Stock Returns, Order Imbalances, and Commonality: Evidence on Individual, Institutional, and Proprietary Investors in China

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Abstract

Using a unique dataset from the Shanghai Stock Exchange, we study the relation between daily open-to-close stock returns and order imbalances and the commonality in order imbalances, across individual, institutional, and proprietary investors. We find that institutional (proprietary) order imbalances have a larger impact, but they account for a significantly smaller proportion of daily price fluctuations. The commonality pattern is much stronger for individual, rather than institutional (proprietary), order imbalances. Institutional (proprietary) investors favor large capitalization stocks and appear to identify winner stocks, and co-movement in institutional (proprietary) order imbalances is stronger for these stocks.

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1. **Introduction**

This paper exploits a novel data set to explore two related questions in market microstructure. First, we study individual, institutional, and proprietary account order imbalances and their association with stock returns.[1] In general, order imbalances are highly persistent and positively related to contemporaneous stocks returns on an individual stock basis. Second, we study the commonalities in order imbalances among different account types.[2] For a large cross-section of stocks on the NYSE, Chodia et al. (2000) report significant and positive loadings on a market-wide liquidity factor for approximately 30-35 percent of their sample stocks while Hasbrouck and Seppi (2001) report stronger commonality in order imbalances.[3]

Institutions often break an order into smaller pieces (Chan and Lakonisiok, 1995; Biais, Hillion, and Spatt, 1995) and brokers trade based on their own in-house research or imitate the trades of informed clients (Sarkar, 1990), thereby inducing correlation in order imbalances. Given their size and potential information content, the impact of institutional trades should be larger than that of individual trades. The trading patterns of individual investors can also be persistent and strongly influence stock returns for a variety of reasons ranging from public information arrival to noise trading. The contrast between the effects of institutional versus individual order imbalances is particularly interesting if we view institutions as informed professionals and individuals as information-poor and more subject to behavioral biases.

A number of explanations for commonality have been proposed. Shleifer and Summers (1990) suggest that individual investors may herd if they follow the same signal, such as brokerage recommendations. Individual investors may also herd if they engage in positive-feedback trading (Lakonishok, Sheifler, and Vishy, 1994) or negative feed-back trading (Shefrin and Statman, 1985). If institutions are better informed, institutional investors will be more likely to herd to under-valued stocks (Nofsinger and Sias, 1999) which, in turn, induces stronger commonality in the order imbalances of winner stocks. Herding studies are usually based on

[1] See Chordia, Roll, and Subrahmanyam, 2002 and 2005; Griffin, Harris, and Topaloglu, 2003; Chordia and Subrahmanyam, 2004; Brown, MacKinlay, and Terker, 1989; Lee, 1992; Lauterbach and Ben-Zion, 1993; Chan and Fong, 2000; Hasbrouck and Seppi, 2001; Corwin and Lipson, 2000; and Goldstein and Kavajecz, 2004.

[2] See Chodia, Roll, Subrahmanyam, 2000; Hasbrouck and Seppi, 2001; and Huberman and Halka, 2001.

[3] Other studies of commonality examine stocks handled by the same specialist firm (Coughenour and Saad, 2004), stocks traded in limit order markets (Brockman and Chung, 2002; Friederich and Payne, 2002; Kempf and Mayston, 2005), spread component (Henker and Martens, 2002), stocks in different countries (Stahel, 2003), and stocks and bonds (Chordia, Sarkar, and Subrahmanyam, 2005; Darbha and Subramanian, 2005; Goyenko, 2005).

quarterly or annual holdings disaggregated into institutional versus individual holdings. However, the commonality literature typically does not distinguish between different types of investors.[4] Indeed, Chodia, et al. (2004) call for additional research to "analyze imbalance caused by different agents (e.g., institutions vs. individual investors)" and to "identify informed traders and liquidity traders in a more precise manner".

Our paper studies the relative importance of order imbalances from individual, institutional, and proprietary investors in determining daily individual stock returns and the degree of commonality in order imbalances among different account types. This substantial extension of the existing literature is made possible by the recent availability of a proprietary tick data set from the Shanghai Stock Exchange (SSE). The limit order trading system on SSE records the identity and shareholdings of each investor who trades in China. With this data, we can classify each trade as initiated from an individual, an institution (ordinary firms, listed firms, insurance companies), or a proprietary account (brokerage firms, mutual funds, and Qualified Foreign Institutional Investors, QFIIs). Broadly speaking, institutional investors are more sophisticated than individual investors, and proprietary accounts are likely to be more sophisticated than those of other institutions. For example, mutual fund managers have more professional training, richer experience, and stronger incentives to perform than other investors do. Similarly, QFIIs are typically well-capitalized foreign financial institutions with a great deal of experience investing in international stock markets. Aside from offering the data needed to support a more detailed study of order imbalances, the Chinese stock market is particularly interesting because of its size, volatility, large presence of individual investors, and substantial scope for information asymmetries given poor disclosure and governance standards.

Our main findings can be summarized as follows. First, proprietary order imbalances are most persistent, and have the largest impact on daily returns. However, the association between order imbalances and daily price movements is significantly lower for institutional (proprietary) investors than it is that for individual investors. Second, the role of institutional (proprietary) order imbalances in explaining daily open-to-close returns increases with firm size and the proportion and frequency of institutional (proprietary) trades. Proprietary investors dominate individual investors in determining daily price fluctuations only for those stocks most heavily traded by proprietary accounts. Third, individual order imbalances exhibit a strong pattern of co-

[4] An exception is Griffin, Harris and Topaloglu (2003). For a sample of NASDAQ 100 stocks, they examine daily and intraday associations between stock returns and the trading of individual and institutional investors.

movement that is larger than the corresponding pattern for institutions (proprietary investors). Fourth, commonality of individual order imbalances is stronger for small stocks, medium-performing stocks, and stocks with light and infrequent institutional (proprietary) trading. In contrast, commonality of institutional (proprietary) order imbalances is stronger for large stocks, winner stocks, and stocks with heavy and frequent institutional (proprietary) trading. The evidence is consistent with institutional (proprietary) investors preferring large-capitalization stocks because they are more liquid (Wermers, 1999) or have more precise earnings information (Falkenstein, 1996). The evidence also suggests that institutional (proprietary) investors are better informed than individual investors.

The rest of the paper is organized as follows. Section 2 describes the data set and sample selection. Section 3 reports summary statistics. Section 4 documents the relation between daily stock returns and order imbalances of individual and institutional investors while Section 5 documents commonality in order imbalances of individual and institutional investors. Section 6 summarizes and concludes the study.

2. Data and sample selection

Our sample consists of 198 stocks, including the current components of the Shanghai 180 index, plus 18 stocks that were replaced after December 2003. The component stocks of this index comprise more than half of the total market capitalization of the SSE as of December 2003. Data on individual trades are supplied by the SSE for the period from October 2003 to March 2004, a total of 117 trading days. Each record includes the investor identity code for both sides of the trade, date, trade sequence, exchange seat code, trade size, stock holding after transaction for both sides of the trade, stock code, order time, trade time, trade price, trade amount, order sequence number, and other variables. The investor identity code allows us to classify both sides of each trade as originating from an individual account, institutional account (ordinary firms, listed firms, insurance companies), or a proprietary account (brokerage firms, mutual funds, and QFIIs). The order sequence number allows us to distinguish which party initiates the transaction.

The SSE is open from Monday to Friday, with 9:15am to 9:25am reserved for an opening batch auction while 9:30am to 11:30am and 1:00pm to 3:00pm are reserved for regular consecutive bidding. We examine daily open-to-close returns and order imbalances during the

regular morning and afternoon sessions.[5] We use the first quote mid-point after 9:30am and the last quote mid-point before 3:00pm to calculate open-to-close returns. We measure trading activity with the number of trades, the volume of shares traded, and turnover measured in local currency, although results for turnover are not reported since they are virtually identical to those for volume. Additional key variables are the order imbalance in terms of numbers of shares (the number of buyer-initiated trades minus the number of seller-initiated trades divided by the total number of trades) and the order imbalance in terms of volume (buyer-initiated volume minus seller-initiated volume divided by total volume). Each of these two measures is computed daily for each stock in the sample and for each of the three investor types: that is, individual, institutional, and proprietary.

3. Summary statistics

Table 1 presents summary statistics for our sample of 198 stocks and six months. Across all sample stocks, the mean daily market capitalization is 2,414 billion yuan (about 300 million U.S. dollars) and the mean daily open-to-close return is 0.111%. The mean lag-one autocorrelation of daily stock returns is -0.094, though none of the 198 individual autocorrelation estimates is significant at the 10 percent level. The mean cross-correlation of raw returns (198×197/2 = 19,503 pairs of individual stocks) is 0.324 and the mean cross-correlation between excess returns is -0.003.

To measure how frequently institutional investors trade each of the 198 stocks over our 117 trading day period, we calculate for each stock the number of days on which there is institutional or proprietary trading, then divide by 117. The cross-sectional mean is 80.9% for institutional trading and 65.5% for proprietary trading. Additional summary statistics for these types of investors exclude days with no institutional or proprietary trading. For a typical stock on a typical trading day, the average number of trades is 3,354, of which 91.76 percent is initiated by individual investors, 3.52 percent is initiated by institutional investors, and 6.46 percent is initiated by proprietary investors. The average daily trading volume is 5,371,000 shares. When trading activity is measured with share volume, institutional and proprietary investors account for 5.31 percent and 9.86 percent of volume respectively while individuals account for 87.31percent, given the relatively smaller size of their trades. Over the sample period,

[5] We also exclude block trading (trades exceeding 50 million shares or 3 million yuan), which takes place between 3:00pm and 3:30pm.

individuals are net sellers, with average order imbalances of -6.28 percent and -4.98 percent in terms of number of trades and share volume respectively. There is a slight tendency for non-individual investors to initiate more sell-side transactions than buy-side transactions, with average daily order imbalances being -0.21 percent and -0.26 percent respectively for institutional and proprietary investors.

