

*Trading Activity in the Indian  
Government Bond Market  
December 16, 2016*

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# Government of India Bond Market is Interesting

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- It is a large and growing market
  - Fourth largest after Japan, China and South Korea
    - 569 billion USD of outstanding bonds as of March 2014
  - Secondary market turnover comparable to Japan and South Korea
    - annual trading volume is four times debt outstanding
- Near-laboratory like nature following the Fiscal Responsibility and Budget Management Act of 2003
- NDS-OM was one such transformational change
  - Price transparency with NDS-OM
  - Search costs reduced with NDS-OM

## Negotiated Dealing System-Order Matching System (NDS-OM) launched in August 2005 was a transformational change

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- Electronic, screen-based trading system
- Participants place anonymous bid/offers on screen
- Order driven with bids and offers matched on price/time priority
- Participants can observe market in real time

# Objective

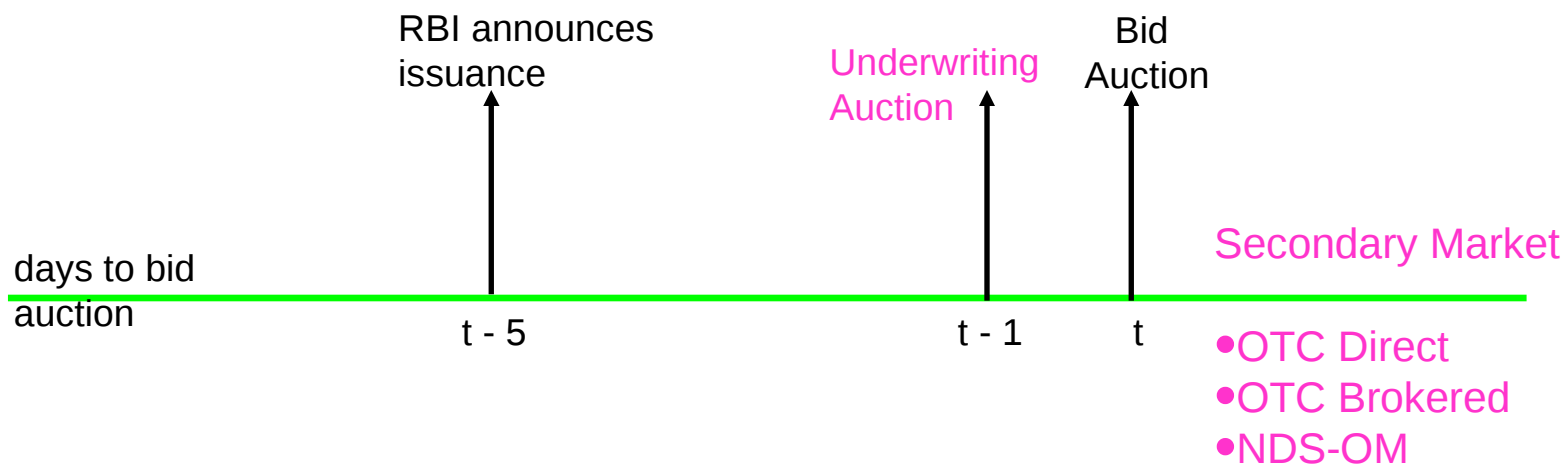
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- Is there an “NDS-OM” effect?
  - Meaningful assessment of effect possible as sample begins in 2003 and NDS-OM went live in August 2005
  - Direct effect on secondary market
  - But also cross-market effect on primary market

# Underwriting Auction unique feature of the Indian Government Bond Issuance Process

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Primary Market



# Primary dealers underwrite issuance for the Reserve Bank of India through a two-part commitment

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- Minimum underwriting commitment (MUC) obligates dealers to underwrite 50% of issuance split equally
- Multiple price auction for the remaining 50%
  - Dealers obligated to bid an amount no less than MUC
- Bids are price -quantity pairs
  - Price is underwriting commission in paise/100 INR
  - Quantity is INR amount willing to underwrite over and above minimum commitment
- Serious bidding rewarded by linking commission for minimum commitment to auction outcome
- Underwriting commissions not tied to success in bid auction that follows

## Succeeding bid auction is similar to treasury auctions in other countries

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- Twist is that it RBI could decide whether it should be multiple price or single price
- Open to entities other than primary dealers
  - Direct bidders are entities with current or securities account with RBI
  - Others are indirect bidders

# Negotiated Dealing System-Order Matching System (NDS-OM) launched in August 2005 was a transformational change

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		OTC Direct	OTC Brokered
Trading venue		telephone	Telephone via NSE/BSE registered brokers
Participants		Direct and indirect bidders in primary market auctions	
Participant identity anonymous?		no	
Reporting		15-minute delay from trade execution but not strictly enforced	
Pre-trade transparency	Participants	none	
	Public		
Post-trade transparency	Participants	15-minute delay	
	Public		



# Negotiated Dealing System-Order Matching System (NDS-OM) launched in August 2005 was a transformational change

		OTC Direct	OTC Brokered	NDS-OM
Trading venue		telephone	Telephone via NSE/BSE registered brokers	Electronic, screen-based, order-matching
Participants		Direct and indirect bidders in primary market auctions		
Participant identity anonymous?		no		yes
Reporting		15-minute delay from trade execution		real-time
Pre-trade transparency	Participants	none		real-time
	Public			real-time of five best bid/offers
Post-trade transparency	Participants	15-minute delay		real-time
	Public			real-time

