Idiosyncratic Volatility and Liquidity Costs*

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Abstract

We examine the cross-sectional relation between idiosyncratic volatility (IV) and stock returns and find the results of Ang, Hodrick, Xing, and Zhang (2006) are critically dependent on the occurrence of zero returns that inflates the measurement of IV. Specifically controlling for liquidity costs engendered in both the percentage of zero returns and the more direct bid-ask spread removes the ability of IV to predict future returns, contrary to Spiegel and Wang (2005) and Ang et al. (2006). Examining external shocks to liquidity due to reductions in the stated quotes after 1997 and 2001, shows a significant reduction in the occurrence of zero returns that is accompanied by a significant reduction in the pricing ability of IV. Restricting our analysis to those firms that experience less than 5% zero returns during the period 1983 to 1996, when the overall pricing ability of IV is at a peak, shows no ability of IV to predict returns. The percentage of zero returns and its affect on IV measurement appears to be a missing component in the ongoing analysis of the pricing of IV.

Keywords: Cross-Sectional Return, Idiosyncratic Volatility, Asset Pricing Model, Zero Returns, Bid-Ask Spread, Liquidity Costs

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1 Introduction

The question of whether cross-sectional idiosyncratic volatility predicts returns strikes at the heart of empirical asset pricing. Recently, Spiegel and Wang (2005) and Ang et al. (2006) present evidence that idiosyncratic volatility is priced in expected returns. Ang et al. (2006) demonstrate that the spread between the extreme value-weighted quintile portfolios, ranked by idiosyncratic volatility estimated from the three-factor Fama-French model, earn 1.0% per month abnormal returns, and even large NYSE listed firms earn approximately 0.66% per month. The market appears to price unsystematic risk in addition to the commonly defined systematic risk factors. Understanding the source of the mispricing and providing remedies to mitigate its effects are fundamental to a better implementation of empirical asset pricing models and the predictions that arise from these models.

We attempt to elucidate why idiosyncratic volatility predicts one-month-ahead returns given the underlying return structure. We argue that the occurrence of zero returns (Lesmond et al., 1999), that presages the importance of liquidity costs, affects the estimation of idiosyncratic volatility (hereafter, IV). We show that IV, as commonly measured, is positively and non-linearly related to the percentage of zero returns. In effect, an increased level of zero returns (liquidity costs) leads to an increased level of IV and this, in turn, results in a negative and significant relation with future returns. Specifically reflecting the incidence of these zero returns demonstrates that IV is *not* priced in expected returns consistent with the fundamental tenets of asset pricing that posit only the pricing of systematic risk factors.

It is generally acknowledged that liquidity is important in asset pricing (Amihud and Mendelson, 1986; Acharya and Pedersen, 2005). But, in the context of IV, Spiegel and Wang (2005) find that while liquidity proxies are positively associated with future returns, the relation between IV and returns is much stronger than is liquidity's relation to returns. Ang et al. (2006) show that the significance in the relation between IV and value-weighted returns persists even after controlling for the bid-ask spread liquidity measure. However, these papers fail to recognize the inextricable relation between IV and liquidity that is caused by the zero returns. We would conjecture that this course of testing mitigates the most demonstrable influence of liquidity on the estimation of IV itself, namely the occurrence of zero returns. This, however, does not obviate the influence of the bid-ask (or effective) spread because the liquidity costs engender the occurrence of zero returns. Rather specifically reflecting these zero returns, as well as liquidity costs (embodied in the bid-ask spread) that cause the zero returns, in tests of the relation of IV and future returns reduces the pricing ability of IV to insignificance.

In our empirical tests, we estimate IV using the classic three-factor Fama-French model over a one-month period in a manner consistent with Ang et al. (2006), thereby mitigating concerns about the asset pricing specification. We find that the IV estimate increases with the percentage of zero returns and reaches a maximum before decreasing to zero when all the returns during a month are zero. In estimating IV, the common datum of zero returns decreases the loading on the systematic risk factors and increases the loading on the idiosyncratic component. In effect, the zero returns inflate the estimated IV over and above the level that would be anticipated if returns were free of a liquidity cost effect. Thus IV estimates contain a liquidity cost component induced by the zero returns.

The importance of zero returns is noted by Bekaert et al. (2007) who find that zeros returns are related to expected returns, in fact more so than is predicated using other liquidity measures. We believe that as a consequence, the evidence of Ang et al. (2006) and Spiegel and Wang (2005) may be puzzling because zero returns inflate the IV measurement leading to significance for IV when none may exist.[1] Our hypothesized relation between IV and zero returns brings these findings into sharper focus by using the underlying return structure that reflects liquidity costs as a central theme in all of these findings. Our perspective exploits the observation that there is a sizable percentage of spread induced zero returns observed each month and argues that these zero returns inflate the IV estimate leading to a negative relation with future returns. This perspective is revealing because it demonstrates that the prior literature's consistent finding that the spread cannot remove IV from

[1]The reason why Bali and Cakici (2008) find that different trading horizons, different breakpoints used to sort IV into quintiles, and different screens for price, size, and liquidity costs determine whether IV is priced is that many of these factors proxy for the influence of zero returns. It is also interesting to note that the results of Malkiel and Xu (2004), who find positive and significant relation between IV and returns, uses a monthly trading horizon that minimizes the zero return influence.

significance in predicting future returns is not incorrect, rather the focus of the tests is misplaced. It is necessary to account for *both* the occurrence of zero returns and the spread costs to reduce the relation between IV and future returns to insignificance. Attempting to test whether IV is priced without specifically reflecting on liquidity's influence on stock returns negates the primary effect of liquidity, namely zero returns.

Our basic results rely on value-weighted quintile portfolios sorted on IV in a manner consistent with Ang et al. (2006). We show that the difference in the abnormal performance between the the highest quintile IV portfolio and the lowest quintile IV portfolio ("High - Low") is significantly negative over the period from 1983 to 2006. The reported difference in the abnormal return relative to the three-factor Fama-French model (Fama and French, 1996) (termed the Fama-French alpha) is -1.429% per month and the reported difference in the abnormal return relative to the four-factor Carhart model (Carhart, 1997) (termed the Carhart alpha) is -0.939% per month. These results are consistent with Ang et al. (2006). However, controlling for both the percentage of zero returns and direct liquidity effects (such as the effective or proportional spread) in the sort procedure reduces the abnormal performance in returns between the highest and lowest IV quintiles to insignificance. The Fama-French alpha is reduced to -0.262% per month and the Carhart alpha is reduced to -0.041% per month. These results are found regardless of using either the proportional or the effective spread.

To remove any potential endogeneity bias in our reported results, we exploit exogenous liquidity shocks to the market by focusing on those periods that have experienced a significant regulatory reduction in the quoted spread to examine the subsequent effect on IV's ability to predict returns. These periods are outlined by Bekaert et al. (2007) who argue that when NYSE stocks lowered the quotes to sixteenth pricing in 1997 and NYSE/Amex/NASDAQ stocks lowered the quotes to decimal pricing in 2001 the percentage of zero returns also fell significantly reflecting reduced liquidity costs. Coincident with the reduction in the incidence of zero returns we find that the ability of IV to predict future returns becomes insignificant from 1997 to 2006 using the Carhart alpha and insignificant from 2001 to 2006 using either the Fama-French alpha or the Carhart alpha.

We extend this analysis to examine the period from 1983 to 1996 that exhibits the largest percentage of zero returns and, not incidentally, the highest association between IV and future returns. We find that if we restrict the sample during this time period to include only those firms that experience 5% (this equates to one zero return per month) or fewer zero returns then the resulting relation between IV and future returns is insignificant. The Fama-French alpha for the "High - Low" IV portfolio is a paltry -0.022% per month in contrast to -1.542% per month for all firms regardless of the percentage of zero returns. The disparate results from sorts that control for the percentage of zero returns and those that do not are striking and point to the importance of these zero returns when assessing IV's ability to predict future returns.

We alleviate the concern that our results may be subject to the daily trading horizon by performing a rolling regression estimation for IV using monthly returns. Again, we find that even with this estimation procedure for IV, the periods from 1997 to 2006 and from 2001 to 2006 that experience a sharp reduction in the percentage of zero returns also experience a sharp reduction (to insignificance) in the relation between IV and future returns.

Concluding our tests, we attempt to disentangle the liquidity influence from the IV effect in predicting future returns. In a departure from the prior literature, we use a residual approach to remove the influence of both the zero returns and the spread effects on IV by first regressing the IV estimates on the percentage of zero returns, the squared percentage of zero returns, and the spread. The squared term controls for non-linearity in the relation between the percentage of zero returns and IV that is evident in the data. We then use the residual from this regression (termed the IV-residual) in quintile sorts on IV and in Fama-MacBeth regression tests. This approach by design examines only the orthogonal component of IV that is distinct from the influence of both zero returns and the spread. These tests specifically address the assertions of Spiegel and Wang (2005) who argue that IV is more powerful than is liquidity in predicting future returns.

We find that the quintile sorts of the IV-residual do not produce significant Fama-French alphas or Carhart alphas. The Fama-French alpha for the "High - Low" IV portfolio falls to -0.630% per month (from -1.429% per month in the baseline sort results) and the Carhart alpha falls to -0.396% per month (from -0.939% per month in the baseline sort results). Neither of the alphas is significant. These results are consistent with the intuition that IV is affected by both measurement issues in estimation (with the zero returns) and with direct liquidity issues as measured by the bid-ask spread. More importantly, the IV-residual results indicate that the IV's predictive power may lie with liquidity effects after all. But these liquidity effects must include the zero returns that are non-linearly related to the IV measurement.

Extending the cross-sectional analysis to a value-weighted Fama and MacBeth (1973) framework allows for controlling multiple influences on future returns that encompass one-month lagged returns (Jegadeesh, 1990), book-to-market (Daniel and Titman, 1997), coskewness (Harvey and Siddique, 2000), number of analyst estimates (Diether et al., 2002), institutional holdings (Chen et al., 2002), and firm size. The baseline result is that IV and returns are associated even after these controls are instituted in the regression and this would be construed as consistent with the results of Ang et al. (2006, 2008). However, as is found in the quintile sorts, the IV-residual is not significantly associated with future returns in the regressions. These results are obtained regardless of using NYSE/Amex or NYSE/Amex/NASDAQ firms for the IV regression tests.

These results are important for the following reasons. The asset pricing literature's focus on liquidity and returns may be neglecting the very common occurrence of zero returns that may have a more direct influence on the mapping of systematic risk(s) to expected returns than does either the bid-ask spread or price impact proxies. Liquidity's importance in asset pricing tests may lie more in the estimation phase than in the execution costs of trading. Relatedly, the level of idiosyncratic volatility is an important input in the study of diversification benefits. The diversification effects noted by Merton (1987) and extended to IV measurement by Malkiel and Xu (2004) should consider the effect of zero returns on asset pricing specifications and the tests of these asset pricing predictions. The percentage of zero returns may be the demonstrable signal of incomplete diversification effects that may point to a more complete asset pricing model that prices liquidity risk as well as other systematic risk factors.

The paper is organized as follows. Section 2 outlines the estimation of the idiosyncratic volatility, describes the liquidity cost variables, and outlines other firm attribute controls. Section 3 presents summary statistics and the preliminary findings relating idiosyncratic volatility to the percentage of zero returns and the spread costs. Section 4 presents the basic value-weighted sorting results outlining the importance of zero returns and spread costs in explaining the pricing of IV. Section 5 examines the effect that exogenous liquidity shocks exert on IV's ability in predicting future returns. Section 6 presents the results of a regression residual approach to disaggregating idiosyncratic volatility from liquidity effects and the resultant effects on IV's ability to predict future returns. Section 7 concludes.

