

Non-Convexities in the 10-Year Treasury Note Market

**Christopher G. Lamoureux & George
Theocharides**

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Motivation

- On July 15, 2008 Senator Harry Reid introduced S 3268, the **Stop Excessive Energy Speculation Act** (did not become law) amid concerns that speculative trading in derivatives markets might distort the price of the underlying commodities.

“...the Commission shall convene a working group of international regulators to develop uniform international reporting and regulatory standards to ensure the protection of the energy futures markets from *non-legitimate hedge trading, excessive speculation, manipulation, location shopping, and lowest common dominator regulation*, each of which pose systemic risks to all energy futures markets, countries, and consumers.”

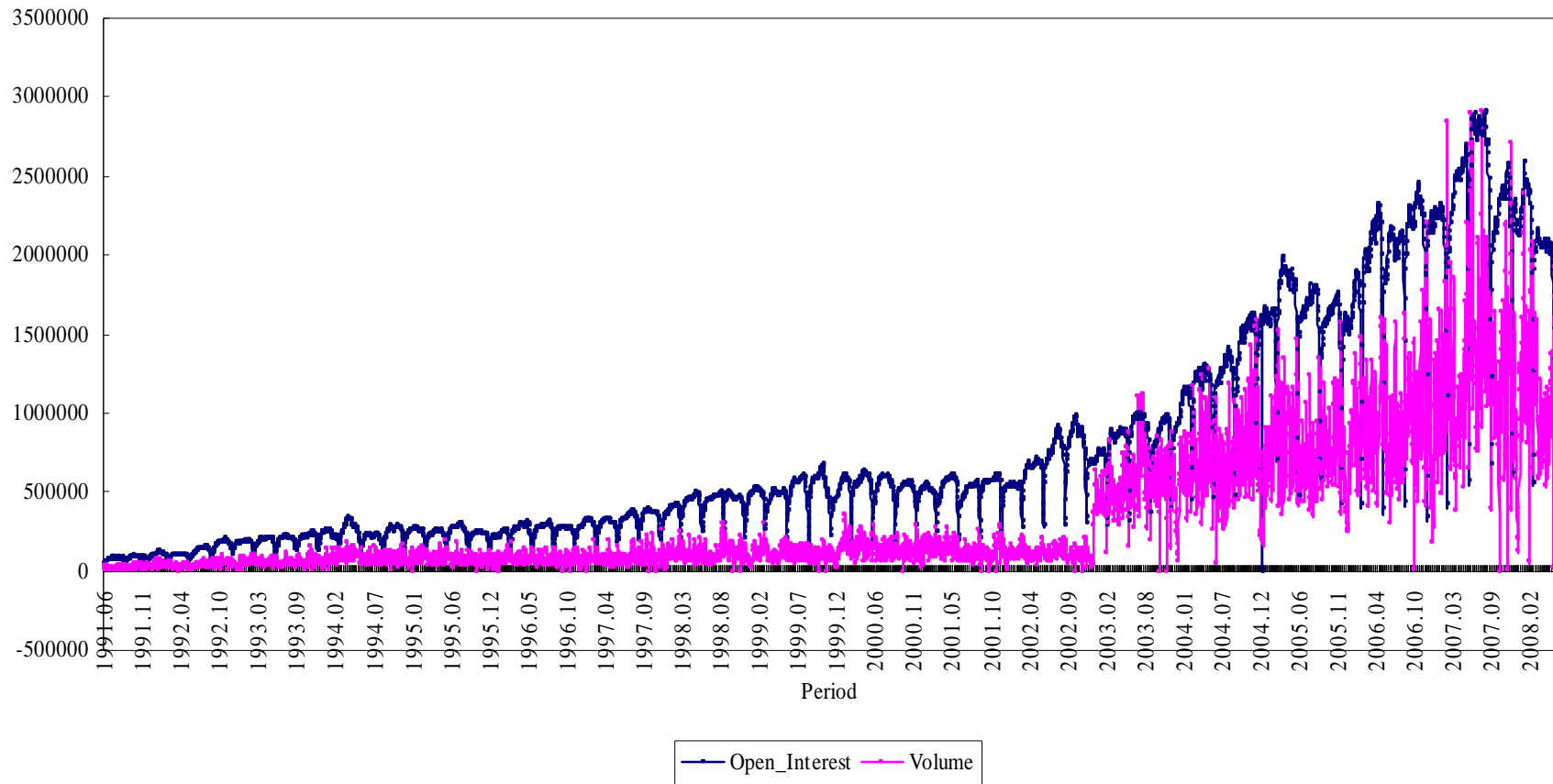
- The problem though is how do we compute the fundamental value of commodities, in order to disentangle the effect of derivatives market? Difficult task!

