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Firm size, ownership structure, and systematic liquidity risk: The case of an emerging market☆

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ABSTRACT

Previous studies support the hypothesis that institutional ownership leads to an enhanced systematic liquidity risk by increasing the commonality in liquidity. By using a proprietary database of all incoming orders and ownership structure in an emerging stock market, we show that institutional ownership leads to an increase in commonality in liquidity for mid- to-large cap firms; however, only individual ownership can lead to such an increase for small cap firms, revealing a new source of systematic liquidity risk for a specific group of firms. We also reveal that commonality decreases with the increasing number of investors (for both individual and institutional) at any firm size level; suggesting that as the investor base gets larger, views of market participants become more heterogeneous, which provides an alternative way to decrease the systematic liquidity risk.

1. Introduction

With the free movement of global capital and the adaptation of high-level technology to financial markets in the last few decades, market participants have started to pay considerable attention to the concept of liquidity. However, even though it was found out that liquidity is an essential factor in the proper functioning of financial markets, many academic researchers and practitioners did not pay enough attention to study and understand the different aspects of liquidity before the recent global financial crisis.

Among those who were deeply involved in the subject, a specific group has revealed a crucial fact by examining the co-movement between individual stock liquidity and market-wide liquidity. According to their work, there exists a significant common component that influences firm-level liquidity; i.e., liquidity is subject to a spillover effect that influences other firms traded in the same stock exchange (Chordia et al., 2000; Huberman and Halka, 2001; Hasbrouck and Seppi, 2001). Thus, liquidity is not just the trading cost of an individual stock but also a potential systematic risk factor due to commonality (Pastor and Stambaugh, 2003; Acharya and Pedersen, 2005; Sadka, 2006; Bekaert et al., 2007; Korajczyk and Sadka, 2008; Kamara et al., 2008). Therefore, understanding the commonality and its sources is important as it might provide a clue to solving the puzzles of market dry-ups and crashes, and further contribute to financial stabilization policies, improved market design and more accurate guidance for portfolio selections. However, although the literature is thorough for the US markets, little research has been conducted on others (Brockman et al., 2009; Karolyi et al., 2012).

The limitation of the number of studies on the remaining global markets leaves us at a curious state regarding the driving mechanisms of commonality in liquidity. In particular, how do the firm size and ownership structure play a role in liquidity commonal-

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ity in other markets? Using several unique datasets, we will try to answer this question for a leading emerging market, Turkey.[1]

Although it is a highly important topic, previous results on the effects of firm size and the ownership structure on commonality in liquidity remain relatively narrow due to limited data on ownership. This importance is highlighted through demand side hypothesis which suggests that trading operations of institutional investors may be correlated due to their herding behavior, the employment of momentum strategies, resemblance of investment styles and risk management practices. Further, independent of these factors, institutional investors seem to prefer very specific types of firms such as the ones with large market capitalization and good governance. Therefore, institutional investors may generate common buying or selling pressure, which, in turn, may affect systematic liquidity.[2] To the best of our knowledge, there are four studies on this subject: Kamara et al. (2008) examine the impact of changing aggregate levels of institutional ownership on commonality in NYSE stocks. Using annual ownership data, they find that commonality increases over time through correlated trading patterns by institutional owners. Using quarterly ownership data, Koch et al. (2016) complement their findings by showing that mutual funds are an important factor in explaining commonality in liquidity in NYSE and AMEX stocks. Recently, Cao and Petrasek (2014) show that there is a significant and positive relation between hedge fund ownership in quarter $q-1$ and the liquidity risk in quarter q for NYSE, AMEX and NASDAQ stocks. Their findings support the model of Brunnermeier and Pedersen (2009), in which adverse liquidity shocks force levered institutions to reduce their leverage by selling off assets, leading to declining liquidity spirals. Finally, Zhang et al. (2009) study commonality in liquidity across international equity markets. With a cross-sectional analysis using data from 25 countries, authors find that cross-border liquidity commonality is particularly high for firms with high foreign institutional ownership.

These results are also theoretically and empirically supported by the studies on the effects of index trading by institutional investors. Accordingly, index trading yields to a correlated trading activity and, in turn, creates common buying or selling pressure, eventually leading to higher levels of commonality in liquidity.[3] For example, in the model of Gorton and Pennacchi (1993), equity basket trading increases the commonality in liquidity for the constitute stocks in the basket, but reduces liquidity commonality for individually traded stocks. Chordia et al. (2000) show that commonality is higher for large cap NYSE stocks and speculate that the reason is the greater prevalence of institutional herd trading in larger firms. Harford and Kaul (2005) examine order flows of U.S. stocks and find significant common effects for S&P500 stocks, but weak effects for others. Similarly, Corwin and Lipson (2011) argue that correlated basket trading (either as natural or algorithmic) is an explanation of liquidity commonality in NYSE stocks.

In terms of the effects of ownership structure on commonality, not only being individual or institutional, but also being foreign or domestic investor may be a potential source of commonality.[4] Even though there is not a specific study in the commonality literature, studies from other context imply plausible reasonings. For example, Choe et al. (2005) show that foreign investors are at an information disadvantage about a local firm compared with domestic investors. Therefore, one can argue that they may be subject to herding more by putting a relatively larger weight on what the others are doing and less weight on their own knowledge due to their information disadvantage.

Another way to look at the effect of ownership structure on commonality would be taking the number of investors into account. In particular, from the supply side hypothesis, more investors joining to the stock market means an increased liquidity supply, hence a declined liquidity commonality. Alternatively, demand side hypothesis would suggest that individual and uninformed traders may trade securities because of sentimental reasons. Therefore, as the number of individual investors increase, we may expect a stronger investor sentiment effect, hence an increase in commonality (Karolyi et al., 2012).

Apparently, studies on ownership effect lead us to another potential source of commonality; namely, the firm size. Chordia et al. (2000) and Kamara et al. (2008) show that large firms are more sensitive than small firms to market-wide liquidity variations in NYSE. In this case, Chordia et al. (2000) only speculate on possible reasons. As we mentioned above, authors believe that this is due to the correlated trading of multiple stocks by institutions with similar investment styles in large firms. They believe lower commonality in small firms is unlikely to be caused by more prevalent asymmetric information specific to them. That would promulgate a lower level of explanatory power in the small firm regressions but not necessarily smaller slope coefficients. Alternatively, they suggest a possible “size factor” in liquidity analogous to the small minus big factor documented for returns by Fama and French (1993). In another study, Kamara et al. (2008) statistically try to show the institutional herd trading is a reason of higher commonality in large firms. Their main argument is that index-based trading and algorithmic trading have increased substantially over the last years. Since they are much more prevalent in large-cap stocks than in small-cap stocks, they should lead to an increase in liquidity commonality for large firms and a reduction in liquidity commonality for small firms. Interestingly, Brockman and Chung (2002) and Brockman et al. (2009) find the opposite results on the firm size effect on liquidity commonality in Hong Kong Exchange and some other markets worldwide, respectively. However, authors do not present any argument on potential reasons.

These studies clearly support the hypotheses that different aspects of ownership structure may have effects on commonality in various ways. May be most importantly, they suggest that institutional ownership leads to an increase in commonality in liquidity and firm size plays an important role in this phenomena. However, if we are to point the finger at the institutional investors for increasing systematic liquidity risk, the subject requires further analysis due to two main reasons.

First, we have to take the certain structural differences into account, in particular the trading habits of individual and institutional investors. For example, the proportion of US public equities managed by institutions is about 67% in 2010 (Blume and Keim, 2012), and the traded value by institutional algorithmic traders is

[1] With 237 USD bn. market capitalization and 431 USD bn. traded value at the end of 2013, equity market of Borsa Istanbul (formerly known as the Istanbul Stock Exchange) is ranked 6th in traded value among all emerging markets in the world. Moreover, it is ranked 3rd in the whole world with a share turnover velocity of 192.3% in the same year, displaying the high level of trading activity at a global scale in Borsa Istanbul. And the fact that foreign ownership accounts for more than 62% of the free-float value in the last four years makes this study even more important, not only for domestic investors but also for foreign market participants.

[2] On the other hand supply side hypothesis suggests that aggregate liquidity is affected by financial market conditions as well such as the stock market performance (in particular during market downturns), short-term interest rates as well as the term spread (or major economic and/or financial events in general).

[3] Index trading is mostly performed by exchange traded funds (ETFs) which are based on an index and aim to reflect the performance of its base index to the investors. ETFs invest in the securities on its base index in proportion to their weight in the index. Thereby, for example, an investor willing to invest in an index can invest in an ETF rather than purchasing the equities of the index separately. ETFs, which were initiated first in 1993, represent one of the fastest growing recent financial innovation.

[4] The terms foreign and domestic are not used to denote the nationality of investors, but to indicate whether the account is opened abroad or not.

more than 80% of the total traded value in the same year (Glantz and Kissell, 2014). In fact, current estimations suggest that individual investors trade less than 10% of the total traded value in US market. On the other hand, during our sample period, individual investors perform roughly the 80% of the total trade in the Turkish market, even though their ownership corresponds the 20% of the total market capitalization.[5,6] We also have to keep in mind that markets may differ based on their technology as some of them may have older technology which puts limits on computerized trading systems that are highly preferred by institutional investors, but are also accused of creating correlated trading. For example, even though algorithmic trading is possible in Borsa Istanbul, high frequency trading (HFT) is not. In addition, orders given by algorithmic traders constitute less than 5% of the total order flow in terms of volume, and the trade volume by these mechanisms is less than 4% of the total trade in the sample period.[7]

Second, previous studies commonly use liquidity measures based on best bid and ask prices such as the quoted or effective spread; however, using these measures may not be equally reliable for all global markets. In particular, Jain (2003) shows that larger and more developed stock markets tend to have lower relative tick sizes than smaller and less developed markets. If the tick size in a stock market is too large, then a possible outcome is that bid-ask spreads always stick to one tick (see Degyrse et al., 2005; Dayri and Rosenbaum, 2015 for a discussion on this fact). In that case, two stocks with different order book characteristics may seem very similar in terms of liquidity when one considers the absolute or the relative spreads only at the best price levels, yielding to possible misleading results in an analysis on the systematic liquidity risk. For example, size of the best bid-ask spread in our sample is equal to one tick for more than 98% of the time, however, cost of trading significantly differs as we walk up the order book.[8]

In our work, by using full order flow data of each stock, we construct a special weighted spread that measures the cost of round trip (buying and selling simultaneously) for a given amount of position. By using different positions to trade, we look for the firm size and ownership effect on commonality in liquidity at the different levels of the order book.[9] At the same time, we also perform our analysis for buy and sell sides separately for a robustness check.

Accordingly, we show that institutional ownership leads to an increase in the commonality in liquidity for mid-to-large cap firms for any position size to trade, a result in parallel to the previous studies. However, only individual ownership can lead to such an increase for small cap firms, revealing a new source of systematic liquidity risk for a specific group of stocks. We also show that commonality decreases with the increasing number of investors (for both individual and institutional) at any firm size level. Accordingly, as the investor base gets larger, views of market participants become more heterogeneous; which suggests the policy makers an alternative way to decrease the systematic liquidity risk in the market.

Further analysis involving the origin of the investors shows that different ownership origins have different impact on liquidity commonality. For the largest firms, only foreign institutional ownership has a significant positive impact on commonality, whereas for mid-size firms, both foreign and domestic institutional ownership have a significant positive impact. Regarding smallest firms, foreign and domestic individual investors both have positive impact on commonality, however their effect differ from each other depending on the order book structure.

Overall, our contribution to the literature can be summarized as follows: First, this is the first study that investigate the relation between commonality in liquidity and the ownership structure in a leading emerging market, Turkey. Second, we use not annually or quarterly but weekly ownership data to understand the liquidity commonality and ownership relation. As far as we know, this is the highest frequency data used in the studies relating commonality in liquidity to ownership structure and it provides us a more robust structure. Third, unlike other studies, we analyze the effect of the number of (different types of) investors on liquidity commonality rather than analyzing solely the ownership ratio. By doing so, we reveal an important finding on the effect of number of investors on commonality. Finally, we use the origin information of investor types to analyze the effect of ownership structure on commonality in liquidity. As a result, we discover interesting findings with potential suggestions to policy makers.

Our findings imply that previous results on ownership and firm size effect may not be general stylized facts due to the different micro-structure and investor characteristics across markets. And the regulators should pay special attention not only to institutional but also the individual ownership structure in order to decrease systematic liquidity risk.

In the rest of this work, we introduce our liquidity measure and its advantages in Section 2, and then we explain our sample selection methodology. Section 3 contains the main empirical analysis, whereas Section 4 checks the robustness of the results using an alternative set of order book liquidity measures. Finally, Section 5 concludes the paper with a brief summary and suggestions for policy makers and regulators.

[5] The trade volume by investor type is rarely disclosed, but similar patterns are observed in some other markets. For example, a recent report by the Saudi Arabia stock exchange shows that institutions own 86% of the total market value, whereas trade volume of individual investors is 82% of the total trade in 2015 (see http://www.tadawul.com.sa/static/pages/en/SOP/WeeklyTrading&OwnershipByNationalityReport_20151001.pdf). Similarly, about 85% of the total trade in Chinese stock markets are performed by individual traders in 2015, according to Reuters. Regarding other markets, Barber et al. (2009) report that individual ownership is around 56% in Taiwan between the years 2000 and 2003, whereas trading by individuals correspond to 90% of the total trade volume. In another study, Rhee and Wang (2009) mention that Indonesian equity market is highly institutionalized, with less than 5% of the free-float value held by individuals between 2002 and 2007. However, even though they do not report the trade volume by investor type, their findings imply that buy-and-hold strategy by institutional investors reduces their need to trade frequently, therefore their presence in a stock diminishes it's trading volume.

[6] In the literature, order flow by an individual investor is typically being considered as uninformed. Although it is not the scope of this paper, the high percentage of individual order flow and trade could point to a potential research hypothesis. In particular, one could look for an answer to the question of "do stocks with more institutional trading have more informed trading?". Depending on the answer, the next question would be "does this situation affect their sensitivity to market wide liquidity?".

[7] These numbers were obtained from a survey conducted on all brokerage firms trading on Borsa Istanbul in the sample period. The actual numbers are impossible to estimate as the orders are transmitted to the exchange via FIX API protocol which does not carry the information on orders being algorithmic or not.

[8] As a more general problem, measures based on best prices may be lack of important information hidden in the order book. In particular, the main problem is that when investors have large positions to trade, their orders will extend beyond best prices. This is a potential concern especially to any institutional investor that re-balances large positions across many stocks as the execution risk may be non-diversifiable. However, although it is extremely important, the research on commonality beyond best prices is highly limited due to the non-availability of order book data. For recent studies on developed markets, see Kempf and Mayston (2008); Corwin and Lipson (2011).

[9] At this step, a potential problem is the allowance of hidden or iceberg orders (the orders with price and volume information is completely or partially invisible). Such a situation may bring out difficulties in re-constructing the order book. Borsa Istanbul does not allow these types of orders, therefore our liquidity measure reflects true information in this setup.