2 Idiosyncratic Volatility Estimation, Liquidity Estimation, and Firm Attribute Controls

We present an outline for the measurement of idiosyncratic volatility, a specification of our microstructure measures, and a detailed outline of our firm and market controls that will be used in our empirical tests.

2.1 Estimating Fama-French Based Idiosyncratic Volatility

Following Ang et al. (2006) and Malkiel and Xu (2004), we focus our main tests on the idiosyncratic volatility estimated from the Fama-French three-factor model. Specifically, we estimate monthly idiosyncratic volatility as the standard deviation of the residuals (RMSE) from the Fama-French three-factor model where each month we regress the daily stock excess returns r_{it} on the market excess returns, $r_{mkt,t}$, returns on the SMB factor, $r_{smb,t}$, and returns on the HML factor, $r_{hml,t}$,

$$r_{it} = \alpha_i + \beta_{mkt,i} r_{mkt,t} + \beta_{smb,i} r_{smb,t} + \beta_{hml,i} r_{hml,t} + \epsilon_{it}, \qquad \epsilon_{it} \sim N(0, \sigma_i^2). \tag{1}$$

Firm-level idiosyncratic volatility is then given as: $IV_i = \hat{\sigma}_i$. We then construct the time-series of monthly IV estimates on a firm-level basis. We specifically exclude ADR's, REIT's, closed-end funds, and primes and scores (or those stocks that do not have a CRSP share code of 10 or 11). It should be noted that focusing on daily returns mitigates the need for GARCH corrections for time-varying properties in the estimation of IV. We recognize that some papers make specific adjustments for time-varying properties, but these adjustments are unnecessary when using IV estimated over a one month period. The short time period mitigates the time-varying concerns.

To conform to the findings of Ang et al. (2006), our trading strategy focuses exclusively on a one month estimation period that is immediately followed by a one month return holding period (this is equivalent to their 1/0/1 nomenclature). Following Ang et al. (2006), we analyze value-weighted portfolio returns based on these idiosyncratic volatility estimates. The value-weighted results are weighted by firm size to reduce the influence of small stocks on the IV and return relation. Our sample runs from 1983:07 (July of 1983) to 2006:06 (June of 2006) for a total of 276 months.

2.2 Liquidity Measures

The Trades and Quotes (TAQ), the Institute for the Study of Security Markets (ISSM), and CRSP databases are used to estimate both the proportional and effective spread costs. The ISSM database covers NASDAQ firms from 1987 to 2006, and NYSE/AMEX firms from 1983 to 2006. We utilize the CRSP database for NASDAQ firms from 1983 to 1987 to complete our sample period from 1983 to 2006.

For each stock, we obtain the daily end-of-day closing quotes and prices using the ISSM, TAQ, and CRSP databases for all NYSE/AMEX/NASDAQ stocks for the same month as we estimate the idiosyncratic volatility.[2] The proportional spread is the ask minus the bid quote divided by the mid-quote average. The effective spread is defined as two times the absolute value of the price minus the quote mid-point divided by the price. The daily proportional and effective spreads are averaged over the month providing monthly spread estimates.

2.3 Firm Attribute Controls

We also estimate the variables that have been shown to be related to future returns or idiosyncratic volatility (IV). These include past returns, coskewness risk, value versus growth, firm size,

[2]This procedure is problematic for the 2001 to 2006 trading period because of the proliferation of alternative market maker and after-hours trading. During these years the TAQ database is "painted" with single-side quotes whereby only one quote, either the ask or bid, is relevant. We control for this by taking the last available quote with complete bid and ask prices that corresponds to the last price that is set by CRSP. This allows for a direct comparison of across all of our liquidity cost measures.

institutional holdings, and analyst coverage. Reversals in returns has been widely documented (see, e.g., Jegadeesh, 1990). Furthermore, Huang et al. (2006) provide evidence that the cross-sectional pricing power of IV may be subsumed by one-month past returns. Negative coskewness risk is shown to be associated with higher returns (Harvey and Siddique, 2000), and idiosyncratic volatility may in part capture that element (Boyer et al., 2007). Firm size is known to be associated with returns with smaller firms experiencing higher expected returns than larger firms. Book-to-market proxies for the value and growth phenomena (Lakonishok et al., 1994). Book-to-market relies on the Compustat, where we extract the book value of assets, and the CRSP, where we calculate the market value of equity as the year-end price multiplied by the number of shares outstanding, following Fama and French (1993). We delete any observations from the analysis that have either non-positive book-to-market ratios or missing information on the book value of the assets.

Roughly classified, institutional holdings and analyst following proxy for an information environment explanation for returns. The percentage of institutional holdings is taken from the Thompson Financial database using the 13-f filings. We measure the percentage of shares held by all institutions at the end of each quarter and then use that percentage for the next three months. The percentage of holdings is adjusted for the newest 13-f filing each quarter and the procedure is repeated. If there is no institutional holding for a firm, we substitute a zero for that quarter. This is consistent with Gompers and Metrick (2001).

The data on analyst coverage derives from the I/B/E/S Historical Summary File and is available on a monthly basis for our entire sample period. Stocks covered by a larger number of analysts have lower expected returns (see, e.g., Diether et al., 2002). We use analyst following rather than the standard deviation of forecasts to ensure both small and large firms are included in our sample. Similar to the procedure employed for institutional holdings, if a stock has no analyst following, we substitute a zero for the number of analyst estimates for that month. Mechanically, if the CRSP cusip does not match any cusip on I/B/E/S than the analyst coverage is assumed to be non-existent or zero. This procedure is similar to that of Ang et al. (2008) and Hong et al. (2000). We find that many firms are not covered by analysts and that the earlier time periods are more prone to the lack of coverage as does Hong et al. (2000). However, this will only bias our tests in favor of IV to the detriment of the liquidity hypothesis.

3 Preliminary Results

We start this section with a graphical depiction of the relation between the percentage of zero returns and IV. Then we present summary statistics of the variables used in our empirical tests by the quintile of the percentage of zero returns to emphasize the relation between IV and the percentage of zero returns and other liquidity cost measures. We further present the baseline sort results to confirm with previous studies.

3.1 Summary statistics

To illustrate the relation between zero returns and IV, we present a representative plot for April, 1988. The 1980's experiences a large number of zero returns as noted by Lesmond et al. (1999) so the effect of the zero returns on IV measurement can be more easily visualized for this time period. Figure 1 reports the firm-level IV estimates as well as a trend line versus the percentage of zero returns in the return structure. As is shown, the trend in the Fama-French based IV is increasing with the percentage of zero returns, reaching a peak at about 60% zero returns. The estimated IV begins to decrease afterwards and falls to zero when all of the returns (during the month) are zero. The overall trend between IV and the zero returns is also noted to be non-linear. The individual IV estimates display considerable dispersion, but the overall observation is that IV is increasing with the percentage of zero returns, and consequently the zero returns do affect the IV estimates.

We initially sort the stocks into quintiles by the percentage of zero returns to provide a relative comparison of IV with other explanatory variables that have been used to explain the IV effect. These sort statistics are equal-weighted and are shown in Table 1. As is shown, sorting by the percentage of zero returns demonstrates a relative correspondence between the percentage of zero returns and IV. The percentage of zero returns increases from 5.6% for the lowest quintile to 53.6% for the highest quintile. To put this into perspective, of the approximately 21 daily returns each month, the lowest zero return quintile contains those firms that experience one zero return per month while the highest zero return quintile contains those firms that experience 11 zero returns per month. Subsequently, the IV estimates rise from 2.772% to 3.840% across the zero return quintiles, but reaching the maximum at the fourth zero return quintile instead. The lack of a more cogent monotonic relation between IV and the percentage of zero stems from the non-linearity between IV and zero returns as illustrated in Figure 1. The sort examines only the linear component of the relation whereas the non-linear component is just as important.

The increase in the zero returns is matched by an increase in the bid-ask spread costs that rise from 1.8% (1.1% effective spread) to 11.1% (3.1% effective spread) across the zero return quintiles. Because NASDAQ firms are typically smaller than NYSE/Amex firms, the inclusion of NASDAQ firms, especially prior to 1991, greatly increases the liquidity costs evident in our sample.The relation between the percentage of zero returns and the bid-ask (and effective) spread with IV illustrates that both liquidity aspects are important in potentially explaining IV's pricing ability. However, we argue that the percentage of zero returns affects the measurement of IV itself while the spread costs are associated with the occurrence of zero returns.

The zero returns are also related to many of the potential explanatory variables used in Ang et al. (2006). Lagged return displays a very interesting trend with a positive lagged return of 2.244% for the lowest zero return quintile and then reverts to a negative return of 0.428% for the highest zero return quintile. The lowest zero return quintile also contains more value stocks than does the high zero return quintile as evidenced by the decline in the book-to-market across the zero return portfolios. Size and price display the same monotonic decline across the quintiles. Downside risk, or coskewness, displays little trend with either the percentage of zero returns or with IV. The relatively low percentage of analyst following and institutional holdings reflects a sparse information environment for high IV firms that also have a large percentage of days that experience no price movement.

3.2 IV sort results for value-weighted quintile portfolios

Because our sample period is significantly shorter than that of Ang et al. (2006) who examine the period from 1963 to 2000, we initiate our analysis by first confirming the basic sorting results to illustrate the robustness of the IV effect for this shortened time period and to provide initial evidence of the effects of zero returns and spread on IV. For all the sort results, we concentrate on NYSE/Amex/NASDAQ firms to conform to the sample used by the prior literature. These baseline results are presented in Table 2.

For the results presented in Table 2, we sort stocks into quintiles based on their monthly estimates of IV, form quintile-sorted portfolios, and then difference the highest and lowest IV quintiles. Specifically, at the beginning of each month, stocks are sorted into five quintiles based on the IV estimated using the daily returns of the last month. A value-weighted portfolio is formed from the stocks within each quintile. The portfolios are held for one month and then re-balanced. We then compare the average returns of the quintile portfolios and, in particular, compare the performance difference between the portfolio with the highest IV ("High") and the portfolio with the lowest IV ("Low"). The difference is the abnormal return one would earn on a zero-cost (arbitrage) portfolio formed by taking a long position in the highest ranked quintile portfolio and taking a short position in the lowest ranked quintile portfolio ("High - Low"). To examine whether the abnormal returns can be explained by the asset pricing models, we also compare the alphas after controlling for factor risks using either Fama-French three-factor model or Carhart four-factor model with the momentum factor.

As shown in Table 2, the average excess return decreases monotonically from the "Low" IV quintile portfolio to the "High" IV quintile portfolio. The abnormal return for the arbitrage portfolio "High - Low" is -1.358% per month and significant at the 1% level. The Fama-French alpha of the arbitrage portfolio is -1.429% per month with a robust t-statistic of 4.82, a result comparable to that of Ang et al. (2006). This result shows that even with an alternative time span, the FF-IV is still significantly related to future returns. The Carhart alpha is -0.939% per month and highly significant, which suggests that including a systematic momentum factor does not sufficiently control for the IV's ability to predict one-month ahead returns although it does reduce the abnormal performance. However, the abnormal performance appears to be most evident in the extreme quintiles, with the bulk of the abnormal performance concentrated in the highest IV quintile.

Notable in these results is that the value-weighted percentage of zero returns and the spread display a monotonic increasing trend from the lowest ranked IV quintile to the highest ranked IV quintile. The percentage of zero returns rises from 8% for the "Low" IV quintile to 14.5% for the "High" IV quintile. This trend is also matched by the spread that rises from 0.007% to 0.038%. This trend is important because it highlights the effect that the return structure has on the estimated IV as well as the liquidity costs that affect the profitability of the trading strategy.

4 Value-Weighted IV Sort Results With Liquidity Controls

In this section, we present the various sort results of IV quintiles that illustrate the influence of zero returns and the bid-ask spread on IV's ability to predict future returns.