Motivation

- To address the effect of derivatives markets (specifically futures) on the price of the underlying asset, we examine the market for **U.S. 10-year Treasury Notes**.
- Why do we choose the 10-year Treasury Note?
 - Market information allows us to obtain (to a reasonable extent) an accurate measure of the intrinsic value of the Note (a STRIPS-implied value is our benchmark for the fundamental value).
 - The U.S. Treasury market is one of the most liquid markets in the world.
 - The 10-year Treasury futures market is also a very liquid market and is used extensively as a hedge by mortgage investors and other portfolio managers.
 - In recent years (since 2003 with the introduction of the electronic platform) there has been an exponential increase in the open interest and trading volume in the futures market.

Motivation

Open Interest & Volume in the 10-year US. Treasury Futures Contract



Aim of Project

- Examine the link between conditions in the 10-year Treasury futures markets (in light of the exponential increase in the open interest since 2003) and the price of the underlying Treasury Note.
 - To achieve this, we need to investigate the delivery into these contracts and how this process affects the price of the deliverable securities. Is there a “*deliverability premium*” attached to these securities?
 - Delivery into the futures contract can be thought of as a non-convexity for the underlying Note, i.e. not part of the distribution of future cash flows (such as liquidity, or age of the bond, can be also thought as non-convexities).
- Examine the link between any premium attached into the deliverable securities, and their borrowing fees (specialness).
 - If a security trades at a premium to its fundamental price, it should also trade at a special rate in the repo market, consistent with the absence of arbitrage [Duffie (JF, 1996)].

Related Literature

- **Related Literature:**

- *Deliverability Premium*: Simpson and Ireland (JFQA, 1985), Garbade (1985), Kuipers (JFM, 2008).
- *On-the-Run/Off-the-Run Premium*: Pasquariello and Vega (JFE, 2008), Vayanos and Weill (JF, 2008), Babbel et al. (WP, 2001), Graveline and McBrady (WP, 2005).
- *Securities Shorting/Repo Specialness*: Duffie (JF, 1996), Jordan and Jordan (JF, 1997), Duffie, Garleanu, and Pedersen (JFE, 2002), Krishnamurthy (JFE, 2002), Nashikkar (WP, 2007), Nashikkar and Pedersen (WP, 2007).

Data

- **Treasury Note Market:**
 - Provided through Bloomberg.
 - Daily pricing on the 10-year and 7-year Notes.
 - Sample starts on June 3, 1991, until June 30, 2008.
 - Pricing on STRIPS to create an intrinsic value for each Note (due to lack of availability through Bloomberg, sample starts between May 15, 1997, until June 30, 2008).
 - In cases of missing STRIPS information, we searched for the data through *Wall Street Journal* archives.
- **Treasury Futures Market:**
 - Obtained from CBOT until Sept. 2005 contract, and remainder through Bloomberg.
 - Sample spans 68 contracts.
 - Since 2003, we have data from both the auction and electronic platform.

Data

- **Repurchase and Lending Rates:**
 - Daily general collateral rates through Bloomberg from May 15, 1997, to June 30, 2008.
 - Federal Reserve's Securities Lending program – through the New York Fed's website.
 - Sample spans from April 29, 1999 to June 30, 2008.

