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Financial networks and trading in bond markets

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Abstract

We examine how financial networks influence asset prices and trading performance. Consistent with theoretical studies on the role of communication networks in information dissemination, we posit that global financial institutions, having more extensive and strategic financial networks, can more efficiently acquire and process information pertaining to asset trading due to their better access to order flows and, thus, have better trading performance than local financial institutions with less extensive and strategic financial networks. Using transaction level Turkish government bond trading data, we find that global financial institutions exhibit a stronger tendency to trade in more liquid bonds and consistently trade at more favorable prices than local financial institutions, suggesting that global financial institutions have an informational advantage. They also enjoy better trading performance on informed trades but this informational advantage tends to decline over time, indicating possible learning by local financial institutions as a result of trading with their global financial counterparts.

JEL classification: G15; G21; F21

Keywords: Financial networks; Informational advantage; Bond market trading

1. Introduction

Although it is well established that information moves security prices, how information flows through financial markets and is impounded in the prices of financial assets is not as well understood. Traditional asset pricing models assume that individuals behave anonymously with

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new information becoming known by all the agents in the market simultaneously, thereby making the information common knowledge. As a result, traditional approaches disregard the possibility that agent behavior (individually and collectively) may be influenced by a communication network. Information, however, can also gradually disseminate in a market by word-of-mouth and observational learning. Because of differences in institutional structures and traders' information processing abilities, it is unlikely that information diffusion will be amorphous. Instead, information is likely to spread more rapidly within trading firms than between trading firms, not only because of the presence of an intra-firm network but also because of financial incentives provided to traders that are related to firm profitability.

In this paper we examine the role of communication networks used by financial institutions in their trading activities and focus on whether these networks affect asset prices and trading performances. We define a communication network (hereafter to be referred to as a financial network) to be a set of trading platforms linked together by a system that collects and processes relevant information and then disseminates the information within the financial institution that uses these platforms. We refer to a financial institution with trading platform(s) that access only one market as "local" and one with trading platform(s) that access more than one market as "global." Consistent with the implications of theoretical studies on the role of networks on information dissemination, we posit that global financial institutions, because of their extensive financial network, can more efficiently acquire and process information closely related to asset trading in global financial markets in which they operate than can local financial institutions with financial network restricted to their home market. Such an advantage may result in global financial institutions pursuing different trading strategies and outperforming local financial institutions in the local market in which they both compete.

Models of trading dynamics recognize the role of asymmetric information. The distinction between informed and uninformed traders leads to a number of useful insights. For instance, informed traders tend to respond more quickly to news, to trade in more liquid markets, and to show better performance than uninformed traders. Yet it is not entirely clear who the informed traders are or how they become informed. In this regard, several empirical studies show that individuals who reside or work in the same location tend to make similar financial decisions, which suggests the presence of some type of internal group communication.[1] The idea is that traders who are spatially or electronically close are exposed to similar information that is diffused via networks within the same group once the information is received by one or more of the traders. For example, anecdotal evidence suggests that Twitter, a social network, plays a role in assessing the markets in the agricultural commodity sector (Berry and Rees, 2009).

Existing research on whether certain types of traders are more informed than others often focuses on whether foreign or domestic traders are more informed using data on equity market trading. The logic favoring domestic traders being more informed than foreign traders is that they may be able to gather more timely and accurate information about the prospects of a company through their formal and informal local networks, be more familiar with local laws and information disclosure policies, and be able to avoid information distortions caused by linguistic and cultural differences. Supporting the position that the foreign investors are more informed is

[1]For example, investors tend to invest locally (e.g., Grinblatt and Keloharju, 2001; Ivković and Weisbenner, 2005; Massa and Simonov, 2003, 2006), as do professional money managers (Coval and Moskowitz, 2001). Investors also tend to follow their colleagues, neighbors, and local information sources (e.g., Duflo and Saez, 2003; Hong, Kubik, and Stein, 2005; Ivković and Weisbenner, 2007; Gurun and Butler, 2012). Along these lines, Hong, Kubik, and Stein (2004) develop a model in which stock market participation is influenced by social interaction, and Xia (2007) shows that the influence of information on transaction prices depends on the structure of the network.

that these investors may be able to exploit their prior investment experience and expertise, as well as their superior (supposedly) knowledge of international business conditions. Foreign investors may also employ locals who are familiar with the domestic market, thereby partially offsetting domestic advantages.

The empirical evidence regarding which group is more informed, however, is mixed. Several empirical studies involving a variety of equity markets suggest that domestic investors are more informed than their foreign counterparts (e.g., Dahlquist and Robertsson, 2004; Lee et al., 2004; Choe, Kho, and Stulz, 2005; Dvorák, 2006) while others report the opposite (e.g., Grinblatt and Keloharju, 2000; Bacmann and Bollinger, 2003; Bailey, Mao, and Sirodom, 2004; Huang and Shiu, 2005). These inconsistent results suggest that extant conclusions are market specific or that the foreign–domestic classification provides only a partial explanation.

We address this inconsistency by examining the trading behaviors in government bonds of financial institutions with different financial networks. We choose government bond markets because, as Biais and Green (2005) point out, they typically provide little pre-trading transparency, and, compared to equities, the information driving government bond prices is more likely to be eventually known by the public. Moreover, as documented by Driessen, Melenberg, and Nijman (2003), Barr and Priestley (2004), and Kim, Moshiran, and Wu (2006), among others, bond markets are integrated in the sense that news that emanates in one market affects that market and other bond markets as well, although not necessarily at the same intensity or at the same time. Together these attributes define a venue where information channels are potentially important and better informed traders may be able to exploit their superior information.

We conduct an extensive empirical investigation of trading in bond markets populated by financial institutions with local and/or global financial networks. Our local bond market is the Turkish Bonds and Bills Market, which is located in Istanbul and hereafter usually referred to as the Istanbul market. The Istanbul market is suitable for our study for four main reasons. First, this market is well-developed, easily accessible to the global investment community, and operates with limited government interference. Because it is not a financial hub, information affecting short-term movements in bond prices worldwide, such as order flows in the major international bond markets, tends to flow to the Istanbul market and not from it. Second, participants in this market are typically financial institutions such as banks or brokerage firms, either acting on their own behalf or at the behest of others, as opposed to the mixture of financial and non-financial institutions as well as households often found in equity markets. This improves the likelihood that the characteristic that distinguishes the performances of different financial institutions is indeed their financial network structure. Third, the financial institutions that trade in the Istanbul market differ in domicile, asset size, trading volume, and scope of financial network. Financial institutions domiciled in countries other than Turkey trade in numerous markets located outside of Turkey, including those located in major financial centers. A few Turkish financial institutions trade in these markets as well. Finally, from a practical perspective, detailed time-stamped price and volume transaction data, including the identities of the transacting counterparties, are available.

Empirical research supports the notion that order flow is an ongoing aggregate measure of the market participants' interpretation of the news that affects the prices of financial assets. Motivated by Kyle's (1985) seminal microstructure model, numerous empirical studies show that order flow explains an economically significant portion of the movement in the market price of a financial asset in the very short run. Examples of this phenomenon on bond pricing include Massa and Simonov (2003), Bessembinder, Maxwell, and Venkataraman (2006), among others. In this paper we document that order flow explains, on average, 43% of bond price changes in the Istanbul market, which is not an atypical percentage when compared to other studies. Hasbrouck (1991) argues that the delayed price impact of a trade measures the informativeness of the trader, and in a foreign exchange rate context, Lyons (1995) and Love and Payne (2008) show that even public information is partially impounded into prices through order flows.

Intuitively, participants whose trading platforms are seamlessly connected to multiple markets are aware of the order flow details of these markets more quickly than those who do not have access. The more markets that are included in their trading network and the more actively they trade, the more informed they will be about global events, particularly if the markets are located in leading financial centers. This suggests that sophisticated participants who observe and process the order flows in their own and other markets will, on average, engage in more profitable trading than those who operate only in their own market and may employ different trading strategies.

To approximate the information flow that a financial institution collects from trading we create two measures of order flow: one for the local market and one for the global market. Both measures are based on trading volume, although they are constructed differently to reflect the observation that in our dataset all of the participants in the local market are known but are not known in the global market. This is because the global market participants include financial institutions that do not trade in the Istanbul market. Our measure for local order flow for a financial institution is its quarterly market share, i.e., the portion of the Istanbul's total quarterly volume associated with that financial institution. Our global order flow measure is also a quarterly market share metric. For each global financial institution, global order flow is its bond trading volume in the global market, which is defined *not* to include the Istanbul market, scaled by the corresponding volume of the financial institution that traded the most in the global market. We choose to express order flow in market share and not the level because it is more plausible that market share is the relative amount of information that affects the trading behavior that we are investigating.

We consider three different definitions of global order flow. The first defines the global market as all of the markets in which our global financial institutions trade, while the second and the third definitions consider the global market contains only those markets located in and outside the nine leading financial centers as defined by Cassis (2010), respectively. We split the global market into two parts to acknowledge the possibility that the quality and quantity of information emanating from the leading financial centers may be greater than that from the rest of the global market. In doing so, we recognize that there may be agglomeration economies in information gathering and dispersal as pointed out by McGahey, et al. (1990, ch. 2), Tschoegl (2000) and Poon (2003), among others.

Our investigation reveals that global financial institutions do indeed perform differently than local financial institutions, after controlling for various measures of size. We find that global financial institutions tend to trade more heavily than their local counterparts in the liquid (active) portion of the bond market. Our finding echoes Chowdhry and Nanda's (1991) notion that informed investors are more likely to trade liquid assets, and it supports the view that global financial institutions enjoy an informational advantage and strategically use more liquid bonds to conceal their superior information.

We also find that the average delayed price impact of trades initiated by global financial institutions is consistently larger than that initiated by their local counterparts. To illustrate, for every hypothetical one million Turkish Lira (TL) traded, an average global financial institution earns 1.92 basis points more than if the trade was executed by a typical local financial institution.

This finding lends support to our conjecture that financial institutions with a global financial network have an informational advantage because they can consistently buy at a lower (or sell at a higher) price than their local counterparts. These results are robust to limiting our attention to only liquid bonds, where liquidity is defined either by trading activity or Amihud's (2002) liquidity measure. Thus, the preference for trading more liquid bonds by global financial institutions is likely to be at least partially due to an informational advantage rather than only liquidity concerns.

Building upon the findings on the informativeness of trades for different financial institutions, we find that global financial institutions earn higher profits on informed trades than their local counterparts. For instance, an average global financial institution earns 1.5 basis points higher trading profit per trading cycle on informed trades than a typical local financial institution for daily complete trading cycles and earns 4.3 basis points more trading profit for informed trades for weekly complete trading cycles. This is consistent with the prediction that financial institutions with more extensive global financial networks have an informational advantage and are likely to perform better than others. We also find that trading profitability exhibits some persistence for all financial institutions, while higher interest rate volatility reduces trading profitability and participation.