4.1 Sort results with the percentage of zero returns and the bid-ask spread

We now examine the effect of holding constant either the percentage of zero returns or bid-ask spread at different levels and allowing IV to vary within each liquidity category. These tests will isolate the relative importance of either the percentage of zero returns or the bid-ask spread costs in controlling for IV's ability to predict future returns. This is important because both Spiegel and Wang (2005) and Ang et al. (2006) have dismissed liquidity costs, as measured by the bid-ask spread or other liquidity cost proxies, as an explanation for the pricing of IV.

For these set of tests, we first sort the stocks into three groups either according to the percentage of zero returns or the bid-ask spread.[3] Then within each liquidity group we further sort stocks into five quintiles according to their IV estimates. We then form value-weighted portfolios within each of the IV quintiles. Hence, we hold liquidity effects relatively constant while allowing IV to vary within

[3] We use three groups for exposition purposes only. The results are similar when we use quintiles for the liquidity costs.

each liquidity category. This double sort procedure separately mitigates each liquidity influence on IV's ability to predict future returns. Table 3 reports the abnormal performance of the IV quintile portfolios and the "High - Low" arbitrage portfolio within each liquidity category. We focus on the Carhart alpha to control for momentum effects on the abnormal return measurement.

As reported in Table 3, controlling for just the zero returns significantly reduces the IV's ability to predict future returns. IV is not significantly associated with future returns in two of the three zero return categories. The Carhart alpha of the "High - Low" IV portfolios is relatively U-shaped across the categories of the percentage of zero returns. It is evident that the percentage of zero returns dominates IV in its relation to future returns. The lack of significance in the abnormal performance of the arbitrage portfolio formed between the extreme IV quintile portfolios is indicative of the effect of the zero returns on the measurement of IV.

The bid-ask spread is not as effective in controlling for IV's ability to predict future returns, consistent with the prior findings of both Spiegel and Wang (2005) and Ang et al. (2006). The abnormal return of the "High - Low" IV portfolio is monotonically increasing with increasing spread costs, and is significant for all but the lowest spread category, reaching a peak of -1.842% per month for the highest spread category.

These results are indicative of two issues. The first is a measurement issue, engendered by zero returns that affects the ability of the standard methodology to properly estimate IV. Using daily returns exacerbates the effect that zero returns exert on the measurement of IV. Using monthly returns reduces these effects, but does not completely obviate them. As we will show later, zero returns can be observed even on a monthly basis, and IV estimated from monthly returns is also subject to this measurement issue. Therefore, the GARCH approach advocated by Spiegel and Wang (2005) and Fu (2008) as providing a better description of the expected idiosyncratic volatility does not obviate this measurement issue. We argue that the prior one-month daily returns can be used to provide a valid estimate of the idiosyncratic volatility, but the datum in the returns (zero returns) must be reflected in the estimate. The second is the cause of the zero returns that has been argued in Lesmond et al. (1999) to be associated with the bid-ask spread costs on decisions to trade. We argue that liquidity is the primary cause of the reported ability of IV to predict future returns because liquidity costs affect returns and the profitability of trading on the strategy.

4.2 Value-weighted IV sort controlling for both liquidity measures

To further test the influence of liquidity on IV's ability to predict future returns, we first perform a triple sort using the percentage of zero returns, the bid-ask (or effective) spread, and IV. Each liquidity control exerts a separate influence on the pricing ability of IV. We use the percentage of zero returns to control for measurement issues surrounding IV and the spread to control for liquidity's effect on profitability. We then average the IV quintile portfolios across the liquidity quintiles to control for the disparate effects of liquidity on IV.

To effect this test, we first sort stocks by the percentage of zero returns into quintiles, then within each of the quintiles ranked by the percentage of zero returns we further sort the stocks by the bid-ask spread, and finally, within each of the zero returns and spread double-sorted quintiles, we sort the stocks by IV. We then average across the 5×5 zero returns and spread quintiles to obtain the five IV quintile portfolios that have similar levels of the percentage of zero returns and spread. The results are presented in Table 4 and show the IV pricing effect on future returns after controlling for the percentage of zero returns and the spread costs. Panel A presents the sorts using the bid-ask spread, and Panel B presents the sorts using the effective spread.

As is shown in Panel A of Table 4, controlling for both the percentage of zero returns and the bid-ask spread eliminates the monotonic trend in each liquidity control across IV quintiles. The percentage of zero returns is held relatively constant at 0.078% and the bid-ask spread is relatively constant at 0.009%. However, there is still a healthy monotonic increase in IV that rises from 0.977% for the "Low" IV quintile to 3.623% for the "High" IV quintile. However, neither the Fama-French alpha nor the Carhart alpha is significant for any IV quintile. Examining the abnormal performance of the "High - Low" IV portfolio shows a similar result; the "High - Low" Fama-French alpha is -0.262% per month and the Carhart alpha is -0.041% per month, both of which are insignificant.

It is often argued that the effective spread is a better control for the costs faced by more informed investors who trade within the spread. Therefore, to control for the measurement issues with the spread measure in this test we replace the bid-ask spread with the effective spread and repeat the sorts as performed previously. The results in Panel B of Table 4 show that spread measurement does not affect the inferences concerning the tandem effects of zero returns and the spread. The Fama-French alpha for the lowest IV quintile is 0.154% per month and it is significant at the 5% level. However, none of the other IV quintiles show significance for either the Fama-French alpha or the Carhart alpha. Most importantly, the Fama-French alpha for the "High - Low" IV portfolio is -0.264% per month and the Carhart alpha is -0.126% per month, neither of which is significant.

It appears that the percentage of zero returns and the spread effects, whether measured using the bid-ask spread or the effective spread, remove the ability of IV to predict future returns. These results point to the importance of the zero returns and its affect on IV. The estimation of IV appears to be critically dependent on the percentage of zero returns; an increased incidence of zero returns inflates the estimate of IV. Controlling for these zero returns, as well as controlling for spread costs, is sufficient in remedying the mispricing evident in the ability of IV to predict future returns.

5 Exogenous Shock to Liquidity: Value-Weighted IV Sort Results

Our prior test results may be subject to endogeneity bias concerns. We eliminate any potential endogeneity bias by examining the relation of IV and future returns in the periods that experience a sudden and severe exogenous liquidity shock. This is a natural experiment where we observe large and sudden changes in the percentage of zero returns and examine the consequent effects on IV's ability to predict returns. We also conduct robustness tests by restricting the sample to firms with low incidence of zero returns in the periods when IV displays the strongest ability to predict future returns. To alleviate the concern that our results are specific to using daily returns, we also estimate Fama-French based IV using rolling regressions of monthly returns.

5.1 Exogenous liquidity shock periods

To control for any endogeneity concerns with our prior results, we examine those time periods that experience external shocks to liquidity due to a sudden change in liquidity. Conveniently, these periods have been outlined in Bekaert et al. (2007) who show that when NYSE stocks lowered the quotes to sixteenth pricing in 1997 and NYSE/Amex/NASDAQ stocks lowered the quotes to decimal pricing in 2001 the percentage of zero returns also fell significantly reflecting reduced liquidity costs. That is, coincident with the decrease in the quotes is a concomitant decrease in the percentage of zero returns. This is shown graphically in Figure 2.

Figure 2 shows a standardized plot of the aggregate percentage of zero returns, the aggregate bid-ask spread, and the aggregate Fama-French IV from 1983 to 2006. As is clearly shown, 1997 marks a significant and precipitous decline in the percentage of zero returns that progresses through the decimalization of all of stock quotes in 2001. The percentage of zero returns clearly shows a marked decline around these two periods. Interestingly, the spread costs experience similar changes, but the magnitude of decline is not nearly as drastic as that of the zero returns. The spread costs also exhibit more volatility during the NASDAQ growth and decline from 1999 to 2002. The idiosyncratic volatility thus also shows a marked increase in it's own volatility during the period from 1999 to 2002, but IV does trend downward from 2001 to 2006. The "volatility" in the IV during the 1999 to 2002 period will work against the zero return hypothesis.[4]

We focus on the period from 1997 to 2006 to encapsulate the change to sixteenth pricing in Panel A of Table 5, and the period from 2001 to 2006 to encapsulate the change to decimal pricing in Panel B of Table 5. Unlike GARCH models, using daily returns in estimating IV will allow for an exact identification of these periods. Again, we focus on NYSE/Amex/NASDAQ stocks. For these sort results we only sort on IV allowing the percentage of zero returns and the spread to vary

[4]The 1980's shows a marked upward trend in idiosyncratic volatility, consistent with the findings of Campbell et al. (2001). In much of the 1990's and continuing after 2000, IV is trending downward, consistent with the findings of Brandt et al. (2008). Indeed, from 1991 to 2006 both the percentage of zero returns and IV can be seen to more gradually decline. The downward trend in IV is somewhat contrary to Cao et al. (2006) who argue that growth options can explain the increasing trend in IV over time because growth options were increasing from 1991 to 2000, yet IV is seen to decrease over that time period. These results would indicate that zero returns have more to do with IV than do growth options.

independently with the IV quintile.

As shown in Panel A of Table 5, the sort results report a marked decline in the percentage of zero returns and lower spread costs across all the IV quintiles when compared to the whole sample period from 1983 to 2006 where the percentage of zero returns ranged form 8% to 14.5% across the IV quintiles (shown in Table 2 for the baseline value weighted IV results). The increased underlying "volatility" in the Fama-French idiosyncratic volatility exhibited during the NASDAQ bubble from 1999 to 2002 is evident. The FF-IV shows a marked increase from 1.150% for the low IV quintile to 6.470% for the high IV quintile. The resulting "High - Low" Fama-French alpha is -1.169% per month and significant at the 5% level. However, this result is likely due to price run-up and momentum before the internet bubble burst in 2000. By contrast, the Carhart alpha does not register significance in any of the IV quintiles nor does it register significance in the "High - Low" abnormal performance. The reported "High - Low" Carhart alpha is reduced to -0.607% per month from -0.939% per month obtained in the period from 1983 to 2006, and insignificant. Thus the period from 1997 to 2006 experiences a degradation in IV performance of more than 35%. We would argue that this decrease in the IV's ability to predict returns is likely due to the decreased level of zero returns.

Turning to period from 2001 to 2006 shows an even more marked decline in the pricing of IV. For this time period, the "High - Low" Fama-French alpha is now positive at 0.074% per month, but insignificant. The Carhart alpha is also positive at 0.107% per month, but also insignificant. The distinction that is raised between these two time periods, even though both periods experience a significant reduction in the percentage of zero returns, is that the period form 2001 to 2006 experiences a more significant reduction in the percentage of zero returns. The percentage of zero returns falls to less than 2%. For comparison, prior to 2000, firms experience an average of 18% zero returns. The reduction in the percentage of zero returns allows for a more adequately mapping of the systematic risk factors to the underlying returns minimizing the influence of IV in predicting future returns.

5.2 Robustness check on the effect of percentage of zero returns

For robustness, we now address the time period from 1983 to 1996 that has been shown to experience an upward trend in IV from 1983 to 1990 and then a relatively steady level in IV from 1991 to 1996. We examine the effect of the zero returns by focusing on those firms that experience fewer than 5% zero returns each month. This equates to only one possible zero return out of the approximately 21 trading days each month. This filter will allow for a direct examination of the zero return influences on IV's ability to predict future returns during a period where IV's pricing ability is particularly high. The results are shown in Table 6. Panel A delineates the unrestricted sample results and Panel B focuses only on those firms that experience less than 5% zero returns. As previously noted, the sort results are only sorted by IV allowing both the percentage of zero returns and the spread to vary within each IV quintile.

