



The Financial News

**3rd Seoul International
Derivative Securities Conference**

Risk Management Through Financial Derivatives

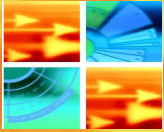
**Managing Credit Risk via Equity Options
Using Put Options to Hedge Credit Risk**

Aug 31, 2005

Raphaël Douady
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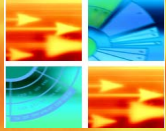




HE'S IN CHARGE OF MARKET DISCIPLINE. NOBODY UNDERSTANDS THE MARKET SO WE'RE CONCENTRATING ON THE DISCIPLINE



Financial Times 1998



Riskdata

Our Clients

**Funds of Funds
Hedge Funds
Asset Managers**

Our Solutions

**Risk Reporting and Analytics
Portfolio Construction and Risk Budgeting**

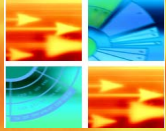
Our Offices

London, Paris, New York

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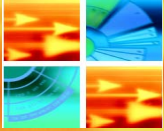
Agenda

- ☐ **CDS vs. Equity and Implied Volatility**
- ☐ Bond Price vs. Equity
- ☐ Credit Risk Modelling
- ☐ Case Study: GM Crisis May 2005
- ☐ Risk by Monte-Carlo Simulations
- ☐ Conclusion

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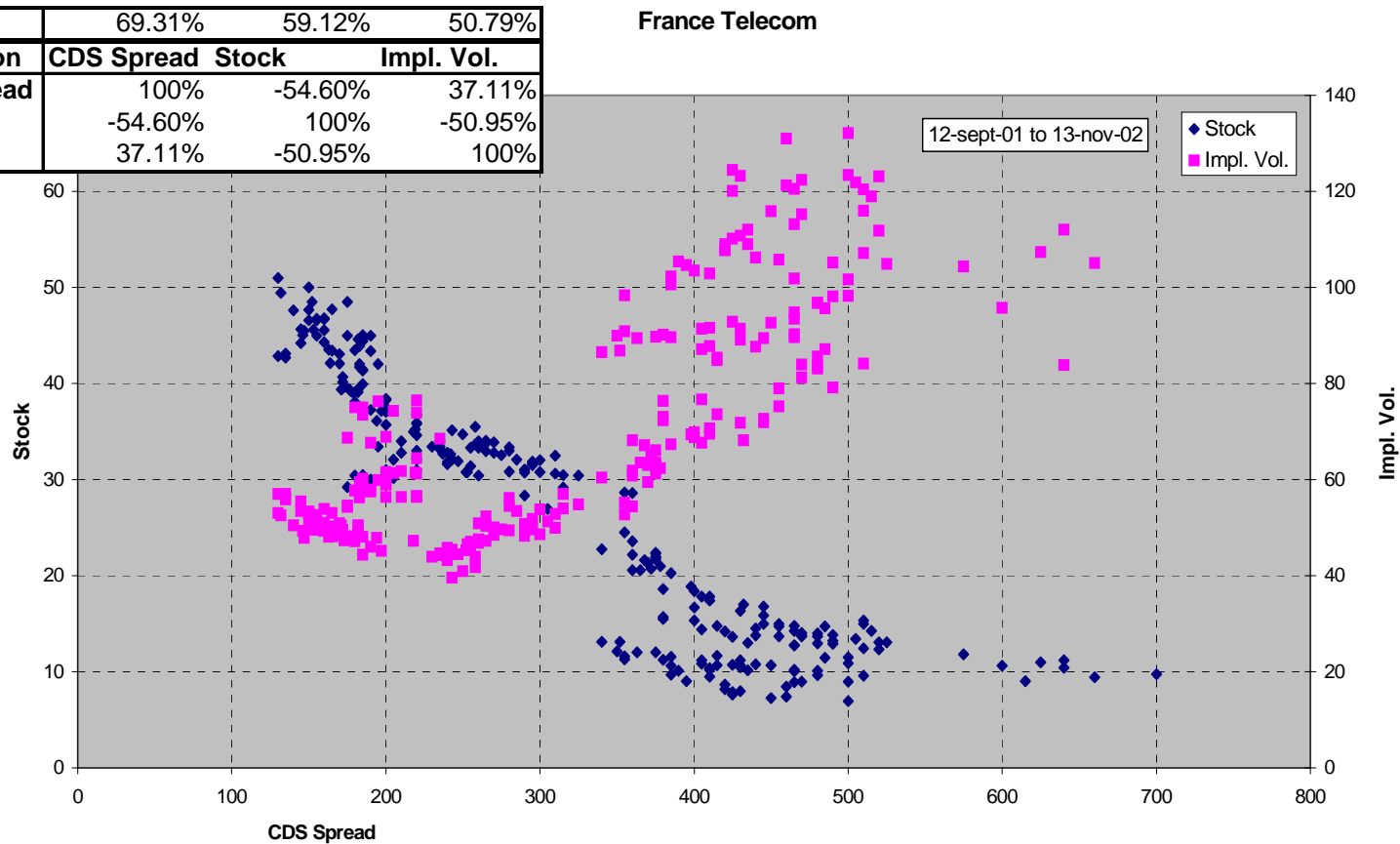
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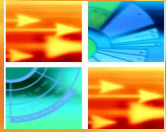