## Data

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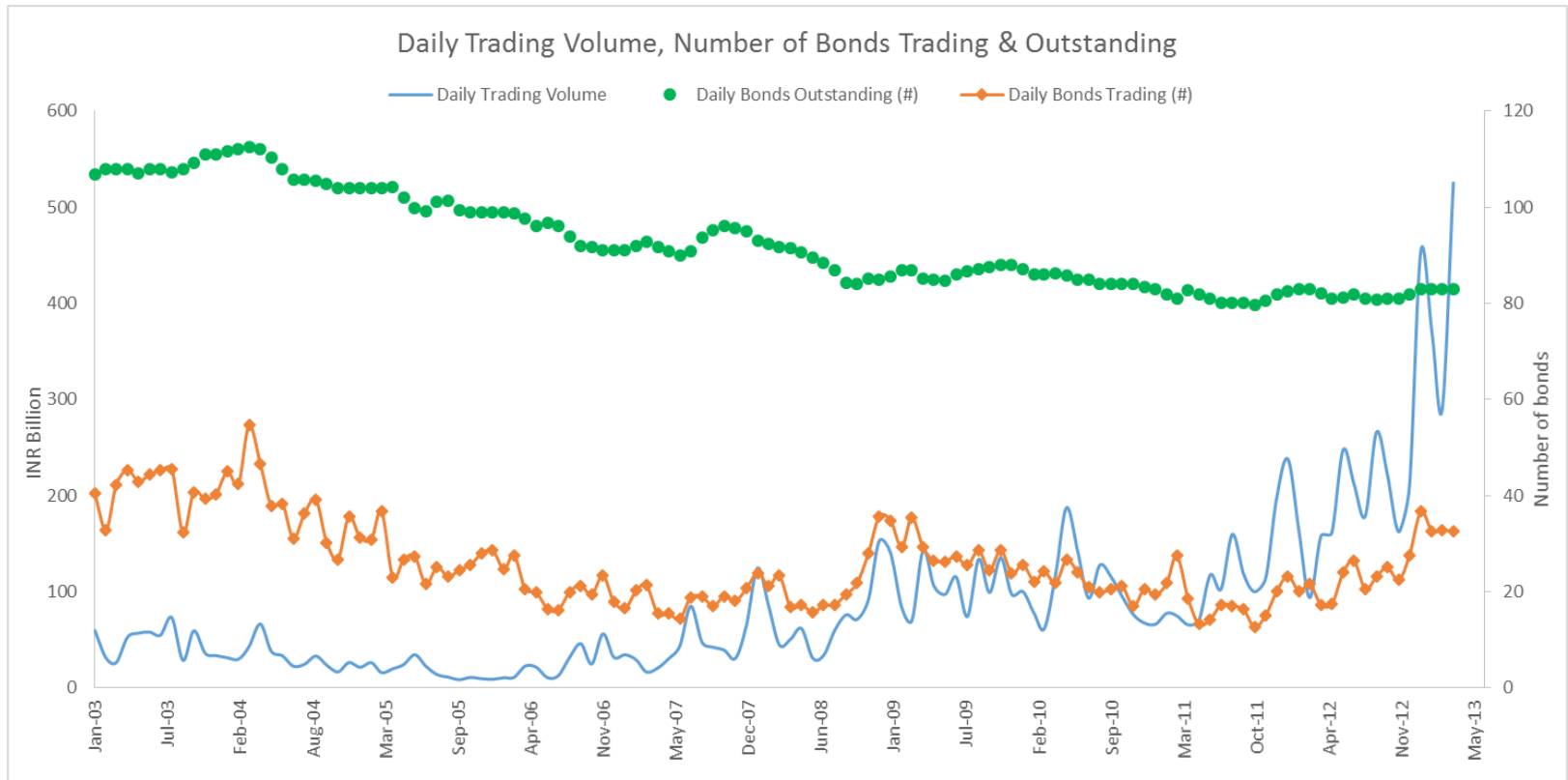
- Underwriting auction-level data for each auction
- Secondary market daily data for each bond
  - trade data by sub-market
  - whether or not FIMMDA-deemed benchmark
  - whether or not Bloomberg tenor-specific benchmark
    - 2-10, 15, 30
- Study covers 2003 to 17 April 2014