Panel A shows that the period from 1983 to 1996 is evidenced by a greatly increased level in IV, percentage of zero returns, and bid-ask spread liquidity costs. The resulting Fama-French alpha for the "High - Low" IV portfolio is -1.542% per month and is highly significant. The Carhart alpha is somewhat less at -1.387% per month, but still highly significant. However, turning to Panel B of Table 6 that focuses only on those firms that allows for a better mapping of the systematic factors onto returns, shows that the Fama-French alpha is now -0.022% per month. Although still negative, it could be construed as zero. The Carhart alpha is now positive, but insignificant. The zero return effect is noticeable across all of the IV quintiles where all of the alphas are insignificant. Indeed, for the highest IV quintile, where the majority of the abnormal performance resides, the Fama-French alpha is now 0.017% per month, which is positive but insignificant. In contrast, the unrestricted case shows a significantly negative Fama-French alpha of -1.410% per month.

These results demonstrate that the occurrence of zero returns materially affects the pricing ability of IV even for time periods where IV is more prone to produce significant pricing power with future returns. Increased occurrence of zero returns upward biases the IV estimate leading to a negative relation with future returns. Reducing the zero return influence allows for a more proper mapping of the systematic risk factors onto returns, thereby decreasing the loading on IV.

The reduced loading on IV removes the ability of IV to predict future returns, consistent with the most basic tenets of asset pricing.

5.3 Robustness check using monthly returns to estimate IV

Finally, we now examine an alternative trading horizon to garner the influence that monthly returns have on the IV performance. We expect that using monthly returns would relax the liquidity constraint. Thus, we anticipate that we will observe fewer zero monthly returns than we would be experienced using daily returns. This is to be expected given Amihud and Mendelson (1986) who argue that investors amortize high liquidity costs with longer holding periods. The reduced number of zero returns in monthly returns is hypothesized to significantly reduce the ability of IV to predict future returns.[5] These tests offset the concerns that our previous results are specific to the daily returns used to estimate the idiosyncratic volatility.

To effect this test, we estimate IV using monthly returns and incorporating a rolling regression approach. Thus, for each month, we use the 60 prior monthly returns to estimate IV using the Fama-French model. We then roll forward one month and repeat the procedure. We use a minimum of 24 months of data to control for incomplete data. We examine the relation between the rolling estimated IV and future returns in the same three periods, from 1983 to 1996, from 1997 to 2006, and from 2001 to 2006. For the first period the estimation begins in 1978 to allow for the performance evaluation in 1983. By its nature, this test allows for more gradual trends in IV that are evident from 1991 to 1999 and are shown previously in Figure 2. The prior results, using daily returns to estimate IV, were more exact in the identification of the time periods, but using monthly returns to estimate IV allows for a more general assessment of IV pricing. The results are presented in Table 7.

Table 7 shows the sorting results in the three time periods where we sort only on the rolling estimated IV. Panel A shows that for the period from 1983 to 1996, there is still an elevated level

[5] Using monthly returns does not eliminate the occurrence of zero returns, it only reduces their occurrence. This may be surprising, but NYSE/Amex/NASDAQ firms typically experience 15% zero returns over a 60-month estimation period.

of zero monthly returns and the Carhart alpha is significantly negative at -0.907% per month. However, the Carhart alpha is significantly smaller than that produced using daily returns over the same time period. For comparison purposes, the Carhart alpha is -1.387% per month using the daily returns. This is a reduction of 35% in the abnormal performance. We would argue that this reduction is likely due to the reduction in the number of zero returns that inflates the IV estimates. Reducing the liquidity effect embedded in IV by incorporating a return basis that decreases the occurrence of zero returns also reduces the pricing ability of IV.

The period from 1997 to 2006, shown in Panel B of Table 7, reports a significantly reduced percentage of zero returns. The difference in percentage of zero returns between the "High" IV quintile and "Low" IV quintile falls from 3.8% in the period from 1983 to 1996 to less than 1% in the period from 1997 to 2006. Not surprisingly the Carhart alpha for the "High - Low" arbitrage portfolio also falls from -0.907% to only -0.207% per month and becomes insignificant.

Finally, we conclude the analysis with an examination of the period from 2001 to 2006 that experienced a very steep reduction in the percentage of zero returns due to decimalization. Consistent with the results obtained using daily returns, we find that the abnormal performance of the monthly rolling estimated IV in this period is even more reduced than that in the period from 1997 to 2006. The incidence of zero returns is virtually nil across the IV quintiles resulting in a virtually zero difference of the percentage of zero returns in the "High - Low" portfolio and consequently virtually zero difference in the Carhart alpha (-0.068%).

6 Regression Residual Approach

Spiegel and Wang (2005) argue that IV is more powerful than is liquidity in explaining future returns. The problem in testing the relative strength of liquidity over IV is simply that IV already contains a liquidity cost component embedded by the zero returns. In this section we further examine the relation of IV with the percentage of zero returns and the spread and attempt to disentangle the liquidity effects from the IV effects in predicting future returns by examining the residual of a regression of IV on the liquidity cost measures.

6.1 The relation between IV, zero returns, and the bid-ask spread

In Table 8, we attempt to provide some statistical merit to our graphical depiction of the zero return influence on the IV estimates shown in Figure 1. We regress the Fama-French IV on the percentage of zero returns, the squared percentage of zero returns, and the proportional spread each month over the full sample period from 1983 to 2006 using the Fama-MacBeth framework,

$$\text{FF-IV} = \alpha_0 + \alpha_1\%\text{Zeros} + \alpha_2(\%\text{Zeros})^2 + \alpha_3\text{Spread} + \epsilon. \tag{2}$$

Although the zero returns are often used as a proxy for the spread, the spread brings additional explanatory power to the test. This is because the percentage of zero returns is the demonstrable result of liquidity costs effect on returns. It is a proxy for liquidity costs, not the sum total of the effect.

The results of Table 8 indicate that IV is concave with respect to the zero returns. The linear term of the percentage of zero returns is positive related to IV and the non-linear (squared) term of the percentage of zero returns is negatively related to IV.[6] The proportional spread is also incrementally associated with the Fama-French IV. In fact much of the goodness-of-fit results from the inclusion of the direct liquidity measure.[7] To ensure that our results are not predicated on the use of daily returns to estimate IV, we further test the rolling IV estimated from monthly data. This IV estimate also demonstrates considerable loading on the liquidity influences of the percentage of zero returns (linear and non-linear components) and the bid-ask spread.

These results provide a basis for decomposing IV into a liquidity influenced component and an orthogonal pure idiosyncratic component to examine the influence of the zero returns and the spread on the relation between IV and future returns. We accomplish this by estimating the residual from the regression in Eq. (2) and using the residual (termed IV-residual) as our instrument for examining IV's ability to predict future returns over and above the liquidity cost components. This

[6] Pantzalis and Park (2007) find that the relation between mispricing and idiosyncratic risk (measured by $1 - R^2$) is U-shaped, which seems to be consistent with our finding because high percentage of zero return stocks tend to have large mispricing.

[7] Although not reported, the effective spread produces similar results.

provides an assessment on the relative strength of IV to predict future returns after specifically controlling for liquidity costs in the estimates of IV.

6.2 Value-weighted IV-residual sort results

Each month, we sort stocks into quintiles by the estimated IV-residual, form value-weighted quintile portfolios, and compare the abnormal performance of the quintile portfolios and the "High -Low" arbitrage portfolio. The results are reported in Panel A of Table 9.

As is shown, controlling for the liquidity effects in the estimates of IV, we clearly see that now the percentage of zero returns and spread no longer increase monotonically from the lowest quintile of IV to the highest quintile of IV, despite the monotonic increase in the level of IV-residual. In fact, the lowest quintile has the highest percentage of zero returns. Consequently, the differences in the percentage of zero returns and spread are -0.034% and 0.005%, respectively between the highest and lowest IV quintiles, which are much smaller than those from the original FF-IV (0.065% and 0.031%, respectively). The Fama-French alpha of the "High - Low" IV-residual portfolio is -0.630% per month, which is significant at the 5% level. For comparison purposes, the prior value-weighted results of Table 2 shows a Fama-French alpha of -1.429% per month. Obviously, the power of IV to predict future returns is greatly reduced after we control for the liquidity costs. Furthermore, the Carhart alpha of the "High - Low" IV-residual portfolio is only -0.396% per month and insignificant, suggesting no significance in IV, over and above liquidity cost influences, to predict future returns.

The results are telling for a number of reasons. First the full sample period is noted to exhibit very strong results for IV's ability to predict future returns, yet over the same period controlling for the percentage of zero returns and spread effects reduces to insignificance IV's ability to predict future returns. These results point to the influence of zero returns on the IV estimation and allow for a remedy that is both consistent and tractable.

For robustness, we allow for an interaction between the percentage of zero returns and the spread in the estimation of the IV-residual. Panel B of Table 9 reports the sorting results for this more general specification. This interaction will control for the marginal effects exerted on the IV by the direct and indirect liquidity cost effects. As is shown, allowing for the interaction between the percentage of zero returns and the spread now completely removes the ability of the IV-residual in predicting future returns. The Fama-French alpha of “High - Low” IV-residual portfolio is -0.392% per month and the Carhart alpha is -0.293% per month. Neither of these abnormal performance measures is significant.

6.3 Fama-MacBeth regression tests

The prior sorting results provide one picture of the relation between IV and returns, but they focus primarily on the extreme portfolios. In order to gain some insight on the overall behavior of the IV and return relation, but simultaneously controlling for additional risk factors or anomalies shown to affect future returns, we employ the Fama and MacBeth (1973) methodology with six lags for the Newey and West (1987) correction.

We first partition the results in terms of the control variables used by Ang et al. (2008) that isolate information effects, reversal effects, firm controls, and market effects. We generalize these results by including the proportional spread or the effective spread. The information variables are the percentage of institutional holdings and the number of analysts estimates. Reversal effects are controlled for by one-month lagged returns. Firm controls are log scaled book-to-market ratio and log scaled firm size. Market effects are measured by coskewness risk. The institutional holdings measure is measured quarterly, and the book-to-market ratio is measure annually, but we use the information determined prior to the measured return. We designate the lagged quarterly value with a subscript $q-1$ and the lagged annual value with a subscript $a-1$. Other control variables are measured coincident with the IV, i.e. lagging the returns by one month (subscript $m-1$). IV is measured using the Fama-French three factor model. These controls are by no means exhaustive, but they represent the principal variables used to model the aspects commonly known to affect expected returns.

To be consistent with Ang et al. (2006), we use value-weighted Fama-MacBeth regressions with the firm size at the beginning of the month as the weight. In additional, while we test whether liquidity or IV dominates, we will also examine the incremental influence of IV over liquidity by including the residual of the regression of IV on liquidity, i.e. IV-residual from Eq. (2). This procedure has a two-fold appeal. Statistically, it corrects for any multicollinearity issues that may arise from the observed high correlation between liquidity and IV. Second, it expressly examines the incremental ability of IV in predicting returns after controlling for liquidity influences on IV itself. The general specification is given as:

$$\begin{aligned}\text{Return}_{i,m} &= \beta_0 + \beta_1\text{IV}_{i,m-1} + \beta_2\text{Lagged Return}_{i,m-1} + \beta_3\text{Book-to-Market}_{i,a-1} + \beta_4\text{Firm Size}_{i,m-1} \\ &+ \beta_5\text{Coskewness}_{i,m} + \beta_6\#\ \text{Estimates}_{i,m-1} + \beta_7\text{Inst. Holdings}_{i,q-1} + \beta_8\text{Liquidity}_{i,m-1} + \epsilon,\end{aligned} \tag{3}$$

where liquidity refers to either the bid-ask or effective spread estimates. If we include the IV-residual, then we exclude the spread measures as well as the IV estimate. The regression results are presented in Table 10 for NYSE/Amex/NASDAQ exchange listed firms.

