Structural Changes and the Indian Government Bond Market*

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December 3, 2015

* The authors are grateful for the excellent research assistance of Vinod Dharmarajan, Weiling Liu, M. Adki, Maruti Nandan Srivastava and Zach Wojtowicz. Helpful comments from K. Biju, Golaka C. Nath, Ravi Rajan, and seminar participants at the workshop organized by the Internal Debt Management Department of the Reserve Bank of India are acknowledged. The views expressed in this paper are solely those of the authors and do not represent the views of the institutions to which the authors are affiliated. For correspondence, email:samitasareen@gmail.com or michael.fleming@ny.frb.org.

I. Introduction

An efficient and well-functioning government securities market is central to the smooth functioning of financial markets more generally. It enables the use of the market for pricing and hedging positions in other fixed income securities, facilitating issuance and secondary market trading in such securities. Government securities' creditworthiness and liquidity can also make them benchmarks for risk-free rates and for pricing instruments in other markets. Such features also make government bonds an important store of value, especially during times of market turmoil. A well-functioning market also facilitates the low-cost financing of government expenditures and the implementation of monetary policy, which is often carried out through the market.

The Indian government bond market is particularly worthy of study. For one, there is its large and growing size and liquidity. Within Asia, India has the fourth largest government bond market after Japan, China and South Korea with 569 billion USD of outstanding government bonds as of March 2014 (Asian Development Bank, 2014). The turnover of the secondary market for government of India bonds is comparable to that of Japan and South Korea, and much more than that of China, with annual trading volume over four times the debt outstanding. Numerous studies describe this important market, including Nath, Rajaram and Ghose (2009), Mohan and Ray (2009), Gandhi (2012), Reddy (2002), and Mohanty (2002).

Until as late as the 1990s, Indian government debt issuance was dominated by fiscal considerations, with automatic monetization of fiscal deficits, and interest rates that were administered to contain borrowing costs. Consequently, there was little scope for the development of a government securities market. That changed with the Fiscal Responsibility and Budget Management Act of 2003, which aimed to bring the government's revenue deficit to zero and fiscal deficit to 3% of GDP over time, while at the same time eliminating the direct participation of the Reserve Bank of India (the central bank) in the issuance of government securities. The act in turn unleashed changes in market infrastructure, making the Indian government securities market a virtual laboratory for analyzing the effects of market structure changes on issuance costs, liquidity and informational efficiency.

One such change was the launch in August 2005 of the anonymous electronic order matching trading system, Negotiated Dealing System-Order Matching System (NDS-OM). It transformed the trading and reporting protocols in the secondary market for government bonds fundamentally in at least two ways. First, it provided an alternative marketplace for government bonds that involved lower search costs for trade execution relative to over-the-counter (OTC) trading, the primary mode of price discovery and trading prior to NDS-OM. Second, since trade book and order-book information could be reported in real time with NDS-OM, it could be publically disseminated in real time as well, in contrast to the OTC market where trade data is published with a 15-minute lag.

This paper studies the Indian government bond market with a view to better understanding how it has changed over time, especially following the Fiscal

Responsibility and Budget Management Act of 2003. In particular, we describe the institutional details of the primary and secondary markets, and the secondary market changes that occurred with the introduction of NDS-OM. We also present information on how debt issuance costs and secondary market trading have changed over time, focusing especially on how NDS-OM affected market performance.

Some studies have examined how the changes ushered in by the 2003 Act influenced the Indian government securities market. Shankar and Bose (2008) examine the variables that affect demand and bid dispersion in the primary market bid auctions. Nath (2007) shows that the secondary market price of a security that is yet-to-be-auctioned declines between the announcement date and the actual date of the auction, and that this effect is statistically less pronounced after the introduction of NDS-OM. Nath (2013) also examines the 2003 Act's effect on liquidity and market volatility, and Nath (2006) compares the liquidity premium of bonds trading on and off NDS-OM.

We find that trading volume more than doubled after the launch of NDS-OM. Moreover, an increasing share of the increasing daily trading volume migrated to NDS-OM over time. From a share of 50% in 2006, NDS-OM share increased to over 80% after 2010. NDS-OM gained market share largely at the expense of the brokered OTC market. From over 80% prior to NDS-OM, the share of the OTC brokered sub-market declined to single digits by the end of the sample. Daily OTC direct trading volume was always below OTC brokered trading volume, but the difference between the two series declined significantly over time until the two series roughly converged. Despite the much lower share of OTC trading, we find that liquidity migrates to the OTC sub-market during periods of uncertainty, despite its higher opaqueness and trade execution costs.

We also find evidence that secondary market price efficiency improved after the introduction of NDS-OM. First, using two different tests, we reject the null hypothesis of price efficiency in the OTC market prior to NDS-OM, but cannot reject the null for the period since NDS-OM's launch. Second, we show that the distribution of the 10-year benchmark OTC and NDS-OM last prices converge when trading is observed in both markets, suggesting that the real-time public dissemination of NDS-OM quote and trade information disciplines the OTC market by providing an additional price discovery channel.

Importantly, we find that the introduction of NDS-OM not only improved secondary market liquidity, but that this improvement translated into lower primary issuance costs. Our analysis suggests that the average underwriting commission rate declined by as much as 80% after NDS-OM went live. The cost saving to the Reserve Bank of India on account of the cross-market "NDS-OM" effect is estimated as 7 billion INR for the 35 trillion INR that it issued over our sample following NDS-OM's launch. These results are robust to the price volatility experienced by the market between 2008 and 2013 on account of the global financial crisis.

The paper proceeds as follows. In the next section, we provide details on the issuance process in the primary market and trading in the secondary market. Section III describes

the data which we have assembled from several public sources, including auction-level data for the primary market and daily secondary market data for each bond outstanding during our sample period. Section IV presents our results. Finally, we conclude in Section V.

II. Market for Government of India Bonds

A wide variety of government securities are issued by the Reserve Bank of India (RBI) in its role as the government's fiscal agent. This includes treasury bills with maturities of less than one year and government bonds with longer maturities, referred to as dated securities.[1] There are several variations in the dated securities: fixed and floating rate coupons, put/call options, nominal and inflation indexed, and special bonds (such as oil bonds). The focus of this paper is on dated securities with fixed coupons issued by the central government. These bonds account for a significant proportion of the outstanding government debt. Figure 1 shows that government debt outstanding has increased from 11.9 trillion INR ($200 billion US dollars) in April 2005 to 51.1 trillion INR ($853 billion US dollars) in March 2014.[2] Dated government securities with fixed coupons account for about 70% of the outstanding debt through this period.

A. Primary Market[3]

Government of India securities are issued in the primary market through two rounds of auctions held on consecutive days: an underwriting auction followed by a bid auction. Announcement of the auction is made via a press release on the RBI website, typically on a Monday for an underwriting auction on the Thursday of the same week and the second-round bid auction on Friday.[4]

The underwriting auction is a unique aspect of government bond issuance compared to other countries. The RBI relies exclusively on primary dealers to underwrite issuance through a two-part mandatory underwriting commitment (MUC). The MUC obligates dealers to underwrite 50 percent of an issue amount split equally among them. The commission paid on the MUC is determined in a multiple price auction for the remaining 50 percent. Dealers submit sealed bids to the RBI between 10.30 a.m. and 12.00 noon on the day of the underwriting auction. A bid comprises a price-quantity schedule where the price is the underwriting fee (per INR 100), and quantity is the amount the dealer is willing to underwrite. The second part of the MUC, referred to as additional competitive underwriting (ACU), relates to this auction: at the least primary dealers are obligated to bid their MUC amounts.

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[1] The Government of India issues bonds besides dated securities with fixed coupon rates. Details on these bonds can be found in "Government Securities Market in India - A Primer", Section 1.6, http://www.rbi.org.in/scripts/FAQView.aspx?Id=79#1.

[2] Exchange rate as of March 31, 2014, from Foreign Exchange Dealers Association of India.

[3] This section is based on the "Government Securities Market in India - A Primer" which is available here: http://www.rbi.org.in/scripts/FAQView.aspx?Id=79#1.

[4] Both auctions take place on an electronic platform.

The cut-off price is the commission at which the ACU demand equals 50 percent of the issue amount. Bids with commissions below the cut-off price are accepted and the rest are rejected. As in any multiple price auction, successful bidders are compensated for their successful bids as per the commissions they have tendered. As mentioned before, the auction also determines the commission paid on the MUC amount. The RBI awards dealers who bid aggressively in the auction. For dealers who are successful in winning at least four percent of the issue amount, the commission is the weighted average of all the accepted bids. Other primary dealers are paid a lower commission: the weighted average of the lowest three bids.

Similar to the underwriting auction, the second-round bid auction is a multi-unit sealed-bid auction. The RBI has the discretion to use the discriminatory or uniform price format, and this is made public in the issuance notification. Entities that hold a current account and a securities account with the RBI can bid directly in the auctions.[5] This includes primary dealers, banks other than primary dealers, and institutional investors such as insurance companies, large pension funds, and mutual funds. Other potential bidders (for example, corporations, smaller pension funds, non-bank finance companies and foreign institutional investors) can bid indirectly via the primary dealers and other banks.[6] Bids are submitted between 10:30 a.m. and 12 noon on the auction day.

The auction process allows for both competitive and noncompetitive bids. A competitive bid comprises a price-quantity schedule where the price is quoted per INR 100 face value in case of a reopened bond, and is in yield terms for a newly issued bond. Noncompetitive bids specify only a bid amount, and up to five percent of the issue amount is reserved for these bids. Successful competitive bids are allotted at the cut-off price in a uniform bid auction and at the quoted price in a multiple price auction. Noncompetitive bids are allotted at the weighted average price/yield.

The two auctions are linked in that primary dealers are obligated to bid at least the amount they have committed to underwrite, including both the ACU and MUC amounts. However, their underwriting commissions are not tied to their success in the bid auction that follows. In the event that in the second-round auction, the bid amount is less than the issue amount at the cut-off price, primary dealers are obligated to purchase the balance in proportion to their underwriting commitment at the cut-off price. This is referred to as a devolvement.

[5] The securities account is referred to as the Subsidiary General Ledger (SGL) account.

[6] For this, indirect bidders need to open a securities account called a gilt account with a direct bidder, which is eligible to open a Constituents' Subsidiary General Ledger Account (CSGL) account with the RBI. In this instance the direct bidder is also the custodian of the indirect bidder's government securities holdings. Essentially, the CSGL account is a pooled custodial account maintained by a direct bidder for the government securities holdings of entities that maintain a gilt account with it.

B. Secondary Market

Secondary market trading in Government of India bonds takes place on three sub-markets: the Negotiated Dealing System-Order Matching System (NDS-OM), the OTC direct or non-brokered market and the OTC brokered market.

NDS-OM is an electronic, screen based, anonymous, order driven trading system for dealing in Government of India securities owned by the Reserve Bank of India (RBI).[7] Participants place anonymous bids and offers directly on the NDS-OM screen and can observe bids/offers and trades in real-time. Figure 2, Panel A provides a snapshot of the NDS-OM screen as observed by participants. Being order driven, the system matches all bids and offers on price/time priority, that is, within the orders of the same price, it matches the oldest order first. Trades happen in multiples of 50 million INR.[8]

OTC trades are negotiated directly over the telephone so that the participants are not anonymous as on NDS-OM. When a deal is struck it is recorded on a deal slip, a specimen of which is in Figure 2, Panel B. Participants can deal directly with one another, which we refer to as the OTC direct or non-brokered market. Alternatively, there is the OTC brokered market where negotiations are through a broker registered with the securities regulator, the Securities and Exchange Board of India, and a commission is paid to the broker on trade consummation.[9] The bulk of the brokered OTC trades are done through member-brokers of the two major stock exchanges, the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE).

NSE and BSE also have an NDS-OM-like screen-based, order driven automated and anonymous trading platform for the wholesale segment of the government debt market.[10] Moreover, the stock exchanges have developed screen-based access to the government debt market for retail investors.[11] Nonetheless, it is our understanding that trading on these segments continues to be insignificant, and that in fact the wholesale debt platforms have ended up as reporting platforms for deals brokered OTC by member-brokers of the exchange.[12]

Similar to the participants in the second-round bid auction, entities who have a current account and securities account (SGL account) with the RBI can trade directly on the

[7] A detailed description of NDS-OM is available here: http://rbidocs.rbi.org.in/rdocs/Publications/PDFs/NDSOM290410.pdf.

[8] To facilitate trading in smaller lot sizes there is a separate 'odd lot' segment in which the minimum trading lot size is only INR 10,000.

[9] Brokers also pay a commission to the NSE which decreases with trade size. For trade sizes exceeding 100 million INR the commission is currently 0.05 per 100 INR.

[10] The first such effort was in June 1994 when the NSE introduced a transparent, fully automated screen-based trading system known as National Exchange for Automated Trading (NEAT) in the wholesale debt market segment.

[11] Since January 16, 2003, retail investors have been able to buy and sell government securities from different locations in the country through exchange registered brokers in the same manner as they buy and sell equities.

[12] See Nath, Rajaram and Ghose (2009). They opine that these platforms did not really promote liquidity of government securities.

NDS-OM and OTC sub-markets. We referred to them as direct bidders when describing the primary market. Other players have indirect access in that they can trade on NDS-OM or OTC only through a subset of the SGL account holders, the primary dealers and other banks. Recall that these are the indirect bidders in the second-round bid auction.

Clearing and settlement of government securities is the exclusive responsibility of the Clearing Corporation of India (CCIL).[13] Setup in April 2001, it is a joint stock company with share capital contribution by major banks and financial institutions. CCIL has also developed and maintains for the RBI several dealing and reporting electronic platforms called the National Dealing System (NDS). This includes NDS-OM, a platform for treasury auctions (NDS-Auction),[14] reporting of secondary trades, and an interface to the Securities Settlement System (SSS) of the Public Debt Office at the RBI.[15]

All trades, irrespective of the market where they take place, must be reported to the CCIL's NDS reporting platform. OTC transactions have to be reported within 15 minutes of the deal confirmation, following which the data automatically flows to the CCIL for clearing and settlement. For NDS-OM, once an order is matched, the deal ticket gets generated automatically and the trade details flow to the CCIL's reporting platform in real time. Furthermore, once a trade is concluded on NDS-OM it is treated as confirmed for settlement. Trades are settled on a T+1 basis on NDS-OM. Settlement on OTC is also T+1 since May 24, 2005.[16]

For orders matched on NDS-OM, information on trades and quotes is disseminated publicly on a close to real-time basis.[17] There are three levels at which real-time activity on NDS-OM is published to the market, Market Watch, Trade Watch, and Quote Watch, and a snapshot of each segment is provided in Figure 2, Panels C-E.[18] Trade information

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[13] CCIL acts as a central counter party for all transactions in government securities by interposing itself between two counterparties. It also guarantees settlement of all trades in government securities in that if any participant fails to provide funds/securities during the settlement process, it makes the same available from its own means. For this purpose it collects margins from all participants and maintains a "Settlement Guarantee Fund".

[14] From October 2012, these primary market auctions are conducted on RBI's e-Kuber electronic platform.

[15] The interface facilitates settlement of transactions in government securities (both outright and repos) conducted in the secondary market.

[16] Settlement could be either T+0 or T+1 prior to this date and was known at the time of deal confirmation. In general, each order has a unique settlement date specified upfront at the time of order entry and used as a matching parameter for trade execution. It is mandatory for trades to be settled on the predefined settlement date. Further since October 8, 2005 there are no outright transactions in government securities on Saturdays. Government securities traded on Fridays on a T+1 basis are settled on Mondays or the next business day if Monday is a holiday. See https://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx?prid=13658 and http://www.nseindia.com/content/circulars/wdtr6313.htm.

[17] There is a delay of 1-2 minutes, which is the time it takes to post it on the web (https://www.ccilindia.com/OMHome.aspx) for public dissemination. Also see http://economictimes.indiatimes.com/markets/stocks/policy/nse-taps-rbi-for-live-gilt-quotes-to-transform-interest-rate-futures-market/articleshow/47507377.cms.

[18] The Market Watch segment displays market-level data in real time, including the total traded volume and number of trades, open, high, low and last traded price (and corresponding yield) for each security. Details of specific trades for each security are published on the Trade Watch segment, including trade timestamp,

includes security description, trade price, trade amount, and the time at which the trade was executed. At any time during which the market is open, information is available on the five best bid and offer prices and quantities available at those prices. Besides the bid and offer prices and amounts, the total number of bids/offers is also made available.

For the OTC sub-market, only trade information is publicly disseminated and there is up to a 15-minute lag from trade execution.[19] Figure 2, Panels F-G present OTC Market Watch and Trade Watch snapshots.

