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Continuous Trading or Call Auctions: Revealed Preferences of Investors at the Tel Aviv Stock Exchange

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ABSTRACT

We use the move of Israeli stocks from call auction trading to continuous trading to show that investors have a preference for stocks that trade continuously. When large stocks move from call auction to continuous trading, the small stocks that still trade by call auction experience a significant loss in volume relative to the overall market volume. As small stocks move to continuous trading, they experience an increase in volume and positive abnormal returns because of the associated increase in liquidity. Overall, though, a move to continuous trading increases the volume of large stocks relative to small stocks.

CHOOSING AMONG ALTERNATIVE TRADING mechanisms is an issue of growing concern to financial economists.[1] Continuous trading increases the frequency of trading, thereby enabling immediate execution during the entire business day. Call auctions, on the other hand, lead to temporal aggregation of trades at predetermined points in time.[2] Brennan and Cao (1996) show that a move

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[1] For surveys of trading systems, see Domowitz (1993), Pagano (1998) and Domowitz and Madhavan (2000).

[2] Amihud and Mendelson (1990), Economides and Schwartz (1995a), and Handa and Schwartz (1996), among others, argue that concentrating orders in a call auction increases price efficiency. They suggest having several call auctions during the day, allowing the investors a choice between waiting for the next call or using the continuous trading mechanism for immediate execution. These arguments are supported by Economides and Schwartz (1995b), who report survey results indicating that many investment managers in the United States are willing to delay execution in an attempt to reduce its cost. Schwartz and Steil (1996) reach a similar conclusion analyzing a European sample. In a similar vein, Grauer and Odean (1995) suggest minimizing execution costs by using a system such as the Arizona Stock Exchange that offers call sessions several times per day.

from periodic call auctions to continuous trading can increase investors' welfare and asset values. Their model assumes initial supply/demand shock followed by information-motivated trading volume. In such an environment, allowing for more trading rounds enables a better reaction to new information and improved risk sharing. The model predicts that higher frequency of trading will result in a larger trading volume. Furthermore, the volume increases should be associated with a positive stock price response.

Nevertheless, one should note that a move to continuous trading is not necessarily an improvement in the investors' welfare. If the supply and demand shocks are dispersed over the entire trading period, continuous trading can result in higher execution costs for liquidity traders. For example, in Kyle's (1985) model, allowing for more rounds of trade will increase the expected profits of the informed, thereby hurting the liquidity traders. Consequently, continuous trading can lead to a reduction in trading volume, and at the extreme, to a market breakdown (see Madhavan (1992)). In such an economy, allowing for more rounds of trade can result in a welfare reduction (theoretical works in this line are Garbade and Silber (1979), Goldman and Sosin (1979) and Vayanos (1999)). Thus, it appears that determining which is the preferred trading system (if there is a clear dominance) is an empirical issue. An empirical examination of the relative merits of these two trading systems is made possible by the gradual transition of the Tel Aviv Stock Exchange (hereafter called TASE) from call auctions to continuous trading.[3] Prior to August 1997, the 977 securities listed at that time on the TASE were traded by computerized call auction (the 100 most active stocks were traded also by semicontinuous trading). During August 1997, the stock exchange introduced a new, fully computerized system for continuous trading called TACT (an acronym for Tel Aviv Continuous Trading). In this well-known computerized limit order book system, the trading day begins with a call session and progresses with continuous trading. Similar versions of these trading mechanisms are used in the Paris Bourse, Toronto Stock Exchange, and other exchanges.

The transition consisted of 18 partial steps over a period of 14 months (August 1997 through October 1998). During this period, securities were either traded in a call auction or a continuous trading mechanism. Therefore, data from this period enable us to conduct a unique experiment allowing for a time-series investigation of the effects of the move on a given security. The data also enable an examination of the effects of the move to continuous trading on securities that continued to trade in call auctions.[4] In their laboratory experiments, Schnitzlein (1996) and Theissen (2000) find that call markets provide more liquidity than continuous markets, and that liquidity traders sustain fewer losses in the call markets. Similarly, Brooks and Su

[3] Hauser and Tanchuma (1998) (in Hebrew) also investigate this event.

[4] Our experiment investigates the effects of the move of all the listed securities at the Tel Aviv Stock Exchange. Hence, our results are not likely to be contaminated by industry effects.

(1997) find that liquidity traders at the NYSE and AMEX can significantly lower their trading costs by trading at opening calls.[5,6]

Amihud, Mendelson, and Lauterbach (1997), on the other hand, present contradictory results in their investigation of the effects of adding a semicontinuous trading session (in addition to the call session) to the relatively liquid stocks at the TASE.[7] They document a significant increase in the volume of trade of these stocks and improvement in other measures of liquidity. They also find a positive stock price response (correlated to liquidity improvements) during the transfer to more continuous trading.[8] This evidence is consistent with the hypothesis that continuous trading is a superior mechanism for trading liquid stocks. The Amihud et al. study differs from ours in that it examines only the behavior of the relatively liquid large-cap stocks traded in calls after the TASE had added a semicontinuous stage to them.[9] Our study examines the move to continuous trading of all securities listed at the TASE.

We find evidence consistent with the hypothesis that investors prefer a continuous trading environment. Following the move to continuous trading at the TASE, investors still have the choice of trading at the opening call auction. However, we observe a relatively large fraction (90 percent) of the total daily trading volume during the continuous stage. The fraction of the daily volume carried out at the continuous stage for the 100 most liquid stocks is even larger (91 percent). Although these stocks offered investors a choice between a call auction during the opening and a semicontinuous session during the time prior to the move to continuous trading, the semicontinuous session accounts for only 63 percent of the daily volume during this period. In other words, as the trading session becomes more continuous during the day, a larger fraction of the daily order flow moves to the continuous stage.

