

Integrating Pricing into Risk Management

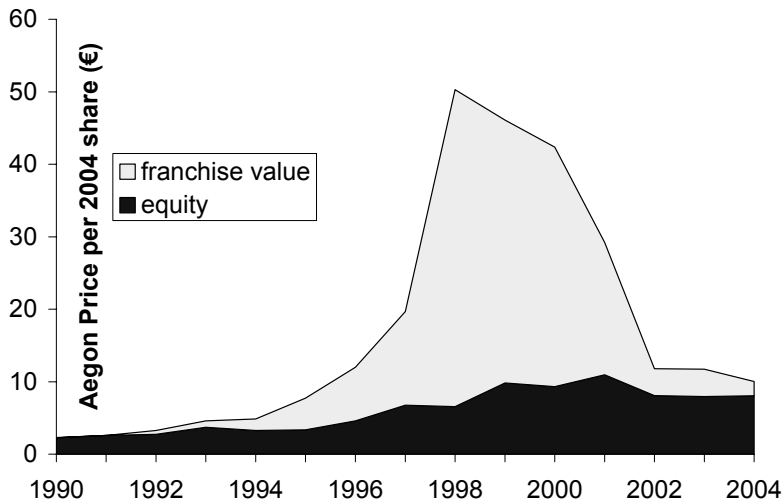
Enterprise Risk Management Symposium, Chicago
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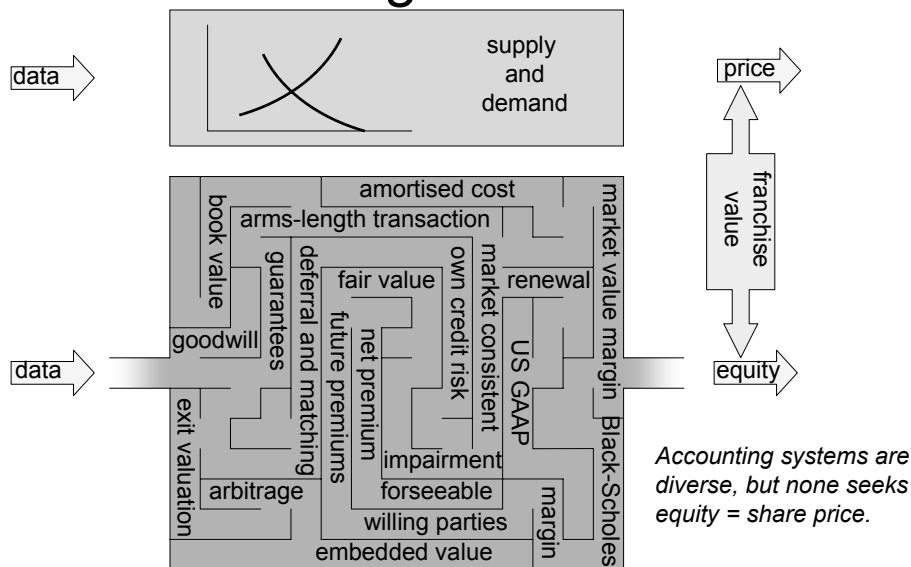
Presentation Overview

- Why we need a share price model
- The Moran-Smith-Walczak Model
- Implications for Product Pricing, Capital and Risk Management

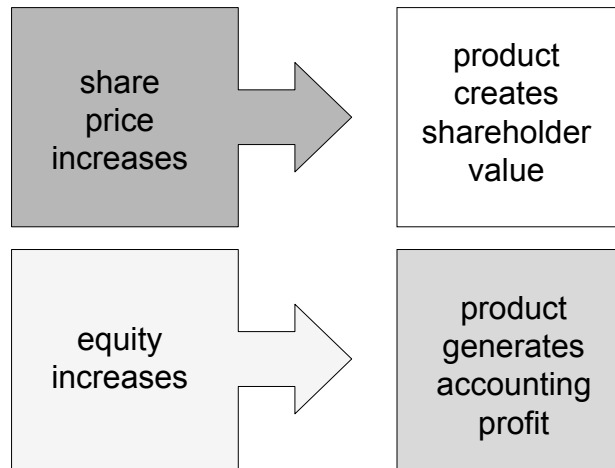
Equity and Franchise Value



Accounting and Markets



Getting Paid to Take Risks



These two tests are different,
because equity is not equal to market capitalisation.

