

*Discussion:*

## The Impact of the Credit Crunch on Quant Investing

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SIFR Conference

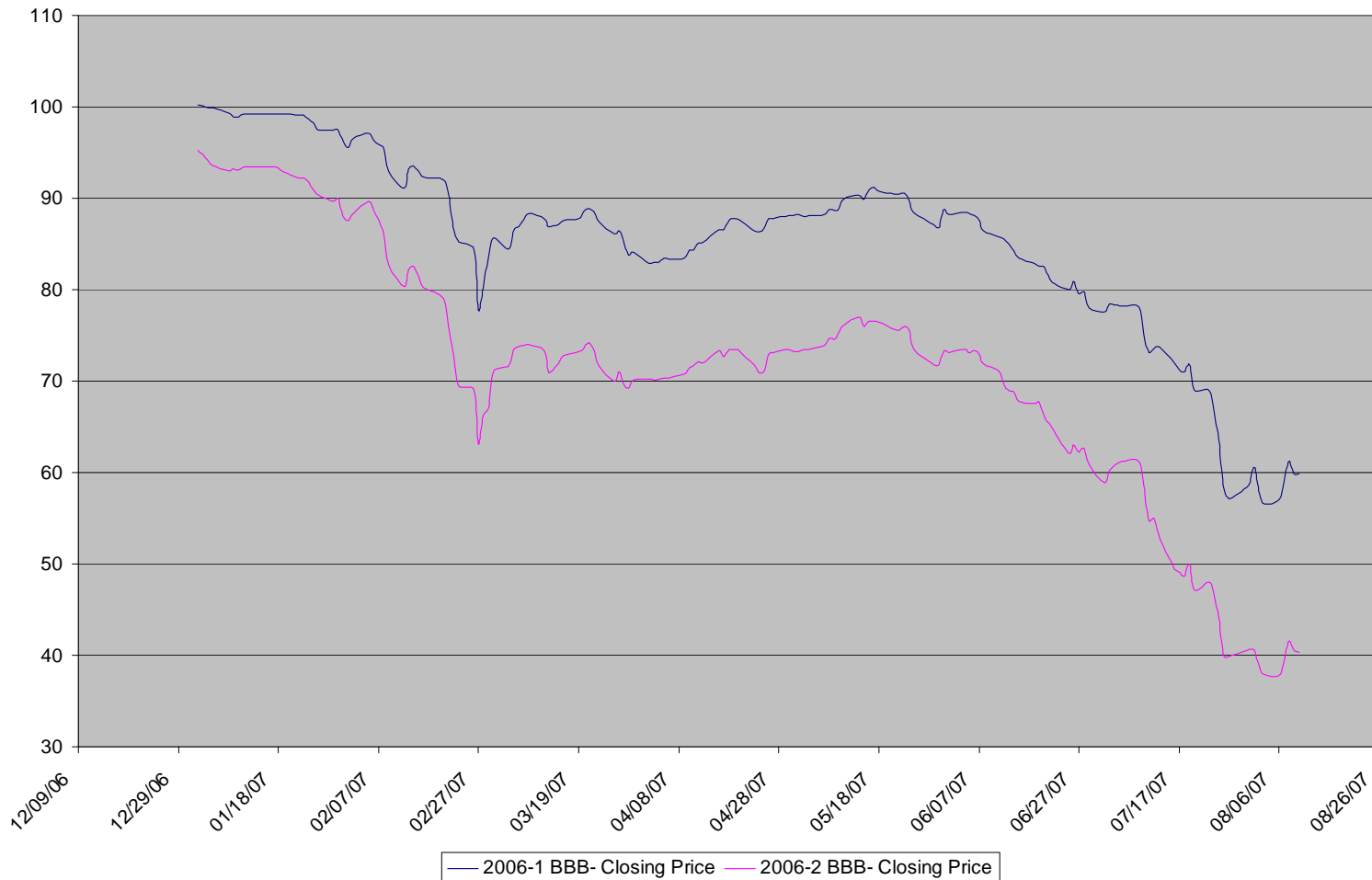
June 25-26, 2008

# Agenda

- 1. The events leading to**
- 2. The Quant-equity strategy crisis -- August 3-10**
- 3. Interpretation**
- 4. Post-August 2008 crisis**
- 5. Implications for quant investing**

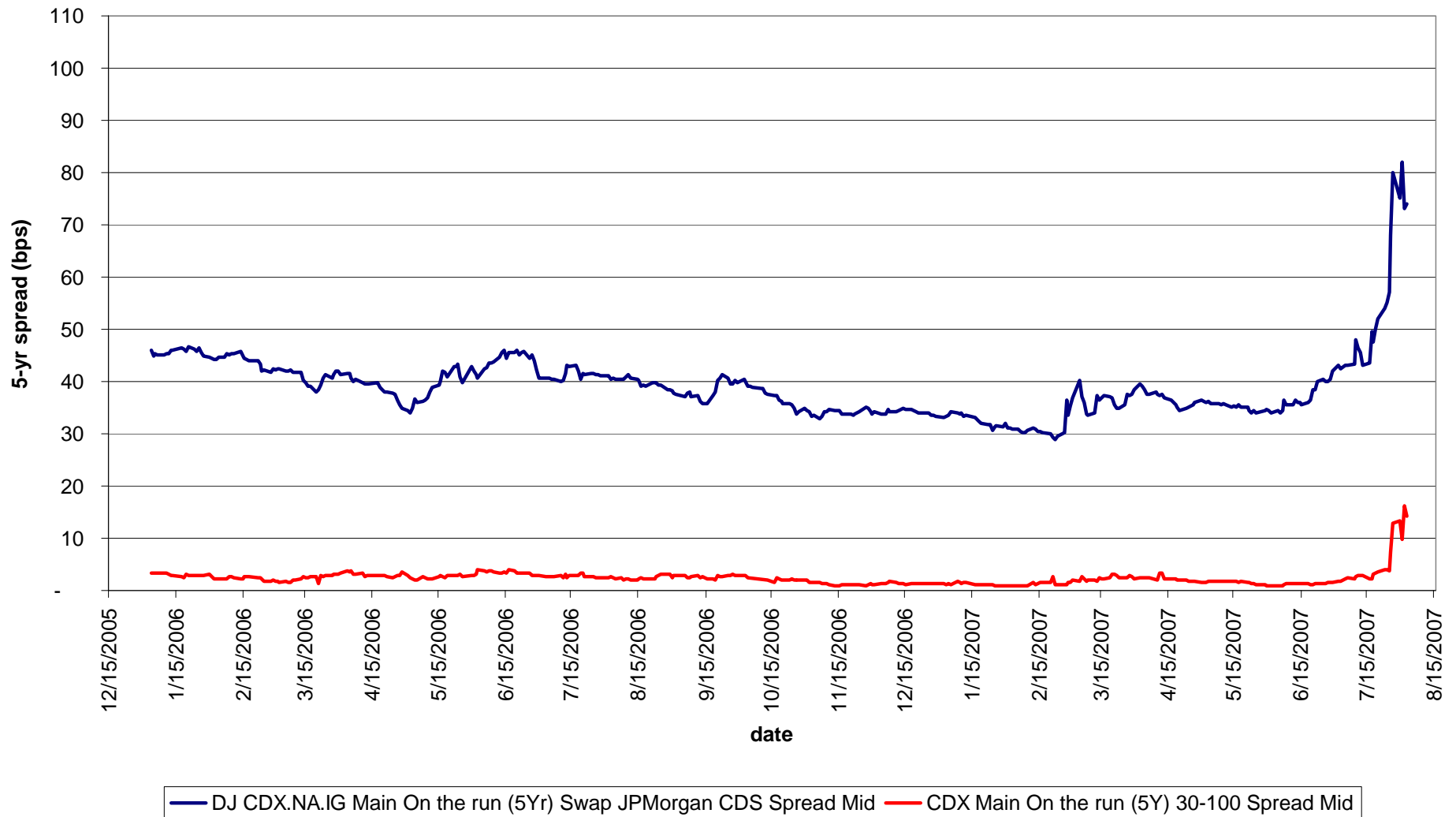
# Losses in Subprime accelerate in June-July

(Bear Stearns hedge funds bankruptcy announced June 16-17)



