Corporate Bond Trading on a Limit Order Book Exchange

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Abstract

We study the case of the Tel Aviv Stock Exchange, where corporate bonds (cbonds) are traded in a limit order book in the same way as stocks. Contrary to the OTC market in the US, the market is liquid with narrow spreads. We attribute this liquidity to the competition the LOB facilitates. We find that the activity of short-term traders (STT) is not concentrated (the Herfindahl index is low). Low concentration is related in the cross-section of bonds to low spreads, low price dispersion and small STT rents. The non-STT (including retail investors, whose participation is significant) compete with the STT on quotation and tend to tighter quotes. As takers, the retail investors do not impose adverse selection costs on the maker side, enabling narrower spreads. Using simultaneous equations we estimate that a difference of 1% in retail participation is negatively related to a change of 6.4% in the bond's spread. Contrary to the US we find that transaction size and trader type (retail vs. non retail) make very little difference to effective spread.

Keywords: corporate bonds, trading costs, retail investors, short-term investors, bid-ask spreads, liquidity

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1. Introduction

Corporate bonds (hereafter c-bonds) are mostly traded worldwide in over-the-counter (OTC) markets while stocks are mostly traded by an open limit order book (LOB) on exchanges. The c-bond OTC market in the US is illiquid (see Table 1, which summarizes empirical findings regarding the corporate bonds market and municipal bonds market in the US). For example, Harris (2015) estimates c-bonds' customer costs as roughly 0.5%. This figure is much higher than the volume-weighted average of the half quoted spread for US stocks, which is less than 0.02%. This is quite puzzling because c-bonds should be more liquid than stocks due to their lower variability (which makes liquidity provision less risky) and the lower degree of information asymmetry (see Biais and Green, 2007).

Several researchers claim that the OTC mechanism is problematic and should be replaced by a limit order book. For example, Harris, Kyle and Sirri (2015) suggest in the spirit of the NASDAQ reform from the 1990s "The US Securities and Exchange Commission (SEC) could rapidly and substantially improve bond market efficiency by simply requiring brokers to post their customers' limit orders ... where one customer's limit order could trade against another customer's order without dealer intermediation." In this context, O'Hara, Wang and Zhou (2016, hereafter OWZ (2016)) cite Rick Ketchum, CEO and chairman of FINRA, who says "It strikes me as odd that we've spent enormous energy in equity markets to measure and save pennies or just basis points on execution quality, while in the fixed income market it's more a question of nickels, quarters and dollars." Biais and Green (2007) find that until the 1940s bond trading was quite active on the NYSE and the trading costs of retail

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1 Biais and Declerck (2013) find lower effective spreads in Europe than in the US but their c-bond sample includes only large market-cap bonds.
2 Based on CRSP data of monthly bid and ask prices of stocks during 2014 (share codes 10 or 11).
3 FINRA (Financial Industry Regulatory Authority) is a private entity that acts as a self-regulatory organization (SRO).
investors were lower than today. They conclude that there are multiple possible equilibria in securities trading, and that the bond market in the US reached an inefficient equilibrium of OTC dominance: "Liquidity may not gravitate to the most efficient trading venue... even in the long term". The reason is that if one market is liquid and a second market is potentially more efficient but currently illiquid, it is not optimal for each trader individually to deviate from the equilibrium and move to the currently less liquid market.

This paper investigates the case of the Tel Aviv Stock Exchange (hereafter TASE), where c-bonds (and government bonds) have been traded for many years by the same open limit order book system as stocks and with no competing exchanges, dark pools, etc. The Israeli c-bond market is quite small (~$76 billion in 2014) and isolated (foreign holdings of 0.9% during 2014 – see Sub-section 2.1). Thus, one would expect it to be illiquid. Nevertheless, we find it to be a lively market with many transactions per bond-day, very little off-exchange trading and spreads which are lower than the comparable numbers in the US.

In this paper we analyze the characteristics of the LOB that enhance liquidity. Before getting into the empirical analysis we provide details about the relevant history of the Israeli market. From the time the TASE was established in 1953, bonds have been traded like stocks. At first, the exchange offered a daily auction in each of its securities (stocks and bonds). Since the market was extremely small (in 1960, the daily volume of all bonds – mostly governmental and few corporate – was $59 thousand) there was no room for the less operationally efficient OTC mechanism. Later, the market expanded dramatically but by then the exchange trading (of stocks and bonds) was already established. This history is in line with Biais and Green's
statement that a market can reach different potential equilibria. It appears that in Israel bond trading reached a different equilibrium than in other countries.

Our sample period is 2014 and we investigate 402 c-bonds denominated in NIS (New Israeli Shekels), of 143 firms, with a minimum market value of at least 100M NIS (approximately $28M during 2014). The market cap of these bonds was 95.3% of the TASE c-bond market cap. We use a unique and proprietary database of the TASE that includes transaction records with trader identification. The database does not include the trader's classification (for example, retail, institutional etc.).

We find that the average half effective spread (HES) of c-bond transactions is 0.078% and the corresponding half quoted spread (HQS) is 0.082%. Contrary to the US findings, the bond spreads are smaller than the corresponding stock spreads. These findings support the case for LOB for c-bonds. But what are the characteristics of the LOB that make it liquid? Our answer in short is: "LOB encourages competition in several ways". We begin our analysis by defining two trader groups. We identify retail investors (RI) as "low-volume" investors with less than 2 million NIS (~ $559,000) in all TASE securities (excluding options). These low-volume investors are almost certainly retail investors. The second group that we identify is short-term traders (STT). We define a short-term trader as a (non-retail) trader that on average flips between buying and selling within a trading day. These short-term traders are the analog for the dealers in the OTC market.

The first aspect of competition that we refer to is competition among the liquidity providers (STT). In an LOB, trading can be done using automated trading systems that monitor many securities simultaneously. Therefore, the monitoring costs per security are small. Indeed, we find that many STT are active in each bond

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4 During 2014 $1 was equal on average to 3.58 NIS (Bank of Israel data).
and the average (median) of the c-bond's *Herfindahl -Hirschman Index* (HHI) is 0.162 (0.126). This is in contrast to OWZ (2016) who find that although there are more than 400 dealer firms in the American market in many bonds there are only 1-2 active dealers per year. As a result, they find an average dealer-HHI of 0.6, which represents a situation between duopoly and monopoly. Looking at the 20 largest STT of our c-bond market (their NIS volume is \(\frac{2}{3}\) of the total NIS volume of the STT) we find that each of them is active in 171 bonds on average, with an average daily volume of 10.9 million NIS (~ $3 million). That is, the daily volume per c-bond is only about $17,500. These findings are consistent with the assumption that LOB enables cheap trading in each bond and therefore enables participation even when the eventual trading volume is low.

Next, we link the competition among the STT to the market's liquidity. We show that the c-bond's HHI is positively related (after controlling for relevant exogenous variables) to its HES, HQS and to the transaction spreads of the non-STT, meaning that competition among the liquidity providers reduces spread. An additional indication of competition and trading efficiency is the price dispersion of transaction prices within the bond minute. Randall (2015) finds in the US c-bond market an average price dispersion of 0.04% for inter-dealer transactions and 0.24% for customer-dealer transactions. This is consistent with inefficiency of the dealer-customer transactions (due to lack of pre-trade transparency, customer discrimination etc.). In contrast, we find that the average price dispersion within a bond minute for STT and non-STT transactions (STT-STT transactions) is 0.02%

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5 The causality is likely to be from the HHI to illiquidity and not the other way around. The reason is that large spreads attract more short-term traders and therefore lead to less concentration and lower HHI.

6 The price dispersion is the standard deviation of prices divided by average price.
(0.03%). Moreover, we find a significant positive relation between a bond's $STT$-$HHI$ and its price dispersion.

Strong competition among the STT is expected to lower their trading profits. Indeed, we find that the NIS weighted realized spreads of the STT in their "making" transactions is 0.029%. This small number is before fees paid to the exchange members (at least the 0.005% fee the exchange charges its members). This leaves very little to cover their costs and compensate them for the risk. Therefore, if there are rents beyond that, they are negligible. In their "taking" transactions (44.09% of their NIS volume) the NIS weighted trading profits before fees are 0.006% and net of fees they are zero at best. As expected, we find that a significant positive relation between a bond's $STT$-$HHI$ and the realized spreads of the STT as "makers".

An additional form of competition is among the different investor types. LOB, as opposed to OTC, enables all traders to compete on quotation. Indeed we find that 48% of the NIS volume of non-STT is by "making". In these transactions, the transaction half spread ($THS$) is lower than when the "makers" are STT (a $THS$ of 0.0714% vs. 0.0865%). In a regression analysis we find that, controlling for other variables, the $THS$ of non-STT as "makers" are lower by 43% than those of STT. These findings are in line with Barclay, Christie, Harris, Kandel and Schultz (1999) and Weston (2000), who find that the NASDAQ reform of the 1990s that enabled competing with the dealers by posting limit orders resulted in narrower spreads.

Next, we focus on retail participation in c-bond trading and examine if and how their participation contributes to liquidity. In the US c-bond OTC market, retail participation is negligible. The LOB is more welcoming to retail investors and indeed

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8 From Table 2 in Edwards, Harris and Piwowar (2007) one can calculate that 1.2% of the dollar trading volume arises from transactions smaller than $100,000. Since there are many institutional
we find that at the TASE 8.8% of the NIS double-sided volume arises from RI. The participation of RI contributes to the liquidity in several ways. In 27% of their NIS volume the RI act as "makers". In a regression analysis we find that, as a "maker" a non-STT is related to a percentage decrease of about 43% in the THS, and if the "maker" is an RI (i.e., a part of the non-STT group), it is related to a further percentage decrease of about 3.5% in the THS. In the transactions where RI act as "takers" (73% of their NIS volume), they impose no adverse selection on the "maker" side. This is contrary to other non-STT. In a regression analysis, we find that being the "taker" RI reduces the adverse selection component of the transaction by 0.05% relative to cases of taking by other non-STT. Reducing the adverse selection potential allows for tighter spreads.  

Next, we examine the effect of retail participation on c-bond liquidity. The difficulty in such estimation is the likelihood that causality works on both sides. We take advantage of the fact that RI tend to invest in the non-CPI-linked c-bonds and perform a simultaneous equations analysis. In this analysis, we estimate that a difference of 1% in retail participation (say from 8% to 9%) is related to a decrease of about 6.4% in the bond's HQS, for example, from 0.10% to 0.094%.

Finally, we examine the relation between trade size and trade cost. In the US the trading costs for small transactions are much higher than for larger transactions (see Table 1). In the same spirit the more active customers pay lower costs than the less active customers (OWZ, 2016 and Hendershott, Li, Livdan and Schürhoff, transactions in this size category (see OWZ, 2016) the fraction of retail investor trading is probably much lower than 1.2%. Because of tax advantages, individuals' holdings are higher in municipal bonds than in corporate bonds. They hold directly (indirectly) 50% (25%) of the market cap of municipal bonds. See Aguilar (2013).

9 The centralized structure of the market and the pre-trade transparency make it accessible to non-professional traders.

10 See for example Proposition 5 in Glosten and Milgrom (1985), who show that the bid-ask spread is smaller as there are more "uninformed" orders.
These differences are viewed as an indication of the non-competiveness of the market. The findings at the TASE are consistent with a competitive market. We divide each bond's transactions according to their NIS value and then group the transactions of each quintile and calculate their average \( THS \). The difference in \( THS \) between the top and bottom quintiles is small (about 0.02%). A simple explanation for this difference is that the smaller the quantity the less it pays to invest effort in minimizing trading costs. Within the quintiles we find that the THS of taking transactions of RI against STT are negligibly larger than the THS of taking transaction of non-STT which are not RI against STT. The negligible difference (~0.005%) can be explained by the larger monitoring costs of RI, which make it less worthwhile for them to wait for better spreads.

The rest of the paper is organized as follows. Section 2 describes the market and the data. Section 3 presents the bid-ask spreads in the market. Section 4 describes the investor types we focus on (retail and short-term traders). Section 5 analyzes the competition between short-term traders. Section 6 analyzes the contribution of non-short-term traders to liquidity. Section 7 analyses the contributions of retail investors to liquidity. Section 8 investigates the relation between transaction size and transaction spread. Section 9 concludes.

[INSERT TABLE 1 ABOUT HERE]

2. Market Description and Data

2.1 Market description

The Tel Aviv Stock Exchange (TASE) is the only exchange in Israel, a country that is a member of the OECD and classified as a developed market according to all data providers (Russell, FTSE, MSCI, S&P and Dow Jones). As of December-
2014, the aggregate market value of the securities on the TASE was about $470 billion: stocks and warrants – $201 billion, corporate bonds – $80 billion, government bonds – $161 billion, ETNs (Exchange Traded Notes – substitutes for ETFs) – $26 billion. In addition, various types of options (on indices, stocks and exchange rates) are traded on the exchange.

