



# If Not the Sharpe Ratio Then **What** and **Why**?

## And How Factor Analysis can Detect **Time Bombs**...

Raphaël Douady  
Research Director, Riskdata®

- [raphael.douady@riskdata.com](mailto:raphael.douady@riskdata.com)
- [www.riskdata.com](http://www.riskdata.com)
- +33 1 44 54 35 00



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# AGENDA

- ❑ **Risk Measures:** For what purpose?  
What do we expect from them?
- ❑ Is Risk info strictly in the **Return series**?  
Or in the Portfolio snapshot composition (**Holdings**) only?
- ❑ What about **Factor Analysis**?  
Why traditional **Linear Models Fail**?  
Alternative Betas, alternative Factors, alternative Models...
- ❑ What is **“Risk Profiling”**?
- ❑ How appropriate and well adapted **Nonlinear Factor Analysis** can help identify **Risky Scenarios** and **Time Bombs**



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# RISK MEASURES

- Sharpe Ratio
  - $S = (\text{Return} - \text{Libor}) / \text{Volatility}$
- Risk-adjusted Return
  - $\text{RAR} = \text{Return} / \text{VaR}$
- Sortino Ratio, Jensen  $\alpha$ , Max-draw-down...
- Omega Ratio
  - Strike ensuring *Empirical* Put-Call Parity
  - $\text{Observed Average}(\text{Rtn} - \Omega)_+ = \text{Observed Average}(\Omega - \text{Rtn})_+$

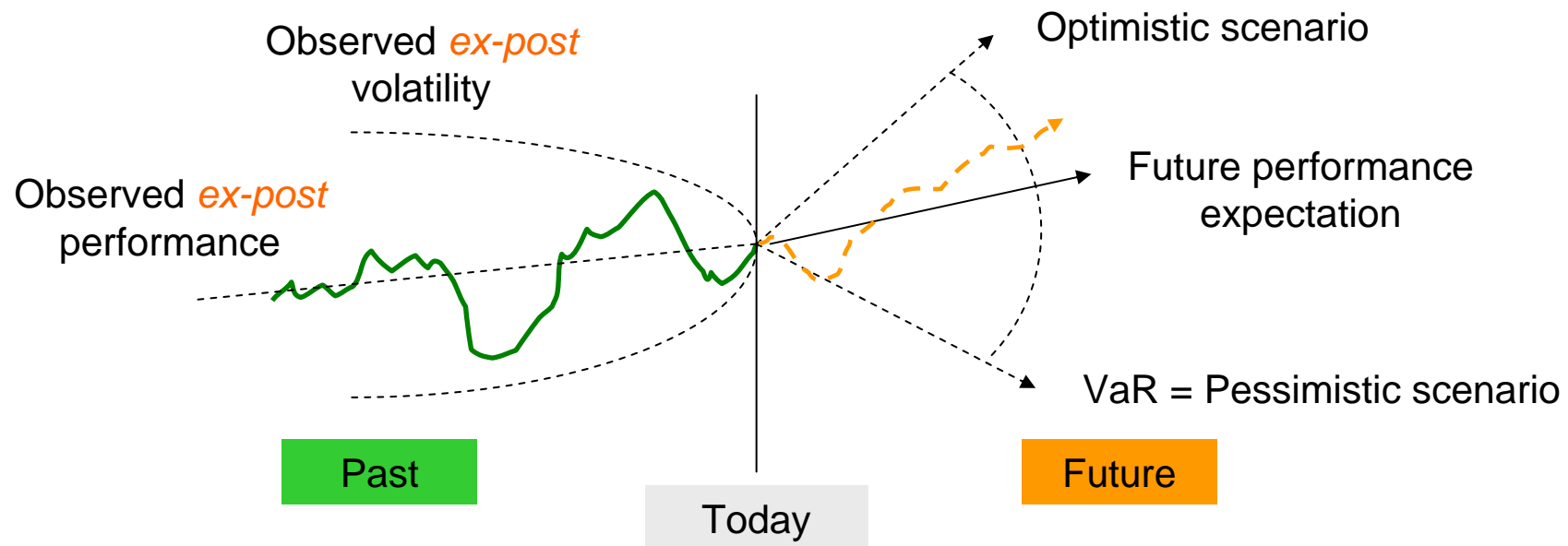
## □ All these are *Ex-post* Performance Measures

- Input = Series of *Past Returns*
- No Relation to Markets
- *No Predictive* Value

# RISK MEASURES

## □ A *Risk Measure* is an *Ex-ante* measure

- Question 1: “What is the *Range* of possible *Future* returns?”
- Answers: Expectations, Value-at-Risk, *ex-ante* Volatility





# RISK MEASURES

❑ A **Risk Measure** must tell how the Investment **Behaves** with Markets and/or Other Investments

❑ **Exposures**

- Related to the investment **Holdings**
- Assume that Holdings will behave like **Indices**

❑ **Sensitivities**

- $\beta$  = **Statistical** joint relation with Markets
- **Correlations** between **Pockets of Investments**
- **Greeks** = Modeled relation between **Derivative** holdings and Markets

❑ **Stress Scenarios**

- Simulated **virtual** or **past** crises



# RISK MEASURES

- ❑ Using **Performance Measures** as **Risk Measures** is making **2 Assumptions**:
  - 1) **Future** will look like the **Past**
  - 2) **No Other Information** than past performances is **Relevant**
  
- ❑ **Risk Measurement** **CANNOT** rely on these assumptions
  
- ❑ **A fortiori Risk Management**
  - **Aggregate** Risk Measures
  - Take **Action** (with Market Instruments...)



# RISK MEASURES

- ❑ **Need to relate *Investment* to *Markets***
  - Sensitivities and/or Exposures
  - Statistics of Global Markets, not only of the Investment past returns
  
- ❑ **Must have *Predictive* value**
  - If the System says you are *Positively exposed* to Yield Curve (i.e. Duration < 0) you expect Positive Return if Rates **tighten**





