Buy-Side Risk Management

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TYPES OF BUY-SIDE FIRMS

Buy-Side Firms & Investors

Structural Types

- Asset Managers
  - Traditional long only
  - 130/30
  - Money Market Funds & 2a7 certification
- Hedge Funds
  - Long/Short
  - Credit Opportunity
  - Distressed
  - Event Driven
- Private Equity
  - Venture Capital
  - Commercial Real Estate
 - Closed End Funds
- Insurance

STRUCTURES

Not all Structures See Risk the Same

- Banks are primarily total return
- Many pension funds are Net Interest Income based
- Some hedge funds manage to Maximum Probable Drawdown
- Others focus on correlation and skew; outperform in down markets

Stand-alone Funds

- Separate legal entity
- Articles of Incorporation
- Investment Advisor appointment
  - Investment Management Agreement
    - Services
    - Sub-adviser relationships
    - Custody
    - Transactions
    - Reporting
    - Fees
    - Acknowledgement of Risks
    - Regulatory & Legal issues; Disclosures
    - Termination of agreement
      - Key Man, etc.
  - Investment Strategy Statements
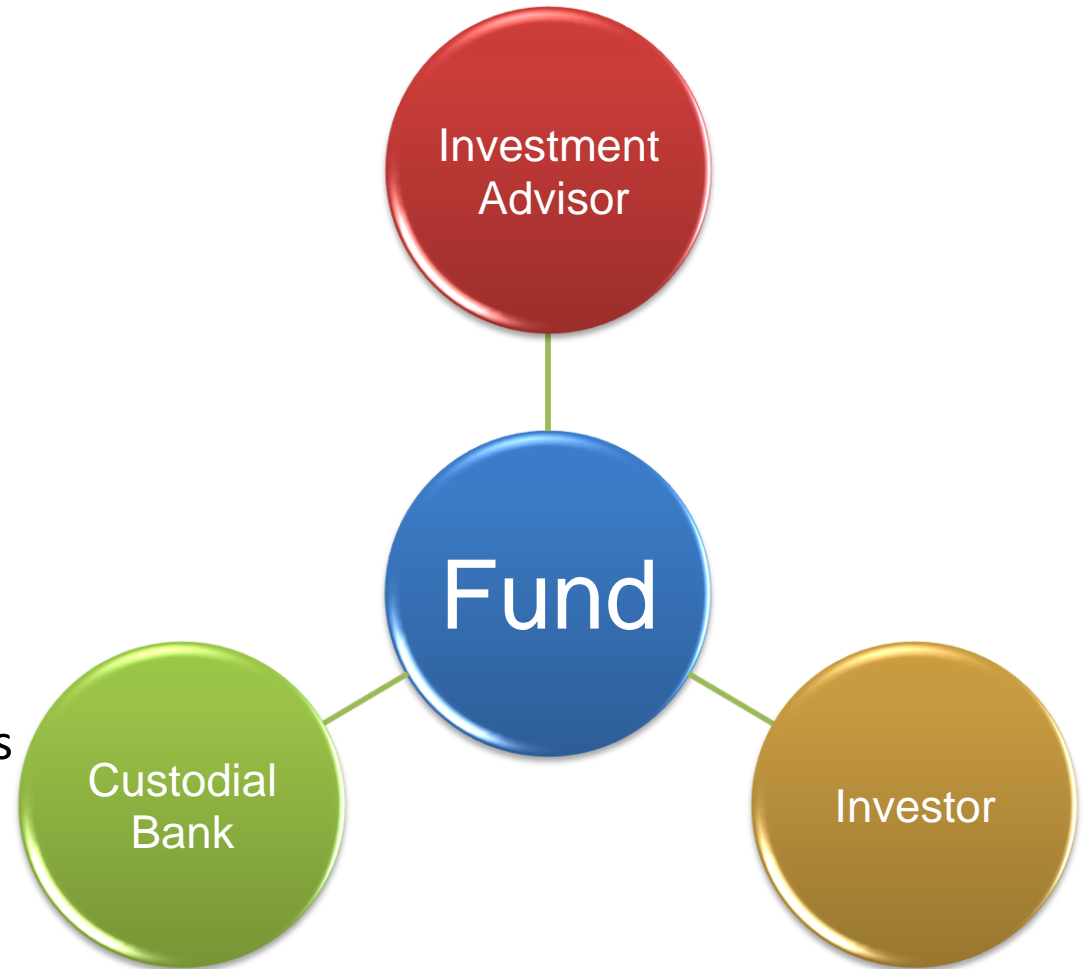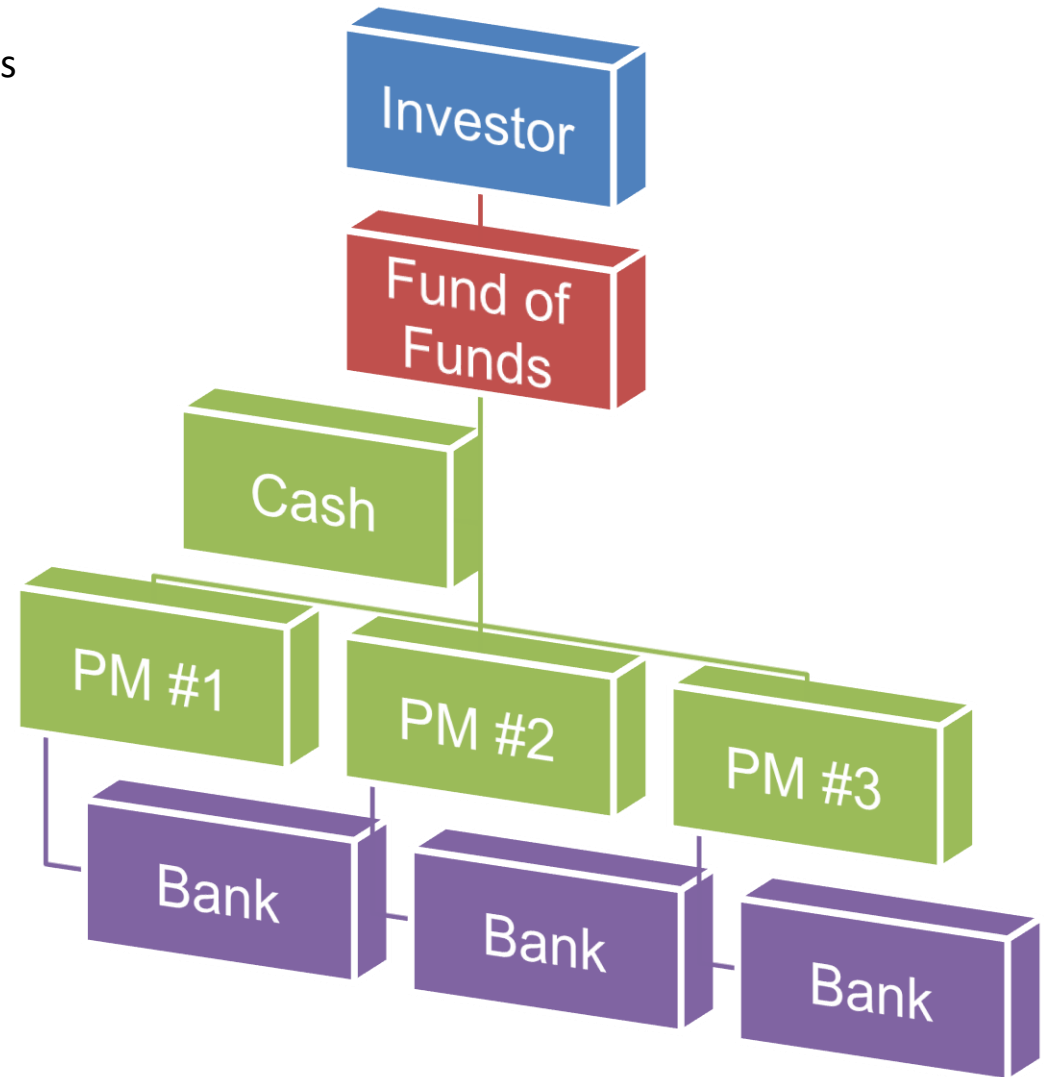
Master-Feeder Structures

- Multiple legal entities
- Master fund is counterpart
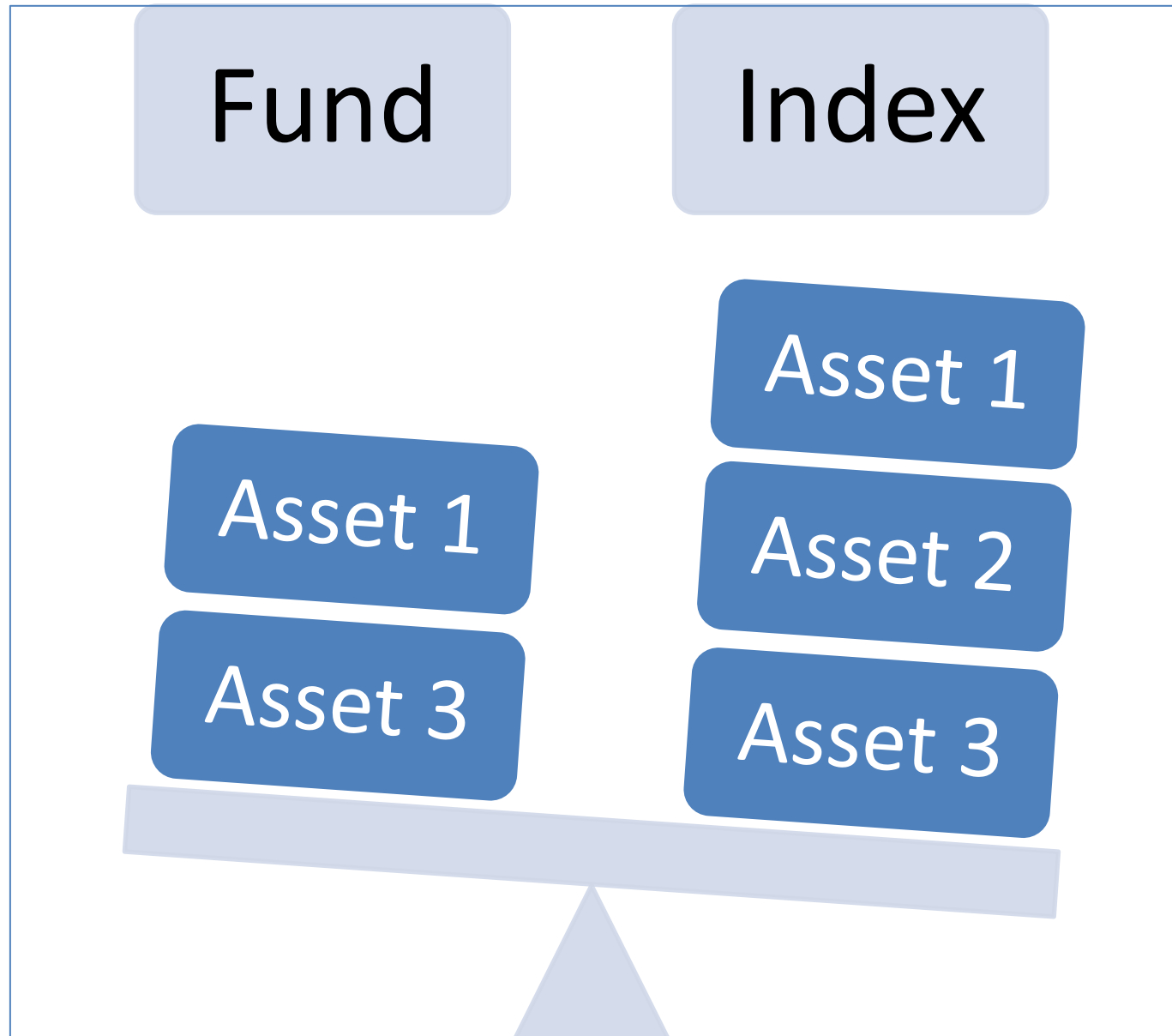- Feeder funds own the assets
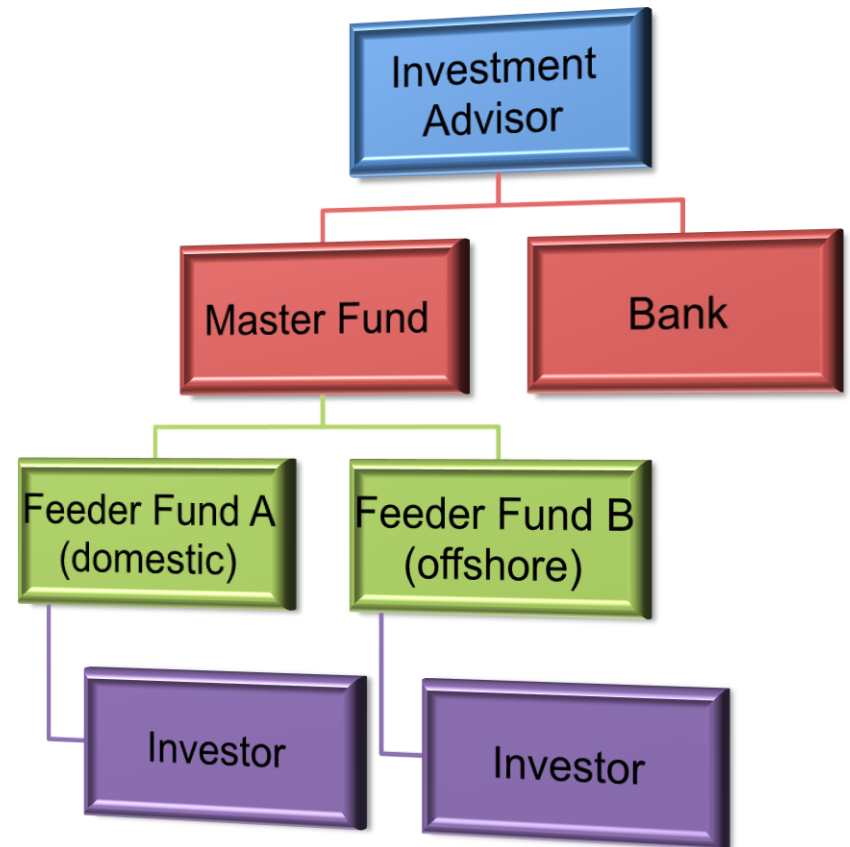
Fund of Funds