The participants in the Israeli market are quite similar to those in other developed markets. The main types are:

1. Institutions that manage "other people's money". These institutions are divided into three main types. The first type is institutions that manage long-term savings that are encouraged by tax benefits (pension funds etc.). The second type is institutions with investors that do not enjoy tax benefits. These institutions include mutual funds, ETNs and hedge funds. The third type is tax-exempt not-for profit institutions.

2. Banks and insurance companies that hold stocks and bonds as assets.

3. Firms that typically trade for short-term horizons (including using automatic trading systems).

4. Individuals: controlling stockholders and retail investors.

5. Foreign investors.

The Bank of Israel publishes statistics on the holdings of exchange-tradable c- bonds. As of December 2014, out of the total c-bonds that were traded on the TASE, 24.6% were held by long-term savings, 24.2% by mutual funds, 18.2% by insurance companies and banks, 6.5% by ETNs and 0.9% by foreign investors. The rest (25.6%) were divided between other trader groups: individuals, not-for-profit

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12 See Tables 12 and 23 in http://www.boi.org.il/
organizations, short-term trading firms and hedge funds. We do not have information about each of these sub-group's holdings.

2.2 The TASE trading mechanism

The mechanism for all the securities on the TASE is continuous limit order book trading, with an opening and a closing auction trading session.\(^\text{13}\) The opening stage of the trade in c-bonds (stocks) takes place between 9:30 and 9:31 (9:45 and 9:46), the exact time for each security being arbitrary. The pre-opening stage, where orders are posted, starts at 9:00 am. The closing call auction stage takes place on Sunday (Monday to Thursday), between 16:24 and 16:25 (17:24 and 17:25), the exact time for each security again being arbitrary.\(^\text{14}\) In all stages the limit orders are executed by price and time priority, and there are no hidden limit orders.\(^\text{15}\) The continuous bilateral stage is conducted throughout the trading day between the opening and the closing sessions. A minimum amount of 10,000 (2,000) NIS (New Israeli Shekels), for c-bonds (stocks) applies for orders placed during the continuous stage.\(^\text{16}\)

In 2014 there were 26 exchange members at the TASE. These members are banks and brokerage firms through which traders can submit orders for all the securities that are traded on the TASE. The exchange members provide their clients with online access to the exchange without any human intervention: the clients can see the status of the order book online and submit orders, which are transmitted immediately (after computerized checks) to the exchange. All the traders can observe

\(^{13}\) Very illiquid securities are traded by daily auctions only.
\(^{14}\) The pre-closing stage on Sunday (Monday to Thursday) starts at between 16:14 and 16:15 (17:14 and 17:15).
\(^{15}\) Hidden orders were introduced in October 2014, but according to the TASE they were rarely used during 2014. The TASE also allows "fill or kill" and "immediate or kill" orders, but they are rarely used.
\(^{16}\) For stocks in the TA-25 index the minimum is 5,000 NIS.
the three best bids and offers on each side of the market in all securities.\textsuperscript{17} The identity of the member firms and traders submitting orders is unknown to the market participants. The tick size at the TASE is a function of each security's market price. For most of the c-bonds it is around 0.01\%. The trading fees (including clearing fees) for each side of the transaction that the TASE charged its members in 2014 were 0.0032\% of the NIS transaction volume subject to a minimal fee per transaction of 1.40 NIS ($0.39 during 2014).\textsuperscript{18} TASE has both stock and c-bond indices. The major c-bond index is the Tel-Bond 60, which includes the 60 fixed-interest and CPI-linked c-bonds with the highest market capitalization that match certain criteria.

\textbf{2.3 Why are bonds traded on the exchange?}

Unlike the situation in other countries, where OTC trading dominates, in Israel corporate bonds are traded on the exchange by the same method as stocks. Are there economic reasons that make exchange trading of c-bonds more suitable for Israel? In our opinion, the current trading characteristics were formed more than 60 years ago, when the economic conditions were entirely different than they are today. Therefore, the exchange trading is not a result of current economic conditions. In this subsection, we give the historical background and provide our explanations for the current situation.

The first institution for securities' trading was established in Tel Aviv in 1935 and was named the "Securities Exchange Chamber". It was a daily gathering of about 10 bankers and brokers that traded for about an hour. They traded for their own

\textsuperscript{17} Since November 2014, the traders are able to observe the five best bids and offers on each side of the market in all securities.
\textsuperscript{18} We do not have formal information about the fees the exchange members charge their customers. According to www.hon.co.il (in Hebrew) the fees of discount brokers for individual c-bond trading were \textasciitilde0.09\% in January 2015. To the best of our knowledge the fees of the institutional investors can be very close to the fees the TASE charges its members.
accounts and on behalf of their clients. The securities traded were a few stocks and a few corporate bonds.¹⁹ In 1953 this institution became the Tel Aviv Stock Exchange (effectively, a not-for-profit organization owned by the broker firms), where all the securities were traded by a daily auction.²⁰ The market was very small (for example, in 1960 the daily dollar volume of all bonds – governmental and corporate – was $60,000).²¹ In those days, most of the bonds were government bonds and the trading volume of corporate bonds was negligible. Saul Bronfeld, past board chairman of the TASE,²² explains that because the market was small, the TASE offered an efficient solution (daily auctions) for all the financial instruments and there was no need for an OTC market, which requires considerable human resources. Later, as the market expanded, market participants were used to the fact that all instruments were traded on the exchange and that the liquidity was there, so an OTC market was not able to attract the initial liquidity.

We find this explanation very convincing. An additional explanation is that until 2005 the institutional investors (for long-term savings and mutual funds) were mostly the banks, which were the potential dealers for an OTC market. Therefore, dealer activity could have exposed the banks to severe conflict of interest and potentially to claims of illegal activity. ²³

¹⁹ The information about the “Securities Exchange Chamber” is from an interview with Shalom P. Doron, which appears in a publication of the TASE marking its 70 years of trading activity. See (in Hebrew) http://www.tase.co.il/resources/pdf/newsjournal/05-11_n132_nov2005_70-year.pdf. We also rely on an article from the daily Israeli Hebrew-language business newspaper “Calcalist” of 13.5.2016 by Mickey Greenfeld, available at http://www.calcalist.co.il/markets/articles/0,7340,L-3687769,00.html and an article by Gad Lior published in 2009 at the magazine of the open University of Israel available at http://www.openu.ac.il/publications/magazine-07/download/Pages_23-27.pdf.
²⁰ The Tel Aviv Stock Exchange is not an accurate translation of the Hebrew name, which uses the term “securities” rather than “stock” and is therefore more general.
²¹ See Ben-Shachar, Bronfeld and Cukierman (1971).
²² Saul Bronfeld served in several key positions in the Israeli capital market, including as vice president of the TASE, later its CEO and eventually as chairman of the board, and has a deep knowledge of the history of the Israeli capital market.
²³ In 2005, this ceased to be an issue when, following a regulation change, the banks sold their funds.
It should be noted that the corporate bond market in Israel expanded dramatically in the 2000s following regulation changes that relaxed limitations on long-term corporate bond investing by institutions. In 2003 the aggregate market cap of c-bonds was $6 billion and it increased to $73 billion in 2009. To sum up, the practice of corporate bond trading on the exchange like stocks was instituted many years ago when market conditions were very different than they are today.

2.4 Why are many of the bonds CPI-linked?

In Israel many of the government bonds and the corporate bonds are CPI-linked. Ben-Shachar, Bronfeld and Cukierman (1971) state that until 1954 no government bonds denominated in the Israeli currency were CPI-linked, and the high inflation of the time caused heavy losses to bond investors. According to Ben-Shachar, Bronfeld and Cukierman this situation led the government to issue CPI-linked bonds. Since then, the Israeli investors have become used to ask for inflation in their bond investing. In the period from 1980 to 1985 Israel experienced hyperinflation (for example, the annual inflation in 1984 was 445%) and during that period almost all bonds (most which were then governmental) were CPI-linked. It should be noted that currently inflation is very low (it was -0.2% in 2014) and the inflation expectations reflected in the term structure of interest rates are low. However, the memory of high inflation probably has an effect on the prevalence of CPI-linked bonds.

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24 The cumulative rate of inflation during 1952-1954 was 113%. Data for prior years is unavailable.
25 According to the Bank of Israel estimate the expectation for 1 year ahead of January 2015 was 0.5% (see a press release at www.boi.org.il).
2.5 The TASE database

We use a unique and proprietary database of the TASE that includes transaction records in which both sides of the transaction are identified. The identification includes the identity of the exchange member and a code that identifies the trader within the member's list of traders. The database does not include the trader's classification (for example, retail, institutional etc.). In addition, the database documents the transaction time, whether the transaction was "buyer initiated" or "seller initiated", and the trading stage at which the transaction was executed.

2.6 Our sample

We focus on a sample of c-bonds which were traded on the TASE during 2014, the only requirements being a market value of at least 100 million NIS per bond (equivalent to approximately $28M) and denomination of the c-bond in NIS.26 The sample consists of 402 c-bonds of 143 firms, which covered 95.3% (95.7%) of the market cap (NIS trading volume) of the 676 c-bonds traded on TASE during 2014.

Most of the c-bonds in our sample are investment grade (according to the average rating of the credit rating agencies):27 at the end of 2014 (or the last trading day if the bond matured during 2014), 361 of the c-bonds in our sample were rated investment grade (BBB and above), 13 were rated speculative grade (below BBB) and 28 were not rated. Most of the bonds in the sample are CPI-linked (272 out of 402)

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26 Two US dollar-linked c-bonds were excluded because of this condition.
27 Israel has two rating agencies: Maalot and Midroog. These rating agencies are subsidiaries of global rating agencies: Maalot is a subsidiary of S&P and Midroog a subsidiary of Moody's. The rating in Israel is local, meaning that the firms are rated relative to other Israeli firms and do not take into account the country risk.
and at the end of 2014 our sample includes all c-bonds of the main c-bond index of the TASE – the Tel-Bond 60.28

Table 2 reports summary statistics of the c-bond sample. Though not reported in the table, it should be noted that 87.02% of the NIS volume occurs in the continuous stage. The average of the mean daily return, adjusted for coupon payments, is around zero (0.02%) and the average STD (standard deviation of daily returns) is 0.48%. The average number of daily transactions is 61 with a daily NIS volume of 1.95 million NIS (around $0.55 million), resulting in an average transaction size of about 32,000 NIS (about $9,000). This transaction size is much lower than the transaction size in the US c-bond market. For example, the average transaction size in Edwards, Harris and Piwowar (2007) is $0.75M (see their Table 1).

[INSERT TABLE 2 ABOUT HERE]

It is possible to have transactions outside the exchange and we have information on the volume of these trades as well. The average of the c-bonds’ NIS proportion outside the exchange is 6.76%. This means that most of the trading needs are fulfilled on the exchange.

3. Bid-Ask Spreads in the TASE Corporate Bond Market

3.1 Bid-ask spread measures

One of the fundamental measures of liquidity is the half quoted spread (HQS), that is, half the average quoted bid-ask spread. The intuition underlying this measure is that it is the average cost of an investor who trades a small quantity immediately after arriving at the market. An additional fundamental measure is the

28 The data on credit rating and the c-bond characteristics are from www.valuation.co.il, which collects daily data on c-bonds traded on the TASE. We thank Eran Ben-Horin for providing the data.
half effective spread \((HES)\), which compares the price of a market or marketable limit order to the mid-quote prevailing before the transaction. At the TASE a transaction cannot occur inside the spread but the effective spread may be systematically different than the quoted bid-ask spread. There are two possible reasons for this:

a. Transactions tend to occur where bid-ask spreads are relatively narrow.

b. There are large quantity orders that "walk on the book", that is, are executed against different layers of the limit order book.

The annual half quoted spread \((HQS)\) and the annual half effective spread \((HES)\) are calculated as follows:

**Half quoted spread \((HQS)\):** The \(HQS\) is the ratio of the quoted bid-ask spread and the bid-ask midpoint:

\[
HQS_{i,j,t} = \frac{Ask_{i,j,t} - Bid_{i,j,t}}{2 \cdot Mid_{i,j,t}},
\]

where \(Mid_{i,j,t} = (Ask_{i,j,t} + Bid_{i,j,t})/2\), \(Ask_{i,j,t}\) and \(Bid_{i,j,t}\) are the ask and bid quotes prevailing on day \(t\) for security \(j\) at hour \(i\). For each security on each trading day, we calculate the bid-ask spread at each hour during the continuous trading. We obtain six daily \(HQS_{i,j,t}\) measures, from 10:00 until 16:00. The \(HQS_{i,j,t}\) is winsorized in the rare cases (0.043%) where the bid or ask are missing or they are greater than 10%. We average the observations over each security-day to get the daily measure of security \(j\) on day \(t\) \(DAILY_{HQS_{jt}}\). The average of \(DAILY_{HQS_{jt}}\) of each security is the half quoted spread of security \(j\): \(HQS_j\)

**Half effective spread \((HES)\):** The half effective spread for each transaction is measured as the absolute value of the difference between the transaction price and the
quote midpoint prior to the transaction, divided by the quote midpoint. Formally, the
$HES$ on day $t$ of security $j$ on transaction $i$ is calculated as:

$$HES_{i,j,t} = \frac{|price_{i,j,t} - Mid_{i,j,t}|}{Mid_{i,j,t}}$$

The $HES_{i,j,t}$ of the transaction is winsorized in the rare cases where it is greater than
10% or in cases where there is no valid bid-ask spread (0.019% of the sample). The
daily average for each security, $DAILY_{HES_j}$, is calculated as the average of the half
effective spreads during the continuous trading stage. If there are no transactions
during the continuous stage of the trading day, the observation is omitted (5.28% of
the sample). $HES_j$, the half effective spread of security $j$, is the average of
$DAILY_{HES_j}$.