Finding evidence of an increase in the fraction of trade during the continuous stage does not rule out a simultaneous reduction in volume. However, our investigation reveals a significant increase (an average of 17 percent) in

[5] Note, however, that Madhavan and Panchapagesan (2000) find that opening prices are sensitive to order flow. Hence, large traders may prefer to break up their order flow into smaller orders and execute them during the day. Madhavan, Richardson, and Roomans (1997) use intraday data to examine the relative effects of noise and information on price changes.

[6] Amihud and Mendelson (1991b) and Ronen (1998) compare open-to-open returns (resulting from call auctions) to close-to-close returns (resulting from continuous trading), finding more noisy opening sessions. However, they point out that these differences could be attributed to the different time of the day. The opening session could be a period with more information asymmetry.

[7] Lauterbach (2001) investigates the effects of moving stocks back to daily call auctions.

[8] This price effect is consistent with Amihud and Mendelson (1986, 1989, 1991a), Kamara (1994), Brennan and Subrahmanyam (1996), Brennan, Chordia, and Subrahmanyam (1998), Datar, Naik, and Radcliffe (1998), and Dimson and Hanke (2000), who find a negative correlation between measures of liquidity and the expected return. Improved liquidity lowers the cost of capital, thereby increasing security prices.

[9] Following the addition of the semicontinuous session, the securities are included in a leading stock index (the Mishtanim). The inclusion in this stock index could potentially explain the increased liquidity and the corresponding price effect.

the relative volume of small-cap securities (i.e., the volume of trade of the security divided by the total daily volume) around their transfer to continuous trading. We also find a significant positive security price reaction around transfers of small-cap securities to continuous trading. The evidence indicates that the security price increases are positively correlated with corresponding changes of volume. Consistent with Brennan and Cao (1996), this evidence indicates that the security price increases stem from improved liquidity.

The significant documented increase in the relative volume and market value of small-cap securities around the move to continuous trading is somewhat surprising. Stocks of large firms, typically covered by many analysts and held by many investors, are likely subject to less informational asymmetry than are small-cap stocks. It is therefore reasonable to expect temporal aggregation of trade (imbedded in call auctions) to be especially beneficial to thinly traded securities. Hence, one could expect call auctions to be optimal for smaller stocks, whereas continuous trading is the best choice for larger stocks.

Moreover, recently the conjecture that call auctions are the better trading mechanism for less liquid stocks has received some institutional support. The Paris Bourse chooses to have its less liquid stocks traded in only two daily call auctions (see Biais, Hillion, and Spatt (1995), footnote 6). The Athens, Brussels, Lisbon, Madrid, Milan, and Vienna stock exchanges also use only call auctions for illiquid stocks, and the Amsterdam stock exchange has recently joined them in adopting this policy.

To further investigate this issue, we compare winners and losers from the move to continuous trading using a longer time interval. The examination of the longer period indicates that large-cap stocks capture a larger fraction of the order flow. Dividing the stock sample into five groups based on their volume of trade in each month, we observe a significant lower relative volume for the bottom four quintiles after the completion of the move to continuous trading. Continuous trading gives large-cap stocks an added advantage in the competition for order flow.[10]

Given the significant relative-volume increase of the bigger stocks all through the period investigated, how can we explain the relative-volume increase of small-cap stocks around the move to continuous trading? The following experiment provides an explanation.

Examination of 690 TASE securities (mostly smaller stocks) that traded in call auctions during the period August 1997 to March 1998, while other securities (mostly larger stocks) moved to continuous trading, indicates dramatic reductions in their relative volume of trade, as well as their absolute volume. During that period, investors seem to have shifted their interests to securities that had already moved to continuous trading. It should be noted that the reduction in the relative volume (and the absolute volume) of trade for the smaller stocks occurred well before their own move to continuous

[10] Kairys, Kruza, and Kumpins (1998) report a reduction in the relative volume of small-cap stocks following the move of the Riga Stock Exchange to continuous trading. After one year of continuous trading, the exchange decided to move the small-cap stocks back to call auction.

trading. In fact, when they did actually move to continuous trading, the small-cap securities exhibited an increase in their relative volume of total trade. Hence, given that large firms move to continuous trading, smaller firms are hurt if they do not.

This evidence indicates that the decision of the European stock exchanges mentioned above to trade small-cap stocks only in call auctions may not have been fully justified. The tendency to trade smaller cap stocks at the TASE (and by implication, at the other exchanges) would have been even weaker had small-cap securities continued to trade in call auctions.[11] Note that one cannot say that, absent the move to continuous trading by large firms, small firms would have been better off by trading continuously.

Finally, we find evidence of a more concentrated trading volume for small-cap securities, following the move.

The paper is organized as follows. Section I describes the trading mechanism on the TASE. Section II describes the data. Section III presents our empirical findings, and Section IV concludes.

I. The Trading Environment at the Tel Aviv Stock Exchange

Prior to the move to continuous trading, most of the securities (877 stocks, warrants, and convertible bonds) listed on the TASE (the only stock exchange in Israel) traded in a daily-computerized call auction called the Caram. The 100 most liquid stocks were traded in an opening call auction identical to the Caram, called the Meretz, and this was followed by a semicontinuous floor trading called Mishtanim. A full description of the rules of the complex computerized call auction can be found in Bronfeld (1995).[12]

The Mishtanim—the semicontinuous trade that follows the Meretz—begins approximately at the end of the call session. In each one of the three trading arenas, securities are called sequentially. Trading terminates with a "quick round" of transactions executed at the closing prices. TASE has no designated market makers. There are quantity restrictions only on trades in

[11] In a work contemporaneous to ours, Muscarella and Piwowar (2001) examine transfers of stocks from the "first list" to the "second list" (and vice versa) at the Paris Bourse. Trading on the first list is continuous and stocks on the second list are traded in two daily call auctions. The Bourse bases its decision on the transfer between the lists on the respective past trading volume. Consistent with our results, Muscarella and Piwowar find a price increase (decrease) around transfers to (from) continuous trading. They also find a relative volume increase following transfers to continuous trading.