CDS vs. Equity and Implied Volatility

France Telecom: Strong Correlations

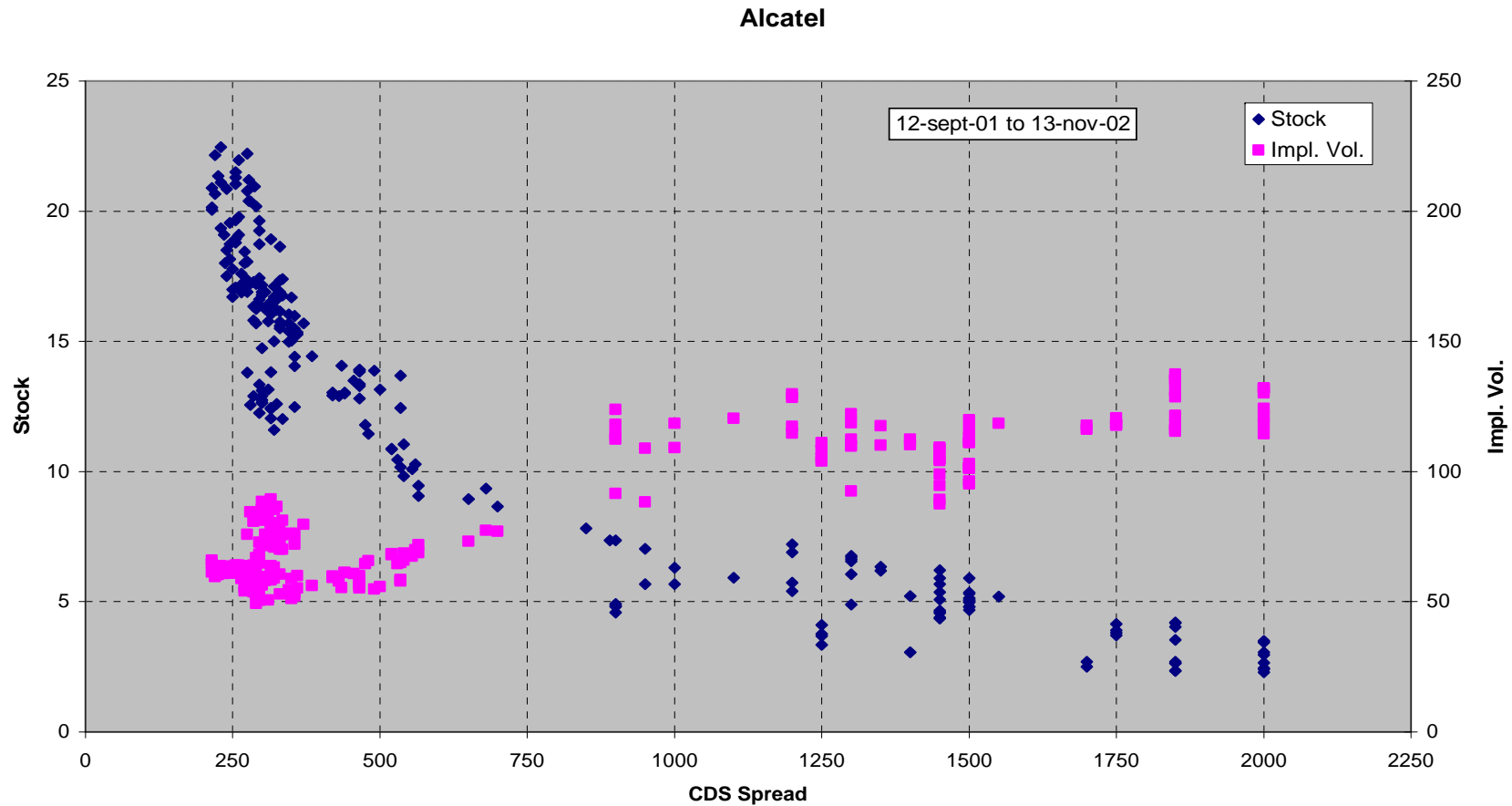
Volatility	69.31%	59.12%	50.79%
Correlation	CDS Spread	Stock	Impl. Vol.
CDS Spread	100%	-54.60%	37.11%
Stock	-54.60%	100%	-50.95%
Impl. Vol.	37.11%	-50.95%	100%





