

# NABE PRESENTATION

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# GALAXY OF RISKS

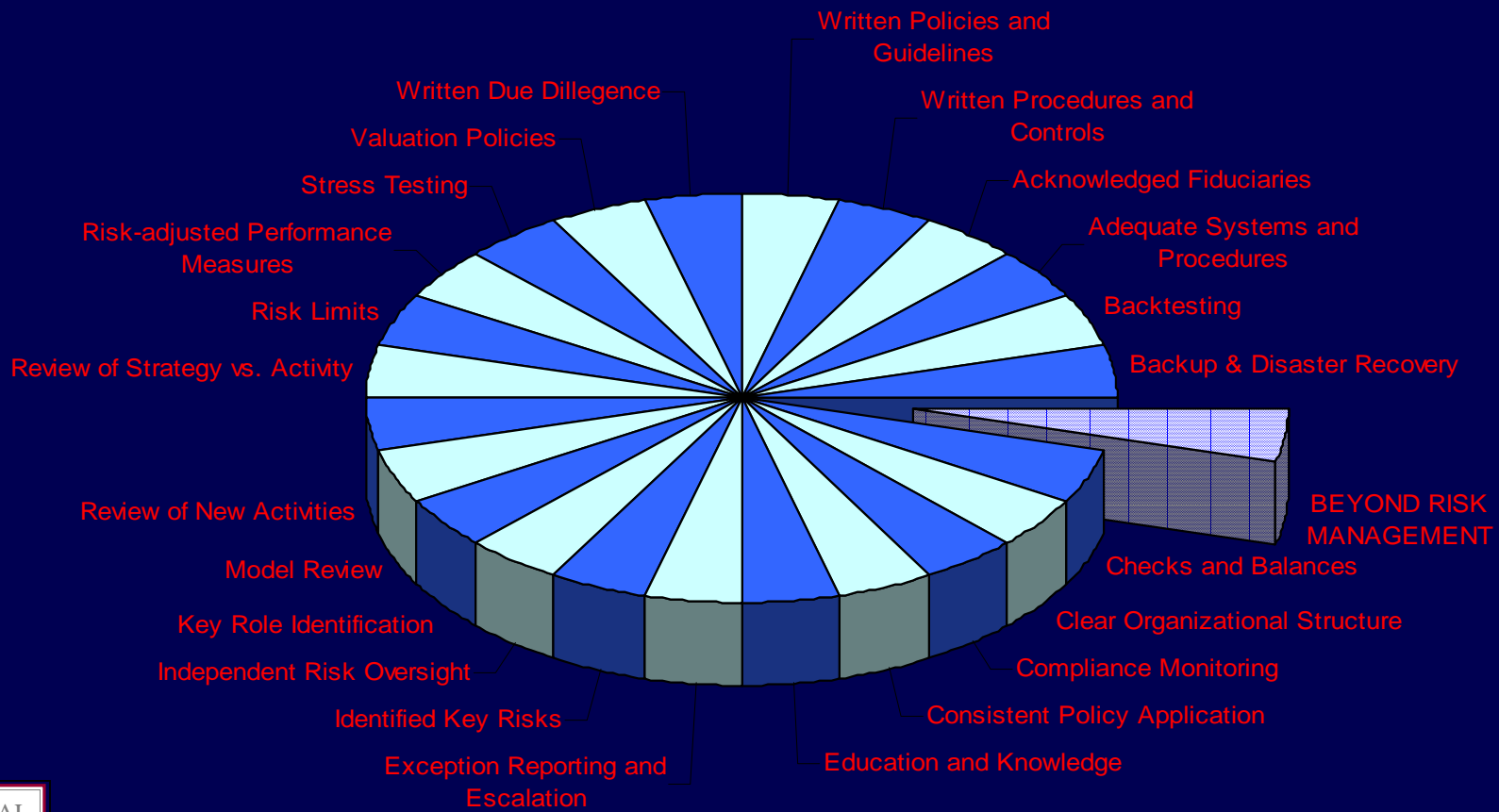
- ◆ Accounting risk
- ◆ Bank Liquidity facility risk
- ◆ Bankruptcy risk
- ◆ Basis risk
- ◆ Bucketing risk
- ◆ Burnout risk
- ◆ Call risk
- ◆ Capital risk
- ◆ Complexity risk
- ◆ Concentration risk
- ◆ Contract risk
- ◆ Correlation risk
- ◆ Counterparty risk
- ◆ Credit Risk
- ◆ Currency risk
- ◆ Curve construction risk
- ◆ Data risk
- ◆ Daylight risk
- ◆ Elbow risk
- ◆ Equity risk
- ◆ Euro risk
- ◆ Extension risk
- ◆ Extrapolation risk
- ◆ Fallout risk
- ◆ Franchise risk
- ◆ Gap risk
- ◆ Hedging risk
- ◆ Horizon risk
- ◆ Iceberg risk
- ◆ Interest rate risk
- ◆ Interpolation risk
- ◆ Knowledge risk
- ◆ Legal risk
- ◆ Limit risk
- ◆ Liquidity risk
- ◆ Mapping risk
- ◆ Market risk
- ◆ Market dislocation risk
- ◆ Model risk
- ◆ Netting risk
- ◆ Operational risk
- ◆ Optional risk
- ◆ Personnel risk
- ◆ Phantom risk
- ◆ Pipeline risk
- ◆ Political risk
- ◆ Prepayment risk
- ◆ Publicity risk
- ◆ Raw data risk
- ◆ Regulatory risk
- ◆ Reinvestment risk
- ◆ Reputational risk
- ◆ Reset frequency risk
- ◆ Rollover risk
- ◆ Spread risk
- ◆ Suitability risk
- ◆ Systemic risk
- ◆ Systems risk
- ◆ Tax risk
- ◆ Technology risk
- ◆ Termination risk
- ◆ Term Structure risk
- ◆ Time lag risk
- ◆ Volatility risk
- ◆ Y2K risk
- ◆ Yield curve risk

(Partial listing)