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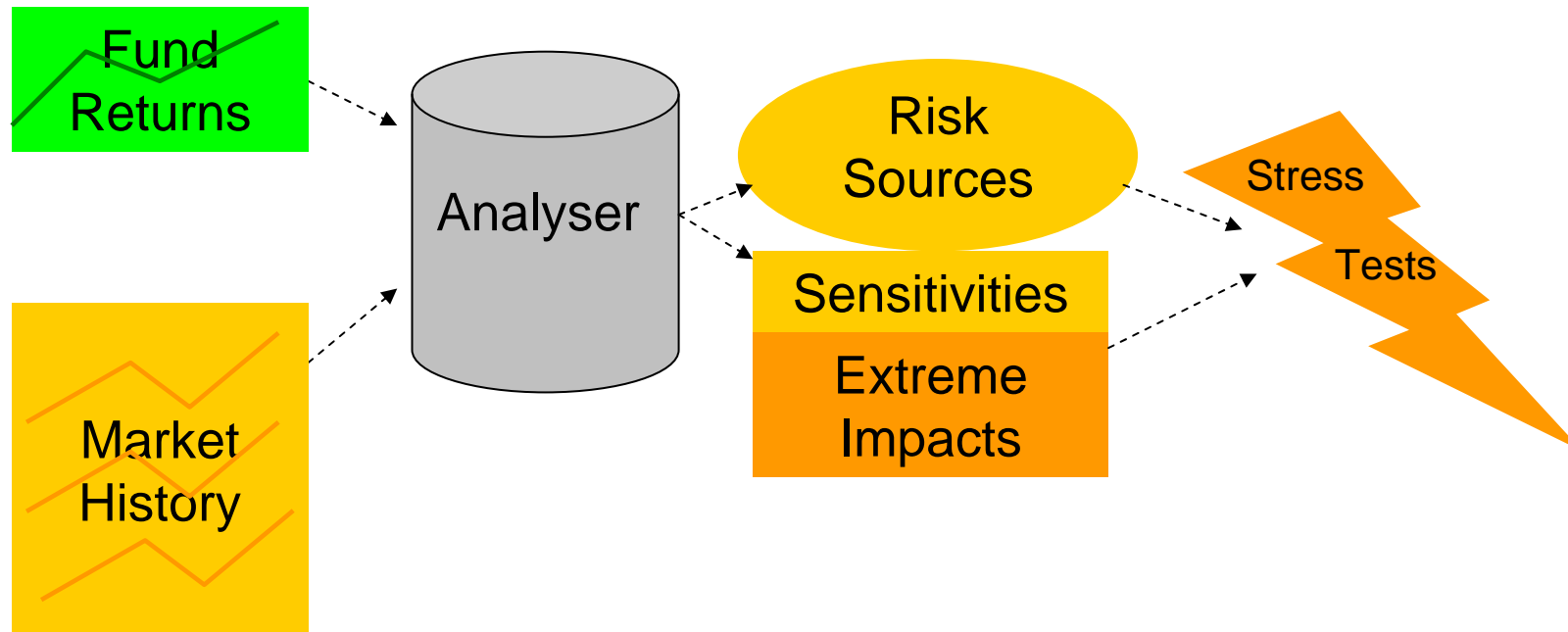
# RETURNS vs. POSITIONS

## □ Return Based Analysis (R.B.A.)

1. Match Past Performances with History of Markets
2. Identify Risk Sources
  - Model, Factor Selection
3. Compute Sensitivities
  - Model Calibration
4. Compute Stress Tests

# RETURNS vs. POSITIONS

## Return Based Analysis (R.B.A.)





# RETURNS vs. POSITIONS

## Return Based Analysis

- Assumption: Fund *Risk Profile* is Persistent
  - Can be deduced from Past Returns
  
- Robustness: Math. Model can include everything systematic
  - Correlation Breaks, Consequences of Liquidity Stress
  - Systematic Portfolio Tilting upon Market Move
  - Delayed impacts of Market Shifts
  - Hidden Risk Factors (impact both Funds and Markets)
  
- Weakness
  - Spurious/Temporary Relations



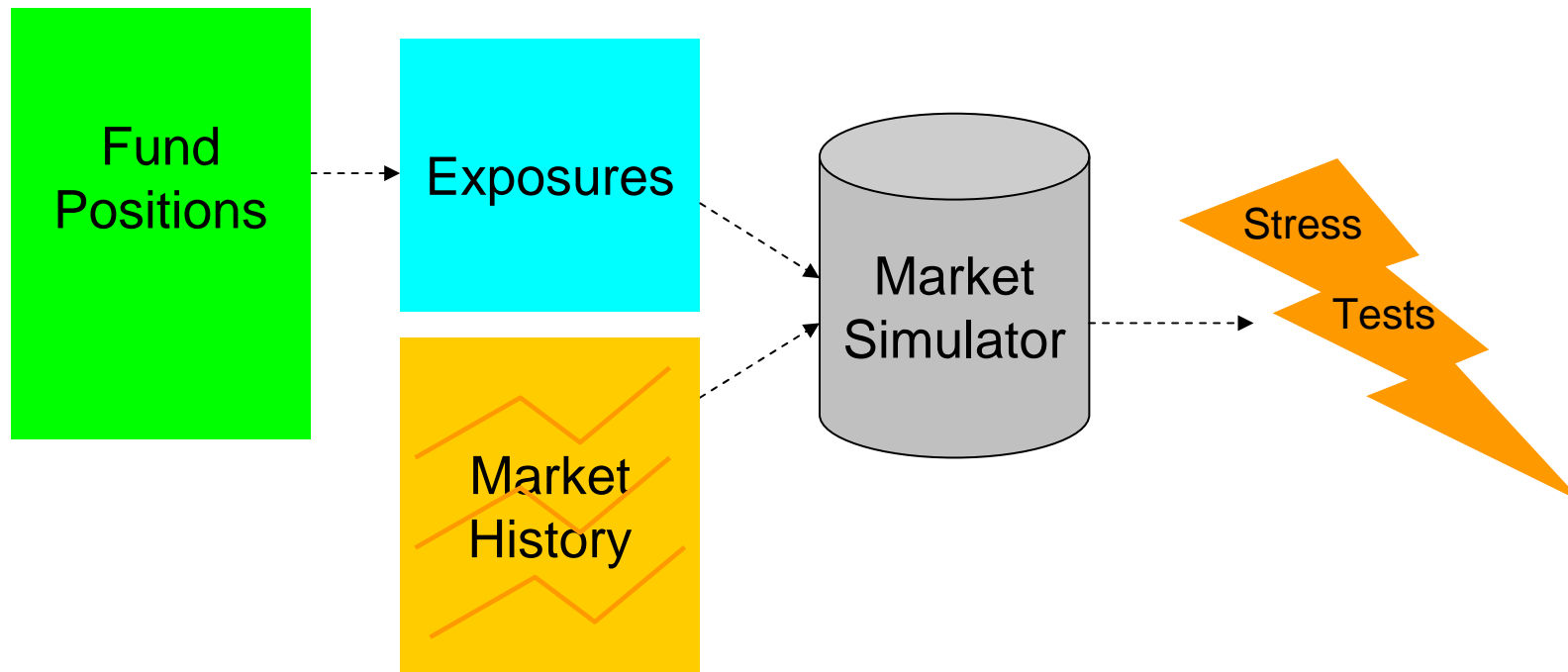
# RETURNS vs. POSITIONS

## □ Holdings Based Analysis (H.B.A.)

1. Compute Portfolio Exposures to Market segments
2. Aggregate Sensitivities to Risk Factors according to Exposures
3. Simulate Stress Scenarios

# RETURNS vs. POSITIONS

## □ Holdings Based Analysis (H.B.A.)





# RETURNS vs. POSITIONS

- Assumption: Portfolio Exposures are Persistent
  - Turnover is Negligible w.r.t. Exposure Risks
  
- Robustness
  - Spurious factors: Impact computes on Actual Holdings (at past date!)
  - Modeled instruments (Derivatives, etc.)
  
