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Dynamic autocorrelation of intraday stock returns

Xi Dong[a], Shu Feng[b], Leng Ling[c,1,*], Pingping Song[d]

[a] Baruch College, City University of New York, New York, USA
[b] Clark University, MA, USA
[c] Georgia College & State University (GCSU), Georgia, USA
[d] Georgia Gwinnett College, Georgia, USA

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ABSTRACT

We discover three significant periodicities in the autocorrelation of intraday stock returns. We demonstrate that (i) the autocorrelation is 64% more negative during afternoons than during mornings, (ii) the autocorrelation is more negative Tuesdays through Fridays than on Mondays, (iii) overall serial correlation becomes less negative when salient information events arrive, i.e., earnings months, but measures less negative during mornings and on Mondays. Our results support the hypothesis that informational demand is more critical following daily and weekly market closures when information accumulated cannot easily be traded on, while liquidity demand intensifies closer to the no-trading periods.

1. Introduction

Serial return correlation is a topic of significant interest in financial economics. Many studies have argued that informed trading and liquidity trading generate very different short-term serial return correlation patterns.[2] Informed trading due to private information tends to generate zero or positive return autocorrelation (Glosten and Milgrom, 1985; Glosten and Harris, 1988; Wang, 1994; Llorente, Michaely, Saar, and Wang, 2002; Boulatov, Hendershott, and Livdan, 2013; Dong, Feng, and Sadka, 2015; Dong and Massa, 2016), while liquidity trading tends to exhibit negative return autocorrelation (Grossman and Miller, 1988; Campbell, Grossman, and Wang, 1993; Llorente et al., 2002; Nagel, 2012; Dong 2012). In this paper we investigate the dynamics of high frequency, *intraday* stock return autocorrelation during different daytime periods as well as across different trading days of the week when the relative importance of information and liquidity are likely to differ. The relevant literature has not fully examined the behavior of intraday serial correlation: previous studies have mainly examined serial correlation ranging from yearly to daily levels, such as the 12-month momentum and the monthly reversal (French and Roll, 1986; Amihud and Mendelson, 1987; Stoll 1989; Lo and Mackinlay, 1988, 1990; Jegadeesh, 1990; Jegadeesh and Titman, 1993). However, the dynamics of intraday return autocorrelation have become particularly important due to critical

* Corresponding author.
E-mail addresses: xi.dong@baruch.cuny.edu (X. Dong), sfeng@clarku.edu (S. Feng), leng.ling@gcsu.edu (L. Ling), psong@ggc.edu (P. Song).

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[2] Liquidity trading in our paper generally refers to trading without new information about future payoff. Liquidity trading may be driven by hedging demand, risk sharing, noise, or any noninformation-based trading.

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implications for understanding high frequency trading, which has accounted for as much as 60–73% of the total US equity trading volume in recent years.[3]

We have built our hypotheses on the central premise of much of the empirical and theoretical microstructure literature: When investors sell (buy) a stock for the purpose of liquidity trading, the stock price must decline (increase) in order to attract other risk averse investors. Since such trades are "non-informational," the expected future payoff of the focal stock remains the same; hence the stock's reduced (increased) price results in a low (high) return for the current period and a high (low) expected return for the next period. The first-order return autocorrelation is therefore negative, i.e., a short-term reversal (Grossman and Miller, 1988; Campbell, Grossman, and Wang, 1993; Llorente et al., 2002; Nagel, 2012). In contrast, the price impacts of informed trades are less likely to reverse, either because the price impact of informational trades is permanent (Glosten and Milgrom, 1985; Glosten and Harris, 1988), or because the full private information is not revealed immediately due to various market frictions (Wang, 1994; Llorente et al., 2002; Boulatov, Hendershott, and Livdan, 2013).

