CDS Rate Predictions of a Structural Model*

Before and During the Crisis

August 2006 –August 2009

Hayne Leland
Prepared for FARFE Conference
MIT Endicott House
October 2009

*** Model presented in Princeton Lectures 2006**
(model includes jump risk and illiquidity premia)
http://www.haas.berkeley.edu/groups/finance/WP/LECTURE2.pdf

Implementation of the Model

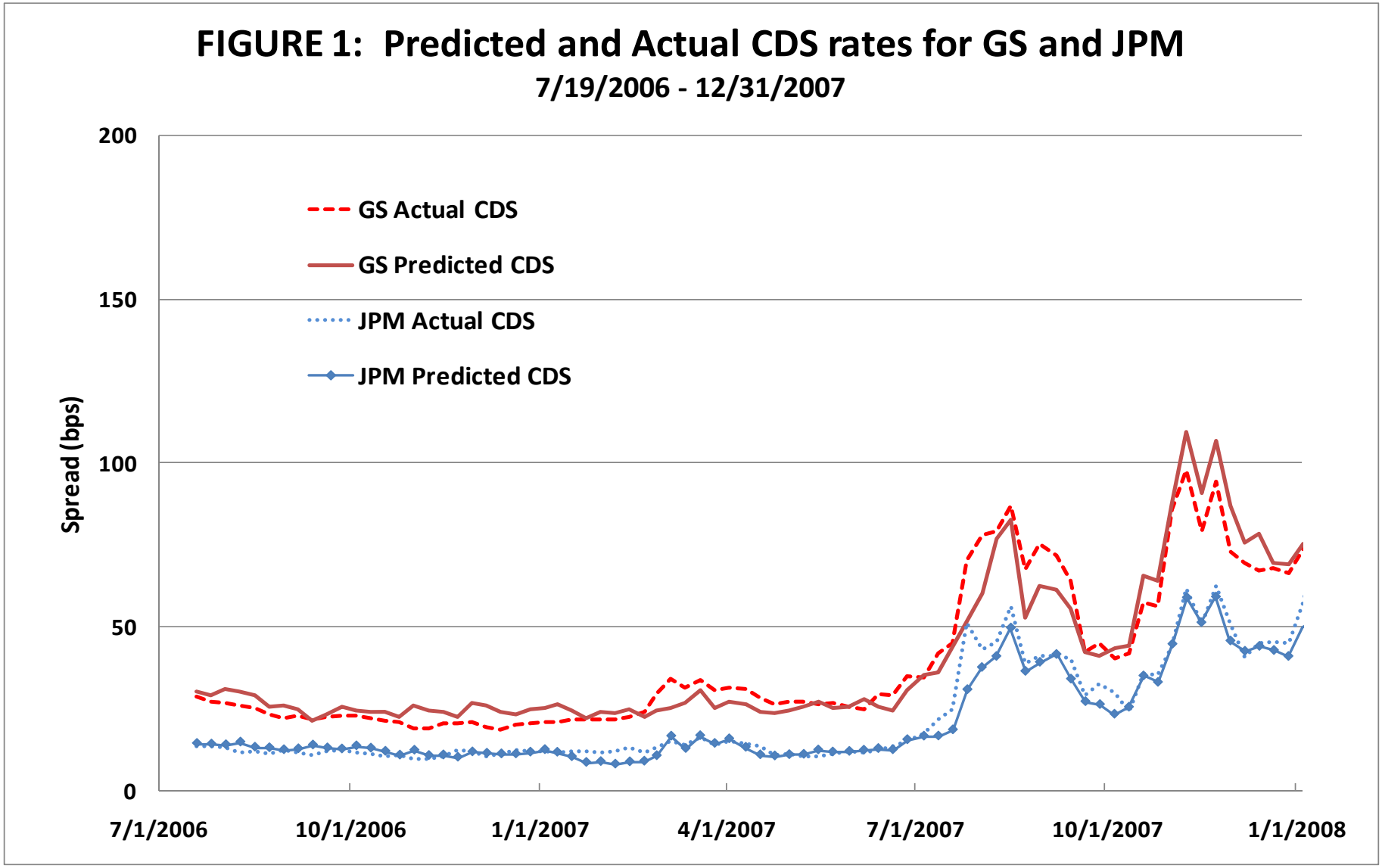
1) Set values of basic parameters (see Appendix), including
CDS liquidity premium = 0 as observed by Duffie, others.
Bond liquidity premium = 60 bps (Longstaff et al. (2005))

