"Liquidity Risk and Correlation Risk: A Clinical Study of the General Motors and Ford Downgrade of May 2005"

Viral Acharya, Stephen Schaefer, and Yili Zhang
London Business School

Liquidity and Liquidity Risk

A surge in recent academic literature on liquidity and liquidity risk (Amihud and Mendelson, 1988, Pastor and Stambaugh, 2003, and Acharya and Pedersen, 2005).

Liquidity shocks are highly episodic and tend to be preceded by or associated with asset return shocks.

Link between Funding Liquidity and Market Liquidity

Prices in capital markets (effectively) exhibit two regimes:

Normal regime: prices reflect fundamentals and no (or little) liquidity effects

Illiquidity regime: prices reflect the shadow cost of capital of intermediaries and depend on the inventory risk they face.

Correlation Risk

The risk that correlations of returns across different markets fluctuate over time.

Resemblance to liquidity risk:

- Correlations in returns of primitive securities (stocks and bonds) rise in bear markets (Longin and Solnik, 2001 and Ang and Chen, 2002)

- Correlations in underlying risks implied by traditional derivative-pricing models also exhibit such substantial fluctuations.

Liquidity Risk and Correlation Risk

Main thesis in this study: An important component of fluctuations in correlations is linked to liquidity risk.

In the *normal* regime: correlations across assets are primarily driven by correlations in fundamentals.

In the *illiquidity* regime: prices are also affected by the shadow cost of constraints and inventory risk faced by intermediaries.

Since the liquidity effect is related to intermediaries' capital, it can affect the prices of securities across the board, inducing a correlation in securities that is over and above the one induced by fundamentals.

The GM and Ford Downgrade

Undertake a clinical study of the GM and Ford downgrade in May 2005, focusing on the credit markets to test the thesis empirically.

Enables us to identify a large negative asset return shock, following which financial intermediaries might face greater funding cost.

The total volume of GM and Ford debt affected was large ($453 billion)

Statistical power to detect liquidity effects in the credit markets (GM and Ford bonds constituted a substantial portion of the daily trading in corporate bonds).

Focus on credit markets (CDS primarily)

- OTC institutional trading, so shocks to the balance-sheet of institutions are of first-order importance.
- Pricing data for CDS is superior to those of bonds
  Plan to examine CDS-bond basis in the future work

Timeline of Events

		GM Rating			Ford Rating		
Date	*Event*	*Moody's*	*S&P*	*Fitch*	*Moody's*	*S&P*	*Fitch*
Prior to October 2004		Baa1(BBB+)	BBB	BBB	Baa1(BBB)	BBB-	BBB+
14th October, 2004	S&P downgrade GM and GMAC 1 notch		BBB-				
14th November, 2004	Moody's downgrade GM and GMAC 1 notch	Baa2(BBB)					
16th March, 2004	Fitch downgrade GM and GMAC 1 notch			BBB-			
5th May, 2004	S&P downgrade GM and GMAC 2 notches to BB		BB				
5th May, 2004	S&P downgrade Ford and FMCC 1 notch to BB+					BB+	
19th May, 2004	Fitch downgrade Ford and FMCC 1 notch						BBB
24th Mary, 2004	Fitch downgrades GM and GMAC 1 notch			BB+			

The GM and Ford Downgrade

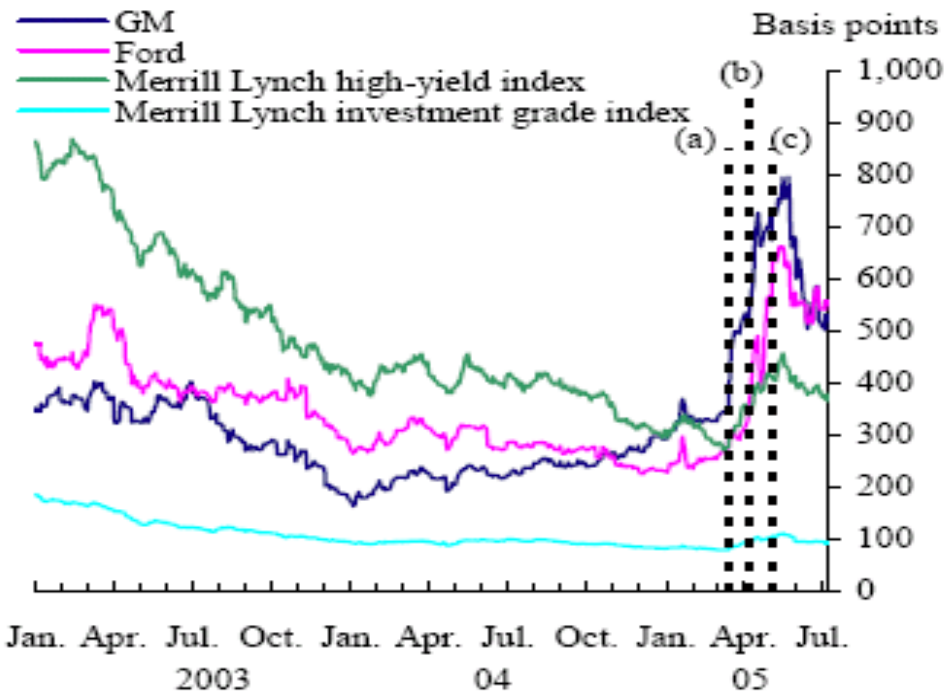
On May 5, 2005, S&P downgraded the debt of GM and Ford to "junk category" and maintained a negative outlook.

While the downgrades were largely anticipated, the timing was uncertain.

Significant price movements, not only in GM and Ford securities and the rest of auto sector but also in other markets and sectors.

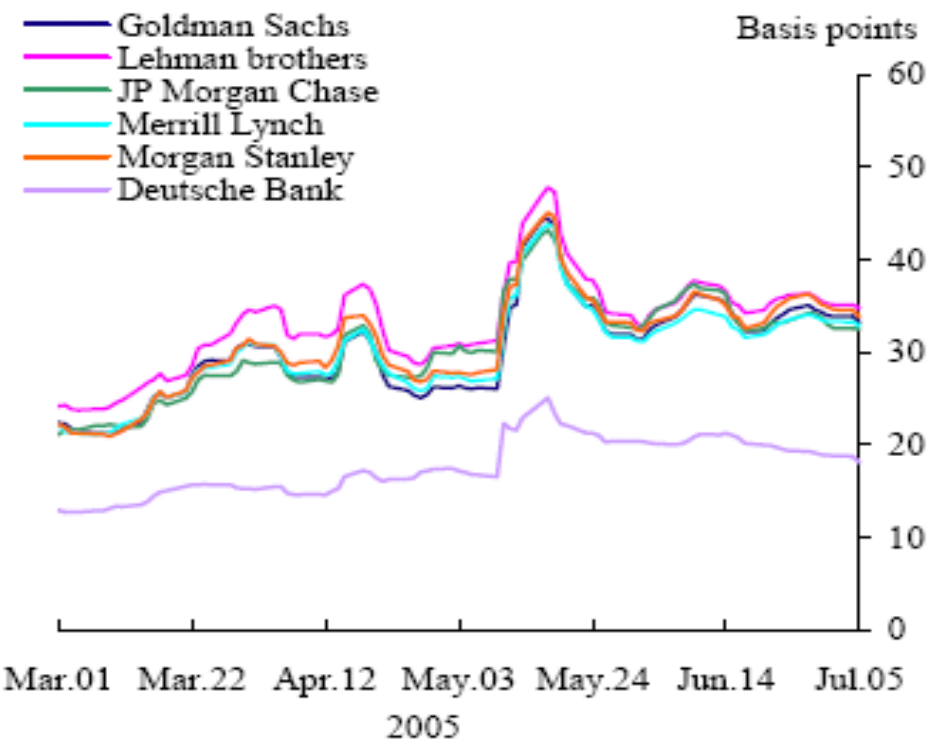
In particular, the credit default swaps (CDS) for large banks, experienced substantial short-run changes that were at least partially reversed within a few weeks.

Chart 1: GM/Ford bond spreads



Source: Merrill Lynch. Spreads option adjusted.
(a) GM profit warning, 16th March.
(b) Ford profit wanting, 8th April.
(c) Ford and GM downgrade to junk by S&P, 5th May.

Chart 7: Selected bank CDS premia[(a)]



Source: MarkIt.

(a) 5-year senior debt CDS contracts.

