Capital Adequacy, Capital Allocation and Risk Pricing: The Current State of Play

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GUY CARPENTER

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Agenda

Section 1	The Best capital allocation method
Section 2	Stepping back
Section 3	Making it work
Section 4	If our own money was at stake…

CPA = ? Accountants, Actuaries and Capital

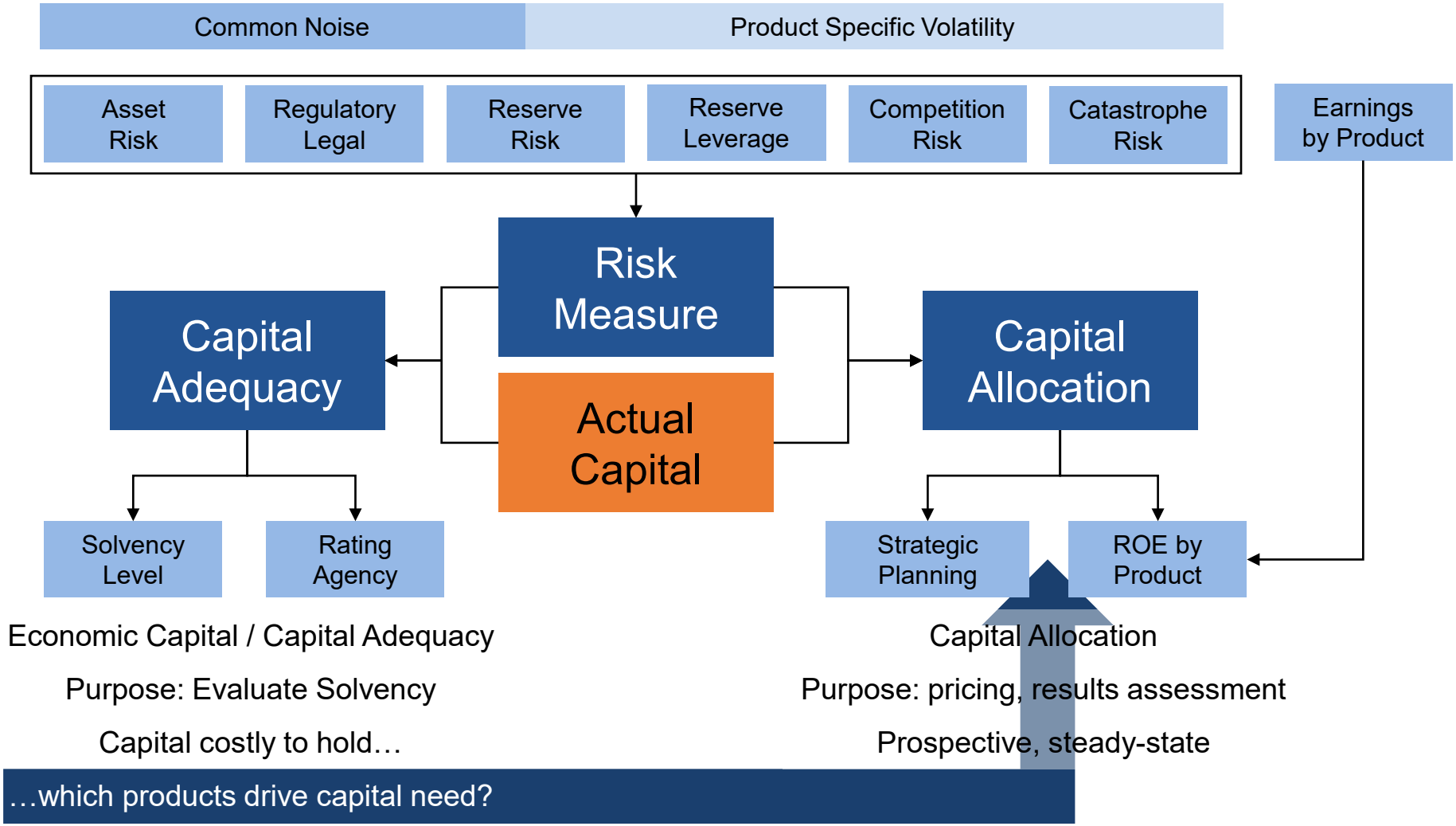
Accountants **determine** capital

Actuaries, and others, opine on its **adequacy**

- Certain accounting capital determinations have economic meaning because they trigger real world consequences
  - Debt default or debt covenant
  - Insolvency
  - Regulatory supervision
  - Etc.
- Companies do not face adverse actions because their internal "economic" capital falls below a self-imposed threshold
  - Though be careful with risk tolerance statements

Section 1: The Best Capital Allocation Method

Capital: adequacy and allocation



Risk of what?

- Risk measures apply to a random quantity

- Which is appropriate quantity to measure?
  - Losses
  - Total cash flow
  - Calendar year income
  - Accident year income
  - Comprehensive income
  - Value created
  - Market capitalization
  - When do you feel pain? =Below plan

- Should cash flows be nominal or discounted?
  - What discount rate should be used for discounting?

What is risk? Four plausible definitions, one unfortunate fact

- Rothschild-Stiglitz offer four possible definitions of when X is “more risky” than Y
  1. X = Y + noise
  2. Every risk averter prefers Y to X (utility)
  3. X has more weight in the tails
  4. Var(X) > Var(Y)

  1, 2 & 3 are equivalent & are different from 4

- Problems collapsing a whole distribution to a single number
  - All moments may not be enough to determine distribution
  - “Local” vs. “global” views
  - Local = distribution based
  - Global = loss within broader economic context

Why the fascination with variance and standard deviation?

