Available online at www.sciencedirect.com
ScienceDirect
Journal of Empirical Finance 15 (2008) 656–678
Journal of EMPIRICAL FINANCE
www.elsevier.com/locate/jempfin

Determinants of bid and ask quotes and implications for the cost of trading ☆

Michael Yuanjie Zhang [a], Jeffrey R. Russell [b,*], Ruey S. Tsay [b]

[a] *Barr Rosenberg Research Center, AXA Rosenberg Group, 4 Orinda Way Bldg E, Orinda, CA 94563, USA*
[b] *Graduate School of Business, University of Chicago, 5807 South Woodlawn Avenue, Chicago, IL 60637, USA*

Received 1 September 2005; accepted 11 December 2007
Available online 11 February 2008

Abstract

Financial transaction costs are time varying. This paper proposes a model that relates transaction cost to characteristics of order flow. We obtain qualitatively consistent model results for different stocks and across different time periods. We find that an unusual excess of buyers (sellers) relative to sellers (buyers) tends to increase the ask (bid) price. Hence, the ask and bid components of spread change asymmetrically about the efficient price. For a fixed order imbalance surprise these effects are muted when unanticipated total volume is high. Unexpected high volatility in the transaction price process tends to widen the spread symmetrically about the efficient price. Our findings are consistent with predications from market microstructure theory that the cost of market making should depend on both the risk of trading with better-informed traders and inventory risk. We also find that order flow surprises have a significant impact on the efficient price and can also explain a substantial amount of persistence in the volatility of the efficient price. This dependence does not violate the efficient market hypothesis since the surprises, by definition, are not predictable.

JEL classification: G23; D82; C15
Keywords: Trading costs; Liquidity; Price dynamics; Market microstructure

1. Introduction

A key measure of the efficiency of a financial market making structure is the cost of trading. Most markets offer separate prices for buyers and sellers. A market's operational efficiency can therefore be measured by its bid/ask

☆ The authors would like to thank Robert Engle, Joel Hasbrouck, Hong Li, Tee Lim, Per Mykland, Rudi Schadt, Neil Shephard, Pietro Veronesi, Kevin Wang and Li Wei for their suggestions. We specially thank Joel Hasbrouck for sharing his maximum likelihood estimation code for the benchmark Hasbrouck model in this paper. The first author is grateful to the University of Chicago Fellowship, the Oscar Mayer Fellowship and his colleagues at Barr Rosenberg Research Center.
* Corresponding author.
E-mail address: jeffrey.russell@chicagogsb.edu (J.R. Russell).

0927-5398/$ - see front matter © 2008 Published by Elsevier B.V.
doi:10.1016/j.jempfin.2007.12.003

spread. As a result, there has been substantial interest in both theoretical and empirical modeling of the behavior of bid–ask spreads. The theoretical literature identifies three main factors that determine spread: inventory carrying costs (Amihud and Mendelson, 1980; Ho and Stoll, 1983; O'Hara and Oldfield, 1986), adverse selection costs (Kyle, 1985; Glosten and Milgrom, 1985; Admati and Peiderer, 1988; Easley and O'Hara, 1992) and order processing costs (Brock and Kleidon, 1992). Among those studies, researchers explore the cross-sectional and time series relationship between spread and volume (Easley and O'Hara 1992; Harris and Raviv 1993; Lee, Mucklow, and Ready 1993). In addition to its relationship with spreads and transaction costs, volume also has close link to market price variability (Gallant, Rossi, and Tauchen 1992; Campbell, Grossman, and Wang 1993; Chan and Fong 2000).

Although markets contain both buyers and sellers, an implicit assumption of "symmetry" is often imposed in the microstructure literature when order flow characteristics such as spreads and volumes are related. The impact of buyer induced and seller induced components is assumed to have a common impact on price setting. We decompose the spread into two components: the cost of buy exposure and the cost of sell exposure. We test and find evidence that the effect of volume on these components is not symmetric. Hence the classic studies which do not account for the asymmetries are missing part of the picture.

Our methodology is closely related to Hasbrouck (1999a). We model the bid and ask prices as deviations from an unobserved efficient price. The efficient price is defined as the price that would prevail in equilibrium in the absence of market frictions and is, consistent with market microstructure theory, assumed to follow a heterosckedastic random walk. The deviations of the bid and ask prices are modeled as functions of past order flows. Since the bid and ask deviations are modeled separately, we can test for symmetry in the response of the bid and ask to order flow characteristics. To the best of our knowledge, this is the first paper to perform such tests.

Information based market microstructure theory focuses on how the market evolves following the arrival of new information, especially, how new information is absorbed into market prices. Hasbrouck (1991) points out that innovations to trade order flows are the ultimate meaningful measure of information effect since innovations exclude the predictable portion of the order flow that conveys no new information. It is therefore natural to separate innovations from market variables. We decompose each market variable into anticipated and unanticipated components and test for the roles the two components play in determining trading cost and efficient price. We find that market variables such as buy/sell volumes, transaction price variance, and spread affect market making costs and the efficient price volatility only through their unanticipated components. We therefore find that surprises or shocks to these variables are more important determinants of price setting behavior than their expected components.

We have two important findings. First, by making distinctions between buyer-initiated and seller-initiated volume and decomposing the two types of volume into anticipated and unanticipated components, we find that the ask and bid components of spread change asymmetrically about the efficient price as a function of the order flow. An unusual excess of buyers relative to sellers tends to increase the ask price more than the bid price, and an unusual excess of sellers has an opposite effect. For a fixed order imbalance surprise (Pressure), these effects are muted when the unanticipated total volume (Level) is high. The impact of expected volume on trading cost is not significant for the stocks analyzed, indicating that effects of the expected component of volume is already impounded in the cost functions. Second, the dynamics of the cost of ask exposure process and the cost of bid exposure process are distinct and hence asymmetric. Except that unexpected high volatility in the transaction price process tends to widen the spread symmetrically about the efficient price, the impacts of other market variables on market making costs are asymmetric. Not surprisingly, we also find that the cost of market making is lower when the expected depth is higher. Our findings are consistent with predications from market microstructure theory that the cost of market making should depend on both the risk of trading with better-informed traders and inventory risk.

A cornerstone of market microstructure theory is that in an asymmetric information environment uninformed agents learn about private information from order flow (O'Hara, 1995). The dynamics of the efficient market price are therefore allowed to depend on the contemporaneous surprise to buyer-initiated (seller-initiated) volume, which has a significant positive (negative) impact on the mean dynamics of the efficient market price. The volatility of the underlying efficient market price is highly persistent in the estimated EGARCH model, but most of this persistence can be explained by the added market variables (bid–ask spreads, buy/sell volumes, and their lags; quoted depths). The persistence of the ARCH effects is significantly reduced after incorporating market variables. This is consistent with the story that the extent of information asymmetry in the market serves as an important source of the volatility clustering observed in the financial market.