Finally, we find that price impact of trades by global financial institutions declines over time. Consistent with the decreased price impact of these trades, although global financial institutions still perform better on informed trades in bond trading than their local counterparts, their superior performance declined over the same time period. Using Seru, Shumway, and Stoffman's (2010) approach, we identify significant learning by local financial institutions as a result of gaining trading experience with better-informed global financial institutions.

Before delving into the details of our analysis, it is useful two raise two concerns relating to the interpretation of the empirical results. First, because the majority of the global financial institutions in our dataset are not domiciled in Turkey, is it possible that our findings only reflect the previously documented foreign versus domestic dichotomy? To answer this question, we exclude trades involving foreign financial institutions from our analysis. Our findings concerning the impact of information qualitatively remain the same, thereby supporting the notion that our classification of the scope of financial networks (global versus local) does not economically correspond simply to the foreign versus domestic categorization of traders.

Second, it is commonly thought that the asset size of a firm and its profitability are positively related. The reasons suggested are varied and include economies of scale (Hall and Weiss, 1967), superior management (Demsetz, 1973), use of strategic groups (Porter, 1979), and lower cost of capital (Meyer, 1967). It has also been suggested that the profitability of trading firms is related to the volume of their trades (e.g., Demsetz, 1968; Warga, 1991; Schultz, 2001), with volume arguably being another dimension of size in the most general sense. Therefore, could our order flow measures proxy for global financial institutions simply being larger than local ones?

Unfortunately, we cannot completely disentangle this relationship because volume and asset size are highly correlated in our sample. Our empirical results concerning local order flow and global order flow, however, suggest that if order flow is a proxy for size, it is a nuanced one. For example, in various tests, global order flow provides significant explanatory power over and above that given by local order flow. In addition, the global order flow definition that contains only trading in the leading financial centers performs significantly better than the version that uses only trading in the markets located outside the leading financial centers. The latter version provides little if any explanatory power. This indicates that information benefits accruing to global trading only pertain to a small set of financial markets. Thus, it is neither the number of financial markets nor their combined trading volume that is economically important; it is the whether the financial markets are important providers of information.

We organize the remainder of our paper as follows. Section 2 describes the Turkish government bond market and its trading system. Section 3 defines our classification of traders as global versus local financial institutions, introduces our global order flow measure, and presents summary statistics. Section 4 provides our empirical analyses and discusses their results. Finally, Section 5 contains concluding remarks.

2. The bonds and bills market

2.1. The market

Turkey's public debt market, the Bonds and Bills Market (Istanbul market), is an important investment and trading venue for financial institutions. Using total market capitalization standardized by Gross Domestic Product (GDP) as a measure of importance, according to World Bank Database on Financial Development and Structure, Turkey ranked 9th out of 30 major world bond markets in 2000, with its bond market being 2.3 times as large as its equity market [see Beck, Demirgüç-Kunt, and Levine (2000) for details].

Almost every month, the Turkish Treasury auctions bonds with maturities ranging from 1 month to 10 years. After the primary market allocation, these bonds are traded on the Istanbul market. The institutions that are authorized to trade on this market are Istanbul Stock Exchange (ISE) member banks and member brokerage houses. These financial institutions typically trade on their own accounts. Sometimes they fill retail buy orders from their inventory, but if their inventory is insufficient they may go to market to meet this demand.

Each institution employs multiple traders who form an information network. They are in constant contact with each other throughout the trading day, permitting them to be better informed of the local buy and sell order flow. For instance, it is common for traders to inform the participants in their network that they have learned that a particular financial institution is a net buyer today or that another financial institution is trying to liquidate a sizeable position and the potential ramifications of these trades for their firm's bond positions and associated trading strategies. Some institutions have trading platforms that access multiple markets, thereby creating multi-market trader networks that facilitate the dissemination of information relevant to the local market within their respective institutions. For example, bond trades in major international bond markets may signal changes in the demand and supply of capital worldwide and significantly impact the capital market in Turkey. Financial institutions with trading platforms that access these bond markets can more quickly and efficiently collect and process the information and disseminate the information to their traders in the Istanbul market, which facilitates more effective strategies to trade Turkish bonds.

Istanbul market participants are a diverse mix of Turkish and foreign financial institutions. These institutions have different arrangements to disseminate information. Many international financial institutions, for instance, have their bond trading platforms connected by a “hoot.” Nowadays a “hoot” refers to an electronic communication system, but originally it was a device devoted to a single trading floor. Anecdotal evidence indicates that “hoot” transmissions tend to flow from New York and London to other markets. In contrast, bond traders of Turkish financial institutions (especially large Turkish banks) gather information by making phone calls to fellow bond traders in overseas financial centers. Of course, global information is also available to all

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traders whose firms have access to public information networks such as Reuters, Bloomberg, and similar providers. Different financial institutions, however, may still have different information processing capabilities, which may lead to differences in interpretation of publicly released information and in turn trading performance.[2]

2.2. The trading system

The Istanbul market, which serves as a secondary market, is a limit order book market that uses an electronic system to match, administer, and report transactions. The market operates in two sessions: from 9:30 a.m. to 12:00 noon, and from 1:00 p.m. to 5:00 p.m. Bonds with same-day and next-day settlement trade until 2:00 p.m., which is the settlement time for the day; between 2:00 p.m. and closing, only bonds with next-day settlement trade. Thus, the number of transactions declines noticeably after 2:00 p.m.

Orders are processed and executed according to price and time priority. The Istanbul market uses an order-driven electronic continuous market with no intermediaries such as market makers and no floor brokers. The majority of the orders are routed electronically via member firms to the central limit order book through an order processing system that does not require any re-entry by the member firms. In very rare cases, member firms call representatives at the exchange to have their orders entered for them. Member firms can execute market orders and limit orders, as well as orders that require further conditions for execution (e.g., fill-or-kill and stop-loss). Member firms are not allowed to enter orders when the market is closed; however, they are allowed to withdraw their existing orders. It is not unusual for traders to fill out their order screen prior to opening time and then submit multiple orders when the market opens.

Price information on the 20 best bids and offers is continuously available to member firms. The system does not display quantity demanded or offered at each of these prices and nor does it reveal the identity of the traders submitted the orders. Past transactions, however, can be viewed by all members. The most recently issued bond is designated as the active (or benchmark) bond. The tick size is one Turkish lira (TL) for a TL 100,000 face value bond, with minimum (maximum) order size set to TL 100,000 (TL 10 million). No formal upstairs market exists for block trades. Incoming market orders are executed automatically against the best limit orders in the book. Execution within the inside quotes is allowed.

Once a transaction takes place, a confirmation notice is sent to the parties involved in the transaction. The other market participants do not learn the identities of the parties, but they do observe that a transaction took place at a specific price and quantity. All information pertaining to price, yield, and volume of best orders, as well as details of the last transaction and a summary of all transactions are disseminated to data vendors, including Bloomberg, Reuters, and some local firms immediately after each transaction. In addition, all trades are reported to the clearing organization, the ISE Settlement and Custody Bank Inc. (Takas Bank), at the end of the day to facilitate bookkeeping. We do not have information on what percentage of the transactions take place in ISE, but anecdotal

[2]Global and local financial institutions also are different in other dimensions. For instance, global financial institutions are generally larger than their local counterparts and have better access to external financing opportunities. According to the *2006 Bank Association of Turkey Statistics*, foreign currency denominated liabilities constitute a larger portion of total liabilities in global financial institutions (56.3%) than the other banks (44.6%). The difference in mean ratio of foreign currency denominated liabilities to total liabilities between global and other institutions is significant ($p=0.05$). This is consistent with the anecdotal evidence that global institutions benefit from lower cost of capital from external (i.e., outside of Turkey) markets. Because of unavailability of data on the cost and the amount of borrowing by these financial institutions, we are unable to explicitly control for differences in the cost of capital by different financial institutions.

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evidence suggests that ISE consolidates more than 97% of the turnover value of the market's transactions. The remainder is captured by over-the-counter markets.

The Turkish government typically plays a minimal role in the Istanbul market. Nevertheless, after the 2001 banking crisis, the undersecretariat of the Treasury initiated a primary dealer system that requires some members that participate in the primary market auction to provide liquidity by quoting a bid and an ask (not necessarily the best bid or ask) in the secondary market. The quotes are identified as being given by a primary dealer. The rationale for this innovation is that these members would accommodate liquidity needs that may arise during times of crisis, although anecdotal evidence indicates that such action by the primary dealers has yet to occur. The number of primary dealer members (typically between eight and 14) and their composition (foreign or domestic) is determined by the undersecretariat. In 2006, there were 12 primary dealers.

3. Data, variables, and summary statistics

Our sample consists of 1,716,917 tick-by-tick time-stamped transactions beginning May 1, 2001 and ending June 15, 2005 (1,039 trading days) for 177 Turkish lira-denominated Treasury bills and notes. For each transaction, we have detailed information on the time of order placed and filled, transaction price, and trade size. Importantly, our dataset also contains a unique code identifying the traders on both sides of a transaction. The starting date of the sample is two months after the Turkish financial crisis attributed to liquidity shortages in the banking system that ended in February 2001. Data availability dictates our sample's ending date.

One hundred seventy distinct financial institutions participated in the Istanbul market. We classify these as either local or global financial institutions. A financial institution is classified as “global” if its trading platforms access bond markets outside Turkey; otherwise, it is classified as “local.” Based on information collected from the ISE, the Turkish Bank Association (http://www.tbb.org.tr/net/subeler), and several financial institutions, we classify 146 as local financial institutions and 24 as global financial institutions.

The roster of global financial institutions includes large foreign financial institutions such as Deutsche Bank, Citibank, and JPMorgan Chase as well as large domestic financial institutions such as Yapı Kredi Bankası A.Ş., Vakıflar Bankası A.Ş., and Akbank A.Ş. The foreign global financial institutions have home offices in New York City and throughout Europe and Asia and trade in many of the markets located in the world's leading financial centers. Using Cassis' (2010) taxonomy, these centers are New York City, London, Frankfurt, Paris, Zurich, Amsterdam, Tokyo, Hong Kong, and Singapore. Deutsche Bank has the most extensive network, having access to nearly 80 markets. Six of the global financial institutions are domiciled in Turkey and together account for more than 22% of the global financial institutions' participation in the Istanbul market. These financial institutions are able to trade not only in New York City and throughout Europe but also in such locales as Bahrain, Tokyo, and Moscow.

Using the trader identification code and our global/local classification scheme, we classify each transaction as being made by a local or global financial institution. Table 1 reports selective summary statistics. Panel A shows the average daily trading volume in U.S. dollars (USD) of the local and global financial institutions sorted by seller- and buyer-initiated trades and their counterparties.[3] To identify buyer- and seller-initiated trades, we use the order submission time

[3]The U.S. dollar volume is obtained by using the daily closing TL/USD exchange rate for that day. Turkey dropped six zeros from its currency at the end of 2004. We incorporate this change in our calculations. During the sample period, the average exchange rate was TL 1.46 = USD 1 with a standard deviation of 0.11.

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Table 1
Transactions by financial institution type.

