

ISRAELI TREASURY AUCTION REFORM¹

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Abstract

This study examines the results of the inclusion of primary dealers in trading in government bonds under the 2006 government bond reform. Using a unique database, we compared the results of Treasury Bond auctions before, during and after implementation of the reform in order to estimate the cost of raising government debt. In order to analyze the effect of the reform on liquidity in the secondary market, we used—in addition to the full demand and winnings database of each of the participants in each auction—an intra-day database. The structure of the data enabled us to test the result of the reform on the cost of government financing by means of a number of calculations for the auction premium. When we isolated the effects of the relevant market variables, we found that after the reform, the auction premium declined significantly, but the development of prices in the secondary market shortly after the auction also changed significantly. We also found that after the reform, the auction premium was negatively affected by the uncertainty and volatility-related variables in the market, which did not affect the auction premium before the reform.

1. INTRODUCTION

In 2006, primary dealers were introduced to the Israeli Treasury securities market as part of a series of reforms introduced by Israel's Ministry of Finance. This study investigates the effect of the reforms on both the auction results and on liquidity in the secondary market.

The reform that introduced designated market makers in Israel provides an opportunity to conduct an empirical event study. The importance of this analysis, beyond documentation of the results of the reform in Israel, lies in the light it sheds on a broader

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question: the significance of adding market makers to a relatively liquid market with an active secondary market of local players in which there are no market makers. Our analysis is based on a unique proprietary database that was provided by the Bank of Israel for this research. This study investigates whether and how prices and activity by the various players changed, both at auctions in both the primary markets and the secondary markets as a result of the entry of market makers.

Most countries (including Israel) use such auctions to issue debt.² For this reason, and especially in view of the global events that followed the financial crisis, which increased the need for government bond issues to raise debt, it is important to understand the effect of market makers on the pricing of government bonds and their liquidity in the primary and secondary markets.

The main empirical question that we investigate in this research is whether this reform has succeeded in reducing the cost of financing government debt. We present several measures for the auction premium, which is defined as the difference between the closing price in the auction and the price in the secondary market. We show that allowing for other relevant variables, the auction premium narrowed significantly following the reform.

Another important question regarding the reform concerns the price dynamic in the secondary market around the auction dates. We show that there has been a material change in this dynamic after the reform. In addition to analyzing the impact on price, we assess the demand curve derived from the bids submitted to the auctions—estimating both its elasticity and the level of the participants' aggressiveness in the bids they submitted. We also show that the number of participants is significantly and negatively correlated with the size of the auction premium, only after the reform. This reflects a close connection between the number of participants and the level of aggressiveness in the bids that they submitted, a connection that did not exist before the reform. The variable used in our study as an estimate for the level of risk in the markets is negatively correlated with the size of the auction premium, a finding that indicates partial substitution between the primary and secondary markets.

The paper is organized as follows: Section 2 provides institutional details on the market structure and the reform. A detailed survey of literature is included in Section 3. Section 4 presents the data investigated in this research. In Section 5 we estimate the auction premium, the level of participation, and the elasticity before and after the reform. In Section 6 we investigate the changes in the secondary market price during the auction days. Section 7 presents the conclusions.

² For a description of the existing auctions in various countries, see Brenner, Galai, and Sade (2009).

2. THE ISRAELI TREASURY SECURITIES AUCTION REFORM

The Israel Ministry of Finance ("the Treasury") instituted a series of reforms in the government bond markets for the purpose of increasing liquidity and efficiency and reducing the cost of its debt. Many of the reforms were enacted in 2006. On June 19th, 2006, responsibility for management of bond issues (other than short-term Treasury securities (*makam*)) and the back office were transferred from the Bank of Israel to the Ministry of Finance.³ As a result of that change, Bloomberg supplied a platform for conducting Israel government bond auctions. Previously, auctions were held via a designated system, *Shva*, which was used only by local participants. One of the objectives of transferring them to an international platform was to enable foreign participants to take part in government auctions in a simple and transparent manner.

The reform introduced primary dealers (PD) to the Israeli bond market. The initial group of these market makers included 19 large, stable financial institutions—eight international banks and institutions and 11 Israeli banks and institutions⁴—that undertook to quote bid and ask prices for large⁵ series of government bonds in a designated trading system. When the market makers reform was launched, a new trading platform also began to function—the Inter-Dealer System, in which primary dealers operate and are obligated to provide quotes on a regular basis. EuroMTS (MTS), the leading European developer of inter-dealer trading infrastructures for government bonds, developed the platform for trading among primary dealers. MTS is used for trading government bonds in several European Union countries, including Italy, Germany, France, Spain, and others. MTS began operating in Israel on September 4, 2006. With the implementation of the reform, the secondary market changed. Before the reform, there was a single trading venue, the TASE, where almost all trading took place. Since the reform, a significant amount of trading has been conducted via the MTS system. In addition to these changes in the secondary market, the designated market makers undertook to conduct a specific minimum volume of activity in the primary market.

³ http://www.finance.gov.il/debt/gen/docs/rep0607_full.pdf

⁴ These were also registered as members of the Tel Aviv Stock Exchange.

⁵ Nominal bonds with fixed coupon, with over NIS 4 billion in par value, and at least one year to maturity.

The primary market auctions used the same pricing rule before and after the reform—the discriminatory price mechanism.⁶ Since the introduction of the reform, however, the participation rules in the auction system have changed. The Treasury decided to conduct two types of auctions: The first type is for primary dealers only, and the second type is open to the participation of banks and other TASE members. Since the reform, 80 percent of the new nominal fixed coupon bonds issued have been sold to the primary dealers only (first type), while the remaining 20 percent have remained open (second type). One technical feature distinguishes between the two types of auctions: the minimum quantity that primary dealers are permitted to bid at any bid price is NIS 1 million, while the minimum for the open market auctions is only NIS 10,000.

