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Can liquidity shifts explain the lockup expiration effect in stock returns?

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Abstract

Several studies on the expiration of IPO lockups document a strong negative reaction even though the unlock event is devoid of any informational content. The empirical finding has remained a conundrum. In this paper, we find that changes in liquidity can account for the observed stock price reaction around lockup expiration. Specifically, firms which show improvement in liquidity subsequent to the unlock day experience positive abnormal returns in the post-expiration period, and vice versa. Another interesting conclusion that emerges from our research is that liquidity changes can predict future abnormal returns. Our results remain robust to the use of alternate procedures to characterize unexpected changes in liquidity.

Keywords: Lockup expiration, Illiquidity

JEL Classification: G14, G24, G32

1. Introduction

As volumes of new research papers in financial economics are produced, we glean fresh insights into the workings of financial markets. Paradoxically, researchers frequently uncover fresh conundrums. The focus in our paper is on the pioneering work of Field and Hanka (2001), which documents the puzzling negative stock price reaction at lock-up expiration of U.S. IPOs. The significant negative reaction at lockup expiration has remained an enigma since the event is devoid of informational content. This is because the exact unlock date is known to market participants well before the actual occurrence. Several researchers have studied this phenomenon with a view to explaining this effect using the standard paradigms of financial economics. However, until now the finding has defied a rational explanation.

We contribute to this growing literature by offering an explanation based on unexpected liquidity changes following lock-up expiration. In the remainder of this section, we first explain the rationale for lockups and summarize the key findings of prior research. We then posit that earlier explanations leave room for further analysis, and subsequently proceed to highlight the key elements of our approach along with a preview of our results and contribution.

Most IPOs in the U.S. feature lockup agreements that prohibit insiders and other Pre-IPO investors from selling their shares for a specified period of time, typically 180 days. Lockups are not mandated by regulators but are contractual agreements between underwriters and issuers and the terms of the lockup are explicitly disclosed in the IPO prospectus. Financial economists have offered three distinct rationales for the existence of lockups – a signalling solution to the adverse problem, a contracting solution to the moral hazard problem, and a rent extraction mechanism by powerful underwriters. Empirical evidence regarding the signalling hypothesis is mixed with Brav and Gompers (2003) rejecting it while Brau, Lambson, and McQueen (2003) find empirical support for it. Brav and Gompers (2003) suggest that lockups serve as a commitment mechanism for the moral hazard problem. They do not find any evidence to support the rent extraction hypothesis.

Empirical evidence regarding effects of lockup expiration have been documented by Field and Hanka (2001) and Bradley, Jordan, Yi and Roten (2001). There is overwhelming evidence of a significant negative stock price reaction at lockup expiration. These researchers also document a concomitant increase in the trading volume after the unlock day. The finding of negative stock price reaction challenges the more extreme versions of the efficient markets hypothesis.

Several hypotheses have been proffered to explain the negative stock price reaction. First, the negative return at lockup expiration could be a statistical artifact caused by an increase in the proportion of trades executed at the bid price. Second, price pressure effects could be depressing the stock prices. Third, an increase in trading costs could be impacting the stock prices due to an increase in the required rate of return. Fourth, stock prices could be lower due to a downward sloping demand curve for stocks. Finally, a larger than expected sales by insiders could be depressing the stock prices. Field and Hanka (2001) rule out the first two explanations by conducting specific empirical tests. Studies that focus on the market microstructure effects of lockup expiration such as Cao, Field and Hanka (2004), Krishnamurti and Thong (2008) and Gao (2005) do not find evidence of increase in bid-ask spreads following lockup expiration. There is no evidence indicating an increase in information asymmetry following lockup expiration that necessitates an increase in the required rate of return. The downward sloping demand curve hypothesis is ruled out by the evidence of Bradley, Jordan, Yi and Roten (2001) who show that CARs are negative and statistically significant even for the subsample of stocks that have lower trading volume after unlock day as compared to the lockup period. Finally, Field and Hanka (2001) find that abnormal return is significantly negative even when no insider sales are reported. Thus we can conclude that the negative stock price reaction is not driven by worse-than-expected insider sales.

Summing up, extant research does not offer a complete explanation regarding the negative stock price reaction at lockup expiration. The existing literature leaves two significant lacunae regarding the impact of lockup expiration on stock prices. First, the finding of negative stock price reaction at lockup expiration challenges the more extreme versions of efficient markets hypothesis as it does not address the question as to how the events of the unlock day could be consistently worse than expected. Second, prior work has not examined the linkage between market microstructure effects of lockup expiration and cumulative abnormal returns in the periods surrounding lockup expiration.

We remedy these issues in the literature by pursuing an explanation based on changes in liquidity in the post-lockup period. We posit that liquidity improves for some firms but deteriorates for other firms in the post-lockup period. Thus the observed stock price reaction should be conditioned on changes in liquidity. Using Amihud's illiquidity measure to characterize changes in liquidity in the post-lockup period, we document a statistically significant association between deterioration in liquidity and cumulative abnormal returns. Our results are robust to alternative ways of characterizing changes in liquidity. Additionally, we find that liquidity changes can predict future abnormal returns.

The rest of the paper is organized as follows. Section 2 contains a brief review of the literature and the theory that motivates our study. Section 3 describes our sample and provides summary statistics. Our principal empirical results are discussed in Section 4. We provide robustness checks by using alternate procedures to characterize liquidity changes in Section 5. In Section 6, we examine the ability of liquidity changes to predict future stock returns. Our conclusions are contained in the final section.

2. Literature Review

2.1 Current Explanations of Lockup Expiration Effects

Several hypotheses have been offered to potentially explain the observed negative abnormal returns around lockup expiration. We describe them below and summarize the empirical evidence regarding their validity.

(a) Statistical Artifact Hypothesis:

If transactions around unlock day tend to be predominantly sell orders generated by insiders that are executed at the bid, then transaction prices around unlock day will be spuriously negative, even if there is no change in bid or ask prices. Field and Hanka (2001) show empirical evidence that indicates that abnormal returns around unlock day is driven by permanent, parallel drops in both the bid and ask prices. The abnormal return is not driven by a change in the proportion of trades that occur at the bid price.

(b) Price Pressure Hypothesis:

One of the hypotheses offered to explain the negative abnormal return around lockup expiration is the price pressure hypothesis. On the unlock day share prices may be temporarily depressed due to a large flow of sell orders. Thus a temporary price drop is necessary in equilibrium to attract liquidity providers. Field and Hanka (2001) show that the abnormal return reaction around unlock day is permanent with no rebound in subsequent weeks. Thus the price pressure hypothesis is rejected.

(c) Increase in Trading Cost Hypothesis:

Another possible explanation for the negative sock price reaction during the post lockup period is an increase in trading costs due to a potential increase in information asymmetry due to insider selling activity. Field and Hanka (2001) find little evidence of a meaningful increase in quoted bid-ask spreads after the unlock day. Cao, Field and Hanka (2004) study the trading cost hypothesis in greater detail. They report that despite considerable insider trading for some IPO firms, there is little impact on effective spreads. In fact, two other liquidity measures – quoted depth and trading activity increase substantially. Furthermore, they report the interesting finding that in cases where insiders disclose share sales spreads actually decline. Krishnamurti and Thong (2008) report that both insider selling and unwinding by venture capitalists in the aftermath of lockup expiration are associated with a decline in quoted and effective spreads. Furthermore, they attribute the decline in spreads to a decline in the adverse selection component of spreads. Similar evidence is provided by Gao (2005) who shows that the information asymmetry of IPO stocks experience little change after the unlock day.

(d) Downward Sloping Demand Curve Hypothesis:

This hypothesis is based on the assumption that demand curves for stocks slope downward. Practitioners allude to this effect as the “scarcity premium” for IPOs with small public float. On lockup expiration day, the public float of stocks increase permanently as insiders unload their holdings. The demand curve effect posits a negative stock price reaction. The Downward Sloping Demand Curve hypothesis differs from the price pressure effect in that the former is a permanent effect while the latter is caused by a temporary increase in the flow of sell orders.

Empirical evidence regarding Downward Sloping Demand Curve hypothesis is mixed. Field and Hanka (2001) report that abnormal return around the unlock day is significantly more negative the larger the fraction of outstanding shares that are locked up. But further tests do not lend support to the Downward Sloping Demand Curve hypothesis. Sixty percent of the sub-sample of firms where the total three-day trading volume is less than 1% of the public float, experience negative abnormal returns. In the case of firms whose three-day trading volume is below their own pre-unlock mean volume, the corresponding three-day abnormal return is still significantly negative.

(e) High Unexpected Insider Sales Hypothesis:

Insider sales are expected to elicit negative stock price reaction since they reflect a lack of insider confidence and suggest a reduction in insiders’ incentives to maximize firm value. Field and Hanka (2001) study the abnormal return of the sub-sample of firms that report insider sales to SEC during the 2-week period centred on the unlock day. They find statistically significant negative abnormal returns. However, even for the sub-sample with no reported insider sales, the abnormal return remains significantly negative.

Thus we conclude that the abnormal return on unlock day is probably not driven solely by unexpectedly high insider sales.

