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Liquidity biases in asset pricing tests ☆

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ABSTRACT

Microstructure noise in security prices biases the results of empirical asset pricing specifications, particularly when security-level explanatory variables are cross-sectionally correlated with the amount of noise. We focus on tests of whether measures of illiquidity, which are likely to be correlated with the noise, are priced in the cross-section of stock returns, and show a significant upward bias in estimated return premiums for an array of illiquidity measures in Center for Research in Security Prices (CRSP) monthly return data. The upward bias is larger when illiquid securities are included in the sample, but persists even for NYSE/Amex stocks after decimalization. We introduce a methodological correction to eliminate the biases that simply involves weighted least squares (WLS) rather than ordinary least squares (OLS) estimation, and find evidence of smaller, but still significant, return premiums for illiquidity after implementing the correction.

1. Introduction

A substantial recent literature considers the effects of microstructure-induced noise for empirical applications in finance. These papers build on the insight of Blume and Stambaugh (1983) and Black (1986) that observed stock prices can be thought of as the sum of unobservable efficient prices and noise attributable to microstructure effects, including the non-informational component of the bid–ask spread. Among the recent studies, Bandi and Russell (2006) develop procedures for estimating separately the volatility of the efficient price and of the microstructure noise, Dennis and Mayhew (2009) examine how microstructure noise affects tests of option pricing models, while Aït-Sahalia, Mykland, and Zhang (2005) study how microstructure noise affects the optimal return measurement interval for purposes of volatility estimation.

We extend this literature by studying how microstructure noise affects the results of cross-sectional asset pricing tests. Blume and Stambaugh (1983) show that

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microstructure noise induces (due to Jensen's inequality) upward bias in measured stock returns, with the bias approximately proportional to the variance of the noise. However, the implications of this bias in measured returns for empirical asset pricing applications do not appear to be widely understood.

We focus in particular on potential biases in tests of whether illiquidity earns a return premium. Theoretical models presented by Amihud and Mendelson (1986), Acharya and Pedersen (2005), and Liu (2006), among others, imply that illiquidity is priced as a security characteristic and/or as a risk factor. The emerging consensus appears to be that illiquidity is indeed associated with a positive return premium. However, we show that standard regression-based tests of whether average returns contain a premium for illiquidity are biased towards finding a premium.[1] In particular, we show that almost half of the empirical estimate of the return premium obtained in cross-sectional Fama-MacBeth regressions of monthly returns on effective bid–ask spreads for a sample of NYSE/Amex stocks is attributable to bias arising from microstructure noise.

While we focus on estimates of illiquidity premiums in stock returns, the issues considered here potentially apply to a broad array of empirical asset pricing tests. The bias in estimated regression slope coefficients arises in any case where the explanatory variables are cross-sectionally correlated with the amount of noise in prices. While a non-zero correlation is particularly likely when explanatory variables are empirical measures of illiquidity, it plausibly also arises for an array of other security-level measures, including characteristics such as market capitalization, return volatility, measures of asymmetric information, etc.

Microstructure noise in observed prices arises in several ways. Most obviously, the fact that market buy orders are typically completed at an average price that exceeds the true value of the asset, while market sell orders are completed at an average price that is less than the true asset value, implies noise due to "bid–ask bounce."[2] Noise also arises due to non-synchronous trading, as the last-trade prices commonly used to compute returns need not reflect value as of the close, even in the absence of other frictions. Noise can arise due to orders originating with uninformed traders, as in Black (1986). Further, large orders, including those from institutional investors, are often completed at prices outside the quotations, implying that temporary "price pressure" from large orders contributes to the noise in prices.[3] Also, the use of a discrete pricing grid adds noise to observed security prices, as Fisher, Weaver, and Webb (2010) emphasize.

We consider a set of possible methodological corrections for the biases that arise due to microstructure noise, and show that the biases can be effectively eliminated by use of a simple weighting procedure where each observed return is weighted by (one plus) the observed return on the same security in the prior period. The effectiveness of this correction relies on the same insights as Blume and Stambaugh's (1983) result that the upward bias in average portfolio returns can be greatly reduced by computing portfolio returns on a "buy-and-hold" basis. In each case, the effectiveness of the correction reflects that if the prior trade occurred at a price above the efficient price, then the return measured for the current period is decreased on average, while the weight on the current return is increased, and vice versa. This negative covariance between portfolio weights and return measurement errors offsets the original upward return bias attributable to microstructure noise.

To address these issues, we present theory, simulation analysis, and empirical evidence. Theoretical analysis confirms that parameters estimated in virtually any cross-sectional regression that uses observed returns as the dependent variable are biased and inconsistent, when prices contain noise. Estimated return premiums for illiquidity in particular are likely to be upward biased. We also demonstrate that the proposed methodological correction eliminates the biases attributable to noise in prices, in large samples. The simulations verify that plausible quantities of microstructure noise are associated with an economically meaningful bias in estimated return premiums for illiquidity. The simulations are also used to evaluate the effect of excluding illiquid securities on the bias and the power of the tests, and to assess the rate at which the bias is eliminated by the proposed correction as the sample size is increased.

Finally, we report the results of a broad empirical investigation of relations between stock returns and liquidity, with and without corrections for microstructure bias, using CRSP monthly return data from 1926 to 2006. Pástor and Stambaugh (2003) note that "liquidity is a broad and elusive concept that generally denotes the ability to trade large quantities quickly, at low cost, and without moving the price." We therefore examine an array of illiquidity measures broadly representative of those widely used in the literature, including six measures

[1] Brennan and Wang (2010) also observe that mean observed returns are upward biased when prices differ from underlying value. However, they focus on market pricing errors, due, for example, to investors' underreaction to new information, as the source of the measurement error, while we focus on zero-mean microstructure noise. Their and our analysis both lead to the implication that the estimated return premium associated with illiquidity is likely to be upward biased. In Brennan and Wang, the conclusion follows from the observation that mispricing, and hence measured return biases, are likely to be greater for illiquid stocks due to impediments to arbitrage, while in our case the conclusion arises directly from microstructure noise, with or without mispricing.

[2] However, the existence of a bid–ask spread does not necessarily imply noise in prices. For example, the model of Glosten and Milgrom (1985) implies that the spread can arise purely due to asymmetric information. In their model trade prices reflect conditional expected values. More generally, "bid–ask bounce" arises from the non-informational components of spreads, including order processing costs, inventory costs, and potential market-making rents. Huang and Stoll (1997) estimate that asymmetric information accounts for less than 10% of the bid–ask spread in their sample of 20 large-capitalization stocks during 1992.

[3] This price pressure may in part reflect a lack of perfect competition in liquidity provision. See, for example, Andrade, Chang, and Seasholes (2008), and Chordia, Roll, and Subrahmanyam (2008) for studies showing price reversals associated with less-than-perfect liquidity.