Questions / Discussion

What do you understand as drivers of share price as opposed to accounting value?
How do you reflect these in product pricing?

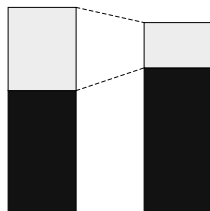
Moran-Smith-Walczak Model

Using the MSW Model



Explain franchise value in terms of:

- present value of future profit
- cost of holding capital
- cost of failure



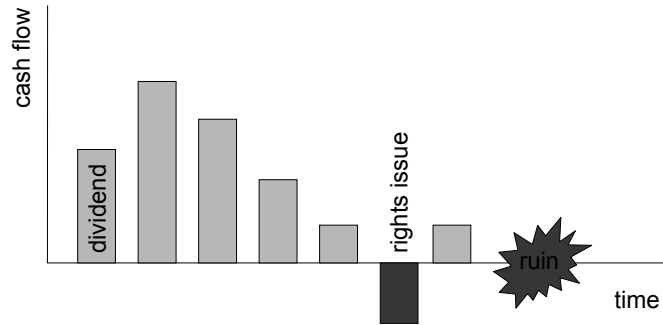
Assess marginal impact of new business:

- Δ present value of future profit
- Δ cost of holding capital
- Δ cost of failure

In addition to new business pricing, model useful for

- optimal capital structure
- investment and reinsurance strategy
- assessing value of risk management
- performance measurement

Using Capital Market Technology to Understand your Stock Price



Analytic MSW

- Closed form solutions
- Simplified business
- Show this today

Monte Carlo MSW

- Dynamic financial analysis model
- With market consistent pricing
- Accurate pricing assessment

Operational Model

| | | |
|--|---|--|
| | + liabilities * $(R_G - R_L)$ | $\left\{ \begin{array}{l} + \text{ premium income} \\ - \text{ benefit outgo} \\ + \text{ investment income} \\ - \text{ increase in liabilities} \\ - \text{ asset related expense} \\ - \text{ liability related expense} \\ - \text{ equity related expense} \end{array} \right.$ |
| + assets * R_A | - liabilities * R_G | |
| - assets * k_A | - liabilities * k_L | <hr/> = profit before tax - tax <hr/> = profit after tax $\left\{ \begin{array}{l} + \text{ new equity raised} \\ - \text{ dividend paid} \end{array} \right.$ |
| - assets * k_E | + liabilities * k_E | |
| + assets * $(R_A - k_A - k_E)$ | - liabilities * $(R_L + k_L - k_E)$ | <hr/> = retained earnings |
| - assets * $k_T * (R_A - k_A - k_E)$ | + liabilities * $k_T * (R_L + k_L - k_E)$ | |
| + assets * $(1 - k_T) * (R_A - k_A - k_E)$ | - liabilities * $(1 - k_T) * (R_L + k_L - k_E)$ | |
| + assets * $[R_G - (1 - k_T) * (R_A - k_A - k_E)]$ | - liabilities * $[R_G - (1 - k_T) * (R_L + k_L - k_E)]$ | |
| + assets * R_G | - liabilities * R_G | |

Example Parameters

Underlying Business Assumptions (risk neutral, continuous compounding)

| | |
|------------------|-------|
| Risk Free | 4.00% |
| Asset return | 4.00% |
| Liability return | 2.00% |
| Growth | 1.00% |

Risk neutral return assumptions summarise many drivers of franchise value, including

- Brand
- Industry image
- State of the economy
- Quality of management
- Relationships with distributors

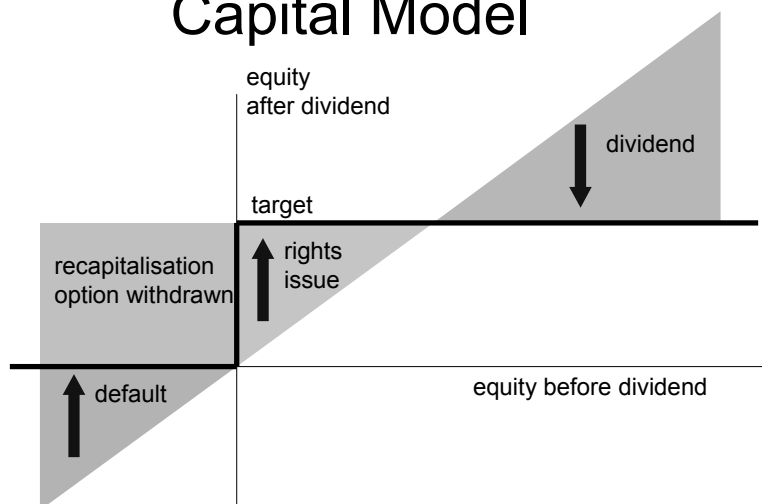
Frictional Costs

| | |
|----------------|--------|
| asset cost | 0.50% |
| liability cost | 0.00% |
| equity cost | 2.00% |
| tax | 20.00% |