- Weakness
  - Turnover



# RETURNS vs. POSITIONS

## □ Risk Analysis must rely on what is **Persistent** in the Fund

- Short Term (days): *Positions*
  - ⇒ **Holdings Based Analysis**
- Long Term (months): *Strategy*
  - ⇒ **Return Based Analysis**





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# FACTOR ANALYSIS

## □ Multilinear Regression

$$\text{Return} = \beta_1 \times \Delta I_1 + \beta_2 \times \Delta I_2 + \dots + \beta_n \times \Delta I_n + \alpha$$

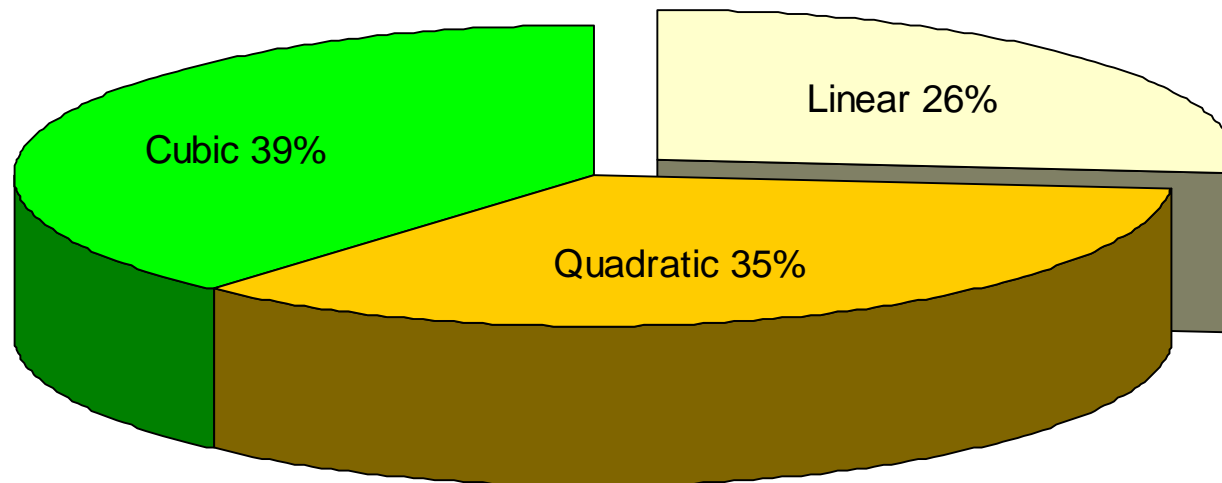
## □ Assumptions

- No lagged impact
- Constant  $\beta_1 \dots \beta_n$
- Need to find the good indices
  - Too many  $\Rightarrow$  Spurious model  $\Rightarrow$  No predictive value

# FACTOR ANALYSIS

## □ Nonlinearity Test

- Only ¼ of Hedge Funds support Linear Modeling

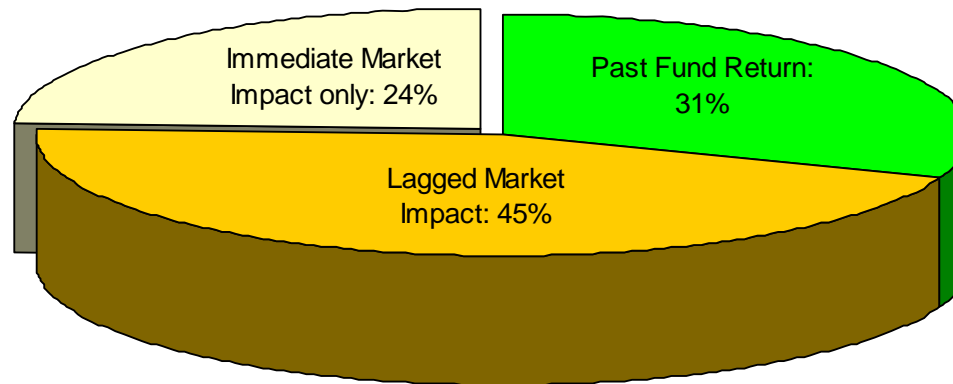


- Study performed on 1000 Hedge Funds All Strategies

# FACTOR ANALYSIS

## □ Test for Lagged Impact

- Only ¼ of Hedge Funds support Modeling without Lags



- Study performed on 1000 Hedge Funds All Strategies

# FACTOR ANALYSIS

- Hypothesis Testing for the need of *Nonlinear* functional form and *Dynamic* model

	Nonlinear test		Lag test			Overall
Null Hypothesis	LS	LD	LS	NLS	NLS	<b>LS</b>
Altern. Hypothesis	NLS	NLD	LD	NLR	NLD	<b>NLD</b>
% of Funds	48%	74%	62%	31%	76%	<b>89%</b>

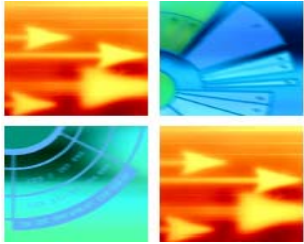
## □ Models:

- LS : Linear Static (without lags)
- LD : Linear Dynamic (with lags)
- NLS : Nonlinear Static (without lags)
- NLR : Nonlinear Serial Correlation (with Fund lags only)
- NLD : Nonlinear Dynamic (with lags)