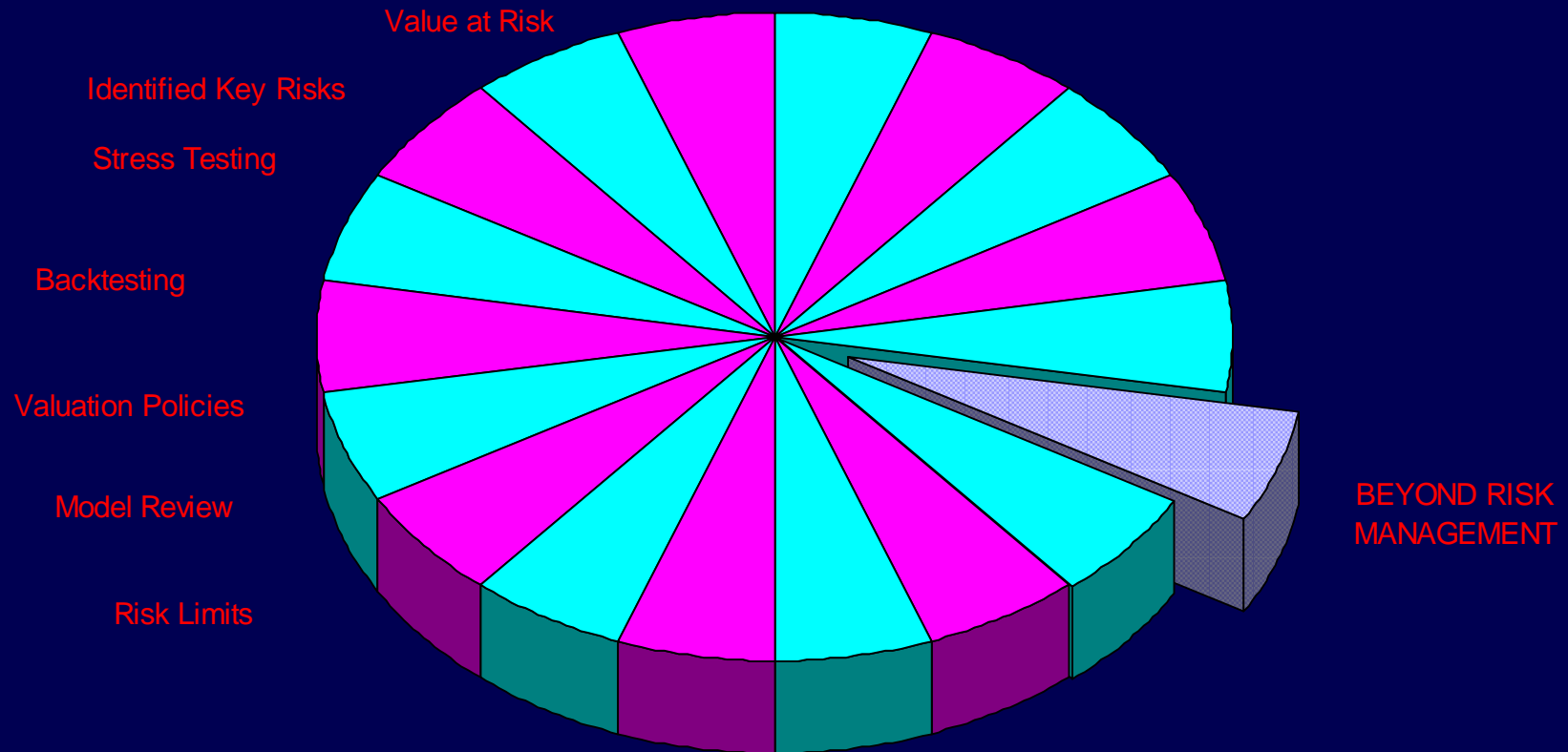
# Risk Management Framework

## Key Components



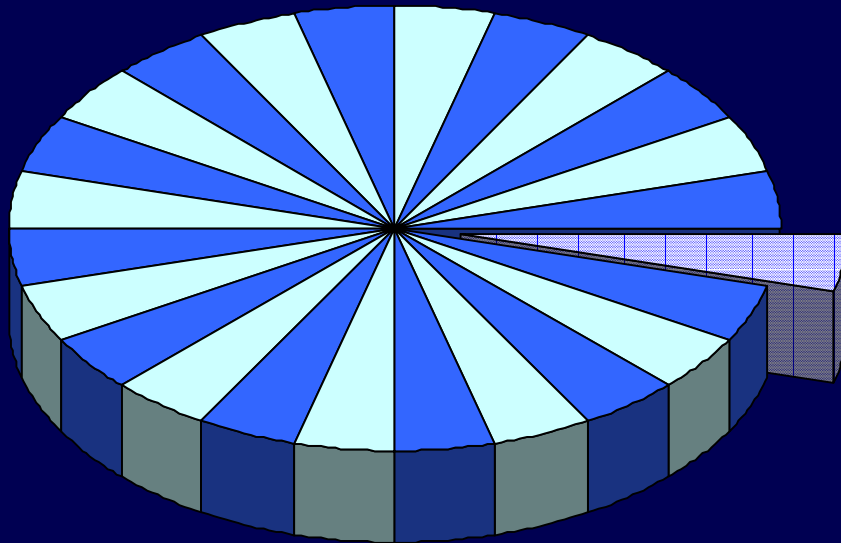
# Risk Management Framework

## Key Components - Only 1/3 are Quantitative



# Risk Management Framework

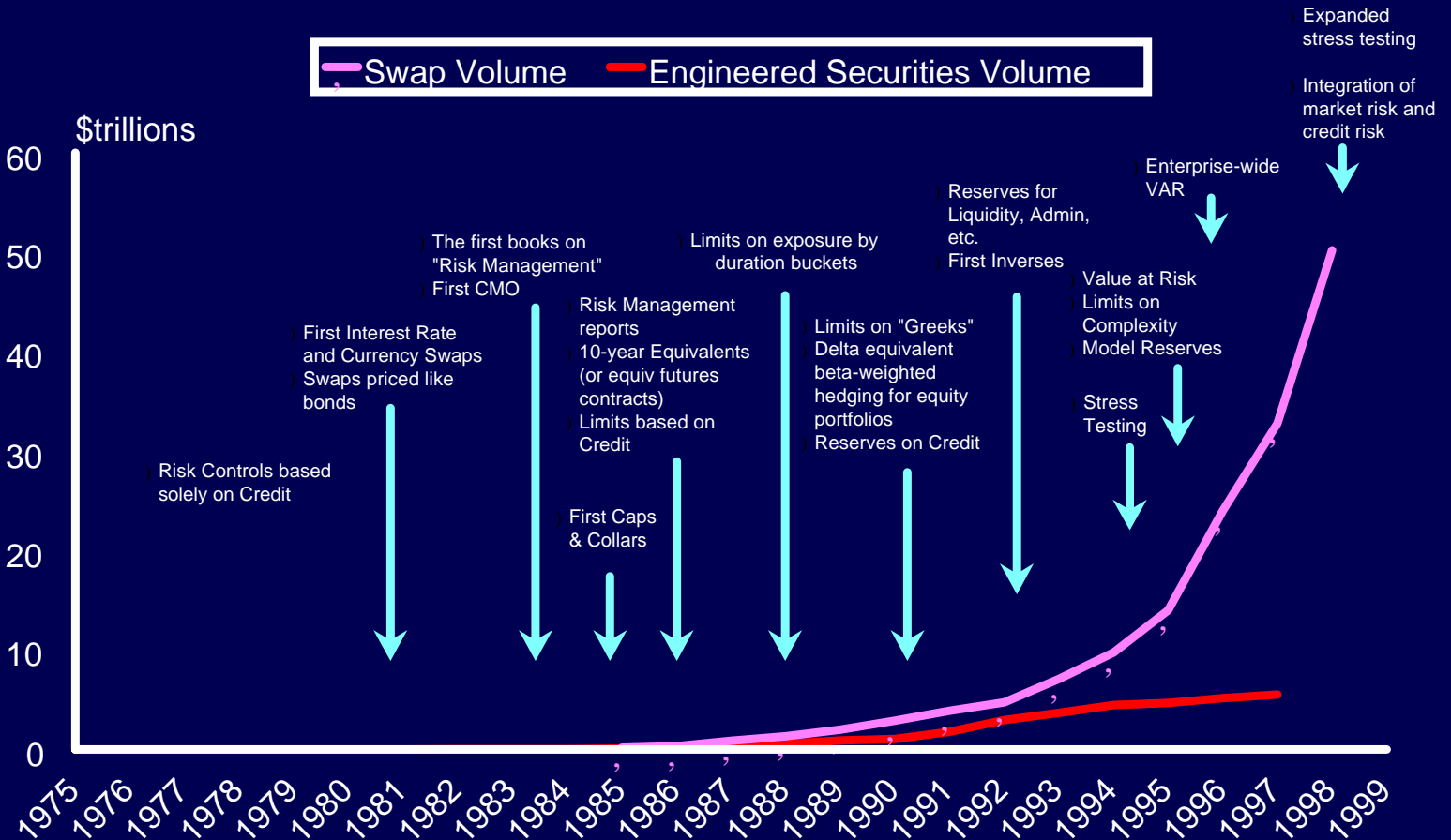
## Beyond Risk Management



**What you cannot control  
should be as small as possible:**

- 1. Clever, new forms of fraud**
- 2. Paradigm changes in markets**
- 3. “New” market moves**
- 4. Surprise regulatory or other infrastructure changes**
- 5. “Act of God” equivalents**

# Evolution of Risk Measurement



# Risk Is Not “Good” or “Bad”

- ◆ How much risk?
- ◆ Who’s managing it?
- ◆ Is the risk adjusted return adequate?
- ◆ What is “Bad” risk?
  - Mispriced
  - Misunderstood
  - Mismanaged
  - Unidentified
  - Unintended



# What is VAR?

- ◆ VAR is the maximum loss a portfolio can incur over a specified time period, with a specified probability
- ◆ VAR is a vital component of current "best" practices in risk measurement
- ◆ VAR is embraced by practitioners, regulators and academics
- ◆ VAR is valuable as a probabilistic measure of potential losses



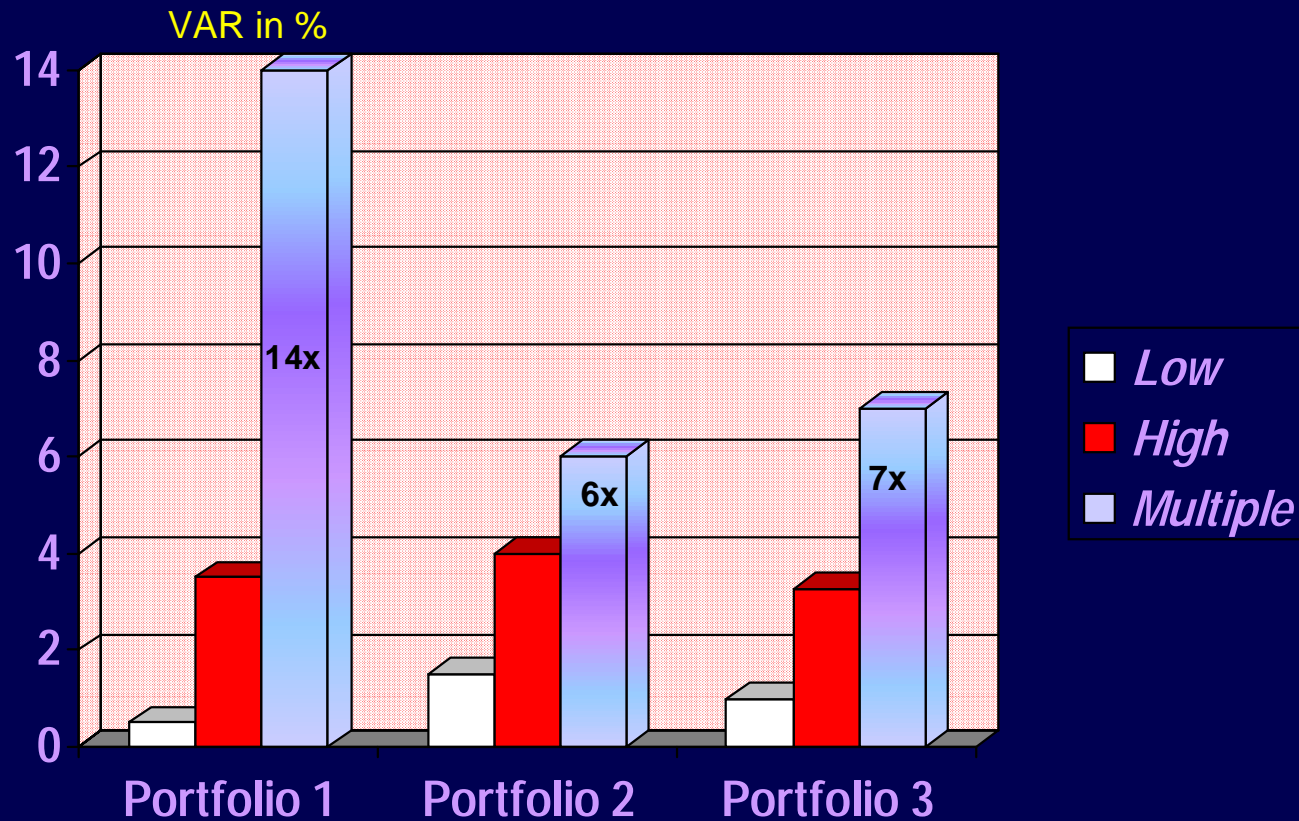
# What VAR is NOT?