III. Data

A. Primary Market

Our primary market data set is compiled by collecting the press releases pertaining to the auction announcements and results (for both underwriting and bid auctions) from the "Press Releases" Section of the RBI.[20] We have primary market auction-level data for 72 dated securities with fixed coupon rates issued via 862 auctions between January 1, 2003 and June 12, 2014.[21] The variables include the dates of the underwriting and bid auctions, a description of the auctioned security, the issue amount, whether the auction is yield or price-based and uniform or discriminatory, underwritten amount, and the ACU auction cutoff underwriting commission in paise for every 100 INR underwritten.[22]

Table 1 summarizes significant characteristics of the auctions in our data set. The average coupon rate is 8% and the average tenor at time of issuance is 17 years. The average auction size is 40 billion INR, and the average underwriting commission is 5 paise per 100 INR, implying that it directly costs the government 20 million INR to underwrite the typical auction. The second-round auctions have an average bid-to-cover ratio (bid received amount to issue amount) of 2.4.

Of the 862 auctions, only 42 auctions (less than 5%) were for new bonds, with previously issued bonds accounting for the remaining 820 auctions. The average bid-to-cover ratio

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amount, price and corresponding yield are displayed. Finally, drilling down to a specific security from the Market Watch segment leads to the Quote Watch segment which displays running quotes available for order matching. During the hours when NDS-OM sub-market is open, real-time Market Watch can be accessed here https://www.ccilindia.com/OMHome.aspx, and real-time Trade Watch can be accessed here https://www.ccilindia.com/OMIT.aspx.

[19] Prior to April 22, 2013, real-time (with a 15-minute lag) OTC deals were published for public dissemination on PDO-NDS (http://www.rbi.org.in/Scripts/NdsUserXsl. aspx), and since then, on NDS-RD (reported deals) (https://www.ccilindia.com/OMRPTDeals.aspx).

[20] http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx.

[21] There are 37 special bonds issued during our sample period which are distinct from dated government securities in that there is no auction-based primary issuance for these bonds. In addition, an inflation-indexed bond and eight floating rate bonds were issued via 7 and 12 auctions, respectively. Three underwriting auctions and 11 bid auctions were cancelled during the sample period. There were also 42 auctions under the Market Stabilization Scheme; these auctions do not have an underwriting round. We exclude all these auctions and bonds from our sample.

[22] 100 paise = 1 INR.

and number of bids received in the second-round auction are significantly higher for newly issued bonds than for reissued bonds. One might have expected primary dealers would demand higher commissions for newly issued bonds to compensate for the potentially higher uncertainty about the market clearing price (because such bonds would not have the same trading history as reissued bonds). But we find that the average underwriting commission for reissued bonds is double that of newly issued bonds. Reissued bonds have an average tenure at issuance of 17 years, versus 15 years for new issues, indicating that older bonds are more likely to be reissued. The average issuance size of newly issued bonds is larger than reissued bonds by 7 billion INR (47 billion vs. 40 billion).

Irrespective of whether it is a new issue or a reissue, around 75% of the second-round bid auctions during the sample period covered by our study are uniform price auctions. It is our understanding that uniform price auctions are typically held during periods of market uncertainty. In support of this, we find that the average bid-to-cover ratio and number of bids received are significantly lower for uniform than discriminatory price auctions.[23] Issuance sizes are also smaller. However, underwriting commission rates are statistically indistinguishable between the two auction formats although the volatility of the underwriting commissions is higher with uniform price auctions.[24]

Another interesting aspect of the primary market is that issuance occurs across the curve in a wide range of securities. Table 2 reports the number of auctions of new and reissued securities by number of years to maturity (rounded to the nearest year) as of the issuance/reissuance date, and rounded to the closest year. New securities were issued at 24 maturity points ranging from 1 to 30 years, and reissuance occurred at all 30 maturity points between 1 and 30 years.

B. Secondary Market

Our secondary market data consists of daily security-specific data for the three sub-markets described in Section II.B: NDS-OM, OTC non-brokered (or direct) and OTC brokered through member brokers of NSE/BSE. For each security we have the ISIN, security description, coupon, maturity date, issue date, trade date, high and low prices, last price, and daily volume traded. The secondary market data series runs from January 1, 2003 to April 22, 2013.[25] For OTC, trading data is obtained from the Reserve Bank of India. For NDS-OM, trading data is compiled from Bloomberg and CCIL. The series begins on August 1, 2005, which is the first day of trading on NDS-OM.[26]

[23] It is our understanding that uniform price auctions are typically held during periods of market uncertainty. This finding is thus similar to the finding of Nyborg, Rydqvist and Sunderasan (2002) for Sweden that quantity demand per bidder relative to the issue amount and consequently the bid-to-cover ratio decline significantly with uncertainty.

[24] We use standard deviations of underwriting commissions to measure volatility. The difference in volatility between the two auction formats is significant at the 1% level.

[25] This was the last date for which OTC data was made available to us. NDS-OM data is available until June 12, 2014.

[26] CCIL data was made available to us only from May 21, 2007 with an end date of April 17, 2014. We relied on data from Bloomberg to fill in the gaps.

Characteristics of the bonds trading during our sample period, regardless of the sub-markets, are reported in Table 3, Panel A. A total of 162 bonds traded during our sample period. Average coupon rate of traded bonds is 9.38%, the average tenor at issuance is just over 15 years, and average daily traded volume of 3.6 billion INR is less than 2% of the average issuance size of 238 billion INR.

Next we confine ourselves to the sample period after the introduction of NDS-OM, and in Table 3, Panel B compare characteristics of bonds trading on different sub-markets. Several aspects of this comparison suggest that relatively more liquid bonds trade on NDS-OM. Daily volume traded of a bond on NDS-OM is over five times that traded OTC and an average bond trades 10 times more on NDS-OM. The average issuance size of bonds trading on NDS-OM is 38 billion INR higher than those trading OTC. While the tenor at issuance of bonds is similar, the coupon rate of bonds that trade OTC is 33 basis points higher.

An additional aspect of bonds that we observe is whether or not they are a benchmark. The Fixed Income Money Market and Derivatives Association of India (FIMMDA) releases a list of bonds it deems to be benchmarks as of the end of each trading day.[27] Broadly, for each maturity year, FIMMDA selects the most liquid bond in terms of volume traded and number of trades.[28]

Table 4 describes daily trading data for benchmark bonds. It is similar to Table 3 except that it reports statistics for bonds deemed benchmark by FIMMDA and daily summary statistics are over trade days the bond is a benchmark. A comparison of Table 4 with 3 suggests that benchmark bonds are more liquid relative to an average bond in the sample. Issuance sizes are 80 billion INR larger, daily traded volume of benchmark bonds is twice as large, and coupon rate is 100 basis points lower. We find that the difference between NDS-OM and OTC sub-markets reported in Table 4 is similar to the comparison in Table 3 with bonds trading on NDS-OM having larger issuance sizes, daily volume traded, and number of trades.

A limitation of FIMMDA benchmark identification is that it does not report the tenor in which the bond is a benchmark. Bloomberg, on the other hand, publishes a daily listing of

[27] The daily benchmark releases are accessible from the FIMMDA website, http://www.fimmda.org/, with a subscription. Since March 2013, FIMMDA refers to benchmark bonds as "Nodal Point".

[28] Bonds are declared to be benchmark on a retrospective monthly basis by FIMMDA. There is a benchmark bond corresponding to each maturity year of the stock of outstanding bonds. The general principle is that a bond is deemed a benchmark if the monthly volume traded and number of trades of a bond exceed a threshold of INR 10 billion and 100 trades respectively, in the preceding month. In the instance when on a specific trading day, the daily volume traded and number of trades of a non-benchmark bond exceeds the threshold, then this bond displaces the benchmark for the corresponding maturity year. For example, one such instance was when a new bond 8.83 GS 2023 was issued in the middle of the month on November 22, 2013. The volume traded was over INR 78 billion on November 25, 2013, the first day it began trading. This bond was declared to be a benchmark bond for the maturity year 2023 displacing the bond 7.16 GS 2023, the existing benchmark.

benchmark bonds by tenor for 2-10, 15 and 30 years applying a proprietary methodology on the FIMMDA data. The tenor-specific daily identity of the benchmark bond is combined with daily NDS-OM trade data to construct NDS-OM benchmark bond daily volume traded and last price data series. Similarly, we construct daily trade data for benchmark bonds that trade OTC. Daily volume traded is aggregated across OTC direct and OTC brokered trades to obtain the daily OTC benchmark bond daily volume traded data series. OTC last price is the price at which the last trade took place across OTC direct and OTC brokered sub-markets.

Table 5, Panel A [Tenor-Wise Bloomberg Benchmark Trading Days] indicates that Bloomberg identifies benchmark bonds for 80% of the 2646 trading days in our sample, on average, though there is considerable variation across tenors. The 10-year benchmark is identified for over 95% of the trade days followed by the 5-year benchmark at over 90%. The long tenors, 15-year and 30-year, are identified for the least number of days, at 57% and 64%, respectively. Parts of our analysis focus on the 10-year benchmark bond. To begin with, the 10-year benchmark is identified for the largest number of trading days. Moreover, trades are reported on over 90% of these days. We also find that the average daily volume traded of the 10-year benchmark (28 billion INR) is 4-21 times larger than any other tenor for which Bloomberg identifies benchmark bonds (see Table 5, Panel B).

Figure 3 [10-Year Benchmark Daily Last Price and Yield] plots the daily price (per 100 INR face value) and equivalent yield for the 10-year benchmark bond trading on NDS-OM (Panel A) and the OTC sub-markets (Panel B). There are noticeable spikes in the price on the date that Bloomberg switches to a new bond (ISIN) underlying the benchmark. In several instances there are steep coupon rate changes between the underlying benchmark bonds. Consequently, we plot the price equivalent yield and note the same pattern in daily 10-year benchmark yields. The difference in magnitude between the average absolute daily yield changes on ISIN switch dates versus dates with no switch is over 20 basis points.

Figure 3 also identifies whether there was an auction within the 20 trade days prior to the switch date for the bond that became the new benchmark, and whether this auction is for a newly issued bond or a reissued bond. It is interesting to observe that auction dates typically coincide with switch dates or precede them by a few days. Moreover, when we compare the NDS-OM series in Panel A with the OTC series in Panel B, we can see that this phenomenon is limited to the period since NDS-OM's launch, and that there is no apparent relationship between auctions and switch dates in the pre-NDS-OM period.

Distinct from these one-off price spikes, there are relatively prolonged periods of stress during 2003, 2008-2010, and 2012-2013. This pattern is corroborated by the daily price volatility in Figure 4 [Daily Secondary Market 10-Year Benchmark Last Price Volatility]. Volatility is measured by the standard deviation of daily secondary market price of the 10-year benchmark bond over a 20-day moving window.[29] The secondary market price series is constructed by combining the OTC and NDS-OM 10-year benchmark bond daily

[29] Similar results are obtained when the standard deviation is computed over a 5- or 10-day moving window.

price series plotted in Figure 3. It is the NDS-OM price on days trading occurs on both NDS-OM and OTC or NDS-OM only, and the OTC price on days trading occurs only OTC.[30]

The 2003 episode in Figure 4 is likely the aftermath of the crash in telecom, media and technology stocks in the U.S. in 2002, and corporate accounting irregularities that pushed corporate default rates to record levels.[31] Coupled with this was the increased geopolitical risk on account of a prospective long-drawn conflict in Iraq which began on March 20, 2003. The volatility in 2008-2010 and 2012-2013 corresponds to the various stages of the global financial crisis and the European sovereign debt crisis. A contributing factor was accommodative monetary policy measures by advanced economy central banks to address the crisis which encouraged foreign inflows much above long-term trend into the bond markets of emerging market economies, including India.

IV. Results

A. Secondary Market Activity

a. Recent Trends

Figure 5 [Daily Trading Volume] presents average daily trading volume by month irrespective of the sub-markets where it occurred. Daily trading volume in the secondary market has increased over ten-fold through the sample period particularly since the introduction of NDS-OM in August 2005. Bond trading was on an average 50 billion INR per day in 2003, 19 billion INR in 2005, INR 24 billion in 2006 and increased to over 400 billion INR per day by 2013. The upward trending pattern of average daily trading volume continued through the global financial crisis with 41 billion INR in 2007, 74 billion INR in 2008 and 107 billion INR in 2009. Moreover the growth in volume traded has been significantly higher than government debt outstanding (compare with Figure 1).[32]

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[30] We will show later in Section 4.B that one cannot reject the null hypothesis that the two distributions are identical.

[31] The S&P 500 index declined about 20 percent in 2002 through mid-August, and was down more than 40 percent compared with its March 2000 peak (https://www.imf.org/External/Pubs/FT/GFSR/2002/03/pdf/chp2.pdf, pp. 7-28). The 12-month default rate on speculative corporate bonds in the U.S. rose to 11.4 percent in January 2002 and was as high as 8.3 percent in October 2002 (https://www.imf.org/External/Pubs/FT/GFSR/2003/01/pdf/chp2.pdf, p. 7-33). Central banks across the globe also started increasing policy rates as they entered into an interest tightening cycle following the 2001 recession (http://www.nber.org/cycles/july2003.html).

[32] Comparison by financial year (ending March 31) shows that the annual growth rate of trading volume was significantly higher than of outstanding government debt other than in 2010. While the average annual growth rate of outstanding debt was relatively constant at around 18% since 2006 (whether or not government bonds other than fixed-rated dated Government of India bonds are included), that of secondary market trading volume was more than double at 40%. Data for the comparison is compiled from Figure 1 and the Handbook of Statistics, Ministry of Finance, Table 1A Column 2 (for outstanding debt) and Table 11 Column 2 (for trading volume) which can be accessed here: http://www.finmin.nic.in/the_ministry/dept_eco_affairs/middle_office/handbook_stat_Debt.pdf.

The upward trend in daily trading volume was accompanied by a secular decline in the number of outstanding bonds. Bonds outstanding daily (averaged by the month) are displayed in Figure 5. From a high of 108 in 2003, the number of outstanding bonds declined to 85 in 2010 and stood at 82 at the end of our sample period. On average, under 30% of the outstanding bonds trade daily. However, we observe no specific trend in the number of bonds trading daily (also plotted in Figure 5), nor any correlation with daily trading volume.[33]

Figure 6 [Sector wise daily trading volume] plots daily trading volume by month for bonds in the short, medium and long sectors with the sectoral classification based on the residual maturity of the bond. Bonds with residual maturity of less than seven years are short bonds, between seven and fifteen years are medium bonds, greater than fifteen years are long bonds.

Sector-wise daily trading volume by month follows the same pattern as daily total trading volume plotted in Figure 5. It increases over ten-fold for the medium and short sector and more than doubles for the long sector. The medium sector accounts for the bulk of daily trading volume with an average of 62 billion INR, followed by the short sector with 13 billion INR and long sector with 7 billion INR. This is not surprising given that that the medium sector includes the 10-year benchmark tenor.

Volume is positively correlated across sectors with the long-medium sector daily trading volume being most correlated (correlation coefficient = 0.53), followed by the medium-short sectors (correlation coefficient =0.46), with the long-short sectors daily trading volume being least correlated (correlation coefficient =0.34). Correlations tend to breakdown during 2009-2011, which roughly corresponds to various phases of the global financial crisis.

The medium and short sectors exhibit the secular declining trend in total bonds outstanding observed in Figure 5. For the medium sector, daily bonds outstanding by year declined from a high of 40 in 2003 to 26 in 2013, and for the short sector from a high of 55 in 2003 to 40 in 2013. The number of long bonds outstanding was fairly stable at around 16 bonds on average. Long bonds outstanding tend to trade the most with the ratio of daily number of bonds trading to outstanding being over 40% on an average for the long sector, 35% for the medium sector, and under 20% for the short sector. Similar to the overall trend, we do not observe any sectoral pattern in number of bonds trading daily or correlation with daily trading volume.

We have observed that on an average trading day only 30% of the outstanding bonds trade. But did trading activity of a typical security trend over the time period covered by our sample? Figure 7, Panel A [Prevalence] is a time series plot of trading activity measured by prevalence (%) by the month across all bonds. The percent is calculated as

[33] The correlation between daily trading volume and number of bonds trading by month is close to zero at 0.01. In contrast there is a strong negative correlation of 0.6 between daily trading volume and bonds outstanding by month.

the total (across bonds) number of security-trading days in a month in which we observe a trade divided by the total (across bonds) number of security-trading days in the month. There is no trending pattern in prevalence. It appears to decline till the middle of 2008 to 18% following which there is a distinct uptick to over 40% in early 2009. It dips to below 17% by the end of 2011 and then increases to over 44% by the end of the sample.

Prevalence does not exhibit a trend even when segregated by sub-markets NDS-OM and OTC as we do in Figure 7 [Prevalence by sub-market]. While the NDS-OM and OTC sub-markets track each other as far as the general trend is concerned, trading activity measured in terms of prevalence by month is higher by 7% on an average in the OTC market relative to the NDS-OM market and the difference is statistically significant at the 1% level.[34]

There is significant variation in trading activity across bonds which is consistent with the sectoral differences in the daily trading to outstanding bonds that we noted earlier. There is no trading for over 10% of the bonds in the sample. Only 10% of the bonds trade on over 90% of the security trading days. To better understand whether security specific characteristics are key drivers of trading activity, we examine this relationship using a two-sided Tobit model. The dependent variable is the percentage of days for which a bond trades irrespective of the sub-market. Independent variables include coupon rate, natural log of issuance size, maturity at issuance, and issuance year.