CDS vs. Equity and Implied Volatility

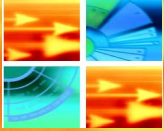
Alcatel: Almost went to Default



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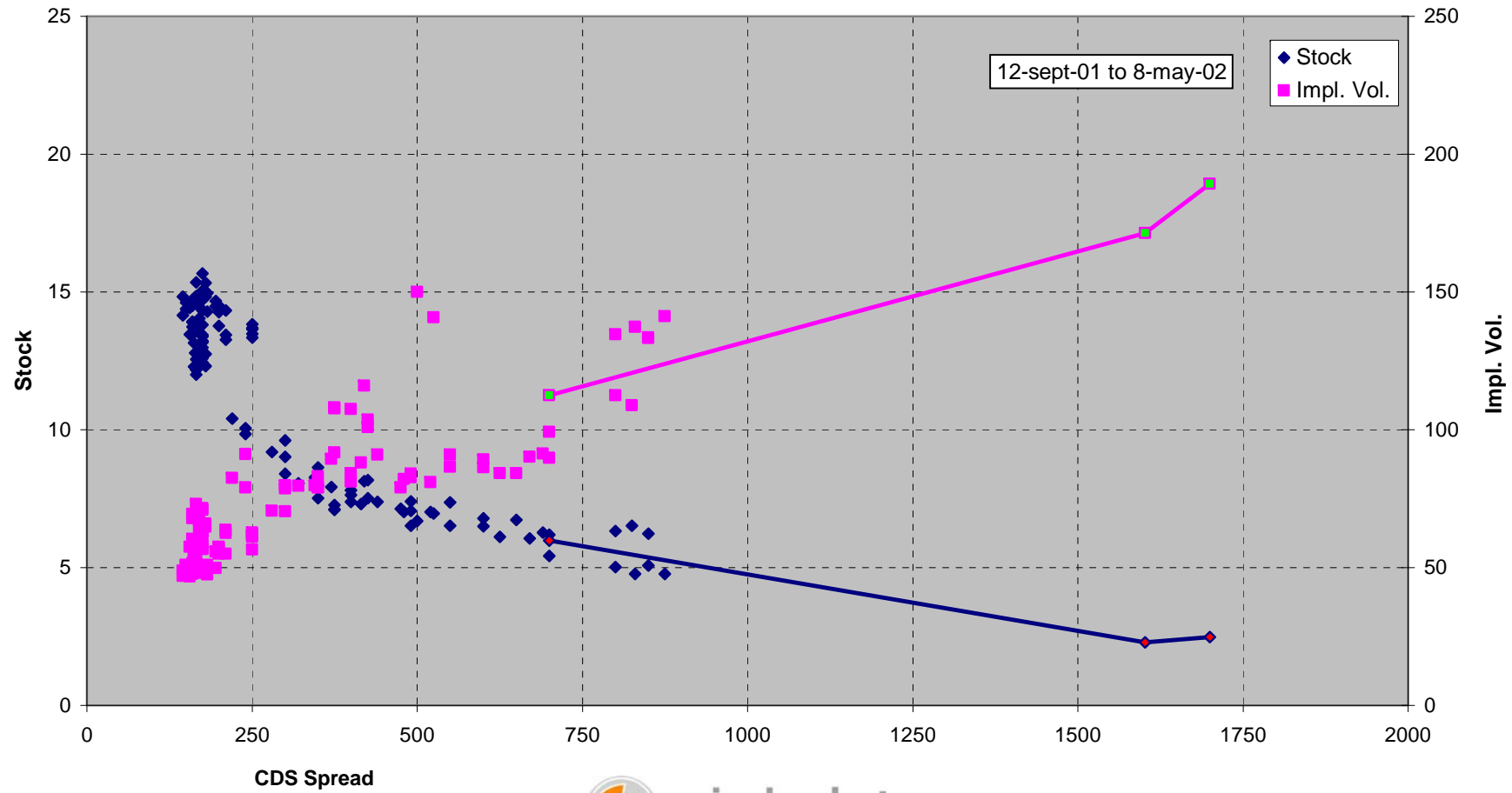
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CDS vs. Equity and Implied Volatility

World Com: A Default Example

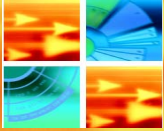
Worldcom



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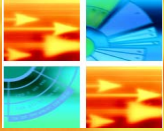
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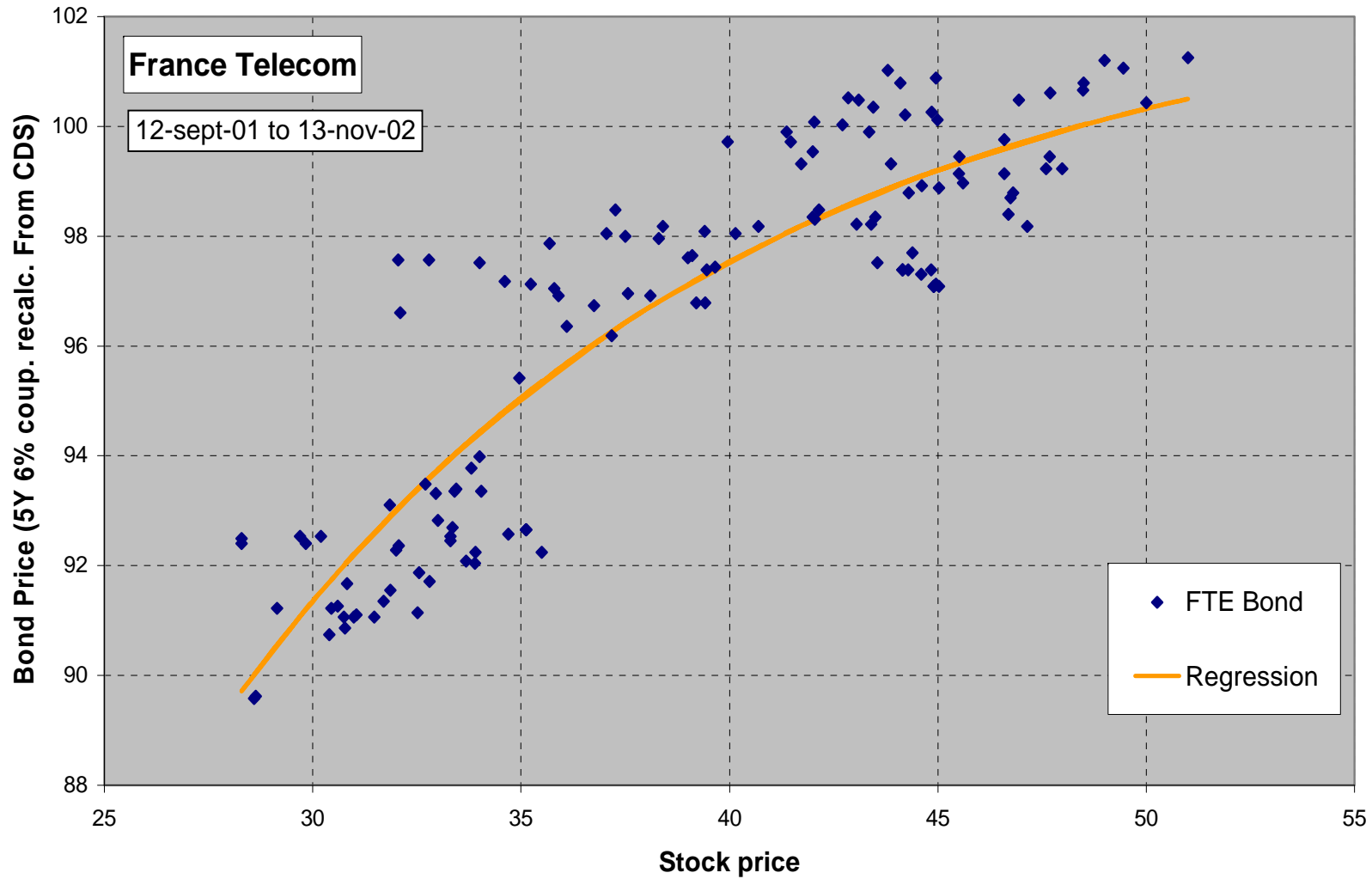
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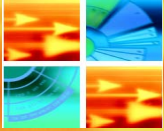
Bond Price vs. Equity