The reform also introduced a "green shoe option" to the auction system: Auction winners may purchase up to 15 percent of the face value amount that they purchased in the auction, at the auction's average price. Primary dealers that serve as market makers on the TASE can get an additional 3 percent at that price. Another important element of the reform is the introduction of bond lending for primary dealers. The facility is operated by the Tel Aviv Stock Exchange Clearing House, under an agreement with the MOF. Each primary dealer may borrow up to NIS 500 million worth of bonds, against the deposit of cash collateral in the MOF accounts at the Bank of Israel. This service enables market makers to reduce their risks in the quotations.

3. SURVEY OF LITERATURE

The important effect that market microstructure has on market activity, liquidity and pricing, has been demonstrated in financial and economics literature.⁷ Moreover, the idea that the introduction of market makers into the market for a particular security is likely to have an important pricing effect has also been researched in the context of secondary

⁶ From treasury publications: Towards the end of the month preceding the month of the auction, an announcement is published stating the auction date and the series and quantities offered for sale. On the day of the auction, participants submit the requested quantity of each bond at each price through their terminals. Participants are permitted to change their bids without restriction until the deadline for bid submission. The last bid submitted by each participant by the deadline is binding. Auctions are conducted using a graded ("discriminatory") auction model: Immediately after the deadline for submitting bids, the auction closes to further bids and the system allocates bonds based on the prices offered, from the highest price to the lowest price, until all the bonds on offer are sold at the prices offered. The closing price is the price obtained at the point at which the full offered quantity is sold. All participants who offer a price higher than the closing price receive all the bonds they requested, and each of them pays the prices he bid in the auction. In the case of surplus demand at the closing price, a pro-rata allocation of the remaining bonds is carried out, according to the quantity requested by each participant at that price. At the end of the auction, each participant receives details of their winning bids as well as general data about the results of the auction, such as the quantity sold, average price and closing price. A summary of the auction results is also released to the public, on the website of the Government Debt Management Unit in the Accountant General's Division, and through the Bloomberg system.

⁷ Early works include Demsetz (1968) and Amihud and Mendelson (1980, 1986, 1991) among others.

markets. For example, Silber (1984) investigated voluntary market makers in the futures markets in the United States. Eldor, Hauser, Pilo, and Shurki (2006) investigated the effect of the introduction of market makers on the liquidity and efficiency of options trading in electronic markets in Israel. Gamrasni's (2011) results indicate that while the reform did improve market activity in terms of trading volumes, it improved neither the cost of liquidity nor market depth. Nimalendran and Petrella (2003), who investigated the impact of specialist intervention in equity markets, found that specialist-based systems resulted in lower execution costs and greater liquidity than other systems.

Multiple works analyze the effect of market makers on the liquidity and pricing of securities in secondary markets. Venkataraman and Waisburd (2007), who conducted an empirical study of the effect of market makers in a limit order market, showed that firms employing unprivileged market makers enjoy 5 percent higher returns than those without market makers, due to better liquidity. Montalvo (2003), who examined the introduction of market makers on the Spanish Futures Market Exchange (MEFF), using intraday price data for Spanish government bond futures spanning a short period, found that market makers have no effect on market liquidity.

Most studies on the subject concentrate on market microstructure's impact on secondary markets, primarily affecting trading volume, price volatility and liquidity. In contrast, this study focuses on market microstructure's impact on the primary market and on price development in the secondary market. Albanesi and Rindi (2000) conducted research related to ours, examining the effects of the 1994 reform in the Italian government bond market. The 1994 reform included the introduction of primary dealers with market making obligations. In contrast to our study, Albanesi and Rindi used a VAR model to estimate the effect of the reform on the shaping of prices, rather than an event study methodology. They found that the 1994 reform was followed by an improvement in market quality in the form of decreased autocorrelation. Our research goes beyond Albanesi and Rindi's study to examine the price effects of the introduction of primary dealers on the primary market, in addition to its influence on price development in the secondary market.

4. DATA AND SAMPLE

We have data on 123 auctions that occurred between 2005 and 2007 (before, during and after the reform). We focus on bond series that were already traded in the secondary market. This provides us with a price benchmark. 54 of those auctions were conducted before the introduction of the primary dealer reform and 69 auctions took place after the reform. Some of the auctions conducted after the reform (43 out of 69) were available only to primary dealers (first type), while others were open to all intermediaries and the public, which submitted orders via intermediaries (second type).

Table 1
Theoretical Statistics

Auction Characteristics Average (Median) [Standard Deviation]	Secondary Issue			
	All of the Auctions		Auctions for Primary Dealers only	Auctions For the Public
	Before the Reform N= 54	After the Reform ¹ N=69	After the Reform N=43	After the Reform N= 26
Total supply (NIS million)	366 (350) [67]	438 (400) [194]	498 (450) [207]	340 (350) [119]
Total demand (NIS million)	3,028 (1,627) [3,222]	2,566 (1,811) [3,725]	2,900 (1,748) [4,626]	1,989 (2,017) [857]
Ratio of demand to supply	8.3 (4.6)	5.9 (4.5)	5.8 (3.9)	5.9 (5.8)
PDC – closing price	0.07 (0.09) [0.236]	0.09 (0) [0.421]	0.11 (0.11) [0.307]	0.07 (-0.01) [0.568]
SDA 11:00 – closing price	0.075 (0.061) [0.150]	0.047 (-0.007) [0.207]	0.085 (0.157) [0.229]	-0.02 ^{***} (-0.016) [0.116]
SDC – closing price	0.17 (0.15) [0.173]	0.06 ^{***} (0.03) [0.317]	0.04 ^{**} (0.03) [0.376]	0.08 ^{**} (0.03) [0.188]
Average price – closing price	0.047 (0.04) [0.038]	0.067 (0.04) [0.068]	0.08 (0.06) [0.07]	0.04 (0.03) [0.05]
Number of participants	19.2 (19.0) [1.8]	17.0 (16.0) [4.6]	14.2 (15.0) [2.6]	21.5 (21.5) [3.3]
Number of winners	13.2 (15.0) [4.7]	9.4 (8.0) [7.0]	8.4 (8.0) [5.4]	11.0 (10.0) [9.0]
Percentage of "green shoe" option exercised ² (percentages)	0.90 (1.00) [0.27]	0.398 (0.196) [0.431]		