- 2 layers of fees – FoF manager and PMs
- Selection bias for FoF manager

Indexed Funds

Index funds might be full replication (passive) or partial replication of an index (active management), The risk tolerance is generally defined as the level of tracking error you want to take.

Fund

Index

Asset 1

Asset 1

Asset 2

Asset 3

Asset 3

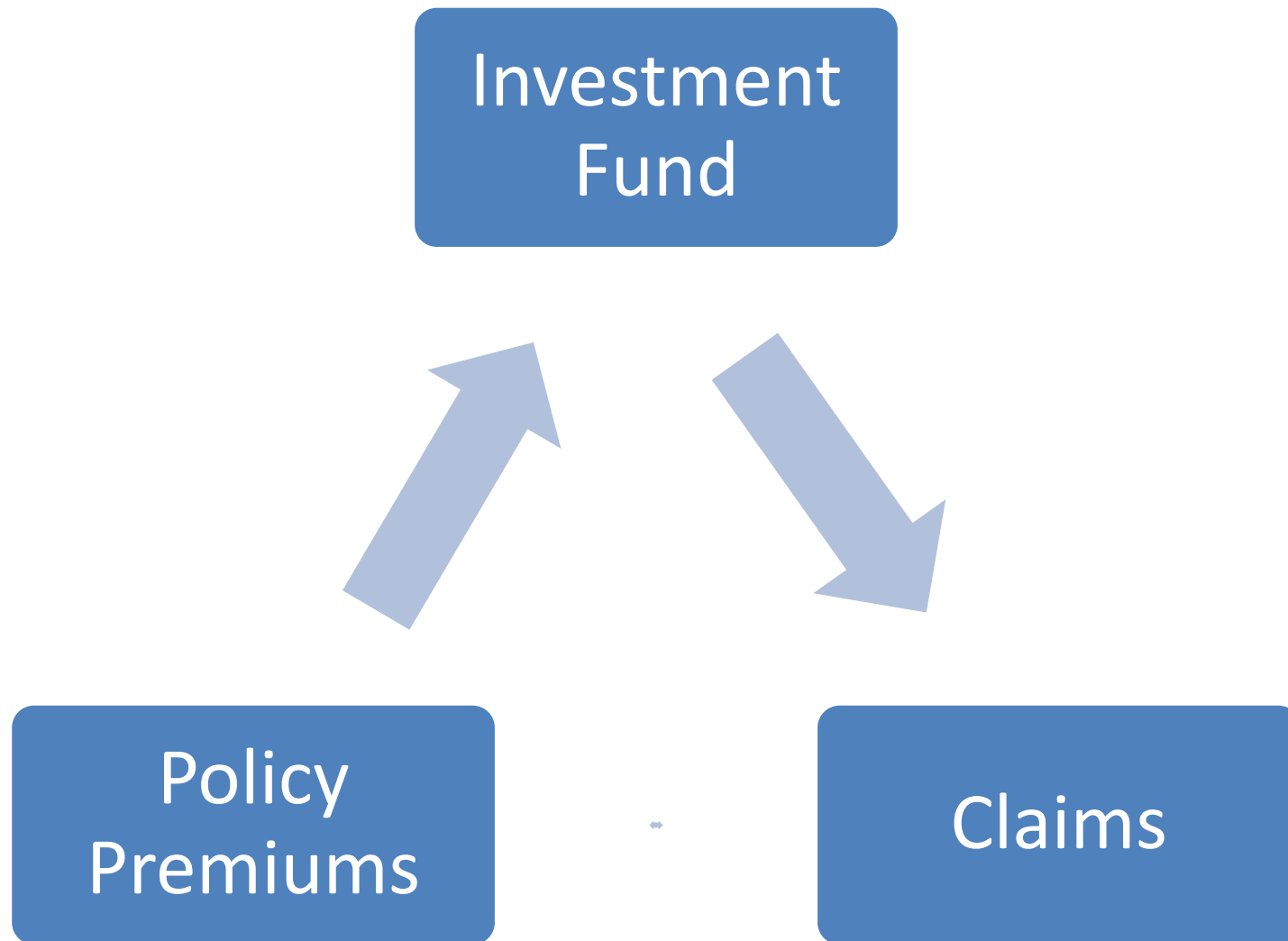# Mutual Funds (Active Management)

Active funds are like buying a little piece of a trading desk. They have targets and goals, but are not as tightly constrained as an index fund

Short Duration

Long Duration

Balanced Fund
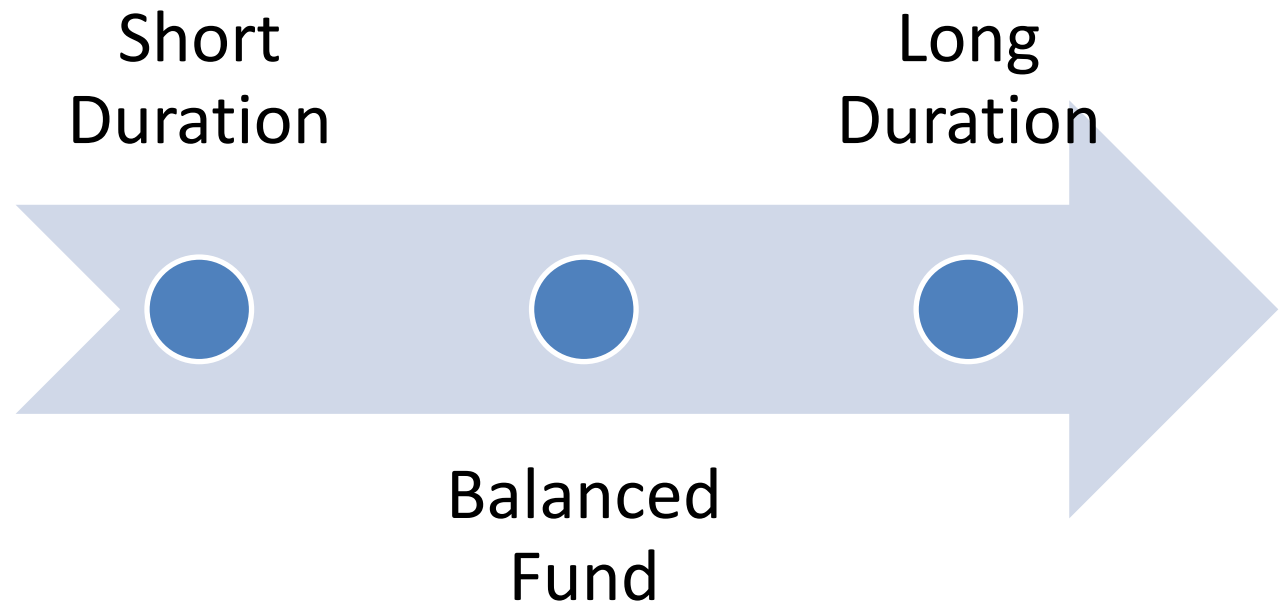
Insurance Risk

Insurance Risk Process
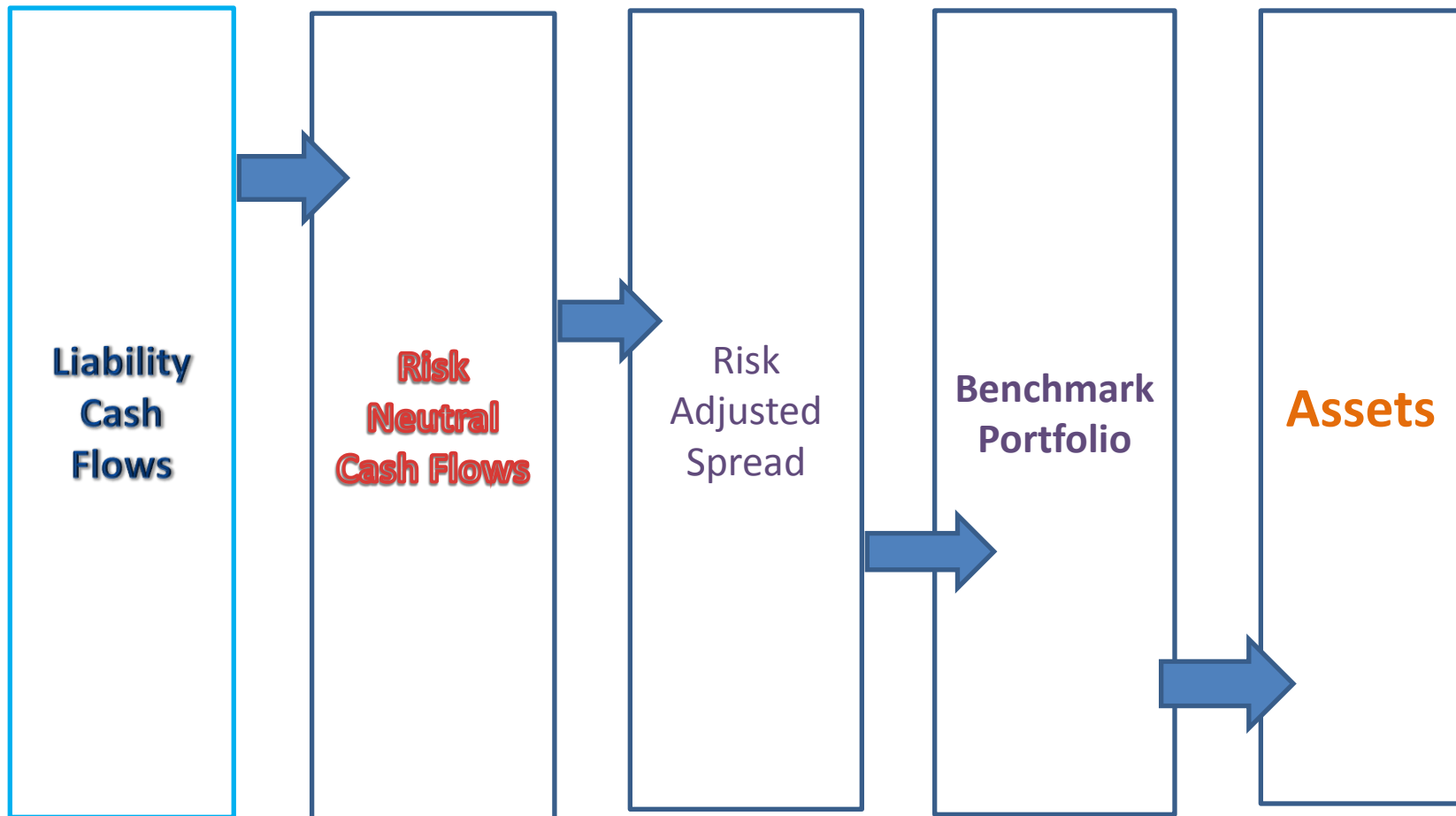
Broker-Dealers

- Regulation
- Principal vs Agent
- Tri-party agreements
- Conduits
- Role in Funding