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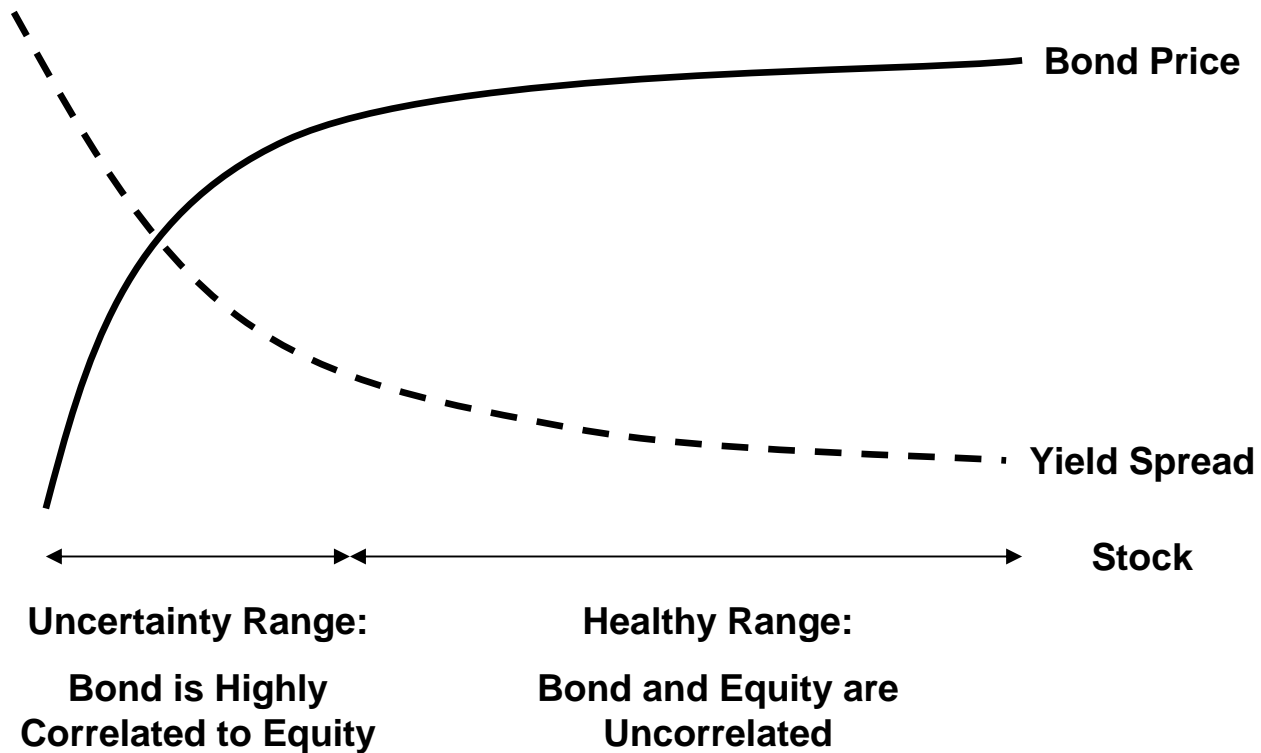


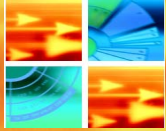
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Corporate Bond Price vs. Equity

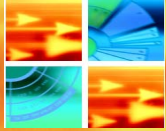
Non-linear relation between Corporate Bond and Equity





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Credit Risk Modelling

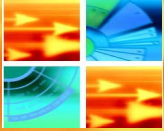
⊕ Statistical Findings (Avramov & al., 2003)

- ✓ Stock volatility is a (if not the) major driver of credit spread changes, especially the specific part of it.
- ✓ Firm specific factors are more important than common factors.
- ✓ Other factors include:
 - Price / Book ratio
 - Leverage

⊕ Suggests a link between

- ✓ Corporate bonds
- ✓ Put options

D. Avramov, G. Jostova, A. Philipov
*Credit Risk Changes: Common Factors and Firm
Level Fundamentals*



Credit Risk Modelling

- Following Merton 73, in case of default, the company can only refund its Liquidation Value = Market Capitalisation + Reserves
- Each issue gets a portion of this value, depending on seniority
- A Corporate Bond can be seen as an Option with Pay-off:

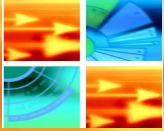
Bond Pay-off = Min(Non-def. Bond Pay-off, $k * \text{Liq. Value}$)

$k \sim \text{Seniority Factor} * \text{Nominal Issue} / \text{Total Debt}$

Bond Pay-Off = Min[NDB-PO, $k' * (\text{Stock} + R)$]