[12] Amihud et al. (1997) provide the following short description: "Traders route orders to the TASE, which electronically communicates the excess demand at the previous day's closing price. Traders observe the excess demand and have a short time interval during which they can send additional 'offsetting orders' which can be only sell orders when the excess demand is positive, or buy orders when the excess demand is negative. Afterwards, the new excess demand, reflecting the offsetting orders, is announced, and traders can submit offsetting orders again. Following this round, the system computes the new equilibrium prices that are announced simultaneously for all stocks" (p. 370).

the Mishtanim. The tick size is 0.25 percent of the security's market price. Prior to the move, the TASE imposed a maximum price change of 10 percent.

The volume of trade conducted outside the exchange is trivial (about five percent) and we find no evidence of changes in this volume following the move to continuous trading.

The new, fully computerized open limit order book system introduced at the TASE in August 1997 is similar to the mechanisms of continuous trading used in Paris, Tokyo, and Toronto (among others). Under the TASE system, there are three stages of trade during each day:

1. In the opening session (at 10:00), all orders transact at the same (clearing) price, priority being set according to price and time.
2. This is followed by the continuous bilateral trading stage (10:00–15:30).
3. In the closing session (15:30–15:45), transactions are executed at the closing prices (a weighted average of the last transactions).

The system is relatively transparent and traders can see the three best quotes of each side. Unlike the Paris Bourse, there are no hidden limit orders at the TASE. The identity of the member posting an order is unknown. The relative tick size (tick/price) varies in size from 0.05 percent to 0.5 percent of the price. A minimum amount of approximately $4,000 applies to orders placed in the continuous stage (the restriction placed on warrants is less binding). The opening and closing sessions have no quantity restrictions. Orders that are not filled completely at the opening stage are passed on to the continuous stage.

II. Data

The data in our sample of 977 securities that move to continuous trading (TACT) were provided to us by the TASE. We refer to the 100 stocks that move from the Mishtanim as the Mishtanim sample, and to the 877 securities that move from the Caram as the Caram sample. We have daily returns for each one of these securities during the period January 1, 1997, to May 31, 1999, and the price and volume of trade for each security for each of the various trading stages (Caram, Meretz, and Mishtanim) prior to the move to continuous trading. For the period following the move, we use the closing price (a weighted average of the last transactions of the day) and the total daily volume. Our data as of January 1, 1998, contain the price and the volume at the opening session of the TACT. We also use the monthly trading volume for each security from January 1996 to March 1999.

Prior to the move to continuous trading (the 10 trading days before August 14, 1997, the time of the first movement of securities to continuous trading), the mean (median) daily volume is 194.24 (212.76) million New Israeli Shekels, NIS (one NIS equals approximately $0.28 during the sample period).

Table I describes the transition period. The first phase (August 14, 1997) is the move of 10 Mishtanim securities and the last phase (September 27, 1998) is the move of 214 Caram securities. We investigate the volume during

Table I

Breakdown of the Timing of Movements of Securities From Mishtanim or Caram to Continuous Trading

In this table, we report the movement date, the total number of securities that move from Mishtanim or Caram to TACT (Tel Aviv Continuous Trading), the number of Mishtanim securities that move, and the number of Caram securities that move. The sample period is August 1, 1997, to November 30, 1998.

Date	Total Number of Securities Moved to TACT	Number of Mishtanim Securities Moved	Number of Caram Securities Moved
08/14/97	10	10	0
09/03/97	10	10	0
09/18/97	10	10	0
10/09/97	15	15	0
10/30/97	15	15	0
11/13/97	20	15	5
12/08/97	28	3	25
12/11/97	6	6	0
12/21/97	8	8	0
12/25/97	8	8	0
01/22/98	41	0	41
02/22/98	51	0	51
03/19/98	65	9	65
04/08/98	94	0	94
05/17/98	120	0	120
07/02/98	142	0	142
09/03/98	120	0	120
09/27/98	214	0	214
Total	977	100	877

the three stages of trade—opening, continuous trading, and closing—following the completion of the move to continuous trading. Analyzing data from November 1998—following the completion of the move to continuous trading—we find that 9.86 percent of the daily trade in NIS takes place during the opening, 86.97 percent during the continuous stage, and 3.17 percent in the closing session. The Caram securities show a slightly bigger percentage of trade during the opening (14.95 percent). Of the total number of transactions for the day, 26.4 percent takes place during the opening of trade and they are characteristically smaller in size.

III. Empirical Evidence

A. The Relative Use of Continuous Trading

The goal of this study is to assess the relative merits of continuous trading versus call auctions. The opening stage of the new mechanism is a call auction

Table II

The Distribution of Trading Volume among Opening, Continuous Trading, and Closing Following the Completion of the Move to Continuous Trading

We divide our total sample into 10 deciles ranked by the daily trading volume for each security. Securities in decile 1 are the most liquid and securities in decile 10 are the least liquid. For each decile, we compute the percentage of trading volume executed at the opening, at the continuous trading, and at the closing session. Our investigation period is November 1998 (after the completion of the move to continuous trading).