Unfortunately, none of the hypotheses examined by prior researchers gives us a rational explanation of the preponderantly negative stock price reaction observed at lockup expiration. We are left with two alternatives – (i) conclude that the negative abnormal stock price reaction is an anomaly unexplained by rational investor behavior or (ii) pursue an alternative explanation grounded in investor rationality. We follow the latter approach, basing our explanation on changes in liquidity of IPO issues after the unlock day. Our approach is elucidated in the following subsection.

2.2 An Alternative View of Liquidity

Our explanation of the lockup expiration effect on stock prices is based on changes in liquidity. We argue that lockup expiration is an event that alters the liquidity characteristics of IPO firms. These changes in liquidity arise from the selling of corporate insiders, venture capitalists and others that were explicitly prohibited from selling their holdings prior to the unlock day. We posit that the change in liquidity after the unlock day for a given stock is partially unpredictable. Specifically, the market's perception of information asymmetry following lockup expirations would depend on ex ante expectations of whether insiders have private information. These expectations would vary in the cross-section but would be difficult to measure using publicly available variables prior to lockup expirations. Thus, sales by insiders after lockup expiration may be interpreted as an increase in information asymmetry only in some cases. Firms that experience unexpected increases in information asymmetry would experience a deterioration in liquidity while other firms may experience an improvement in liquidity.

An unexpected deterioration in market liquidity should lower contemporaneous stock prices. This is due to the fact that higher realized illiquidity raises expected illiquidity. This in turn raises the expected stock returns and lowers stock prices. Thus our principal hypothesis is that stocks which experience deterioration in liquidity, should experience negative abnormal returns at lockup expiration. For stocks which show no perceptible change, there should be no significant stock price reaction. Stocks which exhibit improvements in liquidity should consequently experience positive abnormal reaction after the unlock day.

One of the major hurdles in implementing a test of our hypothesis is a precise definition of liquidity. According to Amihud (2002) “liquidity is an elusive concept”. There are several dimensions of liquidity. Illiquidity can be characterized as the price impact of order flow. For standard-size transactions, Glosten and Milgrom (1985) show that bid-ask spread is a good measure of price impact. When excess demand or excess supply is large bid-ask spread is not a good measure of price impact. Kyle (1985) and Silber (1975) developed other measures of illiquidity that could be useful under situations of excess demand or excess supply. Kyle (1985) develops the price impact measure, λ, which has been extensively applied in market microstructure research. Silber (1975) employs a measure of thinness which is defined as the ratio of absolute price change to absolute excess demand for trading.

Liquidity has a price dimension and a quantity dimension. Furthermore, liquidity can also be measured based on the informativeness of transactions. Thus it is possible that the lockup expiration event has positive impact on some measures of liquidity but negative effect on other measures of liquidity for a given stock. A further difficulty arises from the fact that several measures of liquidity developed by financial economists require detailed tick-by-tick data on quotes and trades of the stocks. In the real world, traders may not have real-time access or the time to process such detailed information in order to detect a change in liquidity of a given stock. Thus we need an easy to compute measure that is sufficiently comprehensive.

A thorough search of the literature led us to Amihud's illiquidity measure as the most suitable measure for our purpose. We are encouraged to use this measure due to the following two reasons. First, Amihud's illiquidity measure is strongly positively related to Kyle's λ, a price impact measure and ψ, the fixed cost component related to the bid-asked spread. Second, Amihud's illiquidity measure has substantial explanatory power to explain returns in an asset pricing model framework with illiquidity as a priced factor. Finally, Amihud (2002) shows that illiquidity affects small stocks more strongly than large firms thus accounting for the time series variation in their premiums.

Amihud (2002) defined his measure of illiquidity as follows:

$$ILLIQ_i = 1/D \sum |R_{it}| \ / \ VOLD_{it}$$

where R_{it} is the return on stock i on day t. $VOLD_{it}$ is the dollar volume for stock i on day t. D represents the number of days over which the ILLIQ measure is computed. This measure is interpreted as the average daily stock price reaction to a dollar of trading volume. Amihud (2002) shows that this measure of expected market illiquidity has a positive and significant effect on ex ante stock excess returns. Amihud (2002) further validates his measure by showing that ILLIQ is related to Kyle's λ and ψ the fixed cost component related to the bid-ask spread.

Lockup expiration is accompanied by potential increases in insider selling and unloading of shares by venture capitalists. These investors were prohibited from doing so in the pre-expiration period. Thus the lockup expiration event is likely to significantly alter the informativeness of trades, especially in those cases when a lot of insider selling takes place. In other cases, liquidity may improve simply due to the larger float of available shares. Therefore, the lockup expiration event is likely to affect the liquidity characteristics of stocks. In particular, we expect that some stocks will become more liquid after expiration while others may become less liquid. Ex ante, it would be very difficult to predict the changes in liquidity of an individual stock after the lockup expiration. In the framework of Amihud (2002), changes in liquidity should have an impact on the value of the firm. This is the primary motivation of our paper.

3. Data and Sample Characteristics

The IPO data are obtained from the Securities Data Corporation (SDC) New Issue database and covers the 1993 – 2005 period. We exclude unit offerings, closed-end funds, ADRs, REITs, and IPOs with offer prices under $5 from our sample. For a firm to be included, the stock prices, the trade and quote data, and the insider trading information must be available on the Center for Research in Securities Prices (CRSP), NYSE’s Trade and Quote (TAQ), and Thomson Financial Insider Filing databases, respectively. These data selection criteria yield a sample size of 1609 IPOs listed on NYSE and NASDAQ. We use SDC database to obtain the basic information on offer date, lockup expiration date, offer price, filing prices, number of shares issued, net proceeds, venture capital funding, number of lead and co-lead managers, lockup days, lockup shares, and over-allotment of shares. The insider selling information in the post-lockup expiration period is obtained from the SEC Form 4 provided by Thomson Financial Insider Filing database.[1] We extract the financial information, such as total assets, total liabilities, net income, return on assets (ROA), and debt-to-asset ratio from the Compustat database. All financial data are based on the most recent fiscal year ending prior to the IPO lockup expiration date. Firm age is measured from the founding year to the IPO year and is obtained from Jay Ritter's website (http://bear.cba.ufl.edu/ritter). Market value is defined as first day closing price times the post-IPO shares outstanding and is obtained from the CRSP database.

For each IPO, we also retrieve the trade and quote data from the NYSE's TAQ database, and omit the following to minimize data errors: (1) quotes if either the ask price or bid price is less than or equal to zero; (2) quotes if either the ask size or the bid size is less than or equal to zero; (3) quotes if the bid price is greater than or equal to the ask price; (4) quotes if the bid-ask spread is greater than $5; (5) before-the-open and after-the-close trades and quotes; (6) trades if the price or volume is less than or equal to zero; (7) out-of-sequence trades and quotes.

Table 1 contains the descriptive statistics of our sample. Panel A contains offer and firm characteristics of the entire sample. In panel B, we provide descriptive statistics of our sample categorized on the basis of liquidity changes. On average our sample firms offer 4.11 million shares in the IPO garnering net proceeds of $60.94 million. The average offer price is $12.64. The filing price range averages 17.24%. Offer-to-close returns average 20.33%. On average, there are 2.80 underwriters per issue. The firms in

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[1] Insider selling in pre-lockup expiration period is identified as early release of lockup. Insiders are defined as directors, committees, officers, affiliates, and beneficial owners.

our sample have an average age of 14.62 years when they go public. The average lockup period is 194.75 days with a median of 180 days. 12.80 million shares are locked up on average. The number of shares outstanding averages 16.87 million. Thus about 69.5% of the outstanding shares are typically locked up. The total assets and total liabilities of the sample average $218.24 million and $187.27 million respectively. The market value of equity averages $311.35 million. Thus the average market-to-book ratio is about 8.71. The average Net Income (NI) and Return on Assets (ROA) of our sample firms are negative while the medians are positive. This indicates the presence of influential outliers. We therefore rely on medians to characterize the average firm. The median NI of our sample is $ 0.83 million. The median value of ROA is 11.4%. Debt-to-Assets ratio averaged 35.5% with a median of 26.1%.

In Panel B of Table 1, we compare the offer and firm characteristics of sub samples based on liquidity changes. We split the sample into two groups on the basis of changes in liquidity in the post-lockup period as compared to the pre-lockup period. Firms whose ratio of Amihud illiquidity measure in the post-lockup [+21,+ 40] to pre-lockup [-40,-21] period is less than 1 are classified as liquid firms (LIQ).[2] Firms with ratios exceeding one are considered as illiquid firms (ILLIQ). We find that most of the offer and firm characteristics of the two sub samples are similar. However, there are a few differences between the two subsamples. On average, LIQ firms tend to have a larger quantity of over-allotment shares and a higher number of underwriters. LIQ firms generally have lower leverage as compared to ILLIQ firms.

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[2] Our windows for measuring pre-and post-lockup periods exclude the (-20,+20) window that is used for computing the cumulative abnormal returns. This is done to obviate a potential measurement problem.

