Corporate Bond Trading on a Limit Order Book Exchange

by

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Abstract

Is corporate bond (c-bond) trading fundamentally different from stock trading when both these security types are traded on an exchange? We investigate a sample of firms with c-bonds and stocks on the Tel Aviv Stock Exchange (TASE), where c-bonds are traded like stocks in a limit order book, and find no fundamental difference between the two types. Compared with stocks, c-bonds have lower average bid-ask spreads (0.077% vs. 0.087%) and lower off-exchange trading (9.47% vs. 25.45%), higher retail participation (7.28% vs. 6.38%), lower short-term trader participation (34.18% vs. 43.70%) with higher market concentration, lower trading costs of retail investors (0.068% vs. 0.087%) and higher trading profits of short-term traders (0.014% vs. 0.002%). However, these small differences arise mainly from the security's characteristics (*STD* and *SIZE*) and not from the security type (c-bond vs. stock). The characteristics of the TASE c-bond market are in contrast to findings from the US c-bond OTC markets where c-bond spreads are higher, retail participation is very low and retail trading costs are very high. These findings provide evidence confirming the feasibility of successful c-bond trading on a limit order book exchange.

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 markets are characterized by a large market share of institutional investors and very low participation of retail investors, who pay high trading costs.[1] For example, Harris (2015) finds that average customer trading costs are 0.85% for trades below $100K and 0.52% for larger trades (and the total annual cost is at least $26B), while the volume-weighted average of the half quoted spread for US stocks was less than 0.02% during 2014.[2]

The fact that c-bond markets are less liquid than stock markets is quite puzzling. C-bonds should be more liquid than stocks because of their lower variability (which makes liquidity provision less risky) and the lower degree of information asymmetry (see Biais and Green, 2007; Harris, 2015). However, the c-bonds which are traded in OTC markets are much less liquid than stocks (spreads are high, there are few transactions per day, and retail trading is negligible). 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) say that "*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 to an electronically accessible broker platform or alternative trading system (ATS), where one customer's limit order could trade against another customer's order without dealer intermediation.*" In this context, O'Hara, Wang and Zhou (2015) 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*

[1] See the literature review at the end of this introduction.
[2] Based on CRSP data of monthly bid and ask prices during 2014 of stocks (share codes 10 or 11).

points on execution quality, while in the fixed income market it's more a question of nickels, quarters and dollars."[3] Biais and Green (2007) find that bond trading was quite active on the NYSE until the 1940s and the trading costs of retail 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, and market forces may fail to correct this inefficiency, even in the long term."*

In this paper, our research question is whether c-bond trading is fundamentally different from stock trading. We investigate the case of the Tel Aviv Stock Exchange (hereafter TASE), where c-bonds (and also government bonds) have been traded for many years by the same open limit order book system as stocks and there are no competing exchanges, dark pools, etc. We find an active c-bond market with characteristics (retail participation, short-term trader participation and the trading costs or profits of these groups) comparable to the stock market but with higher liquidity. These findings lead us to conclude that there is no fundamental difference between c-bond trading and stock trading and that there is no fundamental reason why c-bonds cannot be traded successfully on a limit order book exchange. It should be emphasized that we do not claim that c-bond trading on an exchange is always expected to be a success. Rather we show an example of successful c-bond trading on an exchange. As Biais and Green (2007) say the market can reach several possible equilibria. In Israel the market reached the equilibrium of liquid trading of c-bonds on the exchange.

[3] FINRA (Financial Industry Regulatory Authority) is a private entity that acts as a self-regulatory organization (SRO).

In our comparison of c-bonds and stocks we focus on a sample of non-dual listed firms with both c-bonds and stocks which were traded on the TASE during 2014. We require a total market value of each firm's securities of at least 800 million NIS (equivalent to approximately $223M).[4] This sample consists of 49 firms with 49 stocks and 149 c-bonds (198 securities in total).

Our analysis begins by comparing the bid-ask spreads of the TASE c-bond market to those of the TASE stock market. We find that the average half quoted spread (the effective spread) of the c-bonds is 0.24% (0.21%), which is smaller than for stocks – 0.36% (0.31%). Weighted by the security's NIS volume, the half quoted spread (effective spread) of the c-bonds is also narrower than in the stock market: 0.077% (0.075%) relative to 0.087% (0.087%). In 34 out of 49 firms the stock's half quoted spread is larger than the average of the firm's bond half quoted spreads (the p-value of a binomial test is about 1%). Moreover, the difference holds after controlling for a security's characteristics (market capitalizations and standard deviation of returns). Next, we compare the proportion of NIS trading volume outside the exchange (negotiated deals). This proportion is an indication of trading needs that are not met by the exchange. The average of the c-bonds' NIS proportion outside the exchanges is 6.87%, which is one third of the figure for stocks: 20.74%. The difference is highly statistically significant and in only six of the 49 firms is it reversed. This means that most of the trading of institutional investors in c-bonds is conducted on the exchange, even compared to stocks.

Next we investigate and compare the trading characteristics of TASE stocks and c-bonds based on a proprietary database that includes trader identification (the broker's identity and the client's account number in the broker's records) for both sides

[4] During 2014 $1 was equal on average to 3.58 NIS (Bank of Israel data).

of each transaction.[5] Since we do not know the type of the traders (algo, institutional, retail, etc.) we rely on technical information such as trading volume and trading frequency in order to identify two investor types: retail investors and "short-term" traders. Why do we focus of these two groups? The participation of retail investors in the US c-bond market is negligible, possibly due to the very high transaction costs they face in the OTC market.[6] It is of interest to see if when trading is conducted on an exchange as for stocks, retail participation in c-bonds is still smaller than for stocks. By "short-term" traders we mean those trading on a regular basis over a daily or shorter horizon. The short-term traders provide liquidity to other investor types (including institutional and retail) that trade for a longer horizon. In the US c-bond market, the short-term traders are the dealers. It is of interest to see if when c-bonds are traded on an exchange like stocks, short-term trading takes place as it does in stock trading (mainly by algo trading).

We identify retail investors (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). These low-volume investors are almost surely retail investors: they traded a small number of securities during 2014 (5.05 on average) and very infrequently (4.55 trading days on average). 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.

When investigating the participation of the different investor types we find statistically significant differences between stocks and c-bonds but we get roughly the

[5] It is possible that a trader trades through different exchange members or through different accounts of a given exchange member.
[6] For the participation of retail investors in the US c-bond market and for their trading costs see the literature review at the end of this introduction.

same picture: retail participation (the NIS volume out of the double-sided volume) in stocks (c-bonds) is 6.38% (7.38%); STT participation in stocks (c-bonds) is 43.70% (34.18%); the NIS proportion of transaction where STT trade with non-STT is 45.36% (40.75%) in stocks (c-bonds). After controlling for the security's characteristics (market capitalization, standard deviation of returns) we find somewhat higher STT participation in c-bonds than in stocks and higher RI participation in stocks than in c-bonds. We also investigate the concentration of STT trading (as measured by the *Herfindahl-Hirschman Index)* and find that it is higher in c-bonds than in stocks (0.15 vs. 0.08 per security on average) but the difference is explained by the market cap of the securities and not by their type (c-bond or stock). These low HHI measures (0.15 and 0.08) are indications of unconcentrated liquidity provision in the markets for both stocks and c-bonds. Overall, we find that market participation of RI and STT is mainly explained by the characteristics of the securities (*STD* and *SIZE*) and not by their type (stock or c-bond).

Next we investigate the actual trading profits/costs of the trader groups we have defined.[7] We measure the trading profits for buyers as the security's closing price divided by the transaction price minus one; for sellers, it is this value with a minus sign.[8] A negative profit means a cost. The intuition is that the closing price is the benchmark price for the transaction, or a proxy for the unperturbed "true" value. This measure is approximately equal to minus the half realized spread (with the closing price as a benchmark) for a marketable limit order and it approximately equals half the realized spread for the limit order side of the transaction. We find that the percentage trading costs of RI are slightly lower in c-bonds than in stocks: 0.068% vs.

[7] These profits/costs are before explicit trading costs such as commissions, broker fees, and transaction taxes.
[8] This measure is winzorized at 10%.

0.087% but the difference is insignificant. Controlling for some explanatory variables such as the standard deviation of returns and market capitalization, the difference remains insignificant. We find that the percentage trading profits of STT in c-bonds are slightly higher than in stocks (0.014% vs. 0.002%). We find that this difference arises from the fact that c-bonds have a smaller standard deviation of returns than stocks and smaller market capitalization than stocks. Controlling for these variables we find slightly higher figure (0.009%) for the percentage trading profits of STT in stocks than in c-bonds, but this difference is insignificant. Taking all these pieces of evidence together we do not find a significant difference in the trading characteristics of c-bonds and stocks.

Our formal comparison is between c-bond trading and stock trading on the TASE, but the comparison to the US corporate bond market is striking. As the US market is much larger than the Israeli market, one would expect it to be more liquid. Indeed this is the case for the stock market but for the c-bond market the situation is the opposite. The trading costs for retail investors are about 10 times higher in the US and even the trading costs of institutional investors in the US are higher than the trading costs on the TASE. Edwards, Harris and Piwowar (2007) estimate a cost of 0.75% for $5,000 transactions in the corporate bond market. Goldstein, Hotchkiss and Sirri (2007) find the half dealer markup for corporate bonds to be 1.18% (1.20%) [see their Table 6]. Hendershott and Madahvan (2015) estimate trading costs of 0.88% (1.22%) for $1-100K transactions for investment grade (high yield) bonds.[9] Harris (2015) finds that average customer transaction costs are 0.85% for trades below

[9] These are the estimated costs for regular transactions. The estimated costs for MarketAxess transactions, which are a small fraction of the market, are lower.