Table I

10-Year Futures Contracts & Deliverable Notes

Panel A: U.S. Treasury Notes Eligible for Delivery

	10-yr T-Notes	7-yr T-Notes
No. of Notes	68	8
No. of Reopenings	36	0
Offer. Amt (Includ. Reopenings)	17.47	9.56
First Issuance Date	5/16/1988	7/15/1991
Last Issuance Date	5/15/2008	4/15/1993
Ave. Coupon Rate	6.03	6.63

Panel B: 10-year U.S. Treasury Futures Contracts

	06/1991 - 05/2008	Pre-2003 Period	Post-2003 Period
No. of Contracts	68	46	22
Futures Return	0.0001 (0.0003)	0.0000 (0.0003)	0.0001 (0.0001) [0.48]
Open Interest	763,690 (491,737)	351,768 (292,453)	1,630,156 (1,641,195) [102.77]***
Δ in Open Int.	505 (478)	515 (479)	910 (477) [0.19]
Volume	331,675 (110,945)	87,815 (81,305)	844,257 (763,007) [95.44]***

Panel C: No. of Deliverables/Contract

	Median	Min.	Max.
No. of Deliverables/Contract	12	7	16

Empirical Analysis

- Delivery and Rollover:
 - We want to observe how delivery can impact the price of the underlying security.
 - Usual practice for traders to rollover their position to the nearby contract before start of delivery month.
 - Data on deliveries come from the CME website.
 - Upper bound for rollover is measured using the methodology of Holmes and Rougier (JEF, 2005).

