FINANCIAL MARKETS

Evidence on the Speed of Convergence to Market Efficiency

Although day-to-day returns indicate the lack of significant serial correlation, order imbalances can persist for several days. The lack of interday dependence and the presence of continuing order imbalances over several days suggest that some investors are conducting countervailing trades to correct the order imbalance and that this activity removes serial dependence in returns within the trading day. The authors investigate how long it takes the market to remove this return dependence and make the market weak-form efficient. Their results show that it takes more than 5 minutes but less than 60 minutes.

Research on the efficiency of security markets indicates that markets are generally efficient and security prices are difficult to predict, at least for large stocks in developed markets. These markets are efficient in the weak-form sense, as they do not exhibit significant levels of serial correlation of returns. Markets, however, do not magically become efficient but do so through the actions of individual investors. What process is used to make the markets efficient, and how long does it take? This is the issue addressed by the authors.

They focus on market order imbalances for the S&P 500 Index stocks as documented by Chordia, Roll, and Subrahmanyam (*Journal of Financial Economics*, 2002). Market order imbalances, defined as aggregate daily purchase orders less sell orders, were found to be highly predictable from day to day. High imbalances on one side of the trade were found to persist for several days. Despite the persistence in orders, the S&P 500 essentially followed a random walk over a

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horizon of one day. Thus, the results indicate that although the returns are random and exhibit weak-form efficiency on a day-to-day basis, order imbalances could persist for at least several days. This finding suggests that some perceptive investors are correctly forecasting continued price pressures and conducting countervailing trades sufficient to remove serial dependence in returns. The removal of serial dependence on a day-to-day basis does not mean, however, that the process takes place instantaneously. Some finite time period is most likely required during the day for investors to ascertain what is going on and to complete trading decisions that expunge any serial dependence remaining for the trading day. How long it takes to achieve this degree of weak-form efficiency is the question addressed by this research.

The data used cover 150 large-capitalization stocks listed on the NYSE for the 1996, 1999, and 2002 calendar years. Each transaction for each of the stocks is taken from the Trade and Automated Quotations (TAQ) database of the NYSE. The Lee and Ready (*Journal of Finance*, 1991) trade assignment algorithm is used to estimate whether a particular trade is initiated by the buyer or seller. Several measures of order imbalance (buyer-initiated trades less seller-initiated trades) were calculated for various time intervals during each trading day. The authors first ascertain whether returns are serially dependent during the trading day, thus confirming weak-form efficiency. Using intraday returns for the 150 stocks, there appears to be little evidence of unconditioned serial dependency of returns. Using only the past history of returns, there is little predictability of future returns over intervals even as short as five minutes.

Lagged order imbalances, however, are shown to be significant predictors of returns at intervals up to 30 minutes in 1996, up to 10 minutes in 1999, and up to 5 minutes in 2002. Thus, in less than 30 minutes, order imbalances lose their predictive ability. This evidence is consistent with countervailing trades being undertaken. Within a short period of at most 30 minutes, the market appears to lack strong-form efficiency.