$100K and 0.52% for larger trades (and the total annual costs are at least $26B).[10] All these papers find a negative relation between transaction size and execution costs. Biais and Green (2007) suggest that this relation is due to the weaker bargaining power of small traders.[11] The costs reported above reflect a reduction in transaction costs following an implementation of post-trade transparency (with a delay of 15 minutes) by the TRACE system in 2002 [see Bessembinder, Maxwell and Venkataraman (2006), Edwards, Harris and Piwowar (2007) and Goldstein, Hotchkiss and Sirri (2007)]. The execution costs in the municipal bond market are even higher than in the c-bond market (see Harris and Piwowar, 2006 and Green, Hollifield and Schurhoff, 2007). As for retail participation: 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 retail investors' transactions are probably much smaller, the fraction of retail investor trading is probably much lower than 1.2%. As for transaction sizes and number of transactions per day, on the TASE the average transaction size in c-bonds is comparable to the average transaction size in stocks. As a result the number of daily transactions in c-bonds is quite large (54) compared to the US. For example, the c-bonds of the sample used by Edwards, Harris and Piwowar (2007) were traded 2.4 per day (see their Table 2). In the European c-bond markets there is no post-trade transparency, as in the US with TRACE, and these markets have been less researched than the US market. Biais and Declerck (2013) find lower effective spreads in Europe (during 2003-2005) than in the US: for smaller

[10] Harris (2015) as well as O'Hara, Wang and Zhou (2015) provide evidence that customers often do not trade at the best available prices. O'Hara, Wang and Zhou (2015) find that dealers favor active customers over non-active customers.
[11] See the theoretical model of Bernhardt, Dvoracek, Hughson and Werner (2005).

transactions (up to 10,000 Euro) the effective spread of Euro (Sterling) denominated bonds during 2005 was 0.104% (0.287%).[12]

While there is no acceptable measure for success of a market, all our evidence suggests that the c-bond market on the exchange is successful. Although the TASE is a small market the number of daily transaction per bond is high, the c-bonds' half spreads are narrow (0.078%), the amount of trading outside the exchange is small, the trading attracts different types of investors, including retail and short term, the short-term activity is unconcentrated (competitive) and the profits of the short-term traders are low (0.014%).[13]

The rest of the paper is organized as follows. Section 2 describes the market and the data. Section 3 compares trading characteristics (bid-ask spreads and trading outside the exchange) of c-bonds and stocks. Section 4 compares the participation of different trader groups in c-bonds and stocks. Section 5 compares trading costs/profits of different trader groups in c-bonds and stocks. Section 6 concludes.

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).[14] As of December-2014, the aggregate market value of the securities on the TASE was about $470

[12] The average issue size for their Euro (Sterling) denominated bond sample is about €900M (€400M). In our sample of c-bonds the average issue size is about €120M.

[13] Bid-ask spreads are not available in the US bond market; therefore, we look (in an informal comparison) at bid-ask spreads of stocks with roughly (±10%) the same market cap as the NIS volume-weighted average market cap ($318 million) of our c-bonds. The average half quoted bid-ask spreads in the American stocks is 0.17%, which is much higher than the NIS volume-weighted average half quoted spread of our c-bonds: 0.08%. For this comparison we use CRSP data of monthly bid and ask prices during 2014 (share codes 10 or 11).

[14] The Tel Aviv Stock Exchange is not an accurate translation of the Hebrew name, which uses the term "securities" instead of "stock" and is therefore more general.

billion: stocks and warrants – $201 billion, corporate bonds – $80 billion, government bonds – $161 billion, ETNs (Exchange Traded Notes – substitutes for ETFs) – $26 billion.[15] 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 to two main categories. The first is of institutions that manage long-term savings that are encouraged by tax benefits (pension funds etc.). As of December 2014 they held tradable financial assets on the TASE with a value of $128.6 billion (27.4% of the total market value of the securities on the exchange).[16] The second category is of institutions that do not enjoy tax benefits. These institutions include mutual funds, portfolio managers and hedge funds. As of December 2014 the market cap of the mutual funds that invest mainly on the TASE was $43.5 billion (9.3%% of the total market value of the securities in the exchange).[17] Information about the assets managed by portfolio managers and hedge funds is not publically available.
2. Banks and insurance companies that hold stocks and bonds as assets. As of 2014, the Israeli banks held $33.1 billion in Israeli stocks and bonds (7.05% of the total market value of the securities in the exchange).[18] Data on the assets of insurance companies is not available.

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[15] See TASE annual review, http://www.tase.co.il/Eng/Statistics/QuarterlyandAnnualReviews/Pages/annualquarterlyreviews.aspx
[16] Source: http://mof.gov.il/hon/Pension/Pages/Order-properties.aspx
[17] This excludes funds that mainly invest abroad and currency funds.
[18] This figure includes non-tradable bonds. Source: http://www.boi.org.il/en/NewsAndPublications/RegularPublications/Pages/skira14.aspx . See table 4.1

3. Firms that typically trade for short-term horizons (including algo traders).

4. Individuals: controlling stockholders and retail investors.

5. Foreign investors.

There is no formal data about the aggregate assets held by categories 3, 4 and 5.

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.[19] 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.[20] In all stages the limit orders are executed by price and time priority, and there are no hidden limit orders.[21] 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.[22]

Comment [A1]: ?

In 2014 there were 27 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

[19] Very illiquid securities are traded by daily auctions only.
[20] The pre-closing stage on Sunday (Monday to Thursday) starts at between 16:14 and 16:15 (17:14 and 17:15).
[21] 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.
[22] For stocks in the TA-25 index the minimum is 5,000 NIS.

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 the three best bids and offers on each side of the market in all securities.[23] 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.[24]

TASE has both stock and c-bond indices. The major stock indices are the TA-25 and the TA-100, which include the 25 and 100 stocks with the highest market capitalization that match certain criteria, respectively. The TA-100 index includes the TA-25 (the TA-75 is the index that includes the stocks that are traded in the TA-100 and not in the TA-25). These major stock indices are updated twice a year (at the end of June and the end of December) or following stock listings and de-listings.

The major c-bond indices are the Tel-Bond 20 and the Tel-Bond 60. These indices include the 20 and 60 fixed-interest and CPI-linked c-bonds with the highest market capitalization that match certain criteria, respectively. The Tel-Bond 60 index includes the Tel-Bond 20 (the Tel-Bond 40 is the index that includes the c-bonds that are traded in the Tel-Bond 60 and not in the Tel-Bond 20). The indices are updated twice a year (in the middle of April and the middle of October).

2.3 Why corporate bond trading in Israel is unique

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. Another

[23] Since November 2014, the traders have been able to observe the five best bids and offers on each side of the market in all securities.

[24] In c-bonds, for prices below or equal to 100.00 NIS the tick size is 0.0001 NIS; for prices above 100.00 NIS the tick size is 0.01 NIS. In stocks, for prices below or equal to 10.00 NIS the tick size is 0.001 NIS; for prices above 10.00 NIS and below or equal to 100.00 the tick size is 0.01 NIS; for prices above 100.00 NIS and below or equal to 1000.00 the tick size is 0.1 NIS and for prices above 1000.00 NIS the tick size is 1 NIS.

unrelated unique aspect of Israel is the large portion of CPI index linked bonds (corporate and government). Are there economic reasons that make corporate exchange trading more suitable for Israel? Are there economic reasons for CPI index linked bonds being more prevalent in Israel? In our opinion, the current characteristics have their roots in the economic conditions of 60 years ago, which were entirely different than they are today. In this subsection we give the historical background and provide our explanations for the two unique features of the Israeli bond market (the trading mechanism issue is more important in the context of our paper than the linkage to the CPI).

The first institution for securities trading was established in Tel Aviv (then part of the British Mandate) in 1935 and was named the "Securities Exchange Chamber". It was a daily gathering of about 10 brokers (mostly bankers) that traded among themselves for about an hour. They traded for their own accounts and on behalf of their clients. The securities traded were a few stocks and a few corporate bonds.[25] In 1953, after the establishment of the State of Israel in 1948, this institution became the Tel Aviv Stock Exchange (effectively a nonprofit organization owned by the broker firms) where all the securities were traded by a daily auction. The market was very small (for example, in 1960 the **annual** dollar volume of **all** bonds was $14.4 million).[26] 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, explains that because the market was small, the TASE offered an efficient solution (daily auctions) for all the financial instruments and there was no

[25] 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_nl32_nov2005_70-year.pdf
[26] See Ben-Shachar, Bronfeld and Cukierman (1971) (in Hebrew).

need for an OTC market, which requires considerable human resources.[27] 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 companies owned by banks, and the banks were the potential dealers for an OTC market. Therefore, dealer activity could have exposed the banks to severe conflict of interest and potentially to illegal activity. 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 the sharp decrease in the issuance of subsidized non-tradable government bonds to specific long-term institutions (pension funds etc.) and 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 as stocks was instituted many years ago when market conditions were very different than today.

In addition, in Israel many of the government bonds and the corporate bonds are CPI-linked. Ben-Shachar, Bronfeld and Cukierman (1972, p. 64) state that until 1954 no government bonds denominated in Israeli currency were CPI-linked, and the high inflation of the time caused heavy losses to bond investors.[28] According to Ben-Shachar, Bronfeld and Cukierman this situation led the government to issue CPI-

[27] Saul Bronfeld served in several key positions in the Israeli capital market, including a vice president of the TASE, later it's CEO and eventually chairman of the board, and has a deep knowledge of the history of the Israeli capital market.

[28] The cumulative rate of inflation during 1952-1954 was 113%. Data for prior years is unavailable.

linked bonds. Since then, the Israeli investors have been used to ask for inflation protection in long term investing. 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, including a period hyperinflation in the period from 1980 until 1985 (for example, the annual inflation in 1984 was 445%), probably has an effect on the prevalence of CPI-linked bonds.

2.4 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. Its intuition 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 half effective spread** (*HES*), which compares the prices of a market or marketable limit orders to the mid-quote prevailing before the transactions. 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 half quoted spread (*HQS*) and the 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 ask and bid quotes prevailing on day *i* for security *j* at hour *t*. 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 (0.032%) where the bid or ask are missing or they are greater than 10%. We average the observations over each security day and then average all daily averages of each security to get the measure 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 *i* of security *j* on transaction *t* is calculated as:

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

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 (0.012% of the sample). The daily average for each security, $HES_{i,j}$, 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 (7.65% of the sample). HES_j, the half effective spread of security *j*, is the average of $HES_{i,j}$.

3. Comparing Trading Characteristics of C-Bonds and Stocks

Before getting into a detailed comparison of liquidity characteristics of c-bonds and stocks, some features of the Israeli market should be noted. The number of accounts that participated in the c-bond market during 2014 is 177,511, which is comparable to the corresponding number in the market for stocks: 230,318. The daily average NIS trading volume on the exchange in c-bonds (827 million NIS) is smaller than in stocks (1,447 million NIS) though with relative to market capitalization, the NIS trading volume of c-bonds is roughly twice that of stocks. The difference in turnover can be partially explained by the fact that large stock blockholders who control the firms trade their stocks infrequently.

[Comment [A2]: שריה . לדעתו צריך להשות כמות צפה של לא דואליות. עדיף להוריד. לדעתו הנפח כולל גם גן תעודות סל

In our comparison of c-bonds and stocks we focus on a sample of non-dual listed firms with both c-bonds and stocks which were traded on the TASE during 2014. We require a total market value of each firm's securities of at least 800 million NIS (equivalent to approximately $223M). This sample consists of 49 firms with 49 stocks and 149 c-bonds (198 securities in total). Most of the c-bonds in our sample are investment grade (according to at least one of the credit rating agencies): [29] at the end of 2014, none of the c-bonds in our sample were rated speculative grade (below BBB) and only 13 bonds were not rated (out of the 149 c-bonds). Most of the bonds in the sample are CPI-linked (111 out of 149) and at the end of 2014, 23 bonds were included in the main c-bond index of the TASE – the Tel-Bond 60.[30]

Table 1 reports average daily returns and liquidity statistics of stocks and c-bonds. Though not reported in the table, it is worth mentioning that in both c-bonds and stocks most of the NIS volume occurs in the continuous stage: 87.1% and 82.5%. The average mean daily returns are around zero for stocks and c-bonds (-0.02% and 0.01%, respectively). The average *STD* (standard deviation of daily returns) of c-bonds is, as expected, much smaller than in stocks: 0.32% vs. 1.36%. The average market capitalization is much larger in stocks (3.22 billion NIS) than in c-bonds (0.56

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[29] 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.

[30] The data on credit rating and the c-bond characteristics are from www.valuation.co.il, which collects daily data on corporate bonds traded on the TASE. We thank Eran Ben-Horin for providing the data.

billion NIS) and the average daily volume is also larger: 4.30 million NIS and 1.64 million NIS, respectively. The difference in trading volume also implies a difference in the average number of daily transactions: 219 and 54, respectively. From the average daily NIS volume and the number of daily transactions it is possible to calculate average transaction size in the two markets: 19,634 NIS in stocks and 30,370 NIS in c-bonds. Part of the difference can be explained by the different minimum NIS amount required for posting an order in the continuous trading: 2,000 NIS for stocks (and 5,000 for TA-25 stocks) and 10,000 NIS for c-bonds. The average transaction size in the stock market (about $5,500) is comparable to the transaction size in other stock exchanges.[31] The average transaction size in c-bonds (about $8,500) 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 $1.143M (see their Table 1). The column "VW mean" in our Table 1 represents the mean value weighted according to the NIS trading volume of the stocks or c-bonds. For example, the average *HQS* across the c-bonds is 0.240% but weighted by c-bonds' NIS trading volume it is 0.077%. We think that this measure is more representative of the liquidity of the market than the average mean.

[INSERT TABLE 1 ABOUT HERE]

3.1 Bid-ask spread comparison

Next, we compare the bid-ask spread measures *HQS* and *HES* of c-bonds and stocks. According to Panels A and B of Table 1, both the *HQS* and the *HES* of the c-bonds are considerably lower than the comparable measures of the stocks. The mean

[31] According to the 2012 annual report of the Federation of Stock Exchanges (page 71) the average transaction size at the Taiwan Stock Exchange was $3,900. In larger exchanges the numbers tend to be higher – for example $7,770 at NASDAQ, but there are examples of relatively large exchanges with lower numbers, such as the KRX in South Korea, where the average transaction size was $1,200.

of the *HQS* of c-bonds (stocks) is 0.24% (0.36%) and for the *HES* the means are somewhat lower: 0.21% and 0.31% respectively. The *t*-statistic for the difference between the average of *HQS* (*HES*) in the c-bond and stock series is significant: 2.01 (2.35).[32] When comparing the natural log of these measures, *log_HQS* and *log_HES* the *t*-statistics for the differences between c-bond averages and stock averages are larger: 4.25 and 4.96, respectively.

For a graphical demonstration that c-bonds are more liquid than stocks, we look at the *HQS* at the firm level, where the c-bonds of the same firm are averaged into a single observation. Panel A of Figure 1 presents a scatter plot of the 49 pairs of *HQS*. In most cases (34 out of 49) the points are below the 45^0 line, indicating that the average *HQS* of a firm's c-bonds are lower than the corresponding *HQS* of the firm's stocks. The p-value of a double-sided binomial test in this case is 0.0094. That is, the *HQS* of the c-bonds are significantly smaller than the *HQS* of the stocks. The mean (median) *HQS* at the firm level is 0.36% (0.2%) for stocks and 0.27% (0.13%) for c-bonds. To present a clearer picture of this graph, 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]

So far we have found that the bid-ask spread measures of c-bonds are smaller than the corresponding stock measures. Next, we check if controlling for a security's characteristics the spreads of the bonds are still narrower than the spreads of the stocks. The characteristics we control for are:

[32] *HQS* and *HES* of the securities are regressed on a dummy variable that equals 1 in the case that the security is a c-bond. The *t*-statistics of the dummy variables are -2.01 and -2.35, respectively. Errors are clustered by firm.

STD – the security's standard deviation of daily returns (its summary statistics appear in Panels A and B of Table 1 for stocks and c-bonds, respectively)

LOG_SIZE – the log of the security's size, calculated as the average market capitalization calculated at the beginning and end of the sample period for each security.

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.

We perform two types of analysis to study whether the difference between the bid-ask spread measures of stocks and c-bonds is explained by *DUMMY_CB*, which is a dummy variable that takes the value 1 if the security is a c-bond and 0 otherwise, and the additional explanatory variables. In the first analysis, which appears in Panel A of Table 2, we run 245 "Fama-MacBeth" daily regressions and present the averages of the coefficients. The observations in each daily regression are weighted by the trading volume of the security during the continuous stage, and the *t*-statistics are calculated using the Newey-West (1987) method, where the number of lags is 3. In regressions (1)-(3) of Panel A, the dependent variable is *LOG_DAILY_HQS*, which is the log of the security daily half 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 to 10% if the value is larger or if there is no valid bid-ask spread. In regressions (4)-(6) of Panel A the dependent variable is *LOG_DAILY_HES*, which is the log of the security's daily half quoted effective spread. The half quoted effective spread is the average of the half effective spread of the security transactions. 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 to 10% in the case that the half effective spread is greater than 10% or there is no valid bid-ask spread.

Panel A of Table 2 reports these regressions. For both bid-ask spread measures, *DUMMY_CB* is negative and significant before adding the control variables (see regressions (1) and (4), where the *t*-statistics of *Dummy_CB* are -8.87 and -9.68, respectively) and after adding them (see regressions (3) and (6), where the *t*-statistics of *Dummy_CB* are -20.34 and -18.46, respectively). Comparing the R^2 of regressions (2) and (3) and regressions (5) and (6) it can be seen that the security characteristics (*LOG_SIZE*, *LOG_FIRM_SIZE* and *STD*) explain much more of *LOG_DAILY_HQS* and *LOG_DAILY_HES* than whether the security is a bond or a stock (*DUMMY_CB*).

In the second analysis, which appears in Panel B of Table 2, we run regressions in the cross-section of 198 securities (c-bonds and stocks) where a security's *log_HQS* or *log_HES* are explained by *DUMMY_CB* and the additional explanatory variables.[33] The regressions' error terms are clustered by firm. We focus on the logarithms of the bid-ask spread measures to mitigate the effect of outliers. Indeed we find that *log_HQS* and *log_HES* are much better explained by the explanatory variables (higher R^2) than the original measures. We obtain the same qualitative results as in Panel A when the dependent variables are *HQS* and *HES* and also when the observations are weighted by the securities' NIS volume.

Panel B of Table 2 reports these regressions. In regressions (1)-(3) the dependent variable is *log_HQS* and in regressions (4)-(6) the dependent variable is *log_HES*. The results are similar to those for the Panel A regressions: For both bid-ask spread measures, *DUMMY_CB* is negative and significant before adding the control variables (see regressions (1) and (4), where the *t*-statistics of *Dummy_CB* are -4.25

[33] We find that the average relative tick of the security is not significant in these regressions. For brevity we do not include this variable in our reporting our results.

and -4.96, respectively) and after adding them (see regressions (3) and (6), where the *t*-statistics of *Dummy_CB* are -6.45 and -7.03, respectively). Comparing the R^2 of regressions (2) and (3) and regressions (5) and (6) it can be seen that the security characteristics (*LOG_SIZE*, *LOG_FIRM_SIZE* and *STD*) explain much more of *log_HQS* and *log_HES* than whether the security is a bond or a stock (*DUMMY_CB*). A possible reason why *STD* is insignificant in regressions (3) and (6) is its negative correlation of -0.88 with *DUMMY_CB*, which induces multicollinearity.[34]

[INSERT TABLE 2 ABOUT HERE]

Although we are not sure about its validity in our context of different security types, we compare, as a robustness check, Amihud's (2002) illiquidity measure in c-bonds and in stocks. We explain each security's (log of) Amihud's measure using the explanatory variables as in the regressions of Table 2. The results are qualitatively similar to the results of the regressions in Panel B of Table 2: *DUMMY_CB* is significantly negative in univariate regressions and with additional variables.[35]

A possible reason why we find a negative coefficient for *DUMMY_CB* even after adding the control variables is that we probably do not have a good proxy for information asymmetry. *STD* should be correlated with information asymmetry, but it is possible that the difference in information asymmetry between stocks and c-bonds

[34]As an additional robustness check, we perform the regressions in Panel B of Table 2 at the firm level, averaging the characteristics of c-bonds of the same firm into a single observation. This leaves a total of 98 observations (if a firm has more than one c-bond then their *STD*, *LOG_SIZE*, *LOG_FIRM_SIZE*, *LOG_HQS* and *LOG_HES* are averaged into one observation. In the regressions of *log_HQS* and *log_HES* on *DUMMY_CB*, *LOG(SIZE)* and *LOG(FIRM_SIZE)*, *DUMMY_CB* is still negative and statistically significant. For brevity, we do not present these regressions.

[35] For example, the coefficient of *DUMMY_CB* (in a regression with the other explanatory variables) is -3.03, with a *t*-statistic of -14.28 (the R^2 is 0.7684).

is larger than what is reflected in *STD* differences. We tried to examine the standard deviation of residuals from factor models, based on the assumption that this measure is more correlated with information asymmetry.[36] However, it appears that this measure is highly correlated with *STD* (R^2=0.98) and therefore using it in the regressions in Panel B of Table 2 yields qualitatively similar results.

In sum, we find that when traded on the same exchange, c-bonds are more liquid than stocks, even after controlling for various possible characteristics. We do not want to push this too far because it is possible that we do not have perfect control variables, but it is quite clear that c-bonds are not fundamentally less liquid than stocks.

3.2 Comparing the proportion of volume outside the exchange

Since most of c-bond trading worldwide is off-exchange, it is of interest to use data from the TASE to compare the proportion of c-bonds and stocks in the trade conducted outside the exchange. As can be seen in Table 1 the average proportion of trading volume outside the exchange is 6.87% in c-bonds.[37] This number is much smaller than the corresponding number for stocks: 20.74%. The *t*-statistic for the difference is 7.42 (in a regression on *DUMMY_CB* where errors are clustered by firm). Figure 2 presents a scatter plot of the proportion of trading volume outside the exchange for the 49 pairs. In most of the cases (43 out of 49) the points are below the 45^0 line, indicating that the average *outside_exchange_proportion* of a firm's c-bonds is lower than the corresponding figure for the firm's stocks. The p-value of a double-sided binomial test in this case is approximately 0. That is, the proportion of trading

[36] We use Israeli stock factors (Market, SMB, HML, MOM) provided by Beni Lauterbach and Sharon Garyn-Tal (these data are available at http://sharontalgaryn.wix.com/factorpricingisrael), and added three TASE bond indices (Tel-Bond CPI-linked, Tel-Bond Yields and Tel-Bond Shekel).
[37] For the data on trading outside the exchange see http://www.tase.co.il/Eng/marketdata/otc/Pages/OTC.aspx?day=2

outside the exchange is significantly smaller for c-bonds than for the corresponding stocks.

[INSERT FIGURE 2 ABOUT HERE]

4. Comparing Market Participation in Stocks and Corporate Bond

Having compared the trading characteristics and liquidity of c-bonds and stocks, we continue with a comparison of market participation of different investor types. Since we do not have information on the classification of our traders (algo, institutional, retail, etc.) we rely on technical information such as trading volume and trading activity in order to identify two investor types: retail investors and "short-term" traders. Why do we focus of these two groups? The participation of retail investors in the US c-bond market is negligible, possibly because of the very high transaction costs they face in the OTC market. It is of interest to see if when trading is conducted in an exchange as for stocks, retail participation is different in c-bonds and in stocks. By "short-term" traders we mean those trading on a regular basis over a daily or shorter horizon. The short-term traders provide liquidity to other investor types (institutional, retail) that trade for a longer horizon. In the US c-bond market, the short-term traders are the dealers. It is of interest to see if when c-bonds are traded on an exchange like stocks, short-term trading takes place as it does in stock trading (mainly by algo trading).

4.1 Identifying retail investors (RI) and short-term traders (STT)

As noted, since our proprietary data do not contain trader classification, we rely on trading volume to identify retail investors. We identify retail investors 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). These low-volume investors are almost surely retail investors: they made only a small number of transactions in securities during 2014 (5.05 on average) and very infrequently (4.55 trading days on average). It should be noted that these investors are quite "long term". In only 28.9% (9.7%) of the cases of trading of investors in a certain stock (c-bond) during 2014 we find both buy and sell transactions. We choose the very low cutoff of an annual volume of 2 million NIS to ensure that these are indeed retail investors but it is very likely that there are other retail investors too.

We define the second group, the short-term traders (STT), as traders with frequent trading activity in TASE securities (excluding options). For each trader in each security that she traded on the TASE (excluding options), we calculate the number of times that the trader switched from buying to selling or *vice versa* and divide it by the number of trading days that the trader was active in the security. Then we calculate the value-weighted average of this ratio across the securities the trader traded, and classify the trader as "short-term" in the case that this measure is equal to or greater than 1.[38] Formally, trader j is considered a "short-term" trader if

$$\frac{1}{\sum_{i=1}^{n} trader\_vol_i} \cdot \sum_{i=1}^{n} \left(trader\_vol_i \cdot \frac{sign\_switches_i}{ntd_i} \right) \geq 1$$

where n is the number of securities that the trader traded during the sample period, $trader\_vol_i$ is the trader's NIS trading volume in security i, $sign\_switches_i$ is the number of times the investor switched positions in security i during the sample period

[38] 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.

and ntd_i is the number of trading days of the investor in security i. We require that a "short-term trader" is not a "small 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. Slightly longer horizons may also be interpreted as short-term trading but to be on the safe side we prefer the natural cutoff of "1". Most of the short-term activity we observe is probably algo trading but we do not have information on this issue.

Table 3 and Table 4 provide summary statistics regarding our traders. Table 3 refers to all the stocks and c-bonds on the TASE and Table 4 refers to our sample of securities (198 securities of non-dual firms with stocks and c-bonds, each firm having an aggregate market cap greater than 800 million NIS).

Panel A of Table 3 shows that RI activity is low and infrequent. The average (median) trading volume, per investor, in all TASE securities (excluding options) is 257,718 (109,857) NIS. The average (median) number of trading days (out of the 245 possible trading days) of these investors is 5.83 (3.00). The investor at the ninetieth percentile of trading days traded on 12 trading days. Overall it seems that this low-volume and infrequent activity is carried out by retail investors (RI).[39]

Panel B of Table 3 describes the activity of short-term investors (STT). It can be seen that the mean trading volume on the TASE is quite large (about 374 million NIS), the median annual volume is quite small (about 14 million NIS). Therefore, it is likely that many of these traders are not algo traders. The value-weighted mean (by

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[39] Though, as noted in footnote5, 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.

trader volume) of STT trading in stocks is much higher than in c-bonds: around 8.6 billion NIS. The value-weighted mean of annual number of executed orders is 75,287 in stocks and 48,419 in c-bonds. It seems, therefore, that much of the trading volume of this group arises from algo trading.

[INSERT TABLE 3 ABOUT HERE]

Table 4 reports the summary statistics of the RI and STT that had at least one transaction in our sample of securities. It contains a lower number of RI and STT since it relates to investors that traded in our sample of securities. It can be seen that the activity of RI and STT in the sample is qualitatively similar to that reported in Table 3 for all trade on the TASE, indicating that our sample is reliable and can be taken to represent the TASE market.

[INSERT TABLE 4 ABOUT HERE]

4.2 Comparing market participation of RI and STT in stocks and corporate bonds

Panel A of Table 5 details the market participation of the different investor groups. For each day we calculate the proportion of a group's volume out of the total double-sided NIS volume of a security type (stock or c-bond) and then average across days. We denote this measure as "participation proportion".[40] For example, if all transactions have the same NIS value, 16% of the transactions are between RI and STT and 3% are between RI and RI, then the RI participation proportion is

[40] Calculating the proportions on all days together (that is, not averaging the days) yields very similar results.

$11\% = \frac{16+2*3}{200}$.[41] The *t*-statistics in Table 5 are calculated using the Newey-West (1987) method, where the number of lags is 2. It can be seen that retail participation is higher in c-bonds than in stocks: 7.28% vs. 6.38%, the difference being statistically significant (the *t*-statistic is 4.83). This result is quite surprising since in the US c-bond market retail participation is negligible. As for short-term trading – it is more prevalent in stocks: 43.70% vs. 34.18% in c-bonds, with a *t*-statistic of 16.66.

Panel B of Table 5 details the NIS proportion of transactions between trader groups (calculated by day and then averaged across days). For example 7.68% of the (NIS-weighted) transactions in c-bonds are between RI and STT. Here, we also relate to traders that are not retail investors or short-term traders, and denote them as "other traders". These traders, which are not small or frequent, can be viewed as longer horizon traders. Looking at row (5) of this panel we see that 33.62% of the NIS volume of stock transactions is between non-STT – which means that STT are involved in about two-thirds (66.38%) of the NIS volume. For c-bonds, STT are less involved, but their presence is still significant: STT are involved in 55.55% of the NIS volume of transactions. The difference in the transactions between STT and non-STT (transactions that can be interpreted as liquidity provision by STT to others) in stocks and c-bonds is less pronounced than the difference in STT trading. The reason is that in stocks the NIS proportion of transactions between STT and STT is larger than in c-bonds: 21.02% vs. 13.80%. As a result the difference in the NIS proportion of transactions for STT and non-STT is not large: 45.36% for stocks and 40.75% for c-bonds (the difference is significant, with a *t*-statistic of 10.88).

[41] Calculating the proportions out of the annual volume yields very similar results.

In sum, in both markets there is non-negligible retail participation (about 6-7% of the NIS volume) and in both markets a large fraction (about 40-45% of the NIS volume) is between short-term traders and with longer horizon traders.

[INSERT TABLE 5 ABOUT HERE]

Next, we investigate if in the cross-section of securities there is a difference in RI participation and STT participation for c-bonds and stocks after controlling for the security's characteristics. We run 245 "Fama-MacBeth" daily regressions and present the averages of the coefficients in Table 6. In these regressions a security's NIS participation proportion of RI or STT is explained by *DUMMY_CB* and additional explanatory variables as in Section 4 (for explaining *HQS* and *HES*). The observations are weighted by the trading volume in the security during the continuous stage. The *t*-statistics in Table 6 are calculated using the Newey-West (1987) method, where the number of lags is 2.

[INSERT TABLE 6 ABOUT HERE]

From the average coefficient of *DUMMY_CB* in regression (1) of Table 6, it can be seen that RI participation is significantly larger in c-bonds: the coefficient is positive (1.116%) and significant (the *t*-statistic is 5.87).[42] Regression (2) of Table 6 indicates that RI participation is negatively related to *LOG_SIZE* and positively related to *STD*. Controlling for these factors, the participation of retail investors in c-bonds is significantly smaller than in stocks: the coefficient of *DUMMY_CB* is negative (-2.262%) and significant (the *t*-statistic is -7.84). That is, controlling for the security's characteristics retail participation is smaller by 2.262% in c-bonds than in stocks. It is interesting to see that the average R^2 of regression (1) is 0.030 and for

[42] This result is consistent with the finding reported in Table 5.

regression (2) it is 0.143. That is, security characteristics (*LOG_SIZE*, *LOG_FIRM_SIZE* and *STD*) explain much more of retail participation than whether the security is a bond or a stock. Adding *DUMMY_CB* to the variables of regression (2) adds very little to the explanatory power: the average R^2 is 0.1582.

Regression (4) of Table 6 shows a significant negative relation between STT participation and *DUMMY_CB*: the coefficient is negative (-9.247%) and significant (the *t*-statistic is -16.13).[43] That is, STT participation is lower in c-bonds than in bonds. Regression (6) of Table 6 shows that after controlling for potential explanatory variables the relation becomes significantly positive: The coefficient is 9.413 and the *t*-statistic is 7.79. In examining short-term participation, adding *DUMMY_CB* to the security characteristics (*LOG_SIZE*, *LOG_FIRM_SIZE* and *STD*) adds a little to the explanatory power of the regressions (an average R^2 of 0.2262 in regression (6) compared to an average R^2 of 0.1957 in regression (5)). That is, the security characteristics (*LOG_SIZE*, *LOG_FIRM_SIZE* and *STD*) explain much more short-term traders' participation than whether the security is a bond or a stock.

In sum, we find statistically significant differences between retail participation and short-term trader participation in c-bonds vs. stocks. These differences are not dramatic and are explained mainly by the security characteristics.

4.3 Comparing short-term traders' concentration in stocks and corporate bonds

The short-term traders are the voluntary liquidity providers of the markets. In Section 4.2 we show that in the markets for both stocks and bonds a large fraction of trading (about 40-45% of the NIS volume) is conducted between short-term traders

[43] This result is consistent with the finding reported in Table 5

(STT) and traders with longer horizons (non-STT). Liquidity provision may be affected by the competition between liquidity providers: the more concentrated the liquidity provision, the weaker the competition between liquidity providers is expected to be and the higher we suppose the trading costs they charge to be. Therefore, it is of interest to compare the degree of concentration in STT trading in c-bonds and in stocks. Since we are interested in liquidity provision we focus on transactions between STT and non-STT. In our sample of 49 firms, 1026 different STT were active during 2014, of whom 931 were active in stocks and 314 were active in c-bonds. In each market we rank each STT by its NIS share out of the total of STT and non-STT transactions. In the stock (c-bond) market the market share of the top STT was 11.04% (11.54%). For the top 5 STT in each market, the figures are 29.31% and 36.60%, respectively. Next we use the *Herfindahl-Hirschman Index* (HHI) as a measure of market concentration. 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 and it may be interpreted as the reciprocal of the "equivalent" number of equal share traders. The closer the HHI is to 1 (0) the closer the industry is to monopoly (full competitiveness). In the stocks (c-bonds) the HHI of the STT is 0.0277 (0.0386). The reciprocals of these figures indicate that the "equivalent" numbers of (equal market share) STT in these markets are 36.1 and 25.9, respectively. All these figures suggest that the market for liquidity provision is slightly more concentrated in c-bonds than in stocks, though both markets are rather non-concentrated.[44]

[44] 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 (HHI below 0.15), Moderately Concentrated Markets(HHI between 0.15 and 0.25) and Highly Concentrated Markets(HHI above 0.25).

However, it is possible that in each of the securities the STT activity is concentrated. Therefore we examine the degree of STT concentration in each of the securities. Table 7 reports statistics of STT concentration measures. It can be seen that the concentration in c-bonds is higher than in stocks. For example, the mean market share of the most active STT in the security is 26.45% in c-bonds and 18.91% in stocks.[45] The mean value of $\frac{1}{Herfindahl}$ per security, which represents the "equivalent" number of equal market share STT is 9.66 in c-bonds and 15.30 in stocks. These figures are indications of unconcentrated liquidity provision in the markets for both stocks and c-bonds.

[INSERT TABLE 7 ABOUT HERE]

Next, we investigate whether the differences in the degree of STT competition between c-bonds and stocks are explained by security characteristics. We run regressions in the cross-section of 198 securities (c-bonds and stocks), where a security's *log_(1/Herfindahl)* is the dependent variables.[46] The results are presented in Table 8.

Regression (1) of Table 8 shows a significant negative relation between STT concentration and *DUMMY_CB*: the coefficient is negative and significant (the *t*-statistic is -5.74). Since the dependent variable is the log of the reciprocal of the HHI, this means that our c-bonds are significantly more concentrated than the stocks. Regression (3) of Table 8 shows that after controlling for potential explanatory variables the relation becomes insignificant: The coefficient is -0.261 and the *t*-statistic is -1.45. In examining STT concentration, adding *DUMMY_CB* to the security characteristics (*LOG_SIZE*, *LOG_FIRM_SIZE* and *STD*) adds a little to the

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[45] Biais and Declerck (2013) find that in 2005 the average market share of the most active dealer in each bond was 8.95% (14.75%) in Euro (Sterling) denominated bonds.

[46] *log_(1/Herfindahl)* is better explained in these regressions than *Herfindahl*. Explaining *Herfindahl* yields qualitatively similar results.

explanatory power of the regressions (an R^2 of 0.5238 in regression (3) compared to an R^2 of 0.5092 in regression (2)). That is, the security characteristics (most importantly the market capitalization of the security – *LOG_SIZE*) – explain much more STT concentration than whether the security is a c-bond or a stock.

We analyze the concentration of STT because of the assumption that the lower the concentration, the stronger the competition among STT and the lower the trading costs they charge. Consistent with this assumption we add the *log_(1/Herfindahl)* to regression (3) of Table 2 – Panel A, where the explanatory variable is the security's *HQS*, and find a significant negative relation (the *t*-statistic is -5.83).[47]

[INSERT TABLE 8 ABOUT HERE]

5. Trading Profits/Costs of STT/RI in c-bonds and stocks

5.1 Measuring trading profits/costs

In this section we investigate the actual trading profits or trading costs of the different trader groups in c-bonds vs. stocks.[48] These profits/costs are before explicit trading costs such as commissions, broker fees, and transaction taxes. We measure the trading profits for buyers as the security's closing price divided by the transaction price minus one; for sellers, it is this value with a minus sign.[49] A negative profit means a cost. The intuition is that the closing price is the benchmark price for the transaction, or a proxy for the unperturbed "true" value. This measure is

Comment [A4]: שריה - בארה"ב הספרד כולל עמלות

[47] In Section 5 we measure the STT's trading profits and the RI's trading costs. We find that a security's *log_(1/Herfindahl)* is significantly negatively related to its STT trading profits (the *t*-statistic of this variable when added to regression (6) of Table 10 is -2.22). The relation of *log_(1/Herfindahl)* to the security's RI profit is positive, as expected, but insignificant (the *t*-statistic of this variable when added to regression (3) of Table 10 is 1.44)

[48] Other costs, which are not the focus of this paper, are the costs that arise from execution delay or from non-execution. These costs are sometimes called "the implementation shortfall" (see Perold, 1988). As we do not have order data, we cannot estimate these costs.

[49] This measure is winzorized at 10%.

approximately equal to minus half the realized spread (with the closing price as a benchmark) for a marketable limit order and approximately half the realized spread for the limit order side of the transaction. 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).[50] The 30/60/120/240 minute horizons seem to us to be too short relative to the closing price, because the price reversal following the retail transactions is not completed within these horizons. That is, we find predictable price changes beyond these horizons. We do not find, however, predictable price changes from the closing price to the 24-hour mid-quote, which seems to indicate that the time interval from the closing to 24 hours only adds noise. As a result of these checks we decided to focus on the closing price as the benchmark price for the transactions. This is consistent with the high frequency trading profit estimation in Van Kervel and Menkveld (2015) and the estimations of NYSE specialists' profits in Comerton-Forde, Hendershott, Jones, Moulton and Seasholes (2010).

Comment [A5]: בעקבות שיחה עם שריה . אם פוזיציה נסגרת בתוך היום סוף היום מוסיף רק רעש ולא מטה.

A natural question is why we use a future price (the trading day's closing price) as a benchmark rather than a price prior to the transaction (say the opening price) or the VWAP – the value-weighted average of transaction prices of the day. Using a future price is consistent with fundamental microstructure theoretical modeling [for example, Kyle (1985), Glosten and Milgrom (1985), Hellwig (1980) and many subsequent papers], where the trading gains or losses are measured against a future realization of the asset's value. Furthermore, as noted by Harris (2003), past

[50] In the 30/60/120/240 minute horizons we used the closing price if the horizon ended after the closing.

prices such as opening prices provide biased estimates when traders are "momentum" or "contrarians".[51]

We focus on the continuous trading which attracts about 87% (86%) of the c-bond (stock) trading volume in our sample.[52] We estimate the NIS trading profit for each security/trader type/ day. The sum of the estimated NIS trading profits of the different trading groups within each security-trading day is zero by definition. To get a general picture we calculate for each trader type and security type (stocks or c-bonds) the daily NIS trading profits (the sum of the NIS trading profits across the securities) and the percentage trading profits (the daily NIS trading profits divided by the daily NIS volume). Then we average across days to get an estimate for the "percentage trading profit". Panel A of Table 9 presents these estimates. For example, the estimate presented for the trading profit of RI in stocks is -0.087%, which means a trading cost. Panel A of Table 9 shows that the trading costs of the RI are highly statistically significant for both stocks and c-bonds (*t*-statistics of 8.73 and 9.47, respectively) and they are somewhat lower for c-bonds than for stocks: 0.068% vs. 0.087%.[53,54] The difference is only marginally significant (the *t*-statistic is 1.63). The trading costs of RI are very robust along the trading days: for stocks they are positive on 195 days and for c-bonds they are positive on 233 days (out of the 245 trading days).

[51] Barber and Odean (2000) report contrarian trading of retail stock investors.

[52] The call auction trading mechanism in the opening and closing phases is very different than the mechanism of the continuous trading and requires a different type of analysis than the analysis of this paper.

[53] Estimating the percentage trading profit by lumping all profits across all days and dividing this number by the annual volume, yields slightly more negative estimates for RI percentage profits: -0.100% for stocks and -0.082% for c-bonds. The reason is the negative correlation between daily RI volume and their percentage trading profits.

[54] About 47.7% (28.5%) of RI's NIS trading volume in stocks (bonds) is by "making" rather than "taking" (that is, their orders "sit" on the book and meet coming marketable limit orders). The RI's trading costs in stocks are somewhat lower for "making" (0.076%) than for "taking" (0.094%). For c-bonds, the trading cost of RI are lower for "making" (0.040%) than for "taking" (0.080%).

Comment [A6]: שריה לא מרוצה שאיפשהו כתבנו סליטלי הייר

The trading profits of STT are significantly higher (a *t*-statistic of 3.41) for c-bonds than for stocks: 0.014% vs. 0.002%. The STT's trading profits for c-bonds are highly significant (a *t*-statistic of 9.79) and very robust along the trading days: they are positive on 215 days (out of the 245 trading days). For stocks the profits of STT are insignificant (a *t*-statistic of 0.67) and positive on only 135 days out of the 245 trading days.

Panel B of Table 9 presents the trading costs/profits for interactions between the different types of traders. It can be seen, for example, that RI have positive trading costs when trading with STT and with OT, in both stocks and c-bonds.

The STT have positive percentage trading profits, 0.009% (with a *t*-statistic of 2.84), when trading with OT in c-bonds, but negative percentage trading profits, -0.012% (with a *t*-statistic of -1.73) when trading with OT in stocks. The reason for the difference may be that in stocks there is more information asymmetry than in c-bonds and the informed traders probably belong to the OT groups. In total, the estimation percentage trading profits of STT when trading with OT are around zero (-0.001%). Therefore, it seems that virtually all trading profits of STT arise from trading with RI.

So far, we have seen that when taking all stocks together and all bonds together the percentage trading profits of STT are higher in c-bonds than in stocks and the percentage trading costs of RI are slightly higher in c-bonds than in stocks, the difference being marginally significant. But can these differences be explained but the security's type (stock or c-bond) or are they due to characteristics such as market capitalization and standard deviation of returns?

To answer this question we ran 245 "Fama-MacBeth" daily regressions and present the averages of the coefficients in Table 10. In these regressions a security's daily percentage profits of RI or STT are explained by *DUMMY_CB* and additional explanatory variables as in Section 4 (in explaining *HQS* and *HES*). The observations are weighted by the security's trading volume of the particular trader group in the continuous stage. Since there is no serial correlation in the coefficients, we do not correct the *t*-statistics using Newey-West (1987). From the average coefficient of *DUMMY_CB* in regressions (1) of Table 10, it can be seen that RI trading profits are marginally significantly larger in c-bonds: the coefficient is positive (0.019%) and significant (the *t*-statistic is 1.63). The trading costs are actually marginally significant lower.[55] Controlling for these factors, the trading profits of RI are insignificant (see regression (3)) It is interesting to see that the average R^2 of regression (1) is 0.0461 and of regression (2) it is 0.1092. That is, the security characteristics (*LOG_SIZE*, *LOG_FIRM_SIZE* and *STD*) explain much more retail participation than whether the security is a bond or a stock. Adding *DUMMY_CB* to the variables of regression (2) adds very little to the explanatory power: the average R^2 is 0.1316.