2. Liquidity measure and sample selection

To measure liquidity, we use the Exchange Liquidity Measure (*XLM*) which estimates the cost of trading for a given position size Q (money) at a specific time *t*.[10]

Consider the snapshot of the order book of a stock at time *t*. Let a_i and b_i be the *i*th best ask and bid prices respectively at that instant. Denote by $P_{mid} \equiv (a_1 + b_1)/2$ the mid price of a_1 and b_1 (so called fair price); $LP \equiv (a_1 - b_1)/2P_{mid}$ the half of the bid-ask spread (so-called liquidity premium); $b(n) = (\sum b_i n_i)/n$ where $\sum n_i = n$, the weighted average bid-price at which the total of *n* shares can be sold; $a(n) = (\sum a_i n_i)/n$ where $\sum n_i = n$, the weighted average ask-price; $APM_{bid}(Q) \equiv (b(1) - b(n))/P_{mid}$, where $P_{mid} \times n = Q$ the size of the position in TL,[11] called the adverse price movement for the bid side; similarly $APM_{ask}(Q) \equiv (a(1) - a(n))/P_{mid}$, called the adverse price movement for the ask side. Then, the liquidity measures are calculated as the following;

$$XLM_A(Q) = 100 \times (LP + APM_{ask}(Q))$$

$$XLM_B(Q) = 100 \times (LP + APM_{bid}(Q))$$

$$XLM_{RT}(Q) = XLM_A(Q) + XLM_B(Q)$$

where $XLM_A(Q)$ ($XLM_B(Q)$) is the execution cost for ask (bid) side; i.e., buy (sell) order for a given position Q, measured in points, and $XLM_{RT}(Q)$ denotes the cost of round trip. For example, $XLM_{RT}(25{,}000) = 0.2$ means that implicit cost for buying and selling a specific stock using a position of 25,000 TL would have amounted to 50 TL. As easily understood, *XLM* covers all the static dimensions of liquidity (tightness, depth and breadth); however, unable to capture the dynamic dimensions (resiliency and immediacy) as the measure can only be defined for immediate transactions,[12] therefore, order splitting can not be taken into account. A visual explanation of $XLM_{RT}(Q)$ can be seen in Fig. 1.

2.1. Sample selection criterion

Our order book data comes from Borsa Istanbul database and covers all orders coming to the stock exchange from January 4, 2010 to December 31, 2013. The main requirement of the *XLM* methodology is that a stock should be traded via continuous auction. The number of listed stocks on Borsa Istanbul were in between 323 and 429 through the sample period, and removing the stocks traded via single price auction leaves us with 369 stocks to consider. Among these, one of the requirements we look for is to be listed on the stock exchange during the whole sample period as we do not want to be affected by any initial public offering or delisting effect, and more importantly, including delisted or late listed stocks would introduce a bias in performing a market cap based quantile classification. This criterion reduces the sample size to 276 stocks.

We only use the continuous trading period on each trading day, and take six snapshots of the order book of each stock at 10:00, 11:00, 12:00, 15:00, 16:00 and 17:00, and calculate the *XLM* (ask, bid and round trip) for five different position sizes of Q = 1000, 10,000, 25,000, 50,000, 10,0000 TL.[13] The last criterion to be introduced is based on the position availability as it is not always possible to find a hypothetical order of size Q, in particular when Q is large. Accordingly, we removed the stocks if the order book does not carry the required positions more than 2% of the whole sample period. This criterion leaves us 133 stocks to analyze.[14] For these stocks, in times the order book does not carry the required position, a hypothetical order book is constructed as if there were infinite orders at the last price levels in the order book. Since at least one bid and ask were present all the time, such a construction was not a problem.[15] Comparing with the other commonality studies at the order book level, our analysis includes one of the largest samples since the works by Domowitz et al. (2005); Friederich and Payne (2007); Kempf and Mayston (2008) and Corwin and Lipson (2011) cover 19, 100, 30 and 100 stocks respectively.

Finally, the daily liquidity measure is constructed by taking the arithmetic mean of the six intra-day values.[16]

Through the rest of this study, we denote XLM_A, XLM_B and XLM_{RT} by *A*, *B* and *RT* to simplify notations, and we will use Q1, Q2, Q3, Q4, Q5 to denote the position sizes Q = 1000, 10,000, 25,000, 50,000, 10,0000 TL respectively. For example, Q1_A, Q3_RT and Q4_B would mean $XLM_A(1000)$, $XLM_{RT}(25{,}000)$ and $XLM_B(50{,}000)$ respectively. Overall, we have fifteen different daily liquidity measures per stock.[17]

3. Firm size and the ownership structure

Table 1 shows summary statistics for our sample stocks. It contains the mean, standard deviation and selected percentile values for each variable over the entire sample. For each variable, we first calculate the daily time-series average for each stock and report cross-sectional statistics for the time-series means. *D* denotes the daily percentage change whenever it is used.

The mean values of the cost of trading are increasing with the position size to trade which is consistent with the theory. For all positions, bid side measure is slightly higher than the ask side measure on the average, telling that cost of buying is cheaper compared to cost of selling in general within our sample period. Besides from levels, absolute daily percentage changes in cost of trading also increase with the position size to trade. Moreover, similar to the case in levels, absolute daily percentage change in cost of selling is higher than the absolute daily percentage change in cost of buying for all positions on the average. As the position size to trade increases, absolute daily change in cost of trading becomes more volatile across stocks, possibly due to the cross-sectional heterogeneity of the order book. Table 1 also displays the big gap between

[10] The same measure was previously used by Domowitz et al. (2005) and Rosch and Kaserer (2014) in the context of liquidity commonality.

[11] TL stands for Turkish Lira. Turkey has a liberal foreign exchange regime with a fully convertible currency. In our study, it is not possible to construct the liquidity measure using U.S. dollar since the order flow is not kept in another currency, therefore, we perform our analysis using TL. As a reference to the readers, we give the weekly average USD/TL values which are 1.51, 1.68, 1.80 and 1.91 for the years 2010, 2011, 2012 and 2013 respectively.

[12] Tightness refers to the low transaction costs, such as the difference between buy and sell prices, like the bid-ask spreads. Depth refers to the existence of abundant orders; i.e., a market is deep if there is a large volume of bids and asks above and below the market price. Breadth, as a wider definition of depth, means that orders are both numerous and large in volume with minimal impact on prices. Resiliency is a measure of how quickly prices converge to their correct equilibrium value after they have been moved by large transactions. Finally, immediacy is the opportunity for the immediate processing of transactions.

[13] These position sizes roughly correspond to 50%, 75%, 90%, 95% and 99% percentile of the single order sizes in the sample period. Moreover, the position Q = 1000 TL in our setup acts like an ordinary proportional-spread since this amount can be found at best price levels more than 90% of the time.

[14] According to the Global Industry Classification System, sample stocks belong to the following industries: Consumer Discretionary (32), Consumer Staples (11), Energy (3), Financials (28), Health Care (2), Industrials (23), Information Technology (3), Materials (26), Telecommunication Services (2) and Utilities (3).

[15] For 71 stocks, there was no need for a hypothetical construction, and for 33 stocks, the hypothetical construction was performed less than 0.3% of time. Indeed, only 2 stocks required such a construction for exactly 2% of the whole sample period.

[16] The choice of the calculation frequency solely depends on the computational burden. For randomly selected five stocks, the measure was also calculated at fifteen minutes intervals. The daily averages were the same to the second decimal point.

[17] The same dataset was used by Sensoy (2016) to measure the impact of monetary policy and macroeconomic announcements on commonality in liquidity.

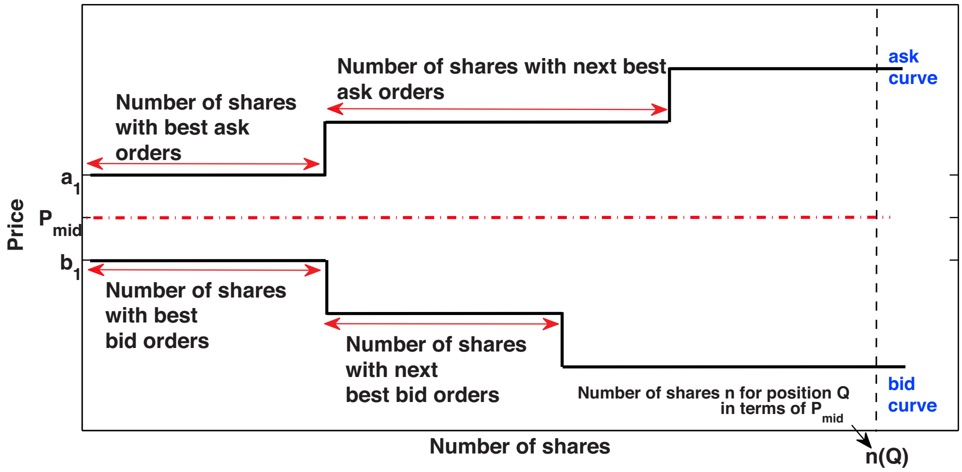

Fig. 1. Visual representation of the XLM_{RT}. $XLM_{RT}(Q) = \frac{\int_0^{n(Q)} \text{ask curve}(x)dx - \int_0^{n(Q)} \text{bid curve}(x)dx}{Q}$.

Table 1
Cross-sectional statistics for time-series means.

	20%	40%	60%	80%	Mean	Std
Traded value (million TL)	2.76	4.65	8.36	16.79	16.98	38.91
Number of shares traded (million)	0.59	1.46	2.86	5.18	4.74	7.84
Market capitalization (billion TL)	0.15	0.43	0.85	2.36	2.83	5.95
Price (TL)	1.18	2.15	4.1	12.11	13.47	34.58
Institutional Ownership	21.4%	40.6%	60.7%	79.9%	50.3%	29.1%
Foreign Institutional Ownership	3.9%	13.7%	32.5%	62.6%	31.8%	29.0%
Q1_A	0.1991	0.212	0.2555	0.4658	0.3168	0.1646
Q1_B	0.2001	0.2149	0.2588	0.4692	0.3188	0.1645
Q1_RT	0.3984	0.4258	0.5125	0.9362	0.6356	0.3292
Q2_A	0.2124	0.2399	0.3014	0.4833	0.3386	0.1628
Q2_B	0.2147	0.2494	0.309	0.4886	0.344	0.1635
Q2_RT	0.4258	0.4866	0.612	0.9703	0.6826	0.3263
Q3_A	0.2259	0.2828	0.3888	0.5274	0.3779	0.1668
Q3_B	0.2296	0.3003	0.3989	0.5268	0.3849	0.1679
Q3_RT	0.4538	0.5807	0.7933	1.0515	0.7628	0.3345
Q4_A	0.2539	0.3615	0.5013	0.5848	0.4468	0.1919
Q4_B	0.2637	0.3853	0.5225	0.6057	0.4578	0.1927
Q4_RT	0.5234	0.7526	1.0235	1.1868	0.9047	0.3837
Q5_A	0.3062	0.4832	0.6563	0.8115	0.5844	0.2752
Q5_B	0.3113	0.497	0.6729	0.8556	0.6013	0.2728
Q5_RT	0.6158	0.9713	1.3319	1.7199	1.1857	0.5439
|DQ1_A|	0.0238	0.0409	0.0601	0.0914	0.061	0.0409
|DQ1_B|	0.0274	0.0454	0.0692	0.1053	0.0686	0.046
|DQ1_RT|	0.0248	0.0419	0.0605	0.0924	0.0619	0.0402
|DQ2_A|	0.0416	0.0858	0.1239	0.179	0.1122	0.0714
|DQ2_B|	0.0484	0.0947	0.1469	0.2135	0.1254	0.0788
|DQ2_RT|	0.0423	0.0794	0.1146	0.1673	0.1021	0.0609
|DQ3_A|	0.0616	0.1225	0.1784	0.2348	0.1513	0.0863
|DQ3_B|	0.0727	0.1335	0.1941	0.2704	0.1674	0.0966
|DQ3_RT|	0.0622	0.1063	0.1518	0.2052	0.1331	0.0735
|DQ4_A|	0.0899	0.1621	0.2274	0.2714	0.1856	0.0935
|DQ4_B|	0.0985	0.1724	0.2426	0.3175	0.2085	0.1107
|DQ4_RT|	0.0827	0.1385	0.19	0.2397	0.1629	0.0825
|DQ5_A|	0.1336	0.2114	0.2699	0.3016	0.2237	0.0984
|DQ5_B|	0.144	0.2297	0.2929	0.3607	0.2567	0.124
|DQ5_RT|	0.1163	0.1792	0.2277	0.2703	0.197	0.0896

Q1, *Q2*, *Q3*, *Q4* and *Q5* refer to the amounts of 1000, 10,000, 25,000, 50,000 and 100,000 TL respectively, whereas the liquidity measures *A*, *B* and *RT* stand for the cost of buying (ask side), selling (bid side) and round tripping (buying and selling simultaneously) a given amount of position respectively. *D* preceding the acronym denotes a proportional change in the variable across successive trading days, and |...| denotes the absolute value.

the trading activity (traded value and number of shares traded), firm size and institutional ownership across the corresponding percentiles.

As might be understood from Table 1, our unique dataset provides us not only the full order flow, but also the weekly ownership structure of each firm in our study. In particular, the ownership data that is provided by the Central Registry Agency of Turkey contains the market cap owned by institutions as the percentage of total market cap and the number of such institutions at the end of each Wednesday. To use this data efficiently, we implement the methodology of Dynamic Conditional Beta (DCB) by Bali et al. (2016) on Eq. (1), which allows us to estimate a time-varying liquidity beta for each firm without consuming any initial data (see Appendix A for the methodology).

$$DL_{i,t} = \alpha_i + \beta_{i,t} DL_{M,t} + \varepsilon_{i,t} \quad (1)$$

In Eq. (1), $L_{i,t}$ is a general notation to denote the measure of an individual liquidity for stock i on day t; $L_{M,t}$ is equally-weighted cross sectional average of the liquidity variable for all stocks on day t excluding stock i; and again, the operator D stands for the daily percentage change. With this estimation, we end up with a liquidity beta value for each Thursday associated with an ownership data for each preceding Wednesday.[18,19]

After estimating the time-varying betas in Eq. (1), we calculate equally-weighted averages of liquidity betas for all the firms in each size quintile which gives us a time-varying beta per quintile. Within these quintiles, to examine the cross-sectional relation between liquidity beta and institutional ownership, the initial idea is to estimate the cross-sectional regression given in Eq. (2) for each Thursday t, where $INST\_RATIO_{i,t-1}$ measures firm i's market cap owned by institutions as the percentage of total market cap at the end of each Wednesday $t-1$.

$$\beta_{i,t} = a + \lambda INST\_RATIO_{i,t-1} + \theta \log(MCAP_{i,t-1}) + \upsilon_{i,t} \quad (2)$$

Because a firm's institutional ownership and size are highly positively correlated, firm size, denoted by *MCAP*, is also included in the regression to alleviate any concerns that the institutional ownership coefficients may be capturing a pure size effect.

Fig. 2 shows some of the time-varying weekly liquidity betas belonging to different size quintiles and Table 2 presents their time averages. For the rest of this section, *M*5 ($n=27$), *M*4 ($n=26$), *M*3 ($n=27$), *M*2 ($n=26$) and *M*1 ($n=27$) will refer to the quintiles constructed by daily average (of four years) market cap, with *M*5 and *M*1 denoting the largest and smallest firms respectively.[20] According to Table 2, we observe higher commonality for small firms compared to large firms. For example, time average beta for *M*1 and *M*2 firms is 0.98 and 1.05 respectively for round tripping the position *Q*1, whereas this value is 0.79 and 0.75 for *M*5 and *M*4 firms respectively.[21] Further, the strength of the commonality pre-

Table 2
Time average of the dynamic liquidity betas.