Table 2 provides quote and trade characteristics of our entire sample and sub-samples based on post-expiration liquidity changes. We examine the spreads, depths, number of quotes, number of trades, trade size, trading value, and returns volatility during 20-day pre- and post-lockup expiration periods. Of special interest to us in this paper is the change in liquidity in the post-lockup expiration as compared to the lockup period. As before, our pre-lockup window is [-40,-21] with respect to the unlock day. The post-lockup window is [+21,+ 40]. When we look at the entire sample, we find that on average, quoted and effective dollar spreads reduce significantly in the post-lockup period as compared to the pre-lockup period. When, we examine the quoted and effective spreads, we notice a statistically significant increase in the post-expiration window as compared to the pre-expiration period. We thus conclude that dollar spread decreases by less than the decrease in stock prices resulting in a marginal increase in percentage spreads. Total depth and its constituents, bid depth and ask depth increase substantially in the post-lockup period as compared to the period prior to the unlock day. The number of quotes recorded registers a substantial increase in the post-lockup period.

A similar pattern emerges when we examine the trade activities in the post-lockup period and compare them with the pre-lockup period. The number of trades, trade size and trading value all show statistically significant increases in the post-lockup period as compared to the pre-lockup expiration period. However, the mean return volatility does not change significantly in the post-lockup expiration period.

We next compare the market microstructure variables of the LIQ subsample during the pre- and post-lockup expiration periods. Several interesting facts emerge. First, while quoted and effective dollar spreads decline in the post-lockup period as observed in the overall sample, the quoted and effective percentage spreads also decline. This is in direct contrast to our findings for the overall sample. It appears that there is a more than proportionate decline in dollar spreads as compared to the change in average stock prices in the post-lockup period. Similar to our findings for the overall sample, we document increases in depth, number of quotes, number of trades, trade size, and trading value in the post-lockup period as compared to the pre-lockup period. Second, our result for return volatility comparisons of the LIQ subsample is different from that observed for the overall sample. We find that return volatility declines substantially in the post-lockup period for the LIQ subsample while the overall sample showed no change.

We then compare the market microstructure variables of our ILLIQ subsample during the pre- and post-lockup expiration periods. We notice several differences as compared to the LIQ subsample. There is no change in the quoted dollar spread in the post-lockup period as compared to the pre-lockup period. There is a slight decrease in the effective dollar spread in the post-lockup period. Both quoted and effective percentage spreads show statistically significant increases in the post-lockup period as compared to pre-unlock period. This finding is exactly opposite to our finding for the LIQ subsample. There is no significant change in depth after the expiration of lockup. A number of trade related microstructure variables clearly show a significant deterioration during the post-lockup period. The number of trades, trade size and trading value all decline significantly in the post-lockup period as compared to the pre-lockup period. Return volatility increases significantly in the post-lockup period as compared to the pre-lockup period signifying a deteriorating trading environment.

Finally, we compare the key market microstructure variables across the LIQ and ILLIQ subsamples during our pre- and post-lockup windows. First, we perform comparisons during the pre-lockup period. We do not find compelling evidence that the liquidity characteristics of the two subsamples are substantially different during the pre-lockup expiration period. However, four out of the twelve variables examines show that the LIQ subsample is more liquid than the ILLIQ subsample. These are: quoted percentage spread, effective percentage spread,, number of quotes, and return volatility. For the eight other variables studied, the liquidity characteristics of the two subsamples are statistically indistinguishable.

Next, we compare the liquidity characteristics of the two subsamples during the post-lockup period. We find a striking difference between the two subsamples. For every measure we examine, we find that the LIQ subsample shows better liquidity than the ILLIQ subsample. This implies that our procedure has done an excellent job of identifying a subset of stocks that underwent significant liquidity deterioration in the post-lockup period.

The above comparisons show that Amihud's illiquidity measure is strongly related to traditional market microstructure measures used in prior research. Furthermore it appears that a subset of firms (ILLIQ) experience a drastic deterioration in liquidity in the post unlock period.

4. Empirical Results

We use the standard event study methodology to examine stock market reaction to lockup expiration. The magnitude of the security price reactions are estimated using the market model with parameters estimated over days t = -120 to t=-21, where t=0 is the lockup expiration date. The CRSP value-weighted index return is the proxy for the market return.

We show results of event study results of lockup expiration in Table 3. We show results of the overall sample and sub-samples based on liquidity changes. In conformity with earlier research, we document statistically significant negative CARs for the overall sample using several windows such as (-1,+1), (-5,+5), (-10,+10) and (-20,+20). On the expiration day, abnormal return averages -0.87% and is statistically significant at the 1% level. As we increase the window length CARs become more and more negative. For the (-20,+20) window, we report a CAR of -4.23%, significant at the 1% level. Median CARs are generally smaller in magnitude but are all statistically significant. CARs in the post expiration windows of (+2, +5), (+2,+10) and (+2,+20) are not significantly different from zero.

We next segregate our sample into two groups based on post-expiration liquidity changes and examine the CARs for each of the windows. The CARs of liquid and illiquid firms differ dramatically from each other.[3] For the LIQ subsample CARs are negative and statistically significant at 1% level only for the (-1, +1) and (0,0) windows. Other windows that include pre-expiration periods typically do not show significant CARs. Interestingly, CARs are significantly positive during the (+2, +5), (+2, +10) and (+2, +20) windows. The ILLIQ subsample shows significant negative CARs for all the

[3] Since the validity of our study critically depends on the measurement of illiquidity we use the windows (-40,-21) and (+21,+40) as the pre- and post-lockup periods respectively. Our pre- and post-lockup windows exclude the (-20, +20) window that is used for computing the cumulative abnormal returns. This is done to eliminate potential spurious correlation between CARs and our illiquidity measure which contains stock returns in the numerator.

windows examined. Of particular interest is the long window of (-20, +20) where we document a CAR of -12.09% significant at the 1% level. All post expiration windows show significantly negative CARs.

A noteworthy finding of our study is the vastly divergent CAR pattern observed during the post-expiration windows for the LIQ and ILLIQ subsamples. The insignificant CAR results documented for the overall sample during the post expiration windows of (+2, +5), (+2, +10), and (+2, +20) is driven the combination of positive CARs of the LIQ subsample and the negative CARs of the ILLIQ subsample. When we compute the difference in CARs between the LIQ and ILLIQ subsamples for each of the windows studied, we observe that they are all positive and significant at the 1% level. Figure 1 graphically portrays the dramatic divergence in CARs for the ILLIQ an LIQ subsamples during the (-20, +20) period.

Having shown the relationship between CAR and liquidity changes in a univariate framework, we proceed to further tests utilizing a multivariate regression framework and report the results in Table 4. We first regress CARs in the (-20, +20) window on a set of variables used in prior research in addition to three other variables: DILLIQ, OI and SUPPLY. The results are reported in Panel A. Specifically, we run the following model:

$$CAR(-20,+20) = \beta_0 + \beta_1 VC_{it} + \beta_2 DILLIQ_{it} + \beta_3 INSIDE_{it} + \beta_3 OI_{it} + \beta_5 SUPPLY_{it} + \beta_6 RUNUP_{it} + \beta_7 TECH_{it} + \beta_8 NYSE_{it} + \beta_9 UWREP_{it} + \varepsilon_{it}$$

where,

VC = 1 if the firm is venture capital backed and zero otherwise;

DILLIQ = the average of the ratio of Amihud illiquidity measure of post-lockup (+21,+40) to pre-lockup (-21,-40) period. Amihud illiquidity measure is computed as $|R_{it}|/DVOL_{it}$;

$|R_{it}|$ is the absolute value of daily return of stock i on day t;

$DVOL_{it}$ represents the dollar volume of trading of stock i on day t.

INSIDE = the insider selling shares in post-lockup period (0,+ 20) divided by the number of shares locked up;

OI = the order imbalance defined as the sum of (sell volume – buy volume)/daily trading volume during the CAR window period (-20, + 20);

SUPPLY = the sum of (daily trading volume – normal trading volume)/normal trading volume during (-20, +20) period. Normal trading volume is computed based on the average of daily trading volume during day -120 to day -21;

RUNUP = the rate of return for each firm computed from closing price on listing date to day -41 with respect to lockup expiration;

TECH = 1 if the firm is identified as high technology firm in SDC, zero otherwise;

NYSE = 1 if the firm is NYSE-listed, zero otherwise;

UWREP = 1 if Jay Ritter's underwriter ranking is greater than 8, zero otherwise.

DILLIQ is the principal variable of interest. A value of DILLIQ greater than 1.0 indicates an increase in the illiquidity of the stock in the post-expiration window of (+21, +40) as compared to pre-expiartion window of (-21, -40). Thus we expect an increase in DILLIQ to be accompanied by a decrease in stock returns. OI measures the cumulative sell side order imbalance during the window surrounding lockup expiration. As such, it is expected to have a negative impact on CAR. SUPPLY quantifies the increase in trading volume during the window surrounding unlock day. An increase in SUPPLY represents an increase in the floating stock of shares and is indicative of an improvement in liquidity. We therefore expect this variable to have a positive effect on CAR.