The results are reported in Table 6. In the univariate regressions we find that more recent issuance year, lower coupon rate, longer maturity, and larger issuance size are all associated with increased trading activity, with issue size the most important of the security specific characteristics. The multivariate regression results are along the lines of the univariate results. The effect of the variable "Tenor at Issuance" is significantly more than in the univariate regression and conditional on that the coupon rate appears to lose its significance.

b. Effects of NDS-OM

In Section 4.A.a. we noted that daily trading volume has a distinctly upward trending pattern during our sample period. Figure 8 [Daily Trading Volume: NDS-OM vs. OTC] suggests that the introduction of NDS-OM in August 2005 is likely to have contributed to this. It plots the average daily trading volume by month on the NDS-OM and OTC sub-markets. NDS-OM daily trading volume was on an average 15 billion INR during 2006. It doubled in the two subsequent years despite the ongoing global financial recession, stabilized around 85-90 billion INR in 2009-2011, and was close to 400 billion INR in the first quarter of 2013. Daily OTC trading volume declined on the introduction of NDS-OM. From 50 billion INR per day in 2003, it declined to roughly 10 billion INR on average in 2006-2007. It recovered somewhat thereafter with 18 billion INR per day in 2008 and 28 billion INR per day in 2012, though the volume trading on NDS-OM during the same years was significantly higher at INR 62 billion and INR 165 billion,

[34] The Kolmogorov-Smirnov test rejects the null hypothesis that the distribution of prevalence across NDS-OM and OTC sub-markets since NDS-OM went live in August 2005 are identical.

respectively. In fact the analysis that follows suggests that the impact of NDS-OM was much more profound than an increase in daily trading volume: an increasing share of this increasing volume migrated to the NDS-OM sub-market at the expense of the OTC sub-market.

Share of the NDS-OM and OTC sub-markets in daily trading volume, averaged by the year, is given in Figure 9 [Daily Trading Volume Share: NDS-OM vs. OTC]. From an equal share of 50% in 2006, NDS-OM share has trended upwards to above 70% in 2007-2009, and then above 80% after 2010. In contrast the share of the OTC sub-market in daily trading volume has declined from 50% to below 15% by 2012.

We next disentangle the daily OTC trading volume into OTC direct and OTC brokered sub-markets to examine whether the impact of NDS-OM on the two OTC sub-markets was similar. Figure 10 [Daily Trading Volume Share: NDS-OM, OTC Direct and Brokered] plots the shares of the NDS-OM, OTC direct and OTC brokered sub-markets in daily trading volume, averaged by month. It decomposes the daily trading volume in the OTC sub-market in Figure 9 into the OTC direct and OTC brokered sub-markets, computes the share of each sub-market in daily trading volume across all three sub-markets, and plots shares averaged by the month. Figure 10 suggests that NDS-OM gained market share in daily trading volume at the expense of the OTC brokered sub-market relative to the OTC direct sub-market. Before NDS-OM, the OTC brokered market accounted for over 80% of the daily trading volume. Its share fell to 30% in 2006 and was in single digits by the end of the sample. Daily OTC direct trading volume was always below OTC brokered trading volume, but the difference between the two series declined significantly over time and they have now roughly converged.

Our analysis also suggests that during periods of uncertainty liquidity migrates away from the NDS-OM sub-market to OTC despite its opaqueness and higher trade execution costs. We observe on several days through the global financial crisis that trading took place exclusively on the OTC sub-market. Table 7 reports results from a univariate regression of NDS-OM daily trading market share on the natural log of the 10-year benchmark price volatility over a 20-day moving window that ends on the day preceding the trade date. NDS-OM sub-market share declines by 2% for every 1% increase in the 10-year benchmark bond price volatility. Since the CCIL acts as a central counterparty for all transactions in government securities by interposing itself between two counterparties and guaranteeing settlement, it is unlikely that trading on OTC is being used as a hedge against counterparty-specific information asymmetry during episodes of market distress. Financial market professionals instead suggest that uncertainty about the market clearing price around periods of market distress lowers the likelihood of trade consummation on NDS-OM as dealers are hesitant to post firm quotes as required by NDS-OM. Trading and price discovery do not come to a standing halt when the market is stressed, only it moves to platforms other than NDS-OM.

Moreover, there is a significant statistical distinction between macroeconomic volatility shocks and those induced by trading infrastructure specific characteristics. Thus, NDS-OM market share declines by 4% for every 1% increase in price volatility. But it

increases by 2% for a percent increase in ISIN-switch induced price volatility suggesting that the bond declared to be the "new" benchmark via the switch trades higher volumes on NDS-OM relative to the OTC sub-market.

B. Market Efficiency

We test market efficiency using the Kendall Tau test and the variance ratio test. The Kendall Tau test assesses whether two variables are statistically dependent. In our analysis, we assess whether bond prices follow a random walk by testing whether the series have independent increments as measured by their daily returns. The null hypothesis is that the Kendall coefficient for the daily return and the prior day's return is equal to zero (Campbell, Lo, and MacKinlay, p. 34).

The variance ratio test is a test of uncorrelated increments across a variety of lag orders—traditionally 2, 4, 8, and 16 (Campbell, Lo, and MacKinlay, p. 49). Under the hypothesis that log prices follow a random walk, the variance of price increments should be distributed linearly as a function of the interval length.

We conduct the market efficiency tests on the benchmark 10-year bond using daily bond prices and report the results in Table 8. For the Kendall Tau test (Panel A), the null hypothesis that the daily price follows a random walk is rejected at the 10% significance level for the pre-NDS-OM period, suggesting that the market is not efficient. The lack of efficiency seems to be coming from negative autocorrelation in returns, as indicated by the negative value of the Kendall coefficient. In contrast, the null hypothesis is not rejected for the post-NDS-OM period.

Similarly, for the variance ratio test (Panel B), the results point to market inefficiency during the period preceding the launch of NDS-OM, but not after. The null hypothesis of an efficient market is thus rejected at the 1% statistical level for the pre-NDS-OM period for lag orders of 4, 8, and 16 (albeit not lag order 2). In contrast, the null hypothesis is not rejected at the 10% level for the post-NDS-OM period for any of the lag orders considered.

In Section 2 we explained that information about OTC trade price and quantity is disseminated publicly with a lag of up to 15-minutes, and NDS-OM quote and trade information is released in real time. Complementing the market efficiency test, we also test if the real-time public dissemination of NDS-OM quote and trade information disciplines the OTC market by providing an additional price discovery channel.

The null hypothesis is that on the days that benchmark bonds trade on both the NDS-OM and OTC sub-markets, the last price distributions converge across the two sub-markets. Table 9 reports the Kolmogorov-Smirnov test statistic for equality of the last price distributions across the two sub-markets for benchmark bonds corresponding to tenors 2, 4-10, 15, and 30. The null hypothesis is not rejected suggesting that the last price distributions converge across the two sub-markets.

C. Underwriting Commissions

a. Recent trends

Figure 11 [UW Commission by Year] reports Tukey's boxplot (as in McGill, Tukey and Larsen, 1978) of underwriting commission cutoff rates grouped by year of the underwriting auction date. For each year, the box represents the middle half of the distribution of commissions for underwriting auctions held in that year. The black line inside the box represents the median commission and the red dot the mean commission for underwriting auctions held that year. For each year, the horizontal bars at the two ends represent the full range of the distribution of commissions for underwriting auctions held in that year, with commissions greater than three times the interquartile range represented by black dots.

The figure shows that the average underwriting commission cutoff rate exhibits a declining trend over our sample period, declining from a high of 11.4 paise per 100 INR in 2004 to a low of 1.2 paise in 2012. This is tantamount to 5 billion INR of reduced commission payment to the dealers for the 6260 billion INR underwritten in 2012 versus being compensated at the 2004 rates.

The years 2009 and 2013 are exceptions to the declining trend with average underwriting commissions in the two years being 7 and 13 paise per 100 INR, respectively. The spread of the distribution of underwriting commissions for these two years is particularly noticeable. The standard deviation of commission rates for underwriting auctions in 2009 (2013) is twice (four times) that of auctions in the sample excluding those in 2009 and 2013. As discussed, the global financial crisis was unfolding in 2009, and 2013 witnessed significant uncertainty surrounding the timing and extent of quantitative easing tapering by the U.S. Federal Reserve.

Table 10 [UW Commission by Sector] groups underwriting commission cutoff rates by residual tenor of the underwritten bond. On average, the underwriting commission is higher by 3 paise per 100 INR for bonds with over 15 years in residual tenor compared to bonds with tenor between 7-15 years, which in turn is little different from underwriting commissions for bonds under 7 years in residual tenor. We consider the possibility that the "year" effects we observe in Figure 11 are on account of longer tenure bonds being underwritten in the years 2004-2005, 2009 and 2013 relative to the other years in our sample but find little support for this idea. On the contrary we find that the residual tenure in 2004-2005 and 2013 is comparable to the sample average of 17 years (see Table 1), and at 14 years is not significantly different for 2009.

We next examine if high underwriting commission auctions tend to be associated with greater volatility. We saw in Figure 11 that 2009 and 2013 were years with high underwriting commissions and relatively high dispersion compared to other years in our sample. In Section III.B we also noted that these were amongst the periods of financial market stress in our sample. In Figure 12 [UW Commission and Volatility] we superimpose underwriting commissions on the days an underwriting auction is held on a

plot of daily 10-year benchmark bond price volatility reproduced from Figure 4. High underwriting commission auctions appear to occur around the volatility spikes. On average, underwriting commissions are 4 paise lower in auctions held during periods of low relative to average price volatility, and an additional 5 paise lower relative to periods of high volatility.[35]

b. Effects of NDS-OM

As discussed, NDS-OM has had a significant impact on the secondary market for dated government securities. Liquidity measured by daily trading volume has improved. The markets have also become more efficient at processing information. Standard tests support market efficiency for the NDS-OM sub-market. But more importantly, the market efficiency hypothesis is also supported for the OTC sub-market after the introduction of NDS-OM, even though it is rejected pre-NDS-OM.

Next we assess if this improved liquidity and efficiency of the secondary market has translated into lower debt issuance costs in the primary market. We examine the underwriting commission component of these costs by a regression whose results are displayed in Table 11. In particular, we regress the underwriting commission cutoff rate in the ACU auction on an indicator variable that takes the value one if the underwriting auction is held post NDS-OM and zero otherwise;

$$Y_t^m = \alpha + \beta * I_{t \geq NDSOM} + \gamma_1 * Volatility_t \ + \gamma_2 * Volatility_t \ * I_t^{ISIN\Delta} + \delta' * \boldsymbol{Z}_t^m \quad (1)$$

In the model above, *t* and *m* index date and auction, respectively.[36] Following our analysis in Section IV.C.a., we include daily price volatility as one of the control variables in the regression. Recall from Sections IV.C.a. and III.B that this is measured by the standard deviation of the daily secondary market price of the 10-year benchmark bond over a 20-day moving window, which in this regression ends on the day preceding the underwriting auction date. Thus, $Volatility_t$ is the volatility in the last 20 days preceding the auction date *t*. In Figure 3, one-off spikes in daily price are observed on days there is an ISIN switch. To distinguish this source of volatility, daily price volatility is interacted with an indicator, $I_t^{ISIN\Delta}$, that takes the value one if there is an ISIN switch in the 20-day window corresponding to the volatility window, and is zero otherwise.

Other control variables in the model are represented by the vector $\boldsymbol{Z}_t^m$ and are described below. They include coupon rate of the auctioned bond, its residual maturity on the underwriting auction date, and indicator variables for whether the auctioned bond is a reissue (indicator variable takes value 1) and whether the second-round bid auction is a

[35] Underwriting auctions, depending on when they are held, have been categorized into auctions held during periods of high, average and low volatility. These categories are identified on the basis of the percentiles of the distribution of the 20-day moving standard deviation of last price. Low, average and high volatility refer to volatility being no more than the 25th percentile, between the 25th and 75th percentile, and higher than the 75th percentile, respectively. Thus, if the price volatility of the 20 days preceding the underwriting auction date is higher than the 75th percentile, we tag this as a high volatility auction.

[36] Underwriting auctions are typically clustered, with auctions of different tenors on the same day.

uniform price auction. Liquidity adjustment facility is a variable equal to the net liquidity injections by the RBI on the day preceding the underwriting auction. These are part of the daily liquidity mismatch operations conducted by the RBI in the form of repos/reverse repos. Net liquidity injections are likely to ease financing constraints faced by dealers in committing to underwrite an auction. The bid-to-cover ratio in the second-round bid auction is used as a proxy for the demand-side of this market.[37] Liquidity differences across auctioned bonds are controlled for through an indicator variable that is 1 if the bond was on the list of FIMMDA-deemed benchmarks on the day preceding the underwriting auction date. Recall from Section III.B that two frequently used liquidity measures, daily trading volume and number of trades, retrospectively determine whether a bond is on the list of FIMMDA benchmarks on a trading day. Fleming (2002) compares U.S. Treasury bill reopenings to new issues of similar residual maturity to show that larger issue sizes are also more liquid. Consequently, we also include natural log of the issuance size of the underwriting auction as an additional control for liquidity.[38]

The univariate regression results are reported in columns (1)-(9). Consistent with the box plot in Figure 11, we find that underwriting commissions are 80% lower after the introduction of NDS-OM and that the effect is statistically significant. Volatility, accounting for 27% of the variation in underwriting commissions, is the single most important determinant of commissions. A 1% exogenous volatility shock increases underwriting commissions by close to 1% and is significantly higher statistically from an ISIN switch-induced volatility shock. The positive coefficients on both the reissue indicator variable and residual maturity suggests that bonds command higher underwriting commissions as they age. Reflecting that primary dealers value liquid bonds, we find that underwriting commissions are lower for larger issuance sizes and if the auctioned bond is on the FIMMDA-deemed list of benchmark bonds. The negative coefficient on the liquidity adjustment facility variable suggests that dealers are willing to underwrite the auctions for lower commissions when there are net liquidity injections on the day preceding the underwriting auction.

The results of the multivariate regression model displayed in Column (10) are in line with the findings in the univariate model. But we do find that the NDS-OM indicator is no longer statistically significant even though the volatility variables are both economically and statistically comparable to their univariate counterparts. The global financial crisis played out exclusively in the time period after NDS-OM went live in August 2006. The price volatility plotted in Figure 4 suggests prolonged stress in the government securities market during 2008-2013 and the box plot in Figure 11 shows distributions of underwriting commissions that are highly skewed to the right in the years 2008, 2009 and 2013. Given this positive correlation between volatility and the NDSOM indicator, it is not surprising that the significance of the latter declines in the multivariate model. Supporting this, we find that if we re-run the multivariate regression excluding the 2008-

[37] Data on all the bids received in the underwriting auction was not available on the RBI press releases website – the source from where primary auction data was obtained.

[38] The correlation between the indicator variable for whether the bond is on the list of FIMMDA-deemed benchmarks and issuance size is -0.1.

2013 time period, the decline in underwriting commissions is of a similar order in magnitude as the univariate model, and is statistically significant at the 1% level.

V. Conclusion

We describe how the Indian government bond market has evolved since the Fiscal Responsibility and Budget Management Act of 2003, paying particular attention to the launch of NDS-OM, the electronic, screen based, anonymous, order driven trading system for dealing in Government of India securities that went live in August 2005. NDS-OM had two transformational features. First, it provided an alternative market place for trading government bonds that involved lower search costs for trade execution relative to OTC. Second, since trade book and order-book information could be reported in real-time with NDS-OM, it could be publicly disseminated in real-time as well.

Our paper shows that several indicators of market quality improved. Daily trading volume increased ten-fold and this increase was observed across maturity sectors. Moreover, an increasing share of the increasing daily trading volume migrated to the NDS-OM sub-market at the expense of the OTC brokered sub-market. From an equal share of 50% in 2006, NDS-OM share trended upwards to over 80% after 2010. At the same time, the share of the OTC brokered sub-market declined from over 80% prior to NDS-OM, to single digits by the end of the sample. Daily OTC direct trading volume was always below OTC brokered trading volume, but the difference between the two series declined significantly over time until the two series roughly converged. Interestingly, during periods of uncertainty, liquidity migrates to OTC despite its opaqueness and higher trade execution costs.

We also uncover an improvement in market efficiency since the introduction of NDS-OM. Using standard market efficiency tests, we reject the null hypothesis of an efficient market in the period preceding NDS-OM, but not in the period since NDS-OM's launch. Moreover, we find that the distribution of the 10-year benchmark OTC and NDS-OM prices converge when trading is observed in both markets, suggesting that the real-time public dissemination of NDS-OM quote and trade information disciplines the OTC market by providing an additional price discovery channel.

Lastly, we document a cross-market effect with an improvement in secondary market quality translating into lower primary issuance costs of fixed coupon central government bonds. Our analysis suggests that the average underwriting commission rate declined by as much as 80% after NDS-OM went live. These results are robust to price volatility in the market between 2008 and 2013 on account of the global financial crisis.