Table 3 reports statistics of the (value-weighted) half effective spreads of the
transactions. Across the 3.5 million transactions of our sample the average (value-
weighted average) is 0.082% (0.077%). The average (value-weighted average) of the
bond's $HQS$, across the transactions of our sample, is (0.078%) 0.067%. These figures
are much lower than the estimates in the US market, especially for transactions of less
than $100,000 (see Table 1 for the findings in the US market).

[INSERT TABLE 3 ABOUT HERE]

3.2 Comparing c-bonds and stocks' bid-ask spreads

It is well-known that the OTC c-bond markets are less liquid than stock
markets (large spreads and few transactions per day). This finding is quite puzzling,
because c-bonds should be more liquid than stocks due to their lower variability
(which makes liquidity provision less risky) and the lower degree of information
asymmetry (Biais and Green, 2007). Several researchers claim that the OTC
mechanism is problematic and should be replaced by a limit order book (Harris, 2015; Harris, Kyle and Sirri, 2015). Since both stocks and c-bonds are traded on the TASE it is of interest to compare their liquidity. We focus on a sub-sample of firms from our c-bond sample (described in Table 2) that traded stocks on the TASE as well during 2014. This sub-sample includes 102 firms with 102 stocks and 346 c-bonds. We compare the bid-ask spread measures HQS and HES of c-bonds and stocks, and find that both the HQS and the HES of the c-bonds are considerably lower than the comparable measures of the stocks. The mean of the HQS of c-bonds (stocks) is 0.18% (0.65%) and for the HES the means are somewhat lower: 0.16% (0.55%).

To demonstrate graphically that c-bonds are more liquid than stocks, in Figure 1 we plot the HQS at the firm level, averaging the c-bonds of the same firm into a single observation. Panel A of Figure 1 presents a scatter plot of the 102 pairs of HQS. In most cases (81 out of 102) the points are below the 45° line, indicating that the average HQS of a firm’s c-bonds is lower than the corresponding HQS of the firm’s stocks. The p-value of a double-sided binomial test in this case is <0.0001. The t-statistic for the series of difference between the numbers in each pair is 5.26. The mean (median) HQS is 0.65% (0.27%) for stocks and 0.25% (0.16%) for c-bonds. That is, the HQS of the c-bonds are significantly smaller than the HQS of the stocks.

To present a clearer picture, in Panel B of Figure 1 we focus on firms with an average HQS (of stocks and c-bonds) that is smaller than 0.5%. The difference in HES between c-bonds and stocks is qualitatively similar to the difference in HQS.

[INSERT FIGURE 1 ABOUT HERE]

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29 In Israel, there are firms with publicly traded bonds that have stocks that are not traded publicly. These firms are not included, of course, in our comparison sample.

30 The results are qualitatively similar when we consider a sub-sample of non-dual listed firms with stocks and c-bonds. This sub-sample includes 84 firms. In most cases (73 out of the 84) the average HQS of a firm’s c-bonds are lower than the corresponding HQS of the firm’s stocks.
In sum, we find that at the TASE, c-bonds are very liquid and more liquid than stocks.

4. Identifying Retail Investors (RI) and Short-Term Traders (STT)

Our data do not include information on the classification of our traders (institutional, retail, short-term, etc.). Therefore, we rely on technical information such as trading volume and trading frequency to classify investor types. We focus on two investor groups: retail investors (hereafter RI) and short-term traders (hereafter STT).

We identify RI as "low-volume" investors with less than 2 million NIS (roughly $559,000 during the sample period – 2014) in all the securities that are traded on the TASE (excluding options). It is possible that there are RI with higher trading volumes but non-retail investors with such low trading volumes are probably rare. Therefore, this definition can be viewed as restrictive. As a robustness check, we also examine a cutoff of 3 million NIS, showing that all main findings (reported in Tables 4,5,8,9,10 and 11) do not change qualitatively.

We find 159,738 RI that were active in our c-bonds sample during 2014. Their activity is low and infrequent. The average (median) trading volume, in all TASE securities (excluding options) is 379,862 (232,485) NIS. The average (median) number of trading days at the TASE (out of the 245 possible trading days) is 6.16 (4.00).³¹ These RI are quite "long-term". In only 10.2% of the cases do we find both buying and selling during 2014.

³¹ It is possible that a trader trades through different exchange members or through different accounts of a given exchange member. Casual observation suggests that retail investors tend to concentrate their trading activity in one account. In any case, however, an account that trades less than 2 million NIS per year is likely to be an account of a small retail investor.
The short-term traders provide liquidity to other investor types (institutional, retail) that trade for a longer horizon. In an OTC market, the short-term traders are the dealers. We define the short-term traders (STT) as traders that flip from buying to selling within a short period of time and are not identified as RI. For each trader in each c-bond of the sample that she traded, we calculate the number of switches from buying to selling or *vice versa* and divide it by the number of trading days that the trader was active in the c-bond. Then we calculate the value-weighted average of this ratio across the c-bonds the trader traded, and classify the trader as "short-term" in the case that this measure is equal to or greater than 1.\(^3^2\) Formally, trader \(j\) is considered a "short-term" trader if
\[
\frac{1}{\sum_{i=1}^n \text{trader\_vol}_i} \cdot \sum_{i=1}^n \left( \frac{\text{sign\_switches}_i \cdot \text{trader\_vol}_i}{\text{ntd}_i} \right) \geq 1
\]
where \(n\) is the number of c-bonds that the trader traded during the sample period, \(\text{trader\_vol}_i\) is the trader's NIS trading volume in c-bond \(i\), \(\text{sign\_switches}_i\) is the number of times the trader switched positions in security \(i\) during the sample period and \(\text{ntd}_i\) is the number of trading days of the trader in c-bond \(i\). We require that a "short-term trader" is not a "retail investor". That is, we exclude from this group short-term trading with very low volume.

The cutoff of "1" to identify "short-term traders" is of course arbitrary. We choose it because flipping from buying to selling and vice versa within a trading day can be naturally interpreted as short-term trading especially on corporate bonds. Slightly longer horizons may also be interpreted as short-term trading but to be on the safe side we prefer a cutoff of "1". As a robustness check, we also examine a cutoff of

\(^3^2\) A ratio of 1 means that on each day the investor traded the security, a sale transaction was followed with a buy transaction (or vice versa), on average.
0.5, showing that all our main findings (reported in Tables 4,5,8,9,10 and 11) remain qualitatively similar.

We find 280 STT that were active in our c-bond sample during 2014. Their mean annual trading volume at the TASE is quite large (about 768 million NIS), with a smaller median annual volume (about 88 million NIS). It seems that many of these traders are small trading firms or individual traders. However, most of the transactions and most of the volume of this group arise naturally from the large traders. This can be verified by looking at all the transactions of the STT and representing each transaction with the annual NIS volume of the STT that trade in the transaction (a transaction between two STTs is represented as two observations). The average value across the transaction observations is 5.58 billion NIS. Roughly speaking an average STT transaction arises from an STT with annual volume of 5.58 billion NIS.

5. Competition between Short-Term Traders

The difference in estimated effective spreads between the Israeli and the American c-bond markets are striking (see our findings for the Israeli market in Section 2 and the findings for the American market in Table 1). The differences are striking since the Israeli market is quite small and therefore expected to be much less liquid than the American market. A natural explanation for this difference is that it arises from the different trading mechanism. This hypothesis is supported by the fact that for exchange stock trading, the spreads in the US are much smaller than in Israel.33 But what are the characteristics of the limit order book trading that make the trading costs low? In our opinion, the limit order book encourages competition in

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33 See Exhibit 3 in Avramovic and Mackintosh (2013).
several dimensions and this competition increases liquidity and leads in particular to narrow spreads.

5.1 Short-term traders’ concentration

In a limit order book exchange, the analog for dealer activity is short-term trading. In a limit order book, trading can be done using automated trading systems that monitor many securities simultaneously. Therefore, the monitoring costs per security are small. Looking at the 20 largest STT (which account for two-thirds of the total NIS volume of the STT) we find that each of them is active in 171 bonds on average, with an average daily transaction volume of 10.9 million NIS (~ $3 million), resulting in a daily volume per c-bond of about $17,500. That is, an LOB enables a presence in many bonds, even though the activity in each of the bonds can be small. Thus, although the Israeli market is quite small we expect to find less concentration in short-term trading than in the dealer activity in the US. The findings reported in Table 4 are consistent with this hypothesis.

Table 4 report statistics on the number and concentration of STT in the cross section of c-bonds. To measure market concentration, we calculate the Herfindahl - Hirschman Index (HHI). The HHI is calculated as:

\[ HHI = \sum_{i=1}^{n} S_i^2 \]

where \( S_i \) is the NIS market share of STT\(_i\).

The HHI ranges from \( 1/n \) to 1 (monopoly) and it may be interpreted as the reciprocal of the "equivalent" number of equal share traders. The mean (median) HHI is 0.162
(0.126). OWZ (2016) find that the \textit{HHI} of dealer activity in the US is much larger: the mean is 0.61 and the median is 0.54. These figures represent a highly concentrated market – roughly a duopoly.\textsuperscript{34} Moreover, at the TASE, for the median corporate bond, the market share of the top STT is 24.15\% and for the top three STT it is 51.42\%. These figures are much smaller than the corresponding figures in OWZ (2016) who find that the median market share of the top dealer (three top dealers) is 69\% (100\%).

To conclude, it is quite clear that short-term trading at the TASE is not concentrated. That is, many STT compete on trading in each bond.

\textbf{5.2 The relation between short-term trader' concentration and liquidity}

We hypothesize that the low concentration of STT contributes to market liquidity. Table 5 presents regressions of liquidity measures on c-bond characteristics with and without \textit{HHI}. The illiquidity measures are \textit{LOG\_DAILY\_HQS}, \textit{LOG\_DAILY\_HES}, and the average transaction half effective spread before the transaction (hereafter \textit{THS}) of non-short-term traders (hereafter non-STT) in their "taking" transactions. We run 245 daily regressions, reporting the averages of the coefficient series in Table 5. As control variables we use the following bond characteristics:

\textit{LOG\_STD} – the log of the standard deviation of the daily returns.

\textit{LOG\_SIZE} – the log of the bond’s size, calculated as the average of the market capitalization at the beginning and end of the sample period for each security.

\textit{LOG\_FIRM\_SIZE} – the log of the market value of the firm’s tradable securities; this variable is a proxy for the firm’s market value.

\textsuperscript{34} It should be noted that the Horizontal Merger Guidelines of the U.S. Department of Justice and the Federal Trade Commission generally classify markets into three types: Unconcentrated Markets (\textit{HHI} below 0.15), Moderately Concentrated Markets (\textit{HHI} between 0.15 and 0.25) and Highly Concentrated Markets (\textit{HHI} above 0.25).
\textit{DUR} – the c-bond's duration.

\textit{RATING} – We consider the average rating according to the two Israeli rating agencies. A c-bond gets a credit rating if at least one of the agencies rates it. The rating categories are translated into numerical values as follows: the variable \textit{RATING} equals 0 if the bond has no rating, 1 if the average rating is 'D' and 26 if the average rating is 'AAA'. All the other rating categories are between 1 and 26.

\textit{DUMMY\_RATING} – A dummy variable that equals 0 if the c-bond has no credit rating from the two Israeli rating agencies and 1 otherwise.\textsuperscript{35}

\textit{NON\_LINKED} – A dummy variable that equals 0 if the c-bond is CPI-linked and 1 otherwise.