Possible Explanations:

1. Counter-party exposure:
   Large banks were prime brokers to some hedge funds that suffered substantial losses.

2. Inventory Risk:
   - The downgrade induced huge sell offs:
     - Regulatory restrictions.
     - GM and Ford bonds out of IG indices (Lehman, Merrill Lynch, and iBoxx)
   - Large banks (intermediaries) ended up holding a large proportion of GM and Ford debt and faced significant risk from further price drop.
   - Increased inventory risk increased the cost of intermediation, which could have produced discounts on securities across the board, including a widening of spreads in the CDS market.

Possible Explanations:

"...we estimate the total amount of debt likely to need to clear the market in moving High Grade holders to High Yield and Distressed holders..."

"...based on average Trace volumes in April, the market could clear that amount of debt in just under four months of trading for both GM and Ford."

Bank of America, Situation Room (May 3-5, 2005)

Overview

1. Data
2. Calculate CDS innovations
3. Evidence on Correlation risk
   - Betas in crisis and non-crisis
   - Auto vs. Financial
   - Sub-inv-grade vs. Inv-grade
4. Evidence on Bond market imbalance
5. Relate correlation risk and liquidity risk
   - Auto vs. Financial
   - Crisis vs. Non-Crisis
   - Sub-inv-grade vs. Inv-grade
   - Banks

Data

Daily CDS (5-yr) spreads between Jan, 2001 and Dec, 2005 from Markit Group

Results virtually identical for 1-yr spreads

1) 20 firms in the auto sector

- Auto sector more likely to be affected by common news in GM/Ford

Also focus on financials

2) 137 firms in the financial sector

Financial	
HSICCD	**Description**
6020	Commercial banks
6021	National Commercial Banks
6022	State Commercial Banks
6029	Commercial Banks, Not Elsewhere Classified
6030	Savings institutions
6035	Savings Institutions, Federally Chartered
6141	Personal Credit Institutions
6162	Mortgage Bankers and Loan Correspondents
6211	Security Brokers, Dealers, and Flotation Companies
6282	Investment Advice
6311	Life Insurance
6321	Accident and Health Insurance
6324	Hospital and Medical Service Plans
6330	Fire, marine, and casualty insurance
6331	Fire, Marine, and Casualty Insurance
6351	Surety Insurance
6361	Title Insurance
6411	Insurance Agents, Brokers, and Service
6711	Holding offices
6712	Offices of Bank Holding Companies
6719	Offices of Holding Companies, Not Elsewhere Classified
6726	Unit Investment Trusts, Face-Amount Certificate Offices, and Closed-End Management Investment Offices
6790	Miscellaneous investing
6798	Real Estate Investment Trusts
6799	Investors, Not Elsewhere Classified

Auto	
HSICCD	**Description**
3710	3710 Motor vehicles and equipment
3711	3711 Motor Vehicles and Passenger Car Bodies
3713	3713 Truck and Bus Bodies
3714	3714 Motor Vehicle Parts and Accessories
5511	5511 Motor Vehicle Dealers (New and Used)

Table 1: Summary Statistics

Panel C: GM			
	Low	Median	High
CDS 1 yr Spread (BP)	33.17	131.45	1701.95
CDS 5 yr Spread (BP)	63.93	229.82	1373.43
Firm Size (equity mkt val, $mm)	10524	23626	38101
Firm debt (book val, $mm)	104638	191133	207174
Firm Leverage (debt at book val)	0.74	0.89	0.95
Credit Rating (Avg Rating)	B	BBB	A

Panel D: Ford			
	Low	Median	High
CDS 1 yr Spread (BP)	32.35	162.44	995.37
CDS 5 yr Spread (BP)	61.67	241.87	984.36
Firm Size (equity mkt val, $mm)	11644	23235	56058
Firm debt (book val, $mm)	94428	119751	125806
Firm Leverage (debt at book val)	0.68	0.82	0.91
Credit Rating (Avg Rating)	BB+	BBB	A

Table 1: Summary Statistics

Panel A: Entire Financial Sector			
	Low	Median	High
CDS 1 yr Spread (BP)	1.98	19.67	1251.67
CDS 5 yr Spread (BP)	7.20	45.30	1051.67
Firm Size (equity mkt val, $mm)	31	8292	286494
Firm debt (book val, $mm)	0	3887	178324
Firm Leverage (debt at book val)	0	0.36	1
Credit Rating (Avg Rating)	B	A	AA
Average stock volume (mm shrs/day)	0.006	0.816	14.529
Average stock turnover (pct/day)	0.007	0.062	50.262
Average stock volatility	0.079	0.224	0.89
Observations /day	15	74	124

Panel B: Entire Auto Sector			
	Low	Median	High
CDS 1 yr Spread (BP)	2.88	109.18	4254.28
CDS 5 yr Spread (BP)	12.16	174.60	2018.49
Firm Size (equity mkt val, $mm)	42	4878	56058
Firm debt (book val, $mm)	67	1887	207174
Firm Leverage (debt at book val)	0.03	0.49	0.96
Credit Rating (Avg Rating)	CCC	BB	AA
Average stock volume (mm shrs/day)	0.028	0.831	10.323
Average stock turnover (pct/day)	0.112	0.934	18.545
Average stock volatility	0.152	0.357	0.601
Observations /day	4	13	18

Empirical Methodology

Exploit the following key idea :

If the widening of spreads on financial CDS was purely due to increase in default risk, then the widening should have been accompanied by a deterioration in the equity value.

Thus, under no cross-market arbitrage opportunities, equity returns can be used to isolate the component of the CDS returns ("CDS innovations") that cannot be attributed to default risk changes.

Empirical Methodology

We employ the methodology in Acharya and Johnson (2005) that relies on the usefulness of hedge ratios from structural models (Schaefer and Strebulaev(2003))

$$\underbrace{(CDS\ return)_{i,t}}_{\%\ change\ \text{in CDS}} = \alpha_i + \sum_{k=0}^{5}[\beta_{i,t-k} + \gamma_{i,t}/(CDS\ level)_{i,t}](Stock\ return)_{i,t-k} + \sum_{t=1}^{5}\delta_{i,t-k}(CDS\ return)_{i,t-k} + TBill_t + TSY_t + u_{i,t}$$

CDS innovation

Allows for a non-linear relationship between returns in CDS and equity.

Isolates the component of the CDS returns ("CDS innovations") that cannot be attributed to default risk changes.

This specification is estimated firm by firm for both auto and financial sector firms to obtain CDS innovations for all firms in the study.

Empirical Findings

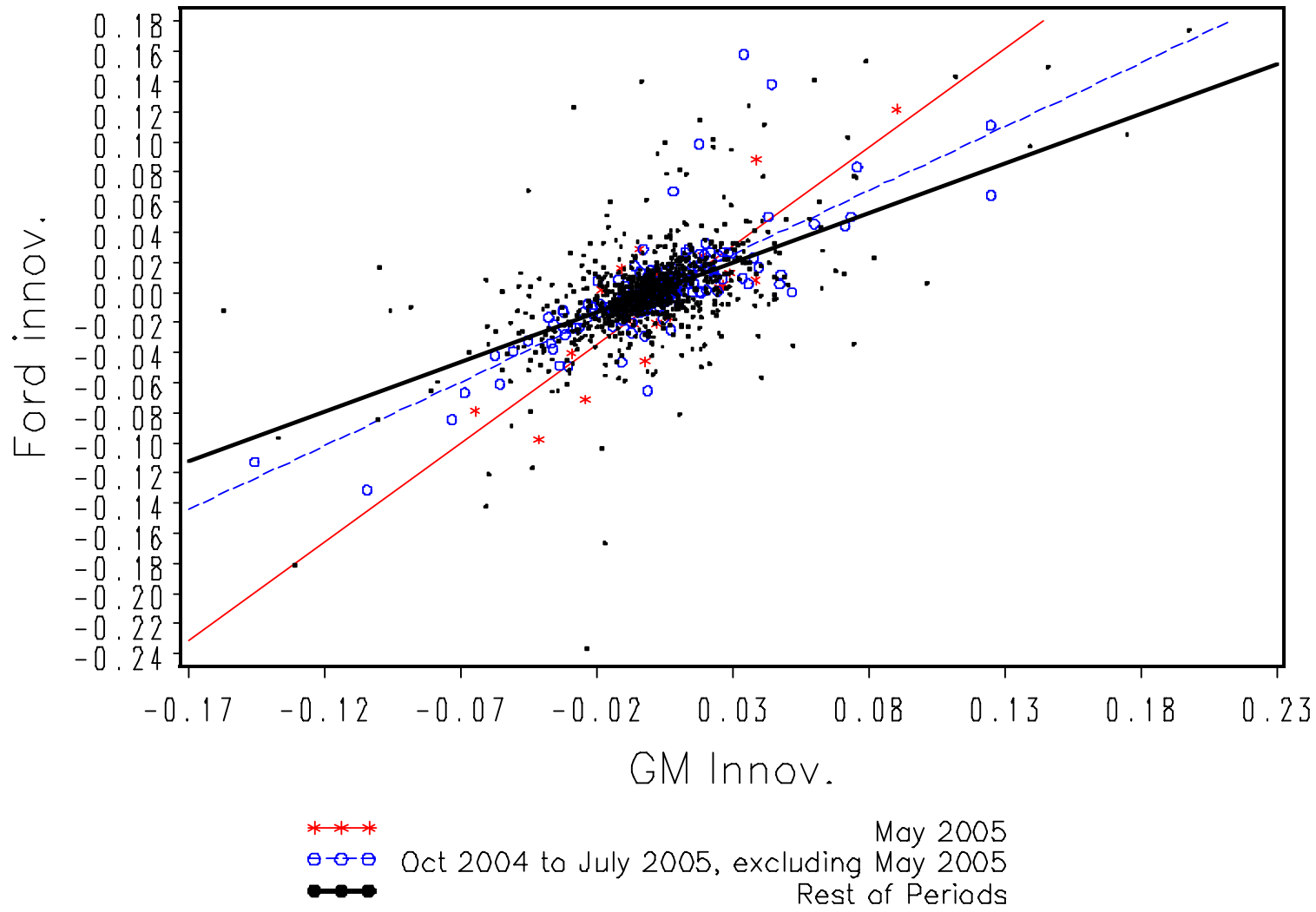
Our main thesis: the downgrade increased the cost of intermediation, forcing banks to discount prices of securities, including those of CDS, across the board.

