Strategy, Pricing and Value

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Main Ideas

- Capital allocation is for strategy and pricing
  - Care needed for the risk pricing to make sense
- Review risk pricing theory
  - Standard theories like CAPM and arbitrage-free pricing have problems in insurance application
    - CAPM ignores higher moments
    - Both emphasize market price which ignores specific risk of each insurer
    - Some possible fixes discussed
- Look at risk measures consistent with pricing
  - Distortion measures and other probability transforms
    - Calibrate to level of firm risk, not to market, to incorporate specific risk of firm

Why Specific Risk Matters

- 1950s finance says it does not as it can be diversified by the investors
- But more recent finance disagrees
  - High cost of raising new capital means that firms should avoid losing existing capital
    - Even risk that shareholders can diversify should be managed
  - Policyholders are not diversified in their insurance purchases and so are more risk adverse than investors
    - They are equally against specific and systematic risk
    - Buying decisions based on this affect shareholders
  - Other frictional costs of holding capital lead to same conclusion

Firm Value Impact is Bottom Line for Risk Management

- Taking more risk or hedging can be evaluated based on impact on value of firm
  - Firm value models tracing back to de Finnetti can be used for this
    - Value = discounted future dividends
  - Some actuarial papers optimize capital level (Gerber and Shiu NAAJ 2006) and risk management (Froot, Major) in this framework
- Still a lot of work on assumptions, etc. needed to make this work practical:
    - Impact of financial strength on business volume, price
    - Cost of raising capital when distressed

CAPM Issues

- Utility theory implies preferences for higher moments
  - Investors like high odd moments, low even moments
  - For non-normal returns, more co-moments needed
    - $E[(X_i - EX)(Y - EY)^2]/\sigma_Y^3$ is co-skewness of X_i with Y
      - Not symmetrical
      - If $\Sigma X_i = Y$, co-skewnesses sum to skewness Y
- Empirical work shows market prices for equities reflect higher co-moments
  - These are needed in insurance due to heavy tails
- Jump risk may have to be priced separately from moments
  - Jumps make market incomplete so of more concern

Fama-French

- Found higher returns for small companies and low market/book
  - Inefficient market hypothesis:
    - These stocks are under-priced
  - Efficient market hypothesis:
    - These stocks are more risky
      - Seems more likely as effects persist
      - Could other risk measures replace FF?
- Empirical work suggests 3rd and 4th co-moments work as well as FF and higher ones can replace FF

Arbitrage-Free Pricing Issues

- Price is mean under scaled probabilities
  - In incomplete market, transform is not unique
  - Also not perfectly hedged, so risk remains
    - Use CAPM for price of that risk?
- Paper shows that CAPM plus higher co-moments is a probability transform
- Different situations of different companies mean that same market price from a single transform will not work for all of them
  - Can recalibrate transform to company risk and allocate that to line

Capital Allocation That Reflects Pricing Issues

- Use risk measures that are related to pricing
  - Risk-adjusted TVaR is excess mean plus a % of excess standard deviation
    - A pricing concept: standard deviation load
    - Can use at lower probability level than TVaR and still get a meaningful load in the tail (avoids linearity of TVaR in tail)
    - This prices non-extreme risk that is still painful to endure
  - Or use diffusion measures, which are transformed means
- Use marginal allocation (Euler method in paper)

More on Diffusion Measures

Complete diffusion measures

Use entire distribution in non-trivial way

Adapted diffusion measures

Positive loads and increasing load in tail

Examples are Wang transform and Esscher transform

Esscher Revisited

Define in terms of percentile of distribution

Esscher with parameter ω:

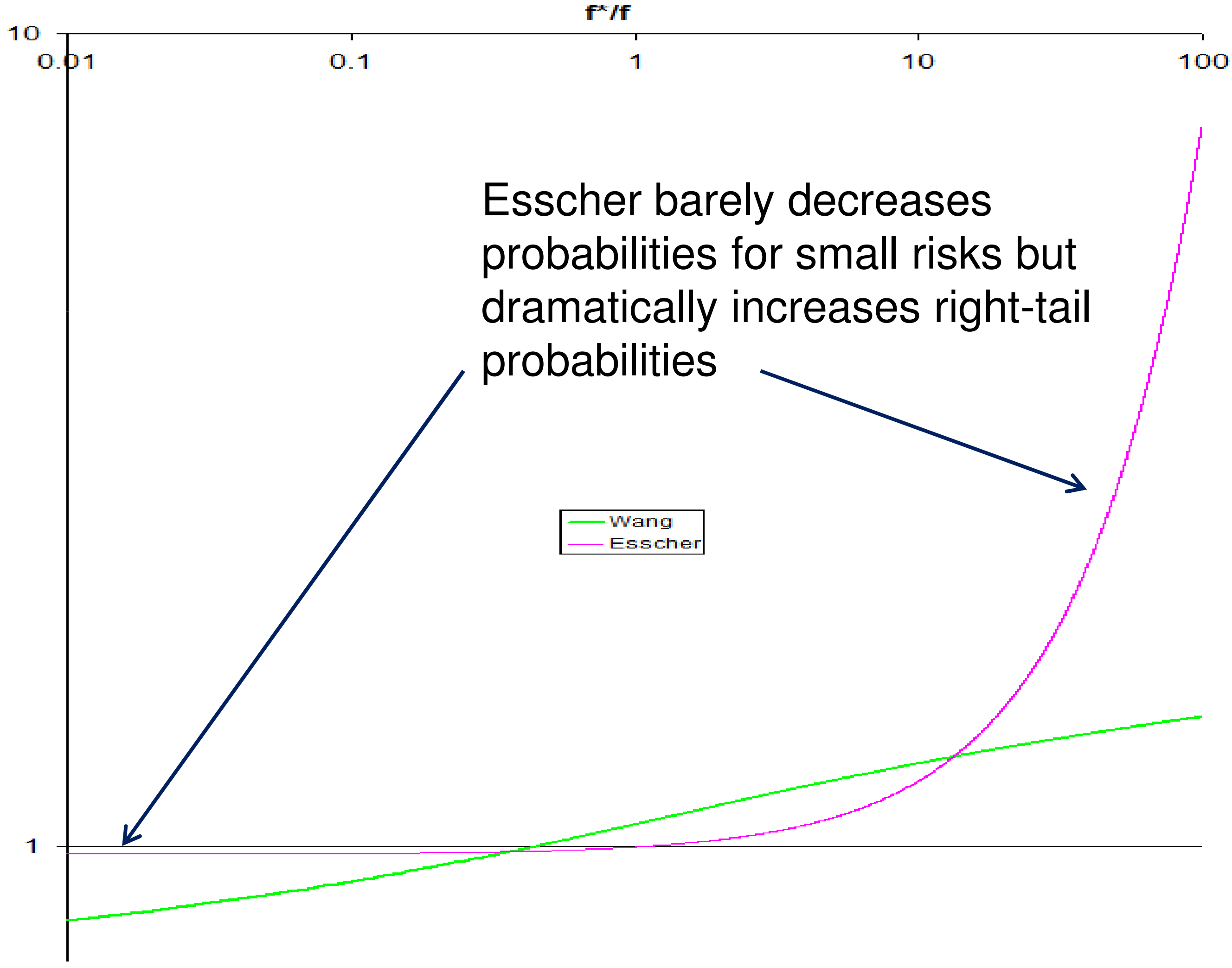
Let $c = S^{-1}(1/\omega)$, so if $\omega = 100$, c is 99th percentile

Transform is $f^*(y) = f(y)e^{y/c}/Ee^{Y/c}$.

Advantage over usual definition is now it scales:

If $Z = bY$, then transformed mean of Z is b times transformed mean of Y with same ω.

Esscher vs. Wang Transform f*/f Example with Same Overall Mean for Heavy-Tailed Distribution



Transforms That Are Not Distortion Measures

In compound Poisson process, transform both frequency and severity

That is martingale transform for that process

E.g., Esscher transform on severity $f^*(y) = f(y)e^{y/c}/Ee^{Y/c}$.
with frequency transform $\lambda^* = \lambda Ee^{Y/c}$

Paper discusses some advantages of this over distortion measures

Summary

- Traditional pricing formulas need further development before they can work in insurance
- Allocating capital by tail measures and equalizing return is not likely to give the right price either
- Using complete, adapted distortion measures or other probability transforms seems like the best alternative at present

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