The \textit{t}-statistics of each explanatory variable are calculated using the Newey-West (1987) method, with the number of lags varying according to the autocorrelation of the coefficient. For each of the dependent variables, \textit{HHI} is significantly positively related to the illiquidity measure. That is, more concentration in short-term trading is related to less liquidity. It should be noted that the causality is likely to be from the \textit{HHI} to illiquidity and not the other way around, since large spreads attract more STT and therefore lead to less concentration and lower \textit{HHI}. The fact that even though we find a positive relation between \textit{HHI} and the bid-ask spread measures is an indication of the effect of \textit{HHI} on the spreads: higher concentration \textarrow{} larger spreads. To interpret the coefficients let us look at regression (4) for example. The average coefficient of \textit{HHI} is 2.105. From Table 4 the standard deviation of the STT's \textit{HHI} is 0.122. Therefore, a 1 standard deviation increase in \textit{HHI} is related to a relative change

\textsuperscript{35} Using this dummy variable allows to include all the c-bonds (including c-bonds without credit rating) without affecting inferences on the slope coefficient. See for example Pontiff and Woodgate (2008).
of about 29% in the daily effective spread \( (e^{0.122\times2.105} - 1) \approx 0.29 \). Note that the dependent variable is \( LOG\_DAILY\_HES\).

[INSERT TABLE 5 ABOUT HERE]

A side issue is that the coefficients of the control variables are with the expected sign except the coefficient of \( LOG\_STD \), which has a negative sign in regression (1). This is not intuitive and the explanation is that \( LOG\_STD \) is positively related to the log of annual volume (\( LOG\_VOL \)), which is negatively related to \( HQS \). Because of this indirect effect (through the volume) we get a negative coefficient in regression (1). When we include \( LOG\_VOL \) in regression (1) the coefficient of \( LOG\_STD \) becomes positive and highly significant.

5.3 Price dispersion

An indication of a lack of competition between liquidity providers is price dispersion. If roughly at the same time there are two transactions for the same bond with significantly different prices, it means that the trader that sold (bought) the bond at the low (high) price did not have access to the better price. The reasons may be lack of pre-trade transparency and/or discrimination between traders according to their identity or types. The limit order book provides pre-trade transparency and discrimination is not possible since the execution is according to price and time priority and because the identity of order submitters is not disclosed. For these reasons we expect price dispersion to be much smaller at the TASE than in the US. Indeed, this is what we find.

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36 The correlation between \( LOG\_STD \) and \( LOG\_VOL \) at the cross-section of c-bonds is 0.758.
Randall (2015) uses price dispersion to measure price competitiveness in the US market. His Figure 5 shows the mean percentage dispersion of prices for a bond within a minute, for customer-dealer and inter-dealer trades. The dispersion is the standard deviation of prices within each minute, divided by the mean of those prices. At the end of the sample period (end of 2010) the mean dispersion for inter-dealer (customer-dealer) trades are around 0.04% (0.24%), consistent with inefficiency of the customer-dealer transactions. In order to compare the price dispersion in the TASE c-bond market, we calculate the daily average of this measure. From Table 6, which details the statistics of these series, it can be seen that the dispersion at the TASE is much lower than in the US market. The average price dispersion in the overall sample is 0.022% and for transactions between short-term traders and non-short-term traders (the analog for dealer-customer transactions in the US) the average is even lower – 0.019%.

We find that at the TASE price dispersion is much smaller than in the US but is it related to STT competition? The answer is positive. We run a regression like regressions (2), (4) and (6) reported in Table 5, but with the daily c-bond's price dispersion as the dependent variable. We find a significant positive relation (the $t$-statistic is 7.50) between $HHI$ and price dispersion. That is, weaker competition between STT (measured by higher $HHI$) is related to higher price dispersion. With the same arguments as in Section 5.2 it can be shown that lower $HHI$ reduces price dispersion. This finding is consistent with OWZ (2016), who find that transaction price differences between institutional clients are positively related to the bond dealers' $HHI$.

5.4 The trading rents of short-term traders
An additional effect of competition is reflected in the trading profits of STT. In about 56% of their NIS volume the STT act as "makers". We measure their trading profits in these cases by the "realized half spread" – RHS (See Foucault, Pagano and Roell, 2013, hereafter FPR (2013), – their Section 2.2.3). That is, their profits are not measured using the mid-quote at the time of the transaction but against a future benchmark price. The reason is the possible adverse price change after the transaction (see FPR (2013)). The realized spread is usually measured using the mid-quote a short time after the transaction. We tried several mid-quote horizons (30 minutes, 60 minutes, 120 minutes, 240 minutes and 24 hours).\(^{37}\) The 30/60/120/240 minute horizons seem too short relative to the closing price, because the price reversal following the transaction is not completed within these horizons. That is, we find predictable price changes beyond these horizons. We do not, however, find predictable price changes from the closing price to the 24-hour mid-quote, indicating that the time interval from the closing to 24 hours only adds noise. Therefore, we focus on the closing price as the benchmark price for the transactions. This is consistent with the high frequency traders' profit estimation in Van Kervel and Menkveld (2015) and the estimations of NYSE specialists' revenues in Comerton-Forde, Hendershott, Jones, Moulton and Seasholes (2010).

To sum up, we define:

- The transaction half spread (THS) is the half effective spread of the transaction.
- The adverse selection component (AS) of the transaction represents the expected costs of trading with better informed investors (see FPR (2013), – their Section 2.2.3). It is:

\(^{37}\) In the 30/60/120/240 minute horizons we used the closing price if the horizon ended after the closing.
\[ AS = \frac{\text{Close}}{\text{mid _ quote _ before _ the _ transaction}} - 1 \] for transactions that are buyer initiated (the buyer is the taker);

\[ AS = 1 - \frac{\text{Close}}{\text{mid _ quote _ before _ the _ transaction}} \] for transactions that are seller initiated (the seller is the taker).

- The realized half spread (RHS) of the transaction is the transaction half spread (THS) minus the adverse selection component (AS).  

For example: the bid was 99, the ask was 101, a transaction occurred at the ask ("buyer initiated") and subsequently the closing price was 100.6. In this case the THS, AS and RHS are 1%, 0.6% and 0.4%, respectively.

Table 7 reports the average of these daily measures. The first line reports these measures in the case that the STT are "makers". Looking at the value-weighted measures we get that the average THS is 0.069%, the average AS is 0.040% and the average realized spread is 0.029%. All these measures are highly statistically different from zero. For the equally weighted measures the figures are slightly higher (0.081%, 0.044% and 0.037% for THS, AS and RHS, respectively). The second line of the table presents the spread measures in the cases where the STT are takers. It can be seen that the value weighted RHS is -0.006% (the p-value is -2.69) indicating a small trading profit (a negative cost).

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38 FPR (2013) mention in their Section 5.2.2 that if the market makers require compensation for inventory risk, it may induce price change persistence in the short run (and long run reversal). This may bias upward (downward) the estimated of AS (RHS). We think that this is not the case here, since we find that in the cases where the STT are makers and RI are takers the AS is roughly zero (and not statistically different from zero), as expected.

39 The value-weighted THS, AS and RHS of all the STT "making" transactions across all days are 0.071%, 0.041% and 0.030%, respectively.
Looking at both "maker" and "taker" transactions we find that the average daily trading profits (RHS as makers and minus RHS as takers; transactions are value weighted) are 0.019%. This small number does not include the trading fees paid to exchange members. The TASE charges exchange members about 0.005% for the transactions of STT. It is reasonable to assume that the STT pay the exchange members at least this figure as trading fees. This leaves a very small amount to cover monitoring costs and compensate them for the risk. Therefore, if there are rents beyond that, they are negligible. This is consistent with a competitive market where the liquidity providers earn very low rents. Indeed, when we estimate, as in Table 5, the relation between bonds' HHI and the realized spreads of the STT as makers we find a significant positive relation.

The STT rents we find are much smaller than the dealer rents in the US and the difference is especially large when the comparison is to small/medium size transactions in the US (see Table 1). For example, Goldstein, Hotchkiss and Sirri (2007) estimate (see their Table 6) that markups for BBB rated c-bonds are 2.37% (0.56%) for transactions smaller than $10 thousand (larger than $100 thousand). These markup figures are for a round-trip; therefore, the figures for one side are 1.18% and 0.28%, respectively. Green, Hollifield and Schurhoff (2007) estimate (see their Table 7) that markups in the municipal bond markets are 2.30% (0.16%) for transactions smaller than $100 thousand (larger than $500 thousand). These markup figures are for a round trip; therefore, the figures for one side are 1.15% and 0.08%, respectively.

6. Non-Short-Term Traders Also Provide Liquidity

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40 We calculate this figure applying the 0.0032% fee and the minimum of 1.40 NIS per transaction.
An additional dimension of competition relates to competition between different investor types on liquidity provision. While in OTC markets, traders must trade with the dealers and cannot compete with them on providing liquidity, in an open limit order book every trader can potentially trade with anyone else. Indeed, in our sample, more than half (53.4%) of the NIS trading volume is between non-short-term traders. Therefore, the competition on liquidity provision is not only among STT. It is intensified by the participation of other traders, who also compete in providing liquidity.

Table 8 presents evidence demonstrating that non-STT provide liquidity. First, the non-STT do not act only as "takers" and in many cases act as "makers" (i.e., post limit orders). Actually 47.78% of the NIS trading volume of the non-STT is by making. It can be seen that when acting as makers the non-STT post narrower spreads than the STT. We run 245 daily regressions where the observations are the transactions; the explained variable is the log of the transaction's half effective spread \((\text{LOG} \_\text{THS})\) and the explanatory variables are the control variables we use in Table 5 and a dummy variable, \(D\_\text{NST}\), which gets the value 1 if the "maker" side is non-STT and 0 otherwise. Regression (1) of Table 8 reports the averages of the coefficient series. The coefficient of \(D\_\text{NST}\) is -0.555 and it is highly statistically significant. The interpretation is that if the maker is a non-STT, the transaction's half effective spread decreases by about 43% \((e^{-0.555} - 1 \approx -0.43\); note that the explained variable is \(\text{LOG} \_\text{THS}\)).

As background, it should be noted that the NASDAQ reform of the 1990s that enabled competing with the dealers by posting limit orders resulted in narrower spreads. See Barclay, Christie, Harris, Kandel and Schultz (1999) and Weston (2000).
7. Retail Participation Contributes to Market Liquidity

So far the paper has presented evidence that the competition among the liquidity providers (i.e., the STT) and the competition between the liquidity providers and the other market participants on liquidity provision increase liquidity. In this section, we focus on the contribution of RI to competition and liquidity.

The OTC market is not designed to attract retail investors. The decentralized structure of the market, the lack of pre-trade transparency and the fact that the prices are bargaining based are not appropriate for non-professional traders. The empirical evidence in the US (see Table 1) indicates larger trading costs for smaller quantities and for less active traders. Indeed, the participation of retail investors in the US is negligible (see footnote 8). In our c-bond sample RI participation is 8.84% of the double-sided NIS trading volume, in contrast to the popular belief that retail investors are not interested in c-bonds. In our case, where the trading mechanism for c-bonds is an open LOB, we find significant retail participation. Naturally, the trading mechanism enables retail investors to trade with low trading costs and this is probably one of the main reasons for retail participation being different from that in the US.

Next we show that retail participation contributes to market liquidity. The intuition is that RI are uninformed and therefore do not impose adverse selection costs for trading with them (see footnote 9). Indeed, Peress and Schmidt (2016) find that distractive news (not related to the economy; such as the verdict in the O.J. Simpson trial) that distracts the attention of retail investors adversely affects stock liquidity. This is because RI contribute to liquidity by serving both as noise traders and as liquidity providers. In the following sub-sections, we present evidence that RI contribute to the liquidity of c-bonds in the same manner: RI act also as "makers" and
with lower spreads than others (Sub-section 7.1); and as "takers" RI impose less adverse selection costs than others (Sub-section 7.2). Sub-section 7.3 measures the contribution of RI to the market liquidity using simultaneous equations analysis.

7.1 Retail investors act also as makers and with lower spreads than others

In 26.84% of their transactions RI act as "makers". The THS in those cases are much lower than in the cases where the STT are makers, and slightly lower than in the cases where the makers are not STT but not RI. To demonstrate this, in regression (2) of Table 8 we run 245 daily regressions where the observations are the transactions; the explained variable is the log of the transaction half spread (LOG_THS) and the explanatory variables are the control variables we use in Table 5 and dummy variables: $D_{NST}$, which gets the value 1 if the "maker" side is non-STT and 0 otherwise, and $D_{RI}$, which gets the value 1 if the "maker" side is non-STT and 0 otherwise. Table 8 reports the averages of the coefficient series. The coefficients of $D_{NST}$ and $D_{RI}$ are $-0.559$ and $-0.036$ and both are highly significant. Therefore, being the maker non-STT is related to a percentage decrease of about 43% in the transaction spread and being the maker RI is related to a further percentage decrease of $\sim 3.5\%$ ($e^{-0.559} - 1 \approx -0.42$ and $e^{-0.036} - 1 \approx -0.035$, respectively. Note that the explained variable is $LOG_{THS}$).