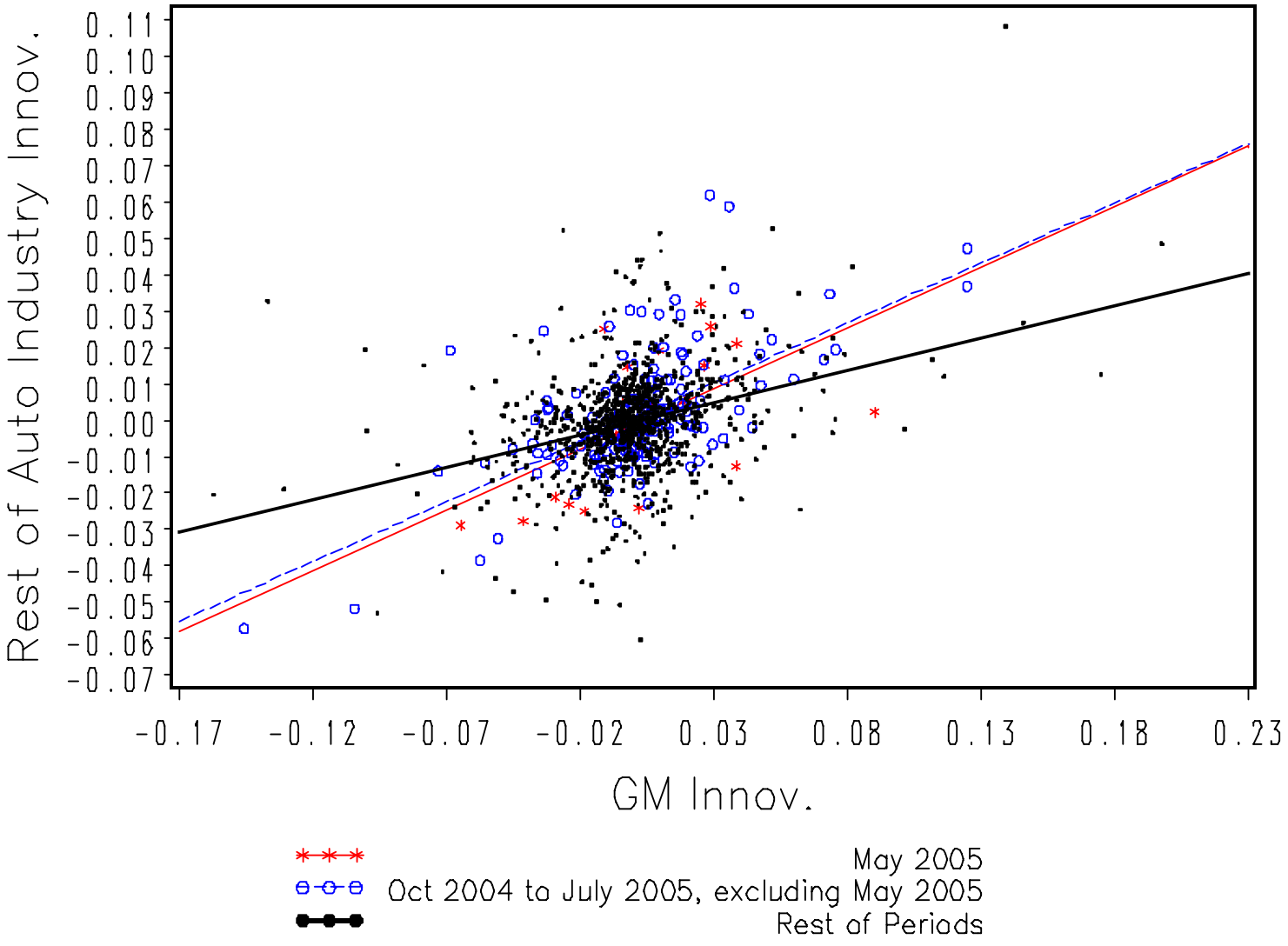
An immediate consequence: CDS innovations across different entities are expected to become more correlated around the downgrade.

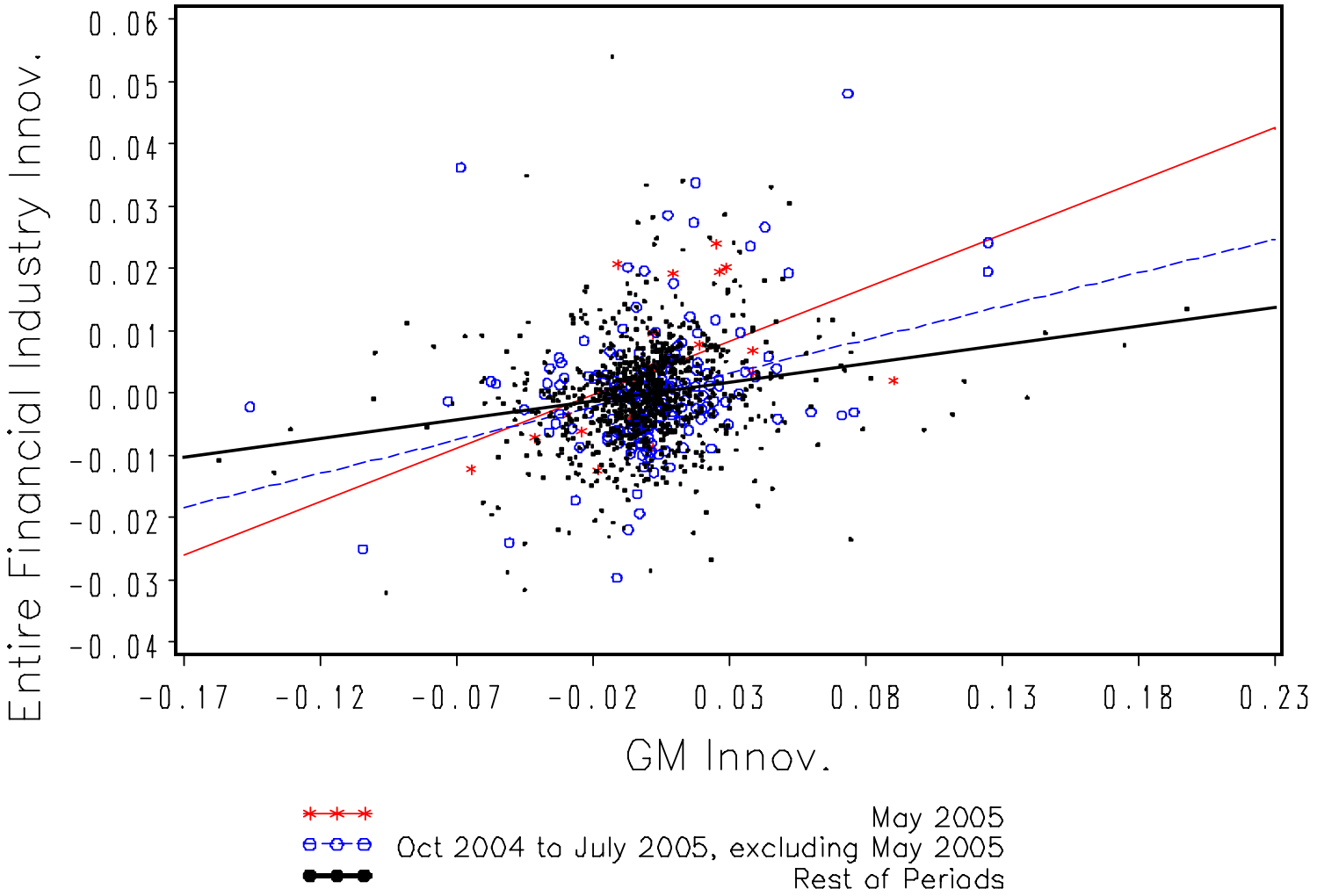
First, we provide evidence of such correlation

