profits go up)
- Sound familiar?

Firm Life Annuity Model over the underwriting cycle

New concepts needed

Variables to index the (annual) state of the cycle

Transition probabilities from one state to the next

Reinsurance or risk management decisions in state *s*

Net profit result after applying risk management

Price decision in state *s*

Profit offset function of price

Capital decision (retained surplus level) in state *s*

Result is a matrix equation to be solved for market value in a particular state, depending on optimal strategies for risk management, premium rate, and surplus

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