As expected, DILLIQ has a negative impact on CAR and remains significant even when other variables are included in the regression. This result shows that an increase in the illiquidity of a stock is associated with a negative stock price reaction. We find that the dummy for VC-backing is associated with a statistically significant negative effect even after controlling for other determinants of stock price reaction. Insider selling is negative and mildly significant at conventional levels. Order Imbalance is associated with a negative stock price reaction and is significant at the 1% level. The supply effect is positive and statistically significant at the 1% level as per expectations. RUNUP represents the post-listing performance of stocks. RUNUP has a negative impact on CAR and is statistically significant at the 1% level. This implies that stocks which performed the best in the pre-expiration period suffer the worst stock price declines during the lockup expiration window. The TECH dummy shows a negative effect on CAR in univariate regression but the effect disappears in multivariate regressions. NYSE listing has a significant negative effect on CARs indicating that the stocks listed on NYSE experience more negative stock price reaction at lockup expiration as compared to Nasdaq stocks. Finally, underwriter reputation has no effect on CARs.

In Panel B, we report results of regressing CAR (+2,+20) on the independent variables of interest. The DILLIQ variable has a statistically significant negative impact on CAR indicating that firms experiencing a deterioration in liquidity also suffer negative CARs. The VC dummy has a negative effect and is statistically significant. The insider selling variable is not statistically significant. Order imbalance has a negative effect on CAR and is statistically significant. The supply variable has a positive effect on CAR and is statistically significant. RUNUP has a statistically significant negative effect on CAR as before. TECH, NYSE and UWREP are not statistically significant.

Note that in our univariate tests, INSIDE is associated with negative CARs. In multivariate regressions when we include DILLIQ, the significance of INSIDE tends to drop. We believe that there are two important reasons for the muted effect of insider sales on CAR. First, insiders could be selling soon after unlock day for one of three reasons: diversification of their holdings, to take advantage of their private information regarding future prospects of the firm, and to make use of their expectation of a decline in overall stock market prices. As pointed out in Section 2.2., the market's expectations about the relative likelihood of each of these possibilities are not observable prior to the lockup expiration, and are manifested in DILLIQ. Second, traders do not have timely information regarding insider sales since they are only required to disclose their trades via Form 4 no later than the tenth day of the month after transactions.

Overall, the most significant result from the multivariate regression analysis is that an increase in illiquidity is associated with a strongly negative stock price reaction. Our regression results confirm the earlier findings that VC-backed firms and those with reported insider selling experience significant negatively abnormal returns around lockup expiration. In addition we document that order imbalance has a significant negative impact on CAR while the supply effect is positive. Thus our empirical results suggest that the negative CAR documented at lockup expiration is associated with a deterioration in liquidity of a subset of stocks.

5. Robustness Checks

The empirical results shown in the previous section indicate that changes in liquidity are strongly negatively associated with CARs at the expiration of IPO lockups. In this section, we check the robustness of our results by conducting three additional sets of tests. First, we use an alternate measure of liquidity changes. Second, we use different windows for measuring pre- and post-lockup expiration periods. Finally, we use an alternate procedure for identifying liquidity changes.

Our first robustness check is based on the premise that there is no universally accepted measure of liquidity. We therefore construct our own index of liquidity changes. The index uses the following five variables to characterize stock market liquidity: time-weighted percentage quoted spread, trade-weighted effective percentage spread, time between trades, number of trades required to transact $1 million, and daily return volatility. These variables are computed for each stock and averaged during the pre- (-21, -40) and post- (+21, +40) lockup expiration windows. The ratio of each variable (Post/Pre) is then calculated for each firm. An equally weighted average of the five variables used constitutes our measure of liquidity changes. Ratios exceeding 1.0 indicate a post-lockup expiration deterioration in liquidity. We use the same windows to denote pre- and post-lockup expiration to make our results directly comparable to that using Amihud's illiquidity ratio measure.

The variables chosen for computing the liquidity index takes into account perceptions of liquidity faced by various types of investors such as retail investors and institutional traders. The first variable, time-weighted quoted spread denotes the perceived cost of liquidity faced by retail investors. The second variable, trade-weighted effective percentage spread corresponds to the cost of liquidity provision from the perspective of dealers making market in the stock. The third variable, time to taken trade, which is measured by total trading hours divided by the number of trades, signifies the trading delay faced by professional traders. The fourth variable, the number of trades required to transact $1 million represents a liquidity measure of interest to institutional traders executing high volume transactions. Finally, the return volatility is a liquidity measure of interest to sophisticated investors such as hedge funds.

The results of our robust regressions are reported in Table 5. In Panel A, we show results using the (-20, +20) CAR window. We find that our constructed index of liquidity changes has a negative and statistically significant coefficient after controlling for control variables. We are thus able to confirm, by using an alternate measure of liquidity changes, that an increase in illiquidity is associated with negative stock returns in the period surrounding lockup expiration. In fact, our results are stronger with the constructed index as compared to Amihud's illiquidity measure.

In Panel B, we provide multivariate regression results using the (+2, +20) window for CAR. Once again, we are able to provide strong confirmatory evidence that an increase in illiquidity is associated with a decline in stock prices in the post-lockup window. Barring minor changes, our principal conclusions remain unaltered.

Our second robustness checks involves repeating our analysis by using the (-20,-1) and (+1,+20) windows to denote pre- and post- lockup periods respectively. Our empirical results remain qualitatively unaltered[4].

[4] These results are available from the authors upon request. Since the Amihud's illiquidity measure uses $|R_{it}|$ there is a potential problem of spurious correlation between this measure and the CARs.

Our final robustness checks involve the use of a transition matrix framework to classify our sample stocks into groups based pre- and post-lockup illiquidity. For each stock, we compute Amihud's illiquidity measure in the 20-day period before and the 20-day period after lockup expiration. For each of the pre- and post- lockup expiration periods, we characterize stocks whose illiquidity measure was below the median as liquid (LIQ) and the others as illiquid (ILLIQ). The diagonal cells [(LIQ, LIQ), and (IILIQ, ILLIQ) contain stocks which are expected to be relatively liquid and illiquid respectively. The stocks in the off-diagonal cells experience changes in liquidity in the post-lockup period. For example, firms in the (LIQ, ILLIQ) cell experience declines in liquidity.

We then compute CARs (-20, +20) for the cells of the transition matrix. For the firms that became illiquid (LIQ, ILLIQ) in the post-lockup period, CAR averages -12.57% and is significantly more negative than those firms with expected illiquidity (ILLIQ, ILLIQ). Firms that became more liquid in the post-lockup period (ILLIQ, LIQ) experience positive CARs of 5.54% on average, which are statistically significant and higher than firms that are expected to be liquid. The fact that firms that experience improvements in liquidity show positive CARs is particularly noteworthy.[5]

Summing up, using our robustness checks involving three different methods, we are able to substantiate our primary result that changes in liquidity are strongly associated with the stock price reaction during the period surrounding lock-up expiration.

6. Can Liquidity Changes Predict CARs?

[5] Detailed results are available from the others upon request.

So far, we have demonstrated that liquidity changes are associated with CARs around lockup expiration. A related question is whether observed liquidity changes can predict future CARs. We address the issue below.

We measure liquidity changes during the pre- and post-lockup expiration windows of (-2, -10) and (+2, +10) and CARs during the (+11, +20) period. We conduct multivariate regressions using CAR as the dependent variable and ΔILLIQ, where the latter represents illiquidity changes in the post-lockup period as the main independent variable. We use the same control variables as in Sections 4 and 5. The results are reported in Table 6. In Model 1, we use Amihud measure for measuring illiquidity changes and in Model 2, we use our constructed index of liquidity changes. Both models show negative and statistically significant coefficients for the ΔILLIQ variable. This result indicates that firms experiencing an increase in illiquidity are predicted to suffer negative CARs in the subsequent period. OI and RUNUP show negative coefficients whereas SUPPLY shows a positive coefficient. The other variables are not statistically significant. Our results are not sensitive to the definition of pre- and post-lockup expiration windows.

Figure 2 graphically depicts the pattern in CARs during the (+11, +30) window. The figure confirms the continued divergence in CARs of the LIQ and the ILLIQ subsamples. The magnitude of decline in CARs of ILLIQ firms is larger as compared to the increase in magnitude of LIQ firms during this window.

In summary, we show that liquidity changes can predict future stock returns subsequent to the measurement period. An implication of this finding is that stocks take a longer time to incorporate liquidity changes into prices.

7. Conclusion

Despite considerable research on the lockup expiration of IPOs, there remain few satisfactory explanations for the observed negative stock price reaction. Since the unlock event per se is devoid of any informational content, the empirical finding has remained a conundrum. Prior studies on the market microstructure effects around unlock day do not find any evidence regarding deterioration in liquidity.

Our contribution in this paper is two-fold. First, we show that a subset of firms experience deterioration in liquidity during the post-lock up period. Second, we show that this deterioration in liquidity is associated with negative CARs during the post-lock up period. Our results are robust to the use of alternate procedures to define changes in liquidity. Further research on the factors driving the observed deterioration in liquidity is likely to be a fruitful endeavour.

References

Amihud, Y (2002). Illiquidity and stock returns: Cross-section and time series effects. *Journal of Financial Markets,* 5, 31 – 56.

Bradley, D., Jordan, B., & Roten, I., & Yi, H. (2001). Venture capital and IPO lockup expiration: an empirical analysis. *Journal of Financial Research,* 24, 465 – 493.

Brav, A. & Gompers, P. (2003). The Role of Lock-ups in Initial Public Offerings. *Review of Financial Studies*, 16, 1 – 29.