Next, we relate it to imbalance in GM and Ford bonds (and other bonds)

Figure 2A: X-Y Scatter Plots of CDS Innovations (5-year CDS spreads)




Rest of Auto Industry Innov.
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
-0.17
-0.12
-0.07
-0.02
0.03
0.08
0.13
0.18
0.23
GM Innov.
May 2005
Oct 2004 to July 2005, excluding May 2005
Rest of Periods


Entire Financial Industry Innov.
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.17
-0.12
-0.07
-0.02
0.03
0.08
0.13
0.18
0.23
GM Innov.
May 2005
Oct 2004 to July 2005, excluding May 2005
Rest of Periods

Hypothesis :

Ho: Corr (Crisis)= Corr (Non-Crisis); Ha: Corr (Crisis)> Corr (Non-Crisis)

Two specifications of Crisis Period: H1: May 2005; H2: Oct 2004 to July 2005

Test the two hypotheses by examining the **Betas** between CDS innovations

$$Ford = Alpha1 + Beta1*GM + Alpha2*DummyA + Beta2*(GM*DummyA) + e$$

Crisis Period Dummy

Testing *Beta2>0* is equivalent to testing *H1 and H2.*

Results identical for correlations, but estimating betas is not subject to bias from changing volatility.

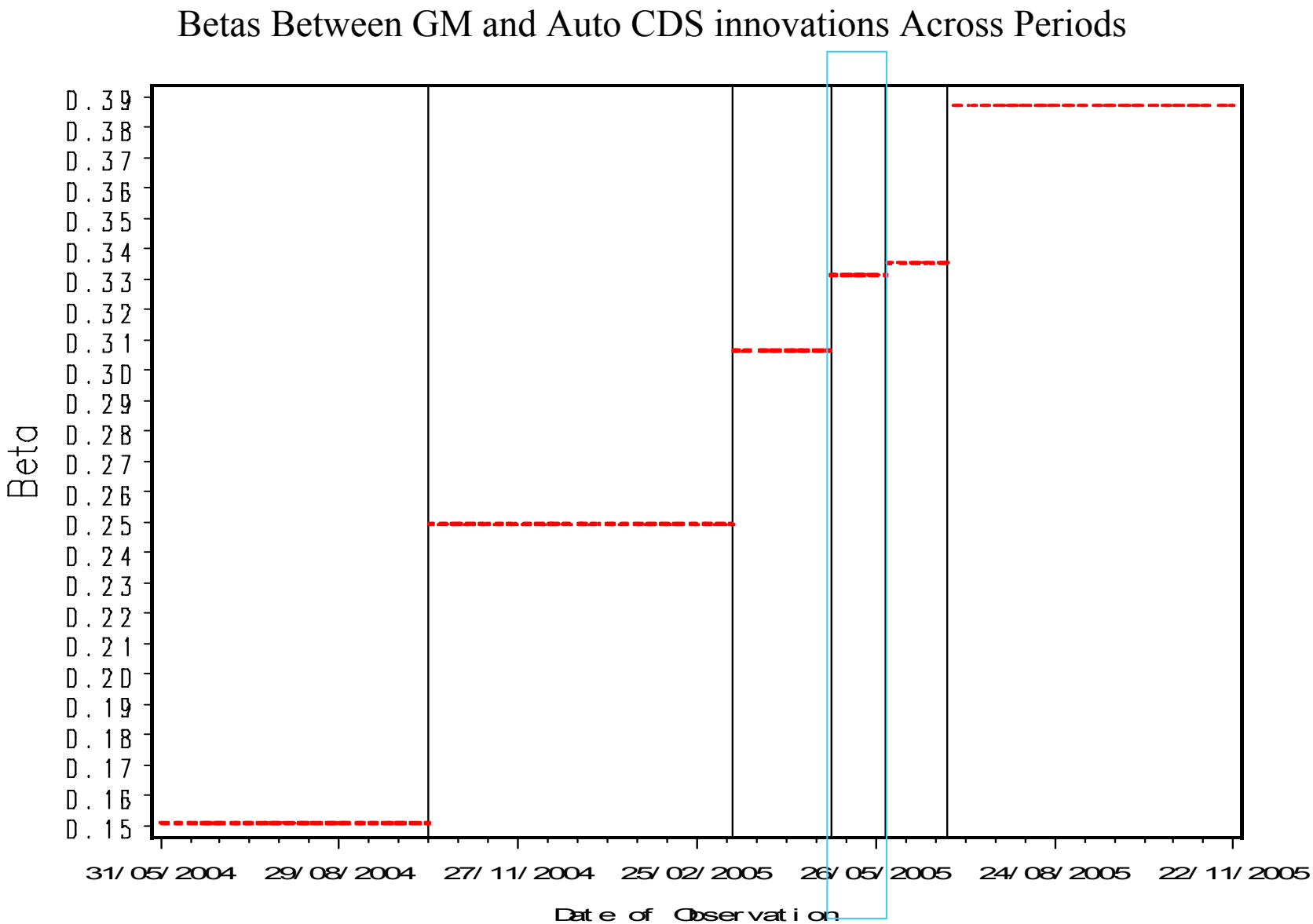
Table 3: Tests for Equality of Betas Across Different Periods