# Corporate IG spreads widen on July 16 to July 30

5-yr CDX & 30-100 Tranche Spreads  
through 8/3/2007

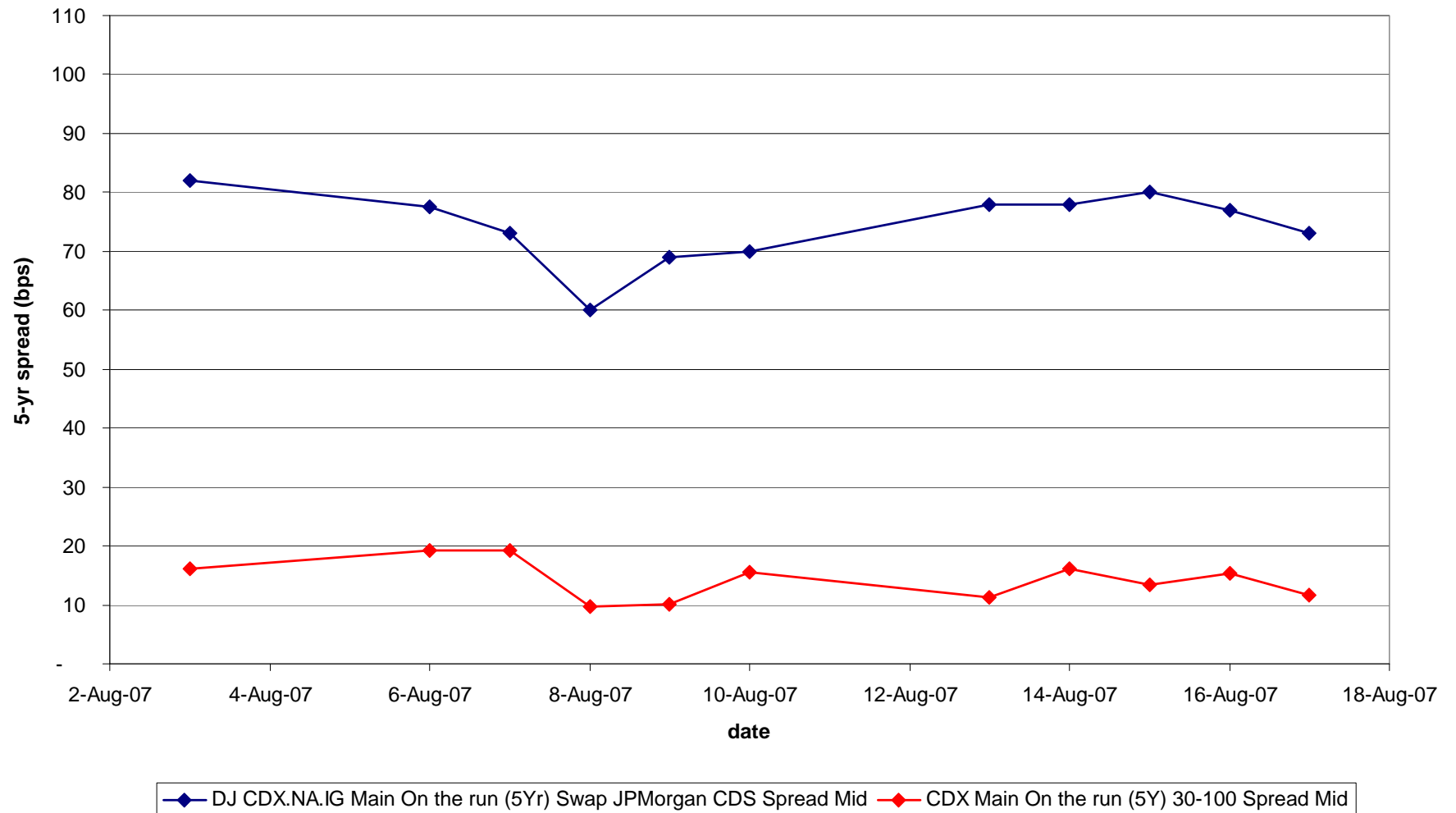


## **August -- Quant Liquidity Crunch**

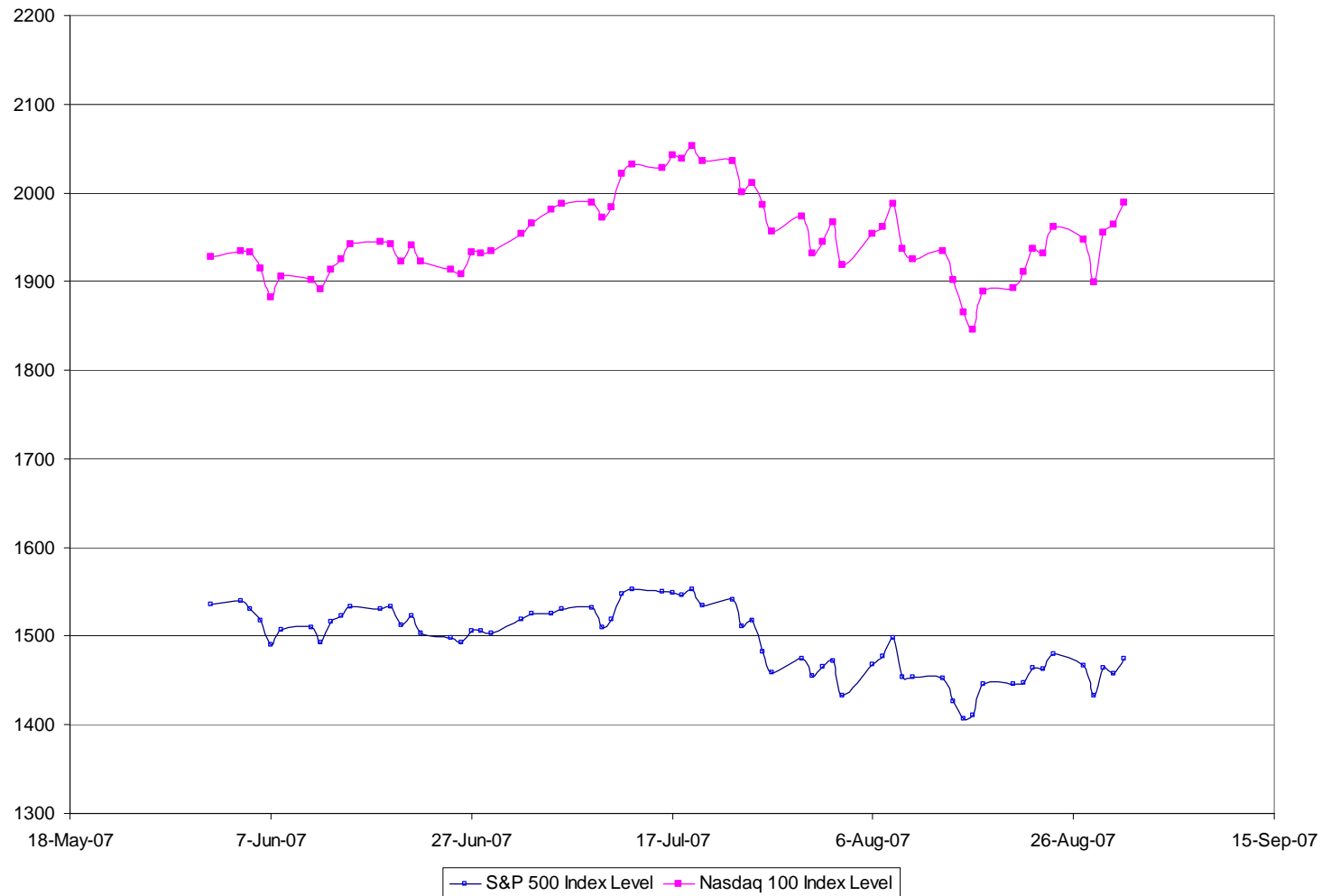
*Friday, August 3 → Friday, August 10*

# Early August Credit markets seem to have stabilized

5-yr CDX & 30-100 Tranche Spreads  
8/3/2007 to 8/17/2007

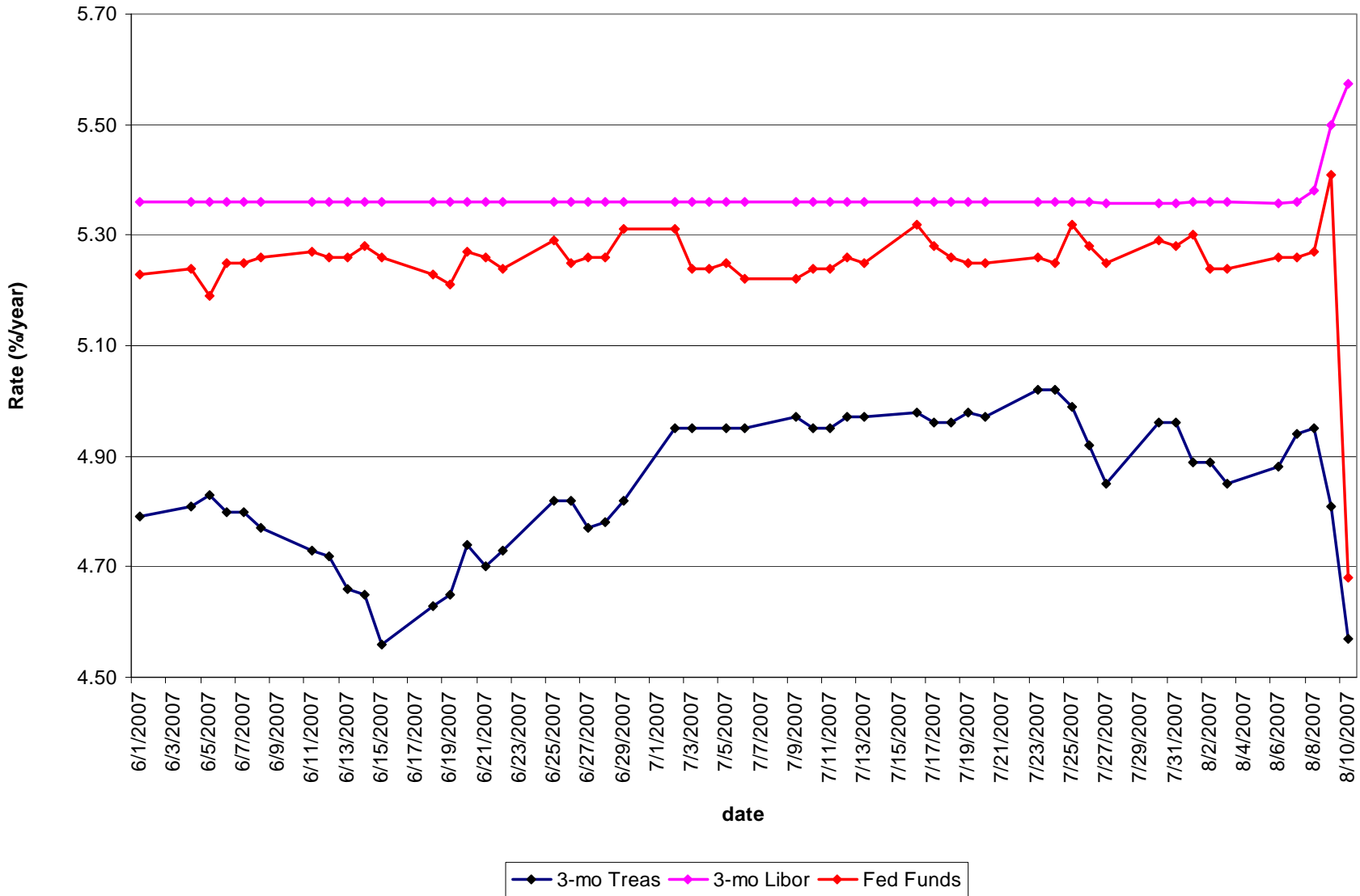


# Equity Markets show no sign of a crisis from June to August



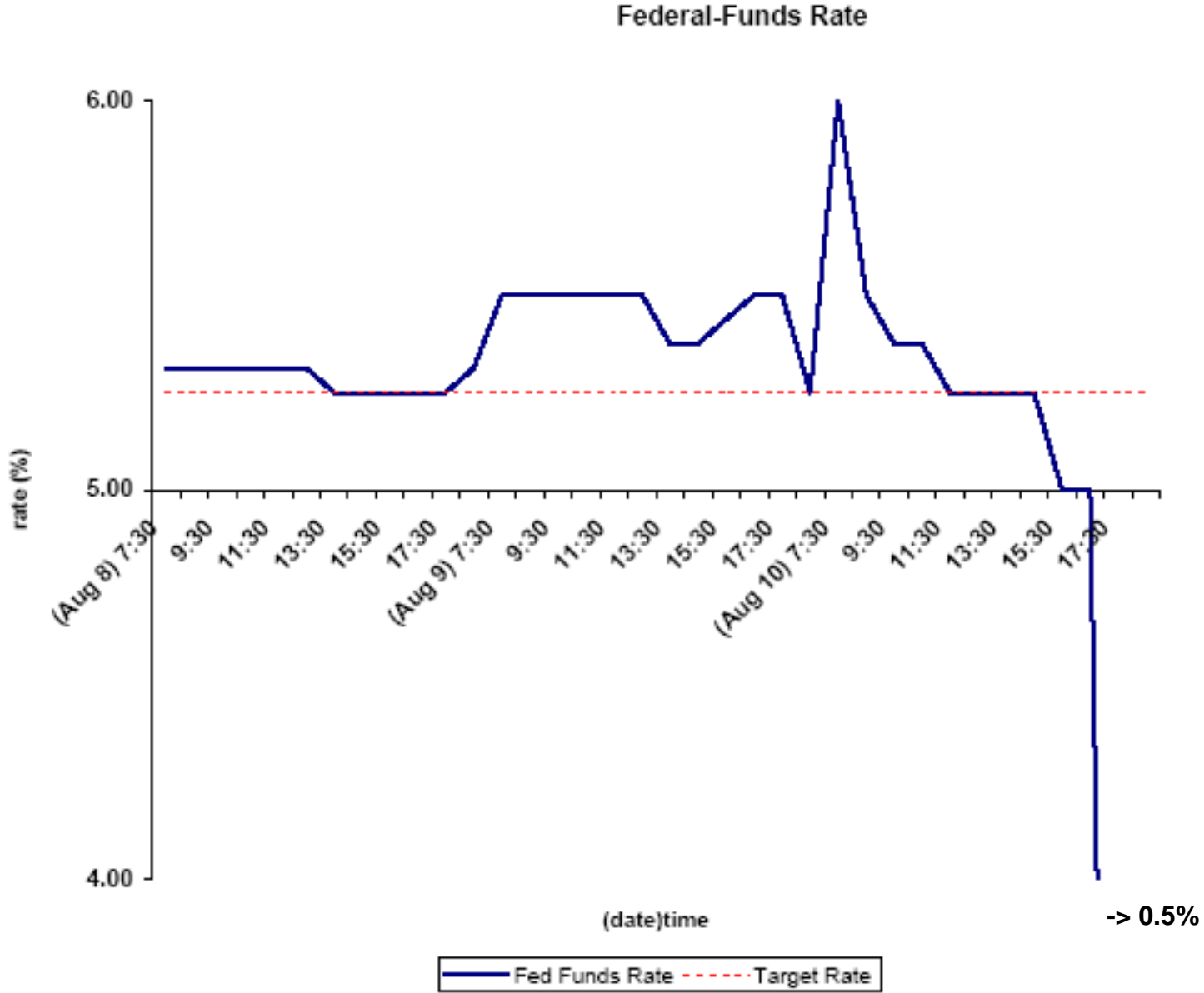
# Until August 8 no (apparent) stress in Interbank market