RISK TOOLS

Risk has many faces…
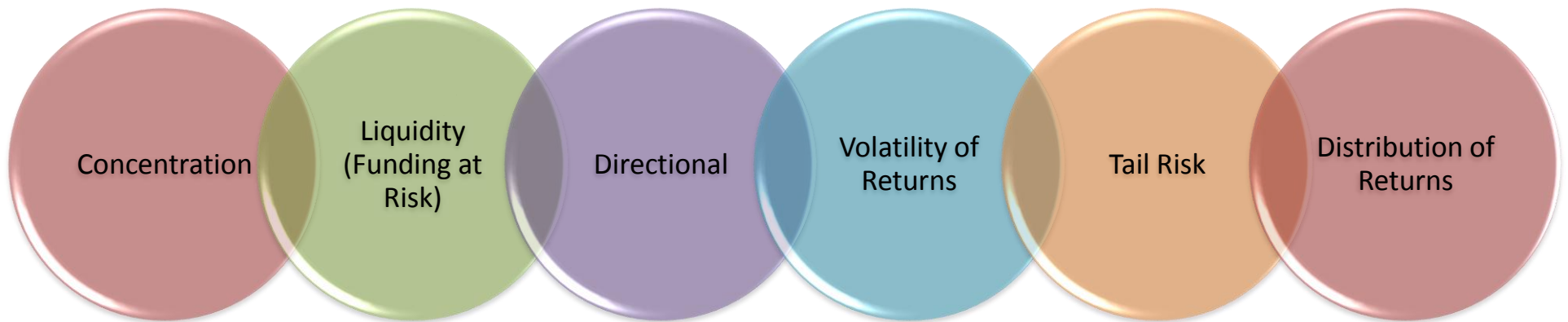
And many measures

- Volatility
- Short-fall
- Maximum loss
- Conditional Loss
- Skew

Volatility

Conditional Loss

Credit Risk
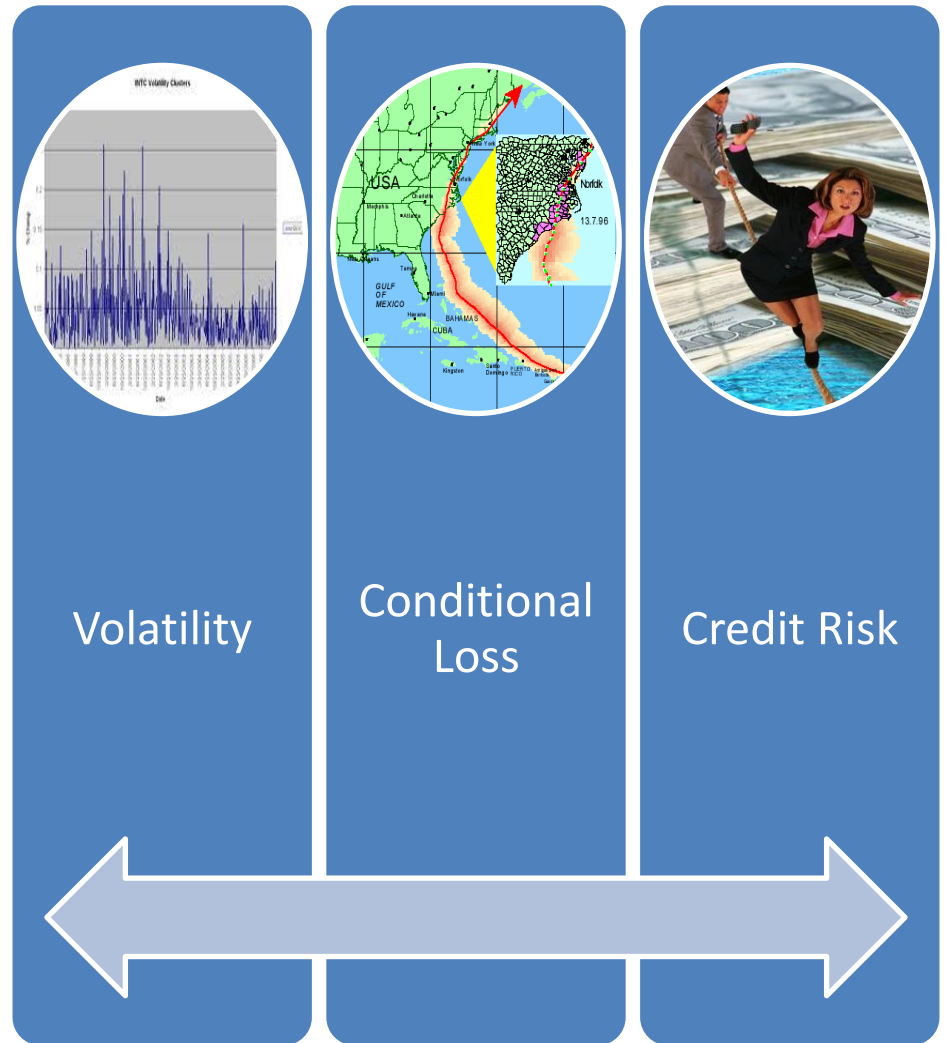
Types of Measures

Distributions of Returns
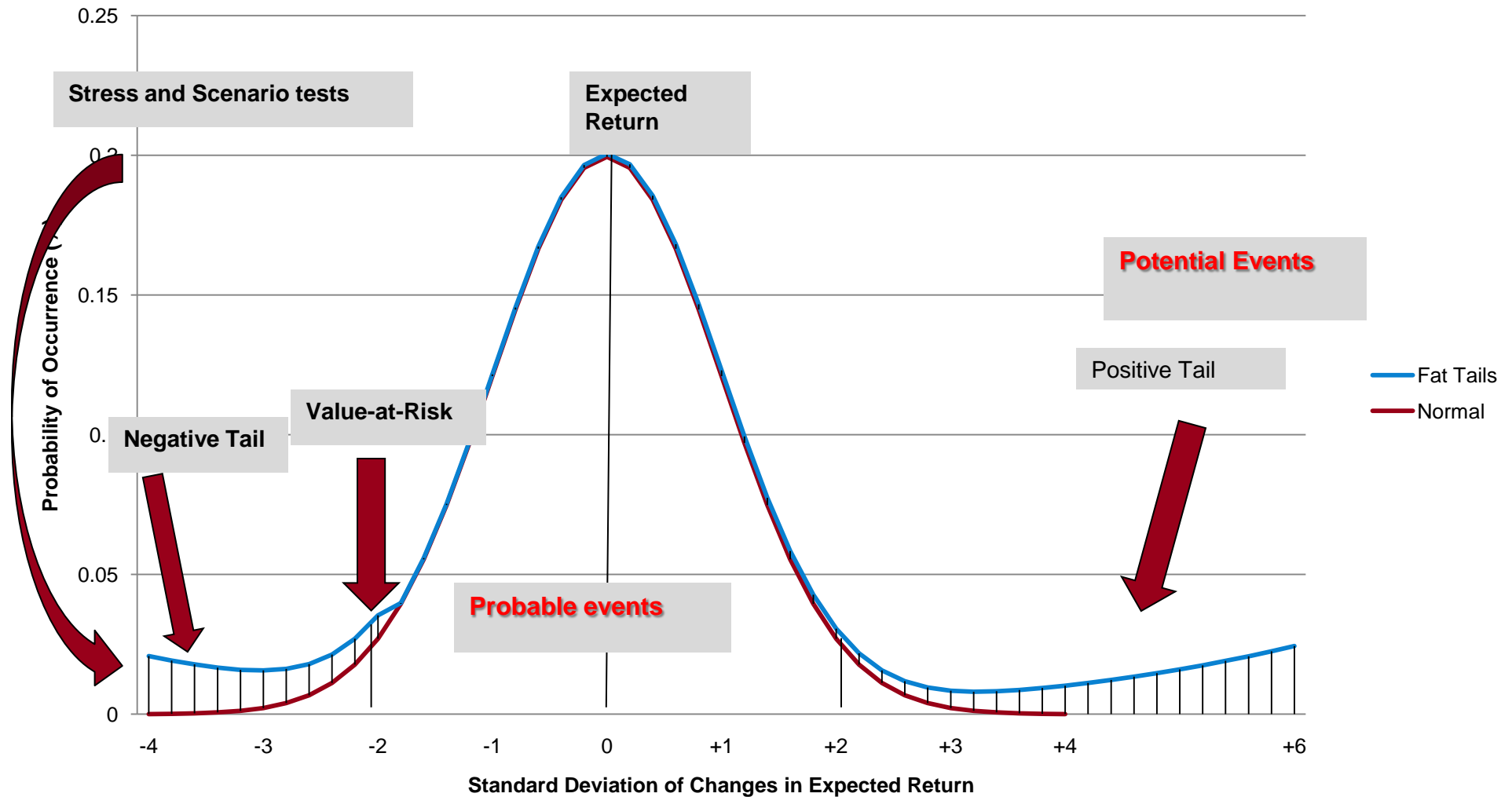
Buy vs. Sell Risk Management –
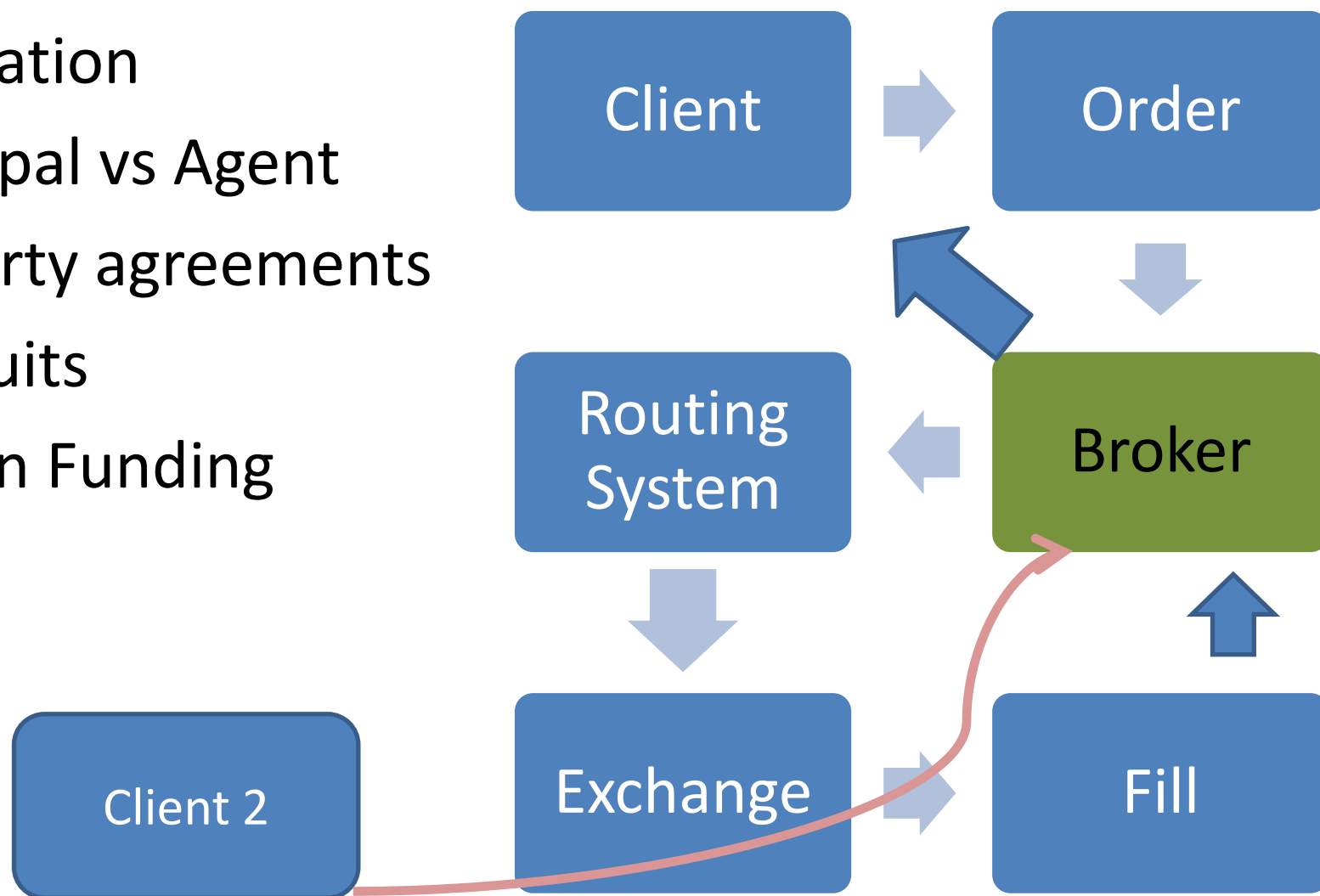## the Same Issues, but a Different Slant

Fund Risk

- Concentration Risk
- Asset Allocation
  - Tool for diversification
- Performance Attribution
  - Valuation
- Systemic vs. Idiosyncratic Risk
- Margin Optimization
- Liquidity
- Regulatory/Reputation Risk

Bank Risk

- Market Risk
- Credit Risk
- Counterparty Risk
- Operational Risk
- Liquidity Risk
- Reputational Risk

What's important for Risk-managing the Buy Side?