- ◆ VAR is NOT the worst case scenario
- ◆ VAR does NOT measure losses under any particular market conditions
- ◆ VAR does NOT address cumulative losses
- ◆ VAR -- by itself -- is NOT sufficient for risk measurement
- ◆ VAR does NOT capture positive skewness



# Range of VARs

## Eight Common Techniques



Source: CMRA Survey of Market Practice, 1995

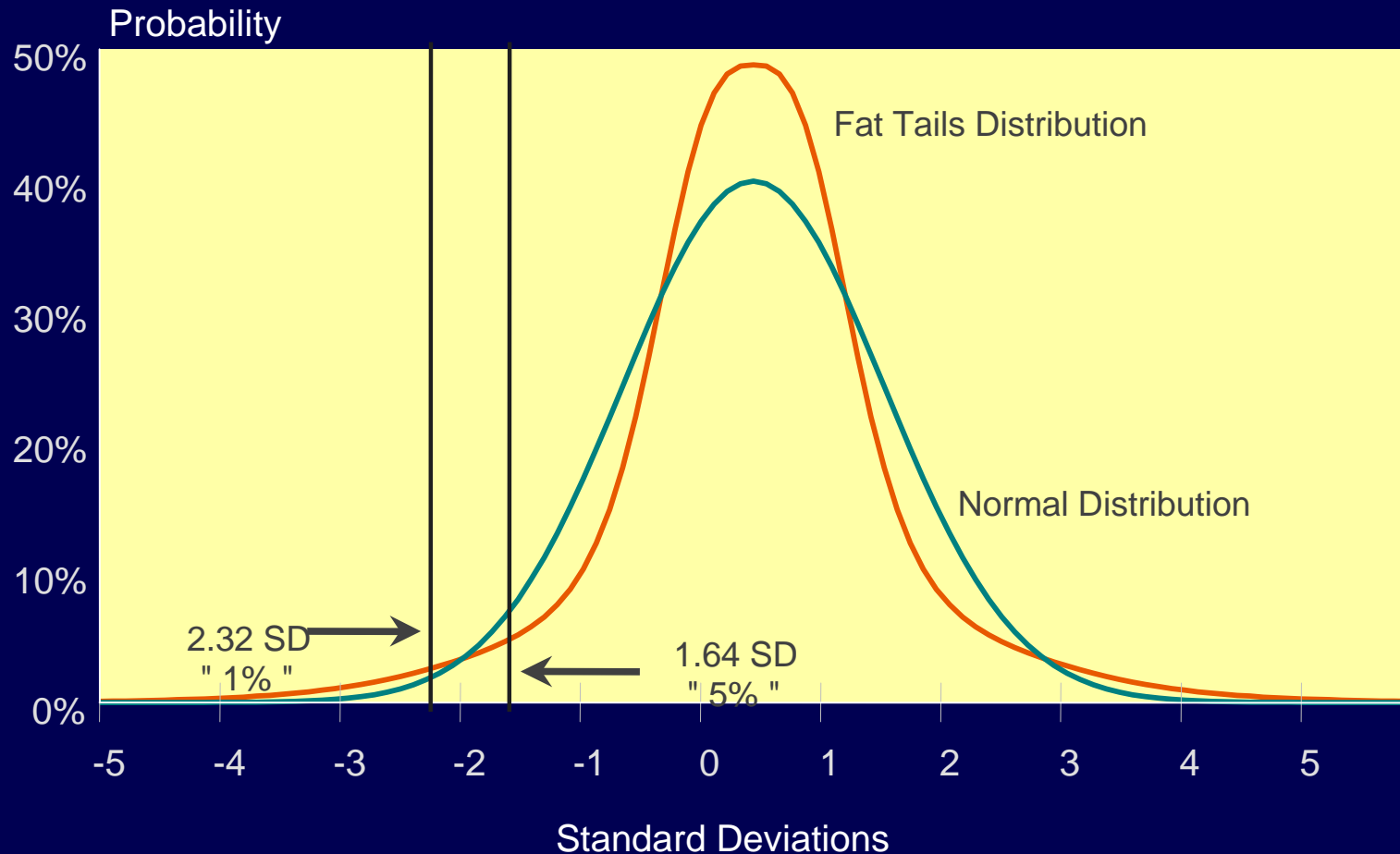
# Assumptions of VAR

- ◆ Normal Statistics
- ◆ Stationary Volatilities
- ◆ Stationary Correlations



# Normal Versus "Fat Tails" Distribution

Non-parametric techniques may be necessary



# Problems With Normal Assumption

## Shape of the Distribution Curve for the Russian Ruble

June, 1993 to September 1998

	Russian Ruble	Normal
<= 1 ST DEV	96.31%	63.4%
>1 ST DEV	1.19%	31.7%
>2 ST DEV	0.60%	4.6%
>3 ST DEV	0.22%	0.3%
>4 ST DEV	0.16%	0.0%
>5 ST DEV	0.14%	0.0%
>6 ST DEV	0.13%	0.0%
<b>Kurtosis</b>	<b>203.0%</b>	<b>0.0%</b>

# Problems With Normal Assumption

## Shape of the Distribution Curve for the Thai Baht January, 1993 to September 1998

	Thai Baht	Normal
<= 1 ST DEV	<b>88.76%</b>	63.4%
>1 ST DEV	<b>4.85%</b>	31.7%
>2 ST DEV	2.40%	4.6%
>3 ST DEV	1.05%	0.3%
>4 ST DEV	0.49%	0.0%
>5 ST DEV	0.25%	0.0%
>6 ST DEV	0.20%	0.0%
<b>Kurtosis</b>	<b>70.4%</b>	<b>0.0%</b>

# Problems With Normal Assumption

## Shape of the Distribution Curve for the Mexican Peso January, 1993 to September 1998

	Mexican Peso	Normal
<= 1 ST DEV	92.52%	63.4%
>1 ST DEV	3.11%	31.7%
>2 ST DEV	1.55%	4.6%
>3 ST DEV	0.52%	0.3%
>4 ST DEV	0.38%	0.0%
>5 ST DEV	0.30%	0.0%
>6 ST DEV	0.20%	0.0%
<b>Kurtosis</b>	<b>67.0%</b>	<b>0.0%</b>

# Problems With Normal Assumption

## Shape of the Distribution Curve for the Indonesian Rupiah January, 1993 to September 1998

	Indonesian Rupiah	Normal
$\leq 1$ ST DEV	91.55%	63.4%
$>1$ ST DEV	3.77%	31.7%
$>2$ ST DEV	1.88%	4.6%
$>3$ ST DEV	0.88%	0.3%
$>4$ ST DEV	0.55%	0.0%
$>5$ ST DEV	0.35%	0.0%
$>6$ ST DEV	0.30%	0.0%
<b>Kurtosis</b>	<b>43.6%</b>	<b>0.0%</b>

# Problems With Normal Assumption

## Shape of the Distribution Curve for the Japanese Yen January, 1993 to September 1998

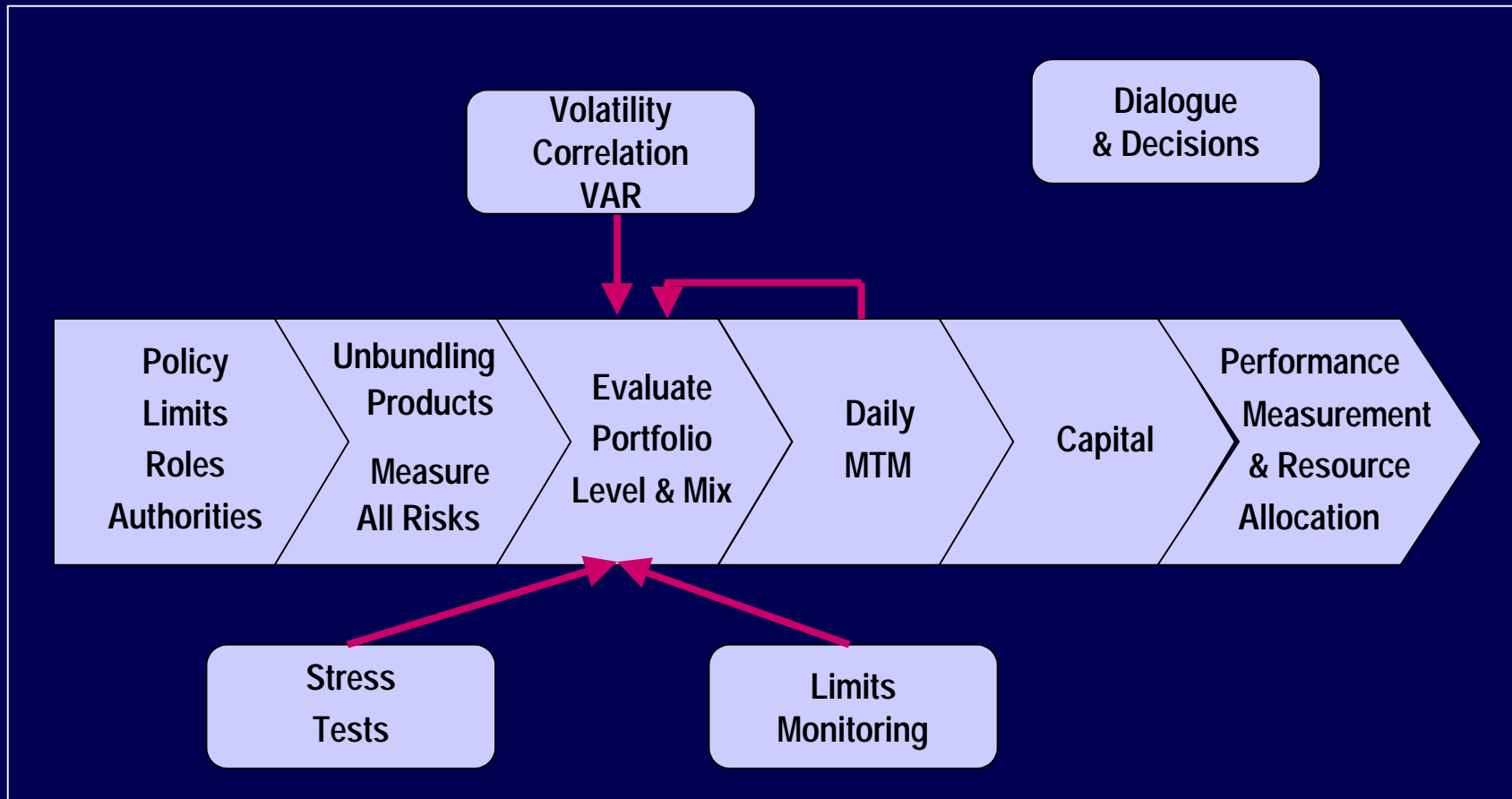
	Japanese Yen	Normal
$\leq 1$ ST DEV	76.28%	63.4%
$>1$ ST DEV	11.59%	31.7%
$>2$ ST DEV	2.98%	4.6%
$>3$ ST DEV	0.98%	0.3%
$>4$ ST DEV	0.33%	0.0%
$>5$ ST DEV	0.12%	0.0%
$>6$ ST DEV	0.08%	0.0%
<b>Kurtosis</b>	<b>4.9%</b>	<b>0.0%</b>