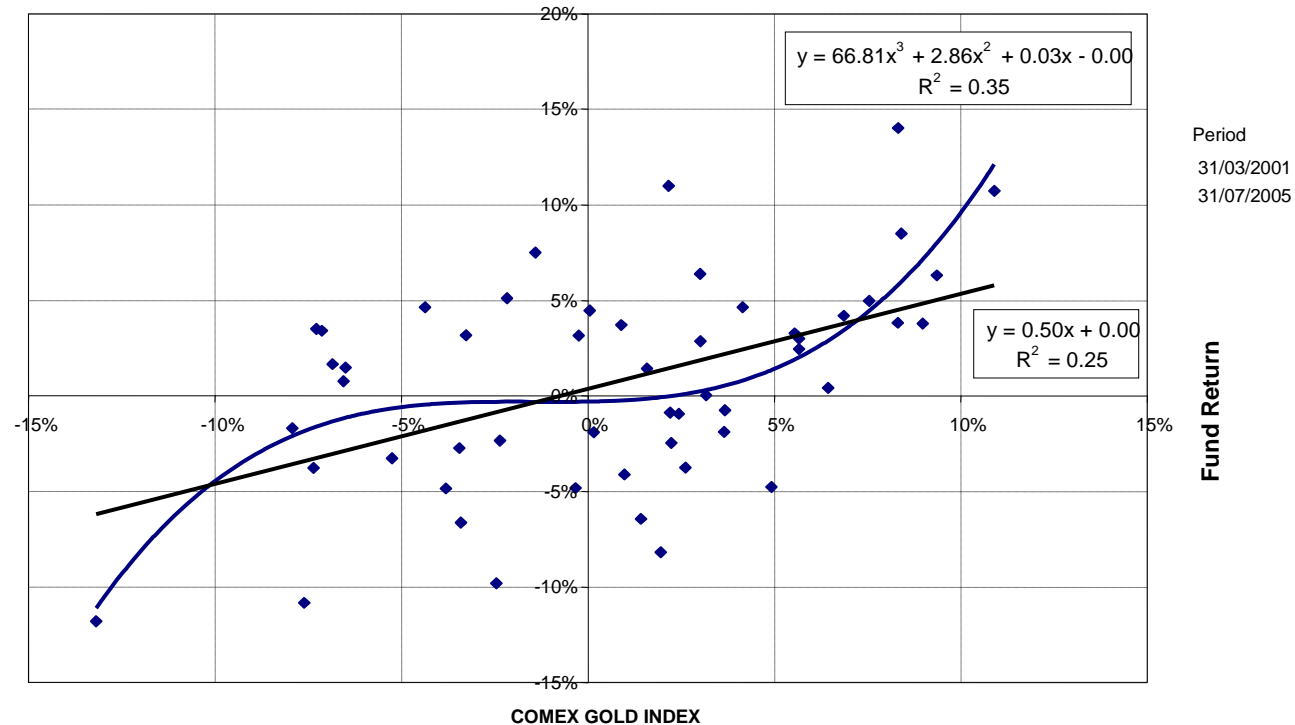
# FACTOR ANALYSIS

- ❑ **Testing Nonlinearity and Lagged Impacts**
- ❑ 1000 Hedge Funds
  - Distribution across Strategies similar to overall HF population
  - Including Dead Funds and their last return
  - Monthly Returns
- ❑ Analysis Period
  - Jan 95 to Jun 05 (restricted to Fund existence)
- ❑ Methodology
  - Select, among investable factors, the most explanatory
  - F-test of Quadratic and Cubic regression vs. Linear regression
    - Identify Funds that reject Linear model with Confidence 95%
  - F-test of Dynamic Model vs. Instantaneous Model
    - Identify Funds that reject Instantaneous model with Confidence 95%



# NONLINEAR PROFILES

## CTA



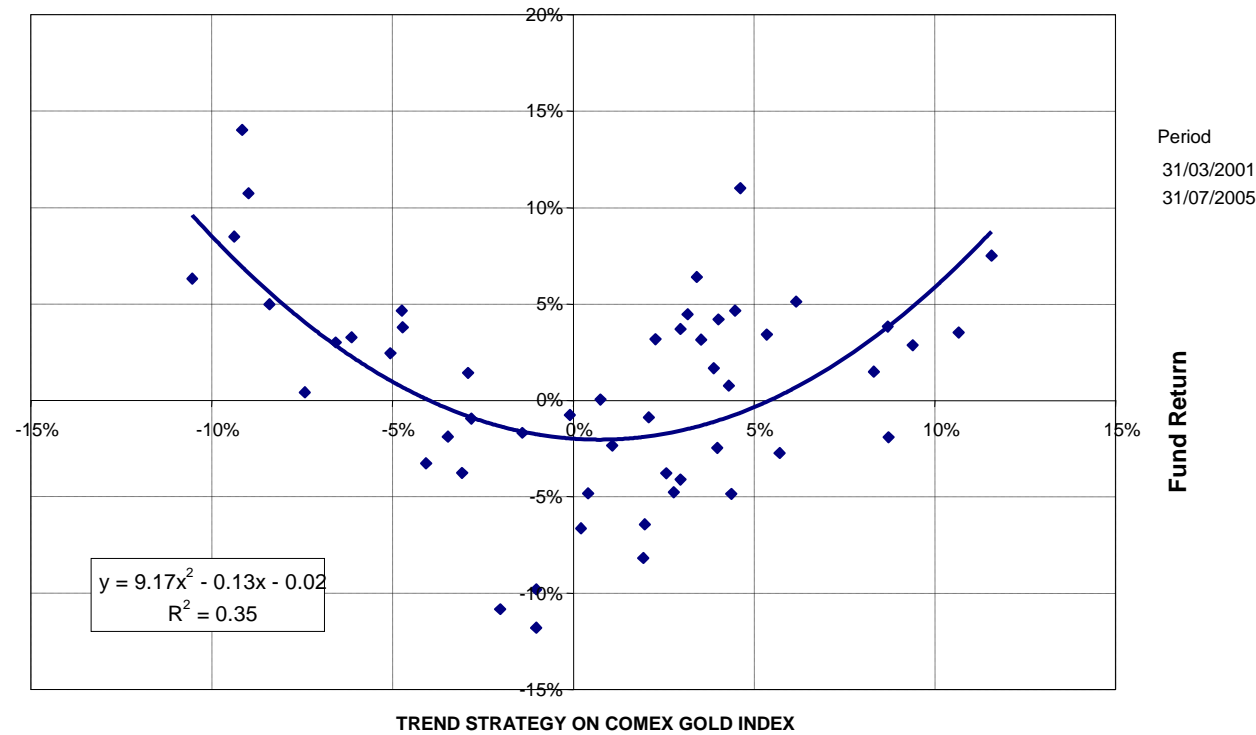
*Strategy:* "The primary objective of the Advisor is the capital appreciation of the Company's assets through the speculation in **commodity futures contracts and cash currencies (FX)**. The Advisor will attempt to meet the objective of capital appreciation by making trading decisions based upon a proprietary trading method. (...)It believes that future price movements in all markets may be more accurately anticipated by historical price movements within a **quantitative or technical analysis** than by fundamental economic analysis. Since **non-directional and limited price directional trading strategies** are employed, major long-term price movements are not necessarily needed for the program to be successful. Rather, diverse models that have yielded good risk/reward characteristics in the past are combined with other uncorrelated models to form a robust trading program that is **less dependent on any one particular market characteristic**"



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# Specific Hedge Fund Index

## CTA with respect to Alternative Factor



- Reverse engineer CTA signal: Trend follower on Trend Following Strategy
- Quadratic on Quadratic  $\Rightarrow$  Cubic shape