Panel A

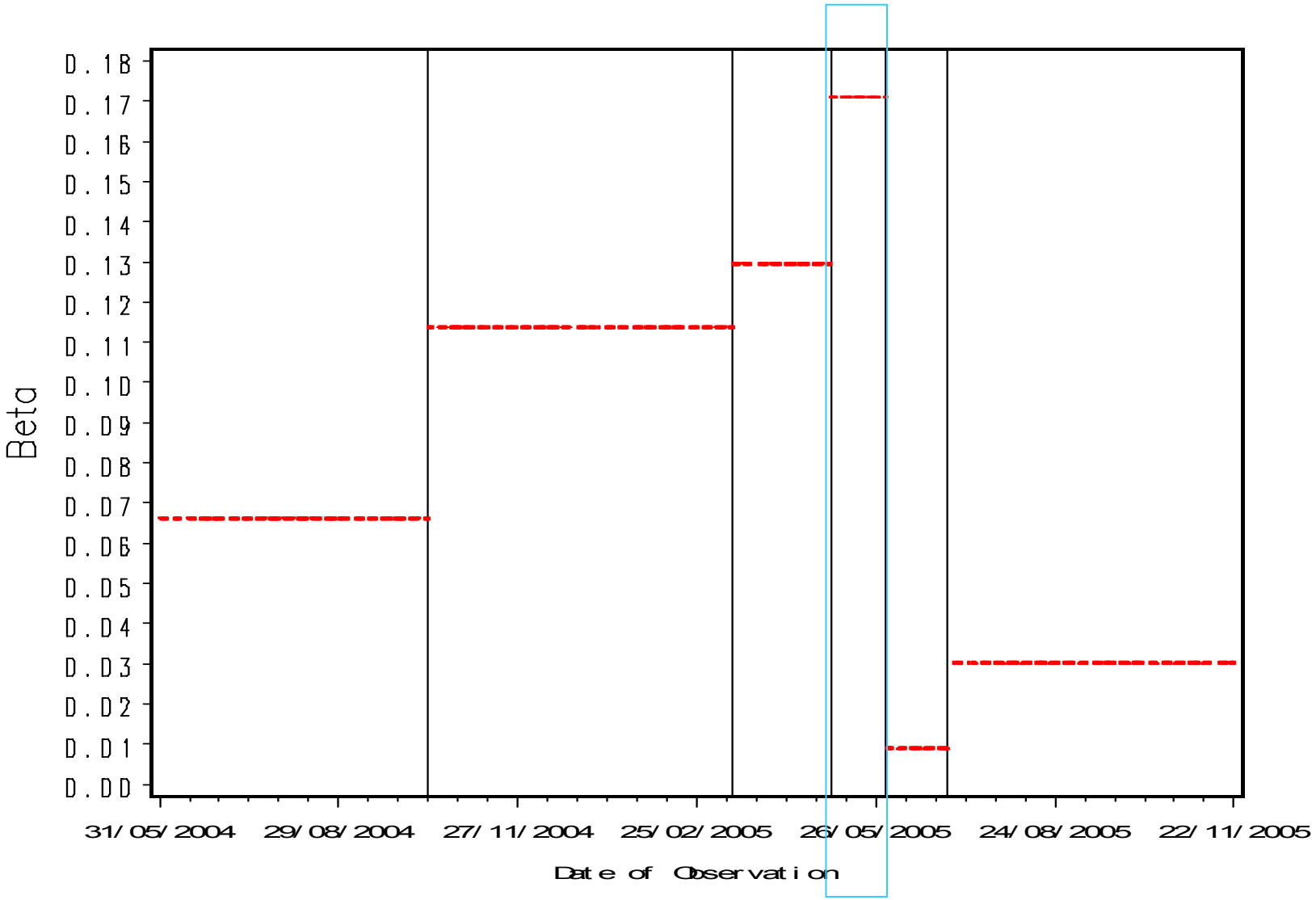
	H1					H2				
Variables	*Alpha1*	*Beta1*	*Alpha2*	*Beta2*	*R^2*	*Alpha1*	*Beta1*	*Alpha2*	*Beta2*	*R^2*
X=GM; Y=Ford	0.0001	0.695***	-0.009	**0.616*****	38.3%	0.0001	0.658***	-0.001	**0.244*****	38.2%
X=GM; Y=Auto_Rest	-0.0002	0.207***	-0.001	**0.127***	15.5%	-0.0004	0.178***	0.001	**0.150*****	16.7%
X=GM; Y=Entire_Fin	-0.0001	0.069***	0.003*	**0.103****	5.7%	-0.0002	0.061***	0.000	**0.056*****	5.7%
X=Ford; Y=Auto_Rest	-0.0003	0.132***	0.001	**0.066**	8.8%	-0.0005	0.114***	0.001	**0.100*****	9.6%
X=Ford; Y=Entire_Fin	-0.0001	0.051***	0.004**	**0.036**	4.2%	-0.0001	0.044***	0.001	**0.041****	4.1%
X=Rest_Auto; Y=Entire_Fin	-0.0001	0.201***	0.004**	**0.274*****	13.5%	-0.0001	0.169***	0.000	**0.192*****	14.2%

*s for Alpha1, Beta1, and Alpha1 indicate the significance of the estimated parameters.

*s for Beta2 indicate the significance of H1, H2, and H3 (one-tailed tests: Beta2>0).


Betas Between GM and Auto CDS innovations Across Periods
Beta
0.39
0.38
0.37
0.36
0.35
0.34
0.33
0.32
0.31
0.30
0.29
0.28
0.27
0.26
0.25
0.24
0.23
0.22
0.21
0.20
0.19
0.18
0.17
0.16
0.15
31/05/2004
29/08/2004
27/11/2004
25/02/2005
26/05/2005
24/08/2005
22/11/2005
Date of Observation

Betas Between GM and Financial CDS innovations Across Periods



Investment Grade vs. Sub-Investment Grade

If the story is about the market's inability to absorb the large supply of junk bonds after the downgrades, we should see sharper rise in CDS premia for sub-investment grade ("junk") firms.

Separate sample into Inv-grade (BBB and above) and Sub-Inv-grade firms.

Examine whether the magnitude of correlation increase was higher for sub-investment-grade firms and than for investment-grade firms?

Table 5: Tests for Equality of Betas Across Different Periods for Investment Grade and Sub-Investment Grade (Junk) Firms

			H1			
Variables	*Beta1*	*Beta2*	*Beta3*	*Beta4*	*Diff in Diff ((Beta4-Beta3)-(Beta2-Beta1))*	*R^2*
X=GM; Y=Auto_Rest	0.165***	0.227*	0.237***	0.416***	0.118***	8.92%
X=Ford; Y=Auto_Rest	0.101***	0.091	0.151***	0.284***	0.143***	0.72%
X=GM; Y=Entire_Fin	0.070***	0.167	0.057***	0.232	0.078*	5.01%
X=Ford; Y=Entire_Fin	0.053**	0.086	-0.018	0.113	0.010***	0.41%
X=Rest_Auto; Y=Entire_Fin	0.106***	0.327	0.132***	0.348	-0.005	1.08%
			H2			
Variables	*Beta1*	*Beta2*	*Beta3*	*Beta4*	*Diff in Diff ((Beta4-Beta3)-(Beta2-Beta1))*	*R^2*
X=GM; Y=Auto_Rest	0.144***	0.253***	0.203***	0.383***	0.070***	9.62%
X=Ford; Y=Auto_Rest	0.089***	0.142***	0.127***	0.267***	0.086***	5.52%
X=GM; Y=Entire_Fin	0.062**	0.114**	0.04	0.143***	0.051***	0.77%
X=Ford; Y=Entire_Fin	0.047*	0.083*	-0.045*	0.099**	0.108***	0.61%
X=Rest_Auto; Y=Entire_Fin	0.079**	0.319***	0.112**	0.235***	-0.118***	1.25%

Inventory Imbalances:

All the evidence so far has been suggestive because we have not linked correlation risk to liquidity risk.

First, we demonstrate there was liquidity risk in the bond market during the downgrade period

The next key step is then to relate CDS innovations to proxies of inventory risk of GM and Ford bond positions faced by financial intermediaries.

Inventory data from MarketAxess:

MarketAxess operates the leading electronic, multi-dealer to client platform for U.S. and European corporate bond trading.

MarketAxess:

Broker-Dealer Clients

MarketAxess:

ISSUEID	CUSIP	ISIN	TICKER	COUPON	MATURITY	BID_LEVEL	BID_SIZE	OFFER_LEVEL	OFFER_SIZE	SPREAD_AGAINST	DEALERID
10106478	013817AF8	013817AF	AA	6	01/15/2012	72	1000	null	null	M	4
10106478	013817AF8	013817AF	AA	6	01/15/2012	72	183	null	null	M	114
10106478	013817AF8	013817AF	AA	6	01/15/2012	78	1150	58	2000	M	7
10106478	013817AF8	013817AF	AA	6	01/15/2012	null	null	60	625	M	6
10106478	013817AF8	013817AF	AA	6	01/15/2012	null	null	62	170	M	2
10097728	013817AH4	013817AH	AA	5.375	01/15/2013	null	null	70	311	M	77

Inventory (Quote) Imbalance Proxies:

Various proxies for daily inventory imbalance:

Imbalance %: *(Total bids– Total offers)/(Total bids + Total offers)*

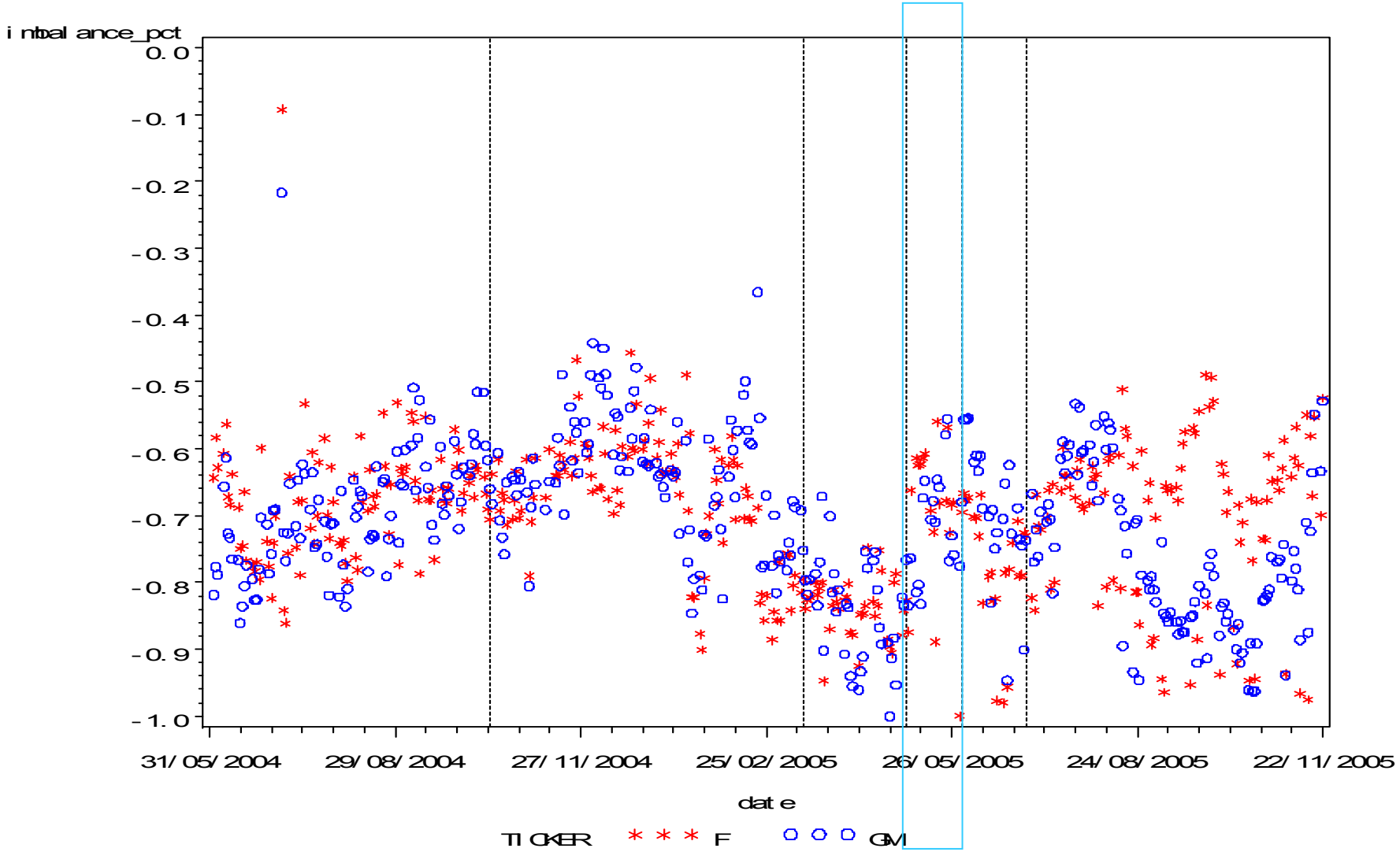
Offer ratio: *Total # of offers / (Total # of offers + Total # of bids)*
Bid ratio: *Total # of bids / (Total # of offers + Total # of bids)*

Classify each institution as net offerer or net bidder daily.

Offerer: *% of institutions that are net offerers*
Bidder: *% of institutions that are net Bidders*

Two quotes %: *% of quotes with both bid and ask components*
Bid-ask spread: *Only for quotes with both bid and ask components*

Imbalance %: *(Total bids (size) – Total offers)/(Total bids + Total offers)*



Relating Correlation Risk and Liquidity Risk

$$\text{CDSinv\_GM}_{i,t} = a + b1 * \text{Imb\_GM}_{t-1} + e_{i,t}$$

$$\text{CDSinv\_Auto}_{i,t} = a + c1 * \text{Imb\_GM}_{t-1} + e_{i,t}$$

$$\text{CDSinv\_Fin}_{i,t} = a + d1 * \text{Imb\_GM}_{t-1} + e_{i,t}$$

$$\textit{Cov}\,(\text{CDSinv\_GM}, \text{CDSinv\_Fin}) = b1 * d1 * \text{Var}(\text{Imb\_GM}_{t-1})$$

$$\text{CDSinv\_Auto}_{i,t} = a + c1 * \text{Imb\_GM}_{t-1} + c2 * \text{Imb\_Auto}_{t-1} + e_{i,t}$$

$$\text{CDSinv\_Fin}_{i,t} = a + d1 * \text{Imb\_GM}_{t-1} + d2 * \text{Imb\_Fin}_{t-1} + e_{i,t}$$

Table 7: Correlations Between CDS Innovations and Imbalance Measures

Panel A: Imbalance Pct

DEP VAR	Industry	Alpha	Imb_GM	E(Sign)	Imb_Industry	R^2
CDSinv_GM		-0.0028	-0.0039	-		0.06%
CDSinv_GM	Auto	-0.0005	-0.0036	-	0.0034	0.14%
CDSinv_GM	Fin	-0.0007	-0.0044	-	0.0033	0.08%
CDSinv_Auto	Auto	-0.0061**	-0.0084**	-		0.86%
CDSinv_Auto	Auto	-0.0056	-0.0083**	-	0.0008	0.88%
CDSinv_Fin	Fin	-0.0047***	-0.0062***	-		1.40%
CDSinv_Fin	Fin	-0.0063**	-0.0058**	-	-0.0024	1.48%

Crisis vs. Non-Crisis Periods

Table 9: Correlations Between CDS Innovations and Imbalance Measures: Crisis vs. Non-Crisis Periods

Panel A: Imbalance Pct

Dep Var	Industry	Alpha	Crisis	Imb_GM	Crisis*Imb_GM	Imb_Industry	Crisis*Imb_Industry	R^2
CDSinv_GM		-0.0015	-0.0384***	-0.0006	-0.0592***			2.82%
CDSinv_GM	Auto	0.002	-0.0354**	-0.0005	-0.0592***	0.0054	0.0043	3.09%
CDSinv_GM	Fin	0.0082	-0.0538***	-0.0005	-0.0438***	0.0126	-0.035*	2.95%
CDSinv_Auto	Auto	-0.0037	-0.0265***	-0.0048	-0.0397***			4.30%
CDSinv_Auto	Auto	-0.0032	-0.0258***	-0.0048	-0.0397***	0.0008	0.0009	4.32%
CDSinv_Fin	Fin	-0.0053**	-0.0063	-0.0062**	-0.0112**			3.42%
CDSinv_Fin	Fin	-0.0043	-0.0158**	-0.0065**	-0.0092*	0.0016	-0.0145**	4.00%

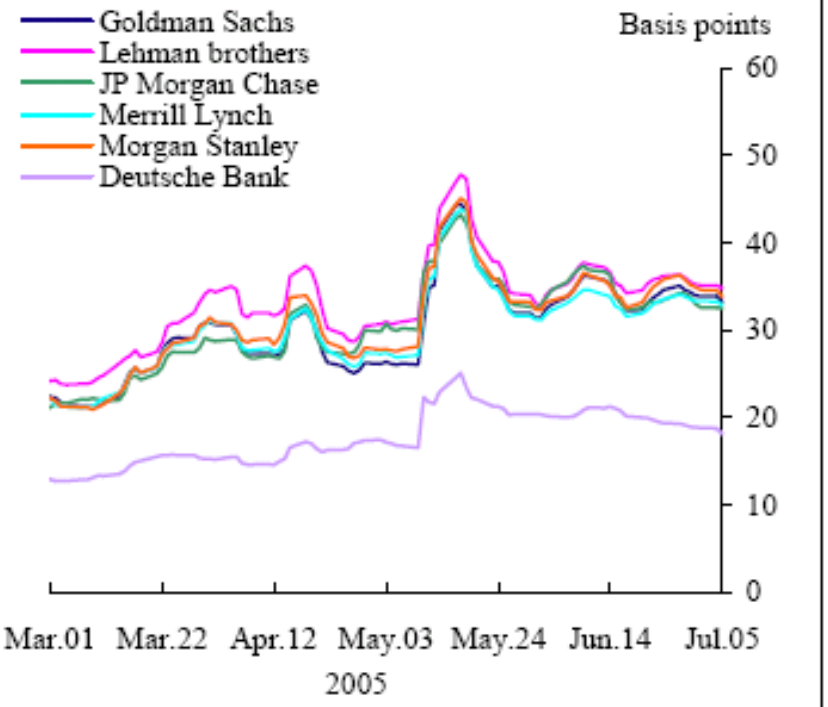
Sub-Inv-grade and Inv-grade in Crisis and Non-Crisis Periods

Table 9: Correlations Between CDS Innovations and Imbalance Measures: Sub-Inv and Inv-grade in Crisis and Non-Crisis Periods

Panel A: Imbalance Pct

Dep Var	Subinv*Crisis*Imb_GM	Subinv*NonCrisis*Imb_GM	Inv*Crisis*Imb_GM	Inv*NonCrisis*Imb_GM	Diff in Diff
CDSinv_Auto	-0.0792***	0.0001	-0.0426***	-0.004	-0.0408**
CDSinv_Fin	-0.0336***	-0.0136***	-0.0175**	-0.0073	-0.0098

Chart 7: Selected bank CDS premia[(a)]



Source: MarkIt.