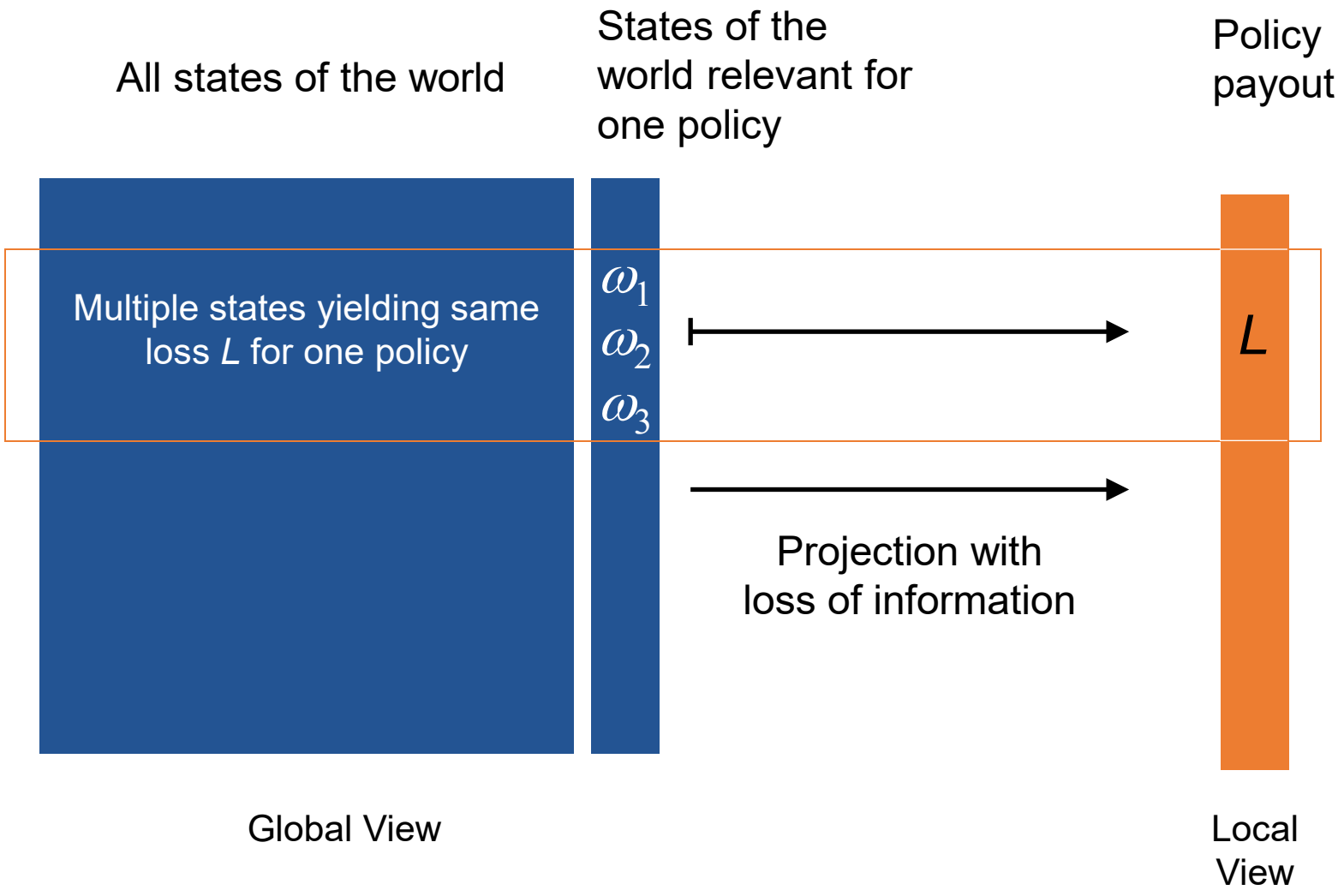
- By **Assumption**: assume risk preferences are determined by mean and standard deviation of return
  - Securities market line, CAPM

- **Utility theory:** certain equivalent pricing c for a **small**, mean zero risk X
  - $U(w - c) = E[\, U(w - X)\,]$ which implies
  - $U(w) - c\, U'(w) = U(w) + \mathrm{Var}(X)\, U''(w)/2$ and so
  - $c = -\mathrm{Var}(X)/2\, U''(w) / U'(w)$, latter is called degree of absolute risk aversion

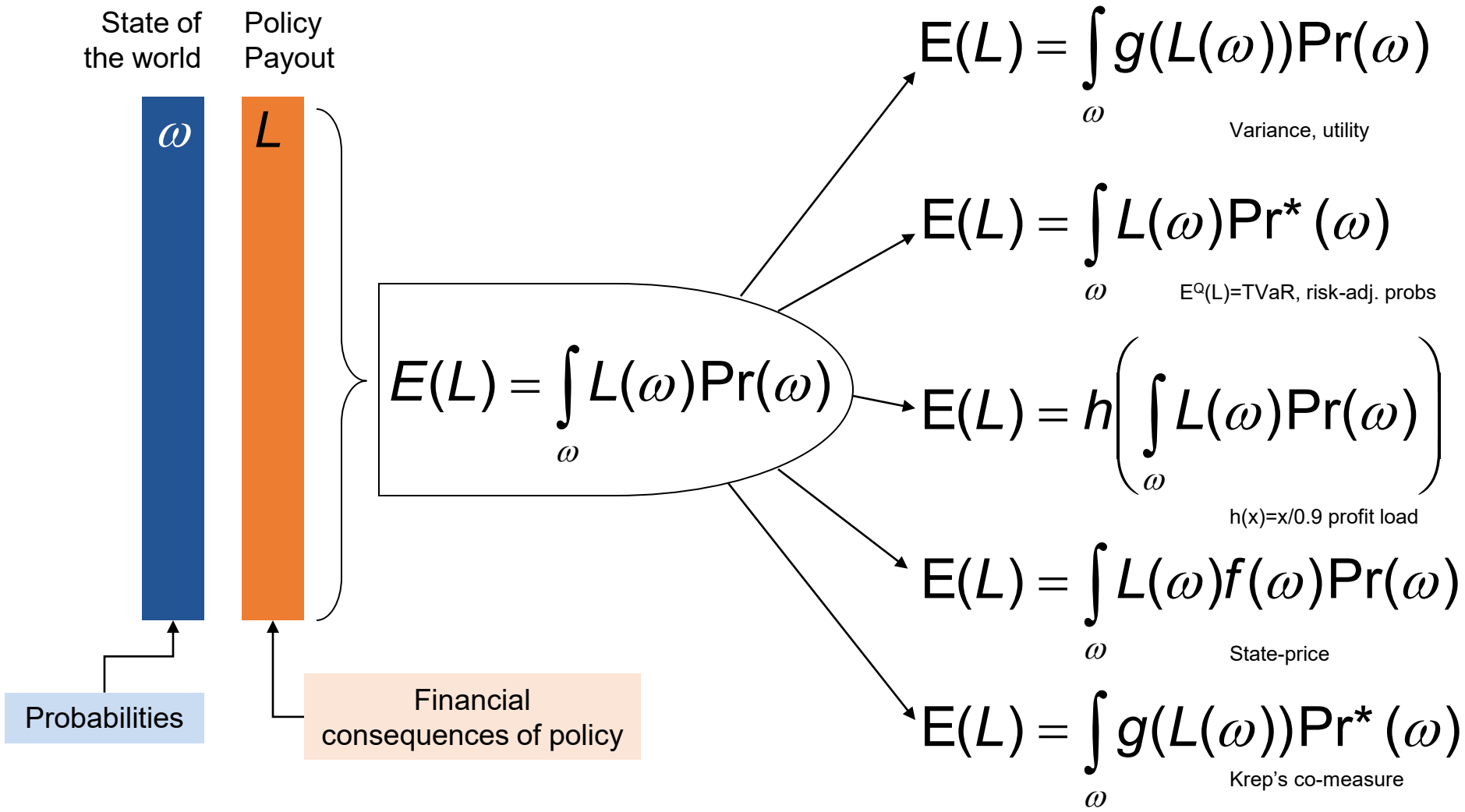
- In theory of Levy processes (=best model of insurance losses) variance corresponds to the continuous, no-jump part of the process