The order imbalances are typically highly auto-correlated. For individuals, the average autocorrelation at lag one is 0.180, and 55.6 percent of the 198 order imbalance autocorrelations are significant at the 10 percent level. For institutions, the average lag-one autocorrelation is 0.171, and 50.0 percent are highly significant. Proprietary investors display an even stronger pattern of order persistence, with an average lag-one autocorrelation of 0.378, and 76.6 percent of the individual autocorrelation coefficients highly significant. This suggests that proprietary traders split orders over a number of days or piggy-back on the trades of their informed clients.

Finally, Table 1 reports cross-sectional mean correlations between daily open-to-close returns and order imbalances. All three mean correlations between daily open-to-close returns and order imbalances measured in number of trades are positive, with the largest, 0.489, for individual order imbalances. Furthermore, individual order imbalances are positively correlated with institutional order imbalances but negatively correlated with proprietary order imbalances. The correlation between institutional and proprietary order imbalances is very low. Results based on trading volume, rather than number of trades, are similar.

4. Daily stock returns and order imbalances

4.1 Contemporaneous order imbalances

Since herding, order-splitting, and other aspects of order submission can extend over more than one day, our first test examines how both contemporaneous and lagged order imbalances affect daily stock returns. We begin by measuring the impact of contemporaneous order imbalances with regressions of individual stock daily returns on contemporaneous order imbalances of individuals (INDV), institutions (INST), and proprietary investors (PROP):

$$r_{it} - r_{mt} = \delta_0 + \delta_{i,\,INDV}\,imbal_{it,\,INDV} + \delta_{i,\,INST}\,imbal_{it,\,INST} + \delta_{i,\,PROP}\,imbal_{it,\,PROP} + \varepsilon_{it}, \qquad (1)$$

where r_{it} is the daily open-to-close return for stock i on day t and r_{mt} is an equal-weighted portfolio return on day t. We use excess returns instead of raw returns because the latter display

a high degree of cross-correlation, as is evident in Table 1. The independent variables, $imbal_{it,\,j}$, are order imbalances (computed with number of trades or trading volume in different specifications) for individual, institutional, and proprietary investors respectively for day t and stock i.

Panel A of Table 2 reports that, for individual investors, the average impact of contemporaneous order imbalances on daily open-to-close returns, measured by the slope coefficient, $\delta_{i,\,INDV}$, is 0.046 with a highly significant t-statistic of 5.62. The averages of $\delta_{i,\,INST}$ and $\delta_{i,\,PROP}$ are 0.080 and 0.088, respectively, for institutional and proprietary investors. The average coefficients suggest that proprietary order imbalances have the greatest impact on daily returns. The corresponding t-statistics of 2.42 and 1.54 are smaller than those for individuals. Ninety-six percent of the slope coefficients for individual order imbalances are positive and significant. For institutional investors, 49 percent of coefficients are positive and significant, and for proprietary investors, 74 percent of coefficients are positive and significant.[6] Inferences based on medians are similar except that the median $\delta_{i,\,PROP}$ also becomes highly significant under the Wilcoxon sign-rank test. Additional non-parametric Wilcoxon sign-rank tests for pairwise groups of individual, institutional, and proprietary coefficients confirm that institutional and proprietary order imbalances have a significantly larger impact on daily open-to-close return than individual order imbalances do.

Panel B of Table 2 reports the regression results using order imbalance measured with share volume, rather than number of trades. The results are similar except that adjusted R^2 are lower using share volume. This confirms the findings of Jones, Kaul, and Lipson (1994) that number of transactions plays a more important role in determining stock returns than share volume. Additionally, the Wilcoxon sign rank test for the null hypothesis $\delta_{i,\,INST} = \delta_{i,\,PROP}$ becomes significant, with a p-value of 0.011, suggesting that the impact of order imbalances of proprietary investors is larger than that of institutional investors. This is consistent with proprietary trading larger quantities measured in share volume compared with institutional investors, resulting in a larger impact on daily open-to-close returns.

[6] The residuals from individual stock-by-stock regressions are highly correlated over the cross-section of 198 stocks. The average pair-wise correlation over (198×197/2 = 19,503) pairs of residuals from regression (1) is 0.113, much higher than that reported by Chordia and Subrahmanyam (2004). Therefore, the t-statistics in Table 2 are adjusted by 4.82, that is $[1+(N-1)\rho]^{0.5}$ and N= 198 (Chordia, Roll, and Subrahmanyam; 2005).

4.2 Contemporaneous and lagged order imbalances

Since order imbalances from both individual and institutional investors are auto-correlated at lag 1, we extend specification (1) above to include lagged order imbalance terms. As before, regressions are estimated with both the number of trades and trading volume measures of order imbalances. Results are reported in Table 3. The overall contribution of the lagged order imbalance is marginal. The mean adjusted R^2 in Panel A rises from 0.309 in Table 2 to 0.321, and the only lagged variable with both significant t- and z-statistics is the individual order imbalance with average slope coefficient (t-test) of -0.005 (1.75) and median slope (z-test) of 0.005 (7.81). The percentage of negative and significant coefficients on lagged imbalances exceeds the percentage of positive and significant coefficients.[7] [8]

If investors strategically split their order to minimize the price impact of their transactions, the order imbalances will be correlated over time. This in turn causes correlation in price changes. The implication is that lagged order imbalances have predictive power for future stock returns. Given that institutional and proprietary investors trade larger amounts and are more likely to split their orders, the predictive power of lagged institutional and proprietary order imbalances to be stronger than that of lagged individual order imbalances. Following Chordia and Subrahmanyam (2004), we estimate regressions that exclude contemporaneous order imbalance terms. Unreported evidence shows that only 4 percent of coefficients for lagged individual order imbalances, $\lambda_{i,\ INDV}$, are positive and significant. About 6 percent of coefficients for institutions and 11 percent of coefficients for proprietary trades are positive and significant. Although these results are weak, they suggest that lagged proprietary order imbalances are most useful in predicting daily open-to-close returns.

4.3 Marginal explanatory power of individual and institutional order imbalances

Previous sections have established that order imbalances from individual, institutional, and proprietary investors are positively and significantly related to daily open-to-close stock

[7] For a sample of NASDAQ 100 stocks, Griffin et al. (2003) also report no evidence that past institutional trading imbalances can forecast daily returns, unlike Chordia and Subrahmanyam (2004).

[8] Chordia and Subrahmanyam (2004) explain negative signs on lagged order imbalances as resulting from "over counting" of the impact of persistence in order imbalances: the impact of persistent order imbalances appears in the slope coefficients on both the contemporaneous and lagged order imbalance. The negative slope on the lagged order imbalance "corrects" for this overweighting.

returns. Next, we measure the relative importance of the three different types of traders in explaining daily fluctuation in stock returns using multiple and partial correlation coefficients from OLS regressions. The multiple correlation (that is, the adjusted R^2) measures the proportion of variance in daily returns that independent variables jointly explain. For example, $R^2_{INDV\_INST\_PROP}$ measures how much variance the order imbalances of individual, institutional, and proprietary traders explains. A partial correlation coefficient, such as $r^2_{INDV,\ Others}$, measures how much variance the individual order imbalance can explain after institutional and proprietary order imbalances are included.

Panel A of Table 4 presents the mean, median, 25, and 75 percentiles of the multiple and partial correlation coefficients from estimates of Equation (1). By itself, individual order imbalances have the highest explanatory power, with an average multiple correlation coefficient of 0.218. Proprietary order imbalances have an average multiple correlation of 0.058 and institutional order imbalances have an average multiple correlation of only 0.031. When order imbalances of both institutional and proprietary trades are used in the regressions, the adjusted R^2 rises to 0.085. This remains smaller than that the explanatory power from individual investor order imbalances. The adjusted R^2 at the 75 percentile of the 198 stocks is 0.330 and 0.138 for individual traders and the sum of institutional and proprietary investors respectively. The partial correlation coefficients confirm these findings. Order imbalances from individual investors have an average marginal explanatory power of 0.248 after order imbalances from both institutional and proprietary investors are included. The average marginal explanatory power for institutions and proprietary traders is 0.036 and 0.092 respectively. Panel B repeats these tests for order imbalances measured with volume, rather than number of trades, and confirms that individual order imbalances are most important in determining daily open-to-close stock returns.

4.4 Firm size, winner-loser stocks, and institutional trading

Next, we examine associations between daily stocks returns and order imbalances for stocks sorted on firm size, winner and loser stocks, and institutional trading. Institutional investors tend to hold large capitalization stocks. For example, mutual fund managers may prefer large stocks because they are more liquid (Wermers, 1999) and enjoy more extensive and precise information that is less costly to obtain (Falkenstein, 1996). Institutional investors may also be better informed as they can devote more resources to collecting and analyzing

information. Thus, institutional investors may be better able to identify undervalued stocks to which they herd (Wermers, 1999). Therefore, we expect a greater impact of order imbalances from institutional and proprietary traders on larger stocks with heavy institutional and proprietary trading.