The first prominent result in Table 10 is that the FF-IV remains significantly related to future returns regardless of the controls included. The estimated marginal effect of FF-IV on future returns is approximately 20 basis points regardless of the specification used for the regression. In addition, consistent with the results of Spiegel and Wang (2005), IV appears to dominate liquidity in its relation to future returns. In fact, the spread variables even have the wrong sign, although value-weighting could possibly affect these inferences.

However, using the residual of the regression specified in Eq. (2), results in a far different outcome. Now the residual of IV (labeled "Residual w/ Zero Sqr") is insignificantly, although negatively, related to future returns. This result implies that the prior regression results controlling for liquidity as an added variable to the regression is affected by multicollinearity concerns. Orthogonalizing IV and liquidity allows for a specification that specifically tests whether IV alone (without the liquidity influence) is associated with future returns. The residual coefficient would indicate that the pure IV marginal effect (without the liquidity influence) is now only 15 basis points and insignificant. The conclusion reached by Spiegel and Wang (2005) is not incorrect, but it does not properly control for the liquidity influence. IV does dominate liquidity as can be seen by the still robust 15 basis point effect on future returns whereas liquidity accounts for only a 6 basis point effect. But removing liquidity's influence on IV also removes the significance of IV in predicting future returns. Furthermore, the nonlinear relation between the percentage of zero returns and IV seems critically important because the residual of IV from a regression that omits the squared percentage of zero returns (labeled "Residual w/o Zero Sqr") still shows significant although weaker effect on future returns.

Finally focusing on only large firms as defined as those firms listed on the NYSE/Amex exchanges we present similar Fama-MacBeth regression results given in Table 11. As shown in Table 11, the IV effect on future returns is relatively consistent with the prior results for the NYSE/Amex/NASDAQ exchange firms, but this is not surprising because value-weighting removes the small firm influence engendered by including the NASDAQ firms. The FF-IV effect on future returns is still approximately 22 basis points regardless of controls for direct spread costs as well the various firm controls. However, focusing on the IV-residual we see that after specifically controlling for liquidity's influence on IV, the residual has little predictive power on future returns.

7 Conclusions

We analyze the empirical relation between cross-sectional idiosyncratic volatility (IV) and expected stock returns. The literature has presented a very vexing set of results with Ang et al. (2006) finding that Fama-French based IV is negatively related to value-weighted returns, even for the largest market capitalization firms. Numerous explanations have been offered to explain this findings such as return reversal (lagged returns), information asymmetry (analyst coverage and institutional holdings), momentum, market friction (short-sale constraint), and liquidity, while others question the robustness of the findings.

We show that zero returns are fundamental to the estimation of IV and in the value-weighted IV's ability to predict future returns. An increasing percentage of zero returns inflates the IV leading to the observed negative relation with future returns. IV estimated from the standard methodology has an embedded liquidity component. We find that controlling for the percentage of zero returns, either by restricting the analysis to the periods that experience a severe and sudden drop in the occurrence of zero returns or by examining only those firms that experience a very limited number of zero returns, can greatly reduce the statistical and economic importance of IV in predicting future returns.

The importance of the findings lies in the link to existing microstructure influences noted clearly in Amihud and Mendelson (1986). However, the arguments for liquidity often are predicated only on spread issues or even price impact issues. We raise the issue whether the mis-specification in the Fama-French three-factor model can be sufficiently remedied by including spread effects and we would have to conclude that microstructure influences are much broader than have been previously thought. Extending microstructure influences to include zero returns on the measurement of IV itself appears to be at least as important as spread effects on asset pricing. But regardless, idiosyncratic volatility and its relation to expected returns appear to depend on the underlying microstructure influences that affect profitability and pricing. It appears that the rejection of liquidity as an explanation for IV's ability to predict future returns is premature.

More telling is the recent work by Ang et al. (2008) who present strong international evidence, which, similar to the evidence in the US, shows that high idiosyncratic volatility stocks yield low returns. However, they fail to find any evidence supporting the notion of exposure to zero returns for this phenomenon. Because liquidity costs in other countries are much higher than in the US, we suspect that the strong relation between IV and returns is again due to liquidity, but one has to take into account the incidence of zero returns in explaining the ability of the idiosyncratic volatility to predict future returns. Future work should incorporate this issue.

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Table 1: Summary Statistics and Preliminary Regression Results

This table presents the summary statistics for a quintile sort using the percentage of zero returns as the basis. The percentage of zero returns (%Zeros) is the fraction of trading days in a month that experiences no price movement from the prior end-of-day price estimated using CRSP daily stock returns. We estimate the idiosyncratic volatility using the Fama-French three factor model specification for all firms listed on the NYSE/Amex/NASDAQ exchanges. Book-to-market is taken from Compustat and is measured quarterly. Firm size multiplies the month end price by the shares outstanding. Coskewness is calculated using the relation: $\frac{E[\epsilon_{i,t}\epsilon_{M,t}^2]}{\sqrt{E[\epsilon_{i,t}^2]}E[\epsilon_{M,t}^2]}$ as recommended by Campbell and Siddique (2000). Both the analyst coverage and institutional holdings commence in 1981. Analyst coverage is provided by I/B/E/S and is a monthly count of the number of one-year ahead earnings forecasts. Institutional holdings is taken from Thompson Financial's recording of the 13-f filings. We measure the total percentage of shares held by institutions estimated quarterly. We project the quarterly holdings for the next three months to complete the monthly statistics. The (proportional) spread is defined as the ask minus the bid divided by the quote midpoint and the effective spread defined as two times the absolute value of the difference between the price and the quote midpoint divided by the price. Our sample period runs from 1983:7 to 2006:6 for a total of 276 months and this period encapsulates the bid-ask spread observations.

Rank	%Zeros	FF-IV	Spread	Eff.Spread	Lag.Ret	B/M	Size	Price	CoSkew	Analyst	Inst.Holdings
Low	0.056**	2.772**	0.018**	0.011**	2.244**	5.227**	2894.016**	36.292**	-0.011**	8.082**	0.412**
	(8.58)	(27.90)	(16.06)	(17.82)	(6.32)	(10.97)	(12.05)	(26.91)	(-4.71)	(33.35)	(40.32)
2	0.146**	3.627**	0.033**	0.023**	3.300**	4.292**	948.803**	20.983**	-0.011**	4.269**	0.293**
	(12.58)	(30.44)	(25.51)	(24.99)	(5.73)	(12.83)	(10.33)	(17.79)	(-2.68)	(46.37)	(40.20)
3	0.213**	3.608**	0.041**	0.028**	1.257**	4.254**	618.657**	19.485**	-0.019**	2.920**	0.248**
	(12.47)	(29.97)	(15.34)	(15.34)	(3.62)	(8.65)	(5.95)	(10.08)	(-6.81)	(42.44)	(19.75)
4	0.310**	3.993**	0.057**	0.033**	0.612	3.714**	281.447**	15.800**	-0.018**	1.640**	0.177**
	(13.48)	(29.65)	(16.32)	(15.57)	(1.80)	(10.35)	(4.97)	(6.31)	(-7.64)	(25.50)	(19.06)
High	0.536**	3.840**	0.108**	0.031**	-0.428	3.862**	92.908**	10.491**	-0.014**	0.561**	0.098**
	(14.32)	(23.26)	(11.59)	(8.77)	(-1.48)	(9.15)	(4.98)	(6.13)	(-7.26)	(9.50)	(10.56)
High - Low	0.480**	1.068**	0.091**	0.020**	-2.672**	-1.365*	-2801.108**	-25.802**	-0.002	-7.521**	-0.314**
	(15.26)	(8.91)	(10.21)	(5.99)	(-10.75)	(-2.37)	(-11.99)	(-11.82)	(-1.27)	(-26.40)	(-52.51)

Table 2: Quintile Portfolios Sorted by Idiosyncratic Volatility

We estimate the idiosyncratic volatility, relative to the Fama-French three-factor model, using daily returns over a monthly period from 1983 to 2006 and then sort stocks into quintiles based on idiosyncratic volatility (FF-IV) estimated in the previous month. The stocks in each quintile are value-weighted to form five quintile portfolios. The row labeled "High - Low" refers to the difference between the portfolio with the highest IV ("High") and the portfolio with the lowest IV ("Low"). The columns are defined as follows: FF-IV is the Fama-French based IV; %Zeros is the proportion of zero returns; Spread is the proportional bid-ask spread; Return is the monthly excess returns of the portfolios; Fama-French Alpha is the alpha estimated from Fama-French three factor model; Carhart Alpha is the alpha estimated from Carhart (1997) four-factor model. Newey and West (1987) robust t-statistics are in parentheses and significance at the 1% level and 5% level is given by an ** and an *, respectively.

Rank	FF-IV	%Zeros	Spread	Return	Alpha	
					Fama-French	Carhart
Value-Weighted Quintile Portfolios Sorted by IV						
Low	1.042**	0.080**	0.007**	0.757**	0.137*	0.079
	(28.12)	(10.17)	(14.49)	(3.78)	(2.04)	(1.12)
2	1.711**	0.075**	0.009**	0.623*	-0.087	-0.051
	(32.26)	(9.91)	(14.18)	(2.38)	(-1.24)	(-0.80)
3	2.509**	0.088**	0.012**	0.604	-0.084	0.050
	(30.96)	(9.60)	(13.26)	(1.79)	(-0.77)	(0.56)
4	3.670**	0.109**	0.019**	0.142	-0.489**	-0.262
	(29.91)	(9.43)	(10.72)	(0.32)	(-2.88)	(-1.66)
High	6.482**	0.145**	0.038**	-0.600	-1.292**	-0.860**
	(30.32)	(9.65)	(9.79)	(-1.16)	(-5.16)	(-3.48)
High - Low	5.440**	0.065**	0.031**	-1.358**	-1.429**	-0.939**
	(29.11)	(7.68)	(8.41)	(-3.05)	(-4.82)	(-3.24)

Table 3: Double Sort Performance of Liquidity Measures and Idiosyncratic Volatility

Carhart (1997) four-factor alphas, with Newey and West (1987) robust t-statistics in parentheses, are reported for idiosyncratic volatility (IV) sorted portfolios that are first sorted by different liquidity measures. For each liquidity measure we perform double sorts by first sorting on the liquidity measure and then, within these partitions, further sorting on IV. Panel A reports the sort results using the percentage of zero returns and Panel B reports the sort results using the proportional bid-ask spread. "%Zeros Low" partition contains those firms with the fewest number of zero returns recorded each month while the "%Zero High" partition contains those firms with the largest number of zero returns recorded each month. The bid-ask spread results are similarly arranged with "Spread Low" representing those firms experiencing the lowest liquidity costs and "Spread High" representing those firms with the highest liquidity costs. "High - Low" is the difference in Carhart alpha between the highest IV ("High") quintile and the lowest IV ("Low") quintile. Significance at the 1% level and 5% level is given by an ** and an *, respectively.