Delivery of Most Delivered Bond as Function of its Issue Size

Actual Delivery of the Most-Delivered Bond as a Function of its Issue Size

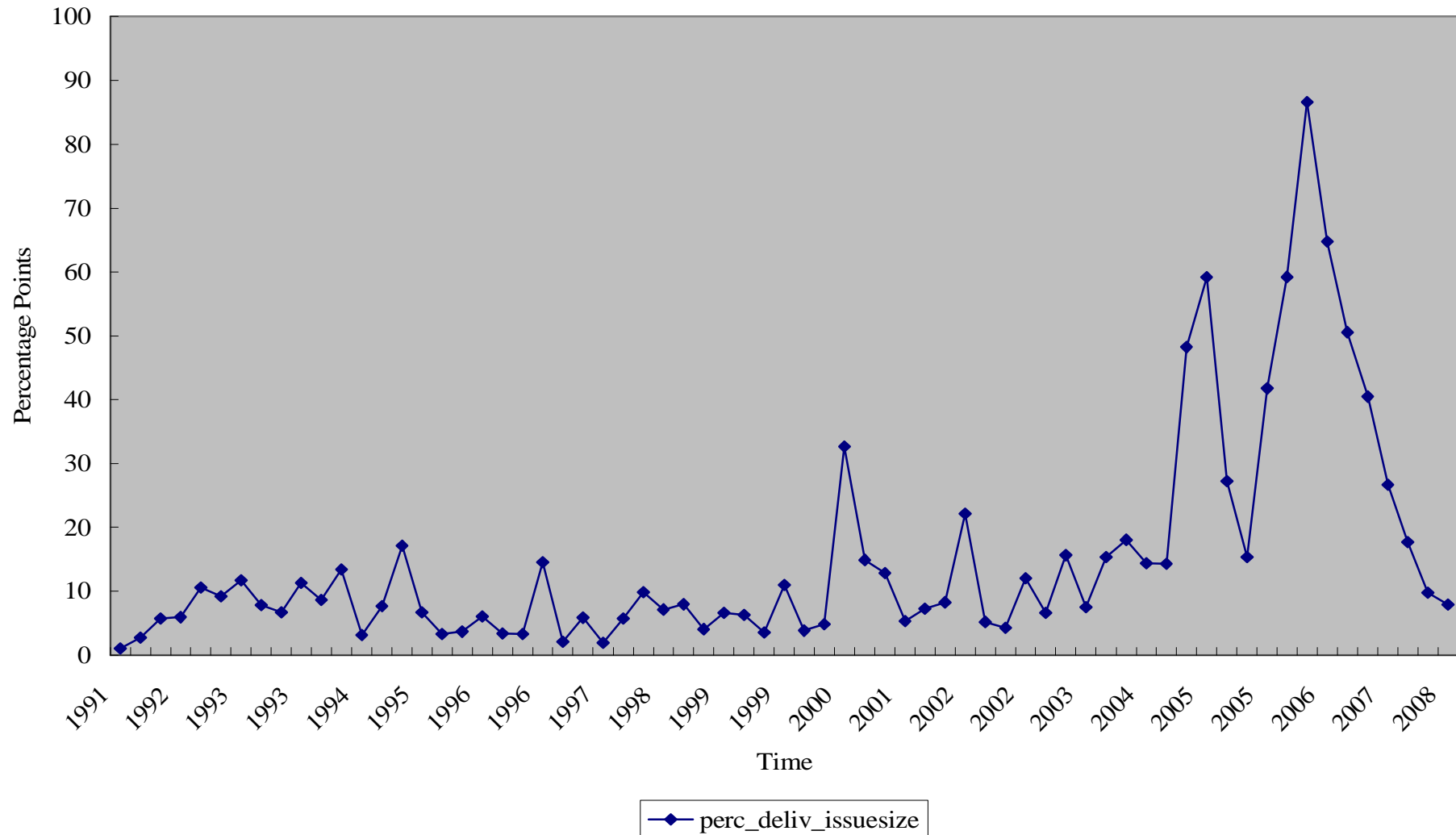


Table V

Deviations from STRIPS-Implied-Value (SIV)

	M e a n	M e d i a n
Panel A: All Notes*		
1997-2008	22	4
Pre-2003 Period	18	1
Post-2003 Period	25 [23.03]***	8
Panel B: On-the-Run Notes		
1997-2008	145	135
Pre-2003 Period	176	177
Post-2003 Period	113 [30.58]***	109
Panel C: 1st-Off-the-Run Notes		
1997-2008	105	96
Pre-2003 Period	115	113
Post-2003 Period	94 [10.89]***	84

Table V

Deviations from STRIPS-Implied-Value (SIV)

	M e a n	M e d i a n
Panel D: 2nd-Off-the-Run Notes		
1997-2008	85	75
Pre-2003 Period	87	81
Post-2003 Period	84	70
	[1.82]*	
Panel E: 3rd-Off-the-Run Notes		
1997-2008	68	63
Pre-2003 Period	63	60
Post-2003 Period	73	65
	[6.16]***	
Panel F: All Deliverables		
1997-2008	64	51
Pre-2003 Period	69	51
Post-2003 Period	60	51
	[12.40]***	
Panel G: All Deliverables, excluding On-the-Run, 1st, 2nd, and 3rd Off-the-Run Notes		
1997-2008	40	37
Pre-2003 Period	33	31
Post-2003 Period	45	41