- Variance / standard deviation is not appropriate for larger jumps

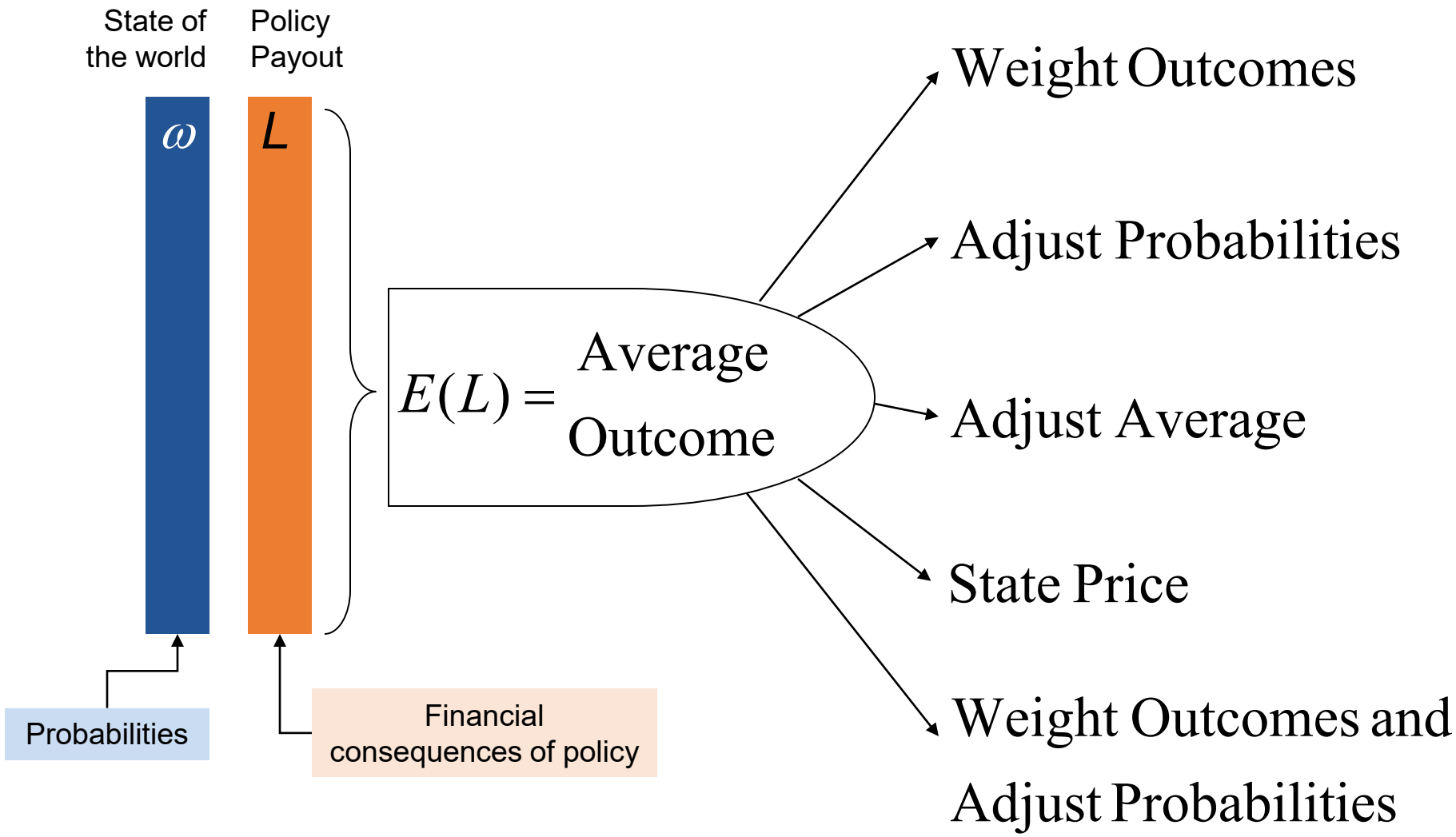
Local and global views of risk



(Basically all) families of risk measures



Families of risk measures – in English



Important fundamental difference

Risk adjusted probabilities apply to **event probabilities**

Utilities apply to **outcomes**

Risk adjusted probabilities can **differentiate between equal loss outcomes**

Do you know your P's and Q's?
Risk measures allowing for ignorance and uncertainty

- P often used to denote objective probabilities; Q risk adjusted or subjective probabilities
  - Think of P, Qs as scenario probabilities

- $\text{TVaR}_a(X) = \max_{\{ Q \}} E_Q(X)$, over Q's where the ratio Q(.)/P(.) < 1/a
  - The max assigns weights to the worst outcomes

- $\text{Risk}(X) = \max_{\{Q \text{ in } \boldsymbol{Q}\}} E_Q(X) - r(Q)$, where r(*Q*) measures likelihood of *Q*
  - E.g. $r(Q) = E_Q[\log(dQ/dP)]$, is relative entropy