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Table 1: Auction Summary Statistics

Panel A: All Auctions		
Variable Name	**Mean**	**Standard Deviation**
Competitive bids received (#)	162.63	69.33
Bid-to-cover ratio	2.43	0.65
Issuance size (INR billion)	40.22	15.46
Coupon (%)	7.98	0.71
Tenor at issuance (years)	17.19	8.48
Underwriting commission cutoff rate (paise per 100 INR)	4.93	10.95
Number of auctions	862	

Notes: The table reports summary statistics for fixed-rate dated Government of India securities held between January 1, 2003 and June 12, 2014. Underwriting commissions are in paise (100 paise = 1 INR) per 100 INR underwritten.

Source: Authors' calculations based on data from "Press Releases" section of the Reserve Bank of India website, http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx.

Panel B: Reissued Bond Auctions vs Newly Issued Bond Auctions					
Variable name	**Reissued Bond Auctions**		**Newly Issued Bond Auctions**		**Difference in Means**
	Mean	Standard Deviation	Mean	Standard error	
Competitive bids received (#)	160.09	67.61	212.36	83.48	-52.27***
Bid-to-cover ratio	2.41	0.64	2.86	0.77	-0.45***
Issuance size (INR billion)	39.89	15.30	46.67	17.20	-6.78***
Coupon (%)	8.00	0.69	7.69	0.96	0.31***
Tenor at issuance (years)	17.31	8.44	14.81	8.93	2.50*
Underwriting commission cutoff rate (paise per 100 INR)	5.07	11.20	2.08	2.53	2.99***
Number of auctions	820		42		

Notes: The table reports summary statistics for fixed-rate dated Government of India securities held between January 1, 2003 and June 12, 2014. Columns 2-3 are summary statistics for auctions of reissued bonds and Columns 4-5 for newly issued bonds. One-, two-, and three- asterisks indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Underwriting commissions are in paise (100 paise = 1 INR) per 100 INR underwritten.

Source: Authors' calculations based on data from "Press Releases" section of the Reserve Bank of India website, http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx.

Panel C: Uniform Price Auctions vs Discriminatory Price Auctions					
Variable name	**Uniform Price Auctions**		**Discriminatory Price Auctions**		**Difference in Means**
	Mean	Standard Deviation	Mean	Standard Deviation	
Competitive bids received (#)	141.86	49.71	224.76	81.63	82.9***
Bid-to-cover ratio	2.34	0.54	2.71	0.85	0.37***
Issuance size (INR billion)	39.24	15.80	43.15	14.02	3.91***
Coupon (%)	8.05	0.67	7.77	0.78	-0.28***
Tenor at issuance (years)	16.74	8.38	18.54	8.66	1.81***
Underwriting commission cutoff rate (paise per 100 INR)	4.83	11.40	5.23	9.52	0.41
Number of auctions	646		216		

Notes: The table reports summary statistics for fixed-rate dated Government of India securities held between January 1, 2003 and June 12, 2014. Columns 2-3 are summary statistics for uniform price auctions and Columns 4-5 for discriminatory price auctions. One-, two-, and three- asterisks indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Underwriting commissions are in paise (100 paise = 1 INR) per 100 INR underwritten.

Source: Authors' calculations based on data from "Press Releases" section of the Reserve Bank of India website, http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx.

Table 2: Issuance History by Tenor

	Maturity (Years)																														
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
2003								AUG	JUN	MAY	APR		JAN		APR	JUL				APR				DEC	JUN				APR	
2004	JUN JUL	JUL			SEP	AUG						JAN						SEP										NOV		
2005							MAY										FEB										APR			JAN
2006				JUL																						APR				
2007			APR											JAN																
2008																			JUN				SEP							
2009			SEP																			AUG			NOV	AUG	JAN			
2010																														
2011											OCT										JUN JUL									
2012															JUN					AUG				SEP						
2013		JUL		FEB								AUG										AUG						NOV		
2014					JAN	JUN	FEB	JUN	JUN	MAY			MAY	JUN		JUN	APR	JUN	JAN										JUN	JUN
Issues	1	5	2	0	6	8	2	3	4	13	5	7	3	3	5	4	2	1	2	2	0	1	0	1	2	0	0	0	1	8
Reissues	3	20	15	7	58	60	57	30	20	115	22	35	39	20	11	23	36	34	34	7	3	21	2	27	14	8	2	16	62	48
Total Issues	4	25	17	7	64	68	59	33	24	128	27	42	42	23	16	27	38	35	36	9	3	22	2	28	16	8	2	16	63	56

Notes: The table illustrates the issuance history for the different maturities of fixed coupon government securities. For each maturity, the first issuance date is in green. The last issuance date as of June 12, 2014 is in red. The row “Issues” indicates the number of new issues and the row “Reissues” indicates the number of reissues in the respective tenor.

Source: Authors' calculations based on data from "Press Releases" section of the Reserve Bank of India website, http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx.

Table 3: Bond Summary Statistics

Panel A: All Sub-Markets		
Variable Name	**Mean**	**Standard Deviation**
Coupon (%)	9.38	2.36
Daily traded volume (INR billion)	3.60	10.67
Issue year (year)	1998.89	8.91
Issuance size (INR billion)	238.21	285.32
Maturity year (year)	2014.20	8.95
Tenor at issuance (years)	15.31	7.82
Number of bonds (ISINs)	162	

Notes: The table reports summary statistics for all bonds trading between January 1, 2003 and April 22, 2013 irrespective of the submarket. A total of 162 bonds identified by their ISIN traded during the sample period. Daily traded volume for each bond/ISIN is calculated as the sum of traded volume across submarkets on a trade day (days we observe volumes or prices on either of the sub-markets); we average this across trade days for each bond/ISIN.

Source: Authors' calculations based on trade data from Bloomberg, Clearing Corporation of India Ltd., Internal Debt Management Department of Reserve Bank of India, and "Press Releases" section of the Reserve Bank of India website, http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx.

Panel B: NDS-OM vs OTC					
Variable Name	**NDS-OM**		**OTC**		**Difference in Means**
	Mean	Standard Deviation	Mean	Standard Deviation	
Coupon (%)	8.73	8.73	9.06	2.27	-0.33
Daily traded volume (INR billion)	4.67	11.14	0.85	1.47	3.82***
Issue year (year)	2001.32	8.25	2000.50	8.30	0.81
Issuance size (INR billion)	322.64	301.81	285.10	297.95	37.54
Maturity year (year)	2017.88	8.04	2016.55	8.36	1.33
Tenor at issuance (years)	16.56	7.64	16.05	7.59	0.52
Number of bonds (ISINs)	114		131		

Notes: The table reports summary statistics for all bonds trading between February 24, 2006 and April 22, 2013 on NDS-OM and OTC sub-markets including both direct trades and those brokered through NSE/BSE member-brokers. NDS-OM went live on August 1, 2005, but February 24, 2006 was picked as the start date for the comparison as this first date for which NDS-OM volume data is available. A total of 114 and 131 bonds identified by their ISIN traded on NDSOM and sub-markets off-NDSOM, respectively. Trade days (days we observe volumes or prices on the respective sub-markets) and volume traded are now specific to the submarket. Daily traded volume for each bond/ISIN is calculated as the sum of traded volume on a trade day; we average this across trade days for each bond/ISIN for the respective sub-market. One-, two-, and three- asterisks indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Source: Authors' calculations based on trade data from Bloomberg, Clearing Corporation of India Ltd., Internal Debt Management Department of Reserve Bank of India, and "Press Releases" section of the Reserve Bank of India website, http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx.

Table 4: Benchmark Bond Summary Statistics

Panel A: All Sub-Markets		
Variable Name	**Mean**	**Standard Deviation**
Coupon (%)	8.32	1.89
Daily traded volume (INR Billion)	8.23	15.76
Issue year (year)	2003.99	5.54
Issuance size (INR Billion)	401.51	296.78
Maturity year (year)	2018.44	8.94
Tenor at issuance (years)	14.45	7.53
Number of bonds (ISINs)	89	

Notes: The table reports summary statistics for all benchmark bonds trading on days they were deemed a benchmark between January 1, 2003 and April 22, 2013, irrespective of the sub-market. A total of 89 bonds identified by their ISIN traded during the sample period. Daily traded volume for each bond/ISIN is calculated as the sum of traded volume across submarkets on a trade day (days we observe volumes or prices on either of the sub-markets); we average this across trade days for each bond/ISIN.

Source: Authors' calculations based on trade data from Bloomberg, Clearing Corporation of India Ltd., Internal Debt Management Department of Reserve Bank of India, and "Press Releases" section of the Reserve Bank of India website, http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx. Identity of bonds that are benchmark is from Fixed Income Money Market and Derivatives Association of India.

Panel B: NDS-OM vs Other Sub-Markets					
Variable Name	**NDS-OM**		**OTC**		**Difference in Means**
	Mean	Standard Deviation	Mean	Standard Deviation	
Coupon (%)	7.79	1.10	7.99	1.53	-0.20
Daily traded volume (INR Billion)	10.71	16.21	1.64	2.06	9.07***
Issue year (year)	2006.43	3.91	2005.38	4.98	1.06
Issuance size (INR Billion)	551.67	245.39	491.23	277.71	60.44
Maturity year (year)	2020.93	8.68	2019.99	8.82	0.95
Tenor at issuance (years)	14.5	7.85	14.61	7.69	-0.11
Number of bonds (ISINs)	59		69		

Notes: The table reports summary statistics for all benchmark bonds trading on days they were deemed a benchmark between February 24, 2006 and April 22, 2013 on NDS-OM and OTC sub-markets including both direct trades and those brokered through NSE/BSE member-brokers. NDS-OM went live on August 1, 2005. February 24, 2006 was picked as the start date for the comparison as this is the first date for which NDS-OM volume data is available. A total of 59 and 69 bonds identified by their ISIN traded on NDS-OM and sub-markets off-NDSOM, respectively. Trade days (days we observe volumes or prices on the respective sub-markets) and volume traded are now specific to the submarket. Daily traded volume for each bond/ISIN is calculated as the sum of traded volume on a trade day; we average this across trade days for each bond/ISIN for the respective sub-market. One-, two-, and three- asterisks indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Source: Authors' calculations based on trade data from Bloomberg, Clearing Corporation of India Ltd., Internal Debt Management Department of Reserve Bank of India, and "Press Releases" section of the Reserve Bank of India website, http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx. Identity of bonds that are benchmark is from Fixed Income Money Market and Derivatives Association of India.

Table 5: Benchmark Trading Statistics

Panel A: Identified vs Traded Benchmark Bonds				
Tenor	Number of Days Benchmark ISIN Identified	Number of Trade Days		
		All	NDS-OM	OTC Sub-Markets
2	2280	1414	765	814
3	2236	1295	682	723
4	1992	1323	783	723
5	2420	2125	1147	1118
6	2131	1737	805	944
7	2158	1833	921	1070
8	1876	1587	748	817
9	1730	1350	596	627
10	2492	2278	1576	1606
15	1496	1283	583	512
30	1696	1379	769	653
Total Trade Days (#)	2646			

Notes: The table reports the number of days for which Bloomberg identifies benchmark bonds by tenor and the number of days these bonds trade from January 1, 2003 to April 22, 2013. There are a total of 2646 trade days in the sample period. "All" refers to NDS-OM and OTC sub-markets.

Source: Authors' calculations based on trade data from Bloomberg.

Panel B: Daily Traded Volume (INR Billion)			
Tenor	All	NDS-OM	OTC Sub-Markets
2	1.93	1.75	1.46
3	1.34	1.23	1.00
4	2.80	3.83	1.05
5	3.82	4.82	1.22
6	3.36	4.30	1.00
7	4.15	5.49	1.11
8	3.75	5.31	0.83
9	7.33	11.66	1.70
10	28.33	34.72	4.38
15	1.96	1.43	0.42
30	1.39	1.78	0.64

Notes: The table reports, tenor wise, average daily traded volume from January 1, 2003 to 22 April, 2013 for Bloomberg benchmark bonds conditional on trading in either of the sub-markets (column “All”) or the respective sub-markets.

Source: Authors' calculations based on trade data from Bloomberg.

Table 6: Prevalence Regression

VARIABLES	(1)	(2)	(3)	(4)	(5)
Coupon rate	-2.00**				0.54
	(0.787)				(0.537)
Ln(issuance size)		13.82***			16.76***
		(1.032)			(1.593)
Ln(Maturity at Issuance)			-1.50		0.58
			(4.038)		(3.114)
Issuance year				1.81***	-0.63**
				(0.220)	(0.290)
Pseudo R2	0.003	0.099	0	0.035	0.103
Observations	181	180	181	181	180

Notes: The table reports the results of two-sided-censored Tobit regressions explaining which bonds trade in the secondary market. The dependent variable is the percentage of days for which a bond trades irrespective of the sub-market. The sample period runs from 01-January-2003 to 22-April-2013. “Coupon rate” is in percent, ln(issuance size) is the natural log of issuance in billion INR, “Maturity at issuance” is the difference in years between the maturity date and issue date of the bond, and issuance year is defined as the issuance year minus 1973. Standard errors are in parentheses. One-, two-, and three-asterisks indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

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

Table 7: NDSOM Market Share Regression

	NDS-OM Market Share (%)	
Ln(Volatility)	-1.57***	-3.71***
	(0.331)	(0.469)
Ln(Volatility)*ISIN Switch		5.93***
		(1.072)
Constant	75.90***	74.12***
	(0.401)	(0.549)
Observations	1,705	1,705
Adjusted R-Squared	0.0103	0.0326

Notes: The dependent variable is the share of NDS-OM sub-market in daily trading volume (INR billion). The sample period runs from February 24, 2006 to April 22, 2013. Volatility is the standard deviation of the daily secondary market price of the 10-year benchmark bond over a 20-day moving window that ends on the day preceding the trade date; volatility*ISIN switch is the interaction of daily price volatility with an indicator variable (ISIN switch) that is equal to 1 if there is an ISIN switch in the 20-day window corresponding to the volatility window. Heteroskedasticity consistent standard errors are reported in parentheses. One-, two-, and three- asterisks indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

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

Table 8: Market Efficiency Tests

Panel A : 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 price.

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

Panel B : 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 price.

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

Table 9: Test for Equality of NDS-OM and OTC Daily Benchmark Price Distribution

Benchmark Tenor	Kolmogorov-Smirnov Test Statistic	P-Value	Observations
Overall	0.008	0.954	7980
2	0.014	1	560
3	0.017	1	482
4	0.025	0.999	489
5	0.02	0.996	850
6	0.022	0.997	692
7	0.013	1	923
8	0.019	1	745
9	0.018	1	624
10	0.014	0.99	1555
15	0.044	0.77	454
30	0.020	1	606

Notes: The table reports the Kolmogorov-Smirnov test statistic, p-value and number of observations for overall and tenor-wise benchmark bonds. Kolmogorov-Smirnov test is used to test the null hypothesis of equality of distribution of daily prices; the test statistics are reported when the benchmark bond trades on both NDS-OM and OTC sub-market on a given day.

Source: Authors' calculations based on data from Bloomberg.

Table 10: Underwriting Commission Cutoff Rate by Sector

Sector	Mean	Median	Standard Deviation	Number of Observations
Short	3.24	0.94	8.05	194
Medium	3.82	1.03	8.55	313
Long	6.83	1.99	13.64	357

Notes: The table reports descriptive statistics on the cutoff commission rate in underwriting auctions for fixed-rate dated Government of India securities held between January 1, 2003 and June 12, 2014. Underwriting commissions are in paise (100 paise = 1 INR) per 100 INR underwritten. Securities are grouped by residual maturity at the time of the auction into short (1-7 years), medium (greater than 7 and less than 15 years), and long (greater than 15 years).

Source: Authors' calculations based on data from "Press Releases" section of the Reserve Bank of India website, http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx.