- How do hedge funds (and dealers) lose money?
    - Over-leverage (e.g. LTCM)
    - Concentrated or Illiquid Positions (e.g. Amaranth, Eagle)
    - Fraud (e.g. Bayou, Wood River)

- Protecting your firm requires a mix of quantitative and qualitative methods

- For starters, ask for initial margin on risk positions

- Utilize a range of analytic methods to measure the risks in client portfolios:
    - Evaluating "portfolio stress loss" based on a conservative product-customized stress-shock model
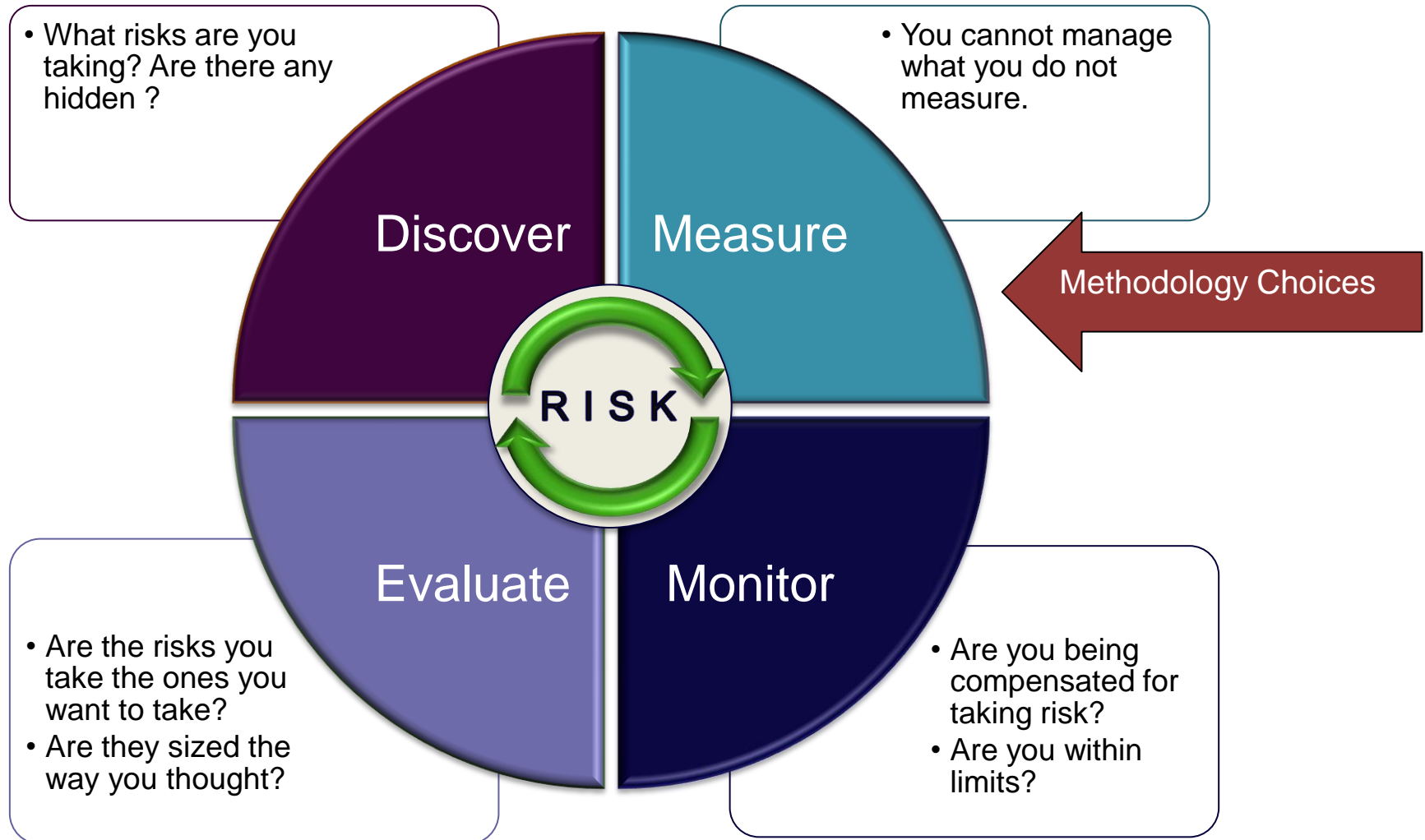   - Assessing significant concentrations within client portfolios
    - Approval process for large and complex trades
    - Know the major client and their risks within the Business.
    - Have a process to validate accurate pricing

- And not forgetting, a healthy dose of human judgment:
    - Risk team oversees risk and margin decisions in the business.
    - Risk Committee with senior business & support area persons: approves all major risk decisions;
    - Continual dialogue with clients and Credits to evaluate clients' creditworthiness.

The Risk Management Process

- What risks are you taking? Are there any hidden ?

Discover

- You cannot manage what you do not measure.

Measure

Methodology Choices

- Are the risks you take the ones you want to take?
- Are they sized the way you thought?

Evaluate

Monitor

- Are you being compensated for taking risk?
- Are you within limits?

RISK

The Common Language of Risk

- All risk measures can be compared over three variables (regardless of use):
  - Severity: How many dollars might be possibly lose?
  - Probability: How likely is the event we are discussing?
  - Time: Over what horizon do we expect the measure to take place?

- There are two basic types of risk measures:

  Probabilistic – measurements of severity associated with events that are viewed as more likely to occur (Value-at-Risk, Tracking Error)

  Potential - measurements of severity associated with events that are viewed as less likely – even extremely unlikely – to occur (Stress and Scenario tests)

- Both types of measures use inputs common to fixed-income analysis:
  - Basis Point Value (BPV or Delta) – The dollar change in value for a 1 bp change in rates
  - Gamma - The dollar change in value for a 1% change in delta
  - Vega – The dollar change in value for a 1% change in volatility

Once you define it…

- Decide time frame

- Choose probability level

- Calculate possible losses

- Across the financial industry, losses estimated with a 95% probability over a 1-day or 10-day horizon are referred to as Value-at-Risk

Calculating potential loss

- Estimates
- Partial Re-value
- Full Re-valuation

- Your choice will depend on your portfolio; and also the frequency with which you measure
- Estimates can be ok if you re-sample frequently
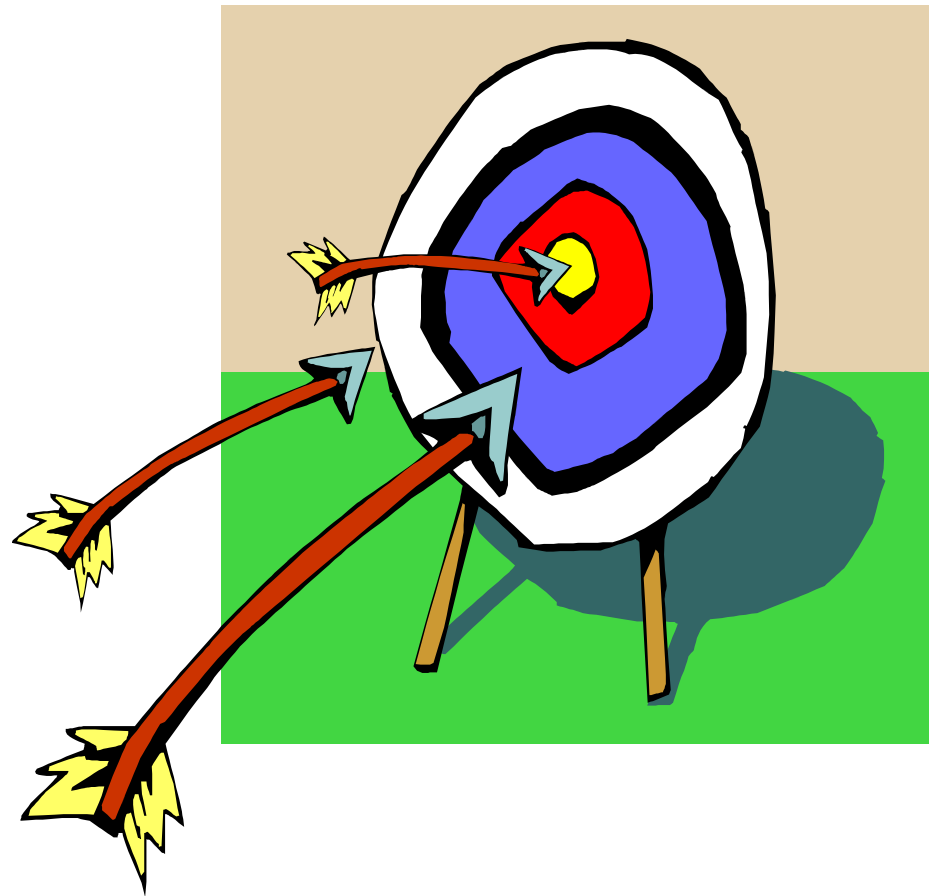
Choices: How do <u>you</u> like your coffee?