Decile Group	Total Daily Trading Volume (Million NIS)	Opening[a] (%)	Continuous (%)	Closing (%)
1	178.878	9.25	87.59	3.16
2	8.254	11.90	84.74	3.36
3	3.631	18.13	79.60	2.26
4	2.083	20.00	77.20	2.80
5	1.260	22.61	74.20	3.19
6	0.751	20.86	73.29	5.85
7	0.452	26.71	69.48	3.81
8	0.258	30.32	64.82	4.85
9	0.114	38.39	57.01	4.60
10	0.021	77.47	16.42	6.10

[a] The percentage of trade at the opening (Meretz) for the stocks previously traded in the Mishtanim is 37. This number should be compared to the fractions of the first two deciles, where all of the 100 Mishtanim stocks can be found.

available to those who prefer to avoid the continuous trading stage. However, 91 percent of the total monthly trade volume for the Mishtanim sample and 85 percent for the Caram sample occur during the continuous stage (including the closing session). Prior to the move, the 100 Mishtanim securities were traded in a call auction (the Meretz session) that preceded the semicontinuous trading stage (the Mishtanim session). We find that 63 percent of the total trade volume of the 100 Mishtanim securities is conducted during the continuous stage of trading. More traders (37 percent of the trading volume) choose the call auction when faced with an alternative of semicontinuous trading than when faced with the alternative of continuous trading (9 percent).

Table II indicates that the investors' choice not to migrate out of continuous trading is not limited to the more liquid securities. We rank all the securities based on their average daily volume of trade during November 1998 and divide them into 10 subsamples. Subsample 1 includes the most liquid securities and subsample 10 includes the least liquid. Note that in all but the two lowest deciles, the fraction of the daily trading during the continuous stage is larger than 63 percent. Note also that the minimum size constraint on orders placed during the continuous trading stage (approximately $4,000) is very restrictive for the subsamples of the least liquid securities. Since the

opening stage does not have such a restriction, many traders are forced to move to the opening to execute orders in the least liquid securities.

B. The Relative Volume and the Move to Continuous Trading

Evidence of a larger fraction of trade during the continuous trading stage does not preclude a reduction in the total volume of trade. Hence, our next step is to investigate the volume of trade around the move to continuous trading. To control for market-wide trends in volume, we use the measure of relative volume, the ratio of NIS trading volume of a security to the total market NIS volume (ignoring newly listed securities). We compute the relative volume for each one of the 977 securities in our sample in an 80-day window around its respective movement day. The window starts 40 days before the move and ends 40 days after the move. For each subsample (total sample, Mishtanim, and Caram), we calculate the average relative volume for each day during the period −40 to +39. We then compare the behavior of the relative volume before and after the move.

The results presented in Table III show a significant increase in relative volume for the Caram subsample. The tests we employ are the *t*-test and nonparametric median test. For the Caram sample, the increase in the means is 17 percent (from 0.0184 percent to 0.0215 percent). For the Mishtanim subsample, the change is not significant. To further investigate the effects of the move on liquid versus illiquid stocks, we partition the sample into 10 subsamples, ranked according to the relative volume measured during the six months from January to June 1997 (before the first window). The first 97 securities with the largest relative volume form subsample number 1, and subsample 10 contains securities with the smallest relative volume. Securities listed after January 1997 are included in subsample 11. For each subsample, we study the change in relative volume during an 80-day window (−40, 39) around the movement. We find that the increase in the relative volume following the move is independent of the level of liquidity prior to the move. Admittedly, this increase in volume could be the result of new trading opportunities in this thin and noisy market.[13] In such a case, a larger volume of trade does not imply increased liquidity. The next step is to investigate the security price response to the move to continuous trading.

C. Security Price Behavior around the Move to Continuous Trading

We document a significantly positive security price response to the movement to continuous trading and statistically insignificant announcement effects. We run the standard market adjusted return event methodology, using an equally weighted market index of Mishtanim stocks. The beta of each security is estimated for the period January 1996 to June 1997 (367 daily observations). Securities with returns in excess of 50 percent (in absolute

[13] We wish to thank an anonymous referee for pointing out this possibility.

Table III

Changes in Relative Volume of Securities Following the Movement to Continuous Trading

The analysis uses an 80-day window, 40 days before the movement and 40 days after the movement, to analyze the change of the relative volume for each stock. Relative volume is defined as the ratio of the daily trading volume of each security divided by the total daily trading volume of the market. For each subsample, we compare two series ("before" and "after") of 40 numbers. Each of these numbers is an average of the relative volumes in the subsample. The period investigated is from June 1997 to November 1998.

	Mean (%)	Median (%)	Std. (%)	*t*-test:[a]	Nonparametric Median Test[b]
Panel A: The Total Sample (Obs. = 977)					
Before	0.1050	0.1048	0.0083	1.0875	0.7744
After	0.1070	0.1066	0.0084	(0.2802)	(0.4387)
Panel B: The Mishtanim Sample (Obs. = 100)					
Before	0.8643	0.8732	0.08052	−0.5490	−0.9926
After	0.8549	0.8473	0.07403	(0.5845)	(0.3209)
Panel C: The Caram Sample (Obs. = 877)					
Before	0.0184	0.0174	0.0029	4.9282	4.7503
After	0.0215	0.0210	0.0026	(0.00)*	(0.0001)*

* *t* values significant at the five percent level or more.

[a] The null hypothesis tested is that the mean relative volume before the movement is equal to the mean relative volume after the movement.

[b] The null hypothesis tested is that the median relative volume before the movement is equal to the median relative volume after the movement.

value) and those having a zero volume during the period −40, −1 or 0, 39 are excluded. We compute the daily mean excess return during an event window from −15 to 30. Not surprisingly, since the announcements are highly predictable, the empirical evidence indicates statistically insignificant announcement effects. The likelihood of observing price reactions around such predictable events is small.

The above-mentioned event study reveals unusual security price behavior from 10 to 15 days after the announcement date, which seems to be very close to the actual movement date. Therefore, we run a similar market-adjusted event test around the movement day. For the Caram sample, we find both significant excess returns around the event and significant CAR (cumulative abnormal return) during the 30 days following the event. As depicted in Figure 1, the Caram securities experience an average excess return of about 6.4 percent during the 30 trading days around the move. We also observe a significantly positive stock price reaction on the movement day (zero) and the following two days.