Treasury, Libor, and Fed Fund Rates 6/1-8/10/2007





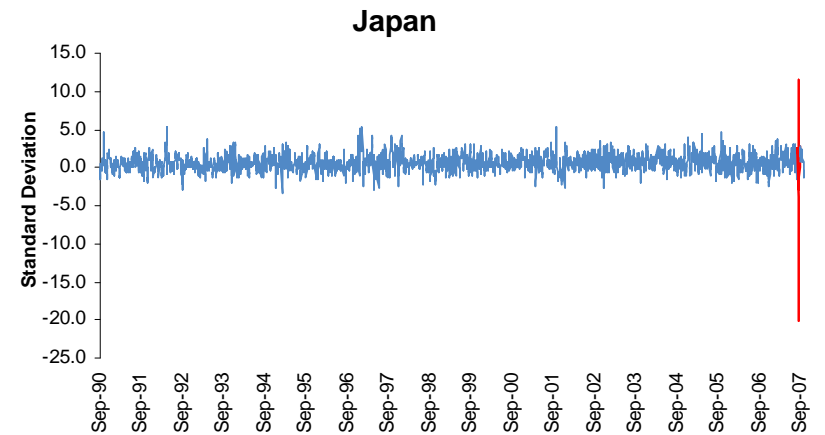
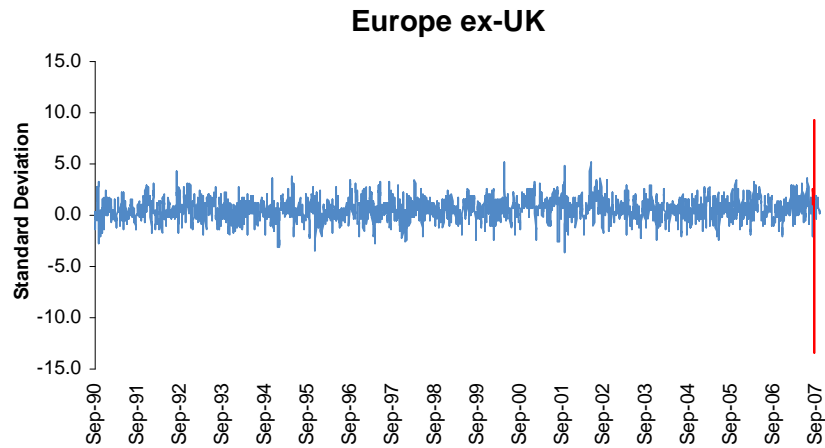
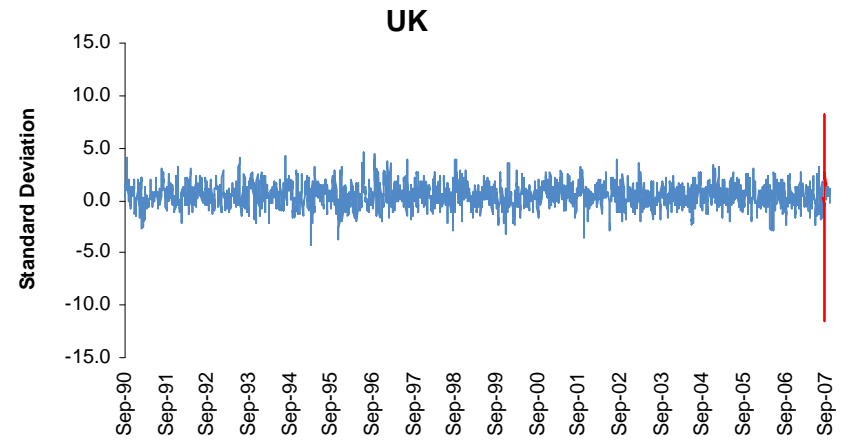
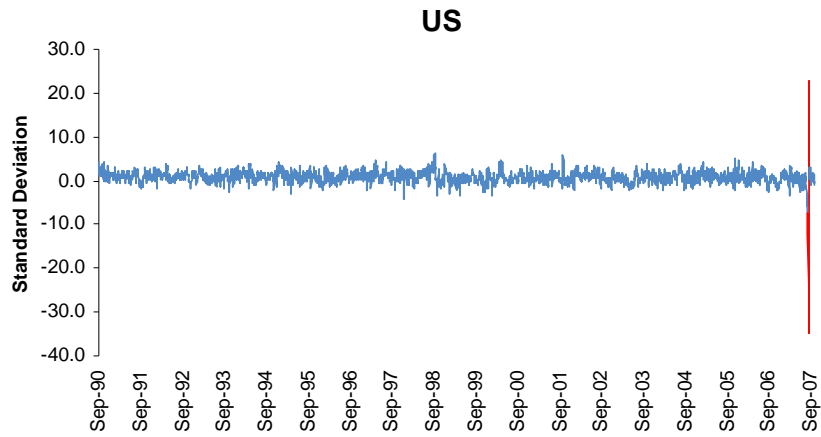
# Federal Funds Rate, August 8-10, 2007



# How unusual was the event for Quant strategies?

## Cumulative 5-day standardized returns

Quant models experienced extraordinary drawdowns in the same week

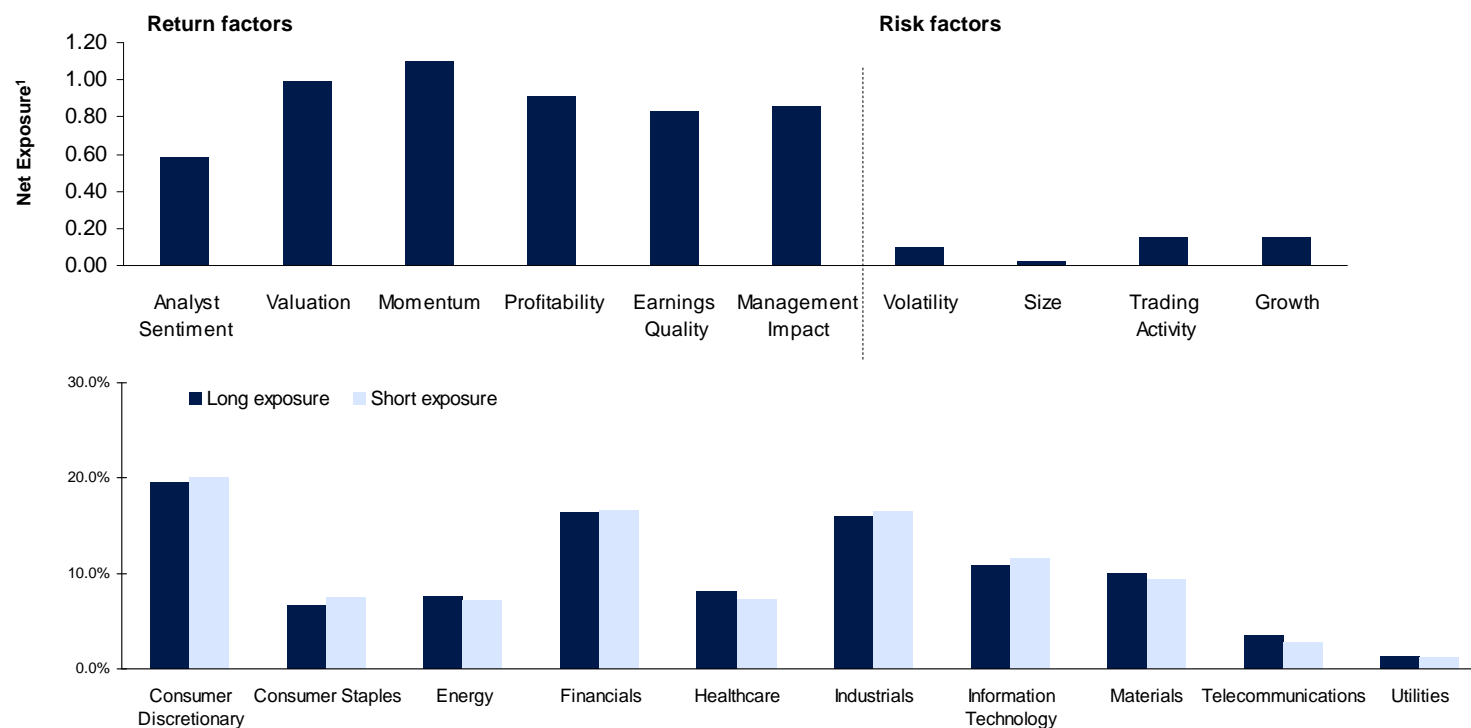


These performance results are backtested based on an analysis of past market data with the benefit of hindsight, do not reflect the performance of any GSAM product and are being shown for informational purposes only. Please see additional disclosures. Source: Goldman Sachs.

# What do quants do?

- Identify fundamental return-driving factors
- Create portfolios with optimal exposures to those factors
- Identify and hedge exposures to risk factors
- Use optimizers to make trade-offs
  - Seek to maximize expected returns, net of expected trading costs, subject to a risk budget