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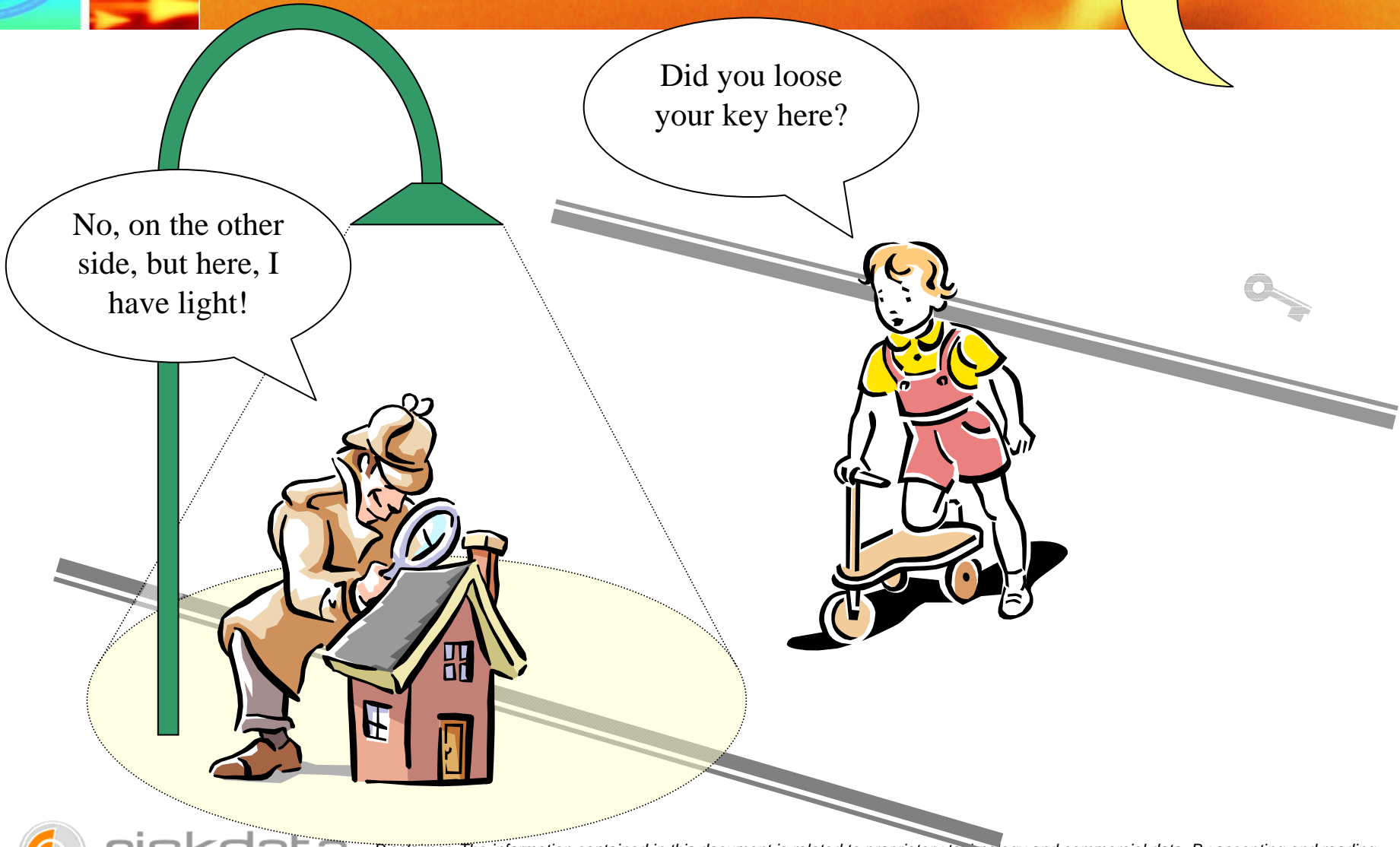
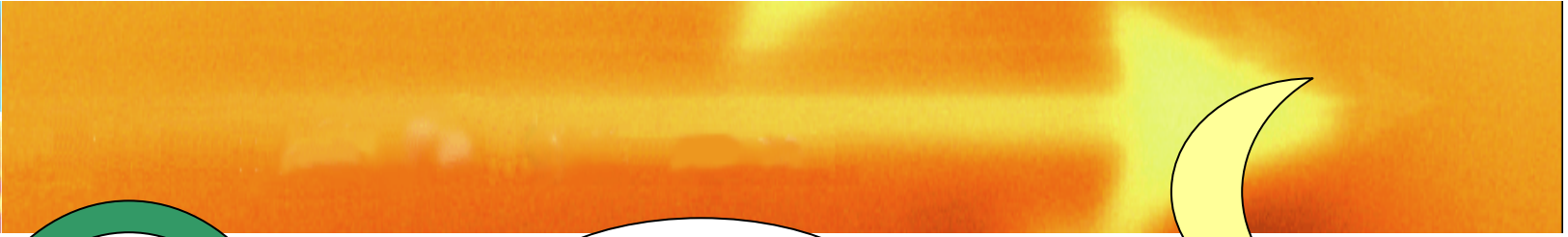
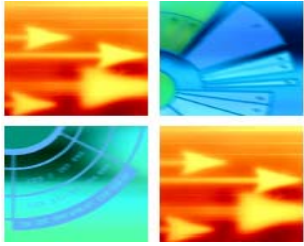
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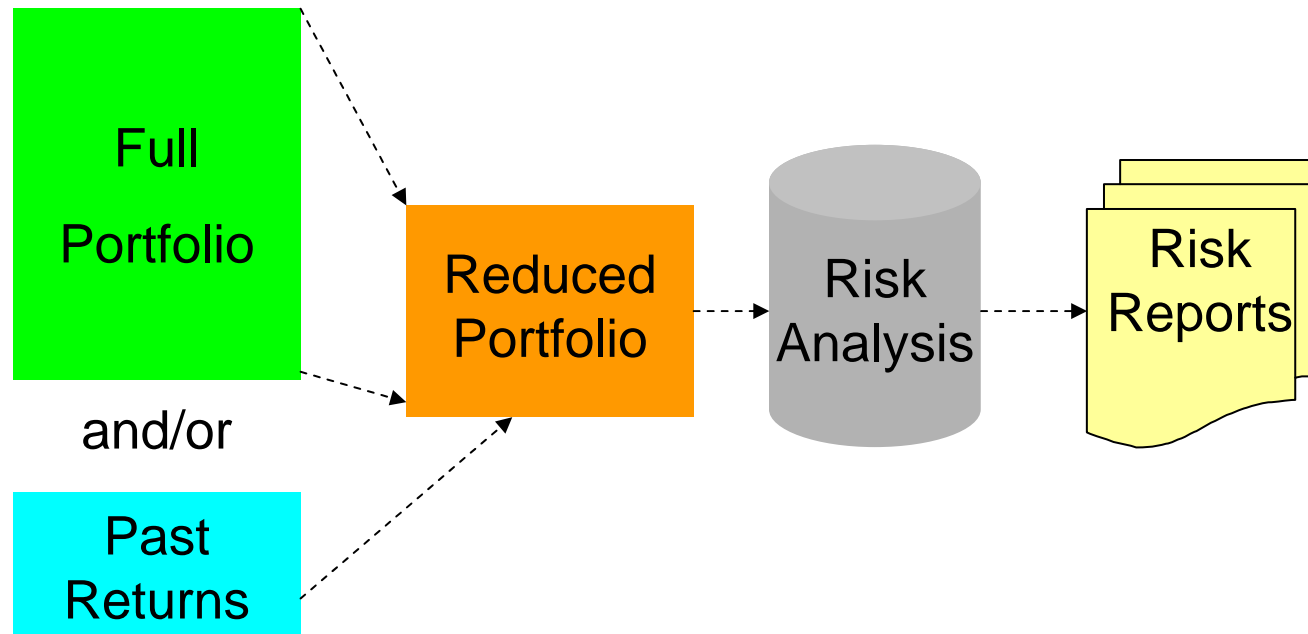
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# RISK PROFILING

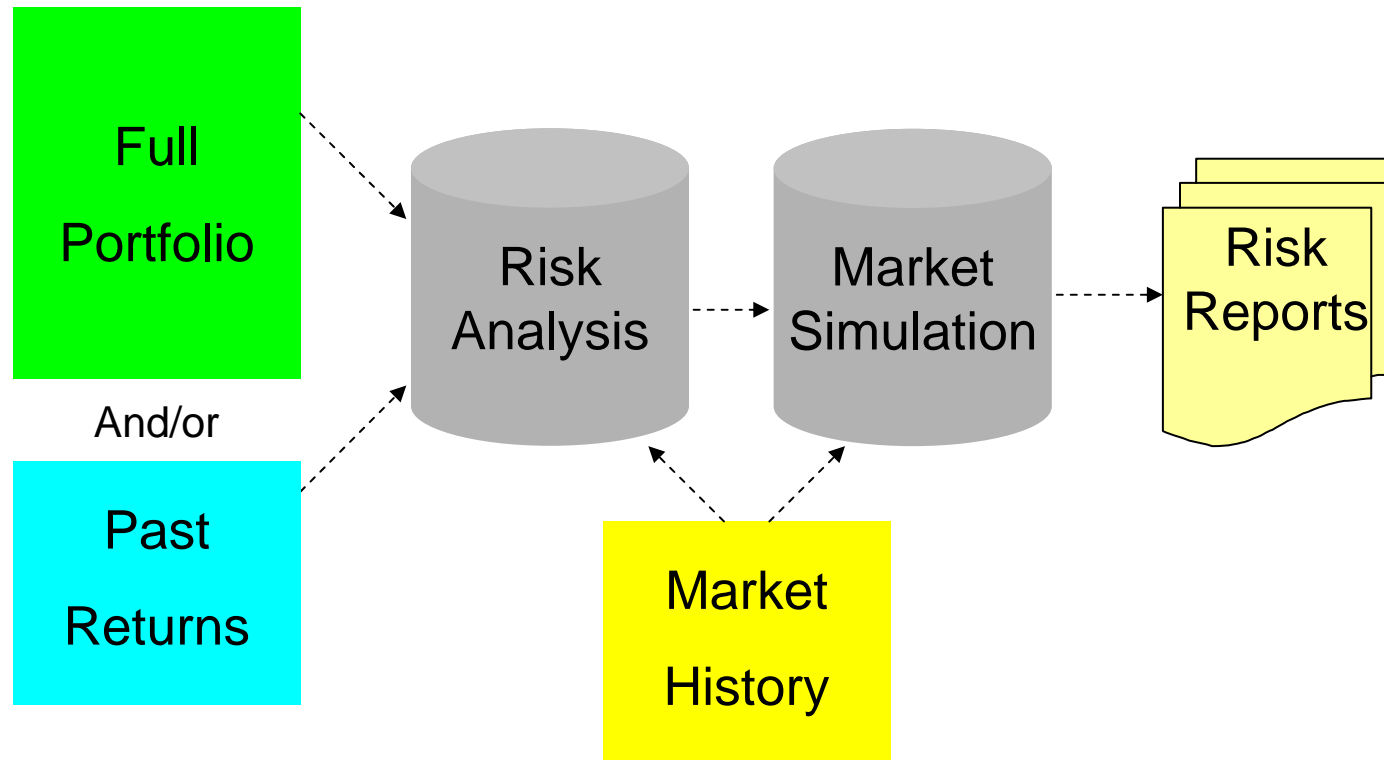
## □ Portfolio Reduction Based Risk System (PRBR)



- Examples of PRBR: Exposure to Sectors/Market segments  
Style analysis...

# RISK PROFILING

## Scenario Based Risk System (SBR)



- Examples of SBR: Stress testing, Monte-Carlo VaR... Riskdata's FOFiX®, Risk Tickers®



# RISK PROFILING

## □ Risk Profiling is Specific to SBR

- Identify Factors and Risk Sources
- Assess Sensitivity to Factor Shifts
  - Usual shifts
  - Extreme shifts
- Long-term Historical Analysis of Risk Factors
  - Joint distributions
  - Correlation breaks
  - Past crises
- Risk Profile of Investment



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# RISK PROFILING

Riskdata FOFIX 1.7 (Dypt version)

No Portfolio Loaded | Simulation Date & DataLink Status: 03/17/2004 1 Day Horizon | Not Connected

Asset Editor | Portfolio Editor | Report | Profiling | FoF | History | Reporting | Admin

**Fund Selection**

Type: All | Strategy: AGGREGATE | Manager: Aggregate

I\_VHUS\_VANU | VH US Van U.S. Hedge Fund Index

Centered Historical S | CASMAL\_USAD

Record Number: 3/3  
Number of Points in History: 99  
Starts: 31/12/1994 | Ends: 28/02/2003

**Analysis Parameters**

Apply | ApplyAll | Stop

Method: Classical  
Horizon: 1 period  
Frequency: End of Month  
From: 08/03/2001 | To: 08/03/2004  
Period: Last 3 Years  
Number of points: 23