# Problems With Normal Assumption

## Shape of the Distribution Curve for the British Pound January, 1993 to September 1998

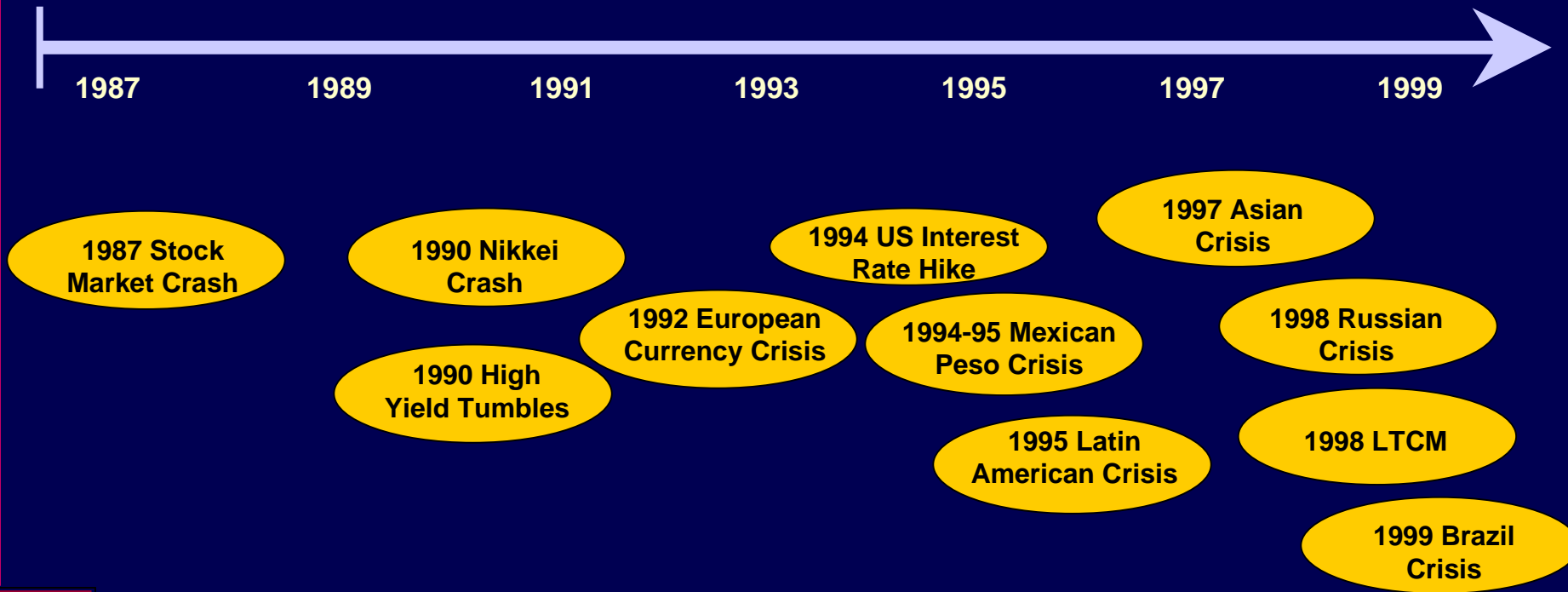
	British Pound	Normal
<= 1 ST DEV	76.96%	63.4%
>1 ST DEV	11.31%	31.7%
>2 ST DEV	2.78%	4.6%
>3 ST DEV	0.87%	0.3%
>4 ST DEV	0.21%	0.0%
>5 ST DEV	0%	0.0%
>6 ST DEV	0%	0.0%
<b>Kurtosis</b>	<b>3.2%</b>	<b>0.0%</b>

# Overview: Risk Management Framework



# Extreme Market Moves Continue to Occur... Yet Many Are Still Unprepared

## “Unexpected” Financial Shocks



# Market Shocks

**While most institutions address potential credit exposure at a two or three standard deviation move, markets regularly move more than two or three standard deviations**

Market	Largest 1 Day Move	Date	Pre-Event STD Deviation	Number of Pre-Event SD	2 STD Dev Move	3 STD Dev Move	20 STD Dev Move
Mexican Peso	20.4%	12/22/94	2.5%	8.1	5.0%	7.6%	50.4%
Thai Baht	19.5%	7/2/97	17.6%	1.1	35.2%	52.7%	351.5%
Russian Ruble	41.2%	8/27/98	1.6%	25.8	3.2%	4.8%	32.0%
Brazilian Real	9.0%	1/13/99	.1%	9.9	1.8%	2.7%	18.2%



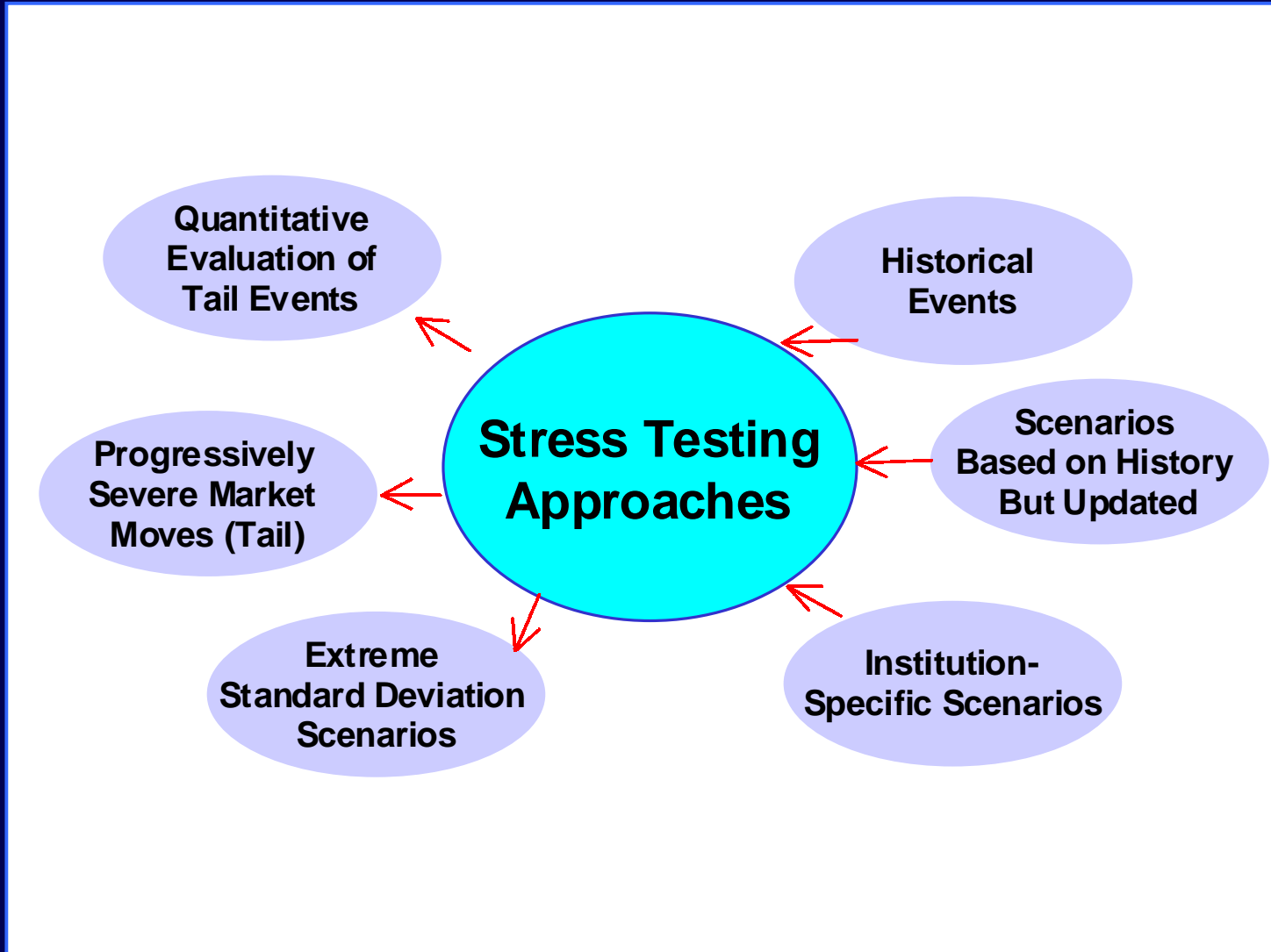
# Post-Mortem on Russian/LTCM Crisis

## Stress Testing

- ◆ Stress testing was not as thoroughly in place as many now believe it should be.
- ◆ 80% of broker/dealers and 40% of banks stress tested their VAR assumptions.
- ◆ 40% of banks and 60% of broker/dealers stress tested parallel volatility curve shifts.
- ◆ Volatility curve twists were not performed by either group.
- ◆ Only 30% of banks and 20% of broker/dealers stress tested correlations.