This table presents summary statistics on transactions by type of financial institution (local and global). Panel A reports the daily mean U.S. dollar trading volume when we focus attention on buyer- and seller-initiated trades. Panel B reports the daily mean U.S. dollar trading volume per financial institution. Panel C presents the mean per-transaction U.S. dollar volume and the average number of transactions per financial institution. The sample period is May 1, 2001–June 15, 2005 (1,039 trading days).

Panel A. Trading volume (in million U.S. dollars)

		Seller-initiated trades	
		Local	Global
Seller	Local	80.47	74.91
	Global	77.11	76.53
		Buyer-Initiated Trades	
		Local	Global
Buyer	Local	81.94	82.35
	Global	74.55	95.60

Panel B. Trading Volume per Financial Institution (in million U.S. dollars)

	Seller-initiated trades	
	Local	Global
Local	1.80	1.14
Global	1.07	3.18
	Buyer-Initiated Trades	
	Local	Global
Local	1.90	1.24
Global	1.05	3.98

Panel C. Transaction volume and number

	Mean per-transaction volume (in million U.S. dollars)	
	Local	Global
Local	0.29	0.38
Global		0.65
	Number of transactions per financial institution	
	Local	Global
Local	11,532	9,813
Global		11,510

and the order execution time. We identify trades as seller (buyer) initiated trades if the execution time is same as buyer (seller) order submission time. Of the USD 640 million of total daily volume, trading between local and global financial institutions has an average daily trading volume reaching USD 152 million for seller-initiated trades and USD 156.9 million for buyer-initiated trades. Trading among global financial institutions has seller- and buyer-initiated daily trading volumes of USD 76.5 million and USD 95.6 million, respectively.

To account for the large difference in the number of global and local financial institutions, we standardize the trading volume/number of transactions by the number of financial institutions involved in the trades. Panel B of Table 1 shows the average daily trading volume in U.S. dollars per local and global financial institutions. Our results indicate that trading among global financial institutions is the highest, with average daily trading volume reaching USD 3.2 million per financial institution for seller-initiated trades and USD 4.0 million for buyer-initiated trades. Trading between local large and global financial institutions is the second highest, with average daily trading volume per financial institution reaching USD 2.2 million for seller-initiated trades and USD 2.3 million for buyer-initiated trades, respectively.

In Panel C of Table 1, we report the average size of tick-by-tick transactions for local and global financial institutions without reference to the initiator. The average volume per transaction is highest at USD 0.65 million among global financial institutions, followed by trading between local and global financial institutions at USD 0.38 million, while trades among local financial institutions ranks third at USD 0.29 million.

Although the simple classification of local versus global financial institutions offers useful insights on the distinctive trading behavior of these financial institutions, we extend our analysis by using local and global order flow to measure the scope of a financial network in collecting and processing information. This dichotomy allows us to assess empirically the incremental effect associated with global order flow. We define local order flow, LOF_{it}, to be the bond trading volume of financial institution i in the local market in quarter t scaled by the corresponding total bond trading volume of all the financial institutions. Thus, LOF_{it} is a measure of market share and reflects all the trading activity in the Istanbul market.[4]

Our measure of global order flow (GOF_{it}) is also a market share measure, although it is calculated somewhat differently than LOF_{it} to reflect the observation that our dataset does not contain the total trading volume in the global markets. In particular, we define global order flow to be the trading volume of financial institution i in quarter t scaled by the corresponding trading volume of the financial institution that has the highest trading volume.[5] More precisely, let $TVOL_{it}$ be the total dollar volume of bond trading in international bond markets for financial institution i in quarter t so that

$$GOF_{it} = \frac{TVOL_{it}}{\max\{TVOL_{1t}, TVOL_{2t}, \ldots, TVOL_{It}\}}, \tag{1}$$

where I is the number of financial institutions trading in global bond markets. Since local financial institutions, by definition, do not trade in markets outside Turkey, the value of GOF_{it} for these financial institutions is zero. For global financial institutions, GOF_{it} is greater than zero and bounded from above by one. Thus, GOF_{it} measures the importance of information known by each financial institution in terms of global market share relative to the financial institution that is most exposed to international markets in terms of trading volume.

[4]We use other measures of local order flow including each financial institution's total trading volume in the previous quarter, the rank of financial institutions based on trading volume in previous quarter, and the size classification provided by the ISE. The results are qualitatively similar to those reported using LOF_{it}.

[5]Our sample contains 17 quarters. The middle 15 are calendar quarters while the first two months of the sample period define the first "quarter" and the final 2.5 months represent the last "quarter". These differences are due to the sample's beginning and ending dates.

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We define the composition of the global market in three ways. First, we define the global market to consist of the markets (excluding Istanbul) in which our sample of financial institutions trade. Second, we restrict the definition of global market to include only the nine markets located in the leading financial centers as defined by Cassis (2010). Third, we consider the global market to be all of the markets in the first definition that are not located in one of the leading financial centers. Thus, the numerator for the global order flow calculation for the second and third definition of global market sum to that of the first definition.

Our empirical analysis shows that both the first and the second definitions provide qualitatively similar results but findings on the second definition are stronger. We also find that when we include both the second and third definitions of global order flow in our analyses, the results of the second definition dominate those of the third, which provides little or no economic or statistical significance. This relationship suggests that information does not emanate equally from all global markets but, instead, comes largely from the markets located in the leading financial centers such as New York City and London. On average, our measure of global order flow from the leading financial centers is roughly 37% and reasonably stable over time. In Section 4, we provide some empirical evidence to substantiate this observation. In the majority of the analysis that follows, we use the second definition of global order flow in which only the markets in the leading financial centers are considered sources of potential information.

4. Empirical analysis and results

Our empirical exploration proceeds as follows. We first investigate the relative informational advantage of different financial institutions. We conduct this analysis from two perspectives: (1) we examine whether global financial institutions have a stronger preference for trading more liquid bonds, a practice that allows them to more easily hide informed strategic trades, and (2) we investigate whether global financial institutions consistently transact at more favorable prices. Building upon the informativeness analysis, we then explore whether the relative informational advantage is reflected in trading performance by examining the trading profitability of different financial institutions at both daily and weekly frequencies. We perform our analysis for both the full sample and two subsamples with an equal number of trading days: May 1, 2002–November 13, 2003 and November 14, 2003–June 15, 2005. Our evidence supports the hypotheses that global financial institutions are more informed and have better performance in bond trading than local financial institutions. Further, we document possible learning effects by local financial institutions.

4.1. Empirical analysis of a relative informational advantage

4.1.1. Strategic trading

Chowdhry and Nanda (1991) show that informed investors tend to trade in more liquid markets, presumably because of their need to hide strategic transactions that convey information. Combining this observation with Pasquariello and Vega's (2007) suggestion that the most liquid bonds are the ones that are most recently issued, we hypothesize that if global financial institutions have an informational advantage over local financial institutions, they tend to trade active bonds, i.e., the most recently issued bonds, relative to the other bonds. We refer to these other bonds as passive bonds.

In Table 2 we report different financial institutions' average daily transactions—measured by trading volume (in U.S. dollars) and number of trades—in active bonds and passive bonds and

Table 2
Relative trading activity in active and passive bonds.

This table summarizes active and passive bond transactions by volume in million U.S. dollars (Panel A) and number of trades (Panel B). We present our measures for transactions involving global financial institutions on both sides of the trade (buy and sell), global financial institutions on at least one side of the trade (buy or sell), and local financial institutions on both sides of the trade. The entries corresponding to “Active” and “Passive” rows represent the volume or number of daily transactions of active and passive bonds, whereas those of “Ratio” refer to the average daily ratio of active to passive bond transactions. An active bond is the most recently issued bond. p-Values are reported for the null hypothesis that the sample mean of one of the categories involving global financial institutions is greater than the mean of the category involving only local financial institutions. The percentage of days Ratio > Local/Local Ratio measures the portion of days that the Global/Global or Global/Local categories are greater than the Local/Local category. The sample period is May 1, 2001–June 15, 2005 (1,039 trading days).

Panel A: Volume of transactions

	Local/Local	Global/Local	Global/Global
Active	0.73	3.00	4.01
Passive	0.66	2.71	3.15
Ratio	1.38	1.38	2.33
Std. error of mean	0.04	0.04	0.30
p-Value		(0.554)	(0.000)
t-Value		0.14	3.10
% of days Ratio > Local/Local Ratio		53.99	55.73

Panel B: Number of transactions

	Local/Local	Global/Local	Global/Global
Active	2.71	7.75	5.66
Passive	2.68	6.32	5.41
Ratio	1.19	1.46	1.34
Std. error of mean	0.03	0.03	0.04
p-Value		(0.000)	(0.000)
t-Value		14.66	4.00
% of days Ratio > Local/Local Ratio		73.53	52.94

the daily ratio of trading in active bonds to passive bonds. Consistent with Pasquariello and Vega (2007), active bonds have the highest trading volume/number of transactions compared to the rest of the bonds. As a robustness check, we calculate the transaction volume at day $t-1$ and designate the bond with the highest score as the active bond for the next trading day. Our conclusions are not affected by this alternative definition of “active” bond.

Next, we split the sample transactions into cases where global financial institutions are on both sides of the transaction, a global financial institution is on one side and a local financial institution on the other, and local financial institutions are on both sides. The results for trading volume and number of transactions are similar, although those for trading volume are more compelling. The ratio of active to passive bonds is greatest in terms of trading volume (in U.S. dollars) when global financial institutions are on both sides of the transaction. For example, the ratio of active to passive bonds in terms of trading volume is 2.33 for global financial institutions and 1.38 for local financial institutions. The difference in the ratios of active to passive bonds for global/global and

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local/local financial institutions is significant ($p=0.000$), suggesting that global financial institutions have a stronger preference for trading active bonds than local financial institutions.

The results based on the number of transactions are similar. While the ratio of active to passive bonds for trades involving only global financial institutions is 1.34, the corresponding ratio for only local financial institutions is 1.19. The difference is again significant ($p=0.000$). Our empirical evidence on preferences of global and local financial institutions with respect to active versus passive bonds thus supports the conjecture that global financial institutions have an information advantage over local financial institutions.

This evidence may also be consistent, however, with alternative explanations such that global financial institutions trade in more active bonds to hedge exchange rate fluctuation because of their higher exposure to foreign currencies than local financial institutions or that global financial institutions have liquidity concerns when trading large quantities. As a robustness check for the former, we exclude the observations for days with changes in the TL/USD exchange rate that are above the average of past 90 days. We find the same quantitative results as reported in Table 2, suggesting that our finding is unlikely to be driven by exchange rate hedging related trades. As for the global financial institutions' preference for trading active bonds because of liquidity concerns, in the section that follows we examine the trading profitability to draw the conclusion on the informational advantage afforded global financial institutions.

4.1.2. Pricing impact

Relying on Kyle (1985), Hasbrouck (1991) suggests that the delayed price impact of a trade measures the informativeness of the trader. In particular, he uses the following basic specification to estimate the price impact of a trade

$$r_t = bx_t + v_t, \tag{2}$$

where r_t is the change in the quote midpoint, x_t is the signed volume, and ν_t reflects the public information. Hasbrouck (1991) argues that the “price impact of the trade is measured by the coefficient b which may be estimated by regression.” Following this idea, a number of empirical studies have used the delayed price impact to assess the informational content of trades by investors. For example, this measure of informativeness is also used in Bessembinder (2003), Massa and Simonov (2003, 2006), and Bessembinder et al. (2006), among many others.