Table 5 summarizes the median values of firm size (market capitalization), stock performance (monthly returns over the 6-month sample period), institutional and proprietary trading, individual, institutional, and proprietary order imbalances, and percentage of days with institutional trading for stocks in quintile groups 1, 3, and 5 from independent sorts on firm size, average monthly returns over the 6-month sample period, percentage trading by institutions, and percentage trading by proprietary traders. Panel A of Table 5 shows that, for size quintile groups, large stocks perform better than small stocks with a margin of 3.84% - 2.54% = 1.30% per month. Consistent with Falkenstein (1996), both institutional and proprietary investors trade large stocks more heavily than small stocks. Average institutional trading is 3.37 percent for the largest size group versus 1.06 percent for the smallest size group. Average proprietary trading is 6.97 percent for the largest size group and 1.40 percent for the smallest size group. Institutional and proprietary trading in larger stocks is also more frequent. While individuals sell more small stocks than large stocks, there is no evidence of bias in institutional and proprietary order imbalances towards either small or large stocks.

Panel B of Table 5 shows that winner stocks have an average 8.10 percent return while loser stocks have an average -0.05 percent return over the 6-month sample period. Trading by proprietary investors is much heavier in winner stocks (8.30 percent) than in loser stocks (2.19 percent). This is also true for institutional investors, although the difference is much smaller. Both institutional and proprietary investors are also net sellers of loser stocks and net buyers of winner stocks, with the most significant effect (order imbalance of -0.98 percent for losers and 1.73 percent for winners) for proprietary traders. Thus, institutional and proprietary investors appear to enjoy stock-picking ability. In contrast, the order imbalances of individual investors are most negative, -8.22 percent, in quintile group 3, that is, medium-performing stocks.

Panels C and D sort our sample stocks by trading activity and similar patterns emerge from sorting either by institutional or proprietary trading. Heavy trading (and positive order imbalances) by these two groups of investors is typically concentrated in large cap stocks and in high-performing stocks.

4.4.1 Open-to-close returns and order imbalances for firms sorted on market capitalization

Next, we examine associations between daily open-to-close returns and order imbalances when firms are sorted by market capitalization. Panel A of Table 6 presents results for firm size quintiles 1, 3, and 5. For brevity, we only report results for order imbalance measured using the number of trades as results are very similar for order imbalances measured using share volume. Overall, the contemporaneous positive association between daily stock returns and order imbalances from individual, institutional, and proprietary groups are significant and robust across all size groups. Additional interesting empirical facts are also evident.

First, slope coefficients on order imbalances of each of the three investor groups typically decrease as firm size increases. Thus, the impact of order imbalance on daily stock returns tends to decline with firm size, as do the regression R^2 coefficients. That is, order imbalances explain stock returns better for smaller firms. Third, the percentage of positive and significant coefficients for individual order imbalances declines as firm size increases while the opposite is true for institutional and proprietary trading. Put another way, institutional order imbalances are more important for larger firms while individual order imbalances are more important for smaller stocks. Mirroring these results, the average partial correlation for individual investors, $r^2_{\text{INDV, Others}}$, drops significantly from 0.322 for the smallest firms to 0.175 for the largest firms. In contrast, the corresponding average partial correlations rise with size for institutional and, particularly, proprietary traders. However, comparing these correlations across investor groups shows that individual order imbalances remain the most important explanatory factor for all stocks.

4.4.2 Open-to-close returns and order imbalances for winner and loser stocks

Panel B of Table 6 presents results for stocks sorted by average monthly returns. The associations between order imbalances and daily stock returns are clear for both winner and loser stocks. Nonetheless, we notice a monotone increase in both mean and median adjusted R^2, reflecting a higher correlation between order imbalance and daily stock returns for winner stocks. This higher association is observed for each of the three investor groups, as is evident from the partial correlation coefficients. Using proprietary trading as an example, the average partial correlations are 0.060, 0.079, and 0.151 for quintiles 1, 3, and 5 respectively. Wilcoxon rank sum tests formally reject the null hypothesis that median partial correlations $r^2_{\text{PROP, Others}}$ for

winner stocks and loser stocks are the same.

4.4.3 Open-to-close returns and order imbalances for firms sorted on institutional trading

Our empirical results so far indicate that individual order imbalances play a more important role in explaining daily variation in open-to-close returns. Therefore, it is interesting to explore the conditions under which institutional trading is particularly important. Therefore, we sort the stocks independently on the daily average percentage of trading of institutions and proprietary trades. From Panel C of Table 5, the median percentage institutional trading activity for quintiles 1, 3, and 5 is 0.65, 1.81, and 5.03 percent, respectively. The corresponding medians for proprietary trading activity quintiles 1, 3, and 5 reported in Panel D of Table 5 are 0.30, 2.91, and 15.56 percent.

Table 7 reports several interesting patterns from sorting on institutional trading. First, slope coefficients on order imbalances of all three investor groups typically decline as institutional or proprietary trading intensifies. Put another way, the impact of order imbalance on daily stock returns declines as the fraction of "professional" trading increases. This is related to the heavy professional trading of large capitalization stocks (Table 5): it takes a larger volume to move the price of large cap stocks. Second, note that, for quintile group 5 sorted by proprietary trading, the average partial correlation, $r^2_{PROP,\ Others}$, reaches 0.192, which is larger than the average partial correlation, $r^2_{INDV,\ Others}$, of 0.143 for individuals. In other words, proprietary order imbalances dominate individual order imbalances in explaining daily returns only for the top quintile sorted on proprietary trading.

5. Commonalty in order imbalances

Having examined our first matter, daily stock returns and order imbalances, we move on to studying our second issue, commonalities in order imbalances across different categories of investors. Using principal components, Hasbrouck and Seppi (2001) report significant commonality in signed volume measures (order flow) aggregated for different trade size groups over 15-minute intervals for 30 Dow Jones stocks in 1994. They do not identify the source of the order flow commonality, but suggest that commonality may derive in part from mutual fund flows. Wermers (1999) tests for the relation between inflows of money and herding in stocks, and finds little evidence of correlation between money inflows and herding. Thus, herding may

originate with fund manager decisions, rather than the investing or redemption decisions of individual investors. This does not exclude the possibility of correlated trading among individual investors in their personal portfolios. Because our dataset allows us to distinguish order flows of different categories of investors, we can directly measure the degree of correlated trading by individual and institutional investors.

Following Chordia, Roll, and Subrahmanyam (2000) and Hasbrouck and Seppi (2001), we apply a market model to the daily time-series of order imbalances:

$$\text{imbal}_{\text{it, j}} = \beta_{\text{i0}} + \beta_{\text{i, j}}\text{imbal}_{\text{mt, j}} + \varepsilon_{\text{it}}, \tag{3}$$

where the order imbalance, $\text{imbal}_{\text{it, j}}$, is measured by either number of trades or volume, the subscript j denotes individual, institutional, or proprietary investors, and $\text{imbal}_{\text{mt, j}}$ is an equally-weighted portfolio of order imbalances on day t for investor type j. The market-wide order imbalance used in the regression for the ith stock excludes the order imbalance of the ith stock to minimize the cross-sectional dependence in the estimated slope coefficients. As in some of our earlier tests on the impact of order imbalances, we take account of the cross-sectional correlation in the residuals of regressions from individual stocks by adjusting standard deviations of the cross-sectional average coefficients by a factor of $[1+(N-1)\rho]^{0.5}$. Table 8 shows that the ρ's are much smaller compared with our earlier regressions of returns on order imbalances.

Table 8 reveals strong evidence of commonality among order imbalances of individual investors. The mean coefficient of $\beta_{\text{i, INDV}}$ is 0.984, with a t-statistic of 118.22. The percentage of positive and significant coefficients is as high as 96 percent, and the average adjusted R^2 is an impressive 0.271. The commonality in institutional order imbalances is weaker. The average coefficient of $\beta_{\text{i, INST}}$ is 0.614, with a t-statistic of 7.15. About 25 percent of the slope coefficients are both positive and significant, and the average adjusted R^2 is 0.011. The average $\beta_{\text{i, PROP}}$ is 0.731 with a t-statistic of 5.82, 37 percent are both positive and significant, and the average adjusted R^2 is 0.023. Clearly, other factors, or noise, largely determine the daily order imbalances of institutional and proprietary investors.

The dominance of herding behavior by individual investors in the Shanghai market echoes evidence from the U.S. Previous authors have examined the herding behavior of U.S. mutual funds (Wermers, 1999) and pension funds (Lakonishok et al. 1992). They report low levels of

herding for these institutional investors, based on quarterly mutual holding information.

5.1 Commonality of order imbalances for large and small firms

Following earlier sections, stocks are sorted by market capitalization, and commonality regressions are estimated for each stock in quintile groups 1, 3, and 5. The following patterns can be observed from Panel A of Table 9. First, mean and median coefficients for individual investors, $\beta_{i,\ INDV}$, decline significantly as firm size increases. The opposite is observed for $\beta_{i,\ INST}$ and $\beta_{i,\ PROP}$. Second, the percentage of positive and significant coefficients for individual investors in general declines with firm size, and, again, the opposite is observed for institutional and proprietary investors. Third, adjusted R^2 coefficients follow a similar pattern. In summary, the co-movement in individual (institutional and proprietary) order imbalances is much stronger in small (large) firms, mirroring our earlier evidence that institutional and proprietary (individual) investors trade large (small) capitalization stocks more heavily.