	Q1_A	Q1_B	Q1_RT	Q2_A	Q2_B	Q2_RT	Q3_A	Q3_B	Q3_RT	Q4_A	Q4_B	Q4_RT	Q5_A	Q5_B	Q5_RT
*M*5	0.786	0.745	0.791	0.764	0.752	0.788	0.711	0.726	0.762	0.727	0.684	0.754	0.679	0.594	0.7
*M*4	0.733	0.732	0.747	0.876	0.853	0.929	0.902	0.853	0.935	0.903	0.841	0.903	0.923	0.849	0.898
*M*3	0.887	0.892	0.919	0.936	0.968	0.999	0.898	0.875	0.927	0.876	0.884	0.921	0.868	0.875	0.912
*M*2	1.035	1.021	1.046	1.206	1.106	1.166	1.099	1.044	1.092	1.024	0.993	1.012	0.959	0.963	0.99
*M*1	1.047	0.976	0.979	1.086	1.082	1.108	1.036	0.98	1.025	0.982	0.944	0.983	0.98	0.98	0.998

We implement the methodology of Dynamic Conditional Beta (Bali et al., 2016) to estimate a time-varying liquidity beta for each firm using the following multiple regressions:
$DL_{i,t} = \alpha_i + \beta_{i,t} DL_{M,t} + \varepsilon_{i,t}$
where liquidity variables for the individual stock i on tth Thursday is represented by $L_{i,t}$; and the equally weighted cross-sectional average of the liquidity variable for all stocks excluding stock i on the same Thursday is denoted by $L_{M,t}$. Here, D preceding the acronym denotes a proportional change in the variable across successive Thursdays. *M*5 ($n=27$), *M*4 ($n=26$), *M*3 ($n=27$), *M*2 ($n=26$) and *M*1 ($n=27$) refer to the quantiles constructed by daily average (of four years) market cap, with *M*5 and *M*1 denoting the largest and smallest firms respectively. We calculate equally weighted averages of liquidity betas for all the firms in each size quintile which produces a time-varying beta per quantile. This table reports the time averages of these dynamic liquidity betas.
In the manuscript, *Q*1, *Q*2, *Q*3, *Q*4 and *Q*5 refer to the amounts of 1000, 10,000, 25,000, 50,000 and 10,0000 TL respectively, whereas the liquidity measures *A*, *B* and *RT* stand for the cost of buying (ask side), selling (bid side) and roundtripping (buying and selling simultaneously) a given amount of position respectively. In this table, they refer to the time average betas of these liquidity measures.

[18] The raw ownership data is stamped as Friday. Since settlement day is T+2 in Borsa Istanbul, i.e., the second business day following the transaction, we obtain the real ownership data by shifting the time stamp two days back. However, we have to mention about a caveat with our dataset in this case. As in many stock exchanges around the world, there is a transaction method called "wire transfer" in Borsa Istanbul used for trading stocks between market participants. There are nine versions of this method in which four of them, the settlement of the transaction occurs on the same day. Although the exact numbers are not known, informal discussions with the settlement & custody authorities state that the majority of the volume traded via this method is in-between foreign institutions, or in-between domestic institutions. Therefore, error in the overall ownership structure implied by our dataset is assumed to be negligible.

[19] Chordia et al. (2000) include lead and lags of the changes in market liquidity in the commonality regression in order to capture the effect of non-concurrent adjustments in the liquidity variation at stock and market level. Accordingly, we checked whether including lead and lag in the commonality regression would make any difference. The findings showed that in almost all cases, the conclusive results are the same, therefore they are not reported.

[20] A common concern in such a classification is that the cross-sectional distribution of firm size may have changed over the sample period; i.e., a small firm in the beginning may fall into large firm quintile in the end of the sample period. This does not pose a big threat in our situation as we consider four years of data, a relatively short sample period for such a sharp change. For example, 23 out of the 27 *M*5 firms in our study are also *M*5 firms in each of the four sample years, and the remaining 4 firms are considered as *M*5 in at least 2 years based on their daily average market cap values. Similar results are also valid for different size quintiles.

[21] As mentioned in Section 1, the relation between firm size and liquidity (spread) commonality usually leads to two different findings. First one is that commonality increases with the firm size (Chordia et al., 2000; Fabre and Frino, 2004; Kamara et al., 2008), whereas the second one claims the opposite (Brockman and Chung, 2002; Brockman et al., 2009). Table 2 suggests that commonality in Borsa Istanbul increases as the firm size decreases, putting our work into the second group.

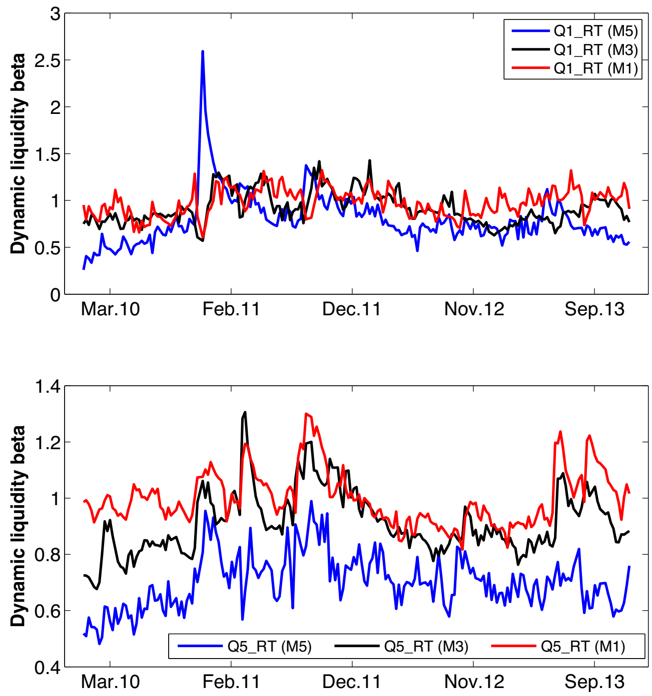

Fig. 2. Selected time varying liquidity betas for different firm size quintiles ($M5$: largest firms, $M1$: smallest firms) estimated by Dynamic Conditional Beta methodology: (a) for smallest position ($Q1$) to roundtrip; (b) for largest position ($Q5$) to roundtrip.

serves its levels throughout the order book for small firms whereas commonality tends to decline for large firms with the increasing position size to trade[22] (e.g., time average liquidity beta for small firms varies between 0.98 and 1.11, whereas for large firms, it decreases from 0.78 to 0.70 monotonically as position size to round trip increases from Q1 to Q5).

First, we start by checking whether there exist a stochastic or deterministic time trend in the commonality in liquidity by estimating the models in Eq.(3) and Eq.(4) respectively, and the corresponding results are displayed in Table 3.

$$\beta_t = a + \delta t + \gamma \beta_{t-1} + u_t \tag{3}$$

$$\beta_t = a + \delta t + u_t \tag{4}$$

According to the Table 3, the significant stochastic trends are limited to only a few buy side commonalities in different quintiles, and we also observe some significant deterministic trends. In addition, all significant trends are positive, thus, there is a partial increase in the liquidity commonality in Borsa Istanbul in the last few years. This may be an evidence for a slight increase in index trading performed by ETFs during the sample period.

Turning back to the ownership effect, we estimate the following cross-sectional regression:

$$\beta_{i,t} = a + \lambda_1 INST\_RATIO_{i,t-1} + \lambda_2 INST\_NUMBER_{i,t-1} + \theta \log(MCAP_{i,t-1}) + \upsilon_{i,t} \tag{5}$$

where $\beta_{i,t}$ is the liquidity beta for firm i on the tth Thursday, and $INST\_RATIO_{i,t-1}$ is the ratio of the market cap of firm i owned by institutional investors on the preceding Wednesday. As an additional variable to the model in Eq. (2), we include the number of institutional investors denoted by $INST\_N\ UMBER$ since we think that it is a potential determinant of commonality. In particular, supply-side hypothesis predicts that commonality in liquidity is positively related to the constrained market conditions; and negatively related to the excess liquidity environment. The increasing number of investors, whether they are individual or institutional, is de facto a liquidity providing effect as these investors submit buy or sell orders to the market. Thus, we may expect a decrease in liquidity commonality. On the other hand, demand side explanation would suggest that if the additional investors entering the market are uninformed and noise traders, heightened sentiment-driven trading activity could result in higher commonality in liquidity.

Table 4 reports the results of the time-series averages of the coefficients in the regressions and their t-statistics using the Fama and MacBeth (1973) methodology, with a Newey and West (1987) correction. Accordingly, except the smallest firms, the ownership effect on commonality is consistent with the previous findings. That is, an increase in the fraction of institutional ownership at the end of each Wednesday is associated with a significantly greater sensitivity to market-wide liquidity in the following Thursday. Thus, institutional investing appears to be a reason for commonality in liquidity for the firms except in $M1$ category. Moreover, the coefficient on the firm's market value is significantly positive at conventional levels in the regressions of all quintiles. However, although the value of the coefficient on the fraction of institutional ownership is highest for the largest firms ($M5$), we do not observe a monotonic decrease in this coefficient as we go from large to small firm quintile. Also, there is not an obvious pattern in this coefficient throughout the order book, except that it takes its maximum value not at the smallest nor the largest positions to trade, but somewhere in the middle.[23]

As expected, an interesting situation appears for the smallest ($M1$) firms. Accordingly, an increase in the fraction of institutional ownership leads to a lesser sensitivity to market-wide liquidity, which is in sharp contrast to the previous findings. Analogously, we

[22] This situation may be an evidence for investor (order flow) herding in small cap firms.

[23] We also estimate the equation where we interchange institutional ownership ratio and the commonality parameter in Eq.(5). The results provides evidence of a bidirectional causality in this case. See the Table 4 in the Appendix B for details.

Table 3
Time trend tests.

	Q1_A	Q1_B	Q1_RT	Q2_A	Q2_B	Q2_RT	Q3_A	Q3_B	Q3_RT	Q4_A	Q4_B	Q4_RT	Q5_A	Q5_B	Q5_RT
PANEL A: Deterministic time trend test															
$(M1)\ \delta\times 10^6$	6.84	24.42	68.50*	69.94*	115.73**	132.70***	−14.24	40.15	15.30	−6.02	−11.87	−8.10	47.92**	16.26	−11.59
	(0.16)	(0.70)	(1.81)	(1.85)	(2.00)	(2.58)	(−0.42)	(0.96)	(0.45)	(−0.22)	(−0.43)	(−0.29)	(2.00)	(0.46)	(−0.37)
$(M2)\ \delta\times 10^6$	−41.37	−10.09	12.32	224.56***	63.36	102.86**	207.21***	50.37	109.45***	69.46*	68.92**	44.17**	64.04	−5.47	8.51
	(−0.56)	(−0.19)	(0.18)	(5.01)	(1.34)	(2.31)	(5.34)	(1.12)	(2.63)	(1.79)	(2.25)	(2.05)	(1.41)	(−0.20)	(0.24)
$(M3)\ \delta\times 10^6$	6.45	−97.46	−31.27	59.63	−30.49	9.98	118.03***	99.27***	67.01*	82.95**	46.78	41.09	39.95	−37.00	30.02
	(0.12)	(−1.64)	(−0.57)	(1.13)	(−0.61)	(0.24)	(3.18)	(3.11)	(1.90)	(2.57)	(1.62)	(1.31)	(1.19)	(−0.98)	(0.80)
$(M4)\ \delta\times 10^6$	−6.40	17.00	94.90*	−14.37	36.86	57.53*	76.37**	19.40	31.89	92.97***	−35.07	39.29**	106.13***	41.26*	49.26**
	(−0.15)	(0.41)	(1.92)	(−0.30)	(1.00)	(1.73)	(2.31)	(0.93)	(1.28)	(3.72)	(−1.56)	(2.09)	(4.63)	(1.70)	(2.28)
$(M5)\ \delta\times 10^6$	−65.71	−65.29	−43.95	58.73	−47.46	25.92	140.18**	42.43	67.97*	65.89***	84.42**	48.50*	56.37***	53.06	24.91
	(−0.60)	(−0.58)	(−0.42)	(0.79)	(−0.68)	(0.39)	(2.50)	(0.99)	(1.70)	(2.58)	(2.15)	(1.83)	(2.58)	(1.31)	(0.72)
PANEL B: Stochastic time trend test															
$(M1)\ \delta\times 10^6$	−0.41	3.16	20.74	11.78	19.32	26.40	−6.66	9.29	3.28	−2.31	−2.06	−2.16	5.40	4.15	−1.38
	(−0.03)	(0.19)	(1.26)	(0.75)	(0.82)	(1.13)	(−0.59)	(0.55)	(0.28)	(−0.33)	(−0.22)	(−0.26)	(0.71)	(0.31)	(−0.19)
$(M1)\ \gamma$ 0.79***	0.68***	0.68***	0.77***	0.78***	0.75***	0.83***	0.72***	0.78***	0.83***	0.78***	0.78***	0.83***	0.72***	0.88***	
	(20.76)	(11.64)	(15.16)	(17.26)	(23.10)	(21.66)	(18.05)	(15.35)	(12.84)	(20.03)	(12.16)	(15.13)	(17.36)	(18.14)	(32.04)
$(M2)\ \delta\times 10^6$	−15.95	−5.31	−2.95	125.57***	4.53	17.20	99.64***	0.64	17.75	15.94	17.42	18.37	11.09	−6.56	0.62
	(−0.80)	(−0.33)	(−0.16)	(3.12)	(0.39)	(1.18)	(3.14)	(0.07)	(1.40)	(0.81)	(1.55)	(1.60)	(0.47)	(−0.34)	(0.02)
$(M2)\ \gamma$	0.81***	0.81***	0.82***	0.40***	0.86***	0.79***	0.48***	0.91***	0.80***	0.64***	0.80***	0.55***	0.65***	0.39***	0.32***
	(27.42)	(22.37)	(25.98)	(4.84)	(30.91)	(21.04)	(5.71)	(44.74)	(21.60)	(13.08)	(15.32)	(6.26)	(12.86)	(4.82)	(4.88)
$(M3)\ \delta\times 10^6$	−8.28	−20.27	−10.52	1.21	−7.86	−3.20	25.82	15.49	4.71	13.06	8.18	2.66	2.67	−6.68	−0.68
	(−0.47)	(−1.59)	(−0.84)	(0.06)	(−0.63)	(−0.27)	(1.27)	(1.64)	(0.39)	(0.92)	(0.94)	(0.34)	(0.28)	(−0.61)	(−0.08)
$(M3)\ \gamma$	0.79***	0.85***	0.85***	0.78***	0.83***	0.83***	0.70***	0.80***	0.82***	0.75***	0.75***	0.87***	0.83***	0.83***	0.89***
	(17.57)	(23.60)	(24.24)	(14.43)	(23.80)	(17.97)	(16.20)	(19.81)	(17.59)	(17.28)	(16.91)	(17.52)	(20.65)	(23.54)	(33.70)
$(M4)\ \delta\times 10^6$	−12.01	−3.69	7.72	−11.26	4.22	7.16	26.17	6.09	11.76	43.03**	−24.54	22.15	45.66***	17.51	15.51
	(−0.66)	(−0.22)	(0.36)	(−0.58)	(0.28)	(0.48)	(1.46)	(0.42)	(0.75)	(2.57)	(−1.62)	(1.59)	(2.82)	(1.40)	(1.56)
$(M4)\ \gamma$	0.76***	0.77***	0.83***	0.65***	0.70***	0.74***	0.57***	0.47***	0.49***	0.49***	0.35***	0.37***	0.52***	0.61***	0.68***
	(7.74)	(8.43)	(10.59)	(10.34)	(9.82)	(13.68)	(7.07)	(4.97)	(6.35)	(6.07)	(2.69)	(4.14)	(6.80)	(8.76)	(9.34)
$(M5)\ \delta\times 10^6$	−26.18	−25.79	−21.34	8.81	−15.38	−5.87	10.90	2.43	9.60	20.67*	13.48	11.87	15.51*	13.43	5.25
	(−0.87)	(−0.88)	(−0.84)	(0.37)	(−1.48)	(−0.42)	(0.85)	(0.15)	(0.80)	(1.72)	(0.90)	(1.01)	(1.77)	(0.98)	(0.47)
$(M5)\ \gamma$	0.79***	0.80***	0.81***	0.71***	0.90***	0.84***	0.87***	0.71***	0.75***	0.63***	0.73***	0.69***	0.66***	0.74***	0.71***
	(19.45)	(22.04)	(24.02)	(19.19)	(38.55)	(24.13)	(21.83)	(10.53)	(15.22)	(9.33)	(14.52)	(12.46)	(12.43)	(12.57)	(12.91)

This table presents the time trend tests for average liquidity betas of firms in each of the five size quintiles ($M5$: largest, $M1$: smallest firm size quintile). First, we regress the beta series on a constant and a time trend; i.e., $\beta_t = a + \delta t + u_t$, to see if there is any deterministic trend. Panel A reports the coefficient estimate of the time-trend and its t-statistic. Secondly, we regress the beta series on their first lags, a drift, and a time trend; i.e., $\beta_t = a + \delta t + \gamma\beta_{t-1} + u_t$, to detect any stochastic trend. Panel B presents the estimate of the first lag, time trend and their t-statistics. The t-statistics are adjusted for heteroskedasticity and autocorrelation using Newey and West (1987) standard errors. In both panels, *, ** and *** denote 10%, 5% and 1% significance level.