Build Sequence

**Profile Edition**

#0 | Label: | From: 08/03/2001 | To: 08/03/2004  
Peer Group: <UNKNOWN>

Factor	Type	SubType	Country	Beta+	Beta-	Sensi	Beta	Gamma	Sensi++	Beta++	Beta--
CASMAL_USAD	CAP SIZE	SMALL	USA	0.9%	1.3%	0.59	1.1%	-0.2%	0.58	1.8%	3.5%
EOMAIN_CAND	EQUITY	MAIN	CAN	0.8%	2.0%	0.47	1.4%	-0.6%	0.62	1.9%	4.0%
SEDisc_EUOD	SECTOR	Discretionary	EUO	1.2%	1.3%	0.46	1.3%	-0.1%	0.59	2.7%	3.9%
CRAAA_USAR	CREDIT	AAA	USA	-0.9%	-1.2%	0.43	-1.0%	0.1%	0.32	-3.1%	-1.5%
STVALU_USAD	STYLE	VALUE	USA	0.9%	1.3%	0.41	1.1%	-0.2%	0.50	1.8%	3.9%
CUSHOR_USAS	CURVE SLOPE	SHORT	USA	1.0%	1.0%	0.38	1.0%	0.0%	0.14	2.4%	1.6%
INSHOR_CHED	INT RATES	SHORT	CHE	-0.7%	0.7%	0.28	0.0%	-0.7%	0.24	-3.3%	7.5%
VOEQUL_EURV	VOLATILITY	EQUITY	EUR	-1.7%	-0.7%	0.17	-1.2%	-0.5%	0.13	-2.0%	-2.9%
COSECT_EUOC	CORRELATION	SECTOR	EUO	-0.9%	-0.5%	0.13	-0.7%	-0.2%	0.01	-2.1%	0.2%
COCMCU_USAD	COMMODITY	CMCU	USA	1.2%	0.9%	0.10	1.0%	0.2%	0.03	2.5%	3.2%
CORATE_USDV	CONVERGENCE	RATES	USA	1.9%	0.2%	0.09	1.0%	0.9%	0.00	0.0%	0.0%
CUSPOT_CHFD	CURRENCY	SPOT	CHE	-1.0%	-0.7%	0.03	-0.9%	-0.1%	0.12	-0.9%	3.4%

Clear Profile Db | Reset | Save | Save As | Delete

**Profile View**

Fund Only | SENSITIVITY | 100%

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# RISK PROFILING

## □ Scenario based Risk vs. Portfolio Reduction based Risk

- At first, PRBR looks simpler
- Problem when **Aggregating** Portfolios
  - Universes of Factors are often Inconsistent
  - Need to Build “Portfolios of Simplified Portfolios”  
⇒ **Over-simplification!**
- **Only SBR allows Efficient Risk Aggregation**
  - Market Scenarios are “Stories”
  - Can easily be **Combined** if telling about different market segments



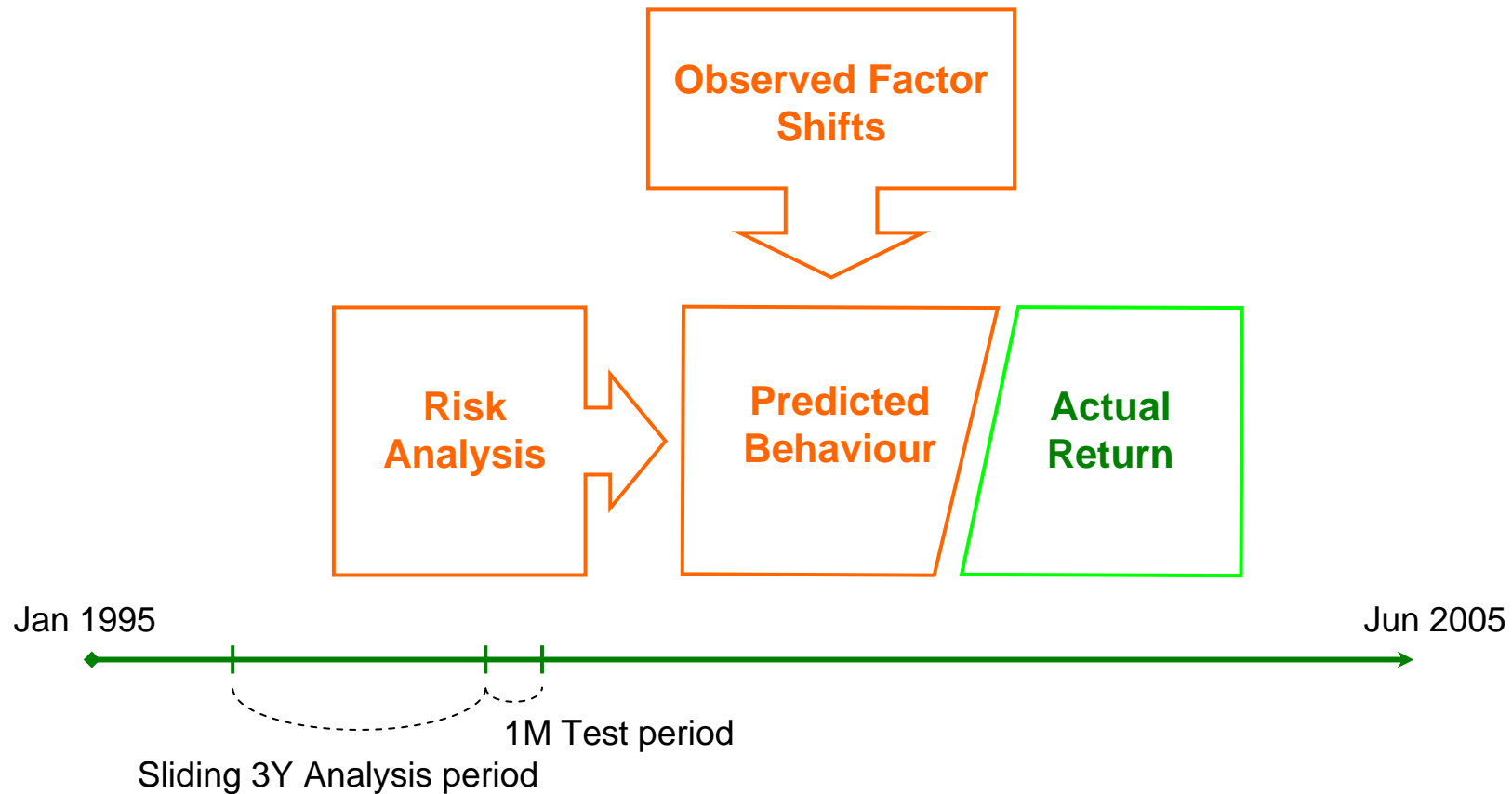
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# CAN WE PREDICT CRISES?