It is possible that the event test we employ suffers from a problem of clustering, as the number of moves is substantially lower than the number

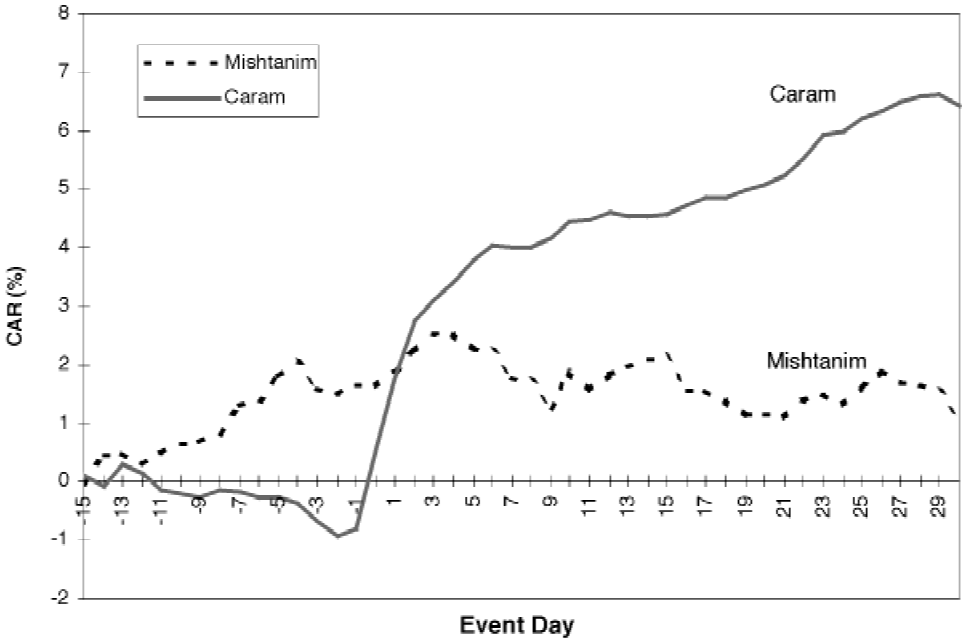

Figure 1. Cumulative abnormal returns (CAR) for the Mishtanim and the Caram sample are calculated using a 46-day window around the movement date. The period investigated is July 1997 to November 1998. Sample sizes for the Mishtanim and the Caram are 100 and 841, respectively.

of securities, and residuals of our market model might be correlated. Our test statistics, in this case, would be upward biased. To overcome this problem, we perform an additional test. We focus on the Caram sample for which we got significant stock price response. We divide the Caram sample into 10 different portfolios corresponding to the 10 different moves: Securities that move to continuous trading in stage j belong to portfolio j. For each portfolio, we compare the equally weighted mean daily rate of return during an event window of length $2t$ $[-t, t - 1]$ to the mean daily rate of return during a nonevent period $[-150, -t - 1]$ and $[t, 149]$. We use both raw returns and market-adjusted returns, performing the adjustment by subtracting the returns of an equally weighted Caram stock index. As detailed in Table IV, the mean daily returns during the event period are significantly higher than during the nonevent periods. For example, using a 10-day window and market-adjusted returns, we find in 6 out of the 10 portfolios (i.e., moves) significantly higher returns (t values significant at the 0.1 level) during the event period. Next, we test the hypothesis that the mean portfolio rate of return during the event period is equal to its mean rate of return during the nonevent period. We have 10 observations (mean return in the event window–mean return outside the event window) corresponding to the 10 portfolios. The mean of this series is 0.358 percent and the t-value is 3.44 (p-value

Table IV

Measuring the Effect of the Move to Continuous Trading on Security Prices by Comparing the Mean Return in the Event Period to the Mean Return During the Nonevent Period

The table investigates the changes of the mean daily rate of return around the movement to continuous trading for Caram securities. We group our total sample into 10 portfolios according to the actual movement date for each security. The market-adjusted return is equal to the raw return minus the return of the Caram index during the same day. We divide the investigated period $[-150, 149]$ into two subperiods. An event period $[-t, t-1]$ with length $2t$, and the other subperiod is $[-150, -t-1]$ and $[t, 150]$. We exclude the securities with a greater than 50 percent (in absolute value) daily rate of return and securities with zero volume either in the $[-40, -1]$ or the $[0, 39]$ windows. Our total sample is 841.

Move	Number of Securities in the Move	Raw Return						Market-adjusted Return					
		6-day Window			10-day Window			6-day Window			10-day Window		
		In[1]	Out[2]	Diff.[3]	In[1]	Out[2]	Diff.[3]	In[1]	Out[2]	Diff.[3]	In[1]	Out[2]	Diff.[3]
1	5	−0.799	0.084	−0.884	−0.840	0.098	−0.938	−0.282	−0.015	−0.267	−0.195	−0.015	−0.181
2	25	0.585	0.060	0.525	0.158	0.067	0.091	0.371	−0.001	0.372	0.204	0.000	0.204
3	40	−0.086	0.021	−0.107	−0.123	0.024	−0.147	0.156	−0.015	0.171	0.121	−0.016	0.137
4	49	2.135	−0.094	2.230*	1.616	−0.107	1.719**	1.422	−0.071	1.500*	0.975	−0.083	1.057*
5	63	0.608	0.001	0.607	0.518	−0.004	0.522*	0.520	0.015	0.506*	0.513	0.008	0.505**
6	93	0.805	−0.060	0.811	0.561	−0.009	0.570*	0.660	−0.021	0.681	0.465	−0.023	0.489*
7	117	0.623	0.079	0.544	0.583	0.072	0.510**	0.519	0.051	0.467	0.437	0.048	0.389*
8	139	0.400	0.051	0.349	0.159	0.055	0.104	0.159	0.005	0.154	0.109	0.004	0.105
9	118	0.385	0.119	0.266	0.183	0.127	0.061	0.469	−0.055	0.524	0.332	−0.057	0.389*
10	192	0.458	0.170	0.287	0.298	0.172	0.126	0.504	−0.019	0.522*	0.046	−0.024	0.484**
Mean (%)				0.463			0.262			0.463			0.358
t-test				1.873			1.232			3.226			3.442
p-value (*t*-test)				0.094			0.249			0.010			0.007
p-value (nonparametric sign test)				0.109			0.109			0.021			0.021