Equity related costs: examples

- (1) loss of control. More money handed to managers.
 - (2) conflict of interest. Managers may not treat assets as their own
 - (3) pet projects: value-destroying M&A, buying market share
 - (4) deep pocket: become a target for plaintiffs or regulators
- Reasons for not holding infinite capital or 0.0001% ruin probability.

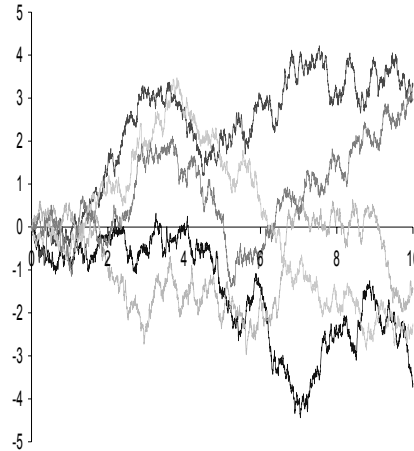
Capital Model



You cannot abstract entirely from accounting measures of wealth, because accounting determines whether you can continue trading

Choice of Stochastic Model

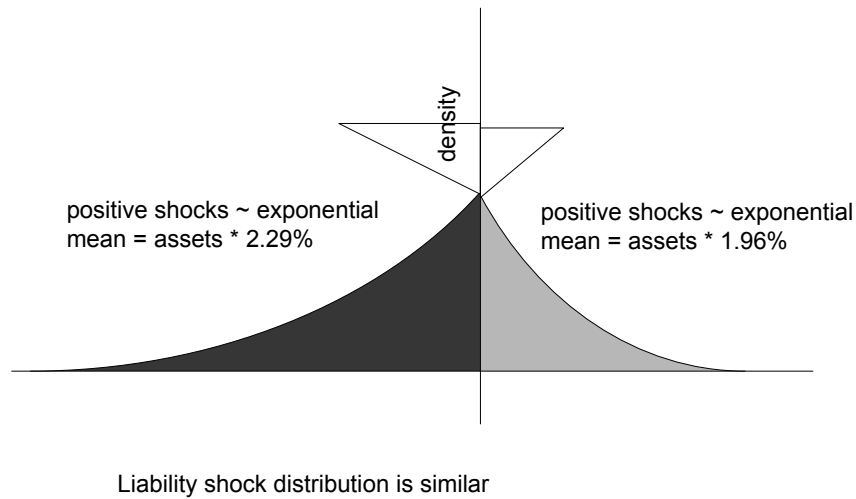
- Much of classical finance is based on normal distributions and Brownian motion
 - Option pricing models
 - VaR economic capital calculators
- We suggest these are inadequate to capture rare ruin events
- Especially when allowing for options to recapitalise



Making the Model Stochastic

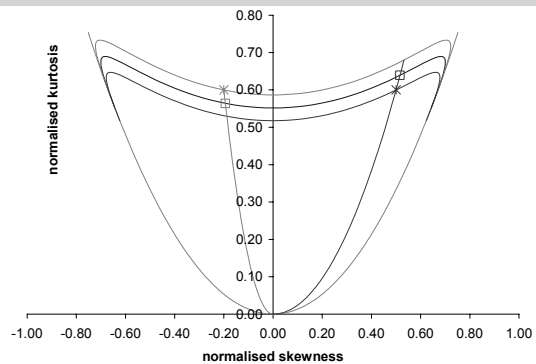
- Asset and liability shock events occur as Poisson process
 - risk neutral law
 - frequency 10.88 per annum
 - Asset shock proportional to assets held, liability shock proportional to liabilities
- For each event
 - generate $E \sim \text{exponential}(1)$
 - generate bivariate normal
 - (asset shock, liability shock)
 - conditional mean $(-0.00327E, 0.00955E)$
 - conditional standard deviation $(0.0300\sqrt{E}, 0.0271\sqrt{E})$
 - conditional correlation 86.79%