- State price density and covariance

$$E_Q(X) - E_P(X) = E_P(X dQ/dP) - E_P(X) = \text{Cov}(X, dQ/dP)$$

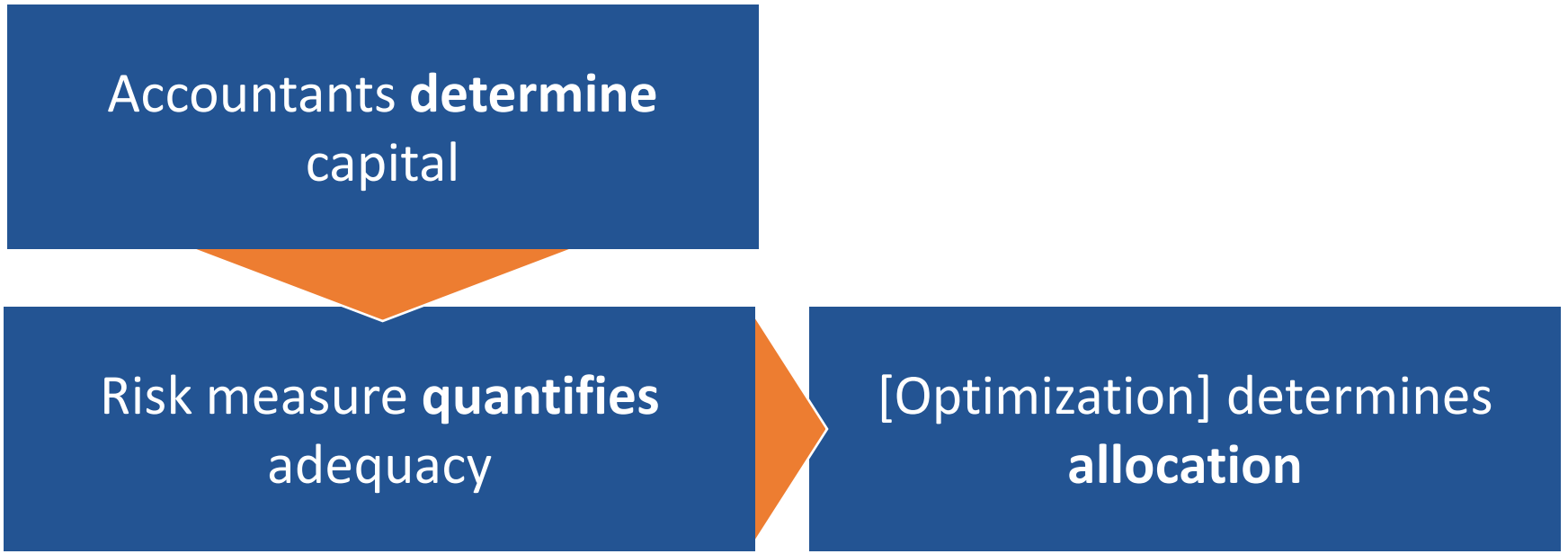
Before discussing how to allocate capital, ask “Why?”

- Capital is costly to hold
  - Double taxation
  - Agency costs
  - Credit sensitive customers
  - Skew averse investors
  - Capital market inefficiencies (costly to raise capital post-event)

- Proxy for allocation of cost of capital

- Cost must be allocated in order to effectively
  - Determine pricing
  - Assess BU profitability
  - Strategic planning

Risk measure assesses capital, drives allocation



…assuming adequacy remains unchanged

Inexorably led to Lagrangian constrained optimization

- Risks X_i priced with profits π_i
- Capital constraint k
- Risk measure r drives capital requirement
- **Select shares w_i to maximize $\Sigma\ \pi_i\ w_i$ subject to $r(\ \Sigma\ w_i\ X_i\ ) < k$**
- Introduce Lagrangian multiplier λ and the Lagrangian L

$$L = \Sigma\ \pi_i\ w_i - \lambda\ \{\ r(\ \Sigma\ w_i\ X_i\ ) - k\ \}$$

- To solve, differentiate wrt to w_i and λ and set equal to zero to get gradient, marginal risk = marginal return, pricing