We adopt this approach and estimate the degree of informativeness of different financial institutions by examining the delayed price changes in the same bond in a D-minute interval following each transaction initiated by the financial institution. Specifically, in every quarter t and for each bond k, we estimate Eq. (3) to identify the relationship between delayed price changes and the size of trades initiated by financial institution i

$$\Delta P^D_{ikt} = \lambda_{ikt} + \theta_{ikt} T_{ikt} + \varepsilon_{ikt} \tag{3}$$

where ΔP^D_{ikt} is the delayed price change of bond k in D minutes following the trade and T_{ikt} is the signed transaction volume in millions of Turkish liras (positive for purchases and negative for sales). Following Hasbrouck (1991), we interpret θ_{ikt} to measure the informativeness of financial institution i that is associated with its bond k trades in quarter t. For ΔP^D_{ikt} to be defined, there must be a transaction in bond k within D minutes after the trade. If there is more than one trade, we use the last transaction within the interval, and if no transaction takes place, we set $\Delta P^D_{ikt}=0$.

We follow Bessembinder (2003) and use a 10-minute time interval ($D=10$) after each transaction as the baseline case in our regression to identify the price impact of informed trades. Given the total number of trades and trading days in our sample, on average there are about

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30 trades per 10-minute interval.[6] We estimate Eq. (3) for each financial institution and each bond. The coefficient θ_{ikt} shows the degree of informativeness of financial institution i, which initiated the trade on bond k in quarter t. A positive θ_{ikt} means that the trade initiator, financial institution i, consistently bought (sold) from (to) other financial institutions before an increase (decrease) in the price of bond k in quarter t. A significant positive value for θ_{ikt} implies that financial institution i is more informed than its trading counterparts with respect to bond k in quarter t. The larger the estimated value for θ_{ikt}, the greater the information content of the trade.

To examine how the degree of informativeness of trades varies with the extensiveness of financial network, we estimate the following equation that relates trade informativeness to financial institution order flow characteristics:

$$\theta_{ikt} = \beta_0 + \beta_1 GOF_{it-1} + \beta_2 LOF_{it-1} + \delta_k IB_k + \kappa_t IQ_t + \varepsilon_{ikt} \tag{4}$$

where GOF_{it-1} represents financial institution i's global order flow associated with the bond markets located in the nine leading financial centers in the previous quarter, LOF_{it-1} measures its local order flow in the previous quarter, IB_k is a binary indicator that takes a value of one for bond k (the bond fixed effect), and IQ_t is a binary indicator that takes a value of one for quarter t (the quarter fixed effect). GOF_{it-1}'s coefficient, therefore, measures the incremental effect associated with a financial institution's ability to exploit its global financial network in an effort to become informed. We estimate Eq. (4) using robust standard error regression clustered by traders and bond fixed effects to control for possible unobserved heterogeneity among different bonds. We include all θs estimated in Eq. (3). Limiting observations to θs that are significant ($p = 0.01$) does not change our results.

Table 3 reports the estimation results of Eq. (4). Panel A presents the results for the full sample and two subsamples. For the baseline 10-minute time interval, the coefficient of GOF_{it-1} is positive and statistically significant for both the full sample and the early subsample. The coefficient using the entire sample suggests that for every TL 1 million traded by a representative global financial institution, the price increases TL 0.015 (0.041×0.37) more in a 10-minute interval than if the TL 1 million were traded by a typical local financial institution. Given the average bond price of TL 78 for the entire sample, the estimated bond price change implies that an average global financial institution enjoys an additional price advantage of 1.92 basis points. Using the average exchange rate during the sample period, 1.46 TL/USD, this effect corresponds to 1.31 U.S. cents. Our results indicate that, on average, global financial institutions enjoy better pricing in bond trading than local financial institutions, which is consistent with having an informational advantage over local financial institutions.

When we applied the estimation to the subsamples, the additional price advantage afforded global financial institutions is larger (TL 0.031 or 3.9 basis points) for the earlier subsample (2001–2003) and insignificant for the later subsample (2003–2005). This indicates that while global financial institutions obtain more favorable prices for the entire sample period, their pricing advantage is declining. The evidence suggests that local financial institutions may be learning from their trading with their global financial counterparts, leading to a decline in the relative informational advantage of global financial institutions over time. We provide further analysis of trading performance later.

[6]We also perform our analysis using 20- and 30-minute time intervals, which increases the average number of trades per interval to approximately 60 and 90, respectively. This analysis allows us to assess how quickly information dissipates in this market. Excluding the top and bottom deciles of trades from each day to control for the potential impact of extreme trading does not change our results.

Table 3
Informativeness of trade by different financial institutions.

Panel A reports the regression results of Eq. (4) for all financial institutions, QUOTE QUOTE where the dependent variable, θ_{ikt}, is degree of informativeness of financial institution i for bond k during quarter t. θ_{ikt} is estimated using Eq. (1). $GOF_{it-1}$is the total bond trading volume of financial institution i in the nine leading financial centers in the previous quarter scaled by the corresponding total bond trading volume of the financial institution that has the highest bond trading volume. $LOF_{it-1}$is the quarterly bond trading volume of financial institution i in the local market in the previous quarter scaled by the corresponding total trading volume of all financial institutions. Standard errors are clustered by financial institution. p-Values associated with coefficient estimates are provided in parentheses. Panel B shows the results obtained after excluding transactions of foreign financial institutions. The first column reports the estimation using the full sample. The second and third columns report estimation results using data before (nine quarters) and after (eight quarters) the midpoint of sample period (November 13, 2003).The sample period is May 1, 2001–June 15, 2005 (1,039 trading days).

Panel A. All financial institutions

	All	Earlier	Later
GOF_{it-1}	0.041	0.084	0.009
	(0.001)	(0.000)	(0.143)
LOF_{it-1}	0.054	0.045	0.059
	(0.090)	(0.143)	(0.053)
Bond fixed effects	Included	Included	Included
Quarter fixed effects	Included	Included	Included
N	107,880	57,073	50,807
R^2	0.32	0.42	0.28

Panel B. Domestic financial institutions only

	All	Earlier	Later
GOF_{it-1}	0.038	0.067	0.018
	(0.001)	(0.000)	(0.014)
LOF_{it-1}	0.035	0.022	0.054
	(0.198)	(0.143)	(0.310)
Bond Fixed Effects	Included	Included	Included
Quarter Fixed Effects	Included	Included	Included
N	87,103	46,429	40,674
R^2	0.32	0.29	0.37

Our findings on the more favorable prices enjoyed by global financial institutions are not simply due to the dichotomy of foreign versus domestic financial institutions. To demonstrate this assertion, we repeat the analysis using only the transactions of domestic financial institutions. Panel B of Table 3 reports these estimation results. GOF_{it-1}'s coefficients are similar to those reported for all financial institutions, although the coefficient is now significant in the later period. The pricing benefit is slightly lower but remains significant using the full sample. The informational advantage afforded global financial institutions is again larger for the earlier subsample than for the later subsample. These results indicate that our findings on favorable pricing in Turkish bond trading are more likely attributed to the global financial institutions than to the foreign versus domestic categorization.

We also performed the regression analysis on two subsamples. The first subsample consists of only liquid bonds. The second subsample excludes financial institutions designated as primary

Table 4
Intraday trades and roundtrip trades.

This table presents descriptive statistics on percentage of transactions that are intraday and roundtrip day trades. All columns sum to 100. A buy (sell) trade is classified as intraday trade if the financial institutions sells (buys) the same security in the same day. An intraday trade is a roundtrip trade if the transaction is part of the transactions that form a day trading cycle as defined in Section 4.2. The sample period is May 1, 2001–June 15, 2005 (1,039 trading days).

Panel A. Volume of trades

	Global	Local	All
Round trips	42.80	48.12	46.44
Intraday non-roundtrips	25.15	14.45	21.12
Non-intraday trades	32.05	37.43	32.44

Panel B. Number of trades

	Global	Local	All
Round trips	24.93	13.44	11.46
Intraday non-roundtrips	41.46	45.01	26.17
Non-intraday trades	33.61	41.55	62.36

dealers. We identified liquid bonds using the Amihud (2002) liquidity measure, calculated for each bond as the absolute value of daily returns divided by daily dollar volume for the previous day, with low (below the median) Amihud measure bonds defined to be the liquid bonds. Our results (not reported) show that the coefficients for global order flow remain quantitatively similar to the findings reported in Table 3. This suggests that more favorable prices enjoyed by global financial institutions are unlikely to be attributed to differences in bond liquidity or the requirement that primary dealers act as liquidity providers.

4.2. Trading performance analysis

4.2.1. Trading profitability

The empirical evidence presented in the previous section suggests that global financial institutions have an informational advantage in bond trading over their local counterparts because of their exposure to global order flow. A natural question is whether the informational advantage is reflected in their trading performances. We address this question by investigating the profitability of the informed trading of bonds by financial institutions. We begin by constructing completed trading cycles (i.e., round trips) for each bond k by financial institution i. We assume that the initial inventory is zero and that purchases increase inventory and sales decrease it. As the time unfolds, the inventory level will typically hit zero several times. The time between the adjacent zeros is considered a cycle and the profits associated with the transactions in each cycle are calculated using the buy and sell prices and corresponding trade volumes.

In Table 4 we report the summary statistics on trading activities by different financial institutions based on trading volume (Panel A) and number of transactions (Panel B) for daily trades. A buy (sell) trade is classified as an intraday trade if a financial institution sells (buys) the same security in the same day. Complete trading cycles (round trips) within a day are by definition part of intraday trades. For our sample, about 38% of transactions are intraday trades but these trades account for almost 68% of trading volume. Overall, complete cycle intraday transactions are 11.5% but account for 46.4% trading volume. Among different types of traders,

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global financial institutions have a higher percentage of complete cycle day trading transactions (25%), which account for 43% of their trading volume. Local financial institutions have about 13% complete cycle day-trading transactions, which account for 48% of their trading volume. These statistics suggest that daily trading activities play an important role in the overall trading activities of these financial institutions, and the profitability associated with these trades is likely to be a sizable fraction of their total trading profitability. Given that non-round trip intraday trades account for a large fraction of all day trades, dealers' positions in the bond market are not necessarily zero overnight. To mitigate the impact of overnight positions on the trading profitability of financial institutions, in addition to examining the trading profitability of daily complete trading cycles, we also analyze the trading profitability on weekly complete cycle trades.