Cao, C., Field, L., & Hanka, G. (2004). Does insider trading impair market liquidity? evidence from IPO lockup expirations. *Journal of Financial and Quantitative Analysis*, 39, 25 – 46.

Easley, D., Kiefer, N., & O'Hara, M. (1997). The information content of the trading Process. *Journal of Empirical Finance*, 4, 159-186.

Field, L. & Hanka, G. (2001). The expiration of IPO share lockups. *Journal of Finance*, 56, 471 – 500.

Gao, Y. (2005). Trading and information environment of IPO stocks around lockup expiration: Evidence from intraday data. Cornell University Working Paper.

Glosten, L., & Milgrom, P. (1985). Bid, ask, and transaction prices in a specialist market with heterogeneously informed traders. *Journal of Financial Economics,* 14, 71 – 100.

Krishnamurti, C. & Thong, T. Y. (2008). Lockup Expiration, Insider Selling and Bid-Ask Spreads. *International Review of Economics and Finance*, Volume 17, 230-244.

Kyle, A. (1985). Continuous auctions and insider trading. *Econometrica*, 53, 1315 – 1335.

Silber, W. L. (1975). Thinness in capital markets: The case of the Tel Aviv Stock Exchange. *Journal of Financial and Quantitative Analysis,* 10, 129 – 142.

Figure 1

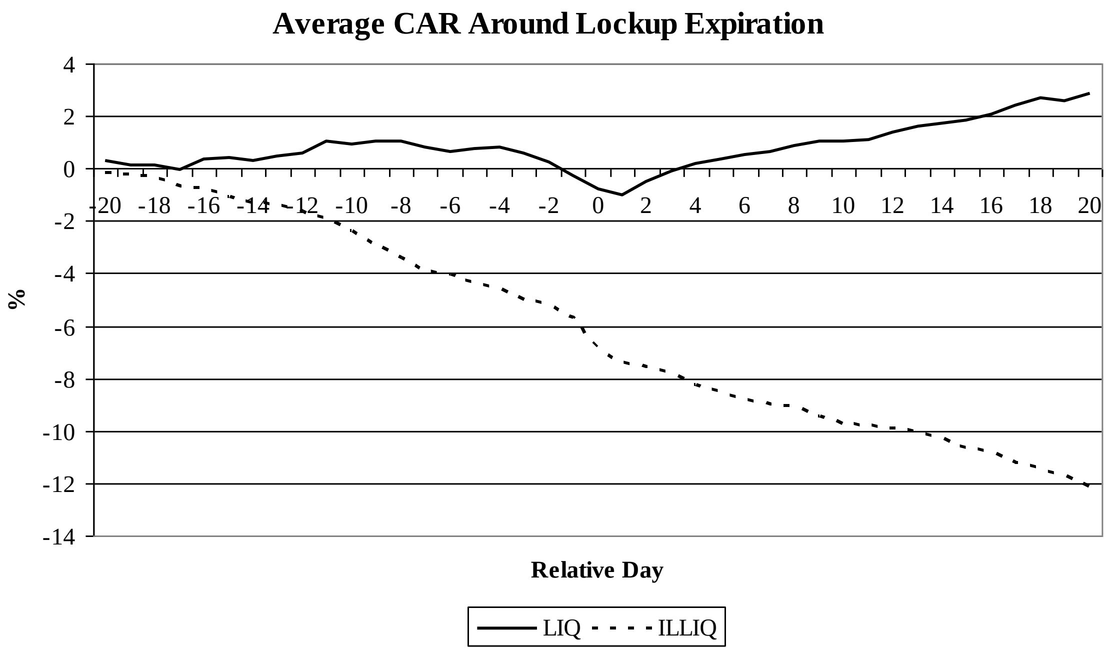

Figure 2

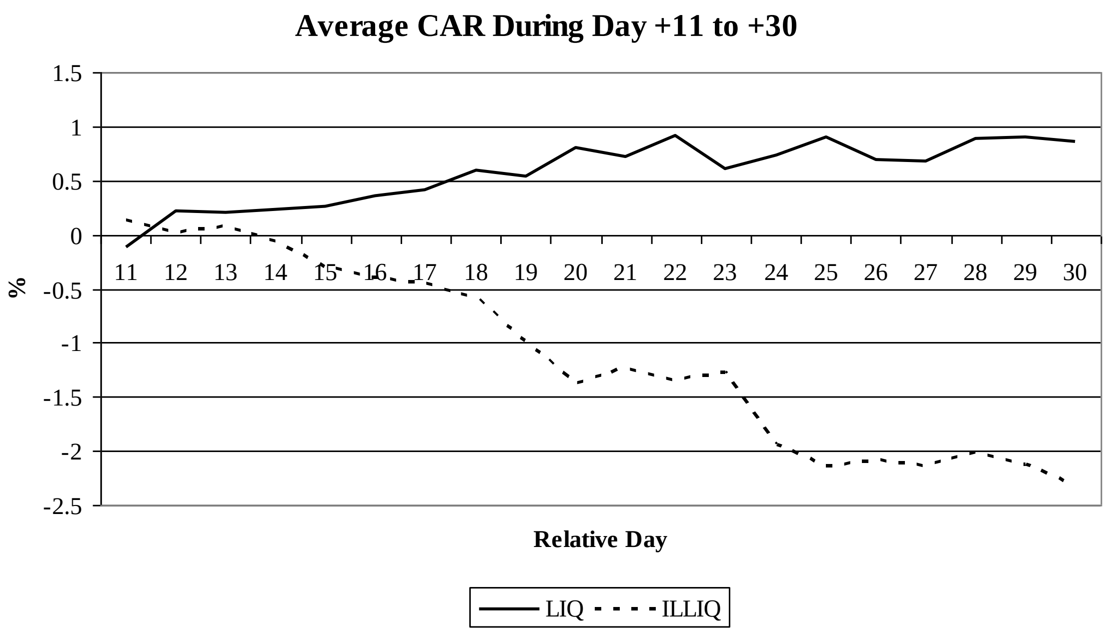

Table 1 Descriptive Statistics

This table presents the offer and firm characteristics for the lockup expiration sample. The IPO sample period is from 1993 to 2005. Panel A and B report the means, medians, and standard deviations for all firms and liquid (LIQ) vs illiquid (ILLIQ) subsamples, respectively. Liquid (illiquid) firms are defined as those firms whose ratio of Amihud illiquidity measure in post-lockup [+21,+40] to pre-lockup [-40,-21] period is less than 1 (more than 1). Amihud illiquidity measure is computed as $|R_{it}|/DVOL_{it}$. Shares offered is the number of shares issued to the public by the issuers. Net proceeds is the total amount raised by the issuers excluding fees and expenses. Offer price is the issuing price of the IPO shares. Filing Price Range is defined as the difference between high and low filing price as a percentage of the low filing price. Offer to close returns is the difference between the closing price and offer price as a percentage of the offer price. Over-allotment shares represents the additional shares that issuer allows the underwriter to offer, typically 15% of the initial issue. The number of underwriters includes lead and co-lead manager in the IPO process. Lockup Days is the number of days that the insiders are prohibited from selling their shares in the aftermarket. Lockup shares are the number of shares held by the managers, executives and other investors which are restricted from selling during the lockup period. These are denoted as shares eligible for future sale in the IPO prospectus. Firm age is measured from the founding year to the IPO year. Shares outstanding represent the number of shares outstanding after IPO. Market value is defined as the first day closing price multiplied by the number of shares outstanding after IPO. The debt to asset ratio equals total debt divided by total assets. Total assets, total liabilities, net sales, net income and returns on assets (ROA) are based on the most recent fiscal year ending prior to the IPO lockup expiration. The mean and median comparisons of LIQ and ILLIQ samples are based on independent t-test and Wilcoxon Signed Ranks test, respectively. ***, **, and * represent significance at the 1%, 5%, and 10% levels for a two-tailed test, respectively.

Panel A: All Firms (1609)

	mean	median	std. dev.
Offer Characteristics			
Shares Offered (million)	4.114	2.900	5.043
Net Proceeds ($million)	60.942	35.828	99.816
Offer Price ($)	12.636	12.000	4.302
Filing Price Range (%)	17.243	16.667	6.655
Offer to Close Returns (%)	20.327	10.294	37.579
Over-allotment Shares (million)	0.704	0.465	0.866
No. of Underwriters	2.800	2.000	1.490
Lockup Days	194.751	180.000	62.116
Lockup Shares (million)	12.796	8.014	20.002
Firm Characteristics			
Firm Age (years)	14.623	8.000	19.175
Shares Outstanding (million)	16.865	10.834	24.585
Market Value ($million)	311.345	153.563	732.492
Total Assets ($million)	218.242	25.957	1,574.374
Total Liabilities ($million)	187.273	16.282	1,386.224
Net Sales ($million)	163.994	31.909	790.641
Net Income ($million)	-0.715	0.831	36.195
ROA	-0.049	0.114	0.663
Debt to Asset Ratio	0.355	0.261	0.487