## Results: Was there an “NDS-OM” effect?

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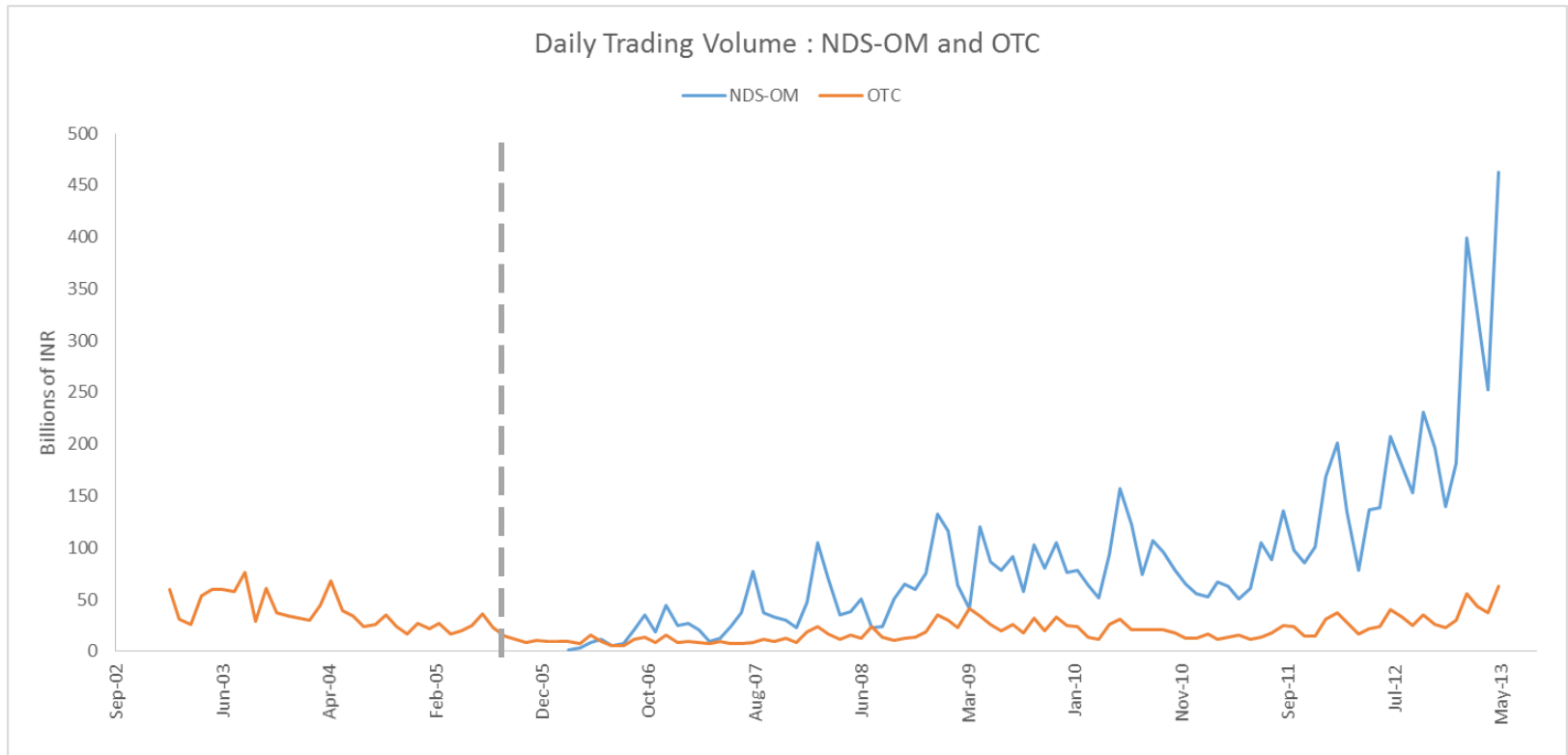
- NDS-OM increased trading activity
  - Trading volume conditional on trading increased significantly
  - Liquidity migrated to NDS-OM sub-market
- Underwriting commissions declined by ~4 paisa/100 INR
- Trading in non-benchmark-like securities concentrates on OTC market
  - Liquidity moves away from NDS-OM to direct OTC sub-market during periods of market turmoil
- Secondary market price efficiency improves after NDS-OM
  - OTC sub-market passes standard efficiency tests after NDS-OM but not before
  - NDS-OM sub-market passes standard efficiency tests
  - OTC and NDS-OM last prices converge on days trading observed on both sub-markets but not otherwise