Using information on the percentage profit and funds invested in trading cycles for all bonds for financial institution i in period t, we construct the trading profitability measure for each investor i in period t as follows:

$$PRF_{it} = \frac{\sum_{k=1}^{K_t}\sum_{c=1}^{C_t}(PROFIT_{itkc} \times INVESTED_{itkc})}{\sum_{k=1}^{K_t}\sum_{c=1}^{C_t} INVESTED_{itkc}}, \tag{5}$$

where $PROFIT_{itkc}$ and $INVESTED_{itkc}$ are profits made and funds invested in trading cycle c in bond k by financial institution i in period t, respectively. K_t and C_t are the number of bonds and complete trading cycles in period t, respectively. PRF_{it} is the weighted average percentage profit per trading cycle for investor i in period t. We ignore direct transaction costs in our calculation because they are very small, being approximately 0.1 basis points. Moreover, since we are not privy to tick-by-tick TL/USD exchange rate observations, we calculate profits per cycle in Turkish lira. Although lira and dollar profits may differ, there is no compelling reason for this difference to create a short-term systematic bias.

To identify information-motivated trading, we use Hasbrouck's (1991) price impact concept previously discussed and argue that informed trades tend to have a large price impact that lasts for a reasonable time interval. Consequently, we classify completed trading cycles as informed trades versus other trades according to the estimated price impact of the first trade of each completed trading cycle.[7] Specifically, we sort all complete trading cycles by the size of the price impact of the first trade of each cycle. We classify a complete trading cycle as informed if the size of the price impact for that trading cycle is above the average size of the price impact for all completed trading cycles and the remaining completed trading cycles as other trades. Our classification of informed trading cycle is not mechanically related to the trading profit of completed cycles. In fact, the median percentage of profits attributed to the first trade is only 2.5%, suggesting that a significant fraction of profits is coming from the subsequent transactions in completed trading cycles.

Table 5 presents the summary statistics for trading profitability for informed and other completed trading cycles for both daily and weekly frequencies. Our results in Panel A indicate that for the informed day trades, on average, all financial institution groups make positive profit. In particular, trading profits are higher for global financial institutions (0.038%) than for local financial institutions (0.025%). In contrast, for other day trades, both groups suffer a loss on average. Further, global financial institutions earn significantly higher day-trading profits on informed trades and suffer significantly lower trading losses on other trades than local financial

[7]We perform robustness checks by classifying informed complete trade cycles using the cumulative price impact of all trades in the same direction as the first trade of a complete trade cycle and find our results to be qualitatively very similar. We obtain similar results when we use the median of the price impact for initial trades to identify informed trades.

Table 5
Trading profitability.

This table presents descriptive statistics on percentage day-trading profits (*PRF*) for global and local financial institutions for the informed day trading cycles and other day trading cycles using daily complete trade cycles (Panel A) and weekly complete trade cycles (Panel B). An informed cycle is the trading cycle with the size of the price impact of the first trade for that trading cycle is above the average size of the first trade price impact for all completed trading cycles and the remaining completed trading cycles are classified as others. We also report the Pearson chi-square values and their corresponding p-values of the hypothesis that the median of the first column is equal to the mean of the second column. *PRF* is calculated using the methodology described in Section 4.2.1. The sample period is May 1, 2001–June 15, 2005 (1,039 trading days).

Panel A. Trading profitability for daily complete trade cycles

	Informed trades				
	Obs	Mean	Std. Dev.	Median	75%
Local	14,812	0.025	0.115	0.014	0.065
Global	5,298	0.038	0.119	0.021	0.081
All	20,110	0.029	0.117	0.016	0.069
	Other trades				
	Obs	Mean	Std. Dev.	Median	75%
Local	19,014	−0.078	0.101	−0.017	0.000
Global	5,076	−0.080	0.099	−0.012	0.000
All	24,090	−0.079	0.100	−0.015	0.000

Median Comparisons

		Informed	Others
Local	Global	19.04 (0.000)	15.23 (0.000)

Panel B. Trading profitability for weekly complete trade cycles

	Informed Trades				
	Obs	Mean	Std. Dev.	Median	75%
Local	9,654	0.053	0.358	0.019	0.127
Global	2,565	0.115	0.384	0.056	0.218
All	12,219	0.066	0.364	0.024	0.144
0.5					
	Other Trades				
	Obs	Mean	Std. Dev.	Median	75%
Local	10050	−0.197	0.392	-0.093	−0.025
Global	2,612	−0.170	0.376	-0.019	−0.015
All	12,662	−0.192	0.389	-0.092	−0.023

Median comparisons

		Informed	Others
Local	Global	25.04 (0.000)	9.45 (0.000)

institutions ($p = 0.000$), based on the median day-trading profitability.[8] Results based on weekly complete trading cycles in Panel B support the findings based on daily trades. Global financial institutions earn significantly higher average trading profits than local financial institutions (0.115 % versus 0.053%) on informed trades. For other trades, global financial institutions also suffer significantly lower median trading losses than local financial institutions.

Several studies have documented that a trader's style matters in their trading performance. Warga (1991) documents that players that trade more do better in the fixed-income market. Schultz (2001) finds that institutions that trade actively in corporate bond markets do better than institutions that trade less and larger trades obtain better prices. Barber et al. (2004) document that frequent day traders perform better than infrequent day traders. In addition, if investors are overconfident in their trading skills, prior profitability will likely influence their participation decisions in day trading. It is also plausible that traders learn from prior trading, adjusting their trading strategies based prior trading successes and market conditions. We therefore include global order flow, local order flow, and prior trading performance in our regression specification.

Because a large proportion of financial institutions do not participate in day trading, we conduct joint estimation of the participation decision and trading profitability using Heckman's (1979) self-selection model, where we specify the participation decision as a function of the trader's prior trading successes and market conditions, as proxied by interest rate volatility and previous day excess trading volume. Specifically, we estimate the following model:

$$\begin{aligned} PRF_{it} &= \beta_0 + \beta_1 GOF_{it-1} + \beta_2 LOF_{it-1} + \beta_3 PRF_{it-1} + \beta_4 PRF_{it-1} \times GOF_{it-1} \\ &\quad + \beta_5 PRF_{it-1} \times LOF_{it-1} + \beta_6 VOLINT_{t-1} + \varepsilon_{it} \\ PART_{it} &= \gamma_1 PRF_{it-1} + \gamma_2 VOLINT_{t-1} + \gamma_3 VOLUME_{t-1} + u_{it} > 0. \end{aligned} \tag{6}$$

In the first expression, PRF_{it} is the percentage trading profit of financial institution i in period t, GOF_{it-1} is the proxy for the financial institution‘s global order flow in the previous quarter, LOF_{it-1} measures its local order flow in the previous quarter, PRF_{it-1} is its percentage profit from previous trading, and $VOLINT_{t-1}$ is the standard deviation of the interest rate on the previous day using 30-minute observations. Of the variables in the second expression not yet defined, $PART_{it}$ represents participation decision, which takes the value of one if financial institution i participates in trading in period t and zero otherwise, and $VOLUME_{t-1}$ is the excess trading volume calculated as the difference between the trading volume on day $t-1$ and the average trading volume for the 90 days preceding $t-1$. The interaction terms capture the impact of past trading performance and market conditions on the trading profitability of various financial institutions.[9] We exclude the observations if there was no trading in the previous period.

Table 6 reports the regression analysis results on trading profitability for complete trading cycles at daily (Panel A) and weekly (Panel B) frequency, respectively. Columns (1)–(3) in Panel A show the estimation results for the Heckman model for the full sample, the informed subsample, and the subsample of other trades for daily complete trading cycles. For the full sample, our regression results suggest that, after controlling for local order flow, interest rate volatility and previous day-trading profitability, an average global financial institution earns 0.0074 (0.020×0.37) percentage points higher profit than those of typical local financial

[8] Analyzing the Taiwanese stock market, Barber et al. (2006) find that individual day traders routinely incur losses, while institutional day traders, on average, profit. The composition of trades in Taiwan stock market is dramatically different from the Istanbul market, however. For instance, in the Turkish market all of the traders are institutions, while this class of traders only account for 10.5% of the Taiwanese trade value.

[9] Our conclusions remain unaffected if we use alternative selection equation specifications such as including (1) a constant term, (2) squared lag profitability, and (3) more lags of prior volatility.

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Table 6
Trading profits, prior profitability, volatility, and financial networks.

This table reports the estimates for the Heckman selection model, Eq. (6), for the entire sample (Columns 1 and 4), for informed cycles (Columns 2 and 5), and remaining cycles (Columns 3 and 6). An informed cycle is the trading cycle with first trade‘s absolute price impact being above the mean of all first trades‘ absolute price impacts. PRF_{it}, the dependent variable, is the day-trading percentage profit of financial institution i on day t, PRF_{it-1} is lagged profitability, and $VOLINT_{t-1}$ is the standard deviation of the interest rate on the previous day using 30-minute observations, $VOLUME_{t-1}$ is the prior day's trading volume in excess of previous 90 days average trading volume, GOF_{it-1} is the total bond trading volume of financial institution i in the nine leading financial centers in the previous quarter scaled by the corresponding total bond trading volume of the financial institution that has the highest bond trading volume. LOF_{it-1} is the quarterly bond trading volume of financial institution i in the local market in the previous quarter scaled by the corresponding total trading volume of all financial institutions. p-Values associated with coefficient estimates are provided in parentheses and are based on robust standard errors clustered by financial institution and day. The sample period is May 1, 2001–June 15, 2005 (1,039 trading days).

Panel A. Estimation using daily data

	All	Informed	Others	All	Informed	Others
GOF_{it-1}	0.0200	0.0390	0.0053	0.0126	0.0360	0.0018
	(0.000)	(0.000)	(0.244)	(0.000)	(0.000)	(0.612)
LOF_{it-1}	0.0954	−0.0952	0.1418	0.0283	0.0436	0.0195
	(0.000)	(0.214)	(0.000)	(0.000)	(0.000)	(0.000)
LOF^2_{it-1}				−0.1085	−0.4002	−0.0199
				(0.013)	(0.000)	(0.335)
PRF_{it-1}	0.0890	0.0585	0.1064	0.0785	0.0570	0.1170
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$PRF_{it-1} \times GOF_{it-1}$	−0.0214	10.0307	−0.0002	−0.0208	−0.0295	0.0000
	(0.219)	(0.206)	(0.652)	(0.210)	(0.312)	(0.872)
$PRF_{it-1} \times LOF_{it-1}$	−0.6901	−0.3175	−1.5685	−0.6120	−0.3076	−1.3077
	(0.014)	(0.441)	(0.001)	(0.023)	(0.235)	(0.001)
$VOLINT_{t-1}$	−1.1788	−1.2739	−1.6140	−1.1982	−1.1130	−1.5027
	(0.000)	(0.013)	(0.000)	(0.000)	(0.013)	(0.000)
Inv. Mill Ratio	0.0517	0.0663	0.0054	0.0630	0.0775	0.0048
	(0.000)	(0.000)	(0.254)	(0.000)	(0.000)	(0.110)
Constant	−0.0205	−0.0460	−0.0283	−0.0300	−0.0618	−0.0419
	(0.000)	(0.000)	(0.322)	(0.000)	(0.000)	(0.583)
PRF_{it-1}	0.1095	−0.1429	0.1093	0.1304	−0.1298	0.0911
	(0.020)	(0.023)	(0.213)	(0.018)	(0.034)	(0.155)
$VOLINT_{t-1}$	−8.5424	−18.7503	−17.2113	−7.2669	−18.9799	−18.6504
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$VOLUME_{t-1}$	0.6757	0.0151	0.2079	0.6146	0.0173	0.2160
	(0.000)	(0.199)	(0.000)	(0.000)	(0.185)	(0.000)
Censored	11,013	10,449	10,889	11,013	10,449	10,889
N	44,148	20,086	25,555	44,148	20,086	25,555