	[21.06]***	
Panel H: CTD Notes		
1997-2008	21	28
Pre-2003 Period	33	27
Post-2003 Period	30	28
	[2.11]**	
Panel I: All Non-Deliverables		
1997-2008	1	-2
Pre-2003 Period	-1	-3
Post-2003 Period	3	-2
	[19.62]***	

Table VI

Determinants of Deviations from SIV

Variables	Predicted Sign	All Notes (84,488 obs.)	All Deliv. (26,447 obs.)	All Non-Deliv. (57,084 obs.)	OTR Notes (2,749 obs.)	CTD Note (2,610 obs.)
Intercept		2.24 (3.33)***	49.13 (16.25)***	1.28 (1.92)*	188.11 (12.21)***	19.24 (2.80)***
Issue Size (linearly de-trended)	-ve	-0.10 (2.63)*** [0.26] {0.22}	-0.79 (5.80)*** [0.86] {0.82}	0.37 (6.38)***	1.20 (0.86)	-0.35 (0.63)
Calendar Spr.	+ve		-0.09 (12.15)***			-0.26 (5.93)***
Gross Basis between CTD & 2nd CTD	+ve					0.10 (0.91)
Post-2003 Dummy	+ve	4.70 (9.76)*** 1.61 {0.89}	20.30 (6.71)*** [1.89]* {1.06}	3.27 (5.75)***	-36.71 (3.75)***	-5.49 (0.80)
Deliverable Dummy	+ve	39.54 (49.92)***				
OTR Dummy	+ve	140.36 (111.28)***	139.55 (64.33)***			
1st Off-the-Run Dum.	+ve	65.53 (72.17)***	62.44 (41.99)***			
2nd Off-the-Run Dum.	+ve	46.29 (58.52)***	43.08 (35.69)***			