[1] The mean daily return within the event window, such as $(-3, +2)$.
[2] The mean daily return outside of the event window, such as $(-150, -4)$ and $(+3, 150)$.
[3] The difference between the mean daily returns of event window and that of nonevent window.
* Significant at five percent level.
** Significant at one percent level.

0.007). Furthermore, the p-value of a nonparametric binomial test for equality of means is 0.021. It seems that lack of control for market movements introduces additional noise, as the difference in the raw returns around the movement is less significant. The explanation we offer for the positive price effect associated with the movements of Caram securities to continuous trading is increased liquidity; these securities experience a more pronounced change in their trading environment.[14] To further investigate this hypothesis, we examine the relations between the ex post change in the volume of trade of the security following the move to continuous trading and its price reaction to it. We are careful not to compute the correlation between volume in NIS and the price response: A similar trade at higher prices (resulting from a positive price response) would result in higher NIS volume. To avoid this problem of spurious correlation, we compute the correlation between the change in the number of securities traded and the percentage change in the security price.

For each security having no returns in excess of 50 percent (in absolute value) and no zero daily volume during the period -40, -1 or 0, 39, we compute the volume change—the number of traded securities 40 days after the move divided by the number of traded securities 40 days before the move. We perform binomial nonparametric tests for the Mishtanim sample and for the Caram sample, investigating the relations between the change in volume and the price reaction. Thirty-one of the 50 Mishtanim stocks that have a volume change lower than the median also have a lower price change than median (p-value = 0.12 in a two-sided test). A mirror image of these results is obtained for the other 50 Mishtanim stocks. Of the 420 Caram stocks with a below median volume change, 234 also have a price change below the median (p-value = 0.02 in a two-sided test). From this, it is reasonable to conclude that a larger increase in liquidity is associated with a more positive stock price reaction. The evidence of a significant increase in the relative volume, a positive security price response, and the positive correlation between them, is consistent with the Brennan and Cao (1996) model.

D. Evidence of an Added Relative Advantage for Large-cap Securities

We find a significant increase in the relative volume and market price around the move to continuous trading only for small-cap securities. This is very puzzling. Stocks of large firms, which are typically covered by many analysts and attract the attention of many investors, are likely to be subject to less informational asymmetry than small-cap stocks. It is therefore reason-

[14] One wonders why these securities react so late to improvements in their liquidity. The efficient market hypothesis would have us expect a more rapid adjustment to the changes in liquidity. One possible explanation is that investors underestimate the effects of the move to continuous trading and actual events revealed to them the true value of the new system. Hence, the gradual adjustment of security prices to the new information is simply a description of their learning process. The data, however, do not support this explanation. Contrary to such explanation, we find the more recent moves to be associated with a significant stock price response.

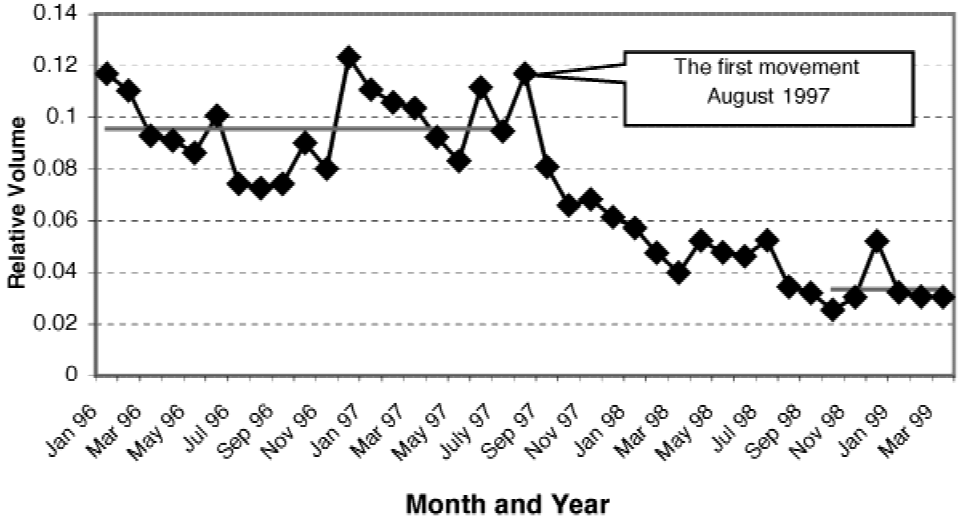

Figure 2. The change in the relative volume of the last four quintiles (small cap stocks) during the period January 1996 to March 1999. We excluded securities that were listed for trade after January 1996 and securities that ceased trading before March 1999. We limit the analysis to stocks. Our final sample is 630 stocks. In each month during our sample period, we divide the 630 stocks into five quintiles based on their relative trading volume.

able to expect temporal aggregation of trade (imbedded in call auctions) to be especially beneficial to thinly traded securities. Hence, one could expect call auctions to be optimal for the smaller stocks and continuous trading to be the best choice for larger-cap securities. Indeed, as mentioned previously, the Paris Bourse and other European exchanges choose *not* to trade the less liquid stocks continuously. Yet we present evidence of benefits from the move to continuous trading mostly for small-cap stocks.