5.2 Commonality of order imbalances for winner and loser stocks

When stocks are classified into winners and losers, commonality for individual investors appears strongest among medium-performing stocks, that is, quintile 3, with an average slope coefficient $\beta_{i,INDV}$ of 1.120. The average slope coefficients are 0.715 for loser stocks and 0.898 for winner stocks. The differences across quintiles are highly significant. The average adjusted R^2 coefficient for medium-performing stocks is 0.328, relative to 0.097 for loser stocks and 0.216 for winner stocks. It may be the case that individual investors are typically less capable of identifying winners and losers and, therefore, the commonality among their order imbalances is weakest for the best- and worst-performing stocks. In contrast, institutional and proprietary commonality is strongest for the best-performing stocks. For example, the average slope coefficients $\beta_{i,PROP}$ are 0.511, 0.648, and 1.415 for worst-, medium-, and best performing stocks, and the percentage of positive and significant coefficients increases with performance. Furthermore, the adjusted R^2 is the largest for winner stocks.

5.3 Commonality for order imbalances for stocks sorted on institutional trading

Our earlier evidence indicates that order flows from institutional and proprietary investors have a particularly important impact on the daily price variation of stocks with

relatively intense institutional and proprietary trading. Therefore, the commonality in institutional order imbalances should also be stronger for stocks with more intense institutional and proprietary trading. We test this conjecture by independently grouping stocks by the percentage of institutional and proprietary trading, and estimate regressions similar to Equation (3). Table 10 shows that, as institutional trading intensifies, the slope coefficients on common institutional order imbalances, $\beta_{i,\ INST}$ and $\beta_{i,\ PROP}$, increase. Furthermore, the percentage of positive and significant coefficients on common institutional order imbalances is highest for stocks with the highest institutional or proprietary trading, as is the average adjusted R^2.

6. Summary and conclusions

This study addresses two issues. The first is the relation between daily open-to-close stock returns and order imbalances of individual investors and two types of institutional investors. The second is whether there exists any commonality in order imbalances among different investor groups. Our proprietary dataset from the SSE allows us to categorize trades by three types of investors: individual, institutional, and proprietary. Our major findings are as follows.

Order imbalances explain about 31.2 percent of daily fluctuations in open-to-close excess returns. The marginal explanatory power of individual investor order imbalances is higher than the marginal explanatory power of institutional and proprietary investor order imbalances. Although the impact of institutional and proprietary order imbalances is larger as measured by slope coefficients, they explain a significantly lower proportion of daily price movements. We also document a strong pattern of commonality among individual order imbalances, with 96 percent slope coefficients positive and the statistically significant and median explanatory power an impressive 27.9 percent. The commonality in institutional and proprietary order imbalances is in general much weaker.

Our findings complement recent work on behavioral finance based on Chinese evidence. Feng and Seasholes (2004) study daily transaction records of individual investors from two regions in China: Shanghai and Guangdong. They find high contemporaneous correlation in individual transactions, particularly when conditioning on the location of the trades. Put another way, groups of geographically close investors tend to trade in the same way. Our sample includes all individual investors from within the country in 198 stocks listed on the SSE. Chen, Kim, Nofsinger, and Rui (2004) find evidence of classical behavioral patterns, such as overconfidence, in a different sample of individual Chinese investors' brokerage records. The strength of these

behavioral patterns, combined with the overwhelming presence of individual investors in the Shanghai market, are likely explanations for the associations we document, particularly the divergences between the impact of individual order imbalances and the impact of order imbalances of professional investors.

Our ability to distinguish order imbalances of three types has generated important evidence on the questions we focus on. An agenda for additional research is as follows. To further understand the interaction between order imbalances and daily returns, feedback from order imbalances to lagged market or individual stock returns can be measured. Furthermore, feedback across order imbalances from different categories of investors can be measured. The impact of order imbalances on spreads is also interesting. Whether and how this impact is related to the co-movement in quoted and effective spreads remains an interesting issue to explore in the future. Finally, the strength of our results from a market, China, where individual investors predominate raises the question of whether the patterns we document are unique to China, or can also be found in other emerging and developed markets.

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Table 1 Summary Statistics

The sample covers 198 stocks listed on the Shanghai Stock Exchange (SSE), including Shanghai 180 index constituent stocks plus 18 stocks that were replaced after December 2003. The sample period is from October 2003 to March 2004. We report the cross-sectional means and medians of statistics for individual stocks. Cross-correlations are computed for 198×197/2 = 19,503 pairs of individual stocks. Proprietary traders are brokerages, mutual funds, and foreigners. Institutional traders are other corporations. For individual, institutional, and proprietary investors in each stock, we calculate the daily number of trades, share volume, and order imbalance as a percentage of total daily trading activity measures (number of trades or share volume). These daily measures are then averaged over 117 trading days for each stock. Order imbalances for institutional and proprietary traders are calculated over days when there is positive trading activity for the group. The figures in parentheses below the autocorrelation figures represent the percentage of 198 stocks that have a significant autocorrelation at lag one. Market capitalizations (end-of-month average in million yuan) are from the China Stock Market Research dataset (CSMAR). All other statistics are calculated using trade and order files from the SSE.

Table 1 Continued

	Mean	Median	Mean	Median
Market capitalization	2,414	1,600		
Daily open-to-close percentage return	0.111	0.111		
Auto-correlation of daily open-to-close return	-0.094	-0.095		
(% significant at 10% level)	(0.0)			
Cross-correlation of returns (raw)	0.324	0.328		
Cross-correlation of returns (market adjusted)	-0.003	-0.011		
Percent of days with institutional trades	80.9	85.6		
Percent of days with proprietary trades	65.5	67.4		
	Number of trades		Share volume	
Average daily measure of trading activity				
Total	3,354	2,190	5,371,000	2,717,000
Percent from individual accounts	91.76	94.96	87.31	92.45
Percent from institutional accounts	3.52	2.17	5.31	3.43
Percent from proprietary accounts	6.46	4.40	9.86	6.60
Average percent daily order imbalance				
Individual accounts	-6.28	-7.17	-4.98	-6.79
Institutional accounts	-0.21	-0.14	0.05	-0.17
Proprietary accounts	-0.26	-0.49	-0.20	-0.61
Auto-correlation of order imbalances				
Individual accounts	0.180	0.162	0.183	0.167
(% significant at 10% level)	(55.6)		(54.6)	
Institutional accounts	0.171	0.167	0.161	0.145
(% significant at 10% level)	(50.0)		(44.9)	
Proprietary accounts	0.378	0.381	0.362	0.367
(% significant at 10% level)	(76.6)		(77.2)	
Median cross-correlation of returns and order imbalances (number of trades)				
Daily return	1.000			
Individual accounts	0.489	1.000		
Institutional accounts	0.107	0.101	1.000	
Proprietary accounts	0.047	-0.091	0.049	1.000
Median cross-correlation of returns and order imbalances (share volume)				
Daily return	1.000			
Individual accounts	0.451	1.000		
Institutional accounts	0.082	0.045	1.000	
Proprietary accounts	0.032	-0.176	-0.031	1.000

Table 2 Daily Stock Returns, Individual, Institutional, and Proprietary Order Imbalances

This table summarizes regressions of individual stock excess returns on contemporaneous order imbalances of individuals (INDV), institutions (INST), and proprietary traders (PROP):

$$r_{it} - r_{mt} = \delta_0 + \delta_{i,\,INDV}\,imbal_{it,\,INDV} + \delta_{i,\,INST}\,imbal_{it,\,INST} + \delta_{i,\,PROP}\,imbal_{it,\,PROP} + \varepsilon_{it}\,, \qquad (1)$$

where r_{it} is the daily open-to-close return for stock i on day t, r_{mt} is an equally-weighted portfolio return on day t, t = 1, 2, …, 117, i = 1, 2, …, 198. Independent variables $imbal_{it,\,j}$, j = INDV, INST, and PROP, are daily percentage order imbalances in number of trades or in share volume. The table reports cross-sectional average and median coefficients, percentage of positive coefficients, percentage of positive and significant coefficients (t > 1.65), percentage of negative and significant coefficients (t < -1.65), and average and median adjusted R^2. Cross-correlation (ρ) adjusted t-statistics and Wilcoxon sign rank z-statistics are reported in parentheses. ** indicates significance of t-statistics at the 5 percent level; $^{++}$ indicates significance of z-statistics at the 5 percent level.