2) Set riskless (swap) rate and debt face value ***equal to their observed values*** *at each date*

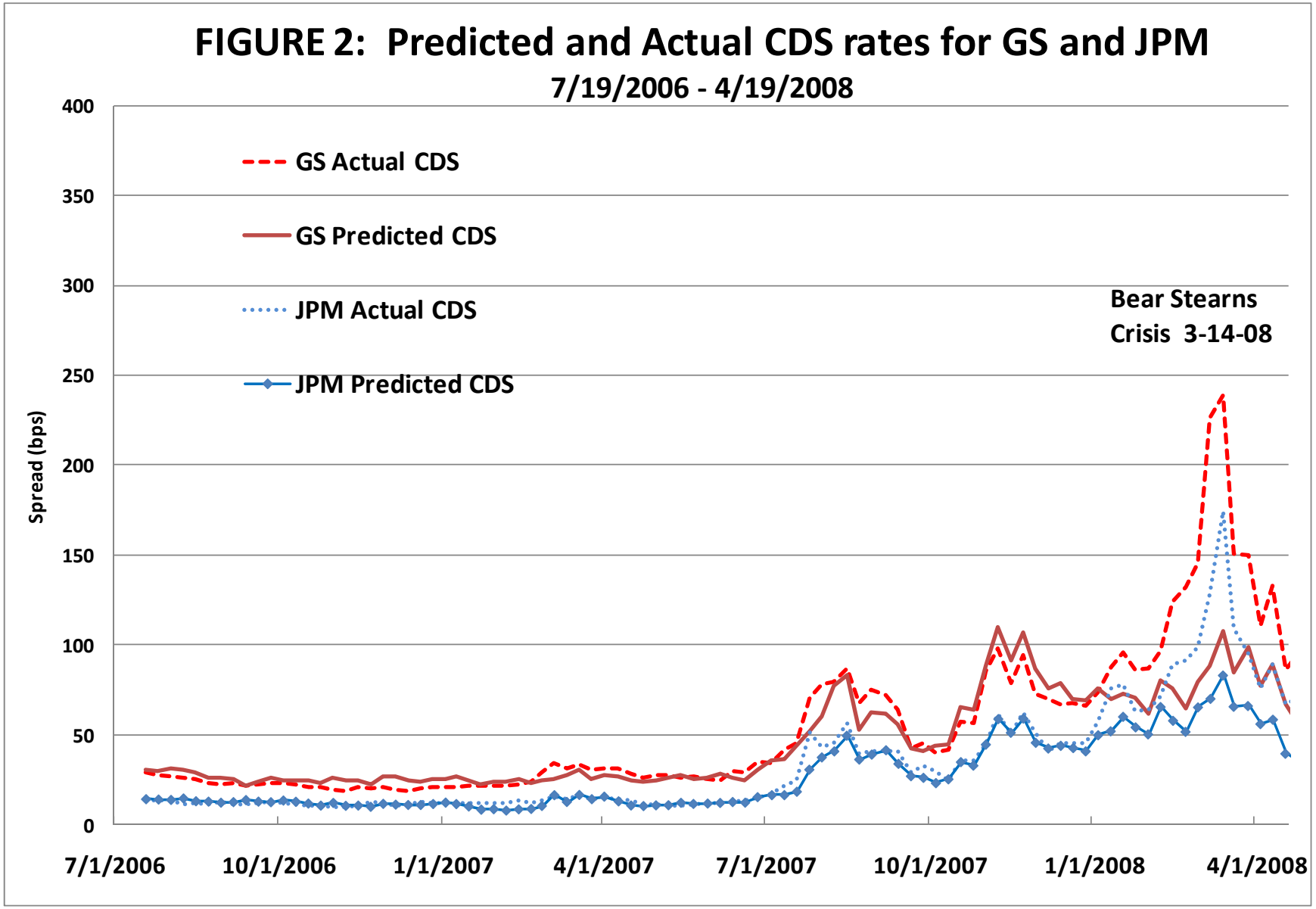
3) Then back out current **asset values** **and** **asset volatilities** consistent with ***observed equity values and implied volatilities*** (6-mo. OTM puts) at each date, given other model parameters