$$\pi_i = \lambda\ \partial r\ /\ \partial w_i$$

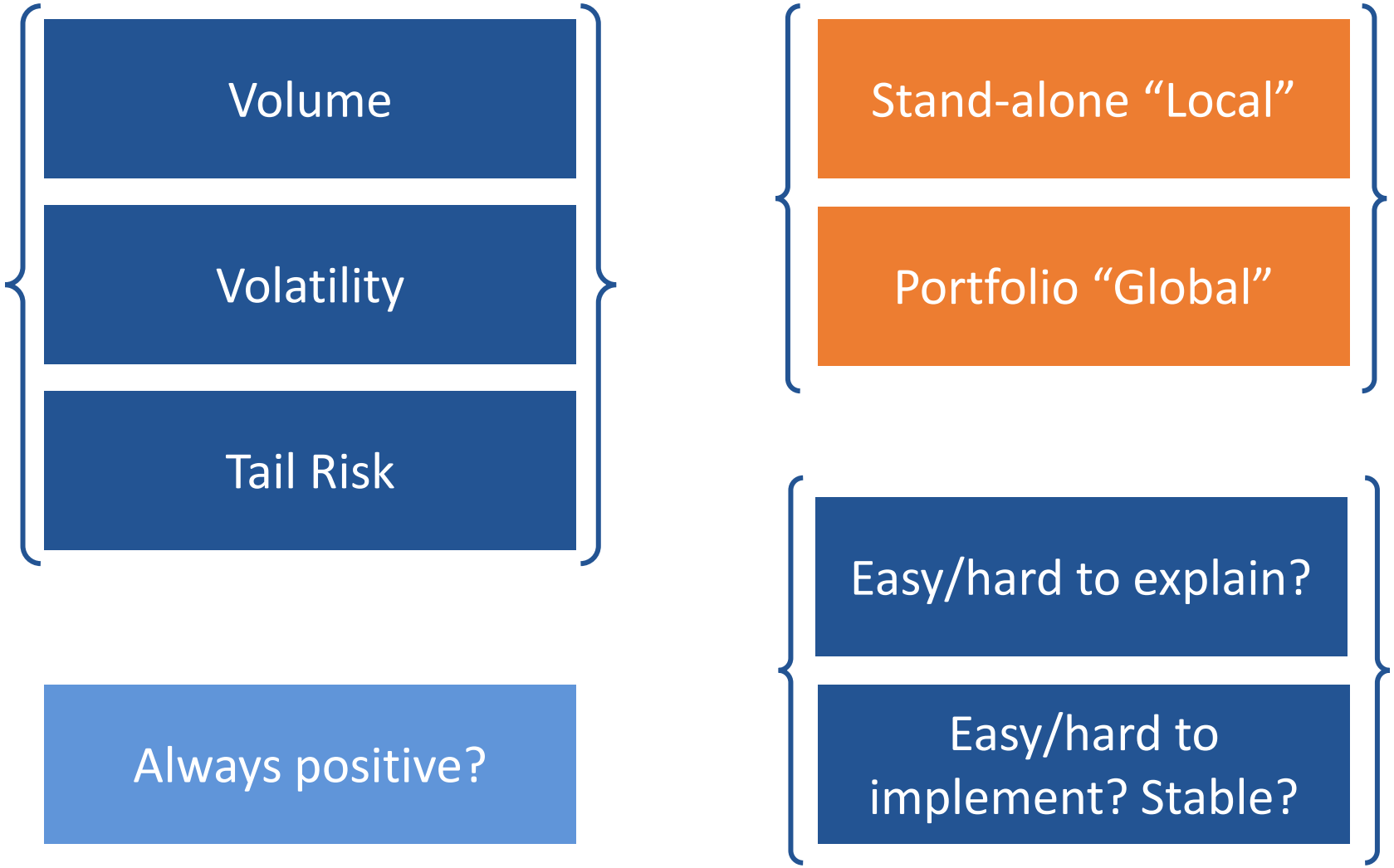
- Links pricing with the risk measure and capital allocation through a cost of capital argument
- Simple translation: think about substitutions, can I increase profit while holding risk constant by swapping one line for another?
  - Solid economic meaning

Other capital allocations from capital adequacy measures

- Optimized via Lagrangian often actually a constrained optimization, Karush-Kuhn-Tucker (KKT) conditions
- Natural = E_Q, co[nditional]-measures, default put
- Diversification Index = $r(X) / \Sigma_i r(X_i)$ = peanut butter spread
- Magically additive = Euler's theorem
- Minimize claim on other areas of firm = equal risk VaR
- Gradient of risk measure reflecting insured's economic reality (Zanjani)
- Any allocation must pass fairness tests
  - No under-cut: can't allocate more than stand-alone capital
  - To regulator: too much diversification benefit
  - To children or grandchildren?
- Properties of risk measure translate into these properties of an allocation

- Allocation should have an economic meaning

Different risk measures sensitive to different aspects of the business



Summary So Far

- Determine a risk measure
- Risk measure calibrated to actual capital using free parameter
  - Actual capital determined by accountants according to some standard
- Capital allocated using risk measure, holding free parameter constant, usually via an optimization argument
- What could be simpler?

Section 2: Stepping Back

Capital (Cost) Allocation
Leading Practice Process

Leading Practice Step	Rationale
1) Design driven approach	Decide what to reflect and ignore Employ sensitivity testing
2) Realistic capital usage costs	Insurer capital is a shared asset with two distinct types of usage, Rental and Consumption Allocate the costs of its true usage to contributing lines
3) Consumption Costs via Risk Preference function	Every risk metric has an implicit risk preference function underlying it Assess capital consumption costs using risk preference function
4) Key sensitivity tests: the Three R's	Reserves, reinsurance and return periods
5) Create an operational buffer between the capital model and the field	Use a sophisticated method to produce percentage allocations which are then applicable to any total Only allocate cost of capital as far down in the organization as necessary Translate cost of capital into familiar terms – e.g., % load in target combined ratios

Capital Cost Allocation System Design
Begin with the End in Mind

- The CFO is operating an internal capital market
  - An unconstrained market of one capital supplier and numerous consumers
- Price access to this capital by any means necessary
  - What to reward and punish, emphasize and ignore
- Decide in that pricing policy whether (and how much) to reflect:
  - Time and history
  - Fact and intuition
  - Return periods
  - Risk factors
- **There is nothing inherently right or wrong about any approach**
  - Only the algorithmic expression of the risk preferences

Desirable Features Of Capital Cost Allocation Approach
Actual Example

1. Drill-Down and Roll-Up (linear)
2. Produce Strictly Positive Allocation (DM pet criteria)
3. Explainable (to key opinion leaders) Methodology (Use Test)
4. Focus on Downside not simply Volatility
5. Measure Risk at the Portfolio Level
6. Stable and Robust (particularly w/r/t updating one business unit's results)

5 and 6 are mutually exclusive

Desirable Features Of A Good Allocation Metric = Covariance

1. Drill-Down and Roll-Up
2. Produce Strictly Positive Allocation
3. Explainable (to key opinion leaders) Methodology
4. Focus on Downside not simply Volatility
5. Measure Risk at the Portfolio Level
6. Stable and Robust

1. Yes – additive
2. Yes –Risk Charge In Proportion Of Contribution To Total Variance
3. ≈ - Implicit risk preferences are buried
4. No – Volatility only
5. Yes – Total variance
6. No – Changes to one segment affect others