	Average coefficient	Median coefficient	Percentage positive	Percentage positive and significant	Percentage negative and significant
Panel A: Excess returns on contemporaneous order imbalance in number of trades (ρ = 0.113)					
$\delta_{i,\,INDV}$	0.046** (5.62)	0.044_{++} (12.15)	99.0	96.4	0.0
$\delta_{i,\,INST}$	0.080** (2.42)	0.060_{++} (10.73)	88.8	49.2	1.5
$\delta_{i,\,PROP}$	0.088 (1.54)	0.066_{++} (10.83)	93.9	74.1	0.0
Adjusted R^2	0.309	0.312			
	P-value (median $\delta_{i,\,INDV} = \delta_{i,\,INST}$): 0.000				
	P-value (median $\delta_{i,\,INDV} = \delta_{i,\,PROP}$): 0.000				
	P-value (median $\delta_{i,\,INST} = \delta_{i,\,PROP}$): 0.213				
Panel B: Excess returns on contemporaneous order imbalance in share volume (ρ = 0.074)					
$\delta_{i,\,INDV}$	0.038** (5.98)	0.035^{++} (12.15)	99.0	91.9	0.0
$\delta_{i,\,INST}$	0.048** (3.05)	0.040^{++} (10.45)	87.8	48.2	1.0
$\delta_{i,\,PROP}$	0.060 (0.86)	0.050 $(10.89)^{++}$	93.4	73.6	0.5
Adjusted R^2	0.248	0.250			
	P-value (median $\delta_{i,\,INDV} = \delta_{i,\,INST}$): 0.000				
	P-value (median $\delta_{i,\,INDV} = \delta_{i,\,PROP}$): 0.000				
	P-value (median $\delta_{i,\,INST} = \delta_{i,\,PROP}$): 0.011				

Table 3 Daily Stock Returns, Contemporaneous and Lagged Order Imbalances

This table reports regressions of individual stock excess returns on contemporaneous and lagged order imbalances of individuals (INDV), institutions (INST), and proprietary investors (PROP):

$$r_{it} - r_{mt} = \delta_0 + \delta_{i,\ INDV}\text{imbal}_{it,\ INDV} + \delta_{i,\ INST}\text{imbal}_{it,\ INST} + \delta_{i,\ PROP}\,\text{imbal}_{it,\ PROP} +$$

$$\lambda_{i,\ INDV}\text{imbal}_{it-1,\ INDV} + \lambda_{i,\ INST}\text{imbal}_{it-1,\ INST} + \lambda_{i,\ PROP}\,\text{imbal}_{it-1,\ PROP} + \varepsilon_{it} \qquad (2)$$

where r_{it} is the daily open-to-close return for stock i on day t, r_{mt} is an equal-weighted portfolio return on day t, t = 1, 2, …, 117, i = 1, 2, …, 198. Independent variables $\text{imbal}_{it,\ j}$, j = INDV, INST, PROP, measure contemporaneous (lagged) daily percentage order imbalances by number of trades or share volume. The table reports the cross-sectional average and median coefficients, percentage of positive coefficients, percentage of positive and significant coefficients (t > 1.65), percentage of negative and significant coefficients (t < -1.65), and average and median adjusted R^2. Cross-correlation (ρ) adjusted t-statistics and Wilcoxon sign rank z-statistics are reported in parentheses. ** and * indicate significance of t-statistics at the 5 and 10 percent level, respectively; $^{++}$ and $^{+}$ indicate significance of z-statistics at the 5 and 10 percent levels, respectively.

Table 3 Continued

	Average coefficient	Median coefficient	Percentage positive	Percentage positive and significant	Percentage negative and significant
Panel A: Excess returns on contemporaneous order imbalances in number of trades (ρ=0.116)					
$\delta_{i,\ INDV}$	0.047** (5.56)	0.044^{++} (12.15)	98.5	95.9	0.0
$\delta_{i,\ INST}$	0.084** (2.45)	0.069^{++} (10.82)	88.3	50.3	1.5
$\delta_{i,\ PROP}$	0.098 (1.49)	0.071^{++} (10.87)	93.9	76.1	0.0
$\lambda_{i,\ INDV}$	-0.005* (-1.75)	-0.005^{++} (-7.81)	25.4	1.5	25.9
$\lambda_{i,\ INST}$	-0.015 (-0.46)	-0.015^{++} (-3.45)	38.6	5.6	15.2
$\lambda_{i,\ PROP}$	-0.043 (-0.45)	-0.015^{++} (-5.54)	29.9	3.6	24.4
Adjusted R^2	0.321	0.328			
P-value (median $\delta_{i,\ INDV} = \delta_{i,\ INST}$): 0.000					
P-value (median $\delta_{i,\ INDV} = \delta_{i,\ PROP}$): 0.000					
P-value (median $\delta_{i,\ INST} = \delta_{i,\ PROP}$): 0.176					
Panel B: Excess returns on contemporaneous order imbalances in share volume (ρ=0.076)					
$\delta_{i,\ INDV}$	0.039** (6.05)	0.035^{++} (12.16)	99.0	92.9	0.0
$\delta_{i,\ INST}$	0.050** (3.09)	0.041^{++} (10.47)	87.3	46.2	1.0
$\delta_{i,\ PROP}$	0.062 (0.82)	0.051^{++} (10.76)	93.4	73.6	0.5
$\lambda_{i,\ INDV}$	-0.005** (-2.07)	-0.005^{++} (-7.55)	23.9	0.5	21.3
$\lambda_{i,\ INST}$	-0.008 (-0.48)	-0.010^{++} (-2.83)	38.1	6.1	16.2
$\lambda_{i,\ PROP}$	-0.032 (-0.64)	-0.008^{++} (-4.56)	32.0	5.1	17.3
Adjusted R^2	0.257	0.262			
P-value (median $\delta_{i,\ INDV} = \delta_{i,\ INST}$): 0.011					
P-value (median $\delta_{i,\ INDV} = \delta_{i,\ PROP}$): 0.000					
P-value (median $\delta_{i,\ INST} = \delta_{i,\ PROP}$): 0.006					

Table 4 Multiple and Partial Correlations for Order Imbalances from Individual, Institutional, and Proprietary Investors

This table reports the mean, median, 25 percentile, and 75 percentile multiple and partial correlations from regressing daily open-to-close stock returns on order imbalance measures. The regressions take the form of Equation (1). Capital letter R^2 denotes the multiple correlation coefficients. For example, $R^2_{INDV\_INST\_PROP}$ measures the joint explanatory power of all three types of investors. To examine the marginal contribution of each order imbalance measure, partial correlation coefficients (r^2) are also reported. For example, $r^2_{INDV,\ Others}$ denotes the explanatory power of order imbalance from individual investors after order imbalances from both institutional and proprietary investors are included in the regressions. Panel B presents the results for order imbalances measured by share volume.

	Mean	25%	Median (50%)	75%
Panel A: Order imbalance measured by number of trades				
R^2_{INDV}	0.218	0.105	0.214	0.330
R^2_{INST}	0.031	-0.001	0.015	0.046
R^2_{PROP}	0.058	-0.001	0.035	0.095
$R^2_{INST\_PROP}$	0.085	0.018	0.056	0.138
$R^2_{INDV\_INST\_PROP}$	0.309	0.228	0.312	0.393
$r^2_{INDV,\ Others}$	0.248	0.157	0.241	0.341
$r^2_{INST,\ Others}$	0.036	0.002	0.017	0.050
$r^2_{PROP,\ Others}$	0.092	0.018	0.072	0.138
	P-value (median $R^2_{INDV} = R^2_{INST\_PROP}$): 0.000			
	P-value (median $r^2_{INDV,\ Others} = r^2_{INST,\ Others}$): 0.000			
	P-value (median $r^2_{INDV,\ Others} = r^2_{PROP,\ Others}$): 0.000			
	P-value (median $r^2_{INST,\ Others} = r^2_{PROP,\ Others}$): 0.000			
Panel B: Order imbalance measured by share volume				
R^2_{INDV}	0.172	0.058	0.153	0.275
R^2_{INST}	0.016	-0.005	0.007	0.023
R^2_{PROP}	0.038	-0.002	0.017	0.064
$R^2_{INST\_PROP}$	0.055	0.005	0.037	0.094
$R^2_{INDV\_INST\_PROP}$	0.248	0.151	0.250	0.347
$r^2_{INDV,\ Others}$	0.209	0.098	0.209	0.304
$r^2_{INST,\ Others}$	0.029	0.001	0.015	0.042
$r^2_{PROP,\ Others}$	0.080	0.015	0.059	0.129
	P-value (median $R^2_{INDV} = R^2_{INST\_PROP}$): 0.000			
	P-value (median $r^2_{INDV,\ Others} = r^2_{INST,\ Others}$): 0.000			
	P-value (median $r^2_{INDV,\ Others} = r^2_{PROP,\ Others}$): 0.000			
	P-value (median $r^2_{INST,\ Others} = r^2_{PROP,\ Others}$): 0.000			

Table 5 Firm Size, Winner-Loser Stocks, and Institutional and Proprietary Trading

This table sorts the sample of 198 stocks into quintile groups on SSE based on one of the following criteria: (1) firm size measured by the average month-end market capitalization over the 6-month sample period; (2) average monthly returns over the 6-month period; (3) daily average of percentage of trading (number of trades) by INST over the 117 trading days; and (4) daily average of percentage of trading (number of trades) by PROP over the 117 trading days. For quintile groups 1, 3, and 5, the table reports the cross-sectional mean of firm size, average monthly return, average INST trading, average PROP trading, average order imbalances from INDV, INST, and PROP, and percentage of days with INST and PROP trading, respectively. Wilcoxon rank sum tests are performed for testing the null hypotheses that median values are the same between quintile groups 1 and 5 sorted on each of the four variables, respectively. $^{++}$ and $^{+}$ indicate significance of z-statistics at the 5 and 10 percent levels, respectively.