In the manuscript, $Q1$, $Q2$, $Q3$, $Q4$ and $Q5$ refer to the amounts of 1000, 10,000, 25,000, 50,000 and 10,0000 TL respectively, whereas the liquidity measures A, B and RT stand for the cost of buying (ask side), selling (bid side) and roundtripping (buying and selling simultaneously) a given amount of position respectively. In this table, they refer to the betas of these liquidity measures.

Table 4
Systematic liquidity and ownership structure in the cross-section.

	Q1_A	Q1_B	Q1_RT	Q2_A	Q2_B	Q2_RT	Q3_A	Q3_B	Q3_RT	Q4_A	Q4_B	Q4_RT	Q5_A	Q5_B	Q5_RT
PANEL A: Systematic liquidity and institutional ownership in the cross-section															
$(M5)\ \lambda_1$	1.672***	1.599***	1.648***	1.986***	2.014***	1.957***	1.874***	1.542***	1.856***	1.708***	0.906***	1.381***	1.415***	0.489***	1.110***
	(8.10)	(7.03)	(8.03)	(8.74)	(6.22)	(9.12)	(5.01)	(4.07)	(5.81)	(12.17)	(4.38)	(7.12)	(11.73)	(5.57)	(11.50)
$(M5)\ \lambda_2 \times 10^3$	−1.090***	−1.050***	−1.100***	−1.170***	−1.310***	−1.340***	−1.200***	−1.300***	−1.290***	−1.400***	−1.220***	−1.310***	−1.240***	−0.710***	−0.970***
	(−12.77)	(−10.80)	(−13.61)	(−15.95)	(−7.52)	(−14.96)	(−9.06)	(−21.49)	(−17.43)	(−15.38)	(−19.14)	(−19.16)	(−13.28)	(−14.58)	(−22.38)
$(M5)\ \theta$	0.163***	0.135***	0.156***	0.114***	0.123***	0.153***	0.061***	0.132***	0.074***	0.063*	0.101***	0.070***	0.026	0.110***	0.078***
	(4.82)	(4.48)	(5.08)	(4.75)	(3.67)	(5.08)	(2.79)	(5.47)	(2.65)	(1.76)	(3.12)	(2.66)	(0.99)	(5.42)	(3.52)
$(M4)\ \lambda_1$	0.565***	0.333***	0.413***	1.209***	0.998***	1.028***	1.350***	1.205***	1.323***	1.241***	1.291***	1.339***	1.204***	1.137***	1.133***
	(4.57)	(2.92)	(3.26)	(12.42)	(11.07)	(12.75)	(21.47)	(19.36)	(20.49)	(31.12)	(29.90)	(31.77)	(16.11)	(23.99)	(22.45)
$(M4)\ \lambda_2 \times 10^3$	0.070	−0.160	−0.150	0.140	0.210	0.360	−0.230	0.200	0.080	−0.450	−0.090	−0.260	−0.610*	−0.420	−0.430
	(0.25)	(−0.52)	(−0.37)	(0.49)	(0.94)	(1.00)	(−0.44)	(0.67)	(0.18)	(−0.89)	(−0.23)	(−0.63)	(−1.77)	(−1.55)	(−1.26)
$(M4)\ \theta$	0.527***	0.636***	0.525***	0.519***	0.934***	0.721***	0.469***	0.830***	0.697***	0.508***	0.676***	0.598***	0.447***	0.595***	0.584***
	(5.38)	(6.76)	(4.60)	(5.12)	(11.72)	(6.70)	(3.07)	(8.25)	(5.97)	(3.68)	(7.36)	(6.90)	(3.26)	(13.62)	(10.46)
$(M3)\ \lambda_1$	0.858***	1.000***	0.901***	1.147***	0.986***	1.078***	1.240***	0.796***	1.127***	1.127***	0.801***	1.013***	0.953***	0.715***	0.844***
	(6.92)	(13.50)	(7.20)	(11.32)	(4.54)	(7.80)	(13.14)	(10.27)	(9.76)	(16.24)	(10.57)	(10.10)	(16.62)	(7.90)	(12.78)
$(M3)\ \lambda_2 \times 10^3$	−1.890***	−1.800***	−2.140***	−3.670***	−2.960***	−3.220***	−3.540***	−2.19***	−2.840***	−2.800***	−1.790***	−2.480***	−1.800***	−1.440***	−1.770***
	(−8.76)	(−4.64)	(−7.01)	(−10.88)	(−6.55)	(−6.87)	(−26.60)	(−9.07)	(−13.72)	(−23.24)	(−9.35)	(−19.31)	(−18.44)	(−4.65)	(−12.23)
$(M3)\ \theta$	0.374***	0.132	0.327***	0.439***	0.416***	0.420***	0.264***	0.207***	0.249***	0.124***	0.239***	0.212***	0.025	0.195***	0.131***
	(7.92)	(1.59)	(5.57)	(10.45)	(6.89)	(8.14)	(10.61)	(3.98)	(7.18)	(5.42)	(7.82)	(11.80)	(0.82)	(6.87)	(7.08)
$(M2)\ \lambda_1$	1.092***	1.040***	1.115***	1.275***	1.053***	1.173***	0.637***	1.022***	0.855***	0.221**	0.526***	0.299***	0.332***	0.170	0.297**
	(6.81)	(9.75)	(7.51)	(15.05)	(23.01)	(20.30)	(7.89)	(17.5)	(14.77)	(2.14)	(8.37)	(4.26)	(3.36)	(1.28)	(2.11)
$(M2)\ \lambda_2 \times 10^3$	−4.700***	−4.310***	−4.620***	−9.180***	−5.190***	−7.040***	−8.180***	−4.910***	−6.610***	−6.290***	−3.600***	−4.970***	−5.020***	−3.520***	−4.140***
	(−5.95)	(−7.25)	(−9.39)	(−16.41)	(−16.05)	(−15.14)	(−20.66)	(−15.76)	(−16.95)	(−16.33)	(−19.79)	(−16.05)	(−12.83)	(−10.66)	(−18.45)
$(M2)\ \theta$	0.038	0.220*	0.153*	0.397	0.495***	0.435**	0.369**	0.461***	0.453***	0.398***	0.520***	0.520***	0.383***	0.515***	0.450***
	(0.46)	(1.81)	(1.67)	(1.52)	(3.11)	(2.46)	(2.27)	(2.81)	(3.17)	(3.15)	(3.77)	(3.91)	(3.97)	(4.93)	(4.09)
$(M1)\ \lambda_1$	−0.530**	−0.393***	−0.172	−0.604***	−0.497*	−0.354	−0.096	−0.045	−0.018	−0.123	−0.031	−0.265***	−0.159**	0.041	0.036
	(−2.44)	(−3.06)	(−1.08)	(−3.79)	(−1.87)	(−1.47)	(−0.49)	(−0.23)	(−0.12)	(−0.72)	(−0.39)	(−3.41)	(−2.10)	(0.37)	(0.36)
$(M1)\ \lambda_2 \times 10^3$	−3.88***	−2.640***	−3.510***	−5.120***	−6.310***	−6.69***	−3.530***	−3.930**	−4.330***	−1.290***	−2.450***	−2.010**	1.240	−1.070	0.000
	(−8.69)	(−3.02)	(−4.96)	(−6.69)	(−6.62)	(−7.92)	(−3.97)	(−2.36)	(−4.34)	(−2.78)	(−3.02)	(−2.51)	(1.58)	(−1.04)	(0.00)
$(M1)\ \theta$	0.581***	0.534***	0.478***	0.666***	0.599***	0.701***	0.442**	0.351**	0.408***	0.228**	0.225***	0.203***	0.147**	0.138***	0.102*
	(6.16)	(7.64)	(5.92)	(4.73)	(2.93)	(3.76)	(2.56)	(2.42)	(2.86)	(2.30)	(4.01)	(2.75)	(2.01)	(3.08)	(1.88)
PANEL B: Systematic liquidity and individual ownership in the cross-section															
$(M1)\ \lambda_1$	0.739***	0.615***	0.374**	0.896***	0.918***	0.735***	0.371**	0.386**	0.351**	0.044	0.273***	0.051	0.260***	0.126	0.101
	(3.10)	(4.94)	(2.20)	(5.34)	(3.70)	(3.36)	(2.08)	(2.18)	(2.46)	(0.29)	(3.53)	(0.61)	(3.14)	(1.23)	(0.96)
$(M1)\ \lambda_2 \times 10^3$	−0.060***	−0.060***	−0.060***	−0.090***	−0.120***	−0.110***	−0.080***	−0.100***	−0.100***	−0.050***	−0.090***	−0.060***	−0.030***	−0.050***	−0.040***
	(−9.31)	(−8.17)	(−9.97)	(−11.11)	(−14.14)	(−20.49)	(−14.72)	(−10.45)	(−12.45)	(−15.40)	(−15.66)	(−10.11)	(−7.80)	(−8.67)	(−6.62)
$(M1)\ \theta$	0.611***	0.593***	0.508***	0.724***	0.700***	0.771***	0.526***	0.459***	0.508***	0.299***	0.357***	0.289***	0.241***	0.209***	0.183***
	(6.80)	(9.86)	(7.82)	(5.90)	(4.17)	(5.06)	(3.97)	(4.38)	(4.58)	(3.95)	(7.22)	(4.96)	(4.00)	(5.73)	(3.53)

Panel A presents the results of Fama and MacBeth (1973) regressions of weekly liquidity beta on institutional ownership, number of institutional investors and firm size; i.e.,

$\beta_{i,t} = a + \lambda_1 INST\_RATIO_{i,t-1} + \lambda_2 INST\_NUMBER_{i,t-1} + \theta \log(MCAP_{i,t-1}) + v_{i,t}$

Institutional ownership is a firm's market value owned by institutions as the percentage of capitalization of the entire market. Size is the logarithm of firm's market capitalization (in million TL). All variables are measured at the end of each Wednesday. Panel B presents the results of the similar Fama and MacBeth (1973) regressions for individual ownership in only small firms; i.e.,

$\beta_{i,t} = a + \lambda_1 INDV\_RATIO_{i,t-1} + \lambda_2 INDV\_NUMBER_{i,t-1} + \theta \log(MCAP_{i,t-1}) + v_{i,t}$

The table presents the averages and *t*-statistics of the coefficient estimates in each quintile ($M5$: largest, $M1$: smallest firm size quintile). The *t*-statistics are adjusted for heteroskedasticity and autocorrelation using Newey and West (1987) standard errors. In both panels, *, ** and *** denote 10%, 5% and 1% significance level.

In the manuscript, Q1, Q2, Q3, Q4 and Q5 refer to the amounts of 1000, 10,000, 25,000, 50,000 and 10,0000 TL respectively, whereas the liquidity measures *A*, *B* and *RT* stand for the cost of buying (ask side), selling (bid side) and roundtripping (buying and selling simultaneously) a given amount of position respectively. In this table, they refer to the betas of these liquidity measures.

estimate the cross-sectional regression in Eq.(6) for $M1$ firms where $INDV\_RATIO$ and $INDV\_NUMBER$ refer to the fraction of individual ownership and the number of individual investors respectively.

$$\beta_{i,t} = a + \lambda_1 INDV\_RATIO_{i,t-1} + \lambda_2 INDV\_NUMBER_{i,t-1} + \theta \log(MCAP_{i,t-1}) + \nu_{i,t} \quad (6)$$

Bottom of the Table 4 reports that an increase in the fraction of individual ownership is associated with a significantly greater sensitivity to market-wide liquidity for the smallest firms. This result agrees with the theory of Baker and Stein (2004) that market liquidity is driven by individual investor sentiment in special cases.