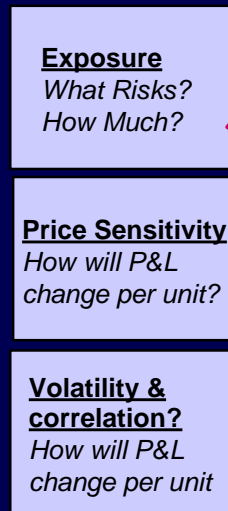
# Stress Testing Approaches



# Categories of Stress Tests

Portfolio Mix & Markets	Model Assumption	Product Complexity	Credit / Liquidity	Sea Change
<ul style="list-style-type: none"> <li>◆ Term structure and yield curve levels and shapes</li> <li>◆ Term structure and relationship of volatility</li> <li>◆ Price shifts in equities, sectors, indices</li> <li>◆ Currency, commodities price shifts</li> <li>◆ Spreads and basis relationships</li> </ul>	<ul style="list-style-type: none"> <li>◆ Yield curves building assumptions</li> <li>◆ Pricing models</li> <li>◆ VAR and Capital Models</li> <li>◆ Asset/Liability model</li> </ul>	<ul style="list-style-type: none"> <li>◆ Products with uncertain cash flows</li> <li>◆ Structured products &amp; complex derivatives</li> <li>◆ Emerging markets and difficult to handle risks</li> </ul>	<ul style="list-style-type: none"> <li>◆ Concentrations</li> <li>◆ Linkages</li> <li>◆ Credit components of securities</li> <li>◆ Volatility of credit spreads</li> <li>◆ Default assumptions</li> </ul>	<ul style="list-style-type: none"> <li>◆ EMU</li> <li>◆ Y2K</li> <li>◆ Changing competitive structure</li> </ul>

# Stress Testing Is Mostly An Exercise In Good Judgment



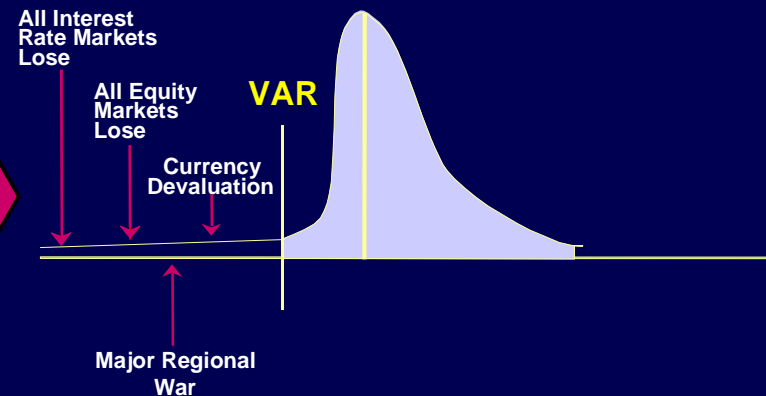
**How much Risk?**  
How much can my P&L change overall?

- ◆ How severe a shock should I test for?
- ◆ What draconian events are not impossible even if unlikely?
- ◆ Anticipate new events, shocks, linkages
- ◆ Look for paradigm shifts, structural changes

## Discipline & Judgement

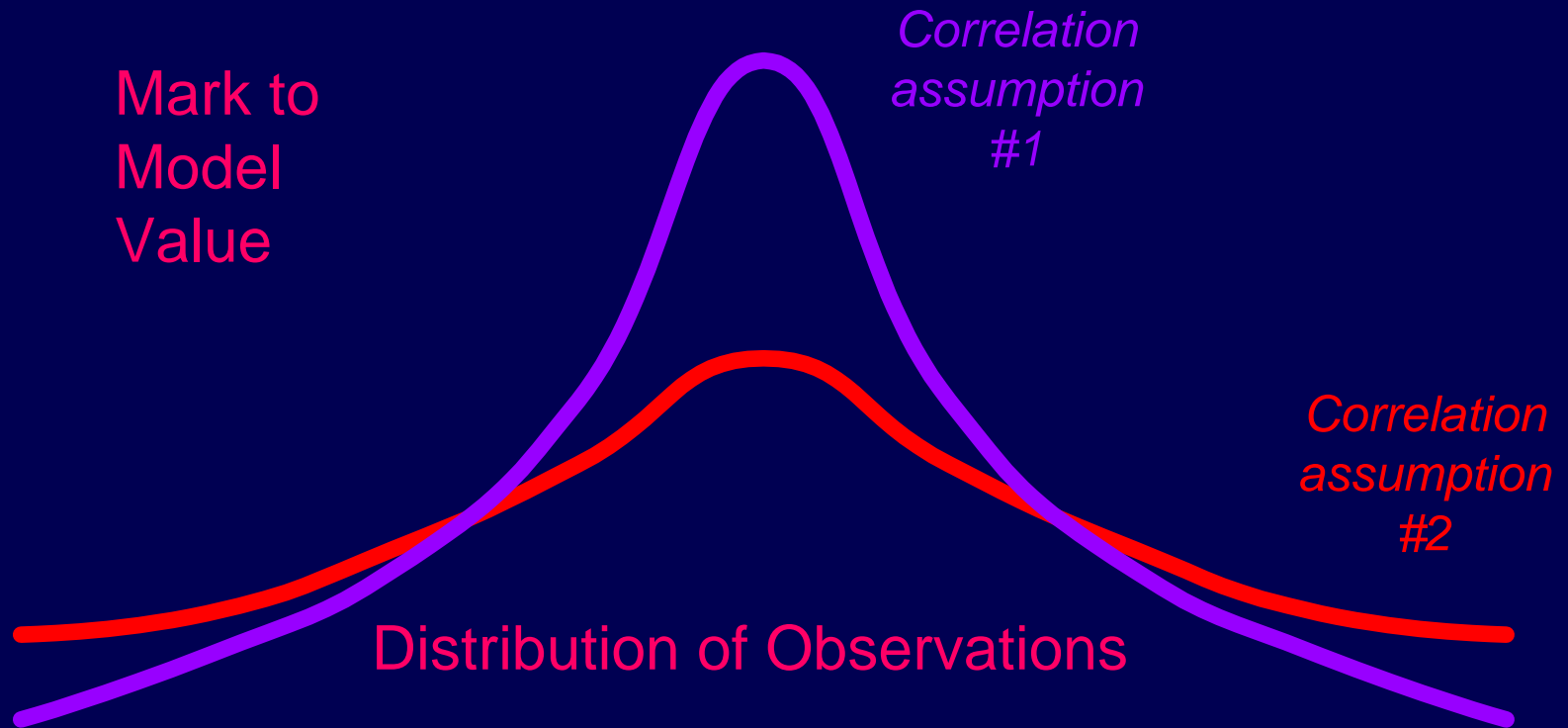
- What shocks and events, however unlikely, could cause severe loss?
- What decisions should be made today?
- What contingency plans should be put in place?

## Stress Test Examples



# Stress Testing Correlation Risk

## How Portfolio Value Varies Under Two Models



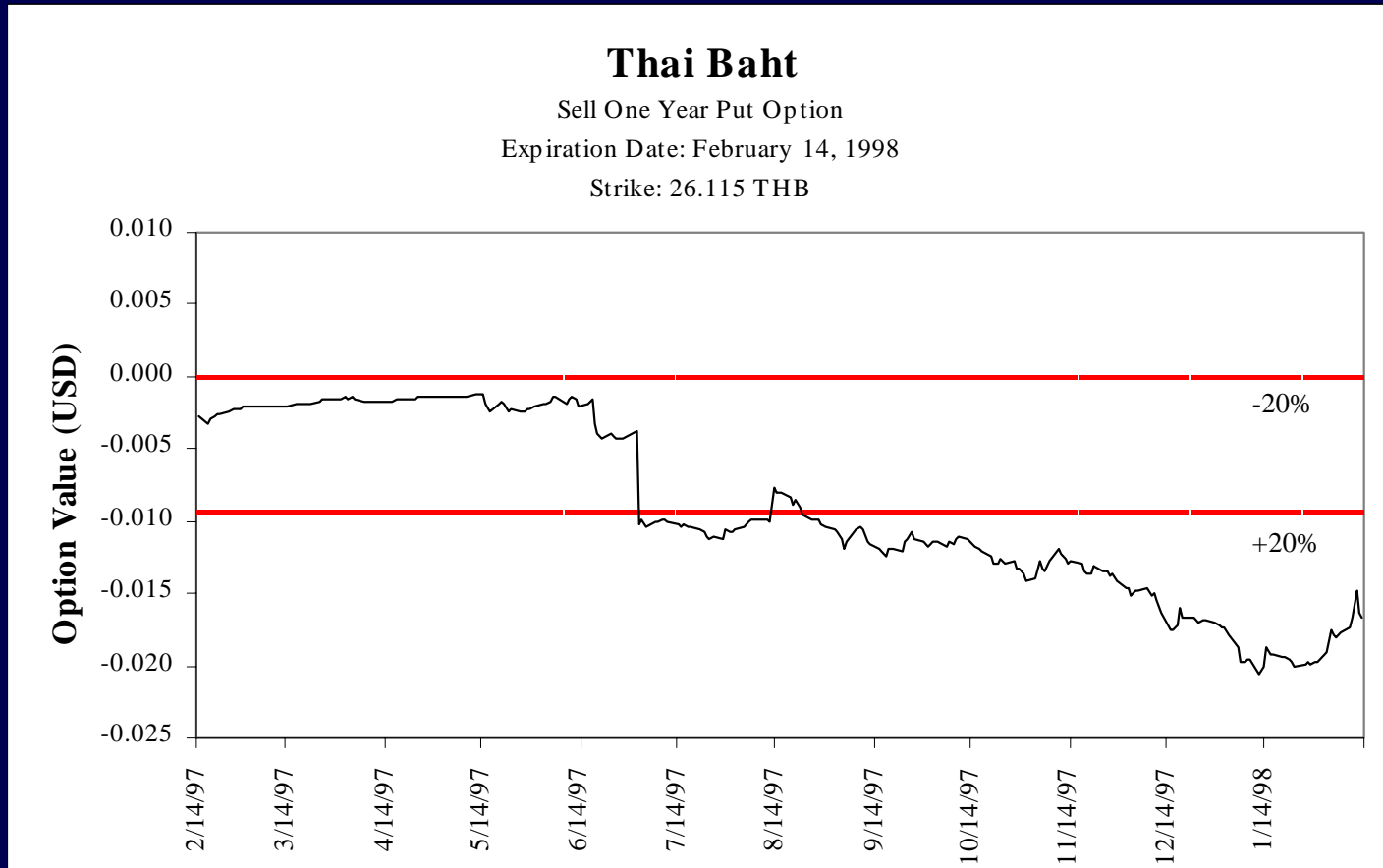
# DPG Stress Tests

- ◆ Parallel yield curve shifts of 100 basis points up and down
- ◆ Steepening and flattening of the yield curves (2's to 10's) by 25 basis points
- ◆ Each of the four permutations of a parallel yield curve shift of 100 basis points concurrent with a tilting of the yield curve (2's to 10's) by 25 basis points
- ◆ Increase and decrease in all 3-month yield volatilities by 20% of prevailing levels
- ◆ Increase and decrease in equity index values by 10%
- ◆ Increase and decrease in equity index volatilities by 20% of prevailing levels
- ◆ Increase and decrease in the exchange value (relative to the US dollar) of foreign currencies by 6%, in the case of major currencies, and 20%, in the case of other currencies
- ◆ Increase and decrease in foreign exchange rate volatilities by 20% of prevailing levels
- ◆ Increase and decrease in swap spreads by 20 basis points