Test of GOF_{it-1} *(Informed)* $> GOF_{it-1}$ *(Others)*

Difference in Coefficients	t-Value	p-Value
0.0337	3.58	0.001

Panel B. Estimation using weekly data

	All	Informed	Others	All	Informed	Others
GOF_{it-1}	0.0412	0.1186	−0.0242	0.0282	0.1070	−0.0497
	(0.056)	(0.000)	(0.255)	(0.050)	(0.000)	(0.089)

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Table 6 (*continued*)

Panel B. Estimation using weekly data

	All	Informed	Others	All	Informed	Others
LOF_{it-1}	0.6443	0.2242	0.2705	2.0652	1.2039	1.6768
	(0.000)	(0.104)	(0.278)	(0.000)	(0.002)	(0.000)
LOF^2_{it-1}				−18.5483	−12.3895	−18.1496
				(0.000)	(0.004)	(0.001)
PRF_{it-1}	0.1077	0.0508	0.1509	0.1122	0.0495	0.1531
	(0.000)	(0.001)	(0.000)	(0.000)	(0.005)	(0.000)
$PRF_{it-1} \times GOF_{it-1}$	0.0254	0.0095	0.0165	0.0249	0.0065	0.0160
	(0.730)	(0.332)	(0.652)	(0.366)	(0.667)	(0.656)
$PRF_{it-1} \times LOF_{it-1}$	−1.4708	−1.0444	−2.4706	−1.6883	−0.7765	−2.6295
	(0.001)	(0.144)	(0.000)	(0.002)	(0.154)	(0.000)
$VOLINT_{t-1}$	−0.5417	0.7494	−1.6401	−0.4609	0.8492	−1.3422
	(0.050)	(0.002)	(0.012)	(0.067)	(0.001)	(0.014)
Inv. Mill Ratio	0.0734	0.0285	0.0086	0.0011	0.0020	0.0038
	(0.034)	(0.088)	(0.065)	(0.022)	(0.041)	(0.034)
Constant	−0.0650	0.0377	−0.1211	−0.0635	0.0299	−0.1314
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PRF_{it-1}	0.1569	0.0679	0.1700	0.1439	0.0579	0.1505
	(0.000)	(0.056)	(0.000)	(0.000)	(0.055)	(0.000)
$VOLINT_{t-1}$	−8.4728	−9.7689	−12.0548	−9.9708	−9.8644	−12.2555
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$VOLUME_{t-1}$	0.8987	0.9577	1.0032	1.0760	0.7627	0.8549
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Censored	2,149	2,447	2,432	2,149	2,447	2,432
N	23,281	12,219	12,662	23,281	12,219	12,662

Test of GOF_{it-1}(*Informed*) $>$ GOF_{it-1} (*Others*)

Difference in Coefficients	t-Value	p-Value
0.1428	4.14	0.001

institutions. Regression analysis applied to the subsamples of informed and other trades further reveals that the higher trading profitability attributed to global financial institutions is derived from informed trades. The estimated coefficient indicates that an average global financial institution earns 0.0144 (0.039×0.37) percentage points higher trading profits, twice as large as the estimated effect for the full sample. The difference in the global order flow estimates between the informed trades and other trades is significant ($p=0.001$). In the meantime, global financial institutions do not significantly outperform local financial institutions on other trades.

Consistent with previous empirical studies, local order flow has a positive effect on trading profitability when estimated using the full sample. Local order flow is significant for the subsample of other trades and insignificant for informed trades. The coefficient for lagged day-trading profitability is positive and significant ($p=0.000$), indicating some persistence in day-trading profitability. Interest rate volatility has a significant negative effect ($p=0.000$) on day-trading profitability and on the decision to participate in day-trading on the following day. This implies that it is more difficult to profit from day-trading when the interest rate is more

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volatile. Consistent with the participation of more informed financial institutions in day trading, excess trading volume has a positive effect on participating in day trading.

To test whether different financial institutions perform differently for different realizations of past day-trading performance, we introduce the interaction terms $PRF_{it-1} \times GOF_{it-1}$ and $PRF_{it-1} \times LOF_{it-1}$. The coefficient for the latter term is significantly negative ($p=0.014$). This suggests that the persistence in day-trading profitability is weaker for financial institutions with larger local order flow than for financial institutions that trade less in the Istanbul market. However, the weaker persistence in day-trading profitability does not apply to global financial institutions.

To capture the possibility of nonlinear relationships between profitability and local order flow, we employ an alternative specification by including a quadratic term of local order flow in Eq. (6). The regression results are reported in Columns (4) through (6) in Table 6. Consistent with the results discussed above, the coefficient for GOF_{it-1} is positive and statistically significant for the full sample and the subsample of informed trades but insignificant for the subsample of other trades. The coefficients for LOF_{it-1} are significantly positive for the full sample and the two subsamples and the coefficients for LOF^2_{it-1} for the full sample and the informed trades subsample are significantly negative. This indicates that the effect of local order flow size on trading profitability for informed trades increases at a decreasing rate.

Panel B in Table 6 reports the results of regression analysis for complete trade cycles at weekly frequency. Consistent with our findings for daily complete trade cycles, global financial institutions earn higher trading profitability than local financial institutions. The effect is again primarily driven by informed trades. Specifically, when measured at weekly frequency, an average global financial institution earns 0.015 (0.041×0.37) percentage points higher trading profit than local financial institutions for the full sample. For the informed subsample, an average global financial institution earns 0.043 percentage points higher trading profit. The difference in the GOF_{it-1} coefficients between informed trades and other trades is statistically significant ($p=0.001$). There is, however, no significant difference in trading profitability between global and local financial institutions on other trades. This indicates that our finding on the superior trading performance of financial institutions with more extensive global financial networks is not affected by the overnight positions held by some traders in this market. Local order flow shows an increasing effect on trading profitability but at a decreasing rate. Trading profitability in the previous period has a positive effect on current trading profitability, suggesting persistence in trading performance. The persistence in trading performance is again weaker for financial institutions with a larger local order flow. Finally, interest rate volatility reduces trading profitability for all financial institutions.

In addition to the above analysis, we examine whether the markets located outside the leading financial centers provide information that enhances trading profits. We accomplish this by adding an order flow measure for these peripheral markets constructed in the same manner as we use for the leading markets. As reported in Table 7, for both daily and weekly trading profits, our results show that profit-oriented information emanates largely, if not solely, from the markets located in the leading financial centers. To illustrate, consider the case of daily trading cycles. When the global order flow measures for the markets located in leading financial centers and the markets outside these centers are included, the contribution to trading profits by the former markets for informed trades is positive and significant ($p=0.000$) while the contribution by the peripheral markets are significantly smaller ($p=0.036$) and insignificant. For other trades the contributions of both categories of markets are small and insignificant. These coefficient results are strikingly similar to those presented in Table 6. Our findings support the notion that there are

Table 7
Markets in leading financial centers versus peripheral markets.

This table reports the estimates for the Heckman selection model, Eq. (6) with an additional variable to account for trading in markets located outside the leading financial centers for the entire sample, for informed cycles, and remaining other cycles. An informed cycle is the trading cycle with first trade's absolute price impact being above the mean of all first trades' absolute price impacts. GOF_{it-1} is the total bond trading volume of financial institution i in the nine leading financial centers in the previous quarter scaled by the corresponding total bond trading volume of the financial institution that has the highest bond trading volume.$PGOF_{it-1}$ is defined in the same manner as GOF_{it-1} but it considers all the peripheral markets—those that are *not* located leading financial centers. All other variables are defined the same as in Table 6. p-Values associated with coefficient estimates are provided in parentheses and are based on robust standard errors clustered by financial institution and day. The sample period is May 1, 2001–June 15, 2005 (1,039 trading days).

Panel A. Estimation using daily data

	All	Informed	Others
GOF_{it-1}	0.0220	0.0430	0.0073
	(0.000)	(0.000)	(0.168)
$PGOF_{it-1}$	0.0014	0.0075	0.0009
	(0.243)	(0.488)	(0.601)
Variables used in Table 6	Included	Included	Included
Selection model			
Variables used in Table 6	Included	Included	Included
Censored	11,013	10,449	10,889
N	44,148	20,086	25,555
$GOF_{it-1}-PGOF_{it-1}$	0.0206	0.0355	0.0064
t-test $(GOF_{it-1}-PGOF_{it-1}=0)$	3.12	4.52	1.82

Panel B. Estimation using weekly data

	All	Informed	Others
GOF_{it-1}	0.0462	0.1312	−0.0004
	(0.024)	(0.000)	(0.519)
$PGOF_{it-1}$	0.0062	0.0075	0.0012
	(0.853)	(0.255)	(0.308)
Variables used in Table 6	Included	Included	Included
Selection model			
Variables used in Table 6	Included	Included	Included
Censored	2,149	2,447	2,432
N	23,281	12,219	12,662
$GOF_{it-1}-PGOF_{it-1}$	0.04	0.1237	−0.0016
t-test $(GOF_{it-1}-PGOF_{it-1}=0)$	4.12	4.52	0.45

agglomeration economies in the gathering and dispersal of information. They also suggest that some global markets provide more information than others.

Similar to our analysis on the price impact of different financial institutions, we also perform regression analysis on the trading profitability for earlier and later sampling periods. Consistent with our findings on the price impact, our results in Table 8 show a decline in the incremental trading profitability for a financial institution with a larger global order flow for both daily and weekly frequencies. Specifically, GOF_{it-1}'s coefficient decreases from 0.025 in the earlier subsample to 0.019 in the later subsample for all daily complete cycle trades and from 0.070 to 0.031for all weekly complete cycle trades, with the latter being insignificant.

Table 8
Trading profitability over time.

This table reports the estimates for the Heckman selection model, Eq. (6), for the entire sample (Columns 1 and 2), for informed cycles (Columns 3 and 4), and remaining cycles (Columns 5 and 6). An informed cycle is the trading cycle with first trade's absolute price impact being above the mean of all first trades' absolute price impacts. The subsamples, "Earlier" and "Later" report estimation using data before (after) midpoint of sample period (November 13, 2003). PRF_{it}, the dependent variable, is the day-trading percentage profit of financial institution i on day t, PRF_{it-1} is lagged profitability, and $VOLINT_{t-1}$ is the standard deviation of the interest rate on the previous day using 30-minute observations, $VOLUME_{t-1}$ is the prior day's trading volume in excess of previous 90 days average trading volume, GOF_{it-1} is the total bond trading volume of financial institution i in the nine leading financial centers in the previous quarter scaled by the corresponding total bond trading volume of the financial institution that has the highest bond trading volume. LOF_{it-1} is the quarterly bond trading volume of financial institution i in the local market in the previous quarter scaled by the corresponding total trading volume of all financial institutions. p-Values associated with coefficient estimates are provided in parentheses and are based on robust standard errors clustered by financial institution and day. The sample period is May 1, 2001–June 15, 2005 (1,039 trading days).