Panel B: Liquid vs Illiquid Firms

	LIQ Firms (845)			ILLIQ Firms (764)			Difference LIQ – ILLIQ	
	mean	median	std. dev.	mean	median	std. dev.	mean	median
Offer Characteristics								
Shares Offered (million)	4.296	3.000	4.880	3.912	2.700	5.212	0.384	0.300***
							(1.52)	(2.93)
Net Proceeds ($million)	64.664	38.363	91.377	56.825	32.480	108.300	7.839	5.883***
							(1.56)	(4.03)
Offer Price ($)	12.747	12.500	4.206	12.514	12.000	4.404	0.233	0.500
							(1.09)	(1.40)
Filing Price Range (%)	17.114	16.667	7.296	17.385	16.667	5.869	-0.271	0.000
							(0.82)	(0.55)
Offer to Close Returns (%)	20.308	11.389	34.410	20.348	8.929	40.821	-0.040	2.460
							(0.02)	(1.39)
Over-allotment Shares (million)	0.758	0.510	0.888	0.645	0.450	0.837	0.113***	0.060***
							(2.61)	(4.52)
No. of Underwriters	2.920	3.000	1.558	2.669	2.000	1.401	0.251***	1.000***
							(3.40)	(3.96)
Lockup Days	194.633	180.000	66.009	194.882	180.000	57.549	-0.249	0.000
							(0.08)	(1.18)
Lockup Shares (million)	13.412	9.086	15.480	12.114	6.910	24.025	1.298	2.176***
							(1.27)	(4.67)
Firm Characteristics								
Firm Age (years)	14.586	8.000	19.088	14.665	8.000	19.285	-0.079	0.000
							(-0.08)	(0.27)
Shares Outstanding (million)	17.605	11.850	18.499	16.047	9.706	29.900	1.558	2.144***
							(1.24)	(5.08)
Market Value ($million)	311.250	169.539	457.165	311.450	131.973	948.454	-0.200	37.566***
							(-0.01)	(4.48)
Total Assets ($million)	216.439	27.413	1,067.660	220.236	24.999	1,990.672	-3.797	2.414**
							(-0.05)	(2.17)
Total Liabilities ($million)	186.232	15.842	971.621	188.423	16.894	1,733.632	-2.191	-1.052
							(-0.03)	(-0.79)
Net Sales ($million)	159.326	32.525	506.632	169.157	30.971	1,016.579	-9.831	1.554
							(-0.24)	(0.96)
Net Income ($million)	-0.869	0.701	29.996	-0.544	1.003	42.019	-0.325	-0.302
							(-0.18)	(-1.48)
ROA	-0.047	0.104	0.687	-0.051	0.123	0.637	0.004	-0.019
							(0.10)	(-1.36)
Debt to Asset Ratio	0.329	0.224	0.393	0.385	0.303	0.571	-0.056**	-0.079***
							(-2.25)	(-2.71)

Table 2 Quote and Trade Characteristics

This table presents the summary statistics for the quote and trade activities for the entire sample as well as the liquid (LIQ) and illiquid (ILLIQ) subsamples around lockup expirations. Liquid (illiquid) firms are those firms whose ratio of Amihud illiquidity measure in post-lockup to pre-lockup period is less than 1 (more than 1). Amihud illiquidity measure is computed as $|R_{it}|/DVOL_{it}$. The pre- and post-lockup expiration windows are [-40,-21] and [+21,+40] days with respect to the unlock day respectively. We compute quoted and effective spreads in terms of dollars and percentages. The quoted and effective spreads are averaged on the basis of time-weighting and trade-weighting respectively. Depth is the sum of bid and ask depths measured in terms of share volume. The number of trades is the total number of transactions per day. Trade size is the average trading volume per transaction and trading value is the average of the product of price and quantity traded per day. Return volatility is the standard deviation of the intraday returns. The comparison of means and medians for LIQ vs ILLIQ in pre- and post-lockup periods are based on the independent t-test and Wilcoxon signed ranks tests. For the comparison of the pre- and post-lockup means and medians, we compute the paired sample t-statistics and the z-statistics based on Wilcoxon signed ranks test in the parentheses. *, **, and *** represent the 10%, 5%, and 1% two-tailed significance level, respectively.

		All Firms (1609)			LIQ Firms (845)			ILLIQ Firms (764)			Difference LIQ – ILLIQ	
		Pre [-40,-21]	Post [+21,+40]	Difference Pre – Post	Pre [-40,-21]	Post [+21,+40]	Difference Pre – Post	Pre [-40,-21]	Post [+21,+40]	Difference Pre – Post	Pre [-40,-21]	Post [+21,+40]
Quote Activities												
Quoted dollar spread	Mean	0.3726	0.3484	0.0242	0.3660	0.3262	0.0398	0.3798	0.3730	0.0068	-0.0138	-0.0468
				(7.02) ***			(9.98) ***			(1.19)	(-1.16)	(-3.81) ***
	Median	0.3256	0.2959	0.0297	0.3102	0.2692	0.0410	0.3345	0.3187	0.0158	-0.0243	-0.0495
				(9.19) ***			(11.00) ***			(1.92) *	(-1.66) *	(-3.76) ***
Quoted percentage spread	Mean	0.0289	0.0301	-0.0012	0.0271	0.0228	0.0043	0.0310	0.0381	-0.0071	-0.0039	-0.0153
				(-2.82) ***			(11.38) ***			(-10.80) ***	(-3.50) ***	(-10.84) ***
	Median	0.0244	0.0236	0.0008	0.0223	0.0178	0.0045	0.0267	0.0314	-0.0047	-0.0044	-0.0136
				(1.45)			(15.01) ***			(-12.09) ***	(-3.69) ***	(-12.47) ***
Effective dollar spread	Mean	0.2225	0.2073	0.0152 ***	0.2176	0.1983	0.0193	0.2279	0.2174	0.0105	-0.0103	-0.0191
				(5.97)			(6.83) ***			(2.43) **	(-1.50)	(-2.79) ***
	Median	0.1998	0.1809	0.0189	0.1919	0.1733	0.0186	0.2055	0.1853	0.0202	-0.0136	-0.0120
				(7.72) ***			(7.77) ***			(3.12) ***	(-1.83) *	(-2.78) ***
Effective percentage spread	Mean	0.0170	0.0178	-0.0008	0.0160	0.0135	0.0025	0.0181	0.0227	-0.0046	-0.0021	-0.0092
				(-3.16) ***			(10.44) ***			(-9.66) ***	(-3.53) ***	(-11.24) ***
	Median	0.0152	0.0142	0.0010	0.0143	0.0117	0.0026	0.0161	0.0188	-0.0027	-0.0018	-0.0071
				(1.39)			(13.52) ***			(-10.59) ***	(-4.28) ***	(-12.89) ***
Depth	Mean	3,429.26	4,667.14	-1,237.88	3,827.04	6,122.89	-2,295.85	2,989.30	3,057.04	-67.74	837.74	3,065.85
				(-6.57) ***			(-7.46) ***			(-0.35)	(1.78) *	(5.39) ***
	Median	247.95	343.60	-95.65	291.11	578.35	-287.24	206.92	196.00	10.92	84.19	382.35
				(-10.66) ***			(-14.81)			(1.65) *	(2.68) ***	(8.28) ***
Bid Depth	Mean	1,670.79	2,209.51	-538.72	1,838.55	2,854.99	-1,016.44	1,485.24	1,495.60	-10.36	353.31	1,359.39
				(-5.67) ***			(-6.91) ***			(-0.09)	(1.53)	(5.11) ***
	Median	119.42	161.84	-42.42	145.40	274.05	-128.65	105.20	97.17	8.03	40.20	176.88
				(-10.32) ***			(-14.06)			(1.28)	(2.66) ***	(8.21) ***
Ask Depth	Mean	1,758.47	2,457.62	-699.15	1,988.49	3,267.90	-1,279.41	1,504.06	1,561.44	-57.38	484.43	1,706.46

				(-6.75) ***			(-7.32) ***			(-0.60)	(1.95) *	(5.48) ***
	Median	126.33	168.80	-42.47	146.16	296.70	-150.54	105.92	100.73	5.19	40.24	195.97
				(-11.09) ***			(-15.06) ***			(1.36)	(2.68) ***	(8.33) ***
Number of Quotes	Mean	312.25	422.38	-110.13	384.08	554.20	-170.12	232.81	276.59	-43.78	151.27	277.61
				(-6.94) ***			(-6.95) ***			(-2.26) **	(4.28) ***	(5.57) ***
	Median	15.72	18.05	-2.33	19.68	30.35	-10.67	13.58	12.10	1.48	6.10	18.25
				(-7.21) ***			(-12.94) ***			(4.96) ***	(3.36) ***	(8.40) ***
Trade Activities												
Number of Trades	Mean	147.18	178.36	-31.18	142.76	234.58	-91.82	152.06	116.19	35.87	-9.30	118.39
				(-3.70) ***			(-7.41) ***			(3.34) ***	(-0.47)	(6.53) ***
	Median	32.85	40.45	-7.60	35.10	69.10	-34.00	30.53	22.81	7.72	4.57	46.29
				(-7.81) ***			(-17.35) ***			(9.80) ***	(1.63)	(11.39) ***
Trade Size	Mean	95,554.63	123,209.72	-27,655.09	89,886.68	156,376.56	-66,489.88	101,823.50	86,526.50	15,297.00	-11,936.82	69,850.06
				(-6.08) ***			(-10.53) ***			(2.47) **	(-1.39)	(6.62) ***
	Median	43,905.00	53,693.20	-9,788.20	44,090.00	84,370.00	-40,280.00	43,247.50	32,605.00	10,642.50	842.50	51,765.00
				(-8.19) ***			(-16.86) ***			(8.08) ***	(0.50)	(12.71) ***
Trading Value ($Thousand)	Mean	2,341.60	2,749.34	-407.74	2,083.98	3,901.28	-1,817.30	2,626.54	1,475.26	1,151.28	-542.56	2,426.02
				(-2.38) **			(-8.26) ***			(4.53) ***	(-1.31)	(6.92) ***
	Median	633.87	685.12	-51.25	669.81	1,264.79	-594.98	604.57	345.65	258.92	65.24	919.14
				(-4.94) ***			(-17.91) ***			(15.06) ***	(1.50)	(15.03) ***
Return Volatility	Mean	0.0143	0.0145	-0.0002	0.0133	0.0111	0.0022	0.0153	0.0181	-0.0028	-0.0020	-0.0070
				(-0.98)			(11.08) ***			(-8.76) ***	(-3.44) ***	(-11.11) ***
	Median	0.0122	0.0116	0.0006	0.0111	0.0090	0.0021	0.0130	0.0152	-0.0022	-0.0019	-0.0062
				(-2.85) ***			(15.54) ***			(-10.61) ***	(-4.06) ***	(-11.86) ***