$k' = 100 * k * \text{Nb Shares} / \text{Nom Issue}$

$\sim (100 / S) * SF * MC / TD$



Credit Risk Modelling

Corporate Bond discount as a Put Option

$$\text{Bond} \sim \text{NDB} - k' * E[\text{Max}(K - S, 0)]$$

$$K = \text{NDB} / k' - R$$

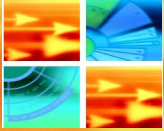
Strike K involves

- ✓ Debt / Share ratio
- ✓ Seniority
- ✓ Reserves upon liquidation

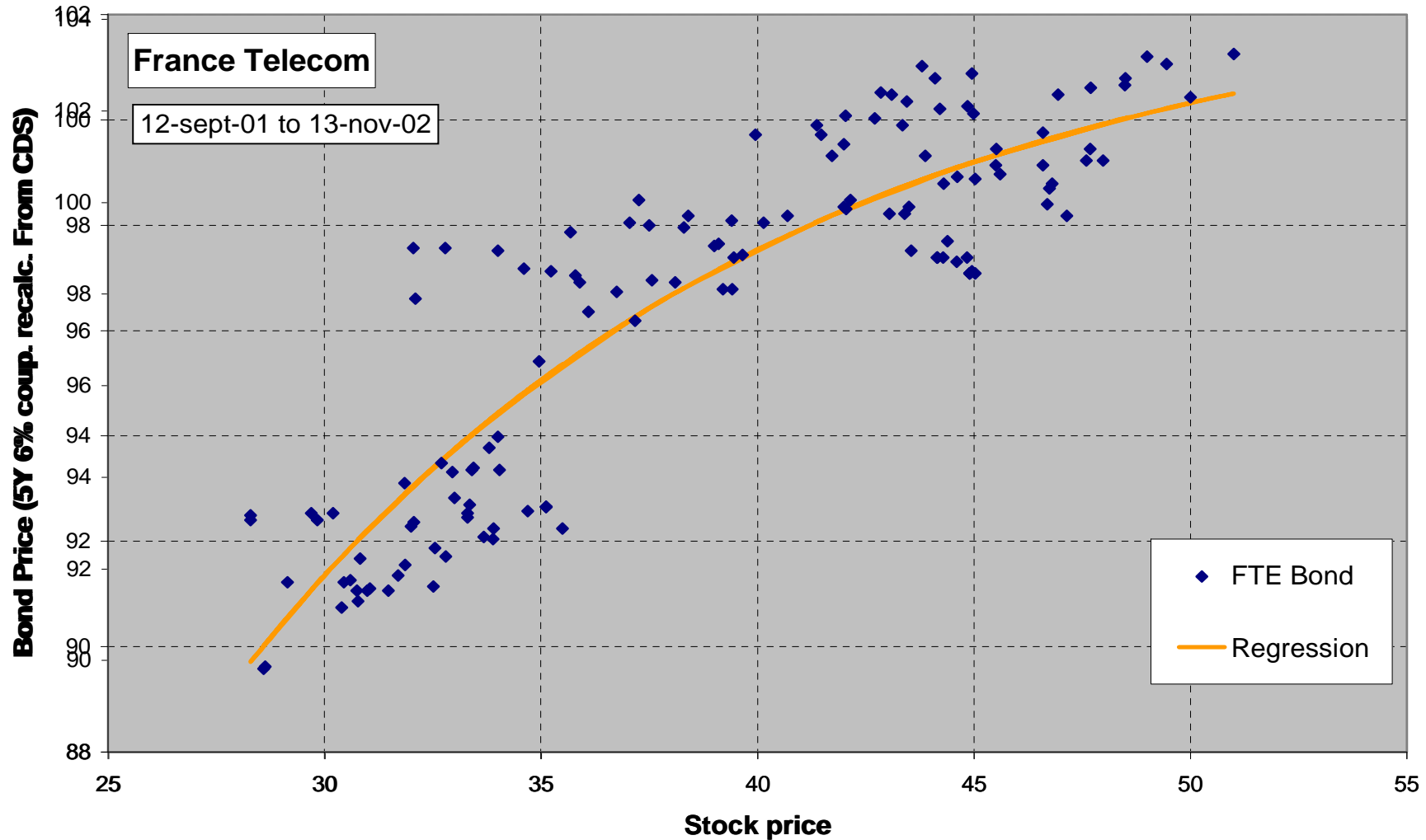
Corporate Bond Price includes

- ✓ Stock price vs. Debt / Share
- ✓ Implied Volatility
- ✓ Non-default Bond may include Liquidity Spread

Non-linear relation (option like)



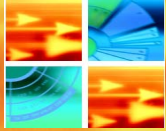
Credit Risk Modelling



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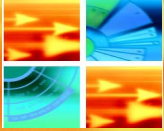
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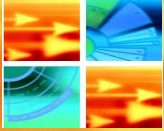