Rank of IV	Low	2	3	4	High	High - Low
Panel A: Double Sort with %Zeros						
%Zeros Low	0.028	-0.058	0.029	-0.126	-0.529*	-0.558
	(0.39)	(-1.12)	(0.30)	(-0.82)	(-2.25)	(-1.95)
%Zeros 2	0.117	0.040	0.213	-0.501*	-0.674*	-0.791*
	(1.24)	(0.36)	(1.15)	(-2.13)	(-2.02)	(-2.16)
%Zeros High	0.086	0.133	-0.120	-0.410	-0.538	-0.624
	(0.65)	(0.66)	(-0.68)	(-1.53)	(-1.39)	(-1.59)
Panel B: Double Sort with Proportional Spread						
Spread Low	0.131	0.012	0.019	0.149	-0.031	-0.162
	(1.73)	(0.16)	(0.21)	(1.16)	(-0.13)	(-0.60)
Spread 2	-0.083	-0.063	-0.195	-0.316*	-0.978**	-0.895**
	(-0.59)	(-0.52)	(-1.22)	(-2.24)	(-4.00)	(-2.62)
Spread High	0.249	0.039	-0.382	-0.447	-1.594**	-1.842**
	(1.33)	(0.21)	(-1.44)	(-1.28)	(-3.95)	(-4.53)

Table 4: Sort Performance of Idiosyncratic Volatility after Controlling for Liquidity Measures

Performance of quintile portfolios sorted on idiosyncratic volatility (IV) after controlling for the percentage of zero returns and the bid-ask (or effective) spread is reported. For thses results we sort first by the percentage of zero returns, and then within the zero return quintiles we further sort on the bid-ask (or effective) spread. We finally sort on the Fama-French based idiosyncratic volatility and average across both the percentage of zero returns and spread quintiles. The row labeled "High - Low" refers to the difference between the portfolio with the highest IV ("High") and the portfolio with the lowest IV ("Low"). The columns are defined as follows: FF-IV is the Fama-French based IV; %Zeros is the proportion of zero returns; Spread is the proportional bid-ask spread; Return is the monthly excess returns of the portfolios; Fama-French Alpha is the alpha estimated from Fama-French three factor model; Carhart Alpha is the alpha estimated from Carhart (1997) four-factor model. Newey and West (1987) robust t-statistics are in parentheses and significance at the 1% level and 5% level is given by an ** and an *, respectively. The period spans 1983 to 2006 and encompasses NYSE/Amex/NASDAQ listed firms.

Rank	FF-IV	%Zeros	Spread	Return	Alpha	
					Fama-French	Carhart
Panel A: Control for %Zeros and Spread						
Low	0.977**	0.078**	0.009**	0.665**	0.095	0.048
	(20.67)	(9.84)	(13.74)	(3.19)	(1.41)	(0.78)
2	1.373**	0.076**	0.008**	0.637*	0.021	0.011
	(20.17)	(9.95)	(14.23)	(2.54)	(0.39)	(0.21)
3	1.764**	0.075**	0.008**	0.557*	-0.001	0.087
	(17.76)	(10.02)	(15.35)	(1.98)	(-0.02)	(1.11)
4	2.318**	0.076**	0.009**	0.523	-0.036	0.062
	(16.10)	(10.34)	(15.83)	(1.41)	(-0.31)	(0.60)
High	3.623**	0.081**	0.010**	0.337	-0.167	0.007
	(15.94)	(10.77)	(14.90)	(0.73)	(-0.82)	(0.04)
High - Low	2.646**	0.003	0.000	-0.328	-0.262	-0.041
	(14.43)	(1.64)	(0.38)	(-0.92)	(-1.07)	(-0.18)
Panel B: Control for %Zeros and Effective Spread						
Low	0.987**	0.078**	0.009**	0.749**	0.154*	0.121
	(22.02)	(9.68)	(12.57)	(3.64)	(2.23)	(1.61)
2	1.363**	0.077**	0.008**	0.592*	-0.041	-0.047
	(24.12)	(9.92)	(14.58)	(2.45)	(-0.51)	(-0.59)
3	1.698**	0.075**	0.008**	0.542	-0.081	-0.033
	(25.75)	(10.16)	(15.46)	(1.92)	(-1.16)	(-0.51)
4	2.168**	0.074**	0.009**	0.438	-0.172	-0.128
	(25.80)	(10.32)	(14.95)	(1.34)	(-1.82)	(-1.42)
High	3.366**	0.075**	0.010**	0.397	-0.109	-0.005
	(25.83)	(10.41)	(13.13)	(0.93)	(-0.69)	(-0.04)
High - Low	2.379**	-0.004	0.001	-0.353	-0.264	-0.126
	(26.63)	(-1.90)	(0.84)	(-1.06)	(-1.27)	(-0.64)

Table 5: Sort Performance of Idiosyncratic Volatility after Exogenous Liquidity Shocks

We control for exogenous liquidity shocks by examining the periods from 1997 to 2006 and from 2001 to 2006 that have been shown to experience significant reductions to liquidity costs. These periods coincide with the NYSE move to sixteenth pricing and the decimalization in quotes, respectively. We sort on the Fama-French based idiosyncratic volatility (FF-IV). The row labeled "High - Low" refers to the difference between the portfolio with the highest IV ("High") and the portfolio with the lowest IV ("Low"). The columns are defined as follows: FF-IV is the Fama-French based IV; %Zeros is the proportion of zero returns; Spread is the proportional bid-ask spread; Return is the monthly excess returns of the portfolios; Fama-French Alpha is the alpha estimated from Fama-French three factor model; Carhart Alpha is the alpha estimated from Carhart (1997) four-factor model. Newey and West (1987) robust t-statistics are in parentheses and significance at the 1% level and 5% level is given by an ** and an *, respectively.

Rank	FF-IV	%Zeros	Spread	Return	Alpha	
					Fama-French	Carhart
Panel A: From 1997:1 to 2006:6						
Low	1.150**	0.025**	0.006**	0.645*	0.149	0.086
	(15.18)	(6.18)	(5.46)	(2.06)	(1.16)	(0.64)
2	1.824**	0.021**	0.007**	0.498	-0.080	-0.036
	(17.08)	(5.74)	(5.46)	(1.10)	(-0.62)	(-0.30)
3	2.635**	0.023**	0.008**	0.528	-0.078	0.059
	(16.27)	(5.41)	(6.24)	(0.84)	(-0.45)	(0.37)
4	3.803**	0.028**	0.008**	0.185	-0.436	-0.215
	(15.86)	(5.40)	(6.42)	(0.20)	(-1.54)	(-0.79)
High	6.470**	0.040**	0.014**	-0.179	-1.020*	-0.521
	(16.71)	(5.85)	(6.51)	(-0.17)	(-2.35)	(-1.44)
High - Low	5.320**	0.016**	0.008**	-0.823	-1.169*	-0.607
	(16.82)	(4.12)	(4.60)	(-0.89)	(-2.28)	(-1.37)
Panel B: From 2001:4 to 2006:6						
Low	0.954**	0.012**	0.003**	0.336	0.053	0.052
	(13.90)	(22.82)	(3.15)	(0.85)	(0.48)	(0.45)
2	1.549**	0.011**	0.004**	0.297	-0.253*	-0.256*
	(15.40)	(20.84)	(3.24)	(0.47)	(-2.07)	(-2.11)
3	2.229**	0.012**	0.004**	0.550	-0.102	-0.107
	(13.32)	(28.54)	(3.79)	(0.68)	(-0.46)	(-0.49)
4	3.226**	0.014**	0.004**	0.444	-0.116	-0.100
	(12.24)	(22.71)	(4.76)	(0.40)	(-0.39)	(-0.31)
High	5.614**	0.021**	0.008**	0.807	0.127	0.159
	(11.74)	(18.82)	(4.76)	(0.58)	(0.30)	(0.34)
High - Low	4.660**	0.009**	0.005**	0.472	0.074	0.107
	(11.34)	(5.79)	(4.50)	(0.43)	(0.15)	(0.20)

Table 6: Sort Performance of Idiosyncratic Volatility for Restrictions on the Zero Returns

We control for the effect of the zero returns by restricting the sample to include only those firms that experience 5% or fewer zero returns each month. We compare these results with those of including all the firms without the restriction on the zero returns. The sample period runs from 1983 to 1996. We sort on the Fama-French based idiosyncratic volatility(FF-IV). The row labeled "High - Low" refers to the difference between the portfolio with the highest IV ("High") and the portfolio with the lowest IV ("Low"). The columns are defined as follows: FF-IV is the Fama-French based IV; %Zeros is the proportion of zero returns; Spread is the proportional bid-ask spread; Return is the monthly excess returns of the portfolios; Fama-French Alpha is the alpha estimated from Fama-French three factor model; Carhart Alpha is the alpha estimated from Carhart (1997) four-factor model. Newey and West (1987) robust t-statistics are in parentheses and significance at the 1% level and 5% level is given by an ** and an *, respectively.

Rank	FF-IV	%Zeros	Spread	Return	Alpha	
					Fama-French	Carhart
Panel A: From 1983:7 to 1996:12						
Low	0.967**	0.118**	0.008**	0.837**	0.132**	0.112*
	(41.40)	(30.04)	(36.07)	(3.23)	(3.14)	(2.49)
2	1.632**	0.113**	0.011**	0.711*	-0.012	0.004
	(37.65)	(35.66)	(26.30)	(2.29)	(-0.19)	(0.06)
3	2.420**	0.134**	0.016**	0.657	0.035	0.088
	(33.33)	(31.56)	(20.54)	(1.80)	(0.35)	(0.90)
4	3.577**	0.166**	0.026**	0.112	-0.432**	-0.307*
	(29.79)	(28.13)	(17.03)	(0.27)	(-3.29)	(-2.26)
High	6.491**	0.218**	0.055**	-0.897	-1.410**	-1.275**
	(26.72)	(27.49)	(16.38)	(-1.92)	(-7.04)	(-5.52)
High - Low	5.524**	0.100**	0.047**	-1.734**	-1.542**	-1.387**
	(24.33)	(11.83)	(14.50)	(-4.85)	(-7.28)	(-5.65)
Panel B: From 1983:7 to 1996:12, %Zeros <= 0.05						
Low	0.939**	0.025**	0.006**	0.740*	0.040	0.021
	(41.94)	(30.56)	(27.53)	(2.57)	(0.52)	(0.26)
2	1.417**	0.025**	0.008**	0.775*	0.004	0.014
	(39.57)	(34.85)	(34.12)	(2.39)	(0.03)	(0.13)
3	1.871**	0.025**	0.009**	0.657*	0.032	0.065
	(30.05)	(36.99)	(16.64)	(2.12)	(0.24)	(0.49)
4	2.519**	0.026**	0.011**	0.422	-0.213	-0.195
	(25.88)	(39.23)	(12.27)	(1.10)	(-1.26)	(-1.14)
High	4.062**	0.027**	0.014**	0.370	0.017	0.068
	(27.45)	(36.99)	(16.89)	(0.85)	(0.07)	(0.26)
High - Low	3.123**	0.002*	0.008**	-0.371	-0.022	0.047
	(23.27)	(2.21)	(10.41)	(-1.17)	(-0.09)	(0.16)

Table 7: Sort Performance of Idiosyncratic Volatility Estimated from Rolling Regressions of Monthly Returns

We estimate the Fama-French based idiosyncratic volatility in rolling regressions using 24 to 60 months of monthly returns. We compare three separate time periods, the first being the period prior to the NYSE conversion to sixteenth quotes (from 1983 to 1996), after the conversion (from 1997 to 2006), and subsequent to the decimalization of all quotes (from 2001 to 2006). We sort on the Fama-French based idiosyncratic volatility estimated from rolling regressions and present the IV sort results by quintile. The row labeled "High - Low" refers to the difference between the portfolio with the highest IV ("High") and the portfolio with the lowest IV ("Low"). The columns are defined as follows: FF-RIV is the Fama-French based rolling IV; %Zeros is the proportion of zero monthly returns in the months used for the estimation; Spread is the proportional bid-ask spread; Carhart Alpha is the alpha estimated from Carhart (1997) four-factor model. Newey and West (1987) robust t-statistics are in parentheses and significance at the 1% level and 5% level is given by an ** and an *, respectively.