Regression (4) of Table 10 shows a significant positive relation between STT participation and *DUMMY_CB*: the coefficient is negative 0.012%) and significant (the *t*-statistic is 3.41).That is, STT trading profits are higher in c-bonds than in stocks. Regression (6) of Table 10 shows that after controlling for potential explanatory variables the relation becomes insignificant. The reason is that the market capitalization of bonds is smaller than that of stocks and the fact that short-term percentage profits are negatively related to the market capitalization of the security.

In examining the profits of short-term traders adding *DUMMY_CB* to the security characteristics (*LOG_SIZE*, *LOG_FIRM_SIZE* and *STD*) adds a little to the explanatory power of the regressions (an average R^2 of 0.1372 in regression (6) compared to an average R^2 of 0.1095 in regression (5). That is, the security

[55] This result is consistent with the finding reported in Table 9.

characteristics (*LOG_SIZE*, *LOG_FIRM_SIZE* and *STD*) explain much more of short-term traders' trading profits than whether the security is a bond or a stock.

In sum, for retail traders we do not find a relation between security type (bond/stock) and their trading cost. We find that the trading profits of short-term investors are slightly higher in c-bonds than in stocks (the difference is 0.012%) but the difference is fully explained by the fact that the market capitalization of bonds is smaller than that of stocks.

6. Conclusion

In this paper, we investigate the case of the Tel Aviv Stock Exchange (TASE), where bonds (both corporate and government bonds) have been traded for many years by the same open limit order book system as stocks. This is in contrast to the common practice worldwide, of c-bonds being mostly traded in over-the-counter (OTC) markets and stocks being mostly traded by an open limit order book (LOB) on exchanges. Our research questions are whether corporate bond (c-bond) trading is fundamentally different from stock trading, and whether c-bonds are suitable for limit order book trading.

We investigate a sample of non-dual listed firms with both c-bonds and stocks that were traded on the TASE during 2014, each of which had a total market value of all its securities of at least 800 million NIS. We find that the bid-ask spread measures of the c-bonds are lower than those of the stocks (0.075%-0.077% vs. 0.087% on average), even after controlling for the characteristics of the securities (market capitalizations and standard deviation of returns), and that the proportion of NIS trading volume outside the exchange, (negotiated deals) is low, 6.87% (lower in c-bonds than in stocks: 20.74%) – which means that most of the trading needs of institutional investors in c-bonds are supplied within the exchange (even compared to stocks).

Next, we rely on technical information such as trading volume and trading frequency to identify two investor types: retail investors (RI) and "short-term traders" (STT). We investigate the participation of these investor types and find statistically significant differences between stocks and c-bonds but roughly the same picture: retail participation (NIS volume out of the double-sided volume) in stocks (c-bonds) is 6.38% (7.38%); STT participation in stocks (c-bonds) is 43.70% (34.18%). After controlling for a security's characteristics (market capitalization, standard deviation of returns) we find somewhat higher STT participation in c-bonds than in stocks and higher RI participation in stocks than in c-bonds.

Finally, we investigate the actual trading profits/costs of the trader groups we have defined. We find that the percentage trading costs of RI are slightly lower in c-bonds than in stocks (0.068% vs. 0.087%) but the difference is insignificant, even after controlling for some explanatory variables such as the standard deviation of returns and market capitalization. With respect to STT, we find slightly higher percentage trading profits in c-bonds than in stocks (0.014% vs. 0.002%). We find that this difference arises from the fact that c-bonds have a smaller market capitalization than stocks. Controlling for this variable we find an insignificant difference between c-bonds and stocks.

Taking all these pieces of evidence together, we conclude that in the case of the TASE there is no fundamental difference between c-bond and stock trading and that there is no fundamental reason why c-bonds cannot be successfully traded on a limit order book exchange. The formal comparison in our paper is between TASE stocks and TASE c-bonds but a comparison to US c-bonds (see the references to relevant papers at the end of the introduction) is striking. Although the TASE market is much smaller than the American OTC market, it has much lower trading costs. especially for retail investors. From the liquidity suppliers' side, the short-term traders' profits are much lower than the estimated US dealers' profits: 0.014% vs. app. 0.5% [see Harris, 2015]. Our paper provides empirical support for the views expressed in Harris (2015), O'Hara, Wang and Zhou (2015) and Harris, Kyle and Sirri (2015) that c-bond markets should move in the direction of centralized open limit open book markets. 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). Related anecdotal evidence is that a sizable number of Israeli firms' stocks are traded abroad (mainly on US exchanges), but very few Israeli c-bonds are. There are probably other reasons for this phenomenon besides the trading mechanism (currency, for example), but it is reasonable to suggest that the trading mechanism at the TASE is a contributing factor.

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Table 1: Summary Statistics of the Securities

The table reports the cross-section statistics of the stocks and corporate bonds of our sample. The sample period is 2014 (245 trading days). The securities are related to non-dual-listed firms with both stocks and corporate bonds and the total market value of the securities of each firm exceeds 800 million NIS. The securities were traded on the TASE throughout 2014. *Daily return* and *STD* are the average daily returns and standard deviation of the daily returns, respectively. *Daily volume* (*Daily volume during the continuous stage*) is the average daily NIS volume (the average daily NIS volume during the continuous stage). *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). *Size* is the market capitalization calculated as an average of the values at the beginning and end of the sample period. *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 to 10% if the value is larger 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 to 10% 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. Panel A (Panel B) presents summary statistics of the stock (corporate bond) sample. "VW mean" is the value-weighted mean according to "Daily volume (in NIS millions)".

Panel A: stock sample

	N	Mean	VW mean	SD	Median	Min	Max
Average return (%)	49	-0.02%	0.01%	0.10%	-0.02%	-0.34%	0.13%
STD (%)	49	1.36%	1.23%	0.30%	1.33%	0.77%	2.34%
Daily volume (in NIS million)	49	4.30	23.78	9.24	1.13	0.04	45.05
Daily volume during the continuous stage (in NIS million)	49	3.54	19.10	7.39	0.98	0.04	37.29
Number of daily transactions	49	219	853	313	92	3	1,618
Number of daily transactions during the continuous stage	49	188	764	284	72	2	1,474
Size (in NIS billion)	49	3.22	11.22	4.28	1.75	0.38	20.10
HQS (%)	49	0.36	0.09%	0.44	0.20	0.03	2.17
HES (%)	49	0.31	0.09%	0.33	0.20	0.04	1.72
Number of traders	49	5,098	18,513	6,776	2,220	199	30,926
Trading outside exchange (%)	49	20.74%	25.45%	12.74%	18.95%	2.66%	64.41%

Panel B: corporate-bond sample

	N	Mean	VW mean	SD	Median	Min	Max
Average return (%)	149	0.01%	0.01%	0.02%	0.01%	-0.09%	0.10%
STD (%)	149	0.32%	0.39%	0.23%	0.26%	0.06%	1.39%
Daily volume (in NIS million)	149	1.64	4.63	2.22	0.76	0.02	13.13
Daily volume during the continuous stage (in NIS million)	149	1.43	4.02	1.93	0.65	0.02	11.13
Number of daily transactions	149	54	119	52	41	1	259
Number of daily transactions during the continuous stage	149	36	89	41	21	1	221
Size (in NIS billion)	149	0.56	1.14	0.59	0.35	0.02	3.20
HQS (%)	149	0.24	0.08	0.35	0.12	0.02	2.05
HES (%)	149	0.21	0.08	0.27	0.11	0.02	1.50
Number of traders	149	2,220	4,621	2,241	1,389	83	10,260
Trading outside exchange (%)	149	6.87%	9.47%	8.26%	4.25%	0.00%	47.81%

Table 2: Explaining Bid-Ask Spread Measures of Corporate Bonds and Stocks

The table presents regressions of stocks and corporate bonds (hereinafter: "securities") of 49 non-dual firms that have both stocks and bonds and were traded on the TASE during 2014. The security sample is defined in Table 1 (there are 149 corporate bonds and 49 stocks). *LOG_SIZE* is the log of the security's size, calculated as the average of its market capitalization at the beginning and end of the sample period. *LOG_FIRM_SIZE* is the log of the market value of the firm's tradable securities. *DUMMY_CB* is a dummy variable that equals 1 for corporate bonds and 0 for stocks. *STD* is the standard deviation of daily returns. Panel A reports the average coefficients of daily cross-section regressions of the security's bid-ask spread measures. In regressions (1)-(3) the dependent variable is *LOG_DAILY_HQS*, which is the log of the security daily half 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 to 10% if the value is larger or if there is no valid bid-ask spread. In regressions (4)-(6) the dependent variable is *LOG_DAILY_HES*, which is the log of the security's daily half quoted effective spread. The half quoted effective spread is the average of the half effective spread of the security transactions. 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 to 10% in the case that the half effective spread is greater than 10% or there is no valid bid-ask spread. The observations in these regressions are weighted by the trading volume of the security during the continuous stage, and the *t*-statistics in are calculated using the Newey-West (1987) method, where the number of lags is 3. Panel B presents the cross-section regressions of the security sample. In regressions (1)-(3) the dependent variable is *LOG_HQS*, which is the log of the security's half quoted spread, *HQS* (defined in Table 1). In regressions (4)-(6) the dependent variable is *LOG_HES*, which is the log of the security's half quoted spread, *HES* (defined in Table 1). The errors are clustered by firm.

Panel A: Daily cross-section regressions

	LOG_DAILY_HQS			LOG_DAILY_HES		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-2.817	6.571	9.148	-2.721	6.048	8.457
	(-148.12)	(29.65)	(46.43)	(-147.80)	(30.97)	(49.78)
DUMMY_CB	-0.250		-0.859	-0.276		-0.807
	(-8.87)		(-20.34)	(-9.68)		(-18.46)
LOG_SIZE		-0.123	-0.302		-0.123	-0.291
		(-11.56)	(-28.90)		(-11.19)	(-28.51)
LOG_FIRM_SIZE		-0.325	-0.233		-0.299	-0.212
		(-28.79)	(-21.04)		(-27.27)	(-20.21)
STD		0.676	0.223		0.697	0.271
		(40.50)	(8.22)		(42.13)	(9.70)
R^2	0.0659	0.3981	0.4688	0.0789	0.4319	0.5043
N	245	245	245	245	245	245

Panel B: Cross-section regressions.