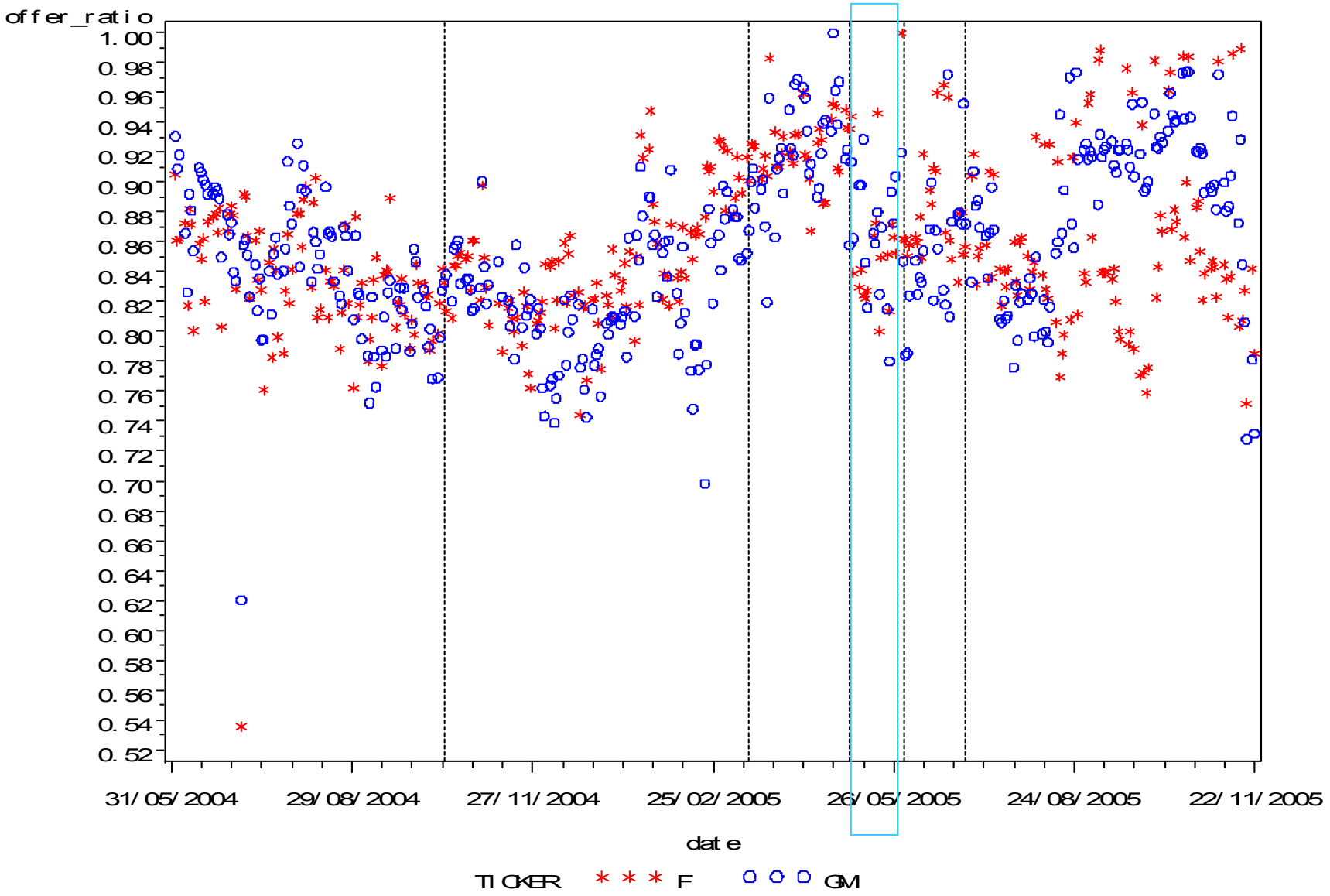
(a) 5-year senior debt CDS contracts.

Table 8: Correlating CDS Innovations with Imbalance Measures: Individual Banks

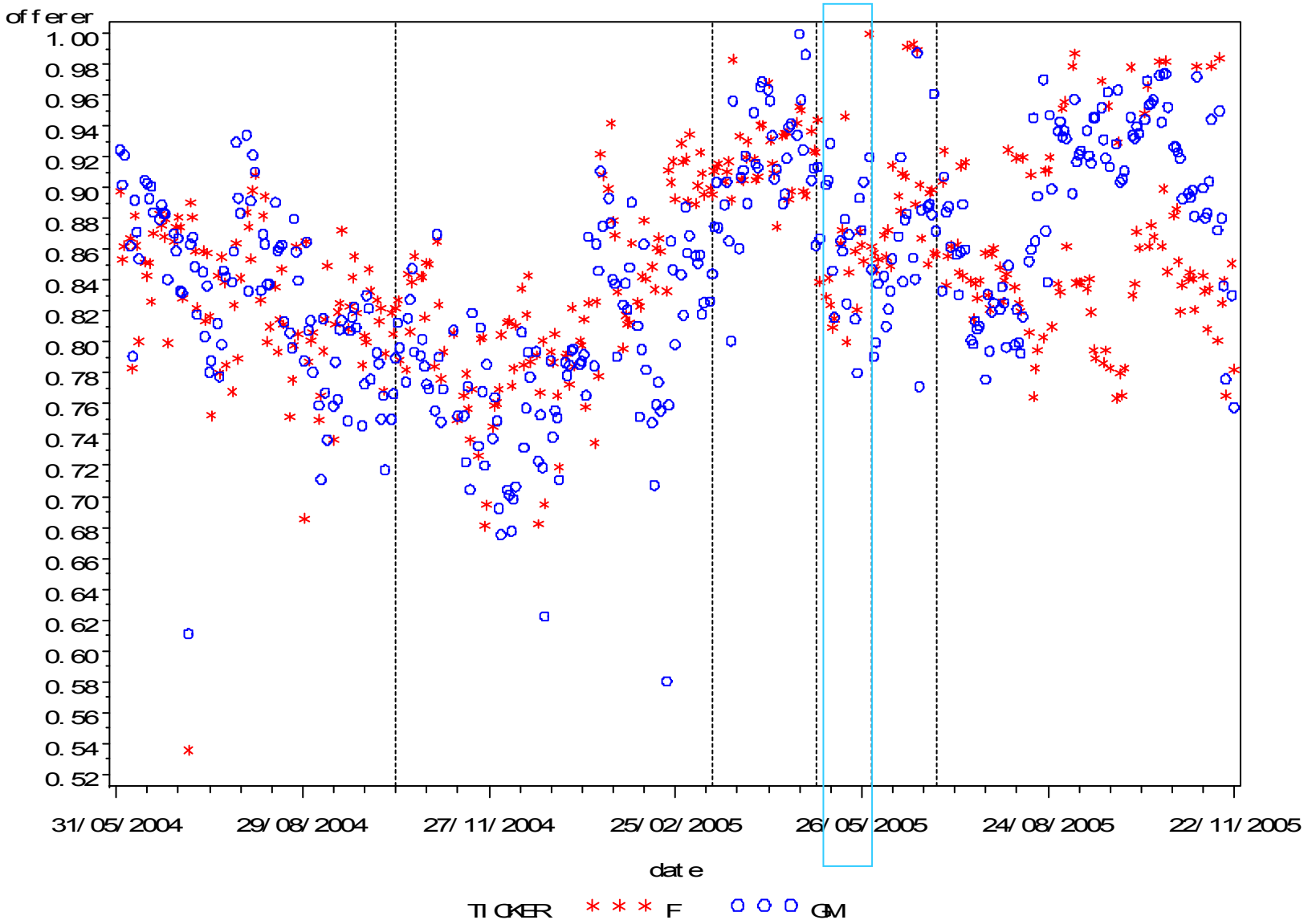
Panel A: Imbalance Pct

Dep Var	Alpha	Imb_GM	Imb_Bank	Imb_Industry	R^2
CDSinv_All Banks	-0.0027	-0.0079*	0.003	0.0021	0.75%
CDSinv_Deutche	0.0019	-0.012*	-0.0014	0.0164	0.99%
CDSinv_Goldman	0.0078	-0.0087*	0.0091*	0.0121	1.17%
CDSinv_JPMorgan	-0.011	-0.012	-0.0018	-0.0009	0.56%
CDSinv_Lehman	0.0112	-0.0063	0.0239***	0.0009	2.10%
CDSinv_Merill	-0.0039	-0.0093*	0.0067	-0.0015	0.95%
CDSinv_MorganS	-0.0005	-0.0059	0.0072	-0.0003	1.20%