4) Use the structural model with these inputs to "predict" the CDS rate at each date

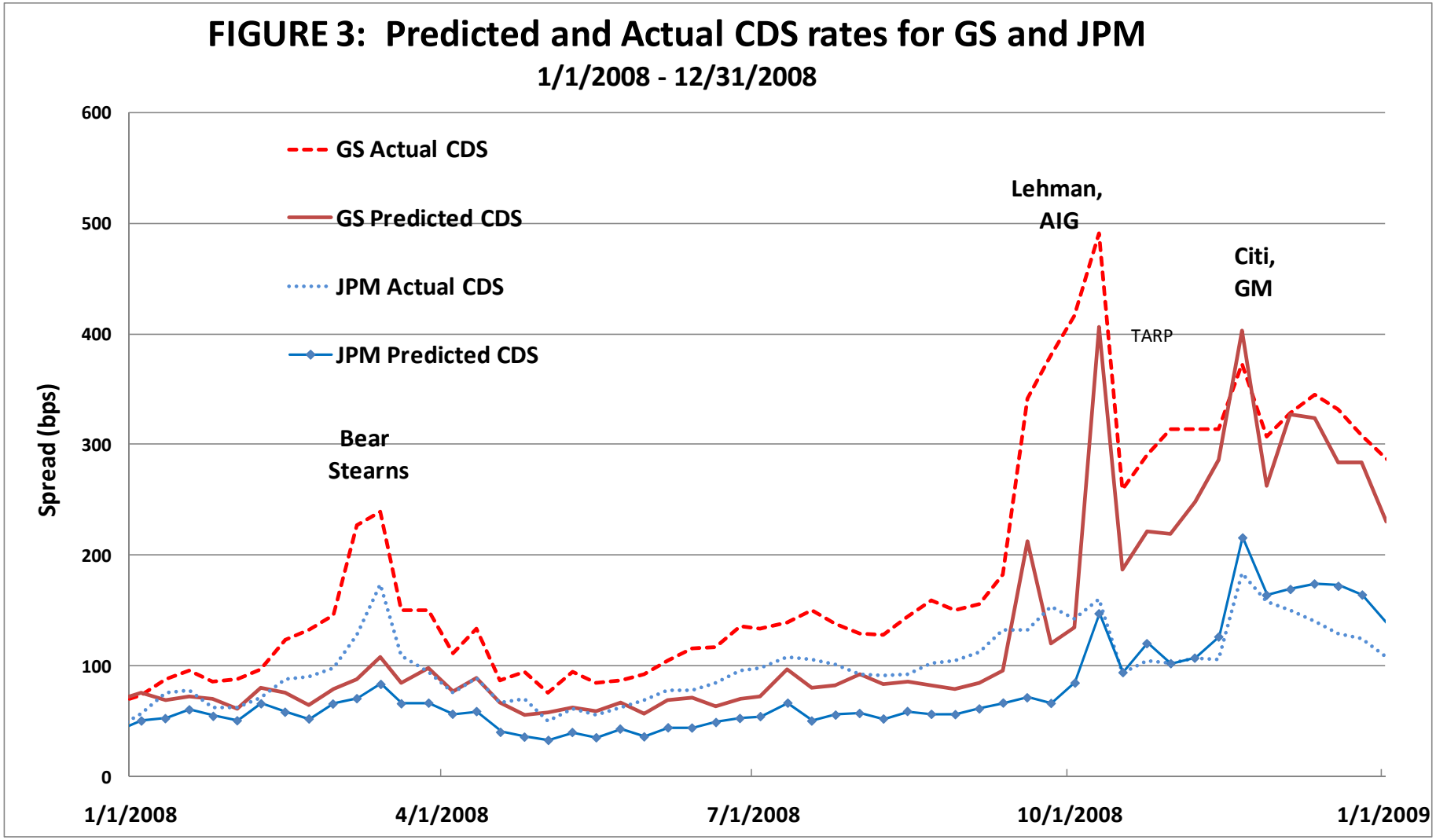
- Compare with actual CDS rate
- "Out of sample" in that no *ex-post data is used*
- Really a test of model's *consistency of pricing*
  - Assumes current parameters are expected to remain constant in future