As an additional contribution to the literature, we find that the sensitivity of firm liquidity to market liquidity decreases significantly as the number of the firm's investors (both individual and institutional) increases, possibly due to the increased variability in the views of market participants.[24]

Other than being weekly, the main advantage of our dataset is that we can categorize the individual and institutional investors further as foreign and domestic (in the sense that investors residing abroad or in the host country). The origins of investors and the differences in their trading patterns have always been hot topics in the literature. Some argue that foreign investors are at an information disadvantage about a local firm compared with domestic investors (Choe et al., 2005), whereas others show that foreign institutional investors with a short investment horizon carry high information asymmetry and are superior in processing public information and producing private information than domestic investors (Grinblatt and Keloharju, 2000). Both cases can easily change the commonality dynamics; however, to the best of our knowledge, effect of the ownership's origin on the commonality in liquidity has not been studied previously. Moreover, the ability to split the origin of investors is especially important in our case considering the fact that more than 62% of the free float of Borsa Istanbul was held by foreign investors through the sample period. For further investigation, we estimate the following cross-sectional regression in Eq.(7):

$$\beta_{i,t} = a + \lambda_1 FOR\_INST\_RATIO_{i,t-1} + \lambda_2 DOM\_INST\_RATIO_{i,t-1} + \lambda_3 FOR\_INST\_NUMBER_{i,t-1} + \lambda_4 DOM\_INST\_NUMBER_{i,t-1} + \theta \log(MCAP_{i,t-1}) + \nu_{i,t} \quad (7)$$

Table 5 reports the estimated coefficients, and it shows that stock ownership by institutional investors with different origins has a different impact on liquidity commonality. Very interestingly, for the largest firms ($M5$), only the fraction of foreign institutional ownership has a significant positive impact on liquidity beta, whereas for the firms in $M4$, $M3$ and $M2$ quintiles, the fraction of both foreign and domestic institutional ownership have a significant positive impact. As in the previous case, an increase in the fraction of institutional ownership (both types) leads to a lesser sensitivity to market-wide liquidity for the smallest firms. Thus, we also estimate the analogous model given in Eq.(8) for the $M1$ quintile using the individual investor data.

$$\beta_{i,t} = a + \lambda_1 FOR\_INDV\_RATIO_{i,t-1} + \lambda_2 DOM\_INDV\_RATIO_{i,t-1} + \lambda_3 FOR\_INDV\_NUMBER_{i,t-1} + \lambda_4 DOM\_INDV\_NUMBER_{i,t-1} + \theta \log(MCAP_{i,t-1}) + \nu_{i,t} \quad (8)$$

As expected and reported at the bottom of Table 5, we observe that ownership by both types of individual investors leads to a higher commonality for the smallest firms. However, we reveal an interesting fact by showing that domestic individuals are a significant source of commonality only for relatively small positions to trade ($Q1$, $Q2$ and $Q3$), whereas foreign individuals have significant positive impact on commonality only for relatively large positions to trade ($Q3$, $Q4$ and $Q5$). This may be due to the fact that foreign individual investors in Borsa Istanbul are mostly originated from countries with GDP per capita significantly higher than Turkey, which allows them to give orders of large sizes. Regarding the effect of the number of investors on commonality, an unexpected outcome arises in the case of foreign individuals as Table 5 reports a positive significant relation. That is, as the number of foreign individual owners increases in a small firm, this firm shows greater sensitivity to market-wide liquidity, which contradicts with our heterogeneity argument and we can only speculate on the reason why: If a foreigner wants to trade in Borsa Istanbul, s/he first has to open an account at a brokerage firm in her/his home country, which also has an entity or a bilaterally agreed brokerage firm in Turkey. Then, a unique ID is assigned for this account. However, if this investor opens multiple accounts from different brokerage firms in her/his home country, then each one of these accounts are considered to belong to different investors; i.e., accounts can not be consolidated, which is a unique case for foreign individual investors in our sample.[25] If a group of foreign individuals open multiple accounts in their home country, the number of investors would seem to increase artificially whereas the homogeneity of the investor base is increasing in real terms. Considering the fact that foreign individual ownership is less than 1% in Borsa Istanbul, opening multiple accounts would have a significant positive impact on commonality even with a limited number of investors. Indeed, our informal discussions with brokerage firms confirm that this is a common operation done for speculative trading.

Overall, we find that institutional investors are the main source of liquidity commonality, but only for mid-to-large cap firms. In contrast to the literature, only individual investors have a significant impact on commonality for small cap firms. Moreover, the level of commonality decreases with the increasing number of investors in general.

4. Robustness check

In this part, we try to check whether results in Section 3 are consistent across other liquidity measures involving order book. First, we use an alternative version of the exchange liquidity measure introduced in Section 2. Since a fixed amount of position Q can be large for a small-cap stock, but small for a large-cap stock, it may bring out challenges in cross-stock liquidity comparison. Therefore, instead of working with fixed sizes across all stocks, we take for each stock the 20%, 40%, 60%, 80% and 99% position, based on the distribution of single order size for that particular stock. These measures are represented by $XLM20$, $XLM40$, $XLM60$, $XLM80$ and $XLM99$ depending on the percentile level. For simplicity, we take the cost of rountripping the buy and sell side simultaneously, rather than considering both sides separately.

Another measure we use is the $DEPTH(X)$ of Degyrse et al. (2015), which is to a certain extend related to our exchange liquidity measure. $DEPTH(X)$ takes the sum of monetary value of the shares

[24] Earlier studies on the variability in the views of market participants, or simply "divergence of opinions" have focused on mostly the relation between variation in investor expectations and a stock's risk and return (Miller, 1977; Bart and Masse, 1981; Varian, 1985; Doukas et al., 2006). To the best of our knowledge, there is not a study relating this divergence to commonality in liquidity. We believe our findings tacitly connect the concepts of divergence of opinions and commonality in liquidity, therefore they can motivate further studies on the subject.

[25] For domestic investors (both types) and foreign institutions, accounts are consolidated.

Table 5
Systematic liquidity and foreign-domestic ownership structure in the cross-section.

	Q1_A	Q1_B	Q1_RT	Q2_A	Q2_B	Q2_RT	Q3_A	Q3_B	Q3_RT	Q4_A	Q4_B	Q4_RT	Q5_A	Q5_B	Q5_RT
PANEL A: Systematic liquidity and foreign-domestic institutional ownership in the cross-section															
(M5) λ_1	1.056***	1.113***	1.128***	1.440***	1.559***	1.402***	1.518***	1.206**	1.507***	1.320***	0.679**	1.088***	1.179***	0.466***	0.967***
	(4.60)	(4.85)	(5.55)	(6.65)	(4.22)	(6.18)	(5.31)	(2.42)	(4.48)	(8.51)	(2.11)	(5.23)	(8.26)	(4.10)	(8.90)
(M5) λ_2	−0.641	0.334	−0.194	−0.043	0.153	−0.077	0.157	0.204	0.248	−0.097	−0.304	−0.084	0.202	−0.035	0.303
	(−1.57)	(1.50)	(−0.94)	(−0.20)	(0.31)	(−0.26)	(0.73)	(0.43)	(0.94)	(−0.68)	(−1.24)	(−0.45)	(1.58)	(−0.29)	(1.48)
(M5) $\lambda_3 \times 10^3$	−0.280**	−0.420***	−0.440***	−0.450***	−0.700***	−0.590***	−0.760***	−0.800***	−0.810***	−0.880***	−0.880***	−0.890***	−0.910***	−0.660***	−0.750***
	(−2.52)	(−3.89)	(−5.27)	(−5.50)	(−6.12)	(−7.71)	(−7.60)	(−5.89)	(−9.10)	(−5.88)	(−4.24)	(−6.63)	(−4.22)	(−7.15)	(−7.79)
(M5) $\lambda_4 \times 10^3$	−2.460***	−2.230***	−2.280***	−2.440***	−2.470***	−2.660***	−1.950***	−2.400***	−2.250***	−2.460***	−2.120***	−2.250***	−2.010***	−0.970***	−1.570***
	(−12.21)	(−9.61)	(−12.00)	(−12.97)	(−7.80)	(−12.45)	(−12.47)	(−7.88)	(−11.18)	(−14.09)	(−5.96)	(−11.69)	(−11.79)	(−6.15)	(−11.71)
(M5) θ	0.064*	0.076**	0.077***	0.025	0.056**	0.068***	−0.011	0.085***	0.013	0.004	0.074**	0.028	−0.003	0.117***	0.095***
	(1.81)	(2.20)	(2.63)	(1.10)	(2.18)	(2.78)	(−0.49)	(3.71)	(0.48)	(0.14)	(2.26)	(1.15)	(−0.14)	(6.32)	(4.31)
(M4) λ_1	0.798***	0.534***	0.582***	1.438***	1.630***	1.472***	1.679***	1.658***	1.731***	1.527***	1.643***	1.622***	1.451***	1.401***	1.369***
	(9.51)	(4.28)	(3.70)	(11.13)	(14.95)	(13.37)	(19.10)	(25.45)	(24.29)	(26.65)	(35.48)	(32.44)	(12.25)	(19.20)	(17.18)
(M4) λ_2	0.434**	0.128	0.284*	0.913***	0.339***	0.558***	0.937***	0.757***	0.849***	0.801***	0.865***	0.947***	0.785***	0.803***	0.804***
	(2.55)	(0.91)	(1.85)	(8.84)	(2.72)	(7.34)	(12.37)	(8.16)	(9.95)	(13.50)	(16.21)	(17.19)	(12.42)	(15.78)	(18.13)
(M4) $\lambda_3 \times 10^3$	−1.830	−1.150*	−1.00	−1.420***	−3.04***	−1.950***	−1.480*	−2.170***	−1.880***	−1.400***	−1.850***	−1.520***	−1.580***	−1.660***	−1.510***
	(−1.63)	(−1.80)	(−0.96)	(−3.07)	(−6.50)	(−4.29)	(−1.95)	(−3.79)	(−3.76)	(−2.65)	(−5.06)	(−3.50)	(−3.08)	(−7.73)	(−6.14)
(M4) $\lambda_4 \times 10^3$	−1.790***	−0.720***	−0.570*	−1.590***	−3.020***	−2.380***	−0.950**	−2.360***	−1.840***	−0.440	−1.460***	−0.830*	−0.240	−0.590*	−0.490
	(−3.81)	(−2.62)	(−1.67)	(−2.77)	(−7.44)	(−5.84)	(−2.26)	(−7.69)	(−5.62)	(−0.71)	(−3.39)	(−1.68)	(−0.43)	(−1.84)	(−1.52)
(M4) θ	0.407***	0.618***	0.495***	0.473***	0.871***	0.673***	0.495***	0.778***	0.679***	0.552***	0.659***	0.613***	0.472***	0.605***	0.594***
	(3.14)	(5.49)	(3.21)	(4.93)	(8.50)	(6.16)	(2.99)	(6.21)	(5.67)	(3.92)	(8.53)	(8.59)	(3.43)	(13.14)	(11.32)
(M3) λ_1	0.809***	1.413***	1.051***	1.157***	0.951***	1.082***	1.479***	0.804***	1.315***	1.267***	0.837***	1.099***	1.064***	0.69***	0.899***
	(3.80)	(9.64)	(4.48)	(7.31)	(2.77)	(4.66)	(9.88)	(5.36)	(5.46)	(9.14)	(7.87)	(5.46)	(9.01)	(5.97)	(8.83)
(M3) λ_2	0.928***	0.750***	0.833***	1.176***	1.011***	1.096***	1.141***	0.827***	1.062***	1.061***	0.810***	0.976***	0.894***	0.751***	0.823***
	(10.40)	(11.18)	(11.00)	(15.11)	(5.50)	(9.41)	(16.19)	(14.10)	(15.10)	(20.85)	(13.30)	(13.61)	(24.32)	(9.88)	(17.28)
(M3) $\lambda_3 \times 10^3$	−1.120	−5.470***	−3.080***	−1.78***	−1.830**	−2.000**	−1.440***	−0.740	−1.290	−1.180**	0.470	−0.400	−0.570	0.580	−0.040
	(−1.52)	(−10.11)	(−5.06)	(−3.26)	(−2.08)	(−2.19)	(−3.26)	(−0.88)	(−1.55)	(−2.38)	(0.70)	(−0.59)	(−1.35)	(1.24)	(−0.08)
(M3) $\lambda_4 \times 10^3$	−2.490***	0.820	−1.470*	−5.090***	−3.760***	−4.100***	−5.130***	−3.280***	−4.010***	−4.010***	−3.440***	−3.990***	−2.690***	−2.950***	−3.030***
	(−4.30)	(1.16)	(−1.71)	(−13.98)	(−3.68)	(−4.69)	(−18.92)	(−5.01)	(−7.97)	(−13.95)	(−7.66)	(−9.33)	(−9.75)	(−5.48)	(−7.31)
(M3) θ	0.371***	0.187**	0.352***	0.423***	0.426***	0.418***	0.248***	0.184***	0.243***	0.117***	0.208***	0.205***	0.012	0.168***	0.111***
	(8.69)	(2.06)	(6.04)	(10.11)	(6.25)	(7.80)	(8.30)	(3.45)	(5.88)	(4.46)	(6.17)	(10.72)	(0.41)	(6.21)	(5.82)
(M2) λ_1	1.568***	1.421***	1.546***	1.674***	1.546***	1.701***	1.005***	1.428***	1.221***	0.796***	0.848***	0.659***	0.728***	0.387***	0.691***
	(14.34)	(9.49)	(10.80)	(14.88)	(10.52)	(15.56)	(8.33)	(13.18)	(12.47)	(7.38)	(8.25)	(9.02)	(8.40)	(2.85)	(5.54)
(M2) λ_2	0.627**	0.663***	0.676***	0.790***	0.420***	0.536***	0.276***	0.448***	0.347***	−0.228	0.110	−0.069	0.045	−0.025	−0.015
	(2.22)	(7.02)	(3.59)	(6.46)	(5.69)	(5.89)	(3.51)	(4.25)	(3.95)	(−1.01)	(1.32)	(−0.68)	(0.29)	(−0.18)	(−0.07)
(M2) $\lambda_3 \times 10^3$	−1.050	−1.140	−0.520	−0.990	2.610	2.340	−5.500*	−4.450*	−2.980**	−7.070***	4.060***	−0.790	−7.200***	−2.520*	−4.910***
	(−0.28)	(−0.51)	(−0.17)	(−0.24)	(1.45)	(1.30)	(−1.73)	(−1.95)	(−2.05)	(−2.95)	(3.33)	(−0.49)	(−3.11)	(−1.81)	(−3.47)
(M2) $\lambda_4 \times 10^3$	−6.720***	−6.200***	−6.940***	−13.53***	−9.450***	−12.100***	−9.760***	−9.790***	−11.560***	−6.600***	−7.500***	−7.260***	−4.490***	−4.120***	−4.240***
	(−4.97)	(−8.95)	(−7.76)	(−17.41)	(−21.84)	(−31.08)	(−11.40)	(−12.04)	(−21.71)	(−7.47)	(−14.76)	(−12.72)	(−6.37)	(−4.35)	(−5.94)

Table 5 (*Continued*)