7.2 As "takers" retail investors impose less adverse selection costs than others

In 73.16% of their transactions RI act as "takers". In these cases they impose practically no adverse selection costs on the "maker" side of the transaction. To see this we measure the AS of RI as detailed in Sub-section 5.3.
In the transactions where RI are takers the average (weighted average) of the daily average of THS is 0.082% (0.069%). The average (weighted average) of the daily average of AS is 0.004% (-0.002%). The series of AS (equally weighted and value weighted) are not statistically different than zero.

We run 245 daily regressions where the observations are the transactions; the explained variable is the AS component and the explanatory variables are the control variables we use in Tables 5 and 8 and the following dummy variables: $D_{NST\_TKR}$, which gets the value 1 if the "taker" side is non-STT and 0 otherwise, and $D_{RI\_TKR}$, which gets the value 1 if the "taker" side is an RI and 0 otherwise. In regressions (1) and (2) of Table 9 the sample is all transactions, and in regressions (3) and (4) of Table 9 the sample is all transactions where the maker is an STT. It can be seen that in both cases the adverse selection component is much lower in cases where the taker is an RI. The average coefficients of $D_{RI}$ are -0.052 and -0.057, respectively. These values are high (in absolute values) relative to the average THS (0.078% and 0.086%, respectively) and they are highly statistically significant (the $t$-statistics are -7.60 and -7.89, respectively).

[INSERT TABLE 9 ABOUT HERE]

7.3 The effect of retail participation on liquidity – simultaneous equations analysis

In Sub-section 7.1 we show that RI act as "makers" in 26.84% of the transactions and that they post tighter limit orders than other trader types. In Sub-section 7.2 we show that as takers RI cause lower adverse selection than other trader types, thereby enabling the posting of narrower spreads. Therefore, it seems that RI enhances market efficiency in these two channels. In this sub-section we estimate the
effect of retail participation on liquidity and more specifically on the spreads (HQS and HES). The difficulty in such estimation is the likelihood that causality works in both sides. Therefore, in a regression of HQS on retail participation (and control variables) the coefficient of retail participation may capture the reverse effect (of spreads on retail participation). To solve this problem, we use a simultaneous equations approach. The variables of interest are:

LOG_HQS\_j – the log of the half quoted spread of c-bond \_j

PROP\_RI\_j – the percentage of the NIS trading volume of RI in c-bond \_j out of the total double-sided NIS volume in our transactions of c-bond \_j (of the continuous stage)

NON\_LINKED\_j – a dummy variable that gets the value 1 if c-bond \_j is non-CPI linked and 0 if it is CPI linked.

We assume the following structural form equations:

\[
\begin{align*}
\text{Log}_j \text{HQ}_S &= \alpha_0 + \alpha_1 \cdot \text{PROP}_j \cdot \text{RI}_j + \sum_{i=3}^{8} \alpha_i \cdot \tilde{X}_{ij} + \tilde{e}_{\text{HQS}_j} \\
\text{PROP}_j \cdot \text{RI}_j &= \beta_0 + \beta_1 \cdot \text{HQS}_j + \beta_2 \cdot \text{NON}_\text{LINKED}_j + \sum_{i=3}^{8} \beta_i \cdot \tilde{X}_{ij} + \tilde{e}_{\text{RI}_j}
\end{align*}
\]

where \(X_{3j},..X_{8j}\) are the following control variables as in Tables 5, 8 and 9: LOG\_STD, LOG\_SIZE, LOG\_FIRM\_SIZE, DUR, RATING and RATING\_DUMMY. That is, we assume that NON\_LINKED does not affect the spread directly but through its effect on other variables (like STD and RI).

We estimate the parameters of the reduced-form equations that have the following form:
\[ Log \_HQS \_j = \gamma_0 + \gamma_2 \cdot NON\_LINKED \_j + \sum_{i=3}^{n} \gamma_i \cdot \tilde{X}_{ij} + \tilde{e}_{HQSj} \]  \hspace{1cm} (3)

\[ PROP\_RI \_j = \delta_0 + \delta_2 \cdot NON\_LINKED \_j + \sum_{i=3}^{n} \delta_i \cdot \tilde{X}_{ij} + \tilde{e}_{RIj} \]  \hspace{1cm} (4)

where \( \gamma_2 = \frac{\alpha_1 \cdot \beta_2}{1 - \alpha_1 \cdot \beta_1} \) and \( \delta_2 = \frac{\beta_2}{1 - \alpha_1 \cdot \beta_1} \), which enables us to set the value of \( \alpha_1 \) using the ratio of

\[ \frac{\gamma_2}{\delta_2} = \alpha_1 \]  \hspace{1cm} (5)

Since the number of exogenous variables that do not appear in Equation (1) (NON-LINKED) equals the number of endogenous variables that appear in Equation (1) (PROP_RI), the coefficients of Equation (1) have an exact identification.

Table 10 presents an estimation of the reduced-form Equations (3) and (4). We run cross-section regressions on the c-bond sample, reporting the results in Table 10. In regression (1) the explained variable is \( LOG\_HQS \) (Equation (3)) and in regression (2) the explained variable is the proportion of retail investors, \( PROP\_RI \) (Equation (4)). The estimated values of the coefficients of NON_LINKED in regressions (1) and (2) are -0.399 and 6.012, respectively. These values represent the estimates for \( \gamma_2 \) and \( \delta_2 \), respectively and from Equation (5) the estimate for \( \alpha_1 \) is

\[ \alpha_1 = \frac{\gamma_2}{\delta_2} = \frac{-0.399}{6.012} = -0.066 \]. The economic interpretation of this value is that a 1% increase in \( PROP\_RI \) (say from 8% to 9%) is related to a decrease of about 6.4% in the bond’s HQS \( (e^{-0.066} - 1 \approx -0.064) \). Note that the explained variable is \( LOG\_HQS \), say from 0.10% to 0.0936%.
It can be shown that $\alpha_1$ is highly statistically significant and its $p$-value is roughly zero. The reason is that from Equation (5) we get

$$P(\alpha_1 > 0) = P(\gamma_2 > 0 \ and \ \delta_2 > 0) + P(\gamma_2 < 0 \ and \ \delta_2 < 0)$$  \hspace{1cm} (6)$$

Since

$$P(\gamma_2 > 0 \ and \ \delta_2 > 0) < P(\gamma_2 > 0)$$
$$P(\gamma_2 < 0 \ and \ \delta_2 < 0) < P(\delta_2 < 0)$$  \hspace{1cm} (7)$$

we get by combining Equation (6) and Equations (7):

$$P(\alpha_1 > 0) < P(\gamma_2 > 0) + P(\delta_2 < 0)$$  \hspace{1cm} (8)$$

Since the $t$-statistics of $NON\_LINKED$ in regressions (1) and (2) are -5.73 and 8.44 we get:

$$P(\gamma_2 > 0) \approx 0 \ and \ P(\delta_2 < 0) \approx 0$$  \hspace{1cm} (9)$$

Therefore, the sum of these probabilities is roughly zero and from Equation (8) we get that

$$P(\alpha_1 > 0) \approx 0$$  \hspace{1cm} (10)$$

[INSERT TABLE 10 ABOUT HERE]

To sum up, we verify the negative effect of retail participation on $HQS$. In the same spirit we estimate the effect of retail participation on $HES$. Regression (3) of Table 10 presents the following regression:

$$\log_{10} HES_j = \gamma_0 + \gamma_2 \cdot NON\_LINKED_j + \sum_{i=3}^{n} \gamma_i \cdot X_{ij} + \epsilon_{HES_j}$$  \hspace{1cm} (11)$$

In this case we estimate:

$$\frac{\gamma_2}{\delta_2} = \frac{-0.284}{6.012} = -0.047$$
With the same arguments as for $HQS$, $\alpha_1$ is highly statistically significant. The economic interpretation of this value is that a 1% increase in $PROP\_RI$ (say from 8% to 9%) is related to a decrease of about 4.6% in the bond's $HES$ ($e^{-0.047} - 1 \approx -0.046$). Note that the explained variable is $LOG\_HES$), say from 0.10% to 0.0954%.

We cannot empirically examine a situation of no retail trading because in our sample all bonds have retail trading. Even after bond issuance there is some retail trading (although the volume is smaller than in other months). Therefore, to get a rough idea of this hypothetical situation we take the point estimate from the simultaneous equations analysis reported above and calculate an estimate for an average of $HES$ for a hypothetical "zero retail trading" situation. We get an estimate of 0.127%, which is higher than the current average of 0.078%. Of course this calculation should be treated as a rough estimate since it is not clear that the coefficient value is intact for such a large change from the current situation. Taking this estimate on its face value it seems that retail traders contribute a lot to market liquidity but even without their presence the bid-ask spread is still reasonably low. We think that it is reasonable to assume that the LOB mechanism is more welcoming to retail investors and therefore attracts more retail trading than OTC. Since retail participation contributes to market liquidity it can be said that besides the direct contribution of the LOB to liquidity there is an indirect effect of attracting retail trading.

A side issue that requires clarification is the positive value of $\delta_2$ that we find; that is, we find that RI tend toward non-CPI-linked investment. This seems plausible to us because the non-retail investors are mostly institutional investors for long-term saving. They are regulated by the Ministry of Finance, which requires each institution to calculate risk measures regarding its portfolios and also the expected effect of
possible changes in risk factors. Therefore, these institutions are much more aware of the inflation risk than the average retail investor (in recent years inflation in Israel has been close to zero). Therefore, it is reasonable to find relatively more RI in non-CPI-linked bonds.

8. The Relation between Transaction Size and Transaction Spread

In the US c-bond market, the smaller the quantity the higher the transaction costs (see Schultz, 2001; Edwards, Harris and Piwowar, 2007; Harris and Piwowar, 2006 among others in Table 1). Biais and Green (2007) suggest that this relation is due to the weaker bargaining power of small traders. In the same spirit, other papers find difference in trading costs between different customer types, with more active customers paying lower costs than the less active customers (OWZ, 2016, and Hendershott, Li, Livdan and Schürhoff, 2016). The evidence at the TASE is consistent with the American evidence, but on a much smaller scale. In demonstrating this, we begin by dividing the transactions of each c-bond into quintiles according to their NIS trading volume. Then we group the transactions of each quintile and calculate their average $HES$. The results are reported in Table 11.

Panel A of Table 11 presents the average $HES$ across quintiles of all the transactions in the sample. As can be seen, the difference between the average transaction size of the highest and lowest quintile is very large: 130,250 NIS vs. 4,500 NIS, but the difference in the average $HES$ is quite small: 0.066% vs. 0.082%. In addition, the difference in the $HES$ across quintiles is mainly between the quintile

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41 See the theoretical model of Bernhardt, Dvoracek, Hughson and Werner (2005).
with the largest transactions and the other four quintiles, which exhibit roughly similar HES. If we look only at the TASE analog for the OTC customer-dealer transactions, namely the transactions of non-STT as "takers" against STT as "makers", we see a slightly sharper pattern (see Panel A). The average THS are 0.073% (the highest volume deals), 0.081%, 0.085%, 0.090%, 0.098% (the lowest volume deals). The differences between the quintiles are significant. The magnitude of the difference, however, is quite small: 0.025% between the lowest and the top quintile. A simple explanation for this difference is that as the smaller the quantity the less the pay-off from efforts to minimize trading costs. To demonstrate this, look at the average deal volume in the lowest quintile, which is roughly $2,000. With this amount, saving 0.025% for example (the difference between the lowest and top quintile) means only $0.5.

So far, we have seen small differences in the transaction spreads based on transaction quantity. Next, we examine if there is a difference between RI and non-RI beyond the difference arising from trade quantity (RI tend to make smaller transactions). We divide the transactions of non-STT "takers" against STT as "makers" into two groups. The first group includes the RI transactions as "takers" and the second includes transactions of the non-RI as "takers". Panel B of Table 1 reports the THS in these groups. It can be seen that the THS of the RI tend to be larger than the THS of the non-RI but the difference is negligible: 0.01% (for the lowest volume deals), 0.001%, 0.004%, 0.003%, 0.004% (for the highest volume deals). The

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42 For each of top four quintiles (the highest volume transactions) we calculate the daily difference between the average THS of the quintile and the average THS of the quintile below. For the top three quintiles the series are statically different from zero (the t-statistics are 6.85, 9.73 and 16.86 respectively). For the two lowest quintiles we do not find a significant difference, but we do find a significant difference between the medium quintile and the lowest quintile (the t-statistic is 7.19).
difference is economically negligible but statistically significant.\textsuperscript{43} The small differences in \textit{THS} can be explained by the fact that for RI monitoring costs are larger than those for other traders, meaning that it is less worthwhile for them to wait for a better spread.