Observe that the model does a good job of tracking over the year prior to the crisis and through initial crisis of 2007.

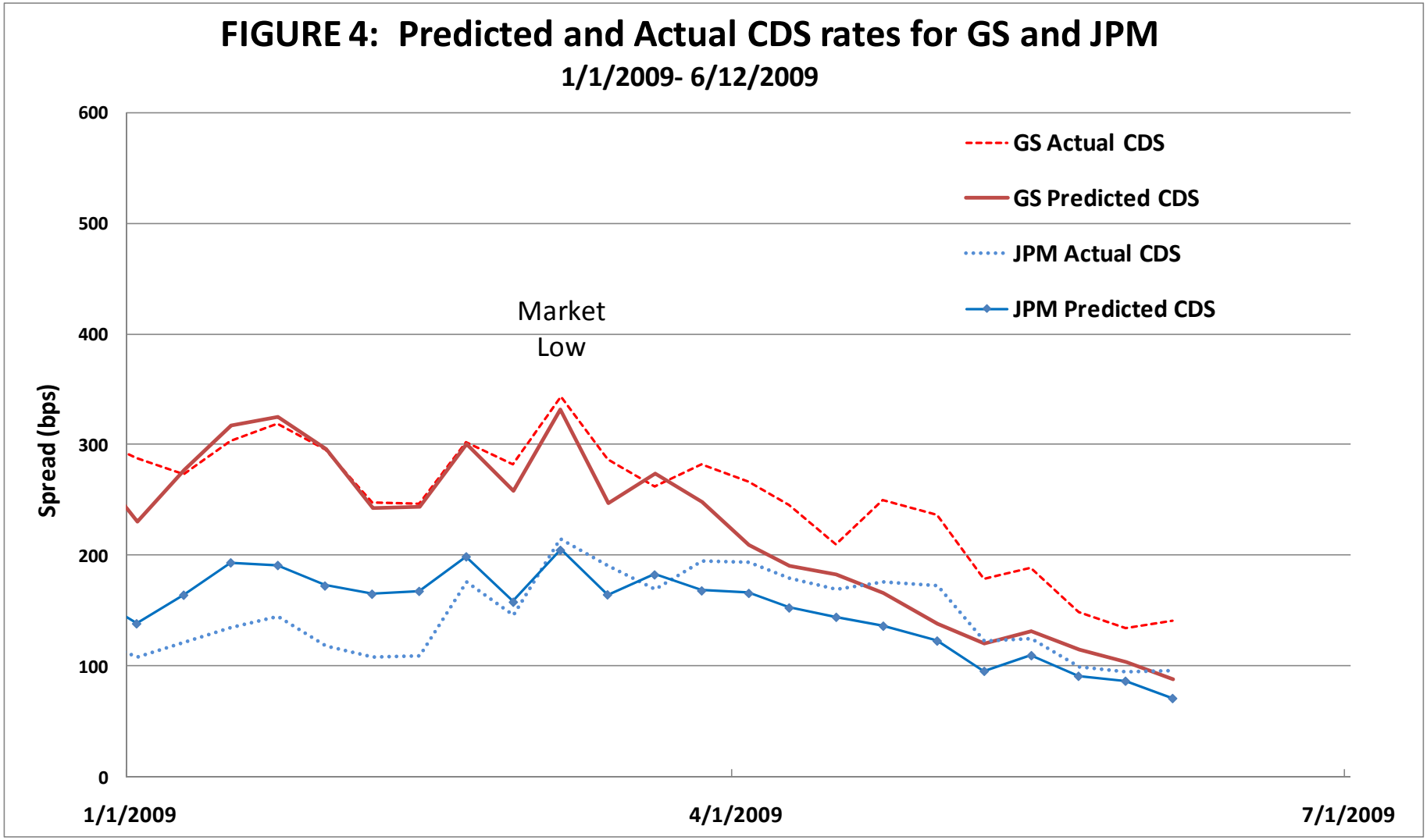


Note change in vertical scale. Beginning of 2008 and through the Bear-Stearns crisis, the actual CDS rates substantially exceed predicted CDS rates using asset volatility consistent with the observed volatility of equity.