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GM Crisis May 2005

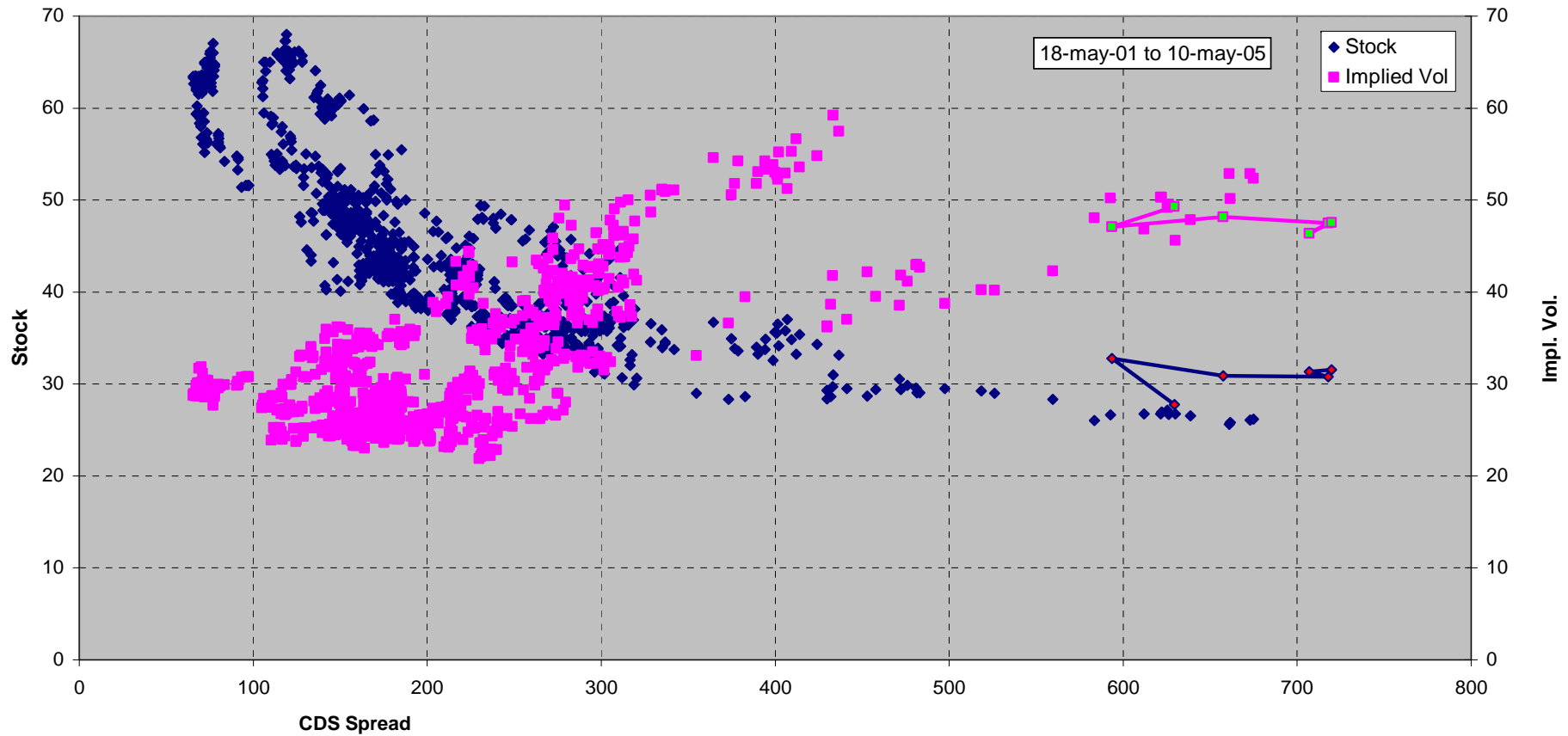
- **Mid-March 2005: Rating Agencies downgrade GM from Investment Grade to High Yield**
 - ✓ CDS progressively slip from 280 to 700+ bps
- **May 4, 2005: Unexplained Trade Orders make the Equity Price Rally +18%**
 - ✓ Bonds continue to loose value
 - ✓ Puts decrease in value as well
 - ✓ Hedging GM Bonds with Puts acts against the Investment



GM Crisis May 2005

General Motors CDS vs. Equity and Implied Volatility

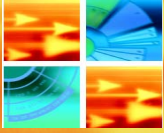
General Motors



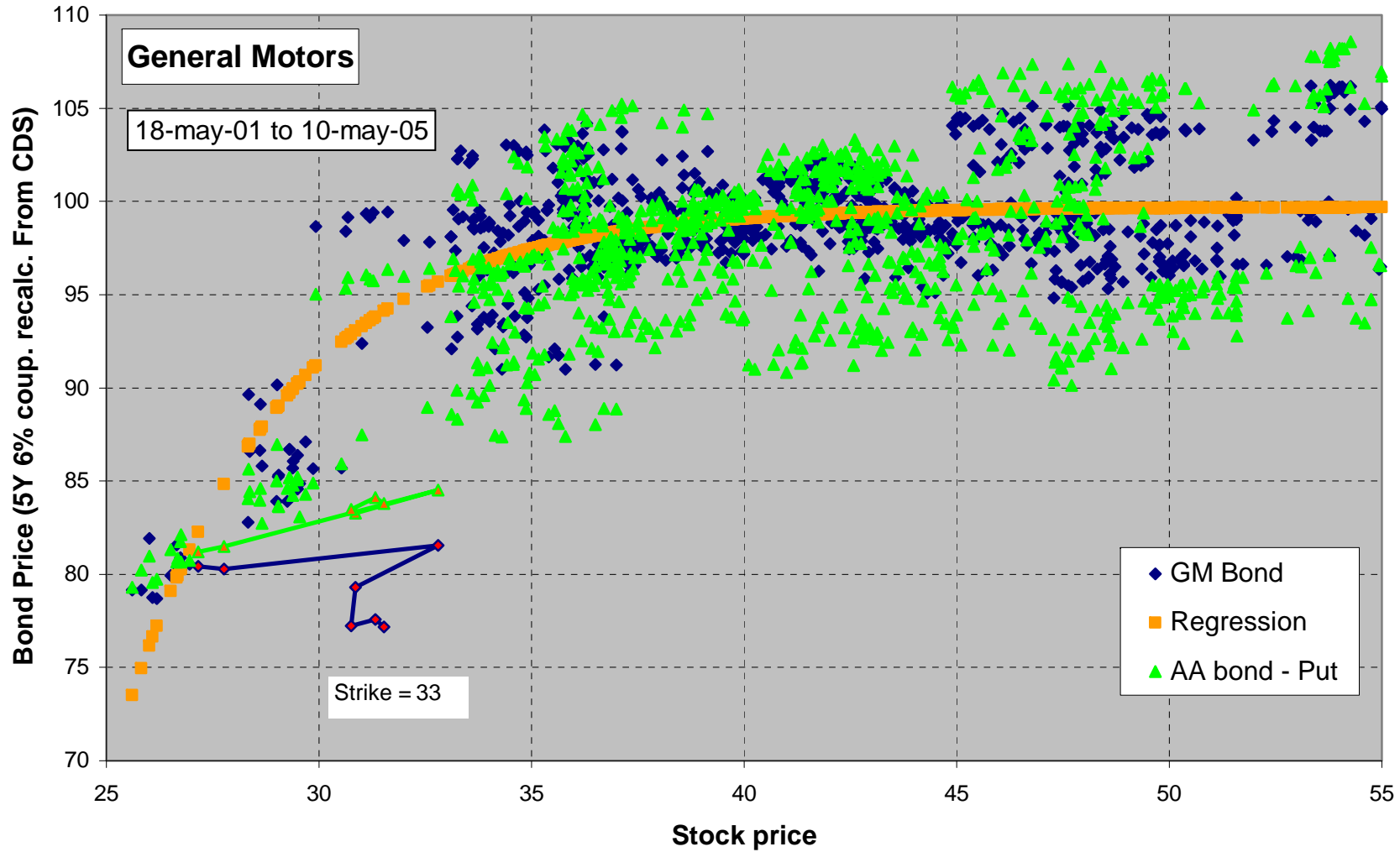
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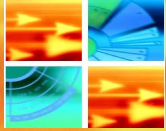
GM Crisis May 2005