This table lists the amounts of supply and demand, the number of participants and winners, and a number of estimates for the auction premium. The auction premium is defined as the difference between the closing price in the auction and the market prices (e.g. the final closing day, just before the auction, and the closing on that day). During the period following the reform, the table lists the average extent to which the green shoe option was exercised and the use of the lending database. (* - 10 percent significance, ** - 5 percent significance, *** - 1 percent significance – for testing the difference between its value and the equivalent value before the reform). PDC – The closing price on the preceding day; SDA 11:00 – the price on the same day at 11:00; SDC – closing price

¹ Between June 19, 2006 and September 18, 2006 the reform was partial: the auctions were conducted on the Bloomberg platform and the list of primary dealers was known, but there were no official commitments yet. Only one outlier observation was deleted – on November 20, 2006 (the second auction of a new series).

² A request to increase the amount of the issue at the average price in the auction submitted before the announcement of the auction results.

Our data were obtained from several data bases: 1. Public auctions; 2. The proprietary auction database obtained from the Bank of Israel; 3. Intraday bond prices in the secondary market that were obtained from the Tel Aviv Stock Exchange; 4. Data on the use of green-shoe and repo transactions.

The data received from the Bank of Israel include the vector of prices and the demand of each bidder, and the bidder's classification in the system (foreign versus local, bank versus broker, and large institution versus small institution). We can thereby construct the full demand and winning curve for each type of bidder (which may represent several clients who decided to submit their bids via one institution) and for the total of all the bidders. These unique and detailed data allowed us to construct the full demand curve, data that are not available to the public, and we were therefore able to test the effect of the reform on the issue auction market in detail.

Table 1 displays summary statistics relating to our sample. On average, NIS 366 million in bonds were offered per auction before the reform. Since the reform, the average bond value offered has been NIS 438 million per auction. The treasury offered larger quantities, NIS 492 million on average, in the auctions that were designated only for the primary dealers, compared with NIS 340 million on average in the auctions that were open to public participation.

Before the reform, an average (per auction) of 19 different bidders submitted bids directly to the auction. After the reform, the number of bidders at the auctions open to the public (second type) averaged 21.

5. DESCRIPTION OF THE EMPIRICAL TESTS AND THEIR RESULTS

a. Estimation of the Auction Premium

The quality of the treasury auction process is usually evaluated by calculating the difference between the price received in the auction and the price of the same security on the secondary market—before, during and after the auction. In the research literature, the result of this calculation, which depends on several factors, is called the "auction premium." The most important of these factors is the level of uncertainty concerning the price of the asset at the point in time when the quantities were allocated in the auction. Uncertainty makes the average price obtained in auctions lower.⁸ A more efficient auction and greater liquidity of the asset in the secondary market will therefore result in a lower auction premium. In this framework, we test the auction premium around the time of the market makers reform in order to examine the extent to which the reform affected the efficiency of the auctions and

⁸ The uncertainty in the auction involves both the price and the fit between the quantity of demand in the auction and the quantity allocated to each participant.

whether that efficiency, which reflects the cost of financing the government's activity, improved.

One of the advantages of our study is that for many of the auctions that were conducted during the study period, the bonds had already been traded on the secondary market. This enables us to compare the auction price to several different benchmarks in the secondary market. We define

$$\text{Premium}_{i,t} = \text{Benchmark}_{i,t} - \text{Closprice}_{i,t}$$

where:

$\text{Premium}_{i,t}$ is the auction premium for the issued series i and for the date of the auction

$\text{Closprice}_{i,t}$ ⁹ is the closing price of the issued series in auction i and on date t

$\text{Benchmark}_{i,t}$ is the benchmark for the reference price

We used the following benchmarks in our calculations:

- The closing prices on the Tel Aviv Stock Exchange on the last trading day before the auction.
- The closing price on the Tel Aviv Stock Exchange on the same day the auction was held.¹⁰
- The average price based on transactions on the Tel Aviv Stock Exchange around the time when participants submit orders to the auction (at approximately 11:00).¹¹

We also calculated a series of average prices based on the transactions on the secondary market at every trading hour, a series that begins three trading days before the auction date and ends three trading days after the auction.

Table 1 and Figures 1a–1d summarize our findings. Before the reform, the price in the secondary market declines prior to the auction, and immediately after the auction the price goes back to the same level it was at before the decline. Thus, the cumulative auction premium is NIS 0.15, on average (Figure 1a). After the reform, however, there is a very large difference between the auctions open to the public and those open to primary dealers only. Thus, it is important to distinguish between the public auctions and the auctions which are exclusively for primary dealers. In the primary dealer auctions, although the auction premiums fell slightly on average, the price dynamic still behaves in the same way it behaved before the reform, but the lowest price is 24 hours after the auction time—the green shoe time. Thus, the cumulative auction premium is higher, reaching NIS 0.25 on average (Figure 1d).¹² In the auctions open to the public, although the auction premiums were close to zero and even negative, the prices in the secondary market tended to

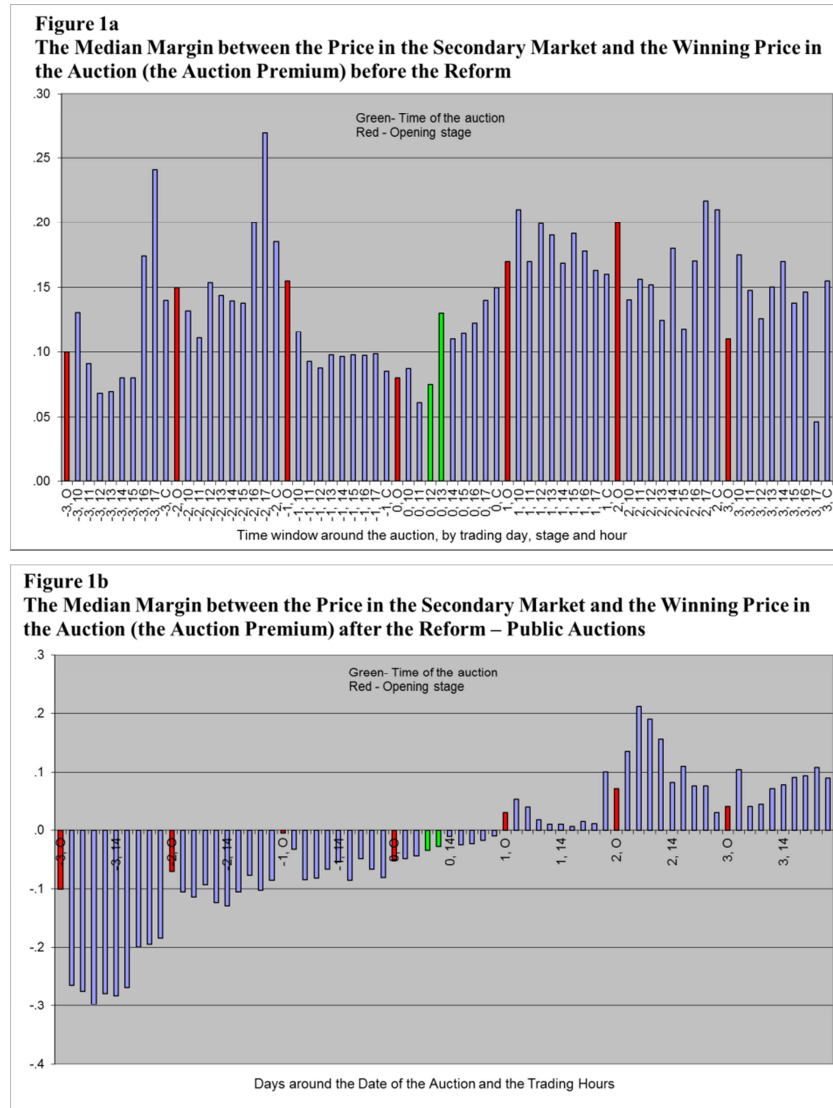
⁹ We also tested the average price variable and the results, while slightly weaker, were still significant.

¹⁰ The closing price mechanism on the Tel Aviv Stock Exchange changed on July 29, 2007, from a closing price that was based on the average of a number of the most recent transactions to either a closing price based on the result of the closing auction, if there is sufficient volume, or to the average of a number of the most recent transactions if the sufficient volume rule was not met.

¹¹ From 10:30 to 11:30.

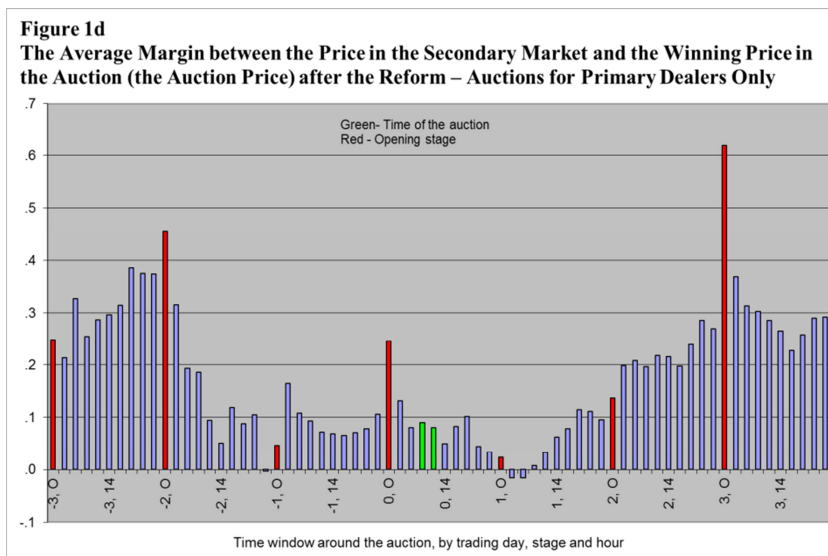
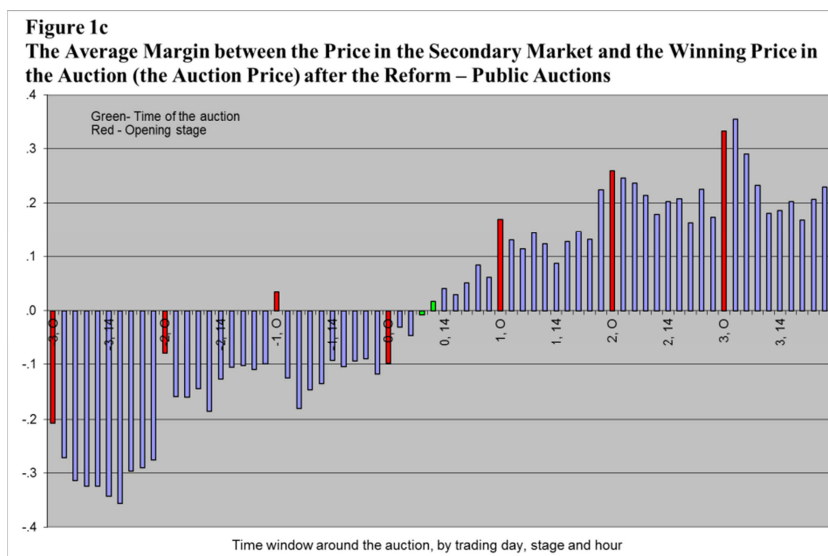
¹² The large local banks, all of which are primary dealers, exercised the green shoe option more than any of the other primary dealers.

gradually increase as the auction day drew near, and tended to increase even more immediately following the auction dates. The cumulative change in the 7 days around the auctions is NIS 0.5 on average (Figure 1c).¹³



¹³ This price dynamic around the auction days can be explained, in theory, by the extent of utilization of the lending facility. However, we didn't find any connection between the use of this facility and the auction days.