- VaR is traditionally calculated in a few basic ways:
- All have certain benefits and certain flaws
- What methods are typically used?
  1. Parametric
     - By security
     - By position
  2. Historical Simulation
  3. Taylor Series Approximation (erstwhile known as Delta-Normal)
  4. Monte Carlo
     - Full revaluation
     - Partial

After you measure – test Actual against Expected: the Backtest
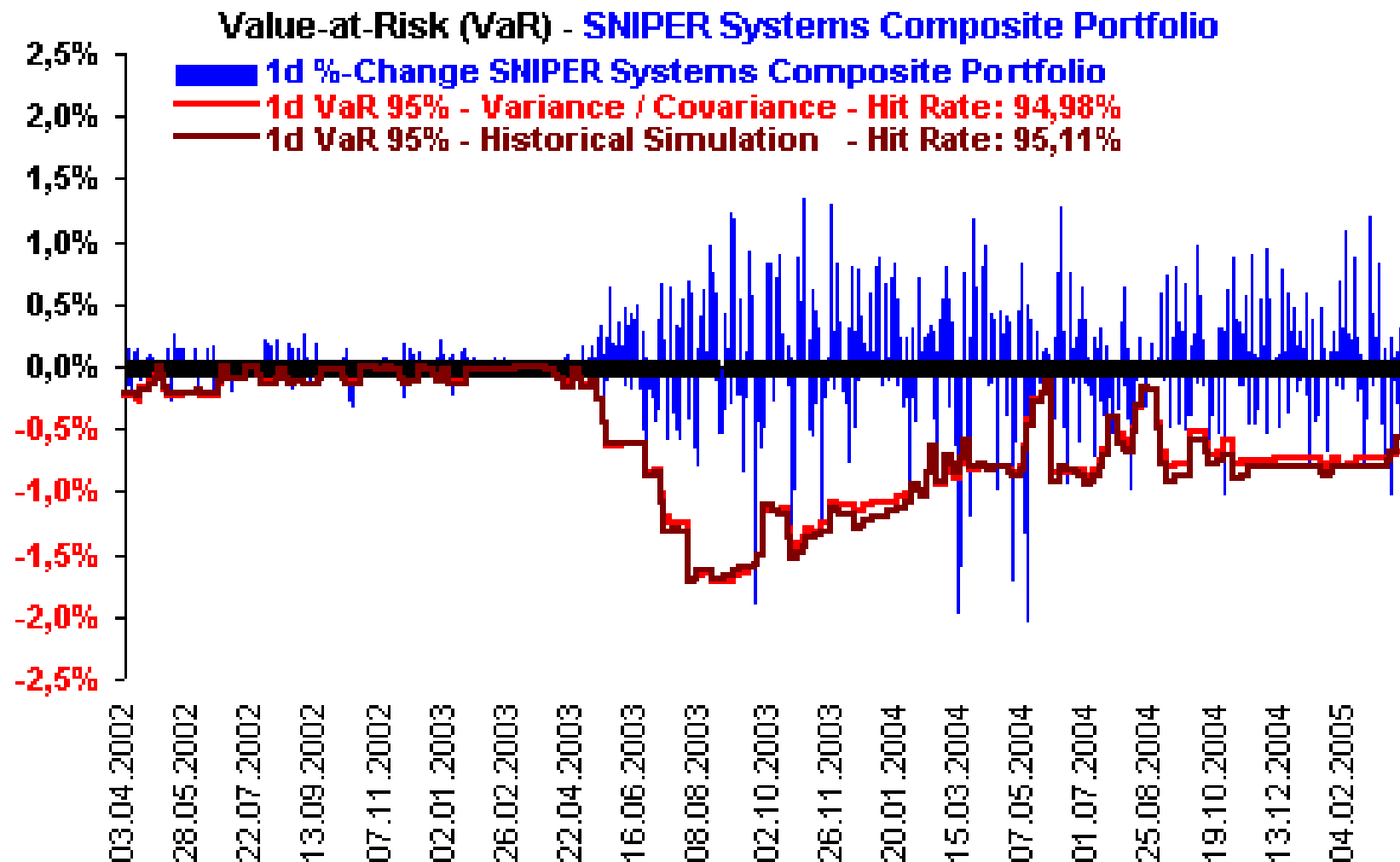
The simplest way to get a VAR?

- Get the current positions
- Get the values of the current positions
- Get volatility assumptions for the positions

Position Value	Asset	Volatility over 10 day time horizon	If price declines 1 standard deviation, then new asset values is…	68% chance over 10 days that the asset will lose no more than…	VaR (95%) is approximately 2.33 standard deviations so VaR =
10,000	ABC	10%	(1-10%)* 10,000 = 9,000	10,000- 9,000 = 1,000	2,330
50,000	DEF	6%	(1-6%)* 50,000 = 47,000	50,000 – 47,000 = 3,000	7,000
25,000	XYZ	25%	(1-25%)* 25,000 = 18,750	25,000 – 18,750 = 6,250	14,580

Then what? Correlation kicks in

- Correlation/covariance matrix creatrion

- If all the price changes are driven by the same event (positive correlation), then the portfolio could lose $23,910

- If the price changes are all driven by different, independent events; then the portfolio could lose perhaps $7,970

- If the event for one asset causes gains for the other two (negative correlation), the loss could be $5,250
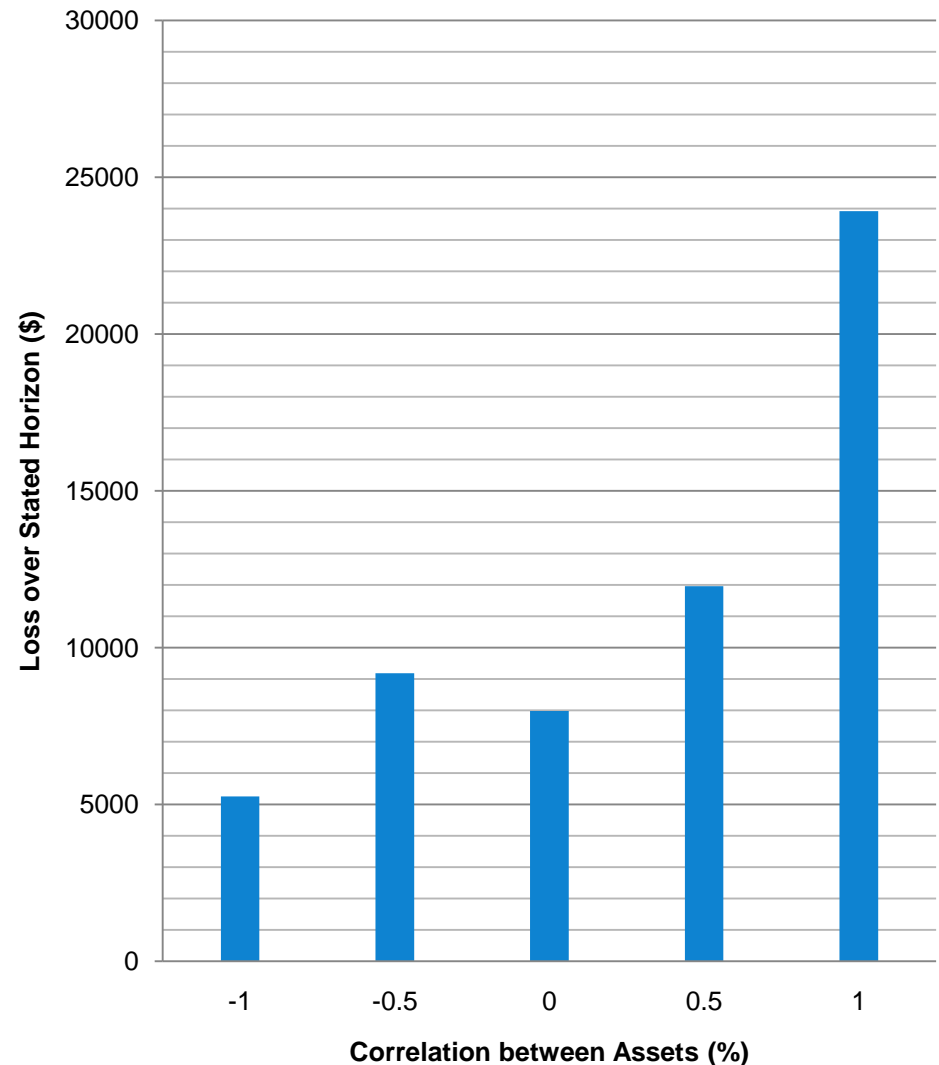
Flaws in the assumptions

- Definition is non-constructive

- This means that the definition of the term specifies the attributes of the measure, but not precisely how to calculate it. This leads to the large range of "common" implementations.
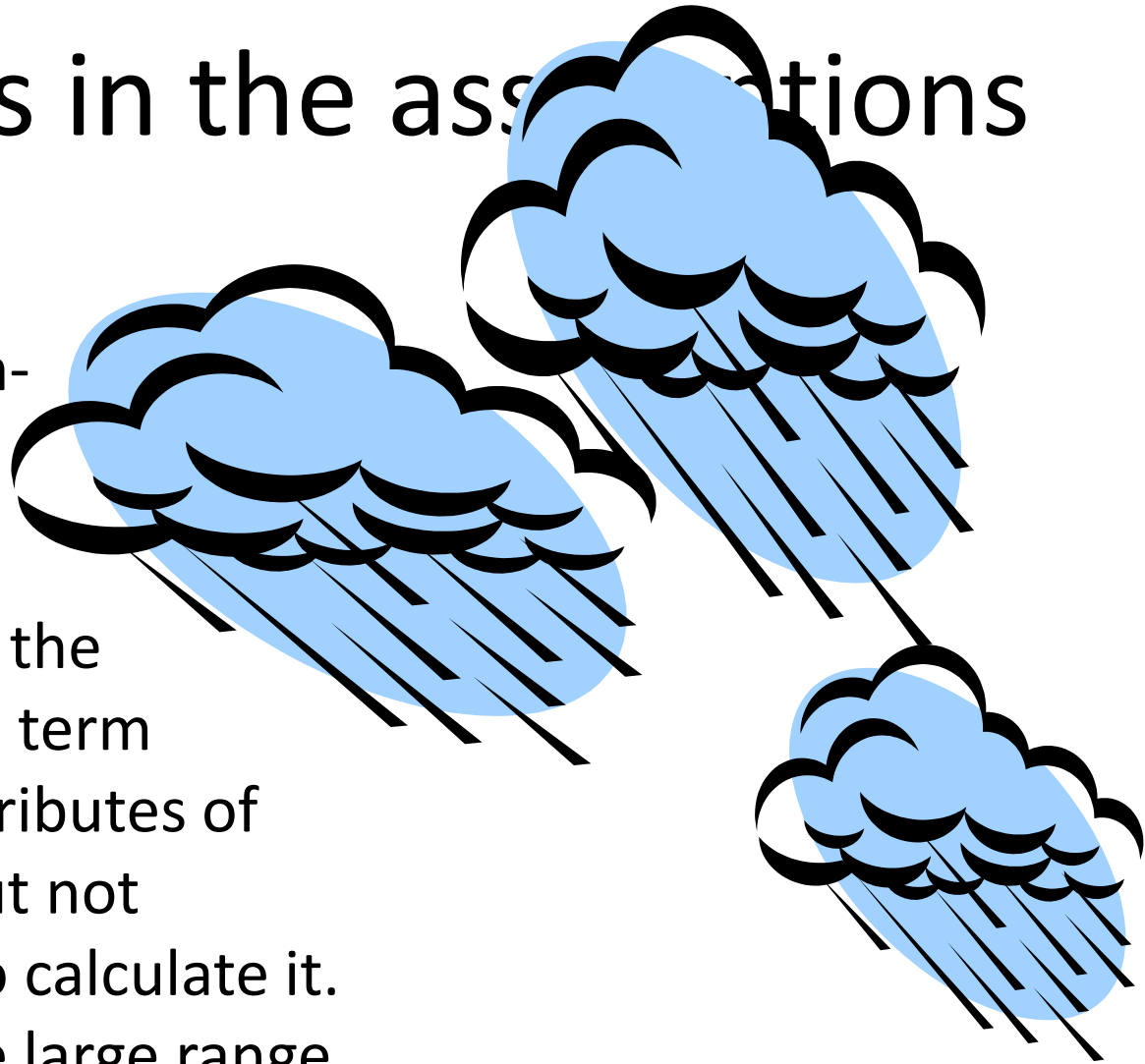
More slings and arrows

- The model assumes non-negative values for assets and rates

- Bond and common stocks can only go to a minimum value of zero, true.

- However there were negative interest rates experienced in Japan in the late 1990s.

- Also many types of derivatives can have negative values.

The rest of the complaints…

- Stationarity – the assumption that the shape of the distribution curve is the same over time. This has to do with estimating the probability of occurrence.

- Time consistency – this the assumption that what is a good estimate for one period of time is good for multiple periods of time.

- Continuous – the implied assumption that trades occur at every price…i.e. no jumps.

- Random walk – the assumption that tomorrow's price moves are independent of today's price moves. This is also phrased as not accommodating autocorrolation.

- Normal distribution – the assumption that returns follow a normal distribution can be alleviated by using a Historic Simulation approach.

- Tail estimation – VaR calculates the area under the curve to the right…does not provide an estimate of the potential loss IF we see an atypical event.

So why do we use it?

- No one has come up with a better idea as yet.

Value-at-Risk Summary

Absolute Risk Measure
- Statistical expectation
- Specific confidence interval
- Pre-set time frame

Benefits
- Good tool for multi-asset class portfolios
- Objective measure
- Familiar to the market

Drawbacks
- "Noisy"
- Less actionable
- Many assumptions when including structured deals
- Volatility dependent

Development
- Conditional VaR – for estimating tail loss
- Backtesting – to calibrate to market

(Chart labels:)
Value at Risk
VaR=0.82 Mio EUR
Portfoliowert heute: 1.89 Mio EUR
10%
Portfoliowert [in Mio. EUR]

Introduction to New Metric: Tracking Error

- It is a measure of potential expected difference in return between an actual portfolio and its benchmark portfolio
  - It incorporates differences in Expected Mean Return E(r) and differences in Volatility

TE = STANDARD DEVIATION[(Return(Portfolio) – Return(Benchmark)]

Here's an example...