Desirable Features Of A Good Allocation Metric = Co-TVaR

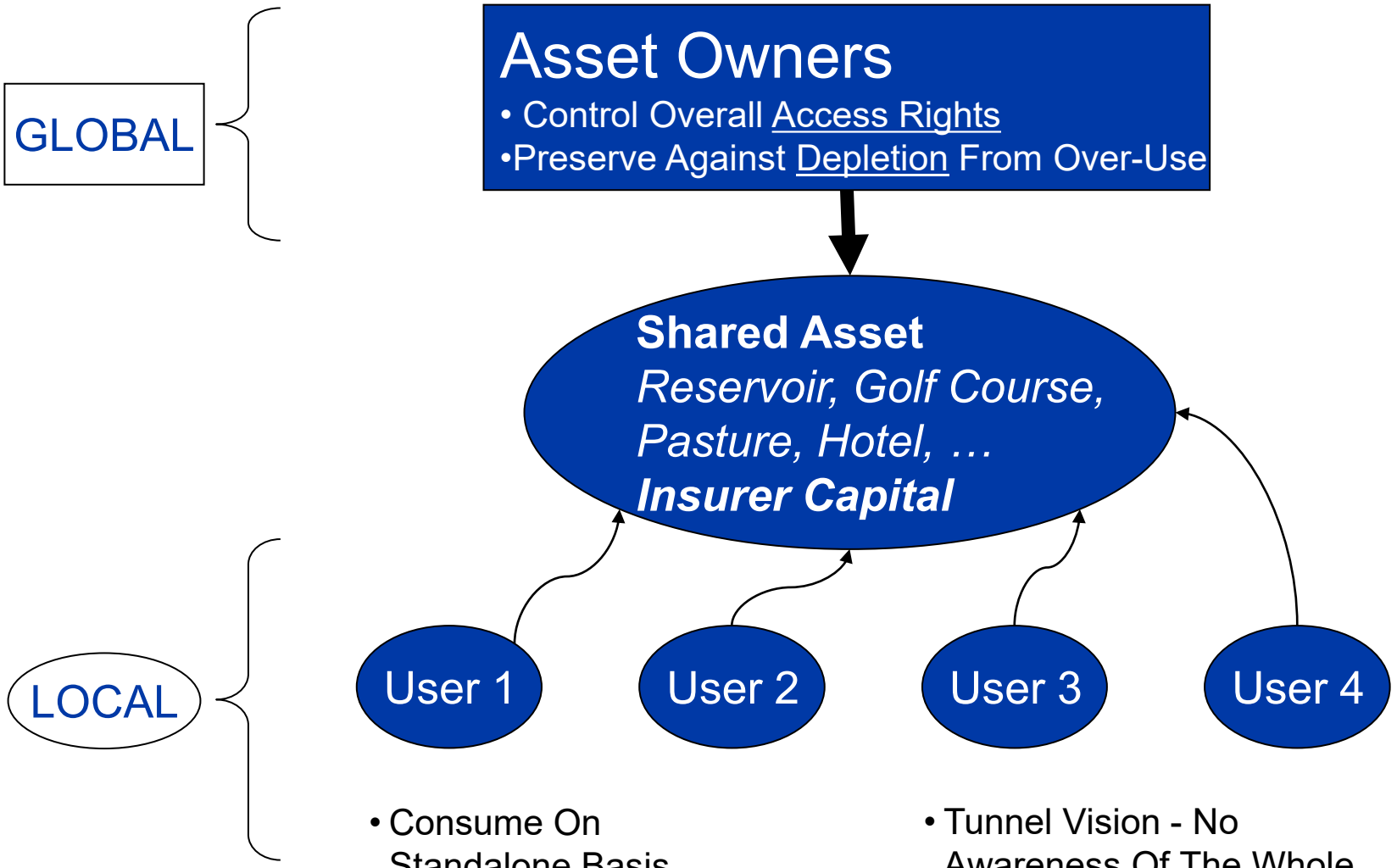
1. Drill-Down and Roll-Up
2. Produce Strictly Positive Allocation
3. Explainable (to key opinion leaders) Methodology
4. Focus on Downside not simply Volatility
5. Measure Risk at the Portfolio Level
6. Stable and Robust

1. Yes – simple sumproduct
2. **Not necessarily**
3. Yes – Fault-finding mission in the tail
4. Yes – Downside based
5. Yes – Risk preference function defined at portfolio level
6. No – Changes to one segment affect others

Foundational Theory of Shared Asset Framework
Valuing Parental Guarantees

- Merton & Perold (1993): "**risk capital**" for a financial services profit center is the cost of parental guarantee to make up any shortfalls
- Insurer provides these **shortfall guarantees** to every policy, product segment, profit center, operating company, etc.
- Guarantees are backed by the entire capital pool
- Everyone has simultaneous rights to (potentially) use up **all the capital**
- Company must manage the timing and size of guarantee exercises:
  - Concentrations
  - Correlation
  - Reserve deficiencies
- Too many calls for cash and the common pool of capital gets drained

Insurer Capital is a Shared Asset



Shared Assets Can Be Used Two Different Ways

Consumptive Use

- Example: RESERVOIR
- ***Permanent*** Transfer To The User

Non-Consumptive Use

- Example: GOLF COURSE
- ***Temporary*** Grant Of Partial Control To User For A Period Of Time

Both Consumptive and Non-Consumptive Use

- Example: HOTEL
- ***Temporary*** Grant Of Room For A Period Of Time
- Guest could destroy room or entire wing of hotel, which is ***Permanent Capacity Consumption***

An Insurer Uses Its Capital Both Ways

1. <u>"Rental" Or Non-Consumptive</u>

- Returns Meet Or Exceed Expectation
- Capacity Is Occupied, Then Returned Undamaged
- A.k.a. ***Room Occupancy***

2. <u>Consumptive</u>

- Results Deteriorate
- Reserve Strengthening Is Required
- A.k.a. ***Destroy Your Room, Your Floor, Or Even The Entire Hotel***

Charge Each Segment for Its Capital Usage

Capital Usage Cost Calculation
Paying for the Parental Guarantee

Two Kinds Of Charges:

1. **Rental** = upfront fee for right to (possibly) use the Guarantee

   → ***Occupying underwriting capacity***

   BCAR, SPCAR, RBC, SCR, …

2. **Consumption** = contingent fee for using the Guarantee

   → Function of ***Potential for Deficit*** *(Consumption)*

   Risk appetite / preference / riskiness leverage function

Some Advantages of Shared Asset Approach

- Unifies Life and General Insurance/P&C/Non-Life
  - Life is mostly Rental (capital planning)
- Existing frameworks are special cases
  - Feldblum/Robbin IRR ~ Rental (one scenario where we make money)
- Can be used in RORAC or RAROC
  - Risk-adjust via capital factors to constant ROE
    OR
  - If constrained to use e.g., S&P capital factors, risk-adjust the ROE's given the (non-risk-adjusted) capital factors
- Realism
- Ease of explanation

Section 3: Making it work

Why? How have we seen it actually played out?