GMM Regressions with Newey-West (1987) st. errors with 30 lags

Square Brackets: Deviations in significance using clustered st. errors in 1-dimension (Note)

Curly Brackets: Deviations in significance using clustered st. errors in 2-dimensions (Note & year)

Table VI

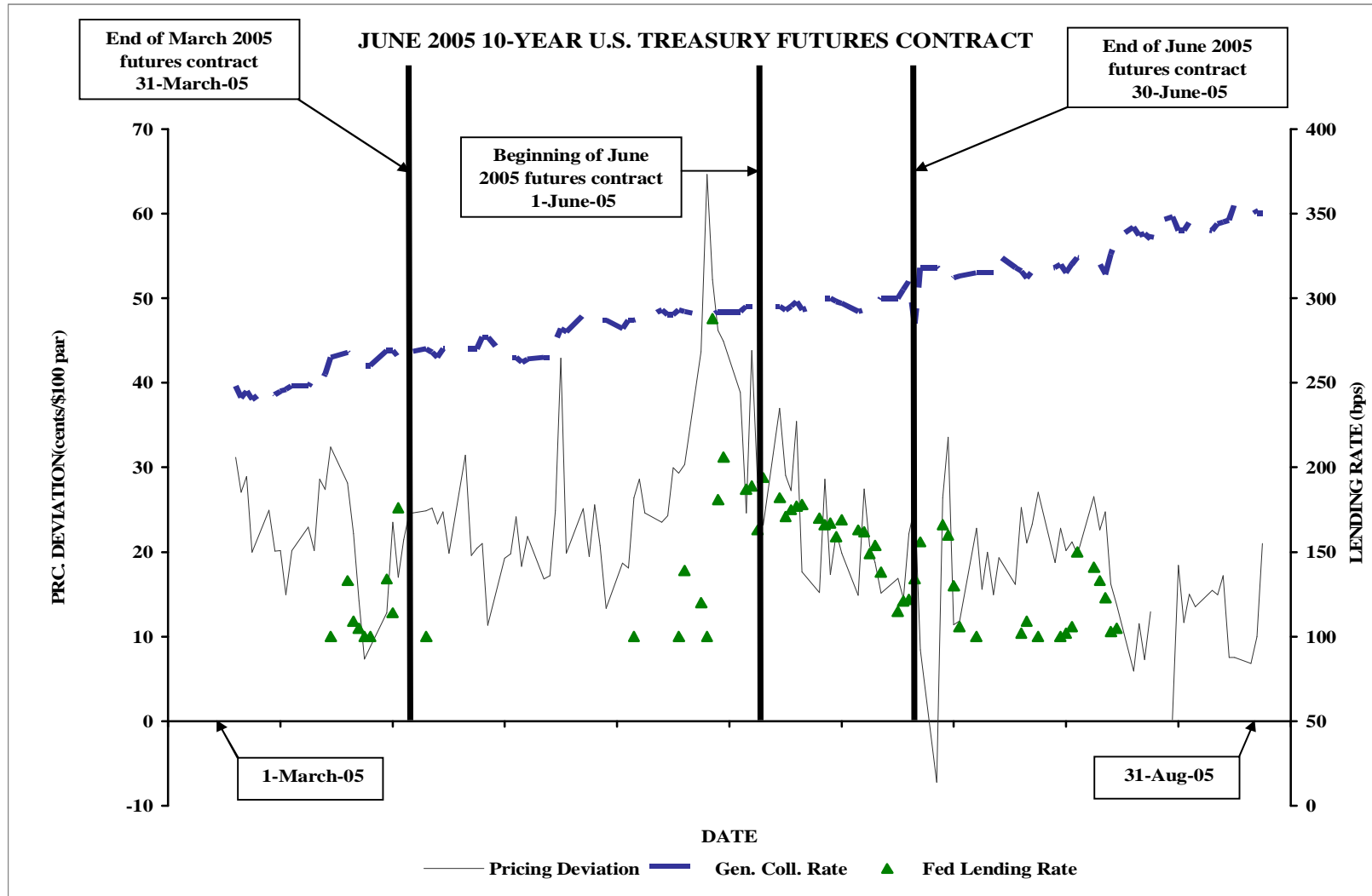
Determinants of Deviations from SIV

Variables		All Notes (84,488 obs.)	All Deliv. (26,447 obs.)	All Non-Deliv. (57,084 obs.)	OTR Notes (2,749 obs.)	CTD Note (2,610 obs.)
3rd Off-the-Run Dum.	+ve	29.39 (42.64)***	25.95 (25.85)***			
CTD Dummy	+ve	-12.50 (15.32)***	-8.51 (7.02)*** [1.70]* {2.27}**			
Open Int./Issue Size	+ve				-6.05 (4.58)***	-0.69 (0.77)
Open Int./Size of All Deliv. Issues	+ve		-38.91 (5.83)*** {1.14}			
Deliv. x Post-2003 Period	+ve	1.62 (1.49)				
OTR. x Post-2003 Period	-ve	-69.79 (48.66)***	-75.42 (32.87)***			
CTD x Post-2003 Period	+ve	-2.41 (2.40)** [0.27] {0.31}	-8.17 (5.33)** [0.99] {1.11}			
Adj. R²		0.589	0.568	0.016	0.311	0.196