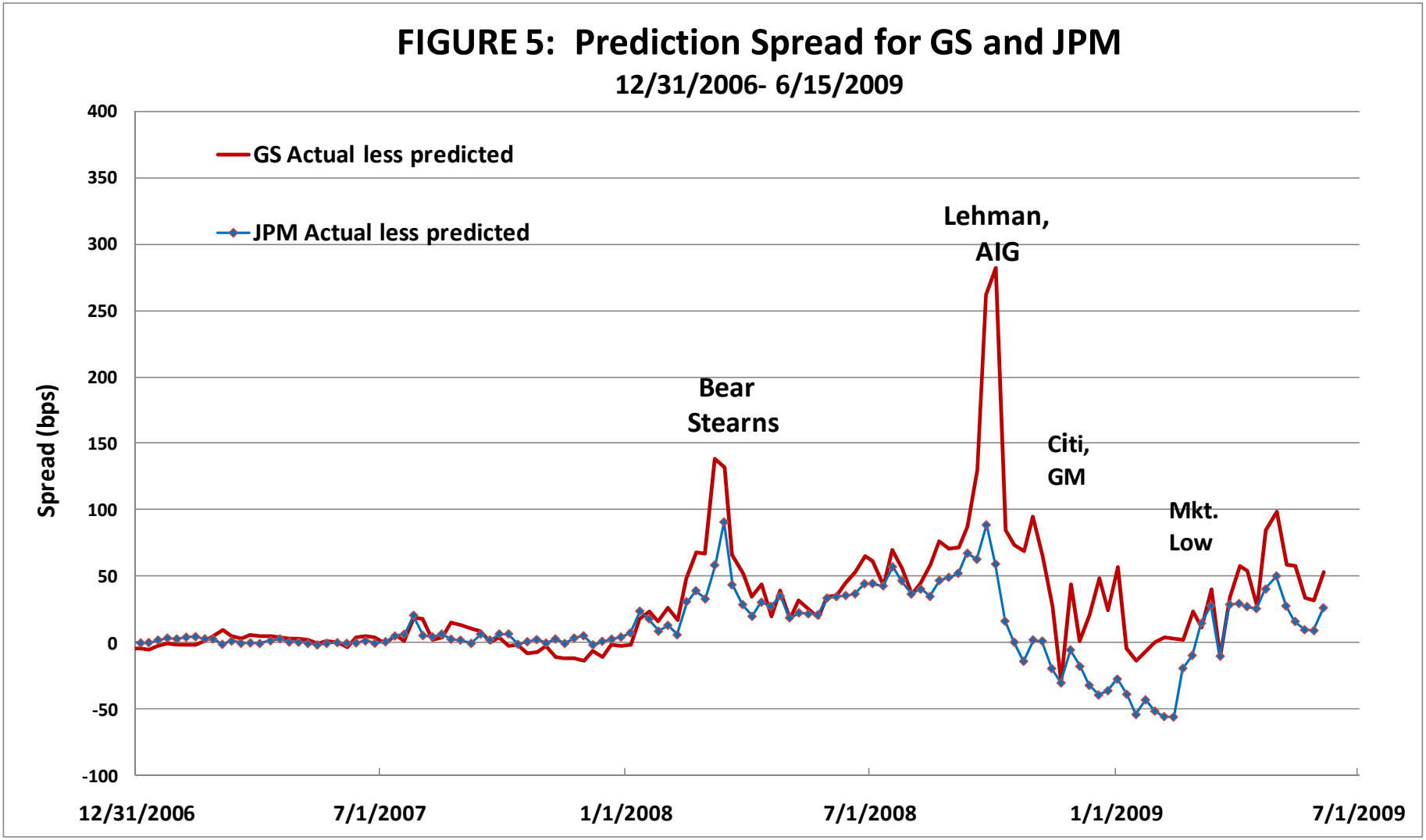


(Note the further change in vertical axis scale).

The pattern observed through bear sterns becomes more pronounced through the Lehman crisis, though is reduced soon thereafter (and even somewhat inverted for JPM).



Actual and predicted credit spreads reach parity as the market low (early March) occurs; a divergence reappears towards mid-June.



This summarizes the difference between actual credit spreads and model-predicted spreads for the two firms.

Preliminary Conclusions of Study:

- *Structural model does well in the* **pre-crisis** period
  - Perhaps not surprising, since that was a stable period

- **During the crisis,** *considerable prediction spread*
  if the unobservable inputs remain constant

- ***Correlation of prediction spreads*** (two firms only!)
  suggest common market factors

  - Increase in ***counter-party risk of CDS sellers can't explain data***
    - Would decrease, not increase CDS spreads since protection doubtful
  - Changes in ***jump risk can't explain data***
    - Diffusion risk would have to be less, given option implied volatilities
  - Change in anticipated recovery rates (with bus. cycle, Fed policy)
    can explain magnitude but not variation in CDS rates

So What Remains As Explanation?

- **Liquidity changes in CDS Markets**
  - Tang and Yang (2007) and others document that CDS spreads on average may be positive (13 bps pre-crash)
  - However: Duffie claims CDS trading remains liquid throughout, and liquidity spreads would have to change dramatically and frequently
- **Changes in Market Supply: the most compelling?**