[INSERT TABLE 11 ABOUT HERE]

To sum up we find very small differences in \textit{THS} according to deal volume and the type of the "taker" (RI or non-RI). These differences can be explained by the different tendency to execute immediately according to deal volume and trader type (RI or non-RI). That is, we do not find evidence of discrimination between traders.\textsuperscript{44}

9. Conclusion

We investigate the case of c-bond trading at the TASE, which is conducted, as for stocks, by an LOB. This is in contrast to the common practice worldwide of c-bonds being mostly traded in OTC markets and stocks being mostly traded by an open LOB on exchanges. We find that it is quite liquid: the average \textit{HES} and \textit{HQS} of c-bonds are around 0.08\%, lower than the comparable figures in the US c-bonds (especially for transactions which are not very large) and for the stocks of the comparable firms.

We attribute this liquidity to the competition the LOB facilitates. For the analysis, we identify two trader groups: the retail investors (RI) which are identified

\textsuperscript{43} For each day we create a difference between the average of the \textit{THS} of the RI as takers (averaged in each quintile and then averaged across quintiles) and the corresponding figure for NON-STT which are not RI. The average of this series is 0.0083\% and it is significant (a t-statistic of 14.68).

\textsuperscript{44} In the cross-section of c-bonds we find an insignificant relation between bond's \textit{HHI} of the STT and the difference between the \textit{THS} in large vs. small transactions. We also find an insignificant relation between the bond's \textit{HHI} of the STT and the difference between the \textit{THS} of the RI as takers and the \textit{THS} of non-STT and non-RI as takers (in each c-bond we look at the average difference across the 5 transaction size quintiles).
by their low trading volume in all TASE securities, and the short-term traders (STT), which are the analog for the dealers in the OTC market.

We find that each STT is active in many c-bonds (probably exploiting the fact that in an LOB, trading can be done by automated trading systems that monitor many securities simultaneously) and as a result the concentration of STT (measured by the Herfindahl-Hirschman Index) is much lower than the concentration of dealers in the US. We also find low price dispersion and show that low concentration is related to lower spreads and low price dispersion. To complete the picture, we show that this high level of competition among STT results in low rents.

An additional dimension of competition is between STT and the other investor types, as an LOB enables all participants to submit their quotations. We show that in the "making" transactions of non-STT the transaction half spread (THS) is lower than in the cases where the "makers" are STT. These findings are in line with Barclay, Christie, Harris, Kandel and Schultz (1999) and Weston (2000), who find that the NASDAQ reform of the 1990s that enabled competition with the dealers by posting limit orders resulted in narrower spreads.

Next, we focus on retail participation. We show that 8.8% of the trading volume arises from RI, and that this participation contributes to liquidity in several ways: First, the RI also compete on quotation and being the "maker" RI further decreases the transaction spread. Second, as "takers" they impose no adverse selection on the "making" side (as opposed to other non-STT) – which enables narrower spreads. In a simultaneous equations analysis we show that RI presence decreases the spreads: a 1% difference in retail participation is negatively related to a change of 6.4% in the bond's spread.
The comparison to US c-bond market is striking. Although the TASE is much smaller than the American market ($80 billion vs. $7840 billion) and quite isolated (foreign holdings of 0.9%) it has much lower trading costs, especially for RI.\(^{45}\) Our paper provides empirical support for the views expressed in Harris (2015), and Harris, Kyle and Sirri (2015), among others, that c-bond markets should move in the direction of a centralized open limit order book. The direct effects of such a change are expected to be a reduction of trading costs and enabling retail investors and small institutions fair and cheap access to the market. The change may have also the indirect effect of reducing the cost of capital of firms (in line with Amihud and Mendelson, 1986).

\(^{45}\) See \url{www.sifma.org} for the aggregate market cap of US c-bonds in 2014
References


Randall, O., 2015. How Do Inventory Costs Affect Dealer Behavior in the US Corporate Bond Market?, working paper, Emory University.


Table 1: Summary of Empirical Findings Regarding the American Markets for Corporate Bonds and Municipal Bonds

The table reports key findings from papers that investigate the corporate bond market and the municipal bond market in the US. The points drawn from the papers are those that are most relevant to our paper. Detailed explanations about the methodologies employed by the papers can be found in Harris (2015).

<table>
<thead>
<tr>
<th>Paper</th>
<th>Sample Description</th>
<th>Sample Period</th>
<th>Findings</th>
</tr>
</thead>
</table>
| Schultz (2001)                    | C-bonds (a sample of insurance companies' trades)        | 1/1995 – 4/1997        | • Average trading costs (one way): 0.135%  
• Active institutions pay less than inactive institutions.  
• The cost decreases with trade size (especially for inactive traders) |
• TRACE decreases transaction costs.  
• The adverse selection (information) component of the spread is not significantly different from zero. |
| Harris and Piwowar (2006)         | Municipal bonds                                          | 11/1999 – 10/2000      | Transaction costs (one way) decrease with trade size. For example, 1.34% (0.24%) for $5K ($1M) transactions |
| Edwards, Harris and Piwowar (2007) | C-bonds                                                 | 1/2003 – 1/2005        | • Transaction costs (one way) decrease with trade size. For example, after the introduction of TRACE: 0.86% (0.15%) for $5K ($1M) transactions of bonds rated "A" and above, with original issue size between $100M to $1B.  
• Costs dropped after the introduction of TRACE.  
• Transaction costs decrease significantly with trade size  
• Cost decrease for better credit rating, larger issue size and closer time to maturity.  
• 1.2% of Dollar volume arises from transactions <$100K |
| Goldstein, Hotchkiss and Sirri (2007) | BBB-rated c-bonds that have an original issue size between $10 million and $1 billion | 7/2002 – 2/2004        | • Markup: transactions <10KS: 2.37%,  
>1000KS: 0.56% (Table 6. Panel A)  
• Transaction costs decrease with trade size.  
• TRACE decreases transaction costs |
• Dealer's bargaining power is decreasing in transaction size. |
<p>| Chen and Zhong (2014)              | C-bond trades                                            | 11/2008 – 3/2011       | • The spreads of bonds that are traded also on the NYSE are lower by 0.10% than the effective spreads of OTC-only bonds (after controlling for relevant factors). |</p>
<table>
<thead>
<tr>
<th>Study</th>
<th>Trade Type</th>
<th>Time Period</th>
<th>Findings</th>
</tr>
</thead>
</table>
| Harris (2015)                             | C-bond trades                           | 12/2014 – 4/2015     | • The spread – an average of the differences between selling prices and buying prices on the same day  
  • The mean relative half quoted spread for all trades with two-sided quotes standing for at least two seconds is 0.435% (0.439% for customer trades) (Table 14).  
  • The mean half effective spread for customer trades are greater for retail-size trades (under $100,000) (0.772%) than for institutional-size trades (0.421%).  
  • There are many instances of trade-through (trading outside the spreads). |
| Hendershott and Madhavan (2015)           | C-bonds regular ("voice") vs. MarketAxess ("electronic") transactions | 1/2010 - 4/2011      | • Trading cost: Investment grade voice (electronic) 0-100K $ 0.88% (0.22%), 100K-1M $ 0.47% (0.14%), 1-5M $ 0.15% (0.11%), >5M $ 0.11% (0.10%)  
  • Cost (one way) is calculated using a benchmark such as the last trade in that bond in the inter-dealer market. |
| O'Hara, Wang, Zhou (2016)                 | C-bond trades by US insurance companies | 2002-2011            | • Less active investors pay on average 0.49% more for buys and receive 1.78% less for sales than do more active investors.  
  • The differences decrease, but remain significant, after the introduction of TRACE.  
  • These differences hold for trading with the same dealer.  
  • The differences are larger for small size transactions.  
  • The top dealer does on average 70% of the annual volume and the average Herfindahl-Hirschman measure is 0.61.  
  • More concentration worsens execution quality differentials between trades for active and less active investors.  
  • Many small trades coming from institutions. |
| Randall (2015)                            | C-bond trades                           | From the start of TRACE in 2002 to 12/2010 | • Dealer markups are larger when dealers’ inventory costs are higher.  
  • Mean percentage dispersion of prices within a bond within a minute at the end of 2010 (Figure 5): for customer-dealer trades ~0.24% and for inter-dealer trades ~0.04%. |
Table 2: Summary Statistics of the Corporate Bond Sample

The table reports the cross-section statistics of the corporate bond sample. The sample period is 2014 (245 trading days). The sample includes 402 corporate bonds with a market cap of more than 100 million NIS. *Average return* and *STD* are the average daily returns and standard deviation of the daily returns, adjusted for coupon payments, respectively. *Daily volume* (*Daily volume during the continuous stage*) is the average daily NIS volume (the average daily NIS volume during the continuous stage) in NIS millions. *Number of daily transactions* (*Number of daily transactions during the continuous stage*) is the average number of daily transactions (the average number of daily transactions during the continuous stage). *Trading outside exchange (%)* is the proportion of NIS trading outside the TASE relative to the total trading volume. *Size* is the market capitalization, calculated as an average of the values at the end of each month the bond was traded during 2014, in NIS millions. *Number of traders* is the number of accounts that participated in at least one transaction of the corporate bond during 2014. "VW mean" is the value-weighted mean according to "Daily volume (in NIS millions)".

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>VW mean</th>
<th>Median</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average return (%)</td>
<td>402</td>
<td>0.02%</td>
<td>0.02%</td>
<td>0.01%</td>
<td>0.06%</td>
<td>-0.42%</td>
<td>0.51%</td>
</tr>
<tr>
<td>STD (%)</td>
<td>402</td>
<td>0.48%</td>
<td>0.47%</td>
<td>0.29%</td>
<td>0.45%</td>
<td>0.02%</td>
<td>3.11%</td>
</tr>
<tr>
<td>Daily volume (in NIS millions)</td>
<td>402</td>
<td>1.95</td>
<td>4.86</td>
<td>0.98</td>
<td>2.70</td>
<td>0.03</td>
<td>25.41</td>
</tr>
<tr>
<td>Daily volume during the continuous stage (in NIS millions)</td>
<td>402</td>
<td>1.70</td>
<td>4.19</td>
<td>0.87</td>
<td>2.26</td>
<td>0.03</td>
<td>18.18</td>
</tr>
<tr>
<td>Number of daily transactions</td>
<td>402</td>
<td>60.99</td>
<td>121.81</td>
<td>47.79</td>
<td>56.45</td>
<td>0.96</td>
<td>363.74</td>
</tr>
<tr>
<td>Number of daily transactions during the continuous stage</td>
<td>402</td>
<td>41.80</td>
<td>90.90</td>
<td>24.87</td>
<td>47.48</td>
<td>0.79</td>
<td>332.29</td>
</tr>
<tr>
<td>Trading outside exchange (%)</td>
<td>402</td>
<td>6.76%</td>
<td>7.41%</td>
<td>3.58%</td>
<td>9.05%</td>
<td>0.00%</td>
<td>78.15%</td>
</tr>
<tr>
<td>Size (in NIS million)</td>
<td>402</td>
<td>647.26</td>
<td>1,388.53</td>
<td>407.07</td>
<td>724.73</td>
<td>100.50</td>
<td>5,421.06</td>
</tr>
<tr>
<td>Turnover</td>
<td>402</td>
<td>63.01%</td>
<td>87.91%</td>
<td>48.85%</td>
<td>48.89%</td>
<td>4.58%</td>
<td>391.76%</td>
</tr>
<tr>
<td>Number of traders</td>
<td>402</td>
<td>2,351.1</td>
<td>4,807.5</td>
<td>1,407.5</td>
<td>2,460.6</td>
<td>71.0</td>
<td>17,686.0</td>
</tr>
</tbody>
</table>
Table 3: Bid-Ask Spread Measures

The table reports the cross-section bid-ask spread measures of the corporate bond sample. The sample period is 2014 (245 trading days). The c-bond sample is defined in Table 1 (402 corporate bonds). *HQS* is the half quoted bid-ask spread of the security calculated at six time points each trading day, on the hour from 11:00 to 16:00. The hourly observation is winsorized if the value is greater than 10% or if there is no valid bid-ask spread. *HES* is the time-series average of the half effective spread. For each transaction, we measure the half effective spread as the absolute value of the difference between the transaction price and the mid-quote prior to the transaction, divided by the mid-quote. The observation is winsorized in the case that the half effective spread is greater than 10% or there is no valid bid-ask spread. The averages of *HQS* and *HES* are calculated for each day and then across days. "VW mean" is the value-weighted mean according to the NIS volume of the transaction.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>VW mean</th>
<th>Median</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>HQS (%)</td>
<td>3,498,596</td>
<td>0.082%</td>
<td>0.077%</td>
<td>0.055%</td>
<td>0.102%</td>
<td>0.012%</td>
<td>2.910%</td>
</tr>
<tr>
<td>HES (%)</td>
<td>3,498,596</td>
<td>0.078%</td>
<td>0.067%</td>
<td>0.039%</td>
<td>0.202%</td>
<td>0.003%</td>
<td>10.000%</td>
</tr>
</tbody>
</table>
Table 4: Concentration of Short-Term Trading