Distribution of Asset Shocks



Stochastic Parameter Selection

| Stochastic Assumptions | | | | | | |
|------------------------|--------------------|-------------|-------------|--------------|-----------------|-----------------|
| | standard deviation | target skew | fitted skew | min kurtosis | target kurtosis | fitted kurtosis |
| Asset return | 10% | -0.20 | -0.19 | 0.05 | 0.60 | 0.56 |
| Liability return | 10% | 0.50 | 0.52 | 0.33 | 0.60 | 0.64 |
| Correlation | min | -95.28% | | | | |
| | max | 81.69% | | | | |
| | selected | 70% | | | | |

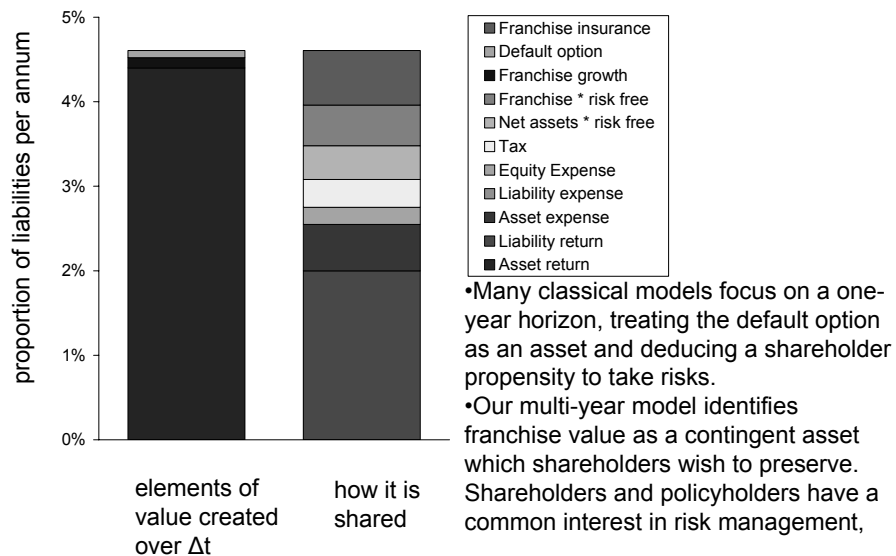


Questions / Discussion

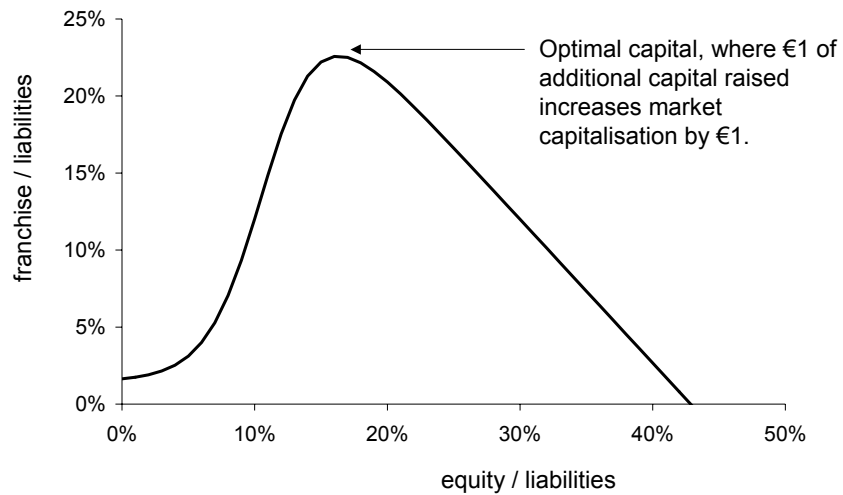
What type of model have you used for this situation and why?

Other possible values for these parameters?