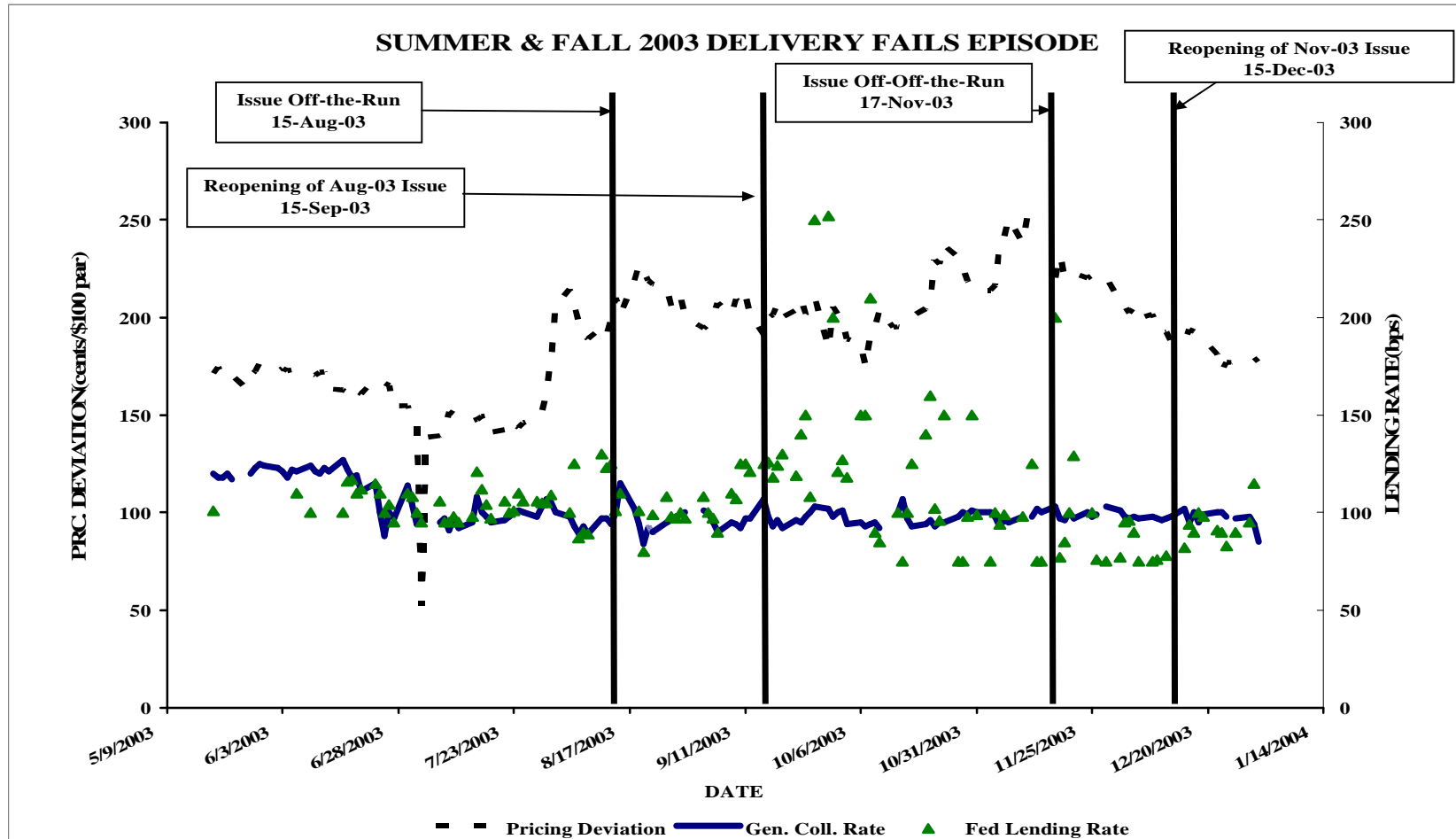
Specialness

- In this section, we want to observe whether the premium of the bond can be partially explained by its specialness, i.e. the fact that you are paying higher borrowing fees to gain control of a security that is trading at a premium.
- We use the daily data from the Fed's Securities Lending Program as indicators of specialness.

Case Analysis (4 7/8% 10-year Note issued on February 15, 2002)



Summer & Fall 2003 Delivery Fails Episode



Impact of the Repo Market on SIV Deviations

Variables	Predicted Sign	All Notes (68,001 obs.)	All Notes (68,001 obs.)	All Notes (68,001 obs.)
Intercept		2.73 (3.08)***	3.69 (4.12)***	-2.65 (2.01)**
Post-2003 Dummy	+ve	0.78 (0.10)	-0.66 (0.80)	1.81 (1.42)
Deliverable Dummy	+ve	59.50 (91.16)***	59.76 (91.83)***	49.29 (27.06)***
OTR Dummy	+ve	75.59 (67.29)***	78.45 (70.28)***	67.46 (10.33)***
CTD Dummy	+ve	-27.26 (38.95)***	-27.39 (39.12)***	-26.95 (7.64)***
Specialness Dummy	+ve	40.24 (19.09)***		
Specialness x Post-2003 Period	-ve	-26.83 (11.28)***		
Degree of Repo Specialness	+ve		0.09 (10.48)*** [1.89]* {2.30}**	
Total Future Specialness	+ve			0.003 (13.79)***
Adj. R ²		0.513	0.504	0.553

GMM Regressions with Newey-West (1987) st. errors with 30 lags

Square Brackets: Deviations in significance using clustered st. errors in 1-dimension (Note)

Curly Brackets: Deviations in significance using clustered st. errors in 2-dimensions (Note & year)