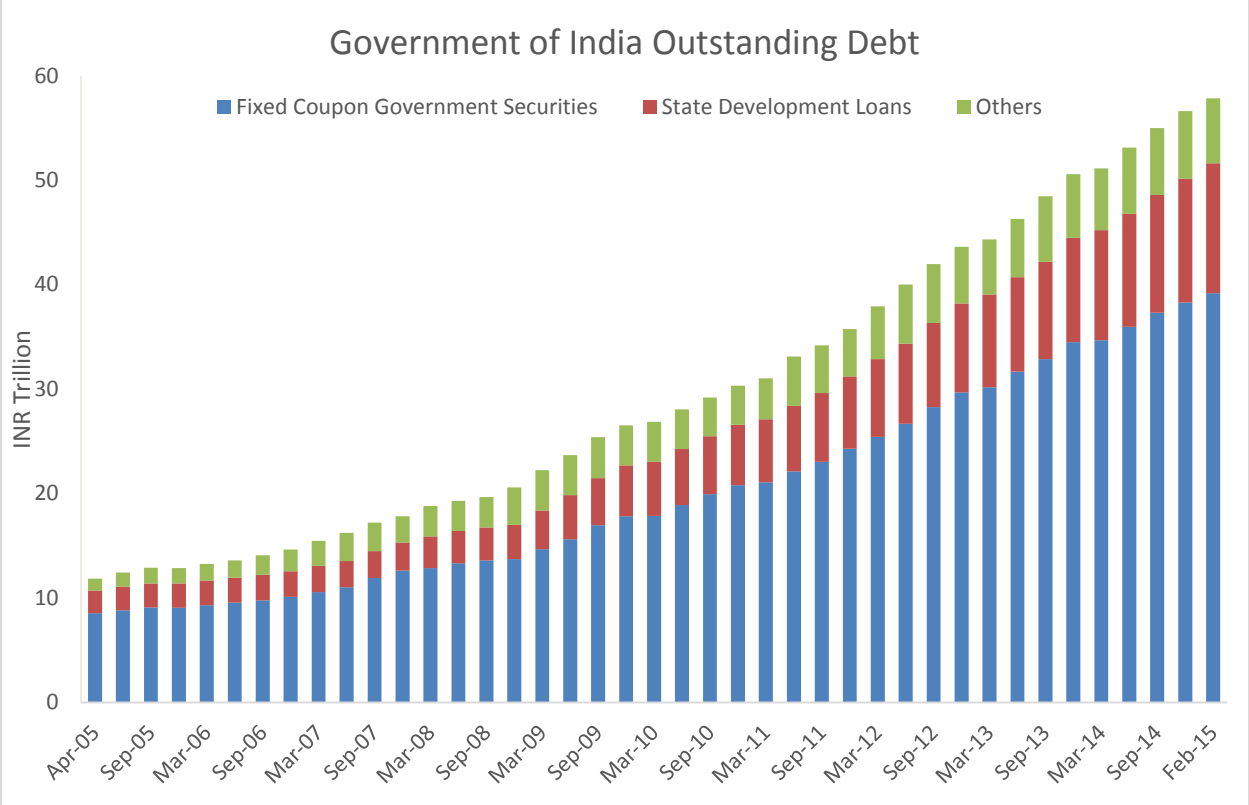
Table 11: Log Underwriting Commission Regression

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11) ALL
NDSOM	-0.83***										-0.32
	(0.213)										(0.270)
Ln(Volatility)		1.05***									0.94***
		(0.066)									(0.068)
Ln(Volatility)*ISIN Switch		-1.40***									-1.24***
		(0.151)									(0.155)
Liquidity Adjustment Facility			-0.47***								-0.31***
			(0.053)								(0.056)
Uniform Price Auction				-0.11							0.18
				(0.111)							(0.119)
Reissued Bond					0.46**						0.59***
					(0.195)						(0.160)
Bid-to-Cover Ratio						-0.50***					-0.35***
						(0.071)					(0.073)
Ln(Issuance Size)							-0.35***				-0.23*
							(0.125)				(0.126)
Residual Maturity								0.04***			0.03***
								(0.006)			(0.006)
FIMMDA Benchmark									-0.36***		-0.26***
									(0.102)		(0.093)
Coupon										-0.19***	0.02
										(0.062)	(0.082)
Constant	1.26***	1.04***	0.56***	0.55***	0.03	1.70***	1.72***	-0.07	0.72***	2.00***	1.85**
	(0.207)	(0.068)	(0.046)	(0.098)	(0.189)	(0.183)	(0.458)	(0.092)	(0.087)	(0.495)	(0.782)
Observations	861	821	861	861	861	861	861	861	861	861	821
R-squared	0.017	0.271	0.061	0.001	0.005	0.058	0.009	0.048	0.015	0.010	0.393
Adjusted R-Squared	0.0162	0.269	0.0599	5.25e-05	0.0040	0.0570	0.0083	0.0466	0.0141	0.0087	0.384

Notes: The dependent variable is the log cutoff rate (paise per 100 INR) in the auction for Additional Competitive Underwriting. The sample period runs from January 1, 2003 to June 12, 2014. NDS-OM is an indicator variable equal to 1 if the underwriting auction date is on or later than August 1, 2005; volatility is the standard deviation of the daily secondary market price of the 10-year benchmark bond over a 20-day moving window that ends on the day preceding the underwriting auction date; volatility*ISIN switch is the interaction of daily price volatility with an indicator variable (ISIN switch) that is equal to 1 if there is an ISIN switch in the 20-day window corresponding to the volatility window; liquidity adjustment facility is a variable equal to the net liquidity injections by the RBI on the day preceding the underwriting auction; uniform price auction is an indicator variable equal to 1 if the second-round bid auction is a uniform price auction, reissued bond is an indicator variable equal to 1 if the auctioned bond is a reissue; bid-to-cover is the ratio of the bid amount to the issue amount in the second-round bid auction; ln(issuance size) is the natural log of the underwriting auction issuance size in ten millions of INR, residual maturity is the time to maturity from underwriting auction day in years; FIMMDA benchmark is an indicator variable equal to 1 if the auctioned bond is on the list of benchmark bonds released by FIMMDA on the day preceding the underwriting auction date. 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.

Source : Authors' calculations based on trade data from Clearing Corporation of India Ltd., Internal Debt Management Department of Reserve Bank of India, "Press Releases" section of the Reserve Bank of India website, http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx, Bloomberg and the website of Fixed Income Money Market and Derivatives Association of India.

Figure 1

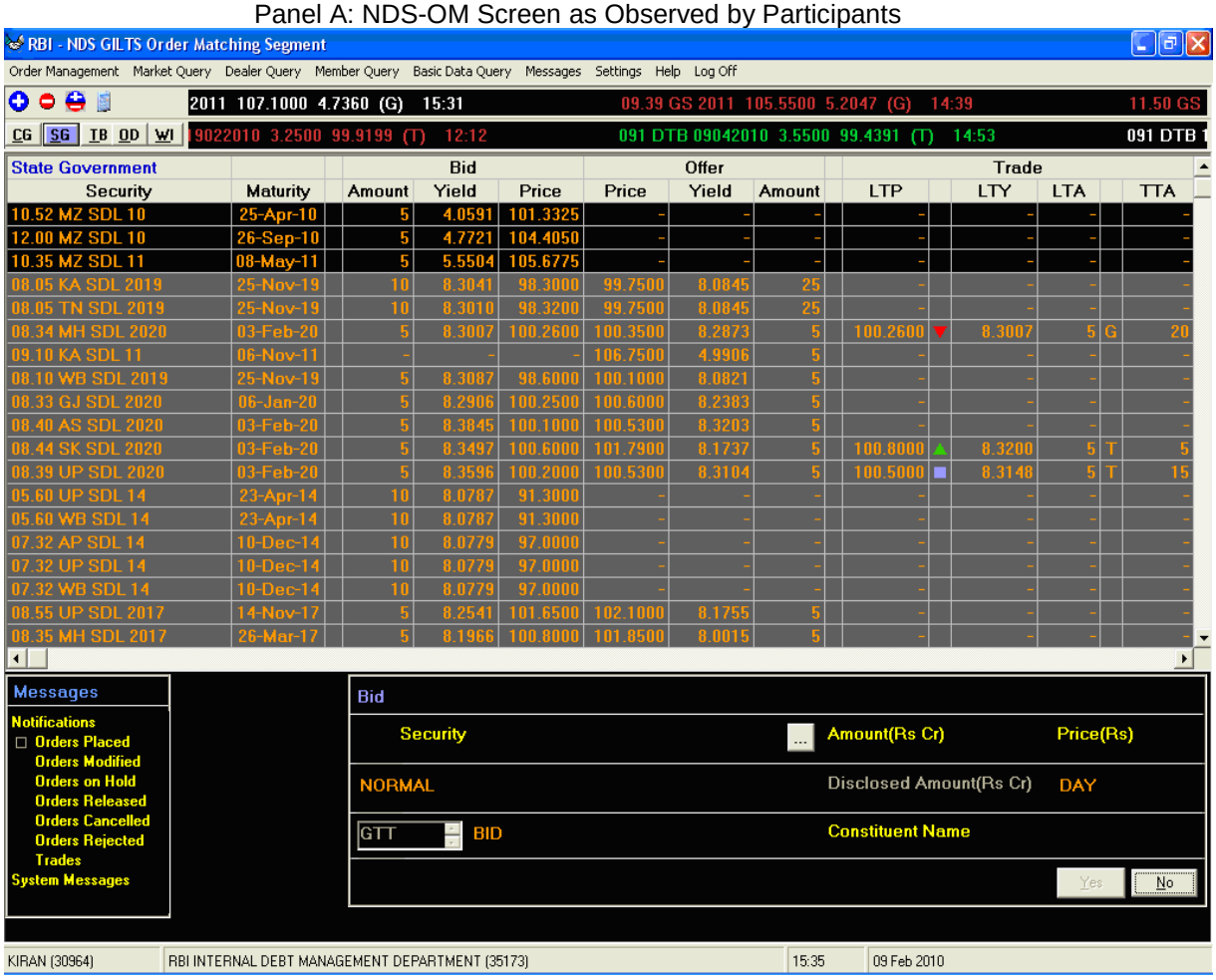


Notes: Figure represents composition of outstanding government debt (Central and State) from April, 2006 to February, 2015. It comprises of fixed coupon central government securities (Fixed coupon Government securities), state development loans (SDL), floating rate bonds, special bonds, treasury bills.

Source: Rakshitra, The Clearing Corporation of India Ltd's Monthly Newsletter on Money, G-Sec and Government Markets, volumes from May, 2005 to March, 2015 (https://www.ccilindia.com/Research/CCILPublications/Pages/RakshitraArchive.aspx) .

Figure 2

Panel A: NDS-OM Screen as Observed by Participants



Panel B: Specimen Deal Slip for Recording OTC Trades

Specimen of Deal Slip

XYZ Urban Co-operative Bank Ltd

Address

Phone:

E-mail :

Deal slip No. :

Deal Confirmation

We agree to BUY / SELL :

1.	OUTRIGHT / REPO	
2.	Transaction id	:
3.	Transaction date	:
4.	Value date	:
5.	Reversal date (in case of repo)	:
6.	Time of Transaction	:
7.	Transaction mode	: Telephone / NDS-OM / Broker
8.	Nomenclature of security	:
9.	Last coupon date	:
10.	Principal amount	:
11.	Accrued Interest	:
12.	Agreed price (per Rs.100)	:
13.	Total amount	:
14.	Name of Broker, if any	:

15. It is agreed to DEBIT / CREDIT our Current account with _____Bank and CREDIT / DEBIT out SGL / Gilt Account / Demat account with _____Bank on value date.

Signed/- Signed/-

Authorised Signatory Authorised Signatory

Panel C: NDS-OM Market Watch Snapshot

Market Session Open

As on Apr 16, 2015 2:55:32 PM IST

Reserve Bank of India

NDS - OM

Negotiated Dealing System

Order Matching Segment

CG Mkt. Watch | SG Mkt. Watch | T-Bills Mkt. Watch | WI Mkt. Watch | Odd Lot Mkt. Watch | Market by Price | Individual Trades | Reported Deals | Mkt. Liquidity Indicators | Active Member List

CG

SG/TB

Refresh

:: Regular Market ::

YTM Curve

Security Description	Trades	TTA	Open	High	Low	LTP			LTY
08.40 GS 2024	1055	9395.00	103.8900	103.9800	103.8800	103.9300	↔	T	7.7942
08.60 GS 2028	698	6250.00	106.4600	106.5150	106.3750	106.4350	↑	T	7.8058
08.27 GS 2020	293	2605.00	102.0725	102.1100	102.0325	102.0925	↑	T	7.7650
08.15 GS 2026	193	1540.00	102.7450	102.8500	102.6825	102.8500	↔	T	7.7711
08.83 GS 2023	57	485.00	105.9000	105.9800	105.8700	105.9450	↔	T	7.8639
08.28 GS 2027	41	265.00	103.3100	103.4300	103.3100	103.3700	↔	T	7.8493
08.12 GS 2020	27	255.00	101.3500	101.4200	101.3300	101.3700	↓	G	7.8117
07.28 GS 2019	23	220.00	98.4400	98.5000	98.4400	98.4400	↓	G	7.7248
07.80 GS 2020	12	95.00	99.9525	99.9975	99.8500	99.9750	↑	T	7.8046
08.24 GS 2033	3	55.00	103.9800	103.9800	103.9800	103.9800	↔	T	7.8289
07.16 GS 2023	8	50.00	95.8900	95.8900	95.8300	95.8300	↓	G	7.8646
09.23 GS 2043	4	50.00	114.7300	114.7300	114.6900	114.6900	↓	G	7.9237
07.83 GS 2018	3	50.00	100.2500	100.2500	100.2500	100.2500	↔	T	7.7337
09.20 GS 2030	7	45.00	111.4875	111.4900	111.4200	111.4200	↓	G	7.9061
07.49 GS 2017	7	45.00	99.4750	99.4875	99.4750	99.4800	↔	G	7.7759
Total	**2501**	**22820.00**							

1 2 3 4

Panel D: NDS-OM Trade Watch Snapshot

Market Session Open

As on Apr 17, 2015 11:29:19 AM IST

Reserve Bank of India

NDS - OM

Negotiated Dealing System

Order Matching Segment

Home Page | CG Mkt. Watch | SG Mkt. Watch | T-Bills Mkt. Watch | WI Mkt. Watch | Odd Lot Mkt. Watch | Market by Price | Active Member List

Refresh

Individual Trade Details

08.40 GS 2024

Click here for other Instruments

Trade Timestamp	Amount (Crs.)	Price	Yield
11:26:01	5.0000	103.8325	7.8084
11:25:22	5.0000	103.8250	7.8095
11:25:18	10.0000	103.8250	7.8095
11:25:13	10.0000	103.8250	7.8095
11:24:29	10.0000	103.8250	7.8095
11:24:19	15.0000	103.8250	7.8095
11:24:19	25.0000	103.8250	7.8095
11:24:19	10.0000	103.8250	7.8095
11:24:13	5.0000	103.8300	7.8088
11:24:08	25.0000	103.8250	7.8095
11:22:44	10.0000	103.8300	7.8088
11:22:39	5.0000	103.8300	7.8088
11:22:15	10.0000	103.8300	7.8088
11:21:31	10.0000	103.8300	7.8088
11:21:22	10.0000	103.8300	7.8088
11:20:12	10.0000	103.8300	7.8088
11:20:00	5.0000	103.8325	7.8084
11:19:21	5.0000	103.8125	7.8114
11:18:22	10.0000	103.8200	7.8103
11:18:07	25.0000	103.8200	7.8103
Trades: 267	**2520.0000**		

1 2 3 4 5 6 7 8 9 10 ...

Price Chart

Yield Chart

Source: NDS-OM hosted at CCIL

Panel E: NDS-OM Quote Watch Snapshot

Market Session Open

As on Apr 16, 2015 2:57:57 PM IST

Reserve Bank of India

NDS - OM

Negotiated Dealing System

Order Matching Segment

Home Page | CG Mkt. Watch | SG Mkt. Watch | T-Bills Mkt. Watch | WI Mkt. Watch | Odd Lot Mkt. Watch | Individual Trades | Active Member List

Refresh

Market by Price

08.40 GS 2024

Click here for other Instruments

Open	High	Low	Last Trade	TTA	Trades
103.8900/7.8002	103.9800/7.7867	103.8800/7.8017	103.9200/7.7957	9430.0000	1060

Nos.	Bid Amt.	Bid Yield	Bid Price	Offer Price	Offer Yield	Offer Amt.	Nos.
2	10.0000	7.7968	103.9125	103.9275	7.7946	5.0000	1
6	40.0000	7.7972	103.9100	103.9300	7.7942	35.0000	2
2	105.0000	7.7976	103.9075	103.9325	7.7938	20.0000	3
1	10.0000	7.7979	103.9050	103.9350	7.7934	15.0000	3
3	20.0000	7.7983	103.9025	103.9375	7.7931	5.0000	1
114	**1410.0000**		**Total**	**Total**		**1140.0000**	**120**

Source: NDS-OM hosted at CCIL

Panel F: OTC Market Watch Snapshot

Market Session Open

As on Apr 16, 2015 3:02:23 PM IST

Reserve Bank of India

NDS - OM

Negotiated Dealing System

Order Matching Segment

Home Page | Active Member List

:: Reported Deals T + 1:: | :: Reported Deals T + 2::

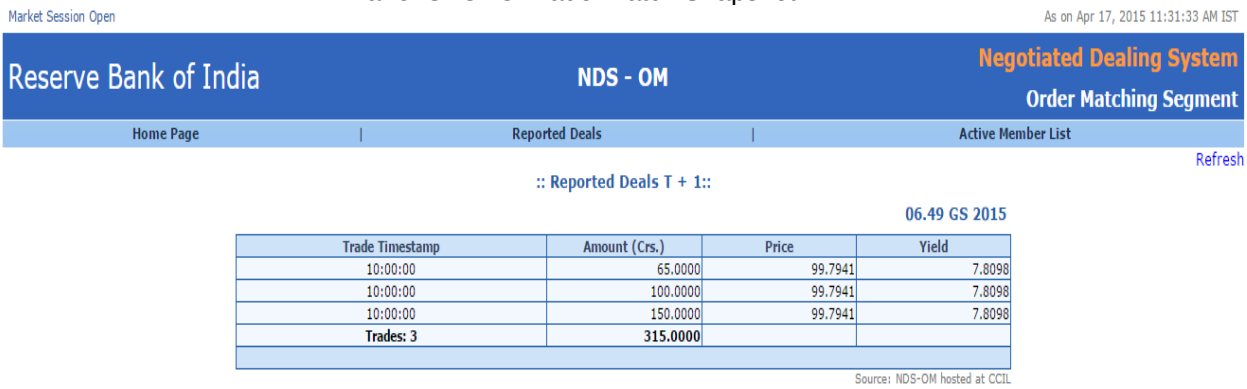
Refresh

:: Standard Lot ::