The two green columns refer to trading close to the auction date. The red columns refer to the opening stage of the trading day. The time window around the auctions ranges from three days before the auction date to three days after the auction date (seven trading days).



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We also tested the significance of the price changes in the secondary market around the auctions, and compared the result to the changes that occurred in the secondary market in the prices of the non-issued series (Table 2). For this purpose, we calculated statistical data for the price changes in four categories of government bond series before and after the auctions, for the issued series (on-the-run) and for the control group of nonissued series (off-the-run). The main finding of this test is that there is a significant price change in the secondary market only for the issued series, while the reform slightly reduced the change in the prices of this series.

Table 2
Statistical Description of Changes in the Intraday Prices of Issued and Non-Issued Bonds Before and After the Reform

Changes in the Intraday Prices between 11:00 AM and 3:00 PM			
The Issued Series before the Reform		The Non-issued Series before the Reform	
Average	0.042	Average	0.001
Standard deviation	0.031	Standard deviation	0.014
Median	0.065	Median	0
Standard deviation	0.228	Standard deviation	0.16
Sample variance	0.05	Sample variance	0.027
Kurtosis of the probability distribution	1.80	Kurtosis of the probability distribution	3.38
Skewness	0.08	Skewness	-0.67
Minimum	-0.53	Minimum	-0.57
Maximum	0.72	Maximum	0.51
Number of observations	54	Number of observations	131
Confidence interval (95%)	0.062	Confidence interval (95%)	0.028
The Issued Series after the Reform		The Non-issued Series after the Reform	
Average	0.025	Average	0.009
Standard deviation	0.026	Standard deviation	0.009
Median	0.017	Median	0.003
Standard deviation	0.21	Standard deviation	0.15
Sample variance	0.05	Sample variance	0.02
Kurtosis of the probability distribution	2.42	Kurtosis of the probability distribution	7.0
Skewness	-0.43	Skewness	1.39
Minimum	-0.59	Minimum	-0.51
Maximum	0.71	Maximum	0.81
Number of observations	68*	Number of observations	260
Confidence interval (95%)	0.052	Confidence interval (95%)	0.018

* One observation is missing because there were no quotations in the secondary market before and during the second auction.

b. What Affects the Auction Premium?

The auction premium that we use is the price in the secondary market at the time the participants submitted their orders in the auction minus the price in the auction. We estimated the factors that may affect the premium.

$$\begin{aligned}
 SDA11:00_{t,i} - WP_{t,i} = & C + B_1 \times STDEV_BI_t \\
 & + B_2 \times PD_t + B_3 \times PD_t \times Duration_{t,i} \\
 & + B_4 \times Par_{t,i} + B_5 \times \ln(Capital) \\
 & + B_6 \times \ln(DTS) + \Sigma_{t,i}
 \end{aligned}$$

where:

SDA11:00 – the secondary market's price of the same issued series.¹⁴

WP – the minimum price of the auction (closing price).

PD – a dummy variable that receives the value "1" if the auction is restricted to primary dealer participation alone.¹⁵ The PD dummy variable is significant relative to the auction premium.

Duration – the duration of the auctioned bond at the time of the auction. We use this variable to investigate the potential effect of the liquidity premium at the auction. One of our findings is that the duration effect exists only in the auctions that are open to the primary dealers alone.

Par – number of participants, as an approximate estimate for competition. Consistent with economic intuition, the number of players is significantly and negatively correlated to the size of the premium.

STDEV_BI – the standard deviation of bond index changes (for 15 trading days before the auction)—as a proxy for uncertainty in the fixed income market. STDEV_BI has a significant and extensive effect on the auction premium only in auctions after the reform.

Capital – the amount issued as a proxy for the liquidity premium in the market for the series offered in the auction. Capital has a significant effect on the auction premium only in auctions after the reform.¹⁶

DTS – the bid amount in the auction relative to the offer amount, as a proxy for the demand pressures in the markets. The DTS has a significant and negative effect on the size of the premium.

Two other variables were estimated but found to be insignificant when estimated together with the STDEV_BI. The two variables are:

¹⁴ The price is estimated based on all the transactions between 10:30 and 11:30.

¹⁵ We found that the auctions before the reform and the auctions after the reform that are open to the public have similar characteristics. This is why the dummy variable that receives the value "1" if the auction was conducted after the implementation of the reform is estimated to be the same as the PD dummy.

¹⁶ This influence, which reflects the size of the issued series until the date of the current auction, was found to be very significant in all of the empirical articles in many countries around the world. For example, see Fung and Rudd (1986), Wasserfallen and Wylder (1988), and Spindt and Stotz (1989).

1. Absolute value of the price change (high-low price) on the day before the auction—as a proximate estimate of uncertainty over the "true" price.
2. Number of days before the 15th of the month (this or next)—as a proximate estimate for uncertainty over the inflation rate. (The Consumer Price Index—CPI in Israel is announced by the Central Bureau of Statistics on the 15th of each month.)

To summarize, controlling for other relevant variables that can affect the premium at the auction, the auction premium has a significant negative correlation with the reform. It should be emphasized that the variable representing uncertainty is negatively correlated with the size of the premium only after the reform. A possible explanation of this result is that after the reform, the auctions become more attractive relative to the secondary market and more competitive than the auctions conducted before the reform. The result of the estimations is displayed in Table 3.