Expected Return = 5.25%,
Standard Deviation = 14.28%

**Empirical Distribution of Returns
Actual Portfolio**

Expected Return = 2.15%,
Standard deviation = 4.65%
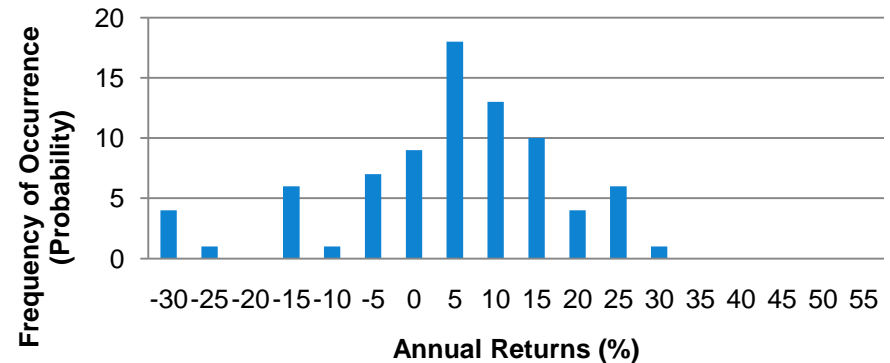
Distribution of Benchmark Returns
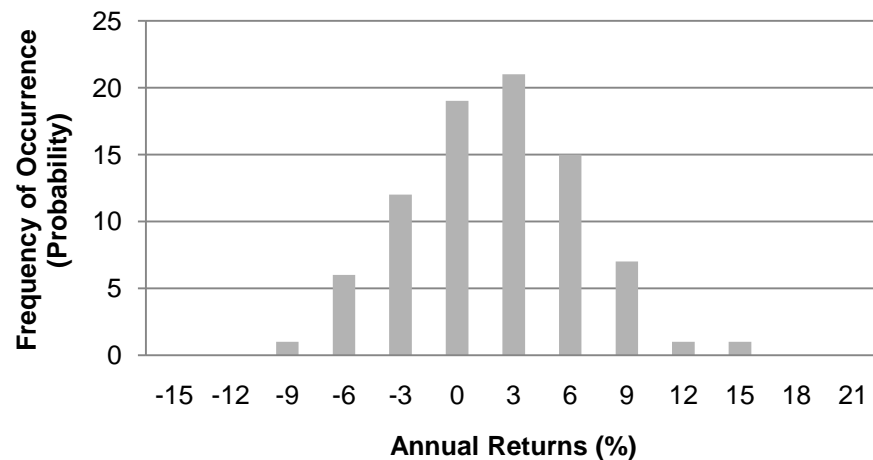
Arrives at the Distribution of Excess Returns

The TE is the standard deviation of the resulting distribution. It is also called the "Active Risk". There is a corresponding increase in expected return when running active risk in a portfolio.

Distribution of Net Returns

- Average = +63 bps
- TE = 192 bps

Scale now in BPS rather than %

Caveats

- The TE is used both ex-ante and ex-post. Ex-ante is predictive and can be used to asses whether the size of an increase in expected return is sufficient for the increase in Active Risk taken on.
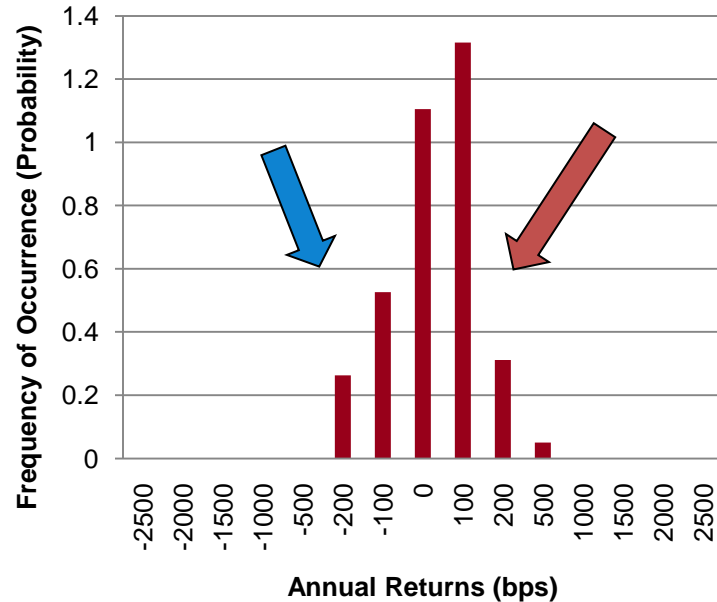
- TE is more predictive the longer the time period it has been measured

- AND the more stable the mandate of the portfolio

- TE is used ex-post to examine the contributions to performance and whether the expected returns have been accurately assessed.

- It is vulnerable to changes in volatility

- It can be misleading (quite large) when the actual portfolio is not normally distributed

Information Ratio

- The risk-adjusted return on a portfolio

- Expected Active Return/Tracking Error

- IR = $\dfrac{E[R(P) - R(BM)]}{\sqrt{var[R(P) - R(BM)]}}$

Sharpe Ratio

- Reward to Variability

- $S = \dfrac{E[R(P) - RFR]}{\sqrt{var[R(P)-RFR]}}$ and

$\sqrt{(VAR)}$ = Standard deviation

1 standard deviation is "normal"

Another way to slice the data: Systemic Risk & Idiosyncratic Risk

- Different than CAPM terminology
- In CAPM, can't hedge systemic risk
- Can diversify idiosyncratic risk by buying more stuff
- Today – we can hedge systemic risk with SPX, CDX, CMBX etc
- Cannot hedge true idiosyncratic risk
- Independently correlated residuals

Systemic Risk

- Systemic Risk in CAPM is also known as Beta Risk; viewed more as idiosyncratic in some arensa

- (Excess Expected Return of the Asset)/(Excess Expected Return of the Market) is Beta in CAPM

- Residuals from Hedge Effectiveness are viewed more as idiosyncratic risk

- Regress risk position against portfolio of hedge instruments – residual is idiosyncratic

So if systemic risk is market risk…

- Idiosyncratic risk is the residual
- In theory, the residuals are uncorrelated
- In practice, we see Beta risk as the risk that can be hedged by an index
- Some residual risks can then be offset by single instrument CDS or futures
- Some alpha is due to no hedge instrument
- If you can't hedge it – it should get a higher expected return

Tracking Error as an Attribution Tool

Tracking Error

Systematic -Market	Systematic – Credit	Idiosyncratic – Credit	Other Idiosyncratic Risk

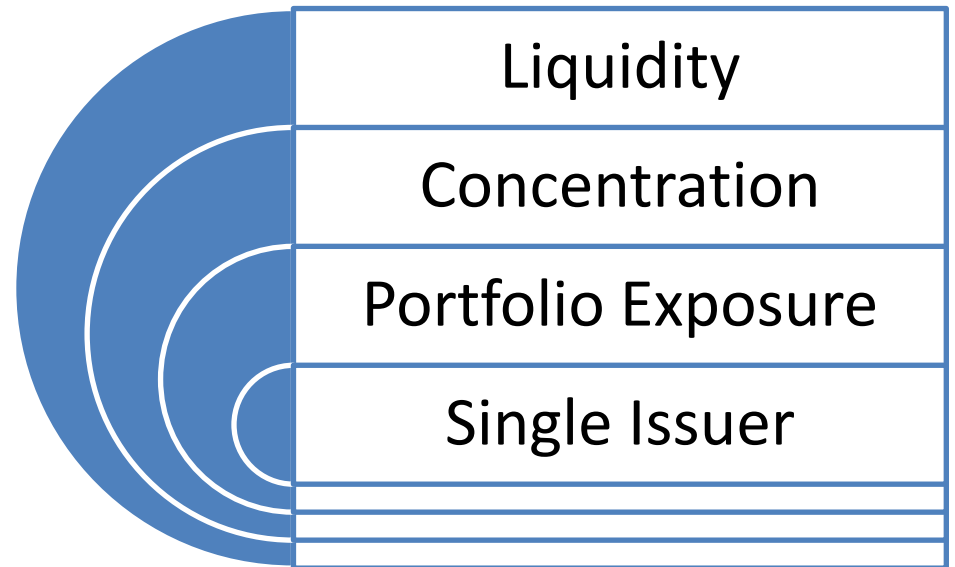| Duration	Correlation	Duration

Credit Risk for the Buy-Side

- Individual name exposure
- Portfolio level exposure
- Concentration risk

- Default
- Migration/Transition
- Credit Spread Volatility

| Liquidity |
| Concentration |
| Portfolio Exposure |
| Single Issuer |

Vocabulary

Credit Exposure – the MTM losses that will occur if a default event occurs, less the expected recovery from the estate. Positive exposure results are "In the money" positions, Negative exposure results are "Out of the money" positions.

Potential Future Exposure – the possible exposure that exists given a particular shock or set of shocks to the market. Often used with zero-cost derivatives

Loss Given Default – the rate of loss on exposure given a default event; includes rate of recovery, physical replacement costs, etc.

Expected Default Frequency – aka the probability of default; i.e. the likelihood that a default will occur. These can be calculated either Through-the-Cycle or Point-in-Time (PIT)

Scenario – a particular combination of parameters (price, default event, loss given default).

Expected Loss – the average loss over all shocks and/or scenarios.

(Average Potential Future Exposure)x (Loss Given Default) x (Default Frequency)

Credit VAR – (Merton or Vasicek models) the worst case loss at a defined confidence interval.
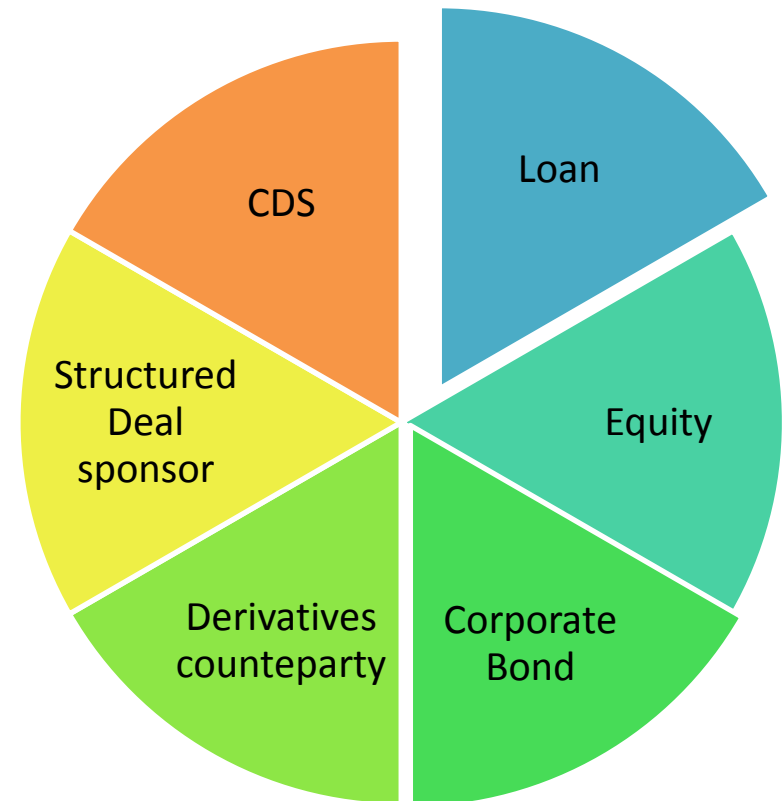
Credit Exposure Reporting

Single Obligor Limits

    Notional

    Market-Value

    Loss Given Default

    Maximum Probable Loss

VAR vs. Credit VAR

VAR (Value at Risk)

- Quantifies risk due to market moves using a confidence interval and time horizon.

confidence interval

- Example: There is a *95%* chance that trading losses over the next *1 month* will be less than *$2,000,000*.

time horizon   risk amount

Credit VAR (Value at Risk)

- Quantifies risk due to defaults or changes in creditworthiness using a confidence interval and time horizon.