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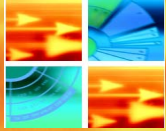
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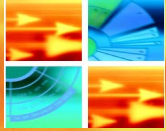
Credit Risk Modelling

☉ Modelling Corporate Bonds Must Include

- ✓ Gov. Bond and/or Swap Yield Curve for each country
- ✓ Issuer's stock
- ✓ Implied volatility surface (one surface for each underlying, allowing term structure and smile deformations)
- ✓ Average Credit Spread Curve for each rating level

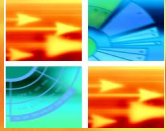
☉ Put Strike

- ✓ Statistically Estimated (if applicable, i.e. Company experienced Uncertainty Range)
- ✓ Computed from Company Economic Data otherwise
- ✓ Estimate to be updated on a regular basis



Credit Risk Modelling

- ⊕ **Implications of accounting for Equity and Volatility risk**
 - **Portfolio diversification**
 - **CDO and other Credit Derivatives**
 - **Firm-level Risk Management, Macro-hedge**
 - **Arbitrage and Alternative Investment Risk**



Credit Risk Modelling

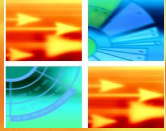
Cross-road of Intensity and Structural Models

☉ Intensity and Copula Models

- ✓ Default intensity Process
- ✓ Correlation to Stock market
- ✓ Non-linear relation

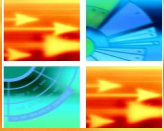
☉ Structural Models

- ✓ Must include Jumps in stock process
- ✓ Stochastic volatility modelling



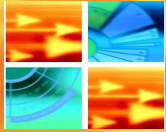
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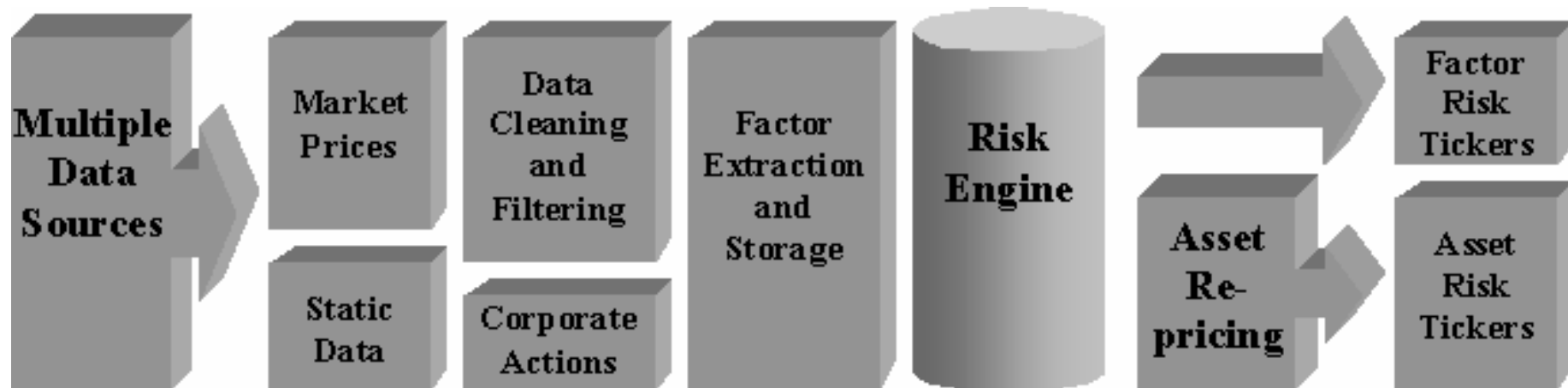
Risk by Monte-Carlo Simulations