Table 3
Linear Regression: Auction Premium

Dependent Variables: SDA11:00-WP

	Before the Reform	After the Reform	All of the Auctions
C	0.42**	1.54**	1.04**
STDEV_BI	-	-0.76**	-0.7**
PD	-	-0.19**	-0.24**
PD*Duration	-	0.018**	0.017**
Par	-0.012*	-0.016**	-0.018**
Ln(Capital)	-	-0.05*	-0.02
Ln(DTS)	-0.09**	-0.04*	-0.06**
R ²	0.33	0.41	0.37
Mean Dependent Var	0.025	-0.011	0.006
N	54	68	122
D.W.	1.74	2.12	2.02

* denotes 5% significance and

** denotes 1% significance.

SDA11:00 – The prices on the same day at 11:00 AM.

WP – minimum price in the auction (the closing price).

STDEV_BI – standard deviation of the changes in the bonds index price.

PD – dummy variable for actions of primary dealers.

PAR – Number of participants in the auction.

Capital – The quantity issued in the auction.

DTS – demand to supply.

c. Bidding Parameters and Estimating the Elasticity

The elasticity of demand is the percentage change in quantity demanded in response to a one percent change in price (all other determinants of demand being constant) $(\Delta q/Q)/(\Delta p/P)$. In order to investigate the elasticity of demand for a financial asset, we need the full aggregate demand curve. The elasticity in financial auctions was previously investigated in the financial literature mainly with respect to equity. For example, Bagwell (1992) examined a sample of 31 share repurchases; Kandel, Sarig and Wohl (1999) investigated a sample of 27 Israeli IPOs sold in a uniform auction; Liaw, Liu and Wei (2001) estimated the elasticity of 52 Taiwanese IPOs sold via a discriminatory auction; and Kalay, Sade and Wohl (2004) estimated the elasticity of demand and supply of equity at the opening stage of trading on the Tel Aviv Stock Exchange (call auction).

We calculate the elasticity at each auction in our sample as follows:

$$\eta_{ik} = [(\Delta q_{itk}/Q_{it})/(\Delta p_{itk}/P_{it})]$$

where:

i, t - the number of the issued series and the date of the auction

k - a vector of the change in the quantity of bonds offered in the auction relative to the quantity offered in auction i, t ; (the tested vector of changes ranges between 0.2 and 2 in increments of 0.1).

P_{it} - the closing price of auction i on day t

Δp_{itk} - the difference in the price resulting from the change in quantity, k , relative to the closing price in auction i, t ¹⁷

Δq_{itk} - the change in the quantity of bonds offered for which we estimate the elasticity

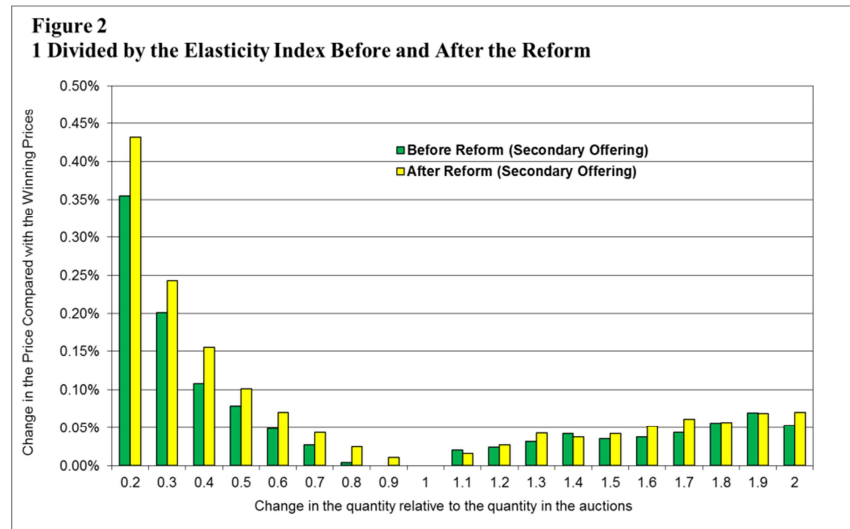
Q_{it} - the quantity of bonds offered in auction i on date t .

We calculate the mean elasticity for the total sample in the auctions before and after the reform. Figure 2 summarizes our findings. The reform affected the elasticity mainly in the direction of a decrease in quantity, and had practically no effect at all in the direction of an increase in the quantity of demand. We found that the reform led to a lower elasticity of demand. This documented change takes place in all of the auctions after the reform—both those open to the public and those for market makers only.

In addition to the elasticity of demand, the bidding parameters show that the auction participants changed their strategies after the reform. The demand price spreads weighted quantity widened considerably, mainly in the auctions open to the public, but also in the primary dealers' auctions. The local primary dealers widened their spreads in the primary dealer auctions, while the foreign primary dealers widened their spreads in the public auctions (the detailed results are displayed in Tables 4 and 5). The differences between the average and closing prices at the auctions show the degree of aggressiveness in the auction

¹⁷ The change in price resulting from the change in the quantity offered in the auction was calculated on the basis of the vector of prices and quantities of demand from each of the participants in the auction.

(Table 1). In the primary dealer auctions, the differences are relatively high, indicating that uncertainty about the winning prices in those auctions was greater.



The graph displays the average of 1 divided by the elasticity before the reform (green) and after the reform (yellow). The X axis represents the change in quantity used to calculate the elasticity. 0.9 represents a 10 percent decrease and 1.1 represents a 10 percent increase. The Y axis represents the value of 1 divided by the elasticity (the percentage of the change in the price relative to the percentage of change in the quantity). The higher this value, the lower the elasticity.