To further examine this surprising result, we compare the relative volume of large- and small-cap stocks before the entire transition process to continuous trading starts to their relative volume during the period following its completion. To be included in this sample, a stock has to trade all through the period January 1996 to March 1999. For each month of the sample period, the resulting sample of 630 stocks is divided into five quintiles based on their NIS volume of trade.[15] Figure 2, detailing the relative volume of the four lowest quintiles from January 1996 to March 1999, reveals a significant shift in the mix of trading from small- to large-cap stocks. The mean relative volume of the four lowest quintiles during the period January 1996 to July 1997 (a period before the first move) is 9.55 percent, significantly higher than the mean relative volume of 3.35 percent during the period October

[15] In this experiment, we limit our attention to stocks. We choose not to include warrants and convertible bonds since we suspect that over a three-year period, the distribution of their volume is not stationary.

1998 to March 1999 (after the last move).[16] An examination of Figure 2 reveals a sharp drop in the relative trading volume of the lowest quintiles immediately following the introduction of continuous trading and the move of large stocks to that system.[17]

E. Changes in the Volume of Call Auctions Resulting from Continuous Trading: The Neighborhood Effect

The long-run evidence around the move reveals dramatic improvement in the volume of large-cap stocks at the expense of small-cap stocks following the move to continuous trading. How can we explain the documented significant increase in the relative volume of small-cap stocks around the move to continuous trading? The following experiment helps to shed light on this issue.

Due to the gradual transition of the TASE to continuous trading, the two systems of trading (call and continuous) operate at the same time. Therefore, we can examine what happens to a security that trades in a call auction while its neighbors move to continuous trading. Table V examines a sample of 690 small-cap securities that trade in call auctions between August 1, 1997, and March 31, 1998, while others move to continuous trading. As shown in Table V and Figure 3, these securities experience a dramatic decline in their trading volume. Columns 5 and 6 describe the mean and median volume of trades (in million NIS) of these 690 securities, corresponding to the first 12 phases of the move to continuous trading. We observe a reduction in their mean trading volume from 36.85 million NIS before the move to 18.88 million NIS after the move of the other securities. This reduction corresponds to a period during which the total mean trading volume increases (see column 3). We define the relative volume of the 690 securities as their

[16] Changes in the absolute level of the volume of trade after the move cannot explain the change in the mix of trading. We find significant differences in the fraction of total volume of trade for the four lower quintiles following the move while controlling for the level of the absolute volume. We use regressions in which the explanatory variables for the relative volumes of each quintile are the total trading volume in the market and a dummy variable for the period following the move. These dummy variables are significant (using the White correction for heteroskedasticity).

[17] Note that both before and after the move to continuous trading there are no designated market makers. The two systems are relatively transparent and the move does not involve listing or inclusion in any index. Yet, the call auction prior to the move is subject to a particular stabilization rule (Sect. I). If, at the opening, excess demand (supply) is observed at yesterday's closing price, investors are allowed to submit only sell (buy) orders. A similar rule is used at the opening stage of the NYSE (see Madhavan and Panchapagesan (2000)). The very existence of this stabilization rule can limit the volume of trade and prevent the market from attaining the "true equilibrium price," thereby inducing positive autocorrelation. Hence, observed increases in the relative volume of trade can be the result of the elimination of this rule rather than the move to continuous trading. We thank the referee for pointing this out to us. It seems, however, that the elimination of the stabilization rule does not fully explain our results. As described above, the relative volume of the small-cap stocks following the move to continuous trading went down. These securities, which are traded only in call auctions prior to the move, should benefit from the elimination of the stabilization rule. Yet, their volume drops. Thus, we conclude that the stabilization rule is not a sufficient explanation for our results.

Table V

Investigation of the Trading Volume of Caram Securities that Did Not Move to the Continuous System as of March 31, 1998: "The Neighborhood Effect"

We examine the behavior of the daily trading volume of 690 Caram securities that did not move to continuous trading by March 31, 1998. The 13 days prior to the first movement are defined as phase 0. Phase 1 starts on August 14, 1997, and ends on September 3, 1997 (the second transfer). Phases 2, 3, and all the others are defined in the same way. Relative volume is computed by dividing the total volume of all the securities that do not move to continuous trading by the total trading volume in the market. This ratio measures the share of the daily volume of the securities that do not move in the total daily volume of the market.

Phase	Period Begins at	Average Daily Trading Volume of the Market (million NIS)		Average Daily Trading Volume of Remaining Securities (million NIS)		Average Daily Relative Volume (%)	
		Mean	Median	Mean	Median	Mean	Median
0	08/01/97	196.24	212.76	36.85	36.12	18.88	18.08
1	08/14/97	143.73	143.27	27.05	25.48	19.21	18.64
2	09/03/97	139.79	140.34	19.87	18.33	14.41	14.86
3	09/18/97	160.20	159.01	18.51	19.03	12.17	11.59
4	10/09/97	225.37	191.63	19.58	21.03	10.01	10.65
5	10/30/97	148.90	141.30	15.85	15.05	11.02	10.52
6	11/11/97	146.51	136.88	14.77	13.62	10.31	10.69
7	12/08/97	183.70	194.54	16.98	16.75	9.39	8.83
8	12/11/97	150.15	152.77	13.26	12.89	9.00	8.84
9	12/21/97	135.29	134.82	14.00	14.10	10.34	10.24
10	12/25/97	140.03	133.07	13.60	13.33	9.87	10.04
11	01/22/98	126.27	119.79	11.36	11.13	9.68	9.60
12	02/22/98	221.49	216.67	13.69	13.04	6.63	6.48
13	03/19/98	239.45	218.82	18.88	19.53	8.65	8.70

total daily volume divided by the total market volume. This measure should be invariant to fluctuations in the total volume of trade. As detailed in column 7, we observe a dramatic reduction in the mean relative volume from 18.88 percent before the move to 8.65 percent after the move. These changes in the relative volume could simply indicate a new division of the existing pie. However, our evidence indicates that this is not the case: The entire trading volume increases while the trading volume of the securities traded in call auctions drops significantly. In a regression of the relative volume of the remaining 690 securities on time and market volume (as a control variable), we find a statistically significant negative coefficient on time.