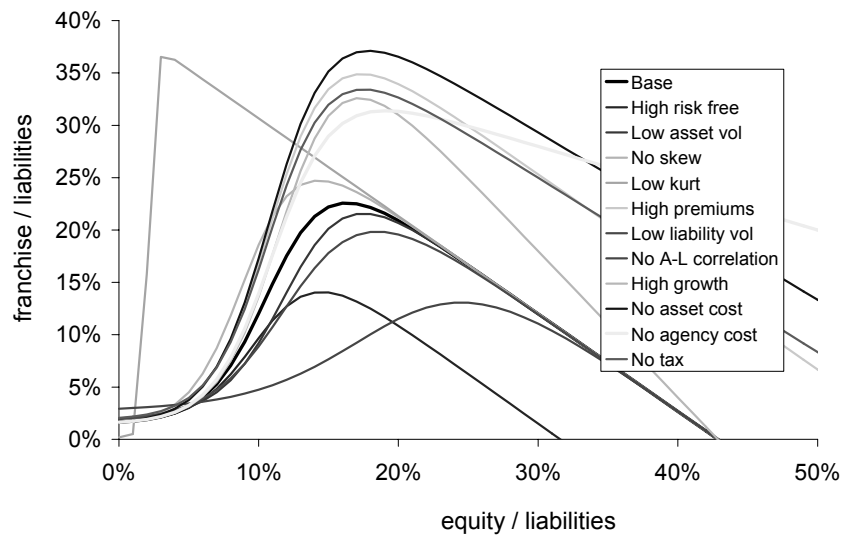
Output – The Equation of Value



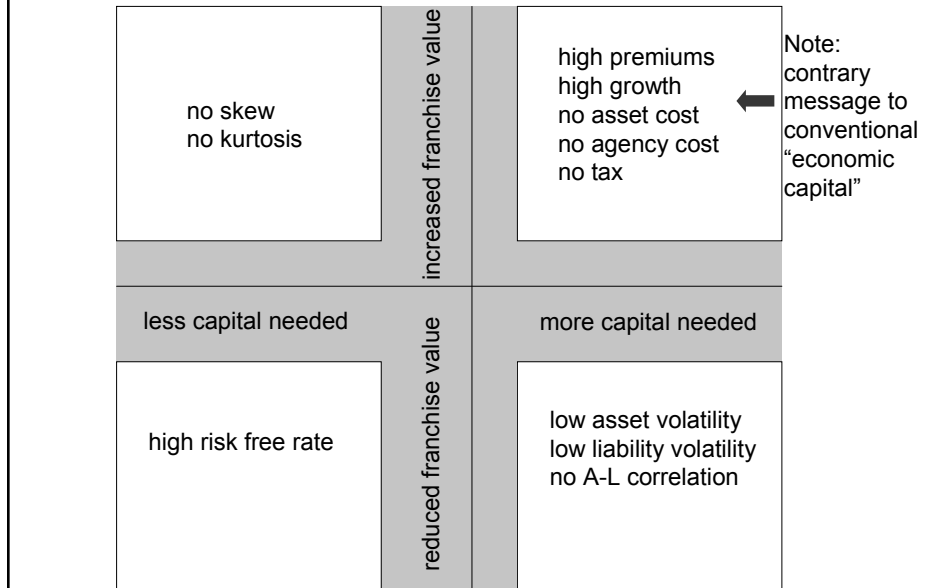
Output – Franchise vs Equity



Assumption Sensitivities



Sensitivity Summary

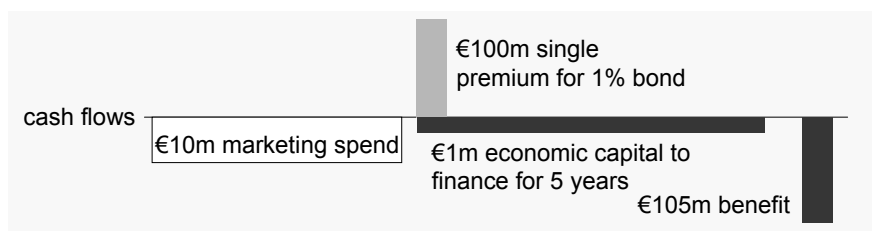


Questions / Discussion

How do you articulate the relationship between VaR, economic capital and target equity?