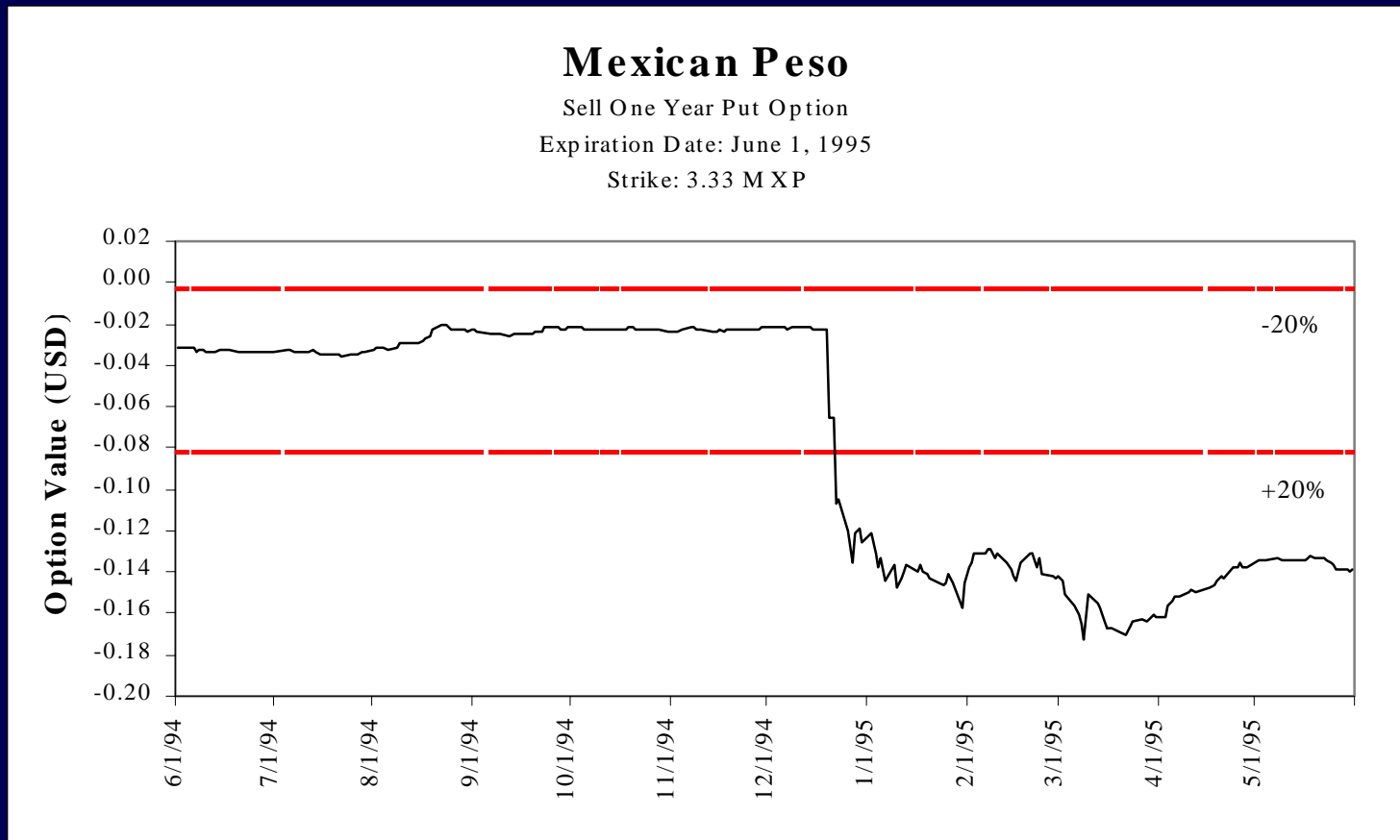
# Option on Thai Baht

Stress Test: Underlying Changes by 20%



# Option on Mexican Peso

## Stress Test: Underlying Changes by 20%



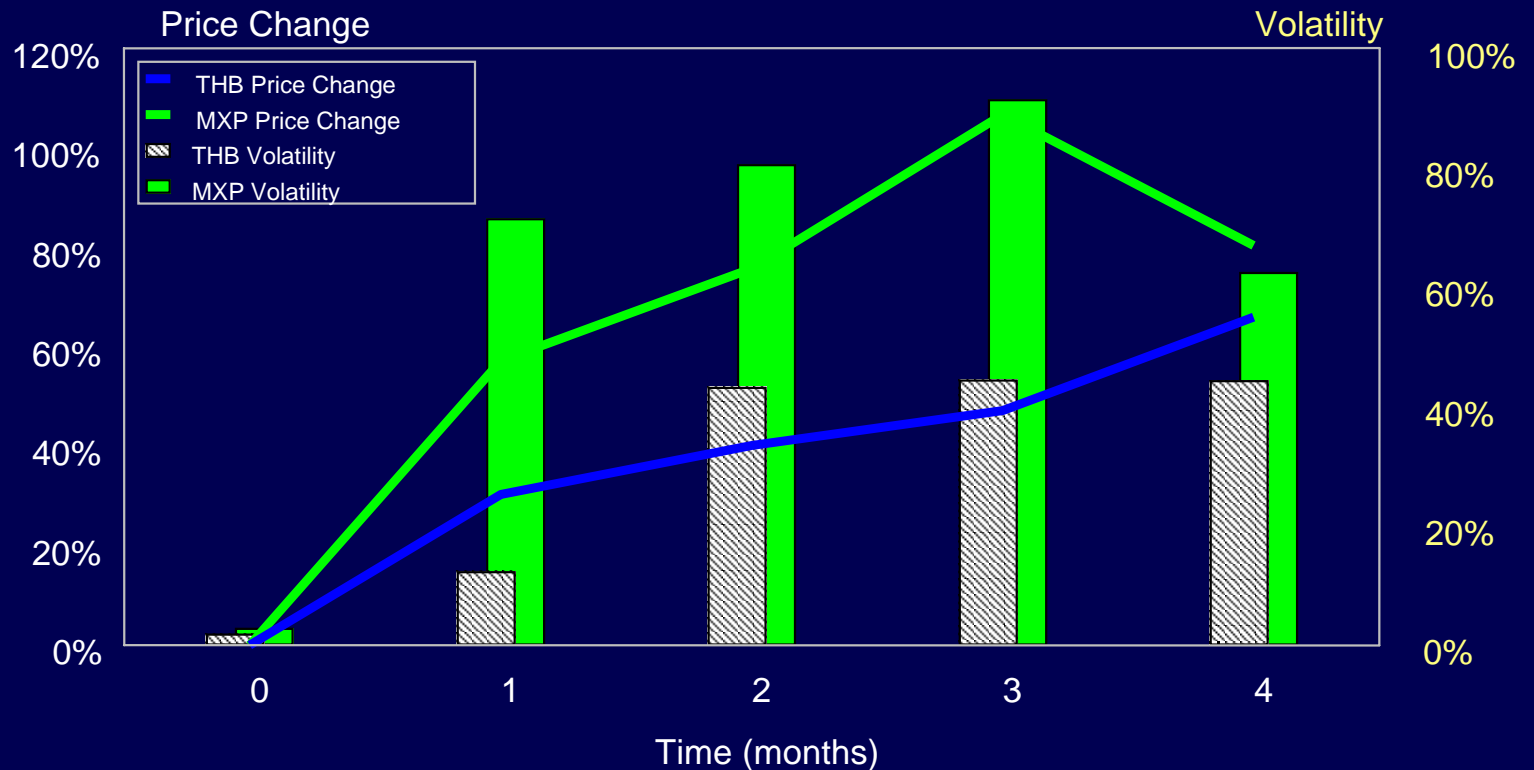
# Option on Russian Equity Index

## Stress Test: Volatility Changes by 20%



# Other Asset Class History IS Valuable

Currency Crisis Comparison: Mexican Peso vs. Thai Baht



# Effective Stress Testing Ensures Survival, Provides Resilience to Capitalize on Unusual Opportunities and Ultimately Enhances Competitiveness

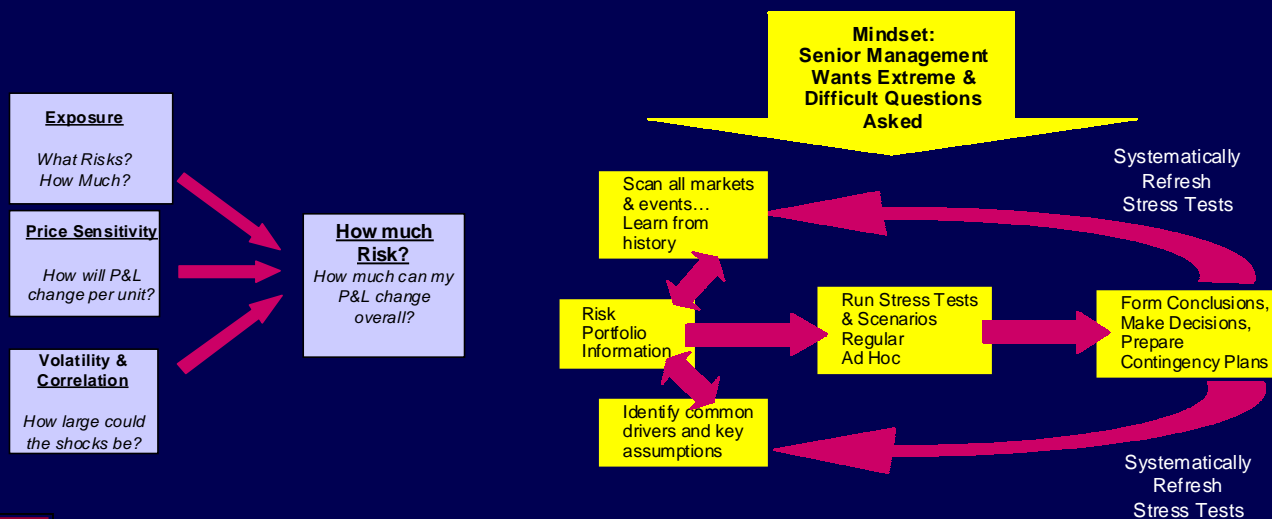
The Art, as well as the Science



A Disciplined & Systematic Program



Benefits of Effective Stress Testing



- ◆ Survives shocks
- ◆ Take the offensive, move quickly
- ◆ Proactively prepare to trade on shocks
- ◆ Competitive edge across market conditions



# Credit Risk Issues

- ◆ Credit exposure is frequently calculated as the current mid-market "mark-to-model" plus a static estimate of "future potential exposure".
- ◆ The "mark-to model" estimate does not usually take into account bid/offer spreads, size of position, or time to unwind.
- ◆ Even when "future potential exposure" is included in the calculation, it is frequently calculated at a 2 or 3 SD confidence interval and is not usually subjected to the same stress testing as market risk estimates.
- ◆ Many institutions, post the August turmoil have counterparties with more than twice the total credit exposure than the credit department envisioned.



# Collateralized Deals

- ◆ Frequently, credit exposure for collateralized deals is viewed as current "mark-to-model" plus a small cushion for the impact of a market move during the several days that the counterparty has to post additional collateral.
- ◆ The impact of liquidity, bid/offer spreads, and size concessions, left some dealers undercollateralized in the latest crises.



# Post-Mortem on Russian/LTCM Crisis

## Risk Management Concerns

- ◆ The top 5 risk management concerns
  - Liquidity
  - Spreads
  - Settlement
  - Volatility
  - Mortgage backed securities

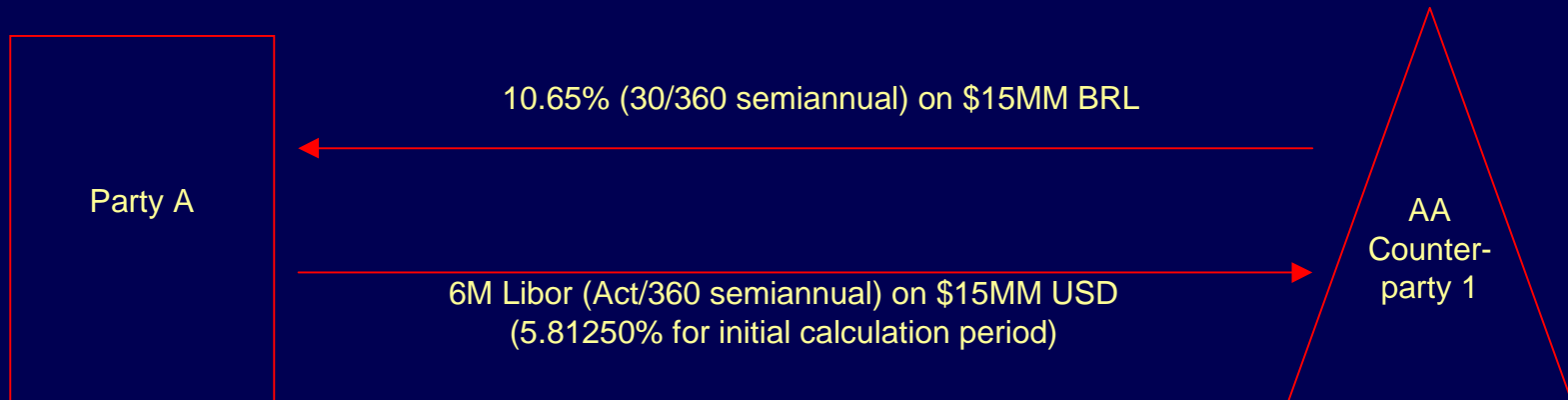
# Post-Mortem on Russian/LTCM Crisis

## Changes made to Risk Management Process

- ◆ 40% of banks and 90% of broker/dealers stated that there were changes made to their risk management processes in response to the turmoil.
- ◆ Both banks and broker/dealers indicated that they increased attention on the following during and after the crisis:
  - Backtesting
  - Scenario analysis
  - Stress testing

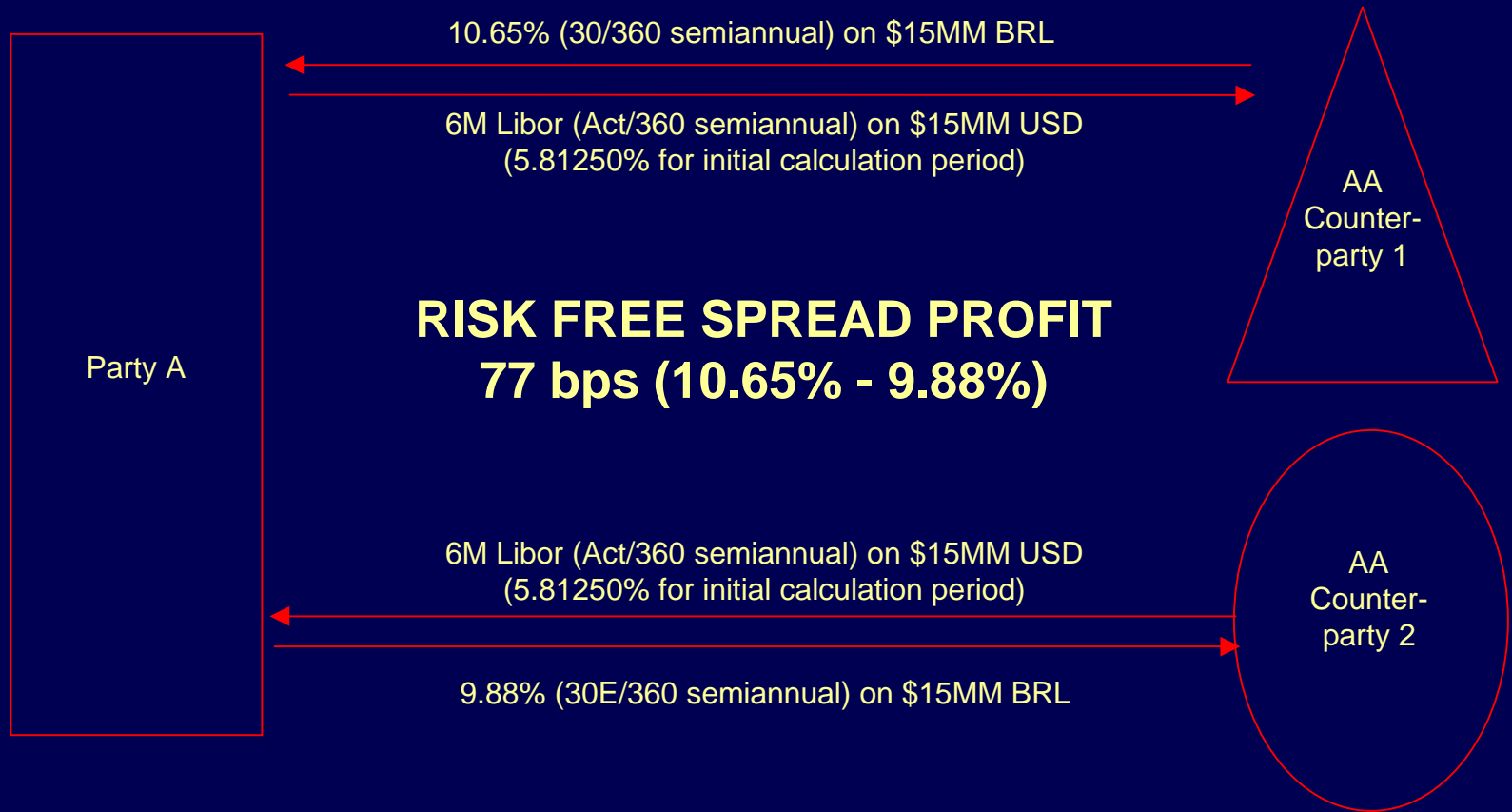
# Emerging Market Credit Derivative

Trade Date 5/12/97  
Effective Date 5/14/97  
Termination Date 2/12/07



# Two “Matched” deals

Trade Date 5/12/97  
Effective Date 5/14/97  
Termination Date 2/12/07



# EARLY TERMINATION OF DEALS

Trade Date 5/12/97  
Effective Date 5/14/97  
Termination Date 2/12/07



**Worst Case  
(\$5.4MM)**

**Best Case  
\$6.5 MM**



# Risk Management Practices for the Private Sector - IIF

- ◆ Comprehensive stress testing and scenario analysis programs should be performed regularly to examine the potential impact of extreme values on the firm's portfolio and risk structure.
- ◆ The results of these programs should be translated into meaningful management tools through limit structures, where possible.
- ◆ Economic country analysis and risk measurement systems should be more closely integrated.
- ◆ Firmwide portfolio strategies should be communicated more clearly and more frequently to the line managers in order to facilitate the process of both initiating transactional relationships and then determining how best to manage those positions during times of stress

# Risk Management Practices for the Private Sector - IIF

- ◆ Top management should understand how sophisticated tools are to be used in conjunction with judgement and experience, and should be prepared to back risk managers strongly in the inevitable conflicts which arise between profit opportunities and prudence.
- ◆ Strong, independent risk control units should be in place and should themselves be accountable to another group or entity within the firm (e.g., the Audit Committee, the Executive Committee of the Board of Directors, the Board of Directors, the Chief Executive Officer).
- ◆ The relationship among broad market movements, liquidity risk, and obligor credit quality needs to be better understood, and methods need to be devised to integrate more closely market risk and credit risk measurement processes.
- ◆ Renewed emphasis on the strict observance of “know your customer” and collateral policies are needed to ensure that lending standards do not slip during boom periods.