Rank	FF-RIV	%Zeros	Spread	Alpha Carhart	FF-RIV	%Zeros	Spread	Alpha Carhart	FF-RIV	%Zeros	Spread	Alpha Carhart
	Panel A: From 1983:7 to 1996:12				**Panel B: From 1997:1 to 2006:6**				**Panel C: From 2001:4 to 2006:6**			
Low	4.922**	0.016**	0.008**	0.078*	5.594**	0.006**	0.007**	0.088	6.253**	0.003**	0.003**	0.045
	(79.32)	(61.07)	(39.95)	(2.14)	(26.14)	(5.70)	(5.16)	(0.76)	(32.57)	(7.09)	(3.10)	(0.50)
2	7.904**	0.017**	0.012**	0.045	8.756**	0.007**	0.006**	0.089	9.436**	0.004**	0.003**	-0.026
	(125.19)	(27.83)	(21.01)	(0.79)	(36.79)	(6.47)	(5.54)	(0.85)	(38.66)	(8.53)	(3.22)	(-0.32)
3	10.678**	0.023**	0.015**	-0.032	12.380**	0.009**	0.007**	0.223	13.286**	0.004**	0.004**	-0.158
	(122.04)	(30.73)	(27.05)	(-0.39)	(38.60)	(5.43)	(6.30)	(0.91)	(39.71)	(11.52)	(3.34)	(-0.85)
4	14.234**	0.032**	0.020**	0.096	17.125**	0.011**	0.007**	0.396	18.471**	0.005**	0.004**	0.026
	(124.97)	(34.27)	(43.70)	(0.65)	(35.50)	(5.86)	(6.48)	(1.55)	(36.67)	(6.10)	(4.32)	(0.11)
High	22.781**	0.055**	0.040**	-0.829**	27.165**	0.013**	0.009**	-0.120	29.060**	0.006**	0.005**	-0.023
	(116.47)	(35.24)	(30.72)	(-3.77)	(39.31)	(5.50)	(5.71)	(-0.43)	(47.97)	(11.23)	(5.54)	(-0.09)
High - Low	17.859**	0.038**	0.032**	-0.907**	21.571**	0.006**	0.002	-0.207	22.806**	0.003**	0.002*	-0.068
	(81.28)	(22.96)	(24.48)	(-3.76)	(42.00)	(5.02)	(1.33)	(-0.61)	(53.96)	(14.80)	(2.50)	(-0.22)

Table 8: Regression of Idiosyncratic Volatility on the Zero Returns and the Bid-Ask Spread

We present regression results of the idiosyncratic volatility on the liquidity influences presented by the percentage of zero returns (%Zeros) and the proportional bid-ask spread (Spread). The sample period runs from 1983:7 to 2006:6. Each of the microstructure controls are estimated contemporaneously with the IV estimates. We control for non-linearity in the relation between zero returns and IV by including the squared percentage of zero returns (Squared % Zeros). FF-IV is the monthly idiosyncratic volatility estimated using daily returns in a month relative the Fama-French three-factor model. FF-RIV is the monthly idiosyncratic volatility estimated from rolling regressions of the previous 60 months of monthly returns with at least 24 months of available observations. The percentage of zero return in the rolling regression is measured as the ratio of the number of zero monthly returns and the total months used in the rolling regression (60 months). T-statistics are in parentheses and significance at the 1% level and 5% level is given by an ** and an *, respectively.

	FF-IV	FF-IV	FF-IV	FF-IV	FF-IV	FF-RIV
Intercept	2.938**	2.382**	2.053**	1.823**	1.756**	10.70**
	(27.01)	(16.83)	(20.19)	(14.22)	(15.43)	(27.02)
%Zeros	3.090**	8.480**		2.209*	-1.666**	30.07**
	(9.34)	(16.80)		(2.47)	(-4.53)	(7.59)
Squared %Zeros		-10.32**		-9.507**	-0.0400	-116.3**
		(-12.24)		(-10.17)	(-0.09)	(-4.06)
Spread			37.99**	44.75**	69.23**	55.43**
			(11.95)	(15.60)	(43.61)	(12.70)
%Zeros×Spread					-58.08**	
					(-14.85)	
N	1229194	1229194	1229194	1229194	1229194	1099670
adj. R^2	0.020	0.037	0.341	0.419	0.495	0.133

Table 9: Sort Performance of Idiosyncratic Volatility Residuals

We use the residual of a regression of IV on the percentage of zero returns, the squared percentage of zero returns, and the bid-ask spread in sort tests. The IV is estimated using the Fama-French three-factor model over one month using daily returns. The regression residuals of IV are estimated each month and then used to determine if the orthogonal component of idiosyncratic volatility (to liquidity effects) has sufficient power in predicting future returns. Panel B includes an additional interaction term in the first stage regression. The sample period runs from 1983 to 2006. The row labeled "High - Low" refers to the difference between the portfolio with the highest IV ("High") and the portfolio with the lowest IV ("Low"). The columns are defined as follows: IV-Resid is the residual of the Fama-French based IV; %Zeros is the proportion of zero returns; Spread is the proportional bid-ask spread; Return is the monthly excess returns of the portfolios; Fama-French Alpha is the alpha estimated from Fama-French three factor model; Carhart Alpha is the alpha estimated from Carhart (1997) four-factor model. Newey and West (1987) robust t-statistics are in parentheses and significance at the 1% level and 5% level is given by an ** and an *, respectively.

Rank	IV-Resid	%Zeros	Spread	Return	Alpha	
					Fama-French	Carhart
Panel A: IV residual (%Zeros, Sq. %Zeros, Spread)						
Low	-1.589**	0.116**	0.010**	0.706**	0.062	0.045
	(-22.88)	(8.11)	(14.09)	(3.46)	(0.84)	(0.58)
2	-0.992**	0.080**	0.007**	0.545*	-0.049	-0.056
	(-20.39)	(9.65)	(15.32)	(2.18)	(-0.63)	(-0.82)
3	-0.393**	0.064**	0.008**	0.585	0.040	0.103
	(-16.95)	(9.63)	(15.10)	(1.85)	(0.40)	(1.01)
4	0.378**	0.059**	0.009**	0.522	0.046	0.102
	(22.06)	(8.78)	(14.07)	(1.27)	(0.33)	(0.79)
High	2.121**	0.082**	0.014**	-0.025	-0.568*	-0.351
	(26.23)	(10.67)	(13.47)	(-0.05)	(-2.40)	(-1.58)
High - Low	3.710**	-0.034**	0.005**	-0.731	-0.630*	-0.396
	(24.99)	(-3.54)	(5.53)	(-1.73)	(-2.29)	(-1.50)
Panel B: IV residual (%Zeros, Sq. %Zerso, Spread, %Zeros×Spread)						
Low	-1.272**	0.102**	0.015**	0.540*	-0.061	0.005
	(-18.55)	(9.64)	(11.78)	(2.44)	(-0.61)	(0.05)
2	-0.740**	0.079**	0.007**	0.589**	-0.027	-0.054
	(-16.27)	(9.69)	(14.47)	(2.66)	(-0.38)	(-0.79)
3	-0.285**	0.072**	0.007**	0.657*	0.079	0.118
	(-13.97)	(9.66)	(15.38)	(2.34)	(1.07)	(1.29)
4	0.328**	0.072**	0.008**	0.504	-0.071	0.004
	(20.47)	(9.69)	(15.21)	(1.34)	(-0.66)	(0.04)
High	1.733**	0.083**	0.011**	0.150	-0.453*	-0.289
	(21.71)	(9.77)	(14.10)	(0.31)	(-2.06)	(-1.29)
High - Low	3.005**	-0.019**	-0.003**	-0.390	-0.392	-0.293
	(20.36)	(-3.80)	(-3.59)	(-0.97)	(-1.43)	(-1.06)

Table 10: Fama-MacBeth Regressions: NYSE/Amex/NASDAQ Exchanges

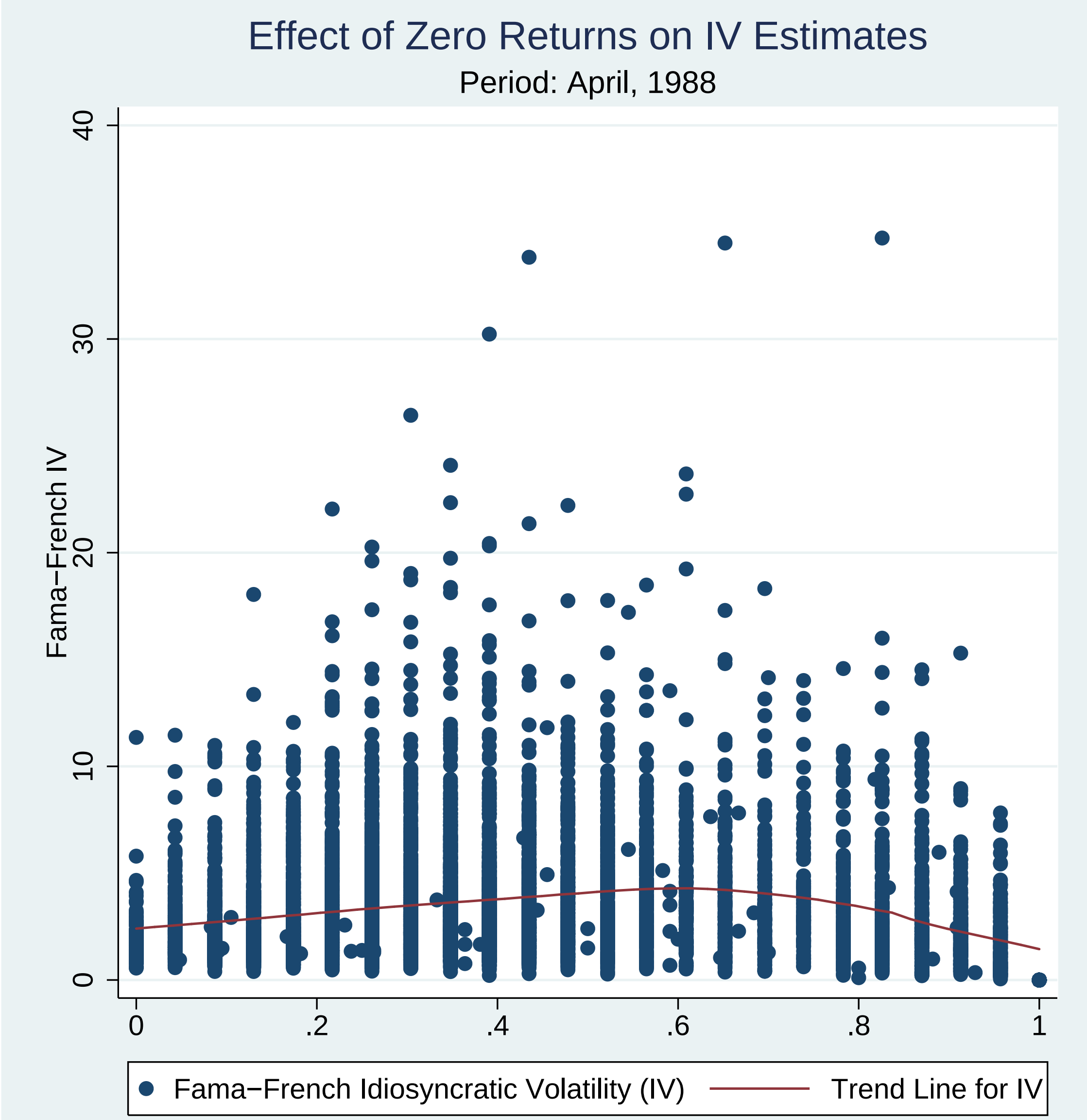
We regress the return against lagged control variables that comprise risk, return reversal, and information environment variables. Each of the regressions is value-weighted using lagged firm size as the weight. We have 276 months in our sample that span from 1983:7 to 2006:6. We measure the idiosyncratic volatility using the Fama-French three factor model for all firms listed on the NYSE/Amex/NASDAQ exchanges. Lagged returns measure the return reversal effect on returns. Book-to-market and firm size measure risk effects, while Coskewness measures downside risk. Analyst coverage and institutional holdings measure the general information environment. With the exceptions of institutional holdings and book-to-market, each of these control variables is measured in the month prior to the return measurement. Quarterly book-to-market is log scaled and is estimated from Compustat. Firm size is log scaled and multiplies the month end price by the shares outstanding. Coskewness is calculated using the relation: $\frac{E[\epsilon_{i,t}\epsilon^2_{M,t}]}{\sqrt{E[\epsilon^2_{i,t}]}E[\epsilon^2_{M,t}]}$ as recommended by Campbell and Siddique (2000). Analyst coverage is provided by I/B/E/S and is a monthly count of the number of one-year ahead earnings forecasts. Institutional holdings is taken from Thompson Financial's recording of the 13-f filings and is the total percentage of shares held by institutions estimated quarterly. We project the quarterly holdings for the next three months to complete the monthly statistics. Our liquidity variables are the proportional spread defined as the ask minus the bid divided by the quote midpoint and the effective spread defined as two times the absolute value of the difference between the price and the quote midpoint divided by the price. We use the residuals of a regression of the Fama-French based IV on the percentage of zero returns, the squared percentage of zero returns, and the spread as an instrument in a two-stage regression. Newey and West (1987) robust T-statistics are in parentheses and significance at the 1% level and 5% level is given by an ** and an *, respectively.