Security Description	Maturity Date	Trades	TTA
08.40 GS 2024	28/07/2024	14	890.00
08.27 GS 2020	09/06/2020	5	705.00
08.60 GS 2028	02/06/2028	3	130.00
08.12 GS 2020	10/12/2020	1	100.00
07.28 GS 2019	03/06/2019	2	60.00
09.20 GS 2030	30/09/2030	2	55.00
08.28 GS 2027	21/09/2027	2	50.00
08.30 GS 2040	02/07/2040	1	45.00
07.80 GS 2021	11/04/2021	2	15.00
07.16 GS 2023	20/05/2023	1	5.00
08.35 GS 2022	14/05/2022	1	5.00
08.15 GS 2026	24/11/2026	1	5.00
08.04 MH SDL 2025	25/02/2025	2	50.00
09.19 KL SDL 2024	28/05/2024	1	50.00
364 DTB 05042016	05/04/2016	2	200.00
	Total	**45**	**2560.00**

1 2

Panel G: OTC Trade Watch Snapshot


Market Session Open

As on Apr 17, 2015 11:31:33 AM IST

Reserve Bank of India

NDS - OM

Negotiated Dealing System

Order Matching Segment

Home Page | Reported Deals | Active Member List

Refresh

:: Reported Deals T + 1::

06.49 GS 2015

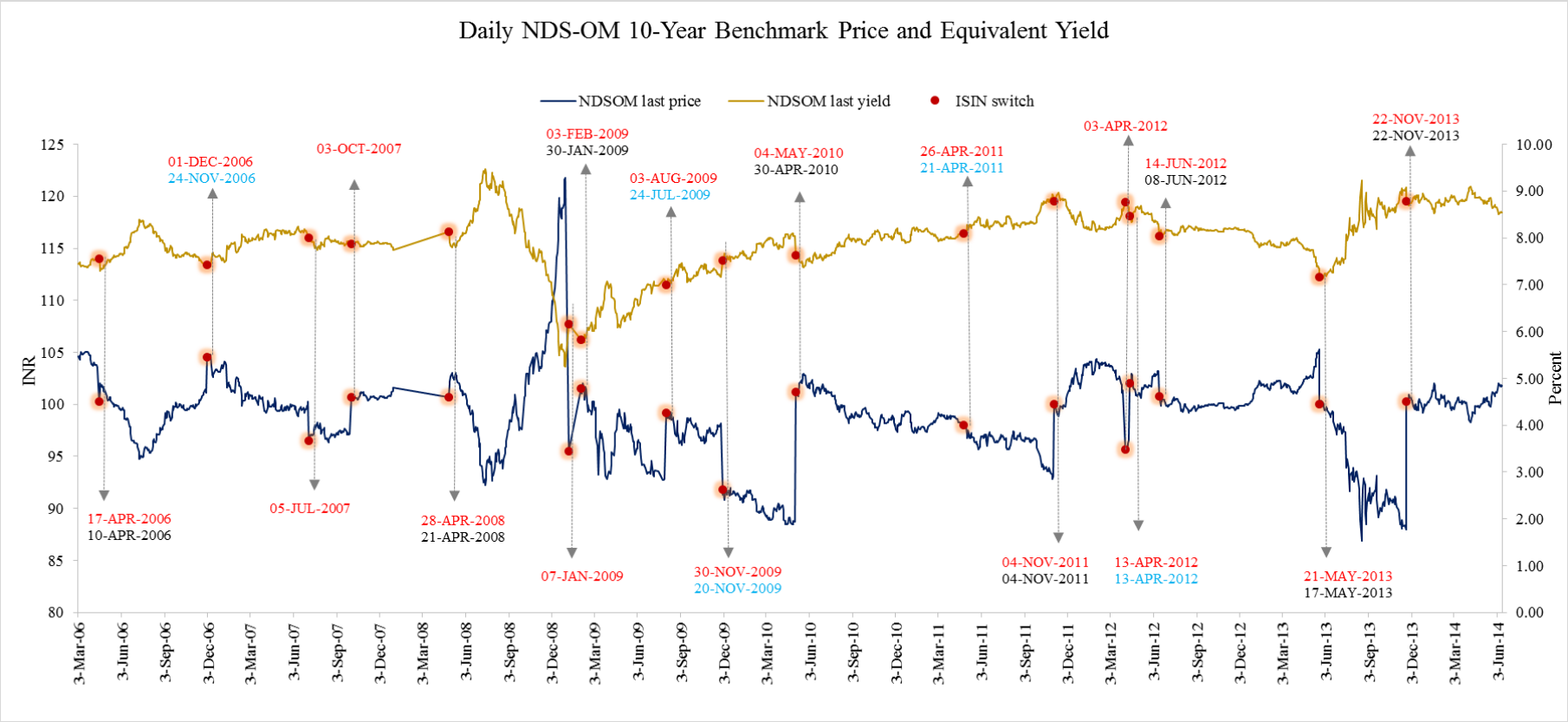
Trade Timestamp	Amount (Crs.)	Price	Yield
10:00:00	65.0000	99.7941	7.8098
10:00:00	100.0000	99.7941	7.8098
10:00:00	150.0000	99.7941	7.8098
Trades: 3	**315.0000**		

Source: NDS-OM hosted at CCIL

Notes: Panel A shows NDS-OM screen as observed by participants. Panel B is the specimen deal slip for recording trades on OTC. Panels C-E are snapshots of the NDS-OM Market Watch, Trade Watch and Quote Watch screens respectively. Panels F and G are snapshots of the OTC Market Watch and Trade Watch screens respectively.

Source: http://rbidocs.rbi.org.in/rdocs/Publications/PDFs/NDSOM290410.pdf, pp. 5-6.

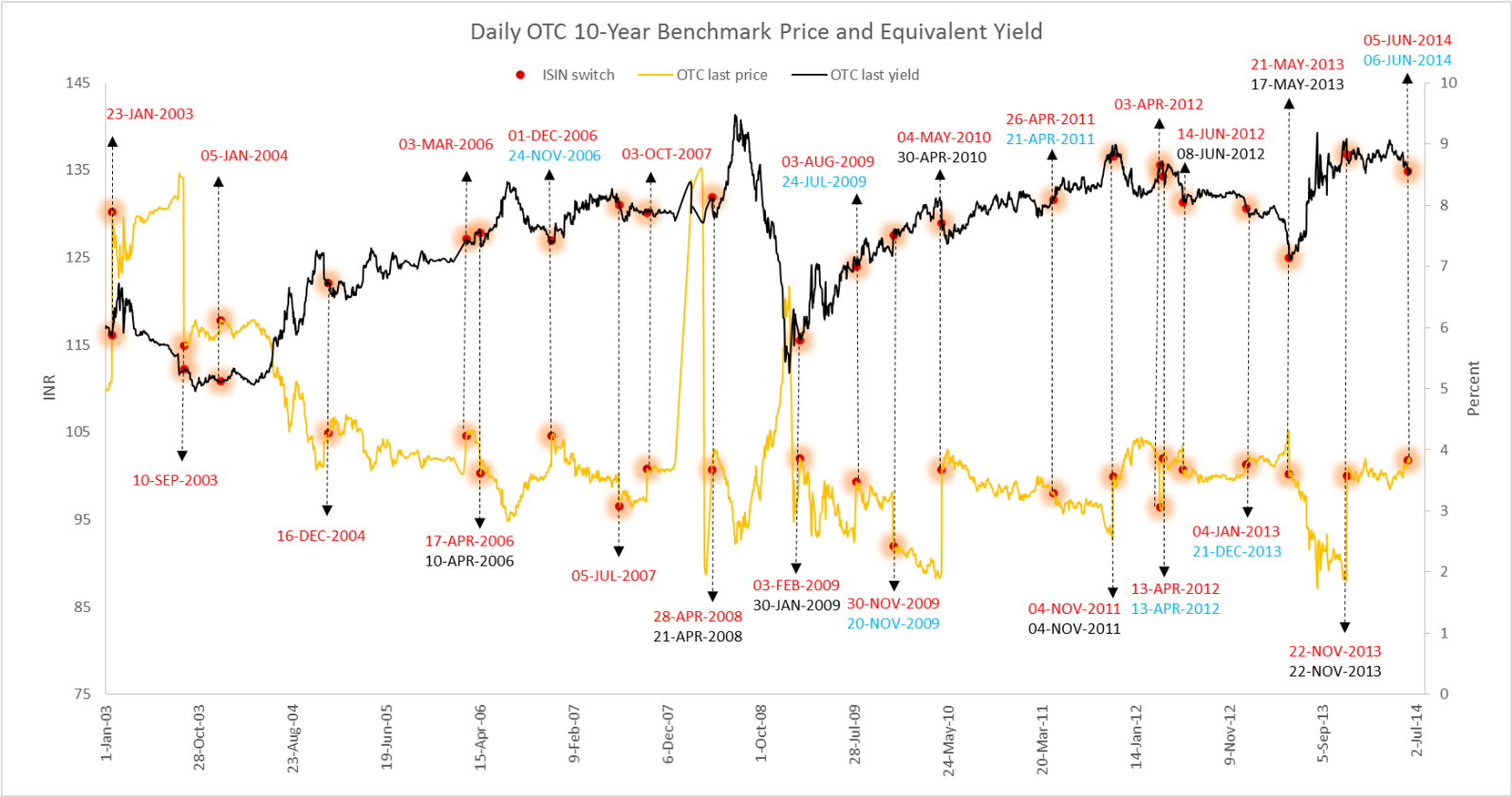
Figure 3 Panel A



Notes: The figure plots the daily last price and equivalent yield of the 10-year benchmark bond on the NDS-OM sub-market from March 03, 2006 to June 12, 2014 along with the dates on which the benchmark ISIN changed. Dates in red are switch dates, in blue are reissue auction dates and in black are new issue auction dates.

Source: Bloomberg and Clearing Corporation of India Ltd.

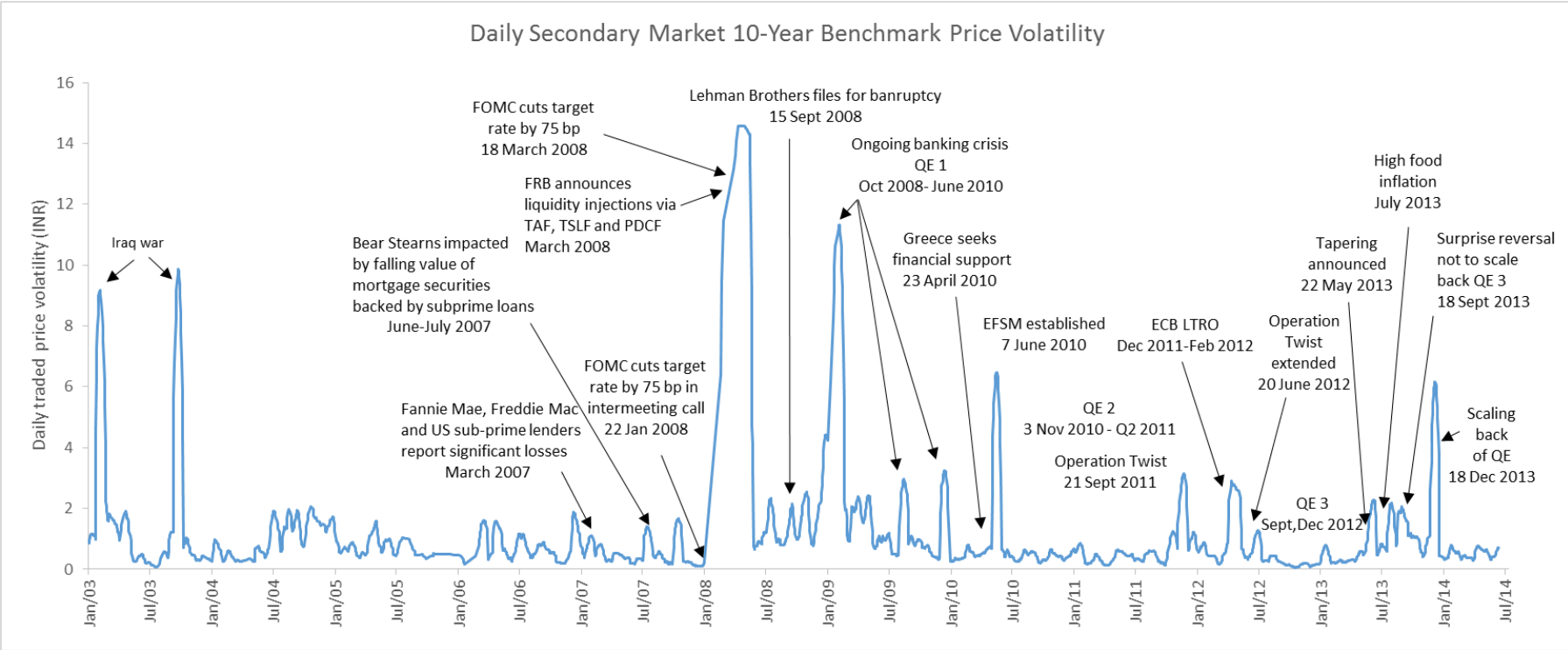
Figure 3 Panel B



Notes: The figure plots the daily last price and equivalent yield of the 10-year benchmark bond on the OTC sub-market from January 1, 2003 to June 12, 2014 along with the dates on which the benchmark ISIN changed. Dates in red are switch dates, in blue are reissue auction dates and in black are new issue auction dates.

Source: Bloomberg and Clearing Corporation of India Ltd.

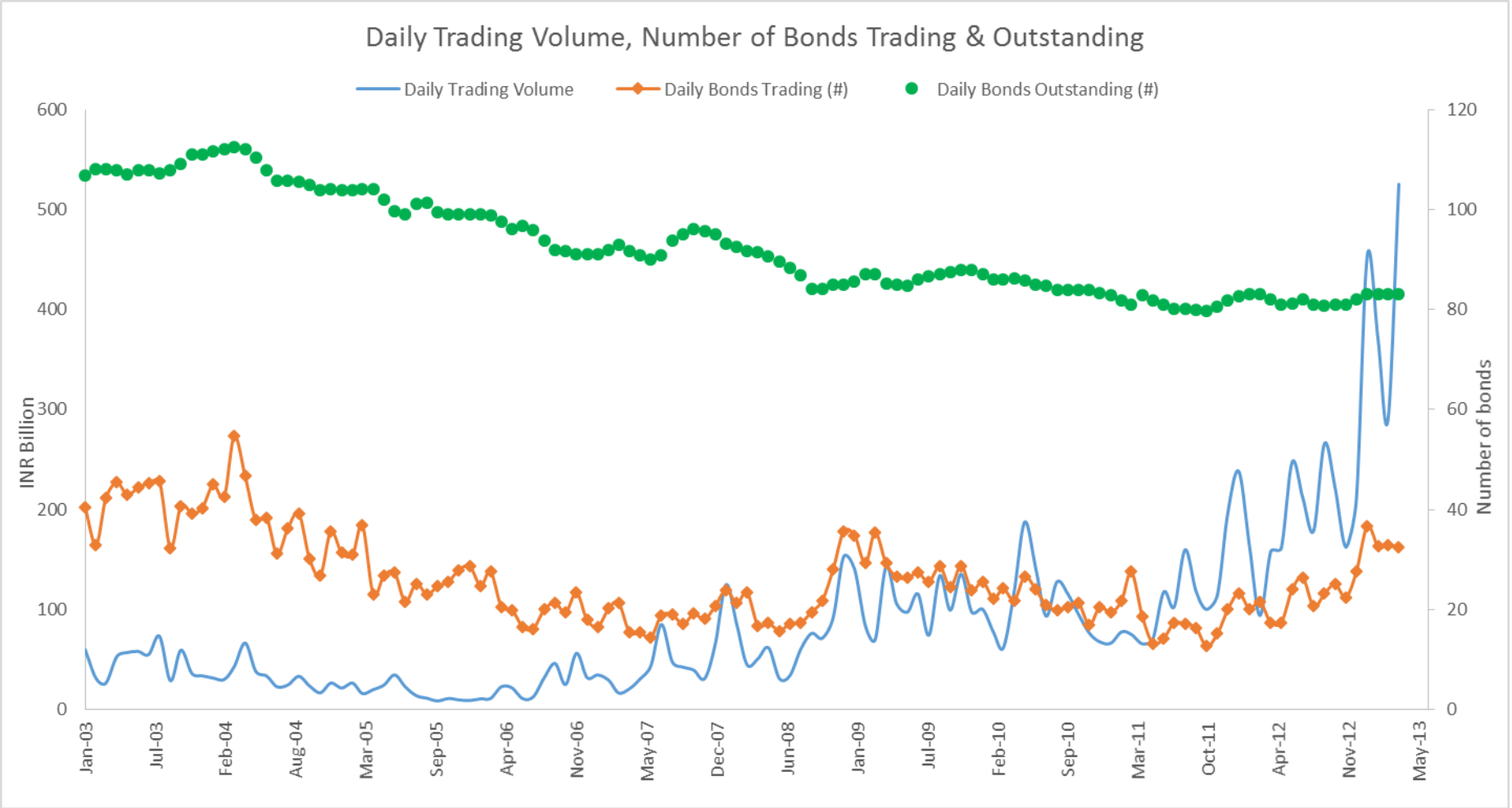
Figure 4



Notes: The figure plots daily secondary market price volatility of the 10-year benchmark bond between 01-Jan-2003 to 12-June-2014. Volatility is measured by the standard deviation of daily secondary market price of the 10-year benchmark bond over a 20-day moving window from the current date. The secondary market price is the NDS-OM last price for the 10-year benchmark bond on the day this bond trades both OTC and NDS-OM; on days the 10-year benchmark bond trades in either of the sub-markets, it is the last price in that sub-market.