- Example: There is a *95%* chance that losses due to default over the next *1 month* will be less than *$2,000,000,000*.
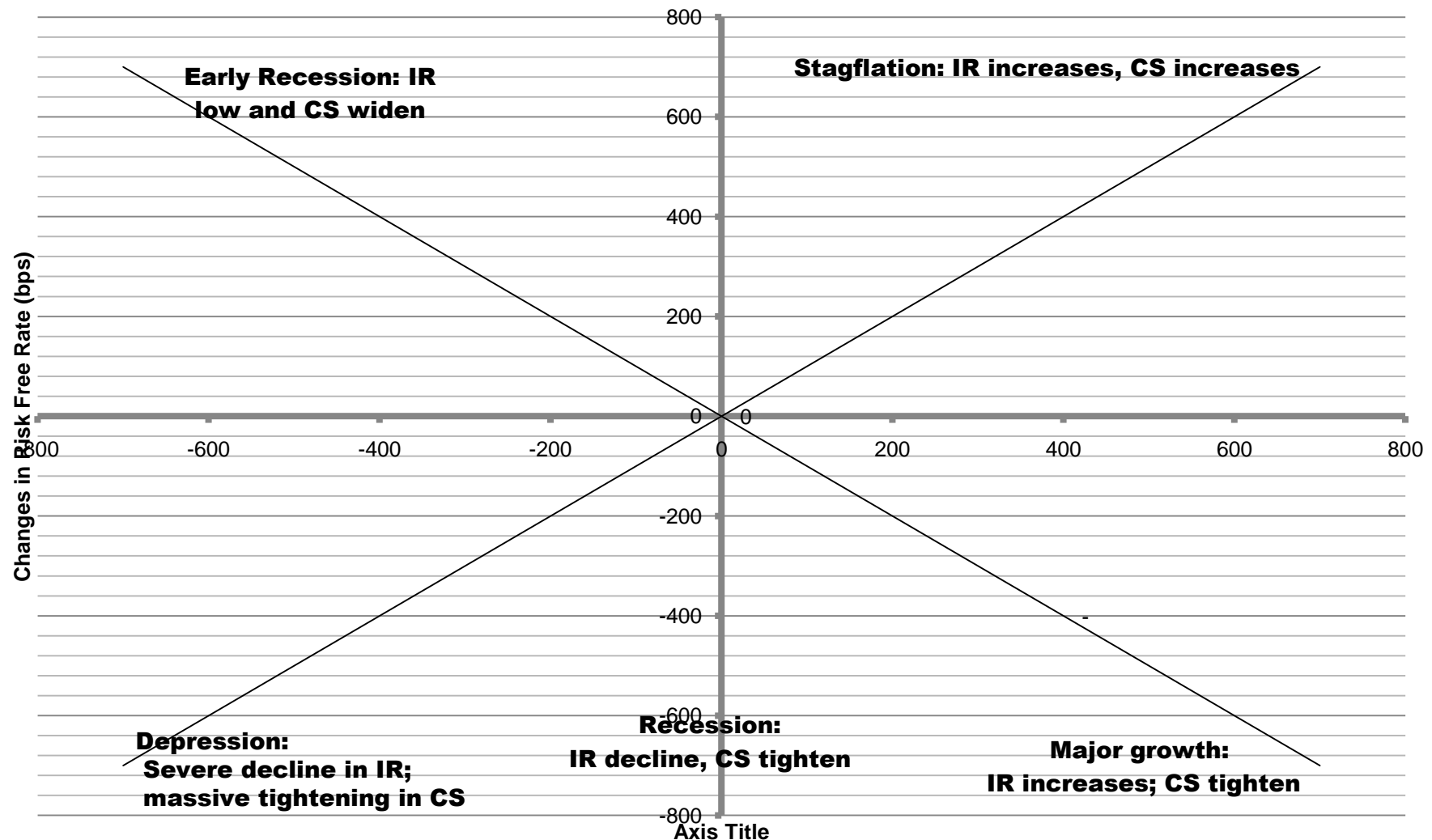
Stress Testing & Scenario Analysis

- Stress and scenarios as the question "what if?"

- The goal for good risk management is to have no surprises…how to achieve?

- Map all potential combinations of changes in risk inputs to macroeconomic events.

- For example>>>

Interest Rates	Credit Spreads	Volatility
+	+	+
–	–	–
+	–	–
+	–	+

Stress Variables and Economics

Tying Stress & Scenario Analysis to Macroeconomic Events

- **Early Recession: IR low and CS widen** (top-left quadrant)
- **Stagflation: IR increases, CS increases** (top-right quadrant)
- **Depression: Severe decline in IR; massive tightening in CS** (bottom-left quadrant)
- **Recession: IR decline, CS tighten** (center-bottom)
- **Major growth: IR increases; CS tighten** (bottom-right quadrant)

Y-axis: Changes in Risk Free Rate (bps), scale from -800 to 800

X-axis: Axis Title, scale from -800 to 800

Non-market Risks

- Weather; Terrorism; Pandemic
- Calculating Aggregate Exposures
- Systems
- Reinsurance
- Catastrophe Bonds

LEVERAGE, AND FINANCING

Leverage & NAV

- Leverage is the amount of securities controlled relative to the amount of capital in the account
- The traditional calculation is:

  L = (LMV+ Cash)/Capital

More conservative, L_{MOD}=(ABS(LMV)+ABS(SMV)+ CASH)/CAPITAL

Begs the treatment of zero cost derivatives like IRS, CDS

What about the cash coming in from shorts?

Inflates cash number in traditional formula!

How do you get leverage?

- Borrow money
  - Unsecured
  - Secured
    - Brokerage & Reg T
    - Banks & Collateral

Definitions

- MARGIN refers to both 1) the amount of upfront cash needed to complete a trade and 2) the cost of the borrowed monies
- Initial Margin (IM) is the amount of upfront monies the fund will post to do a trade.
- Variation Margin is the daily exchange of P&L on the trade
- Total margin = IM+VM
- This does not reduce credit exposure, but increases recovery rate
- Purchasing securities on margin = borrowing money and posting securities as collateral
- Debit balance is the amount owed the broker, minus profits on short sales
- Credit balance is the amount of excess collateral lent to the broker

Margin Games

- Initial Margin can be a static or a dynamic figure. The amount is dependent on the volatility of the traded product and the time frame to settlement.
- Direct trading desks will try to negotiate the IM between their credit officer and the client
- COs and PBs will set the IM at a level to cover all or part of the product volatility, dependent on
  - Their view of the risk of the fund defaulting (Probability of default)
  - The amount of residual equity in the legal entity after investors are redeemed (recovery rate)
  - Estimated client position unwind period
  - The regulatory capital methodology employed by the Bank

Why Prime Brokerage?

- Acting as the Banker for traders and fund managers
- Getting leverage by margining trades
- Posting margin to exchanges on your behalf
- Acting with Correspondent Banks to settle non-domestic currencies
- Give-up and Intermediation products
- Capital Introduction
- Ultimate profit is from client balances: rates charged on debits vs. rates paid on credit
- **Access to markets**
- **ACCESS TO CREDIT**

Definitions

Haircuts versus Advance Rates

A haircut is the percentage of a security's value that is used as initial margin i.e. US Treasury haircut is 2%

An advance rate is the amount of cash you can borrow if you post a certain security as collateral; i.e. you can borrow 98% of the value of a UST bond

Collateral is posted by signing a legal agreement that gives a perfected security interest in the property posted.

How else to get Leverage?

- Repos/Reverses

- Securities Lending
  - Lend out the securities you own to brokers who lend them onwards
  - Operationally intensive
  - Historic challenges of rehypothecation

Collateral and Credit Risk

- **Collateral does not impact Counterparty Current Exposure (CE)**

  -CE is the (-)mark-to-market of all positions with the counterparty, also known as the Replacement Cost. This is how the fund is evaluated by their counterparty bank

- **It increases the Recovery Rate for defaulting counterparties**

- **Reduces theoretical Loss Given Default (LGD)**
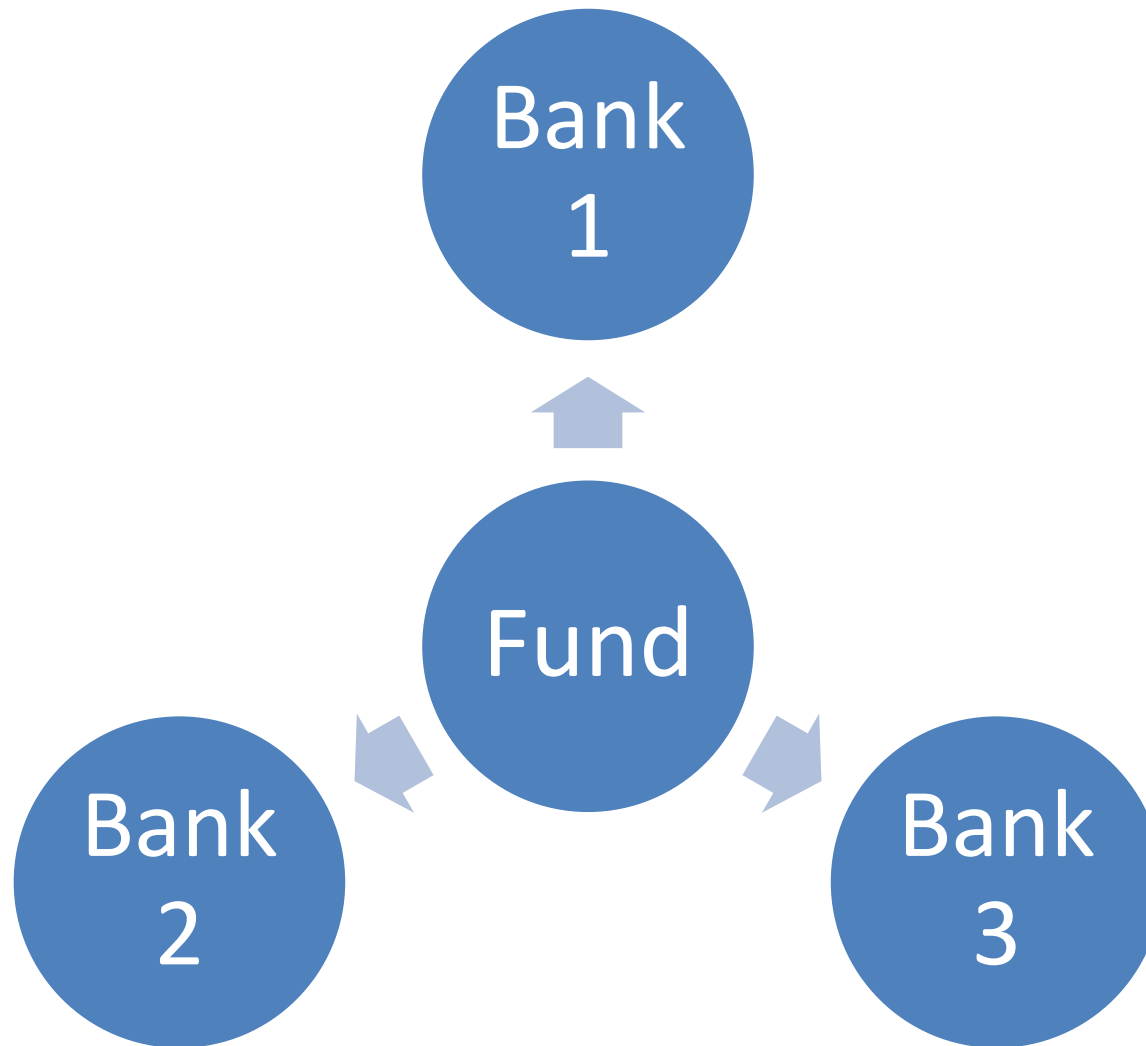
  = Expected Exposure * (1-RR)

Leverage & Liquidity

You can use leverage, and you can deal in illiquids. Doing both simultaneously is dangerous! See the SIVs...