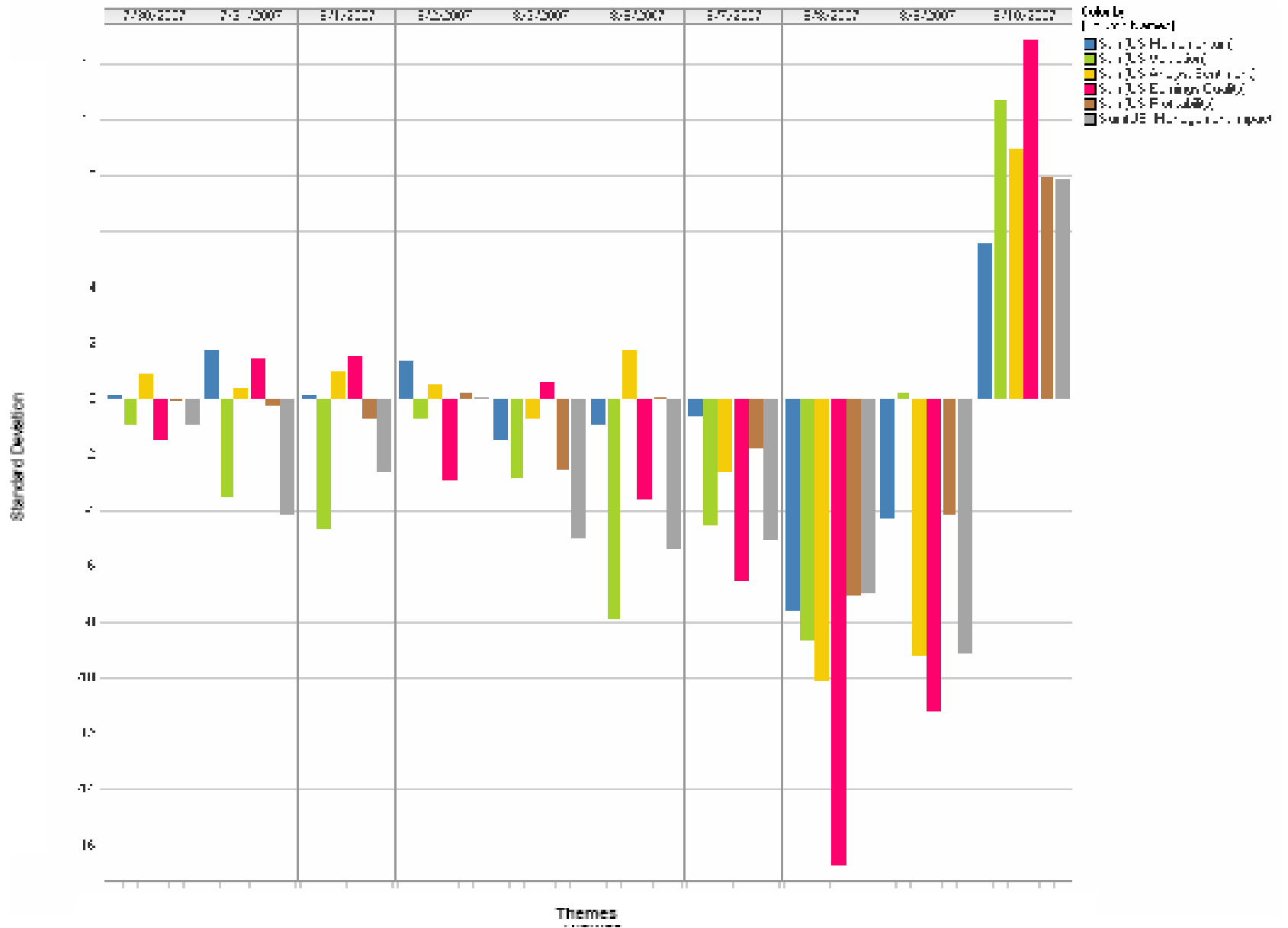
Global Equity Opportunities, Plc



<sup>1</sup> Standard Deviation

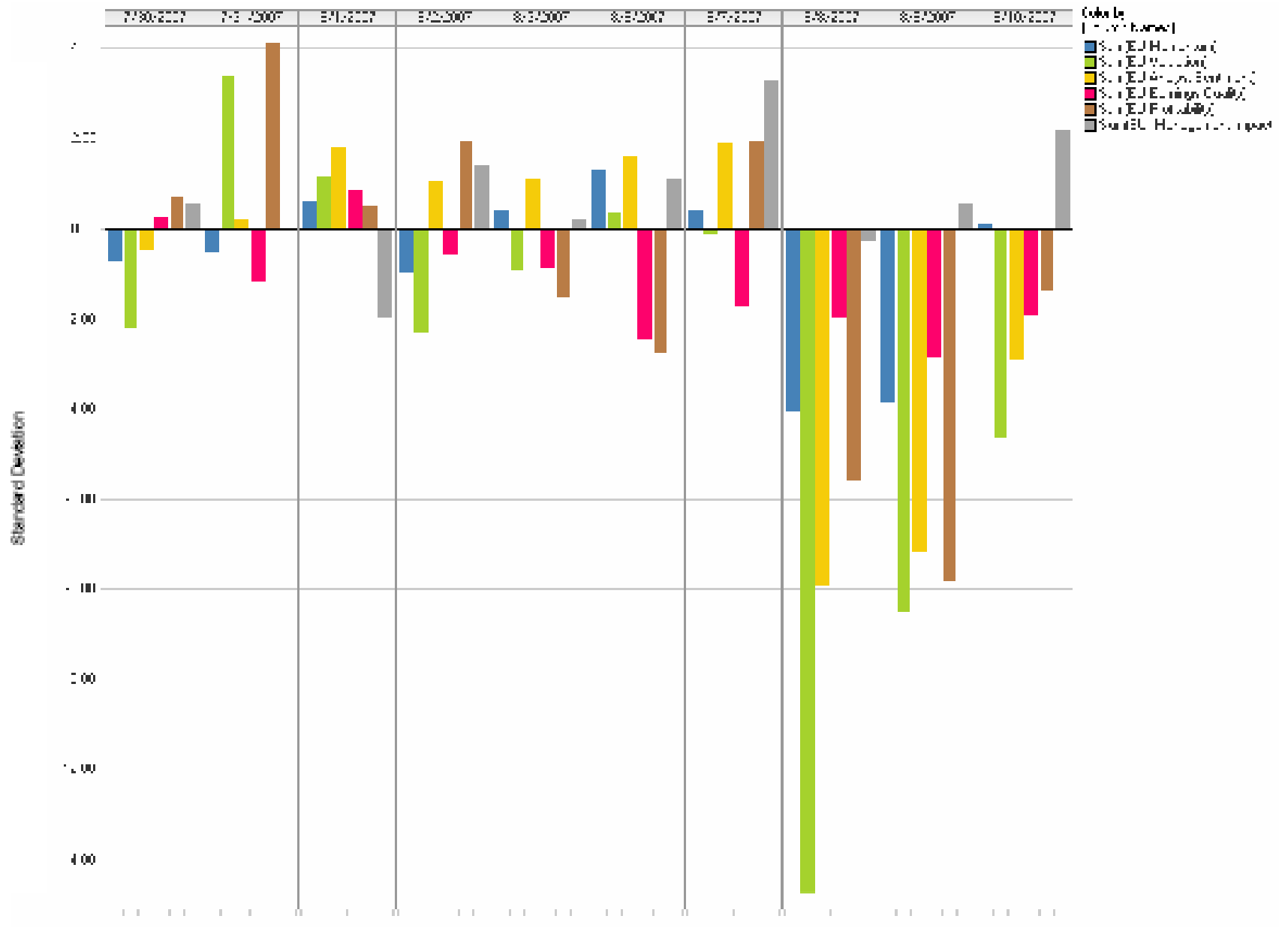
Standard deviation is a statistical measure of the degree to which an individual value in a probability distribution deviates from the mean of the distribution. The above information is as of December 16, 2005. GSAM portfolio holdings are not stagnant and may change over time without prior notice. Source: Goldman Sachs. Please see appendix for other important disclosures.

# US Theme Returns -- August 1-10

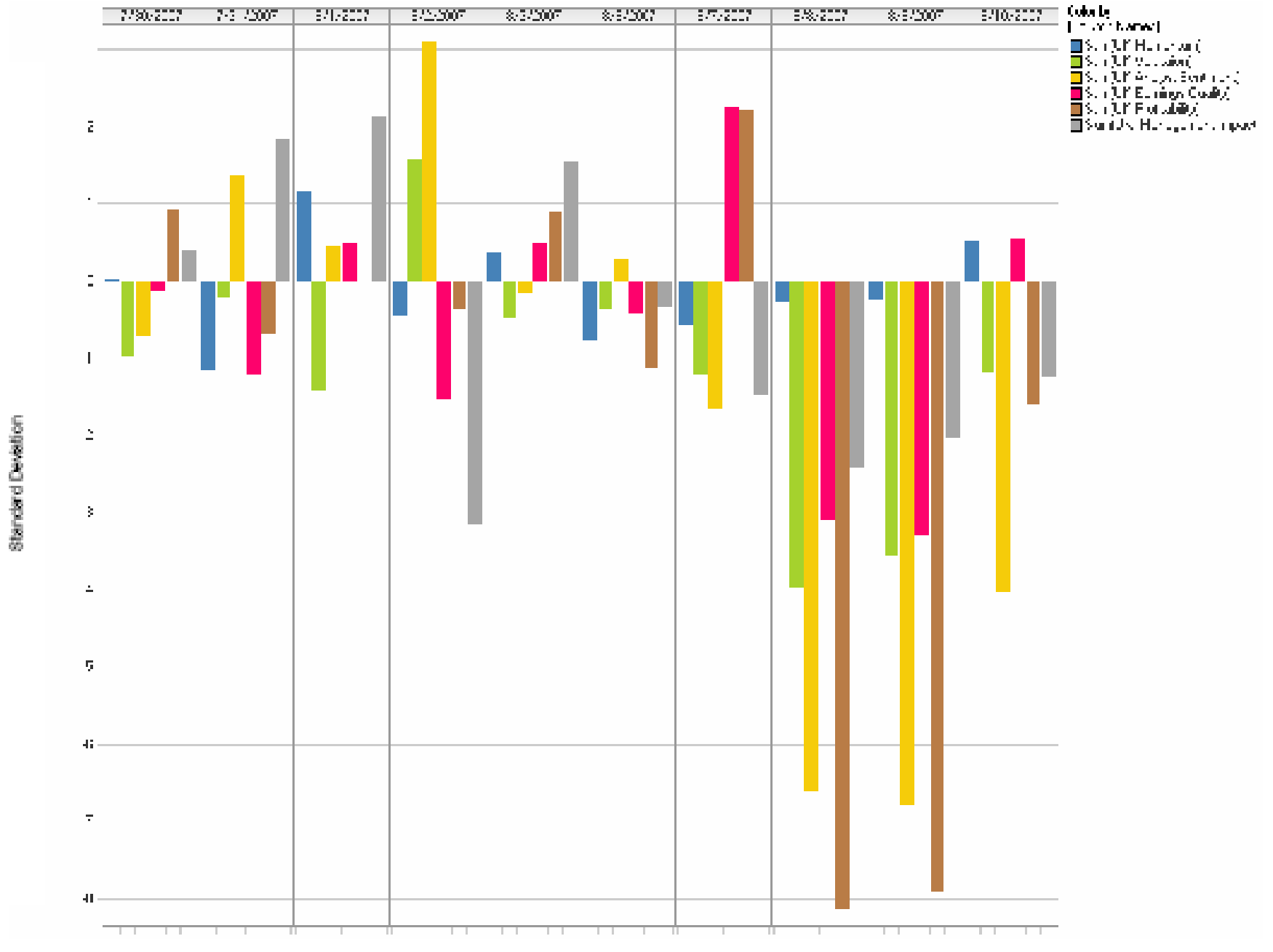




# EU Theme Returns -- August 1-10



# UK Theme Returns -- August 1-10



# Market dynamics: how it (probably?) started

- **Multi-strategy hedge funds and/or large Financial Institution**
  - Hidden losses in illiquid mortgage and credit positions
  - Looking to reduce risk and raise cash
- **Quant equity strategies**
  - Viewed as liquid
  - Required relatively large margin balances (good source of cash)
  - Were not performing well



# Market dynamics: contagion

- **Classic Bank Run developed**
  - Slow trading reduces costs
  - We're all better off if everyone is patient
  - But if others rush to liquidate, I better get out first → panic unwinding
- **Liquidity dried up**
  - Liquidity is normally provided by stat-arb strategies and brokers
  - When small price discrepancies become large imbalances, liquidity providers pull back
  - Normal, slow summer schedules may have contributed

# Market dynamics: positive feedback

- **Classic 'Prisoner's dilemma' accelerated the unwind**
- **Positive feedback loop develops**
  - Unstable equilibrium
  - Explosive dynamics