Source: Authors' calculations, based on data from Bloomberg and Internal Debt Management Division of Reserve Bank of India.

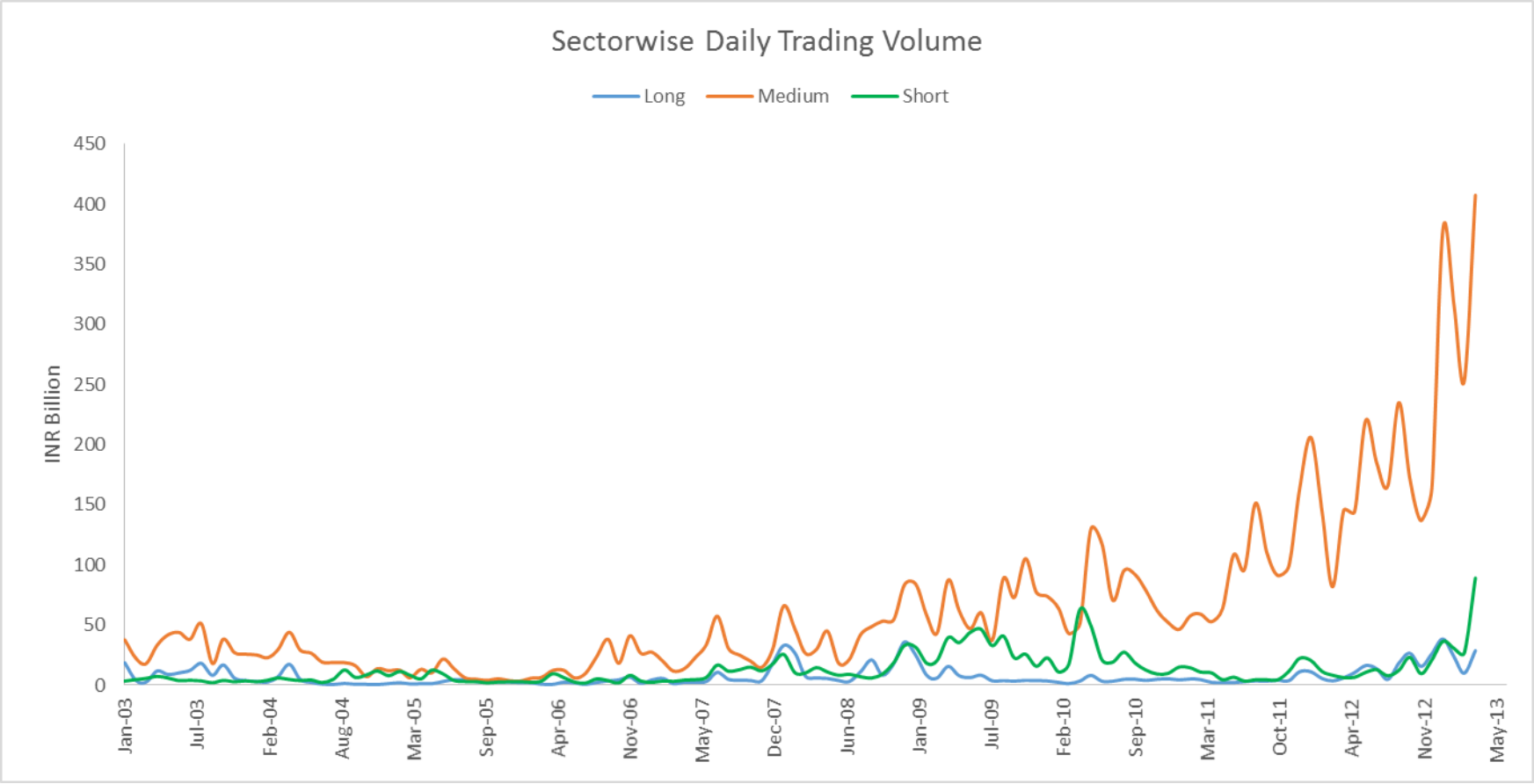
Figure 5



Note: The chart plots the daily trading volume (INR billion), daily number of bonds trading and outstanding averaged by month across all secondary sub-markets for the period January, 2003 to April, 2013.

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

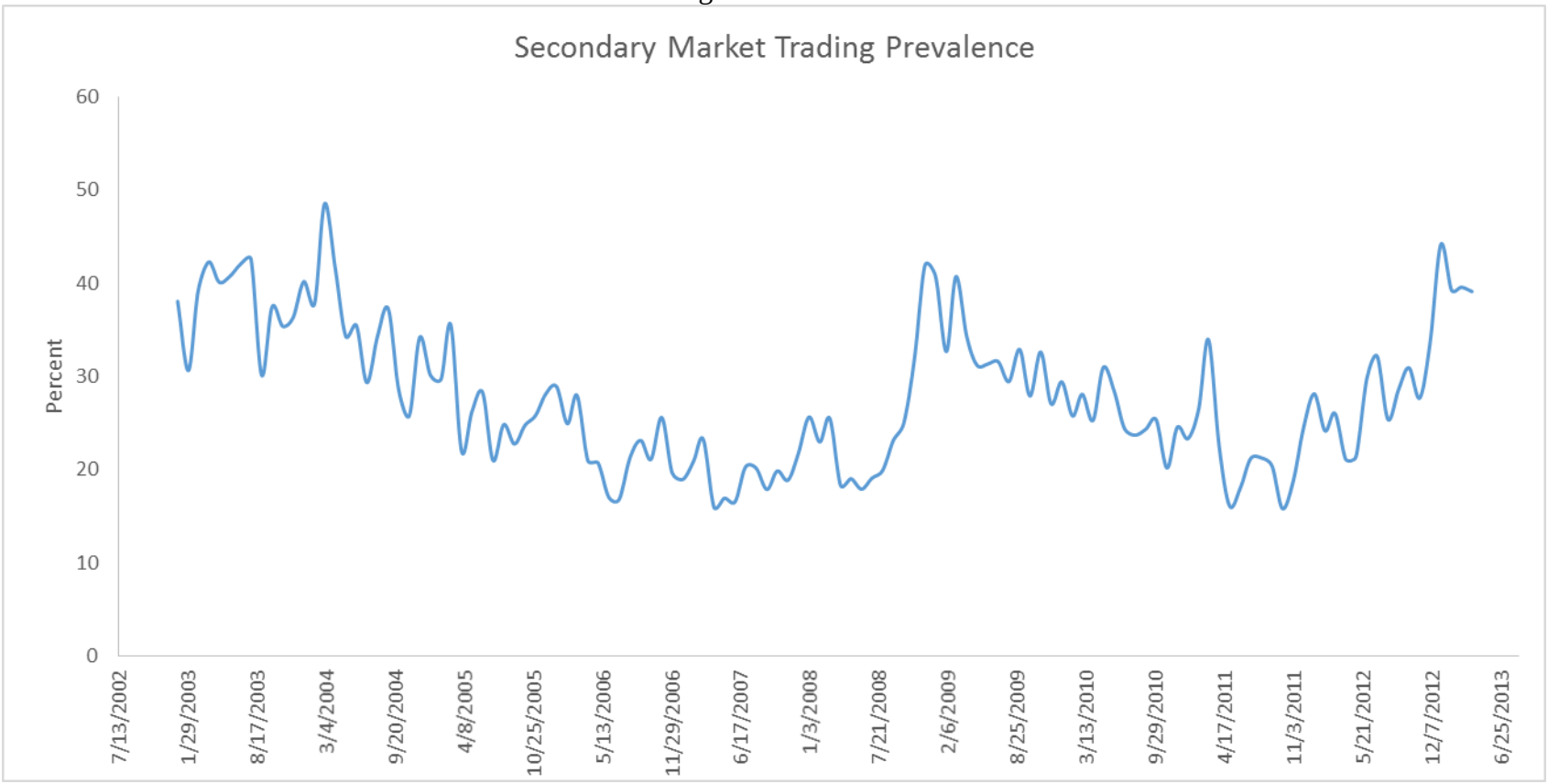
Figure 6



Note: The chart plots sectoral daily trading volume (INR billion) by month across all secondary sub-markets for the period January, 2003 to April, 2013. Bonds with residual maturity of less than seven years are short bonds, between seven and fifteen years are medium bonds, greater than fifteen years are long bonds.

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

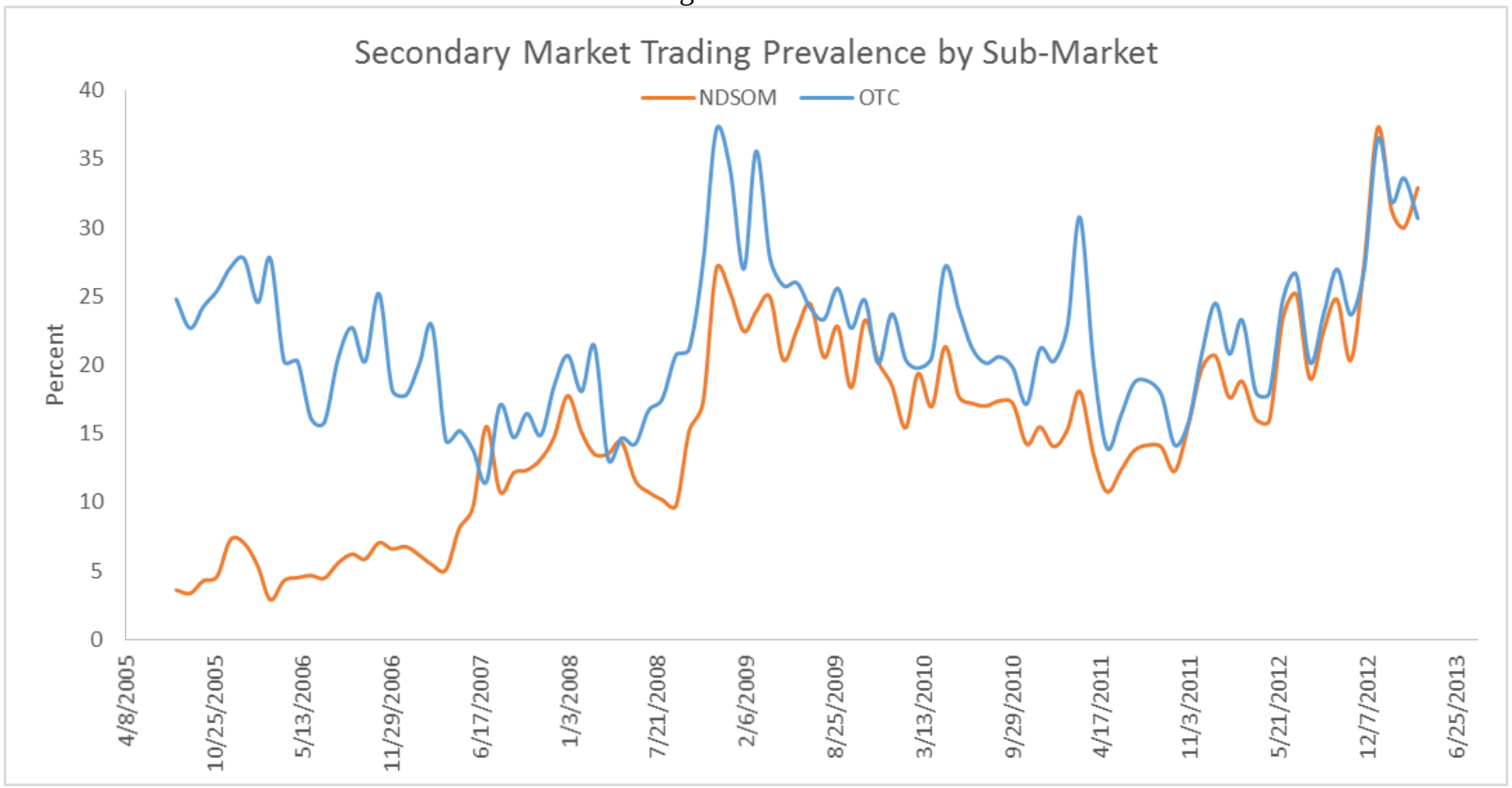
Figure 7 Panel A



Notes: The figure shows the trading prevalence (%) by month across all bonds. The percent is calculated as the total number of security-trading days in a month in which we observe a trade on any sub-market, divided by the total number of security-trading days in the month. The sample period ranges from January 1, 2003 to April 22, 2013.

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

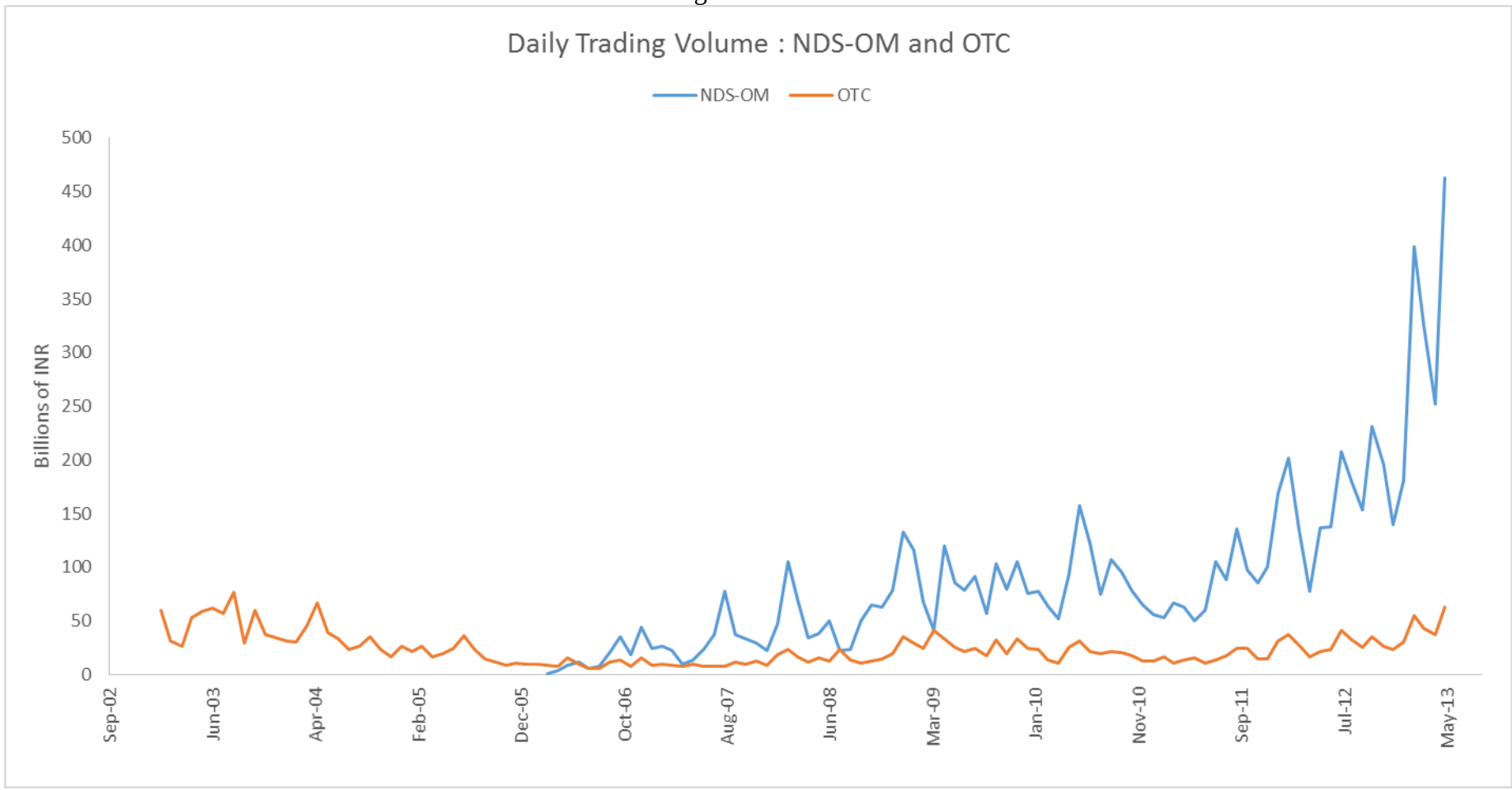
Figure 7 Panel B



Notes: The figure shows the trading prevalence (%) by month across all bonds by sub-market. The percent is calculated as the total number of security-trading days in a month in which we observe a trade on the NDS-OM (OTC) sub-market, divided by the total number of security-trading days in the month. The sample period ranges from January 1, 2003 to April 22, 2013.