Conclusion

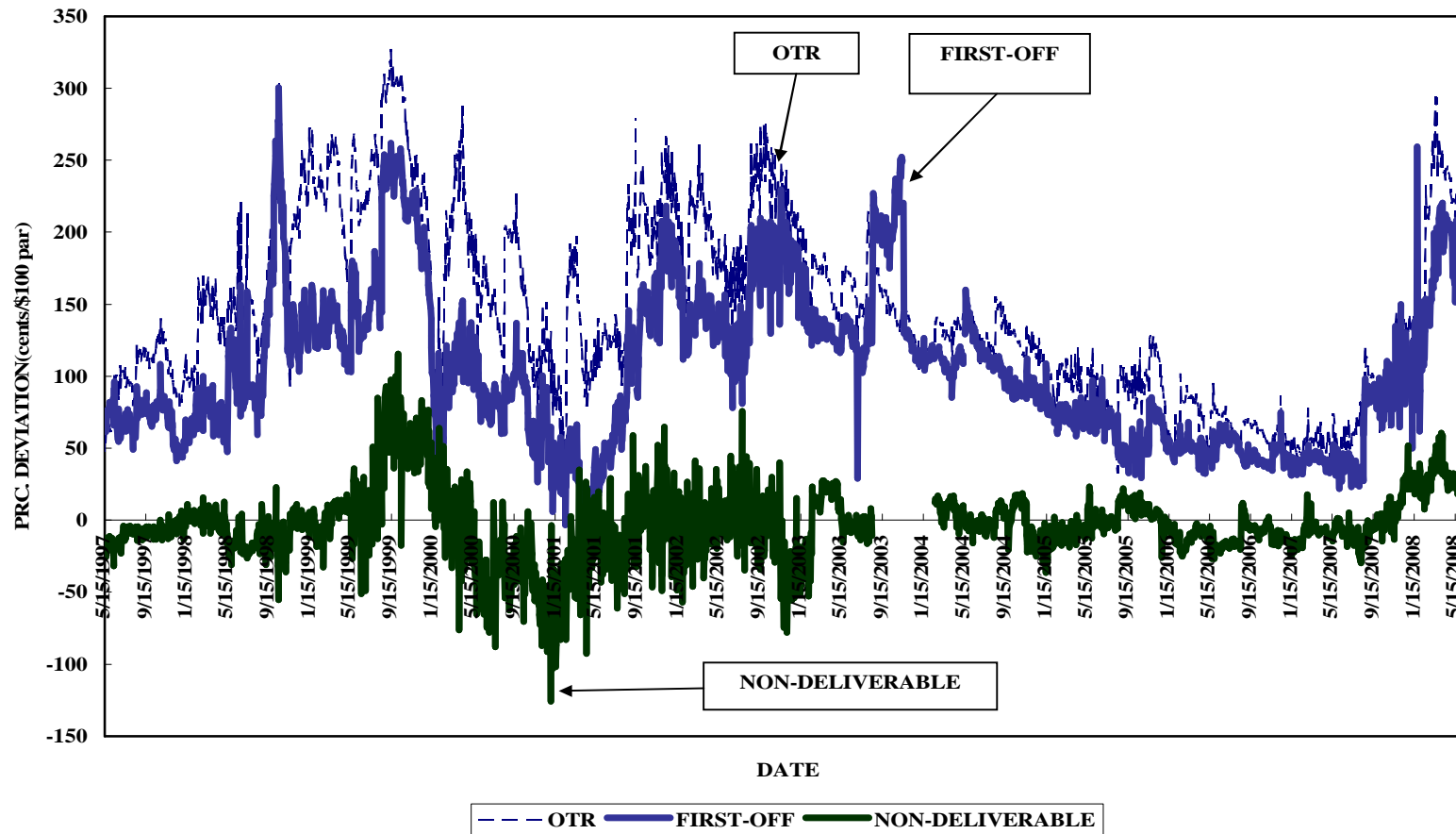
- There is a positive price premium on our Note sample that is diminishing with age of issue.
- We document the “*On-the-Run*” phenomenon that has diminished in the post-2003 period.
- We observe a “*deliverability*” phenomenon that has increased concurrently with the explosion in the futures market.
- Consistent with previous findings, there is a positive and statistically significant effect of the specialness of the security on its price premium.

New Version

- Concentrate more on any scenarios that create deviations from the fundamental price for the 10-year Treasury Note market.
- Obviously, the deliverability into the futures contract and the fear of a squeeze is one such case.
- Costs of delivery fails into a short position is another scenario.
- We also run a Principal Component Analysis and find that the idiosyncratic variation in the pricing deviations has decreased in recent years.
- The markets are becoming more integrated (less segmented) – since 2005 one single factor can explain 80% of the variation in the pricing deviations.

Pricing Deviation Pattern

PRICING DEVIATION (OTR, FIRST-OFF-THE-RUN, NON-DELIVERABLE)



Thank You!