- Cost-Benefit is about 99:1
  - Solvency II investment to date estimated excess of **€500B**
  - Next up: **NAIC ORSA**
- Doesn't mean it was a bad investment, but skeptics are right in seeing
  - No signs of improved valuation or performance
  - No apparent competitive advantage
- Mercenary CFOs want S&P Capital relief
- Model risk: we are trying to follow the model's guidance but it is driving all to short tail and cat

Why? How have we seen it actually played out?

- Numerous small to medium companies have **internalized BCAR**
  - This drives Tom Mount and Matt Mosher nuts
- But is completely understandable given:

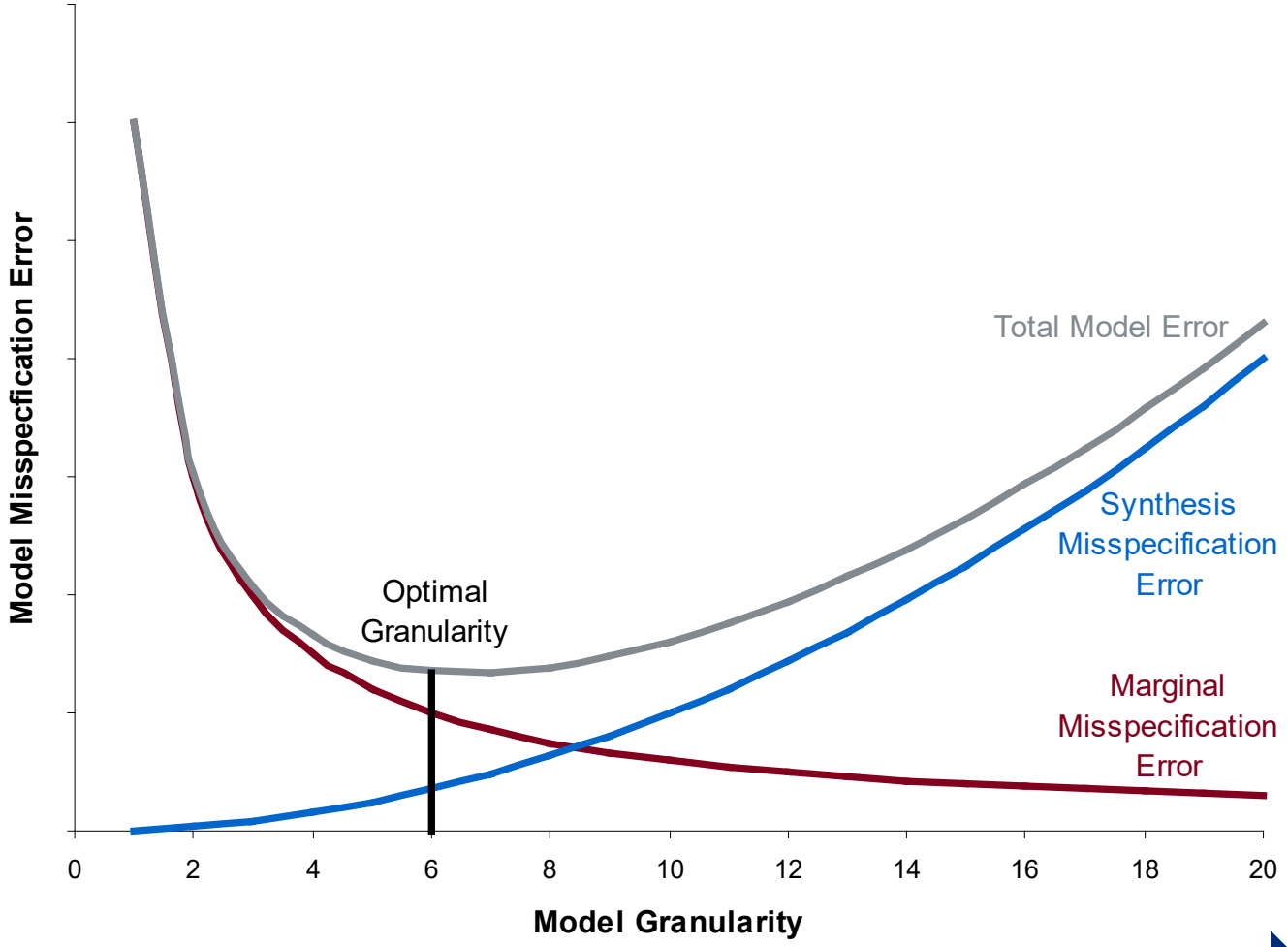
1) My firm lacks sufficient data and resources to build our own capital model

2) Our #1 operational constraint is our BCAR score

- Then marginal impact decisions (like planning) should be informed by impact on BCAR
- Stay tuned for **Stochastic-based BCAR** coming in 2015…

BCAR is “Economic Capital” – it defines the amount of capital needed to trade

Models: Simple, Robust & Understandable
Balance Complexity and Accuracy



Business users push for granularity…
want to see the impact of their efforts

Why? How have we seen it actually played out?

- Global Company A:
  - Problem: CFO tired of quantitative appeals
  - Solution: Named one actuary as ultimate capital allocation arbiter (aka most hated person in company)
  - Reminder: ERM about as glamorous as tax policy

Why? How have we seen it actually played out?

- Large US Company B:
  - Problem: too many masters, attempting to allocate statutory surplus, GAAP equity and economic capital
  - Solution: Several new CROs
  - Reminder: remember “could” versus “should”

Why? How have we seen it actually played out?

- Large US Company C:
  - Problem: Overly complex model, no ties to GAAP or Stat capital
  - Solution: New CRO
  - Reminder: Keep it simple and explainable, understand audience

- Variation:
  - Problem: businesses concerned that model driving book in certain direction
  - Solution: consider alternative “views”
  - Result: no model view

Why? How have we seen it actually played out?

- Mid-sized US Company D:
  - Problem: Address S&P ERM concerns without too much disruption
  - Solution: After detailed analysis, selected a method that was
    - Theoretically respectable
    - Simple to understand and “sellable” to underwriters
    - …and close to the current judgmental allocation
  - Reminder: management intuition contains a lot of valuable insight! Models rarely robust enough to trump management insight

Why? How have we seen it actually played out?