Panel A. Estimation using daily data

	All		Informed		Others	
	Earlier	Later	Earlier	Later	Earlier	Later
GOF_{it-1}	0.0249	0.0187	0.0510	0.0204	−0.0021	0.0080
	(0.000)	(0.003)	(0.003)	(0.000)	(0.566)	(0.208)
LOF_{it-1}	0.0982	0.0840	−0.1006	−0.0762	0.1484	0.1686
	(0.003)	(0.052)	(0.155)	(0.215)	(0.008)	(0.000)
PR_{it-1}	0.0894	0.0843	0.0725	0.0815	0.1006	0.0920
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
$PRF_{it-1} \times GOF_{it-1}$	0.0217	−0.0426	−0.0460	−0.0014	0.0145	−0.0309
	(0.354)	(0.069)	(0.337)	(0.521)	(0.836)	(0.418)
$PRF_{it-1} \times LOF_{it-1}$	−1.0996	−0.6750	−0.2705	−1.1579	−1.4286	−0.9942
	(0.033)	(0.062)	(0.811)	(0.072)	(0.004)	(0.039)
$VOLINT_{t-1}$	−5.2949	−0.8597	0.3450	2.2153	−0.7611	−2.9802
	(0.000)	(0.000)	(0.498)	(0.371)	(0.034)	(0.008)
Inv. Mill Ratio	−0.0136	0.0220	0.0824	−0.0313	0.0027	0.0042
	(0.317)	(0.222)	(0.000)	(0. 651)	(0.048)	(0.072)
Constant	0.0112	−0.0318	0.0299	−0.0432	−0.0334	−0.0211
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Participation equation						
PRF_{it-1}	0.1347	0.0290	−0.2576	−0.0015	0.2738	−0.2436
	(0.012)	(0.909)	(0.005)	(0.812)	(0.003)	(0.040)
$VOLINT_{t-1}$	−1.3528	153.5894	−15.3550	24.5173	−6.9985	39.6338
	(0.501)	(0.000)	(0.000)	(0.056)	(0.003)	(0.019)
$VOLUME_{t-1}$	0.4609	0.4895	−0.0749	0.0366	0.0442	0.2698
	(0.000)	(0.000)	(0.000)	(0.047)	(0.007)	(0.000)
Censored	7,395	3,618	5,839	4,610	6,363	4,526
N	24,490	19,658	10,151	9,935	12,766	12,789

Panel B. Estimation using weekly data

	All		Informed		Others	
	Earlier	Later	Earlier	Later	Earlier	Later
GOF_{it-1}	0.0698	0.0305	0.1652	0.0480	0.0181	−0.0138
	(0.013)	(0.119)	(0.000)	(0.023)	(0.376)	(0.618)
LOF_{it-1}	0.3631	0.6675	0.1197	0.4948	−0.1103	0.2915

Table 8 (*continued*)

Panel B. Estimation using weekly data

	All		Informed		Others	
	Earlier	Later	Earlier	Later	Earlier	Later
	(0.131)	(0.001)	(0.976)	(0.002)	(0.447)	(0.223)
PRF_{it-1}	0.0592	0.2178	0.0595	0.0522	0.2522	0.0709
	(0.000)	(0.000)	(0.003)	(0.045)	(0.000)	(0.000)
$PRF_{it-1} \times GOF_{it-1}$	0.0066	0.1472	−0.0092	0.0819	0.0442	−0.0442
	(0.635)	(0.042)	(0.623)	(0.108)	(0.450)	(0.235)
$PRF_{it-1} \times LOF_{it-1}$	−0.6151	−5.7268	−0.8279	−1.7226	−5.5535	−0.7005
	(0.113)	(0.000)	(0.163)	(0.010)	(0.000)	(0.131)
$VOLINT_{t-1}$	0.8579	−0.4187	−0.6602	0.6597	1.6338	1.3038
	(0.183)	(0.530)	(0.122)	(0.439)	(0.123)	(0.109)
Inv. Mill Ratio	−0.1211	−0.0304	−0.3596	−0.2354	0.1946	−0.0131
	(0.430)	(0.510)	(0.198)	(0.322)	(0.004)	(0.290)
Constant	−0.0025	−0.0415	−0.0287	0.0230	−0.0442	−0.0493
	(0.712)	(0.000)	(0.005)	(0.008)	(0.004)	(0.004)
Participation Equation						
PRF_{it-1}	0.0961	0.1943	0.0725	0.0844	−0.0215	−0.0949
	(0.012)	(0.010)	(0.006)	(0.212)	(0.483)	(0.127)
$VOLINT_{t-1}$	−4.6113	−17.6441	−5.8967	−11.3030	−6.5504	−9.5721
	(0.010)	(0.003)	(0.003)	(0.000)	(0.000)	(0.097)
$VOLUME_{t-1}$	0.8170	1.1952	0.7392	1.0336	0.6235	0.9468
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Censored	1,535	614	1,712	735	1754	678
N	13,137	10,144	7,023	5,196	7,327	5,335

Further, when we restrict our attention to the informed subsample, GOF_{it-1}'s coefficient decreases from 0.051 in the earlier period to 0.020 in the later period for daily complete cycle trades and from 0.165 to 0.048 for weekly complete cycle trades. There is not, however, a significant decrease in the coefficient for GOF_{it-1} for the subsample of other day trades over the two sampling periods for either daily or weekly complete cycle trades nor are any of the coefficients significant.

4.2.2. *Liquidity and trading profitability*

As we mentioned in Section 4.1.1, an alternative explanation for global financial institutions trading liquid bonds is that their large institutional clients have a preference for more liquid bonds (e.g., a preference for on-the-run treasuries). If the decision to trade is solely a result of liquidity preference, the better trading performance afforded global financial institutions would only be limited to liquid bonds and not extended to illiquid bonds. To examine the profitability of different financial institutions in trading bonds with different liquidity, we partition bonds into liquid and illiquid bonds based on two different measures: (1) the active versus passive classification used in Section 4.1, with the active bonds classified as liquid bonds; and (2) the Amihud (2002) liquidity measure used in Section 4.2, with low (below-median) Amihud measure bonds taken to be the liquid bonds. Table 9 reports the estimation results of Eq. (6) for

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Table 9
Day trading profitability and liquidity of bonds.

This table reports the estimates for the Heckman selection model, Eq. (6), using liquid and illiquid bonds. The column heading (Active and Amihud or Passive and Amihud) represents the liquidity measure used to separate bonds. PRF_{it}, the dependent variable, is the day-trading percentage profit of financial institution i on day t, PRF_{it-1} is lagged profitability, and $VOLINT_{t-1}$ is the standard deviation of the interest rate on the previous day using 30-minute observations, $VOLUME_{t-1}$ is the prior day's trading volume in excess of previous 90 days average trading volume, GOF_{it-1} is the total bond trading volume of financial institution i in the nine leading financial centers in the previous quarter scaled by the corresponding total bond trading volume of the financial institution that has the highest bond trading volume. LOF_{it-1} is the quarterly bond trading volume of financial institution i in the local market in the previous quarter scaled by the corresponding total trading volume of all financial institutions. p-Values associated with coefficient estimates are provided in parentheses and are based on robust standard errors clustered by financial institution and day. The sample period is May 1, 2001–June 15, 2005 (1,039 trading days).

	Daily		Weekly	
	Amihud active	Amihud passive	Amihud active	Amihud passive
GOF_{it-1}	0.0365	0.0148	0.0692	0.0369
	(0.000)	(0.000)	(0.045)	(0.176)
LOF_{it-1}	0.1037	0.0478	0.8446	0.7742
	(0.045)	(0.045)	(0.167)	(0.004)
PRF_{it-1}	0.1003	0.0766	0.1256	0.0781
	(0.000)	(0.000)	(0.007)	(0.000)
$PRF_{it-1} \times GOF_{it-1}$	−0.0442	−0.0309	0.0415	0.0219
	(0.198)	(0.102)	(0.525)	(0.485)
$PRF_{it-1} \times LOF_{it-1}$	−0.9670	−0.3247	−2.4643	−0.9812
	(0.023)	(0.241)	(0.005)	(0.075)
$VOLINT_{t-1}$	1.3457	−1.8011	4.1561	−0.7277
	(0.008)	(0.000)	(0.001)	(0.010)
Inv. Mill Ratio	0.0149	−0.1358	−0.3132	−0.0227
	(0.385)	(0.565)	(0.000)	(0.065)
Constant	0.0617	−0.0179	0.3724	−0.0534
	(0.000)	(0.000)	(0.000)	(0.000)
Participation equation				
PRF_{it-1}	0.1431	−0.0892	0.1123	0.0525
	(0.000)	(0.101)	(0.000)	(0.059)
$VOLINT_{t-1}$	−18.4400	−14.6976	−6.1199	−7.4409
	(0.000)	(0.000)	(0.000)	(0.006)
$VOLUME_{t-1}$	0.5639	−0.0073	0.9449	−0.0590
	(0.000)	(0.665)	(0.000)	(0.198)
Censored	11,664	9,615	2344	2438
N	38,507	18,442	11,214	14,329

different groups of bonds with different liquidity using daily (columns 1 and 2) and weekly (columns 3 and 4) complete cycle trades.

Our results indicate that the coefficient for GOF_{it-1} is positive and statistically significant for both liquid and illiquid bonds for daily complete cycle trades and for liquid bonds for weekly complete cycles. Given our results discussed earlier that global financial institutions prefer trading liquid active bonds on informed trades, this finding is consistent with the results reported in Table 6 on the superior trading performance of global financial institutions on informed trades. This is particularly true for daily complete trade cycles but less compelling for weekly complete trade cycles. Overall, our evidence on the trading performance of different financial institutions

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on liquid and illiquid bonds suggests that the higher trading profitability of global financial institutions is not entirely because of their preference, clients' or their own, for more liquid bonds.

4.2.3. Domicile and trading profitability

As discussed earlier, existing studies on the relative informedness have primarily focused on foreign versus domestic investors using data on equity trading. To demonstrate that our findings on the different trading performances of financial institutions with different scope of financial network are not simply due to foreign and domestic dichotomy, we exclude foreign domiciled financial institutions in our analysis and show that the distinction uncovered earlier on trading performances remains significant. Therefore, our findings on the relative trading performances of global versus local financial institutions go beyond the foreign and domestic distinction.