Table 4
Theoretical Statistics – Activity of the Various Types of Participants*
(NIS million)

Characteristics of the Auction	Secondary Issue			
	Before the Reform N= 54	After the Reform All Participants N=69	After the Reform Auctions for the Public N=26	After the Reform Auctions for Primary Dealers N=43
Demand of the Participants in the Auction				
Large local banks (4/4/3)	182	139	89	162
Small local banks (7/7/4)	77	63	41	103
Local brokers (11/8/4)	157	65	86	121
Large foreign banks (1/2/2)	38	90	75	95
Foreign brokers (0/6/6)	-	400	691	222
All participants	132	152	267	153
Winning Participants in the Auction				
Large local banks	36	26	24	31
Small local banks	16	11	10	19
Local brokers	15	13	13	26
Large foreign banks	13	25	18	29
Foreign brokers	-	21	9	28
All participants	19	17	13	26

* (X/Y/Z) – Number of participants (primary dealers only/after the reform/before the reform).

Table 5

Information about the Pricing of Participants' Bids in the Auctions: The Spreads between the Weighted Price Offered in the Auctions and the Closing Prices (NIS), according to Type of Trader *

Characteristics of Demanded Prices	Secondary Issue		
	Before the Reform N= 54	After the Reform – Auctions Open to the Public N=26	After the Tender – Auctions for Primary Dealers N=43
Average (Median) [Standard deviation]			
Not primary dealers	0.19 (0.1) [0.2]	0.29 (0.1) [0.4]	-
Large local banks (1/4) **	0.18 (0.1) [0.2]	0.31 (0.2) [0.4]	-
Small local banks (3/7) **	0.17 (0.1) [0.1]	0.30 (0.1) [0.5]	-
Local brokers (4/11) **	0.19 (0.1) [0.2]	0.25 (0.1) [0.4]	-
Foreign banks (1)	0.16 (0.1) [0.2]	-	-
Foreign brokers (#)	-	-	-
Primary Dealers	-	0.16 (0.1) [0.3]	0.21 (0.1) [0.3]
Large local banks (3)	-	0.10 (0.1) [0.1]	0.21 (0.1) [0.3]
Small local banks (4)	-	0.13 (0.1) [0.3]	0.29 (0.1) [0.5]
Local brokers (4)	-	0.22 (0.1) [0.3]	0.26 (0.2) [0.4]
Foreign banks (2)	-	0.26 (0.1) [0.6]	0.08 (0.1) [0.1]
Foreign brokers (6)	-	0.16 (0.1) [0.3]	0.13 (0.1) [0.2]

* In order to calculate the price offered, we dealt separately with each auction. We took all the bids offered by each trader and calculated the weighted average for them according to their volume in shekels.

** The number of entities in each category (before the reform/after the reform).

6. MEASURING LIQUIDITY

One of the most important aims of the reform was to increase liquidity in the secondary market. Gamrasni (2011) estimated the effect of the reform on liquidity in the secondary market and found that although it did improve market activity, it neither reduced liquidity costs nor increased market depth.

In this paper, we examine the liquidity changes around the auctions and test for structural changes—particularly the effect of the auctions on liquidity in the secondary market—using different acceptable measures (volumes, bid-ask spread (BAS), intraday standard deviation (std), and market depth). We test these measures on Israeli *makam* series (Bank of Israel securities of up to one year) as a control group. The results are presented in Table 6. After the reform, there is improvement in the depth measures of the secondary market on all days and not only on the auction day itself. The liquidity cost index, on the other hand, did not improve and even worsened to some extent on days on which there was no auction. According to the liquidity indices in the *makam* market, it appears that no substantial change occurred in the market capable of explaining the developments in the government bond market. When we test the bid-ask spread in finer resolution, we find that

Table 6

Liquidity Indices of the Secondary Market (the Median) of Newly-Issued Bonds around the Auction Time (millions of NIS)