	Median firm size (mil. yuan)	Median monthly return (%)	Median INST trading (%)	Median PROP trading (%)	Median INDV order imbalance (%)	Median INST order imbalance (%)	Median PROP order imbalance (%)	Percentage of days with INST trading (%)	Percentage of days with PROP trading (%)
Panel A: Quintile groups sorted on firm size									
1	723	2.54	1.06	1.40	-8.92	-0.19	-0.43	70.0	44.0
3	1603	3.36	1.87	2.66	-7.80	-0.23	-0.25	85.4	66.2
5	4342^{++}	3.84^{++}	3.37^{++}	6.97^{++}	-5.10^{++}	-0.41	-0.54	97.9^{++}	96.1^{++}
Panel B: Quintile groups sorted on average monthly return over the 6-month sample period									
1	1534	-0.05	1.69	2.19	-5.11	-0.41	-0.98	724	51.1
3	1719	3.34	1.97	2.62	-8.22	-0.12	-0.46	86.3	71.4
5	2004	8.10^{++}	2.44^{++}	8.30^{++}	-5.47	0.05^{++}	1.73^{++}	94.8^{++}	94.4^{++}
Panel C: Quintile groups sorted on INST trading									
1	1059	2.99	0.65	0.59	-8.94	-0.09	-0.59	64.7	36.9
3	1771	3.66	1.81	3.50	-6.52	-0.23	-0.55	90.6	75.2
5	3137^{++}	4.22^{++}	5.03^{++}	8.35^{++}	-5.84^{++}	-0.01	-0.39^{++}	97.8^{++}	95.7^{++}
Panel D: Quintile groups sorted on PROP trading									
1	1066	2.24	0.86	0.30	-8.23	-0.21	-0.50	72.8	30.8
3	1543	2.34	1.94	2.91	-7.51	-0.44	-0.80	82.3	67.9
5	2800^{++}	4.93^{++}	3.21^{++}	15.56^{++}	-6.19^{++}	-0.01^{++}	0.63^{++}	96.1^{++}	99.6^{++}

Table 6 Firm Size, Winner-Loser Stocks, Daily Stock Returns, and Order Imbalances

This table first sorts the firms into quintile groups based on the average month-end market capitalization during the sample period. Then for quintile groups 1, 3, and 5, Panel A reports the cross-sectional mean and median coefficients from regressions of individual stock excess returns on contemporaneous order imbalances from individual, institutional, and proprietary investors. The regressions take the following forms:

$$r_{it} - r_{mt} = \delta_0 + \delta_{i,\ INDV}\text{imbal}_{it,\ INDV} + \delta_{i,\ INST}\text{imbal}_{it,\ INST} + \delta_{i,\ PROP}\text{imbal}_{it,\ PROP} + \varepsilon_{it}, \quad (1)$$

where r_{it} is the daily open-to-close return for stock i on day t, r_{mt} is an equal-weighted portfolio return on day t, t = 1, 2, …, 117, i = 1, 2, …, 198. Independent variables $\text{imbal}_{it,\ j}$, j = INDV, INST, PROP, measure daily percentage order imbalance in number of trades from individual, institutional, and proprietary investors, respectively, in stock i. In Panel B, the sorting is based on the average monthly returns over the 6-month sample period. Partial correlation such as $r^2_{INDV,\ Others}$ denotes the explanatory power of order imbalance from individual investors after order imbalances from institutional and proprietary investors are included in the regressions. Cross-correlation (ρ) adjusted t-statistics and Wilcoxon sign rank z-statistics are calculated. ** and * indicate significance of t-statistics at the 5 and 10 percent levels, respectively; $^{++}$ and $^{+}$ indicate significance of z-statistics at the 5 and 10 percent levels, respectively.

Table 6 Continued

Panel A: Firm size quintile groups 1, 3, and 5

	Average coefficient	Median coefficient	Percentage positive and significant		Average coefficient	Median coefficient
Size quintile 1, smallest ($\rho = 0.099$)						
$\delta_{i,\ INDV}$	0.062**	0.057^{++}	100.0	$r^2_{INDV,\ Others}$	0.322	0.327
$\delta_{i,\ INST}$	0.131**	0.099^{++}	40.0	$r^2_{INST,\ Others}$	0.031	0.012
$\delta_{i,\ PROP}$	0.127	0.083^{++}	62.5	$r^2_{PROP,\ Others}$	0.059	0.053
Adjust R^2	0.345	0.345				
Size quintile 3 ($\rho = 0.124$)						
$\delta_{i,\ INDV}$	0.046**	0.042^{++}	100.0	$r^2_{INDV,\ Others}$	0.261	0.255
$\delta_{i,\ INST}$	0.066**	0.051^{++}	42.5	$r^2_{INST,\ Others}$	0.030	0.014
$\delta_{i,\ PROP}$	0.079	0.060^{++}	77.5	$r^2_{PROP,\ Others}$	0.085	0.073
Adjust R^2	0.306	0.297				
Size quintile 5, largest ($\rho = 0.204$)						
$\delta_{i,\ INDV}$	0.037**	0.033^{++}	86.8	$r^2_{INDV,\ Others}$	0.175	0.165
$\delta_{i,\ INST}$	0.054**	0.057^{++}	63.2	$r^2_{INST,\ Others}$	0.036	0.029
$\delta_{i,\ PROP}$	0.062**	0.060^{++}	86.8	$r^2_{PROP,\ Others}$	0.130	0.093
Adjust R^2	0.291	0.300				

Groups 1 versus 5: p-value (adjusted R^2 same): 0.086

Groups 1 versus 5: p-value ($\delta_{i,\ INDV}$ same): 0.000, p-value ($r^2_{INDV,\ Others}$ same): 0.000

Groups 1 versus 5: p-value ($\delta_{i,\ INST}$ same): 0.003, p-value ($r^2_{INST,\ Others}$ same): 0.358

Groups 1 versus 5: p-value ($\delta_{i,\ PROP}$ same): 0.008 , p-value ($r^2_{PROP,\ Others}$ same): 0.001

Table 6 Continued

Panel B: Winner-loser groups 1, 3, and 5

	Average coefficient	Median coefficient	Percentage positive and significant		Average coefficient	Median coefficient
Winner-loser quintile 1, loser stocks (ρ=0.161)						
$\delta_{i,\ INDV}$	0.040**	0.038^{++}	90.0	$r^2_{INDV,\ Others}$	0.193	0.167
$\delta_{i,\ INST}$	0.085**	0.053^{++}	45.0	$r^2_{INST,\ Others}$	0.040	0.014
$\delta_{i,\ PROP}$	0.077*	0.069^{++}	70.0	$r^2_{PROP,\ Others}$	0.060	0.035
Adjust R^2	0.230	0.217				
Winner-loser quintile 3 (ρ=0.139)						
$\delta_{i,\ INDV}$	0.038**	0.035^{++}	97.5	$r^2_{INDV,\ Others}$	0.220	0.192
$\delta_{i,\ INST}$	0.096*	0.075^{++}	62.5	$r^2_{INST,\ Others}$	0.035	0.026
$\delta_{i,\ PROP}$	0.115	0.058^{++}	72.5	$r^2_{PROP,\ Others}$	0.079	0.057
Adjust R^2	0.283	0.286				
Winner-loser quintile 5, winner stocks (ρ=0.177)						
$\delta_{i,\ INDV}$	0.054**	0.054^{++}	97.3	$r^2_{INDV,\ Others}$	0.270	0.297
$\delta_{i,\ INST}$	0.086**	0.066^{++}	56.8	$r^2_{INST,\ Others}$	0.055	0.026
$\delta_{i,\ PROP}$	0.067*	0.068^{++}	89.2	$r^2_{PROP,\ Others}$	0.151	0.139
Adjust R^2	0.381	0.391				

Groups 1 versus 5: p-value (adjusted R^2 same): 0.000

Groups 1 versus 5: p-value ($\delta_{i,\ INDV}$ same): 0.004, p-value ($r^2_{INDV,\ Others}$ same): 0.011

Groups 1 versus 5: p-value ($\delta_{i,\ INST}$ same): 0.760, p-value ($r^2_{INST,\ Others}$ same): 0.280

Groups 1 versus 5: p-value ($\delta_{i,\ PROP}$ same): 0.783, p-value ($r^2_{PROP,\ Others}$ same): 0.000

Table 7 Institutional and Proprietary Trading, Daily Stock Returns, and Order Imbalances

This table first sorts the firms into quintile groups based on the daily average of percentage trading activity (num) for institutional investors (INST) from each stock over the 117-day sample period. Then for quintile groups 1, 3, and 5, Panel A reports the cross-sectional mean and median coefficients from regressions of individual stock excess returns on contemporaneous order imbalances from individual, institutional, and proprietary investors. The regressions take the following forms:

$$r_{it} - r_{mt} = \delta_0 + \delta_{i,\ INDV}\text{imbal}_{it,\ INDV} + \delta_{i,\ INST}\text{imbal}_{it,\ INST} + \delta_{i,\ PROP}\text{imbal}_{it,\ PROP} + \varepsilon_{it}, \quad (1)$$

where r_{it} is the daily open-to-close return for stock i on day t, r_{mt} is an equal-weighted portfolio return on day t, t = 1, 2, …, 117, i = 1, 2, …, 198. Independent variables $\text{imbal}_{it,\ j}$, j = INDV, INST, PROP, measure daily percentage order imbalance in number of trades from individual, institutional, and proprietary investors, respectively, in stock i. In Panel B, the sorting is carried out for proprietary investors (PROP). Partial correlation such as $r^2_{INDV,\ Others}$ denotes the explanatory power of order imbalance from individual investors after order imbalances from institutional and proprietary investors are included in the regressions. Cross-correlation (ρ) adjusted t-statistics and Wilcoxon sign rank z-statistics are calculated. ** and * indicate significance of t-statistics at the 5 and 10 percent levels, respectively; $^{++}$ and $^{+}$ indicate significance of z-statistics at the 5 and 10 percent levels, respectively.