The table reports market share of STT and a measure of their concentration in the cross-section of c-bonds. The bond sample is defined in Table 2. The sample period is 2014. STT are defined as follows: For each trader in each corporate bond in the sample (excluding options), we calculate the number of switches from buying to selling or vice versa and divide it by the number of trading days that the trader was active in the bond. A trader is classified as STT if the NIS volume value-weighted average of this ratio across the securities the trader traded is equal to or greater than 1 and the trader total trading volume is higher than 2 million NIS in all TASE securities (excluding options). The table relates to transactions of STT vs. non-STT. Number of STT is the number of STT that traded in the corporate bond during the sample period. HHI is the Herfindahl-Hirschman index, calculated as the sum of the squares of the proportion of each STT’s NIS volume relative to the total NIS volume of the STT in the corporate bond. \(1/\text{HHI}\) is the reciprocal of the Herfindahl-Hirschman index. Proportion of largest trader out of STT volume in the corporate bond/Proportion of 3 largest traders out of STT volume in the corporate bond/Proportion of 5 largest traders out of STT volume in the corporate bond is the NIS volume of the largest STT/3 largest STT/5 largest STT in the corporate bond divided by the total NIS volume of all STT (in their transactions vs. non-STT) in the corporate bond, respectively. Proportion of largest trader out of the corporate bond volume/Proportion of 3 largest traders out of the corporate bond volume/Proportion of 5 largest traders out of the corporate bond volume is the NIS volume of the largest STT/3 largest STT/5 largest STT in the corporate bond divided by the corporate bond's NIS volume, respectively. "VW mean" is the value-weighted mean according to the corporate bonds annual NIS volume.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>VW mean</th>
<th>Median</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of STT</td>
<td>402</td>
<td>32.11</td>
<td>49.64</td>
<td>30.00</td>
<td>18.06</td>
</tr>
<tr>
<td>HHI</td>
<td>402</td>
<td>0.162</td>
<td>0.112</td>
<td>0.126</td>
<td>0.122</td>
</tr>
<tr>
<td>(1/\text{HHI})</td>
<td>402</td>
<td>8.14</td>
<td>10.32</td>
<td>7.92</td>
<td>3.48</td>
</tr>
<tr>
<td>Proportion of largest trader out of STT volume</td>
<td>402</td>
<td>27.76%</td>
<td>22.07%</td>
<td>24.15%</td>
<td>0.14</td>
</tr>
<tr>
<td>Proportion of 3 largest traders out of STT volume</td>
<td>402</td>
<td>54.77%</td>
<td>45.89%</td>
<td>51.42%</td>
<td>0.16</td>
</tr>
<tr>
<td>Proportion of 5 largest traders out of STT volume</td>
<td>402</td>
<td>70.04%</td>
<td>60.95%</td>
<td>68.81%</td>
<td>0.14</td>
</tr>
<tr>
<td>Proportion of largest trader out of the corporate bond volume</td>
<td>402</td>
<td>7.23%</td>
<td>7.10%</td>
<td>6.47%</td>
<td>0.04</td>
</tr>
<tr>
<td>Proportion of 3 largest traders out of the corporate bond volume</td>
<td>402</td>
<td>14.70%</td>
<td>14.81%</td>
<td>14.40%</td>
<td>0.05</td>
</tr>
<tr>
<td>Proportion of 5 largest traders out of the corporate bond volume</td>
<td>402</td>
<td>19.13%</td>
<td>19.75%</td>
<td>19.21%</td>
<td>0.07</td>
</tr>
</tbody>
</table>
Table 5: The Relation between Short-Term Traders' Concentration and Liquidity

The table presents the average coefficients of daily cross-section regressions of the security's bid-ask spread measures. The c-bond sample is defined in Table 1 (402 corporate bonds). The sample period is 2014. LOG_STD is the log of the standard deviation of daily returns. LOG_SIZE is the log of the security's size, calculated as an average of the values at the end of each month. LOG_FIRM_SIZE is the log of the market value of the firm's tradable corporate bonds and stocks. DUR is the corporate bond's duration. NON_LINKED is a dummy variable that equals 0 if the bond is CPI-linked and 1 otherwise. RATING is the average corporate bond's rating according to the Israeli rating agencies. The value of the variable ranges from 1 (credit rating of 'D') to 26 (credit rating of 'AAA'), and equals 0 if the bond has no credit rating. RATING DUMMY is a dummy variable that equals 1 if the corporate bond has a credit rating and 0 otherwise. HHI is defined in Table 4. In regressions (1) and (2) the dependent variable is LOG_DAILY_HQS, which is the log of the security's daily half quoted bid-ask spread. The daily half quoted bid-ask spread of the security is calculated as the average of the quoted bid-ask spread at six time points each trading day, on the hour from 11:00 to 16:00. The hourly observation is winsorized if the value is greater than 10% or if there is no valid bid-ask spread. In regressions (3) and (4) the dependent variable is LOG_DAILY_HES, which is the log of the security's daily half quoted effective spread. For each transaction we calculate the half effective spread as described in Table 3. The daily half quoted effective spread is the daily average of the half effective spread of the security transactions. In regressions (5) and (6) the dependent variable is THS_NST, which is half effective spread of the non-STT in their 'taking' transactions. A trader is classified as Non-STT if she is not a STT. The t-statistics of each explanatory variable are calculated using the Newey-West (1987) method, with the number of lags varying according to the auto-correlation of the coefficient. The number of lags ranges from 0 to 4.
<table>
<thead>
<tr>
<th></th>
<th>LOG_DAILY_HQS</th>
<th>LOG_DAILY_HES</th>
<th>LOG_THS_NST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td></td>
<td>(98.00)</td>
<td>(62.50)</td>
<td>(70.48)</td>
</tr>
<tr>
<td>LOG_STD</td>
<td>-0.042</td>
<td>0.042</td>
<td>0.023</td>
</tr>
<tr>
<td></td>
<td>(-2.54)</td>
<td>(2.88)</td>
<td>(1.41)</td>
</tr>
<tr>
<td>LOG_SIZE</td>
<td>-0.595</td>
<td>-0.515</td>
<td>-0.438</td>
</tr>
<tr>
<td></td>
<td>(-96.26)</td>
<td>(-75.12)</td>
<td>(-76.44)</td>
</tr>
<tr>
<td>LOG_FIRM_SIZE</td>
<td>-0.154</td>
<td>-0.094</td>
<td>-0.110</td>
</tr>
<tr>
<td></td>
<td>(-32.29)</td>
<td>(-21.22)</td>
<td>(-24.50)</td>
</tr>
<tr>
<td>DUR</td>
<td>0.144</td>
<td>0.149</td>
<td>0.116</td>
</tr>
<tr>
<td></td>
<td>(33.63)</td>
<td>(34.98)</td>
<td>(34.76)</td>
</tr>
<tr>
<td>NON_LINKED</td>
<td>-0.319</td>
<td>-0.255</td>
<td>-0.150</td>
</tr>
<tr>
<td></td>
<td>(-24.60)</td>
<td>(-19.46)</td>
<td>(-12.28)</td>
</tr>
<tr>
<td>RATING</td>
<td>-0.076</td>
<td>-0.072</td>
<td>-0.076</td>
</tr>
<tr>
<td></td>
<td>(-29.43)</td>
<td>(-28.76)</td>
<td>(-27.41)</td>
</tr>
<tr>
<td>RATING_DUMMY</td>
<td>1.116</td>
<td>1.436</td>
<td>1.085</td>
</tr>
<tr>
<td>HHI</td>
<td>2.705</td>
<td>2.096</td>
<td>2.205</td>
</tr>
<tr>
<td></td>
<td>(47.73)</td>
<td>(42.71)</td>
<td>(34.93)</td>
</tr>
<tr>
<td>R²</td>
<td>0.5145</td>
<td>0.5634</td>
<td>0.4493</td>
</tr>
<tr>
<td>N</td>
<td>245</td>
<td>245</td>
<td>245</td>
</tr>
</tbody>
</table>
Table 6: Price dispersion

The table reports the price dispersion in the sample of corporate bonds. The sample is defined in Table 1. The sample period is 2014. STT is defined in Table 4. A trader is classified as Non-STT if she is not a STT. Within each c-bond minute, if there are two transactions or more, we calculate the standard deviation of their prices and divide it by the average price. This variable is denoted Dispersion. The price dispersion measures are calculated on the entire sample, on a sub-sample of transactions between STT and Non-STT and on a sub-sample of transactions of STT that trade among themselves.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All sample</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dispersion</td>
<td>857,655</td>
<td>0.022%</td>
<td>0.006%</td>
<td>0.061%</td>
<td>0.000%</td>
<td>3.537%</td>
</tr>
<tr>
<td><strong>STT vs. Non-STT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dispersion</td>
<td>404,280</td>
<td>0.019%</td>
<td>0.006%</td>
<td>0.056%</td>
<td>0.000%</td>
<td>3.987%</td>
</tr>
<tr>
<td><strong>STT vs. STT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dispersion</td>
<td>84,589</td>
<td>0.033%</td>
<td>0.007%</td>
<td>0.075%</td>
<td>0.000%</td>
<td>2.080%</td>
</tr>
</tbody>
</table>
Table 7: Trading Profits of Short-Term Traders

The table reports the rent of short-term traders in the sample of corporate bonds. The sample is defined in Table 1. The sample period is 2014. STT (short-term trader) is defined in Table 4. THS is the half effective spread of the transaction, defined in Table 5. The RHS is the realized half spread, calculated as the c-bond's closing price divided by the transaction's price minus one if the seller is a "maker", and the minus of that value if the buyer is a "maker". AS is the adverse selection component of the transaction, calculated as the transaction half spread minus the realized spread.

<table>
<thead>
<tr>
<th></th>
<th>Equally Weighted</th>
<th>Value Weighted</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>STT as</td>
<td>N</td>
<td>THS (%)</td>
<td>RHS (%)</td>
<td>AS (%)</td>
<td>THS (%)</td>
<td>RHS (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>makers</td>
<td>245</td>
<td>0.081</td>
<td>0.037</td>
<td>0.044</td>
<td>0.069</td>
<td>0.029</td>
</tr>
<tr>
<td>takers</td>
<td>245</td>
<td>0.067</td>
<td>-0.009</td>
<td>0.076</td>
<td>0.055</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(28.00)</td>
<td>(-3.76)</td>
<td>(16.45)</td>
<td>(22.79)</td>
<td>(-2.69)</td>
</tr>
</tbody>
</table>
Table 8: Explaining the Transaction Spread by its Maker’s Type

The table reports the average coefficients of daily cross-section regressions of the security's half effective spread in the transaction (THS). The sample is defined in Table 1 (402 corporate bonds). The sample period is 2014. \textit{LOG\_STD}, \textit{LOG\_SIZE}, \textit{LOG\_FIRM\_SIZE}, \textit{DUR}, \textit{NON\_LINKED}, \textit{RATING} and \textit{RATING\_DUMMY} are defined in Table 5. \textit{D\_NST} is a dummy variable that equals 0 if the investor is an \textit{STT} (\textit{STT} is defined in Table 4) and 1 otherwise. \textit{D\_RI} is a dummy variable that equals 1 if the investor is an RI and 0 otherwise. RI are identified as "low-volume" investors with less than 2 million NIS in all TASE securities (excluding options). The \textit{t}-statistics of each explanatory variable is calculated using the Newey-West (1987) method, with the number of lags varying according to the auto-correlation of the coefficient. The number of lags ranges from 0 to 4.

