

# The Effect of Lockup on Post-IPO Underperformance

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## ABSTRACT

*This research investigates the relationship between lockup decision and post-IPO underperformance, a relationship that has not yet been empirically examined. Three main results are reached. First, the stock performance of IPOs with lockup declines significantly after lockup expired. Specifically, relative to period before lockup expiration and to firms without lockup, firms with lockup significantly underperform post lockup expiration, especially in stock performance. Second, IPOs with lockup and IPOs with longer lockup length tend to experience more serious post-lockup underperformance. Third, IPOs with higher investor sentiment during lockup suffer from greater post-lockup underperformance, in line with the “over-optimism correction” argument.*

**Keywords:** Lockup, Initial Public Offerings, Underperformance.

## INTRODUCTION

Studies have documented lower long-run performance after initial public offerings (IPO).<sup>1</sup> Aggrawal and Rivoli (1990), for example, argue that the IPO long-run underperformance may be due to fads or speculative bubbles in the early aftermarket stage. This study conjectures that the lockup decision is crucial to the IPO underperformance pattern for two reasons. First, some studies find either positive returns (see Aggarwal and Rivoli, 1990; Ritter, 1991) or no underperformance (see Loughran and Ritter, 1995) in the first few months after the listing. Second, the lockup ensures that the insiders' wealth is connected to the fortunes of the IPO firm for a regulated period of time, and thus prompts insiders to manipulate stock or operating performance in lockup period by engaging earnings management (Teoh, Wong and Rao, 1998; Huang and Lin, 2007). Both evidence of better performance right after IPO and the earnings management behavior in lockup period motivate the hypothesis that the lockup decision, whether there is a lockup and, if so, its lockup length, may affect the behavior of post-IPO performance.

In U.S., the management and pre-public investors “voluntarily” engage lockup agreement with the underwriter. Although the lockup period typically lasts for 180 days, it varies from IPO to IPO. Brav and Gompers (2003) report that firms associated with greater potential informational asymmetries lock up their shares for a longer period of time. Intuitively, more earnings management engaged by managers in longer lockup will result in more reversal effect after lockup expired. Therefore, the U.S. IPO sample provides researchers an excellent opportunity to examine the association between lockup length variation and aftermarket performance. The sample is 470 U.S. IPOs over the period of 1988 to 2005. I employ the market-model abnormal return (CAR) and four-factor-model return (FFMR) to measure the long-run stock performance, and employ operating return on assets (OPROA) and operating return on equity (OPEOE) to measure the operating performance. The empirical result reveals that the stock performance, but not the operating performance, exhibits an obvious transition around lockup expiration; relative to period before lockup expiration and to firms without lockup, firms with lockup significantly underperform post expiration in terms of stock performance. Moreover, the lockup decision indeed explains some of the cross-sectional variation in post-IPO long-term stock returns and operating performance. After controlling for firm size, venture capital backing and growth opportunity, the lockup indicator and the lockup length are negatively correlated with post-lockup underperformance.

Morris (1996), Chen, Hong and Stein (2002) and Duffie, Gârleanu and Pedersen (2002) develop models that imply that the long-term performance of IPO is due to expectations among investors about the firm's future cash flows. Ritter (1991) indicates that investors are systematically over-optimistic about IPO firm's future prospective (market hotness), resulting in irrational investment. Ritter proposes that the price correction following stock overvaluation is the

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<sup>1</sup> See, for example, Aggrawal and Rivoli, 1990; Ritter, 1991; Jain and Kini, 1994; Loughran and Ritter, 1995; Mikkelsen, Partch and Shah, 1997.

main reason for post-IPO underperformance. This, in turn, implies that stocks with high investor sentiment will be associated with long-term stock underperformance subsequently. Fisher and Statman (2000), Brown and Cliff (2004), and Baker and Wurgler (2006) investigate the predictability of sentiment in returns, and find that stocks with high investor sentiment experience relatively low return subsequently. The second research purpose of this study is to examine whether the underperformance after lockup is attributable to excessive optimism during lockup. To proxy sentiment, I examine ten market-weather indicators that can be classified into three categories: individual stock sentiment indicator (individual stock return and individual stock trading volume), overall market sentiment indicator (S&P500 index return, S&P500 index trading volume, S&P500 index option Put/Call ratio, the number of IPOs, the average first-day return on IPOs, NYSE share turnover, and Russell 2000 index return), and fund sentiment indicator (net purchases of mutual funds). The empirical results show that the investor sentiment during lockup is negatively correlated with stock performance after expiration, revealing the negative impact of sentiment during lockup on the post-lockup stock performance.

There has been no study relating research realms of lockup and IPO performance that respectively has widely gained attention on corporate finance literature. This study makes two primary contributions to fill the gap in the literature: (1) It examines the effect of lockup decision on the pattern of post-IPO underperformance and thus unearth new information about IPO aftermarket anomaly; (2) It assesses the association between investor sentiment in lockup period and the magnitude of post-lockup underperformance. The next section discusses the research methods, variables and the sample, followed by the empirical results. The last section offers some concluding remarks.

## METHODOLOGY AND DATA

### Estimating Underperformance

This study employs the market-model abnormal return and four-factor-model return to measure the long-run stock performance (Carhart, 1997), and employs operating return on assets (OPROA) and operating return on equity (OPEOE) to measure the operating performance (Jain and Kini, 1994; Shiah-Hou, 2005).

#### 1. Market-model Cumulative Abnormal Return (CAR)

The post-IPO abnormal return for the firm  $i$  on day  $t$ ,  $AR_{it}$ , is computed as:

$$AR_{it} = R_{it} - (\alpha_i + \beta_i * R_{mt}) \quad (1)$$

The abnormal return on any given day of the event window is the market model residual, which is the difference between the stock's actual return,  $R_{it}$ , and the expected return predicted by the market model parameter estimates and the market return,  $R_{mt}$ . I observe the event window from days -180 to 180, where day 0 is the lockup expiration day. Since about two-thirds of the IPO firms have the lockup length of 180 days, the parameters of the market model,  $\alpha_i$  and  $\beta_i$ , are estimated using daily stock returns and value-weighted market returns for days 181 to 300.<sup>2</sup>

#### 2. Four-Factor Model Returns (FFMR)

Gompers and Lerner (2003) show that the market-model abnormal return suffers from the issue of cross-sectional correlation when event clustering, and results in overestimated t statistic. Moreover, the arbitrage pricing theory (APT) by Ross (1976) proposes that there exist multiple common factors explaining the asset returns. Fama and French (1992, 1993) indicate that, besides the market factor of the CAPM model, size and book-to-market are the common factors underlying the stock returns. In addition, Jegadeesh and Titman (1993), Chan, Jegadeesh and Lakonishok (1996) and Carhart (1997) show that the return momentum is able to explain asset returns. The four-factor model is estimated as follows:

$$R_{pt} - R_{ft} = \alpha_0 + \alpha_1 * (R_{mt} - R_{ft}) + \alpha_2 * SMB_t + \alpha_3 * HML_t + \alpha_4 * UMD_t + \zeta_t \quad (2)$$

where  $R_{pt}$  is the monthly return of portfolio  $p$  in period  $t$ ;  $R_{ft}$  is the 30-day treasury bill return in period  $t$ ;  $R_{mt}$  is the composite value-weighted market return of NYSE, AMEX and NASDAQ;  $SMB_t$  is the size risk premium in period  $t$  (small firm over big firm);  $HML_t$  is the book-to-market risk premium in period  $t$  (value stock over growth stock);  $UMD_t$  is the momentum risk premium in period  $t$  (high momentum over low momentum).

<sup>2</sup> Market returns used in this study are the value-weighted returns of the NYSE, AMEX and NASDAQ.

## Estimating Investor Sentiment

To estimate investor sentiment for each stock-month, I employ the principal component analysis as the means of extracting a composite sentiment measure, rather than just select a single indicator to proxy sentiment.<sup>3</sup> Brown and Cliff (2004) show that this estimating procedure is able to successfully extract measures of unobserved sentiment from various indicators. According to Baker and Stein (2004), Brown and Cliff (2004), and Baker and Wurgler (2006), I examine ten market-weather indicators that can be classified into three categories: individual stock sentiment indicator (individual stock return and individual stock trading volume), overall market sentiment indicator (S&P500 index return, S&P500 index trading volume, S&P500 index option Put/Call ratio, the number of IPOs, the average first-day return on IPOs, NYSE share turnover, and Russell 2000 index return), and fund sentiment indicator (net purchases of mutual funds). The selected indicators are discussed as follows.

### 1. Individual Stock Sentiment Indicator

(a) Individual stock return (ISR): De Long, Shlertzer, Summers and Waldmann (1990) and De Bondt (1993) find that investors predict the trend of stock rewards according to previous stock rewards, so that the continuity of the forecasted stock return arises. For example, when the reward continues for a period of time, the investors will be pervaded with a nervous bull psychology. Although the bull quotation has been accomplished for a period of time at this moment and investors believe that there should be an amended quotation in the short term, the investor's bull psychology continues to increase.

(b) Individual stock trading volume (ISV): Baker and Stein (2004) suggest that trading volume is a liquidity index, so that it can be considered as one of the sentiment proxy.

### 2. Overall Market Sentiment Indicator

(a) S&P500 index return (SP500R) and Russell 2000 index return (RU2000R): These two proxies are included for the same reason as the ISR.

(b) S&P500 index trading volume (SP500V): This proxy is included for the same reason as the ISV.

(c) S&P500 put/call ratio (SP500PC): Brown and Cliff (2004) note that a larger (smaller) put/call ratio indicates the optimistic (pessimistic) atmosphere getting stronger. Following Brown and Cliff, this study includes the S&P500 index option Put/Call ratio variation as a proxy of the investor sentiment.

(d) Initial public offering first-day returns (IPOR) and the number of offerings (IPON): Because of the information asymmetries between IPO managers and outside investors, IPO activity is often associated with market tops. Following Brown and Cliff (2004) and Baker and Wurgler (2006), we include both the mean IPO first-day returns and the number of offerings for each year as the proxies of market sentiment.

(e) NYSE share turnover (NYSESET): NYSE share turnover is the ratio of share volume to average shares listed. Baker and Stein (2004) suggest turnover, or more generally liquidity, to serve as a sentiment proxy. In a market with short-sales constraints, irrational investors participate, and thus add liquidity, only when they are optimistic.

### 3. Fund Sentiment Indicator

**Table 1: Investor Sentiment Indicators**

	Indicator	Definition	Weighting
Individual stock sentiment	Individual stock return (ISR)	$\text{Log}(P_{i,t}) - \text{log}(P_{i,t-1})$	0.090
	Individual stock trading volume (ISV)	$V_{i,t} - V_{i,t-1}$	0.077
Market sentiment	S&P500 index return (SP500R)	$\text{Log}(SP_t) - \text{log}(SP_{t-1})$	0.071
	Russell 2000 index return (RU2000R)	$\text{Log}(Ru_t) - \text{log}(Ru_{t-1})$	0.109
	S&P500 index trading volume (SP500V)	$SPV_t - SPV_{t-1}$	0.075
	S&P500 index option put/call ratio variation (SP500PC)	$(\text{Put}_t/\text{Call}_t) - (\text{Put}_{t-1}/\text{Call}_{t-1})$	0.104
	Initial public offering first day return (IPOR)	See Jay Ritter website	0.157
	Number of offerings (IPON)	See Jay Ritter website	0.152
	NYSE share turnover (NYSESET)	Volume/shares listed	0.106
Mutual fund managers sentiment	Net purchases of mutual funds (NP)	$B_{t-1} - S_t$	0.059

<sup>3</sup> See, for example, Neal and Wheatley (1998) and Fisher and Statman (2000).

$P_{i,t}$  is the closing price at the end of month  $t$  for stock  $i$ .  $V_{i,t}$  is the trading volume of stock  $i$  in month  $t$ .  $SP_t$  is the closing price at the end of month  $t$  for S&P500 index.  $R_{u,t}$  is the closing price at the end of month  $t$  for Russell 2000 index.  $SPV_t$  is the S&P500 trading volume in month  $t$ . Call <sub>$t$</sub>  (Put <sub>$t$</sub> ) is the open interest of S&P500 call (put) option in month  $t$ . NP is the dollar amount difference of fund buy and fund sell in a given stock, where  $B_i$  ( $S_i$ ) is the dollar amount of fund buy (sell) in stock  $i$  in month  $t$ .

Net purchases of mutual funds (NP): Brown and Cliff (2004) indicate that the net purchases by foreign investors and mutual funds positively reflect the extent to which they are optimistic to the individual stock. Following Brown and Cliff, we define NP as the dollar amount difference of fund buy and fund sell in a given stock.

Every sentiment proxy has a corresponding factor score. The composite investor sentiment measure (IS) is the sum of multiplying the transformed factor score (weighting) by its corresponding value of each indicator. Table 1 summarizes the brief definition and the corresponding weighting for each proxy. By definition, high IS can be interpreted as excessive optimism.

### The Effect of Lockup on Underperformance

To test the relationship between lockup decision and IPO underperformance, I run the following regressions:

$$\text{STOCK}_t = \beta_0 + \beta_1 * \text{LU}_t + \beta_2 * \text{IS}_{t-1} + \beta_3 * \text{SIZE}_t + \beta_4 * \text{VC}_t + \beta_5 * \text{PB}_t + \varepsilon_t \quad (3)$$

$$\text{OPERATE}_t = \gamma_0 + \gamma_1 * \text{LU}_t + \gamma_2 * \text{SIZE}_t + \gamma_3 * \text{VC}_t + \gamma_4 * \text{PB}_t + \eta_t \quad (4)$$

Ordinary least square (OLS) model with heterogeneous-variance adjustment (White, 1980) is used to estimate the coefficients. To measure the magnitude of “under” performance, STOCK in Model (3) is calculated as the CAR (FFMR) difference between period (-90, -1) and period (0, 89). Likewise, OPERATE in Model (4) is calculated as the OPROA (OPROE) difference between Quarters -1 and Quarter 0.<sup>4</sup> LU is a dummy variable equal to one if the IPO uses lockup, zero otherwise. In addition, I also replace LU with LUDAYS, the logarithm of the lockup days, to examine the association between lockup length and firm performance. To support the hypothesis,  $\beta_1$  and  $\gamma_1$  are expected to be negative. IS, included only in Model (3), is the composite sentiment index (described above) over the three-month period prior to lockup expiration, and its coefficient,  $\beta_2$ , is expected to be negative. The larger the firm, the higher is firm quality (see, e.g., Ritter, 1984; Michaely and Shaw, 1994). SIZE is the logarithm of the total assets of the lockup expiration quarter, and its coefficients ( $\beta_3$  and  $\gamma_2$ ) are expected to be positive. Venture capital (VC) investment is considered active investment, with venture capitalists providing managerial and governance support as well as funding. Barry, Muscarella, Peavy and Vetsuypens (1990) demonstrate that VC-backed IPOs suffer less from mispricing as do other IPOs. Brav and Gompers (1997) attribute better performance to venture-backed issues. VC is a dummy variable equal to one if firm is VC-backed, zero otherwise, and its coefficients ( $\beta_4$  and  $\gamma_3$ ) are expected to be positive. PB, a proxy for IPO firm’s growth opportunity (Jain and Kini, 1994; Loughran and Ritter, 1995), is the ratio of market capitalization at the IPO divided by the book equity in the first reporting period following lockup expiration, and its coefficients ( $\beta_5$  and  $\gamma_4$ ) are expected to be positive. Since size and book-to-market risk factors have been included when estimating FFMR, SIZE and PB will be excluded from Model (3) with FFMR as the dependent variable.

### Data

I initially identified 2349 U.S. IPOs between 1988 and 2005 from the Security Data Company’s new-issues database (SDC).<sup>5</sup> Data of the offer prices, lockup days and venture capital backing are collected from the Thomson Financial. Individual stock price, trading volume and capitalization are obtained from the CRSP. S&P500 index return, S&P500 trading volume, S&P500 index option call/put open interest, NYSE share turnover and Russell 2000 index return are compiled from the Datastream. The number of IPOs and the average first-day returns of IPOs are obtained from the Jay Ritter website (<http://bear.cba.ufl.edu/ritter>). I excluded best efforts offers, ADRs, closed-end funds, REITs, and IPOs of financial firms. I also deleted IPOs with missing data or where the SDC data conflicts with corresponding data in the Center for Security Prices (CRSP) database. After excluding IPOs with offer price below \$5.00 per share, the final sample consists of 470 IPOs. Among them, 352 IPOs are associated with lockup.

<sup>4</sup> Since the managers, presumably, want to manage earnings to provide positive news for selling stocks after the lockup expiration, the relevant performance periods are the quarter before expiration (Quarter -1).

<sup>5</sup> According to Rule 144, promulgated by U.S. Securities and Exchange Commission in 1988, insiders must fully expose the information publicized at present before the sale of restricted stock. Due to this stipulation, the issuing firm and the underwriter begin to set up the lockup as the means of self-regulation to ease the information asymmetry in the IPOs.

## EMPIRICAL RESULTS

### Sample Description

Table 2 presents descriptive statistics of selected variables in the regression models. The mean LU is 0.7347, indicating that 73.47% of IPOs are associated with lockups. The 2.2930 mean LUDAYS represents an average 212 days of lockup for IPOs. The average VC is 0.7260, revealing that almost three-fourths of IPOs are backed by venture capitals.

**Table 2: Descriptive Statistics of Herding Measures and Selected Variables**

Variable	Mean	Std. Dev.	Max.	Min.
CAR	0.0127	0.2816	1.5505	-0.4248
FFMR	0.0248	0.4132	1.3922	-1.4972
OPROA	-0.0232	0.1371	0.1208	-1.3527
OPROE	-0.1629	0.5510	0.9293	-4.0141
LU	0.7347	0.4424	1.0000	0
LUDAYS	2.2930	0.2004	6.5792	2.1998
IS	40.5725	11.3099	70.7055	19.0911
SIZE	2.0462	0.4713	3.9994	0.1927
VC	0.7260	0.4469	1.0000	0
PB	5.4053	7.2838	51.2000	-31.7580

Sample is the 470 U.S. IPOs between 1998 and 2005, including 352 IPOs with lockup and 118 IPOs without lockup. CAR is the cumulative abnormal return estimated by market model. FFMR is the four-factor-model return. OPROA is operating return on assets. OPROE is operating return on equity. LU is a dummy variable equal to one if the IPO uses lockup, zero otherwise. LUDAYS is the logarithm of the lockup days. IS is the composite sentiment index in the three-month period prior to lockup expiration. SIZE is the logarithm of the total assets of the lockup expiration quarter. VC is a dummy variable equal to one if firm is VC-backed, zero otherwise. PB is the ratio of market capitalization at the IPO divided by the book equity in the first reporting period following the IPO.

### The T-test Results

Panel A (Panel B) in Table 3 reports the results of the univariate comparisons of stock (operating) performance versus prior period and versus control sample. The t-value tests the hypothesis that the performance around lockup expirations differs from that of its adjoining prior quarter and that of the firms without lockup in the same quarter. The CAR stock return of IPOs with lockup in period (-90, -1) is worse than that in period (-180, -91) (t values = -1.73, significant at the 10% level), but insignificant so for FFMR measure (t values = -1.07). Most importantly, in both stock measures, the stock performance right after lockup expired (period (0, 89)) are significantly worse than those before (period (-90, -1)) (t values = -1.68 and -1.77 respectively, both significant at the 10% level). The IPO firms also underperform in period (0, 89) relative to firms without lockup (t values = -2.30 and -1.75 respectively, both significant at least at the 10% levels). By contrast, both stock performance measures in period (90, 179) are not significantly different from either those in period (0, 89) (t values = 1.49 and 0.62 respectively) or those of without-lockup firms (t values = -0.80 and -0.31 respectively).

**Table 3: Performance Comparisons between Periods and between Samples**

<b>Panel A: Comparisons of Stock Performance</b>								
CAR				FFMR				
Mean		T value		Period (Days)	Mean		T value	
IPOs with lockup	IPOs without lockup	vs. prior period	vs. IPOs without lockup		IPOs with lockup	IPOs without lockup	vs. prior period	vs. IPOs without lockup
-0.0725	-0.0242	--	-0.44	(-180, -91)	-0.3978	-0.4524	--	1.56
-0.1345	-0.0587	-1.73*	-0.74	(-90, -1)	-0.4524	-0.5219	-1.07	1.62
-0.1895	-0.1288	-1.68*	-2.30**	(0, 89)	-0.5219	-0.5933	-1.77*	-1.75*
-0.1414	-0.1177	1.49	-0.80	(90, 179)	-0.4200	-0.4188	0.62	-0.31

**Panel B: Comparisons of Operating Performance**

OPROA					OPROE			
Mean		T value		Period (Quarter )	Mean		T value	
IPOs with lockup	IPOs without lockup	vs. prior period	vs. IPOs without lockup		IPOs with lockup	IPOs without lockup	vs. prior period	vs. IPOs without lockup
-0.0162	-0.0223	--	0.52	Q -2	-0.0039	-0.0311	--	1.21
-0.0279	-0.0255	-1.93*	-0.16	Q -1	-0.0592	-0.0408	-1.72*	-0.45
-0.0269	-0.0268	0.16	0.02	Q 0	-0.0070	-0.0433	0.80	0.81
-0.0313	-0.0339	-1.12	0.22	Q 1	-0.0208	-0.0713	-0.41	0.30
-0.0274	-0.0410	0.74	0.94	Q 2	-0.0883	-0.0929	-0.99	0.41

Sample is the 470 U.S. IPOs between 1998 and 2005, including 352 IPOs with lockup and 118 IPOs without lockup. CAR is the cumulative abnormal return estimated by market model. FFMR is the four-factor-model return. OPROA is operating return on assets. OPROE is operating return on equity. Day 0 is the IPO date and Quarter 0 is the IPO quarter. The t values are for the two-tailed tests that the difference in means is equal to zero. \*\*\*, \*\* and \* indicates significant at the 0.01, 0.05, and 0.10 level respectively.

The above evidence exhibits an obvious transition of stock returns around lockup expiration. Stock performance measured in CAR and FFMR shows a significant decline post lockup. However, similar results can not be found in the operating performance. Except Quarter -1 vs. Quarter -2 (t values = -1.93 and -1.72 respectively, both significant at the 10% level), all other comparison pairs show that the operating performance in each quarter is not significantly different either from that of its adjoining quarter or from that of firms without lockup. Taking together the evidence in Pane A and Panel B, it draws a clear picture of close consistency between the stock performance and the timing of lockup expiration; the stock performance, but not the operating performance, shows an significant decline post lockup expiration.

**The Regression Results**

Table 4 reports the results of regression estimation for dependent variable of stock performance measures (CAR and FFMR) and operating performance measures (OPROA and OPROE). The Durbin-Watson statistics (DW) for all regressions lie between 1.3 and 2.7, indicating residual autocorrelation not being a problem. I also compute VIFs (variance inflation factor, not shown in the table) for each regression models. VIFs are all smaller than 3, indicating that collinearity does not pose an issue in model estimation (Kennedy, 2003).

As to factors affecting the post-IPO performance, this study is primarily interested in the lockup related variables (LU and LUDAYS) and the composite sentiment measure (IS). LU is negatively related to CAR and FFMR (both p values < 0.0001), which is consistent with the intuition that IPOs with lockup underperform other firms after lockup expired. Furthermore, LUDAYS is negatively related to CAR and FFMR (p values =0.0759 and 0.0202 respectively), lending support to the hypothesis that IPOs with longer lockup are associated with greater post-lockup stock underperformance. Similar results can be found in the operating performance measures in Panel B. LU is negatively related to OPROA and OPROE (p values = 0.0505 and 0.0571 respectively). LUDAYS is also negatively related to both operating measures (p values = 0.0005 and 0.0006 respectively). The evidence shows that IPOs with lockup are associated with dramatic operating underperformance after lockup expired, and the magnitude of underperformance is more pronounced for IPOs with longer lockup length. Finally, as expected, the stock underperformance is adversely affected by the investor sentiment. IS coefficients are significantly negative in all stock-performance regressions in Panel A. This finding is consistent with a return decline to stocks that have previously exhibited high optimistic sentiment during lockup.

**Table 4: Explaining Post-IPO Underperformance**

**Panel A: Explaining Stock Underperformance**

Indep. variable	CAR		FFMR	
	Coefficient estimate (p value)		Coefficient estimate (p value)	
Intercept	2.4604 (0.0348**)	8.1833 (0.0743*)	1.2336 (<0.0001***)	2.5223 (0.0005***)
LU	-1.6937(<0.0001***)	--	-0.6270(<0.0001***)	--
LUDAYS		-1.4949 (0.0759*)		-0.3188 (0.0202**)
IS	-0.0362 (0.0287**)	-0.0246 (0.0554*)	-0.0135 (<0.0001***)	-0.0176(<0.0001***)

VC	0.6754 (0.1154)	-0.6755 (0.1141)	-0.0377 (0.5683)	-0.0593 (0.3407)
SIZE	0.5173 (0.2566)	0.0792 (0.8303)	--	--
PB	0.0134 (0.2705)	-0.0080 (0.6986)	--	--
Adj. R <sup>2</sup>	9.66%	4.04%	26.30%	21.92%
F value(p value)	5.08 (<0.0001***)	2.23 (0.0427**)	17.33 (<0.0001***)	13.84 (<0.0001***)
DW	1.9038	1.9214	1.9102	1.9262

### Panel B: Explaining Operating Underperformance

Indep. variable	OPROA		OPROE	
	Coefficient estimate (p value)		Coefficient estimate (p value)	
Intercept	-0.0306 (0.5592)	0.8077(0.0036***)	-0.1868 (0.3420)	3.0494 (0.0025***)
LU	-0.0421 (0.0505*)	--	-0.1534 (0.0571*)	--
LUDAYS		-0.1793 (0.0005***)		-0.6427 (0.0006***)
VC	0.0126 (0.5563)	0.0358 (0.1207)	0.1920 (0.0174**)	0.1675 (0.0463**)
SIZE	0.0219 (0.3063)	0.0258 (0.1462)	-0.0513 (0.5215)	0.0076 (0.9061)
PB	0.0003 (0.8118)	0.0013 (0.4783)	0.0246 (0.2003)	0.0071 (0.2856)
Adj. R <sup>2</sup>	0.74%	9.95%	13.99%	10.48%
F value(p value)	1.34 (0.2477)	5.04 (0.0002***)	8.45 (<0.0001***)	5.28 (0.0001***)
DW	1.9441	1.9379	1.9485	1.9378

Sample is the 470 U.S. IPOs between 1998 and 2005, including 352 IPOs with lockup and 118 IPOs without lockup. The stock underperformance in Panel A is measured as the CAR (FFMR) difference between period (-90, -1) and period (0, 89). The operating underperformance in Panel B is measured as the OPROA (OPROE) difference between Quarters -1 and Quarter 0. CAR is the cumulative abnormal return estimated by market model. FFMR is the four-factor-model return. OPROA is operating return on assets. OPROE is operating return on equity. LUDAYS is logarithm of the lockup days. IS is the composite sentiment index in the three-month period prior to lockup expiration. SIZE is the natural logarithm of the total assets of the lockup expiration quarter. VC is a dummy variable equal to one if firm is VC-backed, zero otherwise. PB is the ratio of market capitalization at the IPO divided by the book equity in the first reporting period following the IPO. Seventeen yearly dummies (1988 as the base year) are included in each model to control the possible macroeconomic effects on performance (not shown). OLS model with heterogeneous- variance adjustment (White, 1980) is used to estimate the coefficients. DW is the statistic of Durbin-Watson test. \*\*\*, \*\* and \* indicates significant at the 0.01, 0.05, and 0.10 level respectively.

As to control variables, the stock performance of VC-backed IPOs is not significantly different from that of non-VC-backed IPOs. By contrast, the presence of a VC has a positive impact on the OPORE performance, consistent with the findings of Brav and Gompers (1997), but has no significant impact on OPROA. Finally, the coefficient of SIZE and PB are not significant in all regression models. That is, the firm size and growth opportunity do not play a role in explaining the variation of post-lockup underperformance.

#### Robustness Checks

To assess the robustness of the results in Table 3 and Table 4, I conducted two sensitivity tests by: (a) deleting IPOs with the upper 5% lockup days to alleviate the effect of extreme value;<sup>6</sup> (b) re-estimating the regression models on subsamples categorized by VC-backed vs. non-VC-backed, high-PB vs. Low-PB, and large vs. small firm size.<sup>7</sup> The results of these tests (not shown) were qualitatively similar to those reported in Table 3 and Table 4.

### CONCLUSIONS

The poor after-performance of IPO has attracted considerable research interest. The purpose of this study is not limited to adding another piece of evidence to the literature on IPO underperformance. Rather, this paper assessed the effect of lockup decision on the underperformance pattern around lockup expiration. I employ market-model abnormal return and four-factor-model return to measure the long-run stock performance, and employ operating return on assets and operating return on equity to measure the operating performance. The empirical result reveals that the stock performance, but not the operating performance, exhibits an obvious transition around lockup expiration. Relative to period before lockup expiration and to firms without lockup, firms with lockup significantly underperform in the period

<sup>6</sup> This process reduced the sample size to 447 IPOs.

<sup>7</sup> Large and small size (high- and Low-PB) samples are categorized by whether the firm size (PB) is larger or smaller than the median size (PB) of the full sample.

after expiration. In addition, both whether there is a lockup agreement and the length of lockup play a role in explaining performance cross-sectionally. IPOs with lockup and with longer lockup length tend to experience more serious underperformance post lockup expiration. Finally, IPOs with high investor sentiment during lockup are more likely to experience greater post-lockup underperformance, in line with the “over-optimistic” argument made by Ritter (1991).

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