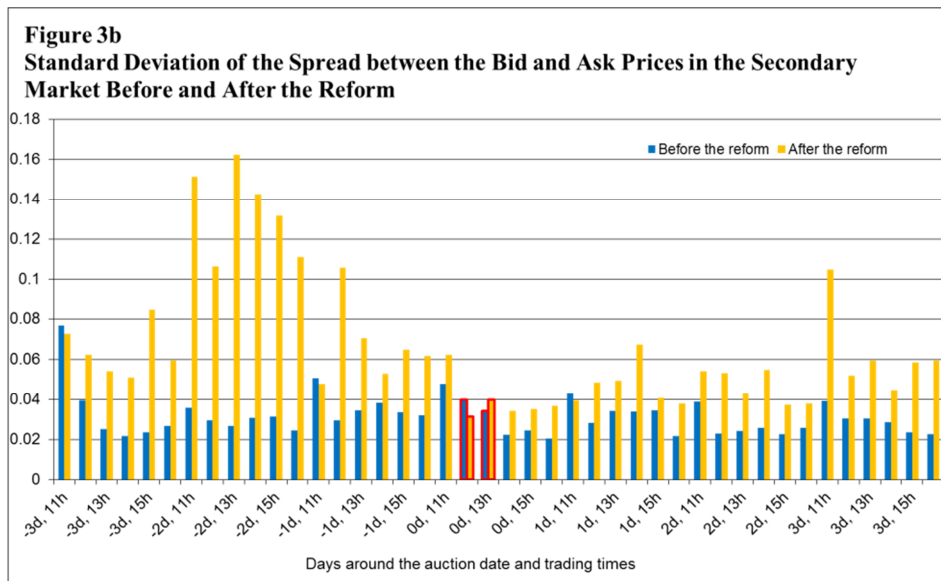
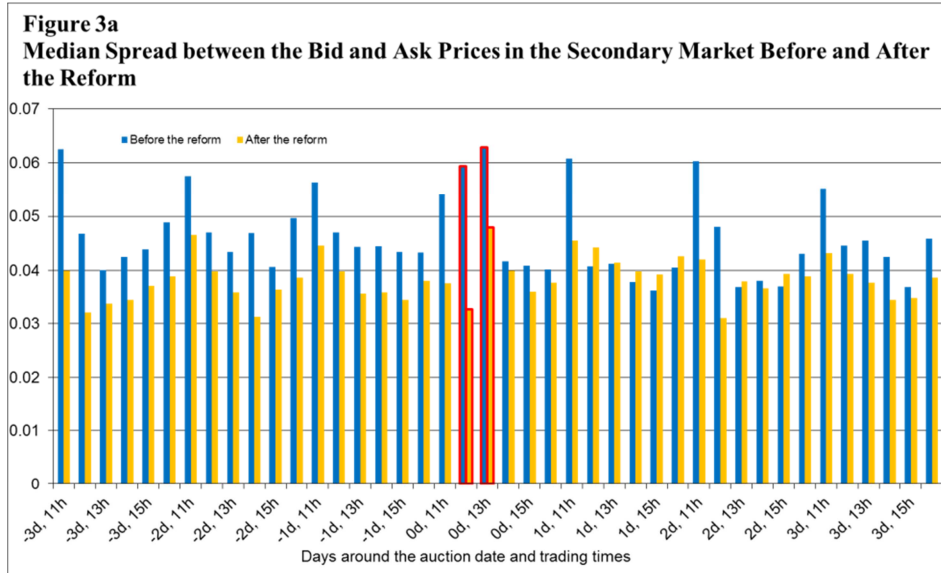
	All Days except for Time Around the Auctions	1 Day before the Auction	Auction Date	1 Day after the Auction	2 Days after the Auction	<i>Makam</i> Series**
Before the Reform						
Depth*	4.3	3.7	5.1	5.1	5	94
Trading volumes	74.9	55.2	118.6	102.4	95.5	190
Spread between the bid and ask prices	0.057	0.053	0.061	0.05	0.052	0.010
Intraday standard deviation	0.041	0.035	0.046	0.042	0.042	0.007
After the Reform						
Depth*	8.2	9.9	11.6	11.8	11	60
Trading volumes	84.9	88.2	208.6	147.4	116.5	184
Spread between the bid and ask prices	0.096	0.063	0.055	0.053	0.053	0.011
Intraday standard deviation	0.062	0.058	0.048	0.05	0.043	0.007

* The quoted amount for the three best bids for buying and selling the bond series before and after the auction.

The quoted quantitative data are weighted for time over the lifespan of the order.

** The reform did not include *makam*; it is displayed here as a control group.

after the reform, it decreased during the hours before the auction and at the time of the auction itself. This shows that the reform increased liquidity in the bond market in only some aspects, not all of them. In particular, it did not reduce the liquidity cost on days on which no auction was held. Another important change that took place is that the standard deviation of the spread increased after the reform, which can be seen very clearly in Figure 3b, apparently affected to a greater extent by uncertainty factors, which vary during the sample period.



7. CONCLUSIONS

The results of the natural trial of introducing market makers, some of whom are foreigners, are important both for understanding processes in the Israeli market and from a broader perspective. They are also important in view of the global events that occurred following the financial crisis and the need to increase volumes of debt raised.

Following the reform in the government bond market instituted by the Israeli Ministry of Finance, the average cost of debt fell according to the accepted calculation method, meaning that the average auction premium was significantly reduced following the reform. When this examination of the auction premium is extended and applied to the time around the auction, it is found that the auction premium did not necessarily fall, and possibly even increased as a result of the material change that occurred in the dynamic of price changes in the secondary market following the reform: Just before the auction, there were short-term price increases in the secondary market, which caused the appearance of a lower premium.

Our findings are summarized below.

a. Lower cost of debt

In the auctions open to the public, bond prices in the secondary market on the TASE rose consistently in the time around (before and after) the auction dates, with the increase totaling NIS 0.50. This increase, which continued after the auction date, is likely to indicate that the prices in the secondary market were relatively low on the auction date, meaning that even if the auction premium is low, the cost to the government of raising debt—which includes the premium, but also the loss in respect of higher prices in the secondary market following the auction—was higher. It is important to note that in auctions for primary dealers only, the development of prices of the issued series was similar to their development before the reform—a positive auction premium, but slightly lower. After the reform, the lowest average price of the issued series in auctions for primary dealers appeared on in the secondary market on the date of the green shoe benefit, not on the date of the auction itself as was the case before the reform. This finding also indicates that after the reform, the price dynamic of the issued series in the secondary market were greatly affected by the existence of the auctions. The question therefore arises of whether the profitability of the primary dealers in their participation in the auctions results not only from the positive auction premium, but also from a dynamic of the increase in the price of the issued series in the secondary market after the tender.

b. Liquidity

We tested the changes in liquidity around the auctions and examined the structural changes that took place following the primary dealers reform. It was found that after the reform, there was a clear improvement in the depth indices in the secondary market, but no clear improvement in the cost of liquidity indices. The latter even worsened to some extent on

days when there were no auctions. It therefore follows that overall, while the reform did increase liquidity in the bond market, this was true only for certain aspects. It was also found that before the reform, there was no clear connection between trading volume and the quantities offered in the auctions, while after the reform, such a connection was clearly present, indicating that the auctions had a stronger influence on developments in the secondary market. We also note that as a result of the reform, international financial mediators began operating in the Israeli bond market.

c. Elasticity of the demand curve

We find that the elasticity measured in the demand curve in the segment of the decrease in demand quantity declined following the reform. Both before and after the reform we found the elasticity of the demand curve in the segment of the decrease in demand quantity to be greater than in the segment of an increase in demand quantity (even though economic theory usually assumes smooth and elastic supply and demand curves). It therefore follows that the reform increased the differences in the elasticity of the demand curve between the segment of decline in the quantity offered and the segment of an increase in the quantity.

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