	(1) ret	(2) ret	(3) ret	(4) ret	(5) ret	(6) ret
Intercept	0.0242**	0.0236**	0.0258**	0.0243**	0.0168*	0.0133
	(3.13)	(3.79)	(3.87)	(3.92)	(2.52)	(1.90)
Fama-French IV	-0.0022*	-0.0021*	-0.0020*	-0.0021*		
	(-2.34)	(-2.32)	(-2.18)	(-2.22)		
Lagged Return	-0.0195**	-0.0190**	-0.0201**	-0.0197**	-0.0198**	-0.0201**
	(-2.99)	(-3.05)	(-3.18)	(-3.08)	(-3.10)	(-3.21)
Ln(Book-to-Market)	0.0008	0.0010	0.0007	0.0007	0.0009	0.0008
	(0.83)	(1.03)	(0.66)	(0.61)	(0.79)	(0.71)
Ln(Firm Size)	-0.0006	-0.0007	-0.0008	-0.0007	-0.0006	-0.0003
	(-1.32)	(-1.78)	(-1.75)	(-1.71)	(-1.39)	(-0.70)
CoSkewness	-0.0014	-0.0013	-0.0012	-0.0012	-0.0011	-0.0011
	(-1.32)	(-1.27)	(-0.92)	(-0.90)	(-0.85)	(-0.85)
# Estimates		0.0000	0.0000	0.0000	0.0000	0.0000
		(0.26)	(0.22)	(0.26)	(0.12)	(0.06)
Inst. Holdings		0.0050	0.0050	0.0050	0.0050	0.0059*
		(1.92)	(1.76)	(1.75)	(1.83)	(2.22)
Prop. Spread			-0.0774			
			(-1.26)			
Eff. Spread				-0.0843		
				(-0.92)		
Residual w/o Zero Sqr					-0.0018*	
					(-1.98)	
Residual w/ Zero Sqr						-0.0014
						(-1.64)
N	1530260	1530256	1243857	1228764	1243857	1243857
adj. R^2	0.071	0.083	0.094	0.093	0.089	0.091

Table 11: Fama-MacBeth Regressions: NYSE/Amex Exchanges

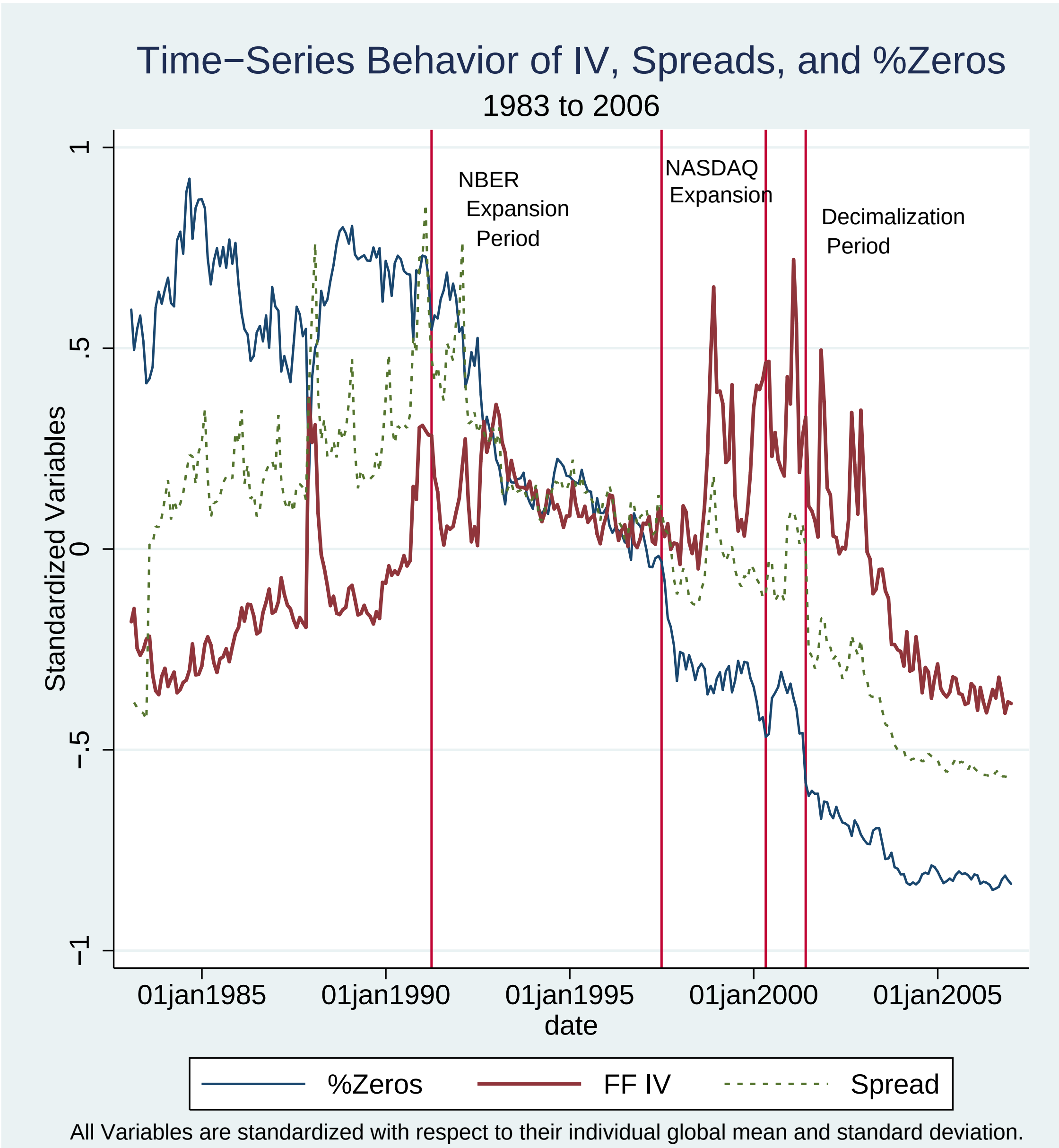
We regress the return against lagged control variables that comprise risk, return reversal, and information environment variables. Each of the regressions is value-weighted using lagged firm size as the weight. We have 276 months in our sample that spans 1983:7 to 2006:6. We measure the idiosyncratic volatility using the Fama-French three factor model for all firms listed on the NYSE/Amex exchanges. Lagged returns measure the return reversal effect on returns. Book-to-market and firm size measure risk effects, while Coskewness measures downside risk. Analyst coverage and institutional holdings measure the general information environment. With the exceptions of institutional holdings and book-to-market, each of these control variables is measured in the month prior to the return measurement. Quarterly book-to-market is log scaled and is estimated from Compustat. Firm size is log scaled and multiplies the month end price by the shares outstanding. Coskewness is calculated using the relation: $\frac{E[\epsilon_{i,t}\epsilon^2_{M,t}]}{\sqrt{E[\epsilon^2_{i,t}]}E[\epsilon^2_{M,t}]}$ as recommended by Campbell and Siddique (2000). Analyst coverage is provided by I/B/E/S and is a monthly count of the number of one-year ahead earnings forecasts. Institutional holdings is taken from Thompson Financial's recording of the 13-f filings and is the total percentage of shares held by institutions estimated quarterly. We project the quarterly holdings for the next three months to complete the monthly statistics. Our liquidity variables are the proportional spread defined as the ask minus the bid divided by the quote midpoint and the effective spread defined as two times the absolute value of the difference between the price and the quote midpoint divided by the price. We use the residuals of a regression of the Fama-French based IV on the percentage of zero returns, the squared percentage of zero returns, and the spread as an instrument in a two-stage regression. Newey and West (1987) robust T-statistics are in parentheses and significance at the 1% level and 5% level is given by an ** and an *, respectively.

	(1) ret	(2) ret	(3) ret	(4) ret	(5) ret	(6) ret
Intercept	0.0238**	0.0223**	0.0196**	0.0201**	0.0148*	0.0119
	(2.98)	(3.19)	(2.66)	(2.84)	(2.18)	(1.70)
Fama-French IV	-0.0022*	-0.0022*	-0.0020*	-0.0022*		
	(-2.30)	(-2.31)	(-2.18)	(-2.42)		
Lagged Return	-0.0233**	-0.0224**	-0.0240**	-0.0238**	-0.0233**	-0.0234**
	(-3.17)	(-3.19)	(-3.35)	(-3.33)	(-3.21)	(-3.29)
Ln(Book-to-Market)	0.0011	0.0013	0.0012	0.0012	0.0013	0.0012
	(1.31)	(1.56)	(1.22)	(1.25)	(1.33)	(1.19)
Ln(Firm Size)	-0.0005	-0.0006	-0.0003	-0.0004	-0.0003	-0.0001
	(-1.19)	(-1.30)	(-0.77)	(-0.89)	(-0.82)	(-0.27)
CoSkewness	-0.0020	-0.0020	-0.0020	-0.0018	-0.0020	-0.0019
	(-1.57)	(-1.62)	(-1.30)	(-1.16)	(-1.28)	(-1.27)
# Estimates		0.0000	-0.0000	-0.0000	-0.0000	-0.0000
		(0.03)	(-0.32)	(-0.30)	(-0.32)	(-0.39)
Inst. Holdings		0.0044	0.0038	0.0042	0.0033	0.0041
		(1.82)	(1.50)	(1.62)	(1.32)	(1.70)
Prop. Spread			-0.0482			
			(-0.56)			
Eff. Spread				0.1052		
				(0.75)		
Residual w/o Zero Sqr					-0.0018	
					(-1.93)	
Residual w/ Zero Sqr						-0.0015
						(-1.88)
N	633791	633791	502846	497299	502846	502846
adj. R^2	0.071	0.085	0.095	0.096	0.089	0.091



IV versus the Percentage of Zero Returns are shown for one representative month

Figure 1



Time−Series Behavior of IV, Spreads, and %Zeros
1983 to 2006
Standardized Variables
1
.5
0
−.5
−1
NBER
Expansion
Period
NASDAQ
Expansion
Decimalization
Period
01jan1985
01jan1990
01jan1995
01jan2000
01jan2005
date
%Zeros
FF IV
Spread
All Variables are standardized with respect to their individual global mean and standard deviation.

Figure 2