- ④ **Every asset/factor is represented as a “Monte-Carlo Series”**
 - ✓ Randomly simulated possible values of Market Variables at one or several given date in the future (factors, indices, stock prices, rates, implied volatilities, etc.)
 - ✓ Market Variables must display Stable Statistics (volatility, correlations, fat tails, etc.)
- ④ **Statistically estimated joint probability distribution**
 - ✓ Requires accurate Historical data Storage and Cleaning
- ④ **Portfolio’s Asset prices are Computed from simulated Market Variables**
 - ✓ Represents the Full Risk, including Specific
 - ✓ Expected Return conditional to given Market move
 - ✓ Can include non-linear features: Convexity, Extreme Behaviour, Jumps...
 - ✓ Can apply pricing model (e.g. Black-Scholes, convertible, etc.)
- ④ **Combine Asset Simulated Prices at the Portfolio Level**
- ④ **Compute Risk Measures (VaR, Sensitivities, Stress Testing, etc.)**



Riskdata's Risk Ticker[®] Production Process

⦿ A Data-processing Factory

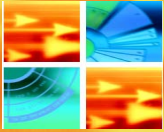


Risk Ticker[®] = Computer object containing Monte-Carlo series

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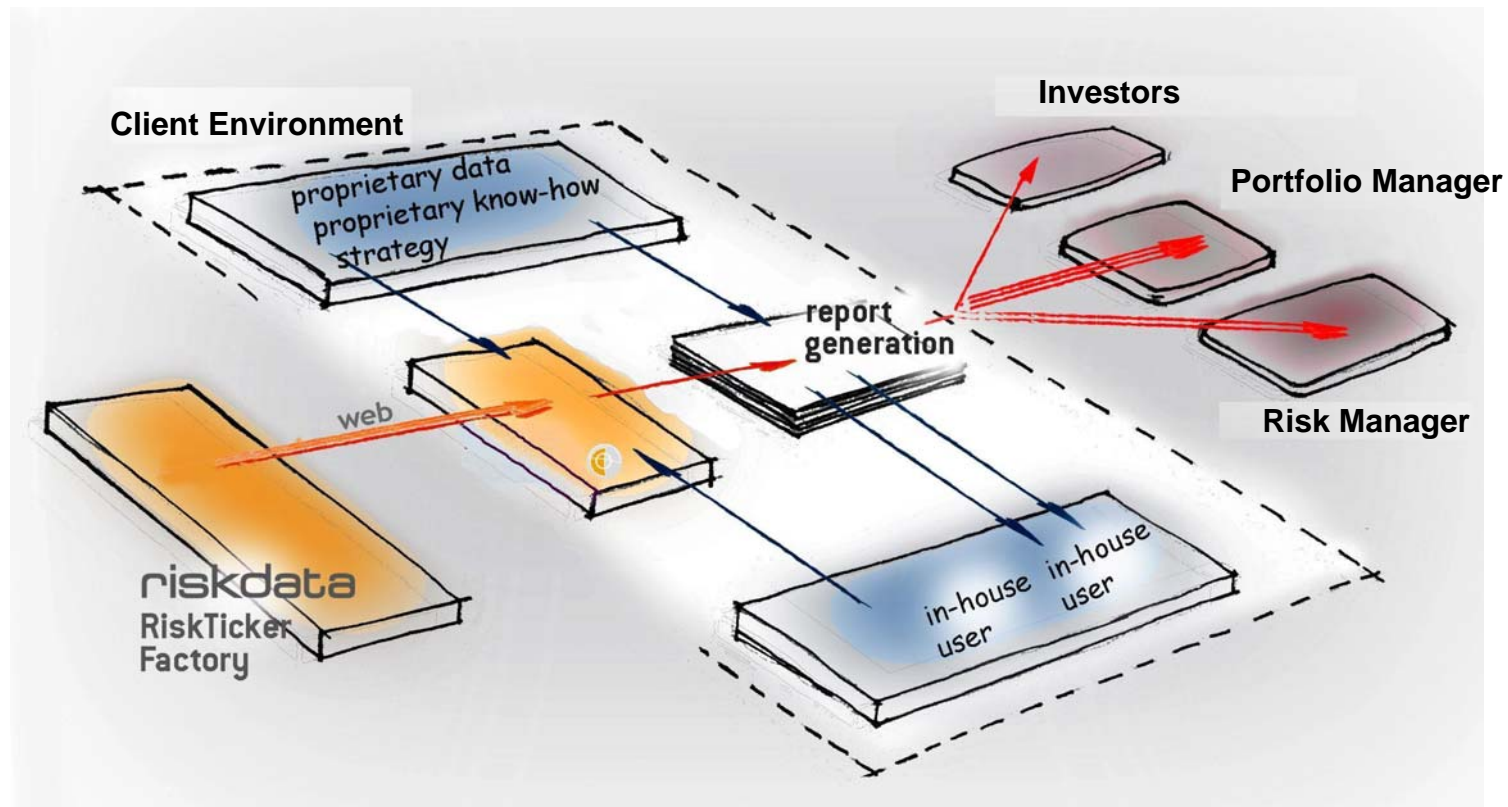


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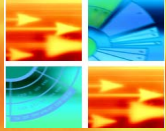
How it works in practice



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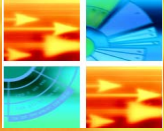


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Conclusion

- ④ **One cannot trade corporate debt without considering the equity market**
- ④ **Corporate Bonds and Out-of-the-money Puts closely related when approaching default**
- ④ **Non-linear relation between Debt and Equity**
 - **Factor models fail to capture the relation**
 - **Monte-Carlo simulations can display accurate Risk figures**
- ④ **Extensive set of Market Variables**
 - **Yield curves**
 - **Spread averages**
 - **Equity prices**
 - **Implied Volatilities**



***There is no risk without uncertainty,
but uncertainty is not just risk.***

C.W.J. Granger

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