Table 3 Cumulative Abnormal Returns (CARs) Around Lockup Expiration

This table reports the mean and median values of the cumulative abnormal returns around IPO lockup expiration dates for all, Liquid (LIQ), and Illiquid (ILLIQ) firms. Liquid (illiquid) firms are those firms whose ratio of Amihud illiquidity measure in post-lockup [+21,+40] to pre-lockup [-40,-21] period is less than 1 (more than 1). Amihud illiquidity measure is computed as $|R_{it}|/DVOL_{it}$. CARs are based on a market model with the CRSP value-weighted index as the proxy for the market return and the estimation period is from day -120 to day -21. The mean and median comparisons of LIQ and ILLIQ samples are based on the independent t-test and Wilcoxon Signed Ranks test, respectively. ***, **, and * represent significance at the 1%, 5%, and 10% levels for a two-tailed test, respectively.

	All Firms (1609)		LIQ Firms (845)		ILLIQ Firms (764)		Difference LIQ - ILLIQ	
windows	mean	median	mean	median	mean	median	mean	median
(-20,+20)	-4.23%***	-3.48%***	2.88%*	1.58%***	-12.09%***	-9.88%***	14.97***	11.46***
	(-6.42)	(-2.60)	(1.96)	(3.43)	(-11.38)	(-7.38)	(8.88)	(8.81)
(-10,+10)	-3.74%***	-3.21%***	0.03%	-1.36%	-7.91%***	-5.08%***	7.94***	3.72***
	(-6.95)	(-4.45)	(-0.14)	(0.12)	(-9.93)	(-6.58)	(7.21)	(6.29)
(-5,+5)	-2.27%***	-1.75%***	-0.26%	-0.84%	-4.49%***	-3.38%***	4.23***	2.54***
	(-5.59)	(-3.20)	(0.08)	(0.19)	(-8.19)	(-4.85)	(5.25)	(4.59)
(-1,+1)	-1.73%***	-1.33%***	-1.30%***	-1.11%***	-2.22%***	-1.61%***	0.92*	0.50
	(-8.80)	(-4.85)	(-4.27)	(-2.70)	(-8.28)	(-4.19)	(1.95)	(1.59)
(0,0)	-0.87%***	-0.50%***	-0.55%**	-0.36%	-1.22%***	-0.70%***	0.67**	0.34**
	(-7.04)	(-3.10)	(-2.48)	(-1.05)	(-7.61)	(-3.40)	(2.29)	(2.05)
(+2,+5)	0.19%	-0.39%	1.39%***	0.19%**	-1.14%***	-1.02%**	2.53***	1.21***
	(1.07)	(0.05)	(4.53)	(2.40)	(-3.21)	(-2.45)	(5.06)	(4.85)
(+2,+10)	-0.04%	-0.63%	2.08%***	0.70%***	-2.38%***	-1.87%***	4.46***	2.57***
	(0.18)	(-0.05)	(4.34)	(3.57)	(-4.30)	(-3.83)	(6.14)	(5.68)
(+2,+20)	-0.19%	-0.82%	3.92%***	2.18%***	-4.72%***	-3.75%***	8.64***	5.93***
	(-0.27)	(0.70)	(5.52)	(5.50)	(-6.19)	(-4.77)	(8.47)	(8.52)

Table 4 Regression Analysis of Cumulative Abnormal Returns (CAR) Around Lockup Expiration

This table reports the regression results for the cumulative abnormal returns around the lockup expiration period. The dependent variables are the CAR(-20,+20) and CAR(+2,+20) in panels A and B, respectively. CARs are based on the market model with the CRSP value-weighted index as the proxy for the market return and the estimation period runs from day -120 to day -21. VC is a dummy variable that equals one if the firm is venture capital backed; otherwise zero. DILLIQ is the average ratio of Amihud illiquidity measure in the post-lockup (+40,+21) to pre-lockup (-21,-40) period. Amihud illiquidity measure is computed as $|R_{it}|/DVOL_{it}$. INSIDE is defined as the ratio of insider sales of shares in the period (0,+20) to the number of shares locked up. Insiders are directors, committees, officers, affiliates, and beneficial owners who are subject to lockup restrictions of investment bankers. OI is the order imbalance defined as the sum of (sell dollar volume – buy dollar volume)/daily trading value during the CAR window. SUPPLY is defined as the sum of (daily trading value – normal trading value)/normal trading value during (-20,+20). Normal trading volume is computed based on the average daily trading value during day -120 to day -21. RUNUP the rate of return for each firm computed from the closing price on listing date to day -41. TECH refers to technology firms and is a dummy variable that equals 1 if identified as high tech in SDC database; otherwise zero. NYSE is equal to 1 if the firm is NYSE-listed; otherwise zero. UWREP is the underwriter reputation which equals to 1 if Jay Ritter's underwriter ranking is greater than 8; otherwise zero. t-value is in the parentheses. *, **, and *** represent the 10%, 5%, and 1% two-tailed significance level, respectively. The t-statistics in the parentheses are White heteroskedasticity-consistent.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Panel A: CAR(-20,+20)												
Intercept	-0.0386***	-0.0145	-0.0446***	-0.0372***	-0.0615***	-0.0325***	-0.0220**	-0.0478***	-0.0341**	0.0145	-0.0518***	0.0247*
	(-4.01)	(-1.46)	(-5.22)	(-4.26)	(-6.96)	(-4.06)	(-2.36)	(-5.20)	(-2.84)	(1.00)	(-5.65)	(1.68)
DILLIQ	-0.0050**									-0.0066***		-0.0044**
	(-2.10)									(-2.90)		(-2.18)
VC		-0.0729***								-0.0656***		-0.0704***
		(-4.28)								(-3.67)		(-4.02)
INSIDE			-0.1108**							-0.0783		-0.0867*
			(-1.96)							(-1.56)		(-1.70)
OI				-0.0064***							-0.0054***	-0.0083***
				(-3.39)							(-2.93)	(-4.52)
SUPPLY					0.0005***						0.0005***	0.0005***
					(3.36)						(3.38)	(3.53)
RUNUP						-0.2018***				-0.2000***		-0.1997***
						(-9.92)				(-9.85)		(-9.84)
TECH							-0.0484***			-0.0120		-0.0170
							(-2.99)			(-0.71)		(-1.02)
NYSE								-0.0048		-0.0445**		-0.0690***
								(-0.25)		(-2.14)		(-3.13)
UWREP									-0.0224	0.0162		0.0092
									(-1.36)	(1.00)		(0.58)
N	1609	1609	1609	1609	1609	1609	1609	1609	1609	1609	1609	1609
Adj. R^2	0.003	0.011	0.003	0.005	0.032	0.128	0.005	-0.001	0.0004	0.142	0.035	0.178
F-statistic	5.76**	18.99***	5.87**	8.67***	53.33***	236.23***	8.30***	0.03	1.65	38.95***	30.01***	39.66***

Panel B: CAR(+2,+20)

Intercept	0.0014	0.0047	-0.0059	0.0025	-0.0188***	0.00002***	-0.0040	-0.0062	-0.0030	0.0111	-0.0109**	0.0135
	(0.24)	(0.77)	(-1.17)	(0.49)	(-3.62)	(0.003)	(-0.68)	(-1.13)	(-0.37)	(1.21)	(-2.04)	(1.46)
DILLIQ	-0.0037**									-0.0041***		-0.0021**
	(-3.00)									(-3.32)		(-2.10)
VC		-0.0225**								-0.0273**		-0.0305***
		(-2.21)								(-2.41)		(-2.77)
INSIDE			0.0060							0.0157		-0.0007
			(0.19)							(0.54)		(-0.02)
OI				-0.0103***							-0.0095***	-0.0112***
				(-5.48)							(-5.02)	(-5.78)
SUPPLY					0.0009***						0.0008***	0.0008***
					(4.42)						(4.36)	(4.20)
RUNUP						-0.0734***				-0.0744***		-0.0752***
						(-7.19)				(-7.31)		(-7.37)
TECH							-0.0032			0.0122		0.0067
							(-0.32)			(1.14)		(0.65)
NYSE								0.0039		-0.0068		-0.0223
								(0.31)		(-0.52)		(-1.61)
UWREP									-0.0043	0.0051		0.0005
									(-0.42)	(0.49)		(0.05)
N	1609	1609	1609	1609	1609	1609	1609	1609	1609	1609	1609	1609
Adj. R^2	0.005	0.003	-0.001	0.014	0.041	0.047	-0.001	-0.001	-0.001	0.054	0.052	0.105
F-statistic	8.70***	5.05**	0.05	23.01**	69.52***	80.97***	0.10	0.06	0.17	14.12***	45.21***	22.00***