DERIVATIVES USE

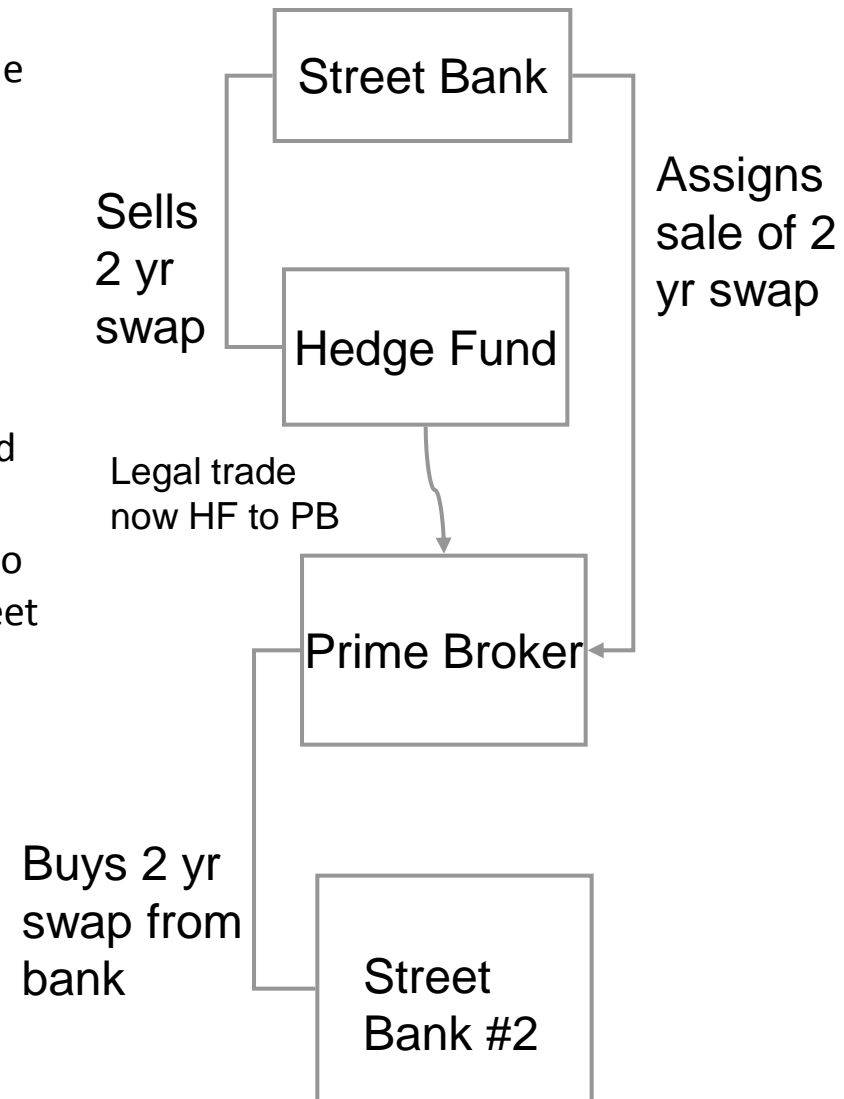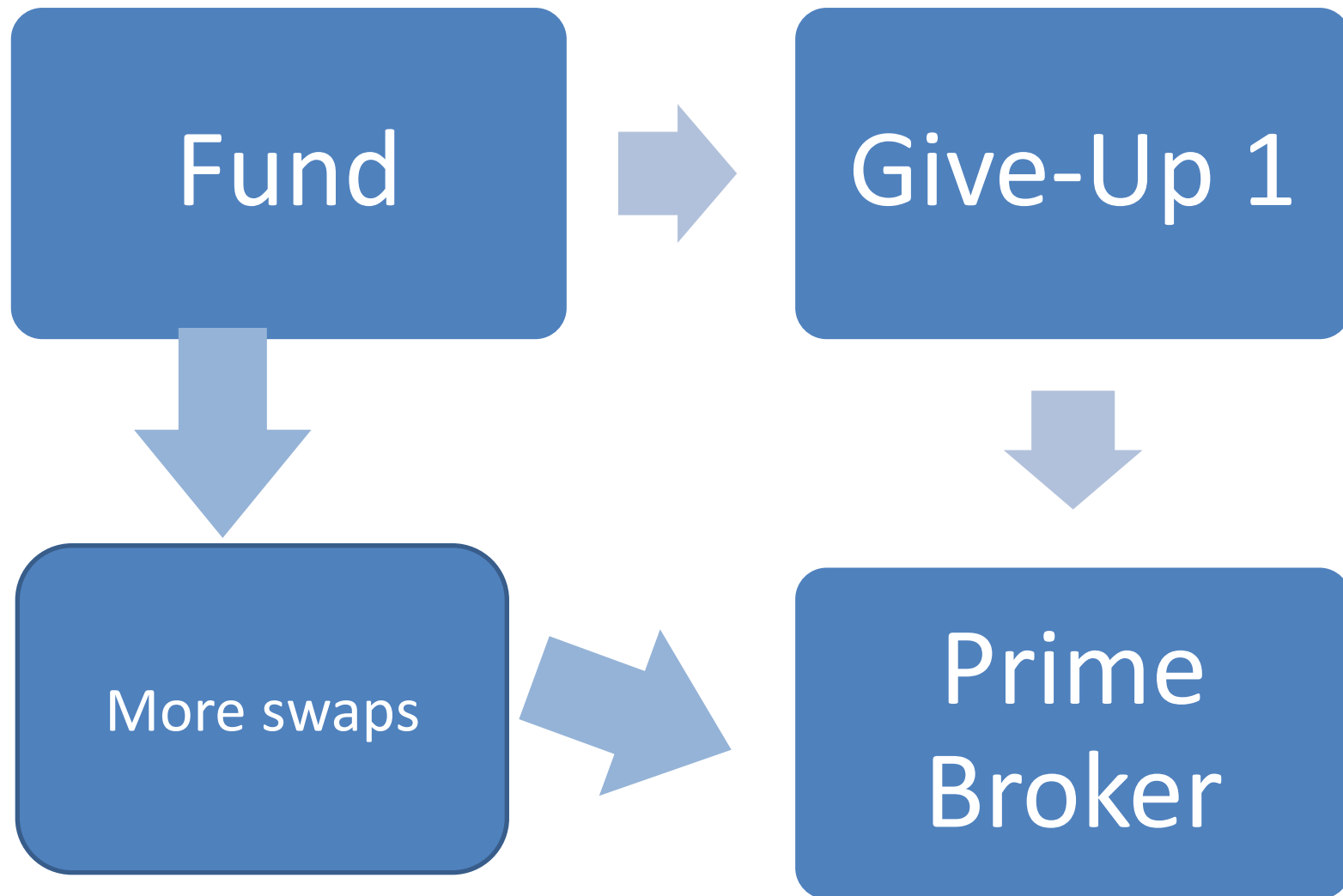# Traditionally…

Then came Give-ups

- Give-ups are when a client executes a trade "away" i.e. with a different Street name, and then the executing bank transfer it to your bank to settle.

- Intermediation a more formalized way of doing this. Leaves PB with no market risk, but credit counterparty risk to both HF and Street names

- Advantages are that ISDAs or other docs do not have to be negotiated with all the Street names separately

Street Bank

Sells 2 yr swap

Assigns sale of 2 yr swap

Hedge Fund

Legal trade now HF to PB

Prime Broker
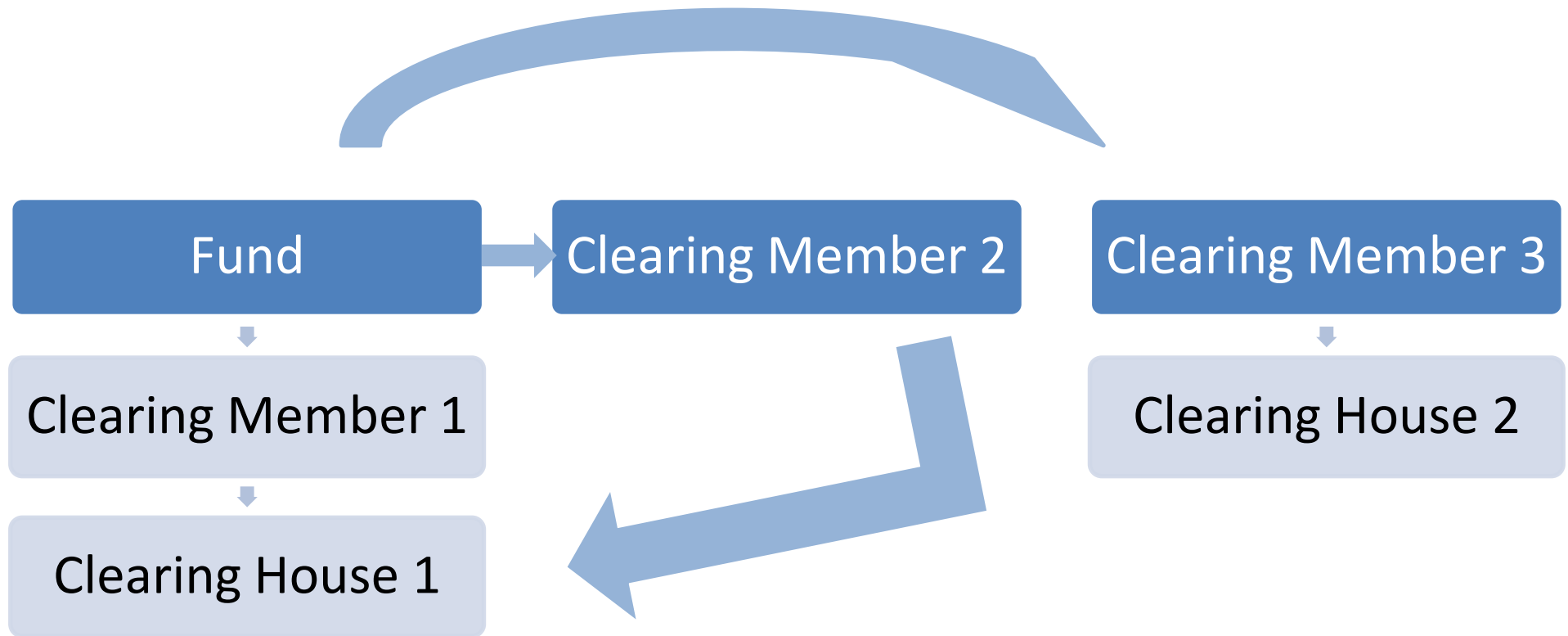
Buys 2 yr swap from bank

Street Bank #2

Net Result of Give-ups

OTC Clearing Impact

The Fund ends up with all their derivatives at only 1 or 2 Clearinghouses. If the Bank becomes insolvent, the Clearinghouse nets the positions and offsets them to another member

LIQUIDITY

Liquidity

1. Periodicity of when you can unwind a legal investment agreement
2. Ability to place a trade in a given size
3. The ability to fund liabilities as they come due

Liquidity – a buy-side definition

- In this context **Liquidity** refers to when you can liquidate the investment
- Mutual funds
  - Liquid assets
  - 100% of capital required on Day1
  - 100% invested Day 2
  - Daily redemption capability
- Hedge Funds
  - 100% of capital required Day1 for existing fund; new funds may ramp up
  - Fully invested Day 2
  - Possibility of side-pockets; liquidating trusts
  - Quarterly or annual redemption with 30-90 day advance notice
- Private Equity structure
  - May include a ramp-up period; could last 3 year or more
  - Tail period of unwind could be much longer than original projections
  - Quarterly or annual redemption with 30-90 day advance notice
  - Often **significant** portion of assets are illiquid

Liquidity Measures

- In the markets, a lack of liquidity is the inability to execute a trade
- Most illiquidity claims are a reluctance to move price – check VWAP againt Hi/lo
- Look for breadth of market – defined as number of two-way participants
  - Breadth sharply declined in 2008 with failure of Bear, Lehman, and closing of 30-odd large funds
- Depth of market defined as size of trade possible without moving price significantly
  - US Treasuries typically the poster child for liquidity
  - Market becomes one-sided as firm de-leverage
  - Depth significantly reduced

Close-out risk

- Defined as the additional costs involved in unwinding portfolios of defaulted counterparties

- Most firms mark-to-market at mid ; unwind will at very least be done at bid or offer

- Question of unwind trades or execute offsetting hedge and let bad trades roll off

- Increases operational risks due to re-booking trades; monitoring hedge execution and effectiveness; restructuring parts of portfolio to reduce model risk or move into more liquid sectors of the market

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