Pricing Implications

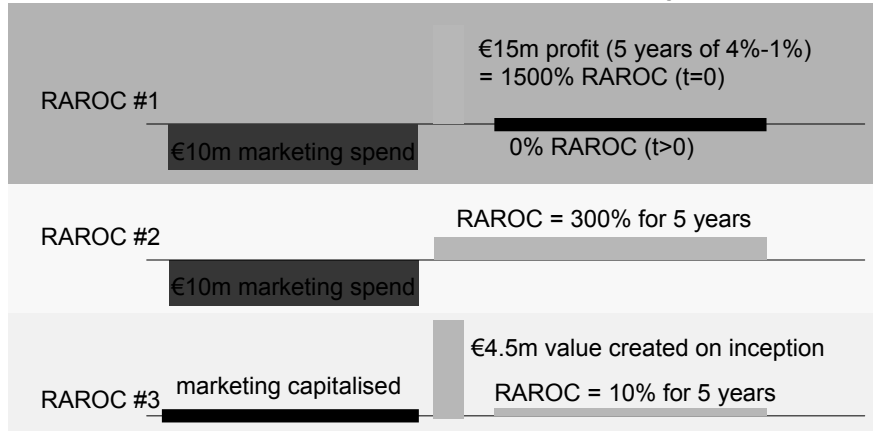
Low Return Bond Example



Mark-to-market profit is €15m at product inception. But should this be

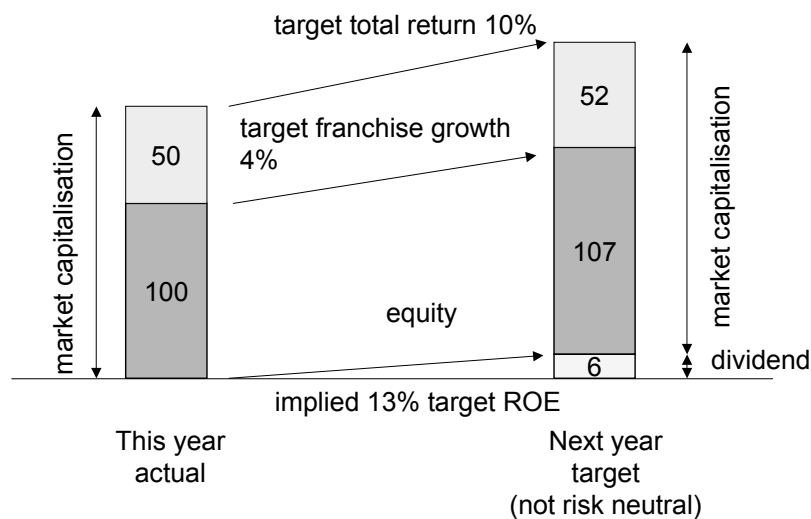
- (1) A return on €1m ECAP at that point
- (2) A return on €1m ECAP spread over the product term
- (3) A return on the €10m marketing spend?

Bond Example: Analysis



A rational analysis of this product attributes the franchise value immediately prior to sale, and writes this down as the profit on inception is recognised. In addition, sufficient provisions are established to finance future ECAP.

Back to the Real World Return Modelling Example

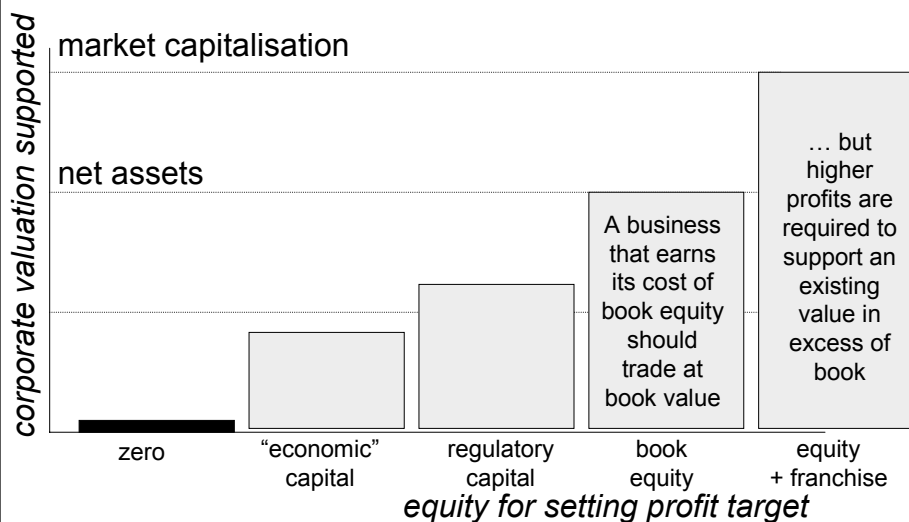


Importance of Franchise Growth

If original assumptions borne out:

| | equity | franchise value | total |
|-------------------|--------|-----------------|----------------------|
| year start | 100 | 200 | 300 |
| profit (post tax) | 30 | 6 | 36 |
| | RAROC | | Market Hurdle Return |
| dividend | 16 | | |
| retained | 14 | | |
| year end | 114 | 206 | 320 |

