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Uncertainty, market structure, and liquidity ☆

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ABSTRACT

In this study we show that market uncertainty [measured by the Chicago Board Options Exchange Market Volatility Index (VIX)] exerts a large market-wide impact on liquidity, which gives rise to co-movements in individual asset liquidity. The effect of VIX on stock liquidity is greater than the combined effects of all other common determinants of stock liquidity. We show that the uncertainty elasticity of liquidity (UEL: percent change in liquidity given a 1% change in VIX) has increased around regulatory changes in the US markets that increased the role of public traders in liquidity provision, reduced the minimum allowable price variation, weakened the affirmative obligation of NASDAQ dealers, and abolished the specialist system on the NYSE.

1. Introduction

In this study we provide evidence regarding the effect of uncertainty on stock market liquidity by analyzing the timeseries relation between an index of stock market volatility [Chicago Board Options Exchange (CBOE) Market Volatility Index (VIX)] and various measures of liquidity. Our study also sheds light on whether the impact of market volatility on liquidity varies with market structure by examining the effects of four major regulatory changes in the US markets on the relation between VIX and liquidity.

Prior research finds commonality in liquidity. Chordia, Roll, and Subrahmanyam (2000), Hasbrouck and Seppi (2001), and Huberman and Halka (2001) show that the liquidity of individual stocks co-varies with both the liquidity of the market as a whole and the liquidity of

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stocks in the same industry. Other studies show that liquidity-related risks are priced. For instance, Acharya and Pedersen (2005) find that the risk premium is related to commonality in liquidity with market liquidity, return sensitivity to market liquidity, and liquidity sensitivity to market returns.[1] Korajczyk and Sadka (2008) show that only the across-measure global systematic liquidity factor commands a risk premium. Sadka (2010) finds that hedge fund returns are significantly related to the covariation of fund returns with unexpected changes in aggregate liquidity. Lee (2011) analyzes liquidity risks using international data and shows that the pricing of liquidity risk varies across countries according to geographic, economic, and political environments.

Prior studies offer both demand- and supply-side theories of liquidity commonality. Demand-side theory suggests that liquidity commonality arises from the behavior of investors and traders. Kamara, Lou, and Sadka (2008) show that an increase in institutional ownership leads to an increase in both liquidity commonality and its cross-sectional variation. Koch, Ruenzi, and Starks (2010) conjecture that co-movements in liquidity could arise among stocks if they are held by a group of investors that tend to trade in the same direction and at the same time and show that stocks with higher mutual fund ownership exhibit larger co-movements in liquidity. Karolyi, Lee, and Van Dijk (2012) show that liquidity commonality is greater during times of high market volatility and in countries with a greater presence of international investors and more correlated trading activity, and they interpret the results as evidence for the demand-side theory.

Supply-side theory suggests that liquidity commonality arises from liquidity providers' information sharing and capital constraints. For example, Coughenour and Saad (2004) hold that liquidity covariation arises because specialists within each firm make common adjustments in liquidity provisions based on their shared capital and information. Chordia, Sarkar, and Subrahmanyam (2005) find evidence that monetary policy gives rise to liquidity commonality in the stock market.[2] Hameed, Kang, and Viswanathan (2010) show that liquidity commonality on the NYSE increases during market decline when funding liquidity is tight. Most factors are likely to affect both the demand for and supply of liquidity, and liquidity commonality would arise from interactions of liquidity demanders and suppliers.

In this study we show that an important source of liquidity commonality is overall market uncertainty using the Chicago Board Options Exchange Market Volatility Index.[3] This index, often referred to as the fear index or the fear gauge, is a measure of the implied volatility of Standard & Poor's (S&P) 500 index options.[4] To the extent that systematic liquidity variation is a priced factor, understanding the causes of liquidity covariation should help investors and traders to better deal with such risk. Empirical evidence regarding the sources of liquidity commonality could also help financial economists to better understand risk premiums and asset prices. In addition, our study sheds light on whether the regulatory changes that relaxed the affirmative obligation of NASDAQ dealers and abolished the specialist system on the NYSE are responsible, at least in part, for the recent fluctuations in market liquidity.

The present study contributes to a growing literature that uses VIX as a measure of expected volatility. Bao, Pan, and Wang (2011) show that monthly changes in aggregate bond market liquidity are strongly related to changes in VIX. Pan and Singleton (2008) and Longstaff, Pan, Pedersen, and Singleton (2010) find a strong correlation between sovereign credit spreads and VIX. Graham and Harvey (2010) show that equity risk premium closely tracks VIX over time and increases sharply during financial crises. Adrian and Shin (2010) argue that risk-management constraints reduce the risk appetite of financial intermediaries in times of high VIX. Bekaert, Hoerova, and Lo Duca (2013) find a high correlation between VIX and monetary policy. Nagel (2012) finds that the expected return from liquidity provision is time-varying and increases with VIX.

Market microstructure theory (see, e.g., Ho and Stoll, 1981; Glosten and Milgrom, 1985) predicts that liquidity providers widen the bid-ask spread (i.e., an inverse measure of liquidity) when inventory holding or adverse selection risks are high. Consistent with this prediction, prior research shows that the bid-ask spread of a stock increases with its own risk, typically measured by the standard deviation of quote midpoint returns or the standard error calculated from the market model (i.e., unsystematic risk) or both.[5] In the present study, we provide empirical evidence that the liquidity of an individual asset is related not only to its own risk, but also to overall market uncertainly reflected in VIX.

How uncertainty exerts an impact on liquidity is likely to depend on market structure. We conjecture that uncertainty exerts a larger impact on liquidity when public traders play a greater role in liquidity provision, when the minimum price variation (i.e., tick size) is smaller, and when market makers play a smaller role in liquidity provision. We test these conjectures using the following four regulatory changes, which serve as natural experiments, in market structure: (1) the implementation of the new order handling rules (OHR) on NASDAQ in 1997, (2) the reduction of tick size from $1/8 to $1/16 in 1997

[1] Pastor and Stambaugh (2003) is the first to report the return sensitivity to market liquidity finding.

[2] Chordia, Sarkar, and Subrahmanyam (2005) also conjecture that common factors drive liquidity and volatility in stock and bond markets based on their finding that innovations to stock and bond market liquidity and volatility are highly correlated.

[3] Chordia, Roll, and Subrahmanyam (2000, p. 5) note that "(T)he risk of maintaining inventory depends also on volatility, which could have a market component." However, they do not expand on the conjecture.

[4] In 1993, the Chicago Board Options Exchange introduced the CBOE Volatility Index (VIX), which measures the market's expectation of 30-day volatility implied by at-the-money S&P 100 index option prices. In 2003, CBOE introduced a new method of estimating the VIX based on the S&P 500 index. The new method estimates expected volatility by averaging the weighted prices of S&P 500 puts and calls over a wide range of strike prices (*source*: http://www.cboe.com/micro/vix/vixwhite.pdf).

[5] See, for example, Benston and Hagerman (1974) and Stoll (2000).