The evidence presented in Table V and Figure 3 explains the seeming contradiction between the long-run reduction in the relative volume (and volume) of small-cap securities and the observed increase in these variables around their own move to continuous trading. Small-cap securities lose volume well before their own move to continuous trading.

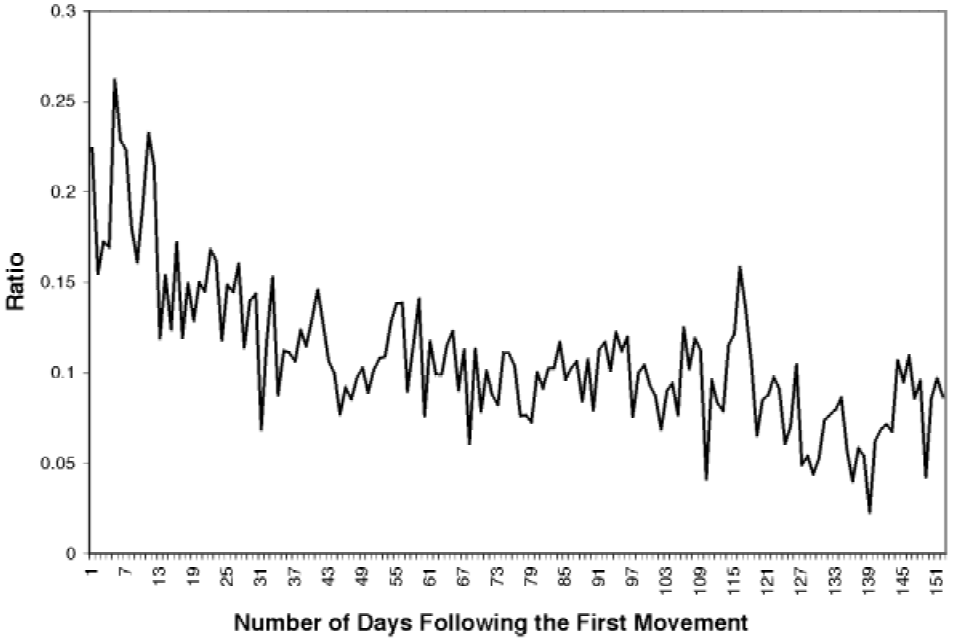

Figure 3. The relative volume (i.e., daily trading volume of securities that did not move to continuous trading to the total daily market trading volume) during the period August 14 to March 13, 1998.

Note that the securities that remain longer in Caram trading have smaller capitalization, as the TASE chooses first to move the more heavily traded securities. Thus it is difficult to draw general conclusions from this experiment. Nevertheless, it seems that the very existence of an attractive continuous trading mechanism as an alternative imposes negative externalities on securities traded in the call auctions. One possible explanation of the shift in investors' interests could be their demand for hedging. It seems reasonable to assume that the stocks that move to continuous trading are good substitutes for the securities that still trade in call auctions. Consequently, investors may prefer to hedge using securities that trade continuously. An alternative explanation could be the tendency of trading desks to concentrate their activity in the main trading system. By doing that they could neglect the call auction. For whatever reason, it seems that the call auctions could not withstand the competition.

F. Evidence of Endogenous Concentration of Trades

It is extremely rare for a Mishtanim stock to have a day without any transaction. For the Caram sample, we find a significant increase in the fraction of days without trades, from a mean of 38.2 percent before the move

to a mean of 51.3 percent after the move. Yet, we observe a significant increase (of 32 percent) in the mean trading volume of the Caram securities around the move. It seems that, for the Caram sample, the higher trading volume is concentrated in fewer days. Indeed we find significantly higher coefficients of variation in daily volume after the move to continuous trading. This evidence is consistent with the hypothesis that traders endogenously aggregate their trading to preferred points in time when it is sufficiently important to do so (see Admati and Pfleiderer (1988) and Anshuman and Kalay (2001)).

IV. Conclusions

This paper considers whether including a continuous trading stage is beneficial to all securities. Theory suggests that continuous trading can be suboptimal to small-cap securities. Indeed, the Paris Bourse (as well as other European exchanges) decided not to include a continuous session in trading small-cap securities. Examining the issue is important practically as most securities (even in the larger exchanges) trade infrequently. Investigating the transition of TASE from call auctions to continuous trading, we find that the large-cap securities are the clear winners. There is a change in the mix of trading following the move to continuous trading: When the smoke clears and the move is complete, small-cap securities have a lower relative volume. However, our evidence indicates that, if left in a call auction while large-cap stocks move to continuous trading, the relative position of the small-cap securities would have been even worse.

Our evidence indicates that the move of large-cap securities to continuous trading shifts interest away from the smaller-cap securities that continue trading in call auctions. Yet, the actual move of these small-cap securities to continuous trading is associated with an increase in their relative volume and with a respective positive security price response. We find a positive correlation between the increases in volume and the respective security price changes. These results are consistent with Brennan and Cao (1996). One can argue that the entire move to continuous trading hurt the liquidity of small-cap stocks. However, not conducting a continuous trading session for them will reduce their liquidity even more. Finally, by using daily data, we document evidence of a more concentrated trading volume for small-cap securities following the move.

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