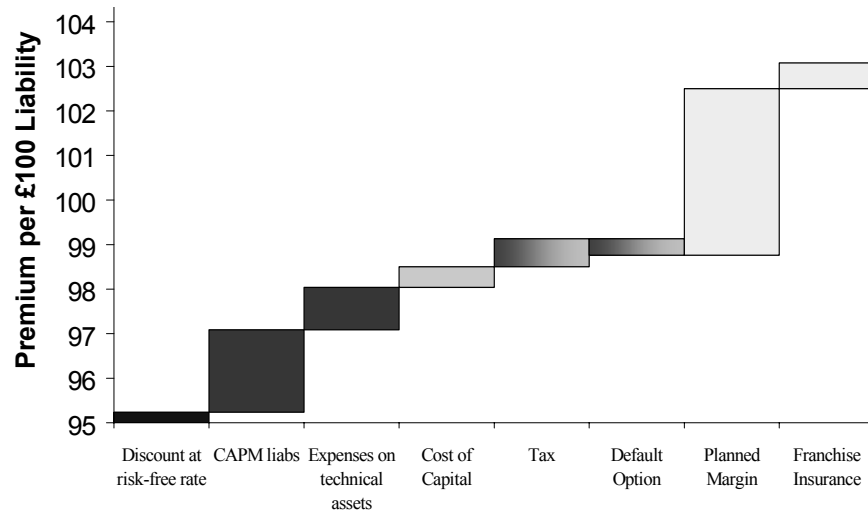
Profit Target: Impact on Valuation



Allowing for Stochastic Behaviour

- Change in Share Price requires an assessment of *marginal* risk impact.
 - Start with MSW model of whole business X
 - Marginal asset and equity (agency) costs require an assessment of marginal capital required
 - Default options and franchise insurance also require marginal assessment
 - $\mathbf{E}\max\{-X-\epsilon Y, 0\} \approx \mathbf{E}\max\{-X, 0\} - \epsilon \mathbf{E}(Y \cdot \chi\{X \leq 0\})$
 - this is the obvious bit – adjust value of projected cash flow Y for the probability that shareholders won't receive it
 - $\mathbf{Prob}\{X+\epsilon Y \leq 0\} \approx \mathbf{Prob}\{X \leq 0\} - \epsilon \mathbf{E}(Y|X=0)f_X(0)$
 - this is the one we to easily forget. Value created if $\mathbf{E}(Y) > 0$ conditional on marginal ruin event $X = 0$, because then the new policy helps to save the group franchise in critical situations.
- Example: policy where the benefit is only due in situations where you are bust anyway.
- Do you have reinsurance like this?

How Premiums Could Look



Credit Risk for Immediate Annuities

- What is the relationship between
 - discount rate for annuity pricing
 - your own credit standing
 - yield on investment portfolio
- Points to think about
 - risk neutral, all assets have the same expected return. No free lunch on high yield bonds.
 - effect of high yielders is on volatility, not on expected return
 - Volatility increases default option but also franchise insurance premium. Sign of credit risk effect ambiguous depending on insurer circumstances.

Economic Capital: a Panacea Risk Measure?

- When might economic capital (based on VaR, risk sensitivities) be a good proxy for risk cost in pricing?
- Is good to have *some* measure of risk, and at least our systems can already produce VaR
 - Correct in a normal distribution / linear response model
 - Proxy for required capital should be sensitive to kurtosis / large jumps
 - Proxy for default option should make the option more valuable as risk increases
 - Proxy for franchise insurance should look at (Δ , Γ , Λ etc) relative to most likely ruin event rather than to current balance sheet.

Conclusions

- You need new business to understand franchise value, and you need to understand franchise value to price new business
- A desire to preserve franchise value creates the shareholder incentive to risk management.
- Three risk aspects of new business pricing; capital needs, default option and franchise insurance.
- Economic capital can be a useful proxy for these risk items but you should understand the approximations involved and not treat a neat system implementation as a substitute for deep thought about the underlying economics.

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