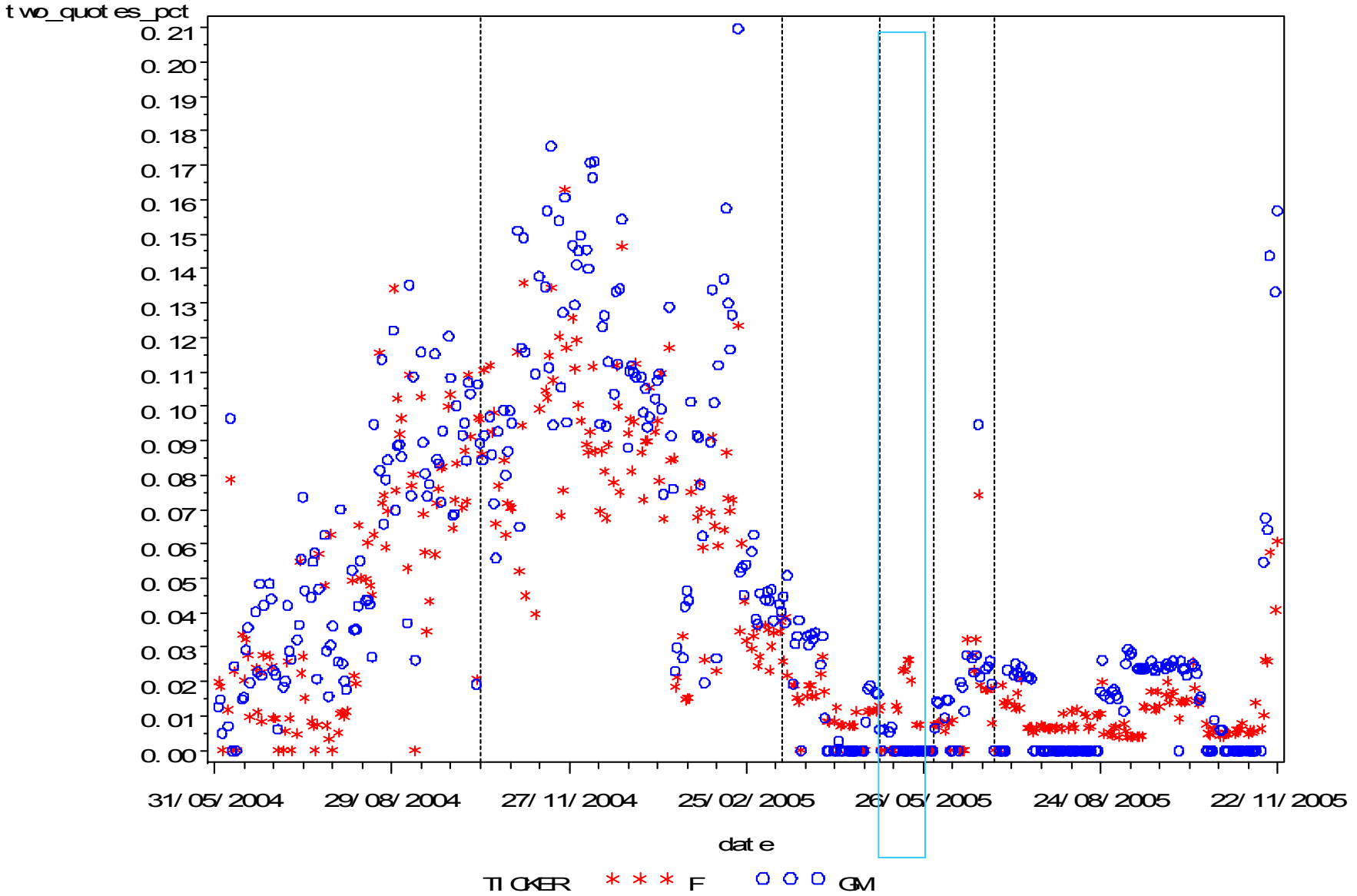
Offer ratio: *Total # of offers / (Total # of offers + Total # of bids)*



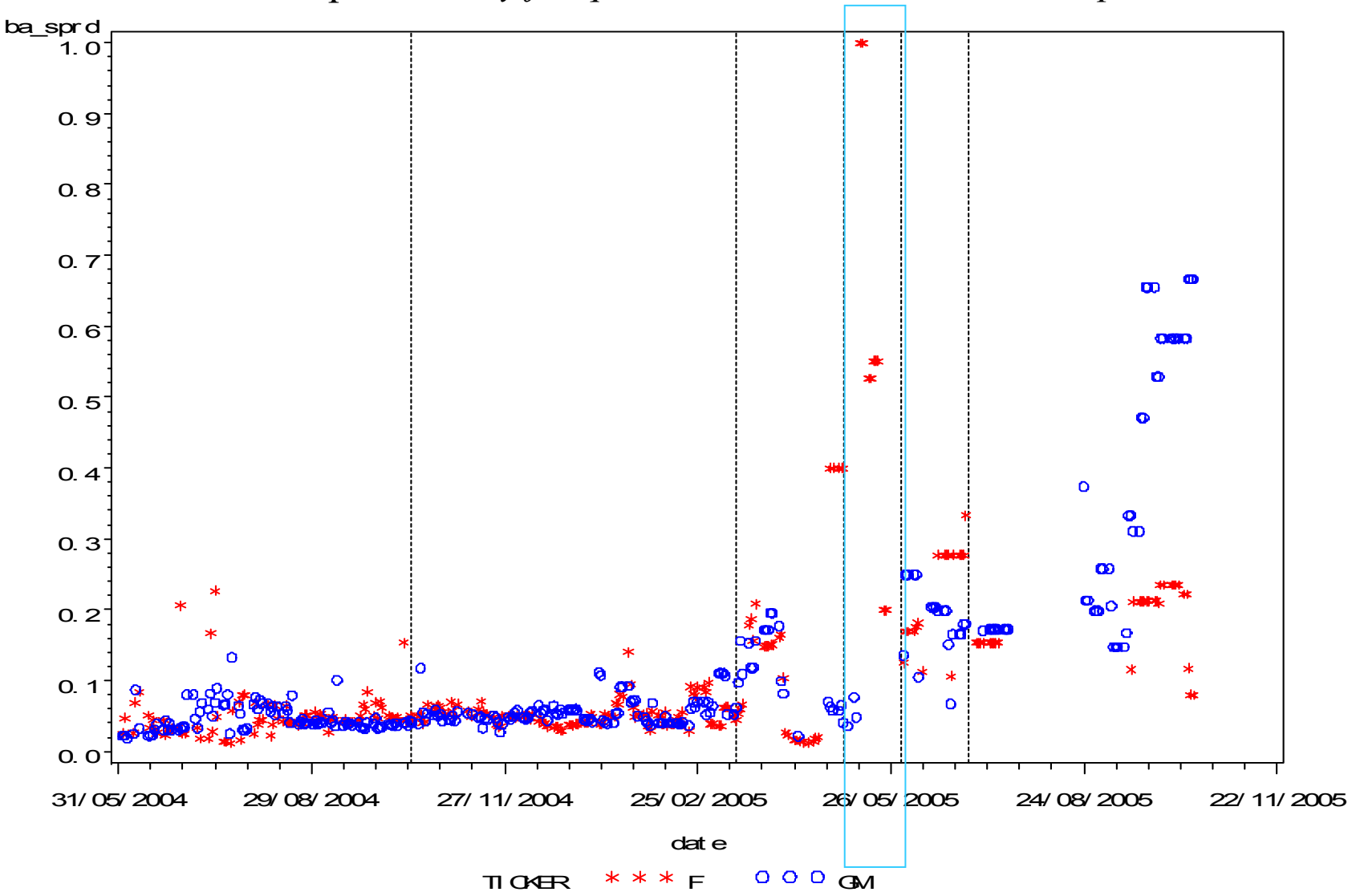
Offerer: *% of institutions that are net offerers*



Two quotes %: *% of quotes with both bid and ask components*



Bid-ask spread: *Only for quotes with both bid and ask components*



Summary of Results

Undertook a clinical study of the GM and Ford downgrade in May 2005, focusing on the CDS market.

- Evidence that co-movement across auto and financial sector increased significantly around the downgrade.
- Correlation reversed itself for financials.
- Evidence of imbalances in GM and Ford (and other) bonds.
- Linked fluctuations in correlation to bond imbalances.

The Next Steps:

- Study CDS-bond basis and its relationship to imbalance.
- Identify and study the 25 banks that broker the CDS market.
- Identify the banks that were prime brokers for hedge funds.
- Evaluate robustness of our methodology to compute CDS innovations.
- Employ market-wide proxies of imbalance in high-yield and investment-grade bonds.
- Your suggestions.

Thank You ☺