	LOG_HQS			LOG_HES		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-1.518	17.075	19.881	-1.550	14.561	17.310
	(-10.95)	(9.15)	(11.33)	(-12.47)	(8.93)	(11.40)
DUMMY_CB	-0.512		-1.520	-0.542		-1.489
	(-4.25)		(-6.45)	(-4.96)		(-7.03)
LOG_SIZE		-0.383	-0.540		-0.390	-0.544
		(-4.58)	(-9.11)		(-4.91)	(-8.32)
LOG_FIRM_SIZE		-0.533	-0.441		-0.417	-0.326
		(-4.69)	(-4.83)		(-3.94)	(-3.74)
STD		0.787	-0.140		0.842	-0.066
		(3.58)	(-0.73)		(4.12)	(-0.41)
R^2	0.0471	0.6145	0.6929	0.0622	0.5988	0.6879
N	198	198	198	198	198	198

Table 3: Trading Activity of Retail Investors (RI) and Short-Term Traders (STT)

The table presents the summary statistics of the trading activity in all TASE stocks and c-bonds of retail investors (RI – see Panel A) and short-term traders (STT – see Panel B). The identification is based on information included in the transaction records: for each side of the transaction: broker code + customer code within the broker’s list. RI are identified as "low-volume" investors with less than 2 million NIS in all TASE securities (excluding options). STT are defined as follows: For each trader in each security that she traded on the TASE (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 security. 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 is not an RI. The sample period is 2014. *Total volume in all TASE securities* is the NIS volume at the TASE (excluding options). *Total volume in stocks* (*total volume in corporate bonds*) is the NIS volume in TASE stocks (corporate bonds). *Number of trading days at the TASE* is the number of trading days on which the trader was involved in at least one transaction in TASE securities (excluding options). *Number of trading days in stocks* (*number of trading days in corporate bonds*) is the number of trading days in which the investor had at least one transaction in stocks (corporate bonds). *Number of traded stocks* (*Number of traded corporate bonds*) is the number of stocks (corporate bonds) in which the investor had at least one transaction during the sample period. *Number of transactions in stocks* (*Number of transactions in corporate bonds*) is the number of transactions of the trader in the (stocks) corporate bonds. *Number of executed orders in stocks* (*Number of executed orders in corporate bonds*) is the number of orders that created the traders' transactions in stocks (corporate bonds). "VW mean" is the value-weighted mean according to the total volume of the trader in all TASE securities.

Panel A - The Activity of Retail Investors (RI)

	N	Mean	VW mean	SD	Median	90% percentile	Max
Total volume in all TASE securites (in NIS)	333,742	257,718	757,767	358,988	109,857	729,973	1,999,975
Total volume in stocks	230,318	107,006	317,155	217,808	31,016	267,345	1,999,975
Total volume in corporate bonds	177,511	150,469	308,376	201,882	77,158	377,745	1,971,834
Number of trading days at the TASE	333,742	5.83	12.87	10.66	3.00	12.00	245
Number of trading days in stocks	230,318	4.76	11.11	10.88	2.00	10.00	245.00
Number of trading days in corporate bonds	177,511	2.87	4.58	3.54	2.00	6.00	162.00
Number of traded stocks	230,318	3.26	6.36	4.84	2.00	7.00	221
Number of traded corporate bonds	177,511	4.08	6.57	4.93	2.00	9.00	364
Number of transactions in stocks	230,318	12.29	34.08	40.46	3.00	26.00	7,920
Number of transactions in corporate bonds	177,511	8.55	15.46	14.94	5.00	20.00	2,860
Number of executed orders in stocks	230,318	7.83	21.12	33.87	2.00	15.00	7,854
Number of executed orders in corporate bonds	177,511	5.16	8.94	12.09	3.00	12.00	2,770

Panel B - The Activity of Short-Term Traders (STT)

	N	Mean	VW mean	SD	Median	90% percentile	Max
Total volume in all TASE securites (in million NIS)	1,163	373.40	8,609.61	1,754.43	14.25	941.38	44,486.17
Total volume in stocks	1,080	148.21	1,957.24	619.98	8.70	242.00	11,399.56
Total volume in corporate bonds	456	236.76	1,632.79	767.28	4.44	719.63	8,590.46
Number of trading days at the TASE	1,163	137.41	216.47	75.87	138.00	242.00	245.00
Number of trading days in stocks	1,080	119.38	158.83	74.95	116.00	227.00	245.00
Number of trading days in corporate bonds	456	69.17	135.26	83.03	25.00	230.00	245.00
Number of traded stocks	1,080	44.28	75.09	48.38	31.00	98.50	403.00
Number of traded corporate bonds	456	49.28	110.75	81.52	10.00	150.00	525.00
Number of transactions in stocks	1,080	8,563	99,741	32,229	1,110	16,358	631,120
Number of transactions in corporate bonds	456	9,155	60,086	29,495	224	27,959	437,381
Number of executed orders in stocks	1,080	5,765	75,287	25,255	645	10,362	546,450
Number of executed orders in corporate bonds	456	6,428	48,419	23,924	151	15,953	366,132

Table 4: The Trading Activity of RI and STT that were active in our sample

The table presents the summary statistics of the trading activity in all TASE stocks and c-bonds of the retail investors (RI – see Panel A) and short-term traders (STT – see Panel B) that were active during 2014 in our sample of stocks and corporate bonds. For definitions of the variables – see Table 3.

Panel A - The Activity of Retail Investors (RI)

	N	Mean	VW mean	SD	Median	90% percentile	Max
Total volume in all TASE securites (in NIS)	173,739	361,972	829,299	411,291	206,938	960,651	1,999,975
Total volume in the sample of stocks	103,073	54,108	113,178	100,462	22,903	124,232	1,999,975
Total volume in the sample of corporate bonds	97,191	78,428	131,460	95,206	47,250	179,999	1,963,293
Number of trading days at the TASE (in the sample securities)	173,739	7.85	14.49	12.95	4.00	16.00	245
Number of trading days in the stock sample	103,073	2.60	4.56	4.58	1.00	5.00	232.00
Number of trading days in the corporate bond sample	97,191	1.96	2.62	1.79	1.00	4.00	141.00
Number of traded stocks in our sample	103,073	1.71	2.40	1.45	1.00	3.00	44
Number of traded corporate bonds in our sample	97,191	2.29	3.05	2.22	2.00	5.00	110
Number of transactions in the stock sample	103,073	5.24	10.18	12.08	2.00	11.00	1,912
Number of transactions in the corporate bond sample	97,191	4.75	6.98	7.12	3.00	10.00	1,115
Number of executed orders in the stock sample	103,073	3.30	6.20	10.15	2.00	6.00	1,848
Number of executed orders in the corporate bond sample	97,191	2.82	3.99	5.63	2.00	6.00	1,077

Panel B - The Activity of Short-Term Traders (STT)

	N	Mean	VW mean	SD	Median	90% percentile	Max
Total volume in all TASE securites (in million NIS)	1,026	413	8,795	1,861	17	991	44,486
Total volume in the sample of stocks	931	48	644	215	2	75	3,763
Total volume in the sample of corporate bonds	314	135	766	410	9	355	4,565
Number of trading days at the TASE (in the sample securities)	1,026	143.29	218.00	74.25	145.50	242.00	245.00
Number of trading days in the stock sample	931	59.45	136.26	67.17	32.00	181.00	245.00
Number of trading days in the corporate bond sample	314	71.42	130.32	87.14	20.50	235.00	245.00
Number of traded stocks	931	9.35	19.59	9.97	6.00	24.00	48.00
Number of traded corporate bonds	314	22.28	40.18	28.73	9.00	60.00	142.00
Number of transactions in the stock sample	931	2,625	32,025	10,539	165	4,638	173,338
Number of transactions in the corporate bond sample	314	5,015	27,349	14,278	284	14,208	170,910
Number of executed orders in the stock sample	931	1,771	24,011	8,052	99	2,880	147,410
Number of executed orders in the corporate bond sample	314	3,533	22,009	11,545	173	9,695	143,206

Table 5: Participation of Trader Types in Stocks and Corporate Bonds

The table reports the NIS participation proportion of different trader types in the sample of stocks and corporate bonds. The sample is defined in Table 1. The sample period is 2014. The investors at the TASE are divided into three groups: retail investors (RI), short-term traders (STT) and other traders (OT). RI and STT are defined in Table 3. OT are traders that are not identified as RI and STT. The proportion of trading is calculated for each trader type on each trading day in each security, and averaged across days. Panel A presents the NIS proportion of the investor types in the sample. Panel B presents the proportion of transactions (out of the total trading NIS volume) that took place between investor types. The *t*-statistics are calculated using the Newey-West (1987) method, where the number of lags is 2.

Panel A: NIS participation proportion of double-sided volume

Investor type	Proportion in stocks	Proportion in c-bonds	*t*-stat (difference)
Retail investors	6.38%	7.28%	4.83
Short-term traders	43.70%	34.18%	-16.66
Other traders	49.92%	58.55%	14.32

Panel B: NIS proportion of transactions out of the total volume

	(A) investor type	(B) with investor type	Proportion in stocks	Proportion in c-bonds	*t*-stat (difference)
(1)	Retail investors	Short-term traders	6.57%	7.68%	5.88
(2)	Retail investors	Other traders	5.10%	5.60%	3.11
(3)	Retail investors	Retail investors	0.55%	0.64%	3.46
(4)	Short-term traders	Other traders	38.78%	33.07%	-13.75
(5)	Non-short-term traders	Non-short-term traders	33.62%	45.45%	16.92
(6)	Non-short-term traders	Non-short-term traders	45.36%	40.75%	-10.88
(7)	Short-term traders	Short-term traders	21.02%	13.80%	-14.3

Table 6: Explaining the Participation of the Trader Types in Stocks and Corporate Bonds

The table reports the average coefficients of daily cross-section regressions of the security's NIS participation proportion of RI or STT (defined in Table 3). The sample is defined in Table 1 (there are 149 corporate bonds and 49 stocks). The sample period is 2014. *LOG_SIZE*, *LOG_FIRM_SIZE*, *STD* and *DUMMY_CB* are defined in Table 2. In regressions (1)-(3) the dependent variable is the proportion of retail investors (RI) out of the security trading volume. In regressions (4)-(6) the dependent variable is the proportion of short-term traders (STT) out of the security trading volume. RI and STT are defined in Table 3. The proportion of trading is calculated for RI and STT on each trading day for each security. The table presents the mean of the series of 245 coefficients. Each observation in the regressions is weighted by the security's trading volume on that day. The *t*-statistics are calculated using the Newey-West (1987) method, where the number of lags is 2.