Table 5 Robust Regression Analysis of Cumulative Abnormal Returns (CAR) Around Lockup Expiration

This table reports the regression results for the cumulative abnormal returns around the lockup expiration period. The dependent variable is the CAR(-20,+20). CARs are based on the market model with the CRSP value-weighted index as the proxy for the market return and the estimation period is from day -120 to day -21. VC is a dummy variable that equals one if the firm is venture capital backed; otherwise zero. ILLIQ_INDEX is computed based on the 5 variables: time-weighted percentage quoted spread, trade-weighted percentage effective spread, total trading hours divided number of trades, $1million divided dollar value of trade, and daily return volatility. We first compute the ratio of each variable in the post-lockup (+40,+21) to pre-lockup (-21,-40) period. We then compute the equally-weighted values based on the ratios. INSIDE is defined as the ratio of insider sales of shares in the period (0,+20) to the number of shares locked up. Insiders are directors, committees, officers, affiliates, and beneficial owners who are subject to lockup restrictions of investment bankers. OI is the order imbalance defined as the sum of (sell dollar volume – buy dollar volume)/daily trading value during the CAR window. SUPPLY is defined as the sum of (daily trading value – normal trading value)/normal trading value during (-20,+20). Normal trading volume is computed based on the average daily trading value during day -120 to day -21. RUNUP the rate of return for each firm computed from the closing price on listing date to day -41. TECH refers to technology firms and is a dummy variable that equals 1 if identified as high tech in SDC database; otherwise zero. NYSE is equal to 1 if the firm is NYSE-listed; otherwise zero. UWREP is the underwriter reputation which equals to 1 if Jay Ritter's underwriter ranking is greater than 8; otherwise zero. t-value is in the parentheses. *, **, and *** represent the 10%, 5%, and 1% two-tailed significance level, respectively. The t-statistics in the parentheses are White heteroskedasticity-consistent.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Panel A: CAR(-20,+20)												
Intercept	0.1433***	-0.0145	-0.0446***	-0.0372***	-0.0615***	-0.0325***	-0.0220**	-0.0478***	-0.0341**	0.2239***	-0.0518***	0.1960
	(6.02)	(-1.46)	(-5.22)	(-4.26)	(-6.96)	(-4.06)	(-2.36)	(-5.20)	(-2.84)	(8.48)	(-5.65)	(7.03)
ILLIQ_INDEX	-0.1793***									-0.1960***		-0.1636***
	(-8.57)									(-9.98)		(-7.80)
VC		-0.0729***								-0.0638***		-0.0681***
		(-4.28)								(-3.73)		(-4.02)
INSIDE			-0.1108**							-0.1089*		-0.1103**
			(-1.96)							(-1.94)		(-1.97)
OI				-0.0064***							-0.0054***	-0.0053***
				(-3.39)							(-2.93)	(-2.92)
SUPPLY					0.0005***						0.0005***	0.0004***
					(3.36)						(3.38)	(3.82)
RUNUP						-0.2018***				-0.2006***		-0.2000***
						(-9.92)				(-10.00)		(-9.95)
TECH							-0.0484***			-0.0180		-0.0206
							(-2.99)			(-1.11)		(-1.28)
NYSE								-0.0048		-0.0486**		-0.0638***
								(-0.25)		(-2.55)		(-3.15)
UWREP									-0.0224	0.0021		-0.0005
									(-1.36)	(0.13)		(-0.03)
N	1609	1609	1609	1609	1609	1609	1609	1609	1609	1609	1609	1609
Adj. R^2	0.051	0.011	0.003	0.005	0.032	0.128	0.005	-0.001	0.0004	0.196	0.035	0.214
F-statistic	87.81***	18.99***	5.87**	8.67***	53.33***	236.23***	8.30***	0.03	1.65	57.12***	30.01***	49.64***

Panel B: CAR(+2,+20)												
Intercept	0.1094***	0.0047	-0.0059	0.0025	-0.0188***	0.00002***	-0.0040	-0.0062	-0.0030	0.1299***	-0.0109**	0.1016***
	(7.03)	(0.77)	(-1.17)	(0.49)	(-3.62)	(0.003)	(-0.68)	(-1.13)	(-0.37)	(6.89)	(-2.04)	(4.66)
ILLIQ_INDEX	-0.1077***									-0.1119***		-0.0813***
	(-7.70)									(-7.81)		(-4.78)
VC		-0.0225**								-0.0262**		-0.0288***
		(-2.21)								(-2.41)		(-2.69)
INSIDE			0.0060							-0.0015		-0.0092
			(0.19)							(-0.05)		(-0.29)
OI				-0.0103***							-0.0095***	-0.0093***
				(-5.48)							(-5.02)	(-4.75)
SUPPLY					0.0009***						0.0008***	0.0006***
					(4.42)						(4.36)	(3.15)
RUNUP						-0.0734***				-0.0748***		-0.0757***
						(-7.19)				(-7.33)		(-7.39)
TECH							-0.0032			0.0087		0.0055
							(-0.32)			(0.85)		(0.54)
NYSE								0.0039		-0.0088		-0.0219*
								(0.31)		(-0.71)		(-1.65)
UWREP									-0.0043	-0.0029		-0.0045
									(-0.42)	(-0.28)		(-0.44)
N	1609	1609	1609	1609	1609	1609	1609	1609	1609	1609	1609	1609
Adj. R^2	0.052	0.003	-0.001	0.014	0.041	0.047	-0.001	-0.001	-0.001	0.103	0.052	0.129
F-statistic	89.68***	5.05**	0.05	23.01**	69.52***	80.97***	0.10	0.06	0.17	27.46***	45.21***	27.42***

Table 6 Predictive Regressions

This table reports the regression results for the cumulative abnormal returns around the lockup expiration period. The dependent variable is CAR (+11,+20). CARs are based on the market model with the CRSP value-weighted index as the proxy for the market return and the estimation period is from day -120 to day -21. VC is a dummy variable that equals one if the firm is venture capital backed; otherwise zero. In Model 1, ΔILLIQ is the average ratio of Amihud illiquidity measure in the post-lockup (+2,+10) to pre-lockup (-2,-10) period. Amihud illiquidity measure is computed as $|R_{it}|/DVOL_{it}$. In Model 2, ΔILLIQ is computed based on the 5 variables: time-weighted percentage quoted spread, trade-weighted percentage effective spread, total trading hours divided number of trades, $1million divided dollar value of trade, and daily return volatility. We first compute the ratio of each variable in the post-lockup to pre-lockup period. We then compute the equally-weighted values based on the ratios. INSIDE is defined as the ratio of insider sales of shares in the period (0,+20) to the number of shares locked up. Insiders are directors, committees, officers, affiliates, and beneficial owners who are subject to lockup restrictions of investment bankers. OI is the order imbalance defined as the sum of (sell dollar volume – buy dollar volume)/daily trading value during the CAR window. SUPPLY is defined as the sum of (daily trading value – normal trading value)/normal trading value during (+11, +20). Normal trading volume is computed based on the average daily trading value during day -120 to day -21. RUNUP the rate of return for each firm computed from the closing price on listing date to day -41. TECH refers to technology firms and is a dummy variable that equals 1 if identified as high tech in SDC database; otherwise zero. NYSE is equal to 1 if the firm is NYSE-listed; otherwise zero. UWREP is the underwriter reputation which equals to 1 if Jay Ritter's underwriter ranking is greater than 8; otherwise zero. t-value is in the parentheses. *, **, and *** represent the 10%, 5%, and 1% two-tailed significance level, respectively. The t-statistics in the parentheses are White heteroskedasticity-consistent.

	Model 1	Model 2
INTERCEPT	0.0171***	0.0448***
	(2.61)	(3.40)
ΔILLIQ	-0.0020**	-0.0281***
	(-2.23)	(2.67)
VC	-0.0059	-0.0056
	(-0.75)	(-0.70)
INSIDE	-0.0148	-0.0179
	(-0.72)	(-0.80)
OI	-0.0170***	-0.0167***
	(-8.01)	(-7.86)
SUPPLY	0.0016***	0.0016***
	(8.05)	(7.62)
RUNUP	-0.0438***	-0.0444***
	(-5.55)	(-5.46)
TECH	-0.0080	-0.0091
	(-1.06)	(-1.18)
NYSE	-0.0059	-0.0069
	(-0.72)	(-0.84)
UWREP	-0.0008	-0.0012
	(-0.11)	(-0.15)
N	1609	1609
Adj. R^2	0.101	0.103
F-statistic	21.11***	21.00***