# NDS-OM increased trading activity



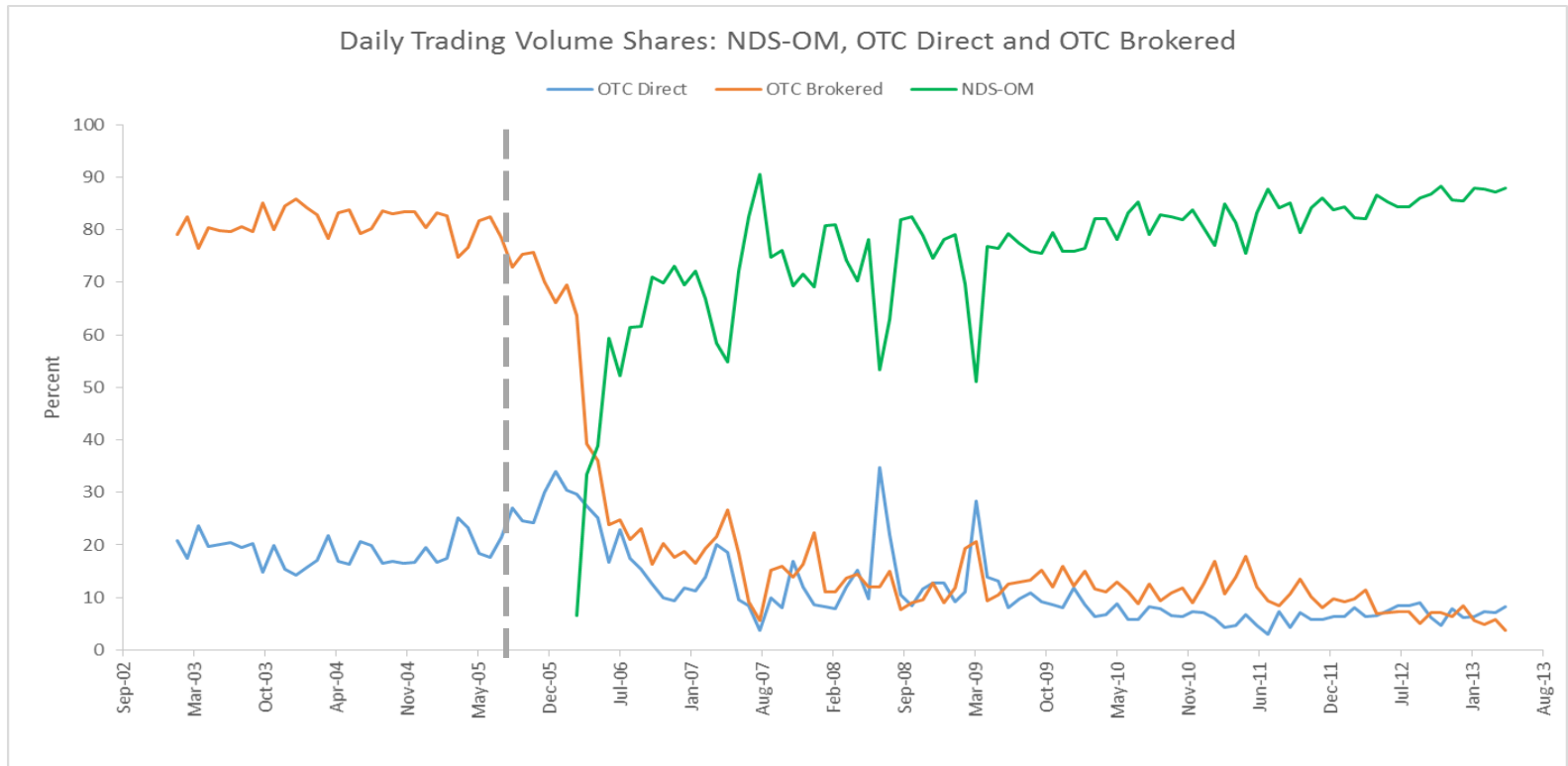
Source: Authors' calculations based on data from Clearing Corporation of India Ltd. and Internal Debt Management Department of Reserve Bank of India

# Liquidity migrated to NDS-OM sub-market



Source: Authors' calculations based on data from CCIL and IDMD, RBI

# NDS-OM sub-market gained market at the expense of the brokered OTC sub-market



Source: Authors' calculations based on data from CCIL and IDMD, RBI

# Unconditional trading volume declines after NDS-OM

Daily Trading Volume Left-Censored Tobit Regression								
Variable Name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FIMMDA benchmark	15.630** *							12.062** *
	(2.648)							(2.084)
NDS-OM		-0.629 (0.740)						<b>-3.678***</b> (0.691)
Coupon rate			-1.116*** (0.256)					-0.122 (0.147)
Amount outstanding				26.367** *				18.351** *
				(4.870)				(3.636)
Time since original issuance					-0.878*** (0.172)			-0.389*** (0.100)
Tenor at original issuance						-0.265*** (0.086)		-0.009 (0.054)
Volatility							-0.783 (0.972)	0.144 (0.692)
Constant	-12.016** *	-9.262***	0.405	-13.847** *	-3.344***	-5.328***	-9.654***	-8.636***
	(1.912)	(1.767)	(2.063)	(2.272)	(0.921)	(1.471)	(1.561)	(2.631)
Observations	246,213	246,213	246,213	246,213	246,213	246,213	221,232	221,232

Notes: Heteroskedasticity consistent standard errors clustered by ISIN are reported in the parentheses. One-, two-, and three- asterisks indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

# Probability of a bond trading declines after NDS-OM

What Trades Logit Regression								
Variable Name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FIMMDA benchmark	2.764*** (0.122)							2.241*** (0.116)
NDS-OM		-0.397*** (0.123)						-1.147*** (0.097)
Coupon rate			-0.153*** (0.033)					-0.042 (0.030)
Amount outstanding				3.717*** (0.347)				3.310*** (0.360)
Time since original issuance					-0.138*** (0.017)			-0.071*** (0.012)
Tenor at original issuance						-0.030** (0.012)		0.019* (0.010)
Volatility							-0.026 (0.095)	0.141* (0.082)
Constant	-1.379*** (0.076)	-0.655*** (0.118)	0.466 (0.332)	-1.535*** (0.098)	0.024 (0.136)	-0.427** (0.206)	-0.890*** (0.093)	-0.619 (0.384)
Observations	246,213	246,213	246,213	246,213	246,213	246,213	221,232	221,232

Notes: Heteroskedasticity consistent standard errors clustered by ISIN are reported in the parentheses. One-, two-, and three- asterisks indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.



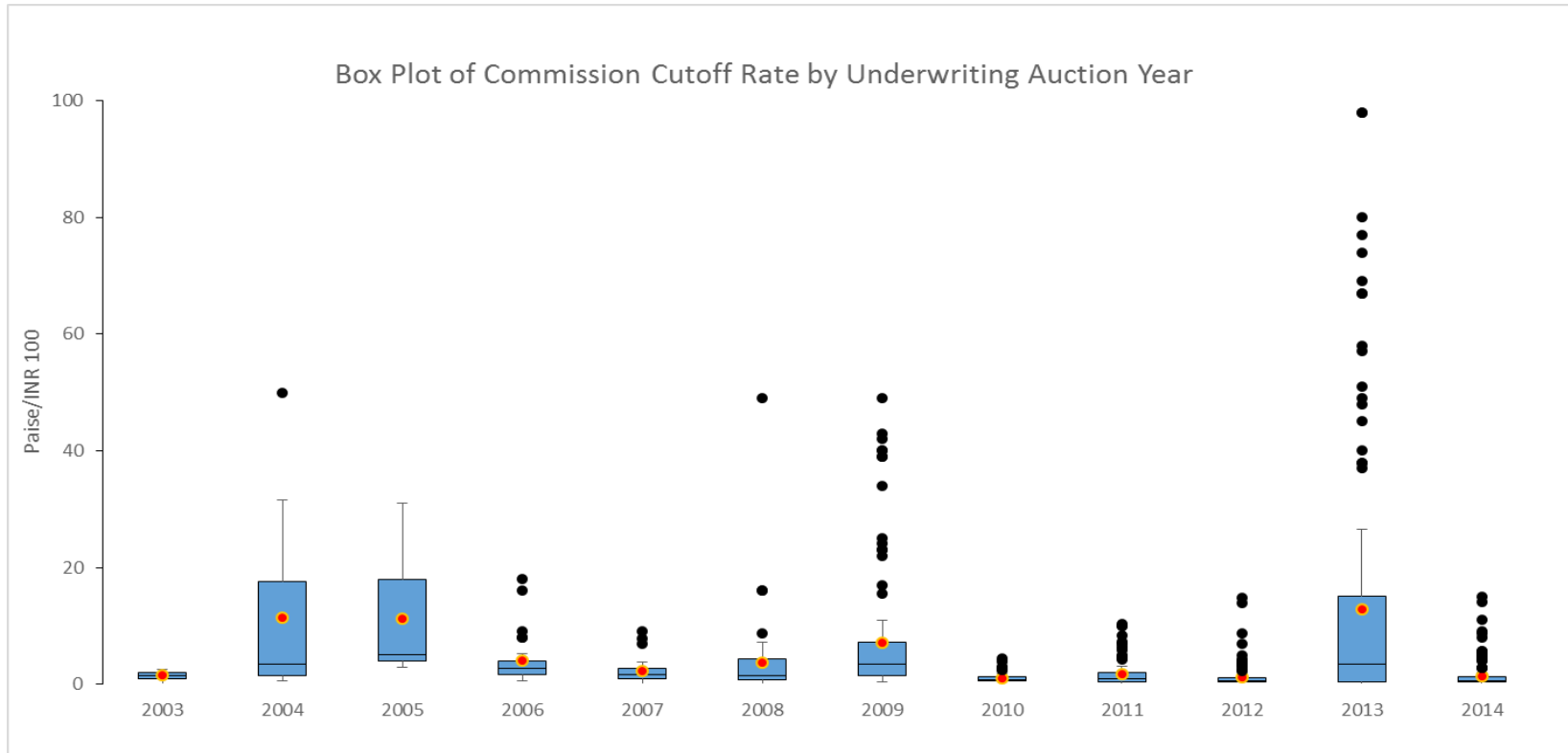
# Conditional on trading, daily volume increased by ~3 billion INR after NDS-OM

## Daily Trading Volume Regression

Variable Name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FIMMDA benchmark	5.720*** (1.203)							4.486*** (0.995)
NDS-OM		3.553*** (0.811)						2.917*** (0.740)
Coupon rate			-0.395*** (0.122)					0.249 (0.179)
Amount outstanding				12.097*** (3.106)				5.046** (2.468)
Time since original issuance					-0.391*** (0.092)			-0.233** (0.099)
Tenor at original issuance						-0.184*** (0.046)		-0.119** (0.055)
Volatility							-1.183 (1.153)	-1.374 (0.996)
Constant	0.830*** (0.119)	0.974*** (0.139)	6.499*** (1.336)	0.286 (0.414)	5.068*** (0.891)	5.925*** (1.130)	3.599*** (0.776)	-0.172 (1.846)
Observations	70,575	70,575	70,575	70,575	70,575	70,575	64,007	64,007
Adjusted R-squared	0.060	0.023	0.005	0.043	0.029	0.013	0.001	0.106

Notes: Heteroskedasticity consistent standard errors clustered by ISIN are reported in the parentheses. One-, two-, and three- asterisks indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

# Underwriting commissions have declined and highly dispersed around global financial crisis



Notes: The black line inside the box (red dot) represents the median (mean) cutoff rate for underwriting auctions held that year.

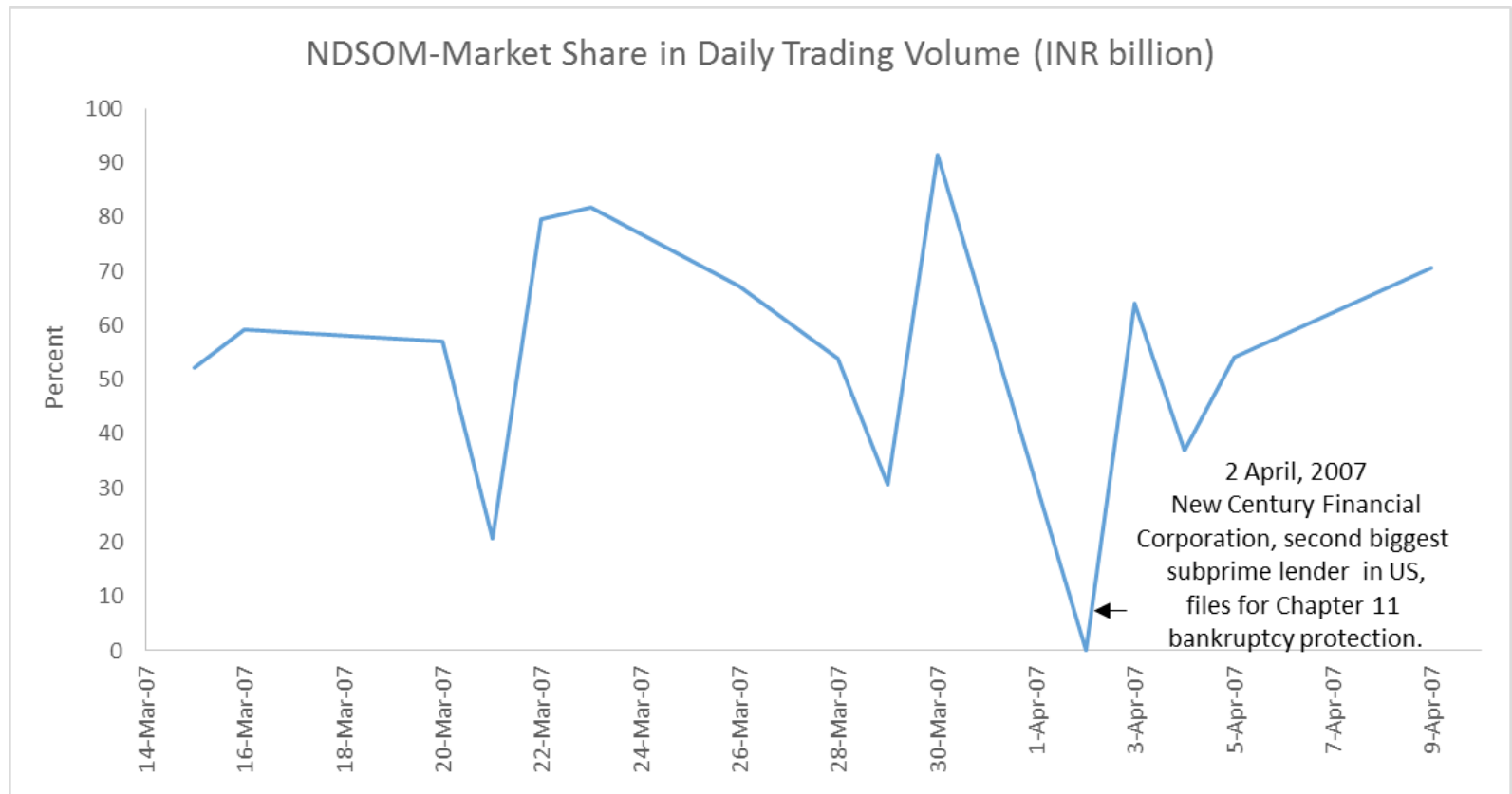
Source: Authors' calculations based on data from "Press Releases" section of the RBI website

# Underwriting commissions are significantly lower post-NDSOM

Log Underwriting Commission Regression											
Variable Name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
NDS-OM	-0.94*** (0.208)										-1.24*** (0.200)
Volatility		1.30*** (0.061)									1.24*** (0.060)
Liquidity adjustment facility			-0.47*** (0.053)								-0.27*** (0.055)
Uniform price auction				-0.13 (0.111)							-0.03 (0.102)
Reissued bond					0.47** (0.195)						0.52*** (0.179)
Bid-to-cover						-0.50*** (0.071)					-0.31*** (0.063)
In(IssuanceSize)							-0.34*** (0.125)				-0.14 (0.113)
Residual maturity								0.04*** (0.006)			0.03*** (0.006)
FIMMDA benchmark									-0.38*** (0.103)		-0.27*** (0.085)
Coupon rate										-0.19*** (0.062)	0.15** (0.069)
Constant	1.37*** (0.202)	2.02*** (0.086)	0.57*** (0.046)	0.57*** (0.098)	0.03 (0.189)	1.70*** (0.183)	1.69*** (0.458)	-0.07 (0.092)	0.74*** (0.087)	1.98*** (0.494)	2.50*** (0.702)
Observations	861	797	861	861	861	861	861	861	861	861	797
Adjusted R-Squared	0.021	0.372	0.060	0.001	0.004	0.056	0.008	0.047	0.016	0.008	0.514

Notes: Heteroskedasticity consistent standard errors are reported in the parentheses. One-, two-, and three- asterisks indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

# Liquidity moves to OTC sub-market from NDS-OM sub-market: event analysis



Notes: The chart plots the daily trading volume (INR billion) by the month for the NDS-OM and OTC sub-markets for the period January-2003 to April-2013.  
Source: Authors' calculations based on data from CCIL, Bloomberg and IDMD, RBI

# Trading volume of non-benchmark-like bonds concentrates on OTC relative to NDS-OM

OTC Trading Share Tobit Regression							
Variable Name	(1)	(3)	(4)	(5)	(6)	(7)	(8)
FIMMDA benchmark	-0.619*** (0.072)						-0.410*** (0.059)
Coupon rate		0.089*** (0.032)					0.025 (0.020)
Amount outstanding			-1.238*** (0.194)				-0.751*** (0.130)
Time since original issuance				0.065*** (0.006)			0.024*** (0.006)
Tenor at original issuance					0.028*** (0.007)		0.021*** (0.003)
Volatility						0.153** (0.077)	0.002 (0.059)
Constant	0.937*** (0.074)	-0.064 (0.287)	1.052*** (0.097)	0.320*** (0.053)	0.218** (0.096)	0.573*** (0.060)	0.421** (0.199)
Observations	42,415	42,415	42,415	42,415	42,415	36,940	36,940

Notes: Heteroskedasticity consistent standard errors clustered by ISIN are reported in the parentheses. One-, two-, and three- asterisks indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

## Results: Was there an “NDS-OM” effect?

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- Underwriting commissions declined by ~4 paisa/100 INR
- NDS-OM increased trading activity
- Liquidity migrated to NDS-OM sub-market
- **Secondary market price efficiency improves after NDS-OM**

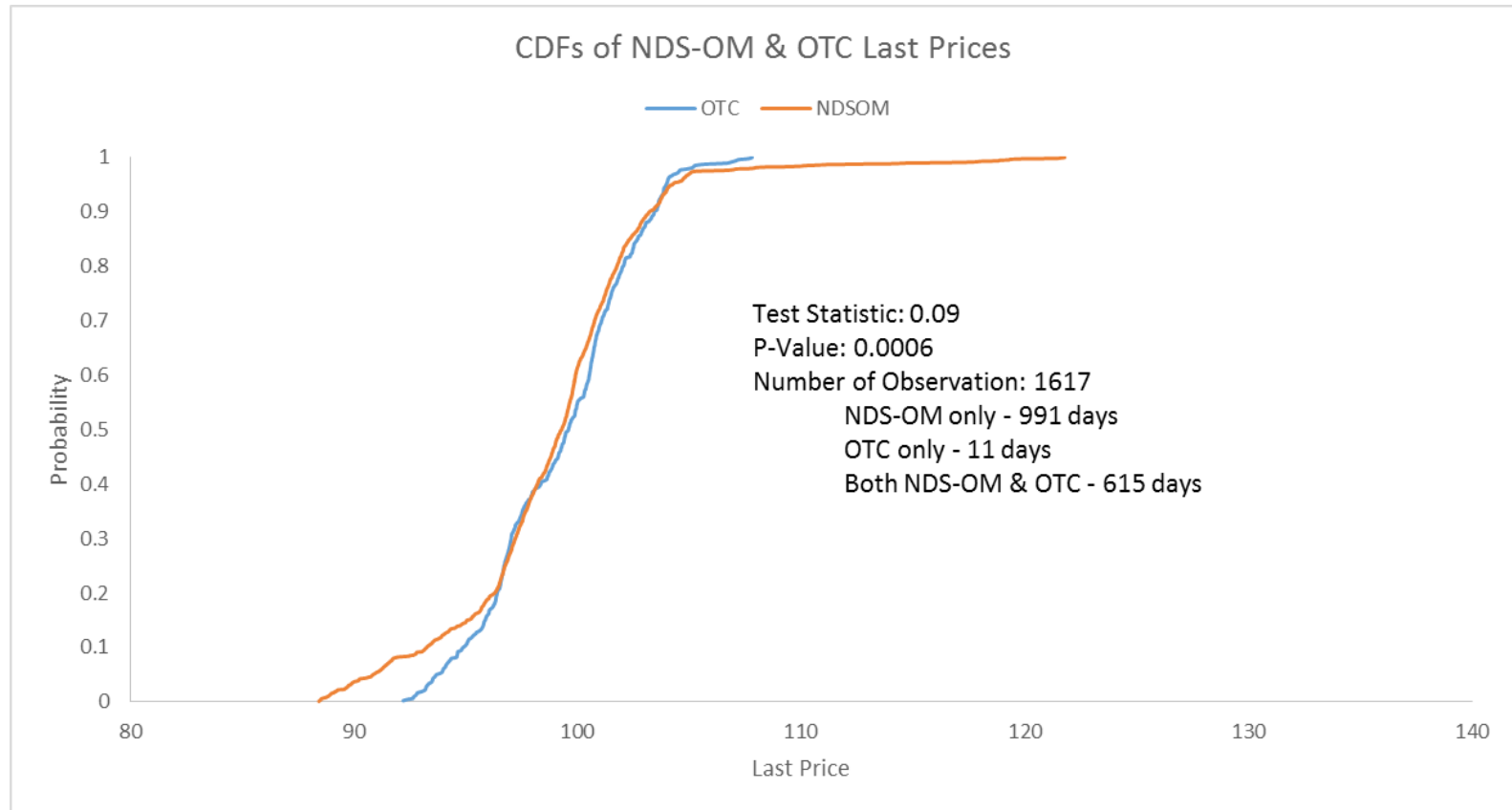
# OTC and NDS-OM Bloomberg benchmark bond last prices converge on days trading observed on both sub-markets

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Benchmark Tenor	Kolmogorov-Smirnov Test Statistic	P-Value	Observations
Overall	0.02	0.98	1391
2	0.25	1.00	4
4	0.10	0.78	93
5	0.04	1.00	201
6	0.04	1.00	48
7	0.09	0.90	76
8	0.08	0.99	60
9	0.04	1.00	111
10	0.01	1.00	615
15	0.06	0.90	187
30	0.05	0.99	196

Source: Authors' calculations based on data from Bloomberg, CCIL and IDMD, RBI.

# OTC and NDS-OM Bloomberg benchmark bond last prices do not converge otherwise



Source: Authors' calculations based on data from Bloomberg, CCIL and IDMD, RBI.



# OTC and NDS-OM Bloomberg benchmark bond last prices do not converge otherwise

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Benchmark Tenor	Kolmogorov-Smirnov Test Statistic	P-Value	Observations
Overall	0.08	0	10,203
2	0.42	0.5	814
4	0.39	0	728
5	0.39	0	1121
6	0.38	0	944
7	0.33	0	1170
8	0.34	0	929
9	0.15	0.02	751
10	0.09	0.0006	1617
15	0.05	0.82	562
30	0.20	0	844

Source: Authors' calculations based on data from Bloomberg, CCIL and IDMD, RBI.

# OTC sub-market passes standard efficiency tests after NDS-OM but not before

## Kendall Tau Test

Period	N	$\tau$ Coefficient	Standard Error	P-Value
All	2187	-23039	34103.19	0.499
Before NDSOM	570	-7493	4541.926	0.099
After NDSOM	1617	4912	21684.12	0.821

Notes: The table reports the results of the Kendall Tau efficiency test for the period January 1, 2003 to April 22, 2013 using the daily 10-Year Bloomberg benchmark OTC price

Source: Authors' calculations based on data from CCIL, Bloomberg and IDMD, RBI.

# OTC sub-market passes standard efficiency tests after NDS-OM but not before

Variance Ratio Test

Period	N	Number of Lags (Q)	VR(Q)	P-Value
All	2173	2	0.96	0.34
	2173	4	0.94	0.53
	2173	8	0.60	0.18
	2173	16	0.46	0.21
Before NDS-OM	556	2	0.96	0.11
	556	4	1.29	0.00
	556	8	1.45	0.00
	556	16	1.52	0.00
After NDS-OM	1601	2	0.96	0.40
	1601	4	0.91	0.37
	1601	8	0.53	0.14
	1601	16	0.37	0.18

Notes: The table reports the results of the variance ratio test for the period January 1, 2003 to April 22, 2013 using the 10-Year Bloomberg benchmark OTC price  
 Source: Authors' calculations based on data from CCIL, Bloomberg and IDMD, RBI.

# NDSOM sub-market passes standard efficiency tests

## Kendall Tau Test

N	$\tau$ Coefficient	Standard Error	P-Value
1566	36124	20666.8	0.08

## Variance Ratio Test

N	Number of Lags (Q)	VR(Q)	P-Value
1625	2	0.90	0.38
1625	4	0.84	0.35
1625	8	0.79	0.30
1625	16	0.76	0.30

Notes: The table reports the results of the Kendall Tau efficiency test and Lo Mackinlay Variance Ratio test for the period August 8, 2005 to April 22, 2013 using the daily 10-Year Bloomberg benchmark NDSOM price  
Source: Authors' calculations based on data from CCIL, Bloomberg and IDMD, RBI.

## Further thoughts...

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- Does transparency improve market quality?
- What determines traders' choice of trading venue when there is co-existence of multiple markets?

# Does reporting and quick public dissemination improve market quality?

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- Theoretical work suggests the effect could go either way
  - Biais, Glosten, and Spatt (2005), Madhavan (1995), Pagano and Roell (1996), Naik, Neuberger, and Viswanathan (1999)
- Empirical papers on US experience with government bonds (GovPx), corporate bonds (TRACE), and municipal bonds (MSRB) report mixed results with different metrics
  - Decline in transaction costs, price dispersion: Bessembinder, Maxwell, and Venkataraman (2006), Edwards, Harris, and Piwowar (2007), Goldstein, Hotchkiss, and Sirri (2007)
  - Trading activity has declined: Asquith, Covert and Pathak (2013)
- “NDS-OM” effect adds to this debate
  - Secondary market transparency has the potential to reduce primary debt issuance costs as well
  - Future analysis with transaction data in future work

# What determines traders' choice of trading venue when there is co-existence of multiple markets?

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- Security-specific features determine self-selection to a market
  - Barclay, Hendershott and Kotz (2006): voice vs electronic IDB market for US treasury securities
- Information asymmetry
  - Zhu (2013): higher execution probability of orders in "lit" (stock exchange) vs dark venue (crossing networks, dark pools) for the informed vs uninformed traders steers informed to the transparent and uninformed to the dark venue.
  - Ye (2012): informed traders more likely to hide their information in the dark
  - Workup vs initiating market order in IDB electronic trading platform (BrokerTec) for US treasuries (Fleming and Nguyen, 2013)
- NDS-OM vs OTC initial analysis suggests that price discovery is more likely in OTC during heightened market volatility
  - Future analysis with transaction data in future work

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