# Risk Management and Measurement

## Recent Experiences, Lessons, and Recommendations

- ◆ Firms failed to appreciate the full extent of positive correlation between downward market trends and individual counterparty credit quality.
- ◆ The lack of proper long-term government yield curves and robust legal regimes for collateral, netting, and bankruptcy complicated the assessment of market risks and recovery values.
- ◆ Corporate headquarters and regional offices need better communication.
- ◆ Strengthened institutional frameworks to secure and enforce interests in collateral were identified, as key components needed to ensure optimal functioning of risk management systems.
- ◆ Independent management systems are critical for ensuring transparency and control of risks.

# Risk Management and Measurement

## Recent Experiences, Lessons, and Recommendations

- ◆ Senior risk managers tend to view and control risk on a consolidated basis for each firm. However, risk measurement tools most often create individual portfolio estimates for market risk (using a combination of value-at-risk, stress test, and scenario analysis tools), credit risk, and country risk without necessarily attempting to aggregate these quantitative estimates across a firm.
- ◆ Credit risk, liquidity risk, operational risk, and country risk are not quantified with the same level of precision as market risk.

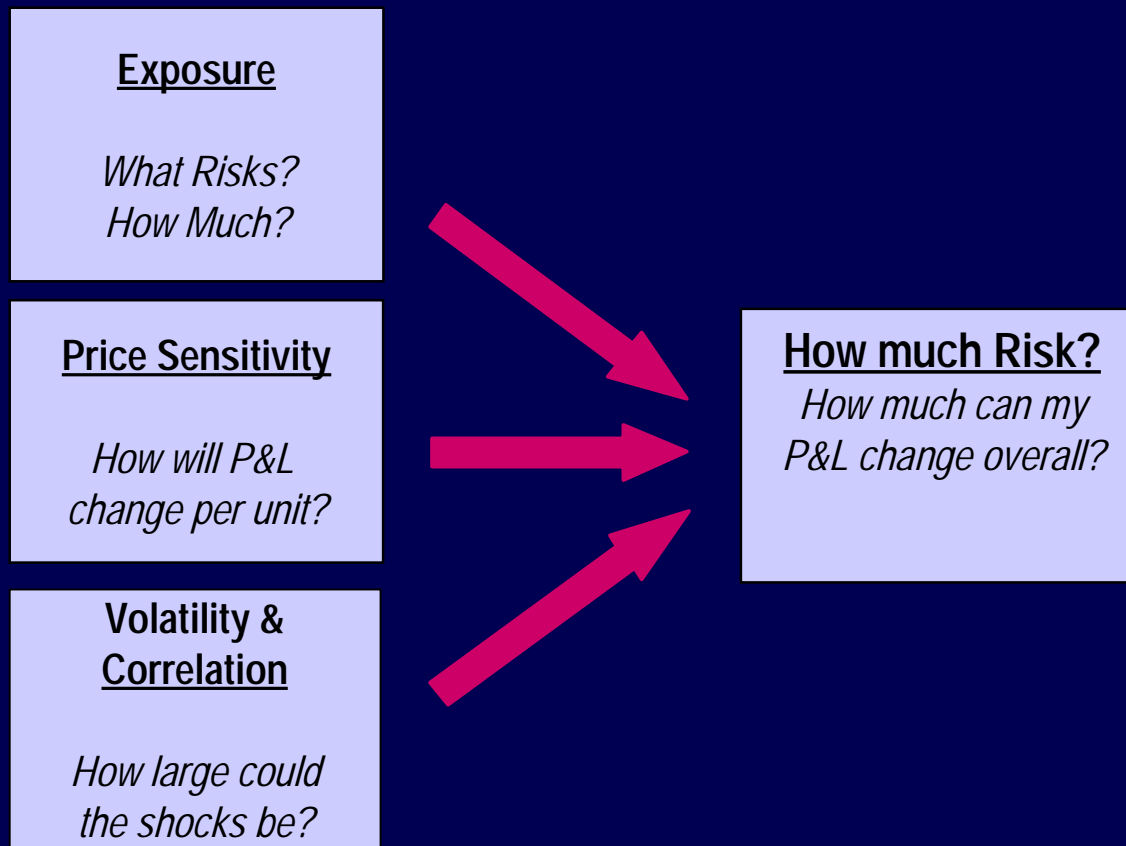
# Risk Management and Measurement

## Recent Experiences, Lessons, and Recommendations

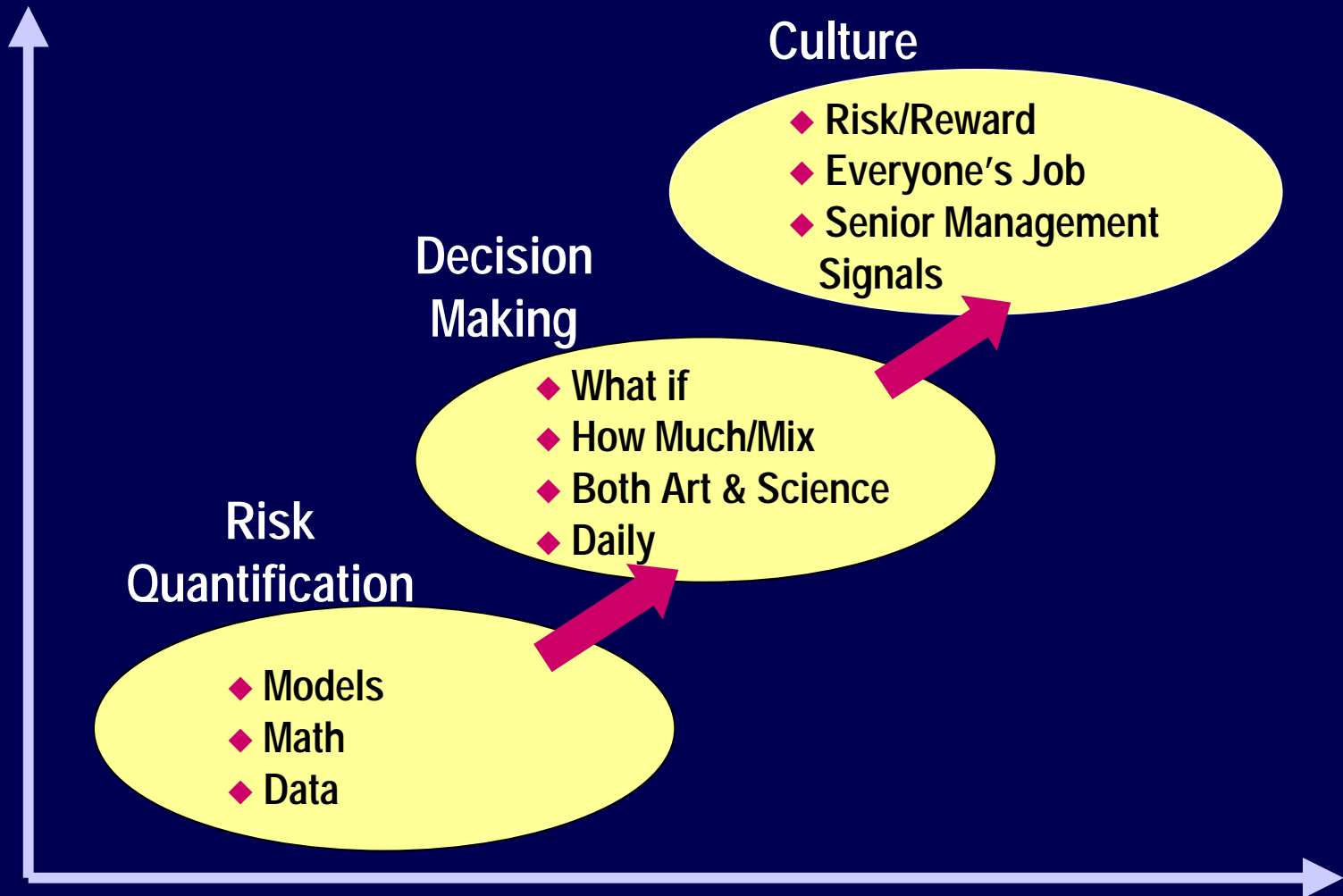
- ◆ When assessing the performance of market risk measurement tools, it is important to distinguish among value-at-risk systems (that seek only to estimate probable loss distributions under normal market situations) and those tools that enable firms to obtain perspective on how extreme market situations might affect portfolio value (stress tests and scenario analysis).
- ◆ Few if any firms identified in advance the degree of potential positive correlation between market values and individual private-sector credit quality.
- ◆ Firms also underestimated the degree of correlation between individual private sector credit quality and sovereign credit quality.
- ◆ Firms should operate under establish concentration limits with respect to their country and counterparty exposures.

# Measuring Risk is Both a Science and an Art

## Risk Measurement Comprises 3 Fundamental Questions



# Effective Risk Management Combines Science and Art



# Daunting Challenges