Table 7 Continued

Panel A: INST trading quintile groups 1, 3, and 5

	Average coefficient	Median coefficient	Percentage positive and significant		Average coefficient	Median coefficient
INST trading quintile 1, lowest (ρ = 0.133)						
$\delta_{i,\ INDV}$	0.052**	0.053^{++}	97.4	$r^2_{INDV,\ Others}$	0.295	0.314
$\delta_{i,\ INST}$	0.125**	0.130^{++}	35.9	$r^2_{INST,\ Others}$	0.013	0.011
$\delta_{i,\ PROP}$	0.104	0.074^{++}	41.0	$r^2_{PROP,\ Others}$	0.036	0.011
Adjust R^2	0.309	0.321				
INST trading quintile 3 (ρ = 0.106)						
$\delta_{i,\ INDV}$	0.051**	0.054^{++}	95.0	$r^2_{INDV,\ Others}$	0.270	0.285
$\delta_{i,\ INST}$	0.082**	0.045^{++}	40.0	$r^2_{INST,\ Others}$	0.043	0.012
$\delta_{i,\ PROP}$	0.065**	0.060^{++}	77.5	$r^2_{PROP,\ Others}$	0.082	0.071
Adjust R^2	0.322	0.299				
INST trading quintile 5, highest (ρ = 0.190)						
$\delta_{i,\ INDV}$	0.037**	0.032^{++}	92.1	$r^2_{INDV,\ Others}$	0.168	0.157
$\delta_{i,\ INST}$	0.054**	0.059^{++}	73.7	$r^2_{INST,\ Others}$	0.069	0.055
$\delta_{i,\ PROP}$	0.092	0.058^{++}	84.2	$r^2_{PROP,\ Others}$	0.128	0.104
Adjust R^2	0.281	0.278				

Groups 1 versus 5: p-value (adjusted R^2 same): 0.229

Groups 1 versus 5: p-value ($\delta_{i,\ INDV}$ same): 0.000, p-value ($r^2_{INDV,\ Others}$ same): 0.000

Groups 1 versus 5: p-value ($\delta_{i,\ INST}$ same): 0.007, p-value ($r^2_{INST,\ Others}$ same): 0.000

Groups 1 versus 5: p-value ($\delta_{i,\ PROP}$ same): 0.338, p-value ($r^2_{PROP,\ Others}$ same): 0.000

Table 7 Continued

Panel B: PROP trading quintile groups 1, 3, and 5

	Average coefficient	Median coefficient	Percentage positive and significant		Average coefficient	Median coefficient
PROP trading quintile 1, lowest (ρ = 0.122)						
$\delta_{i,\ INDV}$	0.059**	0.058^{++}	97.4	$r^2_{INDV,\ Others}$	0.329	0.338
$\delta_{i,\ INST}$	0.126**	0.091^{++}	41.0	$r^2_{INST,\ Others}$	0.034	0.011
$\delta_{i,\ PROP}$	0.148	0.075^{++}	33.3	$r^2_{PROP,\ Others}$	0.016	0.004
Adjust R^2	0.340	0.342				
PROP trading quintile 3 (ρ=0.111)						
$\delta_{i,\ INDV}$	0.043**	0.038^{++}	92.5	$r^2_{INDV,\ Others}$	0.232	0.239
$\delta_{i,\ INST}$	0.075**	0.066^{++}	55.0	$r^2_{INST,\ Others}$	0.046	0.024
$\delta_{i,\ PROP}$	0.079**	0.077^{++}	85.0	$r^2_{PROP,\ Others}$	0.088	0.073
Adjust R^2	0.289	0.293				
PROP trading quintile 5, highest (ρ = 0.266)						
$\delta_{i,\ INDV}$	0.036**	0.033^{++}	92.1	$r^2_{INDV,\ Others}$	0.154	0.143
$\delta_{i,\ INST}$	0.053**	0.048^{++}	52.6	$r^2_{INST,\ Others}$	0.032	0.024
$\delta_{i,\ PROP}$	0.058**	0.055^{++}	97.4	$r^2_{PROP,\ Others}$	0.191	0.192
Adjust R^2	0.290	0.275				

Groups 1 versus 5: p-value (adjusted R^2 same): 0.027

Groups 1 versus 5: p-value ($\delta_{i,\ INDV}$ same): 0.000, p-value ($r^2_{INDV,\ Others}$ same): 0.000

Groups 1 versus 5: p-value ($\delta_{i,\ INST}$ same): 0.006, p-value ($r^2_{INST,\ Others}$ same): 0.392

Groups 1 versus 5: p-value ($\delta_{i,\ PROP}$ same): 0.151, p-value ($r^2_{PROP,\ Others}$ same): 0.000

Table 8 Commonality in Individual, Institutional, and Proprietary Order Imbalances

This table summarizes regression results of individual order imbalance on market-wide individual order imbalance and institutional (proprietary) order imbalances on market-wide institutional (proprietary) order imbalances. The regressions take the following forms:

$$\text{imbal}_{\text{it, j}} = \beta_{\text{i0}} + \beta_{\text{i, j}}\text{imbal}_{\text{mt, j}} + \varepsilon_{\text{it}}\,, \tag{3}$$

where $\text{imbal}_{\text{it, j}}$ denotes order imbalance of stock i on day t for investors type j, measured using number of trades or share volume. Subscript j = INDV, INST, and PROP stand for individual, institutional, and proprietary investors, respectively. The independent variable $\text{imbal}_{\text{mt, j}}$ represents an equal-weighted portfolio of order imbalance on day t for investor type j. Calculation of market-wide order imbalance excludes order imbalance from the i-th stock in the i-th regression. The daily sample covers a total of 117 trading days from October 2003 to March 2004, with t = 1, … , 117. The cross-sectional sample covers 198 stocks with i = 1, …, 198. In Panel A, the average cross-correlation ρ's for INDV, INST, and PROP regressions are -0.004, -0.001, and 0.002, respectively. In Panel B, the corresponding ρ's are -0.004, 0.001, and 0.002, respectively. Cross-correlation (ρ) adjusted t-statistics and Wilcoxon sign rank z-statistics are reported in parentheses. ** indicates significance of t-statistics at the 5 percent level; $^{++}$ indicates significance of z-statistics at the 5 percent level.

Table 8 Continued

	Mean coefficient (t-statistic)	Median coefficient (z-statistic)	Percentage positive	Percentage positive and significant	Percentage negative and significant	Mean adjusted R^2	Median adjusted R^2
Panel A: Order imbalance measured in number of trades							
$\beta_{i,\ INDV}$	0.984** (118.22)	1.030^{++} (12.17)	97.4	95.5	0.0	0.271	0.279
$\beta_{i,\ INST}$	0.614** (7.15)	0.379^{++} (8.32)	77.3	24.7	1.5	0.011	0.002
$\beta_{i,\ PROP}$	0.731** (5.82)	0.245^{++} (7.01)	74.2	36.9	4.0	0.023	0.007
P-value (median $\beta_{i,\ INDV} = \beta_{i,\ INST}$): 0.000			P-value (median adj. R^2 same for INDV and INST): 0.000				
P-value (median $\beta_{i,\ INDV} = \beta_{i,\ PROP}$): 0.000			P-value (median adj. R^2 same for INDV and PROP): 0.000				
P-value (median $\beta_{i,\ INST} = \beta_{i,\ PROP}$): 0.929			P-value (median adj. R^2 same for INST and PROP): 0.001				
Panel B: Order imbalance measured in share volume							
$\beta_{i,\ INDV}$	0.978** (86.42)	1.021^{++} (12.17)	97.4	92.4	0.0	0.224	0.228
$\beta_{i,\ INST}$	0.530** (5.98)	0.266^{++} (7.17)	72.7	20.0	3.0	0.006	-0.003
$\beta_{i,\ PROP}$	0.618** (5.43)	0.232^{++} (6.43)	72.2	28.3	2.0	0.013	0.001
P-value (median $\beta_{i,\ INDV} = \beta_{i,\ INST}$): 0.000			P-value (median adj. R^2 same for INDV and INST): 0.000				
P-value (median $\beta_{i,\ INDV} = \beta_{i,\ PROP}$): 0.000			P-value (median adj. R^2 same for INDV and PROP): 0.000				
P-value (median $\beta_{i,\ INST} = \beta_{i,\ PROP}$): 0.665			P-value (median adj. R^2 same for INST and PROP): 0.022				

Table 9 Firm Size, Winner-Loser Stocks, and Commonality in Order Imbalance

This table first sorts all firms into quintile groups based on the average month-end market capitalization during the sample period. Then for quintile groups 1, 3, and 5, Panel A summarizes the cross-sectional mean and median coefficients from regression of individual order imbalances on market-wide individual order imbalances and institutional (proprietary) order imbalances on market-wide institutional (proprietary) order imbalances. The regressions take the following forms:

$$\text{imbal}_{\text{it, j}} = \beta_{\text{i0}} + \beta_{\text{i, j}}\text{imbal}_{\text{mt, j}} + \varepsilon_{\text{it}}, \tag{3}$$

where $\text{imbal}_{\text{it, j}}$ denotes order imbalance of stock i on day t for investors type j, measured using number of trades or share volume. Subscript j = INDV, INST, and PROP stand for individual, institutional, and proprietary investors, respectively. The independent variable $\text{imbal}_{\text{mt, j}}$ represents an equal-weighted portfolio of order imbalance on day t for investor type j. Calculation of market-wide order imbalance excludes order imbalances from the i-th stock in the i-th regression. Panel B reports the results when the sorting is based on average monthly returns over the 6-month sample period. The daily sample covers a total of 117 trading days from October 2003 to March 2004, with t = 1, … , 117. The cross-sectional sample covers 198 stocks with i = 1, …, 198. Cross-correlation (ρ) adjusted t-statistics and Wilcoxon sign rank z-statistics are calculated. ** and * indicate significance of t-statistics at the 5 and 10 percent levels, respectively; $^{++}$ and $^{+}$ indicate significance of z-statistics at the 5 and 10 percent levels, respectively.