  - Duffie (Princeton Lectures, 2007) suggests ***temporary capital shortages*** important in other markets, pre-crisis
  - Exit of Bear Stearns, Ambac, MBAA, and particularly AIG
    - Supply of credit-worthy writers much diminished
    - Banks' capital much reduced

The Curious Reversal in Prediction Spreads (11/14/08 – 3/04/09)

- Equity options were "expensive" relative to CDS during this period, reversing what was seen before
  - Alternatively stated, equity options imply asset volatility higher than the asset volatility consistent with CDS rates
  - This was a period of rapidly declining equity prices—the "worst of the crisis" for stock averages
  - Put option-writers had huge losses, depleted capital
    - Perhaps this scarcity drove up prices of options relative to CDS rates
- Note that after 3/04/09, CDS rates returned to being expensive relative to equity options

Model Calibration

For further details, including math, see http://www.ccfr.org.cn/cicf2009/files/KSen.pdf

Unobservable Parameters and Empirical Justification

(a) Jump risk λ = .003, consistent with A-rated debt default rates (Moody's data)

(b) Bond liquidity premium h_0 = 60 bps (consistent with Longstaff, Mithal, and Neis (2005))

(c) CDS liquidity premium h_1 = 0 (CDS rate = credit risk only) (Blanco, Brennan, and Marshall (2005), Zhu (2006))

(d) Corporate tax (net) τ = 25%

(e) Default cost (GS = 20%, JPM = 5%), consistent with ratings recovery rates

Jump risk, default costs, and CDS liquidity premia are subsequently permitted fixed in Figures 1-5 above. We subsequently studied effects of allowing these to vary.