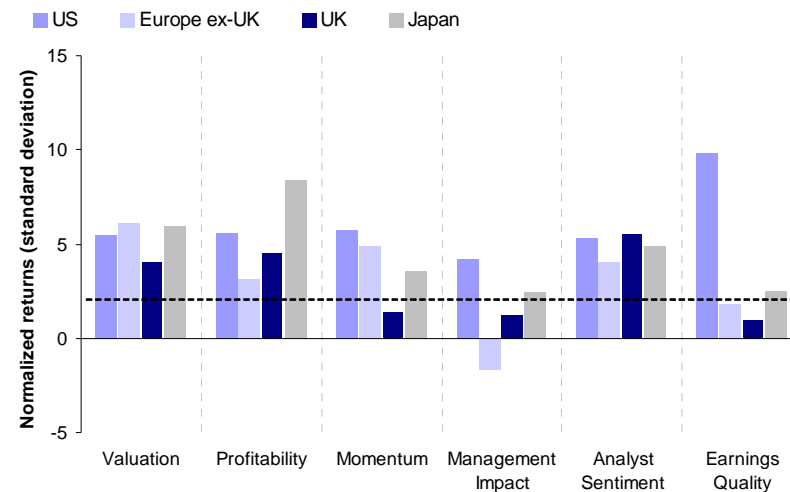


# Market dynamics: opportunity

## What ends the run?

- Supply and demand
  - Prices move farther away from fundamental values
  - Higher risk is offset by higher expected returns
  - Liquidity returns as new sources of capital seek to participate
- Goldman and others injected significant new capital into quant strategies
- ECB injected €95bln on Aug 9 and €61bln on Aug 10 into EU banking system
- FED injected \$24bln on Aug 9 into US banking system

Theme returns by region (August 10 - August 31, 2007)\*

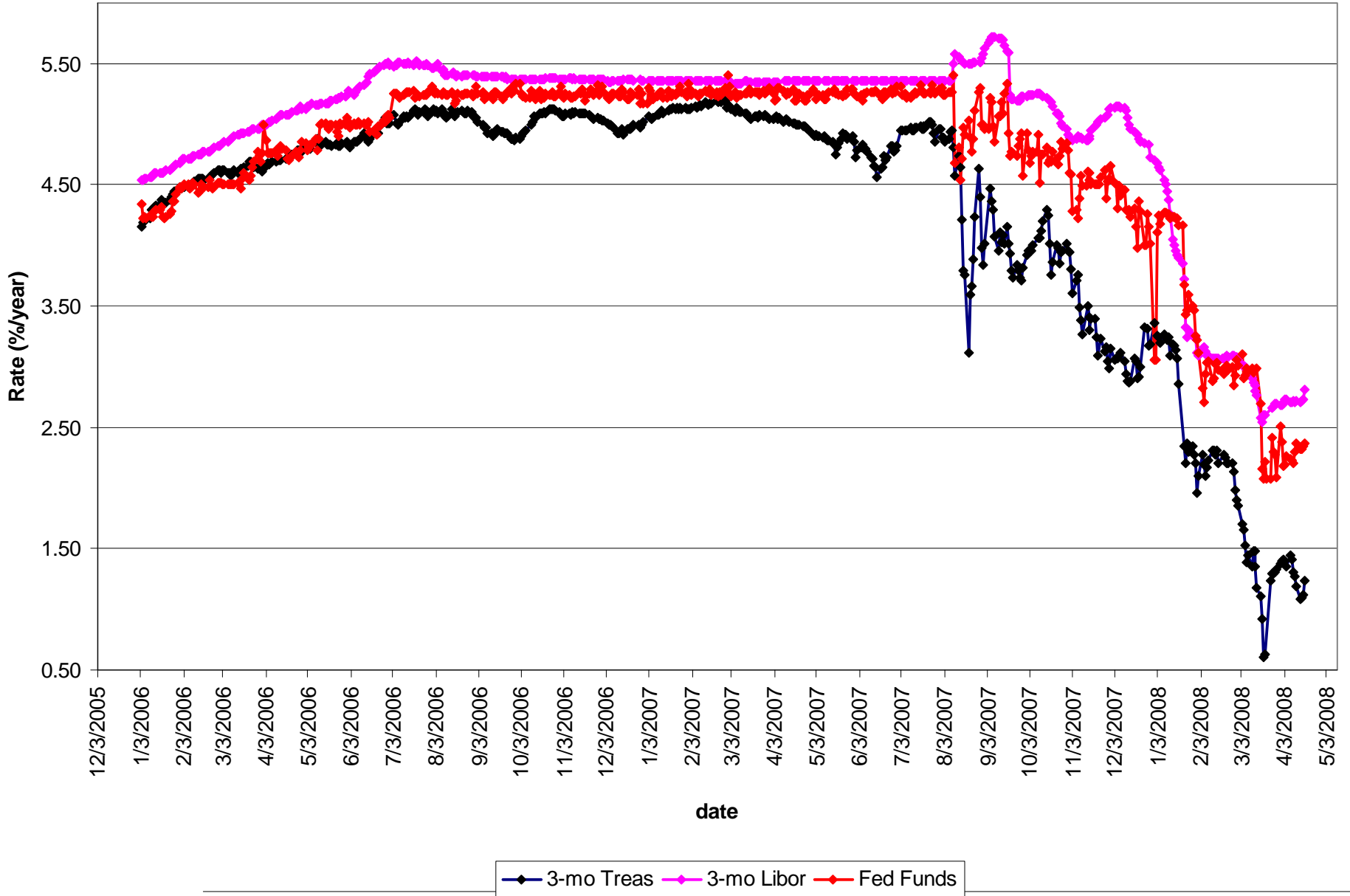


\*Theme returns are shown as of August 10 - 31 for the US and as of August 13 - 31 for Europe ex-UK, UK and Japan.