Anand, Chakravarty and Martell (2005) use a unique dataset that enables them to distinguish between informed (institutional) and uninformed (individual) orders on NYSE stocks. They find that institutional informed trading is more likely to occur during the first half rather than the second half of the trading day. Anand et al. (2005) also find that uninformed (liquidity) trading tends to behave in a manner opposite to informed trading. This result is consistent with the finding in Bloomfield et al. (2005) that informed traders use market orders in the beginning of the trading period.[4]

From this premise we posit first that the intraday return autocorrelation will differ depending on whether trades occur in the morning or the afternoon, as the relative importance of informational and liquidity trading should differ significantly across these two periods. Contrasted with trades later in the day, comparatively more trades in the early hours directly after the opening of the stock market are likely to be motivated by speculation on information, because most information such as earnings becomes available when the market is closed. Therefore, much of the trading demand based on new information is likely to occur immediately after the market reopens the following day. As a result, the autocorrelation of intraday stock returns should be less negative early in the trading day when both liquidity and informational trading demands are significant. Conversely, fewer information-based trades should occur as market participants digest information through trading. Therefore, the volume of informed trades subsides as the day proceeds. Furthermore, because investors cannot trade shares easily when information arrives after the market closes, liquidity-based rebalancing needs are likely to be stronger as the market approaches the closing bell. These liquidity needs include hedging demands initiated by market makers, such as investment banks or hedge funds, who need to rebalance in order to keep their inventory at zero at market close. Hence the autocorrelation of intraday stock returns should be comparatively more negative during the second half of the trading day.

Foster and Viswanathan (1990) argue that since informed traders receive private information throughout the week, and public information is released only on weekdays, informed traders will therefore trade more intensely before the information is revealed. However, uninformed traders, who suffer from a larger information asymmetry on Mondays, will avoid trading in the early part of the week. Cross (1973) finds that price changes on Mondays are higher than price changes Tuesdays through Fridays. These findings motivate us to further posit that the same economic consideration will generate not only autocorrelation difference intraday but also generate a day-of-the-week effect at the daily level. Specifically, most information made available over weekends cannot be traded on until Monday. Conversely, to hedge the information risk over weekends, liquidity needs may grow especially stronger during Tuesdays through Fridays. Therefore, informational trading demands may be stronger on Mondays, while liquidity demand is stronger on subsequent weekdays. This implies less negative return autocorrelation on Mondays than on other weekdays.

Finally, the above mechanisms are also affected by other events that can generate informational trading demand. For example, during the periods when corporate earnings are announced, more trades motivated by earnings information are likely to occur. Therefore, the morning–afternoon and Monday–other weekdays autocorrelation difference should be more significant during earnings announcement months.

To test our hypotheses, we examine the transaction data of individual stocks traded on the New York Stock Exchange (NYSE), American Stock Exchange (AMEX) and NASDAQ during the period 2006–2010. Our first finding is that the first-order autocorrelation of 10-minute stock returns is −0.0928 in the morning versus −0.1521 in the afternoon. This represents a 64% increase in negative autocorrelation as information trading demand subsides while liquidity demand increases. These magnitudes are substantial, especially considering that autocorrelation should be zero in a random walk-based efficient market hypothesis (Fama, 1965).

We obtain this morning–afternoon autocorrelation difference on two types of weekdays — Monday and other weekdays. The results suggest a robust morning–afternoon difference in return autocorrelation that is consistent with the interpretation of more afternoon than morning trades motivated by liquidity.

[3] It is estimated that as of 2009, high frequency trading accounted for 60-73% of all US equity trading volume, with that number falling to approximately 50% in 2012. See "Times Topics: High-Frequency Trading", The New York Times, December 20, 2012. Similar results was also obtained in Brogaard, Hendershott, and Riordan (2014) that high-frequency traders participate in 68.5% of the dollar volume traded during 2008–2009.

[4] In the US markets, Foster and Viswanathan (1993) document the U-shaped intraday pattern of trading volume in NYSE. Barclay and Hendershott (2003) document a U-shaped pattern in price discovery over the trading day with a much larger spike at the beginning of the day. This suggests that there is more informed trading early in the day.