	Q1_A	Q1_B	Q1_RT	Q2_A	Q2_B	Q2_RT	Q3_A	Q3_B	Q3_RT	Q4_A	Q4_B	Q4_RT	Q5_A	Q5_B	Q5_RT
(M2) θ	0.064	0.206**	0.151*	0.397	0.495***	0.429***	0.384**	0.456***	0.440***	0.429***	0.518***	0.532***	0.422***	0.541***	0.486***
	(0.80)	(1.97)	(1.81)	(1.59)	(3.42)	(2.76)	(2.19)	(2.87)	(3.10)	(3.30)	(3.58)	(3.89)	(4.12)	(4.68)	(4.17)
(M1) λ_1	−0.337**	−0.480***	−0.301	−0.406	−0.022	0.027	0.519	0.028	0.371	−0.646***	−0.084	−0.447***	−0.048	−0.314	−0.082
	(−2.04)	(−3.15)	(−1.59)	(−1.30)	(−0.09)	(0.09)	(0.87)	(0.16)	(0.35)	(−3.68)	(−0.71)	(−3.76)	(−0.33)	(−1.43)	(−0.33)
(M1) λ_2	−0.566**	−0.511***	−0.254	−0.685***	−0.736***	−0.548***	−0.278**	−0.209	−0.213**	−0.123	−0.173**	0.055	−0.323***	−0.003	−0.080
	(−2.50)	(−4.16)	(−1.58)	(−5.03)	(−3.44)	(−3.04)	(−2.06)	(−1.41)	(−2.02)	(−1.22)	(−2.44)	(0.89)	(−5.15)	(−0.04)	(−1.02)
(M1) $\lambda_3 \times 10^3$	−0.760	4.690	1.390	−6.180*	−1.620	−6.140	−9.340**	1.430	−3.360	−4.340	4.140	−0.420	1.030	1.110	0.030
	(−0.34)	(1.63)	(0.99)	(−1.72)	(−0.71)	(−1.61)	(−2.50)	(0.40)	(−1.00)	(−1.58)	(1.02)	(−0.14)	(0.39)	(0.38)	(0.01)
(M1) $\lambda_4 \times 10^3$	−4.470***	−3.820***	−4.320***	−5.130***	−6.990***	−6.880***	−2.730***	−4.690***	−4.530***	−0.870**	−3.540***	−2.38***	1.390	−1.350	−0.030
	(−8.37)	(−3.78)	(−5.54)	(−6.86)	(−6.87)	(−8.52)	(−4.10)	(−2.91)	(−4.99)	(−2.01)	(−4.76)	(−3.41)	(1.17)	(−1.63)	(−0.03)
(M1) θ	0.564***	0.507***	0.462***	0.666***	0.568***	0.695***	0.465**	0.327**	0.404***	0.245**	0.217***	0.213**	0.148*	0.152**	0.123
	(6.06)	(7.39)	(5.37)	(4.85)	(2.63)	(3.53)	(2.39)	(2.09)	(2.78)	(2.28)	(2.92)	(2.49)	(1.75)	(2.21)	(1.61)
PANEL B: Systematic liquidity and foreign-domestic individual ownership in the cross-section															
(M1) λ_1	−1.040	−1.008	−0.751	−1.303	−2.522	−2.122	6.690***	2.936	2.434	12.821***	5.069***	5.839**	14.723***	3.893*	7.089***
	(−0.96)	(−0.48)	(−0.60)	(−0.94)	(−1.31)	(−1.03)	(5.53)	(1.02)	(0.98)	(8.51)	(2.67)	(2.36)	(8.44)	(1.66)	(4.97)
(M1) λ_2	0.794***	0.655***	0.418**	0.900***	0.908***	0.759***	0.324	0.355	0.354**	−0.018	0.263	−0.054	0.179	0.135	0.106
	(2.70)	(4.97)	(2.18)	(4.73)	(3.08)	(2.86)	(1.64)	(1.46)	(2.02)	(−0.14)	(1.57)	(−0.53)	(1.04)	(1.14)	(0.76)
(M1) $\lambda_3 \times 10^3$	23.400***	36.110***	21.750***	17.960***	27.200***	20.100***	10.220***	23.030***	17.86***	2.020	13.590***	8.550***	0.240	3.040	0.950
	(8.42)	(9.84)	(6.87)	(7.04)	(7.68)	(8.64)	(3.17)	(9.16)	(14.41)	(0.73)	(7.15)	(4.37)	(0.14)	(1.49)	(0.46)
(M1) $\lambda_4 \times 10^3$	−0.110***	−0.140***	−0.110***	−0.130***	−0.190***	−0.160***	−0.110***	−0.160***	−0.140***	−0.060***	−0.120***	−0.090***	−0.040***	−0.060***	−0.050***
	(−10.33)	(−10.04)	(−10.58)	(−12.16)	(−17.05)	(−23.43)	(−12.04)	(−16.43)	(−22.12)	(−9.79)	(−15.75)	(−12.78)	(−10.93)	(−10.74)	(−10.82)
(M1) θ	0.566***	0.504***	0.463***	0.667***	0.612***	0.713***	0.469***	0.369***	0.443***	0.255***	0.296***	0.247***	0.195***	0.191***	0.168**
	(5.40)	(8.78)	(6.40)	(5.03)	(3.40)	(4.16)	(3.23)	(2.93)	(3.79)	(3.58)	(4.22)	(3.37)	(3.49)	(4.03)	(2.40)

Panel A presents the results of Fama and MacBeth (1973) regressions of weekly liquidity beta on foreign and domestic institutional ownership, number of foreign and domestic institutional investors and firm size; i.e.,
$\beta_{i,t} = a + \lambda_1 FOR\_INST\_RATIO_{i,t-1} + \lambda_2 DOM\_INST\_RATIO_{i,t-1} + \lambda_3 FOR\_INST\_NUMBER_{i,t-1} + \lambda_4 DOM\_INST\_NUMBER_{i,t-1} + \theta \log(MCAP_{i,t-1}) + \upsilon_{i,t}$
(Foreign or domestic) institutional ownership is a firm's market value owned by (foreign or domestic) institutions as the percentage of capitalization of the entire market. Size is the logarithm of firm's market capitalization (in million TL). All variables are measured at the end of each Wednesday. Panel B presents the results of the similar Fama and MacBeth (1973) regressions for foreign and domestic individual ownership in only small firms; i.e.,
$\beta_{i,t} = a + \lambda_1 FOR\_INDV\_RATIO_{i,t-1} + \lambda_2 DOM\_INDV\_RATIO_{i,t-1} + \lambda_3 FOR\_INDV\_NUMBER_{i,t-1} + \lambda_4 DOM\_INDV\_NUMBER_{i,t-1} + \theta \log(MCAP_{i,t-1}) + \upsilon_{i,t}$
The table presents the averages and *t*-statistics of the coefficient estimates in each quintile (*M*5 : largest, *M*1 : smallest firm size quintile). The *t*-statistics are adjusted for heteroskedasticity and autocorrelation using Newey and West (1987) standard errors. In both panels, *, ** and *** denote 10%, 5% and 1% significance level.
In the manuscript, *Q*1, *Q*2, *Q*3, *Q*4 and *Q*5 refer to the amounts of 1000, 10,000, 25,000, 50,000 and 10,0000 TL respectively, whereas the liquidity measures *A*, *B* and *RT* stand for the cost of buying (ask side), selling (bid side) and roundtripping (buying and selling simultaneously) a given amount of position respectively. In this table, they refer to the betas of these liquidity measures.

offered within a fixed interval around the midpoint where the midpoint is the average of the best bid and ask price of the order book and the interval is an amount X points relative to the midpoint. Since in Turkish stock market, stock price is allowed to move at most 20% up or down of the previous day's last session volume-weighted trade price, we take the set $X = \{5, 10, 15, 20\}$.

In addition to those above, we also use the following liquidity measures:

OBSLOPE represents the order book slope which is calculated as the following: Denote price level $k = \{1, 2, \ldots, K\}$ on the pricing grid in an increasing order standing for bid and ask prices, then we form two vectors $y = [P_1, P_2, \ldots, P_K]$ for the prices and $Q = [Q_1/2, Q_1 + (Q_2)/2, \ldots, Q_1 + Q_2 + \cdots + (Q_K)/2]$ for the quantities. Order book slope is obtained by regressing Q vector on the y vector. Lower the slope is, more liquid is the stock.

DEPTHNO refers to the sum of the waiting orders at the best bid and at the best ask prices.

DEPTHTL refers to the sum of the monetary value of waiting orders at the best bid and ask prices by multiplying prices by quantities.

ASPREAD is the absolute spread calculated as the difference between the lowest ask price and the highest bid price.

RSPREAD is the relative spread which is obtained by dividing the absolute spread by mid price and hence makes spreads of different stocks comparable to each other.

For each one of these measures, we estimate the dynamic liquidity betas as in Eq. (1). Table 6 presents the time averages of the liquidity betas belonging to different size quintiles.

According to Table 6, we still observe higher commonality for smallest firms compared to largest firms, except for the absolute spread measure. For example, time average betas for the smallest firm size quantile are 1.05, 1.03, 1.02, 1.03 and 1.06 for the measures *XLM*20, *XLM*40, *XLM*60, *XLM*80 and *XLM*99 respectively, whereas the same averages for the same measures are 0.94, 0.96, 0.95, 0.96 and 0.97 respectively for the largest firm size quantile. Although other measure provide similar results, the mean beta difference between smallest and largest firm size quantiles are not emphasized as in the cases of *XLM* and *RSPREAD*. In fact, for the *DEPTH*(X) measure, this difference is around 0.001 for many X values, which is practically negligible. For other measures than *DEPTH*(X), this difference fluctuates around 0.02.

Even though firm size creates considerable difference in commonality for the *XLM* measure, its effect seems to have diminished compared to the case where we take fixed position sizes to trade (see Table 2). One possible reason for this situation could be explained as follows: In the former approach, when the order book does not have enough depth to fill a trade of a given size Q for less than 2% of the sample period, a hypothetical order book is constructed assuming infinite orders at the last price level. So, in an extreme case, with only one ask and bid available, the complete order is assumed to be filled at that price. But this has the potential to overstate liquidity (even in less extreme examples) for larger sizes of Q. This situation would be expected to occur relatively more for small stocks (as the order book is typically less deep) which would explain why the difference in commonality is much higher in the former case, and not so high in the current estimations. However, results still point out that small-cap firms tend to have higher commonality than large-cap firms.

Regarding the relation between ownership structure and the commonality, we re-estimate the model in Eq.(7) for our new liquidity measures and the results are presented in Panel A of Table 7.

Accordingly, our previous findings are mostly validated. For example, the measure *DEPTH*(X) states that for the largest firms (*M*5), only the fraction of foreign institutional ownership has a significant positive impact on liquidity beta, for any choice of X. Similar conclusion is obtained for the *XLM* measure, except the case of

Table 6
Time average of the dynamic liquidity betas.

	XLM20	*XLM40*	*XLM60*	*XLM80*	*XLM99*	*DEPTH*(5)	*DEPTH*(10)	*DEPTH*(15)	*DEPTH*(20)	*OBSLOPE*	*DEPTHNO*	*DEPTHTL*	*RSPREAD*	*ASPREAD*
M5	0.941	0.958	0.948	0.964	0.97	0.991	0.986	0.986	0.991	0.983	1.01	0.842	0.933	1.046
M4	0.944	0.954	0.992	0.988	0.988	1.013	1.009	1.014	1.014	0.978	0.989	0.878	0.955	0.969
M3	0.954	0.992	0.986	0.961	0.983	1.009	0.988	0.996	0.996	0.972	0.99	0.847	0.958	0.943
M2	0.969	0.969	0.993	0.989	0.982	1.001	0.999	0.998	0.998	0.989	1.008	0.876	0.981	0.916
M1	1.051	1.03	1.015	1.034	1.055	0.992	0.993	0.987	0.992	1	1.026	0.869	1.055	0.919

We implement the methodology of Dynamic Conditional Beta (Bali et al., 2016) to estimate a time-varying liquidity beta for each firm using the following multiple regressions:
$DL_{i,t} = \alpha_i + \beta_{i,t} DL_{M,t} + \varepsilon_{i,t}$
where liquidity variables for the individual stock i on t^{th} Thursday is represented by $L_{i,t}$; and the equally weighted cross-sectional average of the liquidity variable for all stocks excluding stock i on the same Thursday is denoted by $L_{M,t}$. Here, D preceding the acronym denotes a proportional change in the variable across successive Thursdays. *M5, M4, M3, M2* and *M1* refer to the quantiles constructed by daily average (of four years) market cap, with *M5* and *M1* denoting the largest and smallest firms respectively. We calculate equally-weighted averages of liquidity betas for all the firms in each size quintile which produces a time-varying beta per quantile. This table reports the time averages of these dynamic liquidity betas. These liquidity betas are obtained from the following liquidity measures.
*XLM*20, *XLM*40, *XLM*60, *XLM*80 and *XLM*99 measure the cost of roundtripping the position Q where Q is determined for each stock with its 20%, 40%, 60%, %80 and %99 incoming single order size percentiles respectively.
DEPTH(X) takes the sum of monetary value of the shares offered within a fixed interval around the midpoint where the midpoint is the average of the best bid and ask price of the order book and the interval is an amount $X = \{5, 10, 15, 20\}$ points relative to the midpoint.
OBSLOPE refers to the order book slope that is calculated as the following: Denote price level $k = \{1, 2, \ldots, K\}$ on the pricing grid in an increasing order standing for bid and ask prices, then we form two vectors $y = [P_1, P_2, \ldots, P_K]$ for the prices and $Q = [Q_1/2, Q_1 + (Q_2/2), \ldots, Q_1 + Q_2 + \ldots + (Q_K/2)]$ for the quantities. Order book slope is obtained by regressing Q vector on the y vector.
DEPTHNO is calculated as the sum of the waiting orders at the best bid and at the best ask prices.
DEPTHTL is calculated as the sum of the monetary value of waiting orders at the best bid and ask prices by multiplying prices by quantities.
RSPREAD is the relative spread which is obtained by dividing the absolute spread by mid price and hence makes spreads of different stocks comparable to each other.
ASPREAD is the absolute spread calculated as the difference between the lowest ask price and the highest bid price.

Table 7
Systematic liquidity and foreign-domestic ownership structure in the cross-section with alternative liquidity measures.

	XLM20	*XLM40*	*XLM60*	*XLM80*	*XLM99*	*DEPTH*(5)	*DEPTH*(10)	*DEPTH*(15)	*DEPTH*(20)	*OBSLOPE*	*DEPTHNO*	*DEPTHTL*	*RSPREAD*	*ASPREAD*
PANEL A: Systematic liquidity and foreign-domestic institutional ownership in the cross-section														
($M5$) λ_1	1.289***	1.376***	1.215***	1.230***	0.991***	0.539**	2.721***	3.219***	3.430***	4.858***	3.754***	1.605***	1.137***	1.073***
	(6.12)	(9.04)	(7.96)	(3.86)	(3.54)	(2.06)	(3.51)	(4.52)	(3.98)	(6.71)	(5.34)	(3.69)	(5.49)	(5.37)
($M5$) λ_2	0.755	0.048	0.106	0.652***	0.042	0.205	1.182	1.254	1.557	7.249***	1.617	0.295	1.214*	1.513**
	(1.32)	(0.20)	(0.62)	(3.05)	(0.14)	(0.32)	(0.69)	(0.72)	(0.73)	(14.90)	(0.79)	(0.29)	(1.80)	(2.14)
($M5$) $\lambda_3 \times 10^3$	−0.817***	−0.946***	−0.690***	−1.058***	−0.926***	−1.102***	−1.860***	−2.091***	−2.117***	0.147	−2.322***	−1.487***	−0.719***	−0.590***
	(−5.79)	(−8.20)	(−7.55)	(−10.06)	(−13.72)	(−11.88)	(−11.99)	(−9.98)	(−11.74)	(0.43)	(−12.37)	(−9.15)	(−4.72)	(−3.89)
($M5$) $\lambda_4 \times 10^3$	−3.064***	−2.888***	−3.078***	−3.028***	−0.258	0.075	−0.192	−0.260	−0.383	3.014**	−1.286	−0.682*	−3.189***	−3.608***
	(−14.21)	(−13.51)	(−15.97)	(−13.14)	(−1.55)	(0.32)	(−0.29)	(−0.30)	(−0.42)	(2.07)	(−1.35)	(−1.91)	(−17.04)	(−15.69)
($M5$) θ	0.307***	0.294***	0.200***	0.208***	0.172***	0.087	0.394*	0.452	0.494	0.606**	0.598**	0.289**	0.295***	0.322***
	(2.80)	(3.86)	(3.65)	(6.74)	(3.51)	(1.43)	(1.75)	(1.57)	(1.60)	(2.49)	(2.30)	(2.36)	(2.99)	(3.25)
($M4$) λ_1	1.182***	0.694***	0.062	0.805***	1.090***	0.404***	0.325***	0.358***	0.352***	0.447***	0.249***	0.482***	1.559***	1.513***
	(6.12)	(3.89)	(0.92)	(6.70)	(18.09)	(10.75)	(8.61)	(6.93)	(6.43)	(15.18)	(5.04)	(16.33)	(11.47)	(8.46)
($M4$) λ_2	1.180***	1.022***	0.452***	0.266*	0.106	0.577***	0.352***	0.346***	0.358***	0.259***	0.208**	0.029	1.330***	1.631***
	(9.06)	(7.29)	(3.57)	(1.90)	(0.98)	(10.88)	(8.68)	(6.57)	(6.56)	(3.52)	(2.41)	(0.21)	(8.54)	(9.94)
($M4$) $\lambda_3 \times 10^3$	−1.540	−2.290	−2.490*	−2.200***	−1.100***	−0.890***	−1.150***	−0.090***	−1.180***	0.570***	−1.140**	−0.720**	−1.440	−2.490
	(−1.05)	(−1.17)	(−1.92)	(−3.70)	(−5.84)	(−6.29)	(−7.48)	(−7.29)	(−7.70)	(3.07)	(−2.03)	(−2.53)	(−0.68)	(−1.28)
($M4$) $\lambda_4 \times 10^3$	−3.000***	−3.330***	−3.860***	−2.320***	−1.250***	−0.110	−0.350	−0.050	−0.060	0.330*	−1.500***	−1.210***	−3.090***	−3.370***
	(−9.71)	(−6.86)	(−7.54)	(−4.12)	(−5.33)	(−0.82)	(−1.36)	(−0.22)	(−0.30)	(1.68)	(−6.33)	(−7.90)	(−8.82)	(−7.22)
($M4$) θ	0.653	0.634	0.600	0.647***	0.472***	0.013	0.065*	0.088*	0.100**	0.118*	0.179	0.234	0.634	0.523
	(1.19)	(0.83)	(1.23)	(4.53)	(7.24)	(0.24)	(1.79)	(1.91)	(2.02)	(1.94)	(0.46)	(0.96)	(0.90)	(0.67)
($M3$) λ_1	0.794***	1.771***	1.797***	1.105***	0.997***	0.011	0.138***	0.145***	0.121**	0.666	0.569***	0.374***	0.947***	1.437***
	(3.32)	(10.34)	(10.58)	(5.89)	(15.69)	(0.20)	(3.68)	(3.09)	(2.57)	(0.53)	(12.15)	(8.02)	(4.59)	(4.32)
($M3$) λ_2	0.738***	0.732***	1.016***	1.232***	0.823***	0.199***	0.189***	0.173***	0.187***	0.186***	0.326***	0.199***	0.817***	1.152***
	(2.75)	(2.72)	(7.16)	(23.64)	(13.68)	(3.34)	(4.72)	(4.15)	(4.28)	(7.33)	(7.21)	(4.29)	(4.95)	(7.85)
($M3$) $\lambda_3 \times 10^3$	−1.851***	−8.368***	−7.536***	−0.031	−1.637***	−0.006	−0.425*	−0.784***	−0.759***	−2.864	−1.634***	−1.214***	−3.328***	−5.595***
	(−3.54)	(−8.09)	(−5.77)	(−0.05)	(−3.51)	(−0.02)	(−1.73)	(−2.92)	(−2.90)	(−0.49)	(−8.56)	(−8.97)	(−5.86)	(−3.50)
($M3$) $\lambda_4 \times 10^3$	−5.781***	−2.244***	−2.273***	−5.184***	−3.577***	−0.212	−0.046	−0.071	−0.042	0.066	−0.449	0.172	−5.057***	−5.644***
	(−7.93)	(−3.72)	(−6.09)	(−12.26)	(−12.98)	(−0.48)	(−0.13)	(−0.35)	(−0.21)	(0.02)	(−0.77)	(0.41)	(−17.44)	(−11.63)
($M3$) θ	0.521***	0.510***	0.353***	0.170***	0.045*	0.018	0.032	0.037	0.050**	0.074**	0.119*	0.157***	0.553***	0.711***
	(10.60)	(2.64)	(3.11)	(5.35)	(1.76)	(0.51)	(1.59)	(1.60)	(2.09)	(2.33)	(1.75)	(2.88)	(10.48)	(10.32)
($M2$) λ_1	1.129***	1.392***	1.615***	1.161***	0.284**	0.014	0.028	0.029	0.018	0.235*	−2.077**	−0.258	0.899***	0.946***
	(8.08)	(5.87)	(18.45)	(11.13)	(2.04)	(0.21)	(0.39)	(0.31)	(0.14)	(−1.82)	(−2.14)	(−1.38)	(6.33)	(3.01)
($M2$) λ_2	1.048***	1.312***	1.365***	0.641***	0.076	0.106	0.087**	0.129**	0.109*	0.235**	−2.582***	−0.647***	1.032***	0.922***
	(14.05)	(15.02)	(19.51)	(17.68)	(0.96)	(1.64)	(2.12)	(2.00)	(1.69)	(2.37)	(−3.93)	(−7.08)	(8.26)	(8.14)
($M2$) $\lambda_3 \times 10^3$	−3.494	−6.430**	−9.481***	−7.257***	−0.519	−2.563***	−5.593***	−7.352***	−7.213***	−2.715***	−14.624***	−4.133***	4.426	5.761
	(−0.55)	(−2.18)	(−4.23)	(−4.19)	(−0.67)	(−3.83)	(−8.85)	(−10.25)	(−11.81)	(−4.53)	(−4.31)	(−7.09)	(1.16)	(0.69)

Table 7 (*Continued*)

	XLM20	*XLM40*	*XLM60*	*XLM80*	*XLM99*	*DEPTH*(5)	*DEPTH*(10)	*DEPTH*(15)	*DEPTH*(20)	*OBSLOPE*	*DEPTHNO*	*DEPTHTL*	*RSPREAD*	*ASPREAD*
$(M2)\ \lambda_4 \times 10^3$	−6.942***	−8.744***	−11.470***	−10.008***	−3.894***	−1.848***	−0.586**	−0.516	−0.506	−2.509***	−4.676***	−2.382***	−7.349***	−7.940***
	(−5.93)	(−15.58)	(−24.71)	(−17.10)	(−9.29)	(−5.94)	(−2.17)	(−1.35)	(−1.26)	(−5.96)	(−3.45)	(−8.71)	(−8.73)	(−4.99)
$(M2)\ \theta$	0.336***	0.428***	0.383**	0.436***	0.517***	0.164***	0.212***	0.225***	0.231***	0.400***	0.865**	0.406***	0.398***	0.409***
	(3.27)	(6.95)	(2.54)	(2.80)	(3.74)	(11.19)	(12.55)	(10.32)	(9.70)	(15.62)	(2.31)	(7.18)	(5.42)	(5.89)
$(M1)\ \lambda_1$	−1.009*	−0.354	−0.088	−0.239	−0.587***	−0.173	−0.040	−0.161	−0.146	−0.685***	−0.439*	−0.404**	−1.269*	−2.268*
	(−1.76)	(−1.20)	(−0.44)	(−1.08)	(−3.11)	(−1.51)	(−0.27)	(−1.09)	(−0.96)	(−7.71)	(−1.89)	(−2.00)	(−1.95)	(−1.86)
$(M1)\ \lambda_2$	−1.372***	−0.873**	−0.708**	−0.391	−0.413*	−0.142	−0.143	−0.087	−0.127	−0.526***	−0.010	−0.085	−1.542***	−1.613
	(−2.98)	(−2.05)	(−2.27)	(−1.54)	(−1.80)	(−1.05)	(−1.32)	(−0.70)	(−1.16)	(−3.63)	(−0.08)	(−0.63)	(−2.95)	(−1.04)
$(M1)\ \lambda_3 \times 10^3$	−3.187	−3.787	−7.889***	−7.123	−1.796	1.432	0.931	1.619	1.251	−1.394	6.870	6.392	3.154	4.352
	(−1.60)	(−1.08)	(−2.61)	(−1.59)	(−0.81)	(1.55)	(1.20)	(1.57)	(1.52)	(−0.98)	(1.26)	(1.12)	(1.58)	(1.12)
$(M1)\ \lambda_4 \times 10^3$	−5.935***	−7.538***	−7.333***	−5.543***	−1.454***	−0.751*	−0.441	−0.915	−0.656	0.043	−2.388***	−1.958***	−5.469***	−12.960***
	(−8.89)	(−10.05)	(−10.41)	(−8.96)	(−3.33)	(−1.87)	(−0.82)	(−1.64)	(−1.14)	(0.24)	(−4.14)	(−3.08)	(−6.26)	(−7.42)
$(M1)\ \theta$	0.892***	0.869***	0.773***	0.572***	0.312***	0.149***	0.179***	0.198***	0.201***	0.208***	0.198**	0.175**	0.954***	1.350***
	(3.08)	(3.99)	(3.85)	(3.97)	(2.81)	(6.96)	(6.32)	(4.96)	(5.74)	(5.30)	(2.57)	(2.11)	(3.20)	(3.23)
PANEL B: Systematic liquidity and foreign-domestic individual ownership in the cross-section														
$(M1)\ \lambda_1$	−14.208	−10.287	−9.131	−0.114	3.745***	−0.527	−0.358	−0.500	−0.423	5.597***	4.087	3.341	−15.241	−14.492
	(−1.63)	(−1.56)	(−1.64)	(−0.04)	(3.71)	(−0.49)	(−0.37)	(−0.49)	(−0.40)	(3.68)	(1.25)	(0.88)	(−1.38)	(−1.29)
$(M1)\ \lambda_2$	1.495**	0.987**	0.842**	0.452	0.217	0.113	0.134	0.138	0.163	0.678***	−0.050	0.045	1.712***	2.121
	(2.56)	(2.04)	(2.13)	(1.60)	(0.92)	(0.61)	(0.65)	(0.63)	(0.83)	(3.05)	(−0.49)	(0.37)	(2.60)	(1.16)
$(M1)\ \lambda_3 \times 10^3$	32.839***	29.191***	19.861***	8.529**	6.425***	5.084**	0.942	2.419	2.469	−4.664	3.875	1.119	33.368***	28.563***
	(8.71)	(16.03)	(10.10)	(2.07)	(2.81)	(2.44)	(0.42)	(1.21)	(1.25)	(−0.93)	(1.20)	(0.28)	(9.85)	(3.69)
$(M1)\ \lambda_4 \times 10^3$	−0.117***	−0.135***	−0.125***	−0.095***	−0.066***	−0.020***	0.002	−0.004	−0.006	−0.024*	−0.036***	−0.021*	−0.111***	−0.133***
	(−27.55)	(−21.98)	(−12.66)	(−9.04)	(−11.40)	(−4.05)	(0.25)	(−0.71)	(−1.20)	(−1.81)	(−3.22)	(−1.94)	(−21.53)	(−9.67)
$(M1)\ \theta$	0.846***	0.762***	0.680***	0.498**	0.310***	0.167***	0.193***	0.223***	0.227***	0.245***	0.201***	0.187***	0.921***	1.278**
	(2.78)	(3.15)	(3.14)	(2.57)	(3.66)	(5.32)	(3.99)	(3.56)	(4.11)	(4.06)	(4.94)	(3.78)	(3.01)	(2.19)

Panel A presents the results of Fama and MacBeth (1973) regressions of weekly liquidity beta on foreign and domestic institutional ownership, number of foreign and domestic institutional investors and firm size; i.e.,
$\beta_{i,t} = a + \lambda_1 FOR\_INST\_RATIO_{i,t-1} + \lambda_2 DOM\_INST\_RATIO_{i,t-1} + \lambda_3 FOR\_INST\_NUMBER_{i,t-1} + \lambda_4 DOM\_INST\_NUMBER_{i,t-1} + \theta \log(MCAP_{i,t-1}) + \upsilon_{i,t}$
(Foreign or domestic) institutional ownership is a firm's market value owned by (foreign or domestic) institutions as the percentage of capitalization of the entire market. Size is the logarithm of firm's market capitalization (in million TL). All variables are measured at the end of each Wednesday. Panel B presents the results of the similar Fama and MacBeth (1973) regressions for foreign and domestic individual ownership in only small firms; i.e.,
$\beta_{i,t} = a + \lambda_1 FOR\_INDV\_RATIO_{i,t-1} + \lambda_2 DOM\_INDV\_RATIO_{i,t-1} + \lambda_3 FOR\_INDV\_NUMBER_{i,t-1} + \lambda_4 DOM\_INDV\_NUMBER_{i,t-1} + \theta \log(MCAP_{i,t-1}) + \upsilon_{i,t}$
The table presents the averages and *t*-statistics of the coefficient estimates in each quintile (*M*5 : largest, *M*1 : smallest firm size quintile). The *t*-statistics are adjusted for heteroskedasticity and autocorrelation using Newey and West (1987) standard errors. In both panels, *, ** and *** denote 10%, 5% and 1% significance level.
For the definition of the liquidity measures *XLM*20,*XLM*40, *XLM*60, *XLM*80, *XLM*99, *DEPTH*(5), *DEPTH*(10), *DEPTH*(15), *DEPTH*(20), *OBSLOPE*, *DEPTHNO*, *DEPTHTL*, *RSPREAD* and *ASPREAD* refer to the Section 4.

*XLM*80. On the other hand, the measures *OBSLOPE*, *RSPREAD* and *ASPREAD* point out the significant effect of domestic institutional investors on the commonality for largest firms, in addition to the foreign institutions.

Similar to our previous findings, the fraction of both foreign and domestic institutional ownership have a significant positive impact on commonality for the firms in *M*4, *M*3 and *M*2 quintiles. And in the case of smallest firm quantile, our liquidity measures (except *DEPTH*(*X*)) tend to find that an increase in the fraction of institutional ownership (both types for *XLM*, *OBSLOPE* and *RSPREAD*; and only domestic for *DEPTHNO*, *DEPTHTL* and *ASPREAD*) leads to a lesser sensitivity to market-wide liquidity for the smallest firms. Thus, we also estimate the analogous model given in Eq. (8) for the *M*1 quintile using the new liquidity measures and the results are given in Panel B of Table 7. We observe that for the *XLM*, *OBSLOPE* and *RSPREAD* measures, individual ownership leads to a higher commonality for the smallest firms. In particular, according to *XLM* and *OBSLOPE*, both foreign and domestic individual investors have a role in commonality for these firms, whereas *RSPREAD* states that only domestic individuals have significant impact. Similar to the earlier case, *XLM* reveals that domestic individuals are a significant source of commonality only for relatively small order size percentiles (20%, 40% and 60%), whereas foreign individuals have significant positive impact on commonality only for the largest percentile (99%).

Finally, except in a very small number of cases (i.e., the case of *OBSLOPE* measure for *M*5 and *M*4 firm size quintiles), we show that the sensitivity of firm liquidity to market liquidity decreases significantly as the number of the firm's institutional investors increases. Interestingly, *DEPTH*(*X*) states that only the number of foreign institutions has a significant effect for the *M*5, *M*4 and *M*3 firm size quintiles. Regarding the effect of the number of domestic individual investors, we validate our previous findings by the all new measures, except *DEPTH*(*X*) for $X = \{10, 15, 20\}$. In particular, commonality decreases with the increasing number of domestic individual investors. On the other hand, *XLM*, *RSPREAD* and *ASPREAD* states that as the number of foreign individual owners increases in a small firm, this firm shows greater sensitivity to market-wide liquidity; a result that is consistent with our previous findings on the effect of foreign individuals on commonality, and possible reasons to this situation are explained in the end of Section 3.

5. Discussion and conclusion

This study aims to find out the relation between firm size, ownership structure and the systematic liquidity risk in a leading emerging market, Turkey. First, by using a proprietary database of all orders coming to the stock market, we construct a weighted spread that measures the cost of trading for a given amount of position. Then, taking this spread as a proxy for liquidity, we analyze the effects of firm size and ownership structure on commonality in liquidity at the different levels of the order book with the help of unique ownership data. Moreover, empirical analysis is also performed for buy and sell sides separately first, then for several other order book liquidity measures as a check for robustness. The findings can be summarized as the following:

First, we reveal that commonality in liquidity exists in the Turkish market, and we observe higher commonality for small firms compared to large firms, whereas the results on developed markets often state the otherwise. This may be due to the fact that in Turkish market, (i) although algorithmic trading is possible, it is not highly preferred; and the current technology does not allow HFT. It is known that institutional investors in developed markets use these automated systems mostly in trading liquid and large firm stocks, and these systems contribute a lot to order flow and trading volume. Thus, a priori is that large firms may be less subject to commonality in a market without active computerized trading; (ii) regulators put extra constraints on short-selling the small firms (such as imposing the up-tick rule), which are expected to increase the commonality in liquidity in these firms, especially on the buy side; (iii) large firms are mostly owned by institutional investors. A recent report by officials state that during our sample period, the mean duration of holding blue-chip stocks (large firms) by institutional investors is around one year, whereas this duration is approximately one month for individual investors. Therefore, buy-and-hold strategy of institutional investors in large firms is expected to decrease their correlated trading, hence to lower the commonality in liquidity. In other words, in a market where there is no HFT or high level of institutional trading as in developed markets, individuals may create the same effect of institutional investors on commonality by highly active day trading in some specific type of stocks.[26]

Second, we reveal that for any position size to trade, institutional ownership leads to an increase in the commonality for mid-to-large cap firms, a result supporting the arguments of the related studies. However, only individual ownership can lead to such an increase for small cap firms, which is in contrast to the previous findings. A possible reason is that institutional investors in Turkish market prefer to hold large capitalization stocks which usually provide lower returns, but display lower volatility. On the other hand, individual investors prefer small cap firms which are highly speculative but provide higher expected returns. Since the information received from small firms are usually little to none in this market, individual investors of these firms may display a herding behavior in their trading strategy by putting a relatively larger weight on what the others are doing and less weight on their own noisy private information, which would eventually lead to a commonality in order flow to small firms, hence significantly increase the corresponding commonality in liquidity.

Third, we reveal that commonality decreases with the increasing number of investors (for both individual and institutional) at any firm size level, suggesting that as the investor base gets larger, views of market participants become more heterogeneous.

Fourth, a deeper analysis involving the origin of the investor base shows that for any position size to trade, only foreign institutional ownership increases the commonality in liquidity for the largest firms. Interestingly, only domestic individual ownership leads to an increase in commonality for the smallest firms, but only for relatively small positions to trade; whereas only foreign individual ownership leads to such an increase for the smallest firms, but only for relatively large positions to trade. This finding may be a reflection of the noticeable difference between the corresponding GDP per capita values on order sizes, since the foreign individual investors in Turkish market are mostly originated from countries with GDP per capita significantly higher than Turkey (such as Luxembourg and Switzerland), which allows them to give orders of large sizes.

Accordingly, to decrease the level of systematic liquidity risk in this market, policy makers and regulators should (i) find ways to increase the information received by individual investors from small firms in order to decrease (individual) herding; (ii) put incentives/penalties (such as tax reduction/increase) to prolong the mean duration of share holding by individual investors in order to decrease the correlated trading activity in small firms; (iii) decrease the level of constraints on short selling the small firms in order

[26] According to the World Federation of Exchanges, share turnover velocity in South Korea, Saudi Arabia, Taiwan, Turkey, China (Shanghai) and China (Shenzhen) markets are 106%, 132%, 222%, 223%, 566%, 616% respectively in 2014, with individual investors leading the trading volume. Therefore, further research could look for answers to the question of why individual investors do participate in day trading at such a high rate in some markets.

to decrease the commonality in liquidity, especially on the buy side; (iv) try to introduce new regulations or provide incentives to increase the number of investors in the market in order to increase the heterogeneity in investors' decisions.

Overall, findings imply that previous results on ownership and firm size effect may not be totally valid for all global markets in a commonality analysis, and the topic requires special attention due to the differences in their market micro-structure and investor characteristics.

Appendix A. Dynamic conditional beta

To get the dynamic conditional liquidity beta, we start with the following

$$DL_t = \mu + \epsilon_t \tag{A.1}$$

where $DL_t = [DL_{i,t} DL_{M,t}]'$ is the vector of weekly liquidity changes (from Thursday to Thursday) in the individual asset i and the corresponding market M, μ is a vector of constants, and $\epsilon_t = [\epsilon_{i,t}\epsilon_{M,t}]'$ is the vector of residuals.

In the next step, we obtain the conditional volatilities h_t from the univariate GJR-GARCH(1,1) process.

$$\begin{aligned} h_{i,t}^2 &= \omega_i + (\alpha_i + \gamma_i I_{\epsilon_{i,t-1}<0})\epsilon_{i,t-1}^2 + \beta_i h_{i,t-1}^2 \\ h_{M,t}^2 &= \omega_M + (\alpha_M + \gamma_M I_{\epsilon_{M,t-1}<0})\epsilon_{M,t-1}^2 + \beta_M h_{M,t-1}^2 \end{aligned} \tag{A.2}$$

In this setup, $E_{t-1}[\epsilon_t] = 0$ and $E_{t-1}[\epsilon_t \epsilon_t'] = H_t$, where $E_t[\cdot]$ is the conditional expectation on $\epsilon_t, \epsilon_{t-1}, \ldots$. The conditional covariance matrix H_t can be written as

$$H_t = D_t^{1/2} R_t D_t^{1/2} \tag{A.3}$$

where R_t is the conditional correlation matrix and the diagonal matrix of the conditional variances is given by $D_t = diag(h_{i,t}, h_{M,t})$. Engle (2002) models the right hand side of Eq.(A.3) rather than H_t directly and proposes the dynamic correlation structure

$$\begin{aligned} R_t &= \{Q_t^*\}^{-1/2} Q_t \{Q_t^*\}^{-1/2}, \\ Q_t &= (1-a-b)S + a u_{t-1} u_{t-1}' + b Q_{t-1}, \end{aligned} \tag{A.4}$$

where Q_t is the dynamic covariance driving process, $u_t = [u_{i,t} u_{M,t}]'$ with $u_{i,t}$ and $u_{M,t}$ are the transformed residuals; i.e., $u_{i,t} = \epsilon_{i,t}/h_{i,t}$ and $u_{M,t} = \epsilon_{M,t}/h_{M,t}$; $S \equiv E[u_t u_t']$ is the $n \times n$ unconditional covariance matrix of u_t; $Q_t^* = diag\{Q_t\}$ and a, b are non-negative scalars satisfying $a + b < 1$. The final estimation is performed by maximizing the joint log-likelihood of the model given by

$$\begin{aligned} \mathbb{L} = &-\frac{1}{2}\sum_{t=1}^{T}(n\ln(2\pi) + \ln|D_t| + \epsilon_t' D_t^{-1}\epsilon_t) \\ &-\frac{1}{2}\sum_{t=1}^{T}(\ln|R_t| + u_t' R_t^{-1} u_t - u_t' u_t) \end{aligned} \tag{A.5}$$

and the resulting model is called DCC. We estimate the time-varying conditional covariance matrix, giving us the dynamic covariance between stock liquidity L_i and the market liquidity L_M, and also the dynamic variance of the market liquidity L_M. Finally, simple division yields to the time-varying liquidity betas based on the mean-reverting DCC model of Engle (2002). For recent applications of dynamic conditional beta on stock markets, see Bali and Engle (2010); Engle et al. (2015).

Table A1
Institutional ownership and systematic liquidity in the cross-section.

	Q1_A	Q1_B	Q1_RT	Q2_A	Q2_B	Q2_RT	Q3_A	Q3_B	Q3_RT	Q4_A	Q4_B	Q4_RT	Q5_A	Q5_B	Q5_RT
$(M5)\ \lambda_1 \times 10^3$	0.095***	0.101***	0.102***	0.119***	0.113***	0.124***	0.127***	0.111***	0.125***	0.136***	0.101***	0.13***	0.157***	0.086***	0.137***
	(3.26)	(3.48)	(3.95)	(4.33)	(3.27)	(3.92)	(4.78)	(2.93)	(3.78)	(5.7)	(3.13)	(4.2)	(8.01)	(4.23)	(6.18)
$(M5)\ \lambda_2$	0.034***	0.038***	0.038***	0.057***	0.049***	0.054***	0.059***	0.045***	0.056***	0.059***	0.037***	0.057***	0.081***	0.042***	0.087***
	(10.7)	(10.84)	(12.51)	(14.81)	(13.95)	(12.46)	(15.16)	(7.01)	(15.52)	(18.46)	(4.35)	(12.04)	(17.91)	(7.73)	(12.6)
$(M5)\ \theta$	0.058***	0.058***	0.057***	0.055***	0.057***	0.054***	0.057***	0.059***	0.058***	0.059***	0.064***	0.06***	0.058***	0.074***	0.069***
	(4.71)	(5.23)	(5.07)	(4.54)	(4.18)	(4.69)	(4.52)	(4.44)	(4.97)	(5.17)	(5.79)	(5.05)	(5.98)	(8.57)	(6.65)
$(M4)\ \lambda_1 \times 10^3$	0.461***	0.472***	0.478***	0.419***	0.428***	0.425***	0.433***	0.412***	0.397***	0.452***	0.418***	0.416***	0.468***	0.458***	0.459***
	(7.98)	(8.93)	(8.47)	(4.76)	(5.99)	(4.3)	(3.48)	(4.94)	(3.55)	(3.25)	(4.15)	(3.51)	(5.04)	(5.54)	(5.07)
$(M4)\ \lambda_2$	0.053***	0.018**	0.024***	0.106***	0.061***	0.068***	0.114***	0.091***	0.102***	0.141***	0.116***	0.135***	0.139***	0.127***	0.133***
	(5.84)	(2.19)	(3.32)	(9.67)	(10.62)	(10.14)	(22.97)	(15.95)	(18.64)	(24.23)	(23.05)	(24.63)	(15.04)	(23.61)	(29.1)
$(M4)\ \theta$	0.098*	0.086	0.082	0.112**	0.128**	0.115*	0.117	0.137**	0.137**	0.135**	0.139**	0.145***	0.126***	0.133***	0.138***
	(1.81)	(1.44)	(1.42)	(2.11)	(2.16)	(1.8)	(1.55)	(2.24)	(2.18)	(2.21)	(2.09)	(2.9)	(3.33)	(2.78)	(3.82)
$(M3)\ \lambda_1 \times 10^3$	1.054***	1.061***	1.069***	1.159***	1.078***	1.109***	1.235***	1.097***	1.154***	1.237***	1.095***	1.18***	1.159***	1.093***	1.147***
	(12.48)	(10.7)	(10.48)	(12.98)	(11.28)	(14.36)	(18.58)	(15.77)	(16.63)	(21.31)	(15.56)	(18.74)	(24.45)	(12.97)	(14.79)
$(M3)\ \lambda_2$	0.058***	0.064***	0.062***	0.063***	0.043***	0.052***	0.094***	0.051***	0.085***	0.127***	0.083***	0.117***	0.152***	0.088***	0.128***
	(7.32)	(13.41)	(6.75)	(7.62)	(4.58)	(6.63)	(20.24)	(11.72)	(12.56)	(21.57)	(13.73)	(12.82)	(16.4)	(8.29)	(11.11)
$(M3)\ \theta$	−0.019	−0.006	−0.018	−0.022	−0.014	−0.019	−0.019	−0.007	−0.016	−0.011	−0.016	−0.021	−0.003	−0.015	−0.014
	(−0.28)	(−0.06)	(−0.21)	(−0.34)	(−0.16)	(−0.26)	(−0.34)	(−0.1)	(−0.24)	(−0.27)	(−0.32)	(−0.45)	(−0.08)	(−0.26)	(−0.31)
$(M2)\ \lambda_1 \times 10^3$	1.5***	1.485***	1.483***	1.655***	1.504***	1.62***	1.529***	1.519***	1.609***	1.361***	1.391***	1.382***	1.426***	1.373***	1.409***
	(5.66)	(6.08)	(5.77)	(6.99)	(7.58)	(9.98)	(7.8)	(7.72)	(10.18)	(8.67)	(7.91)	(8.58)	(7.35)	(5.41)	(5.81)
$(M2)\ \lambda_2$	0.081***	0.079***	0.078***	0.06***	0.067***	0.067***	0.043***	0.08***	0.067***	0.023***	0.049***	0.032***	0.044***	0.025	0.044***
	(9.37)	(12.76)	(9.37)	(8.62)	(20.77)	(22.95)	(5.83)	(12.15)	(9.44)	(2.69)	(8.02)	(4.16)	(3.02)	(1.48)	(2.77)
$(M2)\ \theta$	0.136***	0.124***	0.129***	0.129***	0.104***	0.112***	0.137***	0.103***	0.115***	0.141***	0.121***	0.137***	0.139***	0.141***	0.134**
	(3.53)	(4.29)	(3.69)	(4.2)	(4.14)	(4.72)	(3.24)	(3.57)	(3.92)	(3.08)	(4.05)	(3.68)	(2.93)	(2.4)	(2.15)
$(M1)\ \lambda_1 \times 10^3$	−0.297	−0.213	−0.278	−0.329	−0.364	−0.326	−0.256	−0.301	−0.289	−0.181	−0.197	−0.154	−0.18	−0.159	−0.227
	(−1.37)	(−1.16)	(−1.61)	(−1.42)	(−1.59)	(−1.52)	(−1.18)	(−1.44)	(−1.48)	(−0.93)	(−1.13)	(−0.83)	(−0.79)	(−0.99)	(−0.98)
$(M1)\ \lambda_2$	−0.04	−0.03***	−0.011	−0.035***	−0.019	−0.015	−0.012	−0.008	−0.005	0.007	−0.003	0.033**	−0.032	0.009	0.012
	(−1.6)	(−4.24)	(−0.65)	(−3.2)	(−1.18)	(−0.88)	(−0.59)	(−0.42)	(−0.27)	(0.35)	(−0.22)	(2.12)	(−1.61)	(0.53)	(0.48)
$(M1)\ \theta$	0.231***	0.217***	0.217***	0.231***	0.227***	0.229***	0.223***	0.218***	0.219***	0.21***	0.207***	0.201***	0.213***	0.202***	0.206***
	(9.01)	(16.28)	(11.62)	(9.82)	(11.81)	(10.39)	(12.37)	(15.04)	(14.7)	(14.91)	(15.67)	(17.45)	(16.89)	(15.49)	(17.47)

Table presents the results of Fama and MacBeth (1973) regressions of weekly institutional ownership on past liquidity beta, number of institutional investors and firm size; i.e.,
$INST\_RATIO_{i,t} = a + \lambda_1 INST\_NUMBER_{i,t-1} + \lambda_2 \beta_{i,t-1} + \theta \log(MCAP_{i,t-1}) + \nu_{i,t}$
Institutional ownership is a firm's market value owned by institutions as the percentage of capitalization of the entire market. Size is the logarithm of firm's market capitalization (in million TL). All explanatory variables are measured at the end of each Wednesday. The table presents the averages and t-statistics of the coefficient estimates in each quintile ($M5$: largest, $M1$: smallest firm size quintile). The t-statistics are adjusted for heteroskedasticity and autocorrelation using Newey and West (1987) standard errors. In both panels, *, ** and *** denote 10%, 5% and 1% significance level.
In the manuscript, $Q1$, $Q2$, $Q3$, $Q4$ and $Q5$ refer to the amounts of 1000, 10,000, 25,000, 50,000 and 10,0000 TL respectively, whereas the liquidity measures A, B and RT stand for the cost of buying (ask side), selling (bid side) and roundtripping (buying and selling simultaneously) a given amount of position respectively. In this table, they refer to the betas of these liquidity measures.

Appendix B. Table

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