Specifically, we analyze trading profitability using complete cycle trades entirely by domestic global and local financial institutions at both daily and weekly frequencies. Table 10 shows that the estimation results for all complete cycle trades, informed trades, and other trades excluding trades involving foreign financial institutions. We find that the estimation results using trades of only domestic financial institutions offer similar conclusions as the results using both foreign and domestic financial institutions reported in Table 6. Global domestic financial institutions earn higher trading profits than do local financial institutions, although the magnitude of better performance for global financial institutions is slightly smaller than with foreign financial institutions included (the coefficient for GOF_{it-1} is 0.020 versus 0.009 for all daily complete trade cycles and 0.041 versus 0.034 for all weekly complete trade cycles). The incremental trading profitability for global financial institutions remains much higher for the informed subsample than for the subsample of other day trades (the coefficient for GOF_{it-1} is 0.020 versus 0.001 for daily complete trade cycles and 0.119 versus −0.024 for weekly complete trade cycles). Our findings indicate that global financial institutions derive incremental benefit relative to local financial institutions beyond foreign versus domestic classification.

4.2.4. Learning by trading by different financial institutions

To provide further evidence on the learning effect of different financial institutions, we examine the relation between the fraction of informed trades for different financial institutions and their trading experiences. In a recent study, Seru, Shumway, and Stoffman (2010) investigate the learning by trading of individual investors by examining their trading performances and experiences in trading stocks. They measure individual investors' trading experiences by the number of years that an investor has been trading and with the cumulative number of trades that an investor has placed. Following Seru, Shumway, and Stoffman (2010), we use the cumulative number of trades or trading volume of transactions between financial institution i and its trading partners for which the trading partners are more informed and enjoy more favorable prices. We focus on informed trades by different financial institutions because these trades have information content and less informed financial institutions should learn the most from these transactions.

Specifically, we define FIT_{it} as the fraction of informed trades for which financial institution i enjoys more favorable prices in all transactions the financial institution participated in week t and TrE_{it} as the trading experience of financial institution i. We use the following specification to test the learning effect:

$$FIT_{it+1} = \alpha + \beta_1 TrE_{it} + \beta_2 Local_i + \beta_3 Local_i \times TrE_{it} + \beta_4 Local_i \times TrE_{it} + \varepsilon_{it}, \tag{7}$$

Table 10
Trading profit analysis excluding foreign financial institutions.

This table reports the estimates for the Heckman selection model, Eq. (5), excluding foreign financial institutions. PRF_{it}, the dependent variable, is the day-trading percentage profit of financial institution i on day t, PRF_{it-1} is lagged profitability, and $VOLINT_{t-1}$ is the standard deviation of the interest rate on the previous day using 30-minute observations, $VOLUME_{t-1}$is the prior day's trading volume in excess of previous 90 days average trading volume, GOF_{it-1} is the total bond trading volume of financial institution i in the nine leading financial centers in the previous quarter scaled by the corresponding total bond trading volume of the financial institution that has the highest bond trading volume. LOF_{it-1} is the quarterly bond trading volume of financial institution i in the local market in the previous quarter scaled by the corresponding total trading volume of all financial institutions. p-Values associated with coefficient estimates are provided in parentheses and are based on robust standard errors clustered by financial institution and day. The sample period is May 1, 2001–June 15, 2005 (1,039 trading days).

	Daily			Weekly		
	All	Informed	Others	All	Informed	Others
GOF_{it-1}	0.0086	0.0203	0.0007	0.0338	0.1195	−0.0239
	(0.013)	(0.030)	(0.851)	(0.019)	(0.005)	(0.522)
LOF_{it-1}	0.0801	−0.0688	0.0722	0.6871	0.1803	0.2083
	(0.012)	(0.103)	(0.045)	(0.004)	(0.626)	(0.533)
PRF_{it-1}	0.1183	0.0804	0.1097	0.1075	0.0638	0.2080
	(0.003)	(0.004)	(0.003)	(0.000)	(0.004)	(0.000)
$PRF_{it-1} \times GOF_{it-1}$	−0.0656	0.0127	−0.0479	−0.0699	−0.0459	−0.0735
	(0.000)	(0.589)	(0.133)	(0.067)	(0.311)	(0.076)
$PRF_{\ it-1} \times LOF_{it-1}$	−0.2159	−0.6333	−0.9987	−0.2775	−0.6046	−1.2500
	(0.554)	(0.433)	(0.034)	(0.323)	(0.331)	(0.023)
$VOLINT_{t-1}$	−2.3543	1.1170	−0.9333	−0.8776	0.5125	−1.4860
	(0.000)	(0.025)	(0.018)	(0.013)	(0.156)	(0.010)
Inv. Mill Ratio	−0.1831	−0.0037	−0.3704	0.0003	−0.0019	0.0054
	(0.004)	(0.133)	(0.003)	(0.100)	(0.447)	(0.076)
Constant	0.0431	0.0193	0.0415	−0.0645	0.0322	−0.1358
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PRF_{it-1}	−0.4028	−0.0337	−0.2077	0.1542	0.0677	0.1738
	(0.000)	(0.435)	(0.020)	(0.002)	(0.046)	(0.000)
$VOLINT_{t-1}$	43.6478	−19.5942	6.3893	−8.7553	−10.1566	−12.5878
	(0.000)	(0.000)	(0.003)	(0.001)	(0.000)	(0.000)
$VOLUME_{t-1}$	0.3878	0.0393	0.1311	0.9729	0.8987	1.0287
	(0.000)	(0.132)	(0.000)	(0.000)	(0.000)	(0.000)
Censored	9,418	8,969	9,306	2,149	1,247	1,266
N	38,531	17,494	22,642	12,147	6,944	5,335

where TrE_{it} is measured either by the cumulative number of trades ($CumNT_{it}$) or trading volume ($CumVol_{it}$) up to week t of transactions between financial institution i and its trading partner for which the trading partner is more informed. $Local_i$ is a dummy variable that takes a value of one if financial institution i is a local financial institution and takes a value of zero otherwise, and the benchmark group is global financial institutions. A positive coefficient estimate for the interaction term $Local_i \times TrE_{it}$ indicates that as local financial institutions accumulate more experiences from trading with better informed financial institutions, the fraction of informed trades by the local financial institutions increases more than that for global financial institutions.

We estimate Eq. (7) using the Fama-MacBeth method. For each week t we perform cross-sectional regressions and then perform statistical inferences based on the distribution of the estimates for each coefficient. Table 11 reports the Fama-MacBeth estimation results using data

Table 11
Learning by trading.

This table reports the estimation results for the learning by trading effect by different financial institutions (see Eq. (6)) using the Fama-MacBeth method. The dependent variable (FIT_{it}) is the fraction of informed trades for which financial institution i enjoys more favorable prices in all transactions involving this financial institution in week t. Trading experiences are measured by either the cumulative number of trades in million transactions ($CumNT_{it}$) or trading volume in billion TL ($CumVol_{it}$) up to week t for which financial institution i's trading partners enjoyed more favorable prices in the transactions. $Local_i$ is a dummy variable which takes a value of one if financial institution i is a local financial institution and a value of zero otherwise. The reported coefficients are time series average of the cross-sectional estimates. p-Values associated with the coefficient estimates are provided in parentheses. Observational unit of the analysis is calendar week. The sample period is May 1, 2001–June 15, 2005 (1,039 trading days).

	FIT_{it}	FIT_{it}
$CumNT_{it}$	−1.165	
	(0.368)	
$CumVol_{it}$		3.567
		(0.251)
$Local_i$	0.048	0.038
	(0.000)	(0.000)
$Local_i \times CumNT_{it}$	8.645	
	(0.000)	
$Local_i \times CumVol_{it}$		3.567
		(0.251)
Constant	0.504	0.510
	(0.000)	(0.000)
Week fixed effects	Included	Included
R^2	0.036	0.038

on all financial institutions. The coefficient estimate for the interaction term $Local_i \times CumNT_{it}$ is positive and significant, indicating that local financial institutions learn more from trading than global financial institutions when local financial institutions trade more often with global financial institutions. The coefficient for $Local_i \times CumVol_{it}$, however, is positive and insignificant. This indicates that local financial institutions may not necessarily learn more from making large trades than global financial institutions. The results reinforce the finding that local financial institutions learn from trading with better-informed global financial institutions.

4.2.5. Other robustness tests

As a robustness check, we also performed the regression analysis on bonds with different maturities and the effect of macroeconomic news announcements. Balduzzi, Elton, and Green (2001) find that intermediate- and long-term bonds are more responsive to macroeconomic news than short-term bonds. We therefore examine whether day-trading profitability behaves differently between short-term bonds (remaining maturity is one year or less) and long-term bonds (remaining maturity is longer than one year). We find consistent results (not reported) for the short-term bonds but weaker results for the long-term bonds. Morris and Shin (2002) suggest that bond yields react most to news emphasized by the media. We estimate Eq. (6) by excluding Turkish scheduled macroeconomic announcements collected from Bloomberg. The news items include announcements related to inflation, gross national product, industrial production, current account, trade balance, unemployment, and capacity utilization. The coefficient estimates based on the no-domestic macroeconomic news subsample are qualitatively similar to those reported in Table 6 so that the effect of global order flow remains stronger for the short-term bonds than for the long-term bonds. We also exclude dates on which Turkey's sovereign rating is changed by the three principal sovereign rating agencies (Standard & Poor's (S&P), Moody‘s Investor Services, and Fitch Investors Service). Again, we obtain similar results.

5. Concluding remarks

We investigate the role of financial networks in influencing asset prices and trading performance. Consistent with theoretical studies on the role of communication networks on information dissemination, we posit that financial institutions with a more extensive global financial network (global financial institutions) can more efficiently acquire and process information than institutions with only a limited local network (local financial institutions) beyond the local order flow and domicile differences. This may lead to different trading performances by different financial institutions. We conduct an extensive empirical analysis on the informational advantage and associated benefits of a more extensive global versus a limited local financial network in trading government bonds such as more favorable pricing and trading profitability.

Using transaction-level data from the Turkish Bonds and Bills Market, which is located in Istanbul, we find that global financial institutions have a greater propensity to trade in the more liquid segment of the market than do their local counterparts, consistent with the need of informed investors to strategically hide trades that might convey information. In addition, global financial institutions consistently buy (or sell) prior to market price increases (or decreases), i.e., enjoy more favorable pricing in bond trading, relative to local financial institutions. Taken together, these findings suggest that global financial institutions have an informational advantage over their local counterparts. Further analysis on trading profitability of different financial institutions reveals that global financial institutions consistently and significantly outperform local financial institutions on informed trades, lending support to the informational advantage afforded the global financial institutions. However, our analysis also reveals that a larger network does not necessarily mean a more effective network. It is only the information that emanates from markets located in leading financial centers that improves trading performance in a smaller, local market. Our findings continue to hold when we restrict our sample to only domestic financial institutions and to bonds with different liquidity, which suggests that our findings are unlikely to be due to the foreign versus domestic dichotomy or to liquidity. We also find that both the pricing advantage and the better performance in trading profitability for the global financial institutions decline over time. This suggests that local financial institutions learn from their trading experiences with their global counterparts.

Overall our empirical analysis provides strong evidence that in a globally integrated financial market, financial institutions with a global information network can more efficiently acquire and process information such as order flows than financial institutions with only a local network, and this informational advantage allows the global financial institutions to enjoy more favorable pricing and consistently outperform their local counterparts. It does, however, depend on the nature of the global network. For global financial institutions to reap the benefits of being global in a local market, their network should include leading financial centers.

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