	Retail investors (RI)			Short-term traders (STT)		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	6.413	2.227	9.930	43.723	-88.223	-114.681
	(43.42)	(1.46)	(5.73)	(98.22)	(-13.79)	(-16.96)
DUMMY_CB	1.116		-2.262	-9.247		9.413
	(5.87)		(-7.84)	(-16.13)		(7.79)
LOG_SIZE		-3.305	-3.797		4.195	6.260
		(-31.30)	(-31.24)		(14.96)	(16.33)
LOG_FIRM_SIZE		3.202	3.425		1.586	0.400
		(25.42)	(25.86)		(4.20)	(1.03)
STD		4.222	3.084		0.538	5.587
		(23.31)	(13.57)		(1.04)	(8.18)
R^2	0.0300	0.1431	0.1582	0.0935	0.1958	0.2262
N	245	245	245	245	245	245

Table 7: Concentration of Short-Term Trading in Stocks and Corporate Bonds

The table reports the market share and competition of short-term traders (STT) in the sample of stocks and corporate bonds. The sample is defined in Table 1. The sample period is 2014. STT are defined in Table 3. The Table relates to transactions of STT vs. non-STT. *Number of STT* is the number of STT that traded in the security during the sample period. *Herfindahl* 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 security. *1/Herfindahl* is the reciprocal of the Herfindahl-Hirschman index (if all STT have an equal share the reciprocal of the index is the number of STT in the security). *Proportion of largest trader out of STT volume in the security* (*Proportion of 5 largest traders out of STT volume in the security*) is the NIS volume of the largest STT (5 largest STT) in the security divided by the total NIS volume of all STT (in their transactions vs. non-STT) in the security. *Proportion of largest trader out of the security volume* (*Proportion of 5 largest traders out of the security volume*) is the NIS volume of the largest STT (5 largest STT) in the security divided by the security's NIS volume. "VW mean" is the value-weighted mean according to the securities annual NIS volume.

	Stocks					C-bonds				
Variable	N	Mean	VW mean	Median	STD	N	Mean	VW mean	Median	STD
Number of STT	49	168.63	361.00	129.00	122.25	149	44.25	76.39	40.00	28.62
Herfindahl	49	0.080	0.050	0.069	0.045	149	0.150	0.089	0.097	0.119
1/Herfindahl	49	15.30	21.62	14.52	6.10	149	9.66	12.84	10.26	4.76
Proportion of largest trader out of STT volume in the security	49	18.91%	15.13%	17.10%	6.67%	149	26.45%	19.68%	21.98%	14.60%
Proportion of 5 largest traders out of STT volume in the security	49	50.41%	39.50%	47.92%	12.99%	149	66.00%	53.90%	59.87%	17.45%
Proportion of largest trader out of the security volume	49	5.67%	5.58%	5.50%	2.19%	149	6.85%	6.88%	6.33%	3.05%
Proportion of 5 largest traders out of the security volume	49	15.08%	14.54%	15.54%	4.22%	149	18.11%	18.87%	17.76%	5.53%

Table 8: Explaining the Concentration of Short-Term Trading in Stocks and Corporate Bonds

The table presents the cross-section regressions of stocks and corporate bonds of our sample. The sample is defined in Table 1. The sample period is 2014. The dependent variable is *LOG_(1/HHI_STT)*, which is the log of the reciprocal of the Herfindahl-Hirschman index. The Herfindahl-Hirschman index is defined in Table 7. Each observation in the regressions is weighted by the security's trading volume. The errors are clustered by firm. *LOG_SIZE, LOG_FIRM_SIZE, STD* and *DUMMY_CB* are defined in Table 2.

	LOG_(1/HHI_STT)		
	(1)	(2)	(3)
Intercept	3.036	-2.099	-1.307
	(37.99)	(-2.66)	(-1.56)
DUMMY_CB	-0.543		-0.261
	(-5.74)		(-1.45)
LOG_SIZE		0.168	0.109
		(3.01)	(2.21)
LOG_FIRM_SIZE		0.050	0.081
		(0.89)	(1.58)
STD		0.112	-0.021
		(1.03)	(-0.12)
R^2	0.4027	0.5092	0.5238
N	198	198	198

Table 9: Trading Profits/Costs of the Trader Types

The table reports the trading profits of the different trader types. The sample period is 2014. The traders are divided into 3 groups: retail investors (RI), short-term traders (STT) and other traders (OT). RI and STT are defined in Table 3. OT are defined in Table 5. The percentage profit is calculated as follows. For buyers, it is the stock's closing price divided by the transaction price minus one (in %). For buyers, it is this value with a minus sign. The NIS profit is the percentage profit multiplied by the transaction amount. The daily percentage profit of a trader type is its NIS profit on that day divided by its trading volume on that day. Panel A presents that average of the daily percentage profit. It is calculated as follows: on each trading day, for each investor group and for security type (stocks, c-bonds and both types) it is the sum of the NIS profits divided by the total volume and this ratio is averaged across days. In the same way, Panel B presents the percentage trading profit of transactions that took place between specific investor groups.

Panel A: Percentage trading profit of trader types

Panel A: percentage profit of trader type (in %)

Investor type	Profit in stocks	Profit in c-bonds	Total profit	*t*-stat (difference)
Retail investors	-0.087%	-0.068%	-0.078%	(1.63)
t-stat	(-8.73)	(-9.47)	(-11.70)	
Short-term traders	0.002%	0.014%	0.008%	(3.41)
t-stat	(0.67)	(9.79)	(4.23)	
Other traders	0.011%	0.000%	0.004%	(-2.67)
t-stat	(2.89)	(0.38)	(2.59)	

Panel B: Percentage trading profit/cost of trading between groups

Panel B: percentage profit of trader type (in %)

	(A) investor type	(B) with investor type	Profit in stocks	Profit in c-bonds	Total profit	*t*-stat (difference)
(1)	Retail investors	Short-term traders	-0.096%	-0.087%	-0.093%	(0.69)
	t-stat		(-8.85)	(-10.44)	(-12.23)	
(2)	Retail investors	Other traders	-0.093%	-0.057%	-0.074%	(2.53)
	t-stat		(-7.37)	(-7.77)	(-9.96)	
(3)	Short-term traders	Other traders	-0.012%	0.009%	-0.001%	(2.73)
	t-stat		(-1.73)	(2.84)	(-0.36)	
(4)	Short-term traders	Non-short-term traders	0.004%	0.024%	0.014%	(3.05)
	t-stat		(0.68)	(9.49)	(4.18)	

Table 10: Explaining Investor profits in Stock and Corporate Bond Trading

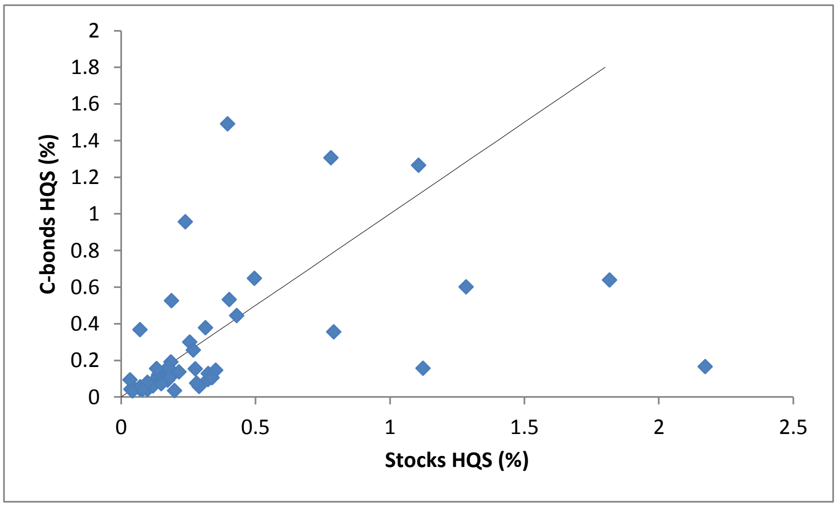
The table reports the average coefficients of daily cross-section regressions of the security's percentage trading profit of RI or STT (defined in Table 3). The sample is defined in Table 1 (there are 149 corporate bonds and 49 stocks). The sample period is 2014. The explanatory variables *LOG_SIZE*, *LOG_FIRM_SIZE*, STD and *DUMMY_CB* are defined in Table 1. In regressions (1)-(3) the dependent variable is the percentage profit of retail investors (RI). In regressions (4)-(6) the dependent variable is the percentage profit of short-term traders (STT). RI and STT are defined in Table 3. The percentage profit of RI or STT in a certain security on a certain day is defined in Table 9. The table presents the mean of the series of 245 coefficients. Each observation in the regressions is weighted by the security's trading volume of the relevant group (STT or RI) on that day.

	Retail investors (RI)			Short-term traders (STT)		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.087	-0.528	-0.582	0.002	0.067	0.098
	(-8.73)	(-6.10)	(-5.60)	(0.67)	(1.50)	(1.79)
DUMMY_CB	0.019		0.027	0.012		-0.009
	(1.63)		(1.36)	(3.41)		(-1.12)
LOG_SIZE		0.022	0.028		-0.009	-0.011
		(3.50)	(7.57)		(-5.04)	(-5.74)
LOG_FIRM_SIZE		0.001	-0.002		0.006	0.007
		(0.23)	(-0.50)		(2.30)	(2.99)
STD		-0.065	-0.051		0.004	0.000
		(-4.59)	(-2.53)		(0.99)	(0.01)
R^2	0.0461	0.1092	0.1316	0.0457	0.1095	0.1372
N	245	245	245	245	245	245

Figure 1: Bid-Ask Spreads of Stocks and Corporate Bonds of the Same Firm

The figure reports the half quoted bid-ask spread (*HQS*) of stocks and corporate bonds of the same firm in our sample of securities traded on the TASE. The sample and *HQS* are defined in Table 1. Corporate bonds of the same firm are averaged into a single observation. Panel A relates to the entire 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: $\overline{HQS}(\%) < 0.5$

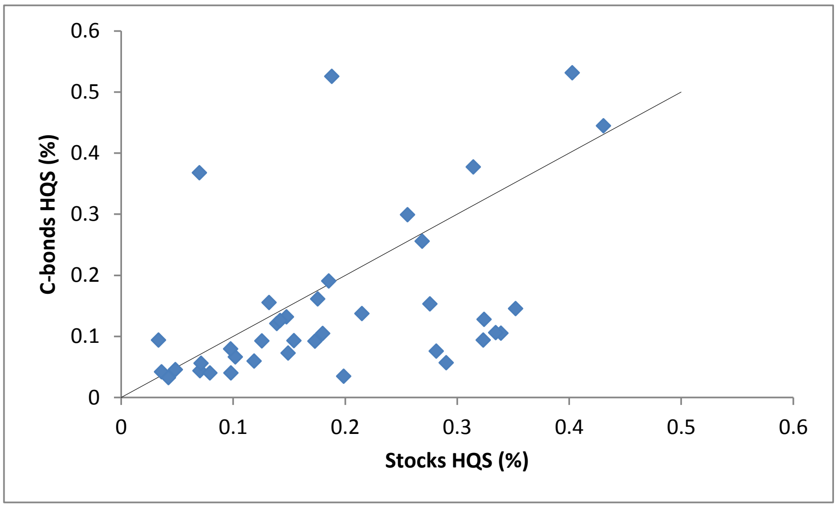


Figure 2: Proportion of Trading Outside the Exchange of Stocks and Corporate Bonds of the Same Firm

The figure reports the proportion of trading outside the TASE in the stock and corporate bond sample. The sample is defined in Table 1. Corporate bonds of the same firm are averaged into a single observation.