<table>
<thead>
<tr>
<th></th>
<th>\textit{LOG_THS}</th>
<th>\textit{LOG_THS}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Intercept</td>
<td>5.109</td>
<td>5.105</td>
</tr>
<tr>
<td></td>
<td>(39.74)</td>
<td>(39.64)</td>
</tr>
<tr>
<td>\textit{LOG_STD}</td>
<td>0.017</td>
<td>0.017</td>
</tr>
<tr>
<td></td>
<td>(0.91)</td>
<td>(0.94)</td>
</tr>
<tr>
<td>\textit{LOG_SIZE}</td>
<td>-0.308</td>
<td>-0.308</td>
</tr>
<tr>
<td></td>
<td>(-71.05)</td>
<td>(-71.27)</td>
</tr>
<tr>
<td>\textit{LOG_FIRM_SIZE}</td>
<td>-0.067</td>
<td>-0.067</td>
</tr>
<tr>
<td></td>
<td>(-13.86)</td>
<td>(-13.72)</td>
</tr>
<tr>
<td>\textit{DUR}</td>
<td>0.072</td>
<td>0.072</td>
</tr>
<tr>
<td></td>
<td>(29.68)</td>
<td>(29.81)</td>
</tr>
<tr>
<td>\textit{NON_LINKED}</td>
<td>-0.045</td>
<td>-0.044</td>
</tr>
<tr>
<td></td>
<td>(-4.09)</td>
<td>(-3.95)</td>
</tr>
<tr>
<td>\textit{RATING}</td>
<td>-0.085</td>
<td>-0.085</td>
</tr>
<tr>
<td></td>
<td>(-25.57)</td>
<td>(-25.53)</td>
</tr>
<tr>
<td>\textit{RATING_DUMMY}</td>
<td>1.272</td>
<td>1.270</td>
</tr>
<tr>
<td></td>
<td>(14.62)</td>
<td>(16.41)</td>
</tr>
<tr>
<td>\textit{D_NST}</td>
<td>-0.555</td>
<td>-0.549</td>
</tr>
<tr>
<td></td>
<td>(-109.64)</td>
<td>(-99.44)</td>
</tr>
<tr>
<td>\textit{D_RI}</td>
<td></td>
<td>-0.036</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-6.20)</td>
</tr>
<tr>
<td>\text{R$^2$}</td>
<td>0.2478</td>
<td>0.2482</td>
</tr>
<tr>
<td>\text{N}</td>
<td>245</td>
<td>245</td>
</tr>
</tbody>
</table>

56
Table 9: Explaining the Adverse Selection by Taker’s Type

The table reports the average coefficients of daily cross-section regressions of the adverse selection in the corporate bonds’ transactions. The sample is defined in Table 1. The sample period is 2014. \( \text{LOG\_STD, LOG\_SIZE, LOG\_FIRM\_SIZE, DUR, NON\_LINKED, RATING and RATING\_DUMMY} \) are defined in Table 5. \( D\_\text{NST\_TKR} \) is a dummy variable that equals 1 if the “taker” is a non-STT and 0 otherwise. \( D\_\text{RI\_TKR} \) is a dummy variable that equals 1 if the “taker” side is an RI and 0 otherwise. RI is defined in Table 8. Non-STT is defined in Table 5. The dependent variable is adverse selection of the transaction (in %), defined in Table 6. The \( t \)-statistics of each explanatory variable is calculated using the Newey-West (1987) method, with the number of lags varying according to the auto-correlation of the coefficient. The number of lags ranges from 0 to 4.

<table>
<thead>
<tr>
<th></th>
<th>All sample (1)</th>
<th>All sample (2)</th>
<th>STT_MKR (3)</th>
<th>STT_MKR (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.906</td>
<td>0.875</td>
<td>0.786</td>
<td>0.755</td>
</tr>
<tr>
<td></td>
<td>(29.88)</td>
<td>(29.40)</td>
<td>(29.31)</td>
<td>(28.97)</td>
</tr>
<tr>
<td>LOG_STD</td>
<td>-0.004</td>
<td>-0.003</td>
<td>-0.001</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(-1.59)</td>
<td>(-1.12)</td>
<td>(-0.46)</td>
<td>(0.40)</td>
</tr>
<tr>
<td>LOG_SIZE</td>
<td>-0.028</td>
<td>-0.028</td>
<td>-0.024</td>
<td>-0.024</td>
</tr>
<tr>
<td></td>
<td>(-15.52)</td>
<td>(-14.92)</td>
<td>(-18.80)</td>
<td>(-16.01)</td>
</tr>
<tr>
<td>LOG_FIRM_SIZE</td>
<td>-0.009</td>
<td>-0.007</td>
<td>-0.007</td>
<td>-0.005</td>
</tr>
<tr>
<td></td>
<td>(-7.89)</td>
<td>(-6.59)</td>
<td>(-6.67)</td>
<td>(-5.27)</td>
</tr>
<tr>
<td>DUR</td>
<td>0.003</td>
<td>0.003</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(4.93)</td>
<td>(5.35)</td>
<td>(0.93)</td>
<td>(1.17)</td>
</tr>
<tr>
<td>NON_LINKED</td>
<td>-0.024</td>
<td>-0.019</td>
<td>-0.019</td>
<td>-0.013</td>
</tr>
<tr>
<td></td>
<td>(-11.08)</td>
<td>(-10.33)</td>
<td>(-9.44)</td>
<td>(-6.95)</td>
</tr>
<tr>
<td>RATING</td>
<td>-0.009</td>
<td>-0.009</td>
<td>-0.007</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(-9.74)</td>
<td>(-10.78)</td>
<td>(-9.57)</td>
<td>(-8.69)</td>
</tr>
<tr>
<td>RATING_DUMMY</td>
<td>0.124</td>
<td>0.110</td>
<td>0.075</td>
<td>0.055</td>
</tr>
<tr>
<td></td>
<td>(5.75)</td>
<td>(5.86)</td>
<td>(4.00)</td>
<td>(2.89)</td>
</tr>
<tr>
<td>D_\text{NST_TKR}</td>
<td>-0.028</td>
<td>-0.011</td>
<td>-0.034</td>
<td>-0.013</td>
</tr>
<tr>
<td></td>
<td>(-9.02)</td>
<td>(-5.96)</td>
<td>(-8.37)</td>
<td>(-5.56)</td>
</tr>
<tr>
<td>D_\text{RI_TKR}</td>
<td>-0.052</td>
<td>-0.057</td>
<td>-0.052</td>
<td>-0.95</td>
</tr>
<tr>
<td></td>
<td>(-7.60)</td>
<td>(-7.89)</td>
<td>(-7.60)</td>
<td>(-7.89)</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.0310</td>
<td>0.0351</td>
<td>0.0307</td>
<td>0.0371</td>
</tr>
<tr>
<td>N</td>
<td>245</td>
<td>245</td>
<td>245</td>
<td>245</td>
</tr>
</tbody>
</table>
Table 10: Explaining Bond' Bid-Ask Spread and Retail Participation:
Simultaneous Equations

The table reports the coefficients of cross-section regressions. The regressions are the reduced-form regressions of the simultaneous Equations (1) and (2). The reduced-form regressions appear in Equations (3) and (4). The sample is defined in Table 1 (402 corporate bonds). The sample period is 2014. The explanatory variables \( LOG_{STD}, LOG_{SIZE}, LOG_{FIRM\_SIZE}, NON\_LINKED \) and \( RATING\_DUMMY \) are defined in Table 5. \( DUR \) is the average duration of the corporate bond during the sample period. \( RATING \) is the average credit rating of the corporate bond during the sample period. In regression (1) the dependent variable is \( LOG\_HQS \), the log of \( HQS \), which is defined in Table 3. In regression (2) the dependent variable is \( PROP\_RI \), which is the proportion of RI trading in the NIS trading volume of the c-bond during the sample period. RI is defined in Table 8. In regression (3) the dependent variable is \( LOG\_HES \), the log of \( HES \), which is defined in Table 3. Standard errors are clustered by firm.

<table>
<thead>
<tr>
<th></th>
<th>( LOG_HQS )</th>
<th>( PROP_RI )</th>
<th>( LOG_HES )</th>
<th>( PROP_RI )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{Intercept} )</td>
<td>14.615</td>
<td>-6.883</td>
<td>13.220</td>
<td>-6.883</td>
</tr>
<tr>
<td></td>
<td>(14.09)</td>
<td>(-0.80)</td>
<td>(14.50)</td>
<td>(-0.80)</td>
</tr>
<tr>
<td>( \text{LOG_STD} )</td>
<td>-0.001</td>
<td>-0.212</td>
<td>-0.036</td>
<td>-0.212</td>
</tr>
<tr>
<td></td>
<td>(-0.01)</td>
<td>(-0.27)</td>
<td>(-0.55)</td>
<td>(-0.27)</td>
</tr>
<tr>
<td>( \text{LOG_SIZE} )</td>
<td>-0.683</td>
<td>-0.516</td>
<td>-0.633</td>
<td>-0.516</td>
</tr>
<tr>
<td></td>
<td>(-13.79)</td>
<td>(-1.16)</td>
<td>(-15.69)</td>
<td>(-1.16)</td>
</tr>
<tr>
<td>( \text{LOG_FIRM_SIZE} )</td>
<td>-0.147</td>
<td>1.366</td>
<td>-0.129</td>
<td>1.366</td>
</tr>
<tr>
<td></td>
<td>(-3.80)</td>
<td>(3.35)</td>
<td>(-3.39)</td>
<td>(3.35)</td>
</tr>
<tr>
<td>( \text{DUR} )</td>
<td>0.128</td>
<td>0.221</td>
<td>0.119</td>
<td>0.221</td>
</tr>
<tr>
<td></td>
<td>(5.02)</td>
<td>(1.08)</td>
<td>(5.72)</td>
<td>(1.08)</td>
</tr>
<tr>
<td>( \text{NON_LINKED} )</td>
<td>-0.399</td>
<td>6.012</td>
<td>-0.284</td>
<td>6.012</td>
</tr>
<tr>
<td></td>
<td>(-5.73)</td>
<td>(8.44)</td>
<td>(-4.62)</td>
<td>(8.44)</td>
</tr>
<tr>
<td>( \text{RATING} )</td>
<td>-0.065</td>
<td>-0.314</td>
<td>-0.068</td>
<td>-0.314</td>
</tr>
<tr>
<td></td>
<td>(-4.26)</td>
<td>(-2.29)</td>
<td>(-5.35)</td>
<td>(-2.29)</td>
</tr>
<tr>
<td>( \text{RATING_DUMMY} )</td>
<td>0.939</td>
<td>-0.481</td>
<td>0.895</td>
<td>-0.481</td>
</tr>
<tr>
<td></td>
<td>(2.79)</td>
<td>(-0.16)</td>
<td>(3.06)</td>
<td>(-0.16)</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.7335</td>
<td>0.2949</td>
<td>0.7322</td>
<td>0.2949</td>
</tr>
<tr>
<td>( N )</td>
<td>402</td>
<td>402</td>
<td>402</td>
<td>402</td>
</tr>
</tbody>
</table>
Table 11: The Relation between Transaction Size and Transaction Spread

The table reports the quintiles of the transaction half spread ($THS$) of the c-bond sample. $THS$ is defined in Table 6. The sample of bonds is defined in Table 1 (402 corporate bonds). The sample period is 2014. Panel A includes two transaction samples. The first sample (left table) includes all the transactions of the sample of c-bonds. The second sample (right table) includes the transactions in which the non-STT are "takers" and the STT are "makers". STT is defined in Table 4. Panel B includes transactions in which the non-STT act as "takers" and the STT act as "makers" in our c-bond sample. This sample of transactions is divided into two: the first sub-sample (left table) includes the transactions of RI as "takers" (and STT as "makers"). The second sub-sample (right table) includes the transactions of non-STT which are not RI as "takers" (and the STT as "makers"). RI is defined in Table 8. For both Panels A and B, we divide each corporate bond transaction into quintiles according to the NIS volume of the transaction. Each quintile includes the transactions of the corresponding c-bonds' quintiles.

Panel A:

<table>
<thead>
<tr>
<th>Quintile</th>
<th>All transactions</th>
<th>Non-STT as takers vs. STT as makers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Average transaction NIS volume</td>
</tr>
<tr>
<td>1</td>
<td>699,723</td>
<td>4,508</td>
</tr>
<tr>
<td>2</td>
<td>699,628</td>
<td>12,487</td>
</tr>
<tr>
<td>3</td>
<td>699,881</td>
<td>20,243</td>
</tr>
<tr>
<td>4</td>
<td>699,810</td>
<td>33,159</td>
</tr>
<tr>
<td>5</td>
<td>699,585</td>
<td>130,250</td>
</tr>
</tbody>
</table>

Panel B:

<table>
<thead>
<tr>
<th>Quintile</th>
<th>RI as takers vs. STT</th>
<th>Non-RI Non-STT as takers vs. STT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Average transaction NIS volume</td>
</tr>
<tr>
<td>1</td>
<td>108,998</td>
<td>6,978</td>
</tr>
<tr>
<td>2</td>
<td>104,145</td>
<td>13,639</td>
</tr>
<tr>
<td>3</td>
<td>101,412</td>
<td>19,612</td>
</tr>
<tr>
<td>4</td>
<td>86,710</td>
<td>27,676</td>
</tr>
<tr>
<td>5</td>
<td>51,047</td>
<td>44,829</td>
</tr>
</tbody>
</table>
Figure 1: Bid-Ask Spreads of Corporate Bonds and Stocks of the Same Firm

The figure reports the half quoted bid-ask spread (HQS) for a sub-sample of firms that traded stocks on the TASE as well as corporate bonds. The sample is defined in Table 2. HQS is defined in Table 3. Corporate bonds of the same firm are averaged into a single observation. Panel A relates to the entire sub-sample. Panel B presents the firms for which the average HQS (of stocks and c-bonds) is smaller than 0.5%.

Panel A: \( \overline{HQS}(\%) \)

Panel B: \( \overline{HQS}(\%) < 0.5 \)