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

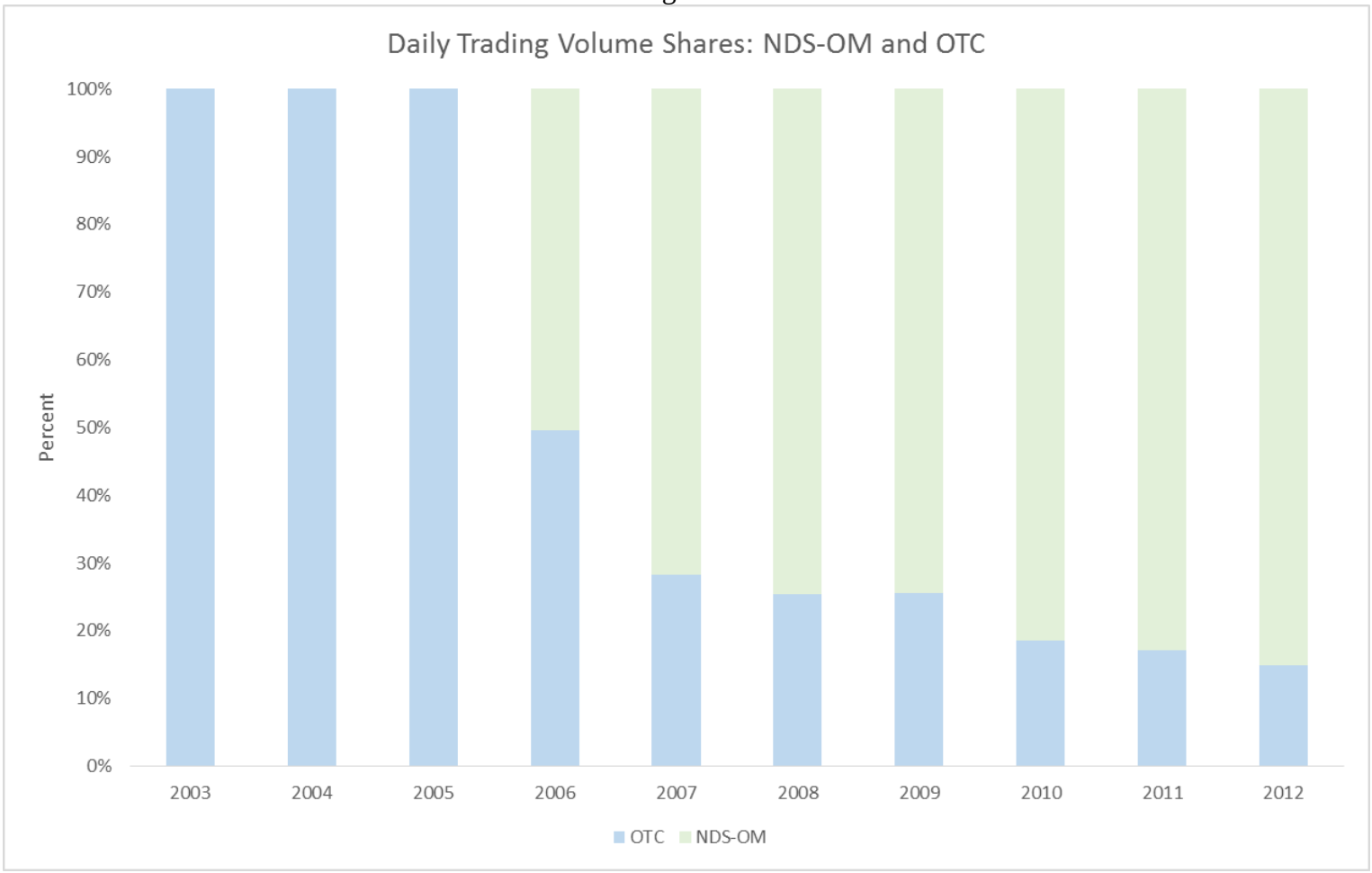
Figure 8



Note: The chart plots daily trading volume (INR billion) by month for the NDS-OM and OTC sub-markets for the period January, 2003 to April, 2013.

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

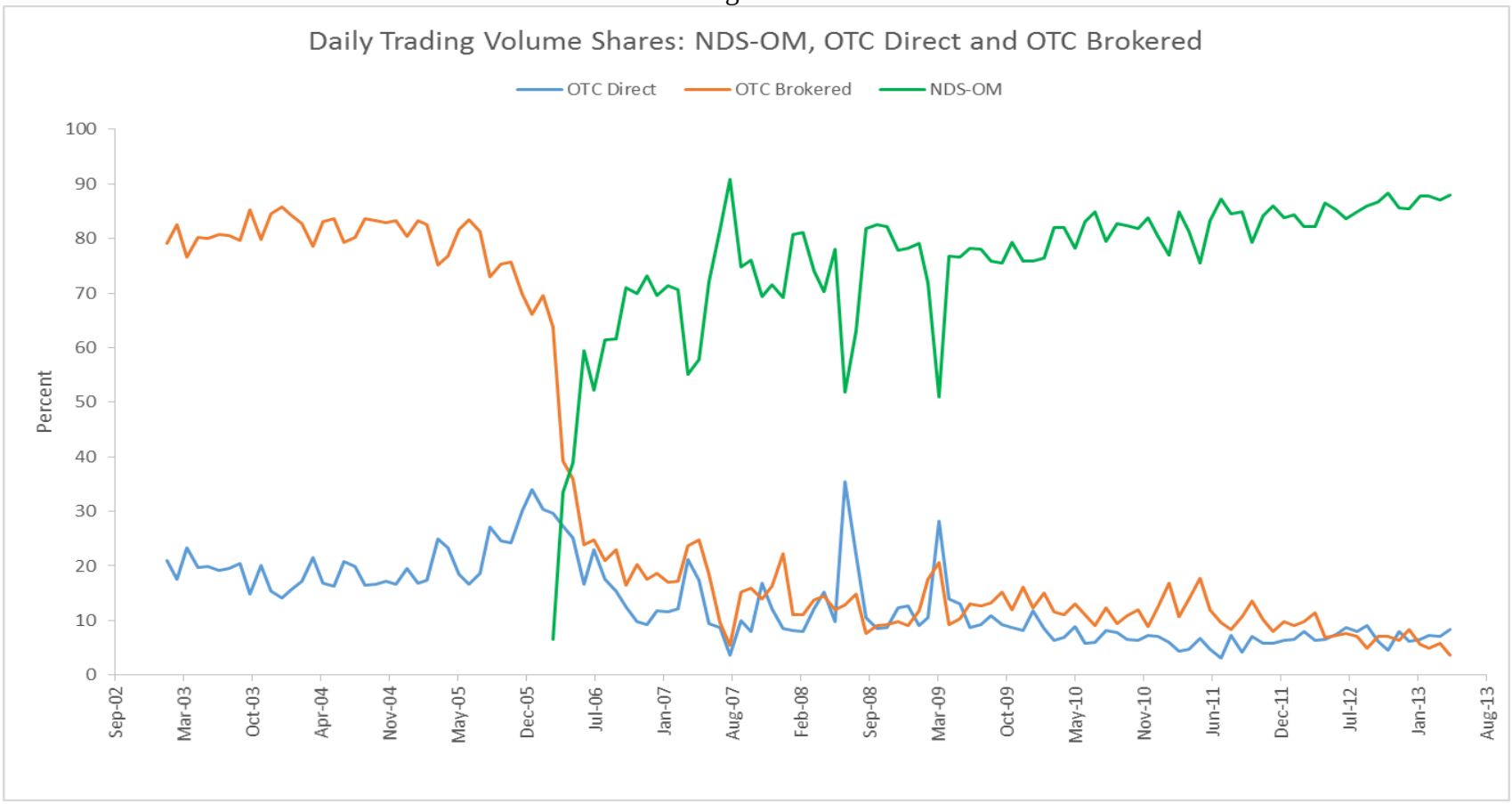
Figure 9



Note: The chart plots the trading volume shares of the NDS-OM and OTC sub-markets by year for the period January, 2003 to April, 2013.

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

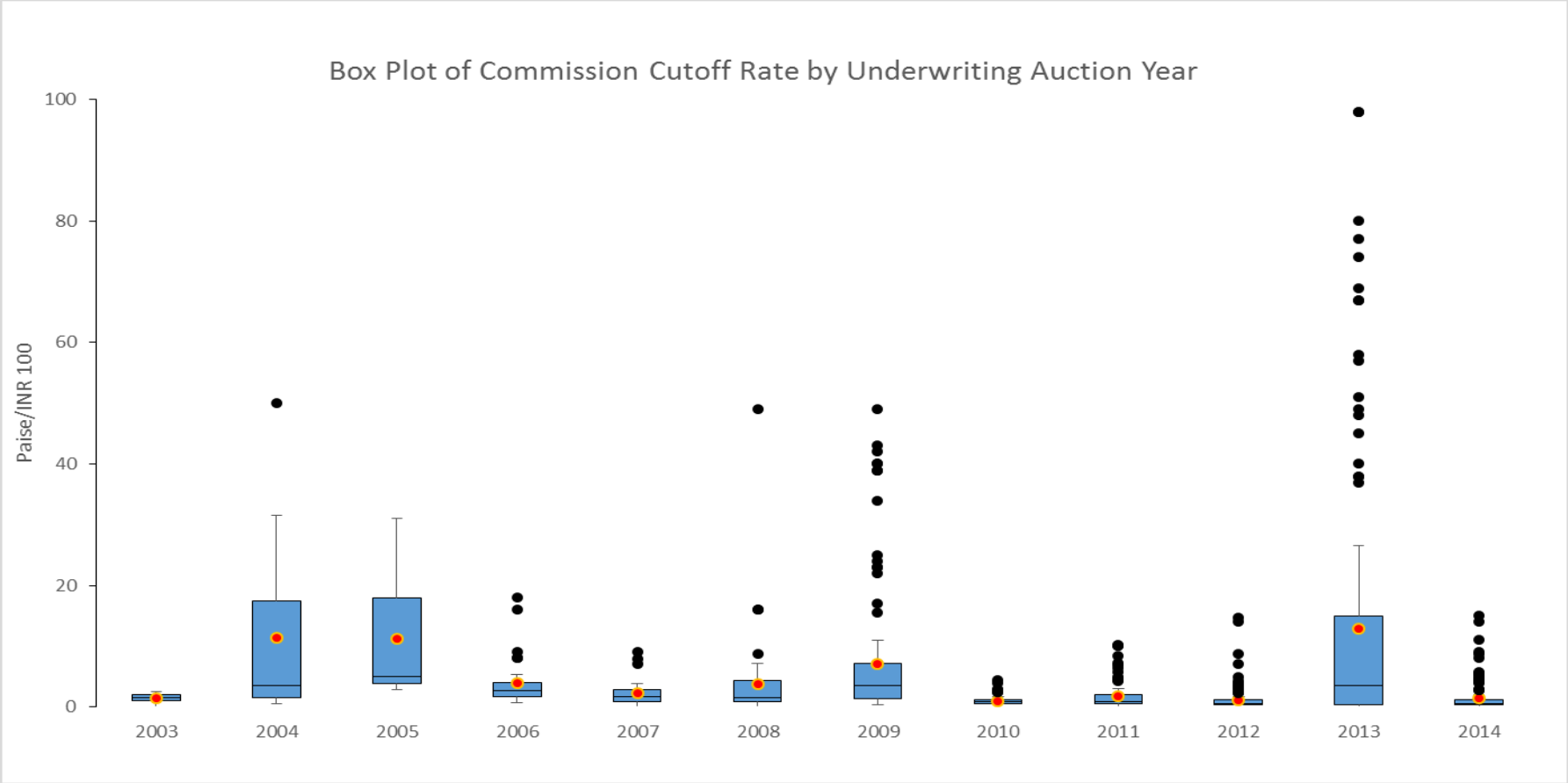
Figure 10



Note: The chart plots the trading volume shares of the NDS-OM, OTC direct and OTC brokered sub-markets by month for the period January, 2003 to April, 2013.

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

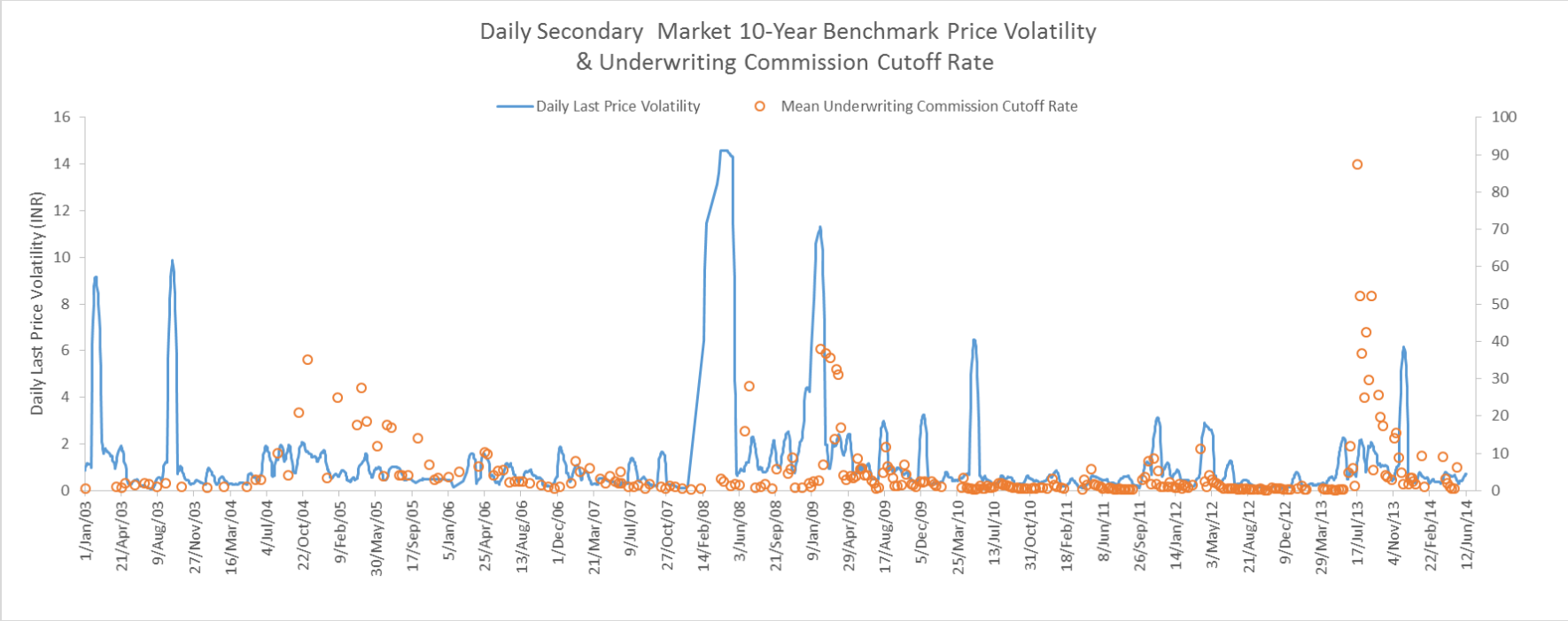
Figure 11



Notes: The figure is a box plot of the underwriting commission cutoff rate (paise/INR 100) by the year in which the underwriting auction is held. For each year, the upper and lower ends of the box represents the third (Q3) and first (Q1) quartile respectively. The black line inside the box (red dot) represents the median (mean) cutoff rate for underwriting auctions held that year. The upper horizontal bar represents Q3+(1.5*interquartile range) or the largest value in the distribution, whichever is smaller. The lower horizontal bar represents Q1-(1.5*interquartile range) or the lowest value of the distribution, whichever is larger, and it appears on the graph only if it is statistically distinguishable from Q1.

Source: Authors' calculations based on data from "Press Releases" section of the Reserve Bank of India website, http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx.

Figure 12



Notes: The figure plots daily secondary market price volatility of the 10-year benchmark bond and superimposes on it the mean commission cutoff rate (orange dots) by date on which the underwriting auctions are held. The period covered is from 01-Jan-2003 to 12-June-2014. Volatility is measured by the standard deviation of daily secondary market price of the 10-year benchmark bond over a 20-day moving window from the current date. The secondary market price is the NDS-OM last price for the 10-year benchmark bond on the day this bond trades both OTC and NDS-OM; on days the 10-year benchmark bond trades in either of the sub-markets, it is the last price in that sub-market.

Source: Authors' calculations, based on data from Bloomberg, Internal Debt Management Division of RBI, and "Press Releases" section of the Reserve Bank of India website, http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx.