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Predicting VNET: A model of the dynamics of market depth[☆]

Robert F. Engle^a, Joe Lange^{b,*}

^a*Department of Economics, University of California, San Diego, 9500 Gilman Drive,
San Diego, CA 92093, USA*

^b*Federal Reserve Board, Mail Stop 59, 2000 C Street NW, Washington, DC 20551, USA*

Abstract

The paper proposes a new intraday measure of market liquidity, VNET, which directly measures the depth of the market corresponding to a particular price deterioration. VNET is constructed from the excess volume of buys or sells associated with a price movement. As this measure varies over time, it can be forecast and explained. Using NYSE TORQ data, it is found that market depth varies with volume, transactions, and volatility. These movements are interpreted in terms of the varying proportion of informed traders in an asymmetric information model. When an unbalanced order flow is transacted in a surprisingly short time relative to that expected using the Engle and Russell (*Econometrica* 66 (1998) 1127) ACD model, the depth is further reduced providing an estimate of the value of patience. The analysis is repeated for 1997 TAQ data revealing that the parameters of the relationships changed only modestly, despite shifts in market volume, volatility, and minimum tick size. A dynamic market reaction curve is estimated with the new data. © 2001 Elsevier Science B.V. All rights reserved.

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* Corresponding author. Tel.: +1-202-452-2628.

E-mail address: joe.lange@frb.gov (J. Lange).

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1. Introduction

Over the past decade, equity market activity has increased dramatically in terms of both trading volume and price volatility. From one perspective, the ability of the stock market to handle an increasing number of daily transactions points to greater liquidity. However, the large price fluctuations that accompanied many of the high-volume days indicate that the market did not absorb the additional transactions without some degree of price impact. The net effect on the cost of trading is by no means obvious. Clearly neither volume nor volatility is a direct measure of liquidity, although they are closely connected. Beyond the bid–ask spread, few established measures of market liquidity are available and several are measurable only cross-sectionally.

To the extent that stock market liquidity is a time-varying process, it may be possible to forecast when the market will be most accommodative to incoming trade activity. A tool capable of distinguishing and predicting shifts in market depth would be particularly valuable to institutional traders conducting high-volume trades in a particular stock. In addition, risk managers seeking ways to measure liquidity risk should find the prediction of market reaction curves useful. Not only would this present the possibility of computing price deterioration from a known quantity of portfolio holdings, but it also would offer a menu of liquidation costs depending upon the unwind strategy chosen.

This paper introduces a new, intraday statistic for market depth. Quoted depth reflects the number of shares that can be bought or sold at a particular bid or offer price. The new statistic, VNET, measures the number of shares purchased minus the number of shares sold over a period when prices moved a certain increment, and it is therefore a measure of realized depth for a specific price deterioration. VNET is constructed in event-time, similar to Cho and Frees (1988), and can be measured repeatedly throughout the trading day to capture the short-run dynamics of market liquidity.

Motivated by the asymmetric information models in the market microstructure literature, a predictive model of intraday market depth is developed and estimated for 17 stocks from the NYSE's TORQ data set. As anticipated, VNET is observed to vary both over time and across stocks. The results show VNET to be a function of the magnitude and timing of current and lagged transaction flows. The transactions data used to derive our measure of market depth presumably were themselves optimized according to investor criteria. Thus, time variation in expected VNET must be a result of agents who chose not to completely smooth liquidity over time, such as information-based traders. The prediction of VNET based on a valid conditioning set can only be precisely associated with market depth under the assumption that the contemplated trades are treated by the market in the same way that trades were treated historically. That is, a well-known troubled hedge fund might find that the depth

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