Table 9 continued

Panel A: Firm size quintile groups 1, 3, and 5

	Mean coefficient	Median coefficient	Percentage positive and significant	Mean adjusted R^2	Median adjusted R^2
Size quintile 1 smallest					
$\beta_{i,\ INDV}$	1.111**	1.137^{++}	97.5	0.304	0.317
$\beta_{i,\ INST}$	0.198**	0.117^{++}	10.0	0.005	-0.004
$\beta_{i,\ PROP}$	-0.008	0.029	17.5	0.008	0.001
Size quintile 3					
$\beta_{i,\ INDV}$	0.997**	1.082^{++}	97.5	0.276	0.271
$\beta_{i,\ INST}$	0.484**	0.428^{++}	27.5	0.008	0.001
$\beta_{i,\ PROP}$	0.337*	0.213^{++}	22.5	0.014	0.001
Size quintile 5 (largest)					
$\beta_{i,\ INDV}$	0.892**	0.929^{++}	92.1	0.282	0.288
$\beta_{i,\ INST}$	1.325**	1.265^{++}	55.3	0.031	0.017
$\beta_{i,\ PROP}$	1.898**	1.506^{++}	60.5	0.052	0.033

Groups 1 versus 5, p-value ($\beta_{i,\ INDV}$ same): 0.002, p-value (INDV adj. R^2 same): 0.653
Groups 1 versus 5, p-value ($\beta_{i,\ INST}$ same): 0.000, p-value (INST adj. R^2 same): 0.000
Groups 1 versus 5, p-value ($\beta_{i,\ PROP}$ same): 0.000, p-value (PROP adj. R^2 same): 0.001

Panel B: Winner-loser quintile groups 1, 3, and 5

	Mean coefficient	Median coefficient	Percentage positive and significant	Mean adjusted R^2	Median adjusted R^2
Winner-loser quintile 1 (loser stocks)					
$\beta_{i,\ INDV}$	0.715**	0.756^{++}	77.5	0.159	0.097
$\beta_{i,\ INST}$	-0.061	-0.037	12.5	0.004	-0.002
$\beta_{i,\ PROP}$	0.511*	0.217^{++}	27.5	0.031	0.018
Winner-loser quintile 3					
$\beta_{i,\ INDV}$	1.120**	1.108^{++}	100.0	0.319	0.328
$\beta_{i,\ INST}$	0.631**	0.383^{++}	22.5	0.010	-0.003
$\beta_{i,\ PROP}$	0.648**	0.234^{++}	35.0	0.018	0.001
Winner-loser quintile 5 (winner stocks)					
$\beta_{i,\ INDV}$	0.898**	0.850^{++}	100.0	0.238	0.216
$\beta_{i,\ INST}$	1.289**	0.722^{++}	42.1	0.029	0.010
$\beta_{i,\ PROP}$	1.415**	1.087^{++}	57.9	0.036	0.023

Groups 1 versus 5, p-value ($\beta_{i,\ INDV}$ same): 0.139, p-value (INDV adj. R^2 same): 0.007
Groups 1 versus 5, p-value ($\beta_{i,\ INST}$ same): 0.000, p-value (INST adj. R^2 same): 0.001
Groups 1 versus 5, p-value ($\beta_{i,\ PROP}$ same): 0.023, p-value (PROP adj. R^2 same): 0.936

Groups 3 versus 1, p-value ($\beta_{i,\ INDV}$ same): 0.000, p-value (INDV adj. R^2 same): 0.000
Groups 3 versus 5, p-value ($\beta_{i,\ INDV}$ same): 0.000, p-value (INDV adj. R^2 same): 0.002

Table 10 Institutional and Proprietary Trading and Commonality in Order Imbalance

This table first sorts the firms into quintile groups based on the daily average of percentage trading activity (num) by institutional investors (INST) over the sample period. Then for quintile groups 1, 3, and 5, Panel A reports the cross-sectional mean and median coefficients from regressions of individual order imbalances on market-wide individual order imbalances and institutional order imbalances on market-wide institutional order imbalances. The regressions take the following forms:

$$\text{imbal}_{\text{it, j}} = \beta_{\text{i0}} + \beta_{\text{i, j}}\text{imbal}_{\text{mt, j}} + \varepsilon_{\text{it}}, \tag{3}$$

where $\text{imbal}_{\text{it, j}}$ denotes order imbalance of stock i on day t for investor type j, measured using number of trades. Subscript j = INDV, INST, and PROP stand for individual investors, institutional investors type 1, and institutional investors type 2, respectively. The independent variable $\text{imbal}_{\text{mt, j}}$ represents an equal-weighted portfolio of order imbalance on day t for investor type j. Calculation of market-wide order imbalance excludes order imbalance from the i-th stock in the i-th regression. In Panel B, the sorting is based on the daily average of percentage proprietary trading (PROP). The daily sample covers a total of 117 trading days from October 2003 to March 2004, with t = 1, … , 117. The cross-sectional sample covers 198 stocks with i = 1, …, 198. Cross-correlation (ρ) adjusted t-statistics and Wilcoxon sign rank z-statistics are calculated. ** and * indicate significance of t-statistics at the 5 and 10 percent levels, respectively; $^{++}$ and $^{+}$ indicate significance of z-statistics at the 5 and 10 percent levels, respectively.

Table 10 continued

Panel A: INST trading quintile groups 1, 3, and 5

	Mean coefficient	Median coefficient	Percentage positive and significant	Mean adjusted R^2	Median adjusted R^2
INST quintile group 1 (lowest)					
$\beta_{i,\ INDV}$	1.093**	1.221^{++}	97.5	0.318	0.350
$\beta_{i,\ INST}$	0.081**	0.074^{++}	7.5	0.001	-0.004
$\beta_{i,\ PROP}$	0.054	0.148^{++}	27.5	0.013	0.008
INST quintile group 3					
$\beta_{i,\ INDV}$	0.964**	0.978^{++}	97.5	0.254	0.221
$\beta_{i,\ INST}$	0.253**	0.353^{++}	22.5	0.013	0.004
$\beta_{i,\ PROP}$	0.760**	0.337^{++}	42.5	0.028	0.025
INST quintile group 5 (highest)					
$\beta_{i,\ INDV}$	0.874**	0.903^{++}	94.7	0.243	0.231
$\beta_{i,\ INST}$	1.651**	1.353^{++}	50.0	0.026	0.015
$\beta_{i,\ PROP}$	1.790**	1.306^{++}	63.2	0.048	0.030

Groups 1 versus 5, p-value ($\beta_{i,\ INDV}$ same): 0.000, p-value (INDV adj. R^2 same): 0.015

Groups 1 versus 5, p-value ($\beta_{i,\ INST}$ same): 0.000, p-value (INST adj. R^2 same): 0.001

Groups 1 versus 5, p-value ($\beta_{i,\ PROP}$ same): 0.000, p-value (PROP adj. R^2 same): 0.018

Panel B: PROP trading quintile groups 1, 3, and 5

	Mean coefficient	Median coefficient	Percentage positive and significant	Mean adjusted R^2	Median adjusted R^2
PROP trading quintile group 1 (lowest)					
$\beta_{i,\ INDV}$	0.973**	1.069^{++}	92.5	0.271	0.286
$\beta_{i,\ INST}$	-0.049	0.042	7.5	0.003	-0.004
$\beta_{i,\ PROP}$	0.093*	0.086^{++}	32.5	0.019	0.014
PROP trading quintile group 3					
$\beta_{i,\ INDV}$	1.001**	1.094^{++}	95.0	0.282	0.319
$\beta_{i,\ INST}$	0.640**	0.428^{++}	25.0	0.010	0.001
$\beta_{i,\ PROP}$	0.219	0.164^{+}	17.5	0.010	-0.002
PROP trading quintile group 5 (highest)					
$\beta_{i,\ INDV}$	0.916**	0.920^{++}	100.0	0.241	0.226
$\beta_{i,\ INST}$	1.170**	0.783^{++}	44.7	0.023	0.010
$\beta_{i,\ PROP}$	2.692**	2.703^{++}	71.1	0.056	0.037

Groups 1 versus 5, p-value ($\beta_{i,\ INDV}$ same): 0.031, p-value (INDV adj. R^2 same): 0.174

Groups 1 versus 5, p-value ($\beta_{i,\ INST}$ same): 0.000, p-value (INST adj. R^2 same): 0.004

Groups 1 versus 5, p-value ($\beta_{i,\ PROP}$ same): 0.000, p-value (PROP adj. R^2 same): 0.009