# Post August Events

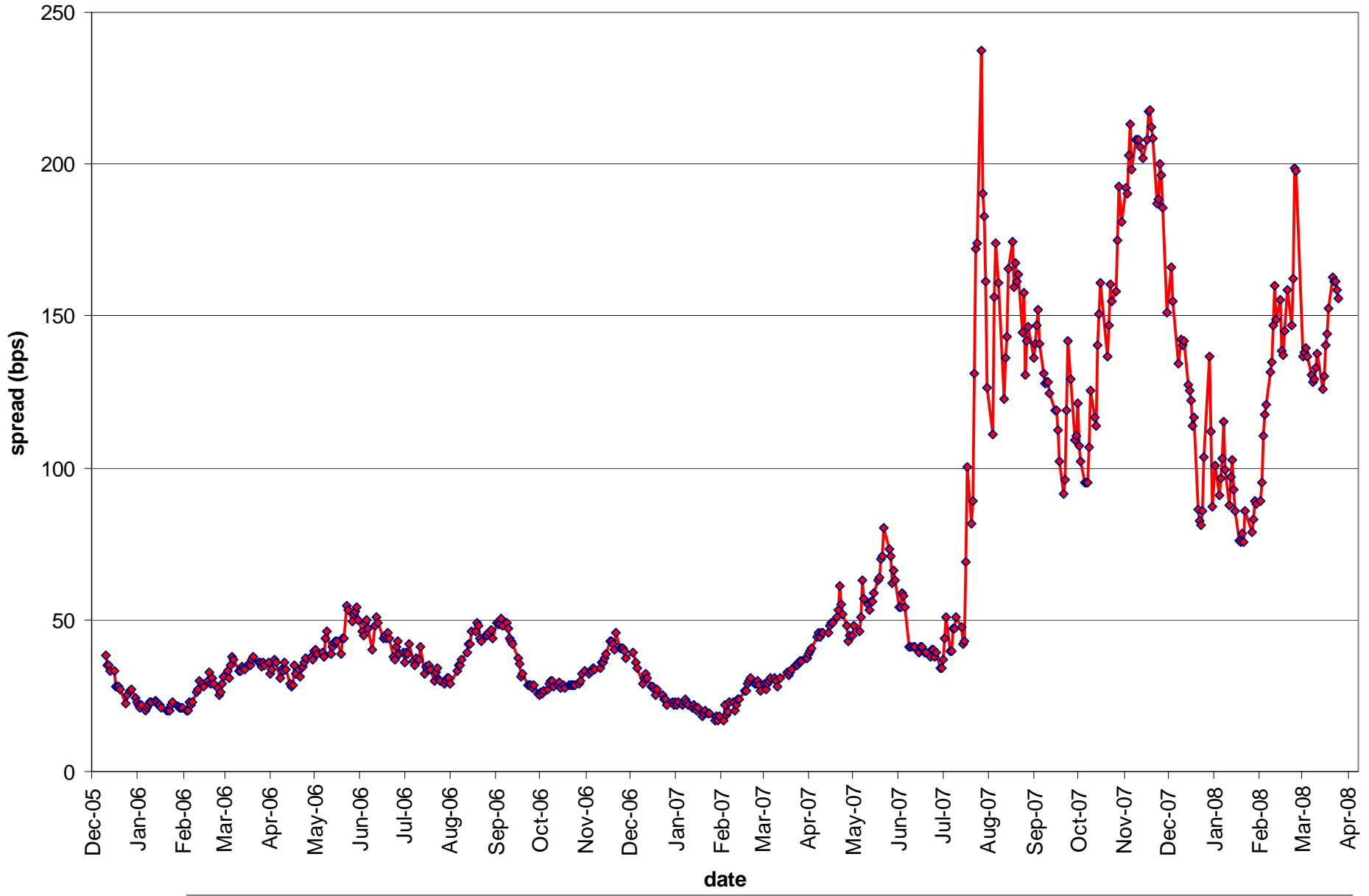
August 2007 -> today

Treasury, Labor, and Fed Fund Rates 1/1/2006-4/18/2007

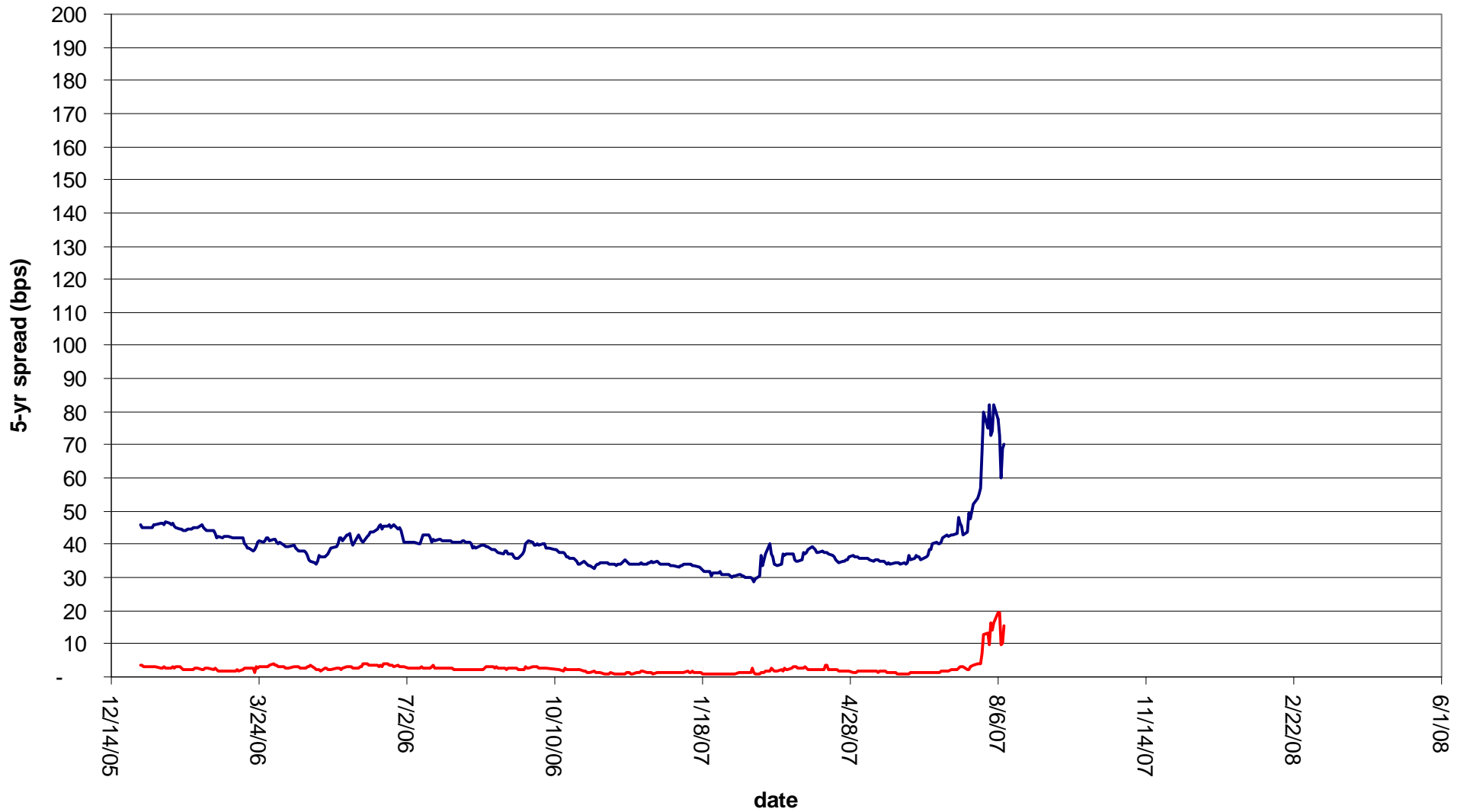


# Problems in Interbank Market worsened

TED Spread 1/1/06 -- 4/18/08



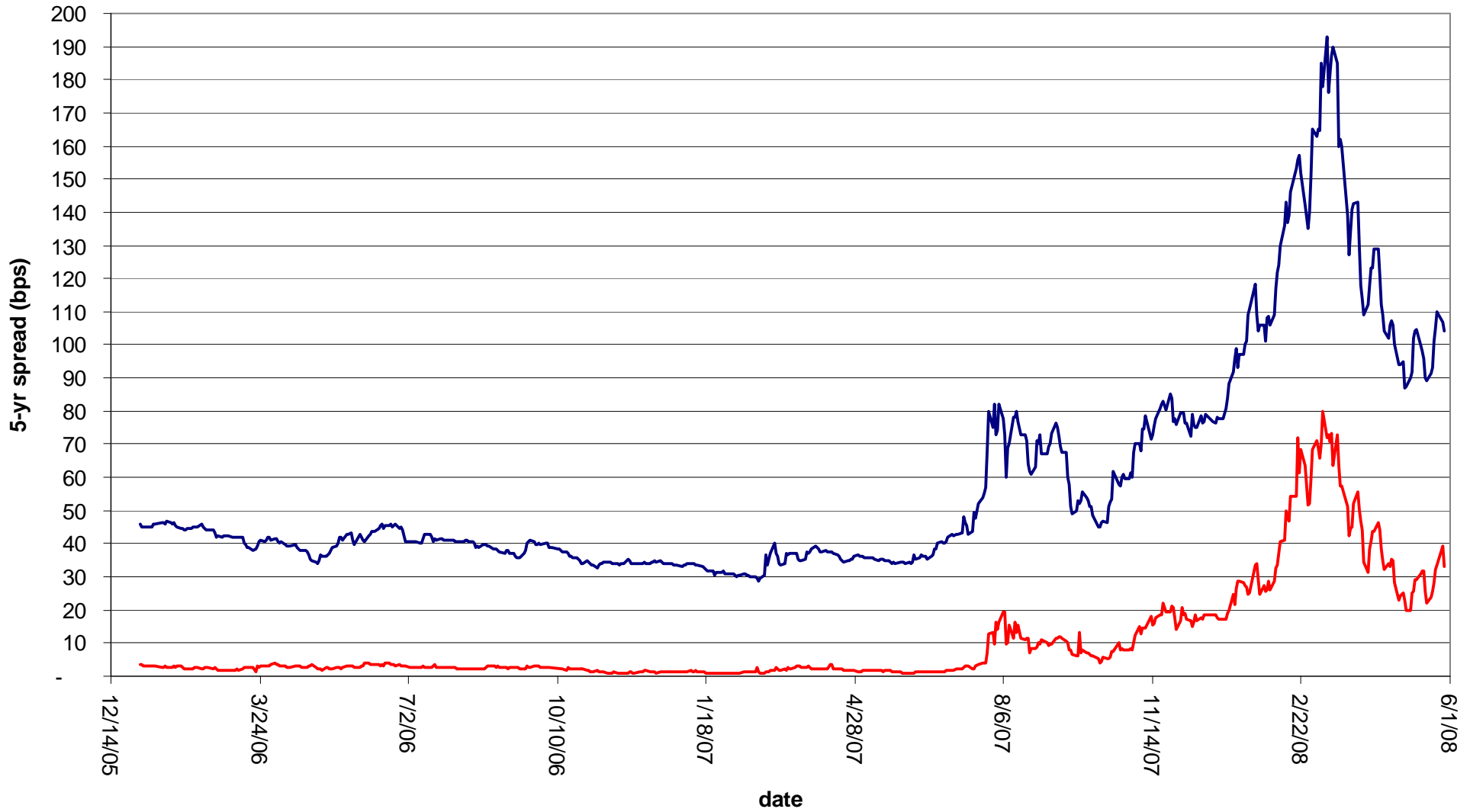
### 5-yr CDX IG-index & Super Senior Tranche Spreads 2006:01 - 2008:05



— DJ CDX.NA.IG Main On the run (5Yr) Swap JPMorgan CDS Spread Mid — CDX Main On the run (5Y) 30-100 Spread Mid

# Credit conditions worsened

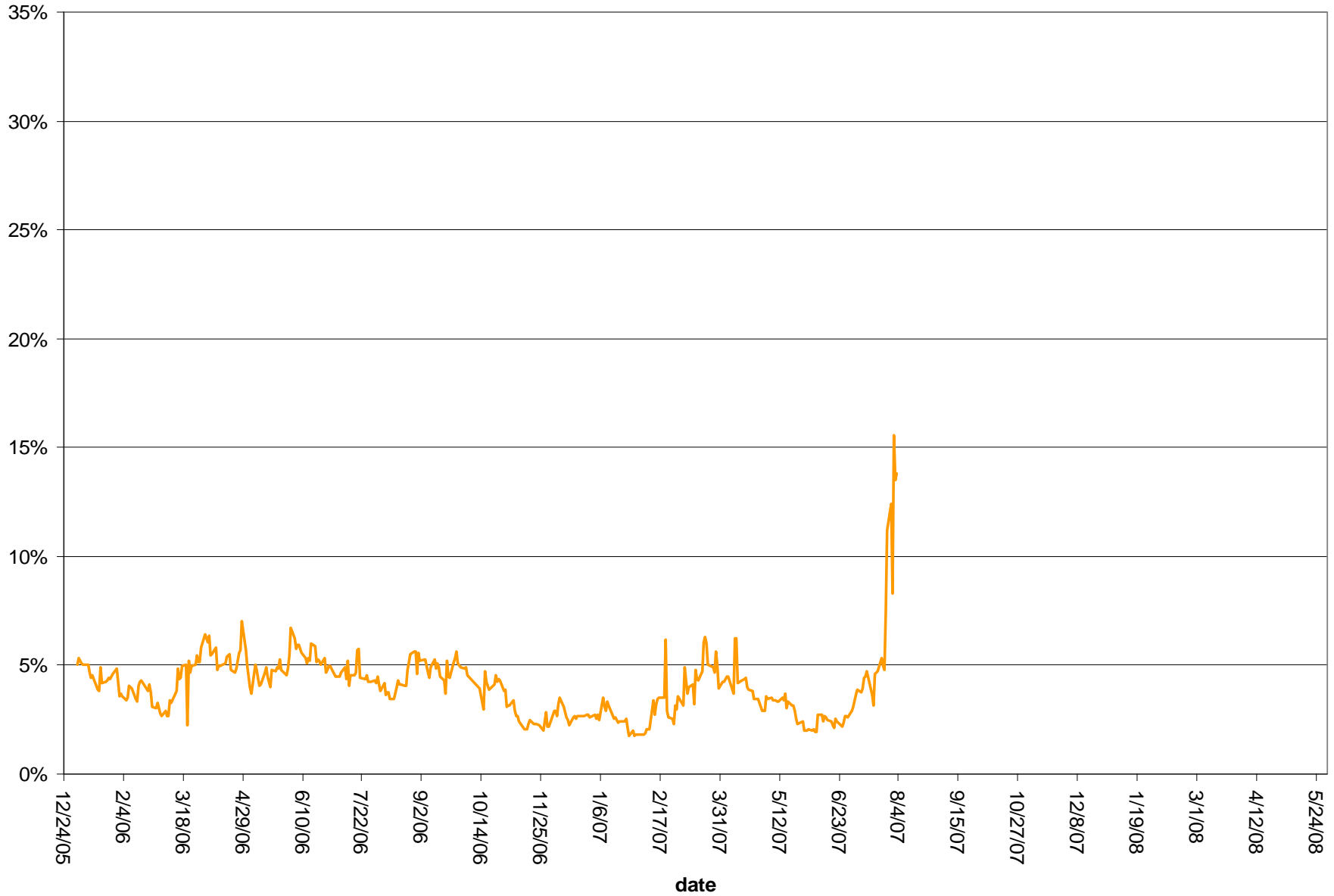
5-yr CDX IG-index & Super Senior Tranche Spreads  
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— DJ CDX.NA.IG Main On the run (5Yr) Swap JPMorgan CDS Spread Mid — CDX Main On the run (5Y) 30-100 Spread Mid

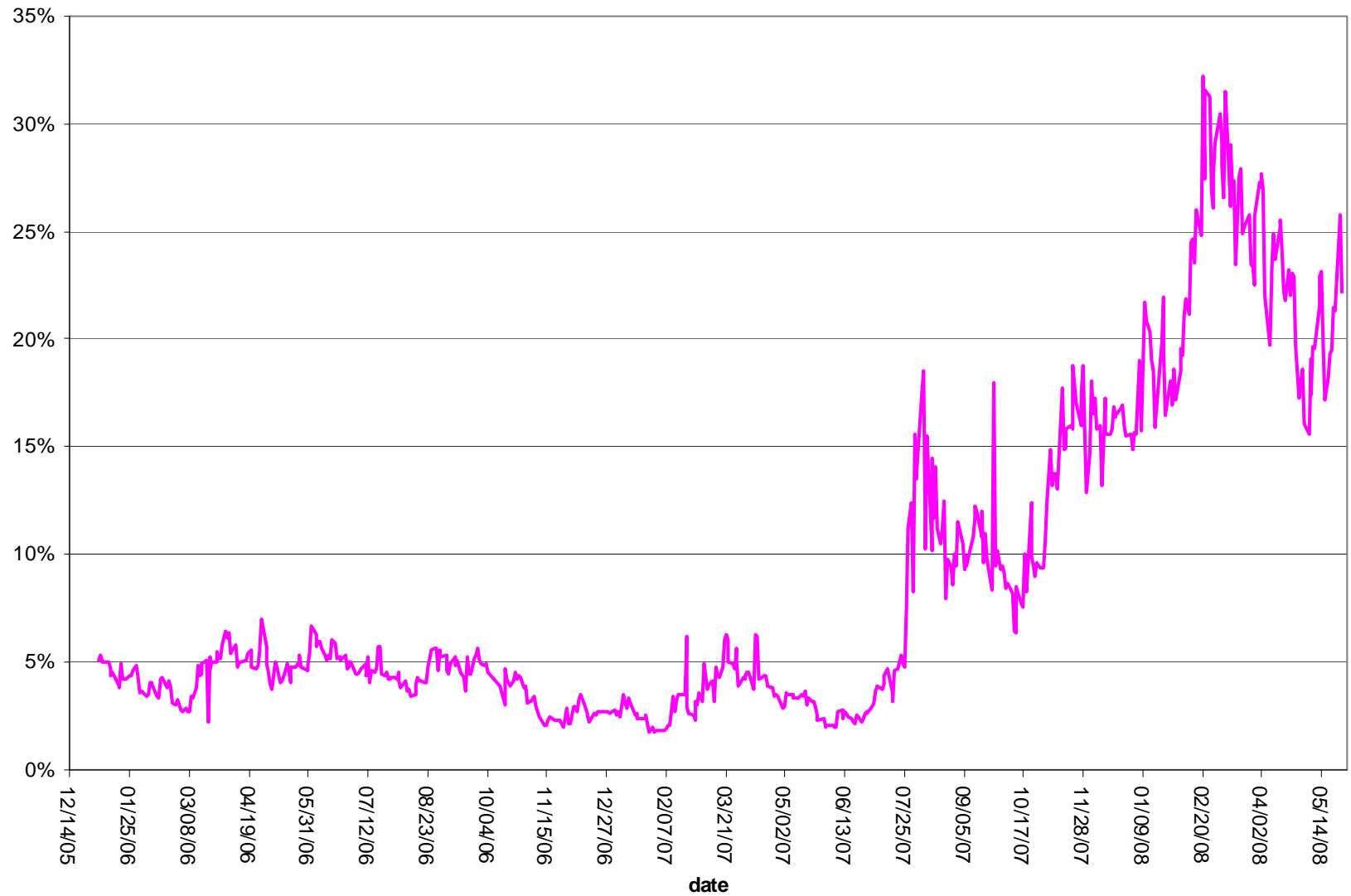


**Fraction of CDX Index Spread attributable to Expected Loss implied by Super-Senior Tranche**  
*-- through August 3, 2007 --*



# (Implied) Systemic Risk on the rise

Fraction of CDX spread attributable to super-senior tranche  
1/1/2006 -> 5/24/2008

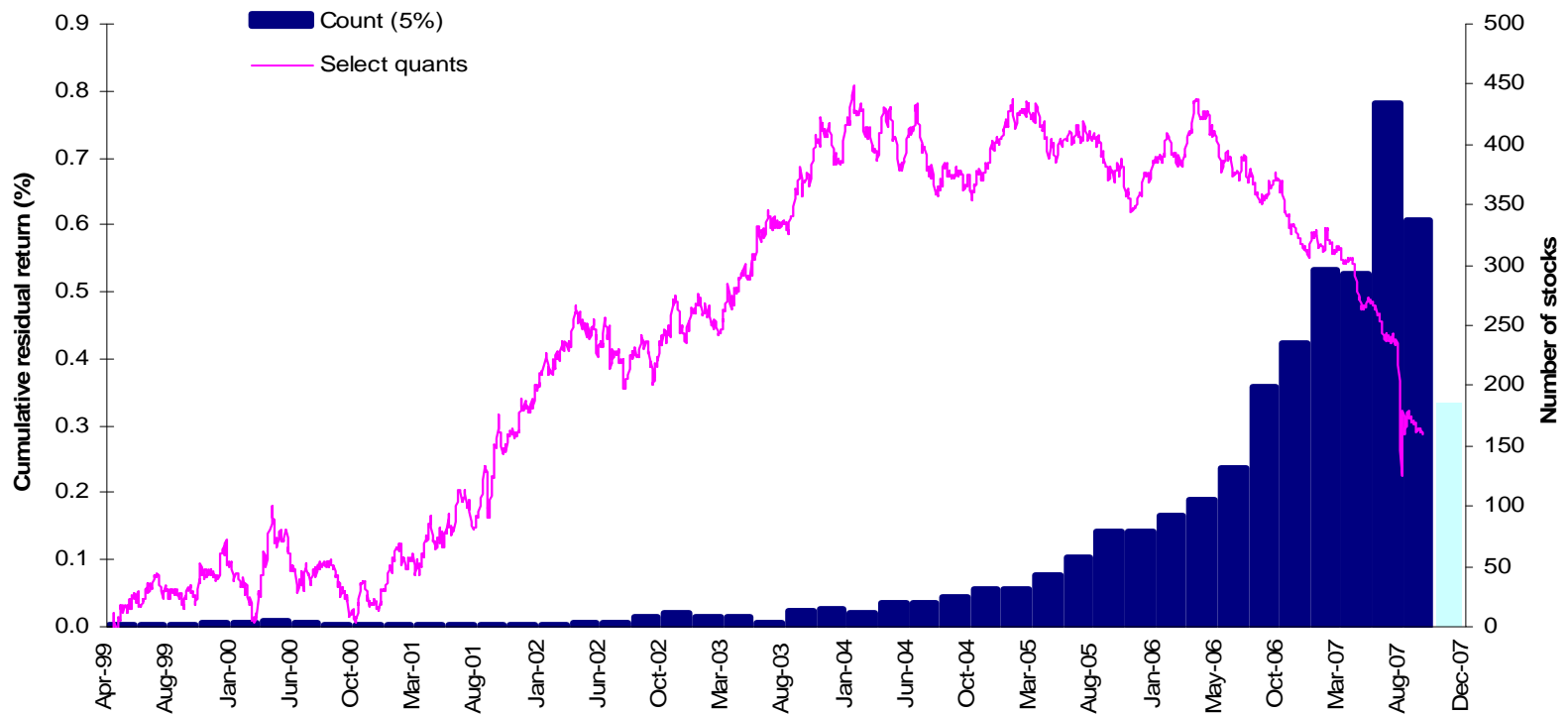


# Implications of the Liquidity Crisis?

- **For Quant Investors**
  - Model contagion/crowding of factors
  - Financing/funding costs
  - Leverage/Risk-management
  - Counterparty risk
  - Execution
- **For Credit Markets**
  - Electronic trading
  - Central clearing, netting, collateral management
  - CDS Futures?
  - Securitization?
- **For Rating Agencies**
  - Expected Loss versus Market Risk
  - Model-based Ratings for securitized products?
- **For Banks and GSEs**
  - Internal Risk Systems (aggregate positions for macro-hedging)
  - Incentive problems
  - Transparency (off vs. on balance sheet)?
- **For Regulators**
  - Investor of Last resort?

# Quant space is crowded (“Quantcentration”)

Cumulative residual returns of the top 50 most concentrated quant stocks<sup>1</sup> (select quant universe)<sup>2,3</sup> and the number of stocks in the Russell 3000 universe where quant managers own more than 5% of the outstanding shares<sup>4</sup> (Select quant universe)<sup>2,3</sup>



<sup>1</sup> In the US market.

<sup>2</sup> Set of ‘active quantitative managers’ determined by screens proposed by sell-side researchers and Thomson Financial Corp. It includes only pure quant firms and is therefore representative of trends but not levels. This classification excludes GSAM and other known large multi-strategy managers, as well as managers with significant passive assets under management.

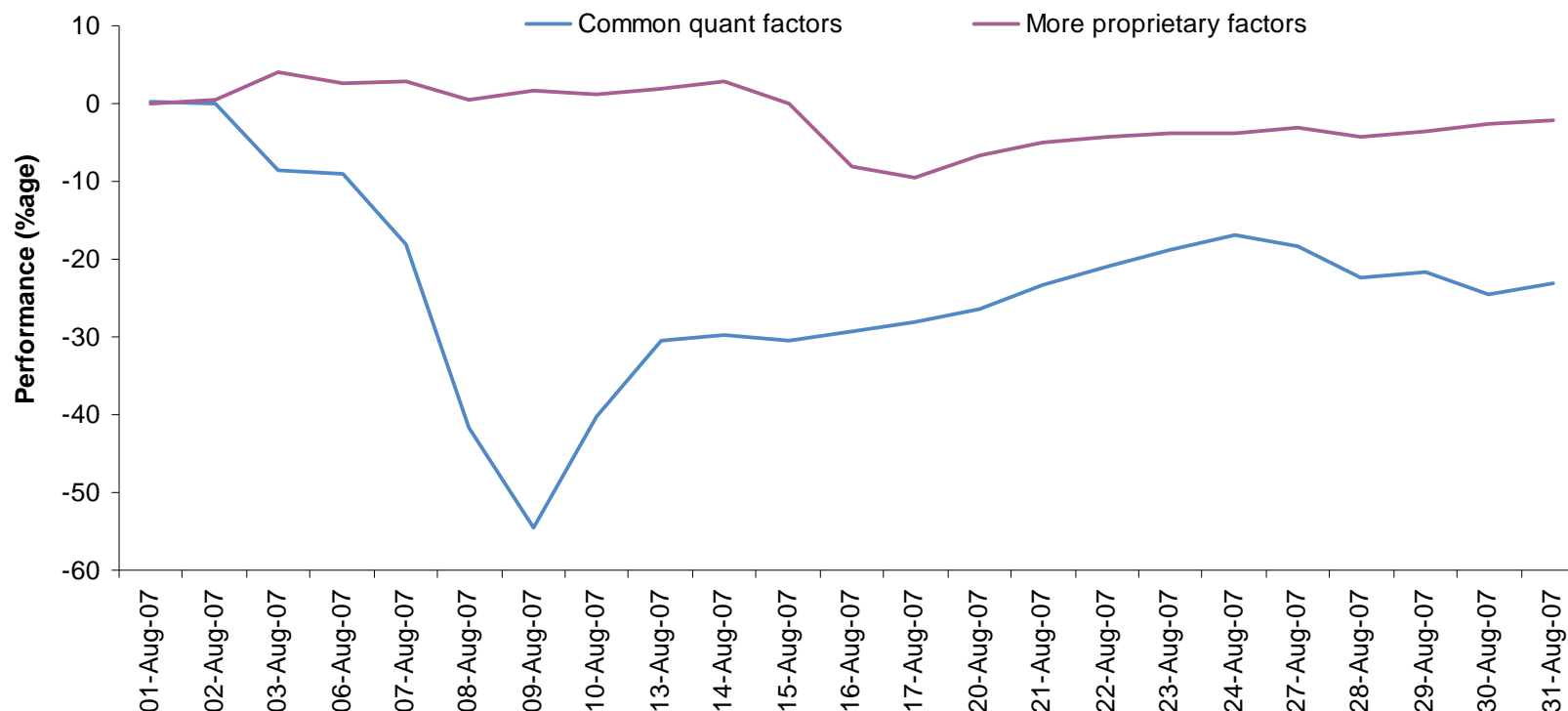
<sup>3</sup> Potential December results based on the assumption that assets under management continued to decline in Q4 at the rate they did in Q3, assuming the Q3 deleveraging occurred during and after the August liquidity crunch 06-Aug-07 to 08-Aug-07). The forecasts are for informational purposes and there are no assurances that the forecasts will be achieved. These forecasts are estimated based on assumptions and may change materially as market conditions change.

<sup>4</sup> Source: Quarterly 13F Filings compiled by Thomson Financial Corp. These numbers reflect the levered notionals of the long side of select managers’ portfolios in common equity only.

# Identifying “proprietary” factors

Performance of ‘More proprietary factors’ vs. ‘Common quant factors’ during the liquidity crisis in Aug-07, scaled to 1% daily volatility<sup>1</sup>

Factor performance in Aug-07 - proprietary factors vs. popular quant factors (targeted 1% daily volatility)



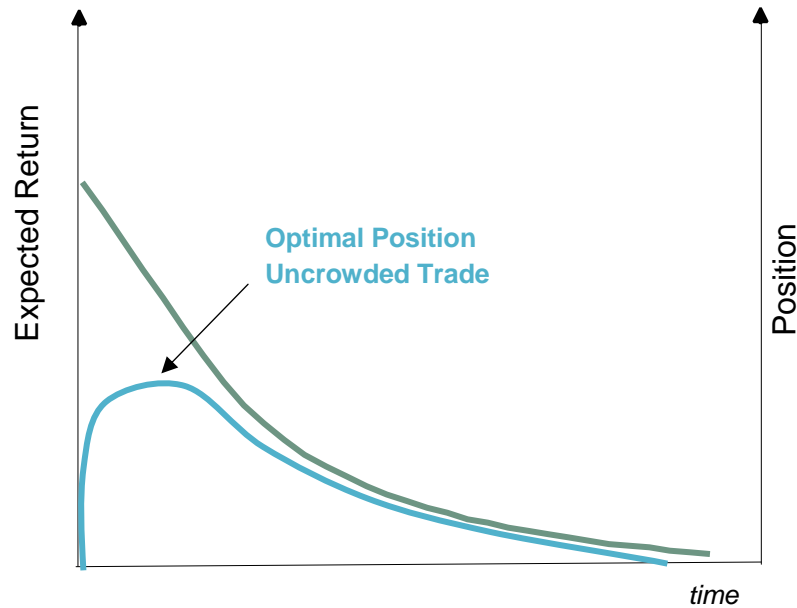
Source: QIS

<sup>1</sup> Equivalent to 16% annualised volatility.

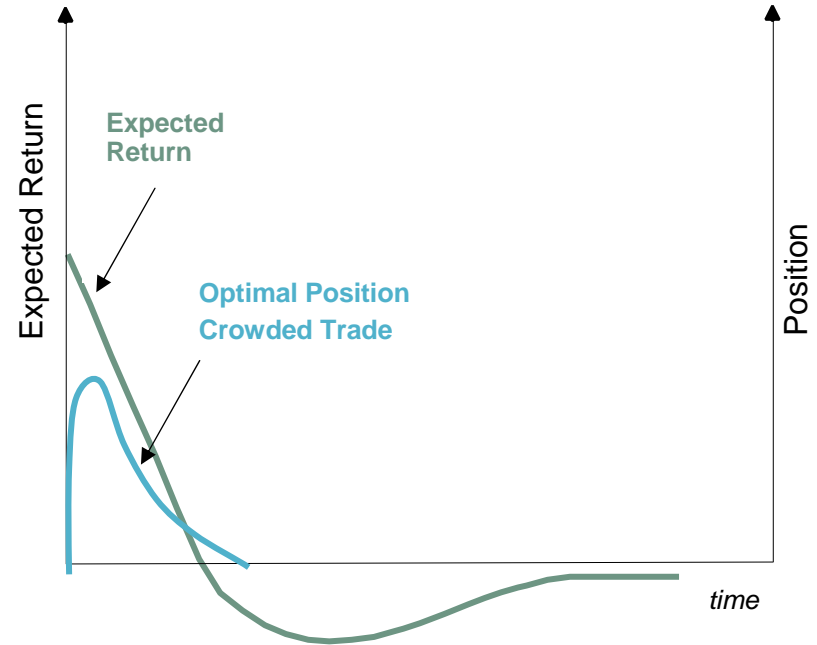
The first point in each chart represents simulated average daily returns to our target investment portfolios without taking into account transactions costs. Subsequent points represent average daily returns to portfolios formed in the same way. These returns are reported for informational purposes only and do not reflect the performance of any GSAM product. Simulated performance results do not reflect actual trading and have inherent limitations. Please see additional disclosures. These performance results are backtested based on an analysis of past market data with the benefit of hindsight, do not reflect the performance of any GSAM product and are being shown for informational purposes only. Please see additional disclosures. Targets are subject to change and are current as of the date of this presentation. Targets are objectives and do not provide any assurance as to future results. Simulated performance results do not reflect actual trading and have inherent limitations. Please see additional disclosures. These performance results are backtested based on an analysis of past market data with the benefit of hindsight, do not reflect the performance of any GSAM product and are being shown for informational purposes only. Please see additional disclosures.

# Crowdedness will affect execution and sizing of positions

Uncrowded Trade



Crowded Trade



- When building their positions, managers analyse the trade off between a rapid build up of the positions and the transaction costs implied.
- In an uncrowded space, signals decay slowly enough to allow managers to build positions gradually.

- Crowding causes signals to decay faster.
- In crowded trades, managers need to get in and out of positions more quickly.

For illustrative purposes only.

Expected returns are estimates of hypothetical average returns of economic asset classes derived from statistical models. There can be no assurance that these returns can be achieved. Actual returns are likely to vary. Please see additional disclosures.

# Crowdedness requires monitoring (timing?) factors

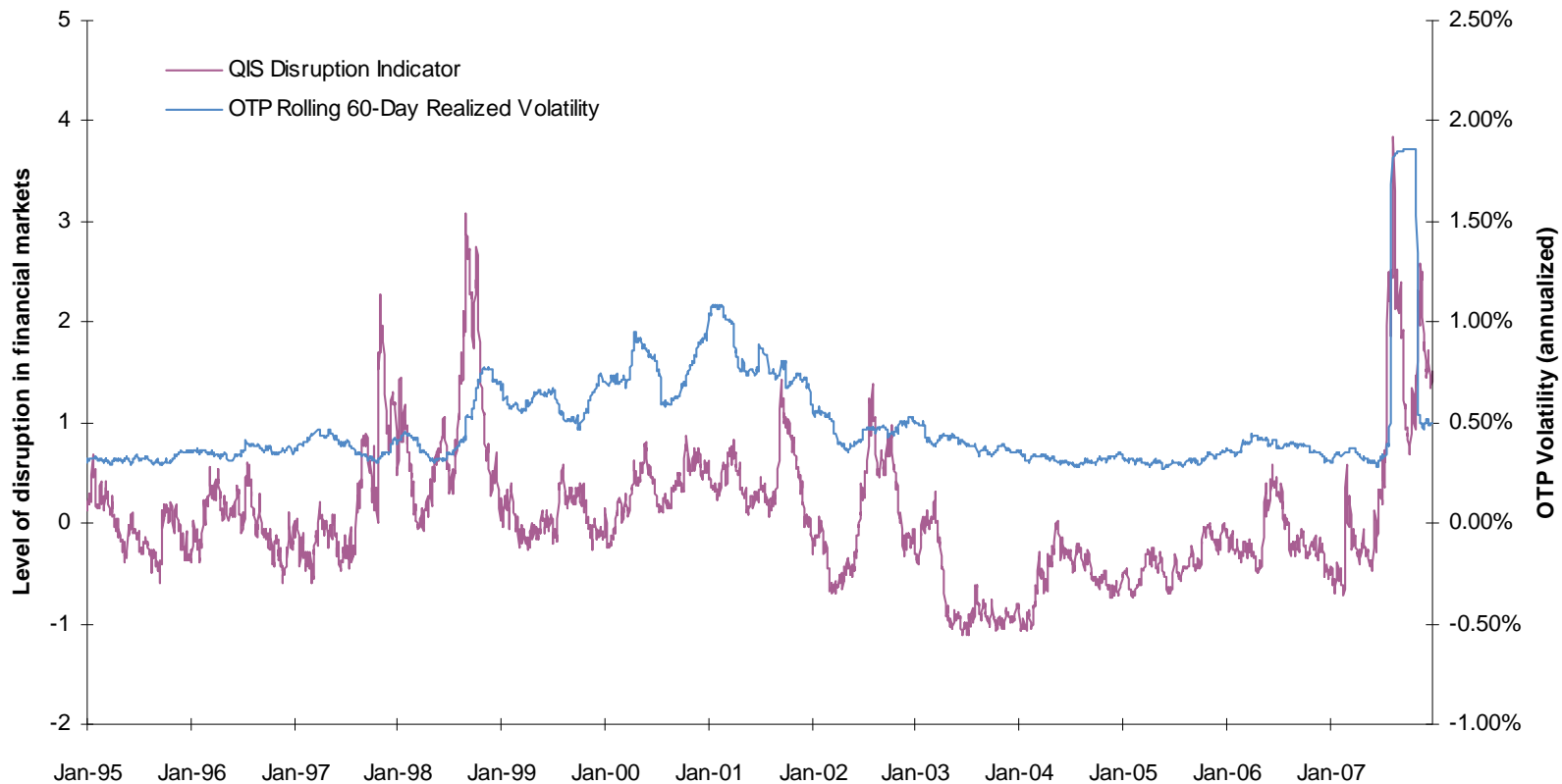
Value spreads in the US market: Jul-81 to Dec-07



The within-industry value spreads are the coefficients of variation across stocks of book-to-price ratios over time. The across-industry value spreads are the coefficients of variation across industries of the industry-average book-to-price ratios over time. The above uses Global Industry Classification Standard (GICS) industries.  
Source: PACE and Compustat.

# Dynamic risk allocation

Predicting changes using contagion models: US OTP Rolling 60-Day Realized Volatility and QIS Disruption Indicator<sup>1</sup>, 01-Jan-95 to 31-Dec-07



Note: In a logarithmic scale, the distance between each unit of distance reflects an equal percentage change.

<sup>1</sup> For illustrative purposes only.

The QIS Disruption Indicator, which starts in January 1995, is a proprietary composite of various indicators of financial disruption, including equity market returns, implied volatility measures, quantitative forecasting signals, credit spreads and other signals. In an effort to make the underlying data sets comparable, each component was first normalized, using a rolling 3-year window to calculate means and volatilities. This means that we subtracted the average return from the realized return and then divided by the standard deviation. We then calculated the average across all of the financial factors to arrive at the indicator.

The returns presented herein are gross and do not reflect the deduction of investment advisory fees, which will reduce returns.

This presentation and its contents are private and confidential.



# Conclusion

- Quants have become an increasing percentage of actively traded assets
- As a result, quants have gradually moved from being price takers to being price setters.
- The returns to many popular quantitative strategies have declined and their risks have increased

This implies Quant investors need to:

- Be smarter in the design of new strategies
- Be more Careful in the implementation of existing ones
- Develop better Risk-management and trading systems

Specifically, they will need to:

- Develop additional proprietary data and models
- Account for information decay in popular signals
- Dynamically allocate risk in popular signals (factor timing)