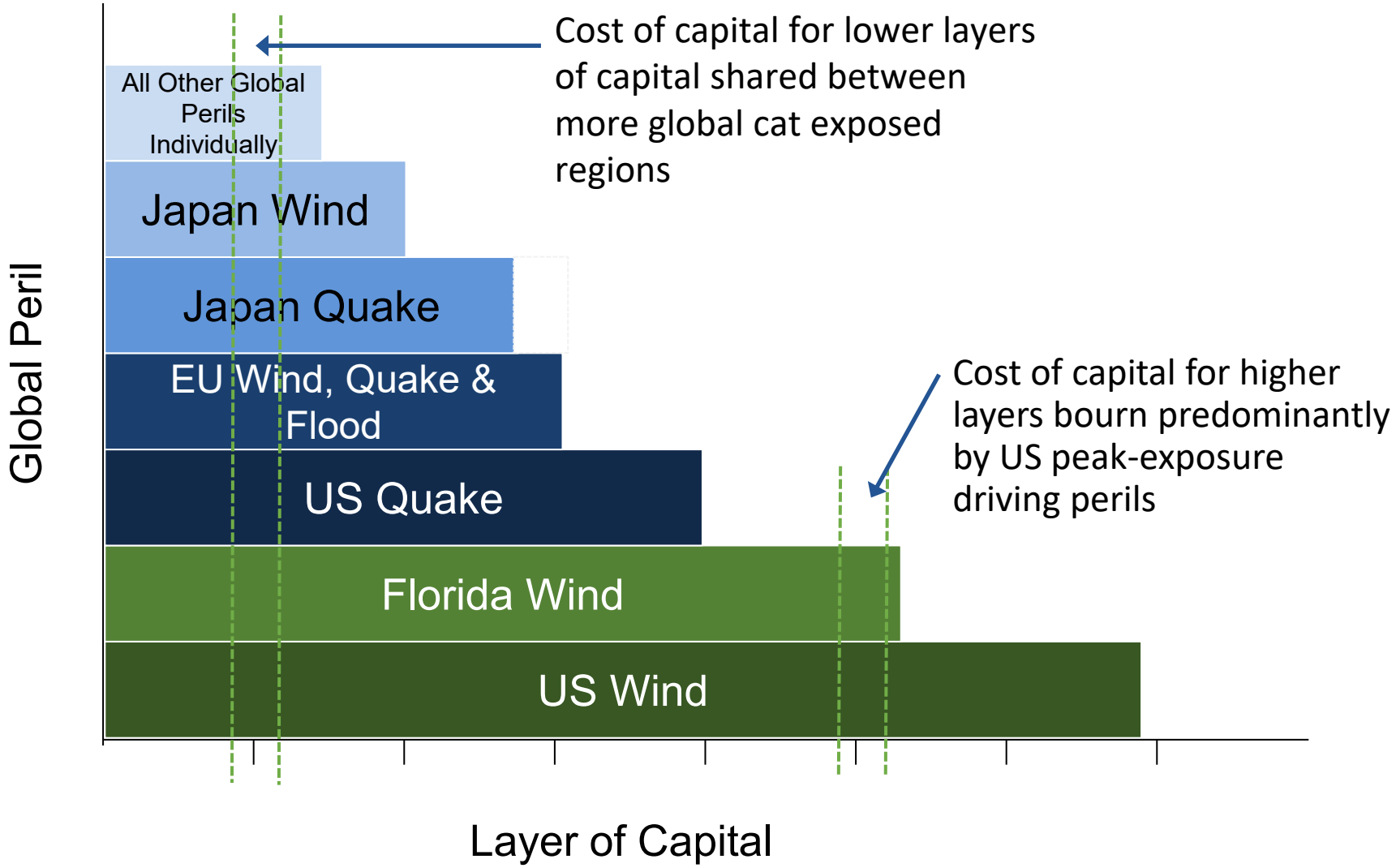
- Reinsurance Company E:
  - Problem: how do we price cat risk?
  - Solution: this is where capital allocation really matters…and the cat models provide a reasonable basis
  - Reminder: best solutions optimize economically real variables – dollars and cents

Why property cat is special

- **For capital allocation to matter, profit margin must vary materially between insureds**
- For profit margin to vary materially it must be material
- Most lines of insurance are written with underwriting profit margins of 10% or less
- Pure cat risk produces significant premium at significant margins
- **Profit margin must also vary materially in a way that can be modeled**

Evidence from the real world

Global cost of catastrophe reinsurance capacity by layer



Evidence from the real world considered

- Picture is descriptive of supply & demand, and regulatory realities
  - It shows the aggregate result of independent company actions
  - It is consistent with higher pricing in peak zones observed in the market
  - Explains macro pricing dynamics but lacks true predictive power at the company level: doesn't say write/don't write
  - Size of bars is an **input** to global industry picture

- Picture does not solve an economic optimization problem for any agent
  - Pricing produced by individual optimization decisions, driven by risk measure and capital constrained optimization interacting with heterogeneous global distribution of risk
  - Company selection of limits and capacity deployment is a decision variable: individual company picture will not mirror industrywide picture
  - Size of the bars must be a model **output** for individual companies

Section 4: If our own money was at stake…

The current state of the art and why it makes sense…

- It is no surprise we see global convergence towards simple factor based models for measuring risk for non-cat lines combined with more sophisticated model-driven assessment of cat risk
  - Standard formula in S2
  - RBC with revised cat load
  - BCAR
  - S&P CAR

- Model shortcomings largely recognized by users
  - Operational risk charge =10 to 25% surcharge
  - Events not in experience period excluded; models extend the experience period
  - In practice models trumped by underwriting and commercial judgment

Risk measures miss many important considerations

- Cost of acquiring new business or changing the portfolio
- Single year vs. multi-year view
  - Life time policyholder value concept used (talked about) in personal lines
- Unmodelable risk = social risk: driving forces dynamic, today's model not predictive tomorrow
- Unparameterizable risk = lack experience: three pandemics in last 100 years, none with modern travel patterns, populations, or medical technologies
- Capital: actually on balance sheet vs. available in market
  - Pre- and post-event funding, availability and cost; dilution
- I really care about shareholder value…
- Attend Bauer / Zanjani session C-24, Wed Nov12, 8:00-9:30
  - The Marginal Cost of Risk in a Multi-period Risk Model

Q&A

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