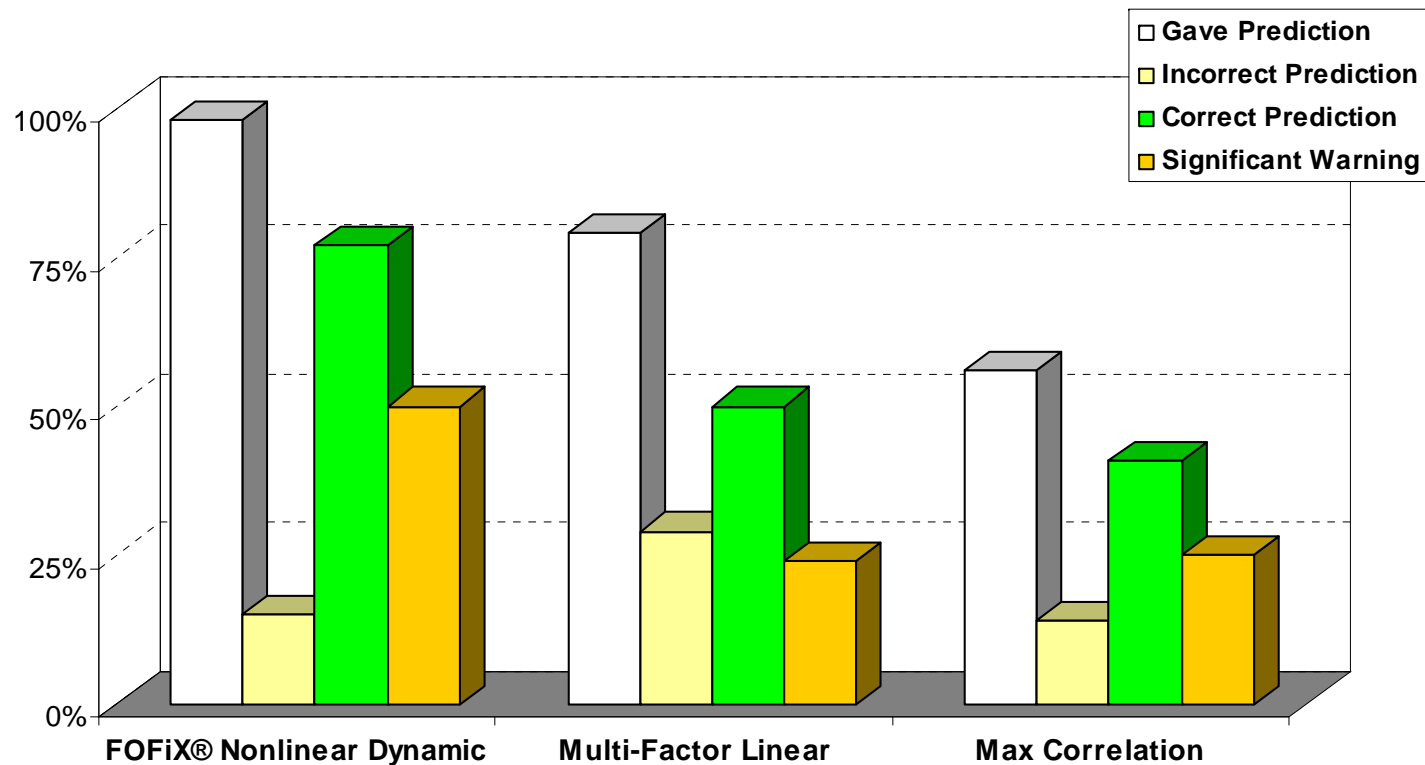
## □ Ex-ante Test = Out of Sample



# CAN WE PREDICT CRISES?

## □ Back-test Results

➤ **Crisis Analysis:** Assume **Fund Return <  $-1\sigma$**  (represents 13% of cases)



# CAN WE PREDICT CRISES?

Riskdata FOFIX 2.3.0.5 (Beta version)

No Portfolio Loaded | Simulation Date: 11/11/2004 | DataLink Status: 2 Weeks Horizon | Speed is Unknown

Asset Editor | Portfolio Editor | Report | Profiling | FoF | History | Reporting | Admin

Fund Selection: Type: All, Strategy: Macro, Manager: RISKDATA

VIOLET Violet

The fund invests on a worldwide basis using an opportunistic approach. The fund focuses on equity debt and currencies that it believes .....

Analysis Parameters: Method: Classical, Horizon: 1 period, Frequency: End of Month, From: 11/04/1995, To: 11/04/1998, Period: Last 3 Years, Number of points: 35

Record Number: 1/1 | Number of Points in History: 166 | Starts: 31/12/1989 | Ends: 30/09/2003 | Preferred Frequency: [ ]

Profile Edition: #4 | Label: [ ] | Peer Group: <UNKNOWN> | From: 11/04/1995 | To: 11/04/1998

Factor	Sensi	Beta+	Beta-	Type	SubType	Country	Beta	Gamma
EQMAIN_RUSD	0,4	2,2%	1,3%	EQUITY	MAII	RUS	1,1%	0,9%
COEQUI_GLBC	0,3	0,0%	-2,4%	CORRELATION	GLB	GLB	-1,2%	2,4%
COCMNI_USAD	0,3	0,0%	2,1%	COMMODITY	CMII	USA	1,0%	-2,1%
CUSPOT_PLZD	0,2	-1,3%	-3,0%	CURRENCY	SPOT	PLN	-0,9%	4,3%
INLONG_EURD	0,2	-3,3%	2,5%	INT RATES	LOIG	EUR	-0,4%	-5,8%
SEStap_USAD	0,2	0,9%	2,0%	SECTOR	Staples	USA	1,5%	-1,1%
CRBAA_USAS	0,2	-0,1%	-0,4%	CREDIT	BAA	USA	-0,3%	0,4%
COEQUI_USDV	0,2	0,0%	0,0%	CONVERGENCE	EQUITY	USA	0,0%	0,0%
CALASM_AUSR	0,1	-1,2%	0,0%	CAP SIZE	LASMALL	AUS	-0,6%	-1,2%
VOLFQII_IPNV	0,1	0,0%	-7,1%	VOL &ILITY	FOITV	IPN	-3,6%	7,1%

Profile View: Fund Only | SENSITIVITY | 100%

Buttons: Clear Profile Db, Reset, Save, Save As, Delete



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# CONCLUSIONS

- ❑ Risk Measure  $\neq$  Performance Measure
  - Risk measure is **ex-ante**, Performance measure is **ex-post**
- ❑ Risk Management  $\neq$  Risk Measurement
  - Measurement for Reporting, regulators
  - Management for Portfolio Construction
- ❑ Return Based vs. Holding Based
  - Holdings for SHORT TERM RISK
  - Returns for LONG TERM RISK
- ❑ Scenario based Risk vs. Portfolio simplification
  - Only scenario based risk can efficiently be aggregated
- ❑ Alternative Models
  - Yes!.. Provided *Nonlinear* and *Dynamic*
  - Cannot predict market crises, but can predict Impact on Funds